ENGLISH

Model 173

INSTALLATION, OPERATION & MAINTENANCE MANUAL

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Delta Controls
CORPORATION

Before installation and operation, please read this manual and take note of all safety instructions. Wear required personal protective equipment during installation, operation, and maintenance. Use this product only if it is in good condition. Delta Controls Corporation is not liable for damage caused by improper or non-designated use.

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Engineered Reliability

TABLE OF CONTENTS

1. Introduction 4

1.1 Model Overview 4

1.2 Theory of Operation 4

INSTALLATION

2. Installation 5

2.1 Mounting the Unit 5

2.2 Integrally Mounted Electronics Unit 5

2.3 Remote Mounted Electronics Unit 6

2.4 Wiring the Unit 6

OPERATION

3. Operation (without HART®) 7

3.1 Pushbuttons Used to Operate Model 173 7

3.2 Setup Parameters 7

3.3 Calibration 9

4. Operation with a HART® Communicator 10

4.1 Menus 10

4.2 Transmitter Setup using HART® 13

4.3 Calibration with a HART® Communicator 13

MAINTENANCE

4. Troubleshooting 14

SPECIFICATIONS

5. Specifications 15

6. Model Numbering System 15

1. Introduction

1.1 Model Overview

Model 173 probe style transmitter is microprocessor based and utilizes digital techniques and algorithms. It is used for critical measurement of liquid/solid level and interface position. It is insensitive to variations in liquid conductivity, fluid coatings or solids buildup. The instrument utilizes highly stable crystal references and filters. This allows it to reliably transmit the level of low dielectric materials. The probe is normally inserted vertically down into the liquid from the top of the tank.

The Model 173, integrally mounted on the probe, can be provided for penetration or mounting at any angle and can be up to 125 feet long. The integral electronics module is potted in epoxy for improved reliability and stability.

It will accurately measure almost any kind of liquid, including: water, oil, gasoline, acid, caustic, soup, milk, gear lube, and antifreeze. It is particularly advantageous when used in fuel oil tanks, cooling tower basins, fruit juice holders, chlorine storage tanks, irrigation channels, and pharmaceutical reactors. The loop-powered, 4-20 mA DC signal is ideal for driving controllers, displays, and supervisory computers.

It will correctly transmit the position of an interface by sensing the ratio of the admittance of the two liquids. Typical interfaces include foam/effluent, gasoline/acid, and oil/water. The interface can be accurately detected even though it may be “cloudy” or have an interface (“rag layer”).

Up to 10 calibration points allow the 173 to linearize the measured level to account for round, cylindrical or irregular tank shapes.

1.2 Theory of Operation

Model 173 utilizes capacitance technology to measure how much of its sensing probe is covered by the material of interest. This is accomplished by generating a radio frequency signal which travels from the sensing probe to the ground reference (usually the tank wall). The dielectric constant of the material is higher than that of the gas above the material, so energy flows more easily through the material. The amount of material then determines how much energy is transferred. The amount flowing (very small and low level in all cases) is a highly repeatable measure of the material level or interface position. The amount is integrated and applied to a 10-position lookup table to produce the 4-20 mA DC signal.

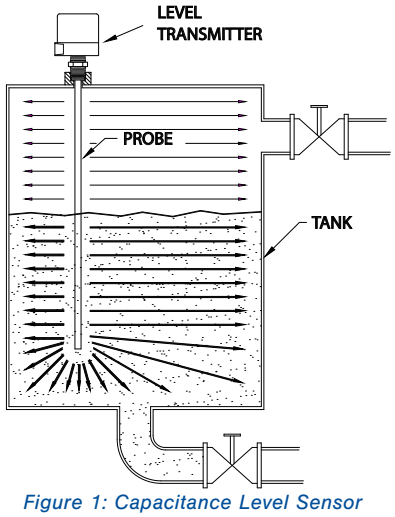


Figure 1: Capacitance Level Sensor

2. Installation

2.1 Mounting the Unit

Select a mounting point and hook up arrangement in accordance with good instrument practice. Wire the unit in accordance with the National Electrical Code or other governing code.

The sensing portion of the probe rod should normally be vertical and should span the distance between material elevations where 0% and 100% signal are to be set. Further, it should extend at least 3 inches (76.2 mm) both above and below these points.

2.2 Integrally Mounted Electronics Units

A. To install, mount the transmitter housing on the head of the probe, remove the cover and the two nuts holding the potted transmitter unit in place.

B. Remove the unit from the housing and attach the wire terminal lug to the “PROBE” terminal of the transmitter. The “COMP” terminal is not used with integrally mounted probes.

C. Replace the transmitter unit and its two hold-down nuts.

D. Consult the wiring diagram for proper Power Loop connections.

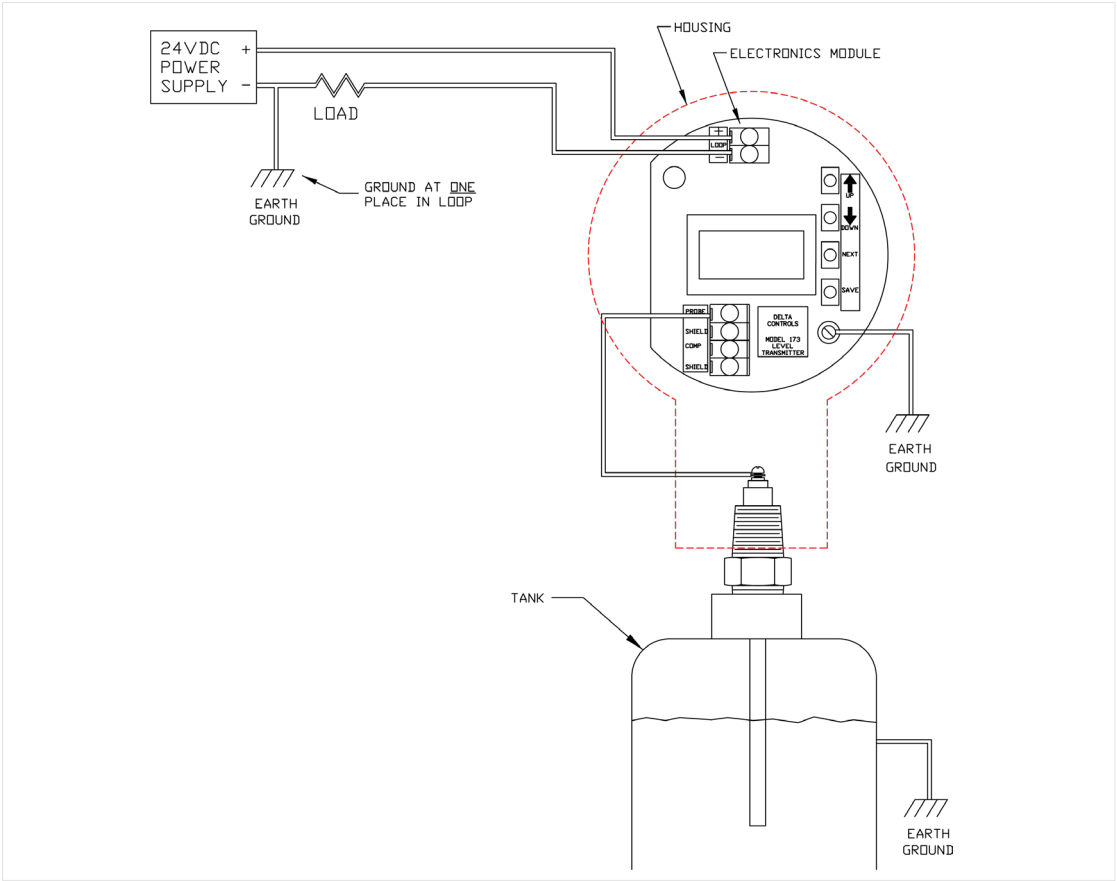


Figure 2: Model 173 Layout and Wiring

2.3 Remote Mounted Electronics Units

Remote mounted units may be mounted up to 75 feet (22.86 m) away from the sensing probe. The maximum range is decreased by 14 pF per foot of separation. Thus, with a 75-foot (30.48 m) separation, the maximum range is decreased and limited to a maximum of 100 feet of water. A second coaxial interconnecting cable is required to compensate for thermal changes in the capacitance of the probe cable. See Figure 3 for proper coaxial cable connections.

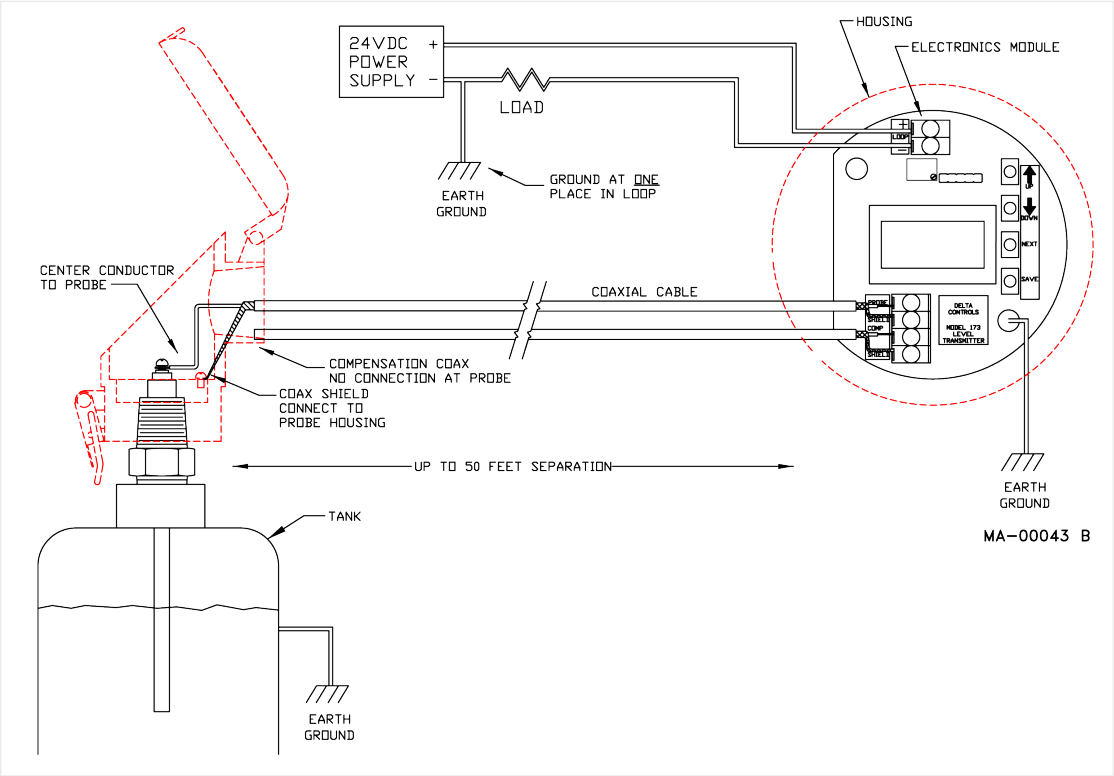


Figure 3: Model 173 Layout and Wiring

2.4 Wiring the Unit

All wiring, fusing, and hook up must be done in exact accordance with the governing code; this takes precedence over any instruction or implied method contained in this manual or other commentary provided by Delta Controls Corporation, other persons, or other organizations.

Wire the 4-20 mA connections as shown in the wiring diagram with a twisted or shielded pair. The 4-20 mA signal is isolated from earth ground. The output signal loop must be earth grounded at a single point within the loop. The Model 173 contains reverse polarity protection.

3. Operation (without HART®)

The Internal display and pushbuttons can be used to set up the 173 electronics module, but it is generally easier to set up the device using a HART communicator. The Model 173 user interface consists of an LCD display and 4 setup pushbuttons. The temperature characteristics of the display are such that the unit should only be calibrated when the ambient temperature is between +30 °F and +125 °F (0 °C to +50 °C). Beyond this temperature range, the transmitter will operate properly, but the display may be difficult to read.

3.1 Pushbuttons Used to Operate Model 173

Pushbutton	Purpose
SAVE	Pressing the SAVE button saves all calibration values. The display will indicate “Saving...” to verify that the values are being saved.
DOWN	Pressing the DOWN button causes the value displayed to be decremented. Holding the button down causes the value to continue downward at an ever increasing rate.
UP	Pressing the UP button causes the value displayed to be incremented. Holding the button down causes the value to continue upward at an ever increasing rate.
NEXT	Pressing the NEXT button shifts the display to the next setup parameter.

3.2 Setup Parameters

Parameter	Description
PV	Process Variable. Typically, this is the interface level or position on the probe, either as a length or as a percentage. It can also represent volume or other units derived from level. The units of measure are selected below.
Loop mA	The current in milliamperes being sent by the transmitter.
Loop %	The current being sent by the transmitter as a percentage, where 0 % represents 4 mA and 100% represents 20 mA.
Units	The units of measure being used for PV and the calibration points. This value can be length (in, ft, cm, mm), percent, or undefined. Undefined units would typically be selected for any other desired units (such as volume units) not mentioned above.
4 mA =	Lower Range Value - The interface level position corresponding to 4 mA. The units of measure are selected in Units above.
20 mA =	Upper Range Value - The interface level position corresponding to 20 mA. The units of measure are selected in Units above.
Num Pts	The number of calibration points to be used.
Point 1	Calibration point number one. The value for this and other Points below is in the units selected in Units above.
Point 2	Calibration point number two.
Point 3	Calibration point number three.
Point 4	Calibration point number four.
Point 5	Calibration point number five.
Point 6	Calibration point number six.
Point 7	Calibration point number seven.
Point 8	Calibration point number eight.
Point 9	Calibration point number nine.
Point10	Calibration point number ten.

The following less common parameters can be accessed by pressing and holding the NEXT button while pressing and releasing the UP button, then releasing the NEXT button.

Parameter	Description
Version	Software revision number
Input 1	This is the measured net capacitance at calibration point 1.
Input 2	This is the measured net capacitance at calibration point 2.
Input 3	This is the measured net capacitance at calibration point 3.
Input 4	This is the measured net capacitance at calibration point 4.
Input 5	This is the measured net capacitance at calibration point 5.
Input 6	This is the measured net capacitance at calibration point 6.
Input 7	This is the measured net capacitance at calibration point 7.
Input 8	This is the measured net capacitance at calibration point 8.
Input 9	This is the measured net capacitance at calibration point 9.
Input 10	This is the measured net capacitance at calibration point 10.
RANGE	Selects the maximum input range of the instrument. 0 (default) = 0 - 2000 pF, 1 = 0 - 600 pF, 2 = 0 - 200 pF. 0 is usually the most appropriate setting for desalter applications, which usually have a probe capacitance greater than 1000 pF.
DAMPING	The measurement time constant in seconds. Higher numbers provide more smoothing.
4mA TRIM	This value is used to trim the 4 mA value.
20mA TRIM	This value is used to trim the 20 mA value.
ALRM ACTN	Tells unit how the loop current behaves when internal diagnostics find a fault. 0 = drive high (above 22 mA), 1 = drive low (below 3.5 mA), 2 = hold last value, 3 =ignore fault.
HART ADDR	This is the HART address used to respond to HART command 0.
LOOP CNTRL	Used to control the current loop behavior. 0 = Loop current follows process variable, 1 = Loop current fixed at 4.00 mA (used for multidrop HART), 2 = Loop fixed; current can be manually set by adjusting the Loop mA parameter. **Note that LOOP CNTRL = 2 is used for testing only and reverts back to 0 on device reset or cycling power.**
RAW	Probe, Comp, Ref1 and Ref2 raw values are used at the factory for diagnostic purposes.
Probe	Capacitance measured at the probe terminal.
Comp	Capacitance measured at the compensation terminal.
Net	Net Capacitance (Probe-Comp). This value gets stored in the Inpnt 1-10 values during calibration.
OFFSET CAL	When set to 0, changing a calibration point only affects that point – all others are unchanged. When set to 1, changing a calibration point shifts all active calibration points by the same amount. OFFSET CAL reverts to 0 after any calibration.
BOARD TEMP	Electronics module temperature in °C. This value is only used diagnostically to evaluate circuit accuracy.
MEM CMD	Factory use only.
Up Sns Lim	Maximum capacitance that can be measured by the circuit. Value depends on RANGE parameter setting.

3.3 Calibration

Access a Parameter by pressing the NEXT button until the desired parameter is displayed.

Modify a parameter by pressing the UP or DOWN button until the desired value is displayed. Press SAVE to save changes.

Calibration points can be entered in any order. When SAVE is pressed, the instrument automatically sorts the calibration points in order of increasing level.

Calibration points can be anywhere on the sensing probe, but for best results, should be as widely separated as possible. For typical interface position measurement, only two points of calibration are needed. For more unusual needs, such as to account for nonlinearities due to tank geometry, up to 10 calibration points can be entered. Again, they should be as widely separated as possible.

To remove a calibration point: Access the point. Press and Hold the DOWN button and press the NEXT button. The display will indicate “DELETED”. Deleting a point will reduce the value of Num Pts by one.

> **NOTE**
> There must be at least two calibration points, so a point can only be deleted if Num Pts is greater than 2.

To remove all calibration points and reset the unit to factory default conditions, do the following: Press and hold NEXT, press and release UP, DOWN, and SAVE in that order.

Calibration Procedure:

A. Press “NEXT” until the UNITS parameter is displayed. Press “UP” or “DOWN” to select the desired units of measure. Then Press “SAVE”.

B. Press “NEXT” until the Num Pts parameter is displayed. Modify the parameter as desired for the number of calibration points you will be using. (Usually, the minimum value of 2 is set here.)

C. Press the “NEXT” button until calibration point 1 is shown on the display.

D. Press the “UP” or “DOWN” push button until the process value corresponding to the current interface position, appears on the display.

E. Press “SAVE” to hold this value in memory.

F. Change the level as much as practical. Generally, at least a 20% of full-scale change should be made. The more change made, the better the resulting calibrated accuracy will be.

G. Press the “NEXT” button until calibration point #2 is shown on the display.

H. Press the “UP” or “DOWN” pushbuttons until the percent of output signal value, corresponding to the current interface position, appears on the display.

I. Press “SAVE” to hold that value in memory.

J. Repeat steps F through I for up to 10 calibration points.

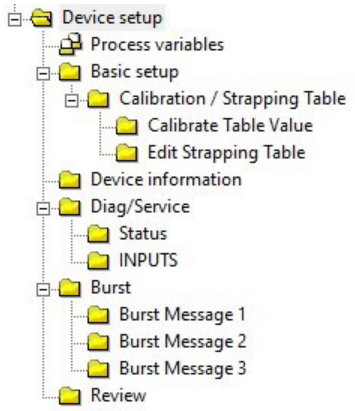
K. Calibration is now complete. Push “NEXT” until the Process Variable is displayed.

4. Operation with a HART® Communicator

Complete control of all transmitter operating parameters are accessible through the use of a HART® communicator. HART® Device Definition files are available on the Delta Controls website, www.deltacnt.com. See document 00-17335 for complete field device specifications.

4.1 Menus

Device Setup Menu:



Process Variables Menu:

Value	Description
PV	The process variable being transmitted.
PV Loop Current	The current in mA being transmitted.
PV Range	The process variable being transmitted as a number between 0% to 100%.
PV URV	Process Variable Upper Range Value — The PV value corresponding to 20 mA. Shown on this menu for indication only—use the Basic Setup menu to change this value.
PV LRV	Process Variable Lower Range Value — The PV value corresponding to 4 mA. Shown on this menu for indication only—use the Basic Setup menu to change this value.
PV PDQ	Data quality of the measured value.
Status Indicator	**Description**
Probe Overrange	Typically either the probe is shorted or the measured capacitance is greater than the maximum range of measurement. Try reducing the Range parameter.
Comp Overrange	Typically either the comp coax is shorted or too long. Try reducing the Range parameter.
Ref1 Out of Range	Internal error has occurred.
Ref2 Out of Range	Internal error has occurred.
Temp Out of Range	Board temperature is outside of the range required for measurement accuracy.
Maintenance Required	Internal diagnostics have detected a problem in the transmitter.
Device Variable Alert	Internal diagnostics have detected a problem that could render the measurement invalid.
Process applied to the Primary Variable is outside operating limits of the field device	Typically, either the probe is shorted or the measured capacitance is greater than the maximum range of measurement

Status Indicator, continued	Description, continued
PV Analog Channel Saturated	The calculated output current is greater than 21 mA or less than 3.9 mA.
PV Analog Channel Fixed	The 4 mA - 20 mA channel is held constant and is not responding to changes in measurement.
Field Device has more status available	HART® 'more status available' bit is set.
A reset or self test of the field device has occurred, or power has been removed and reapplied	Alert triggered by reset, self-test, or power loss.
A modification has been made to the field device	Some parameter has been changed.
Field device has malfunctioned due to a hardware error or failure	Alert triggered by detected hardware malfunction or failure.

Basic Setup Menu:

Value	Description
Process Variable Units	Units of measure being used for PV and the calibration points. This value can be length (in, ft, cm, mm), percent, or undefined. Undefined units would typically be selected for any other desired units (such as volume units) not mentioned above.
PV URV	Process Variable Upper Range Value – The value corresponding to 20 mA.
PV LRV	Process Variable Lower Range Value – The value corresponding to 4 mA.
PV Damp	Measurement damping time constant in seconds.
Loop Current Mode	When enabled, loop current responds to changes in level measurement. When disabled, loop current is fixed at 4 mA. Set this to 'Disabled' for multidrop applications.
PV Alarm Type	Programs the transmitter behavior when an internal failure is detected. 0 – Disregard the error, and attempt to output the process variable. 1 - Hi – drive the 4–20 mA output to 22 mA. 2 - Lo – drive the 4–20 mA output to 3.8 mA. 3 - Hold – hold the 4–20 mA output at the last known good reading.
Input Range	Selects the maximum input range of the instrument. 0 (default) = 0-2000pF, 1 = 0-600pF, 2 = 0-200pF.

Device Information Menu:

Value	Description
Manufacturer	Delta Controls Corporation
Model	173
Universal Rev	HART® Revision
Fld Dev Rev	Field Device Revision
Software Rev	Version of software running on the transmitter.
Hardware Rev	Hardware revision of the transmitter.
Dev ID	Unique transmitter identifier.
Maximum number of device variables	#
Number of required preamble characters	#
Cfg Chg Count	Number of configuration changes that have occurred.
Poll Addr	HART® polling address.
Tag	User identifying information.
Long Tag	User identifying information.
Date	User date field - Enter with any date desired such as last calibration date or date of installation. This date is for storage only and does not change until updated.
Descriptor	User identifying information.
Message	User information.
Final Assembly Num	User information.

Diag/Service Menu:

Value	Description
Status	Displays the status values previously described on the Process Variables Menu.
Device Reset	Use to restart the transmitter as if power were removed and reapplied.
Squawk	Use to verify which transmitter in a multidrop installation is being addressed. Causes a rectangle to briefly appear around the LCD display of the unit being squawked.
Loop Test	Loop test is used to force the 4 mA – 20 mA output to a fixed desired current. The current will return to normal operation following a power failure or device reset.
D/A Trim	Use to calibrate the 4 mA - 20 mA output if a measurement discrepancy is found between the reported current output and the measured current output.
Inputs	Menu used for troubleshooting transmitter malfunctions. The menu reports the raw inputs from the sensor.

Burst Menu:

The transmitter support 3 standard HART® Burst messages.

Review Menu:

Displays a summary of device information

4.2 Transmitter Setup using HART®

A. Access the Basic Setup menu.

B. Set the PV Units Parameter to the desired units.

C. Set the PV URV to the value corresponding to 20 mA.

D. Set the PV LRV to the value corresponding to 4 mA.

4.3 Probe Calibration with a HART® Communicator

A. Access the Calibration / Strapping Table menu.

B. Set the Number of Calibration Points parameter to the desired number of calibration points to be used. (Usually, the minimum value of 2 is set here.)

C. Select “Calibrate Table Value”.

D. Set “Table Entry to Update” to 1.

E. Select “Calibrate Table Entry”.

F. Measure the actual level in the vessel and enter that measured PV value.

G. Change the level as much as practical. Generally, at least a 20% of full-scale change should be made. The more change made, the better the resulting calibrated accuracy will be.

H. On the Calibrate Table Value menu, set the Table Entry to Update to 2, and select Calibrate Table Entry.

I. Measure the actual level in the vessel and enter that measured PV value.

J. Repeat steps G through I for the remaining number of calibration points.

K. Calibration is now complete.

4. Troubleshooting

Visually inspect the unit for mechanical defects such as broken wires, etc.

Check to see that supply power is provided. There must be 11-35v at the loop terminals.

If the display is blank and power is okay, the module must be replaced.

The unit performs a self-test on power up. If the unit says “Testing Bad” during this self-test, the unit must be replaced.

If the unit passes the self-test, any remaining problems are probably in the probe (shorted probe, open probe wire), the Comp cable (shorted or open), or in the grounding of the unit (see proper grounding on the wiring diagram).

If these items seem okay, try re-calibrating the unit.

5. Specifications

Level Span:	10 pF minimum
Minimum Level Span:	10 pF
Maximum Range:	2000 pF
Zero Suppression:	to 1900 pF
HART:	4-20 mA DC, 2 wire, loop powered, isolated
Loop Supply Voltage Range:	14 VDC to 35 VDC
Maximum Loop Impedance:	450 ohms @ 24 V, 950 ohms @ 35 V
Accuracy and Stability:	Within 0.2% of full scale.
Ambient Operating Temperature:	-20 °F to +175 °F (-29 °C to +79 °C)
Temperature Effect (0 °F to +150 °F):	0.1 pF; typically less than 0.1 inch in water.

6. Model Numbering System

MODEL EXAMPLE	MODEL	-	HOUSING RATING	-	MOUNTING LOCATION	-	OPTIONS [1]
	173	-	7WI	-	AA	-	AA

MODEL	DESCRIPTION
173	Capacitance Level Transmitter, Loop Powered, Digital Circuitry

HOUSING RATING	DESCRIPTION
AA	None
4XI	Environment-proof, 4X, PVC, integral mount
4XR	Environment-proof, 4X, PVC, remote mount
7WI	Explosion-proof, 7X, aluminum, Classes 1 & 2, Divisions 1 & 2, Groups BCD, EFG, integral mount
7WR	Explosion-proof, 7X, aluminum, Classes 1 & 2, Divisions 1 & 2, Groups BCD, EFG, remote mount
7TI	Explosion-proof, 7X, 300 Stainless Steel, Classes 1 & 2, Divisions 1 & 2, Groups BCD, EFG, integral mount
7TR	Explosion-proof, 7X, 300 Stainless Steel, Classes 1 & 2, Divisions 1 & 2, Groups BCD, EFG, remote mount

MOUNTING LOCATION [2]	DESCRIPTION
AA	None (integral)
**P	** feet of interconnecting cable for remote mounting, includes sensor and compensation cable, 160 °F (71 °C), PVC [2]
**D	** feet of interconnecting cable for remote mounting, includes sensor and compensation cable, 400 °F (204 °C), FEP [2]

OPTIONS [1-2]	DESCRIPTION
AA	None
PS1	Internal power supply, 120 ACV to 24 DCV
PSM	Housing mounting bracket for remote mounting; surface or 2 in pipe mounting [2]

Notes:

[1] A hyphen will separate multiple options selected

[2] PSM **P, **D only available with remote mount housing

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