

# Fisher™ FIELDVUE™ DLC3020f Digital Level Controller for FOUNDATION™ fieldbus

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This quick start guide applies to:

Device Type	3020
Device Revision	1
Hardware Revision	1.0
Firmware Revision	1.0
DD Revision	0x03



### Note

This guide provides installation, setup and calibration information for the DLC3020f digital level controller using AMS Suite: Intelligent Device Manager. For all other information on this product, including reference materials, maintenance procedures and replacement parts details, refer to the DLC3020f Instruction Manual ([D103434X012](#)). If a copy of this document is required, contact your Emerson sales office or Local Business Partner, or go to [Fisher.com](#).

## Installation

### **⚠ WARNING**

To avoid personal injury or property damage, always wear protective gloves, clothing, and eyewear when performing any installation operations.

Personal injury or property damage due to sudden release of pressure, contact with hazardous fluid, fire, or explosion can be caused by puncturing, heating, or repairing a displacer that is retaining process pressure or fluid. This danger may not be readily apparent when disassembling the sensor or removing the displacer. Before disassembling the sensor or removing the displacer, observe the appropriate warnings provided in the sensor instruction manual.

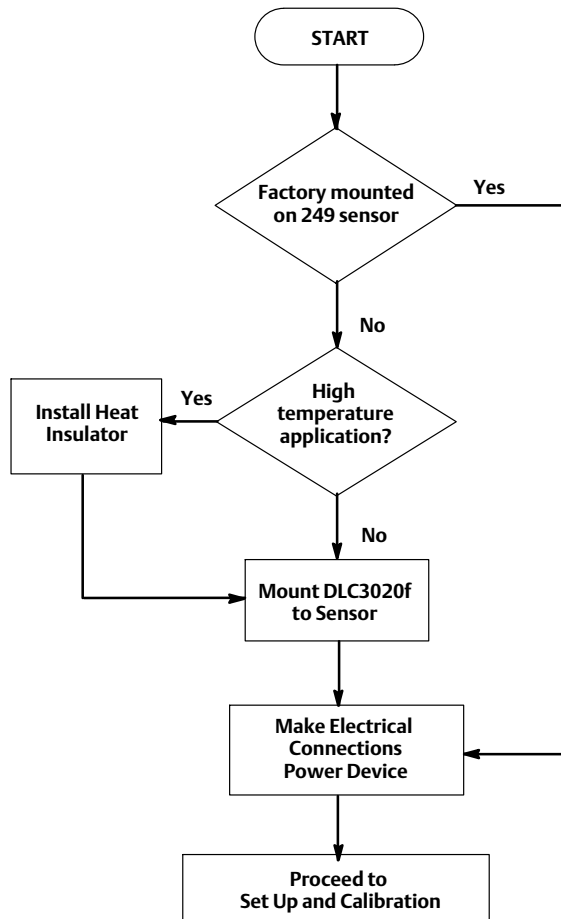
Check with your process or safety engineer for any additional measures that must be taken to protect against process media.

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Do not install, operate, or maintain a DLC3020f digital level controller without being fully trained and qualified in field instrument and accessory installation, operation, and maintenance. To avoid personal injury or property damage, it is important to carefully read, understand, and follow all of the contents of this manual, including all safety cautions and warnings. If you have any questions regarding these instructions contact your [Emerson sales office](#) or Local Business Partner before proceeding.

Refer to figure 1 for the installation flow chart.

Figure 1. Installation Flowchart



## Configuration: On the Bench or in the Field

Configure the digital level controller before or after installation in the field.

It may be useful to configure the instrument on the bench before installation to ensure proper operation, and to familiarize yourself with its functionality.

## Protecting the Coupling and Flexures

### CAUTION

Damage to flexures and other parts can cause measurement errors. Observe the following steps before moving the sensor and controller.

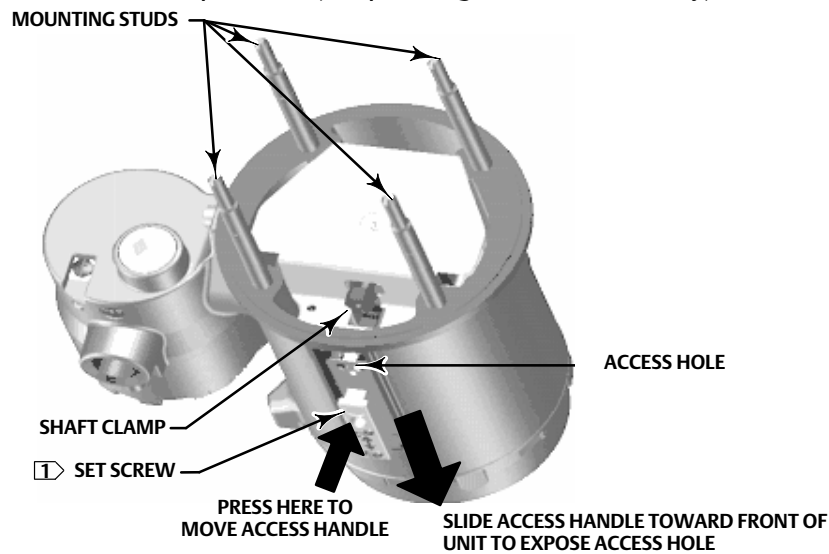
## Lever Lock

The lever lock is built in to the coupling access door. When the door is open, it positions the lever in the neutral travel position for coupling. In some cases, this function is used to protect the lever assembly from violent motion during shipment.

A DLC3020f digital level controller will have one of the following mechanical configurations when received:

1. A fully assembled and coupled caged-displacer system shipped with the displacer or driver rod blocked within the operating range by mechanical means. In this case, the access handle (figure 2) will be in the unlocked position. Remove the displacer blocking hardware before calibration (see the appropriate sensor instruction manual). The coupling should be intact.

Figure 2. Sensor Connection Compartment (Adapter Ring Removed for Clarity)



NOTE:  
 1 SET SCREW IS USED TO LOCK THE LEVER IN PLACE FOR OPERATION

### CAUTION

When shipping an instrument mounted on a sensor, if the lever assembly is coupled to the linkage, and the linkage is constrained by the displacer blocks, use of the lever lock may result in damage to bellows joints or flexure.

2. If the displacer cannot be blocked because of cage configuration or other concerns, the transmitter is uncoupled from the torque tube by loosening the coupling nut, and the access handle will be in the locked position. Before placing such a configuration into service, couple the instrument to the sensor as follows:
  - a. Slide the access handle to the open position to lock the lever assembly in place and expose the access hole. Press on the back of the handle as shown in figure 2 then slide the handle toward the front of the unit. Be sure the locking handle drops into the detent.
  - b. If in process, ensure that the level or interface is in the lowest position on the displacer.
  - c. If on the bench, ensure that the displacer is dry and the displacer rod lever arm is not hitting a travel stop.
  - d. Insert a 10 mm deep well socket through the access hole and onto the torque tube shaft clamp nut. Tighten the clamp nut to a maximum torque of 2.1 N•m (18 lbf•in).
  - e. Slide the access handle to the closed position for operation or calibration. (Press on the back of the handle as shown in figure 2 then slide the handle toward the rear of the unit.) Be sure the locking handle drops into the detent.

## Hazardous Area Classifications and Special Instructions for “Safe Use” and Installation in Hazardous Locations

Certain nameplates may carry more than one approval, and each approval may have unique installation/wiring requirements and/or conditions of “safe use”. These special instructions for “safe use” are in addition to, and may override, the standard installation procedures. Special instructions are listed by approval.

### **⚠ WARNING**

**Failure to follow these conditions of “safe use” could result in personal injury or property damage from fire or explosion, and area re-classification.**

#### Note

This information supplements the nameplate markings affixed to the product.

Always refer to the nameplate itself to identify the appropriate certification. Contact your [Emerson sales office](#) or Local Business Partner for approval/certification information not listed here.

### CSA

#### Intrinsically Safe, Explosion-proof, Division 2, Dust Ignition-proof

No special conditions for safe use.

Refer to table 1 for approval information.

Table 1. Hazardous Area Classifications—CSA (Canada)

Certification Body	Certification Obtained	Entity Rating		Temperature Code
CSA	Intrinsically Safe Class I, II, III Division 1 Groups A,B,C, D,E,F,G T4 per drawing GE37118 (see figure 20)	Fieldbus		T4 (Tamb ≤ 80°C)
		RTD Terminals Voc = 6.6 VDC Isc = 29.5 mA Po = 49 mW Ca = 22 μF La = 40 mH	Main Circuit Terminals Vmax = 24 VDC Imax = 380 mA Pi = 1.4 W Ci = 5 nF Li = 0.55 mH	
		FISCO		
		RTD Terminals Voc = 6.6 VDC Isc = 29.5 mA Po = 49 mW Ca = 22 μF La = 40 mH	Main Circuit Terminals Vmax = 17.5 VDC Imax = 380 mA Pi = 5.32 W Ci = 5 nF Li = 0 mH	
	Explosion-proof Class I Division 1 Groups B,C,D T6	---	---	T6 (Tamb ≤ 80°C)
	Class I Division 2 Groups A,B,C,D T6	---	---	T6 (Tamb ≤ 80°C)
Dust Ignition-proof Class II Division 1,2 Groups E,F,G T6	---	---	T6 (Tamb ≤ 80°C)	
Class III	---	---	T6 (Tamb ≤ 80°C)	

FM

Intrinsically Safe, Explosion-proof, Non-Incendive, Dust Ignition-proof

No special conditions for safe use.

Refer to table 2 for approval information.

Table 2. Hazardous Area Classifications—FM (United States)

Certification Body	Certification Obtained	Entity Rating		Temperature Code
FM	Intrinsically Safe Class I, II, III Division 1 Groups A,B,C, D,E,F,G T4 per drawing GE37117 (see figure 22)	Fieldbus		T4 (Tamb ≤ 80°C)
		RTD Terminals Voc = 6.6 VDC Isc = 29.5 mA Po = 49 mW Ca = 22 μF La = 40 mH	Main Circuit Terminals Vmax = 24 VDC Imax = 380 mA Pi = 1.4 W Ci = 5 nF Li = 0.55 mH	
		FISCO		
		RTD Terminals Voc = 6.6 VDC Isc = 29.5 mA Po = 49 mW Ca = 22 μF La = 40 mH	Main Circuit Terminals Vmax = 17.5 VDC Imax = 380 mA Pi = 5.32 W Ci = 5 nF Li = 0 mH	
	Explosion-proof Class I Division 1 Groups A,B,C,D T5	---	---	T5 (Tamb ≤ 80°C)
Non-Incendive Class I,II,III Division 2 Groups A,B,C,D, E,F,G T4	---	---	T4 (Tamb ≤ 80°C)	
Dust Ignition-proof Class II Division 1 Groups E,F,G T5	---	---	T5 (Tamb ≤ 80°C)	

## ATEX

### Special Conditions for Safe Use

#### Intrinsically Safe

This apparatus can only be connected to an intrinsically safe certified equipment and this combination must be compatible regarding the intrinsic safety rules (see electrical parameters in table 3).

#### Flameproof, Type n

No special conditions for safe use.

Refer to table 3 for additional approval information.

Table 3. Hazardous Area Classifications—ATEX

Certification	Certification Obtained	Entity Rating		Temperature Code
		Fieldbus	FISCO	
ATEX	Ⓢ II 1 G D Intrinsically Safe Ex ia IIC T5/T6 Ga Dust Ex ia IIIC T87°C (Tamb ≤ 80°C), T80°C (Tamb ≤ 73°C) Da IP66	Ui ≤ 24 V li ≤ 380 mA Pi ≤ 1.4 W Ci ≤ 5 nF Li = 0 mH	Ui = 17.5 V li = 380 mA Pi = 5.32 W Ci = 5 nF Li = 0 mH	T5 (Tamb ≤ 80°C) T6 (Tamb ≤ 73°C)
	Ⓢ II 2 G D Flameproof Ex d IIC T5/T6 Gb Dust Ex t IIIC T87°C (Tamb ≤ 80°C), T80°C (Tamb ≤ 73°C) Db IP66	---	---	T5 (Tamb ≤ 80°C) T6 (Tamb ≤ 73°C)
	Ⓢ II 3 G D Type n Ex nA IIC T5/T6 Gc Dust Ex t IIIC T87°C (Tamb ≤ 80°C), T80°C (Tamb ≤ 73°C) Dc IP66	---	---	T5 (Tamb ≤ 80°C) T6 (Tamb ≤ 73°C)



## IECEX

### Conditions of Certification

#### Intrinsically Safe

This apparatus shall only be connected to an intrinsically safe certified equipment and this combination must be compatible regarding the intrinsic safety rules (see electrical parameters in table 4).

#### Flameproof, Type n

No conditions of certification.

Refer to table 4 for additional approval information.

Table 4. Hazardous Area Classifications—IECEX

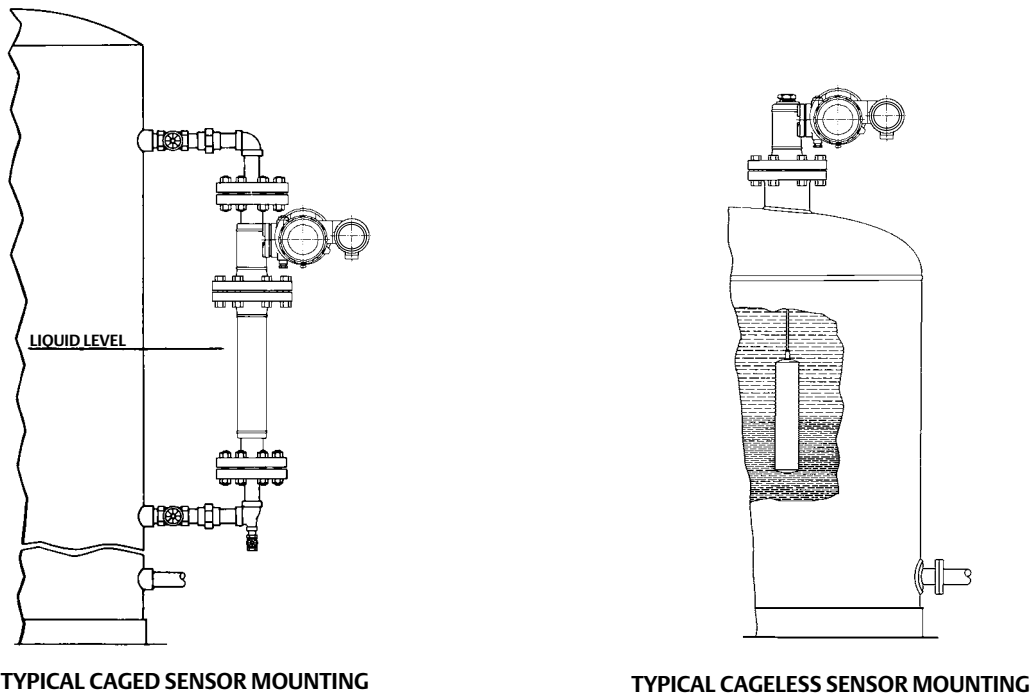
Certification	Certification Obtained	Entity Rating		Temperature Code
		Fieldbus	FISCO	
IECEX	Intrinsically Safe Ex ia IIC T5/T6 Ga Dust Ex ia IIIC T87°C (Tamb ≤ 80°C), T80°C (Tamb ≤ 73°C) Da IP66	Ui = 24 V Ii = 380 mA Pi = 1.4 W Ci = 5 nF Li = 0 mH	Ui = 17.5 V Ii = 380 mA Pi = 5.32 W Ci = 5 nF Li = 0 mH	T5 (Tamb ≤ 80°C) T6 (Tamb ≤ 73°C)
	Flameproof Ex d IIC T5/T6 Gb Dust Ex t IIIC IP66 T87°C (Tamb ≤ 80°C), T80°C (Tamb ≤ 73°C) Db	---	---	T5 (Tamb ≤ 80°C) T6 (Tamb ≤ 73°C)
	Type n Ex nA IIC T5/T6 Gc	---	---	T5 (Tamb ≤ 80°C) T6 (Tamb ≤ 73°C)

## Mounting

### Mounting the 249 Sensor

The 249 sensor is mounted using one of two methods, depending on the specific type of sensor. If the sensor has a caged displacer, it typically mounts on the side of the vessel as shown in the left image in figure 3. If the sensor has a cageless displacer, the sensor mounts on the side or top of the vessel as shown in the right image in figure 3.

Figure 3. Typical Mounting



The DLC3020f digital level controller is typically shipped attached to the sensor. If ordered separately, it may be convenient to mount the digital level controller to the sensor and perform the initial setup and calibration before installing the sensor on the vessel.

#### Note

Caged sensors have a rod and block installed on each end of the displacer to protect the displacer in shipping. Remove these parts before installing the sensor to allow the displacer to function properly.

## DLC3020f Orientation

Mount the DLC3020f with the torque tube shaft clamp access hole (see figure 2) pointing downward to allow accumulated moisture drainage.

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### Note

If alternate drainage is provided by the user, and a small performance loss is acceptable, the instrument could be mounted in 90 degree rotational increments around the pilot shaft axis. The LCD meter may be rotated in 90 degree increments to accommodate this.

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The digital level controller and torque tube arm are attached to the sensor either to the left or right of the displacer, as shown in figure 4. This can be changed in the field on the 249 sensors (refer to the appropriate sensor instruction manual). Changing the mounting also changes the effective action, because the torque tube rotation for increasing level, (looking at the protruding shaft), is clockwise when the unit is mounted to the right of the displacer and counter-clockwise when the unit is mounted to the left of the displacer.

All 249 caged sensors have a rotatable head. That is, the digital level controller can be positioned at any of eight alternate positions around the cage as indicated by the position numbers 1 through 8 in figure 4. To rotate the head, remove the head flange bolts and nuts and position the head as desired.

## Mounting the DLC3020f on a 249 Sensor

Refer to figure 2 unless otherwise indicated.

1. If the set screw in the access handle (figure 5) is driven against the spring plate, back it out until the head is flush with the outer surface of the handle, using a 2 mm hex key. Slide the access handle to the open position to lock the lever assembly in place and to expose the access hole. Press on the back of the handle as shown in figure 2 then slide the handle toward the front of the unit. Be sure the locking handle drops into the detent.
2. Using a 10 mm deep well socket inserted through the access hole, loosen the shaft clamp (figure 2).
3. Remove the hex nuts from the mounting studs. Do not remove the adapter ring.

### **CAUTION**

**Measurement errors can occur if the torque tube assembly is bent or misaligned during installation.**

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Figure 4. Typical Mounting Positions for the FIELDVUE DLC3020f Digital Level Controller on a Fisher 249 Sensor

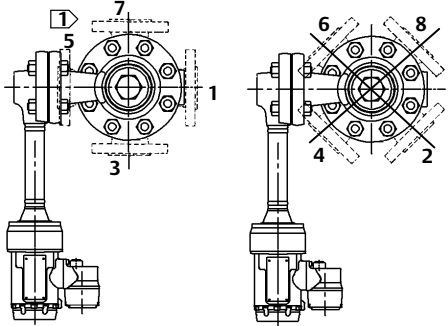
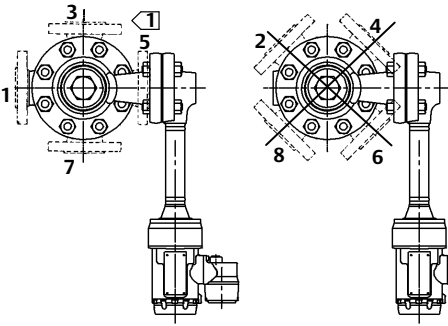
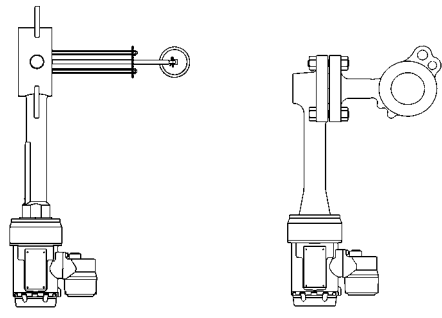
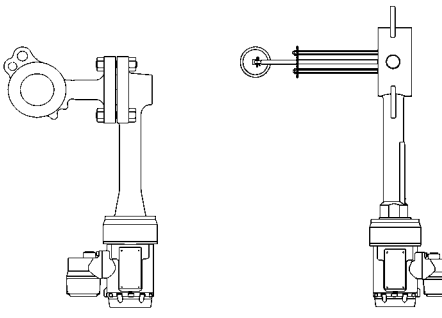
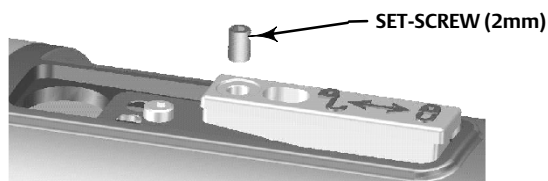
SENSOR	LEFT-OF-DISPLACER	RIGHT-OF-DISPLACER
CAGED		
CAGELESS	 <p style="text-align: center;">249VS                      249W</p>	 <p style="text-align: center;">249W                      249VS</p>
<p>1 NOT AVAILABLE FOR SIZE NPS 2 CL300 AND CL600 249C SENSOR.</p>		

Figure 5. Close-up of Set-Screw



4. Position the digital level controller so the access hole is on the bottom of the instrument.
5. Carefully slide the mounting studs into the sensor mounting holes until the digital level controller is snug against the sensor mounting flange.
6. Reinstall the hex nuts on the mounting studs and tighten the hex nuts to 10 N•m (88.5 lbf•in).

## Mounting the DLC3020f for High Temperature Applications

Refer to figure 6 for parts identification except where otherwise indicated.

The digital level controller requires an insulator assembly when temperatures exceed the limits shown in figure 7.

A torque tube shaft extension is required for a 249 sensor when using an insulator assembly.

Figure 6. Digital Level Controller Mounting on Sensor in High Temperature Applications

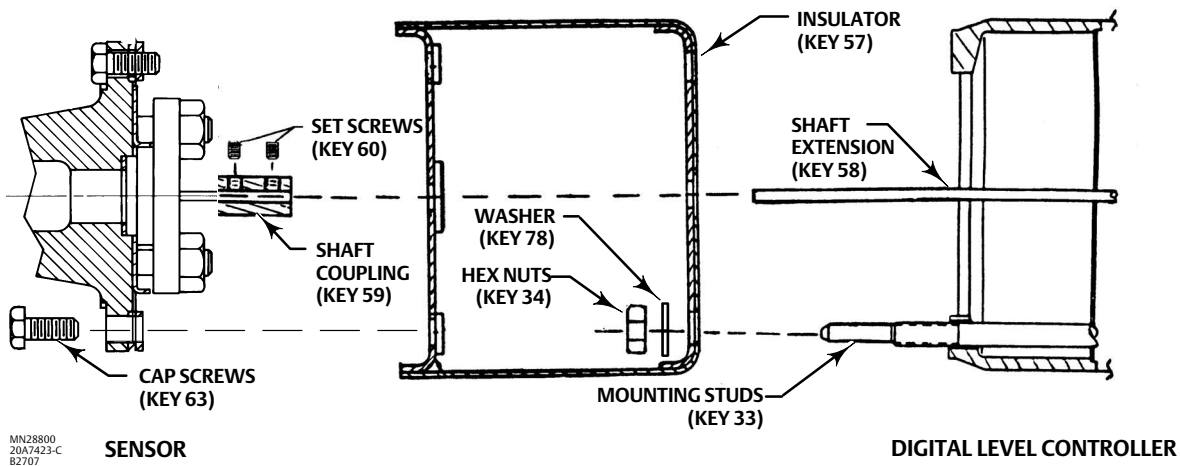
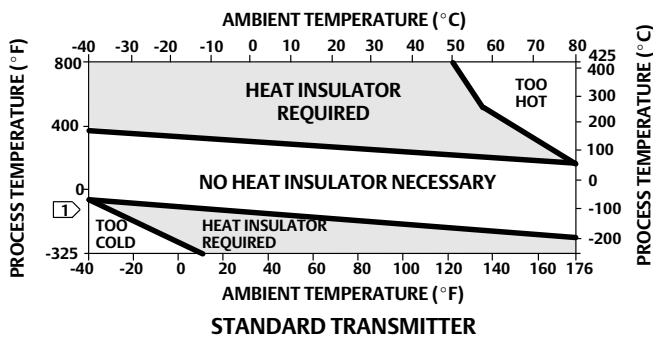


Figure 7. Guidelines for Use of Optional Heat Insulator Assembly



NOTES:  
 1. FOR PROCESS TEMPERATURES BELOW -29°C (-20°F) AND ABOVE 204°C (400°F) SENSOR MATERIALS MUST BE APPROPRIATE FOR THE PROCESS - SEE TABLE 9.  
 2. IF AMBIENT DEW POINT IS ABOVE PROCESS TEMPERATURE, ICE FORMATION MIGHT CAUSE INSTRUMENT MALFUNCTION AND REDUCE INSULATOR EFFECTIVENESS.

39A4070-B  
 A5494-1

### CAUTION

Measurement errors can occur if the torque tube assembly is bent or misaligned during installation.

1. When mounting a DLC3020f on a 249 sensor, secure the shaft extension to the sensor torque tube shaft via the shaft coupling and set screws, with the coupling centered as shown in figure 6.
2. Slide the access handle to the locked position to expose the access hole. Press on the back of the handle as shown in figure 2 then slide the handle toward the front of the unit. Be sure the locking handle drops into the detent.
3. Remove the hex nuts from the mounting studs.
4. Position the insulator on the digital level controller, sliding the insulator straight over the mounting studs.
5. Install 4 washers (key 78) over the studs. Install the four hex nuts and tighten.
6. Carefully slide the digital level controller with the attached insulator over the shaft coupling so that the access hole is on the bottom of the digital level controller.
7. Secure the digital level controller and insulator to the torque tube arm with four cap screws.
8. Tighten the cap screws to 10 N•m (88.5 lbf•in).

## Electrical Connections

The following describes how to make fieldbus connections to the digital level controller.

### **⚠ WARNING**

**To avoid personal injury resulting from electrical shock, do not exceed the maximum input voltage specified in table 8 or on the product nameplate. If the input voltage specified differs, do not exceed the lowest specified maximum input voltage.**

### **⚠ WARNING**

**Select wiring and/or cable glands that are rated for the environment of use (such as hazardous area, ingress protection and temperature). Failure to use properly rated wiring and/or cable glands can result in personal injury or property damage from fire or explosion**

**Wiring connections must be in accordance with local, regional, and national codes for any given hazardous area approval. Failure to follow the local, regional, and national codes could result in personal injury or property damage from fire or explosion.**

**Personal injury or property damage caused by fire or explosion may occur if this connection is attempted in a potentially explosive atmosphere or in an area that has been classified as hazardous. Confirm that area classification and atmosphere conditions permit the safe removal of the terminal box cover before proceeding**

## Fieldbus Connections

The digital level controller is normally powered over the bus from a fieldbus 9 to 32 volt power supply and can be connected to the segment using field wiring. Refer to the site preparation guide for proper wire types, termination, length, etc. for a fieldbus segment.

### **Note**

As shipped from the factory, the DLC3020f will have the transducer block mode set Out of Service. See the Configuration section for information on setup and calibration and placing the instrument in service. The initial value for all blocks are shown in the parameter list for each block in the Blocks section.

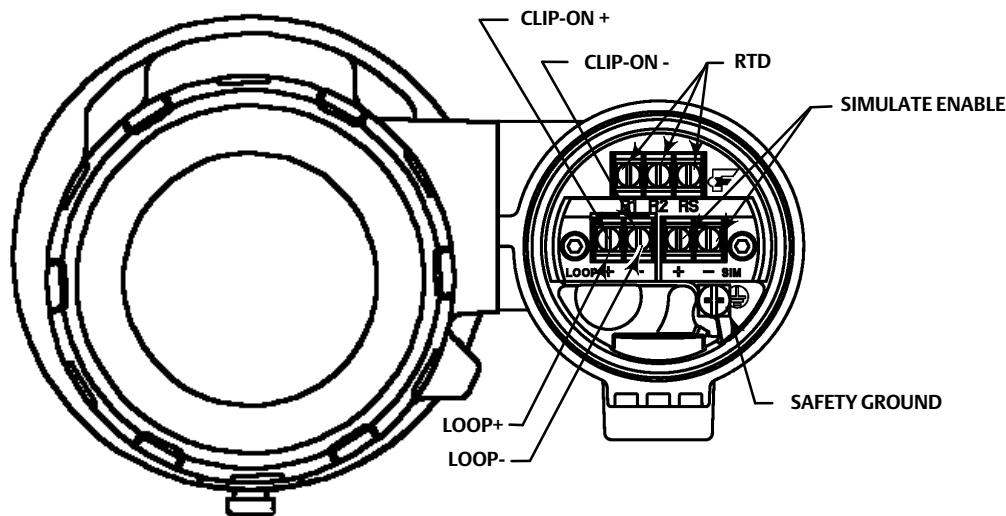
1. Remove the terminal box cover (key 6) from the terminal box (key 5).
2. Bring the field wiring into the terminal box. When applicable, install conduit using local and national electrical codes which apply to the application.
3. Connect one wire from the control system output card to the LOOP + terminal in the terminal box as shown in figure 8. Connect the other wire from the control system output card to the LOOP - terminal. The instrument is not polarity sensitive.

**⚠ WARNING**

Personal injury or property damage, caused by fire or explosion, can result from the discharge of static electricity. Connect a 14 AWG (2.08 mm<sup>2</sup>) ground strap between the digital level controller and earth ground when flammable or hazardous gases are present. Refer to national and local codes and standards for grounding requirements.

4. As shown in figure 8, ground terminals are available for connecting a safety ground, earth ground, or drain wire. The safety ground terminal is electrically identical to the earth ground. Make connections to these terminals following national and local codes and plant standards.
5. Replace and tighten the terminal box cover, ensuring that it is weather-tight; engage the optional set screw lock if required.

Figure 8. Terminal Box Assembly



## Communication Connections

### **⚠ WARNING**

Personal injury or property damage caused by fire or explosion may occur if this connection is attempted in a potentially explosive atmosphere or in an area that has been classified as hazardous. Confirm that area classification and atmosphere conditions permit the safe removal of the terminal box cap before proceeding.

### **Note**

Host system device manager interfaces, such as Emerson's AMS Device Manager or the Field Communicator communicate directly with the device.

A FOUNDATION fieldbus communicating device, such as a Field Communicator, interfaces with the DLC3020f from any wiring termination point in the segment. If you choose to connect the fieldbus communicating device directly to the instrument, attach the device to the LOOP + / - clip-on connections inside the terminal box to provide local communications with the instrument.

## Accessing Configuration and Calibration Procedures

Navigation paths for Configuration and Calibration procedures are included for both AMS Device Manager and the Field Communicator.

For example, to access *Guided Calibrations*:

AMS Device Manager	Configure > Calibrate > Guided Calibrations
Field Communicator	Configure > Calibrate > Full Calibration (Bench) <i>or</i> Full Calibration (Field)

Menu selections are shown in italics, e.g., *Full Calibration (Field)*.



# Configuration

## Note

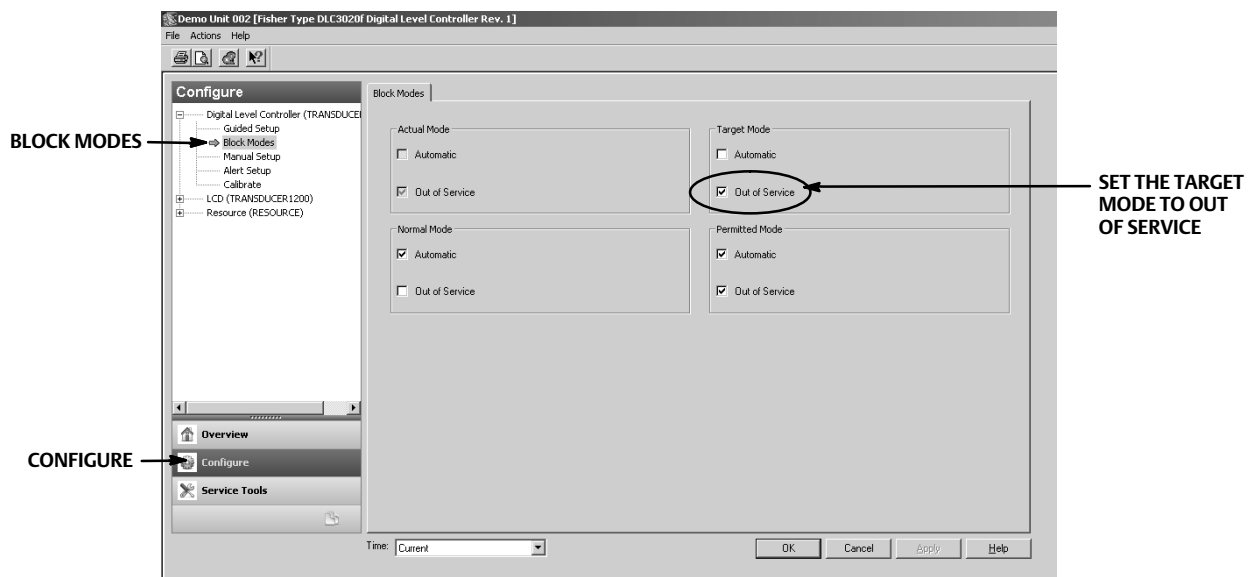
This quick start guide documents procedures in AMS Device Manager 10.5 and later. Earlier versions of AMS Device Manager contain the same procedures and methods, but access is through the block in which they reside.

## Note

The primary transducer block must be set to out of service before the device can be configured.

When using AMS Device Manager 10.1 and earlier go to Target Mode in Block Modes tab to set the primary transducer block in and out of service. Refer to figure 9.

Figure 9. Block Modes Tab (AMS Device Manager 10.1 and earlier)

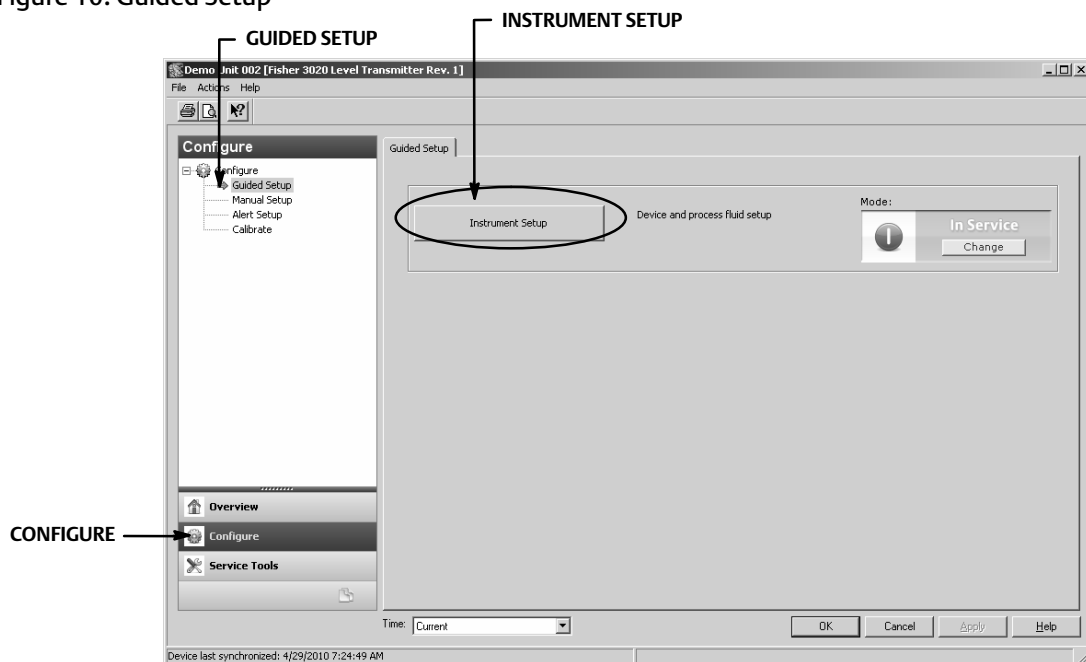


## Guided Setup

AMS Device Manager	Configure > Guided Setup
Field Communicator	Configure > Instrument Setup

Access *Instrument Setup* from the Guided Setup tab, as shown in figure 10, for sensor, device and process fluid setup. Follow the prompts to setup the DLC3020f.

Figure 10. Guided Setup



## Manual Setup

AMS Device Manager	Configure > Manual Setup
Field Communicator	Configure > Manual Setup

The *Device*, *Process Fluid*, *Instrument Display*, *Snap Acting Control*, and *Options* tabs are accessible through Manual Setup.

### Note

An error will be generated if the instrument is put back in service without applying device configuration changes; you must apply changes before putting the instrument back In Service. To clear an error, set the Mode to Out of Service, select Apply, then put back In Service.

## Device

Select the Device tab (figure 11) to access *Variable Configuration*, *Sensor Limits*, *Sensor Hardware Information*, *Sensor Units*, *Mode*, *Sensor Parameters*, *Instrument Mount Position*, and *Torque Tube*.

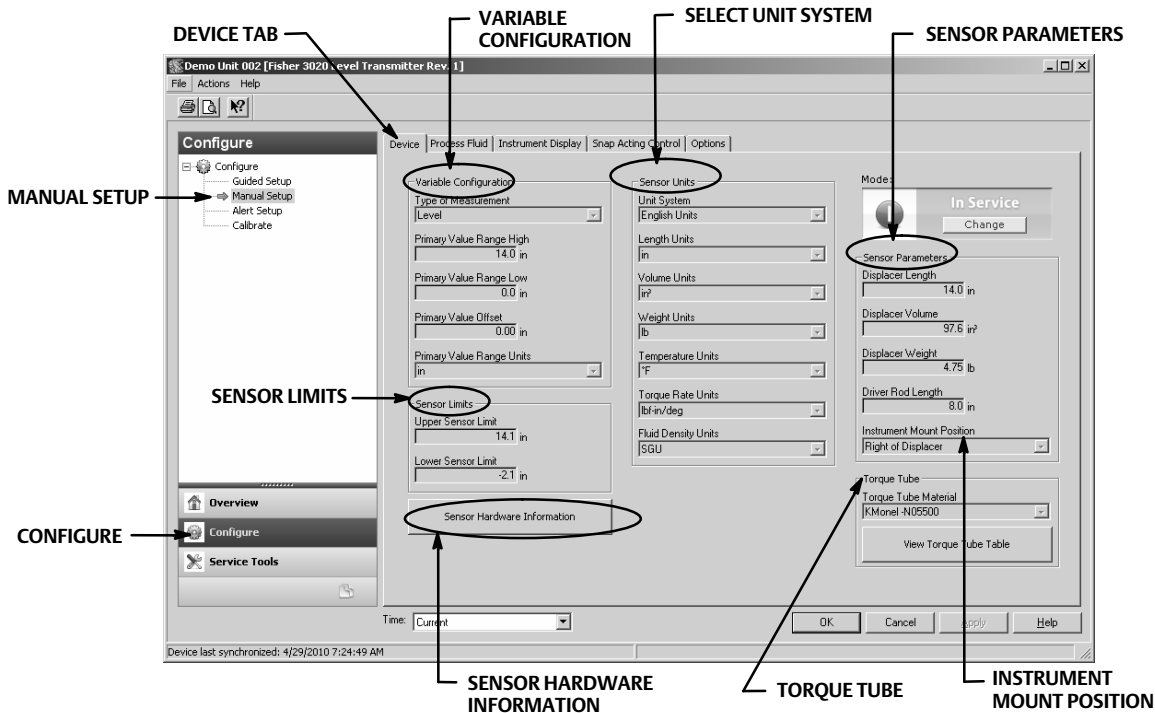
### Variable Configuration

*Type of Measurement*— Level or Interface

*Primary Value Range High*— defines the maximum operational end point for reported PV.

*Primary Value Range Low*— defines the minimum operational end point for reported PV. Default is above zero.

Figure 11. Configure > Manual Setup > Device



*Primary Value Offset*— the constant offset applied to the level/interface measurement.

*Primary Value Range Units*— units for PV, PV Range, and Sensor Limits.

## Sensor Limits

*Upper Sensor Limit*— Indicates the maximum usable value for the Primary Value Range High.

*Lower Sensor Limit*— Indicates the minimum usable value for the Primary Value Range Low.

The Upper and Lower Sensor Limit limit what the DLC3020f can read; values above and below these limits will not be detected by the instrument. This is a dynamic reading based on temperature used when Temperature Compensation is enabled.

## Sensor Hardware Information

Enter the following information by selecting *Sensor Hardware Information*.

Model Type, End Connection Style, End Connection Type, Body Material, Pressure Rating, Mechanical Sensor Serial Number, Displacer Size Displacer Material, Displacer Rating, G Dimension, Torque Tube Material, Torque Tube Wall, Heat Insulator.

Sensor information is typically found on the sensor nameplate.

## Note

This data is informational only and is not used in calibration or PV calculations.

## Sensor Units

Select the appropriate sensor units for your application.

---

### Note

Default units from factory are SI (Metric).

If you choose Mixed Units you must select the units for each sensor parameter.

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*Unit System*—English Units, Metric/SI Units, Mixed Units

*Length Units*—mm, cm, m, in, or ft

*Volume Units*—mm<sup>3</sup>, ml, L, in<sup>3</sup>

*Weight Units*—oz, lb, g, or kg

*Temperature Units*—°F, °R, °C, or K

*Torque Rate Units*—N•m/deg, dyne•cm/deg, lbf•in/deg

*Fluid Density Units*—degAPI, SGU (Specific Gravity) lb/in<sup>3</sup>, lb/ft<sup>3</sup>, lb/gal, degBaum hv, degBaum lt, kg/m<sup>3</sup>, g/cm<sup>3</sup>, kg/L, g/ml, or g/L

## Sensor Parameters

Enter the sensor parameters. Selections shown in the drop down are based on the sensor units chosen.

*Displacer Length*

*Displacer Volume*

*Displacer Weight*

*Driver Rod Length*

*Instrument Mount Position*

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### Note

Table 5 provides the driver rod length of 249 sensors with vertical displacers. If your sensor isn't included in table 5 refer to figure 12 to determine the driver rod length.

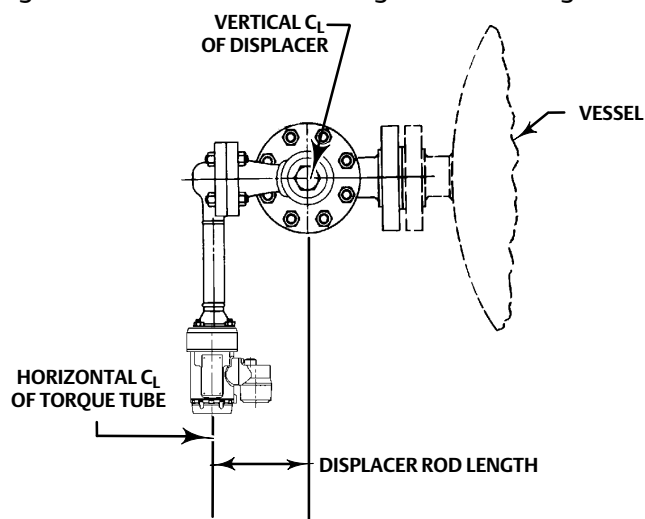
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Table 5. Driver Rod Length<sup>(1)</sup>

Sensor Type <sup>(2)</sup>	Driver Rod	
	mm	Inch
249	203	8.01
249B	203	8.01
249BF <sup>(3)</sup>	203	8.01
249BP	203	8.01
249C	169	6.64
249CP	169	6.64
249K	267	10.5
249L	229	9.01
249N	267	10.5
249P <sup>(3)</sup> (CL125-CL600)	203	8.01
249P <sup>(3)</sup> (CL900-CL2500)	229	9.01
249V (Special) <sup>(1)(3)</sup>	See serial card	See serial card
249V (Std) <sup>(3)</sup>	343	13.5
249VS	343	13.5
249W	203	8.01

1. Driver rod length is the perpendicular distance between the vertical centerline of the displacer and the horizontal centerline of the torque tube. See figure 12. If you cannot determine the driver rod length, contact your [Emerson sales office](#) and provide the serial number of the sensor.  
 2. This table applies to sensors with vertical displacers only. For sensor types not listed, or sensors with horizontal displacers, contact your Emerson sales office for the driver rod length. For other manufacturers' sensors, see the installation instructions for that mounting.  
 3. 249BF, 249P, and 249V sensors are only available in Europe.

Figure 12. Method of Determining Driver Rod Length from External Measurements



### Torque Tube

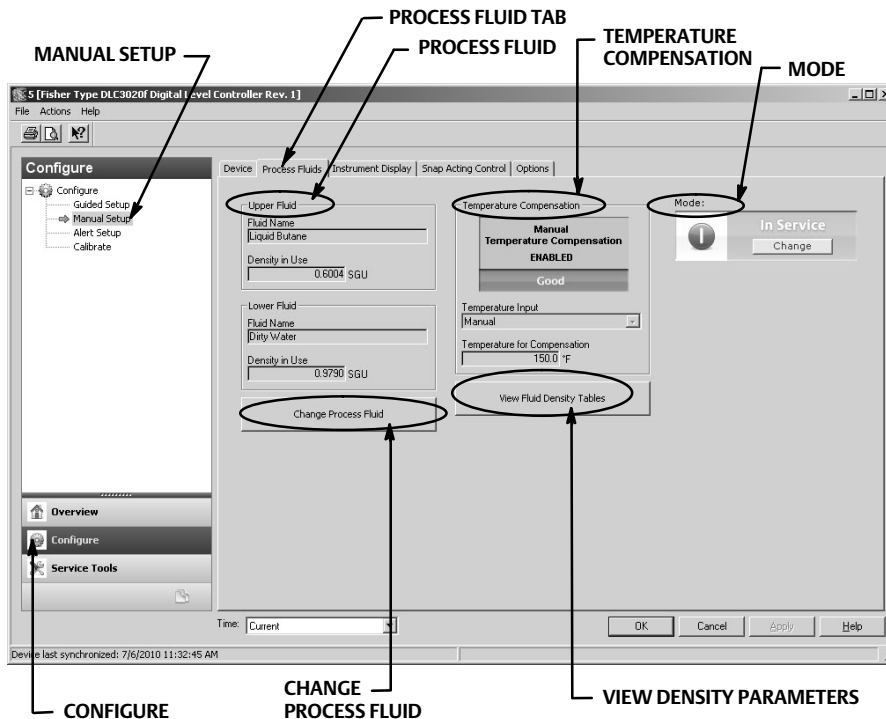
*Torque Tube Material*—select the material of the torque tube being used. See the sensor nameplate.

*View Torque Tube Table*—select View Torque Tube Table to see the torque tube gain over the entire temperature range and the compensated torque rate.

## Process Fluid

Select the Process Fluid tab (figure 13) to access *Process Fluid*, *Temperature Compensation*, and *Mode*.

Figure 13. Configure > Manual Setup > Process Fluid



### Note

The instrument software contains density tables for common categories of fluids. Custom tables can be built if needed.

Some fluid categories have wide variations within fluid types. Select the fluid category and then the fluid type.

Input the operating process temperature and the density. The DLC3020f will load the density table that best matches the fluid type at operating conditions.

## Process Fluid

### Fluid Name

### Density In Use

**Change Process Fluid**—Select Change Process Fluid to begin the process to properly select the corrections for density of the fluid that occur at operational temperature.

If Temperature Compensation is selected, the proper density table for use in temperature compensation is selected. If Temperature Compensation is not needed, enter the operating conditions and name the fluid.

## Temperature Compensation

If Temperature Compensation is selected, provide the following information:

*Temperature Input*—select None, Manual, AO Block, or RTD.

Temperature compensation, when enabled, can come from a manually entered temperature, a temperature from a fieldbus transmitter (AO block) or a temperature from an RTD.

*Temperature for Compensation*—the temperature in use for fluid density and torque tube material compensation.

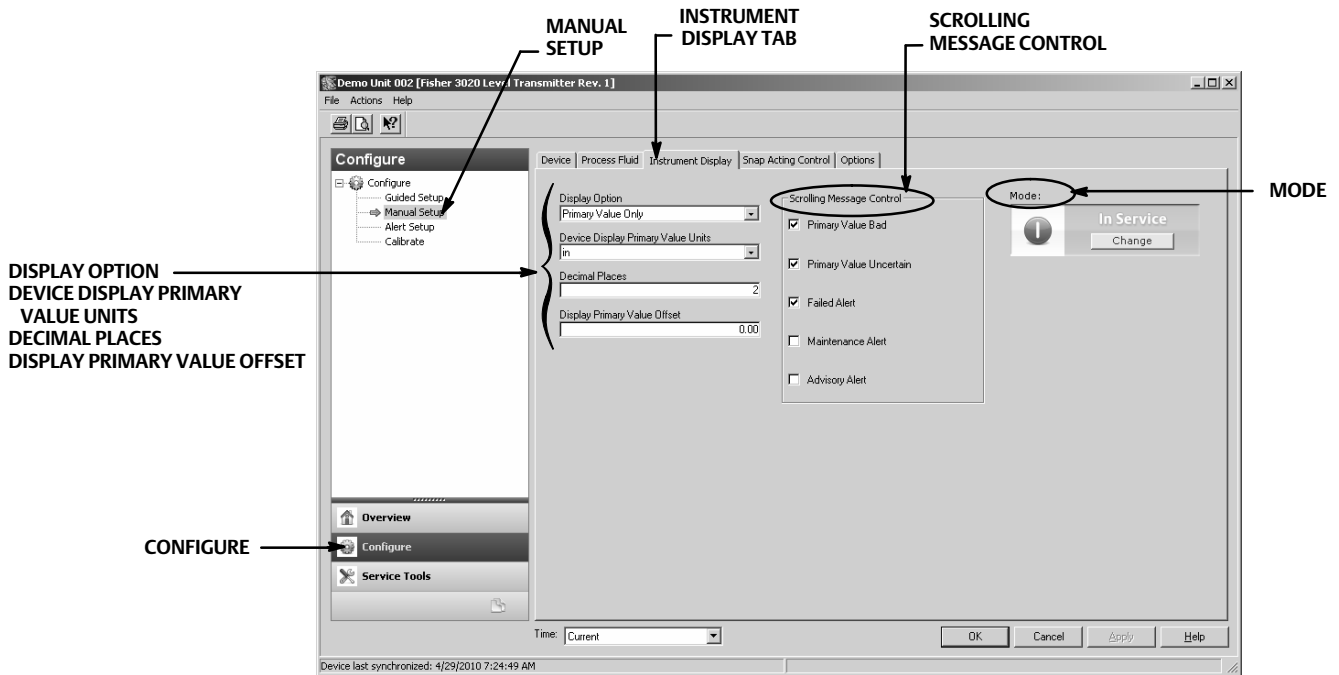
## View Fluid Density Table

Select View Fluid Density Table to see information concerning the temperature effect on process fluid density.

## Instrument Display

Select the Instrument Display tab (figure 14) to access *Display Option*, *Device Display Primary Value Units*, *Decimal Places*, *Display Primary Value Offset*, and *Scrolling Message Control*.

**Figure 14. Configure > Manual Setup > Instrument Display**



## Display Option

Select Primary Value Only, % Range, or Primary Value / % Range to be displayed on the DLC3020f LCD.

## Device Display Primary Value Units

Select the units for the device display Primary Value.

## Decimal Places

Enter the number of desired decimal places for the device display.

## Display Primary Value Offset

Enter the PV Offset to apply it to the LCD readout.

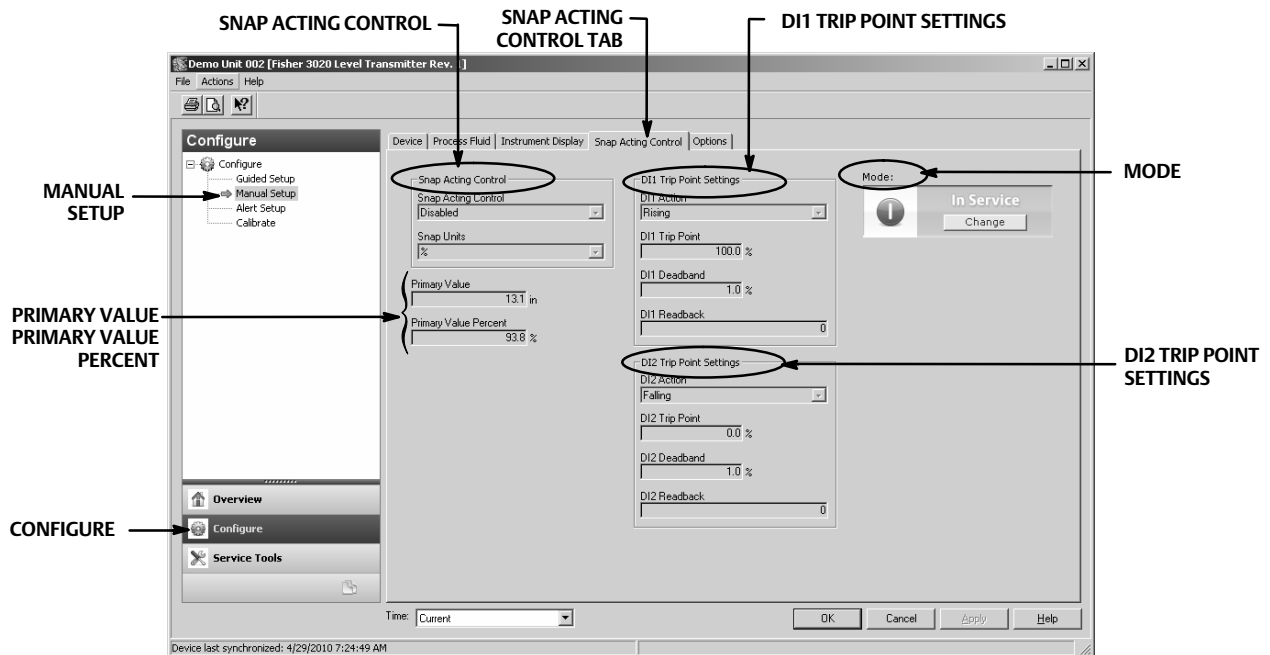
## Scrolling Message Control

Messages that can be scrolled on the LCD screen. Choose from; Primary Value Bad, Primary Value Uncertain, Failed Alert, Maintenance Alert, or Advisory Alert.

## Snap Acting Control

Select the Snap Acting Control tab (figure 15) to access *Snap Acting Control*, *Primary Value*, *Primary Value Percent*, *DI1 Trip Point Settings*, *DI2 Trip Point Settings*, and *Mode*.

Figure 15. Configure > Manual Setup > Snap Acting Control



## Snap Acting Control

The DLC3020f can act as a snap acting controller while simultaneously reporting PV. When Snap Acting Control is enabled, either one or both of the DI blocks will act as controllers and output a 0 (inactive) or 1 (active), depending on if the level has gone past (either rising or falling) a user specified level value.

*Snap Acting Control*—enable or disable Snap Acting Control.

*Snap Units*—select the desired snap unit in engineering units; length units or percent (%).



## Primary Value

PV in engineering units

## Primary Value Percent

PV in %

## DI1 Trip Point Settings

Set Channel 1 or 2 of the DI for snap acting control.

*DI1 Action*—indicate whether the trip point is active on *rising* or *falling* level.

*DI1 Trip Point*—enter the point where DI1 is active.

*DI1 Deadband*—enter the desired deadband. This is the distance away from the trip point that DI1 clears.

*DI1 Readback*—indicates the status of the trip point.

0 indicates that DI1 Trip is inactive. 1 indicates DI1 Trip is active.

## DI2 Trip Point Settings

*DI2 Action*—indicate whether the trip point is active on *rising* or *falling* level.

*DI2 Trip Point*—enter the point where DI2 is active.

*DI2 Deadband*—enter the desired deadband. This is the distance away from the trip point that DI2 clears.

*DI2 Readback*—indicates the status of the trip point.

0 indicates that DI2 Trip is inactive. 1 indicates DI2 Trip is active.

## Options

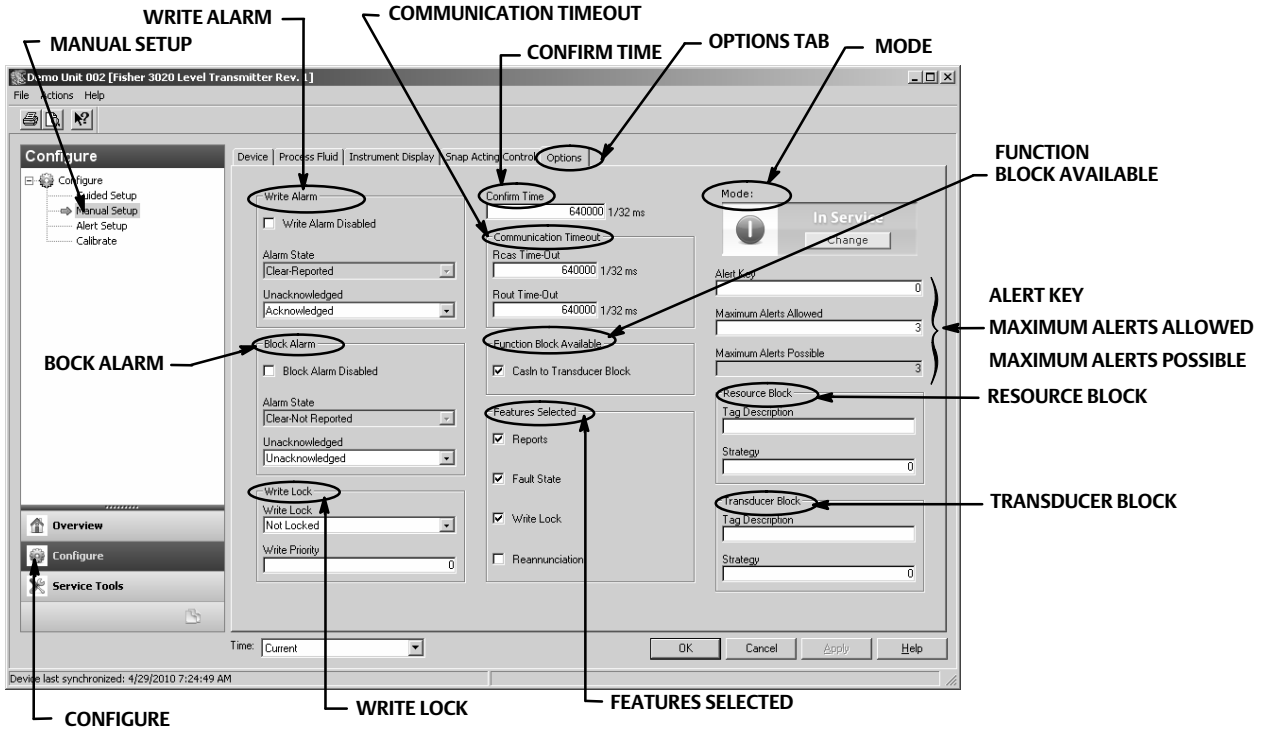
Select the Options tab (figure 16) to access *Write Alarm*, *Block Alarm*, *Write Lock*, *Confirm Time*, *Communication Timeout*, *Function Block Available*, *Features Selected*, *Alert Key*, *Maximum Alerts Allowed*, *Maximum Alerts Possible*, *Resource Block*, *Transducer Block*, and *Mode*.

## Write Alarm

The Write Alarm (WRITE\_ALM [40]) is used to alert when parameters are writable to the device.

*Write Alarm Disabled*—select to disable the Write Alarm

Figure 16. Configure > Manual Setup > Options



**Alarm State**—indicates the state of the Write Alarm. Five states are possible; Undefined, Clear-Reported, Clear-Not Reported, Active-Reported, Active-Not Reported.

**Unacknowledged**—select Undefined, Acknowledged, or Unacknowledged

### Block Alarm

The block alarm is used for all configuration, hardware, connection failure, or system problems in the block. Alarm Summary (ALARM\_SUM [37]) determines if the Write Alarm and Block Alarm are disabled.

**Block Alarm Disabled**—select to disable the Block Alarm

**Alarm State**—indicates the state of the Block Alarm. Five states are possible; Undefined, Clear-Reported, Clear-Not Reported, Active-Reported, Active-Not Reported.

**Unacknowledged**—select Undefined, Acknowledged, or Unacknowledged

### Write Lock

Write Lock determines if writes are permissible to other device parameters.

**Write Lock**— When Write Lock is set to Locked, no writes are permitted to any parameters within the device except to set Write Lock to Not Locked. When locked, the device functions normally, updating inputs and outputs and executing algorithms. When Write Lock is set to Not Locked, the Write Alarm alert is active.

**Write Priority**—Write Priority sets the priority for Write Alarm. The lowest priority is 0. The highest is 15.

## Confirm Time

Confirm Time determines the time in 1/32 of a millisecond, the instrument waits for confirmation of receipt of a report before trying again. If Confirm Time is 0, the instrument does not try to resend the report. Enter 0 or a value between 320000 (10 seconds) and 640000 (20 seconds).

## Communication Timeout

*Rcas Time-Out*—Rcas Timeout determines how long function blocks in the DLC3020f should wait before giving up on remote computer writes to RCas parameters. When the timeout is exceeded, the block sheds to the next mode as defined by the block shed options. If RCas Timeout is set to 0, the block will not shed from RCas. Enter a positive value in the RCas Timeout field. Time duration is in 1/32 milliseconds (640000 = 20 secs).

---

### Note

Typically this parameter does not need to be changed. The unit will be operational using the default values assigned by the factory. Perform this procedure only if a remote computer is sending setpoints from your “advanced” control.

Default value for RCas Timeout is 20 seconds.

---

*Rout Time-Out*—ROut Timeout (SHED\_ROUT [27]) determine how long function blocks in the DLC3020f should wait before giving up on computer writes to ROut parameters. When the timeout is exceeded, the block sheds to the next mode as defined by the block shed options. If ROut Timeout is set to 0, the block will not shed from ROut. Enter a positive value in the ROut Timeout field. Time duration is in 1/32 milliseconds (640000 = 20 secs).

---

### Note

Typically this parameter does not need to be changed. The unit will be operational using the default values assigned by the factory. Perform this procedure only if a remote computer is sending setpoints from your “advanced” control.

Default value for ROut Timeout is 20 seconds.

---

*Write Lock*—permits using Write Lock to prevent any external change to parameter values. Block connections and calculation results will proceed normally, but the configuration is locked.

*Reannunciation*—permits the instrument to support Reannunciation of alarms.

## Function Block Available

*CasIn to Transducer Block*

## Features Selected

---

### Note

Typically this parameter does not need to be changed. The unit will be operational using the default values assigned by the factory.

---

Features Selected indicates which Resource Block Options features have been selected and is used to select the desired features.

*Reports*—Selecting reports enables alert and event reporting. Reporting of specific alerts may be suppressed.

*Fault State*—Selecting Fault State enables the ability of the output block to react to various abnormal conditions by shedding mode.

*Write Lock*—When selected, permits using Write Lock to prevent any external change to parameter values. Block connections and calculation results will proceed normally, but the configuration is locked.

*Reannunciation*— When selected, the instrument will support Reannunciation of alarms.

### Alert Key

Alert Key is a number that permits grouping alerts. This number may be used to indicate to the operator the source of the alert, such as the instrument, plant unit, etc. Enter a value between 1 and 255.

### Maximum Alerts Allowed

The number of alert reports that the device can send without getting a confirmation up to the maximum permitted

### Resource Block

*Tag Description*— The Tag Description is used to assign a unique 32 character description to each block within the digital level controller to describe the intended application of the block.

*Strategy*— Strategy permits strategic grouping of blocks so the operator can identify where the block is located. The blocks may be grouped by plant area, plant equipment, etc. Enter a value between 0 and 65535 in the Strategy field.

### Transducer Block

*Tag Description*— The Tag Description is a 32 character description used to assign a unique description to each block within the digital level controller to describe the intended application for the block.

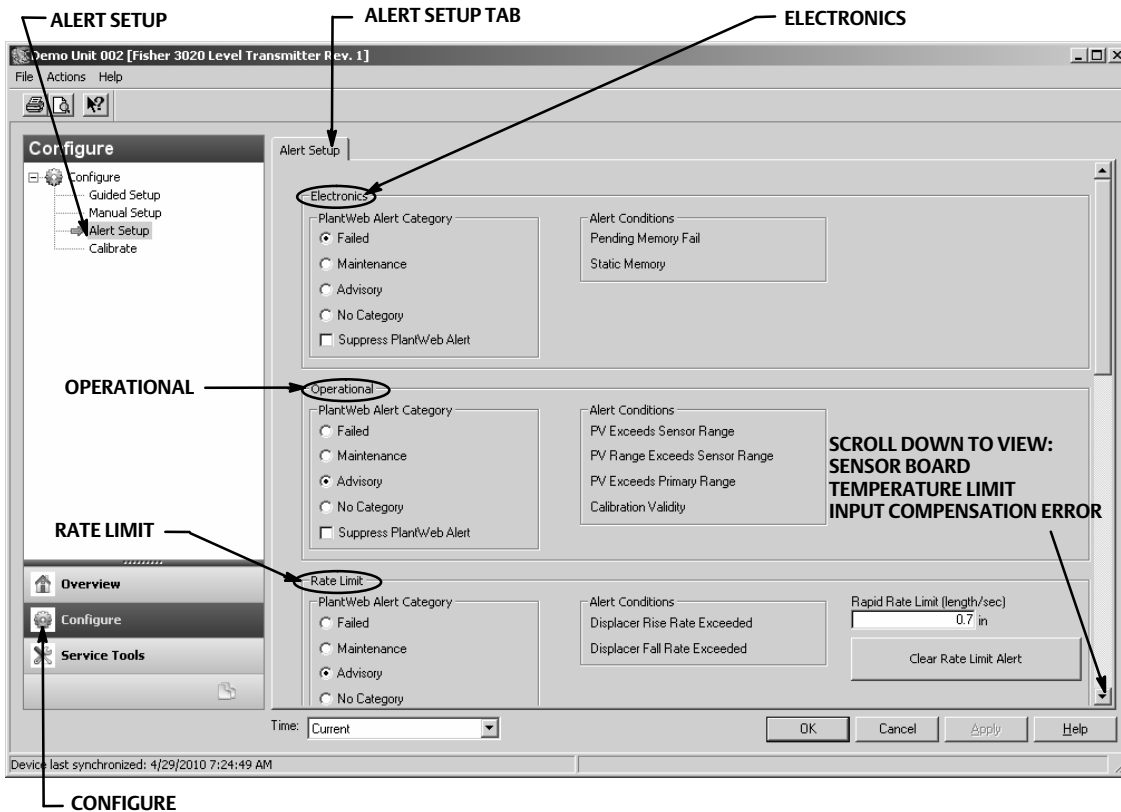
*Strategy*— Strategy permits strategic grouping of blocks so the operator can identify where the block is located. The blocks may be grouped by plant area, plant equipment, etc. Enter a value between 0 and 65535 in the Strategy field.

## Alert Setup

AMS Device Manager	Configure > Alert Setup
Field Communicator	Configure > Alert Setup

The Alert Setup tab is shown in figure 17.

Figure 17. Alert Setup



## Alerts

The DLC3020f provides two levels of alerts; Instrument alerts and PlantWeb alerts.

### Instrument Alert Conditions

Instrument Alert Conditions, when enabled, detect many operational and performance issues that may be of interest. To view these alerts, the user must open the appropriate status screen on a host such as AMS Device Manager or a Field Communicator.

### PlantWeb Alerts

Instrument alert conditions can be used to trigger PlantWeb alerts that will be reported in Failed, Maintenance or Advisory categories, as configured by the user. PlantWeb alerts, when enabled, can participate in the DeltaV alarm interface tools such as the alarm banner, alarm list and alarm summary.

When a PlantWeb alert occurs, the DLC3020f sends an event notification and waits a specified period of time for an acknowledgment to be received. This occurs even if the condition that caused the alert no longer exists. If the acknowledgment is not received within the pre-specified time-out period, the event notification is retransmitted. This reduces the possibility of alert messages getting lost.

DLC3020f alerts can be reported in the following categories.

**Failed**— indicates a problem with the DLC3020f that affects its operation. Immediate action is required for a Failed condition.

*Maintenance*— indicates a problem with the DLC3020f that, if ignored, could eventually lead to its failure. Maintenance conditions require prompt action.

*Advisory*— indicates a minor problem with the DLC3020f. An advisory condition does not have an impact on the process or device.

*No Category*— the alert has not been categorized.

*Suppress PlantWeb Alert*— the alert is still evaluated by the DLC3020f, but, it does not report the status condition through an instrument alert.

## Electronics

- Pending Memory Fail— when selected indicates if a pending memory error has been detected in the main board.
- Static Memory Fail— when selected indicates if a memory error has been detected in the main board.

## Operational

- PV Exceeds Sensor Range— when selected indicates if the Primary Variable (PV) has reached or exceeded the Sensor Range and is no longer correct.
- PV Range Exceeds Sensor Range— when selected indicates if the Primary Variable (PV) Range has exceeded the range of the sensor's current calibration. The PV is still accurate but could move out of sensor range.
- PV Exceeds Primary Range— when selected indicates if the the Primary Variable (PV) has exceeded the PV Range.
- Calibration Validity— when selected indicates if a vital calibration parameter has been changed.

## Rate Limit

- Displacer Rise Rate Exceeded— when selected indicates if the device detected a rise rate that exceeded the Rapid Rate Limit.
- Displacer Fall Rate Exceeded Alert— when selected indicates if the device detected a fall rate that exceeded the Rapid Rate Limit.
- Rapid Rate Limit—when selected, triggers an alarm when the configured set point has been exceeded. Rapid rate limit is user-configured based on application.

Select *Clear Rate Limit Alert* to clear the alert

## RTD Sensor

- RTD Sensor—when selected indicates if the RTD readings are out of range or the RTD is incorrectly connected.
- RTD Open—when selected indicates if the RTD is not connected.

## Sensor Board

- Instrument Temperature Sensor— when selected indicates if the electronic sensor readings are out of range.
- Sensor Board Processor— when selected indicates if the device cannot communicate properly or other electronic problem is effecting the processor.

- Hall Sensor—when selected indicates if the Hall Sensor readings are out of range.

## Temperature Limit

- Instrument Temperature High—when selected indicates if the device has exceeded the Instrument Temperature High Limit.
- Instrument Temperature Low—when selected indicates if the device has exceeded the Instrument Temperature Low Limit.

## Input Compensation Error

- Temperature Input Error—when selected indicates if the AO temperature status or RTD status has become “Bad” or “Uncertain” or the device is not set up correctly to receive AO temperature.
- Upper Fluid Input Error—when selected indicates if the Upper Fluid AO status has become “Bad” or “Uncertain” or the device is not setup correctly to receive AO density for the Upper Fluid.
- Lower Fluid Input Error—when selected indicates if the Lower Fluid AO status has become “Bad” or “Uncertain” or the device is not setup correctly to receive AO density for the Lower Fluid.
- Fluid Values Crossed—when selected indicates if the process fluid density values have crossed; the Upper Fluid density is too close to (0.1 SG), or has become greater than, the Lower Fluid density.
- Invalid Custom Table—when selected indicates if the custom process fluid density table or torque tube table being used for temperature compensation is invalid.
- Temperature Out of Compensation Range—when selected indicates if the Compensation Temperature has exceeded the compensation limits.

# Calibrate

## Guided Calibrations

AMS Device Manager	Configure > Calibrate > Guided Calibrations
Field Communicator	Configure > Calibrate > Full Calibration (Bench) <u>or</u> Full Calibration (Field)

Guided Calibrations (figure 18) provides access to guided calibration methods for use in the field or on the bench.

### Calibration in Use

*Name*—indicates the calibration in use.

*Date*—indicates when the calibration was performed.

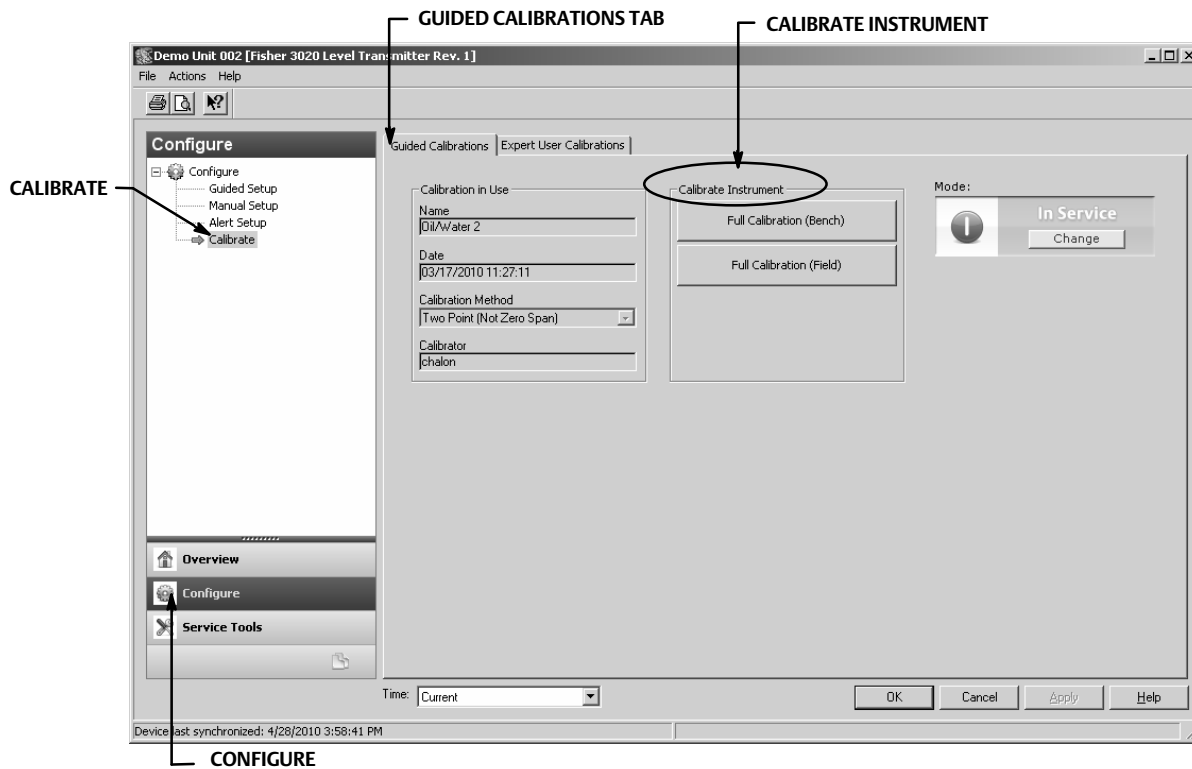
*Calibrator*—indicates who performed the calibration.

*Calibration Method*—indicates the method of calibration.

## Calibrate Instrument

Choose *Full Calibration (Bench)* or *Full Calibration (Field)* and follow AMS Device Manager (or the Field Communicator or other host system) prompts to calibrate the instrument. Guided Calibration recommends an appropriate calibration procedure.

Figure 18. Guided Calibrations



## Expert User Calibrations

AMS Device Manager	Configure > Calibrate > Expert User Calibrations
Field Communicator	Configure > Calibrate > Expert User Calibrations

Expert User Calibrations (figure 19) allows you to select the appropriate calibration based on configuration and available application data. Follow AMS Device Manager (or the Field Communicator or other host system) prompts to calibrate the instrument.

A brief description of available calibrations are included starting on page 33.

### Calibration in Use

*Name*—indicates the calibration in use.

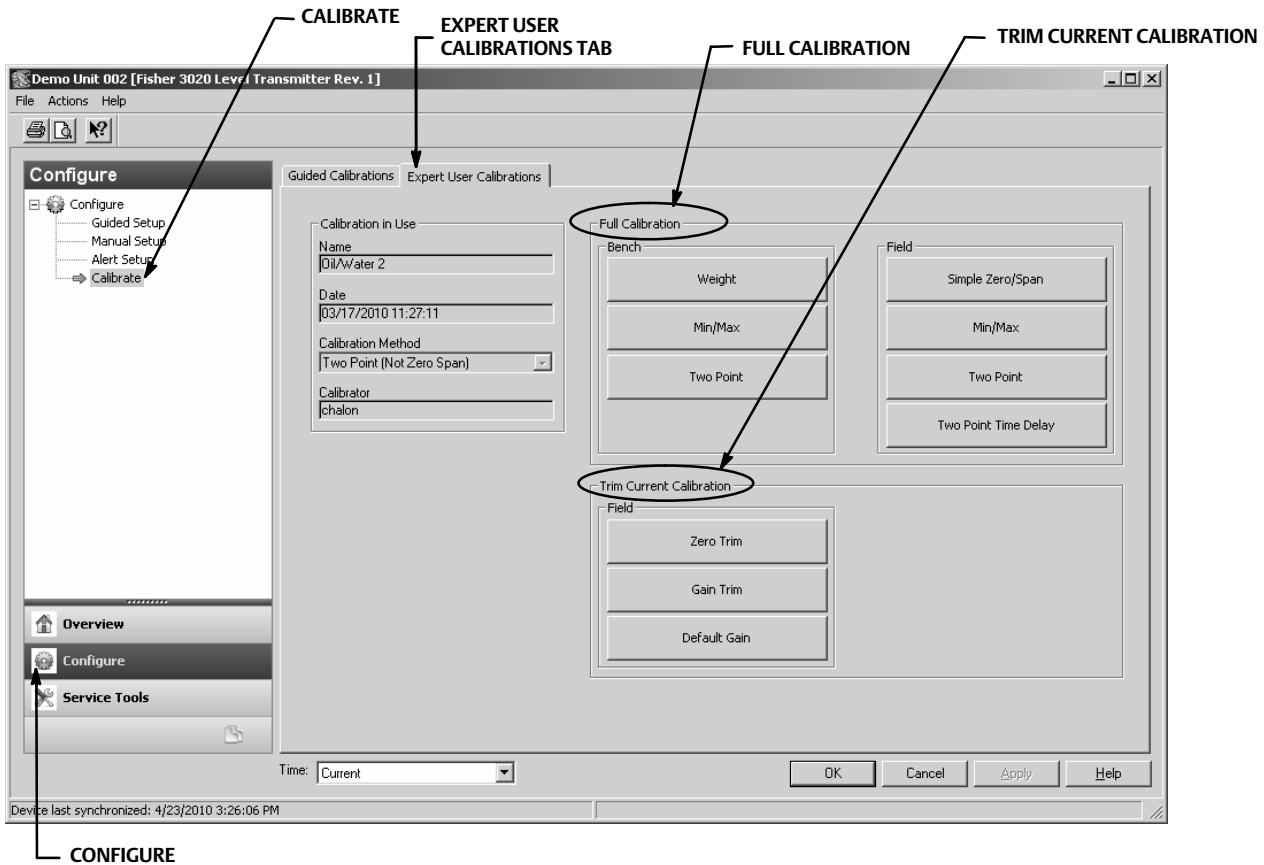
*Date*—indicates when the calibration was performed.

*Calibrator*—indicates who performed the calibration.

*Calibration Method*—indicates the method of calibration.



Figure 19. Expert User Calibrations



## Calibration Descriptions

### Full Calibration

**Weight (Bench only)**—Weight Calibration is a bench calibration where weights are used to simulate the different forces the device sees at the minimum and maximum levels. All configuration data is needed to perform a Weight calibration. Weights are suggested based on the current density values so that the two weights closely simulate the minimum and maximum points the device should see, or based on water for certain setups. These are suggested values only; you can enter other values if desired.

#### Note

The larger the difference in the weights, the better the calibration will be, provided that the unit is not on a mechanical stop.

#### Note

Ensure that the moment arm is not resting on a travel stop during the calibration process. Also, the weights tend to oscillate when placed on arm, so allow sufficient time for this to dissipate before capturing the points.

When complete, the torque rate or gain will be correct at the calibration temperature. After finalizing the installation a zero trim may be needed since a zero shift may take place when installing the device.

**Two Point (Bench or Field)**—A Two Point Calibration fully calibrates the device by observing the level/interface at two points. The two points must be at least 5% of the displacer length apart. All instrument configuration data is needed to perform a Two Point calibration. Use this method of calibration when the length/interface can be externally observed.

**Min/Max (Bench or Field)**—During the Min/Max Calibration torque rate gain and zero are computed by completely submerging the displacer in two different fluids (one of which may be air or vapor). All instrument configuration data is needed to perform a Min/Max calibration and must contain the correct values for displacer volume and driver rod length.

**Simple Zero/Span (Field only)**—for applications with relatively constant density and temperature conditions. Two points (separated by at least 5% of the displacer length) are captured in this calibration. Only the displacer length is needed to perform the Simple Zero/Span procedure. This calibration does not allow the use of Temperature Compensation

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**Note**

When using Simple Zero/Span the device cannot be temperature compensated for fluids or torque tube. This calibration should only be used when the temperature and the process density do not change, otherwise an untrimmable error will occur the farther away your process conditions get from the calibrated conditions.

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**Two Point Time Delay (Field only)**—the Two Point Time Delay Calibration is a two point calibration in which the two points captured can be taken some time apart. The first point is captured and stored indefinitely until the second point is captured. All instrument configuration data is needed to perform a Two Point calibration.

## Trim Current Calibration

**Zero Trim**—Zero trim is an adjustment to the current calibration. This adjustment assumes that the current torque rate is correct and the PV error is due to a shift in the zero position.

**Gain Trim**—Gain trim is an adjustment to the current calibration. This adjustment assumes that the zero point is correct and the PV error is caused by a torque rate change.

**Default Gain**—Default Gain is an adjustment to the current calibration. This adjustment requires you to set the default gain to the known torque tube rate.

# Schematics

This section includes loop schematics required for wiring of intrinsically safe installations. If you have any questions, contact your [Emerson sales office](#) or Local Business Partner.

Figure 20. CSA Schematic – Drawing GE37118 (Refer to figure 21 for Notes)

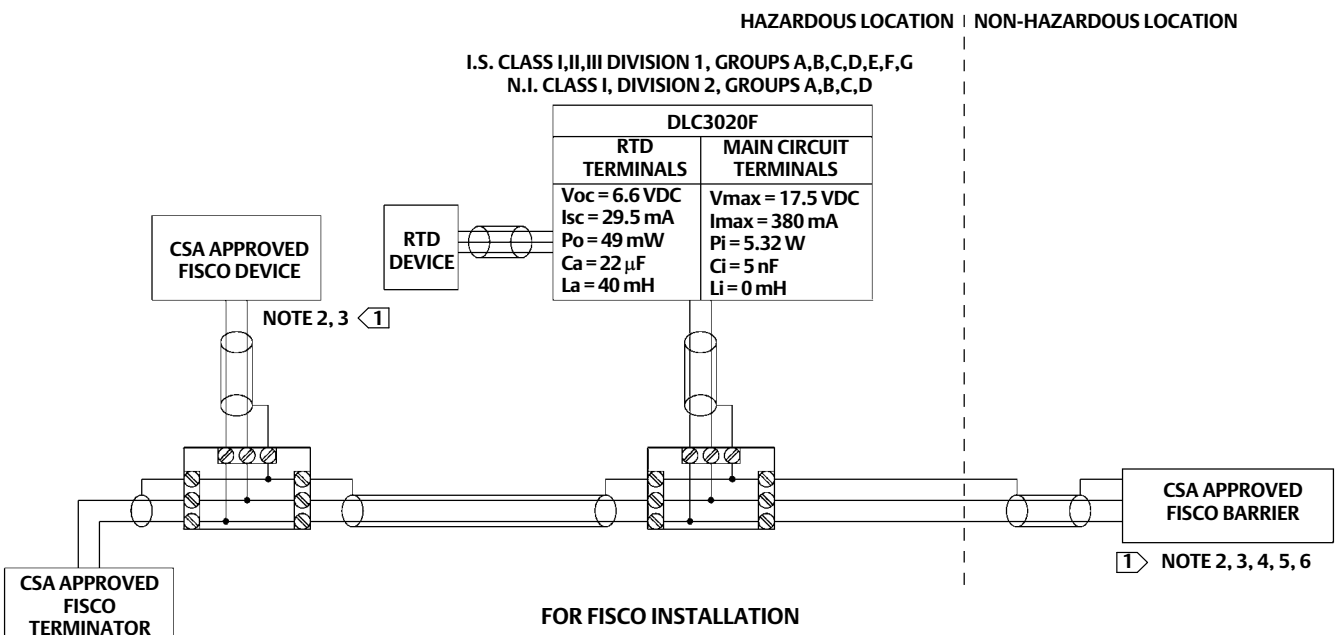
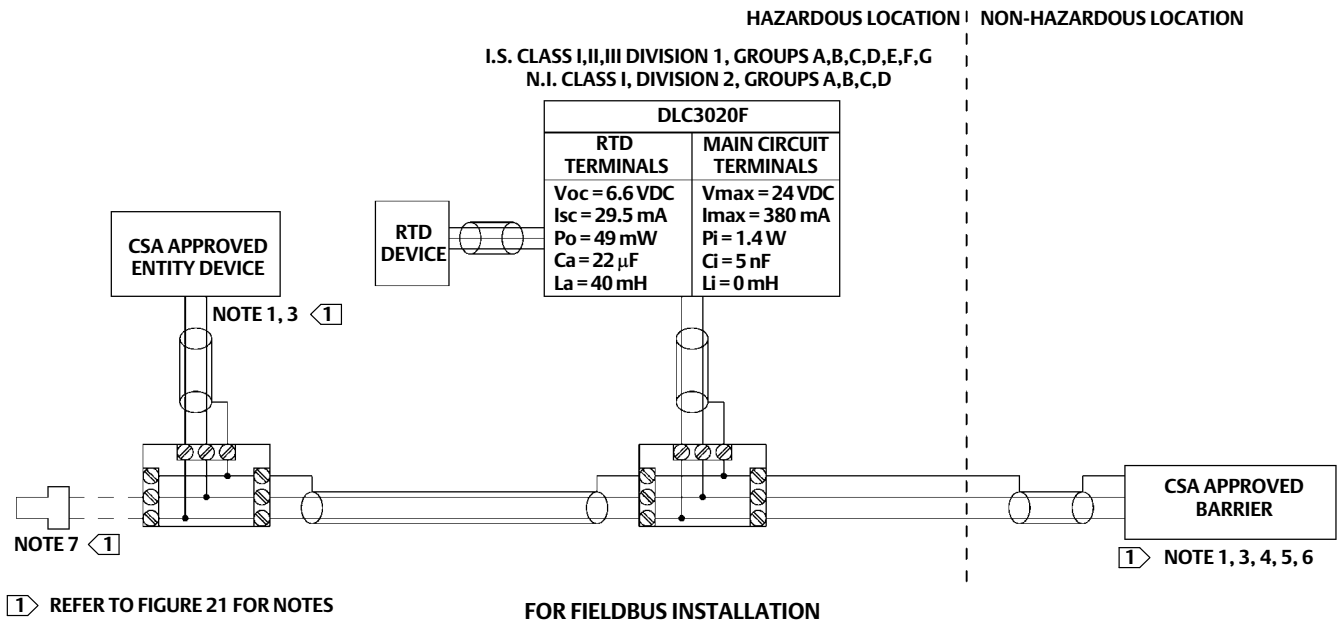


Figure 21. CSA Schematics (Notes)

① THE ENTITY CONCEPT ALLOWS INTERCONNECTION OF INTRINSICALLY SAFE APPARATUS TO ASSOCIATED APPARATUS NOT SPECIFICALLY EXAMINED IN SUCH COMBINATION. THE CRITERIA FOR INTERCONNECTION IS THAT THE VOLTAGE ( $V_{max}$  or  $U_i$ ), THE CURRENT ( $I_{max}$  or  $I_i$ ), AND THE POWER ( $P_{max}$  or  $P_i$ ) OF THE INTRINSICALLY SAFE APPARATUS MUST BE EQUAL TO OR GREATER THAN THE VOLTAGE ( $V_{oc}$  or  $U_o$ ) AND THE CURRENT ( $I_{sc}$  or  $I_o$ ), AND THE POWER ( $P_o$ ) DEFINED BY THE ASSOCIATED APPARATUS. IN ADDITION, THE SUM OF THE MAX UNPROTECTED CAPACITANCE ( $C_i$ ) AND MAX UNPROTECTED INDUCTANCE ( $L_i$ ), INCLUDING THE INTERCONNECTING CABLING CAPACITANCE ( $C_{cable}$ ) AND CABLING INDUCTANCE ( $L_{cable}$ ), MUST BE LESS THAN THE ALLOWABLE CAPACITANCE ( $C_a$ ) AND INDUCTANCE ( $L_a$ ) DEFINED BY THE ASSOCIATED APPARATUS. IF THE ABOVE CRITERIA IS MET, THEN THE COMBINATION MAY BE CONNECTED.

$$V_{max} \text{ or } U_i \geq V_{oc} \text{ or } U_o \quad I_{max} \text{ or } I_i \geq I_{sc} \text{ or } I_o \quad P_{max} \text{ or } P_i \geq P_o \quad C_i + C_{cable} \leq C_a \quad L_i + L_{cable} \leq L_a$$

② THE FISCO CONCEPT ALLOWS INTERCONNECTION OF INTRINSICALLY SAFE APPARATUS TO ASSOCIATED APPARATUS NOT SPECIFICALLY EXAMINED IN SUCH COMBINATION. THE CRITERIA FOR THE INTERCONNECTION IS THAT THE VOLTAGE ( $V_{max}$  or  $U_i$ ), CURRENT ( $I_{max}$  or  $I_i$ ) AND POWER ( $P_{max}$  or  $P_i$ ), WHICH AN INTRINSICALLY SAFE APPARATUS CAN RECEIVE AND REMAIN INTRINSICALLY SAFE, CONSIDERING FAULTS, MUST BE EQUAL TO OR GREATER THAN THE VOLTAGE ( $V_{oc}$  or  $U_o$ ), CURRENT ( $I_{sc}$  or  $I_o$ ), AND POWER ( $P_o$ ) LEVELS WHICH CAN BE DELIVERED BY THE ASSOCIATED APPARATUS, CONSIDERING FAULTS AND APPLICABLE FACTORS. IN ADDITION THE MAXIMUM UNPROTECTED CAPACITANCE ( $C_i$ ) AND INDUCTANCE ( $L_i$ ) OF EACH APPARATUS (OTHER THAN THE TERMINATION) CONNECTED TO THE FIELD BUS MUST BE LESS THAN OR EQUAL TO 5 nF AND 10  $\mu$ H RESPECTIVELY.

IN EACH SEGMENT ONLY ONE ACTIVE DEVICE, NORMALLY THE ASSOCIATED APPARATUS, IS ALLOWED TO PROVIDE THE NECESSARY ENERGY FOR THE FIELD BUS SYSTEM. THE VOLTAGE ( $U_o$  or  $V_{oc}$  or  $V_t$ ) OF THE ASSOCIATED APPARATUS HAS TO BE LIMITED TO THE RANGE OF 9 V TO 17.5 VDC. ALL OTHER EQUIPMENT CONNECTED TO THE BUS CABLE HAS TO BE PASSIVE, MEANING THAT THEY ARE NOT ALLOWED TO PROVIDE ENERGY TO THE SYSTEM, EXCEPT FOR A LEAKAGE CURRENT OF 50  $\mu$ A FOR EACH CONNECTED DEVICE. SEPARATELY POWERED EQUIPMENT NEEDS A GALVANIC ISOLATION TO ASSURE THAT THE INTRINSICALLY SAFE FIELD BUS CIRCUIT REMAINS PASSIVE.

THE CABLE USED TO INTERCONNECT THE DEVICES NEEDS TO HAVE THE PARAMETERS IN THE FOLLOWING RANGE:

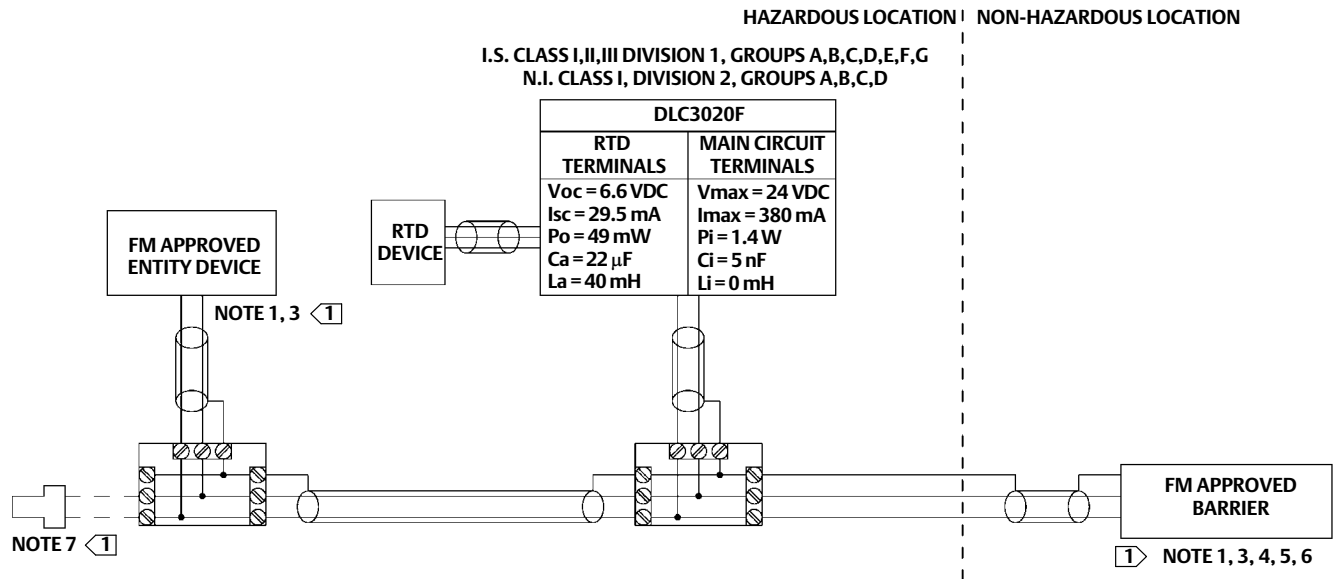
LOOP RESISTANCE R:	15 TO 150 ohms/km
INDUCTANCE PER UNIT LENGTH L:	0.4 TO 1 mH/km
CAPACITANCE PER UNIT LENGTH C:	80 TO 200 nF/km
C = C' LINE/LINE + 0.5' LINE/SCREEN, IF BOTH LINES ARE FLOATING OR	
C = C' LINE/LINE + C' LINE/SCREEN, IF THE SCREEN IS CONNECTED TO ONE LINE.	
LENGTH OF SPLICE:	<1 m (T-BOX MUST ONLY CONTAIN TERMINAL CONNECTIONS WITH NO ENERGY STORAGE CAPABILITY)
LENGTH OF SPUR CABLE:	<30 m
LENGTH OF TRUNK CABLE:	<1 Km

AT EACH END OF THE TRUNK CABLE AN APPROVED INFALLIBLE TERMINATION WITH THE FOLLOWING PARAMETERS IS SUITABLE:  
 $R = 90$  TO  $100$  ohms AND  $C = 0$  TO  $2.2$   $\mu$ F. NOTE, A BUILT-IN TERMINATOR IS INCLUDED ON THE FIELD SIDE AND A SELECTABLE TERMINATOR IS AVAILABLE ON THE HOST SIDE.

THE NUMBER OF PASSIVE DEVICES CONNECTED TO THE BUS SEGMENT IS NOT LIMITED IN THE FISCO CONCEPT FOR INTRINSICALLY SAFE REASONS. IF THE ABOVE RULES ARE RESPECTED, UP TO A TOTAL LENGTH OF 1000 m (SUM OF THE LENGTH OF THE TRUNK CABLE AND ALL SPUR CABLES), THE INDUCTANCE AND CAPACITANCE OF THE CABLE WILL NOT IMPAIR THE INTRINSIC SAFETY OF THE INSTALLATION.

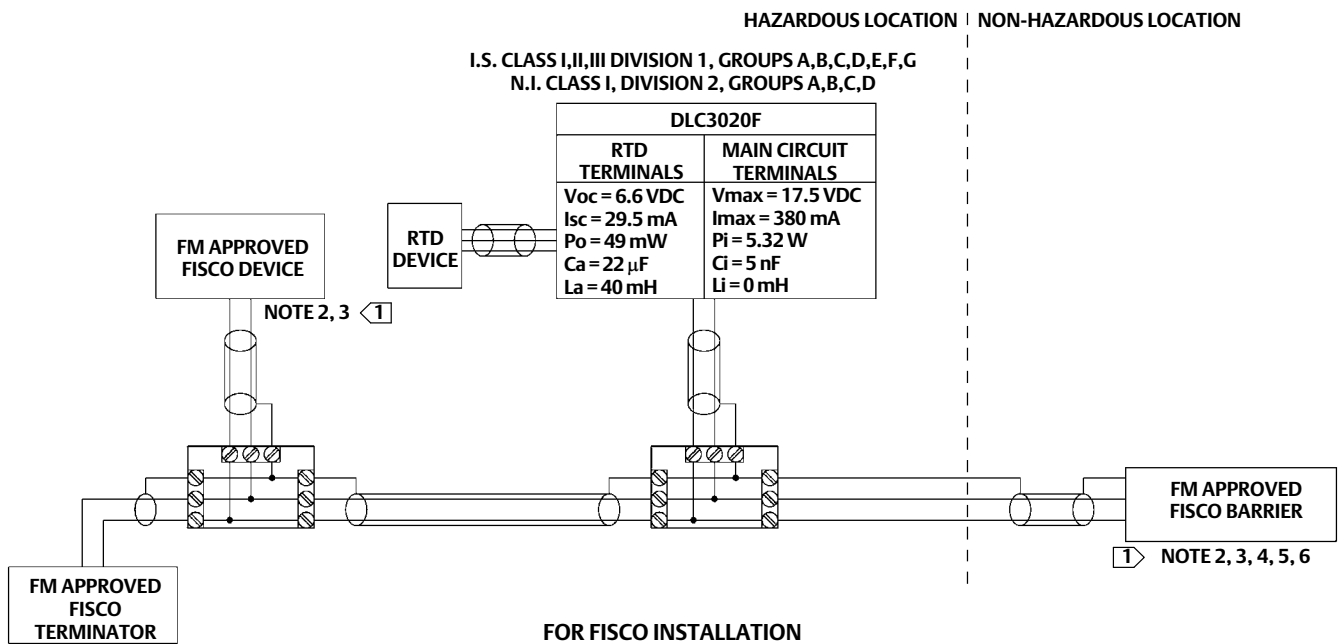
- ③ INSTALLATION MUST BE IN ACCORDANCE WITH THE CANADIAN ELECTRICAL CODE (CEC) PART 1 AND ANSI/ISA RP12.6
- ④ MAXIMUM SAFE AREA VOLTAGE SHOULD NOT EXCEED 250  $V_{rms}$
- ⑤ RESISTANCE BETWEEN INTRINSICALLY SAFE GROUND AND EARTH GROUND MUST BE LESS THAN ONE OHM.
- ⑥ LOOPS MUST BE CONNECTED ACCORDING TO THE BARRIER MANUFACTURER'S INSTRUCTIONS
- ⑦ IF HAND-HELD COMMUNICATOR OR MULTIPLEXER IS USED IT MUST BE CSA APPROVED WITH ENTITY PARAMETERS AND INSTALLED PER THE MANUFACTURER'S CONTROL DRAWING

Figure 22. FM Schematic – Drawing GE37117 (Refer to figure 23 for Notes)



1 REFER TO FIGURE 23 FOR NOTES

FOR FIELDBUS INSTALLATION



1 REFER TO FIGURE 23 FOR NOTES

GE37117

Figure 23. FM Schematics (Notes)

① THE ENTITY CONCEPT ALLOWS INTERCONNECTION OF INTRINSICALLY SAFE APPARATUS TO ASSOCIATED APPARATUS NOT SPECIFICALLY EXAMINED IN SUCH COMBINATION. THE CRITERIA FOR INTERCONNECTION IS THAT THE VOLTAGE ( $V_{max}$  or  $U_i$ ), THE CURRENT ( $I_{max}$  or  $I_i$ ), AND THE POWER ( $P_{max}$  or  $P_i$ ) OF THE INTRINSICALLY SAFE APPARATUS MUST BE EQUAL TO OR GREATER THAN THE VOLTAGE ( $V_{oc}$  or  $U_o$ ) AND THE CURRENT ( $I_{sc}$  or  $I_o$ ), AND THE POWER ( $P_o$ ) DEFINED BY THE ASSOCIATED APPARATUS. IN ADDITION, THE SUM OF THE MAX UNPROTECTED CAPACITANCE ( $C_i$ ) AND MAX UNPROTECTED INDUCTANCE ( $L_i$ ), INCLUDING THE INTERCONNECTING CABLING CAPACITANCE ( $C_{cable}$ ) AND CABLING INDUCTANCE ( $L_{cable}$ ), MUST BE LESS THAN THE ALLOWABLE CAPACITANCE ( $C_a$ ) AND INDUCTANCE ( $L_a$ ) DEFINED BY THE ASSOCIATED APPARATUS. IF THE ABOVE CRITERIA IS MET, THEN THE COMBINATION MAY BE CONNECTED.

$$V_{max} \text{ or } U_i \geq V_{oc} \text{ or } U_o \quad I_{max} \text{ or } I_i \geq I_{sc} \text{ or } I_o \quad P_{max} \text{ or } P_i \geq P_o \quad C_i + C_{cable} \leq C_a \quad L_i + L_{cable} \leq L_a$$

② THE FISCO CONCEPT ALLOWS INTERCONNECTION OF INTRINSICALLY SAFE APPARATUS TO ASSOCIATED APPARATUS NOT SPECIFICALLY EXAMINED IN SUCH COMBINATION. THE CRITERIA FOR THE INTERCONNECTION IS THAT THE VOLTAGE ( $V_{max}$  or  $U_i$ ), CURRENT ( $I_{max}$  or  $I_i$ ) AND POWER ( $P_{max}$  or  $P_i$ ), WHICH AN INTRINSICALLY SAFE APPARATUS CAN RECEIVE AND REMAIN INTRINSICALLY SAFE, CONSIDERING FAULTS, MUST BE EQUAL TO OR GREATER THAN THE VOLTAGE ( $V_{oc}$  or  $U_o$ ), CURRENT ( $I_{sc}$  or  $I_o$ ), AND POWER ( $P_o$ ) LEVELS WHICH CAN BE DELIVERED BY THE ASSOCIATED APPARATUS, CONSIDERING FAULTS AND APPLICABLE FACTORS. IN ADDITION THE MAXIMUM UNPROTECTED CAPACITANCE ( $C_i$ ) AND INDUCTANCE ( $L_i$ ) OF EACH APPARATUS (OTHER THAN THE TERMINATION) CONNECTED TO THE FIELD BUS MUST BE LESS THAN OR EQUAL TO 5 nF AND 10  $\mu$ H RESPECTIVELY.

IN EACH SEGMENT ONLY ONE ACTIVE DEVICE, NORMALLY THE ASSOCIATED APPARATUS, IS ALLOWED TO PROVIDE THE NECESSARY ENERGY FOR THE FIELD BUS SYSTEM. THE VOLTAGE ( $U_o$  or  $V_{oc}$  or  $V_t$ ) OF THE ASSOCIATED APPARATUS HAS TO BE LIMITED TO THE RANGE OF 9 V TO 17.5 VDC. ALL OTHER EQUIPMENT CONNECTED TO THE BUS CABLE HAS TO BE PASSIVE, MEANING THAT THEY ARE NOT ALLOWED TO PROVIDE ENERGY TO THE SYSTEM, EXCEPT FOR A LEAKAGE CURRENT OF 50  $\mu$ A FOR EACH CONNECTED DEVICE. SEPARATELY POWERED EQUIPMENT NEEDS A GALVANIC ISOLATION TO ASSURE THAT THE INTRINSICALLY SAFE FIELD BUS CIRCUIT REMAINS PASSIVE.

THE CABLE USED TO INTERCONNECT THE DEVICES NEEDS TO HAVE THE PARAMETERS IN THE FOLLOWING RANGE:

LOOP RESISTANCE R:	15 TO 150 ohms/km
INDUCTANCE PER UNIT LENGTH L:	0.4 TO 1 mH/km
CAPACITANCE PER UNIT LENGTH C:	80 TO 200 nF/km
C' = C' LINE/LINE + 0.5' LINE/SCREEN, IF BOTH LINES ARE FLOATING OR	
C' = C' LINE/LINE + C' LINE/SCREEN, IF THE SCREEN IS CONNECTED TO ONE LINE.	
LENGTH OF SPLICE:	<1 m (T-BOX MUST ONLY CONTAIN TERMINAL CONNECTIONS WITH NO ENERGY STORAGE CAPABILITY)
LENGTH OF SPUR CABLE:	<30 m
LENGTH OF TRUNK CABLE:	<1 Km

AT EACH END OF THE TRUNK CABLE AN APPROVED INFALLIBLE TERMINATION WITH THE FOLLOWING PARAMETERS IS SUITABLE:  
 $R = 90$  TO  $100$  ohms AND  $C = 0$  TO  $2.2$   $\mu$ F. NOTE, A BUILT-IN TERMINATOR IS INCLUDED ON THE FIELD SIDE AND A SELECTABLE TERMINATOR IS AVAILABLE ON THE HOST SIDE.

THE NUMBER OF PASSIVE DEVICES CONNECTED TO THE BUS SEGMENT IS NOT LIMITED IN THE FISCO CONCEPT FOR INTRINSICALLY SAFE REASONS. IF THE ABOVE RULES ARE RESPECTED, UP TO A TOTAL LENGTH OF 1000 m (SUM OF THE LENGTH OF THE TRUNK CABLE AND ALL SPUR CABLES), THE INDUCTANCE AND CAPACITANCE OF THE CABLE WILL NOT IMPAIR THE INTRINSIC SAFETY OF THE INSTALLATION.

③ INSTALLATION MUST BE IN ACCORDANCE WITH THE NATIONAL ELECTRICAL CODE (NEC) NFPA70 AND ANSI/ISA RP12.06.01

④ MAXIMUM SAFE AREA VOLTAGE SHOULD NOT EXCEED 250  $V_{rms}$

⑤ RESISTANCE BETWEEN INTRINSICALLY SAFE GROUND AND EARTH GROUND MUST BE LESS THAN ONE OHM.

⑥ LOOPS MUST BE CONNECTED ACCORDING TO THE BARRIER MANUFACTURER'S INSTRUCTIONS

⑦ IF HAND-HELD COMMUNICATOR OR MULTIPLEXER IS USED IT MUST BE FM APPROVED WITH ENTITY PARAMETERS AND INSTALLED PER THE MANUFACTURER'S CONTROL DRAWING

## Specifications

Specifications for DLC3020f are shown in table 6. Specifications for 249 sensors are shown in table 8.

**Table 6. Specifications**

<p><b>Available Configurations</b></p> <p>Mounts on 249 caged and cageless sensors.</p> <p>Function: Transmitter, Controller, Switch</p> <p>Communications Protocol: FOUNDATION fieldbus</p> <p><b>Digital Communication Protocol</b></p> <p>FOUNDATION fieldbus registered device (ITK 5)</p> <p><b>Supply Requirements</b></p> <p>9 to 32 volts DC, 17.7 mA DC; instrument is not polarity sensitive</p> <p><b>Device Inputs</b></p> <p>Level Sensor Input (required) Rotary motion of torque tube shaft is proportional to buoyant force of the displacer caused by changes in liquid level or interface level</p> <p>Process Temperature Compensation Input (optional) <i>RTD</i>—interface for 2- or 3-wire 100 ohm platinum RTD <i>AO Block</i>—FOUNDATION fieldbus temperature transmitter <i>Manual</i>—compensation values manually entered in the device</p> <p><b>LCD Meter Indications</b></p> <p><i>Process Variable in engineering units</i> <i>Process Variable in percent (%) only</i> <i>Alternating Process Variable in engineering units and percent (%)</i> <i>Optional: Alerts as configured</i></p> <p><b>Function Block Suite</b></p> <p>AI, PID, DI (two), AO (three), ISEL, and an ARTH function block</p> <p><b>Block Execution Times</b></p> <p>AI, PID, DI, AO, ISEL: 15 ms ARTH: 25 ms</p> <p><b>Fieldbus Device Capabilities</b></p> <p>Backup Link Active Scheduler (BLAS)</p>	<p><b>Performance</b></p> <table border="1"> <thead> <tr> <th>Criteria</th> <th>DLC3020f<sup>(1)</sup></th> </tr> </thead> <tbody> <tr> <td>Independent Linearity</td> <td>± 0.1% of output span</td> </tr> <tr> <td>Accuracy</td> <td>± 0.15%</td> </tr> <tr> <td>Repeatability</td> <td>&lt;0.1% of full scale output</td> </tr> <tr> <td>Hysteresis</td> <td>&lt;0.10% of output span</td> </tr> <tr> <td>Deadband</td> <td>&lt;0.05% of input span</td> </tr> <tr> <td>Humidity</td> <td>± 0.10% (RH9.2% to 90%)</td> </tr> </tbody> </table> <p>Note: At full design span, reference conditions. 1. To lever assembly rotation inputs.</p> <p><b>Minimum Differential Specific Gravity</b></p> <p>0.1 SGU with standard volume displacers</p> <p><b>Ambient Temperature Effect</b></p> <p>The combined temperature effect on zero and span is less than 0.01% of full scale per degree Celsius over the operating range -40 to 80°C (-40 to 176°F)</p> <p><b>Process Temperature Effect</b></p> <p>Temperature compensation can be implemented to correct for fluid density changes due to process temperature variations. See page 23 for information on how to correct with temperature compensation.</p> <p><b>Electromagnetic Compatibility</b></p> <p>Meets EN 61326-1:2013 and EN 61326-2-3:2006 Immunity—Industrial locations per Table 2 of EN 61326-1 and Table AA.2 of EN 61326-2-3. Performance is shown in table 7 below. Emissions—Class A ISM equipment rating: Group 1, Class A</p> <p><b>Lightning and Surge Protection</b>—The degree of immunity to lightning is specified as Surge immunity in table 7. For additional surge protection commercially available transient protection can be used.</p> <p><b>Alerts and Diagnostics</b></p> <p><i>Electronic Alerts</i> advise when there is an electronic error in memory</p> <p><i>Operational Range Alerts</i> notify when PV range and sensor range changes might affect calibration</p> <p><i>Rate Limit Alerts</i> indicate rapid rise or fall in displacer, which can signify abnormal operating conditions</p> <p><i>RTD Alerts</i> show health and condition of connected RTD</p>	Criteria	DLC3020f <sup>(1)</sup>	Independent Linearity	± 0.1% of output span	Accuracy	± 0.15%	Repeatability	<0.1% of full scale output	Hysteresis	<0.10% of output span	Deadband	<0.05% of input span	Humidity	± 0.10% (RH9.2% to 90%)
Criteria	DLC3020f <sup>(1)</sup>														
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Deadband	<0.05% of input span														
Humidity	± 0.10% (RH9.2% to 90%)														

-continued-

**Table 6. Specifications (continued)**

**Alerts and Diagnostics (continued)**

*Sensor Board Alerts* indicate if the device is operating above or below maximum recommended limits; advises if the electronic sensor electronics cannot communicate properly

*Input Compensation Error Alerts* advise of “Bad” or “Uncertain” status of AO connection or setup

**Simulate Function**

Simulate Active, when enabled, simulates an active alert without making it visible.

**Operating Limits**

Process Temperature: See table 9 and figure 7

**Ambient Temperature<sup>(1)</sup> and Humidity**

Conditions	Normal Limits	Transport and Storage Limits	Nominal Reference
Ambient Temperature	-40 to 80°C (-40 to 176°F)	-40 to 85°C (-40 to 185°F)	25°C (77°F)
Ambient Relative Humidity	0 to 95% (non-condensing)		40%

Altitude Rating: Up to 2000 meters (6562 feet)

**Electrical Classification**

Pollution Degree 4

Hazardous Area:

CSA— Intrinsicly Safe, Explosion-proof, Division 2, Dust Ignition-proof

FM— Intrinsicly Safe, Explosion-proof, Non-Incendive, Dust Ignition-proof

ATEX— Intrinsicly Safe, Flameproof, Type n

IECEX— Intrinsicly Safe, Flameproof, Type n

Refer to Hazardous Area Classifications and Special Instructions for “Safe Use” and Installation in Hazardous Locations on page 6 for additional information

**Electrical Housing:**

CSA— Type 4X

FM— NEMA 4X, IP66

ATEX— IP66

IECEX— IP66

**Other Classifications/Certifications**

CUTR— Customs Union Technical Regulations (Russia, Kazakhstan, Belarus, and Armenia)

INMETRO— National Institute of Metrology, Standardization, and Industrial Quality (Brazil)

NEPSI— National Supervision and Inspection Centre for Explosion Protection and Safety of Instrumentation (China)

Contact your [Emerson sales office](#) or Local Business Partner for classification/certification specific information

**Mounting Positions**

Digital level controllers can be mounted right- or left-of-displacer, as shown in figure 4

**Construction Materials**

**Case and Cover:** Low-copper aluminum alloy

**Internal:** Plated steel, aluminum, and stainless steel; encapsulated printed wiring boards; Neodymium Iron Boron Magnets

**Electrical Connections**

Two 1/2-14 NPT internal conduit connections; one on bottom and one on back of terminal box. M20 adapters available

**Weight**

Less than 2.7 Kg (6 lb)

**Options**

■ Heat insulator ■ Mountings for Masoneilan™, Yamatake, and Foxboro™-Eckhardt displacers available

1. The pressure/temperature limits in this document and any applicable standard or code limitation should not be exceeded.



Table 7. FIELDVUE DLC3020f EMC Summary Results—Immunity

Port	Phenomenon	Basic Standard	Test Level	Performance Criteria <sup>(1)</sup>
Enclosure	Electrostatic discharge (ESD)	IEC 61000-4-2	4 kV contact 8 kV air	A
	Radiated EM field	IEC 61000-4-3	80 to 1000 MHz @ 10V/m with 1 kHz AM at 80% 1400 to 2000 MHz @ 3V/m with 1 kHz AM at 80% 2000 to 2700 MHz @ 1V/m with 1 kHz AM at 80%	A
	Rated power frequency magnetic field	IEC 61000-4-8	30 A/m at 50/60 Hz	A
I/O signal/control	Burst	IEC 61000-4-4	1 kV	A
	Surge	IEC 61000-4-5	1 kV (line to ground only, each)	A
	Conducted RF	IEC 61000-4-6	150 kHz to 80 MHz at 3 Vrms	A

1. Performance criteria: +/- 1% effect. A = No degradation during testing. B = Temporary degradation during testing, but is self-recovering.

Table 8. Fisher 249 Sensor Specifications

<p><b>Input Signal</b></p> <p>Liquid Level or Liquid-to-Liquid Interface Level: From 0 to 100 percent of displacer length Liquid Density: From 0 to 100 percent of displacement force change obtained with given displacer volume—standard volumes are ■ 980 cm<sup>3</sup> (60 inches<sup>3</sup>) for 249C and 249CP sensors or ■ 1640 cm<sup>3</sup> (100 inches<sup>3</sup>) for most other sensors; other volumes available depending upon sensor construction</p> <p><b>Sensor Displacer Lengths</b></p> <p>See tables 11 and 12 footnotes</p> <p><b>Sensor Working Pressures</b></p> <p>Consistent with applicable ANSI pressure/temperature ratings for the specific sensor constructions shown in tables 11 and 12</p> <p><b>Caged Sensor Connection Styles</b></p> <p>Cages can be furnished in a variety of end connection styles to facilitate mounting on vessels; the</p>	<p>equalizing connection styles are numbered as shown in figure 24.</p> <p><b>Mounting Positions</b></p> <p>Most level sensors with cage displacers have a rotatable head. The head may be rotated through 360 degrees to any of eight different positions, shown in figure 4.</p> <p><b>Construction Materials</b></p> <p>See tables 10, 11, and 12</p> <p><b>Operative Ambient Temperature</b></p> <p>See table 9. For ambient temperature ranges, guidelines, and use of optional heat insulator, see figure 7.</p> <p><b>Options</b></p> <p>■ Heat insulator ■ Gauge glass for pressures to 29 bar at 232°C (420 psig at 450°F), and ■ Reflex gauges for high temperature and pressure applications</p>
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Table 9. Allowable Process Temperatures for Common Fisher 249 Sensor Pressure Boundary Materials

Material	Process Temperature	
	Minimum	Maximum
Cast Iron	-29°C (-20°F)	232°C (450°F)
Steel	-29°C (-20°F)	427°C (800°F)
Stainless Steel	-198°C (-325°F)	427°C (800°F)
N04400	-198°C (-325°F)	427°C (800°F)
Graphite Laminate/SST Gaskets	-198°C (-325°F)	427°C (800°F)
N04400/PTFE Gaskets	-73°C (-100°F)	204°C (400°F)

Table 10. Displacer and Torque Tube Materials

Part	Standard Material	Other Materials
Displacer	304 Stainless Steel	316 Stainless Steel, N10276, N04400, Plastic, and Special Alloys
Displacer Stem, Driver Bearing, Displacer Rod and Driver	316 Stainless Steel	N10276, N04400, other Austenitic Stainless Steels, and Special Alloys
Torque Tube	N05500 <sup>(1)</sup>	316 Stainless Steel, N06600, N10276

1. N05500 is not recommended for spring applications above 232°C (450°F). Contact your Emerson sales office or application engineer if temperatures exceeding this limit are required.

Table 11. Caged Displacer Sensors<sup>(1)</sup>

Torque Tube Orientation	Sensor	Standard Cage, Head, and Torque Tube Arm Material	Equalizing Connection		Pressure Rating <sup>(2)</sup>
			Style	Size (NPS)	
Torque tube arm rotatable with respect to equalizing connections	249 <sup>(3)</sup>	Cast iron	Screwed	1-1/2 or 2	CL125 or CL250
			Flanged	2	
	249B, 249BF <sup>(4)</sup>	Steel	Screwed or optional socket weld	1-1/2 or 2	CL600
			Raised face or optional ring-type joint flanged	1-1/2	CL150, CL300, or CL600
	249C <sup>(3)</sup>	316 stainless steel	Screwed	1-1/2 or 2	CL600
			Raised face flanged	1-1/2	CL150, CL300, or CL600
	249K	Steel	Raised face or optional ring-type joint flanged	1-1/2 or 2	CL900 or CL1500
			2	CL150, CL300, or CL600	
	249L	Steel	Ring-type joint flanged	2 <sup>(5)</sup>	CL2500

1. Standard displacer lengths for all styles (except 249) are 14, 32, 48, 60, 72, 84, 96, 108 and 120 inches. The 249 uses a displacer with a length of either 14 or 32 inches.  
 2. EN flange connections available in EMA (Europe, Middle East and Africa).  
 3. Not available in EMA.  
 4. 249BF available in Europe only. Also available in EN size DN 40 with PN 10 to PN 100 flanges and size DN 50 with PN 10 to PN 63 flanges.  
 5. Top connection is NPS 1 ring-type joint flanged for connection styles F1 and F2.

Figure 24. Style Number of Equalizing Connections

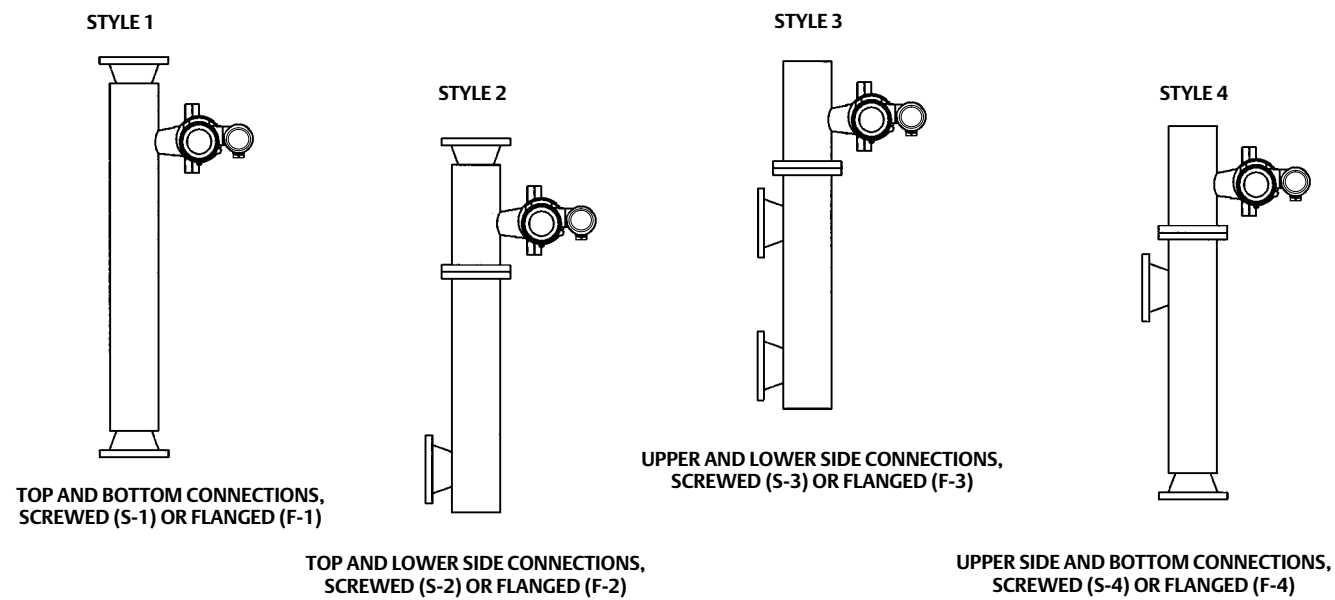


Table 12. Cageless Displacer Sensors<sup>(1)</sup>

Mounting	Sensor	Standard Head <sup>(2)</sup> , Wafer Body <sup>(6)</sup> and Torque Tube Arm Material	Flange Connection (Size)	Pressure Rating <sup>(3)</sup>
Mounts on top of vessel	249BP <sup>(4)</sup>	Steel	NPS 4 raised face or optional ring-type joint	CL150, CL300, or CL600
			NPS 6 or 8 raised face	CL150 or CL300
	249CP	316 Stainless Steel	NPS 3 raised face	CL150, CL300, or CL600
	249P <sup>(5)</sup>	Steel or stainless steel	NPS 4 raised face or optional ring-type joint	CL900 or 1CL500 (EN PN 10 to DIN PN 250)
NPS 6 or 8 raised face			CL150, CL300, CL600, CL900, CL1500, or CL2500	
Mounts on side of vessel	249VS	LCC, WCC (steel), CF8M	For NPS 4 raised face or flat face	CL125, 150, 250, 300, 600, 900, or 1500 (EN PN 10 to DIN PN 160)
			For NPS 4 butt weld end, XXS	CL2500
Mounts on top of vessel or on customer supplied cage	249W	WCC (steel) or CF8M	For NPS 3 raised face	CL150, CL300, or CL600
		LCC (steel) or CF8M	For NPS 4 raised face	CL150, CL300, or CL600

1. Standard displacer lengths are 14, 32, 48, 60, 72, 84, 96, 108, and 120 inches.  
 2. Not used with side-mounted sensors.  
 3. EN flange connections available in EMA (Europe, Middle East and Africa).  
 4. Not available in EMA.  
 5. 249P available in Europe only.  
 6. Wafer Body only applicable to the 249W.

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