



USER'S MANUAL

UM341-2

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XTC™ Transmitters
Series 341 Pressure Transmitters
with
Model 275
HART® Communicator

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SECTION AND TITLE

PAGE

1.0 INTRODUCTION

This User's Manual is for the APACS® XTC™ Model 341 Series of Smart Pressure Transmitters. Some configuration, calibration, and test procedures employ the Model 275 HART Communicator.

NOTE

Refer to UM341-1 for information about using the Model 341 with the earlier XTC Communicator (MXC).

This manual contains bench test, installation, configuration, system test, and service procedures. Three illustrations show the basic Model 341 types. A Model 341D differential pressure transmitter is shown in Figure 1-1. Figure 1-2 shows Models 341A and 341G, absolute and gauge pressure transmitters respectively. The Model 341P, a gauge pressure transmitter with a flush diaphragm connection, is shown in Figure 1-3.

IMPORTANT

Save this User's Manual for installing, configuring, operating and servicing a Model 341 transmitter.

1.1 SECTION CONTENTS

Ten sections make up this Manual. A brief description of each section follows.

Section 1, INTRODUCTION, describes each section in this Manual and provides a brief description of the Model 341 Smart Pressure Transmitter line. Product support information is also furnished.

Section 2, MODEL 275 UNIVERSAL HART COMMUNICATOR, describes use of the Model 275 to test, configure, and calibrate a transmitter.

Section 3, COMMISSIONING AND BENCH TESTING, provides procedures to perform a bench test of the transmitter to ensure proper operation of all functions. Start-up configuration is described here. If desired, go to Section 5 to perform a complete configuration. The calibration procedure in Section 7 can be performed following configuration if the mounting position will induce a zero shift.

Section 4, INSTALLATION, furnishes specific information for mechanical and electrical installation.

Section 5, ON-LINE CONFIGURATION AND OPERATION, describes on-line configuration and operation, as well as, local operation using the magnetic switches.

Section 6, POST INSTALLATION CHECKOUT, describes the system checkout procedure.

Section 7, CALIBRATION AND MAINTENANCE, provides a calibration procedure and a zeroing procedure for eliminating any mounting position induced error. It also furnishes preventive maintenance, troubleshooting, and transmitter replacement procedures. A parts list is provided at the back of this Manual.

Section 8, CIRCUIT DESCRIPTION, contains an assembly level circuit description to support transmitter servicing.

Section 9, MODEL DESIGNATIONS AND SPECIFICATIONS, furnishes tables describing transmitter model numbers, and it contains mechanical, functional, performance, and environmental specifications. Hazardous area certifications are also listed.

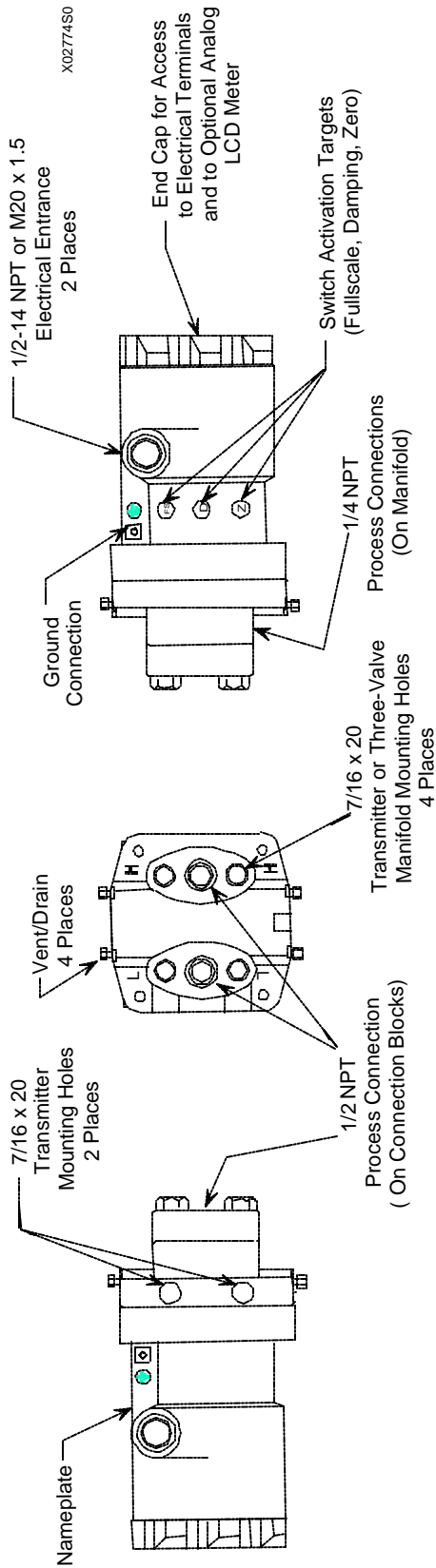


FIGURE 1-1 Model 341D

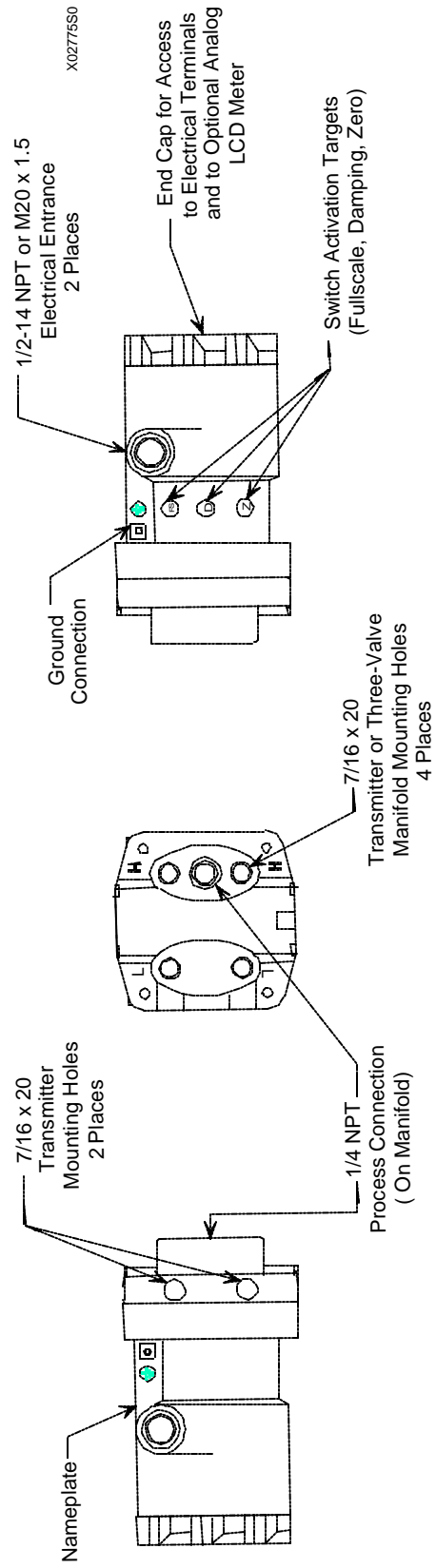


FIGURE 1-2 Models 341A and 341G

Before installing or servicing a transmitter, read the information on the nameplate and ensure that the correct model is at hand and that the correct procedures are followed.

Section 10, GLOSSARY, contains definitions of various transmitter related terms.

APPENDIX A, FUNCTION BLOCK DESCRIPTIONS, describes transmitter function blocks and the parameters available.

APPENDIX B, HAZARDOUS AREA INSTALLATION, contains hazardous area installation drawings and information needed for barrier selection.

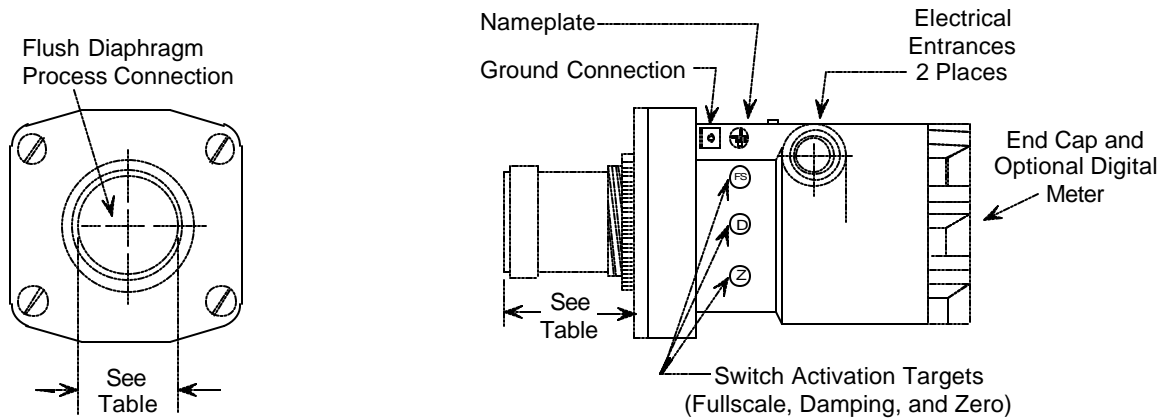
APPENDIX C, TRANSMITTER CONFIGURATION DOCUMENTATION, provides an area for recording application-specific configuration data.

APPENDIX D, ELEVATION AND SUPPRESSION CORRECTION, explains how to perform elevation and suppression calculations necessary for certain liquid level gauging applications.

APPENDIX E, STATIC PRESSURE CORRECTION, provides the method to achieve the static pressure specification in Section 9.

WARRANTY contains the product warranty statements and information concerning servicing of the product during the warranty period.

PARTS LIST shows an exploded view of the transmitter and a list of on-hand spare parts and field replaceable parts.



MOUNTING	LENGTH	DIAMETER
Standard Thread	1.8 (45.7)	1.59 (40.4)
Miniature Bolt-in-Place	1.75 (44.5)	1.049 (26.6)

X02939S1

FIGURE 1-3 Model 341P

1.2 PRODUCT DESCRIPTION

Model 341 transmitters are part of the Moore Products Co. XTC line of smart pressure and temperature field devices. They provide reliable, accurate, stable, and cost-effective measurement of differential, absolute and gage pressures. The four basic models are:

- Model 341D, differential pressure
- Model 341A, absolute pressure
- Model 341G, gauge pressure
- Model 341P, flush-mount gauge pressure

Figures 1-1, 1-2, and 1-3 show the four basic models.

Each transmitter is a microprocessor-based, self-contained pressure-to-current converter. The heart of the transmitter is the MycroSENSOR™. Developed and patented by Moore Products Co., the MycroSENSOR is a silicon, dual-capacitance pressure sensor assembly. It generates a direct digital output signal that is proportional to input pressure. The sensor assembly is mounted in a manifold assembly located within the transmitter enclosure.

The direct digital output in conjunction with the microprocessor provides Direct Digital Processing (DDP™). DDP provides advanced processing and compensation for varying ambient temperature and static pressure. This yields improved performance, stability, and reliability over conventional analog transmitters. Although signal processing is digital, a transmitter can be configured to operate in either an analog mode or a digital mode, for a Point-To-Point or a Multi-Drop network respectively.

ANALOG MODE: A single transmitter is connected to a controller, recorder or other field device. A loop known as a Point-To-Point Network interconnects the instruments. Figure 1-4 shows a traditional application. The transmitter's output is the process variable and it is sent to a controller or recorder using a standard 4-20 mA analog current. Figure 1-5 shows a 0-100% Analog LCD Meter for local viewing of the process variable. A Terminal Board with screw terminals is provided for connecting the loop to the transmitter; see Figure 1-6.

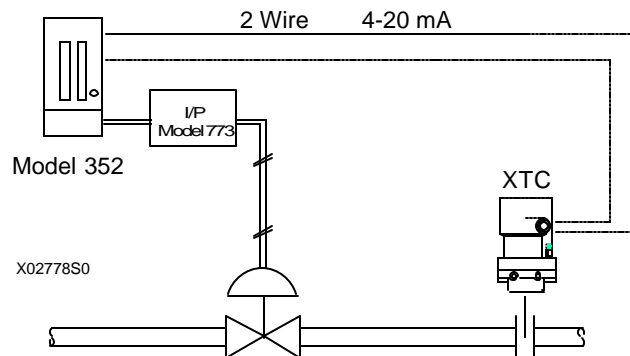


FIGURE 1-4 Traditional Process Variable Measurement

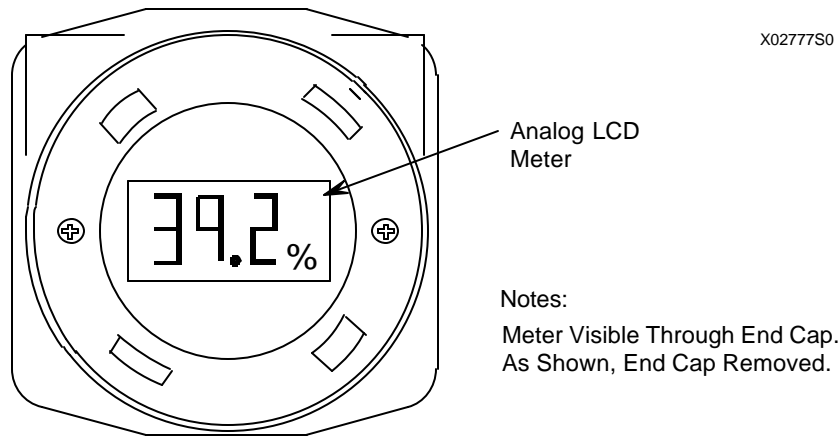


FIGURE 1-5 Optional Analog LCD Meter

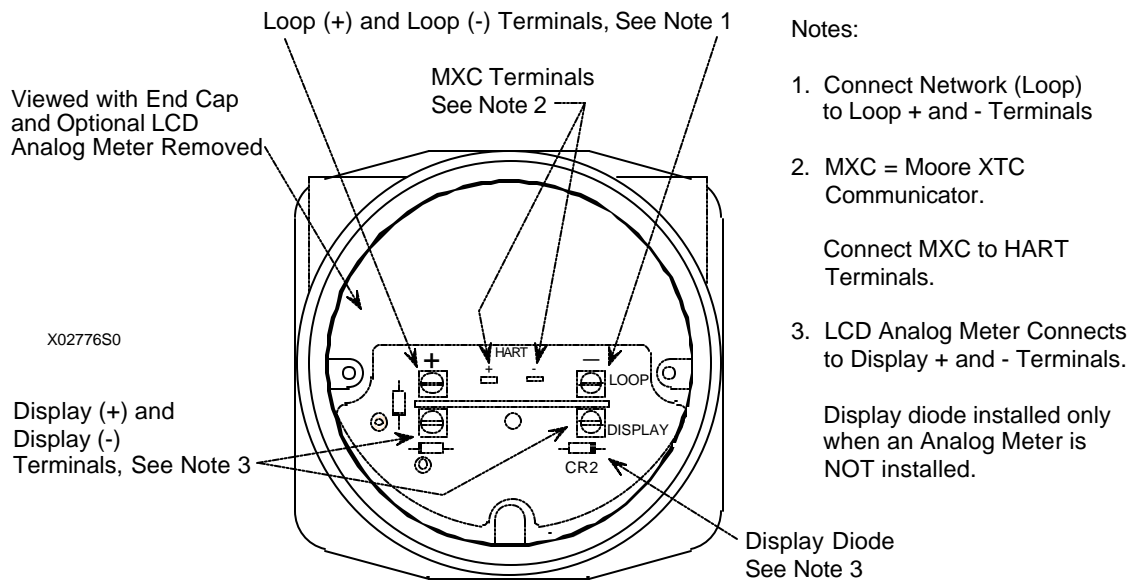


FIGURE 1-6 Terminal Board

The HART (Highway Addressable Remote Transducer) protocol is used for communication between the transmitter and a Model 275 Universal HART Communicator, a personal computer running MXTC Configuration Software or other remote device. This is done by superimposing the HART digital signal on the analog current. A typical communication can be to: transfer a new or edited configuration, remotely monitor the process variable, or service a transmitter.

DIGITAL MODE: Twisted-pair cable is used to wire up to fifteen parallel connected transmitters to the Multi-Drop Network. HART protocol is used to send all process variable information to a HART compatible controller, recorder, or other device. Of course, the digital process variable will not be viewable on the optional analog LCD meter. Loop connections are made to the terminal board.

Models 341A, D, and G have an intrinsically safe, explosion proof, NEMA 4x (IP66/IP68), field mountable, hardened enclosure. Available process connections are 1/2 NPT or M20. All process wetted materials are 316 stainless steel.

Model 341P is intrinsically safe with a NEMA 4x (IP66/IP68), hardened enclosure. The flush-mount process connection is compatible with standard spuds (nipples) for tanks and pipes.

1.3 CONFIGURATION

A smart transmitter must be configured before being used on-line or off-line. Each transmitter is shipped with either a default configuration or, if specified at time of order, a custom configuration defined by the user. A default configuration may need to be edited by the user before the transmitter is used in a loop.

1.4 PRODUCT SUPPORT

Product support can be obtained from the Moore Products Co. Technical Information Center (TIC). TIC is a customer service center that provides direct phone support on technical issues related to the functionality, application, and integration of all products supplied by Moore Products Co.

To contact TIC for support, either call 215-646-7400, extension 4TIC (4842) or leave a message in the bulletin board service (BBS) by calling 215-283-4968. The following information should be at hand when contacting TIC for support:

- Caller ID number, or name and company name
During your first call for support, a personal caller number will be assigned. A 'caller card' with this number will be mailed to you. Having the number available when calling for support will allow the TIC representative taking the call to use the central customer database to quickly identify the caller's location and past support needs.
- Product part number or model number and version (see Section 9.0 for model designations)
- If there is a problem with product's operation:
 - Is problem intermittent
 - The steps performed before the problem occurred
 - Any error messages displayed
 - Installation environment

For product support outside of North America, contact your local Moore Products Co. subsidiary:



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2.0 MODEL 275 UNIVERSAL HART COMMUNICATOR

The Model 275 Universal HART Communicator is a hand held interface that provides a common communication link to XTC 341 Series transmitters and other HART-compatible instruments.

This section describes HART Communicator connections, liquid crystal display, keypad, and on-line and off-line menus. It also provides short overviews of some of the Communicator's functions. The Communicator is shown in Figure 2-1. For information about the Communicator's battery pack, Memory Module, Data Pack, and maintenance procedures, refer to the manual supplied with the Communicator.

2.1 INTRODUCTION

From a wiring termination point, the HART Communicator interfaces with a Model 341 transmitter or other HART device using a 4-20 mA loop, provided a minimum load resistance of 250Ω is present between the Communicator and the power supply. The Communicator uses the Bell 202 frequency-shift keying (FSK) technique of high-frequency digital signals imposed on a standard transmitter current loop of 4-20 mA. Because no net energy is added to the loop, HART communication does not disturb the 4-20 mA signal. The Communicator can be used in hazardous and non-hazardous locations.

WARNING

Explosions can cause death or serious injury. Before connecting the HART Communicator in an explosive atmosphere, make sure that the instruments in the loop are installed in accordance with intrinsically safe or non-incendive field wiring practices. Refer to the Communicator nameplate and the manual supplied with the Communicator for certifications and approvals before connecting.

2.2 COMMUNICATOR CONNECTIONS

The Communicator can interface with a transmitter from the control room, the instrument site, or any wiring termination point in the loop. Connections are made through loop connectors on the Communicator's connection panel (Figure 2-1). The connection panel also may have a jack for the optional NiCad recharger, and it has a serial port for a future connection to a personal computer (PC).

To interface with a transmitter or other HART device, connect the HART Communicator in parallel with the instrument or load resistor. The connections are non-polar. For intrinsically safe FM and CSA wiring connections, see the manual supplied with the Communicator.

WARNING

Explosions can result in death or serious injury. Before making connections to the serial port or NiCad recharger jack in an explosive atmosphere, check the Communicator nameplate and the manual supplied with the Communicator for approvals.

Figure 2-2 illustrates typical wiring connections between the HART Communicator and a loop with a Model 341 transmitter or other HART-compatible device.

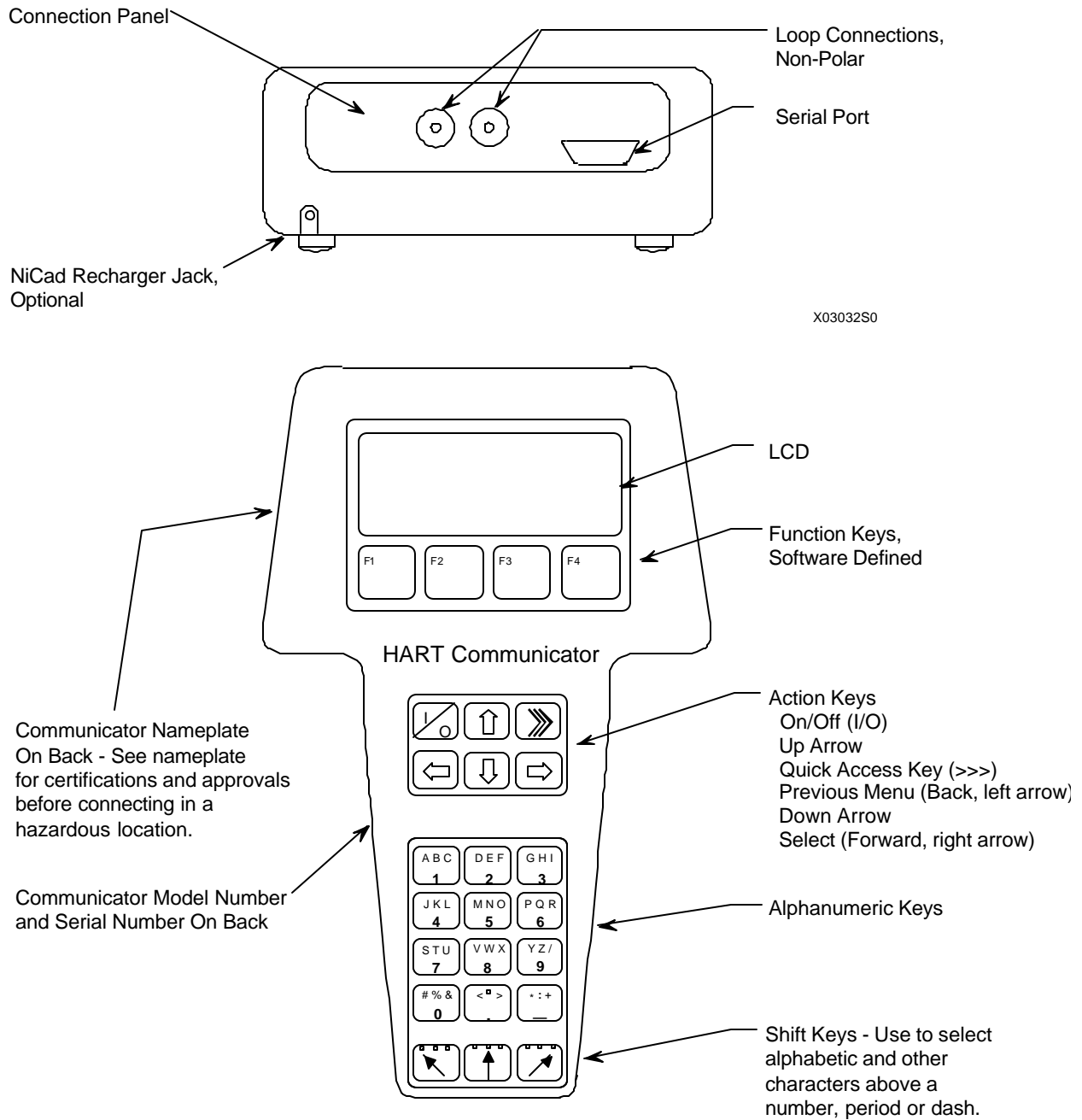
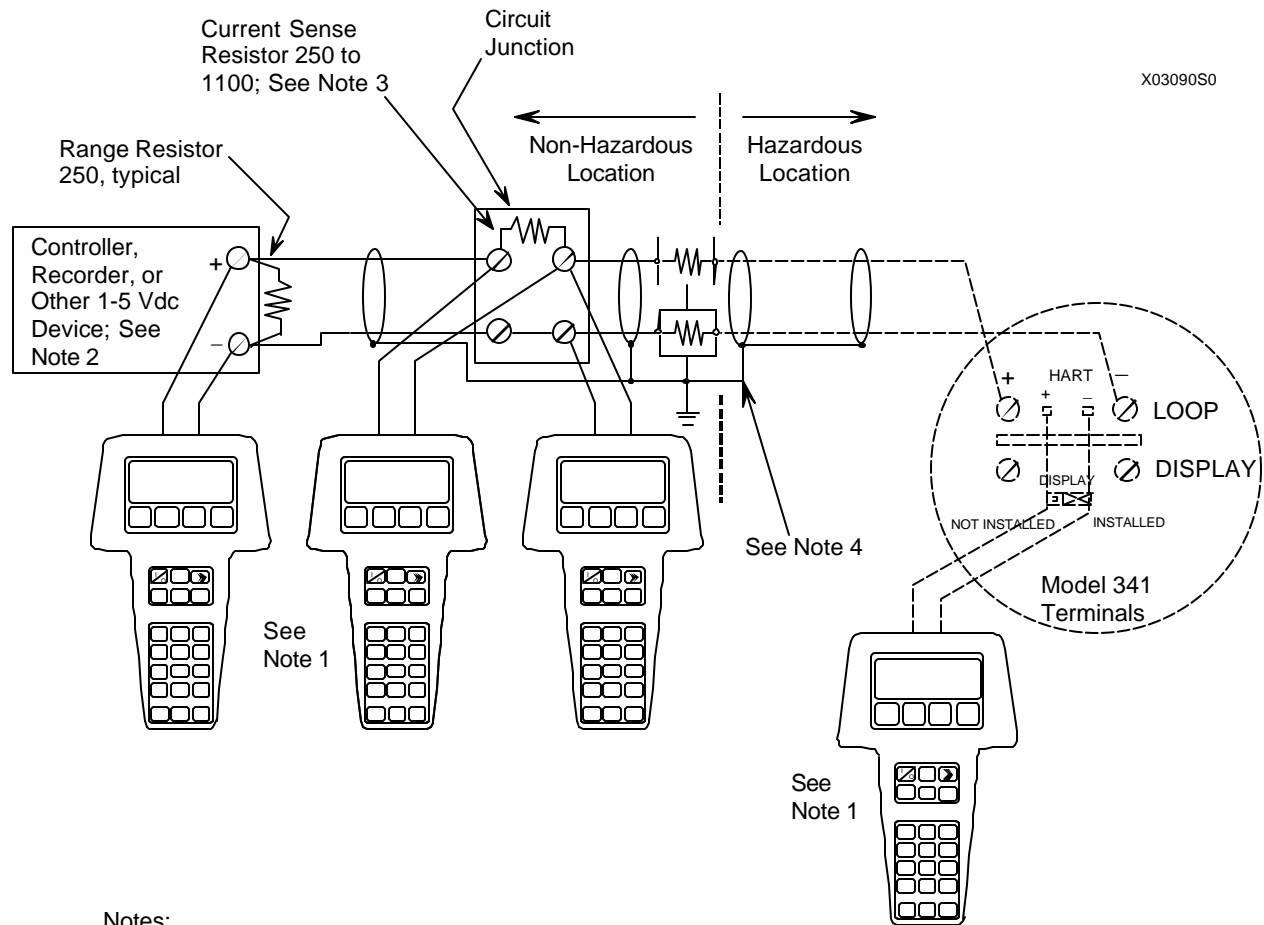


FIGURE 2-1 Model 275 Universal HART Communicator

X03090S0



Notes:

1. HART Communicator Connections:
 Non-hazardous location - Connect as shown above.
 Hazardous location - Refer to Communicator nameplate and the Manual supplied with the Communicator for certifications and approvals before connecting.

 The HART Communicator is a non-polar device.
2. The System Power Supply may be part of the host input device or a separate device.
3. Network resistance equals the sum of the barrier resistances and the current sense resistor. Minimum value 250 Ohms; maximum value 1100 Ohms.
4. Supply and return barriers shown. Interconnect all cable shields and ground only at the barriers.

FIGURE 2-2 HART Connections to a Transmitter Loop

A 40" (1 m) cable with a dual banana plug on one end and two mini-grabber clips on the other is provided. The dual banana plug is inserted into the top of the Communicator; the mini-grabber clips are connected to lugs in the Model 341's terminal board compartment or to the loop's current sense resistance, usually at a receiving instrument (see Note below).

NOTE

The HART protocol requires a network (loop) resistance between 250 Ω and 1100 Ω to support communications. See Section 4.3.6 to determine resistance value and loop supply voltage.

2.3 CONTROLS OVERVIEW

As shown in Figure 2-1, the front of the HART Communicator has five major functional areas: liquid crystal display (LCD), function keys, action keys, alphanumeric keys, and shift keys. The next five sections describe how each of these functional areas is used to enter commands and display data.

2.3.1 Liquid Crystal Display

The liquid crystal display (LCD) is an 8-line by 21-character display that provides communication between the user and a connected device. When the HART Communicator is connected to a Model 341 transmitter or other HART-compatible device, the top line of the Online menu displays the model name of the device and its tag. A typical display is shown below:

```

MPCO 341:PT100
Online          ←⌘
1->Loop Override
2 Calibrate/Test
3 Configure Xmtr
4 Range Xmtr
HELP |SAVE

```

The bottom line of each menu is reserved for dynamic labels for the software-defined function keys, F1-F4, which are found directly below the display. More information on software-defined function keys is given in the next section.

2.3.2 Software-Defined Function Keys

The four software-defined function keys (soft keys), located below the LCD and marked F1 through F4, are used to perform software functions as indicated by the dynamic labels. Pressing the function key immediately beneath a label activates the displayed function.

The label appearing above a function key indicates the function of that key for the current menu. For example, in menus providing access to on-line help, the HELP label appears above the F1 key. In menus providing access to the Online menu, the HOME label appears above the F3 key. Table 2-1 lists these labels and describes what happens when each function key is pressed.

TABLE 2-1 Function Keys With Their Labels And Actions Performed

F1	F2	F3	F4
HELP access on-line help	ON/OFF activate or deactivate a bit-enumerated binary variable	ABORT terminate current task	OK acknowledge information on the LCD
RETRY try to reestablish communication	DEL delete current character or Quick Access Key menu item	ESC leave a value unchanged	ENTER accept user-entered data
EXIT leave the current menu	SEND send configuration data to device	QUIT terminate session because of a communication error	EXIT leave the current menu
YES answer to yes/no question	PGUP move up one help screen	PGDN move down one help screen	NO answer to yes/no question
ALL include current Quick Access Key item on Quick Access Key menu for all devices	PREV go to previous message in a list of messages	NEXT go to next message in a list of messages	ONE include Quick Access Key item for one device
NEXT go to the next variable in off-line edit	SAVE save information to Communicator	HOME go the top menu in the device description	
FILTR open customization menu to sort configurations	MARK toggle marked variable in configuration to be sent to a field device	BACK go back to the menu from which HOME was pressed	
	XPAND opens detailed configuration information	EDIT edit a variable value	
	CMPRS closes detailed configuration information	ADD add current item to Quick Access Key menu	

2.3.3 Action Keys

Directly beneath the LCD and software-defined function keys are six blue, white, and black action keys. Each has a specific function as described below:



ON/OFF KEY – Use to power-up the Communicator. When the Communicator is turned on, it automatically searches for a HART-compatible device on the 4-20 mA loop. If no device is found, the Communicator displays the Main menu:

```
HART Communicator
1->Offline
2 Online
3 Frequency device
4 Utility
```

If a HART-compatible device is found, the Communicator displays the Online menu:

```
MPCO 341:PT100
Online ←⌘
1->Loop Override
2 Calibrate/Test
3 Configure Xmtr
4 Range Xmtr
HELP |SAVE
```



UP ARROW KEY – Use to move the cursor up through a menu or list of options or to scroll through lists of available characters when editing fields that accept both alpha and numeric data.



DOWN ARROW KEY – Use to move the cursor through a menu or a list of options or to scroll through lists of available characters when editing fields that accept alpha and numeric data.



LEFT ARROW/PREVIOUS MENU KEY – Use to move the cursor to the left or back to the previous menu.



RIGHT ARROW/SELECT KEY – Use to move the cursor to the right or to select a menu option.



QUICK ACCESS KEY (HOT KEY) – When the Communicator is on and connected to a HART-compatible device, pressing the Quick Access Key instantly displays the Quick Access Key menu of user-defined options. When the Communicator is off and the Quick Access Key is pressed, the Communicator automatically powers-up and displays the Quick Access Key menu.

See Section 2.6 for more information on using the Quick Access Key.

IMPORTANT

When performing certain operations, the message “OFF KEY DISABLED” indicates that the Communicator cannot be turned off. This feature helps prevent accidental shutoff of the Communicator while the output of a device is fixed or a device variable is being edited.

2.3.4 Alphanumeric and Shift Keys

The alphanumeric keys perform two functions: (1) rapid selection of menu options and (2) data entry. The shift keys located below the alphanumeric keys on the keypad are used during data entry to select from among the characters available above each number.

2.3.4.1 Rapid Selection of Menu Options

From any menu, use the keypad to select available options in two ways. First, use the UP or DOWN arrow keys, followed by the RIGHT ARROW/SELECT key, to access available options displayed on the LCD.

As an alternative, use the rapid select feature. Simply press the number on the alphanumeric keypad that corresponds to the desired menu option. For example, to quickly access the Utility menu from the Main menu, simply press “4” on the keypad.

2.3.4.2 Data Entry

Some menus require data entry. Use the alphanumeric and shift keys to enter all alphanumeric information into the HART Communicator. Pressing an alphanumeric key alone while editing causes the large character in the center of the key (number 0-9, decimal point, or dash) to be entered.

Pressing and releasing a shift key activates shift and causes the appropriate arrow icon (↵, ↑, or ↷) to appear in the upper right-hand corner of the LCD. When shift is activated, the indicated alpha characters or symbols are entered when the keypad is used.

Example

To enter a number, such as “7,” simply press the number key.

To enter one of the small characters appearing above the large numeral (i.e., a letter, space, or mathematical symbol), first press and release the corresponding shift key at the bottom of the keypad, then press the desired alphanumeric key. To enter the letter “E,” press and release the middle shift key, then press the number “2” key.

To deactivate a shift key without entering a letter, space, or mathematical symbol, simply press that shift key again.

2.4 GETTING TO KNOW THE COMMUNICATOR

The HART Communicator operates in either of two modes: on-line or off-line. Off-line operation is used to create or edit a configuration that can then be downloaded to a HART device, such as the Model 341. On-line operation is used to download a configuration to a HART device, upload a configuration, edit HART device operating parameters, and monitor process values.

For off-line operation, the Communicator need not be connected to a HART device. On-line operation requires a connection to a HART device.

The menu that appears first when the Communicator is turned on depends on the mode. When the Communicator is powered-up in off-line mode, the first menu displayed is the Main menu. When the Communicator is powered-up in on-line mode, the first menu displayed is the Online menu. To work off-line when connected to the loop, access the Main menu from the Online menu by pressing the LEFT ARROW/PREVIOUS MENU key.

2.4.1 Display Icons

Several different symbols (icons) appear on the LCD to show the state of the Communicator and provide visible response to actions of the user. Figure 2-3 shows the display icons and how they relate to keypad functions.

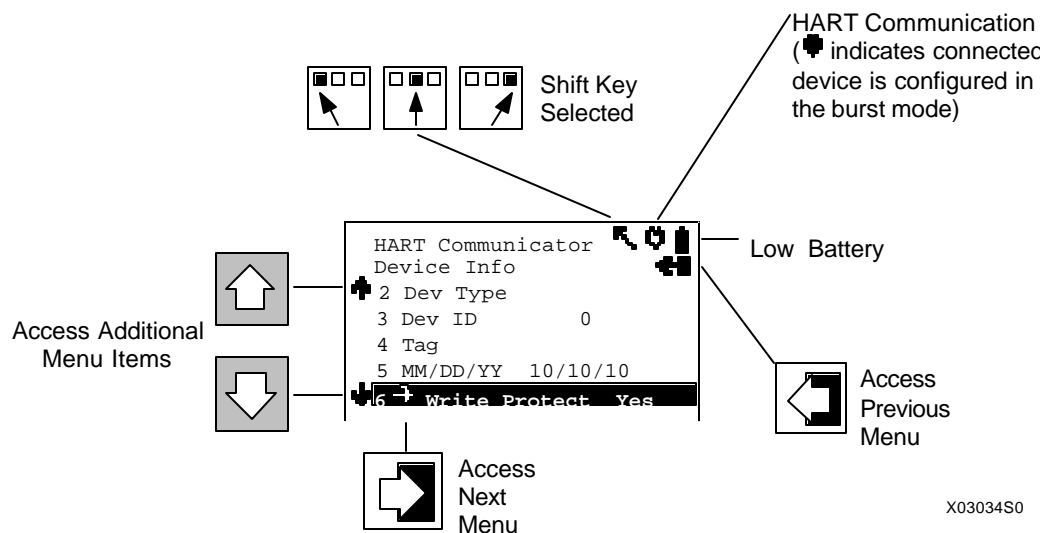


FIGURE 2-3 Communicator Display Icons

2.4.2 Menu Structure

The HART Communicator uses a hierarchical menu structure. That is, high-level menus are accessed first, and they provide access to lower-level menus. This structure groups related functions together and minimizes the number of options displayed at once.

To learn how the menu structure works, perform the following actions:

1. With the Communicator off-line (not attached to any devices), press the ON/OFF key to turn the Communicator on. It displays the Main menu, with the cursor (->) positioned at "1 Offline."
2. Access the Utility menu by pressing the DOWN arrow key three times, then pressing the RIGHT ARROW/SELECT key. The display changes to show the Utility menu.
3. Access the Configure Communicator menu from the Utility menu by pressing the RIGHT ARROW/SELECT key. The display changes to show the Configure Communicator menu.
4. Access the Contrast menu by pressing the DOWN arrow once, then pressing the RIGHT ARROW/SELECT key. The display shows a message explaining how to adjust the LCD contrast.
5. Press ESC (F3) to return to the Configure Communicator menu.
6. Press the LEFT ARROW/PREVIOUS MENU key two times to return to the Main menu.
7. Press the ON/OFF key to turn the Communicator off.

2.4.3 Reviewing Installed Devices

For the HART Communicator to recognize a HART-compatible device, it must have a description for that device installed. The HART Communicator is supplied from the factory with descriptions for Model 341 Transmitters and other HART-compatible devices from leading manufacturers. In addition, it contains a generic device description, which allows limited access to most HART devices when no device description for that specific device exists in the Communicator.

To review the currently installed devices on the Communicator, use the following steps:

1. Turn on the Communicator (off-line) to display the Main Menu.
2. From the Main menu, press "4" on the keypad for quick access to the Utility Menu.
3. From the Utility menu, press "5" on the keypad to access the simulation mode. The LCD shows the Manufacturer menu, which contains a list of manufacturers whose device descriptions are installed in the Communicator.
4. Press the DOWN arrow until Moore Products appears. Press the RIGHT ARROW/SELECT key to reveal the Model menu, which lists the Moore Products Co. devices currently installed in the Communicator (see Table 2-2).
5. To end the review of devices, press the LEFT ARROW/PREVIOUS MENU key three times.
6. Turn off the Communicator or proceed to the next section.

TABLE 2-2 Moore Products Co. Device Descriptions

MODEL	FIELD DEVICE REVISION	DESCRIPTION	APPROXIMATE VINTAGE ¹
341B	Dev V1, DD V1	341 Transmitter-Controllers (pushbutton design)	8/90 - 8/96, Model #s 341__B...
341	Dev V1, DD V1	341 Transmitter (pushbutton design)	8/90 - 8/94, Model #s 341__A...
344	Dev V1, DD V1	344 Transmitter-Controller	8/90 - 8/94 Model #s 344...
	Dev V2, DD V1	344 Transmitter-Controller	8/90 - Present, Model #s 344...
341 Type 5	Dev V1, DD V1	341 Transmitter	8/94 - Present, Model #s 341...
341 Type 6	Dev V1, DD V1	341 Transmitter (pushbutton design)	8/94 - 8/96, Model #s 341__A...
	Dev V2, DD V1	341 Transmitter (magnetic switch design)	Present, Model #s 341__B...
340S	Dev V1, DD V1	340S SteaMeter™	Present Model

Note

¹Always verify the Model and Field Device Revision for the device at hand using the Quick Access Key\Status\Model command of the Model 275 HART Communicator.

2.5 MAIN MENU

When the Communicator is not connected to a device, the first menu to appear after powering up is the Main menu (at right). If the Communicator is turned on when connected to a device, access the Main menu by pressing the LEFT ARROW/PREVIOUS MENU key. Depending on which submenu of the on-line series is displayed, it may be necessary to press the LEFT ARROW/PREVIOUS MENU key more than once. Alternatively, press HOME (F3) to display the Online menu, followed by the LEFT ARROW/PREVIOUS MENU key to display the Main menu.

HART Communicator
1->Offline
2 Online
3 Frequency Device
4 Utility

From the Main menu, access additional menus by moving the cursor to them with the UP or DOWN arrow keys, followed by pressing the RIGHT ARROW/SELECT key, or simply by pressing the appropriate number (1-4) on the alphanumeric keypad.

2.5.1 Offline Menu

The Offline menu provides access to two other menus: New Configuration and Saved Configuration. These two configuration menus can be used without connecting to a HART-compatible device, but it is not possible to send saved data to a device if no device is connected.

From the Main menu, press “1” on the keypad or the RIGHT ARROW/SELECT key to access the Offline menu. The complete menu tree for the Offline Menu is shown in Figure 2-4.

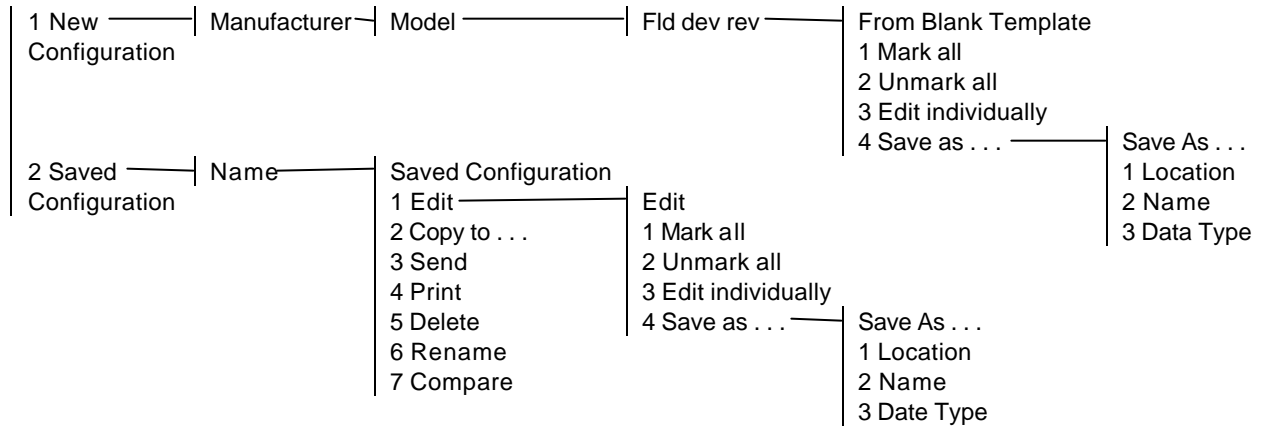


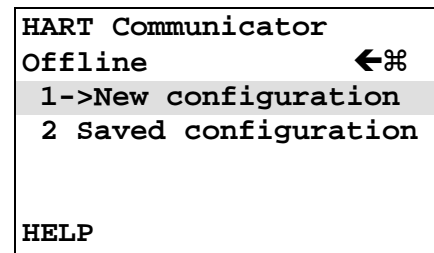
FIGURE 2-4 Offline Menu Tree

2.5.1.1 New Configuration

This option is used to compile a custom set of device configuration data for downloading later to one or more HART-compatible devices. Downloading the same data to multiple devices ensures that they all store identical configuration data.

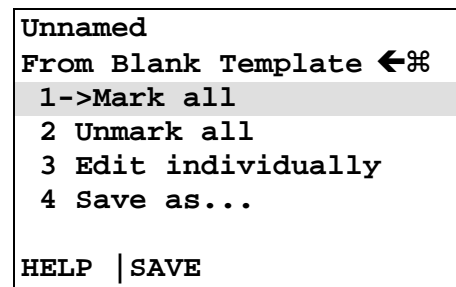
Use the following steps to compile off-line, new device configuration data:

1. From the Main menu, press “1” to access the Offline menu.
2. Press “1” to enter a new configuration. The Manufacturer menu appears.
3. Choose a manufacturer by scrolling to the manufacturer name with the DOWN arrow, then pressing RIGHT ARROW/SELECT. The Model menu appears.
4. From the Model menu, choose a device by scrolling through the list, then pressing RIGHT ARROW/SELECT. The Field Device Revision (Fld dev rev) menu appears.



The Field Device Revision menu contains the currently installed software revisions for the field device and device descriptions (DD) for the model selected from the Model menu.

Select the software revision (RIGHT ARROW/SELECT or number) to access the Blank Template menu (at right). To discover the software revision for a particular device, connect the Communicator to the device and follow instructions given in the device manual.



To find the software revision number for a Model 341 Transmitter, establish a connection to the Communicator, then press the Quick Access Key. From the Quick Access Key menu, press “1” to view the Status menu. The software

revision is line 3. If the software revision is not displayed, press “3” to view the Software rev screen.

- With the Blank Template menu displayed, choose from the options available, as follows:

Mark All – Flag all configurable variables before sending them to a HART-compatible device.

Unmark All – Remove the flags from all configurable variables in the configuration. Unmarked configuration variables cannot be sent to a connected HART-compatible device.

Edit Individually – Open the Edit individually menu (at right).

Example

The Edit individually menu permits the user to change a configuration parameter. For example, to change the engineering units from inH₂O to mmH₂O, press the EDIT function key (F3) to display the Measured Var Unit menu (below right).

```

Unnamed
Edit individually
  Unit
    in H2O

Not marked to send
NEXT | MARK | EDIT | EXIT
  
```

With the Measured Variable Unit menu displayed, use the DOWN arrow to highlight the new unit, then press the ENTER function key (F4). Or, to leave the Unit variable menu without making any change, press the ESC function key (F3) to return to the Edit individually menu. From the Edit individually menu, use EXIT to go back to the Blank Template menu.

```

Unnamed
Measured Var Unit
inH2O
inH2O
inHg
ftH2O
↓mmH2O

ESC | ENTER
  
```

Save As . . .

Selecting the Save As option allows a new configuration to be saved to either the Memory Module or the Data Pack.

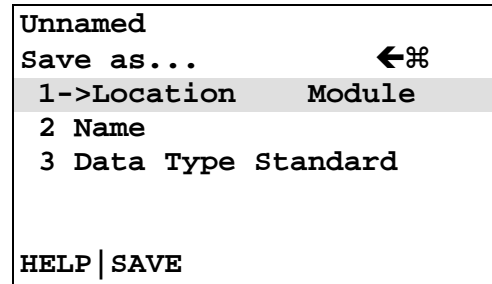
The Memory Module holds up to 10 typical configurations, and contains the operating system software and device application software in non-volatile memory. The Data Pack stores up to 100 typical configurations in nonvolatile, removable memory.

Example

From the Offline menu, choose 1 New configuration. This displays the Manufacturer menu. Choose a device, then

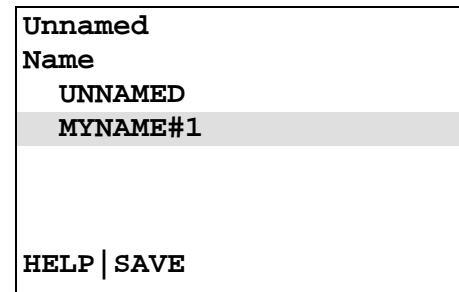
choose a model from the Model menu. Choose a software revision from the Fld dev rev menu.

The Communicator creates a configuration and displays the Blank Template menu. Choose Save as... to display the Save as... menu (at right). With the Location highlighted, press the SAVE (F2) function key to save the configuration.



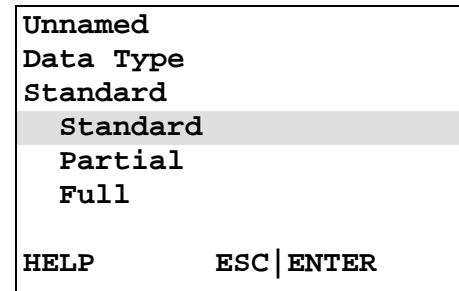
If the location highlighted is the Module, but the configuration is to be stored in the Data Pack, or vice versa, press the RIGHT ARROW/SELECT key to display the Location menu. Choose either Module or Data Pack by pressing ENTER (F4). This displays the Save as... menu again. Press SAVE (F2) to save the configuration in the desired location.

The Save As... menu also is used to enter or edit the configuration Name and Data Type. To name a configuration, simply choose option 2, then use the keypad with shift keys to enter the name as shown at right.



When the Save As... menu is displayed, one of the options – Standard, Partial, or Full – will be shown. To change the option, move the cursor to the Data Type _____ line of the Save As... menu and press the RIGHT ARROW/SELECT key to display the Data Type menu (below right).

Data Type Standard refers to all user-editable variables in a device configuration. Data Type Partial refers to only the marked editable variables. Data Type Full refers to a all device variables, whether user-editable or not. In general, it is best to save as Data Type Standard. Saving as Data Type Full preserves a complete configuration for future reference.



When all changes have been made, save the new configuration to either the Memory Module or the Data Pack and return to the Offline menu.

2.5.1.2 Saved Configuration

The second option on the Offline menu is the Saved Configuration menu, which permits access to previously stored configuration data.

1. Press “2” from the Offline Menu to display the Saved Configuration menu (at right).
2. Select either Module Contents or Data Pack Contents to open stored configurations. Both storage locations list all saved configurations by assigned Tag. See XPAND (below) for more configuration identification details. (**Note:** The PC option shown on the menu is not operational with firmware release 1.6.)

```
HART Communicator
Saved Configuration ←⌘
1->Module Contents
2 Data Pack Contents
3 PC
HELP
```

The Module Contents menu, which lists the configurations currently stored in the Memory Module, is shown at right. The Data Pack menu is similar. Both give the user several options for handling and viewing configuration data, as explained below.

FILTR

The FILTR function key (F1) opens a menu that provides both Sort and Filter options. These options select only the chosen configurations from all those stored. This is particularly valuable for the Data Pack, which stores up to 100 configurations.

```
HART Communicator
Data Pack Contents ←⌘
->PT101
PT102
PT103S
PT104
FILTR | XPAND
```

Sort allows unique device configurations to be grouped and displayed by Tag, Descriptor, or user-assigned Name.

Filter allows configurations to be grouped and displayed according to certain characters within the chosen device identifier (Tag, Descriptor, or Name). It is useful for selecting all the tags from a certain area of the process or plant.

When setting up a Filter (see display at right), two wildcard characters, the period (.) and the asterisk (*) are used. The period replaces a single character of any value. The asterisk replaces one or more alphanumeric characters of any value.

For example, if A-*.1 is entered as the filter, the configurations displayed will be all those with device tags starting with A-, followed by any combination of characters (e.g., XYZ, S2, 3R) followed by a dash, followed by any single character (e.g., 1, D, M), and ending with a 1. The

```
HART Communicator
Tag Filter
*
A- *-1
HELP | DEL | ESC | ENTER
```

tags A-M1-B1, A-N2-Z1, or A-SF-X1 would display, whereas the tags BA53, PT101, or ATT48 would not display.

XPAND

The XPAND function key allows a user to view the Tag, Descriptor, and Name for the configuration being edited or viewed. Selecting Compress restores the previous compressed display, which shows only the current Tag, Descriptor, or Name.

3. With the Module Contents or Data Pack Contents menu displayed, press the RIGHT ARROW/SELECT key to open the Saved Configuration menu for a device that was highlighted (at right).

Edit – displays the Edit menu, providing the functions as described under “Edit individually” in Section 2.5.1.1.

When editing off-line, only stored data may be edited. Moreover, data stored as a Partial configuration must be converted to a Standard configuration, then saved, prior to editing.

Copy To... – specifies the storage location for a copy of the configuration. Copy To... also provides a way to change the configuration name.

Send – sends a saved configuration to a connected device.

Print – not implemented with firmware release 1.6.

Delete – removes a saved configuration from memory. A confirmation message appears. Press Yes or No to complete the function.

Rename – provides access to the configuration name editing menu. After making name changes, enter and save the data to return to the previous storage location menu.

Compare – compares a selected device configuration from a stored location with other device configurations. The HART Communicator can compare device types, variables, marked lists, and other configuration parameters. Messages appear indicating if the configurations compared are the same or different.

```

PT118
Saved Configuration ←⌘
1->Edit
2 Copy to...
3 Send
4 Print
5 Delete
HELP

```


2.5.2 Online Menu

The Online menu permits a Model 341 Transmitter to be tested and configured while it is operating. Options available through the Online menu are summarized in Figure 2-5. The Online menu is displayed immediately if a device description for the connected device exists in the Communicator. If not, the Generic Online menu is displayed (see Figure 2-6).

Main Menu

From the Main menu, with a HART-compatible device connected, press “2” to access the Online menu (at right). The Online menu displays the name of the device at the top of the LCD, if it is a supported device. If a device description for the connected device is not present in the Communicator, contact the manufacturer of the device.

When no device description is found, the Communicator provides a generic interface, which enables users to perform functions common to all HART-compatible devices. Model 341-specific menu options are described in detail in Sections 3 and 6.

Generic Menu

The Generic Online menu (at right) is the first menu in the generic interface. It displays critical, up-to-date device information. Configuration parameters for the connected device may be accessed using the Device setup option. Figure 2-6 shows the complete Generic Online menu tree.

From the Online menu, use the options below to change device configurations.

Device setup – provides access to the Device Setup menu. Configurable device parameters common to all HART-compatible devices can be accessed from this menu.

Primary Variable (PV) –the dynamic primary variable and the related engineering unit. When the primary variable contains too many characters to display on the Online menu, access the PV menu to view the primary variable and related engineering units by pressing “1.”

Analog Output (AO) – the dynamic output and the related engineering units. The analog output is a signal on the 4-20 mA scale that corresponds to the primary variable. When analog output contains too many characters to display on the Online menu, access the PV AO Menu to view the analog output and related engineering unit by pressing “3.”

```

MPCO 341:PT100
Online                               ←⌘
1->Loop override
2 Calibrate/Test
3 Configure Xmtr
4 Range Xmtr

HELP | SAVE

```

```

1151:GENERIC                          ©
Online                               ←⌘
1->Device setup
2 PV      50.0000 inH2O
3 AO      12.000 mA
4 LRV     0.0000 in H2O
5 URV    100.0000 in H2O
          SAVE

```

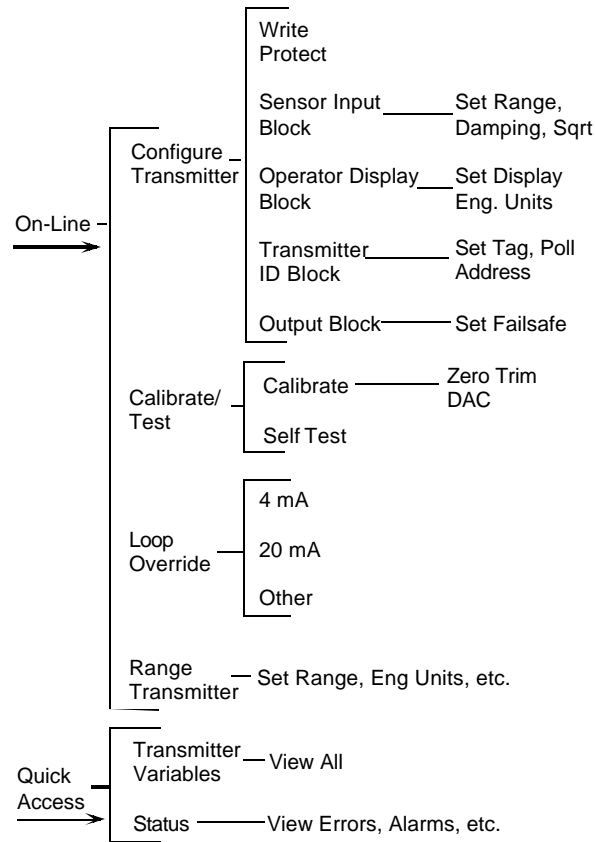


FIGURE 2-5 Online Menu Tree for Model 341 Transmitter

Lower Range Value (LRV) – the current lower range value and the related engineering unit. When the lower range value contains too many characters to display on the Online menu, access the PV LRV Menu to view the lower range value and related engineering unit by pressing “4.”

Upper Range Value (URV) – the current upper range value and the related engineering unit. When the lower range value contains too many characters to display on the Online menu, access the PV URV Menu to view the upper range value and related engineering unit by pressing “5.”

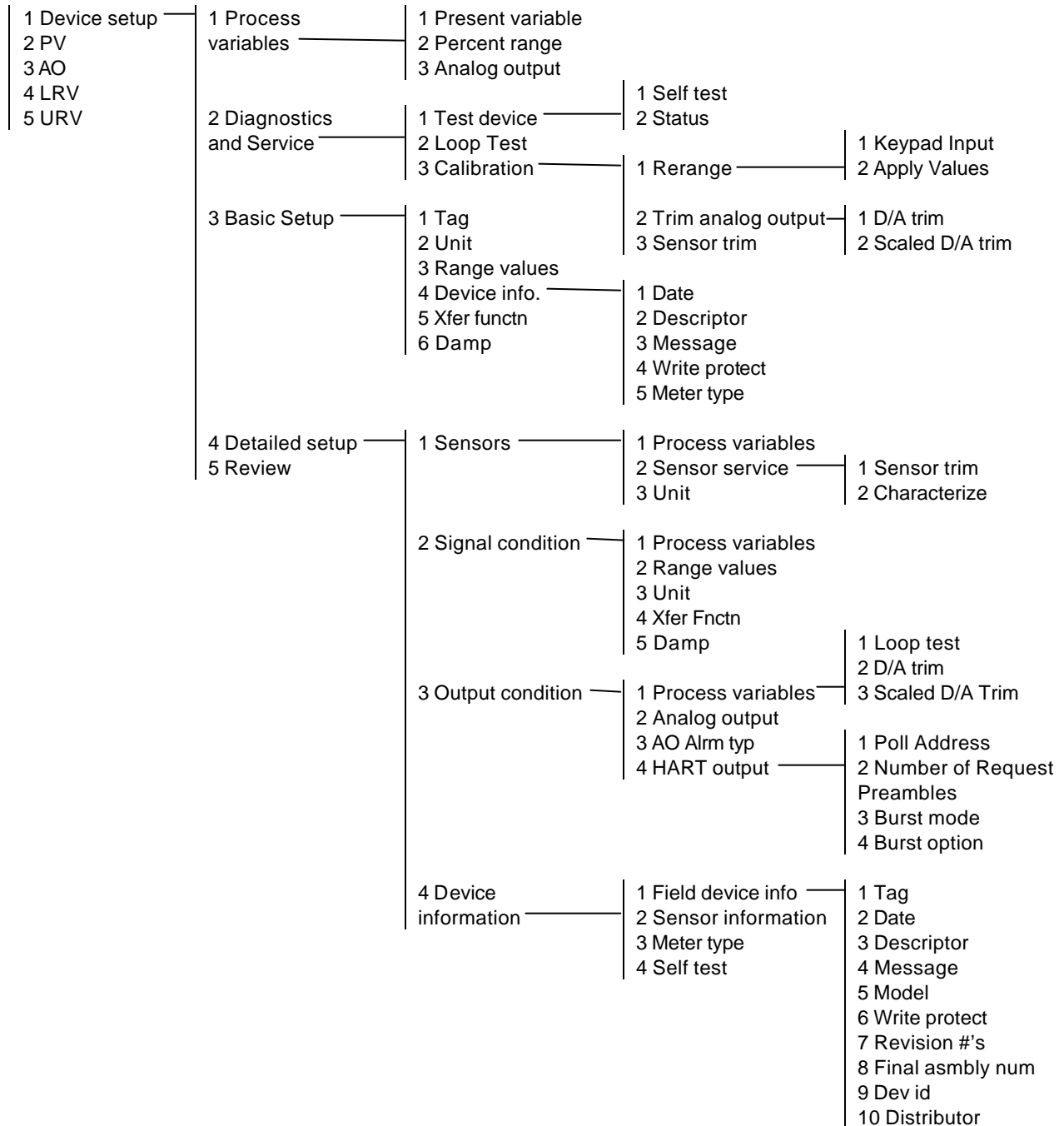


FIGURE 2-6 Generic Online Menu Tree

2.5.3 Frequency Device Menu

From the Main menu, press “3” to access the Frequency Device menu. This menu displays the frequency output and corresponding pressure output for current-to-pressure devices. For Model 341 transmitters, the display frequency and pressure values are both “none.”

2.5.4 Utility Menu

From the Main menu, press “4” to access the Utility menu (at right). This menu provide functions that affect the operation of the Communicator, not the connected devices.

```
HART Communicator
Utility ←⌘
1->Configure Communic
2 System Information
3 Listen for PC
4 Storage Location
5 Simulation
```

2.5.4.1 Configure Communicator

From the Utility Menu, press “1” to access the Configure Communicator menu (below right). Use this menu to set the polling, adjust the contrast of the LCD, set the Communicator shutoff time, or set how many diagnostics messages to ignore before a warning message is displayed.

```
HART Communicator
Configure Communica ←⌘
1->Polling
2 Contrast
3 Off Time
4 Ignore diagnostics

HELP
```

Use the **Polling** option to direct the HART Communicator to search for a connected device. The Communicator finds every device in the loop and lists them by tag number. If Polling is Never Poll, then the Communicator will not find a connected device.

The **Contrast** menu is used to change the LCD contrast. Contrast returns to the default value when the Communicator is turned off.

Off Time is used to set the Communicator to turn off automatically when not in use to conserve battery power.

The Communicator normally displays diagnostic messages from a connected device. The **Ignore Diagnostics** option permits the user to specify the number of messages to ignore so that messages will not be displayed as often, extending the time between displayed messages. The message count defaults to a nominal count of 50 each time the Communicator is turned on.

2.5.4.2 System Information

From the Utility menu, press “2” to access the System Information menu (at right). This menu can be used to provide information on the motherboard (e.g., firmware revision number), the module hardware and software characteristics, and the Data Pack EEPROM.

2.5.4.3 Listen for PC

Not implemented in firmware release 1.6.

2.5.4.4 Storage Location

From the Utility menu, the Storage Location menu (at right) provides access to data concerning the Memory Module or the Data Pack. Information available through this menu includes a label for the Memory Module or Data Pack, a feature that displays the total storage used (bytes) and the storage remaining (“free” bytes). The PC selection is not implemented in firmware release 1.6.

2.5.4.5 Simulation

The HART Communicator provides a mode that allows users to simulate an on-line connection to a HART-compatible device without connecting to the device. The simulation mode is a training tool that allows users to become familiar with different devices before configuring them in a critical environment. Simulation of an on-line connection is done by selecting a manufacturer from the Manufacturer menu, then selecting a device from the Model menu, just as is done when on-line. After selecting a software revision, the Online menu for the simulated device is displayed. Functions are the same as those available when on-line.

```
HART Communicator
System Information ←⌘
1->Motherboard
2 Module
3 Data Pack

HELP | DEL | ESC | ENTER
```

```
HART Communicator
Storage location ←⌘
1->Module
2 Data Pack
3 PC

HELP | DEL | ESC | ENTER
```

2.6 USING THE QUICK ACCESS KEY

Pressing the Quick Access Key (Hot Key) while on-line displays the Quick Access Key menu, a user-definable menu that provides immediate access to up to 20 frequently performed tasks. The Quick Access Key menu is accessible when the Communicator is powered and on-line, or when the Communicator is off, by simply pressing the Quick Access Key. For the Quick Access Key to be active, the Communicator must be connected properly to a HART-compatible device.

From the factory, the Quick Access Key menu includes (for Model 341 only):

- **XMTR Variables** – View such variables as percent range, process value, set point, and valve.
- **Status** – Determine model number and other transmitter identification information, errors, alarm status, and totalizer status.

Use of these functions is described in Section 5.1.4. More options can be added to provide rapid access to frequently performed tasks. User-defined options can be deleted later, but the five factory options are permanent.

To use the Quick Access Key:

1. Connect the Communicator to a HART-compatible device.
2. Press the Quick Access Key (upper right-hand key in the action keys group). The Communicator will power-up and display the Quick Access Key menu (at right).
3. Before any custom options have been installed, the Quick Access Key menu displays only the five factory-installed options. To add options, see Section 2.6.1.
4. Use the UP and DOWN arrows followed by the RIGHT ARROW/SELECT key to choose an option, or press the option's number on the keypad. The menu for the chosen option displays.
5. Follow the instructions given in Section 5.1.4 to use the option selected.
6. When finished, press the Quick Access Key to return to the previous menu.

```

MPCO 341:PT100
Quick Access Key  ←⌘
1→XMTR Variables
2 Status

SAVE

```

2.6.1 Adding Quick Access Key Options

The Quick Access Key menu contains space for up to 20 on-line options. For example, if device tags and damping must be changed often, simply add both of them to the menu. The Communicator automatically saves them so they can be accessed quickly by pressing the Quick Access Key.

From one of the menus or submenus reached via the Online menu, use the following steps to add customized options to the Quick Access Key Menu:

1. Using the UP or DOWN arrow keys, move the menu bar to highlight the option to be added to the Quick Access Key menu (e.g., Damping, under the Configure Xmtr\Sensor Input menu).

2. Press any shift key, release it, then press the Quick Access Key. The Hotkey Configuration menu displays (at right).

The Hotkey Configuration menu displays the new topic being added to the list of current Quick Access Key options. For example, in the figure at right, Damping is being added.

3. Press ADD (F3) to add the option. Pressing EXIT (F4) terminates the procedure and displays the menu that was displayed when “Shift,” Quick Access Key was pressed.
4. After pressing ADD (F3), either press ALL (F1) to add the new option to the Quick Access Key menu for all the HART-compatible devices supported by the Communicator or press ONE (F4) to add the option to the Quick Access Key Menu only for the type of device that is currently connected.
5. Next, the question “Mark as read-only variable on Quick Access Key menu?” may appear. Press YES (F1) to mark the variable for this option as read-only. Press NO (F4) to mark the variable as read/write. Marking a parameter for a device as read-only allows users to view, but not change, the parameter using the Quick Access Key Menu. Marking it as read/write permits the value to be changed from the Quick Access Key menu.

Finally, “Display value of variable on hotkey menu?” is displayed. Press YES (F1) to display the current variable associated with the option next to the option on the Quick Access Key menu as shown at right for Damping and Tag. Press NO (F2) not to display the variable on the Quick Access Key menu.

6. When finished adding options, press EXIT (F4) to exit the Hotkey Configuration menu and return to the menu of the last option deleted.

```

MPCO 341:PT100
Hotkey Configuration
ADD: Damping
  XMTR Variables
  Status

                                ADD | EXIT
  
```

```

MPCO 341:PT100
Quick Access Key    ←⌘
↑6 Damping         2.00 s
7->Tag             PT100

HELP | SAVE
  
```

2.6.2 Deleting Quick Access Key Options

Use the following steps to delete an option from the Quick Access Key menu:

1. From any on-line menu, press any shift key, release it, then press the Quick Access Key.
2. The Hotkey Configuration menu displays (at right).
3. Using the UP or DOWN arrow key, move the menu bar to highlight the option to be deleted and press DEL (F2). Factory-provided options cannot be deleted.
4. When finished deleting options, press EXIT (F4) to exit the Hotkey Configuration menu and return to the menu of the last option deleted.

```
MPCO 341:PT100
Hotkey Configuration
ADD: Descriptor
↑Damping
Tag

DEL | ADD | EXIT
```


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3.0 COMMISSIONING AND BENCH TESTING

Before operating a Model 341 on-line, the instrument should be set up either at the bench or in the field and commissioned using the HART Communicator. Commissioning consists of checking that the transmitter is operational and that all configuration information is correct. For an in-depth discussion of transmitter configuration, refer to Section 5 On-Line Configuration and Operation.

3.1 COMMISSIONING PROCEDURE

A Model 341 can be commissioned either before or after installation. Commissioning on the bench before installation is recommended. A complete transmitter functional test can be performed and configuration procedures can be practiced. If commissioning after installation, install the transmitter as described in Section 4, then return to this section.

To commission the transmitter on the bench, make the connections shown in Figure 3-1. For commissioning in the field, use either the set-up shown in Figure 3-2 or the appropriate installation wiring figure in Section 4.

3.1.1 Test Equipment Needed

TEST EQUIPMENT	DESCRIPTION (see Specifications, Section 9.3.2)
Power Supply	10 to 42 Vdc, see Section 4.3.6
Multimeter:	
Current	Range: 4 to 20 mA to measure loop current
Voltage	Range: 10-50 Vdc to measure power supply and loop voltage
Current Sense Resistor	250 to 1100 Ω to support HART digital communications
Configuration Device	HART Communicator

NOTE

Test equipment should be 2 to 10 times more accurate than the transmitter accuracy.

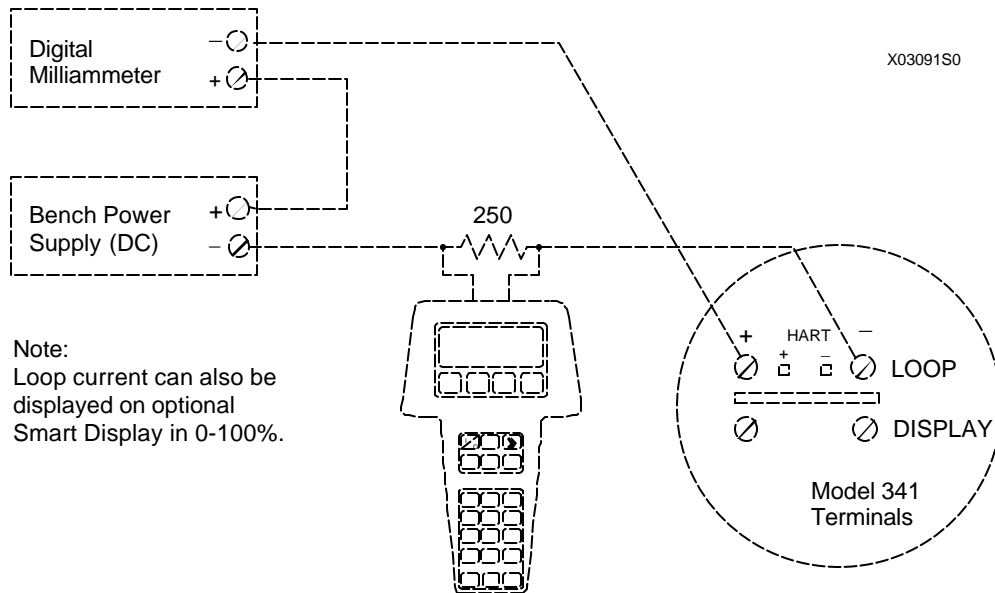


FIGURE 3-1 Bench Test Connections

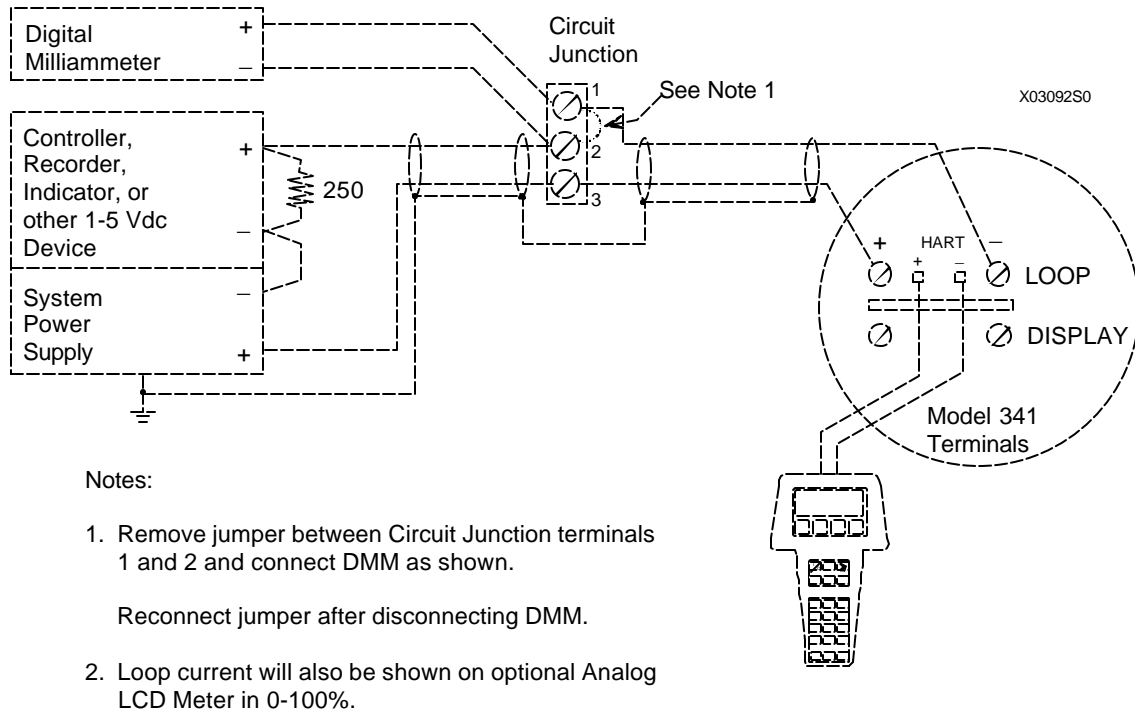


FIGURE 3-2 Field Test Connections

3.2 ESTABLISHING COMMUNICATION

1. Connect the transmitter, power supply, and HART Communicator in a loop.
2. Apply power to the transmitter.
3. Press the HART Communicator's ON/OFF key. The first display is the Online menu (at right).
4. If the Online menu does not appear, or if a "Device not found" message displays, check connections and try again.

```

MPCO 341:PT100
Online ←⌘
1->Loop Override
2 Calibrate/Test
3 Configure Xmtr
4 Range Xmtr

HELP | SAVE

```

3.3 TESTING THE TRANSMITTER

Although a Model 341 Transmitter continuously performs an on-line self-test, a more extensive self-test can be performed when communication with the HART Communicator has been established.

1. From the Online menu, choose option 2, Calibrate/Test to display the Calibrate and Test selections.
2. From the Calibrate/Test menu, choose option 1, Selftest. Press the RIGHT ARROW/SELECT key to start the test.
3. The Communicator will display a warning screen (at right). If a process might be harmed by a change in transmitter output, press "1," ABORT to stop the test. If it is okay to proceed, press "2," CONTINUE.
4. The transmitter performs the self-test.
 - If testing is successful, the message "Transmitter PASSED the transmitter selftest" displays.
 - If testing fails, the message "Transmitter FAILED the transmitter selftest" displays, and the transmitter goes to the prescribed failsafe condition.
5. Press OK (F4) to acknowledge the test results and display the Calibrate/Test menu.

```

MPCO 341:PT100
WARNING! Self test
may bump transmitter
output.
1 ABORT
2 CONTINUE

ABORT | ENTER

```

3.4 REVIEWING CONFIGURATION DATA

Before placing a transmitter in service, use the HART Communicator to check that the proper configuration information has been stored.

1. Establish communication as described in Section 3.2.
2. From the Online menu, press “3” to view the Configure Xmtr menu (at right). For each of the function blocks on this menu, check to see if each of the parameters is set to the correct value as recorded in user documentation of parameters (Appendix C). See Section 6 for detailed information on changing function block parameters.
3. For each function block, perform the following steps:
 - 1) Use the UP or DOWN arrow key to highlight the function block. Press the RIGHT ARROW/SELECT key to view the function block options.
 - 2) Examine each of the options on the function block menu, changing values if necessary. When the first change is made, the SAVE softkey changes to SEND.
4. When all configuration parameters have been examined and changed as needed, press SEND to download the configuration to the transmitter. The SEND softkey changes to SAVE.
5. If this configuration will be used for other transmitters, save the configuration to either the Memory Module or Data Pack by pressing SAVE (F3) from the Configure Xmtr menu or any of its submenus.

```

MPCO 341:PT100
Configure Xmtr      ←⌘
1->Write protect
2 Sensor Input
3 Operator Display
4 Transmitter ID
↓5 Output Block
HELP |SAVE |HOME
  
```

3.5 CHECKING TRANSMITTER OUTPUT

After the transmitter configuration has been confirmed and adjusted if necessary, check to be sure that the transmitter is reading the proper pressure in the proper units. Use a dead weight tester or other acceptable plant pressure standard to apply 0, 25, 50, 75, and 100% of input values to the transmitter. Check that the corresponding outputs are 4, 8, 12, 16, and 20 mA. With the transmitter configured properly, and with the test equipment in place, perform the following steps:

1. Connect the HART Communicator and press the Quick Access Key.
2. From the Quick Access Key menu, choose 1 XMTR Variables to view the current transmitter output (at right).
3. Apply pressure representing 0% of the configured range. Wait at least 5 seconds.
4. Choose “6” to see the current display. The current should read 4.00 mA.
5. Repeat steps 1-4 for pressures representing 25, 50, 75, and 100% of the configured range. Check for the corresponding pressure readings and current values.

MPCO 341:PT100		♥
XMTR Variables		←⌘
1->% Range		34.0%
2 MV		8 ftH2O
3 PV		495 BBL
4 I		9.33 mA
↓		
HELP		SAVE

This completes commissioning and bench testing of the transmitter.



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- 3.1.1 Test Equipment Needed 1
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- 3.3 TESTING THE TRANSMITTER..... 3
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- 3.5 CHECKING TRANSMITTER OUTPUT 4

4.0 INSTALLATION

This Section describes installation of a Model 341 Pressure Transmitter. Topics include: receipt of shipment, installation considerations, and mechanical and electrical installation.

IMPORTANT

The installation must conform to the National Electrical Code and all other applicable construction and electrical codes.

Refer to the installation drawings in Appendix B when locating a Transmitter in a hazardous area.

4.1 EQUIPMENT DELIVERY AND HANDLING

4.1.1 Factory Shipment

Prior to shipment, a Transmitter is fully tested and inspected to ensure proper operation. It is then packaged for shipment. Most accessories are shipped separately.

4.1.2 Receipt of Shipment

Each carton should be inspected at the time of delivery for possible external damage. Any visible damage should be immediately recorded on the carrier's copy of the delivery slip.

Each carton should be carefully unpacked and its contents checked against the enclosed packing list. At the same time, each item should be inspected for any hidden damage that may or may not have been accompanied by exterior carton damage.

IMPORTANT

A Moore Products Co. magnetic screwdriver (shown in Section 5.2) is packed with each Model 341. The magnetic screwdriver is needed for local setting of zero, full scale and damping. Keep the supplied screwdriver with the Transmitter.

If it is found that some items have been damaged or are missing, notify Moore Products Co. immediately and provide full details. In addition, damages must be reported to the carrier with a request for their on-site inspection of the damaged item and its shipping carton.

4.1.3 Storage

If a Transmitter is to be stored for a period prior to installation, review the environmental specifications in Section 9.3.

4.2 ENVIRONMENTAL CONSIDERATIONS

Many industrial processes create severe environmental conditions. The conditions at each transmitter location must be within the specifications stated in Section 9.3.

The Transmitter is designed to perform in harsh conditions, however, it is prudent to locate a Transmitter to minimize the effects of heat, vibration, shock, and electrical interference.


CAUTION

Exceeding the specified operating temperature limits can adversely affect performance and may cause damage.







4.3 INSTALLATION CONSIDERATIONS

Sections 4.3.1 and 4.3.2 outline basic considerations needed to achieve a successful mechanical/ electrical installation. The remaining sections then provide detailed pre-installation information.


4.3.1 Mechanical

-  A transmitter can be used on, but is not limited to, the following process measurements. A transmitter's nameplate displays the model designation; see Section 9.1 Model Designation for an explanation of the alphanumeric sequence.

PROCESS MEASUREMENT	MODEL 341D DIFFERENTIAL PRESSURE	MODELS 341A, 341G, AND 341P ABSOLUTE AND GAUGE PRESSURE
Direct Pressure	Liquid, Gas, Steam	Liquid, Gas, Steam
Flow	Liquid, Gas, Steam	Liquid, Gas, Steam
Level	Open and Closed Tank	Open Tank

-  Determine if an optional analog meter for local monitoring of transmitter output is required. Refer to Section 9.1 for model designation or 9.2 for accessory part numbers.
-  Determine physical mounting of transmitter. Consider:
 -  Optional brackets for pipe mounting or surface mounting
 -  Pipe or tank wall thickness, diameter, rigidity, and freedom from vibration
 -  Clearance for installation and maintenance and for reading the optional analog meter
 -  Need to rotate optional analog meter for viewing ease

Refer to Figures 9-1 and 9-2 for transmitter dimensions and the figures in sections 4.3.4, 4.4 and 4.5 for typical mechanical installations. Refer to Section 9.3 for mechanical and environmental specifications.

-  Determine if an explosion-proof or intrinsically safe installation is required. Refer to the Transmitter nameplate for electrical classifications and to Sections 4.8 and 9.3.

An intrinsically safe installation requires user-supplied intrinsic safety barriers that must be installed in accordance with barrier manufacturer's instructions for the specific barriers used.

Transmitter certification is based on the "Entity" concept in which the user selects barriers that permit the system to meet the entity parameters.

- ✎ Models 341D, A, and G - Consider pressure piping recommendations. Refer to Section 4.3.3.
- ✎ Determine conduit routing. Refer to Section 4.6.2.
- ✎ Consider bolting the Transmitter to a two or three-valve manifold.

Model 341D - Install a three-valve manifold as this device provides both an equalizing valve and high and low pressure block valves.

Use the equalizing valve to equalize pressure between inputs before calibrating or servicing the transmitter. Use block valves to isolate the transmitter from the process for servicing or removal.

Models 341A and G - Install a two-valve manifold for similar purposes to those stated above.



- ✎ Prepare installation site drawings showing the following:
 - ✎ Location of the Master Device (e.g., HART Communicator or controller)
 - ✎ Location and identification of each Transmitter
 - ✎ Routing plan of signal cable(s)
 - ✎ Location of any signal cable junctions for connecting the HART Communicator

4.3.2 Electrical










- ✎ Determine Transmitter operating mode (analog or digital) and type of Network needed; refer to Section 4.3.5.
- ✎ Determine minimum power supply requirements. Refer to Section 4.3.6.
- ✎ Select twinaxial cable type and determine maximum cable length. Refer to Section 4.3.7.
- ✎ Determine the need for network junctions. Refer to Section 4.3.8.
- ✎ Intrinsically Safe installations will need barriers. Refer to Section 4.3.9.
- ✎ Consider the effect of connecting additional equipment (e.g., recorder, loop powered display) to the network. Refer to Section 4.3.10.
- ✎ Read Section 4.3.11 for grounding and shielding recommendations.

4.3.3 Impulse Piping for Models 341D, A, and G


Impulse piping is the piping to be connected to the Transmitter's process connection(s). For suggested flow and level measurement piping arrangements, refer to:

-  Model 341D - Figures 4-1 and 4-2
-  Model 341A or G - Figures 4-3, 4-4 and 4-5




Note the following when planning and installing piping.

-  Install impulse piping in accordance with ANSI Code B31.1.0.
-  Make impulse piping length as short as possible to reduce frictional loss and temperature-induced pressure variations. However, when using impulse lines on a high temperature process, locate the transmitter far enough away from the heat source to keep it within temperature specifications [10EC (50E F) per foot cooling to a normal ambient is assumed for uninsulated impulse lines].
-  For lines between the process and Transmitter, use impulse piping of 3/8" OD or larger to avoid friction effects (causes lagging) and blockage.
-  Use the least number of fittings and valves possible to minimize leakage problems. TFE/PTFE  tape is the recommended thread sealant for process connections at the Transmitter.
-  Valves used in pressure service should be either globe or gate type. Valves used in gas service should be of a type that does not permit condensate to build up behind the valve.
-  Install sediment chambers with drain valves to collect solids suspended in process liquids or moisture carried with non-condensing gases.
-  Install air chambers with vent valves at high point in piping to vent gas entrained in process liquid.
-  Remote diaphragm seals can be used to keep corrosive liquid or gas from the transmitter pressure inlets and isolation diaphragm (see PI340-2 for details).

Alternatively, use sealing fluid to isolate the process from the transmitter. Sealing fluid must be of greater density than process fluid and non-miscible.

-  For Transmitters located above the process, slope piping from the Transmitter at least 1 inch/foot (83 mm/M) down toward process.

For Transmitters below the process, slope piping at least 1 inch/foot (83 mm/M) up to process.

-  Protect pressure lines (by shielding if necessary) from objects or equipment that may bend or kink the line causing fluid flow restriction.
-  Protect the pressure lines from extreme temperature ranges. Lines should be protected from freezing by installing a heat trace.
-  A three-valve manifold should be used with a Model 341D Transmitter to permit servicing and zero checks. A two-valve manifold can be used with a Model 341A or G.

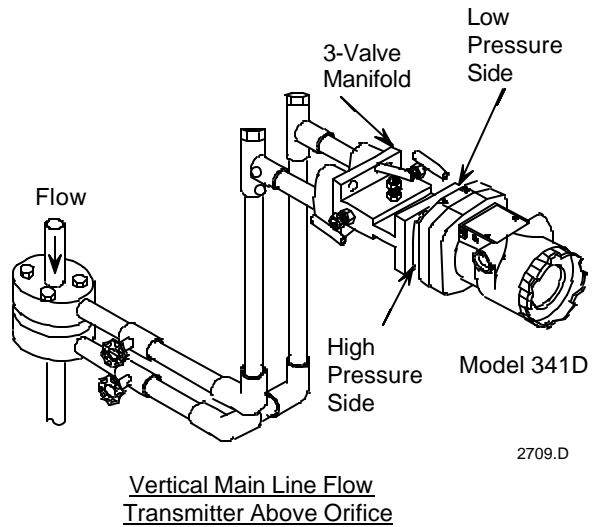
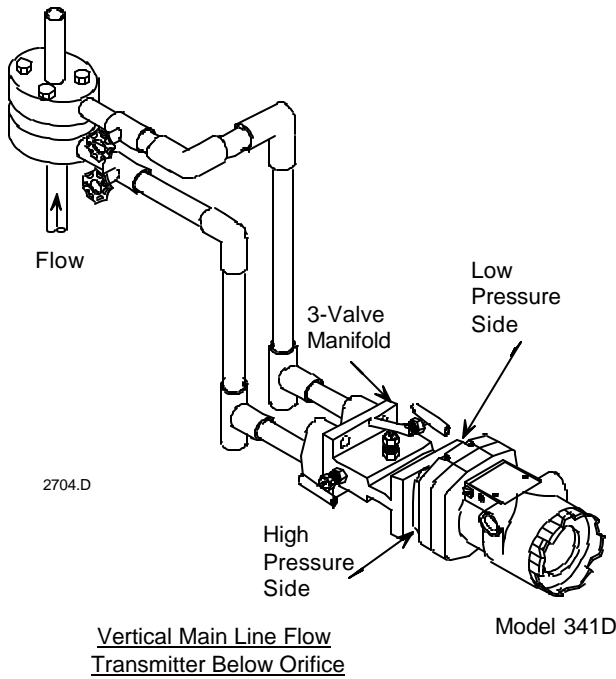
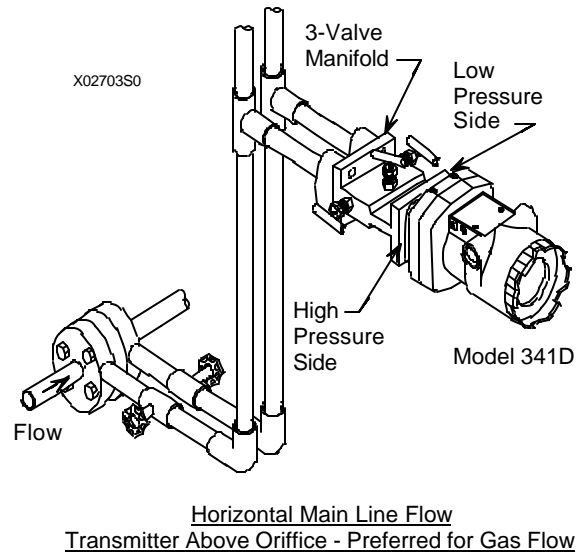
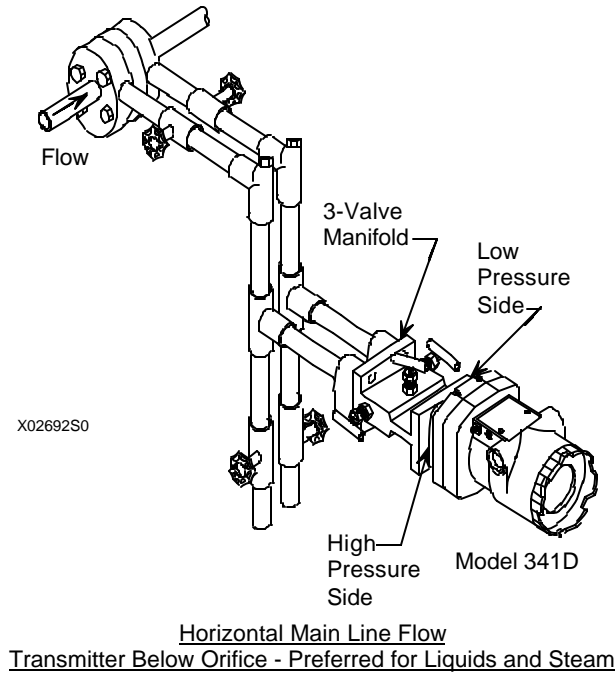
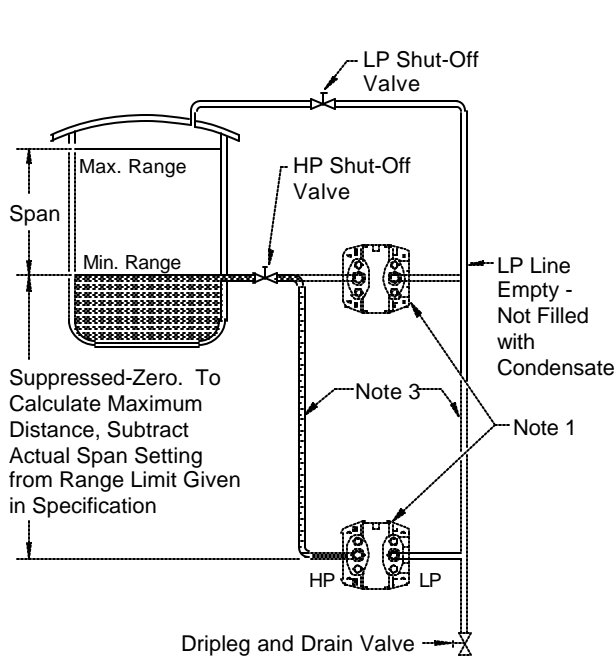
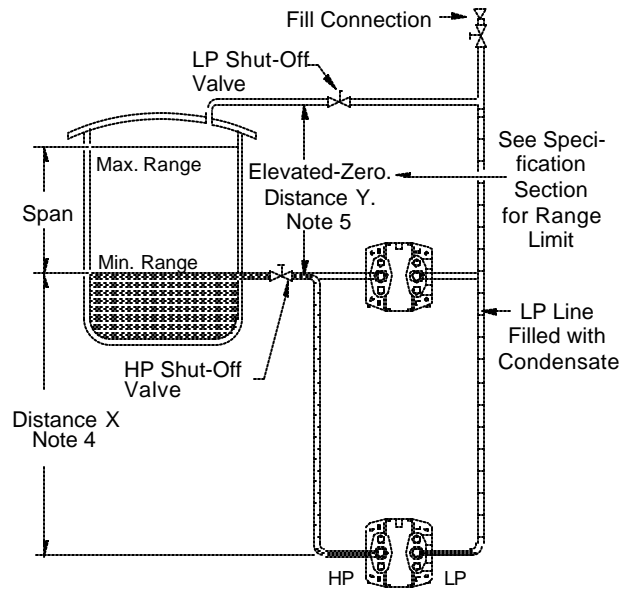


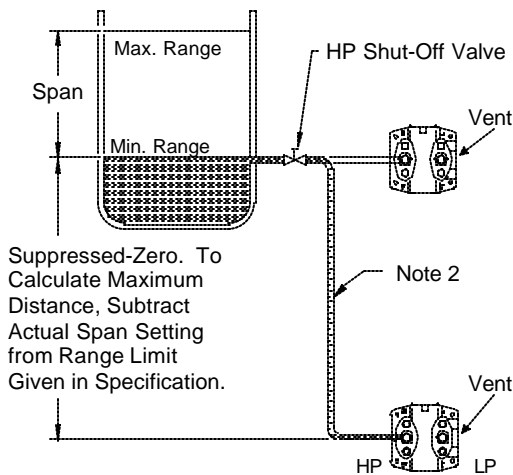
FIGURE 4-1 Model 341D, Flow Measurement Piping for Gas and Liquid



A. Pressurized (Closed) Vessel Installation:
Non-Condensable Fluid



B. Pressurized (Closed) Vessel Installation:
Condensable Fluid



C. Open Vessel Installation

Notes:

1. Transmitter may be mounted at the minimum level to be measured or below the minimum level.
2. Open or vented vessels require only a high pressure (HP) connection.
3. High pressure line senses static pressure plus level. Low pressure line senses static pressure only. The two pressures oppose each other cancelling the effect of static pressure.
4. Distance "X" can be any distance since both high and low pressure lines have equal and opposite forces which cancel the forces created by this distance.
5. Entire length of low pressure pipe is kept full of condensate to act as a reference.

X0266100

FIGURE 4-2 Model 341D, Liquid Measurement Piping

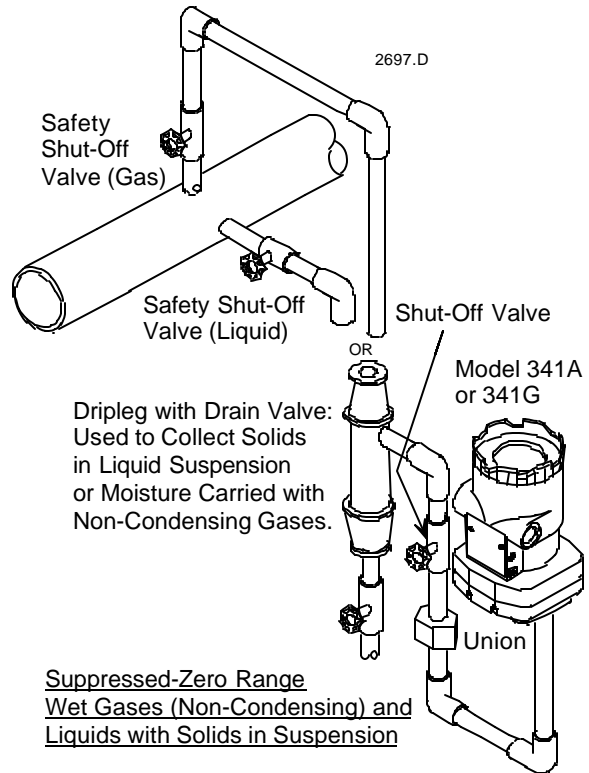
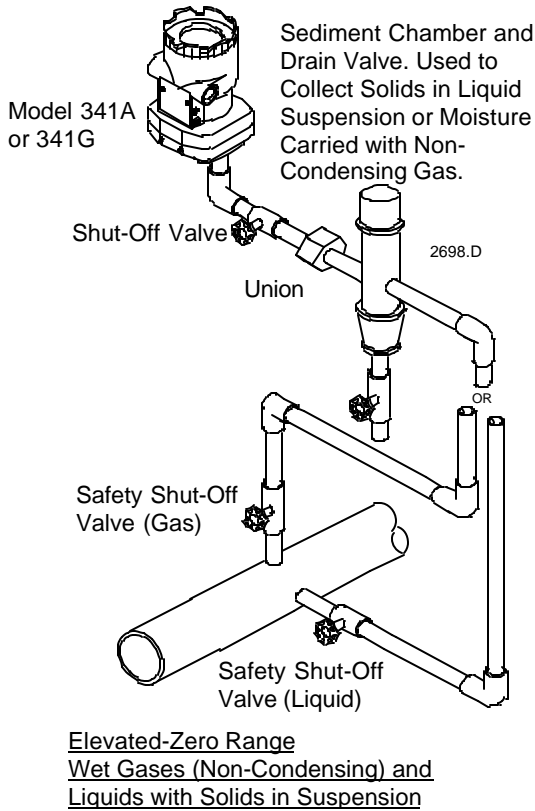
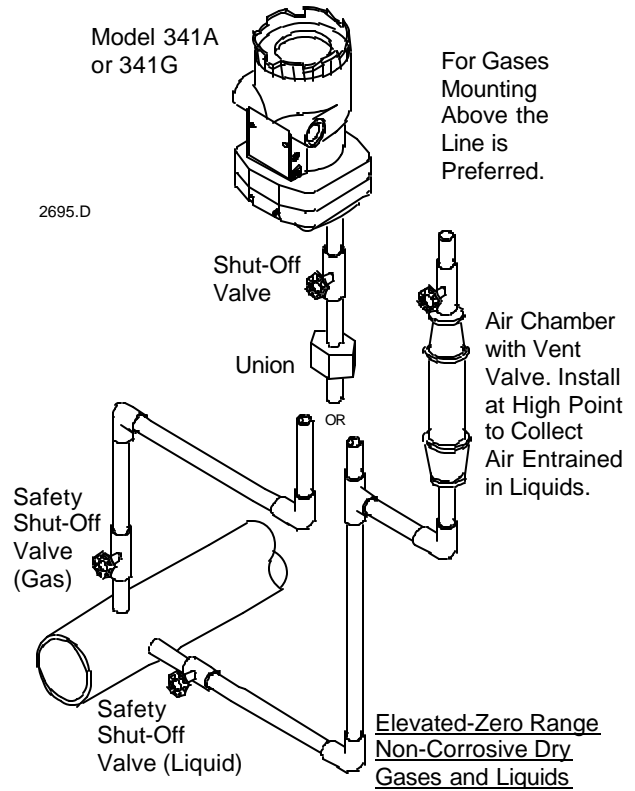
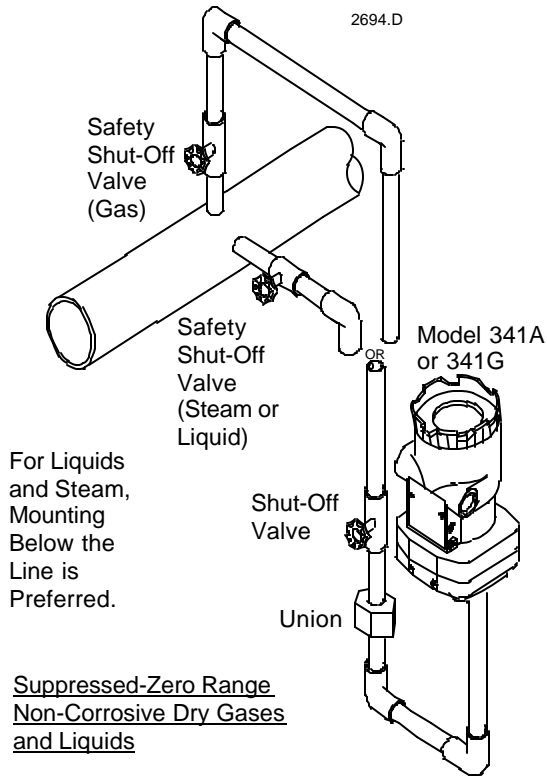
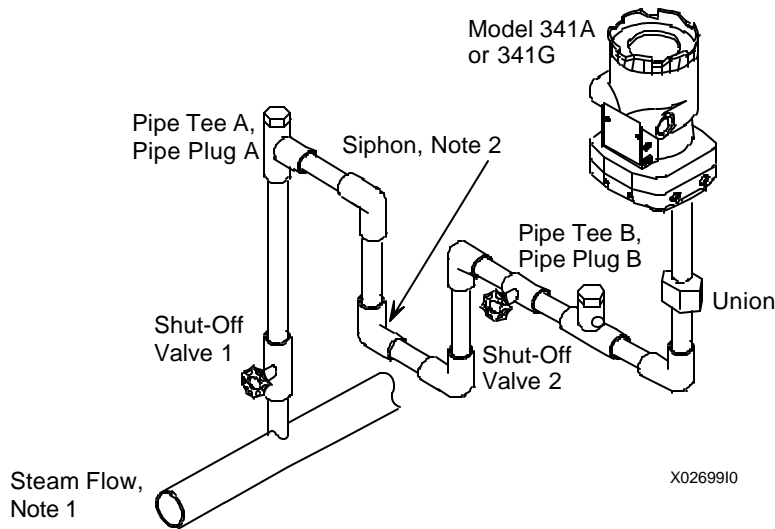


FIGURE 4-3 Model 341A or G, Piping for Gas or Liquid



Filling the Siphon:

1. Close Shut-Off Valve 1.
2. Remove Pipe Plug B.
3. Open Shut-Off Valve 2.
4. Remove Pipe Plug A.
5. Slowly pour water or antifreeze into the pipe at Pipe Tee A.
6. When water is seen at Pipe Tee B, install Pipe Plug A.
7. Install Pipe Plug B.
8. Open Shut-Off Valve 1.

Notes:

1. Line pressure must be able to support a liquid column from the pipe line to the transmitter.
2. Siphon protects transmitter manifold assembly from damage due to contact with process steam.

FIGURE 4-4 Model 341A or G, Above the Line Mounting, Steam Service

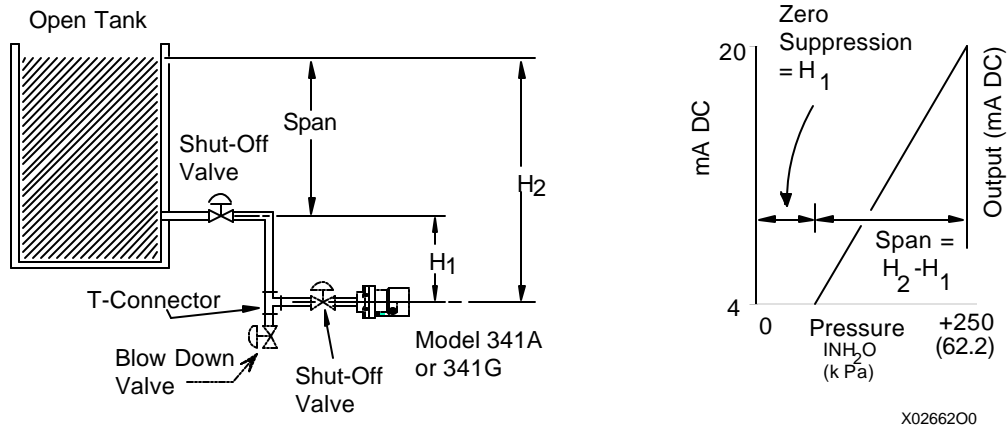


FIGURE 4-5 Model 341A or G, Open Tank Liquid Level Measurement

4.3.4 Tank and Pipe Mounting for Model 341P

As shown in Figure 4-6, Model 341P is typically mounted to a tank or pipe using a closely dimensioned spud (nipple). A hole is cut in the tank or pipe and the spud welded in place. It is imperative that the spud manufacturer's installation instructions be followed to prevent distortion of the spud and a poor or interference fit between the spud and transmitter.

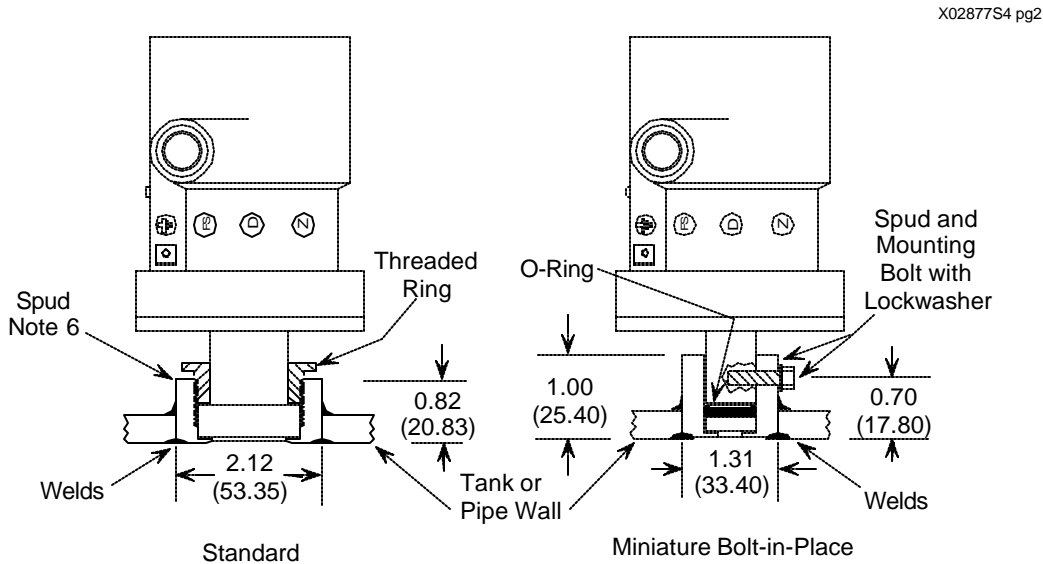


FIGURE 4-6 Model 341P, Tank and Pipe Mounting

4.3.5 Transmitter Operating Mode and Network Type

A Transmitter will output either an analog current or an equivalent digital signal, depending upon the selected operating mode. The operating mode also determines the type of Network (Point-To-Point or Multi-Drop) to be installed, as shown in Table 4.1 and the following subsections. Select the operating mode during Transmitter configuration as described in the following subsections and Section 5.

TABLE 4.1 Operating Mode and Network

OPERATING MODE	NETWORK TYPE	NETWORK FIGURE(S)
Analog	Point-To-Point	4-7 and 4-8
Digital	Multi-Drop	4-9

4.3.5.1 Analog Mode

When a transmitter is configured for analog mode operation, the following statements apply.

- ✎ The transmitter outputs a 4-20 mA signal for input to devices such as controllers and recorders.
- ✎ A Point-To-Point Network is used comprising a Transmitter, Primary/Secondary Master, and other non-signalling devices. Transmitter polling address is 0 (zero).

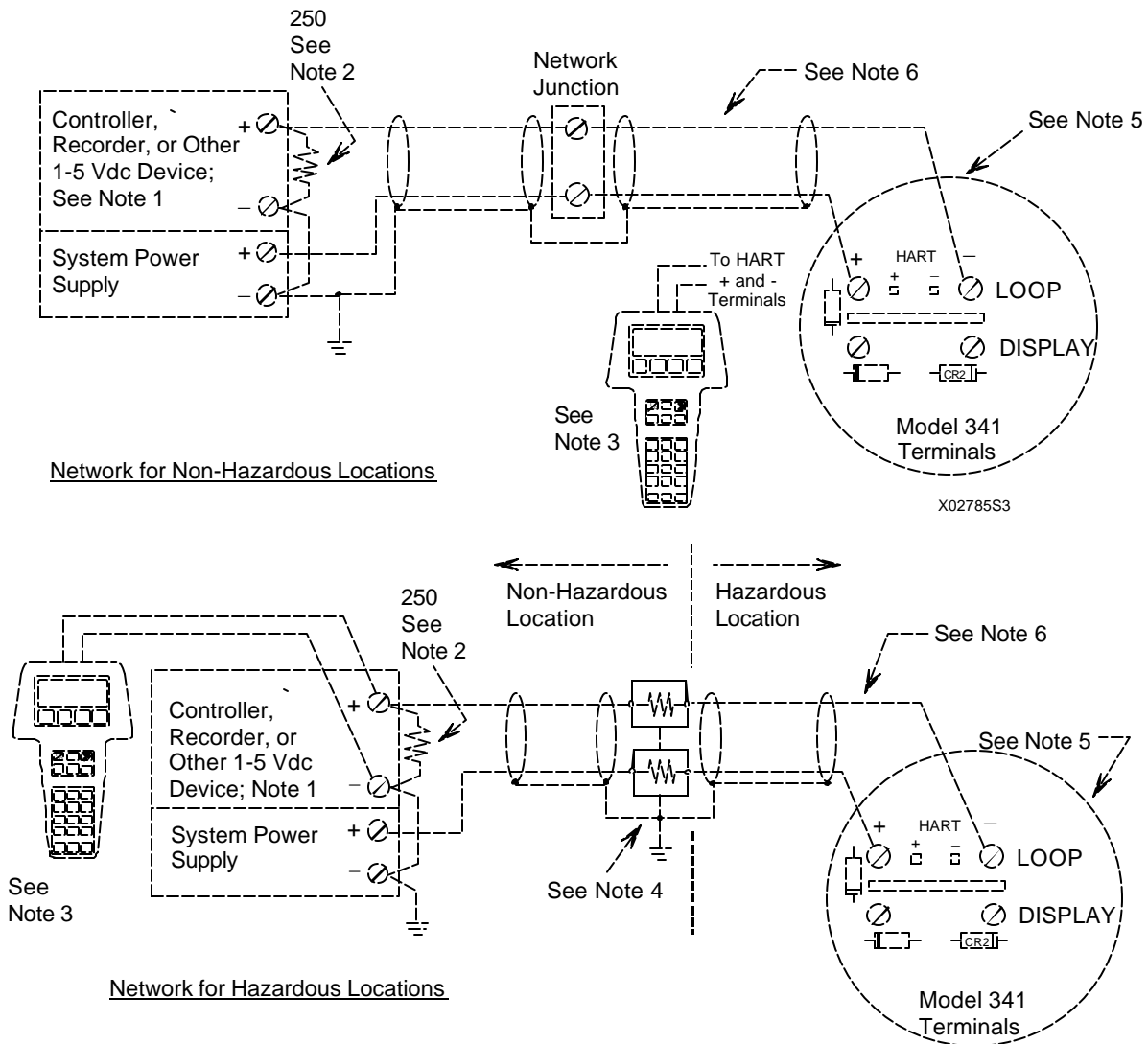
Point-To-Point Networks are shown in Figures 4-7 and 4-8.

- ✎ The optional Analog Meter can be used for local indication of transmitter output.
- ✎ Each Transmitter is factory configured for analog mode unless otherwise ordered. The POLLING ADDRESS is set to zero (0).
- ✎ A HART Communicator is used for configuration, diagnostics, and reporting the current process variable.

4.3.5.2 Digital Mode

When a transmitter is configured for digital mode operation, the following statements apply.

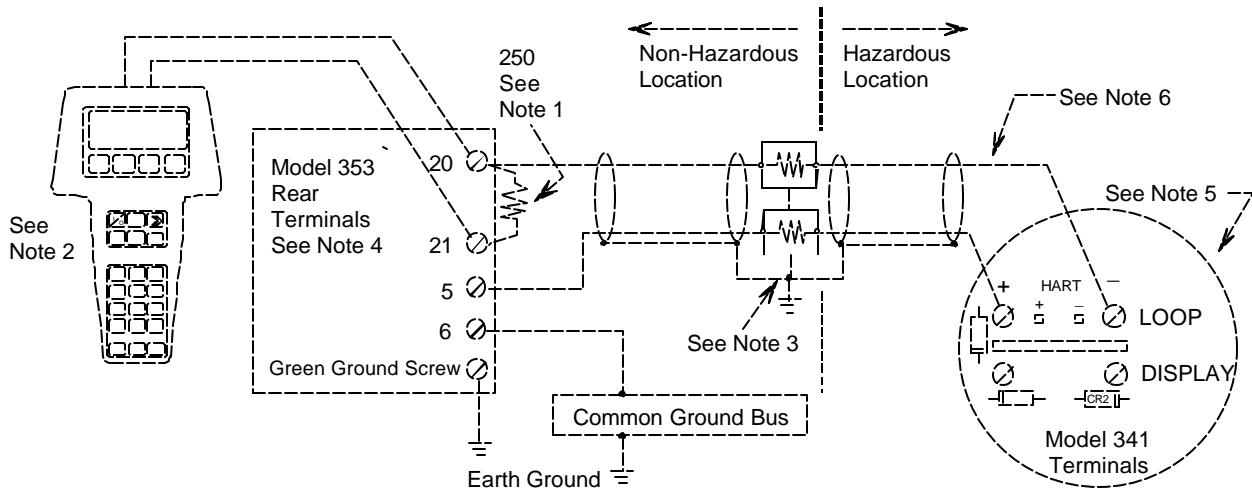
- ✎ The process variable is transmitted digitally. The analog output of each transmitter is "parked" at 4 mA.
- ✎ Employs a Multi-Drop Network. See Figure 4-9.
- ✎ The optional Analog Meter can not be used since there is no 4-20 mA output signal.
- ✎ The number of Allowable Network Elements is:
 - Primary and Secondary Masters - 1 each
 - Transmitters - 1 to 15
- ✎ The HART communication source can be a Primary or Secondary Master. A Primary Master can be used for data acquisition, maintenance, or control purposes. A Secondary Master, the HART Communicator for example, may be used for configuration, diagnostics, and reporting current process variable.
- ✎ Place the transmitter in the digital mode by assigning it a POLLING ADDRESS (1 to 15) when configuring the TRANSMITTER ID BLOCK with the HART Communicator (see Section 5.1.1).
- ✎ Each transmitter must have a unique address.



Notes:

1. The System Power Supply is shown separate from the host input device. In practice, it may be part of the host input device. The host input device can be either a HART or non-HART signaling device, a Primary Master or a Secondary Master.
2. Network resistance equals the sum of the barrier resistances and the current sense resistor. Minimum value 250 Ohms; maximum value 1100 Ohms.
3. The Model 275 is a non-polar device.
4. Supply and return barriers shown. Interconnect all cable shields and ground only at the barriers.
5. For access to Model 341 terminals, remove end cap and, if installed, Analog Meter. Terminal board may differ from that shown.
6. Maximum loop cable length calculated by formula in Section 4.3.

FIGURE 4-7 Point-To-Point Network (Analog Mode)

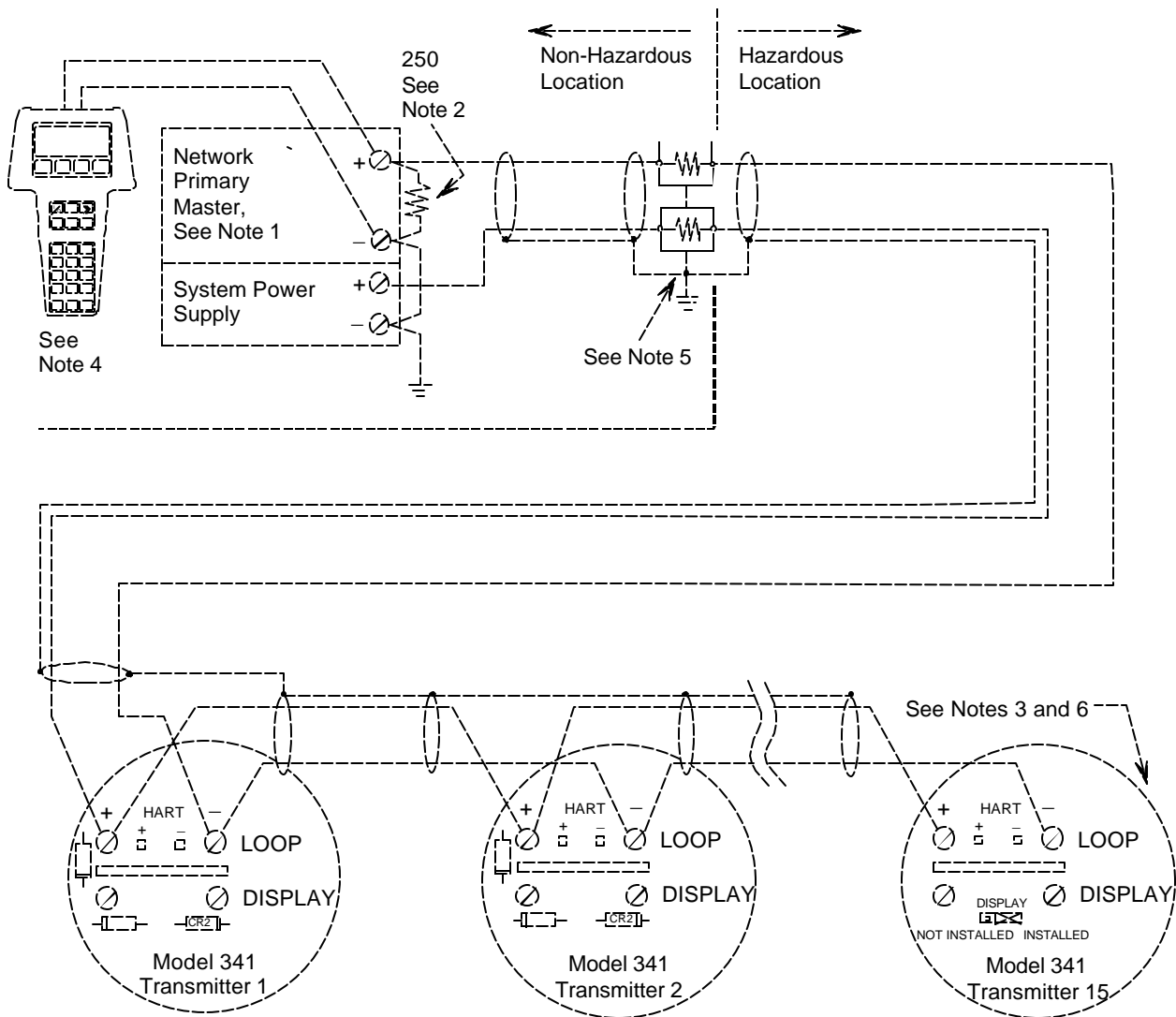


Notes:

1. Network resistance equals the sum of the barrier resistances and the current sense resistor.
Minimum value 250 Ohms; maximum value 1100 Ohms.
2. The Model 275 is a non-polar device.
3. Supply and return barriers shown. Interconnect all cable shields and ground only at the barriers.
4. Model 353 Rear Terminal Assignments
 20 - Analog Input 1 (AIN1+)
 21 - Analog Input Common (AINC)
 5 - Two-Wire Transmitter Power (+26 Vdc)
 6 - Transmitter/Station Common (COM)
 Green Ground Screw - Safety/Case Ground
 See User's Manual UM353-1 for details.
5. For access to Model 341 terminals, remove enclosure end cap and, if installed, Analog Meter.
6. Maximum loop cable length calculated by formula in Section 4.3.

MG000841

FIGURE 4-8 Model 353 and Model 341 Connections (Analog Mode)



Notes:

1. The System Power Supply is shown separate from the host input device. In practice, it may be part of the host input device. The host input device can either be a HART or non-HART signaling device, a Primary Master or Secondary Master.
2. Network resistance equals the sum of the barrier resistances and the current sense resistor. Minimum value 250 Ohms; maximum value 1100 Ohms.
3. A maximum of 15 transmitters may be connected. All must be configured for digital mode.
4. The Model 275 is a non-polar device.
5. Supply and return barriers shown. Interconnect all cable shields and ground only at the barriers.
6. For access to Model 341 terminals, remove enclosure end cap and, if installed, Analog Meter. Both types of terminal boards are shown and either or both may be present on the Network.

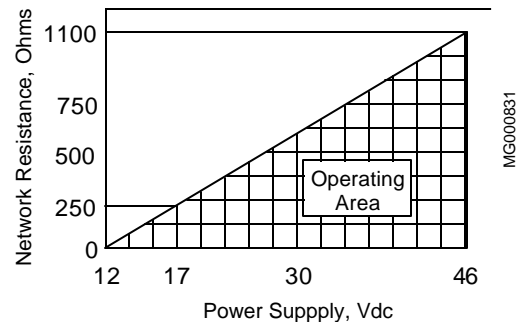
FIGURE 4-9 Multi-Drop Network (Digital Mode)

4.3.6 Power Supply Requirements

A power supply is needed to power the Transmitter(s). The power supply can be:

- ✎ A separate stand-alone supply capable of powering several Transmitters. It can be mounted in a control room or in the field. Follow the power supply manufacturer's recommendations with regard to mounting and environmental considerations.
- ✎ Located in a controller (such as a Primary Master) or other station able to safely provide additional operating current and meet the power supply specifications of Section 9.3.2

Determine needed power supply output voltage by calculating the Network Resistance and consulting the adjacent Figure. It shows the minimum power supply voltage needed for the calculated Network Resistance (when an optional analog LCD meter is installed).



The total Network Resistance is the sum of the Current Sense Resistance, end-to-end Barrier Resistance (if used), wire resistance, and any other resistances in the loop. The minimum Network Resistance (see Glossary) required to support HART communications is 250S. The maximum resistance is 1100S.

4.3.6.1 Point-To-Point Network

The above Figure defines an analog mode Transmitter's operating region for the allowable ranges of supply voltage and network resistance. Perform the following simple calculations to ensure that the power supply output voltage permits the Transmitter to remain within the indicated operating range.

1. Calculate the minimum power supply output voltage.

The minimum network power supply voltage requirement is a function of Network Resistance and full scale current (22.5 mA), and is calculated by the following formula:

$$\text{Minimum Power Supply Output Voltage} = 12 \text{ volts} + (0.0225 \times \text{Network Resistance in ohms})$$

Power supply output voltage must be greater than the calculated value. The minimum voltage across the input terminals of a Transmitter is 12 volts.

2. Calculate the maximum power supply output voltage.

The maximum network power supply voltage is a function of Network Resistance and zero scale current (3.85 mA), and is calculated by the following formula:

$$\text{Maximum Power Supply Output Voltage} = 42 \text{ volts} + (0.00385 \times \text{Network Resistance in ohms})$$

Power supply output voltage must be less than the calculated value. The maximum voltage permitted across the input terminals of a Transmitter is 42 volts.

4.3.6.2 Multi-Drop Network

Perform the following simple calculations to ensure that the power supply output voltage permits the Transmitter to remain within its operating range.

1. Calculate the minimum power supply output voltage.

Minimum network power supply voltage is a function of Network Resistance and the total current draw of all transmitters in the Network, and is calculated by the following formula:

$$\text{Minimum Supply Output Voltage} = 12 \text{ volts} + [(0.004 \times \text{number of transmitters on Network}) \times (\text{Network Resistance})]$$

Power supply output voltage must be greater than the calculated value. The minimum voltage across the input terminals of a Transmitter is 12 volts.

2. Calculate the maximum power supply output voltage.

Maximum network power supply voltage is a function of Network Resistance and total current draw of all the transmitters in the Network, and is calculated by the following formula:

$$\text{Maximum Supply Output Voltage} = 42 \text{ volts} + [(0.004 \times \text{number of transmitters on Network}) \times (\text{Network Resistance})]$$

Power supply output voltage must be less than the calculated value. The maximum voltage permitted across the input terminals of a Transmitter is 42 volts.

The maximum number of Transmitters that can be connected to a Multi-Drop Network is fifteen. Each Transmitter is "parked" in a low current draw mode (4 mA) to conserve power. Ensure that the network power supply is capable of sourcing the total current consumed by the number of transmitters on the Network.

4.3.7 Cable Capacitance and Maximum Length

A cable length calculation is necessary when HART communication is to be employed. Cable capacitance directly affects maximum Network length.

4.3.7.1 Cable Capacitance

Cable type, conductor size, and recommended cable model numbers are stated in Section 9.3.3 Two-Wire Cable.

Cable capacitance is a parameter used in the calculation of the maximum length of cable that can be used to construct the Network. The lower the cable capacitance the longer the Network can be. Manufacturers typically list two capacitance values for an instrumentation cable:

1. Capacitance between the two conductors.
2. Capacitance between one conductor and the other conductor(s) connected to shield. This capacitance is the worst case value and is to be used in the cable length formula.

4.3.7.2 Maximum Cable Length Calculation

The maximum permissible single -pair cable length is 10,000 feet (3000 meters) or less as determined by the following formula:

$$L = \frac{65,000,000}{R \times C} - \frac{C_f + 10,000}{C}$$

Formula Definitions:

- L: The maximum total length of cable permitted to construct the Network. L = Feet when C is in pF/ft. L = meters when C is in pF/meter.
- R: The Network Resistance which is the ohmic sum of the Current Sense Resistance and Barrier Resistance (both Return and Supply), if any, in the Network and the resistance of the wire.
- C: Cable capacitance per unit length between one conductor and the other conductor connected to the shield. C may be in pF/ft or pF/meter.
- C_f: Total input terminal capacitance of Field Instruments; the Primary Master is excluded. C_f is given by the following formula:

$$C_f = (\text{sum of all } C_n \text{ values}) \times (5000)$$

Where C_n is an integer (e.g., 1, 2, 3) corresponding to the input terminal capacitance of a Field Instrument. C_n values are determined as follows:

<u>FIELD INSTRUMENT CAPACITANCE</u>	<u>C_n VALUE</u>
Less than 5000 pF	1
5000 pF to less than 10000 pF	2
10000 pF to less than 15000 pF	3
15000 pf to less than 20000 pF	4
20000 pF to less than 25000 pF	5

For Field Instruments without C_n values, use C_n = 1

Example Calculation:

Assume a Network consists of two Field Instruments (both C_n = 1).

Let R = 250S, C = 40 pF/ft., C_f = (1 + 1) x 5000 = 10,000




$$\text{Then } L = \frac{65,000,000}{(250)(40)} - \frac{10,000 + 10,000}{40} = 6000 \text{ feet (1800 meters)}$$

4.3.8 Network Junctions

A Network Junction is shown in Figure 4-7. It is a wiring junction installed at a convenient point in the loop to facilitate wiring, testing, and troubleshooting. Typically the Junction is a conventional terminal block mounted on a panel with a protective cover, cabinet, or junction box to enclose and protect wiring terminals.








Multiple Junctions can be installed to provide field access terminals for the connection of an HART Communicator.

Note the following:

-  Network with Barriers - Locate a Junction anywhere along the Network in the non-hazardous area between a barrier and the Current Sense Resistor.
-  Network without Barriers - A Junction may be located anywhere along the Network between the Current Sense Resistor and Transmitter.
-  A Junction should be a simple electrical series connection containing NO repeaters or other devices (active or passive) that can degrade HART communications.

4.3.9 Safety Barriers

Installed safety barriers must comply with the following:

-  Locate intrinsic safety barriers between the system power supply (e.g., Primary Master, if used) residing in the non-hazardous area and the transmitter(s) in the hazardous area.
-  Combined or separate supply and return barriers may be used.
-  For an intrinsically safe application, the DC voltage applied to the safe side of the barrier must be 0.6 Vdc less than the rated barrier working voltage.
-  An Active Supply Barrier must be operated within its specified input working voltage.
-  Barrier shunt impedance to ground to the HART range of frequencies (500 Hz to 2500 Hz) shall not be less than 5000S.
-  Barrier end-to-end resistance, stated by the manufacturer, is used in calculating the maximum Network cable length and minimum and maximum network voltages.
-  The barrier shall be installed and wired in accordance with the manufacturers instructions.

Refer to Appendix B for a list of barriers tested for use with typical HART Primary Masters.

4.3.10 Connection of Miscellaneous Hardware

Miscellaneous non-signaling hardware (e.g., recorders, current meters) may be connected to a Point-To-Point Network in accordance with the following list.

IMPORTANT

No non-signaling hardware (meters or measuring devices) may be connected to a Multi-Drop Network since the transmitters, in this mode, do not output an analog process variable.


- ✎ Miscellaneous hardware may be series or parallel connected to the Network according to its function.
- ✎ Miscellaneous hardware must be passive two-terminal devices.
- ✎ Miscellaneous hardware may not generate any type of noise or signals, other than noise that is inherent in resistive components.
- ✎ Individual miscellaneous hardware must meet the following requirements:
 - ✎ Capacitance to Ground 50 pF maximum
 - ✎ Resistance to Ground 1 MS minimum
 - ✎ Impedance if Series Connected Less than 10S
 - ✎ Impedance if Parallel Connected Greater than 50kS.
- ✎ The maximum number of miscellaneous devices per Network is 16. The combined electrical characteristics may not exceed the following:
 - ✎ Maximum capacitance to ground 800 pF
 - ✎ Minimum resistance to ground 62.5kS
 - ✎ Maximum series impedance 160S
 - ✎ Minimum parallel impedance 3125S

4.3.11 Shielding and Grounding


The preferred method of grounding the loop cable shield is illustrated in Figures 4-7, 4-8, and 4-9.

The following guidelines represent proven grounding practices that will reduce magnetically coupled interference:

- ✎ Ground the cable shield at ONE point, as shown.
 - ✎ Non-hazardous location - At the Network power supply
 - ✎ Hazardous location - At the barrier(s)

 When the cable shield is grounded at the power supply (non-hazardous location only):

- a) The cable shield should remain open (not connected) at the Field Instrument (Transmitter).
- b) The shields of both cables at a Network Junction should be spliced. Alternatively, connect both to a terminal in the Box or Panel, provided that the terminal is isolated from ground.

 Point-To-Point Network (non-hazardous location only)


Other permissible single point grounding schemes are:

- a) The cable shield may be grounded at the Ground Connection in the signal terminal compartment of the transmitter's electronic housing. It is recommended that a separate ground wire be run from this Ground Connection to building ground to ensure a dependable ground.

The power supply (+) and (-) connections must be floated and the shields at Network Junctions must be connected as discussed above.

- b) The cable shield(s) may be grounded at a Network Junction Box or Wiring Panel provided that the cable shields are connected to either a terminal or the Box or Panel frame, and the terminal or frame is grounded.

The power supply (+) and (-) connections must be floated and the cable shield at the transmitter must not be connected.

 Multi-Drop Network (non-hazardous location only)

If the Primary Master's power supply output is isolated from ground, the Network may be floated.





The cable shield should be connected only to one point: the Primary Master's negative supply output.

4.4 MECHANICAL INSTALLATION, MODELS 341D, A, and G

This section describes the mechanical installation of a Transmitter and the installation of electrical conduit for wiring. Transmitter dimensions are given in Figure 9-1. Related mounting information for optional mounting bracket kits is provided in Figures 4-10, 4-11, 4-12, and 4-13.

Mount a Transmitter in any position (orientation). The mounting position can cause a zero shift, however, any zero shift is simply calibrated out with the Transmitter installed in its final mounting position. Refer to Section 7 Calibration and Maintenance for details.

Be sure to allow sufficient clearance for:

-  Installation of impulse piping
-  Installation of wiring
-  Removal of the enclosure end cap
-  Viewing of the optional Analog Meter

4.4.1 Pipe Mounting, Models 341 D, A, and G

A Transmitter can be mounted to a vertical or horizontal 2-inch pipe using an optional mounting bracket kit; kit part numbers are given in Section 9.2.

1. Fasten Mounting Bracket to Transmitter

Standard Bracket to Transmitter

- 1) Refer to Figure 4-10 and align the pair of holes in the transmitter manifold with either of the two pairs of holes in the bracket.
- 2) Using the two supplied 7/16-20 x 3/4 bolts, secure the Transmitter to the bracket.

Universal Bracket to Transmitter

- 1) Refer to Figure 4-11 and align each pair of holes in the face of the manifold or in the connection blocks with the desired pair of elongated holes found on the bracket face.

There are four opposing elongated holes on the bracket that allow mounting positions that differ by 90 degree increments.

- 2) Secure Transmitter to bracket:

Model 341D - Use the four supplied 7/16-20 x 1 bolts

Model 341A or G - Use the four supplied 7/16-20 x 3/4 bolts

NOTE

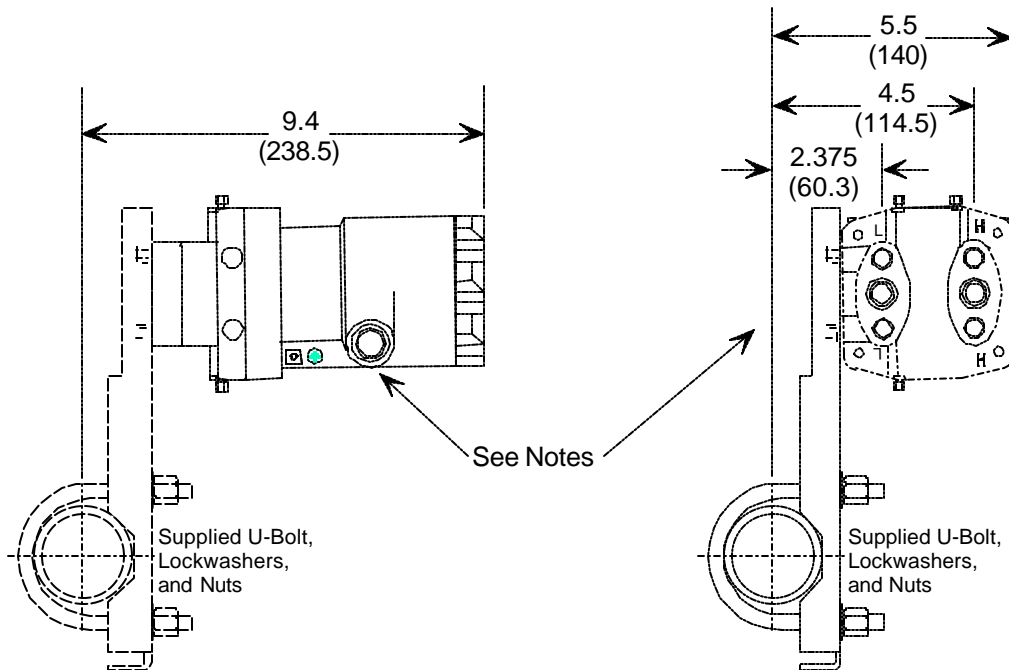
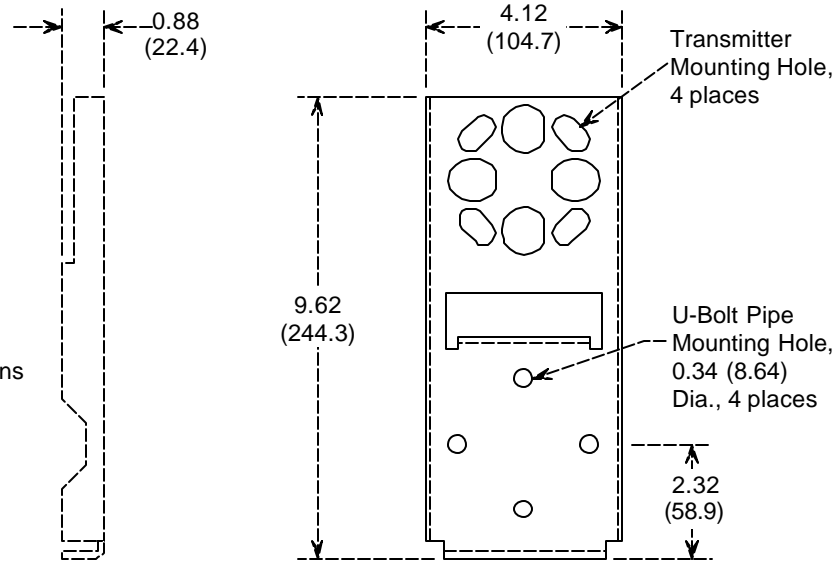
Alternatively, the threaded holes in the side of the transmitter manifold (see Figure 4-10) can be aligned with a pair of elongated holes in the bracket and 7/16-20 x 3/4 bolts used to secure the transmitter to the bracket.

Stainless Steel "L" Bracket to Transmitter

- 1) Refer to Figure 4-12 and align the pair of holes in the side of the manifold with one of the opposing pairs of holes in one end of the "L" shaped bracket (note hole pair spacing to select proper end of bracket).
- 2) Using the two supplied 7/16-20 x 1-1/2 bolts and washers, secure the Transmitter manifold directly to the bracket.

Notes:

1. Dimensions are in inches (millimeters).
2. Model 341D shown. Models 341A and 341G mount similarly.
3. Additional transmitter orientations are possible using the other mounting holes on the bracket.



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FIGURE 4-10 Models 341D, A, and G, Standard Bracket, Pipe Mount

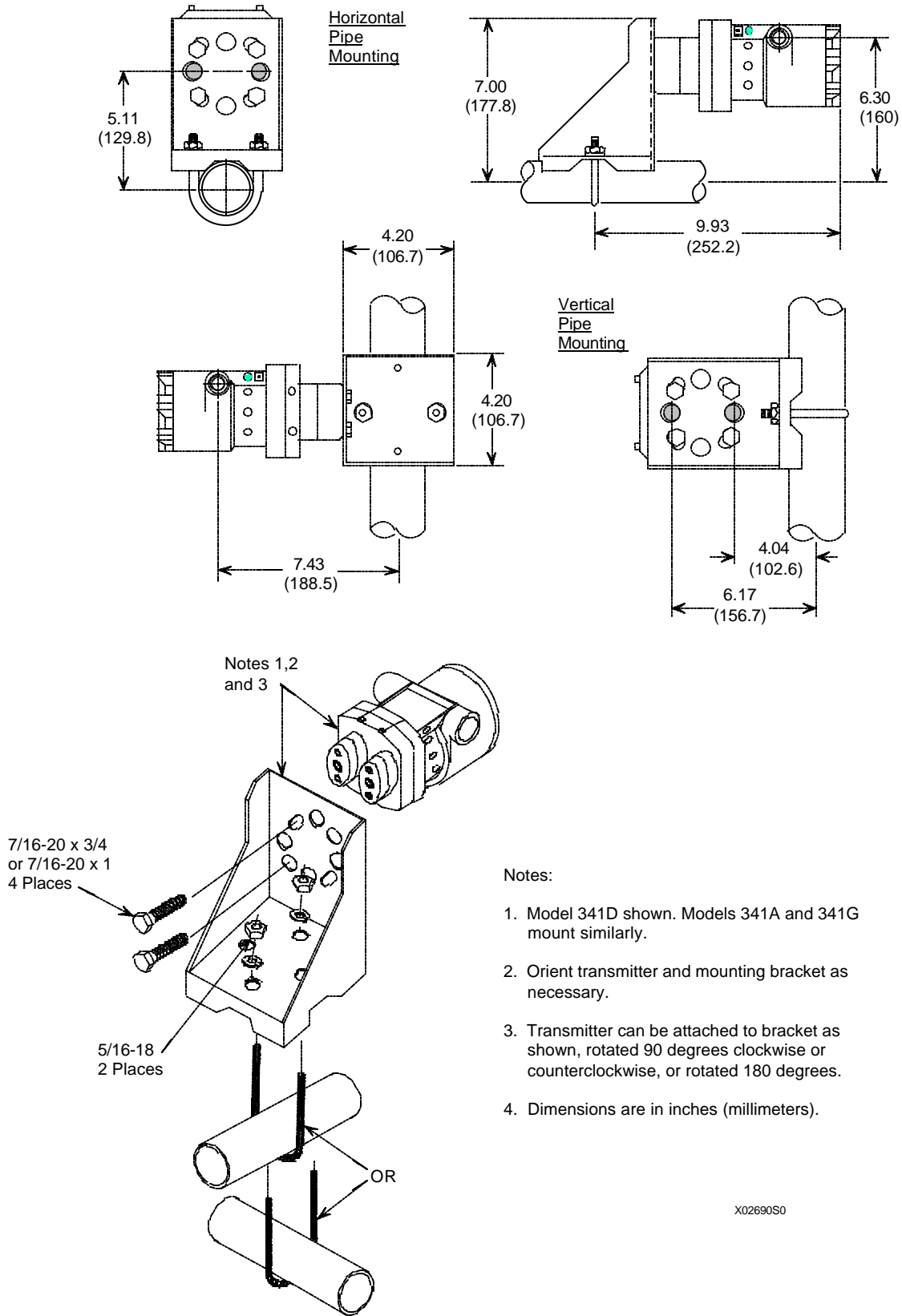


FIGURE 4-11 Models 341D, A, and G, Universal Bracket, Pipe Mount

2. Fasten Mounting Bracket to Pipe

Standard Bracket to Pipe

- 1) At the selected location on the pipe and in the desired orientation, place the pipe groove side of the mounting bracket against the desired part of the pipe surface. See Figure 4-10.
- 2) Slip the supplied U-bolt around the pipe and through one of the two pairs of mounting holes in the bracket.
- 3) Place a supplied washer and hex nut on each end of the U-bolt and hand tighten the nuts. Rotate the bracket around the pipe to place the Transmitter in the desired position, then secure the bracket to the pipe. *Do not over tighten nuts.*

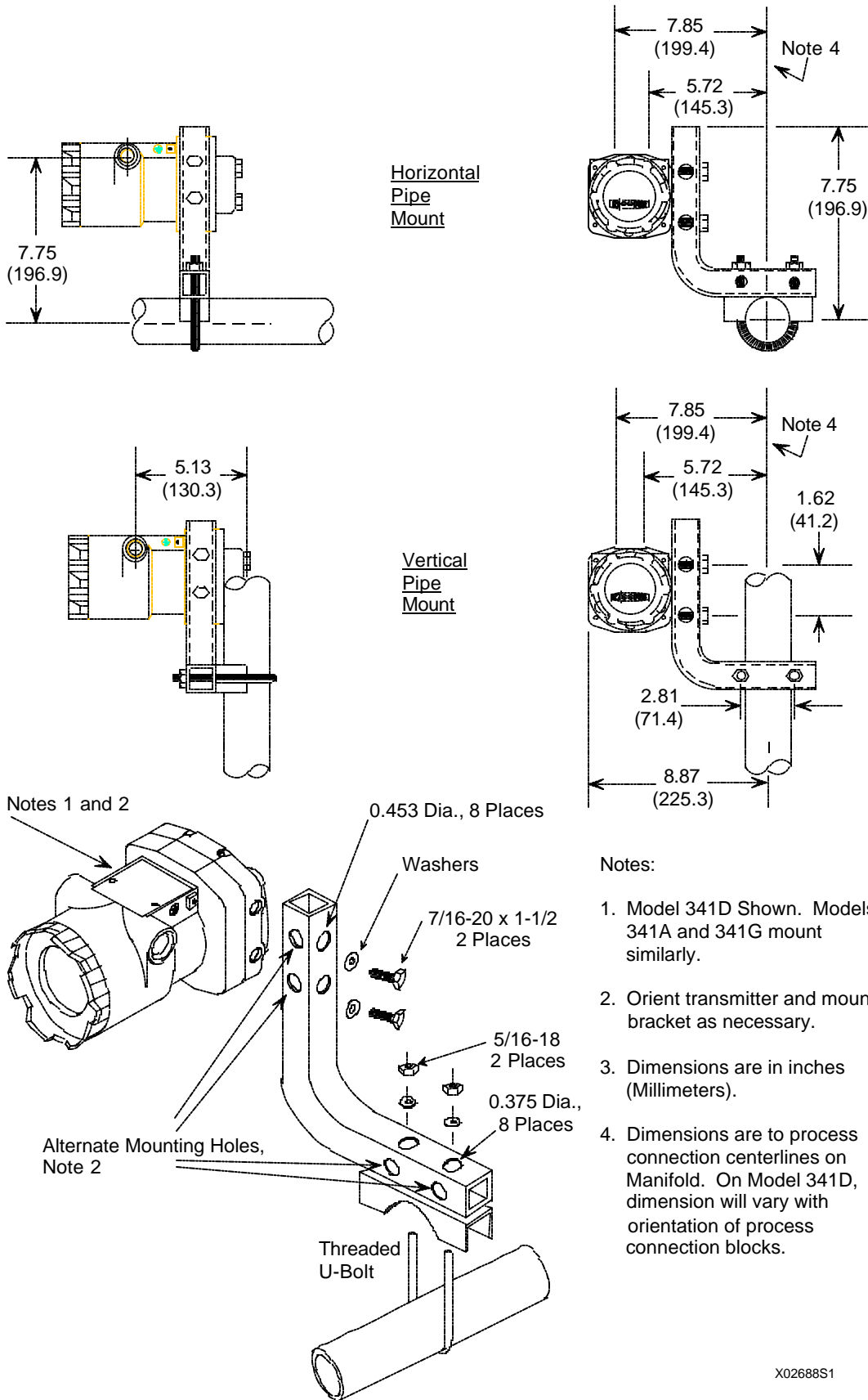
Universal Bracket to Pipe

- 1) At the selected location on the pipe, place the pipe groove side of the mounting bracket against the pipe surface. See Figure 4-11.
- 2) Slip the supplied U-bolt around the pipe and through one of the two pairs of mounting holes in the bottom end of the bracket.
- 3) Place a supplied washer and hex nut on each end of the U-bolt and hand tighten the nuts. Rotate the bracket around the pipe to place the Transmitter in the desired position, then secure the bracket to the pipe.

Stainless Steel "L" Bracket to Pipe

- 1) At the selected location on the pipe and in the desired orientation, place the pipe clamp against the desired part of the pipe surface. See Figure 4-12.
- 2) Slip the supplied U-bolt around the pipe, through the pipe clamp, and then through one of the two pairs of mounting holes in the "L" bracket.
- 3) Place a supplied washer and hex nut on each end of the U-bolt and hand tighten the nuts. Rotate the bracket around the pipe to place the Transmitter in the desired position, then secure the bracket to the pipe.

3. Reposition the optional local analog display as necessary. Refer to Section 4.6.1.



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FIGURE 4-12 Models 341D, A, and G, Stainless Steel "L" Bracket, Pipe Mount

4.4.2 Flat Surface Mounting, Models 341D, A, and G

The Transmitter can be mounted to a flat surface using the Universal Mounting Bracket kit and user supplied 5/16 inch bolts.

Refer to Figure 4-13 and the following for mounting guidance:

1. Fasten the Mounting Bracket to a flat surface.
 - 1) Determine mounting hardware. See the Figure for bracket mounting hole dimensions.
 - 2) Lay out the mounting hole pattern on the selected surface. Drill four mounting holes in the wall or plate (typically, 0.344-inch diameter to accept 5/16-inch bolts).

Consider the thickness of the mounting surface and the selected mounting hardware (e.g., screw anchors, nuts and washers) in determining the required length of the mounting bolts.

 - 3) Place the pipe-groove side of the bracket against the mounting surface site and align the bracket and surface mounting holes. Install the bracket with user supplied 5/16-inch bolts, washers, and hex nuts.
2. Fasten the Transmitter to the Mounting Bracket; refer to Section 4.4.1, step 1, Universal Bracket to Transmitter.
3. Reposition the Transmitter's optional Analog Meter as necessary. Refer to Section 4.6.1.

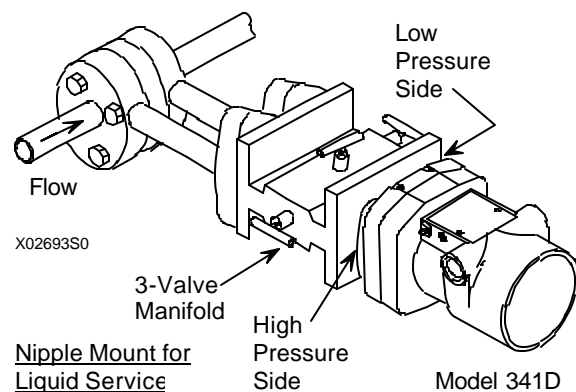
4.4.3 Direct Mounting to Process, Model 341D

The Transmitter can be interfaced to the process through a commercially available two or three-valve manifold and supported by the piping connections (3-inch nipples) if mounted directly at the point of measurement.

Transmitter process connections are on 2.13-inch (54 mm) centers to allow direct mounting (bolting) to a manifold with the same spacing. Each transmitter process connection has two tapped 7/16-20 mounting holes and a 1/4 NPT tapped pressure inlet.

Process orifice flanges with standard 2.13-inch spacing permit a transmitter and two or three-valve manifold combination to be direct mounted.

The procedure for mounting a Transmitter to a two or three-valve manifold, and the manifold to the orifice flanges, is covered by the installation instructions supplied by the manifold manufacturer.



The following is a guide and may need to be modified for some installations. TFE/PTFE tape is the recommended thread sealant for process connections at the Transmitter.

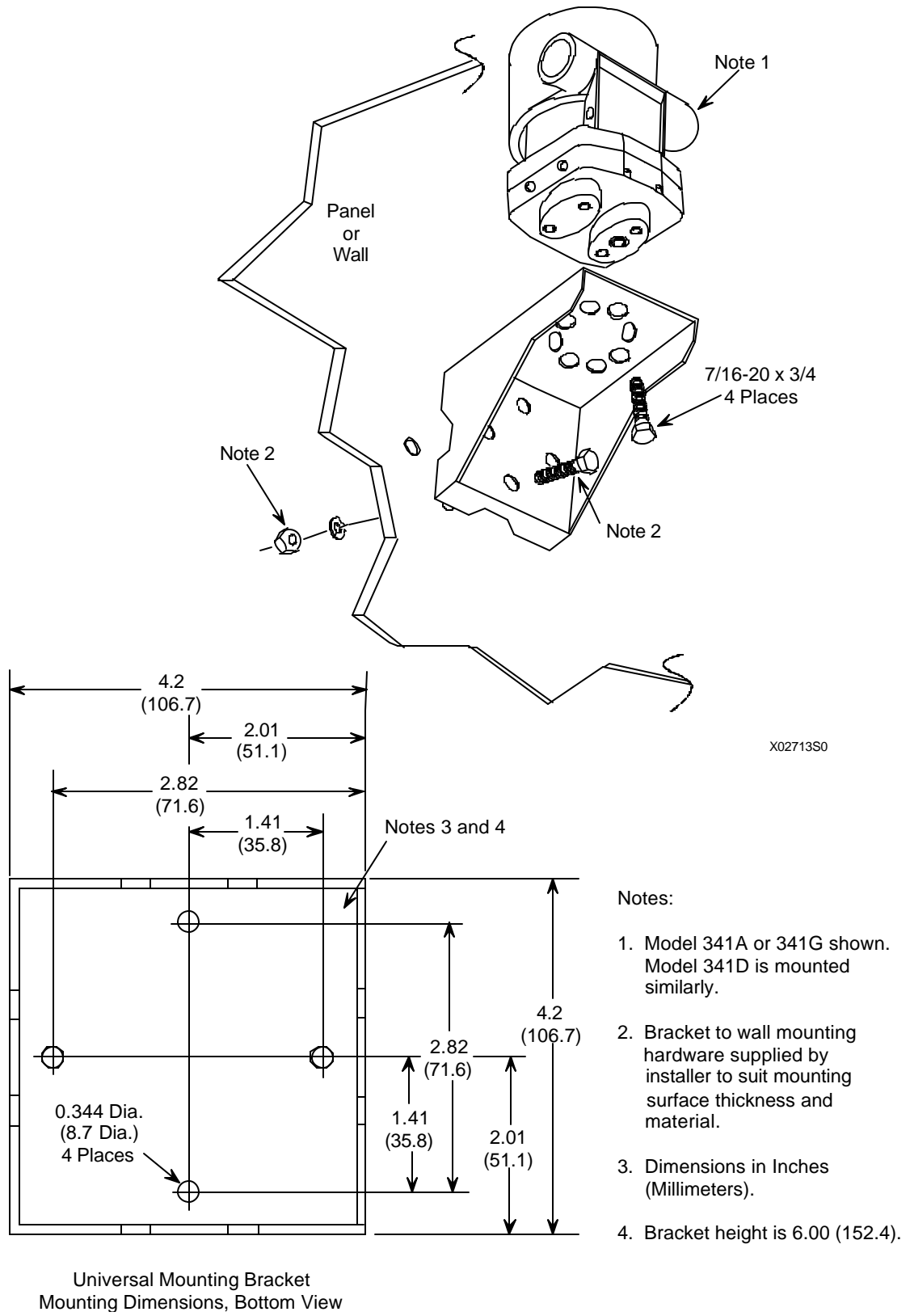


FIGURE 4-13 Models, 341D, A, and G, Universal Bracket, Flat Surface Mount

1. Remove process connection blocks from the Transmitter's process manifold.
2. Press supplied O-ring seals into the grooves in the face of the two or three-valve manifold and bolt the Transmitter process manifold to the transmitter side of the two or three-valve manifold.
3. Thread 1/2" nipples of 3 inch (or less) length into the high and low pressure ports of the orifice flanges. Thread sealant must be used.
4. Thread the process connection blocks directly onto the nipples. Thread sealant must be used. The 1/2" NPT tapped hole in a process connection block is off center to accommodate 2" or 2.25" centers (Figure 9-1). For 2.13" pipe centers, the tapped holes should be offset to the right side.
5. Place the supplied TFE/PTFE gaskets on the connection blocks and bolt them to the manifold.
6. Reposition the optional Analog Meter as necessary. Refer to Section 4.6.1.

4.5 MECHANICAL INSTALLATION, MODEL 341P

Figure 4-14 shows the typical mounting of a Model 341P in a spud.

To mount a spud in the desired tank or pipe and then install the transmitter, refer to the information supplied with the spud and to the general procedure provided below.

4.5.1 Mount The Spud

1. Cut hole for spud
 - 1) Mark on the tank or pipe the exact location where the spud and transmitter are to be mounted.
 - 2) Determine the outside diameter of the spud from the manufacturers literature.
 - 3) Cut or drill a hole that is slightly smaller than this diameter in the tank or pipe.
 - 4) Use a file or other tool to slightly enlarge the hole so that the spud fits tightly. This minimizes distortion during welding.
2. Weld spud in place
 - 1) With the spud in the tank or pipe, insert the transmitter plug in the spud. The transmitter diaphragm must be flush with the inside wall of the tank -- on small diameter pipes the spud and transmitter will extend into the pipe.
 - 2) Mark the spud both inside and out where it is to be welded. *Remove the transmitter.*
 - 3) Weld the spud to the tank or pipe. The plug will use either heliarc or arc and stabilized 316 stainless steel rod to prevent carbide precipitation and corrosion of the weld. Be careful not to distort the spud.
3. Grind spud flush
 - 1) Grind the spud flush with the inside of the tank.
 - 2) Remove any burrs or rough edges being careful not to score the spud's inside walls. A scored wall can allow leakage past the gasket or O-ring. A burr in the Bolt-In-Place spud's bolt hole can damage the O-ring during transmitter installation.

4.5.2 Install The Model 341P

IMPORTANT

Silicon Grease - The Miniature Bolt-In-Place model has the O-ring installed and lubricated at the factory with silicon grease. Handle the transmitter carefully.

1. Standard Thread Mtg. - Place the TFE/PTFE gasket in the spud.
2. Insert the transmitter into the spud and tighten the threaded ring or mounting bolt.
3. If possible, check inside the tank or pipe to see that the transmitter's diaphragm is flush with the spud's tip. Fill pipe or tank and check for leaks.

4.6 MECHANICAL INSTALLATION, All Models

4.6.1 Local Analog Display Installation, Repositioning and Removal

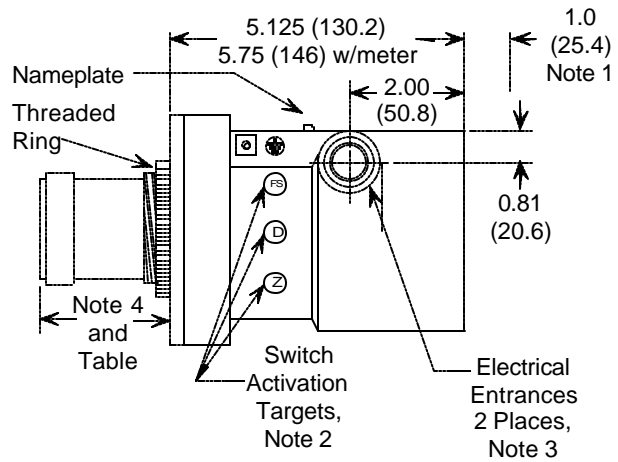
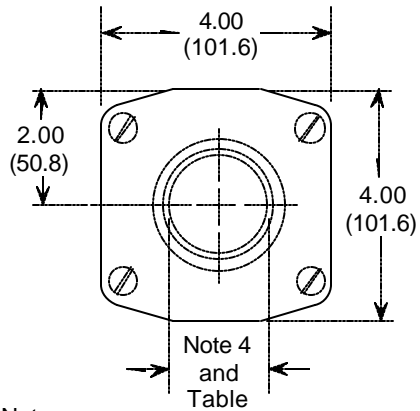
This section describes field installation and orientation, for best viewing, of an Analog LCD Meter. The Meter can be rotated in increments of 90 degrees. A small straight or phillips blade screwdriver and a larger straight blade screwdriver for #6 screws will be needed. Meter removal is addressed last.

Install a Meter :

1. Turn off power to transmitter. Remove enclosure cap to access Terminal Board.
2. Note type of Terminal Board installed. Refer to Figure 4-15 for Terminal Board versions.

TERMINAL BOARD VERSION	ACTION
Display Jumper version	<i>Non-Removable Jumper</i> - Send transmitter to factory. Refer to Section 7.9 Return Shipment for RMA and MSDS information. <i>Removable Jumper</i> - Some early, non-approved transmitters can be field updated. Move the jumper to "Installed." Go to step 3.
Display Diode version with "CR2" printed below the Display + screw terminal but without the diode installed	Go to step 3.
Display Diode version with CR2 installed (below the Display + screw terminal)	Carefully clip out and remove diode CR2, then go to step 3.

3. Support the Meter and connect it to the Terminal Board as follows:
 Red wire to the "DISPLAY +" terminal
 Black wire to the "DISPLAY -" terminal
4. Go to Reposition a Meter, step 3, for orientation and mounting.



Notes:

1. Clearance to remove end cap.
2. Activate switches using supplied magnetic screwdriver.
3. Orient transmitter as desired. Dimensions in inches (millimeters).
4. See table at right for mounting connection dimensions.
5. Transmitters shown below are not to scale.
6. Carefully install spud per manufacturer's instructions.

MOUNTING	LENGTH	DIAMETER
Standard Thread	1.8 (45.7)	1.59 (40.4)
Miniature Bolt-in-Place	1.75 (44.5)	1.049 (26.6)

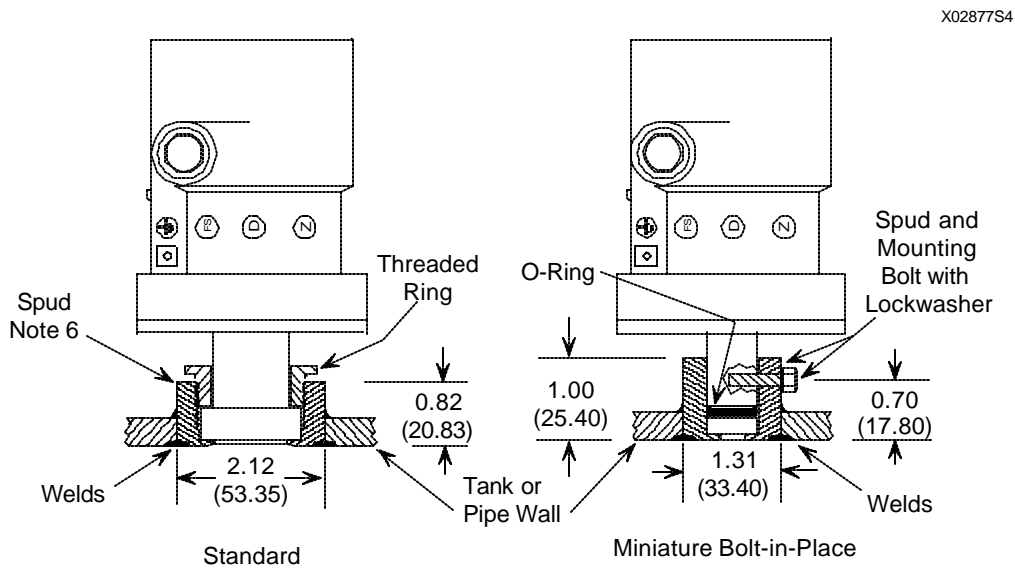
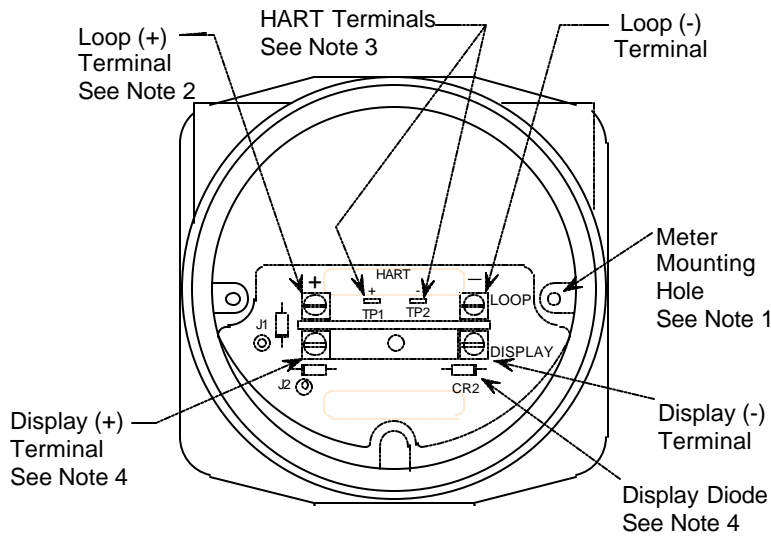


FIGURE 4-14 Model 341P, Installation



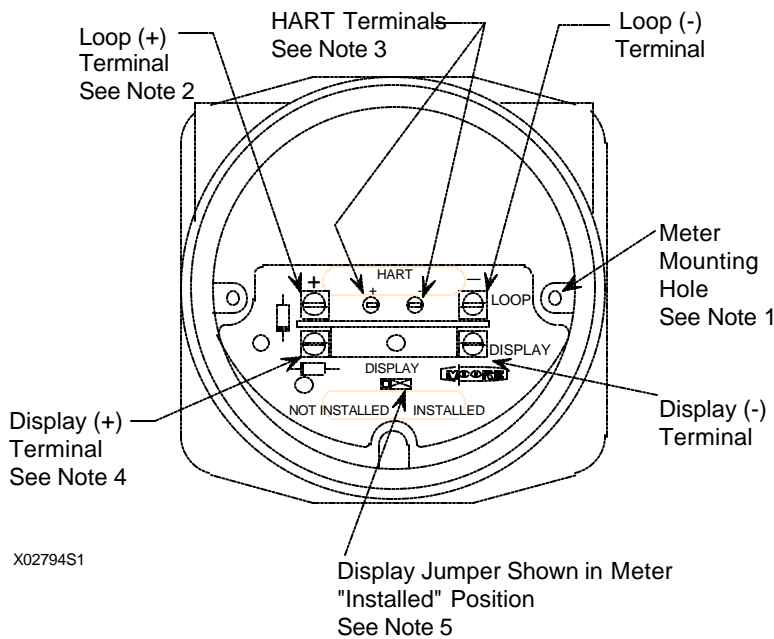
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Display Diode Version

Notes:

1. Viewed with Enclosure Cap and Optional Analog LCD Meter Removed.
2. Connect Network (Loop) to Loop + and - Terminals.
3. Connect Model 275 to HART Terminals (TP1 and TP2). The Model 275 is a non-polar device.
4. Connect Analog LCD Meter to Display + and - Terminals; clip out display diode CR2.

Display diode CR2 must be installed when Meter is NOT installed.



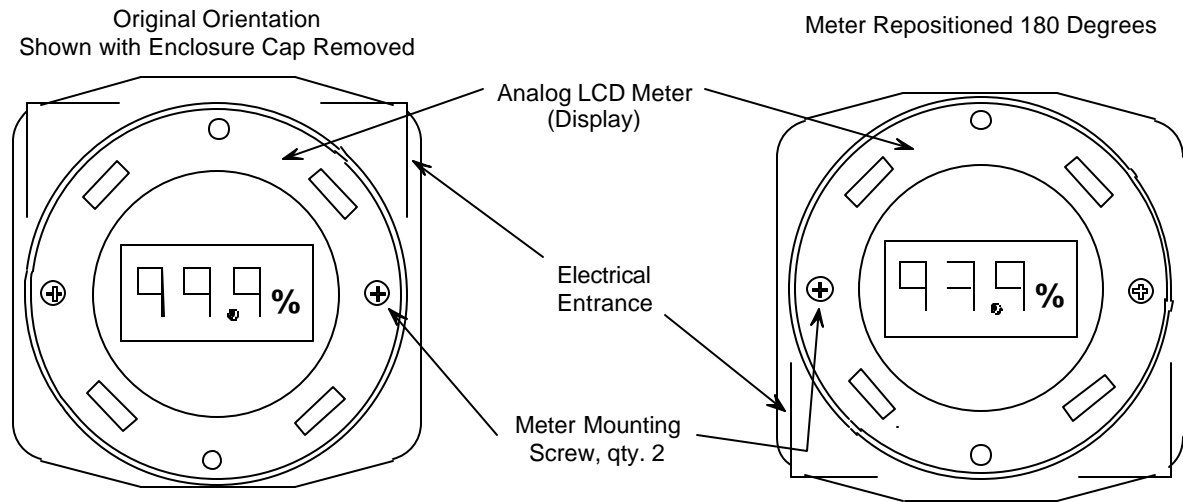
X02794S1

Display Jumper Version

Notes:

1. Viewed with Enclosure Cap and Optional Analog LCD Meter Removed.
2. Connect Network (Loop) to Loop + and - Terminals
3. Connect Model 275 to HART Terminals. The Mode 275 is a non-polar device.
4. Connect Analog LCD Meter to Display + and - Terminals. Display Jumper is set to "Installed."
5. Display Jumper position is fixed and can not be changed in some transmitters, notably, those with a hazardous area classification.

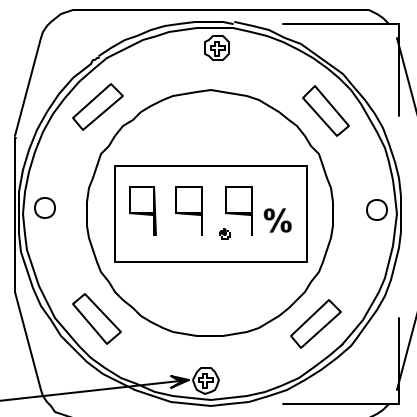
FIGURE 4-15 Terminal Board Versions



Notes:

1. Meter (Display) can be rotated clockwise or counterclockwise, either 90 degrees or 180 degrees. Do not rotate more than 180 degrees to avoid damage to Meter wires.
2. Remove Enclosure Cap for access to Meter.
3. Move Meter mounting screws when repositioning Meter 90 degrees CW or CCW.
4. Terminal Board (for Loop, Model 275 and Display connections) behind Meter.

Meter Repositioned 90 Degrees CCW



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FIGURE 4-16 Analog Meter Removal and Repositioning**Reposition a Meter :**

1. Turn off power to transmitter. Remove enclosure cap to access Analog Meter.
2. Loosen the two captive screws securing the Meter.
3. To orient the Meter for best viewing after Transmitter installation (e.g. rotate it either 90E or 180E), refer to Figure 4-16 and perform one of the following.

IMPORTANT

Do not rotate the Meter more than 180 degrees to avoid damaging meter wires.

To rotate 180 degrees:

- 1) Gently lift the Meter just clear of the enclosure. Removal of the leads is not required.
- 2) Rotate the Meter 180 degrees and align the screws with the tapped holes in the enclosure.

To rotate 90 degrees:

- 1) Remove the captive screws securing the Meter; turn screws counterclockwise to unthread them from the meter body.
- 2) Lift the Meter just clear of the enclosure and rotate it 90 degrees in the desired direction.
- 3) Note the locations of the two tapped holes in the enclosure. Thread the screws in the Meter perimeter and align with the enclosure holes.
4. Lower the Meter into the enclosure and gently tighten the screws. Be careful not to pinch wires. Do not over tighten screws.
5. Install enclosure cap and restore power.

Permanently Remove a Meter:

Display Diode and Non-Removable Display Jumper Versions - Transmitter must be returned to the factory. Refer to Section 7.9 Return Shipment for RMA and MSDS information.


Removable Display Jumper Version - Disconnect and remove Meter. Set Display Jumper to "Not Installed."

4.6.2 Electrical Conduit and Cable Installation


All electrical conduit and all signal wires must be supplied by the user. Access to electrical terminals is described in Section 4.6.2.3.

For conduit and cable routing, refer to user's installation drawings. Installation of conduit and cabling should follow the guidelines given below.

4.6.2.1 Conduit

-  Transmitter conduit inlets accept male conduit fittings. Refer to the Transmitter's nameplate and Section 9.1 to determine whether conduit threads are 1/2"-14 NPT or M20 x 1.5.

Seal 1/2" NPT fittings with TFE/PTFE tape; seal M20 fittings with a soft-setting sealing compound rated for at least 105EC (221EF).

-  When routing conduit, avoid areas that might subject the conduit to chemical or physical abuse or areas with high EMI/RFI conditions.

- ✎ Install conduit for field wiring.
- ✎ If a high humidity environment can exist and the transmitter is located at a low point in the conduit run, install drain seals at the transmitter's conduit inlets to prevent condensation from entering the Transmitter. See Figure 4-17.
- ✎ Remove all sharp edges or burrs from conduit that may damage wires.

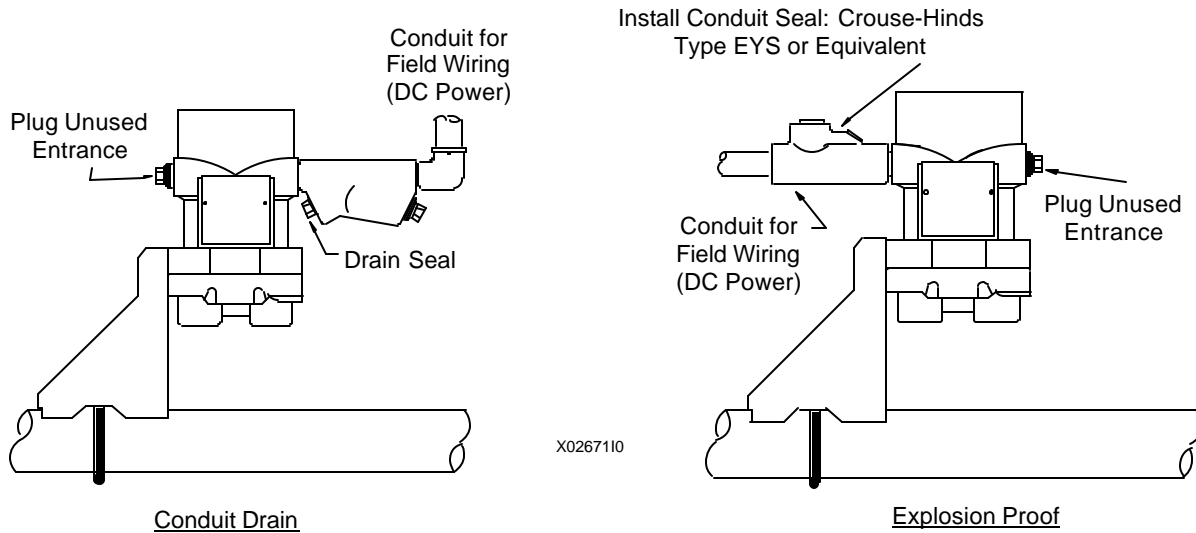


FIGURE 4-17 Conduit Drain and Explosion Proof Installations

4.6.2.2 Cables

- ✎ Mark or tag each cable conductor as either LOOP (+) or LOOP (-) to ensure correct connection at the Transmitter.
- ✎ Use pulling grips and cable lubricants for easier cable pulling. Pull cable through conduit into Transmitter terminal compartment.
- ✎ Do not exceed the maximum permitted pulling tension on the cables. Maximum tension is normally specified as 40% of the cable's breaking strength.
- ✎ Do not exceed the maximum conduit fill specified by the National Electric Code.

4.6.2.3 Access to Transmitter Terminal Compartment





1. To access the terminal board and loop and display connections, unscrew the enclosure end cap protecting the terminal compartment. A cap wrench is needed to remove the enclosure end cap from CENELEC approved transmitters.
2. Remove the two screws securing the Analog Meter, if installed. Note Meter orientation, then lift it from the enclosure. Note meter wiring connections and wire color at the DISPLAY (+) and (-) terminals. Disconnect the Meter and set it aside in a safe location to avoid damage or loss.

This completes the mechanical installation.

4.7 ELECTRICAL INSTALLATION

This section describes loop wiring for Point-To-Point and Multi-Drop Networks. Refer also to Section 4.8 for installations in hazardous locations. Figure 4-18 shows typical conductor terminations.

The following should already have been completed:

-  Selection of either analog or digital operating mode and corresponding Point-To-Point or Multi-Drop Network; Section 4.3.5.
-  Selection of a power supply; Section 4.3.6.
-  Mechanical installation of Transmitter(s) installed; either Section 4.4 or Section 4.5.
-  Pulling of loop cable through conduit and into terminal compartment; Section 4.6.2.

Connect the transmitter to the loop as follows.

1. Access transmitter signal terminals by unscrewing the enclosure cap.
2. Remove the two screws securing the Analog Meter, if installed. Lift the Meter a short distance from the enclosure. Note meter wiring connections and wire color at the DISPLAY (+) and (-) terminals. Disconnect the Meter and set it aside.
3. Determine method of connection to transmitter signal terminals; see Figure 4-18 for typical connection methods.

Strip loop cable and conductors. Install ring tongue or spring spade terminals for #6 screws and the cable conductor gauge. If terminals will not be used, tin conductor ends and form a loop.

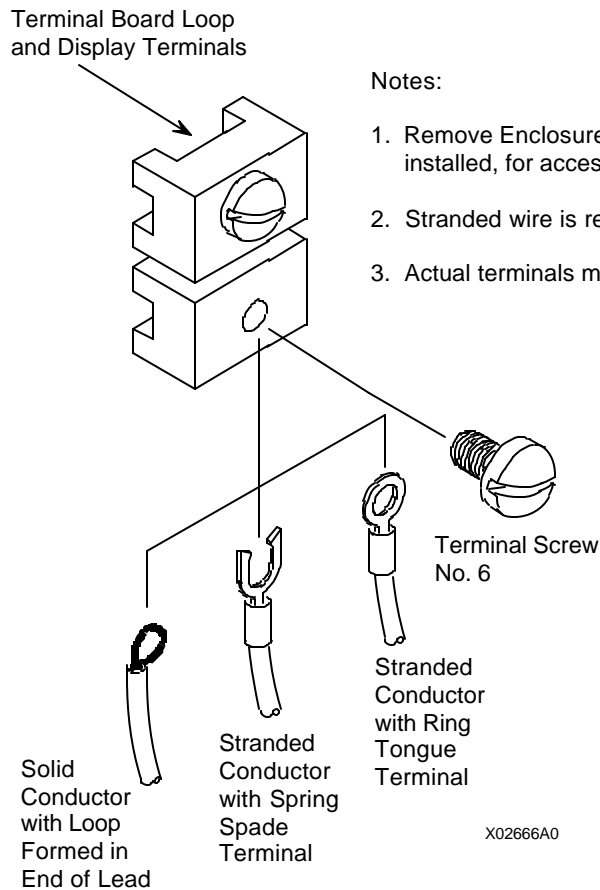


FIGURE 4-18 Conductor Terminations

4. Connect the loop cable to the LOOP (+) and (-) terminals inside the Transmitter's enclosure. Refer to Figure 4-7, 4-8 or 4-9 for the needed connections for the type of Network. Terminals will accommodate wire sizes up to 16 AWG.

IMPORTANT

The cable shield must be insulated from all terminals and the transmitter enclosure. Refer to Section 4.3.11 for additional shielding and grounding information.

5. Reinstall a removed Analog Meter. Refer to Section 4.6.1 to reposition or rotate the Meter.
6. Reinstall enclosure cap. Tighten cap to compress the internal O-ring.
7. If one of the two electrical conduit entrances in the housing is not used, it should be plugged. Refer to the Transmitter's nameplate and Section 9 to determine whether entrance holes accept 1/4-14 NPT or M20 x 1.5 fittings.

Seal 1/4 NPT fittings with TFE/PTFE tape; seal M20 fittings with a soft setting sealing compound rated for at least 105EC (221EF).






4.8 HAZARDOUS AREA INSTALLATIONS

Drawings showing Transmitter installation data for hazardous areas are located in Appendix B. Entity parameters, barrier selection, and important wiring information are specified on these drawings. The Appendix also contains a list of tested barriers.

Before installing a transmitter in a hazardous area, check the nameplate and Sections 9.1 and 9.3 of this Manual for required approvals or certifications.

EXPLOSION-PROOF INSTALLATION

If the installation is required to be explosion-proof per the National Electrical Code, refer to a current copy of the Code and the following:

-  User supplied explosion-proof conduit seals (glands) are required on transmitter housing conduit outlets and any installed junction boxes. See Figure 4-17.
-  Explosion-proof glands must provide a good seal. Apply a sealing compound around the sealing surface if necessary.
-  Power wiring conduit entries at the Transmitter must have a minimum of five threads fully engaged.
-  The enclosure cap must be installed and have a minimum of eight threads fully engaged with no damaged threads permitted.
-  Go to Section 4.7 for wiring connections to the transmitter's terminals. Refer to Appendix B for additional hazardous area installation information that includes barriers recommendations and wiring diagrams.

This completes the physical installation.



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5.0 ON-LINE CONFIGURATION AND OPERATION

On-line operation includes remote configuration and monitoring involving communication between the HART Communicator (host device) and Model 341 (field device). It also includes local configuration using the transmitter's built-in magnetic switches.

Figures 2-2, 3-1, and 3-2 show connections for on-line configuration. Here, the HART Communicator and Model 341 are directly communicating and data may be uploaded from the transmitter to the HART Communicator or downloaded from the HART Communicator to the transmitter. In addition, the Model 341 can be configured locally using built-in magnetic switches.

The first part of this section contains the steps to configure and monitor a Model 341 from a HART Communicator. The latter part of the section describes local operation of a transmitter using its magnetic switches.

5.1 REMOTE CONFIGURATION AND OPERATION

5.1.1 Configuration

Each transmitter is shipped with default data stored in its memory. Some of this data controls communication and transmitter operation and cannot be altered by the user. Other data is used to make the transmitter respond to changes in pressure with a change in current or digital output and is alterable by the user. This data includes configuration parameters that are used to set up the transmitter.

Begin configuration as described in the following pages. Note that a two-column format is used for the remainder of this section: HART Communicator screens are shown in the right-hand column, related procedure steps in the left-hand column.

1. Establish communication with a transmitter (see Section 3.2).
The Online menu is displayed.
2. Press "3" on the Communicator keypad to display the Configure Xmtr menu (at right). This menu shows the list of function blocks and other transmitter features that can be configured.
3. The top line on the display shows the transmitter type and the transmitter tag number.

Write Protection

Write protecting a transmitter prevents other instruments on the loop from changing configuration parameters. To change the write protection of transmitter, follow the steps below.

1. From the Configure Xmtr menu, press "1" on the keypad to display the Write protect menu. This menu offers two options:

```

MPCO 341:PT100
Configure Xmtr      ←⌘
1->Write Protect
2 Sensor Input
3 Operator Display
4 Transmitter ID
↓5 Output Block
HELP |SAVE |HOME
  
```

- Disable – Permits transmitter parameters to be changed and a configuration to be downloaded to a transmitter by pressing SEND key.
 - Enable – Prevents changes to transmitter parameters and downloading of a configuration to a transmitter.
2. From the Write protect menu (at right), choose either Enable or Disable. Write protection is now either enabled or disabled for the transmitter to which the Communicator is connected.
 3. When the Configure Xmtr menu appears again, turn off the Communicator before continuing with configuration.

```

MPCO 341:PT100
Write protect
1 Disable
2 Enable

ABORT | ENTER

```

Function Blocks

There are 4 function blocks in a Model 341 transmitter, including the Write Protect block discussed above. Each block contributes a specific operation and each operation is defined by one or more user-defined parameters. Configuration is the process of selecting the needed function blocks and entering or editing the parameters. Appendix A describes each function block with its parameters. Appendix C provides the default value for each parameter.

After parameters have been defined, the new configuration information for that block can be sent immediately to a transmitter, or the user can change the parameters of other function blocks, then send the configuration for all the function blocks at once.

NOTE

Configurations cannot be sent if write protect mode is enabled.

The next several sections describe configuration of individual function blocks. To configure a specific function block:

1. Choose the function block to be configured by pressing the DOWN arrow until the function block's name is highlighted on the Configure Xmtr menu (e.g., Sensor Input at right).
2. Press RIGHT ARROW/SELECT to display the menu for the chosen function block.
3. Go to the section of this manual for the chosen function block (Sections 5.1.1.1 through 5.1.1.4).

```

MPCO 341:PT100
Configure Xmtr      ←⌘
1 Write Protect
2->Sensor Input
3 Operator Display
4 Transmitter ID
↓5 Output Block
HELP |SAVE |HOME

```


5.1.1.1 Sensor Input Block

Sensor Input block parameters and the range of values are described in Appendix A. Default values are in Appendix C.

1. From the Sensor Input menu, press “1” on the keypad to display the Measured Var Unit menu. The current MV unit is shown directly beneath the menu name (right).
2. To change the MV unit, use the UP or DOWN arrow keys to highlight the desired unit. Units are listed in Appendix A under the Sensor Input Block description.
3. Press ENTER (F4) to select the highlighted unit and display the Sensor Input menu.
4. To view or change either MV Lo or MV High, scroll to the menu item, then press RIGHT ARROW/SELECT.
5. Use the keypad to enter the new value, then press ENTER (F4). Press ESC (F3) to display the Sensor Input menu without making a change.
6. To view or change the Damping value, scroll to highlight the menu item, then press RIGHT ARROW/SELECT, or press “4” on the keypad.
7. Enter a new value for Damping (in seconds), then press ENTER (F4). Press ESC (F3) to return to the Sensor Input menu without making a change.
8. To choose a transfer function, scroll to highlight the menu item, then press RIGHT ARROW/SELECT, or press “5” on the keypad to see the transfer function options (at right).
9. Scroll to the desired transfer function, then press ENTER (F4) to select this function or ABORT (F3) to abandon the procedure and return to the Sensor Input menu.
10. To view or change the zero dropout value, scroll to highlight the menu item, then press RIGHT ARROW/SELECT, or press “7” on the keypad.
11. Type a new value for zero dropout, then press ENTER (F4), or press ESC (F3) to return to the Sensor Input menu without making a change.
12. To range the transmitter by applying actual URV and LRV pressures, scroll to highlight Active Input, then press RIGHT ARROW/SELECT, or press “8” on the keypad. The Active Input menu (at right) displays. The screen shows the actual pressure measurements.

```

MPCO 341:PT100
Measured Var Unit
inHg
↑inHg
ftH2O
mmH2O
↓mmHg
HELP           HOME
  
```

```

MPCO 341:PT100
Square Root
1 Linear
2 Square Root

ABORT | ENTER
  
```

```

MPCO 341:PT100           ©
Active Input             ←⌘
1 MV                     0 inHg
2 MV Lo                  1 inHg
3 MV Hi                  1 inHg
4 Set Lo
5 Set Hi
HELP | SEND | HOME
  
```

13. Rearrange by performing the following procedure:
 - 1) Apply the LRV pressure to the transmitter.
 - 2) Scroll to the Set Lo menu option or press “4” on the keypad. Press RIGHT ARROW/SELECT to enter the current measured value as the LRV.
The display recycles and shows the new LRV.
 - 3) Apply the URV pressure to the transmitter.
 - 4) Scroll to the Set Hi menu option or press “5” on the keypad. Press RIGHT ARROW/SELECT to enter the current measured value as the URV.
 - 5) The screen recycles and shows the new URV.
 - 6) Press the LEFT ARROW/PREVIOUS MENU key two times to return to the Sensor Input menu.

NOTE

To conserve battery power, do not leave the HART Communicator in the Sensor Input mode.

14. Go to the next section or the next desired function block.

5.1.1.2 Operator Display Block

Operator Display block parameters and the range of values are described in Appendix A. Default values are in Appendix C.

1. From the Operator Display menu (at right), press “1” on the keypad to display the Process Var Unit menu.
2. Type the alphabetic or alphanumeric sequence for the process engineering variable unit, then press ENTER (F4) to confirm the new unit or press ESC (F3) to return to the Operator Display menu without making a change.
3. To change the PV low value, press “2” on the keypad to display the Process Var Lo menu.
4. Type the desired low value for the process variable range, then press ENTER (F4) to confirm the new value or press ESC (F3) to return to the Operator Display menu without making a change.
5. To change the PV high value, press “3” on the keypad to display the Process Var Hi menu.
6. Type the value for the desired high value for the process variable range, then press ENTER (F4) to confirm the new value or press ESC (F3) to return to the Operator Display menu without making a change.

MPCO 341:PT100		
Operator Display		←⌘
1->PV Units		GPM
2 PV Lo	0.00	GPM
3 PV Hi	85.95	GPM
4 AutoRerange		
5 Local Units		
	SEND	HOME

7. To turn the Auto Rerange feature on or off, press “4” on the keypad to view the AutoRerange menu.
8. Use the UP or DOWN arrow key to select either Off or On, then press ENTER (F4) to confirm the selection or press ESC (F3) to return to the Operator Display menu without making a change.

Note: The local units code has no bearing on a Model 341 as its display is % only.

Go to the next section or the next desired function block.

```

MPCO 341A:PT100
MV Units
1 % Range
2 PV Units
3 MV Units

ABORT | ENTER
    
```

5.1.1.3 Transmitter ID

Transmitter ID block parameters and the range of values are described in Appendix A. Default values are in Appendix C.

1. From the Transmitter ID menu (at right), press “1” on the keypad to display the Tag menu.
2. Type the alphanumeric tag for the transmitter (up to 8 characters), then press ENTER (F4) to confirm the new name or press ESC (F3) to return to the Transmitter ID menu without making a change.
3. To change the transmitter’s descriptor, press “2” on the keypad to display the Descriptor menu.
4. Type the alphanumeric descriptor (up to 16 characters), then press ENTER (F4) to confirm the descriptor or press ESC (F3) to return to the Transmitter ID menu without making a change.
5. To change the message text for the transmitter, press “3” on the keypad to display the Message menu.
6. Type the desired message text (up to 32 characters), then press ENTER (F4) to confirm the message or press ESC (F3) to return to the Transmitter ID menu without making a change.
7. To enter a date, press “4” on the keypad to display the Date menu (at right).
8. Type the date in DD/MM/YY format, then press ENTER (F4) to confirm the new name or press ESC (F3) to return to the Transmitter ID menu without making a change.
9. To enter the transmitter serial number, press “5” on the keypad to display the Device S/N menu.
10. Type the serial number (no letters permitted), then press ENTER (F4) to confirm the new number or press ESC (F3) to return to the Transmitter ID menu without making a change.

```

MPCO 341:PT100
Transmitter ID ←⌘
1 → Tag
2 Descriptor
3 Message
4 Date
↓ 5 Device S/N
HELP | SEND | HOME
    
```

```

MPCO 341:PT100
Date
06/23/96
0/23/96

HELP | ESC | ENTER
    
```

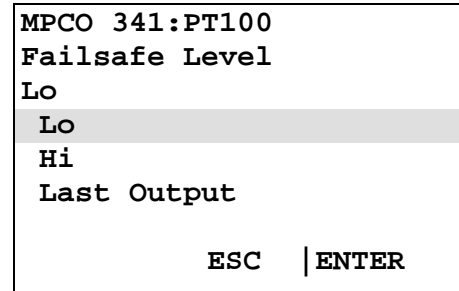
11. To enter a polling address, press “6” on the keypad to display the Poll addr menu.
12. Type a polling address (0, or 1-15), then press ENTER (F4) to confirm the new polling address or press ESC (F3) to return to the Transmitter ID menu without making a change.
13. Go to the next section or the next desired function block.

5.1.1.4 Output Block

The Output block is used to set the failsafe level at one of three positions:

- Lo – 3.85 mA
- Hi – 22.5 mA
- Last Output – The last output (in mA) before failure occurred.

1. From the Configure Xmtr menu, press “7” on the keypad to display the Output Block menu.
2. To change the failsafe value, press “1” or the RIGHT ARROW/SELECT key to display the Failsafe Level menu (at right).
3. Use the UP or DOWN arrow keys to scroll to the desired failsafe level, then press ENTER (F4) to select the level or ESC (F3) to return to the Output Block menu without making a change.
4. Press the LEFT ARROW/PREVIOUS MENU key once to display the Configure Xmtr menu.
5. Go to the next section or the next desired function block.



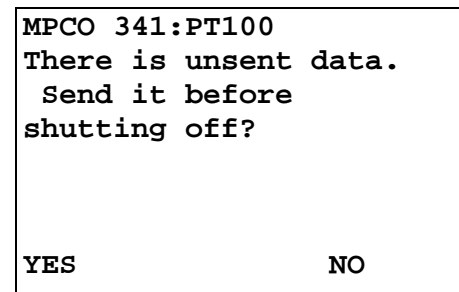
5.1.2 SEND and SAVE a Configuration

When the Configure Xmtr menu is first displayed, it shows a SAVE (F2) softkey. As each function block menu is displayed, the SAVE softkey continues to be displayed.

As soon as a change is made to any parameter, the SAVE softkey changes to SEND. Pressing SEND downloads the configuration with the new values to the transmitter, and the softkey returns to SAVE.

During a configuration session, the user decides whether to press SEND each time a change is made or wait until all changes have been made. Attempting to turn off the Communicator without sending data causes an error message to be displayed (at right).

Press YES (F1) to send the changed configuration data to the transmitter. The new configuration replaces the previous configuration in the transmitter.



Press NO (F2) to turn off the Communicator without sending the changes (changes are lost).

If data is sent to the transmitter, the SAVE softkey displays. Pressing SAVE allows data to be saved in the Memory Module or the Data Pack. Each saved configuration is given a unique name that can be used to retrieve the configuration later to save effort when configuring additional transmitters (see Section 2.5.1.2).

5.1.3 Range Xmtr

The Range Xmtr menu (at right) permits measured variable and process variable units and Lo/Hi values to be changed. It also provides access to Auto Rerange and Transfer Function menus.

1. Press the number of the desired menu option or use the UP or DOWN arrows to scroll to the option, then press RIGHT ARROW/SELECT.
2. To make changes to measured variable (MV) values or select a transfer function, see Section 5.1.1.1.
3. To make changes to process variable (PV) values or set Auto Rerange On or Off, see Section 5.1.1.4.
4. When finished, press SEND to download the changed data to the transmitter. If desired, press SAVE to store the new configuration in the Memory Module or Data Pack.
5. Press the LEFT ARROW/PREVIOUS MENU key to return to the Quick Access Key Menu.

MPCO 341:PT100		
Range Xmtr		←⌘
1->MV Units		inHg
2 MV Lo	1	inHg
3 MV Hi	1	inHg
4 PV Units		Q5AH
↓5 PV Lo	0.00	Q5AH
HELP SAVE		

5.1.4 Quick Access Key Functions

Next, Quick Access Key options are described. User-selected options can be added to the Quick Access Key menu; see Section 2.6.1. To access the Quick Access Key functions, press the Quick Access Key (1) to power-up the Communicator or (2) from any online menu when connected to a transmitter.

The two Quick Access Key options provided with Model 341 Transmitters are:

- XMTR Variables
- Status

5.1.4.1 XMTR Variables

Parameters observable (but not changeable) from the XMTR Variables menu are those being supplied “live” from the connected transmitter, as follows:

MENU ITEM	PARAMETER	DESCRIPTION
1	% Range	Percent of range (0-100%).
2	MV	Measured variable.
3	PV	Process variable.

4	Current	Current in milliamperes.
---	---------	--------------------------

1. From the XMTR Variables menu, press a key from “1” through “4” to observe the desired variable.
2. Press EXIT (F4) to return to the XMTR Variables menu. Press LEFT ARROW/PREVIOUS MENU to return to the Quick Access Key menu.

5.1.4.2 Status

The Status menu provides data about the connected transmitter, as follows:

MENU ITEM	PARAMETER	DESCRIPTION
1	Model Number	Model number and other identification data.
2	Errors	Check for errors and report.

1. From the Status menu, press “1” to display the Model Number menu (at right).
2. If no data shows for a particular attribute, press the number of the attribute (e.g., “3” for Software rev) to view the attribute value, then press EXIT (F4) to return to the Model Number menu.
3. In the same manner, press “2” through “6” on the keypad to observe any attributes not showing on the display, then press EXIT (F4) to return to the Model Number menu.
4. Press LEFT ARROW/PREVIOUS MENU to display the Status menu.
5. To observe errors, press “2” on the keypad to initiate a check for errors. The Communicator checks for errors, then displays “No Errors” or appropriate error codes (see Section 7). Press OK to display the Status menu.
6. If no data are showing for a particular parameter, press its number on the keypad (e.g., “3” for Interrupt) to view the parameter’s value, then press EXIT (F4) to return to the Totalizer Status menu.
7. Press the LEFT ARROW/PREVIOUS MENU key twice to display the Quick Access Key menu.

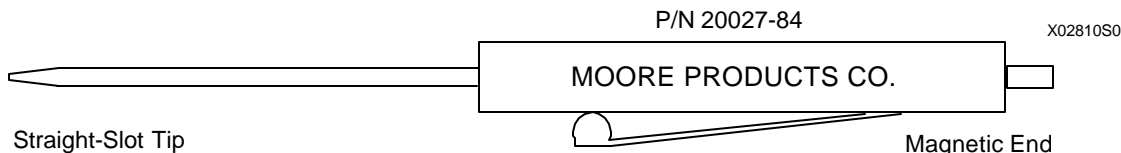
```

MPCO 341:PT100
Model Number      ←⌘
1->Tag            PT100
2      341DDASAAB1N113
3 Software rev    2
4 Sensr s/n      1377010
5 Model
HELP |SAVE

```

5.2 LOCAL TRANSMITTER OPERATION

The Model 341 has three local magnetic switches labeled FS (fullscale), D (damping), and Z (zero) located on the housing. These switches are activated using the magnetic end of the Moore Products Co. screwdriver supplied with each unit.



IMPORTANT

Use only the Moore Products Co. magnetic screwdriver to actuate the magnetic switches. Other magnets can cause inconsistent behavior of one or more switches.

5.2.1 Set Local Zero

The Z (zero) switch is used to set the Lower Range Value parameter of the transmitter to the applied pressure. The Z selection will not affect span.

1. Set the process pressure to the zero value.
2. Place the transmitter in Pushbutton Mode by holding the magnetic end of the screwdriver on the Z switch for *5 or more seconds* before removing it. Pushbutton Mode will automatically time-out after one minute.

NOTE

Failure to hold the screwdriver magnet on the switch for a minimum of 5 seconds will prevent entry into Pushbutton Mode.

Pushbutton Mode can be de-activated in two ways: by momentarily holding the magnetic end of the screwdriver on the D switch and then removing it, or by allowing the one minute "active mode" period to time-out.

3. Enter the zero value by momentarily pressing the magnetic end of the screwdriver on the Z switch. This stores the pressure applied in step one as the Lower Range Value.

NOTE

If the process is out of the range of the transmitter, a new zero value will not be stored.

NOTE

If the new zero value would shift the fullscale value past the sensor limit, the new fullscale value is automatically set to the appropriate sensor limit

(except in the case where this would produce a span that is too small, in which case new zero and fullscale values are not stored).

5.2.2 Set Local Fullscale

The FS (fullscale) switch is used to set the Upper Range Value equal to the applied pressure. Changing the fullscale value will not change the zero.

1. Apply fullscale pressure to the transmitter.
2. Place the transmitter in Pushbutton Mode by holding the magnetic end of the screwdriver on the FS switch for a minimum of 5 seconds, as described above.
3. Enter the fullscale value by momentarily holding the magnetic end of the screwdriver on the FS switch. This stores the pressure applied in step 1 as the fullscale pressure.

NOTE

Changing the fullscale value of the transmitter does not affect the zero value. If the input value is either smaller than the minimum span or larger than the maximum span allowed by the transmitter, a new fullscale value will not be stored.

5.2.3 Set Local Damping

The D (damping), Z and FS switches are used to select one of the ten damping values. A Model 275 can be used to confirm the damping settings in the following procedure.

1. Place the transmitter in Pushbutton Mode by holding the magnetic end of the screwdriver on the D switch for a minimum of 5 seconds.
2. Set the damping value to zero seconds by momentarily pressing the Z switch with the magnetic end of the screwdriver at least ten times. This provides a known starting point, 0 seconds.
3. Momentarily press the magnetic end of the screwdriver against a Z or FS switch to select a new damping value from the following choices: 0, 0.1, 0.2, 0.5, 1, 2, 5, 10, 20, or 30 seconds. Each press of the magnet against a Z or FS switch steps the damping one selection. The Z switch steps the selection down from the starting point (e.g. 30, 20, 10...); the FS switch steps the selection up from the starting point (e.g., 0.1, 0.2, 0.5...).

NOTE

If unsure of the number or presses or present damping value, perform step 2 again to set the value to zero or check the value with a Model 275.

4. Momentarily press and release the D switch with the magnetic end of the screwdriver to store the new damping value in the transmitter's EEPROM.

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6.0 POST INSTALLATION CHECKOUT

This section provides guidelines to verify that the proper transmitter is installed, correctly wired, and operational prior to placing the system in service. If the transmitter was not commissioned on the bench prior to installation, refer to Section 3 before proceeding.

6.1 EQUIPMENT REQUIRED

- User configuration data for transmitter(s) under test (see Appendix C)
- HART Communicator (see Section 2 of this manual)
- Laboratory grade digital multimeter (DMM); for calibrating the 4 to 20 mA output signal

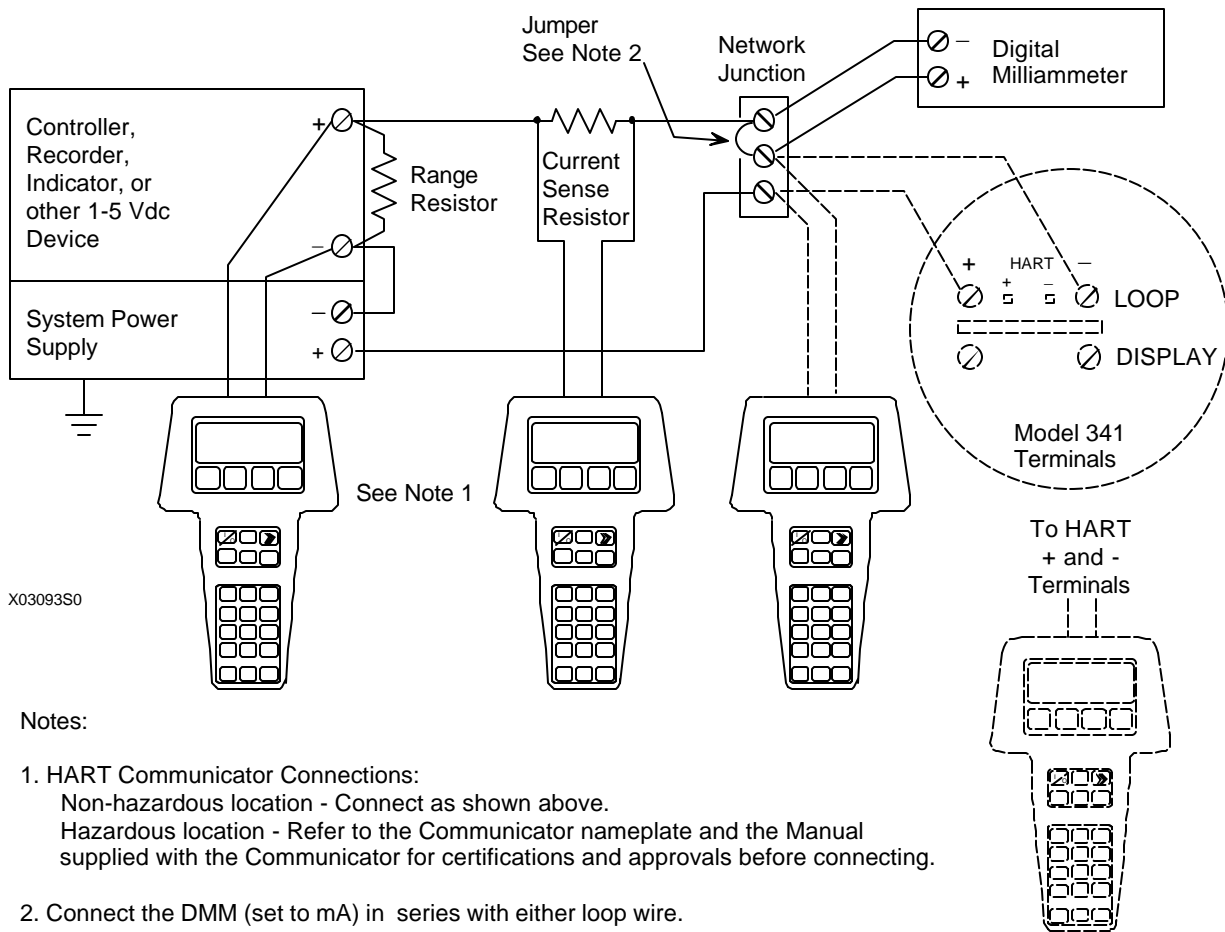
Voltmeter Section	Accuracy $\pm 0.01\%$ of reading
	Resolution 1.0 mV
Ammeter Section	Input impedance 10 M Ω
	Accuracy $\pm 0.1\%$ of reading
	Resolution $\pm 1 \mu\text{A}$
	Shunt resistance 15 Ω or less

6.2 INSTALLATION REVIEW

1. Note the model designation and certifications on the transmitter's nameplate and compare to model specified in user's documentation (P&I drawing).
2. Refer to Section 9 to confirm that the correct model with the correct certifications has been installed. Confirm that any needed hazardous area barriers have been installed and all other installation requirements have been met.
3. Check all wiring for correct and secure connection. Refer to Section 4 of this manual and user's documentation for wiring diagrams.
4. Check wire runs to be sure wires are protected from abrasion or other damage, correctly supported, and isolated from other signal or power wiring.
5. Check that a current sense resistor of the correct value has been installed.
6. Apply power to the power supply or other loop power source (e.g., controller). Use the DMM to check power supply output voltage.

6.3 EQUIPMENT CONNECTION

1. Connect the HART Communicator across a network junction, the current sense resistor, range resistor, or the transmitter under test as shown in Figure 6-1. There is no connection polarity as the HART Communicator is a non-polar device.
2. Connect a DMM in series with either loop wire; see Figure 6-1. Set the DMM to read 4-20 mA.



Notes:

1. HART Communicator Connections:
 Non-hazardous location - Connect as shown above.
 Hazardous location - Refer to the Communicator nameplate and the Manual supplied with the Communicator for certifications and approvals before connecting.
2. Connect the DMM (set to mA) in series with either loop wire.
 Remove jumper to install DMM and replace when DMM is removed.

FIGURE 6-1 Equipment Connections for System Checkout

6.4 VERIFICATION

This section covers communication test, communication error check, analog output verification, and configuration verification.

6.4.1 Communication Test

This test verifies that the HART Communicator and transmitter(s) can communicate properly. From user configuration documentation, obtain transmitter IDs, addresses, and tags.

1. Turn on the HART Communicator.

If the Communicator finds a transmitter on a Point-To-Point Network, the Online menu with the transmitter's type and tag name is displayed. Go to Section 6.4.2.

If the Communicator displays: No device found at address 0. Poll?, go to either step 2 or 3.

2. POINT-TO-POINT NETWORK

Check the following: Communicator connections, all other loop connections, power to transmitter, transmitter address (0), transmitter model number. Repair as necessary and repeat step 1.

3. MULTI-DROP NETWORK

Press Yes (F1) to enter digital mode and search for devices with polling addresses of 1-15.

If the Communicator finds a transmitter on a Multi-Drop Network, the Online menu with the transmitter's type and tag name is displayed. Each transmitter connected to the loop can be interrogated in sequence. Go to the next Section.

If the Communicator displays: No device found. Press OK, check all loop connections, power to transmitters, transmitter addresses (1-15), transmitter model numbers, etc. Repair as necessary and repeat step 1.

6.4.2 Communications Error Check

1. Establish communication; the Online menu displays. Press the Quick Access Key to display the Quick Access Key menu.
2. Press "2" on the keypad to display the Status menu. Press "2" again to start checking for errors. The Communicator checks for errors.
3. If no error is present, the message "No Errors" displays. Go to step 4.
4. If one or more errors is detected, one or more error codes is displayed. Go to step 4, then refer to Section 7.3 Troubleshooting to confirm and resolve the error(s).
5. Press OK (F4). Turn off the Communicator or press the LEFT ARROW/PREVIOUS MENU key to return to the menu for the next procedure.

6.4.3 Verify Analog Output Signal

This test verifies that a transmitter is operating properly and is capable of transmitting a 0% or 100% analog output signal that can be received at its destination. The test applies only to transmitters operating in analog mode.

1. Establish communication; the Online menu displays. Press "1" or RIGHT ARROW/SELECT to select Loop Override.
2. A warning appears: "WARN-Loop should be removed from automatic control." If the loop status cannot be changed for operational reasons, press ABORT (F3) to end this procedure and return to the Online menu. If it is okay to proceed, go to step 3.

3. Remove the loop from automatic control, then press OK (F4). When OK is pressed, a list of analog output options is displayed (at right).
4. Press “1” on the keypad or ENTER (F4) to select the 4 mA option. The Communicator displays the message “Fld dev output is fixed at 4.000 mA.” Press OK (F4) to confirm and proceed with testing or press ABORT (F3) and proceed to step 8.
5. Read the DMM. The value should be 4 mA.
6. Repeat steps 4 and 5 using the 20 mA output level. The DMM reading should be 20 mA.
7. For outputs other than 4 or 20 mA, choose option 3, Other, and enter any desired output value. The DMM reading should be the entered value in mA.
8. To end the loop override session, press “4” on the keypad or the ABORT (F3) softkey. The message “Returning fld dev to original output” appears.
9. When the message “NOTE–Loop may be returned to automatic control” appears, return the loop to automatic control, then press OK (F4). This completes verification of analog output.

```
MPCO 341:PT100
Choose analog output
level
1 4mA
2 20mA
3 Other
4 End
ABORT | ENTER
```

IMPORTANT

Failure to exit loop override correctly can cause the transmitter to remain parked at a fixed current.

This completes the system checkout. Disconnect test equipment, connect any disconnected wires, and restore any removed protective covers on the transmitter or other devices. ■

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7.0 CALIBRATION AND MAINTENANCE

This section describes calibration, preventive maintenance, and troubleshooting. The Calibration section contains procedures to calibrate a Model 341 and to eliminate any position induced zero shift.

The Maintenance section has preventive maintenance procedures that are employed to prevent conditions from occurring that would be detrimental to the reliability of the Transmitter. Should a malfunction occur, troubleshooting procedures will assist in minimizing down-time. This section also includes Transmitter removal and replacement procedures, recommended spare and replacement parts, and an exploded view drawing with a parts list.

WARNING

In Division 1 areas, where an explosion-proof rating is required, *remove power from the Transmitter* before removing the Transmitter's end cap for access to the electrical terminal compartment.

7.1 CALIBRATION

A Transmitter is calibrated at the factory and should not require field calibration, except to eliminate any position induced zero shift. Section 7.1.2 describes field calibration of a Transmitter.

Some transmitter orientations will cause a position induced zero shift. Perform the brief procedure in Section 7.1.3 to re-zero the transmitter. Note that calibrating an installed Transmitter or positioning the Transmitter during a bench calibration to exactly match the installed orientation eliminates the need to perform the procedure.

Transmitter calibration should be checked at least annually and the procedures in this section performed if out of tolerance.

A Model 275 is needed for calibration. It provides two calibration programs:

- DAC OUTPUT - Calibrates the Digital-to-Analog Converter that sets the transmitter's analog output signal.
- MOUNTING POSITION - Re-zeros transmitter for position induced zero shift.

Recommended test equipment is listed in Section 7.1.1 and typical wiring diagrams are shown in Figures 7-1 and 7-2.

7.1.1 Equipment Required

- Model 275 Universal HART Communicator - refer to Section 2 of this User's Manual
- Laboratory grade digital multimeter (DMM); for calibrating the 4 to 20 mA output signal
 - Voltmeter Section Accuracy +/-0.01% of reading
 - Resolution 1.0 mV
 - Input impedance 10 MS
 - Ammeter Section Accuracy +/-0.1% of reading
 - Resolution +/-1 uA
 - Shunt resistance 15S or less
- 24 Vdc power supply; for bench calibration
- Resistor 250S +/-1%, carbon, 1/4 watt; for bench calibration

7.1.2 Calibrate Digital-to-Analog Converter (DAC)

Calibration of the DAC is not normally required and should be performed only after all other options have been exhausted. Bench calibration is recommended; perform steps 1 through 15.

1. Disconnect the transmitter from the process by performing the steps in Section 7.5.

NOTE

Removing a transmitter can interrupt power to other transmitters powered from a common power source. Note the effect this can have on process control and operation and, if necessary, follow the proper procedures to shut down the process.

When disconnecting the LOOP leads, carefully insulate each lead as it is removed to prevent accidental shorts.

2. Remove the enclosure cap to access the terminal compartment.
3. Connect the HART Communicator and DMM to the loop as shown in either Figure 7-1 or 7-2. Set the DMM to measure 4-20 mA.
4. Establish communication between the Communicator and transmitter. Refer to Section 3.2 as necessary.
5. Be sure the polling address is set to 0 (analog mode). Refer to Section 5.1.1.3 as necessary.
6. From the Online menu, press “2” to display the Calibrate/Test menu. Press “2” to display the Calibrate menu.
7. Press “2” to begin the Calibrate DAC process. The Communicator displays the message “WARN–Loop should be removed from automatic control.” If it is permissible to do this, do so, and press OK (F4). If not, press ABORT (F3) to terminate this procedure.
8. If OK was pressed, the Communicator displays the reminder message “Connect reference meter.” If necessary, press ABORT (F3) to terminate the procedure and make the meter connection. Return to step 3 and start over.
9. If OK was pressed, the Communicator displays “Setting fld dev output to 4 mA.” Press OK (F4) to continue or press ABORT (F3) to terminate the procedure.

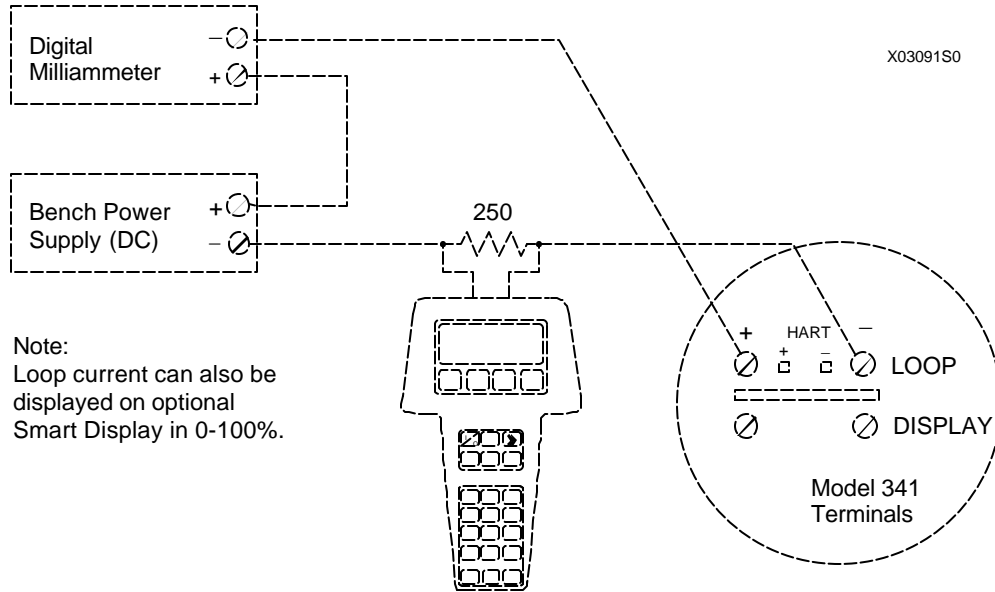


FIGURE 7-1 Bench Test Connections

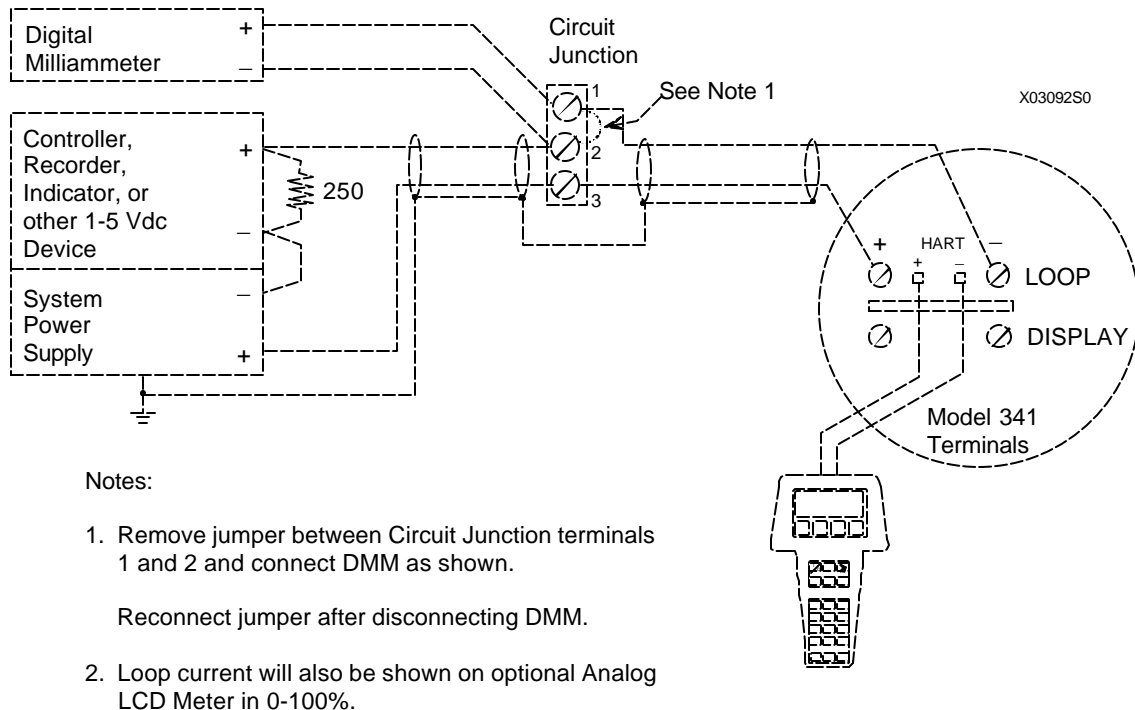
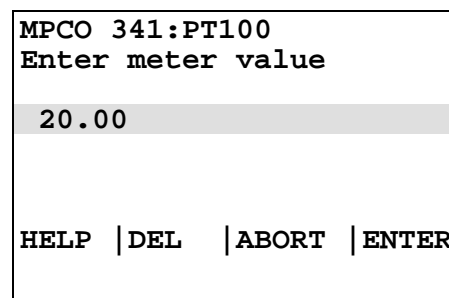
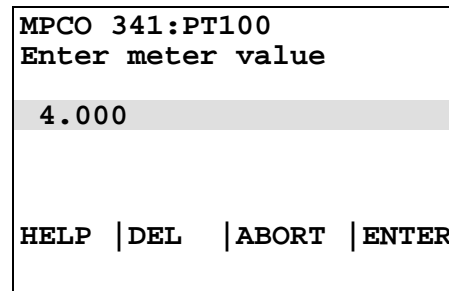


FIGURE 7-2 Field Test Connections

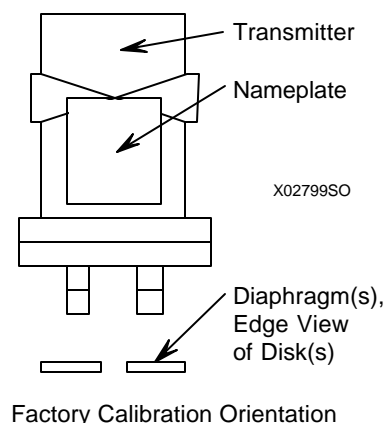
9. Observe the DMM reading, type the reading on the screen displayed (at right), and press ENTER (F4) to confirm the value. Press ABORT (F3) to terminate the procedure without calibrating the DAC.
10. The Communicator displays a confirmation message “Fld dev output 4.000 mA equal to reference meter?” If this is true, press “1” to indicate YES. If it is false, press “2” to indicate NO.
11. If the answer NO is selected, the display goes back to the one shown in step 9. Enter the correct value and proceed.
12. After completing the 4.000 mA calibration, the Communicator displays the message “Setting fld dev output to 20 mA.” Press OK (F4) to continue or press ABORT (F3) to terminate the procedure.
13. Observe the DMM reading, type the reading on the screen displayed (at right), and press ENTER (F4) to confirm the value. Press ABORT (F3) to terminate the procedure without calibrating the DAC.
14. The Communicator displays a confirmation message “Fld dev output 20.000 mA equal to reference meter?” If this is true, press “1” to indicate YES. If it is false, press “2” to indicate NO.
15. If the answer NO is selected, the display goes back to the one shown in step 12. Enter the correct value and proceed.
16. After completing the 20.000 mA calibration, the Communicator displays the message “Returning fld dev to original output” followed by the “Loop may be returned to automatic control.” Press OK (F4) to continue and terminate the procedure.
17. Disconnect the test equipment, reconnect the jumper on the circuit junction terminals (Figure 7-2), and if necessary return the polling address to the appropriate value.



This completes calibration of the transmitter.

7.1.3 Mounting Position Zero Shift Calibration

Factory calibration is performed with the transmitter oriented vertically, as shown here. A zero shift can occur as a Transmitter is rotated from this orientation, depending upon transmitter type and direction of rotation. Maximum zero shift is 1.2 inches H₂O (299 Pa). The following paragraphs can help predict zero shift for a selected transmitter model and desired mounting orientation.



Model 341D:

- Two diaphragms are used.
- There is no zero shift as long as the two diaphragms are in the same horizontal plane and that plane is parallel to the surface of the earth.
- Maximum zero shift will occur when the two diaphragms are in a vertical plane with one above the other (i.e., rotated 90E CW or CCW) from that shown in the adjacent figure.

Models 341A, 341G, or 341P:

- One diaphragm is used.
- There is no zero shift as long as the diaphragm is parallel to the surface of the earth.
- Maximum zero shift will occur when the diaphragm is perpendicular to the earth (i.e., rotated 90E in any direction) from that shown above.

Each time a transmitter is rotated from the orientation in which it was zeroed, there is the possibility of zero shift and the need for re-zeroing.

Zero shift is easily removed by performing the following procedure.

1. Mount the Transmitter in its final mounting position (orientation).

IMPORTANT

A bench re-zeroing can be performed provided the Transmitter is exactly positioned (oriented) as it will be when installed in the field. A field re-zeroing is preferred for best accuracy.

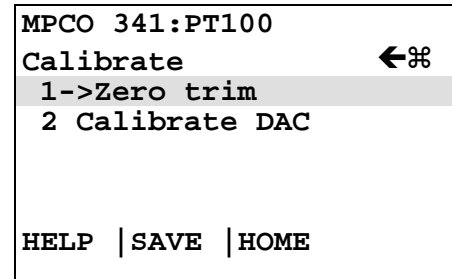
2. Pipe the transmitter and adjust applied pressures.
 - Model 341D Differential Pressure Transmitter - For best performance, NO pressures, other than atmospheric, should be applied to the Transmitter's process HIGH and LOW input pressure ports unless used in a process that has a constant measurable static pressure. In this case perform this procedure at the operating static pressure.

For field mounted differential pressure transmitters with piping connected to the LOW pressure port, the manipulation of piping valves and/or drains may be needed to ensure the appropriate requirement is met.

- Model 341A Absolute Pressure Transmitter - To zero the Transmitter, a full vacuum must be pulled on the Transmitter. A zero off-set will occur with less than a full vacuum.

3. Connect the HART Communicator to the transmitter and apply power.
4. From the Online menu, press “2” on the keypad to access the Calibrate/Test menu. From the Calibrate/Test menu, press “2” to access the Calibrate menu (at right).

If the transmitter zero is being calibrated at the bench, be sure the transmitter is positioned exactly as it will be when installed.



5. Press “1” on the keypad or press the RIGHT ARROW/SELECT key to access the Zero trim menu.
6. The Communicator displays the message “WARN–Loop should be removed from automatic control.” If it is permissible to do this, do so, and press OK (F4). If not, press ABORT (F3) to terminate this procedure.
7. If OK was pressed, the Communicator displays the message “WARN–This will affect sensor calibration.” Press OK (F4) to continue or press ABORT (F3) to terminate this procedure without calibrating the sensor zero.

If OK was pressed, the Communicator displays “Apply 0 input to sensor.” Make sure 0 input is being applied to the transmitter, then press OK (F4).

8. The Communicator automatically re-zeros the sensor while displaying the message “Sensor input stabilizing.” It then displays “Sensor zero succeeded” followed by “NOTE–Loop may now be returned to automatic control.” This signifies that the zero has been adjusted correctly.

To terminate the procedure, do not change the input and press ABORT (F3).

9. Return the loop to automatic control if necessary, then press OK (F4) to return to the Calibrate menu. This completes the zero trim procedure.

7.2 PREVENTIVE MAINTENANCE

Preventive maintenance consists of periodic inspection of the Transmitter, cleaning the external surface of the Transmitter's enclosure, draining condensate from conduit, and blowing-down or purging impulse piping to keep it free of sediment. Preventive maintenance should be performed at regularly scheduled intervals.

7.2.1 Tool and Equipment Requirements

The following tools and equipment are required for servicing:

- Set of Phillips and flat-blade screwdrivers.
- Set of open-end or box-end wrenches.
- Torque wrench (30 ft-lbs), 11/16" socket; used for connection block bolts.
- Digital Multimeter (DMM); see Section 7.1.1 for specifications

7.2.2 Transmitter Exterior Inspection

The frequency of the inspection will depend on the severity of the Transmitter's environment.

1. Inspect the exterior of the Transmitter enclosure for accumulated oil, dust, dirt, and especially any corrosive process overspray.
2. Check that the enclosure cap is fully threaded onto the enclosure, compressing the O-ring between the cap and the enclosure. The O-ring must not be cracked, broken, or otherwise damaged.
3. If an analog meter is installed, inspect the protective viewing glass in the enclosure cap for cleanliness and damage. A cracked or punctured glass **must** be replaced; see Section 7.4 and the Parts List at the back of this Manual.
4. Inspect both enclosure conduit entrances for possible moisture leaks. An unused conduit entrance **must** be plugged and sealed. Inspect the cable clamps of all watertight cable conduits for loose clamps and deteriorated sealing material. Tighten clamps and reseal as necessary.
5. If a conduit drain is installed, inspect the drain seals for obstructions.
6. If subjected to vibration, inspect all transmitter and mounting bracket hardware for tightness. Tighten loose hardware as necessary. Consider steps to reduce vibration.
7. Model 341D, A, or G - Inspect process connection blocks for evidence of leakage, both at the impulse pipe connections and at the block interface to the enclosure manifold. If necessary, add sealant to pipe threads, tighten block bolts, and replace block TFE/PTFE seals.
8. Model 341P - Inspect transmitter and spud for leakage. Depending upon model, tighten threaded ring or replace O-ring.

7.2.3 Transmitter Exterior Cleaning

After an exterior inspection of the Transmitter, the enclosure can be cleaned with the Transmitter operating.

1. Clean the enclosure (except enclosure cap glass) and process manifold with a mild, nonabrasive liquid detergent, and a soft bristle brush, sponge, or cloth. Rinse the weatherproof enclosure with a gentle spraying of water.

If the Transmitter is subjected to heavy process overspray, keep the enclosure free of excessive accumulation of process residue. Hot water or air may be used to flush away process residue if the temperature of the cleaning medium does not exceed the operating temperatures of the Transmitter as listed in Section 9.3.4 Environmental.

2. Clean enclosure cap glass with a mild nonabrasive liquid cleaner and a soft, lint-free cloth.

7.2.4 Transmitter Enclosure Interior Inspection

Remove the enclosure cap periodically to inspect the interior of the enclosure's terminal compartment. Because the enclosure is sealed, there should be no accumulation of dust, dirt, or water (condensate) in the interior. If condensate is present, a conduit drain must be installed. See Figure 4-17.

Check that all wire connections are tight.

Enclosure threads *must be coated* with a wet, paste-type, anti-seize compound such as Never-Seez by Emhart Bostik. Inspect the enclosure O-ring for damage.

7.2.5 Transmitter Calibration

An annual calibration check should be performed to ensure that the transmitter is within specifications. Refer to Section 7.1 for details.

7.2.6 Impulse Piping, Models 341D, A, and G

To ensure accuracy and continued satisfactory performance, impulse piping must be kept clean and inspected for damage.

Sediment or other foreign particles must not clog or collect in piping or the pressure chamber of the process manifold's process connection blocks. A build up of residue can cause faulty measurement.

1. Inspect impulse piping for loose, bent, or cracked piping. Replace damaged piping.
2. At regular intervals, blow down the piping without passing line fluids containing suspended solids through the process manifold's process connection blocks.

The time interval between blow downs is determined by the user's previous experience with such systems or determined by evaluating system performance only after the Transmitter has been in operation for a period of time.

7.3 TROUBLESHOOTING

This Section provides guidance and procedures to assist in identifying and correcting a malfunctioning transmitter. Section 7.2.1 lists needed tools and equipment.

Make all documentation associated with the transmitter, including piping and loop wiring diagrams and configuration documentation, available to maintenance personnel to facilitate troubleshooting.

The most common symptom of a malfunctioning transmitter is incorrect, erratic, or no output. A malfunction can affect the transmitter's analog output (4-20 mA) or its digital (HART) output. Furthermore, a malfunction can be the result of external forces and not a transmitter fault at all. Section 7.3.1 discusses troubleshooting techniques for the analog output. Section 7.3.2 discusses troubleshooting techniques for the digital output. Section 7.3.3 describes verifying a true transmitter failure should Section 7.3.1 or 7.3.2 not yield desirable results.

7.3.1 Analog Output

An analog output problem can appear as one of the following:

- No output or very low output. – There is no transmitter output or the output remains low despite changes in the process.
- High output. – Transmitter output remains high despite changes in the process.
- Erratic output. – Transmitter output varies when process does not.
- Sluggish Response – Transmitter seems to respond to process changes very slowly.

Often an analog output problem is caused by incorrect transmitter configuration or by something external to the transmitter. The following list shows possible causes and corrective actions for these problems. If reviewing this list and performing applicable corrective actions does not remedy the problem, proceed to Section 7.3.3 Diagnosing a Defective Transmitter.

Check Impulse Piping

- Check that high and low pressure pipe connections are not reversed.
- Check for leaks or blockage.
- Check for entrapped gas in liquid lines or for liquid in dry lines.
- Check for sediment in transmitter's process connection blocks.
- Check that blocking valves are fully open and that bypass valves are tightly closed.
- Check that the density of the fluid in piping is unchanged.

Check Loop Power Supply/Wiring

- Check loop power supply for blown fuse or tripped circuit breaker.
- Check for 12 Vdc minimum across loop +/- terminals in transmitter terminal compartment.
- Check power supply output voltage: 17 Vdc minimum; 42 Vdc maximum.
- Check polarity of loop wiring at both power supply and transmitter.
- Check for loose or broken loop wiring at power supply terminals, supply barriers (if used), junction boxes, and transmitter terminal compartment.
- Check for disconnected or broken current sense resistor.
- Check for short between shield and loop + wire.
- Check for accumulation of moisture in transmitter terminal compartment.
- Check loop cable for proper type and length.
- Check for electrical interference between the loop cable and any adjacent cables in a cable tray or conduit.

Check Transmitter Configuration

- Check for proper operating mode: analog, address 0; digital, address 1-15.
- Check for appropriate transfer function.
- Check zero dropout value.

Check for a Transmitter Stuck in Override Mode

- Re-enter Loop Override from HART Communicator Online menu and properly exit Loop Override Mode.

Check for Variable Process Fluid Flow

- Install mechanical dampers in process pressure piping.
- Select a higher damping value (software filter time constant).

Check Primary Element

- Check that primary element is correctly installed.
- Check element for damage and leaks.
- Note any changes in process fluid properties that can affect output.

7.3.2 Digital Output (Communication)

A malfunctioning digital output can indicate a defective communication circuit. More commonly, however, these problems are caused by an incorrect or poor installation. It is possible to install a transmitter such that the 4-20 mA signal is correct, yet the digital HART signal is not.

The most common symptom of a communication problem is the inability to locate a transmitter on the loop using a HART Master Device, such as the HART Communicator. Typical messages from the HART Communicator include: device disconnected, no device found, or communication error.

If communication problems occur, check the following. Refer to the specifications in Section 9 as necessary.

- Check that loop resistance is between 250 Ω and 1100 Ω .
- Check that electrical noise on loop is not excessive: power supply ripple should not exceed 12 mVp-p.
- Check that there are no high inductance devices in the loop (I/P for example). Install a HART communication filter across such a device.
- Check that the power supply voltage is high enough for the installed total loop resistance. Refer to Section 4.
- Refer to Section 4 and confirm that loop cable length is not excessive.
- Check that the HART Master is connected across a load.

7.3.3 Diagnosing a Defective Transmitter

Should the above not remedy the problem, the sensor assembly or electronics module may have failed.

If the failure permits HART communication, use the HART Communicator to access the transmitter. Microprocessor based self-diagnostic tests continuously examine the sensor assembly and electronics module.

Perform the procedure below to access the diagnostic displays and determine if a fault exists.

1. If not already in communication with the suspect transmitter, establish communication (see Section 3.2).
2. Press the Quick Access Key and then press “2” to view the Status Menu. If “FAILSAFE” is displayed the transmitter has entered the failsafe mode.
3. From the Status menu, press “2” to obtain a list of errors. Note which of the error messages in the table below is displayed (multiple errors can be displayed).
4. Confirm that the fault still exists. Press the Quick Access Key again to return to the Online menu. Activate the selftest function by choosing “2” Calibrate/Test, then press “1” to perform a self-test. The transmitter will display a warning message, then perform the test.
 - If the fault was temporary – possibly as a result of excessive electrical noise or a power line spike – the Communicator will display “Transmitter PASSED transmitter selftest.” If the transmitter passes the selftest, it automatically exits the failsafe mode and resumes normal operation. No further action is required.
 - If the fault remains, the Communicator displays the message “Transmitter FAILED transmitter selftest.” Repeat the test for additional confirmation. If the transmitter fails again, consult the table below and perform the appropriate corrective action.

CODE	PROBABLE CAUSE	CORRECTIVE ACTION
E2 ROM	ROM CHECKSUM match failed.	Replace transmitter.*
E3 RAM	Microprocessor failed, RAM inoperative.	Replace transmitter.*
E4 EPROM	Microprocessor cannot retain configuration or calibration data	Reconfigure/recalibrate transmitter. Perform transmitter self-test (step 4). If self-test fails, replace transmitter.
E5 TIMER	A major cycle interrupted itself.	Replace transmitter.*
E6 SENSOR	CHECKSUM match failed. Database Rev. No. does not match software Rev. No.	Replace transmitter.*

* See Section 7.5 to replace a transmitter. Send the removed transmitter to the factory for repair. See Section 7.9.

7.3.4 Diagnosing a Process Manifold Assembly Failure

The Process Manifold Assembly cannot be field repaired. If these steps confirm a problem within the Manifold Assembly, see Section 7.9 to return the Transmitter to the factory for repair.

These procedures, consisting of a combination of Transmitter self-diagnostics and a known particular symptom, can be used to confirm a Manifold Assembly problem:

1. Check for obvious physical damage to the Assembly or evidence of a loss of fill fluid.
2. Check Transmitter STATUS and perform a Transmitter SELFTEST. The Transmitter TEST will check for a failed Assembly EEPROM, displayed as message E6 SENSOR on the ERRORS screen.

Transmitter self-diagnostics will not report a failure of the Assembly's Sensor or Enhanced-Mode Oscillator (EMO). To identify this type failure, proceed to step 3.

3. Check for failed EMO/Sensor by pressing the Model 275 Quick Access Key/Xmtr Vars to display the MV (measured variable), I (analog current), and PV (process variable) parameters. Interest is centered only on the MV and I parameters. If the EMO or Sensor has failed, the value of the MV and I are as follows:

MV ~ LRL - $\frac{\text{Span}}{2}$ (Maximum Span) ; see Section 9.3 SPECIFICATIONS.

I ~ 3.84 mA (if URV is > LRV) or $\frac{\text{Span}}{2}$ 21.6 mA (if URV is < LRV)

An example illustrating a few possible MV values for a Range D Assembly follows:

- Range D - Lower Range Limit: -450 inH₂O and Maximum Span: 450 inH₂O (from Section 9.3)
- 450 inH₂O is equivalent to: 16.25 PSI, 33.7 in. Hg, 842.4 mm Hg

For a Transmitter SENSOR INPUT BLOCK configured for any one of the following MV UNITS, the corresponding fail condition for the MV is listed:

MV UNITS	VALUE = 450 in. H ₂ O	MV ~ Value
PSI	16.25 PSI	-24.375 PSI
inHg	33.7 inHg	-50.55 inHg
mmHg	842.4 mmHg	-1263.6 mmHg
inH ₂ O	450 inH ₂ O	-675 inH ₂ O

4. If steps 1, 2, and 3 *do not confirm* a Process Manifold Assembly defect, and all other loop elements and wiring have been thoroughly tested, and the transmitter is still not performing properly, see Section 7.9 to return the Transmitter for repair.

7.3.5 Enclosure Thread Lubrication

An enclosure cap should turn smoothly and easily on the enclosure threads. These threads are factory coated with a wet, paste-type, anti-seize compound such as Never-Seez by Emhart Bostik.

- Do not use force to thread a cap onto the enclosure.
- Be careful not to wipe off the lubricant while handling the transmitter.
- Recoat the enclosure threads if the cap is at all difficult to turn on the enclosure threads.
- Always inspect the enclosure O-ring for damage before installing a cap.

7.4 NON-FIELD-REPLACEABLE ITEMS

- Enclosure Cap Display Viewing Glass: Agency regulations do not permit field replacement of a broken or damaged glass as this would invalidate the enclosure's explosion proof rating. Replace the entire damaged enclosure end cap assembly.
- Transmitter Electronics ---
- Transmitter Process Manifold Assembly ---

7.5 TRANSMITTER REPLACEMENT

To replace a Transmitter, refer to the procedure below and one or more of the following Sections in the Installation section of this Manual:

- 4.4 Mechanical Installation, Models 341D, A, and G
- 4.5 Mechanical Installation, Model 341P
- 4.6 Mechanical Installation, All Models
- 4.7 Electrical Installation
- 4.8 Hazardous Area Installations

WARNING

Before loosening process connections, be certain that process material will not cause injury to personnel. Depressurize transmitter and drain process material as necessary.

REMOVAL

1. Remove power from Transmitter. Close shut-off valves and open by-pass valves.
2. Remove enclosure end cap and free but do not disconnect the Analog Meter (if installed). Refer to Sections 4.6.1 and 4.6.2.3 as necessary. Carefully support Meter.
3. Disconnect conduit and loop wiring. Refer to Section 4.7 Electrical Installation. Re-install Meter and enclosure end cap.
4. Disconnect Transmitter from process. Refer to the Mechanical Installation Section for the transmitter at hand; see above list.

WARNING

Be certain that disconnecting transmitter from process will not release process material.

Model 341D, A, or G - Disconnect all process piping (e.g., impulse piping or 3-valve manifold). Then remove Transmitter from mounting bracket.

Model 341P - Remove transmitter from spud.

REPLACEMENT

1. Fasten Transmitter to mounting bracket. Refer to Mechanical Installation section for transmitter at hand.
2. Connect Transmitter to process.
3. Connect conduit and loop wiring. Refer to Sections 4.6.2 Electrical Conduit and Cable Installation and 4.7 Electrical Installation.
4. Apply power to Transmitter and configure. Refer to Section 5 On-Line Configuration and Operation.
5. Check all connections then open shut-off valves and close by-pass valves.

7.6 MAINTENANCE RECORDS

An accurate record keeping system for tracking maintenance operations should be established and kept up to date. Data extracted from the record may serve as a base for ordering maintenance supplies, including spare parts. The record may also be useful as a troubleshooting tool. In addition, maintenance records may be required to provide documentary information in association with a service contract. It is suggested that, as appropriate, the following information be recorded:

1. Date of service incident
2. Name or initials of service person
3. Brief description of incident symptoms and repairs performed
4. Replacement part or assembly number
5. Software compatibility code of original part
6. Software code of replacement part
7. Serial number of original part
8. Serial number of replacement part
9. Issue number of original circuit module
10. Issue number of replacement circuit module
11. Date of completion

7.7 RECOMMENDED SPARE AND REPLACEMENT PARTS

The quantity and variety of spare parts is determined by the time a Transmitter can be permitted to remain out of service or off-line. There are no recommended on-hand spare parts.

Replaceable parts are listed in the Parts List at the back of this Manual.

To replace a part, refer to Section 4, Installation and the Parts List drawing at the back of this Manual. For example, refer to Section 4.6.1 to rotate, remove or replace an Analog Meter.

When ordering a part, provide the following information for the item, module or assembly to be replaced or spared. This information will help insure that a repair addresses the observed problem, and that a compatible part is supplied.

1. Part number from Parts List or from a label on assembly
2. The single number software compatibility code
3. Serial number from the label on the Transmitter's nameplate
4. User purchase order number of original order, available from user records
5. New user purchase order number for the assembly to be replaced or spared
6. Reason for return for repair; include system failure symptoms, station failure symptoms, and error codes displayed.

Returns should be packaged in original shipping materials if possible. Otherwise, package item for safe shipment or contact factory for shipping recommendations. Refer to Section 7.9 to obtain a Return Material Authorization number.

7.8 SOFTWARE COMPATIBILITY

A single number software compatibility code identifies Transmitter software revision level. This software controls the Transmitter's operating routines and its HART communications with loop connected stations and gateways.

To read the software level of a Transmitter:

1. Establish communication with the transmitter (see Section 3.2).
2. From the Online menu, press the Quick Access Key.
3. From the Quick Access Key menu, press "2" to access the Status menu, then press "1." to access the Model Number menu.
4. The third item on the Model Number menu is the software revision number. If this number is not displayed, press "3" to display the Software rev screen, then press EXIT (F4).
5. Turn off the Communicator or press the Quick Access Key to return to the Online menu.

7.9 Return Shipment

The return of equipment or parts for any reason must always be coordinated with the manufacturer. Should it become necessary to make a return shipment, be sure to contact Moore Products Co. first and obtain packaging information and carrier recommendations.

Equipment Return Within North America

To Return Equipment

- Call the Repair Service Group at (215) 646-7400, ext. 4RMA (4762) weekdays between 8:00 a.m. and 4:45 p.m. Eastern Time to obtain an RMA number. Mark the RMA number prominently on the outside of the shipment.
- When calling for an RMA number, provide the reason for the return. If returning equipment for repair, failure information (e.g., error code, failure symptom, installation environment) will be requested. A purchase order number will be requested.

Material Safety Data Sheet

- A Material Safety Data Sheet (MSDS) must be included with each item being returned that was stored or used anywhere hazardous materials were present.

Packaging

- Package assembly in original shipping materials. Otherwise, package it for safe shipment or contact the factory for shipping recommendations. A module must be placed inside a static shielding bag to protect it from electrostatic discharge.

Equipment Return Outside of North America

Contact the nearest Moore Products subsidiary. Provide the reason for the return. A purchase order number will be requested. Request equipment packaging and shipping instructions.

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8.0 CIRCUIT DESCRIPTION

This section provides a block diagram level circuit description of an XTC Model 341 Pressure Transmitter. Figure 8-1 shows the functional block diagram of the Transmitter's Sensor Assembly and Electronics Assembly.

The Model 341 Transmitter family consists of three model types: Differential Pressure, 341D; Absolute Pressure, 341A; and Gauge Pressure, 341G. All models have the same Electronics Assembly design. All models use the HART protocol to communicate with an XTC Communicator (HART Communicator) or other HART Master.

8.1 SENSOR ASSEMBLY

The Sensor Assembly consists of a custom Application Specific Integrated Circuit (ASIC) and a capacitive pressure sensor element. These two components form the MycroSENSOR™, a state-of-the-art pressure sensor. The Sensor Assembly is part of the Process Manifold Assembly.

The Process Manifold Assembly also includes the process diaphragms, manifold and connection blocks. During manufacturing, an operating Process Manifold Assembly is subjected to a carefully controlled series of temperature and pressure cycles. Data recorded during those cycles are used to generate characterization factors that are stored in an Electronics Assembly EEPROM. Sensor range limits are also stored in the EEPROM. The resulting characterization curve describes that Process Manifold Assembly's output for combinations of pressure and temperature.

The sensor element contains two silicon based capacitors: a sense capacitor (C_s) whose value changes in response to an applied process pressure, and a reference capacitor (C_r) whose value is independent of pressure. Layers of glass and silicon are combined to form the capacitive element. These layers are anodically bonded to form a seal that is stronger than the glass itself and provides a monolithic structure which is extremely stable and has no measurable hysteresis.

The custom ASIC, which is inside the sealed Sensor Assembly, contains oscillator, amplifier, and buffer circuitry. The capacitive sensor element, the ASIC's oscillator circuit and the enhanced mode oscillator (EMO) generate three frequencies based on the capacitive measurements of C_s , C_r , and C_s+C_r . These frequencies are amplified and buffered by the ASIC and presented as CMOS compatible square wave outputs for processing by the Electronics Assembly. (Request PI340-1 for additional details concerning the MycroSENSOR.)

8.2 ELECTRONICS ASSEMBLY

The Electronics Assembly is a single circuit board located in the transmitter's housing. Electronic components are installed using advanced surface mount technology. A separate Terminal Board contains components that protect against overvoltage and reverse polarity of loop connections.

The circuit board contains the following:

- A standard Bell 202 Modem that employs Frequency Shift Keying (FSK) for remote communications via the HART protocol.

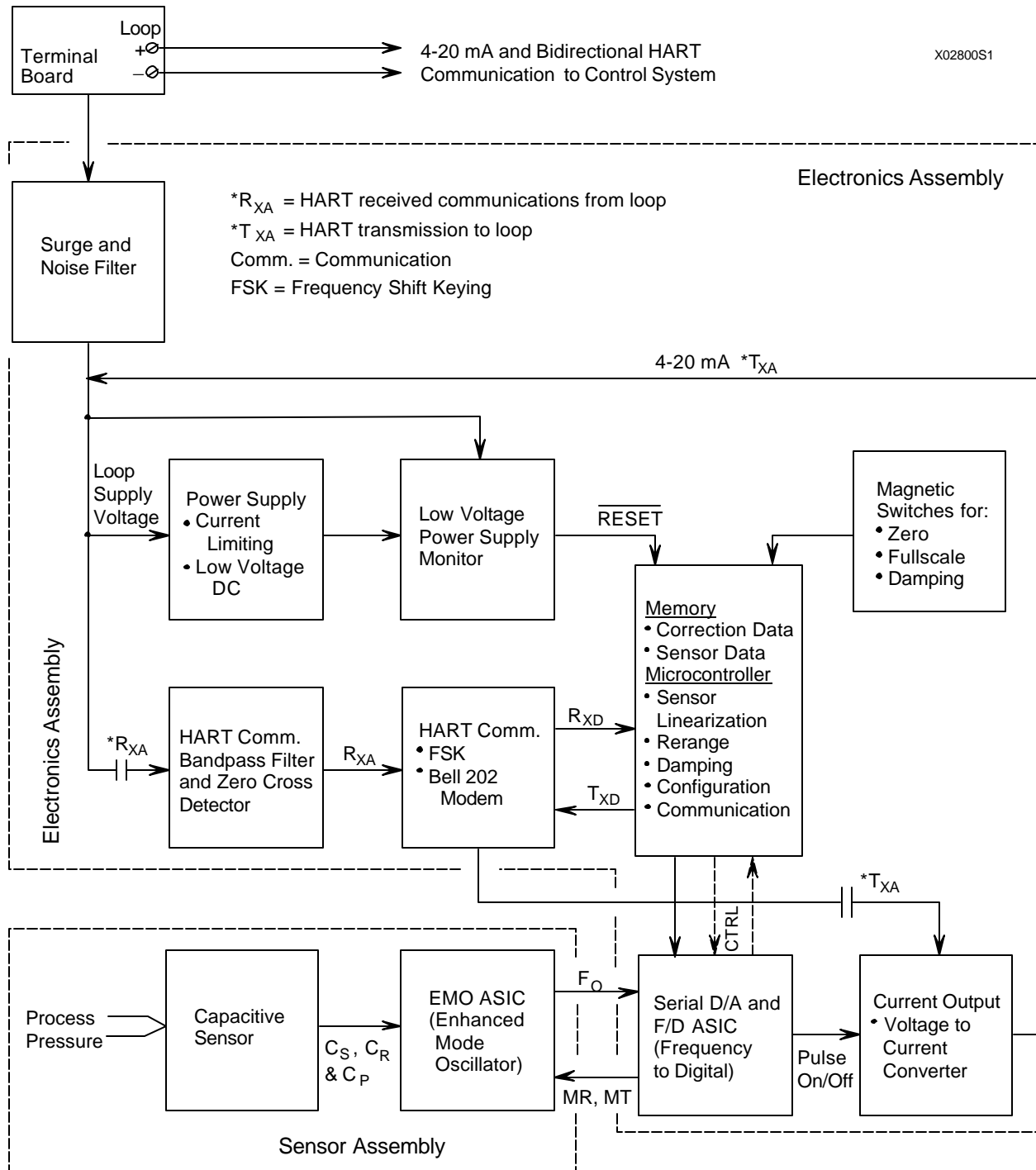


FIGURE 8-1 Block Diagram, Electronics and Sensor Assemblies

- A Microcontroller that:
 - Controls communications
 - Corrects and linearizes the input pressure signal
 - Stores configuration data; configuration data is stored in nonvolatile EEPROM memory in the Microcontroller and is retained when power is interrupted permitting the Transmitter to become functional upon power-up
 - Performs re-ranging and damping value selection upon input from user actuated local Zero, Fullscale, and Damping magnetic switches
- A custom ASIC (Application Specific Integrated Circuit) that provides:
 - A clock to the Microcontroller
 - Frequency-to-digital conversion of pressure signal from sensor module
 - Serial D/A conversion of the Sensor Assembly's signal to drive the V/I Converter
- A Low Voltage Power Supply with current limiting that provides DC operating power to the Sensor and Electronic Assemblies
- A power supply Voltage Monitor that generates a Microcontroller Reset signal when the Network (Loop) supply voltage is interrupted.
- A Bandpass Filter that passes HART signals and rejects low frequency analog signaling.
- A Voltage-to-Current Converter (V/I) that converts the output of the ASIC's D/A to a 4 to 20 mA loop output signal.

8.3 THEORY OF OPERATION

The following description applies to all Model 341 Transmitters since they operate similarly.

8.3.1 Pressure to Frequency Conversion

The process fluid applied to the capacitive pressure sensor changes the value of the sensor's C_s capacitor, thereby generating a sense frequency (F_s) by the Enhanced Mode Oscillator (EMO) that is directly proportional to the applied pressure. The EMO uses the reference capacitor (C_r) and the sum of both capacitors (C_{s+r}) to generate additional frequencies F_r and F_{s+r} . One at a time, each of the three frequencies are gated to the EMO ASIC by digital commands from the Electronics Assembly.

8.3.2 Frequency to Digital Conversion

The first of the three frequencies (F_r , F_{s+r} , and F_s) generated by the EMO is applied to the ASIC. Two counters in the ASIC count the time and number of cycles for each frequency. This data is stored and a command is sent to the EMO to switch to the next frequency. When all three frequencies are stored, the Microcontroller shifts the data into its serial port.

The Microcontroller uses a specially developed algorithm that cancels the effects of parasitic capacitance C_p and calculates the true ratio C_r/C_s . When the ratio is equal to one (1), the pressure difference between the two capacitors is known to be zero. A ratio less than one corresponds to a positive pressure difference and a ratio greater than one to a negative pressure difference. The ratio is now linearized and temperature corrected to produce an accurate pressure signal that is sent back to the ASIC for D/A conversion.

8.3.3 D/A Conversion and Current Signal Transmission

The pressure signal received by the Microcontroller is applied through the ASIC to a D/A Converter.

The D/A Converter translates the digitized pressure signal into a Pulse Width Modulated signal whose pulse width is proportional to the magnitude of the process pressure. The pulses are filtered and applied to an Operational Amplifier which drives a V/I Converter, whose output is a Darlington transistor pair acting as a pass transistor, that outputs a standard 4-20 mA current signal to the Network (output loop).

8.3.4 Communication Format

The Model 341 communicates, via the HART protocol, with the portable HART Communicator and any Primary or Secondary Master connected to the Network.

HART communication uses phase-continuous frequency-shift-keying (FSK) at 1200 bits/sec and frequencies of 1200 Hz for logic 1 and 2200 Hz for logic 0. HART communications are superimposed (AC coupled) on the analog 4-20 mA signal. Because the digital signaling is high frequency AC, its DC average is zero and does not interfere with analog signaling.

A 2-Pole Active Filter connected to the loop input receives HART transmissions. The filter rejects low frequency analog signaling, and other out-of-band interference, preventing a compromise of the digital reception. The filtered signal is applied to a Zero Crossing Detector which converts the filtered information into clean pulses of uniform amplitude before introduction to the Bell 202 Modem.

The Modem receives and processes (e.g., demodulation) the serial FSK signal (R_{xa}) and outputs the signal (R_{xd}) to the Microcontroller where serial to parallel conversion is performed.

In response to the received signal, the Microcontroller outputs a signal (T_{xd}) to the Modem where it is modulated and fed into the feedback circuit of the V/I Converter for transmission (T_{xa}) over the loop.

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9.0 MODEL DESIGNATIONS AND SPECIFICATIONS

This section contains the model designation tables, a comprehensive accessory list, and functional and performance specifications, and hazardous area classifications for all XTC Model 341 Pressure Transmitters.

IMPORTANT

Before installing, calibrating, troubleshooting or servicing a transmitter review this section carefully for applicable specifications and hazardous area classifications.

9.1 MODEL DESIGNATIONS

Tables 9.1, 9.2, 9.3, and 9.4 on the following pages identify each model designation entry on a transmitter's nameplate. The nameplate also carries other important transmitter information in addition to the model designation:

- Bill of material number (B/M)
- Serial number
- Span limits
- Maximum working pressure (MAX. WPR)
- Factory calibration (FACTY CAL)
- Certifications.

IMPORTANT

Confirm transmitter model by referring to the transmitter's model designation on its nameplate and the above Tables before installing, applying or removing power, configuring or servicing.

9.2 ACCESSORIES

Table 9.5 lists the accessories available for all Model 341s. Additional information about many transmitter accessories can be found in PI34-3, XTC Transmitter Accessory Guide.

Notes for Model Designation Tables 9.1 through 9.4

1. Standard for all ranges.
2. Stock model selection.
3. Must specify Body Parts code "AE."
4. Please describe the modification or provide a quotation reference number.
5. Not available with FM/CSA approvals.
6. Must specify Body Parts code "RR."
7. Not available with Input Range "B."
8. Mounting hardware purchased separately.
9. Must select housing "2" or "4."

TABLE 9.1 Model 341D, Model Designation

Basic Model Number

341D Differential Pressure Transmitter

Input Span Limits, Min./Max.

B 0.75 inH₂O / 15 inH₂O (0.186 kPa / 3.73 kPa)

D 10 inH₂O / 450 inH₂O (2.49 kPa / 112 kPa)

Output

A Standard, 4-20 mA_{dc} with HART Protocol ⁽¹⁾⁽²⁾

E Enhanced, 4-20 mA_{dc} with HART Protocol

Process Diaphragm

S 316L Stainless Steel

A 316L SS with 2 Remote Seals (specify RR for body parts) ⁽⁶⁾

B 316L SS with 1 Remote Seal on high side (specify RR for body parts) ⁽⁶⁾⁽⁷⁾

C 316L SS with 1 Remote Seal on low side (specify RR for body parts) ⁽⁶⁾⁽⁷⁾

Body Parts

	<u>Wetted</u>	<u>Vent/Drain</u>	<u>Process Connection</u>
AA	316 SS	Dual	½ NPT ⁽¹⁾⁽²⁾
AE	316 SS	Dual	¼ NPT
RR	Remote Seal(s)	None	¼ NPT

Fill Fluid

B Silicon DC200

Output Indicator

1 Analog LCD Meter 0-100% Scale ⁽²⁾

N Not Required

Standard Options

X Oxygen Cleaned

Y Special Feature ⁽⁴⁾

N Not Required ⁽²⁾

Mounting Bracket

1 2" Pipe Mount Bracket with SS Hardware ⁽²⁾

2 Universal Mounting Bracket - 2" Pipe or Flat Surface

3 Stainless Steel "L" Mounting Bracket - 2" Pipe Mount

N Not Required

Housing

1 Aluminum ½-14 NPT ⁽²⁾

2 Aluminum M20 x 1.5 ⁽⁵⁾

3 316 SS ½-14 NPT

4 316 SS M20 x 1.5 ⁽⁵⁾

Hazardous Area Classification

3 FM/CSA All ⁽¹⁾⁽²⁾

L CENELEC EExia & BASEEFA Ex N

M CENELEC EExd

R SAA All & ABS Type Approved ⁽⁹⁾

W FM/CSA All & ABS Type Approved

N Not Required

Notes indicated by (#).
See page 9-1 for Notes.

341D D A \$ AA N N N N 1 3 **Sample Model Number**

TABLE 9.2 Model 341A, Model Designation

Basic Model Number

341A Absolute Pressure Transmitter

Input Span Limits, Min./Max.

D 10 inH₂O abs / 450 inH₂O abs (2.49 kPa abs / 112 kPa abs)

E 9 psia / 100 psia (62.0 kPa abs / 689 kPa abs)

Output

A Standard, 4-20 mA_{dc} with HART Protocol ⁽¹⁾

E Enhanced, 4-20 mA_{dc} with HART Protocol

Process Diaphragm

S 316L Stainless Steel

B 316L SS with 1 Remote Seal ⁽³⁾

Body Parts

	Wetted	Vent/Drain	Process Connection
AA	316 SS	None	½ NPT ⁽¹⁾
AD	316 SS	Dual	½ NPT
AE	316 SS	None	¼ NPT
AH	316 SS	Dual	¼ NPT

Fill Fluid

B Silicon DC200

Output Indicator

1 Analog LCD Meter 0-100% Scale

N Not Required

Standard Options

X Oxygen Cleaned

Y Special Feature ⁽⁴⁾

N Not Required

Mounting Bracket

1 Standard Mounting Bracket - 2" Pipe Mount

2 Universal Mounting Bracket - 2" Pipe or Flat Surface

3 Stainless Steel "L" Mounting Bracket - 2" Pipe Mount

N Not Required

Housing

1 Aluminum ½-14 NPT

2 Aluminum M20 x 1.5 ⁽⁵⁾

3 316 SS ½-14 NPT

4 316 SS M20 x 11.5 ⁽⁵⁾

Hazardous Area Classification

3 FM/CSA All (1)

L CENELEC EExia & BASEEFA Ex N

M CENELEC (EExd)

R SAA All & ABS Type Approved ⁽⁹⁾

W FM/CSA All & ABS Type Approved

N Not Required

Notes indicated by (#).
See page 9-1 for Notes.

341A D A S AA B ll N N 1 3 **Sample Model Number**

TABLE 9.3 Model 341G, Model Designation

Basic Model Number

341G Gage Pressure Transmitter

Input Span Limits, Min./Max.

- D 10 inH₂O / 450 inH₂O (2.49 kPa / 112 kPa) ⁽²⁾
- E 9 psig / 100 psig (62.0 kPa / 689 kPa) ⁽²⁾
- F 60 psig / 600 psig (414 kPa / 4.14 MPa) ⁽²⁾

Output

- A Standard, 4-20 mA_{dc} with HART protocol ⁽¹⁾⁽²⁾
- E Enhanced, 4-20 mA_{dc} with HART protocol.

Process Diaphragm

- S 316L Stainless Steel ⁽¹⁾⁽²⁾
- B 316L SS with 1 Remote Seal ⁽³⁾

Body Parts

	<u>Wetted</u>	<u>Vent/Drain</u>	<u>Process Connection</u>
AA	316 SS	None	½ NPT ⁽¹⁾⁽²⁾
AD	316 SS	Dual	½ NPT
AE	316 SS	None	¼ NPT
AH	316 SS	Dual	¼ NPT

Fill Fluid

- B Silicon DC200

Output Indicator

- I Analog LCD Meter 0-100% Scale ⁽²⁾
- N Not Required

Standard Options

- X Oxygen Cleaned
- Y Special Features ⁽⁴⁾
- N Not Required ⁽²⁾

Mounting Bracket

- 1 Standard Mounting Bracket - 2" Pipe ⁽²⁾
- 2 Universal Mounting Bracket - 2" Pipe or Flat Surface
- 3 Stainless Steel "L" Mounting Bracket - 2" Pipe
- N Not Required

Housing

- 1 Aluminum ½-14 NPT ⁽²⁾
- 2 Aluminum M20 x 1.5 ⁽⁵⁾
- 3 316 SS ½-14 NPT
- 4 316 SS M20 x 1.5 ⁽⁵⁾

Electrical Connection

- 1 ½-14 NPT
- 2 M20 x 1.5

Hazardous Area Classification

- 3 FM/CSA All ⁽¹⁾⁽²⁾
- L CENELEC EExia & BASEEFA Ex n
- M CENELEC (EEx d)
- R SAA All & ABS Type Approved ⁽⁹⁾
- N Not Required
- W FM/CSA & ABS Type Approved

Notes indicated by (#).
See page 9-1 for Notes.

341G D I S 2 B N N N N 1 3 **Sample Model Number**

TABLE 9.4 Model 341P, Model Designation

Basic Model Number

341P Gage Pressure Transmitter with Flush Diaphragm Process Connections

Input Span Limits, Min./Max.

- D 1 psig / 30 psig (6.895 kPa / 206.84 kPa) ⁽²⁾
- F 10 psig / 150 psig (68.95 kPa / 1.034 MPa) ⁽²⁾

Output

- A Standard, 4-20 mA_{dc} with HART protocol ⁽¹⁾⁽²⁾
- E Enhanced, 4-20 mA_{dc} with HART protocol

Process Diaphragm

- H Hastelloy C-276

Body Parts

- | | <u>Wetted</u> | <u>Process Connection</u> |
|----|---------------|--|
| AB | 316 SS | Miniature Bolt-In-Place, 1.049" Diameter ⁽²⁾⁽⁸⁾ |
| AS | 316 SS | Standard Thread-Mount, 1.59" Diameter |

Fill Fluid

- B Silicon DC200

Output Indicator

- 1 Analog LCD Meter 0-100% Scale
- N Not Required ⁽²⁾

Standard Options

- Y Special Features ⁽⁴⁾
- N Not Required ⁽²⁾

Mounting Bracket

- N Not Required

Housing

- 1 Aluminum 1/4"-14 NPT ⁽²⁾
- 2 Aluminum M20 x 1.5 ⁽²⁾

Hazardous Area Classification

- 6 CSA IS
- N Not Required ⁽²⁾

Notes indicated by (#).
See page 9-1 for Notes.

341P F A H AB B N N N 1 N **Sample Model Number**

TABLE 9.5 Model 341 Accessories

DESCRIPTION	MODEL 341				PART NUMBER
	A	D	G	P	
Three-Valve Manifold, Steel*	☛	☛	☛	☞	16275-252
Three-Valve Manifold, 316 SS*	☛	☛	☛	☞	16275-251
Transient Protector*	☛	☛	☛	☛	14999-287
General Purpose Power Supply, 24 Vdc, 2A*	☛	☛	☛	☛	15124-1
Field Mounted Power Supply, 28 Vdc, 125 mA*	☛	☛	☛	☛	16055-299
Cap Wrench for 341P and CENELEC Explosion Proof models	☛	☛	☛	☛	20027-83
Mounting Bracket Kits: ☛ Standard Bracket, Pipe Mount ☛ Universal Bracket, Pipe and Flat Surface Mount ☛ L-Shaped Bracket, Stainless Steel, Pipe Mount	☛	☛	☛	☞	16275-121 20027-166 20027-167
Analog LCD Meter Kit, 0-100% Linear (includes meter and enclosure cap)*	☛	☛	☛	☛	20027-241
Analog LCD Meter Kit, 0-100% Linear, Stainless Steel Enclosure Cap*	☛	☛	☛	☛	20027-485
Gasket ☛ Standard TFE/PTFE ☛ Miniature Buna-N O-Ring (bolt-in-place mounting)	☞	☞	☞	☛	20027-331 2938-50
Plug ☛ Standard Threaded ☛ Miniature Bolt-In-Place	☞	☞	☞	☛	20027-311 20027-313
Spud Kit (includes spud, O-ring or gasket, and plug) ☛ Standard Threaded ☛ Miniature Bolt-In-Place	☞	☞	☞	☛	20027-314 20027-316
Miniature Bolt-In-Place SS Set Screw and Lockwasher	☞	☞	☞	☛	20027-317
Aluminum Test Spud ☛ Standard Threaded ☛ Miniature Bolt-In-Place	☞	☞	☞	☛	20027-318 20027-320
Spud ☛ Standard Threaded ☛ Miniature Bolt-In-Place	☞	☞	☞	☛	20027-332 20027-336
Universal HART Communicator	☛	☛	☛	☛	20027-275

* Refer to PI34-3, XTC Transmitter Accessory Guide for additional details.

☛ = For use with transmitter model in table column head; ☞ = Not for use

9.3 SPECIFICATIONS

The following specifications are for all transmitter models except as noted.

9.3.1 Mechanical

PARAMETER	MODEL 341D, A, G	MODEL 341P
Transmitter Dimensions	Figure 9-1	Figure 9-2
Mounting Bracket Dimensions	---	---
Standard Bracket	Figure 4-10	---
Universal Bracket	Figures 4-11 and 4-13	---
Stainless Steel "L" Bracket	Figure 4-12	---
Spud Dimensions	---	Figure 9-2
Weight, approximate	---	3.8 lbs (1.7 kg)
Transmitter with Display and Connection Blocks, less Mounting Bracket	8.5 lbs (3.9 kg)	---
Standard Bracket	1.5 lbs (0.7 kg)	---
Universal Bracket	2.5 lbs (1.1 kg)	---
Stainless Steel "L" Bracket	1.1 lbs (0.5 kg)	---

9.3.2 Functional and Performance

Range, Span, and SWP, Model 341D

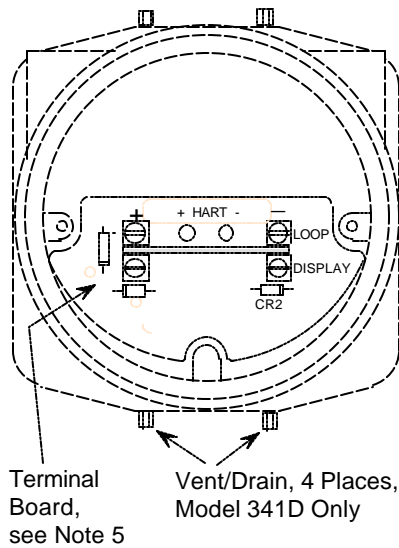
RANGE	LRL/URL	MIN/MAX SPAN	SWP
B	-15 inH ₂ O / 15 inH ₂ O (-3.73 kPa / 3.73 kPa)	0.75 inH ₂ O / 15 inH ₂ O (0.186 kPa / 3.73 kPa)	"100 psig ("689 kPa)
D	-450 inH ₂ O / 450 inH ₂ O (-112 kPa / 112 kPa)	10 inH ₂ O / 450 inH ₂ O (2.49 kPa / 112 kPa)	"2000 psig ("13.8 MPa)

Notes: LRL - Lower Range Limit; URL - Upper Range Limit; SWP - Safe Working Pressure

Range, Span, and SWP, Model 341A

RANGE	LRL/URL	MIN/MAX SPAN	SWP
D	0 / 450 inH ₂ O abs (0 / 112 kPa abs)	10 inH ₂ O / 450 inH ₂ O abs (2.49 kPa / 112 kPa abs)	250 psia (1.72 MPa abs)
E	0 / 100 psia (0 / 689 kPa abs)	9 psia / 100 psia (62.0 kPa / 689 kPa abs)	1500 psia (10.3 MPa abs)

Note: LRL - Lower Range Limit; URL - Upper Range Limit; SWP - Safe Working Pressure



Notes

1. Dimensions in Inches (Millimeters)
2. The following connection centers are formed by rotating the Process Connection Blocks.
 2.00 (50.1)
 2.13 (54.1)
 2.25 (57.2)
3. Clearance to remove the enclosure cap.
4. See Section 4 for Transmitter Mounting and Mounting Bracket dimensions.
5. Board viewed with Enclosure Cap and optional Analog LCD Meter removed. Display Diode (CR2) version of Board shown.

X0265910

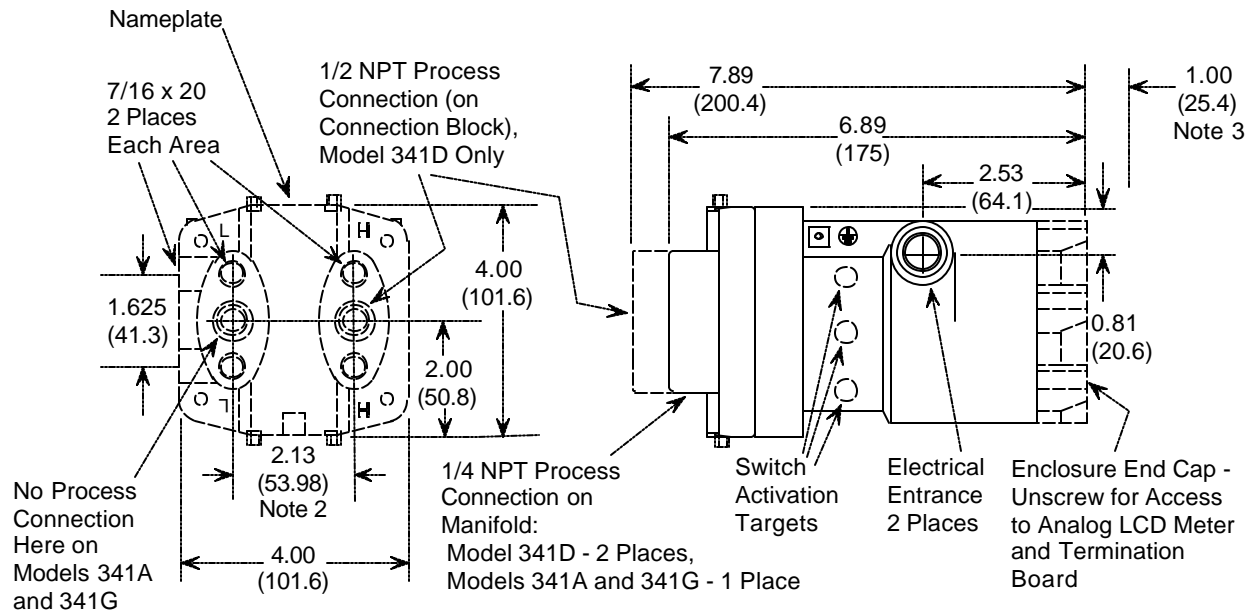
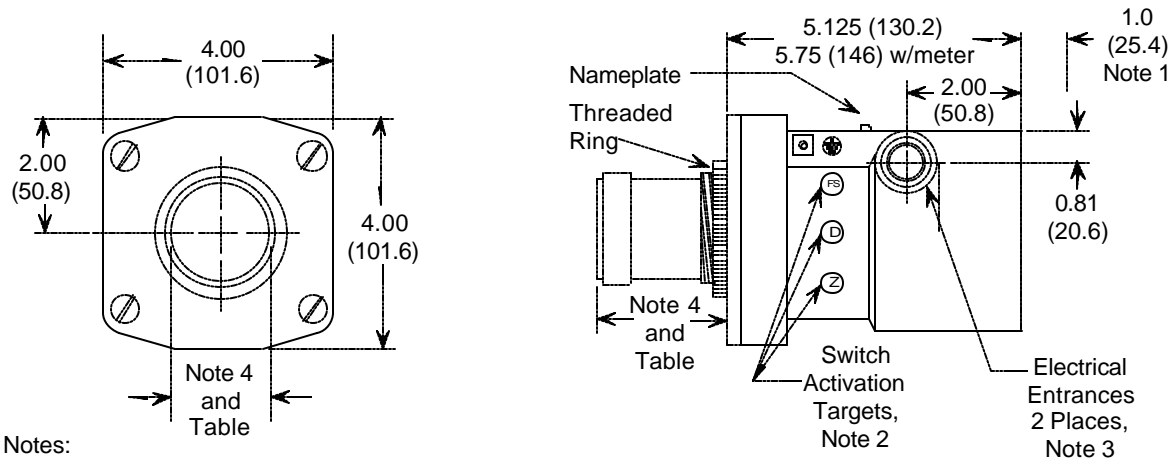


FIGURE 9-1 Models 341D, A and G, Dimensions



Notes:

1. Clearance to remove end cap.
2. Activate switches using supplied magnetic screwdriver.
3. Orient transmitter as desired. Dimensions in inches (millimeters).
4. See table at right for mounting connection dimensions.
5. Transmitters shown below are not to scale.
6. Carefully install spud per manufacturer's instructions.

MOUNTING	LENGTH	DIAMETER
Standard Thread	1.8 (45.7)	1.59 (40.4)
Miniature Bolt-in-Place	1.75 (44.5)	1.049 (26.6)

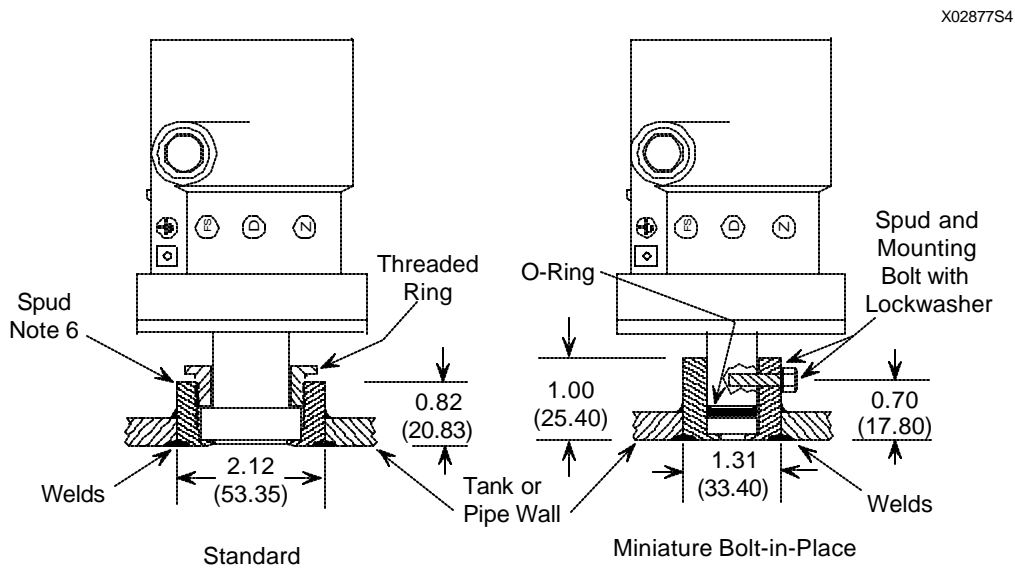


FIGURE 9-2 Model 341P, Dimensions

Range, Span, and SWP, Model 341G

RANGE	LRL/URL	MIN/MAX SPAN	SWP
D	-416 inH ₂ O / 450 inH ₂ O (-103 kPa / 112 kPa)	10 inH ₂ O / 450 inH ₂ O (2.49 kPa / 112 kPa)	250 psig (1.72 MPa)
E	-15 psig / 100 psig (-103 kPa / 689 kPa)	9 psig / 100 psig (62.0 kPa / 689 kPa)	1500 psig (10.3 MPa)
F	-15 psig / 600 psig (-103 kPa / 4.14 MPa)	60 psig / 600 psig (414 kPa / 4.14 MPa)	3000 psig (20.7 MPa)

Note: LRL - Lower Range Limit; URL - Upper Range Limit; SWP - Safe Working Pressure

Range, Span, and SWP, Model 341P

RANGE	LRL/URL	MIN/MAX SPAN	SWP
D	-14.7 psig / 30 psig (-103 kPa / 206.84 kPa)	1 psig / 30 psig (6.895 kPa / 206.84 kPa)	250 psig (1.72 MPa)
F	-14.7 psig /150 psig (-103 kPa / 1.034 MPa)	10 psig / 150 psig (68.95 kPa / 1.034 MPa)	1200 psig (8.27 MPa)

Note: LRL - Lower Range Limit; URL - Upper Range Limit; SWP - Safe Working Pressure

Accuracy, Analog Output

Standard:

SPAN	ACCURACY
Span up to 10:1	0.2% of calibrated span
Span from 10:1 to 45:1	"[0.128 + 0.0072 (URL/span)]"

Enhanced:

SPAN	ACCURACY
Span 10:1	0.1% of calibrated span
Span from 10:1 to 45:1	"[0.028 + 0.0072 (URL/span)]"

Stability

Zero Better than 0.1% of URL for 1 year
 Span..... No span drift

Position Effect..... Less than 1.2 inH₂O (300 kPa) worst case (zero out at installation)

Static Pressure Effect on Span, Model 341D only

RANGE	PRESSURE EFFECT CORRECTABLE TO
B	0.20%/ 100 psi (689 kPa)
C, D, E	0.20%/1000 psi (6.89 MPa)

Note: Zero effect eliminated at operating pressure.

Turndown

RANGE	MODEL 341D	MODEL 341A	MODEL 341G	MODEL 341P
B	20-1	---	---	---
D	45-1	45-1	45-1	30-1
E	---	11-1	11-1	---
F	---	---	10-1	15-1

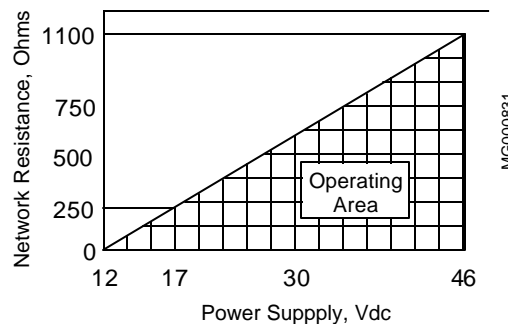
Damping 0 to 30 seconds

Outputs

- Analog..... Two-wire with digital communication superimposed on the 4-20 mA signal
- Digital..... HART protocol for field communication bus

Power Supply, Minimum Compliance Voltage (Refer to Section 4.3.6)

- Optional Digital Display *Not* Installed +10 Vdc with no loop resistance, see Figure below
- Optional Digital Display Installed +12 Vdc with no loop resistance, see Figure below



Operating Area with Digital Display Installed

Maximum Loop (Current Sense or Loop)	
Resistance (R _L)*	250S minimum, 1100S maximum *R _L = 50V _S - 600; where V _S = power supply voltage
Maximum Transmitter Voltage	+42 Vdc across LOOP terminals
Ripple	0.2 V _{p-p} , 47-125 Hz
Noise.....	0.6 mV RMS maximum
Impedance	10 Ohms maximum
Power Supply Effect.....	Less than 0.005% of output span per volt
Indication, optional.....	Analog LCD 0-100% linear
Transmitter Input Capacitance.....	12,500 pF, HART C _n = 3; refer to section 4.3.7
Network Topology	
Point-To-Point	
Transmitter Quantity.....	1
Network Signal and Connection.....	Analog 4-20 mA, single current loop, see Figures 4-7 and 4-8
Network Resistance	See Figure on previous page
Multi-Drop	
Transmitter Quantity.....	1 to 15
Network Signal and Connection.....	Digital, parallel connected; see Figure 4-9
Network Resistance	See Figure on previous page

9.3.3 Two-Wire Cable

Type	Twisted Single-Pair, Shielded, Copper
Conductor Size for Network Length	
Less than 5000 ft. (1524m).....	24 AWG minimum
More than 5000 ft. (1524m).....	20 AWG minimum, 16 AWG maximum
Cable Capacitance.....	Refer to Section 4.3.7
Recommendation.....	Belden 8641, 24 AWG Belden 8762, 20 AWG Screened core or shielded cable required for EMC compliance**
Length, Maximum.....	Refer to Section 4.3.7

** Per CENELEC standards, see Declaration of Conformance later in this section. A sample Model 341 was tested in accordance with EN50082-2:1994 and found to have display errors of +1.5% at 541 MHz and 3.4% at 181 MHz with shielded cable and no errors outside of normal performance criteria with screened core cable when subjected to the radiated immunity testing. The same sample had deviations of the measured input pressure of +2.4 inH₂O to -5.8 inH₂O in the frequency range of 150 kHz to 370 kHz when subjected to conducted immunity testing.

9.3.4 Environmental

Temperature Range, Storage and Operating, Models 341D, A, and G

Process.....	-40E to 125EC (-40E to 257EF)
Process, Vacuum Service	-40E to 85EC (-40E to 185EF)
Electronics (ambient temperature)	-40E to 85EC (-40E to 185EF)

Temperature Range, Storage and Operating, Model 341P

Process.....	-40E to 100EC (-40E to 212EF)
Process, Vacuum Service	-40E to 85EC (-40E to 185EF)
Electronics (ambient temperature)	-40E to 85EC (-40E to 185EF)

Ambient Temperature Effect

Models 341D, A, and G.....	"0.75% URL maximum shift for any change from 25EC (72EF) over the operating temperature range
Model 341P.....	"(0.025% URL + 0.125% span) per 28EC (50EF)

Humidity

Operating.....	0-100% RH
Storage	0-100% RH, non-condensing

Maximum Moisture

Operating.....	Less than 0.050 lb. H ₂ O per lb. of dry air
Storage	Less than 0.028 lb. H ₂ O per lb. of dry air

Corrosive Atmosphere..... Operates in Class G3 (Harsh) environment per ISA-S71.04

Vibration Effect..... Less than "0.1% URL per G from 15 to 200 Hz in any axis (per SAMA PMC 31.1)

EMI Susceptibility..... Less than 0.25% of maximum span at 30V/m, 20 MHz-1GHz

ESD Susceptibility

IEC severity level 4, 15 kV

Surge Protection (case to any terminal)..... "60 Vdc from 5 FF capacitor through 600S +2500V at 150S source resistance

Process Wetted Material..... Meets NACE standard MR0175-92

9.3.5 Hazardous Area Classification

Transmitters are designed for the following classifications. Before installing, applying power to, or servicing a transmitter, see the transmitter's nameplate and the Tables in section 9.1 for the electrical classification. Contact Moore Products Co. for latest approvals and certifications.

FM/CSA

Intrinsically Safe:	Class I, Division 1, Groups A, B, C, and D Class II, Division 1, Groups E, F and G Class III, Division 1
Explosion Proof:*	Class I, Division 1, Groups B, C and D Class II, Division 1, Groups E, F, and G Class III, Division 1
Non-Incendive:	Class I, Division 2, Groups A, B, C and D Class II, Division 2, Groups E, F, and G Class III, Division 2

CENELEC

Intrinsically Safe:	EEx ia IIC T3 IP66/IP68
Explosion Proof:*	EEx d IIB T3 IP66/IP68
EMC Compatibility:	EN50081-1:1992 and EN50082-2 with screened core cable See Declaration of Conformity on following page and Section 9.3.3 Two-Wire Cable

Electronics Housing: NEMA 4X/6P, IP 66/68

* Models 341D, A, and G

9.3.5.1 CSA Hazardous Locations Precautions

This section provides CSA hazardous location precautions that should be observed by the user when installing or servicing the equipment described in this Instruction. These statements supplement those given in the preceding section.

WARNING

Failure to observe the following precautions could result in an explosion hazard.

Precautions - English

For Class I, Division 1 and Class I, Division 2 hazardous locations,

☞ Use only factory-authorized replacement parts. Substitution of components can impair the suitability of this equipment for hazardous locations.

For Division 2 hazardous locations:

When the equipment described in this Instruction is installed without safety barriers, the following precautions should be observed. Switch off electrical power at its source (in non-hazardous location) before connecting or disconnecting power, signal, or other wiring.

Précautions - Français

Emplacements dangereux de classe I, division 1 et classe I, division 2:

☞ Les pièces de rechange doivent être autorisées par l'usine. Les substitutions peuvent rendre cet appareil impropre à l'utilisation dans les emplacements dangereux.

Emplacement dangereux de division 2:

Lorsque l'appareil décrit dans la notice ci-jointe est installé sans barrières de sécurité, on doit couper l'alimentation électrique à la source (hors de l'emplacement dangereux) avant d'effectuer les opérations suivantes branchement ou débranchement d'un circuit de puissance, de signalisation ou autre

✂

DECLARATION OF CONFORMITY

according to EN 45014

We

Moore Products Co.
Sumneytown Pike, Spring House, PA 19477

declare under our sole responsibility that the product,

Model 341, Pressure Transmitter with any factory installed options and in any configuration available from the factory

to which this declaration relates is in conformity with the following standards or other normative documents

EMC: EN50081-1 and EN50081-2 Emissions
EN50082-1 and EN50082-2 Immunity

following the provisions of the EMC directive

Spring House, PA U. S. A.

James O. Moore 10 1000. 95

James O. Moore
General Manager
Measurement and Control Division

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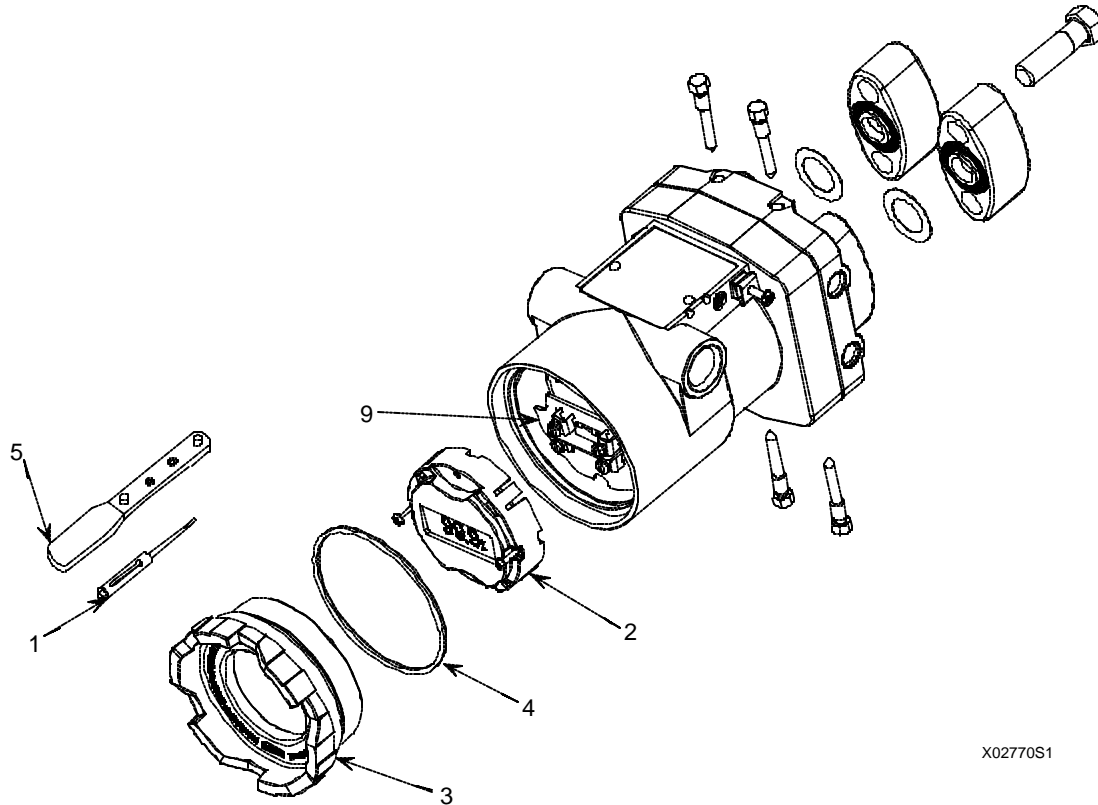
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PARTS LIST





PL341-1
Rev: 2
June 1998

XTC™ PRESSURE TRANSMITTER MODELS 341A, 341D, 341G, AND 341P



PART NO.	DESCRIPTION	CONTENTS AND (DRAWING ITEM NUMBER(S))
16275-411*	Magnetic Screwdriver Kit	Magnetic Screwdriver for XTC (1), for local configuration, quantity 12
20027-501	Terminal Board Kit	Terminal Board (9)
20027-504	Display Kit	Includes Analog LCD Meter (2), Stainless Steel Enclosure End Cap (3), and O-Ring (4).
16275-411	Display Kit	Includes Analog LCD Meter (2), Aluminum Enclosure End Cap (3), and O-Ring (4).
20027-83*	Cap Wrench	Cap Wrench for End Cap (5)
15965-659	Process Connection Blocks Kit	For Model 341D, kit includes: Hex Hd SST 7/16-20 x 1.5 Bolt, quantity 4 Gasket, quantity 2 Connection Block, quantity 2
15965-1218	Process Connection Block Kit	For Models 341A and G, kit includes: Hex Hd SST 7/16-20 x 1.5 Bolt, quantity 2 Gasket, quantity 1 Connection Block, quantity 1

Notes:

-  Refer to User's Manual UM341-2 for accessory part numbers and before servicing a transmitter.
-  An * identifies a recommended on-hand spare part.
-  Always specify, range, serial number, and other nameplate information when ordering spare or replacement parts.
-  Kits are for all models unless otherwise stated.