

# Fisher™ FIELDVUE™ DLC3100 and DLC3100 SIS Digital Level Controllers

This manual applies to:

Device Type	130D
Device Revision	1
Hardware Revision	1
Firmware Revision	1.0.9
DD Revision	1

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Figure 1. Fisher DLC3100 Digital Level Controller



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# Section 1

## Introduction and Specifications

### Scope of Manual

This instruction manual is a supplement to the DLC3100 and DLC3100 SIS Quick Start Guide ([D104214X012](#)) that ships with every digital level controller. This instruction manual includes specifications, operating, and maintenance information for FIELDVUE DLC3100 and DLC3100 SIS digital level controllers.

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#### Notes

The DLC3100 SIS is identified by a label affixed to the terminal box cover.

Unless otherwise noted, the information in this document applies to both DLC3100 and DLC3100 SIS. However, for simplicity, the DLC3100 model name will be used throughout.

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This instruction manual supports the 475 Field Communicator with device description revision 1, used with DLC3100 instruments with firmware revision 1.0.9. You can obtain information about the process, instrument, or sensor using the Field Communicator. Contact your [Emerson sales office](#) to obtain the appropriate software.

Do not install, operate, or maintain a DLC3100 digital level controller without being fully trained and qualified in valve, actuator, and accessory installation, operation, and maintenance. To avoid personal injury or property damage, it is important to carefully read, understand, and follow all the contents of this manual, including all safety cautions and warnings. If you have any questions regarding these instructions, contact your Emerson sales office before proceeding.

## Installation, Mounting and Electrical Connections, and Initial Configuration and Calibration using the Local User Interface

Refer to the DLC3100 and DLC3100 SIS Quick Start Guide ([D104214X012](#)) for installation and connection information, as well as initial configuration and calibration using the local user interface. If a copy of this quick start guide is needed contact your Emerson sales office or visit [Fisher.com](#).

### Conventions Used

This manual describes using the Field Communicator to configure and calibrate the digital level controller.

Procedures that require the use of the Field Communicator have the text path and the sequence of numeric keys required to display the desired Field Communicator menu.

### Description

#### DLC3100 Digital Level Controller

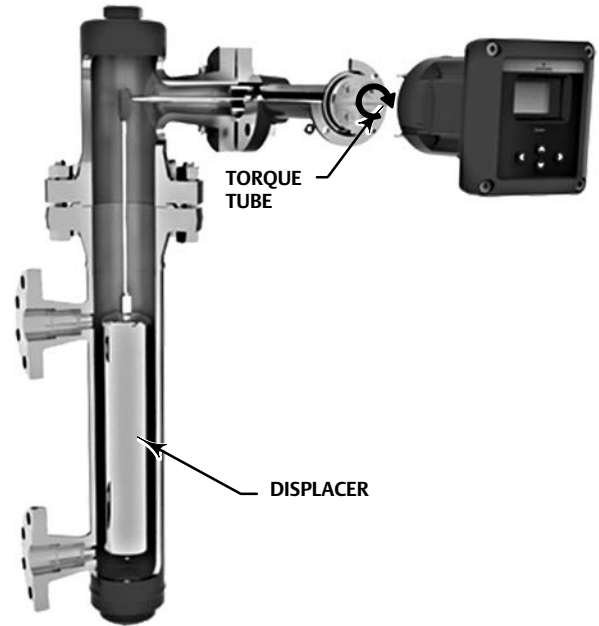
DLC3100 digital level controllers (figure 2) are used with level sensors to measure liquid level, the level of interface between two liquids, or liquid density. Changes in level or density exert a buoyant force on a displacer, which rotates the torque tube shaft (see figure 3). This rotary motion is applied to the digital level controller, transformed to an electrical signal and digitized. The digital signal is compensated and processed per user configuration requirements, and converted back to a 4-20 mA analog electrical signal. See the block diagram in figure 4.

Figure 2. Fisher DLC3100 Digital Level Controller



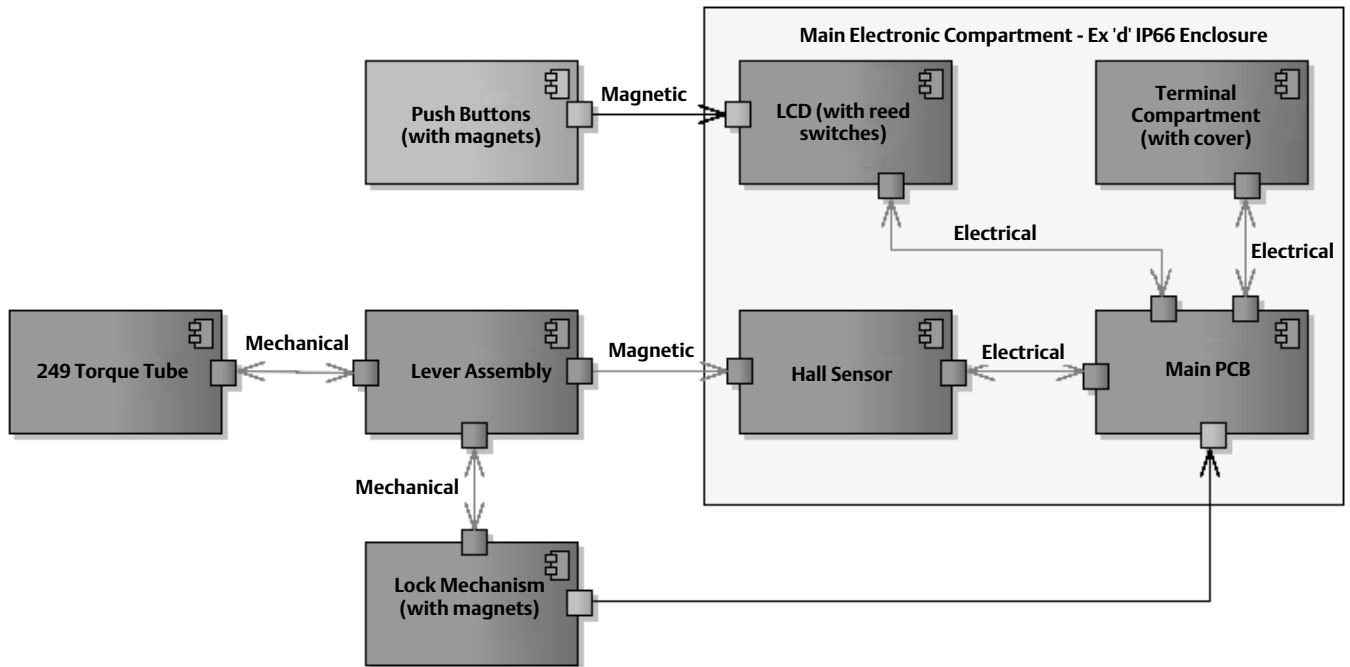
X1461

Figure 3. Fisher 249 Torque Tube Rotation



X1501

Figure 4. Mechanical Architecture



Several operations with the DLC3100 can be performed using the Field Communicator. The digital level controller can be configured, calibrated, or tested. Using the HART protocol, information from the field can be integrated into control systems or be received on a single loop basis.

DLC3100 digital level controllers are designed to directly replace standard pneumatic and electro-pneumatic level transmitters. DLC3100 digital level controllers mount on a wide variety of caged and cageless 249 level sensors. They can also be mounted on other manufacturers' displacer type level sensors with designed mounting kits.

## CAUTION

**There are many magnets used in the DLC3100 (lever assembly, push button, coupling handle). Care must be taken to avoid having a high powered magnet in close proximity. This could cause permanent damage to the DLC3100. Potential sources of damaging equipment include, but are not limited to: transformers, DC motors, stacking magnet assemblies.**

**General Guidelines for use of High Power Magnets:**

**Use of high power magnets in close proximity to any instrument which is operating a process should be avoided. Regardless of the instrument model, high power magnets can affect its functionality.**

## 249 Caged Sensors

249, 249B, 249BF, 249C, 249K and 249L sensors side-mount on the vessel with the displacer mounted inside a cage outside the vessel.

## 249 Cageless Sensors

249BP, 249CP and 249P sensors top-mount on the vessel with the displacer hanging down into the vessel.

249VS sensor side-mounts on the vessel with the displacer hanging out into the vessel.

249W wafer-style sensor mounts on top of a vessel or on a customer-supplied cages.

## Related Documents

Other documents containing information related to the DLC3100 digital level controllers and 249 sensors include:

- FIELDVUE DLC3100 and DLC3100 SIS Quick Start Guide ([D104214X012](#))
- CSA (United States and Canada) Hazardous Area Approvals - DLC3100 Digital Level Controller ([D104232X012](#))
- ATEX and IECEx Hazardous Area Approvals - DLC3100 Digital Level Controller (D104233X012)
- Fisher 249 Caged Displacer Sensors Instruction Manual ([D200099X012](#))
- Fisher 249 Cageless Displacer Sensors Instruction Manual ([D200100X012](#))
- Fisher 249VS Cageless Displacer Sensor Instruction Manual ([D103288X012](#))
- Fisher 249W Cageless Wafer Style Level Sensor Instruction Manual ([D102803X012](#))
- Simulation of Process Conditions for Calibration of Fisher Level Controllers and Transmitters ([D103066X012](#))
- Bolt Torque Information ([D103220X012](#))
- Bulletin 11.2:DLC3100 - FIELDVUE DLC3100 and DLC3100 SIS Digital Level Controllers ([D104216X012](#))
- Bulletin 34.2:249 - Fisher 249 Sensor, Level Controller, and Transmitter Dimensions ([D200039X012](#))

These documents are available from your [Emerson sales office](#) or at Fisher.com.

Table 1. Fisher DLC3100 Specifications

Available Configurations	Transient Voltage Protection										
<p>Mounts on caged and cageless 249 sensors</p> <p>Function: Transmitter</p> <p>Communications Protocol: HART</p> <p><b>Input Signal</b></p> <p>Level, Interface, or Density<sup>(1)</sup>: Rotary motion of torque tube shaft proportional to changes in liquid level, interface level, or density that change the buoyancy of a displacer.</p> <p>Process Temperature: Interface for 2- or 3-wire 100 ohm platinum RTD for sensing process temperature, or optional user-entered target temperature to permit compensating for changes in specific density.</p> <p><b>Output Signal</b></p> <p>Analog: 4 to 20 mA DC</p> <ul style="list-style-type: none"> <li>■ Direct action—increasing level, interface, or density increases output; or</li> <li>■ Reverse action—increasing level, interface, or density decreases output</li> </ul> <p>High saturation: 20.5 mA                      Low saturation: 3.8 mA                      High alarm<sup>(2)</sup>: &gt; 21.0 mA                      Low Alarm<sup>(2)</sup>: &lt; 3.6 mA</p> <p>Digital: HART 1200 Baud Frequency Shift Keyed (FSK)</p> <p>HART impedance requirements must be met to enable communication. Total shunt impedance across the master device connections (excluding the master and transmitter impedance) must be between 230 and 600 ohms.</p> <p>The transmitter HART receive impedance is defined as:                      Rx: 30.2 k ohms and                      Cx: 5.45 nF</p> <p><b>Supply Requirements</b></p> <p>12 to 30 volts DC; 25 mA                      Instrument has reverse polarity protection.</p> <p>A minimum compliance voltage of 17.75 VDC (due to HART impedance requirement) is required to guarantee HART communication.</p>	<table border="1" style="width: 100%; margin-bottom: 10px;"> <thead> <tr> <th colspan="2">Pulse Waveform</th> <th rowspan="2">Max V<sub>CL</sub> @ I<sub>pp</sub> (Clamping Voltage) (V)</th> <th rowspan="2">I<sub>pp</sub> (Peak Pulse Current) (A)</th> </tr> <tr> <th>Rise Time (μs)</th> <th>Decay to 50% (μs)</th> </tr> </thead> <tbody> <tr> <td>10</td> <td>1000</td> <td>48.4</td> <td>12.4</td> </tr> </tbody> </table> <p><b>Electrical Classification</b></p> <p>Overvoltage Category II per IEC 61010 clause 5.4.2d                      Pollution Degree 4</p> <p><b>Altitude Rating</b></p> <p>Up to 2000 meters (6562 feet)</p> <p><b>Ambient Temperature</b></p> <p>The combined temperature effect on zero and span without the 249 sensor is less than 0.02% of full scale per degree Celsius over the operating range -40 to 80°C (-40 to 176°F)</p> <p>LCD operating temperature limits: -20 to 70°C (-4 to 158°F)<sup>(3)</sup></p> <p><b>Process Temperature</b></p> <p>The process density and torque rate are affected by the process temperature (figure 6). Temperature compensation can be implemented to correct for process density changes.</p> <p><b>Process Density</b></p> <p>The sensitivity to error in knowledge of process density is proportional to the differential density of the calibration. If the differential specific gravity is 0.2, and error of 0.02 specific gravity units in knowledge of a process fluid density represents 10% of span.</p> <p><b>Hazardous Area</b></p> <p>CSA                      Class/Division: Intrinsically Safe, Explosion-proof<sup>(4)</sup>, Division 2, Dust Ignition-proof                      Zone: Intrinsically Safe, Flameproof, Type n, Dust by intrinsic safety and Enclosure                      ATEX/IECEX—Flameproof, Intrinsic Safety, Dust by Intrinsic Safety</p> <p><b>Electrical Housing</b></p> <p>IP66, Type 4X</p> <p>Electrical Connections: Two 1/2-14 NPT internal conduit connections. Both are at the bottom of terminal box.</p>	Pulse Waveform		Max V <sub>CL</sub> @ I <sub>pp</sub> (Clamping Voltage) (V)	I <sub>pp</sub> (Peak Pulse Current) (A)	Rise Time (μs)	Decay to 50% (μs)	10	1000	48.4	12.4
Pulse Waveform		Max V <sub>CL</sub> @ I <sub>pp</sub> (Clamping Voltage) (V)	I <sub>pp</sub> (Peak Pulse Current) (A)								
Rise Time (μs)	Decay to 50% (μs)										
10	1000	48.4	12.4								

-continued-

Table 1. Fisher DLC3100 Specifications (continued)

<p><b>Electromagnetic Compatibility</b></p> <p>DLC3100 meets EN61326-1:2013 Performance is shown in table 2</p> <p>DLC3100 SIS meets EN61326-3-2:2008 Performance is shown in table 3</p> <p><b>DLC3100 SIS</b> <b>Safety Instrumented System Classification</b></p> <p>SIL2 capable - certified by exida Consulting LLC</p> <p><b>Performance</b></p> <table border="1"> <thead> <tr> <th>Performance Criteria</th> <th>DLC3100 Digital Level Controller<sup>(1)</sup></th> <th>w/ NPS 3 249W, Using a 14-inch Displacer</th> <th>w/ All Other 249 Sensors</th> </tr> </thead> <tbody> <tr> <td>Independent Linearity</td> <td>± 0.25% of output span</td> <td>± 0.8% of output span</td> <td>± 0.5% of output span</td> </tr> <tr> <td>Hysteresis</td> <td>&lt;0.2% of output span</td> <td>---</td> <td>---</td> </tr> <tr> <td>Repeatability</td> <td>± 0.1% of full scale output</td> <td>± 0.5% of output span</td> <td>± 0.3% of output span</td> </tr> <tr> <td>Dead Band</td> <td>&lt;0.05% of input span</td> <td>---</td> <td>---</td> </tr> <tr> <td>Hysteresis plus Deadband</td> <td>---</td> <td>&lt;1.0% of output span</td> <td>&lt;1.0% of output span</td> </tr> </tbody> </table> <p>NOTE: At full design span, reference conditions. 1. To lever assembly rotation inputs.</p> <p>At effective proportional band (PB)&lt;100%, linearity, dead band, and repeatability are derated by the factor (100%/PB)</p>	Performance Criteria	DLC3100 Digital Level Controller <sup>(1)</sup>	w/ NPS 3 249W, Using a 14-inch Displacer	w/ All Other 249 Sensors	Independent Linearity	± 0.25% of output span	± 0.8% of output span	± 0.5% of output span	Hysteresis	<0.2% of output span	---	---	Repeatability	± 0.1% of full scale output	± 0.5% of output span	± 0.3% of output span	Dead Band	<0.05% of input span	---	---	Hysteresis plus Deadband	---	<1.0% of output span	<1.0% of output span	<p><b>Minimum Differential Specific Gravity</b></p> <p>0.05 SGU</p> <p><b>Construction Material</b></p> <p>Housing and Cover: Low-copper aluminum die casting alloy Internal: Aluminum, and stainless steel; encapsulated printed circuit board Lever assembly: Plated steel, Neodymium iron boron magnets Hall Guard: Thermoplastic elastomer</p> <p><b>Weight</b></p> <p>Less than 3.45 kg (7.57 lb)</p> <p><b>Options</b></p> <ul style="list-style-type: none"> <li>■ Heat insulator (see figure 5 for use guidelines)</li> <li>■ Sunshade ■ Mountings for Masoneilan, Yamatake, Foxboro-Eckhardt sensors ■ Factory Calibration: available for instruments factory-mounted on 249 sensor, when application, process temperature and density are supplied</li> </ul>
Performance Criteria	DLC3100 Digital Level Controller <sup>(1)</sup>	w/ NPS 3 249W, Using a 14-inch Displacer	w/ All Other 249 Sensors																						
Independent Linearity	± 0.25% of output span	± 0.8% of output span	± 0.5% of output span																						
Hysteresis	<0.2% of output span	---	---																						
Repeatability	± 0.1% of full scale output	± 0.5% of output span	± 0.3% of output span																						
Dead Band	<0.05% of input span	---	---																						
Hysteresis plus Deadband	---	<1.0% of output span	<1.0% of output span																						

1. Density application is not available in DLC3100 SIS.  
2. Only one of the High/Low alarm definition is available in a given configuration. Both alarms are NAMUR NE43 compliant.  
3. Outside of this limit, LCD will not be readable but it will not affect the functionality of DLC3100 if the temperature is still within the normal limits. Push buttons will be disabled when instrument temperature is below -20°C (-4°F) or above 70°C (158°F) where LCD display might be intermittent.  
4. Not for use in Ester and Ketone atmospheres.

Table 2. DLC3100 EMC Summary Results—Immunity per EN61326-1

Port	Phenomenon	Basic Standard	Test Level	Test Results <sup>(1)(2)</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
	Radiated power frequency magnetic field	IEC 61000-4-8	30 A/m at 50 and 60 Hz	A
I/O signal/control	Burst	IEC 61000-4-4	1 kV	A
	Surge	IEC 61000-4-5	1kV (line to ground only, each)	B
	Conducted RF	IEC 61000-4-6	150 kHz to 80 MHz at 3 Vrms	A
Protective earth	Burst	IEC 61000-4-4	2 kV	A
	Surge	IEC 61000-4-5	2 kV (line to ground only)	B
	Conducted RF	IEC 61000-4-6	150 kHz to 80 MHz at 3 Vrms	A

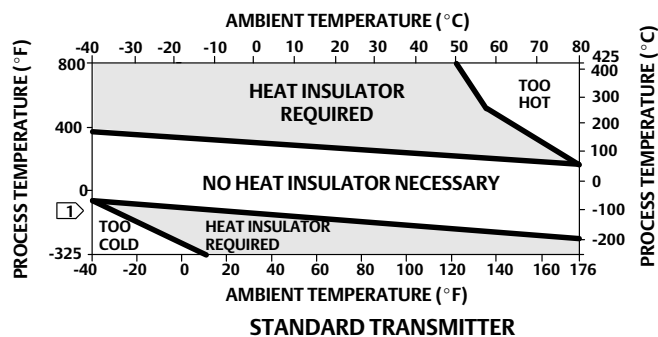
1. A = No degradation during testing. B = Temporary degradation during testing, but is self-recovering. Specification limit = +/- 1% of span.  
2. HART communication was considered as "not relevant to the process" and is used primarily for configuration, calibration, and diagnostic purposes.

Table 3. DLC3100 SIS EMC Summary Results—Immunity per EN61326-3-2

Port	Phenomenon	Basic Standard	Test Level	Test Results <sup>(1)(2)</sup>
Enclosure	Electrostatic discharge (ESD)	IEC 61000-4-2	6 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 @ 10V/m with 1 kHz AM at 80% 2000 to 2700 MHz @ 3V/m with 1 kHz AM at 80%	A
	Radiated power frequency magnetic field	IEC 61000-4-8	100 A/m at 50 and 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)	FS
	Conducted RF	IEC 61000-4-6	10 kHz to 80 MHz at 10 Vrms	A
Protective earth	Burst	IEC 61000-4-4	2 kV	A
	Surge	IEC 61000-4-5	1 kV (line to ground only)	A
	Conducted RF	IEC 61000-4-6	10 kHz to 80 MHz at 10 Vrms	A

1. A = No degradation during testing. B = Temporary degradation during testing, but is self-recovering. FS = Fail Safe. Specification limit = +/- 2% of span.  
2. HART communication was considered as "not relevant to the process" and is used primarily for configuration, calibration, and diagnostic purposes.

Figure 5. 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 5.  
 2. IF AMBIENT DEW POINT IS ABOVE PROCESS TEMPERATURE, ICE FORMATION MIGHT CAUSE INSTRUMENT MALFUNCTION AND REDUCE INSULATOR EFFECTIVENESS.

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A5494-1

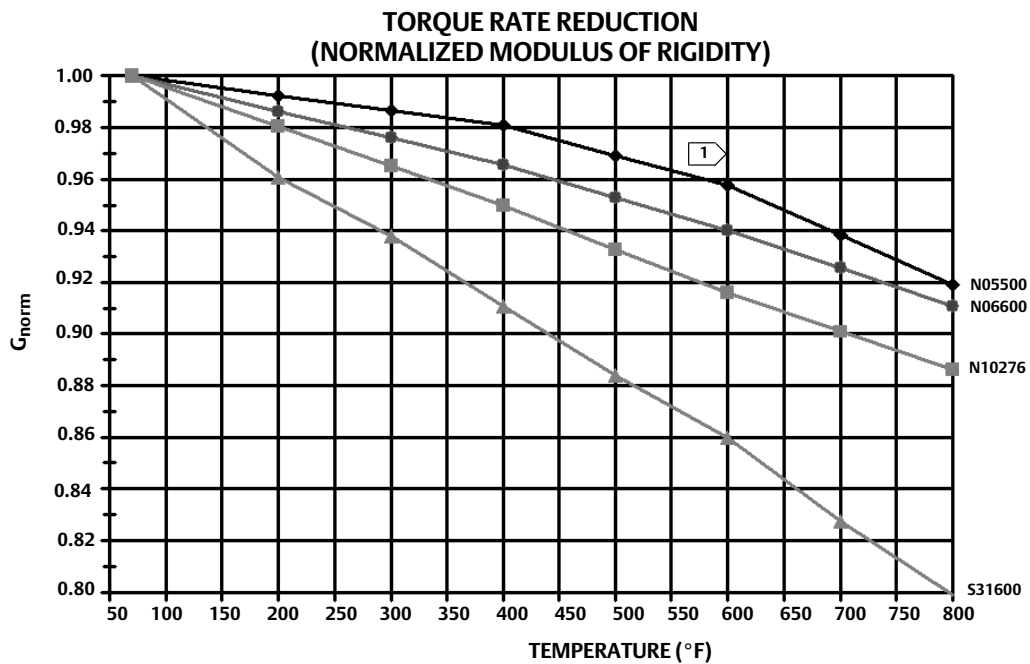
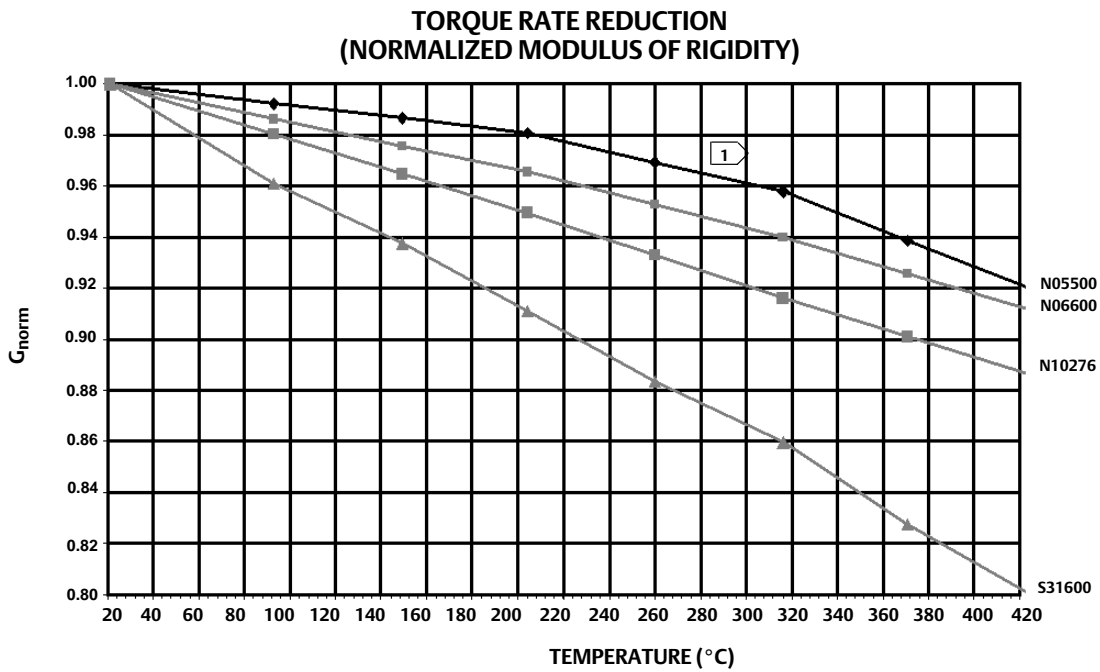
## Educational Services

For information on available courses contact:

Emerson Automation Solutions  
 Educational Services, Registration  
 Phone: +1-641-754-3771 or +1-800-338-8158  
 e-mail: education@emerson.com  
 emerson.com/fishervalvetraining



Figure 6. Theoretical Reversible Temperature Effect on Common Torque Tube Materials



NOTE:  
 1 > DUE TO THE PERMANENT DRIFT THAT OCCURS NEAR AND ABOVE 260°C (500°F), N05500 IS NOT RECOMMENDED FOR TEMPERATURES ABOVE 232°C (450°F).

Table 4. 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 7 and 8 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 7 and 8</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 and are shown in figure 7.</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.</p> <p><b>Construction Materials</b></p> <p>See tables 6, 7, and 8</p> <p><b>Operative Ambient Temperature</b></p> <p>See table 5 For ambient temperature ranges, guidelines, and use of optional heat insulator see figure 5</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 5. Allowable Process Temperatures for Common 249 Sensor Pressure Boundary Materials

MATERIAL	PROCESS TEMPERATURE	
	Min.	Max.
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 6. 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 7. 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
			Raised face flanged		1-1/2
	249K	Steel		Raised face or optional ring-type joint flanged	1-1/2 or 2
			249L		Steel

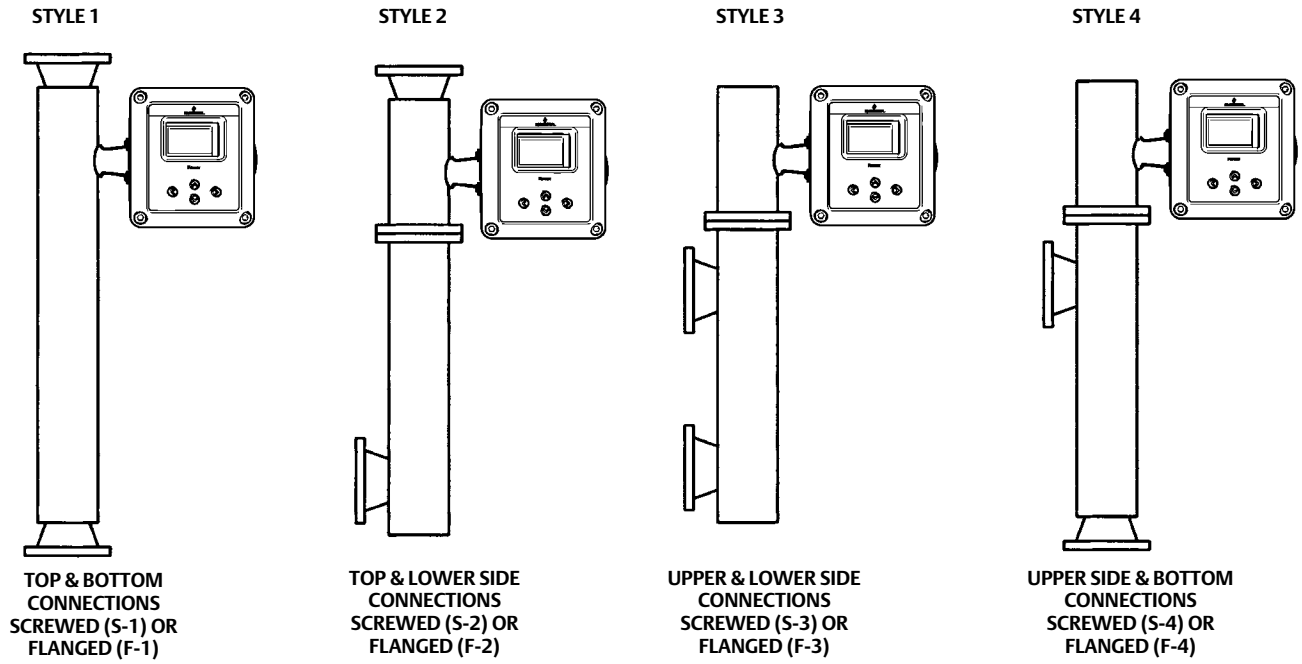
1. Standard displacer lengths for all styles (except 249) are 14, 32, 48, 60, 72, 84, 96, 108 and 120 inches. The 249 uses a displacer with a length of either 14 or 32 inches.  
 2. EN flange connections available in EMA (Europe, Middle East and Africa).  
 3. Not available in EMA.  
 4. The 249BF available in EMA 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.

Table 8. 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	WCC (steel) LCC (steel), or CF8M (316 stainless steel)	For NPS 4 raised face or flat face	CL125, CL150, CL250, CL300, CL600, CL900, or CL1500 (EN PN 10 to DIN PN 160)
		WCC, LCC, or CF8M	For NPS 4 butt-weld end, XXZ	CL2500
Mounts on top of vessel or on customer supplied cage	249W	WCC or CF8M	For NPS 3 raised face	CL150, CL300, or CL600
		LCC 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 EMA only.  
 6. Wafer Body only applicable to the 249W.

Figure 7. Style Number of Equalizing Connections



E1697

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## Section 2

# Electrical Connections

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### Note

This information supplements the Electrical Connections section in the quick start guide ([D104214X012](#)) that shipped with your instrument. If a copy of this quick start guide is needed contact your [Emerson sales office](#) or visit [Fisher.com](#).

---

## Test Connections

### **⚠ WARNING**

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

---

Test connections inside the terminal box can be used to measure loop current across an internal 1 ohm resistor.

1. Remove the terminal box cap.
2. Adjust the test meter to measure mV.
3. Connect the positive lead of the test meter to the + connection and the negative lead to the TEST connection inside the terminal box.
4. Measure Loop current as  $mV = mA$ . For example, if the meter measures 12.5 mV, it means the loop current is 12.5 mA.
5. Remove test leads and replace the terminal box cover.

## Alarm Conditions

Each digital level controller continuously monitors its own performance during normal operation. This automatic diagnostic routine is a timed series of checks repeated continuously. If diagnostics detect a failure in the electronics, the instrument drives its output to trip alarm current either below 3.6 mA or above 21 mA, depending on the position (High/Low) of the alarm switch.

An alarm condition occurs when the self-diagnostics detect an error that would render the process variable measurement inaccurate, incorrect, or undefined, or a user defined threshold is violated. At this point the analog output of the unit is driven to a defined level either above or below the nominal 4-20 mA range, based on the position of the alarm switch. The factory default Alarm Switch setting is High.

Refer to table 9 for alerts that will trigger the Trip Alarm Current when enabled.

Table 9. Trip Alarm Current Default Setting

Alerts	Trip Alarm Current Default Setting
Device Malfunction	Enable
Reference Voltage Failed	Enable
PV Analog Output Readback Limit Failed	Enable
Instrument Temperature Sensor Alert	Enable
Hall Sensor Alert	Enable
RTD Sensor Alert	Enable
Hall Diagnostic Failed	Enable
RTD Diagnostic Failed	Enable
Program Memory Failed	Enable
NVM Error	Enable
RAM Test Error Alert	Enable
Watchdog Reset Executed	Enable
PV HiHi Alert	Disable
PV LoLo Alert	Disable

## Loop Test

### Note

The DLC3100 must be put out of service during Loop Test. Place the loop into manual operation before putting device out of service as the DLC3100 output may not be valid.

When the DLC3100 is out of service, it is locked for exclusive access by the Primary/Secondary master that put it out of service. If the instrument reports Locked by HART or Access Restricted when you attempt to configure it, and a master of the original priority is not available, use Force Mode on the Local User Interface menu to force the instrument mode to In Service. You will then be able to take it out of service with your own master to make changes.

Loop Test can be used to verify the controller output, the integrity of the loop, and the operations of any recorders or similar devices installed in the loop. To initiate a loop test, perform the following procedure:

1. Connect a reference meter to the controller. To do so, either connect the meter to the test connections inside the terminal box (see Test Connections procedure) or connect the meter in the loop as shown in figure 8.
2. Access Loop Test via Service Tools > Maintenance > Tests > Loop Test (3-4-2-2).
3. Select OK after you set the control loop to manual. The Field Communicator displays the loop test menu.
4. Put the instrument to "Not in Service" and select analog output level: 4mA, 20mA or Other to manually input a value between 4 and 20 milliamps.
5. Check the reference meter to verify that it reads the value that is commanded. If the readings do not match, either the controller requires an output trim, or the meter is malfunctioning.

After completing the test procedure, the display returns to the loop test screen and allows you to choose another output value or end the test and put instrument back in service.

## Section 3 Overview

Overview provides information about the current state of the instrument, measurement data, and device variables that are of interest.

### Status

Name	Status	Description
Device	Good	There are no active alerts and instrument is In Service.
	Failure	The highest severity active alert is in the Failure category.
	Maintenance	The highest severity active alert is in the Maintenance category.
	Advisory	The highest severity active alert is in the Advisory category.
Communications	Polled	Communication with digital level controller is established.
	Simulation Active	Digital level controller is in alert simulation mode.
Mode	In Service	Digital level controller is online and performing its function.
	Not In Service	Digital level controller is Out of Service. Output may not be valid.

### Primary Purpose Variables

Name	Description
Process Fluid	Name of the process fluid.
Process Fluid Compensated Density	Density of the process fluid. If temperature compensation is enabled, the density value is after compensation.
PV	Actual measurement in percentage of span.
PV Value	Actual measurement in unit.
Process Temperature	Actual temperature of the process (via RTD or manual input).
Analog Output	Current output of the digital level controller, in milliamps.

### Device Information

#### Identification

Name	Description
Tag	A unique name to identify the HART device, up to 8 characters.
Long Tag	A unique name to identify the HART device, up to 32 characters.
Model	Field device model: DLC3100
Device ID	The ID of the printed wiring board in the instrument.
Instrument Serial Number	Serial number printed on the nameplate of the device.
Sensor Serial Number	Serial number printed on the nameplate of the 249 sensor.
Instrument Assembly Code	Unique code in device for traceability.

## Revisions

Name	Description
HART Universal Revision	The revision number of the HART Universal Commands used by the instrument.
Device Revision	The revision number of the instrument-to-HART communicator interface software.
Hardware	The revision number of the instrument hardware.
Firmware	The revision number of the instrument firmware.

## Alarm Type and Security

Name	Value	Description
Alarm Switch	High	Analog output will be $\geq 21$ mA when Trip Alarm Current is activated.
	Low	Analog output will be $\leq 3.6$ mA when Trip Alarm Current is activated.
Protection	Enable	When protection is enabled, writing to parameters and calibration are not allowed.
	Disable	When protection is disabled, device can be configured and calibrated.



## Section 4

# Configuration and Calibration using AMS Device Manager or a Field Communicator

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### Note

Refer to the DLC3100 and DLC3100 SIS Quick Start Guide ([D104214X012](#)) for configuration and calibration using the local user interface. If a copy of this quick start guide is needed contact your [Emerson sales office](#) or visit Fisher.com.

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DLC3100 has to be set to “Not In Service” during configuration and calibration which include:

- Device Setup
- PV Setup
- Process Setup
- Calibration
- Manual Setup
- Alert Setup

The DLC3100 will continue to regulate the current output based on lever assembly position. The output can be at failed current value (determine by alarm switch on the Main Electronics Board) depending on the device alerts/status. This current output shall not be treated as actual level/interface measurement as the device is “Not In Service”.

### CAUTION

**The control loop must be in manual before putting DLC3100 to Not In Service.**

---

### Note

When configuring the DLC3100 using the DD, the access of DLC3100 via Local User Interface will be locked.

---

If a DLC3100 digital level controller ships from factory mounted on a 249 sensor, initial setup and calibration may not be necessary. The factory enters the sensor data, couples the instrument to the sensor, and calibrates the instrument and sensor combination.

**Note**

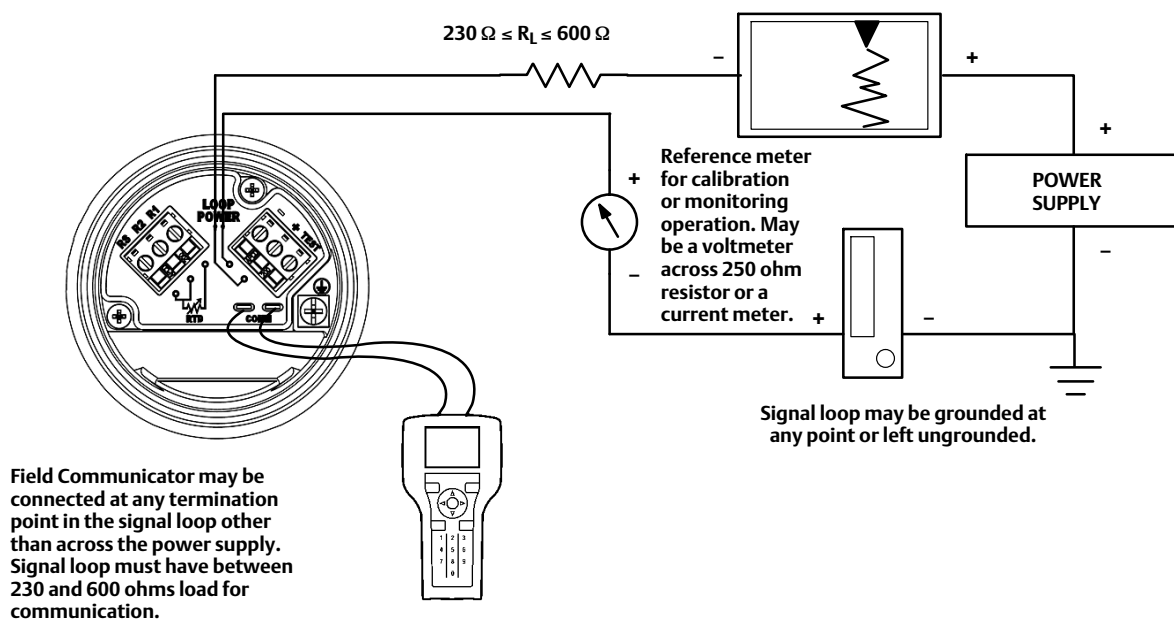
If the digital level controller mounted on the sensor is received with the displacer blocked, or if the displacer is not connected, the instrument will be coupled to the torque tube assembly and the lever assembly unlocked. To place the unit in service, if the displacer is blocked, remove the rod and block at each end of the displacer and check the instrument calibration. (If the “factory cal” option was ordered, the instrument will be pre-compensated to the process conditions provided on the requisition, and may not appear to be calibrated if checked against room temperature with 0% and 100% water level inputs). If the displacer is not connected, hang the displacer on the torque tube.

If the digital level controller mounted on the torque tube arm and the displacer is not blocked when received (such as in skid mounted systems), the instrument will not be coupled to the torque tube assembly, and the lever assembly will be locked. To place the unit in service, couple the instrument to the sensor and unlock the lever assembly.

When the 249 assembly is properly connected and coupled to the digital level controller, establish the zero process condition and perform the Trim Zero procedure. The torque tube rate should not need to be recalibrated.

To review the configuration data entered by the factory, connect the instrument to a 24 VDC power supply as shown in figure 8. Connect the AMS Device Manager/Field Communicator to the instrument and turn it on. Go to Configure and review the data under Manual Setup and Alert Setup. If application data has been changed since the instrument was factory-configured, refer to the Manual Setup section for instructions on modifying configuration data.

Figure 8. Connecting to a Power Supply



For instruments not mounted on a level sensor or when replacing an instrument, initial setup consists of entering sensor information.

Sensor information includes displacer and torque tube information, such as:

- Displacer Information (Length, Volume and Weight)
- Driver Rod Length
- Mounting position (Left or Right of Displacer)
- Torque Tube Material
- Torque Tube Wall
- Measurement Application (Level, Interface or Density)
- Direct/Reverse Action
- Temperature Compensation (Enable/Disable)
- Process Fluid Density

Refer to table 10 for information required to setup the DLC3100. Most of the information is available from the sensor nameplate. The moment arm is the effective length of the driver rod length, and depends upon the sensor type. For a 249 sensor, refer to table 11 to determine driver rod (moment arm) length.

**Table 10. Setup Information**

Description	Value	Units Available in LUI
Displacer Length		mm, cm, m, in, ft
Displacer Volume		mm <sup>3</sup> , cm <sup>3</sup> , L, in <sup>3</sup>
Displacer Weight		G, kg, oz, lb
Driver Rod (Moment Arm) Length		mm, cm, m, in, ft
Mounting		Right of displacer, Left of displacer
249 Sensor		249 Cast, 249A, 249B/249BF, 249BP, 249C, 249CP, 249K, 249L, 249N, 249P (CL150-600), 249P (CL900-2500), 249PT, 249V, 249VS, 249VT (TeeMount), 249VT (SideMount), 249W, 259, Other, Masoneilan, Foxboro-Eckardt, Yamatake Honeywell, Unknown
Torque Tube Material		K-Monel, Inconel, 316SST, Hasteloy C, DuraNickel, Monel, Alloy 20, Incoloy, Hasteloy B2, 304SST, 304L SST, 316L SST, 321SST, 347SST, Custom
Torque Tube Wall		Thin, Standard, Heavy, Unknown
Measurement Application		Level, Interface, Density
Analog Output Action		Direct, Reverse
Fluid Density		SGU, g/cm <sup>3</sup> , g/mL, g/L, kg/m <sup>3</sup> , lb/in <sup>3</sup> , lb/ft <sup>3</sup> , lb/gal, Degrees Baume – Heavy, Degrees Baume – Light, Degrees API <sup>(2)</sup>
2. When setting up the density in Degrees Baume, note of the range supported: Degrees Baume Heavy - 0 degree to 37.6 degree Degrees Baume Light - 10 degree to 100 degree Degrees API - 0 degree to 100 degree		

## Configuration Advice

### Force Mode

Local User Interface	Menu > Force Mode
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When the DLC3100 is out of service, it is locked for exclusive access by the Primary/Secondary master that put it out of service. The same master must be used to put the instrument back in service; another master will not be able to change anything on the device and the LCD will return a “Locked by HART” message, unless you run Force Mode.

Select Force Mode to force the instrument mode to In Service if the original master is not available.

---

#### Note

Make sure no outstanding tasks are on-going in the device, including configuration and calibration, before forcing the DLC3100 In Service

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### Write Protection

To setup and calibrate the instrument, write protection must be set to disable.

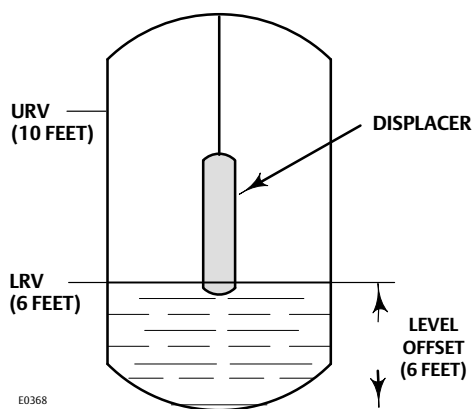
### Level Offset

Level Offset is the value DLC3100 reports when the process level is at the bottom of the displacer. Adding a level offset permits the process variable value in engineering units to be reported with respect to a reference point other than the bottom of the displacer. Examples include: bottom of the process vessel, the process set point, or sea level. Set Level Offset is only available in Level or Interface measurement mode. Follow the prompts on the Field Communicator to enter the offset value (2-3-2-1-6).

Level Offset will affect URV/LRV, PV Hi/Lo, PV HiHi/LoLo alerts. Changing PV alert points assumes you have already considered the affect of Level Offset on the alert points. This parameter should be cleared to zero before running Device Setup.

---

Figure 81. Example of the Use of Level Offset



## Initial Setup

Initial Setup consists of the following:

- Device Setup
- PV Setup
- Process Setup

All three setup procedures must be completed when configuring the DLC3100 in order for the device to function properly.

Initial Setup directs you through initialization of configuration data needed for proper operation. When the instrument comes out of the box, the default dimensions are set for the most common Fisher 249 construction. If any data is unknown, it is generally safe to accept the defaults. The mounting position - left or right of displacer - is important for correct interpretation of positive motion. Use Manual Setup to locate and modify individual parameters when they need to be changed. Refer to the Initial Setup section below for DLC3100 configuration.

---

### Notes

The DLC3100 has to be “Not In Service” when carrying out Initial Setup. Place the loop into manual operation before putting device out of service as the output will not be valid.

When the DLC3100 is out of service, it is locked for exclusive access by the Primary/Secondary master that put it out of service. If the instrument reports Locked by HART or Access Restricted when you attempt to configure it, and a master of the original priority is not available, use Force Mode on the Local User Interface menu to force the instrument mode to In Service. You will then be able to take it out of service with your own master to make changes.

---

Guided setup is available to aid initial setup. Follow the prompts to enter information required by the setup. Most of the information is available from the sensor nameplate.

## Device Setup

AMS Configure > Guided Setup > Device Setup

Field Communicator Configure > Guided Setup > Device Setup (2-2-1)

Input the required information as follows:

- Displacer Information (Length, Weight and Volume)
- Driver Rod Length (refer to table 11 and figure 9)
- Mounting Position (Left or Right of Displacer)
- 249 Sensor Model
- Torque Tube Material and wall thickness

The Driver Rod (moment arm) is the effective length of the driver rod length, and depends upon the sensor type. For a 249 sensor, refer to table 11 to determine driver rod length.

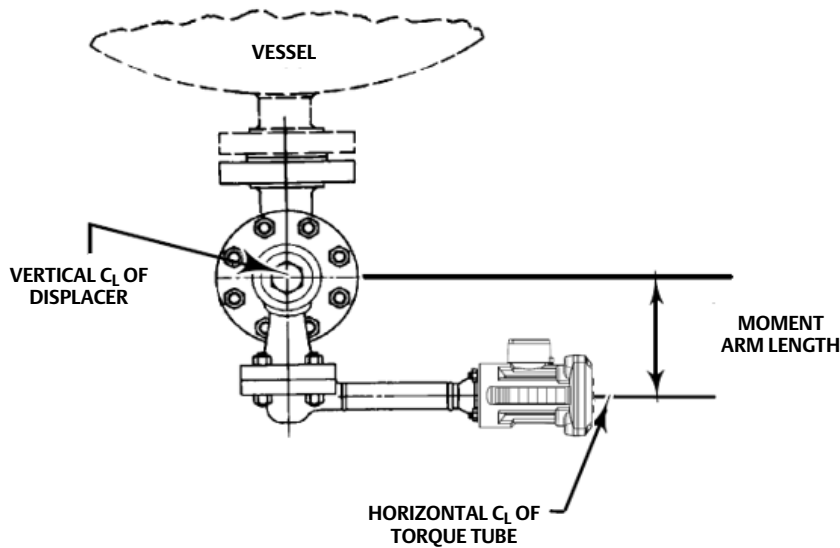
Once Device Setup is completed, configure the application settings using the PV Setup procedures.

Table 11. Driver Rod Length<sup>(1)</sup>

SENSOR TYPE <sup>(2)</sup>	MOMENT ARM	
	mm	Inch
249	203	8.01
249B	203	8.01
249BF	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 (CL125-CL600)	203	8.01
249P (CL900-CL2500)	229	9.01
249VS (Special) <sup>(1)</sup>	See serial card	See serial card
249VS (Std)	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 9. 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.

Figure 9. Method of Determining Moment Arm from External Measurements



## PV Setup

AMS Configure > Guided Setup > PV Setup  
 Field Communicator Configure > Guided Setup > PV Setup (2-2-2)

PV Setup consists of the following:

- Measurement Application (Level, Interface or Density) (see table 12)
- Analog Output Action (Direct or Reverse)
- Level Offset
- Measurement Range (Lower Range Value and Upper Range Value)

### Note

For interface applications, if the 249 is not installed on a vessel, or if the cage can be isolated, calibrate the instrument with weights, water, or other standard test fluid, in level mode. After calibrating in level mode, the instrument can be switched to interface mode, then enter the actual process fluid specific gravity and range values, follow with Trim Zero.

Table 12. Application Information

Measurement Application	Description
Level, Interface	The default process variable units are set to the same units chosen for displacer length. When level offset is changed, range values will be initialized based on level offset and displacer length. The default upper range value is set to equal to displacer length and the default lower range value is set to zero when the level offset is 0.
Density	The default process variable units are set to "SGU" (Specific Gravity Units). The default upper range value is set to "1.0" and the default lower range value is set to "0.1".

When a DLC3100 with analog output is set for direct action the loop current will increase as the fluid level increases. Upper Range Value is the process variable values at 20 mA and Lower Range Value is the process variable values at 4 mA.

Choosing Reverse action will swap the default values of the upper and lower range values. The loop current will decrease as the fluid level increases. Upper Range Value is the process variable values at 4 mA and Lower Range Value is the process variable values at 20 mA.

Once PV Setup is completed configure the process information using the Process Setup procedures.

## Process Setup

AMS Configure > Guided Setup > Process Setup  
 Field Communicator Configure > Guided Setup > Process Setup (2-2-3)

Process Setup consists of the following:

- Process Temperature Input (None, Manual or RTD) (see table 13)
- Fluid Type (Water/Steam, Hydrocarbon, H<sub>2</sub>SO<sub>4</sub> Aqueous Solution or Custom Fluid)
- Fluid Density

Process Temperature Input allows the DLC3100 to know the temperature in the process to carry out temperature compensation. Selecting Manual or RTD will enable the temperature compensation.

**Table 13. Process Temperature Input Information**

Process Temperature Input	Temperature compensation
None	Disable.
Manual	Enable. input process temperature into DLC3100 manually.
RTD	Enable. install RTD to the DLC3100 terminal box. DLC3100 will base on the RTD reading and derive the temperature of the process.

When Temperature Compensation is enabled (by selecting Manual or RTD in Process Temperature Input), select the process fluid type, and enter the temperature/density table. The DLC3100 will use the best matched compensated density value from the pre-loaded fluid type tables in DLC3100 for level measurement based on the actual process temperature. If Custom Fluid is selected, input Temperature/Density values to custom fluid table. For level measurement applications, only the lower fluid table is required. For interface measurement applications, both upper fluid and lower fluid tables are required. Neither table is used for density applications.

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#### Note

A minimum of two pairs of temperature/density values must be entered to the table. The temperatures entered must be in ascending order.

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## Manual Setup

AMS Configure > Manual Setup

Field Communicator Configure > Manual Setup (3)

The DLC3100 digital level controller communicates via the HART protocol. This section describes the advanced features that can be accessed with the DD/Field Communicator.

---

#### Note

Changing setup parameters will require instrument protection to be disabled, and the instrument to be put out of service. Place the loop into manual operation before putting device out of service as the DLC3100 output may not be valid.

When the DLC3100 is out of service, it is locked for exclusive access by the Primary/Secondary master that put it out of service. If the instrument reports Locked by HART or Access Restricted when you attempt to configure it, and a master of the original priority is not available, use Force Mode on the Local User Interface menu to force the instrument mode to In Service. You will then be able to take it out of service with your own master to make changes.

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General

Group	Name	Description
Device Information	Tag	A unique tag to identify the HART device, up to 8 characters.
	Date	Calibration date entered by user.
	Descriptor	A loop descriptor with a maximum length of 16 characters.
	Message	A message with a maximum length of 32 characters.
Serial Numbers	Instrument Serial Number	Serial number on the instrument nameplate.
	Sensor Serial Number	Serial number on the sensor nameplate.
Instrument Clock	Instrument Date	Dynamic date on the instrument clock for use in stamping logged events. The order of year, month and day depends on the setting of the operating system.
	Instrument Time	Time of day (hh:mm:ss) on instrument clock for use in stamping logged events.

Device

Group	Name	Description
Primary Variable	Application	Measurement application: Level, Interface or Density
	PV Upper Range Value	Defines the operational endpoint from which the 20 mA or 100% of the percent range are derived.
	PV Lower Range Value	Defines the operational endpoint from which the 4 mA or 0% of the percent range are derived.
	Primary Value Offset	The primary variable value you want the instrument to report when physical level is at bottom of a displacer.
Analog Output Action	Analog Output Action	Defines whether loop current increases/decreases when level changes. Direct – Loop current increases as the fluid level increases. Reverse – Loop current decreases as the fluid level increases.
Sensor Limits	PV Upper Sensor Limit	Indicates the maximum usable value for the Upper Range value.
	PV Lower Sensor Limit	Indicates the minimum usable value for the Lower Range value.
Damping	PV Damping	Time constant of filter applied to PV signal after all compensation and before generating AO command.
	Input Filter Time	Time constant of filter applied to torque tube sensor input signal.

## Sensor

Group	Name	Description
Sensor Dimensions	Displacer Length	Full length of the displacer.
	Displacer Volume	Volume of the displacer.
	Displacer Weight	Weight of the displacer.
	Driver Rod Length	Length of the moment arm.
	Instrument Mounting	The location of the instrument when mounted on the level sensor, whether it is to the right or left of displacer.
Sensor Units	Length Units	The selected units for length measurements and parameters.
	Volume Units	The selected units for displacer volume.
	Weight Units	The selected units for displacer weight.
	Temperature Units	The selected units for temperature measurements and parameters.
	Fluid Density Units	The selected units for density measurements and parameters.
Torque Tube	Torque Rate Units	Unit of torque rate.
	Compensated Torque Rate	Compound torsion rate of torque tube, pilot shaft, and instrument flexure, computed during calibration.
	Torque Tube Material	Selected torque tube material for torque tube temperature compensation.
	Torque Tube Wall	The thickness of the torque tube used.
	Sensor Type	249 model level sensor used.

## Process

Group	Name	Description
Process Fluid	Process Fluid	Actual process fluid to be measured.
	Process Fluid Compensated Density	Actual fluid density after temperature compensation.
	Fluid Density Units	The selected units for density measurements and parameters.
Temperature Compensation	Process Temperature Input	Temperature input to the instrument via RTD, manually input, or none.
	Process Temperature	Actual temperature of the process.
	Temperature Units	The selected units for temperature measurements and parameters.

HART

Group	Name	Description
Communication Settings	Polling Address	The polling address for the instrument. If a point-to-point configuration is used, enter 0. If a multidrop configuration is used, enter a value in the range of 1 to 62, and disable loop current mode.
Variable Mapping	PV is	Field device dynamic variable that has been mapped into the Primary Variable.
	SV is	Field device dynamic variable that has been mapped into the Secondary Variable.
	TV is	Field device dynamic variable that has been mapped into the Tertiary Variable.
	QV is	Field device dynamic variable that has been mapped into the Quaternary Variable.

Safety Recovery (DLC3100 SIS)

Group	Name	Description
Recovery	Trip Recovery Mode	Auto: DLC3100 SIS is in Trip Alarm Current state; when the alarm current condition is cleared, the instrument will automatically revert back to normal operating current condition.
		Manual: DLC3100 SIS is in Trip Alarm Current state, when the alarm current condition is cleared, instrument will remain in trip alarm current state. You will need to manually reset the instrument by "Safety Reset".

## Alert Setup

### Note

The DLC3100 has to be put out of service when carrying out Alert Setup. Place the loop into manual operation before putting device out of service as the output will not be valid.

When the DLC3100 is out of service, it is locked for exclusive access by the Primary/Secondary master that put it out of service. If the instrument reports Locked by HART or Access Restricted when you attempt to configure it, and a master of the original priority is not available, use Force Mode on the Local User Interface menu to force the instrument mode to In Service. You will then be able to take it out of service with your own master to make changes.

### Primary Variable

Group	Description
PV Alert Deadband	The monitored primary variable must move more than this value to clear the alert.
PV Hi Hi Alert	Indicates that the primary variable has violated the user-specified high high alert point. Output current will be set to alarm current depending on the hardware Alarm Switch configuration.
PV Hi Alert	Indicates that the primary variable has violated the user-specified high alert point.
PV Lo Alert	Indicates that the primary variable has violated the user-specified low alert point.
PV Lo Lo Alert	Indicates that the primary variable has violated the user-specified low low alert point. Output current will be set to alarm current depending on the hardware Alarm Switch configuration.

### Note

PV alert settings will be affected by the analog output action. See tables 14, 15, and 16. When setting analog output action, always check the PV alert settings to make sure the alert thresholds are according to the analog output action.

Table 14. Analog Output Action - Direct

Direct Action (Span = Upper Range Value – Lower Range Value)		
Alarm Variable	Default Value in unit	Default Value in percentage
PV Hi Hi Alarm	Upper Range Value	100%
PV Hi Alarm	95% span + Lower Range Value	95%
PV Lo Alarm	5% span + Lower Range Value	5%
PV Lo Lo Alarm	Lower Range Value	0%

Table 15. Analog Output Action - Reverse

Reverse Action (Span = Lower Range Value – Upper Range Value)		
Alarm Variable	Default Value in unit	Default Value in percentage
PV Hi Hi Alarm	Lower Range Value	0%
PV Hi Alarm	95% span + Upper Range Value	5%
PV Lo Alarm	5% span + Upper Range Value	95%
PV Lo Lo Alarm	Upper Range Value	100%

For example, with a 14 inch displacer, PV Hi and PV HiHi alert will be active when the fluid level goes beyond the alert points. Likewise, PV Lo and PV LoLo will be active when the fluid level falls below the alert points.

Table 16. Example; 14 Inch Displacer

Action	Range Value		PV Alerts	Units	Percentage
Direct	URV	14 in	PV HiHi	13.3 in	95%
			PV Hi	12.6 in	90%
	LRV	0 in	PV Lo	1.4 in	10%
			PV LoLo	0.7 in	5%
Reverse	URV	0 in	PV HiHi	13.3 in	5%
			PV Hi	12.6 in	10%
	LRV	14 in	PV Lo	1.4 in	90%
			PV LoLo	0.7 in	95%

### Rate Limit

Name	Description
Displacer Rise Rate Exceeded	Indicates if the device detected a rise rate that exceeded the limit.
Displacer Fall Rate Exceeded	Indicates if the device detected a fall rate that exceeded the limit.

### Temperature

Name	Description
Process Temperature Deadband	The process temperature must move more than this value to clear the alert.
Instrument Temperature Deadband	The instrument temperature must move more than this value to clear the alert.
Process Temperature Hi Alert	Indicates that the process temperature has violated the user-specified high alert point.
Process Temperature Lo Alert	Indicates that the process temperature has violated the user-specified low alert point.
Instrument Temperature Hi Alert	Indicates that the instrument temperature has violated the user-specified high alert point.
Instrument Temperature Lo Alert	Indicates that the instrument temperature has violated the user-specified the low alert point.

## Operational

Name	Description
Calibration Validity Alert	Indicates that parameters affecting calibration validity have been changed since the last calibration was accepted.
Analog Output Fixed	Indicates that the output is in fixed current mode, not tracking process.
Analog Output Saturated	Indicates that the analog output is saturated at 3.8 mA or 20.5 mA.
PV Out of Limits	Indicates that the process applied to the primary variable is outside the operating limits of the field device.
Non-PV Out of Limits	Indicates that the process applied to the non-primary variable is outside the operating limits of the field device.
Device Malfunction	Indicates that the field device has malfunctioned due to a hardware error or failure.
PV AO Readback Fail	Indicates that the output readback for the primary variable has deviated by the hard-coded limits.
Lever Assembly Locked	Indicates that the lever assembly is in locked position and will not respond to level changes.
Calibration in Progress	Set if a calibration routine is currently running in the instrument.

## Informational

Name	Description
Configuration Changed	Indicates that a modification has been made to the configuration of the field device (configuration variable, tag descriptor or date).
Device Configuration Locked	Indicates that the device is locked for exclusive access or in write-protect mode.
Out of Service	Indicates that the device is not in service.
Cold Start	Indicates that a reset or selftest of the field device has occurred, or power has been removed and reapplied.

## Input Compensation

Name	Description
Fluid Value Crossed	Indicates that process fluid density values have crossed. The upper fluid density is too close to 0.1 SGU or has become greater than the lower fluid density.
Invalid Custom Table	Indicates that the custom process fluid density table or torque tube table being used for temperature compensation is invalid.
Temp Out of Compensation Range	Indicates that the compensation temperature has exceeded the compensation table limits.

## Hardware

Name	Description
Reference Voltage Failed	Indicates that the reference voltage for the Analog/Digital converter is outside the hard-coded limits.
Hall Sensor Alert	Indicates that the hall sensor reading has not been changing for 10 consecutive samples or has violated one of the hard-coded limits.
RTD Sensor Alert	Indicates that the apparent resistance measured at the RTD terminals is less than 10 ohms or greater than 320 ohms.
Hall Diagnostic Failed	Indicates that the internal hall diagnostics has possible failure in the Hall circuitry.
RTD Diagnostic Failed	Indicates that the device has failed to diagnose the integrity of the RTD.
Instrument Temperature Sensor Alert	Indicates that both mainboard temperature sensors are reporting outside operating temperature range or differ by more than 10 degC.

## Program and Memory

Name	Description
Watchdog Reset Executed	Indicates that the watchdog timer has timed out, triggering a hardware reset.
Program Memory Failed	Indicates that the program memory is corrupt.
NVM Error	Indicates that data in the critical section of configuration memory is corrupt.
Program Flow Error	Indicates that the instrument is not performing the expected series of calculations.
EEPROM Write Accumulator	Indicates that the total number of EEPROM writes has exceeded 950,000 cycles.
RAM Test Error Alert	Indicates that an on-going RAM test has detected possible corruption in the critical data.
EEPROM Daily Write Accumulator	Indicates that the total number of EEPROM writes has exceeded 160 times within the day.

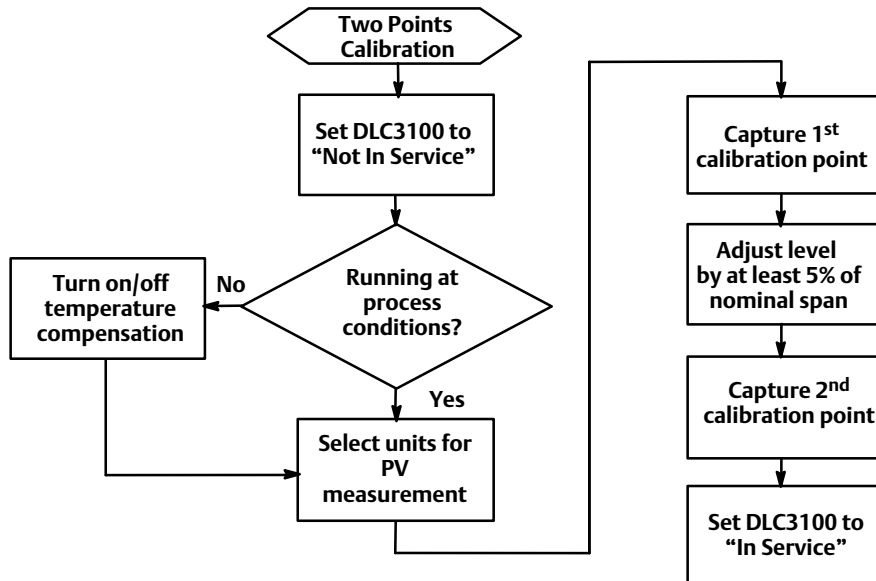
## Alert Record

Name	Description
Alert Record Not Empty	Indicates that the alert record has entries.
Alert Record Full	Indicates that the number of alert events has met or exceeded the storage capacity of the instrument.
Instrument Time Not Set	Indicates that the instrument time was not initialized after the last power cycle.

# Calibration

AMS Configure > Calibration  
 Field Communicator Configure > Calibration (2-4)

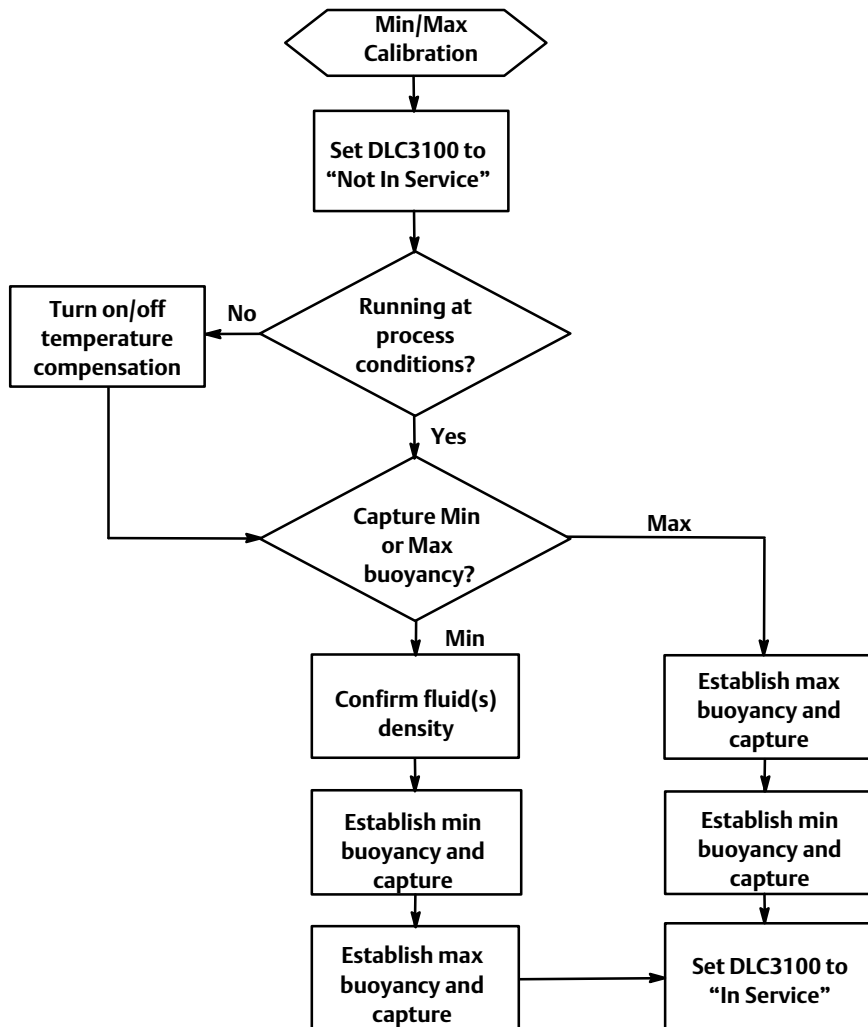
## Two Points Calibration



Two-Points Calibration is usually the most accurate method for calibrating the sensor. It uses independent observations of two valid process conditions, together with the hardware dimensional data and specific gravity information, to compute the effective torque rate of the sensor. The two data points can be separated by any span between a minimum of 5% to 100%, as long as they remain on the displacer. Within this range, the calibration accuracy will generally increase as the data point separation gets larger. Accuracy is also improved by running the procedure at process temperature, as the temperature effect on torque rate will be captured. (It is possible to use theoretical data to pre-compensate the measured torque rate for a target process condition when the calibration must be run at ambient conditions).

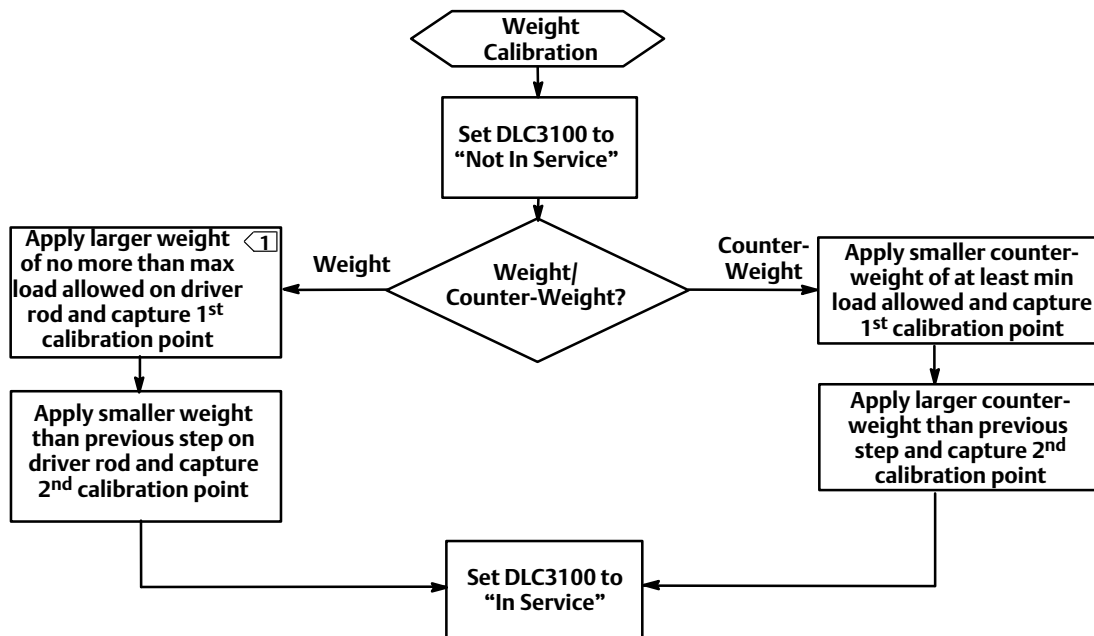


### Min/Max Calibration



Min/Max Calibration can be used to calibrate the sensor if the process condition can be changed to the equivalent of a completely dry and completely submerged displacer, but the actual precise intermediate values cannot be observed (eg. no sight glass is available, but the cage can be isolated and drained or flooded). Correct displacer information and the SG of the test fluid must be entered before performing this procedure.

## Weight Calibration



1 REFER TO TABLE 17 FOR MAXIMUM LOAD ALLOWED ON TORQUE TUBE.

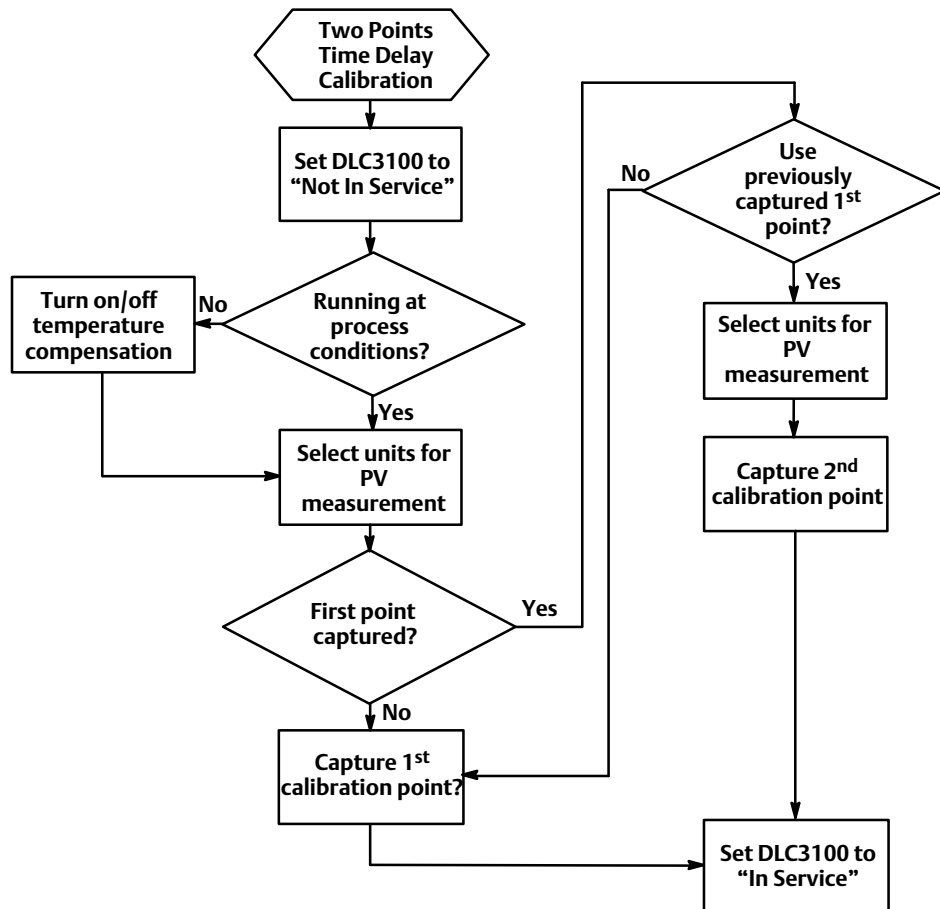
Weight Calibration may be used on the bench or with a calibration jig that can apply a mechanical force to the driver rod to simulate displacer buoyancy changes. It allows the instrument and sensor to be calibrated using equivalent weights or force inputs instead of using the actual displacer buoyancy changes. If the displacer information has been entered prior to beginning the procedure, the instrument will be able to compute reasonable weight value suggestions for the calibration. The weight values suggested during the weight calibration aim to achieve maximum torque tube rotation for better accuracy. It does not necessary mean the weight at 0% or 100%. The only preliminary data essential for the correct calibration of the torque rate is the length of the driver rod being used for the calibration. Weight equivalent to the net displacer weight at two valid process conditions must be available. The sensor must have been sized properly for the expected service, so that the chosen process conditions are in the free motion linear range of the sensor.

Table 17. Maximum Unbuoyed Displacer Weight

Sensor Type	Torque Tube Wall Thickness	Displacer Weight, $W_T$ (lb)
249, 249B, 249BP	Thin	3.3
	Standard	5.0
	Heavy	9.5
249C, 249CP	Standard	4.0
	Heavy	6.4
249VS	Thin	3.0
	Standard	5.5
249L, 249P <sup>(1)</sup>	Thin	4.5
	Standard	8.5
249K	Thin	3.8
	Standard	7.3

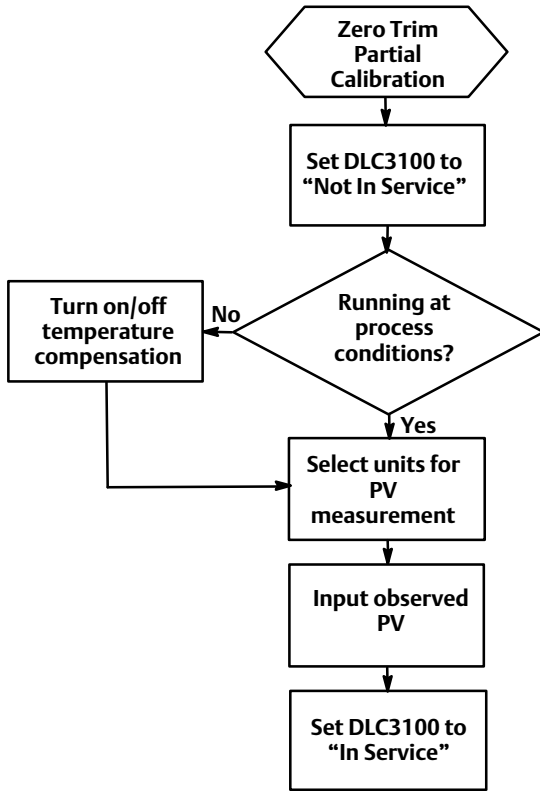
1. High pressure Class 900 through 2500.

### Two Points Time Delay Calibration



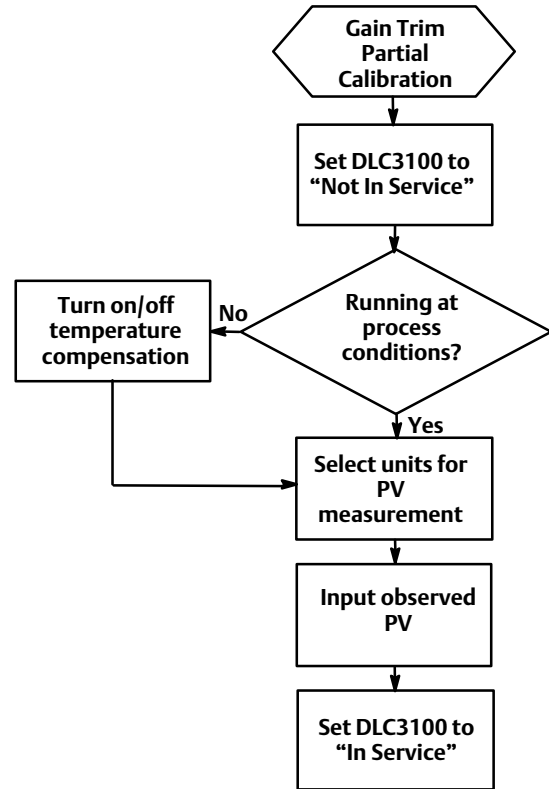
Two Points Time Delay is a two points calibration in which the two points captured can be taken some time apart. The first point is captured and stored indefinitely until the second point is captured. All instrument configuration data is needed to perform a Two Points Time Delay Calibration.

## Zero Trim



Trim Zero computes the value of the input angle required to align the digital Primary Variable with the user's observation of the process, and corrects the stored input zero reference, assuming that the calibration gain is accurate.

## Gain Trim



Gain Trim trims the torque rate value to align the digital Primary Variable with the user's observation. This calibration assumes that sensor zero is already accurate and only a gain error exists. Actual process condition must be nonzero and able to be measured independently. Configuration data must contain density of calibration fluid(s), displacer volume, and driver rod length.

## Torque Rate Gain

Torque Rate Gain allows you to input the torque rate.

## Accuracy Considerations

### Effect of Proportional Band

If a DLC3100 with level sensor is operating at low Proportional Band [PB = 100% times (full span torque tube rotation) / (4.4 degrees)], there will be a degradation factor of about  $(100\%)/(PB\%)$  on the device accuracy specifications.

---

#### Note

This formula is most correct for linearity errors that are relatively steep-sided. If the linearity error curve shape is simple with relatively gradual slope, the net effect of reducing span may be less. Instruments such as the DLC3100, that use a compensation technique to reduce the residual mechanical or electrical non-linearity, will generally have a complex shape for the net-error curve.

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If this is too much degradation, an improvement of 2.0 can be obtained by using a thin-wall torque tube. Additional gain can be achieved by increasing the displacer diameter. Available clearance inside the cage, and the need to keep the net displacer weight at the highest and lowest process conditions within the usable range of the torque tube/driver rod combination, place practical limits on how much the sizing can be adjusted.

With an overweight displacer, the calibration process becomes more difficult as the zero buoyancy condition will occur with the linkage driven hard into a travel stop. In interface measurement application, it is recommended to calibrate with actual process fluids (upper and lower fluids), or set the application to level and use water to calibrate the DLC3100.

### Density Variations in Interface Applications

A high sensitivity to errors in the knowledge of fluid density can develop in some interface applications.

For example: Suppose the whole input span is represented by an effective change in SG of 0.18. Then a change in the actual SG of the upper fluid from 0.8 to 0.81 could cause a measurement error of 5.6% of span at the lowest interface level. The sensitivity to the knowledge of a fluid density is maximum at the process condition where that fluid covers all the displacer, zero at the opposite extreme process condition, and varies linearly between those points.

If the fluid density changes are batch-related or very gradual, it may be practical to keep track of the SG of the fluid and periodically reconfigure the DLC3100 density setting to match the actual process condition. Frequent automatic updates to this variable are not advisable as the NVM location where it is stored has a write limit. If changes are only a function of temperature, the characteristic of the fluid can be loaded once in the density table, and an RTD connected to measure the process temperature and drive the temperature compensation table. If temperature is not the driving influence, the best that can be done is to calibrate for the widest potential differential SG. This will keep the variations as small a percentage of calibrated span as possible. Then calculate an alarm threshold that will prevent vessel over- or under-flow at the worst-case error.

## Extreme Process Temperatures

For applications that will run at extreme temperatures, the effect of process temperature on the torque tube must be considered. Best results are obtained by running the torque tube calibration at actual process temperature. However, the decrease in spring rate with temperature can be simulated at room temperature by increasing the load on the torque tube during room-temperature calibration. This will produce the same deflection that would occur at actual process conditions. This compensation is theoretical and not perfect, but is still an improvement over ambient calibration with no attempt at compensation.

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### Note

For additional information, refer to the Simulation of Process Conditions for Calibration of Fisher Level Controllers and Transmitters instruction manual supplement ([D103066X012](#)), available at Fisher.com.

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## Temperature Compensation

AMS Configure > Manual Setup > Process  
Field Communicator Configure > Manual Setup > Process (2-3-4)

If the process temperature departs significantly from calibration temperature, temperature compensation can be enabled. By selecting Process Temperature Input to either RTD or Manual, the temperature compensation will be enabled. DLC3100 digital level controller will use the correct fluid density from the default fluid table (depending on fluid type selected, see table 18 for example) or custom table (user input) based on the actual process temperature. Custom Table must have ascending temperature inputs.

Table 18. Example Specific Gravity vs Temperature Table for Saturated Water

Data Point	Temperature		Specific Gravity
	°C	°F	
1	26.7	80.0	0.9985
2	93.3	200.0	0.9655
3	176.7	350.0	0.8935
4	248.9	480.0	0.8040
5	304.4	580.0	0.7057
6	337.8	640.0	0.6197
7	354.4	670.0	0.5570
8	365.6	690.0	0.4940
9	371.1	700.0	0.4390
10	374.7	706.5	0.3157

You can also correct the temperature effect by applying a correction factor to the torque tube rate. Interpolate the correction factor from the material-specific tables of theoretical normalized modulus of rigidity versus temperature, as described in Simulation of Process Conditions for Calibration of Fisher Level Controllers and Transmitters ([D103066X012](#)). Multiply the measured torque tube rate (editable in Configure > Calibration > Trim Current Calibration > Torque Tube Gain) by the correction factor and enter the new value. This approach allows a better approximation of the actual torque tube behavior at process conditions when calibration cannot be carried out at process temperature.

## Section 5 Service Tools

### Active Alerts

AMS Service Tools > Alerts

Field Communicator Services Tools > Alerts (3-1)

Alert	Description
Configuration Changed	Any device configuration has been changed (configuration variable, tag descriptor or date).
Calibration Validity	A parameter that directly affects PV calculation has been modified through an inappropriate calibration method.
Cold Start	Power has just been applied to the device or a device reset has occurred.
Analog Output Fixed	The device is in Out of Service mode or in fixed current mode.
PV Hi	PV is above the PV Hi alarm value.
PV Lo	PV is below the PV Lo alarm value.
Process Temperature Too High	Process temperature is above Process Temperature Hi alarm value.
Process Temperature Too Low	Process temperature is below Process Temperature Lo alarm value.
Instrument Temperature Too High	Electronics board temperature is above Electronics Temperature Hi alarm value.
Instrument Temperature Too Low	Electronics board temperature is below Electronics Temperature Lo alarm value.
Alert Event Record Not Empty	There is at least one entry in the device alert event record log.
Alert Event Record Full	The Alert Event Record log has reached its maximum number of 30 entries.
Calibration in Progress	The device is in calibration sequence.
Instrument Time Not Set	Instrument time has not been set since power up.
Device Configuration Locked	Instrument is in write protection mode or it is locked.
Lever Assembly Locked	Lever assembly is in locked position.
Analog Output Saturated	The loop current has been driven to saturation, 3.8 mA or 20.5 mA.
PV Out of Limits	PV is less than 0% or more than 100%.
PV Range Out of Sensor Range	PV has gone beyond 20% of sensor range.
Displacer Rise Rate Exceeded	Level has risen greater than Rapid Rate Limit value.
Displacer Fall Rate Exceeded	Level has fallen greater than Rapid Rate Limit value.
Fluid Values Crossed	SG of two fluids are too close or have crossed.
Invalid Custom Table	Custom table has less than 2 pairs input or temperature inputs are not in ascending order.
Temperature Out of Compensation Range	The current temperature is beyond the valid table temperature range.
Non-PV Out of Limits	Instrument temperature is beyond the operating range. Process temperature is beyond the range of -200 degC to 427 degC. In Level or Interface application, compensated lower SG is outside the range of density limits.
Program Flow Error	Any critical or non-critical tasks missed execution for 5 consecutive cycles.

- continued on next page -

## Active Alerts (continued)

Alert	Description
PV HiHi Alert	The PV has gone above user-adjustable PV HiHi alarm threshold.
PV LoLo Alert	The PV has gone below user-adjustable PV LoLo alarm threshold.
Device Malfunction	Any of the below alerts are active: <ul style="list-style-type: none"> <li>• Hall Sensor Alert</li> <li>• Program Memory Failed</li> <li>• NVM Error</li> <li>• RAM Test Error Alert</li> </ul>
Reference Voltage Failed	Internal reference voltage has deviated more than tolerance.
PV Analog Output Readback Limit Failed	PV Analog Output Readback has deviated from the driven current.
Instrument Temperature Sensor Alert	Electronics temperature sensors have failed.
Hall Sensor Alert	Hall sensor reading is invalid.
RTD Sensor Alert	The sensor reading for the process temperature is invalid.
Hall Diagnostics Failed	Hall current readback has deviated from the driven current.
Program Memory Failed	Ongoing flash checksum operation does not match firmware checksum.
NVM Error	Configuration data affecting the safety critical parameters in the memory is corrupted.
RAM Test Error Alert	Critical RAM data is corrupted.
Watchdog Reset Executed	Watchdog reset has just been performed.

## Tests

AMS Service Tools > Maintenance > Tests

Field Communicator Service Tools > Maintenance > Tests (3-4-2)

Test	Description
Instrument Display	This is a LCD test. It will turn on/off all the pixels on LCD for 3 seconds.
Analog Output	This is a loop test. It allows changing of output current. This test has to be done when the instrument is not in service.



## Reset/Restore Device

AMS Service Tools > Maintenance > Reset/Restore Device

Field Communicator Service Tools > Maintenance > Reset/Restore Device (3-4-1)

Restore Factory Defaults will set the following parameters to default values:

Parameter	Default Setting
Polling Address	0
Instrument Mounting	Right of Displacer
Temperature Compensation	Disable
Process Temperature Input	None
Torque Tube Material	K-Monel
Application	Level
Displacer Length	14 in
Displacer Volume	99 in <sup>3</sup>
Displacer Weight	4.75 lb
Driver Rod Length	8 in
Lower Fluid Density	1 SGU
Torque Rate	8.80662 lb-in/deg
Write Protection	Disable
Trip Recovery Mode (DLC3100 SIS only)	Manual Recovery
PV Damping	0 sec
Input Filter Time	0 sec
Level Offset	0 in
PV HiHi Alert	14 in
PV LoLo Alert	0 in
PV Hi Alert	13.3 in
PV Lo Alert	0.7 in
PV Alert Deadband	0.14 in
HART Universal Revision	7
Instrument Temperature Hi Alert	176 degF
Instrument Temperature Lo Alert	-40 degF
Instrument Temperature Deadband	9 degF
Process Temperature Hi Alert	797 degF
Process Temperature Lo Alert	-328 degF
Process Temperature Deadband	9 degF
Rate Limit	1.778 in
Maximum Recorded Temperature	0 degF
Minimum Recorded Temperature	176 degF

Reset Device is equivalent to power cycle the DLC3100 digital level controller.

## Section 6

# Maintenance and Troubleshooting

The DLC3100 digital level controller features a modular design for easy maintenance. If there is a malfunction, check for an external cause before performing the diagnostics describe in this section.

Sensor parts are subject to normal wear and must be inspected and replaced as necessary. For sensor maintenance information, refer to appropriate sensor instruction manual.

### **⚠ WARNING**

To avoid personal injury, always wear protective gloves, clothing, and eyewear when performing any maintenance 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.

### **CAUTION**

When replacing components, use only components specified by the factory. Always use proper component replacement techniques, as presented in this manual. Improper techniques or component selection may invalidate the approvals and the product specifications, as indicated in table 1. It may also impair operations and the intended function of the device.

## Alert Messages

In addition to the level measurement and output current, the LCD displays abbreviated alert messages for troubleshooting the digital level controller. To check for alert messages, push the left button when the LCD is in Home screen with “ALERTS” shown at the bottom of the LCD. A description of each alert message is shown in table 19.

Table 19. Alert Messages

Alert	Description
DEVICE MALFUNC	Device Malfunction
ANALOG O/P   FIXED	Analog Output Fixed
ANALOG O/P   SATURATED	Analog Output Saturated
NON-PV   OUT OF LIMITS	Non-PV Out of Limits
PV   OUT OF LIMITS	PV Out of Limits
PROG MEM FAIL	Program Memory Failed
TEMP SENSOR	Instrument Temp Sensor
HALL SENSOR	Hall Sensor
HALL DIAG FAIL	Hall Diagnostics Failed
REF VOLT FAIL	Reference Voltage Failed
PV ANALOG O/P   READBACK FAIL	PV Analog Output Readback Limited Failed
RTD DIAG FAIL	RTD Diagnostics Failed
RTD SENSOR	RTD Sensor
CALIBRATION   IN PROGRESS	Calibration In Progress
CAL VALIDITY	Calibration Validity
PROG FLOW ERR	Program Flow Error
INST TIME   NOT SET	Instrument Time Not Set
PV HI	PV Hi
PV HI HI	PV Hi Hi
PV LO	PV Lo
PV LO LO	PV Lo Lo
PROC TEMP   TOO HIGH	Process Temperature Too High
PROC TEMP   TOO LOW	Process Temperature Too Low
INST TEMP   TOO HIGH	Instrument Temperature Too High
INST TEMP   TOO LOW	Instrument Temperature Too Low
FLUID VALUES   CROSSED	Fluid Values Crossed
TEMP OUT OF   COMP RANGE	Temperature Out of Compensation Range
CUSTOM TABLE   INVALID	Invalid Custom Table
RISE RATE   EXCEEDED	Displacer Rise Rate Exceeded
FALL RATE   EXCEEDED	Displacer Fall Rate Exceeded
WATCHDOG RESET	Watchdog Rest Executed
RAM ERROR	RAM Test Error
NVM ERROR	NVM Error
OUT OF SERVICE	Instrument Out of Service
EEPROM WRITE   EXCEEDED	EEPROM Write Exceeded
EEPROM DAILY   WRITE EXCEEDED	EEPROM Daily Write Exceeded

## Hardware Diagnostics

If a malfunction is suspected despite the absence of diagnostic alert messages on the LCD, follow the procedures described in table 20 to verify that the digital level controller hardware and process connections are in good working order. Under each of the major symptoms, specific suggestions are offered for solving problems. Always deal with the most likely and easiest-to-check conditions first.

Table 20. Troubleshooting

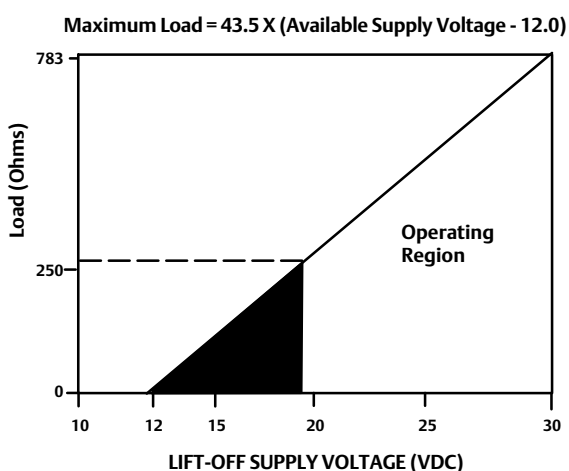
Symptom	Potential Cause	Corrective Action
Analog Output is within valid range but instrument does not communicate with Field Communicator	Device Description	Make sure the Field Communicator has the correct Device Description to communicate with the DLC3100 digital level controller.
	Loop Wiring	Check resistance between the power supply and the Field Communicator connection. The net resistance in the loop must be between 230 and 600ohms for HART communication. Check for adequate voltage to the digital level controller. Refer to figure 10 for requirements. Some models of battery operated field calibrators do not have sufficient compliance voltage to operate a DLC3100 over the entire output current range. Check for excessive capacitance in the field wiring (Isolate the instrument from field wiring and try to communicate locally).
	Terminal Box	The terminal box may have developed a high internal resistance. Try replacing the terminal box electronics board.
	Main Electronics Board	Replace the Main Electronics Board with a known good part.
Output at 0mA	Loop Wiring	Check for open circuit. Check for proper polarity at the +/- terminals. Check for adequate voltage to the digital level controller.
	Terminal Box	Check resistance between Loop Power "+" and "T" terminals of terminal box. If greater than 1.1 ohm, the terminal sense resistor may be damaged. Replace the terminal box electronics.
	Main Electronics Board	Replace the Main Electronics Board with a known good part.
Fixed Output at <= 3.6mA	Alarm Condition (Alarm Low setting)	Check LCD for alert messages to isolate failures. For DLC3100 SIS, check if the digital level controller is locked in safety and requires a manual reset. Check PV against the PV HiHi and PV LoLo alarm threshold and deadband setting, if these alarms are enabled.
Fixed Output at 3.8mA	Low Saturation	Check the PV against the upper and lower range values. Check actual process condition and calibration adjustments.
Fixed Output at 20.5mA	High Saturation	Check the PV against the upper and lower range values. Check actual process condition and calibration adjustments.
Fixed Output at >= 21mA	Alarm Condition (Alarm High setting)	Check LCD for alert messages to isolate failures. For DLC3100 SIS, check if the digital level controller is locked in safety and requires a manual reset. Check PV against the PV HiHi and PV LoLo alarm threshold and deadband setting, if these alarms are enabled.
Output is within 4-20mA range, but does not track displayed PV value: <ul style="list-style-type: none"> <li>• Gain error</li> <li>• Low saturation occurs at value higher than 3.8mA</li> <li>• High saturation occurs at a value lower than 20.5mA</li> </ul>	Main Electronics Board	Connect the Field Communicator and run a Loop Test. If the forced output does not track the commands, replace the Main Electronics Board.
Output Drifting while at fixed process input	Sensor	Check torque tube rate change versus temperature per figure 6. Use appropriate material for process temperature. Pre-compensate the calibration for target process condition.
	Transducer Module	Connect the Field Communication and check instrument temperature. If instrument temperature value is extreme, replace the whole DLC3100 digital level controller.
	Main Electronics Board	Connect the Field Communicator and run Loop Test. Leave instrument in fixed current mode at 12 mA command and observe analog output variation with ambient temperature. If drift exceeds specifications, replace the main electronics board.
	Configuration Data	Connect the Field Communicator and check stored Specific Gravity values against independent measurement of process density. If process SG has changed from calibration values, correct the SG in configuration to match the process.

-continued-

Table 20. Troubleshooting (continued)

Symptom	Potential Cause	Corrective Action
Erratic Output	Loop Wiring	If output current enters a limit cycle between zero and a value within the 4-20 mA range when level reaches some arbitrary upper threshold, check for excessive loop resistance or low compliance voltage.
Erratic display on LCD	Loop Wiring	Check for excessive loop resistance or low compliance voltage.
	LCD Assembly	Replace front cover assembly with known good part.
Push Buttons Stuck	Push Buttons Assembly	Replace front cover assembly.

Figure 10. Power Supply Requirements and Load Resistance



## Removing the DLC3100 from the Sensor

Because the DLC3100 digital level controller has a modular design, most of the service and maintenance to the digital level controller can be done without removing it from the sensor. However, if it is necessary to replace sensor to instrument mating parts or parts in the transducer housing, or to perform bench maintenance, perform the following procedures to remove the digital level controller from the sensor.

### **⚠ WARNING**

**On an explosion proof instrument, remove the electrical power before removing the instrument covers in a hazardous area. Personal injury or property damage may result from fire and explosion if power is applied to the instrument with the covers removed.**

## Tools Required

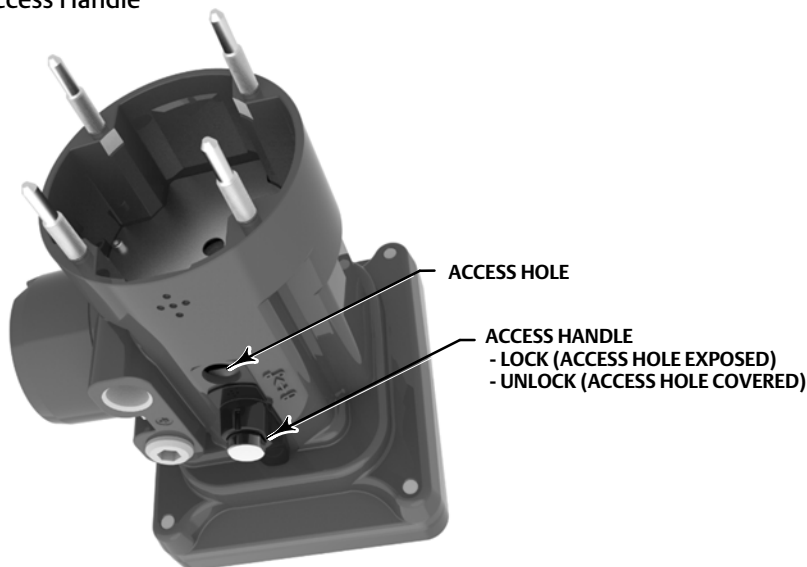
Table 21 lists the tools required for maintaining the DLC3100 digital level controller.

Table 21. Tools Required

Tool	Size	Usage
Hex Key	2 mm	Terminal box cover set screw (key 34)
Hex Key	6 mm	Front Cover screws (key 49)
Hex Key	4 mm	Lever assembly mount cap screws (key 11)
Hex Socket	10 mm	Coupling nut
Open-end	13 mm	DLC3100 mounting nuts (key 15)
Small Flat Blade Screwdriver	---	Terminal screws Electronics module mounting screws

1. Loosen the set screw (key 34) in the terminal box cover assembly (key 7) so that the cover can be unscrewed from the terminal box.
2. After removing the cover, note the location of field wiring connections and disconnect the field wiring from the wiring terminals.
3. As shown in figure 11, locate the access handle on the bottom of the transducer housing. Push the handle button and slide toward the front of the DLC3100 (locked position), to expose the access hole. Be sure the locking handle drops into the detent.

Figure 11. Access Handle



X1499

### Note

If the access handle will not slide, the sensor linkage is most likely in an extreme position. When the lever assembly is at a hard stop inside the housing, the locking pin on the access door may not be able to engage the mating slot in the lever assembly. This condition can occur if the displacer has been removed, if the sensor is lying on its side, or if the instrument had been coupled to the sensor while the displacer was not connected. To correct this condition, manipulate the sensor linkage to bring the lever assembly to within approximately 4 degrees of the neutral position before attempting to slide the handle. A probe inserted through the top vent of the 249 head may be required to deflect the driver rod to a position where the lever assembly is free.

4. Using a 10 mm deep well socket inserted through the access hole, loosen the shaft clamp (figure 11).
5. Loosen and remove the hex nuts (key 15) from the mounting studs (key 14).

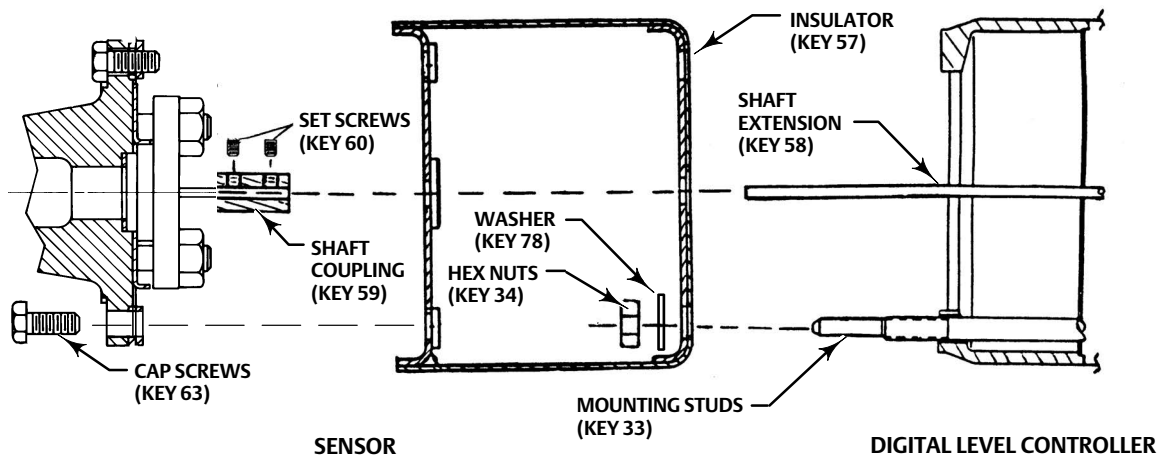
**CAUTION**

**Tilting the instrument when pulling it off of the sensor torque tube can cause the torque tube shaft to bend. To prevent damage to the torque tube shaft, ensure that the digital level controller is level when pulling it off the sensor torque tube.**

6. Remove the digital level controller as follows:
  - For standard temperature applications carefully pull the digital level controller straight off the sensor torque tube.
  - For high temperature applications carefully pull the digital level controller straight off the sensor torque tube shaft extension (key 58), shown in figure 12, and continue on with step 7.
7. Pull the heat insulator (key 57) off the mounting studs.

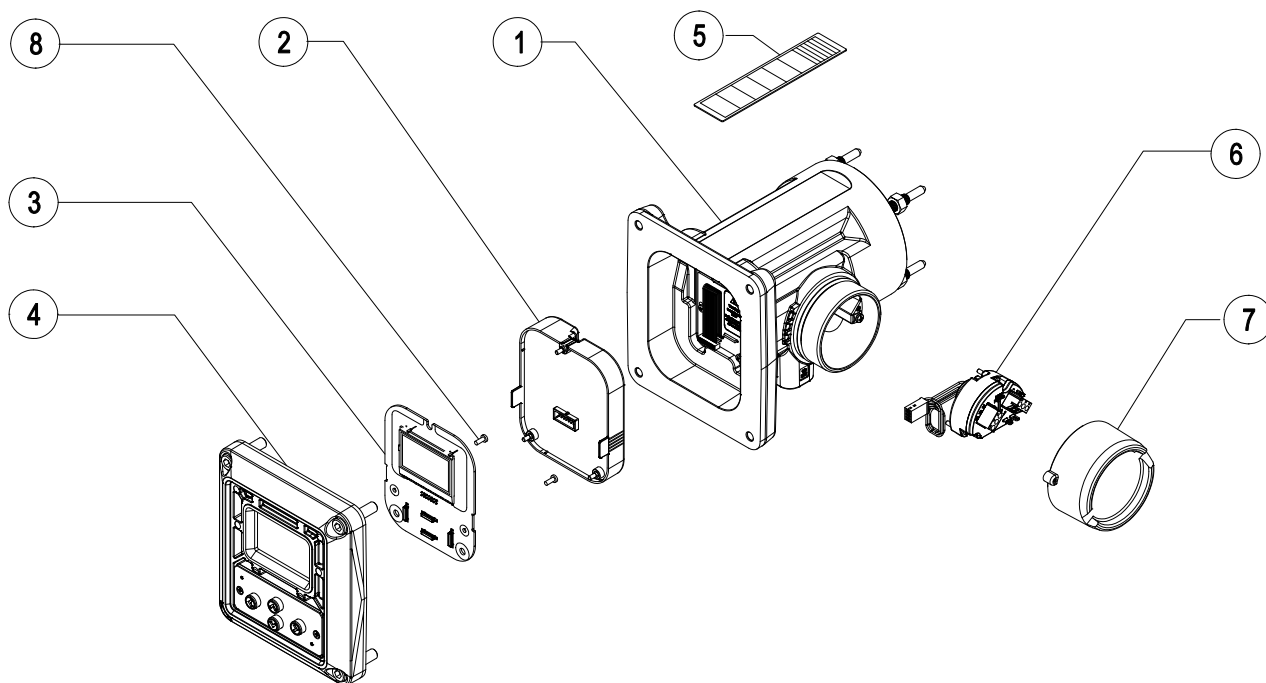
When re-installing the digital level controller, follow the appropriate procedure outlined in the quick start guide ([D104214X012](#)). Setup the digital level controller as described in the Initial Setup section.

Figure 12. Digital Level Controller Mounting on Sensor in High Temperature Applications



B2707

Figure 13. DLC3100 Assembly Drawing



GG25866

## Front Cover Assembly

### **⚠ WARNING**

In an explosion proof or flame proof installation, remove the electrical power before removing the instrument covers in a hazardous area. Personal injury or property damage may result from fire and explosion if power is applied to the instrument with the covers removed.

### Removing the Front Cover Assembly

Perform the following procedure to remove the front cover assembly:

1. Disconnect power to the digital level controller.
2. Loosen the four cap screws (key 49) and pull the front cover out slowly, as the main electronics board is connected to the hall sensor electronics board cable and terminal box cable.
3. Disconnect the hall sensor board and terminal box electronics board cables from the main electronics board.
4. Unscrew the three screws holding the main electronics board and remove it from the LCD assembly.
5. Remove the two screws holding the LCD assembly and remove it from the front cover assembly.



## Replacing the Front Cover Assembly

Perform the following procedure to replace the front cover assembly:

1. Mount the LCD assembly onto the front cover assembly and tighten the two screws.
2. Mount the main electronics board onto the LCD assembly and tighten the three screws.
3. Connect the cables from the hall sensor board and terminal box electronics board to the main electronics board.
4. Make sure the O-ring is in place and install the front cover assembly to the digital level controller housing with the four cap screws, and tighten to 35 N • m (310 lbf • in).

## Main Electronics Board

### Removing the Main Electronics Board

---

**Note**

The Main Electronics Board is potted and it is a non-repairable unit. If a malfunction occurs, the entire main electronics board must be replaced.

---

### **⚠ WARNING**

**On an explosion proof instrument, remove the electrical power before removing the instrument covers in a hazardous area. Personal injury or property damage may result from fire and explosion if power is applied to the instrument with the covers removed.**

---

1. Disconnect power to the digital level controller.
2. Remove the front cover and disconnect the cables of the hall sensor board and the terminal box electronics board connected to the main electronics board.
3. Unscrew the three screws holding the main electronics board.
4. Firmly grasp the Main Electronics Board and remove it from the LCD assembly.

### Replacing the Main Electronics Board

Perform the following procedure to replace the main electronics board:

1. Mount the main electronics board onto the LCD assembly.
2. Tighten the three mounting screws.
3. Install the cables of the hall sensor board and the terminal box electronics board to the main electronics board.
4. Install the front cover with the four cap screws and tighten to 35 N • m (310 lbf • in) torque value.

## LCD Assembly

### Removing the LCD Assembly

#### **⚠ WARNING**

**On an explosion proof instrument, remove the electrical power before removing the instrument covers in a hazardous area. Personal injury or property damage may result from fire and explosion if power is applied to the instrument with the covers removed.**

1. Disconnect power to the digital level controller.
2. Remove the front cover and disconnect the cables of the hall sensor board and the terminal box electronics board connected to the main electronics board.
3. Remove the main electronics board
4. Loosen the two screws holding the LCD assembly to the front cover assembly.

### Replacing the LCD Assembly

Perform the following procedure to replace the LCD assembly:

1. Mount the LCD assembly onto the front cover assembly.
2. Tighten the two mounting screws.
3. Connect the main electronics board to the LCD assembly and tighten the three mounting screws.
4. Install the cables from the hall sensor board and the terminal box electronics board to the main electronics board.
5. Install the front cover to the housing with the four cap screws and tighten to 35 N • m (310 lbf • in) torque value.

## Terminal Box Electronics Board

The terminal box is located at the side of the housing and contains the terminal strips for field wiring connections.

#### **⚠ WARNING**

**On an explosion proof instrument, remove the electrical power before removing the instrument covers in a hazardous area. Personal injury or property damage may result from fire and explosion if power is applied to the instrument with the covers removed.**

### Removing the Terminal Box Electronics Board

1. Disconnect power to the digital level controller.
2. Loosen the four cap screws and remove front cover assembly. Disconnect the terminal box electronics board cable connected to the main electronics board.
3. Loosen the set screw (key 34) in the terminal box cover assembly (key 7) so that the cover can be unscrewed from the terminal box.

4. After removing the cover (key 35), note the location of field wiring connections and disconnect the field wiring from the wiring terminals.
5. Remove the screw (key 68) and pull out the terminal box electronics board.

## Replacing the Terminal Box Electronics Board

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### Note

Inspect all O-rings for wear and replace as necessary.

---

1. Orient the terminal box electronics board and carefully insert into the housing.
2. Ensure the cable of the terminal board electronics board goes through the housing.
3. Tighten the screws of the terminal box electronics board to the housing.
4. Connect the terminal box electronics board cable to the main electronics board.
5. Install the front cover assembly to the housing and tighten the four cap screws.
6. Connect the field wiring to the terminals on the terminal box electronics board.
7. Screw the terminal box cover assembly (key 7) completely onto the terminal box to seat the O-ring (key 16). Loosen the cover (not more than 1 turn) until the set screw (key 24) aligns with one of the recesses in the terminal box beneath the cover. Tighten the set screw to engage the recesses but not more than 0.88 N•m (7.8 lbf•in).

## Packing for Shipment

If it becomes necessary to return the unit for repair or diagnosis, contact your [Emerson sales office](#) for returned goods information.

### CAUTION

**Lock the lever assembly when shipping the standalone instrument, to prevent damage to the flexure.**  
**Use the original shipping carton if possible.**

---

## Section 7 Parts

### Parts Ordering

Whenever corresponding with your [Emerson sales office](#) about this equipment, always mention the controller serial number.

#### **⚠ WARNING**

**Use only genuine Fisher replacement parts. Components that are not supplied by Emerson Automation Solutions should not, under any circumstances, be used in any Fisher instrument. Use of components not supplied by Emerson may void your warranty, might adversely affect the performance of the instrument, and could cause personal injury and property damage.**

### Parts Kits

Kit	Description	Part Number
1*	Small Hardware Spare Parts Kit	GG51086X012
	<b>Includes</b>	<b>Qty/kit</b>
	Set screw, key 34	2
	Cap screw, key 21	2
	Wire Retainer, key 17	2
	Wire Retainer, key 18	2
	Cap screw, key 11	2
	Cap screw, key 13	4
	Hex nut, key 15	8
	Machine screw, key 8	4
	Stud, key 14	8
2*	Spare O-Rings Kit	GG51085X012
	<b>Includes</b>	<b>Qty/kit</b>
	Key 16	2
	Key 37	8
	Key 38	2
	Key 70	2

### Parts List

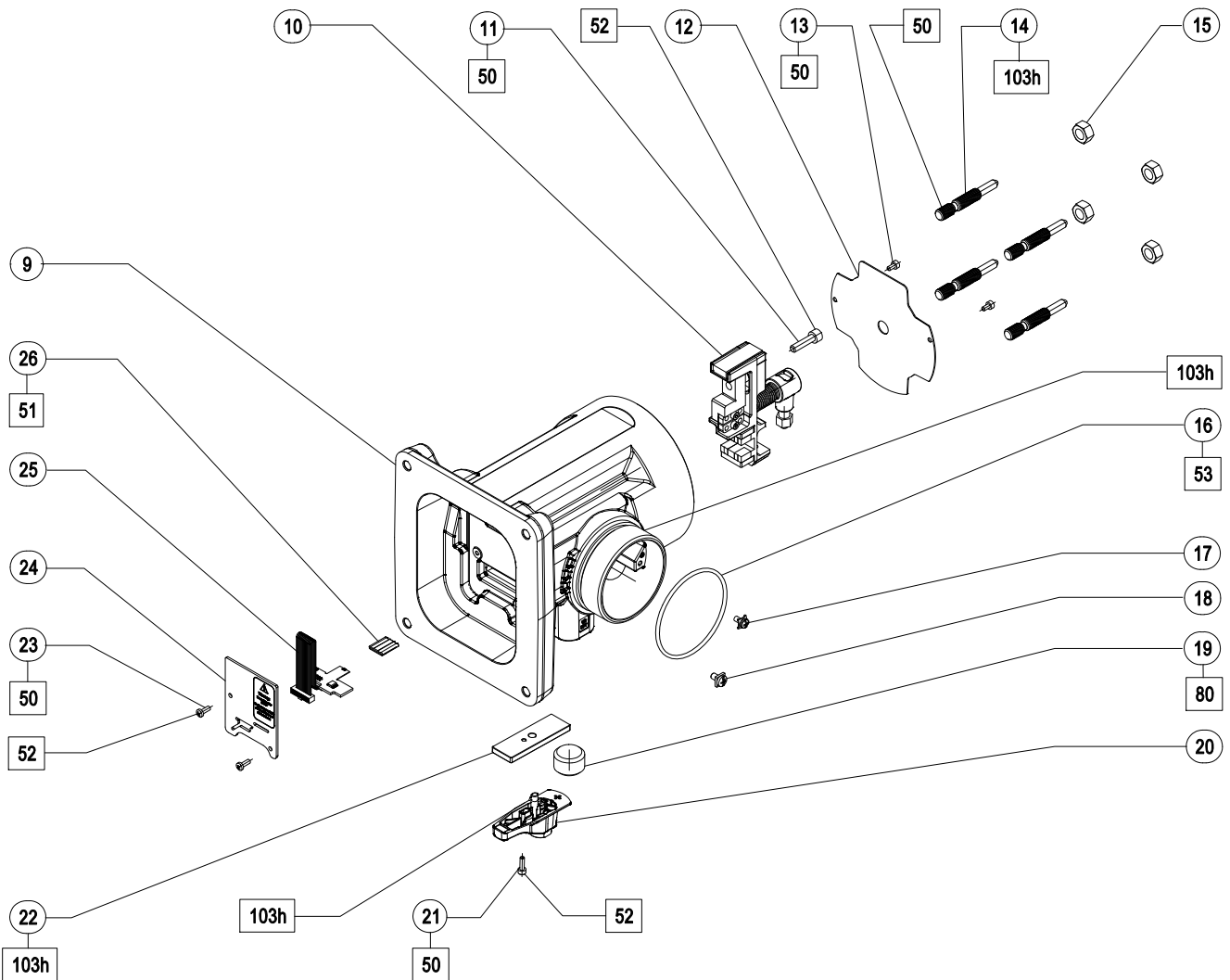
Refer to figure 14 and 15.

#### **Note**

Contact your Emerson sales office for Part ordering information.

Key	Description	Part Number
1	Housing Assembly	
2	Main Board Assembly	
3	LCD Assembly	GG25852X012
4	Cover Assembly	GG25861X012
5	Nameplate, instrument	
6	Terminal Box Assembly	GG25784X012
7	Terminal Cover Assembly	GG25788X012
8	Screw, machine	
9	Transducer Housing	
10	Lever Assembly	
11	Screw, cap	
12	Shield, coupling	
13	Screw, cap	
14	Stud	
15	Nut, hex	
16	O-ring	
17	Wire Retainer	
18	Wire Retainer	
19	Pipe Plug	

Figure 14. Fisher DLC3100 Digital Level Controller Assembly

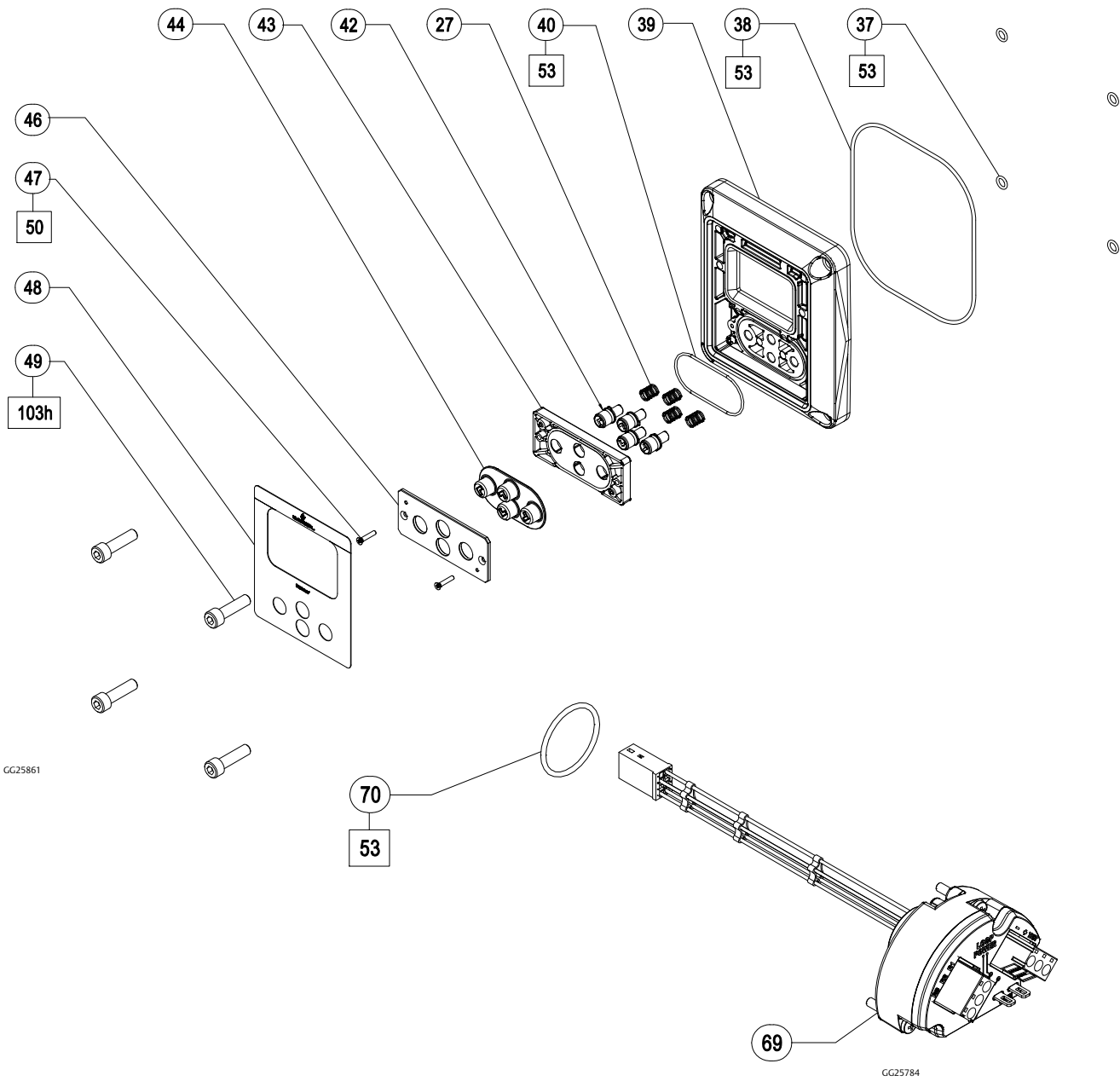


GG25838

APPLY LUBRICANT/ADHESIVE/THREADLOCK

Key	Description	Key	Description
20	Handle Assembly	59	Potting compound
21	Screw, cap	60	Magnet
22	Guide, inner	61	Button, sticker
23	Screw, machine	62	Pipe Thread Sealant
24	Bracket, plate	67	Label, blank
25	PCBA, Sensor	68	Screw, machine
26	Hall Sensor Guard	69	Terminal Box Assembly
		70	O-ring
27	Spring, compression	71	Wire Assembly
28	Button, striker	72	Terminal Box Assembly
29	Pin, locking		
30	Handle	100	Coupling Block Subassembly
31	Handle	100a	Coupling Block
32	Magnet	100b	Insert, front
33	Adhesive	100c	Insert, back
34	Screw, set		
		101	Lever Subassembly
35	Terminal Box Cap	101a	Lever
37	O-ring	101b	Roll Pin
38	O-ring	101c	Coupling Bellows
39	Cover Assembly	101d	Counter Weight
40	O-ring	101e	Adhesive, 3M Scotch
42	Button, striker		
43	Retainer	102	Magnet and Lever Subassembly
44	Button, membrane	102a	Backup Plate
46	Retainer	102b	Magnet
		102c	Adhesive
47	Screw, countersunk	102d	Activator
48	Plate, face		
49	Screw, cap	103a	Bolt, lock
50	Adhesive, Loctite	103b	Washer, lock, spring
51	Sealing Compound	103c	Nut, clamp
52	Sealant	103d	Block, flexure
53	Lubricant, silicone sealant	103e	Flexure
54	Screw, machine	103f	Clamp, flexure
55	Retainer, screen	103g	Screw, cap
56	Cover	103h	Lubricant, grease
57	O-ring	103j	Adhesive, structural
58	Cover, front	103k	Activator
		103m	Loctite 499

Figure 15. Fisher DLC3100 Digital Level Controller Assembly



# Mounting Kits

**Note**

Contact your [Emerson sales office](#) for information on ordering the following mounting kits or for information on the availability of additional mounting kits.

Key Description

## 249 Sensors with Heat Insulator (figure 16)

- 57 Heat Insulator,
- 58 Shaft Extension
- 59 Shaft Coupling
- 60 Set Screw, hex socket (2 req'd)
- 61 Screw, hex hd (4 req'd)
- 78 Washer, plain (4 req'd)

Key Description

## Masoneilan Sensors (figures 17 and 18)

### 12100 or 12800 without Heat Insulator

- 58 Shaft Extension
- 59 Shaft Coupling
- 60 Set Screw, hex socket (2 req'd)
- 61 Screw, hex hd (4 req'd)
- 62 Mounting Adapter
- 63 Screw, hex socket, (4 req'd)

### 12100 or 12800 with Heat Insulator

- 57 Heat Insulator
- 58 Shaft Extension
- 59 Shaft Coupling
- 60 Set Screw, hex socket (2 req'd)
- 61 Screw, hex hd (4 req'd)
- 62 Mounting Adapter
- 63 Screw, hex socket (4 req'd)
- 78 Washer, plain (4 req'd)

Figure 16. Mounting Kit for 249 Sensors with Heat Insulator

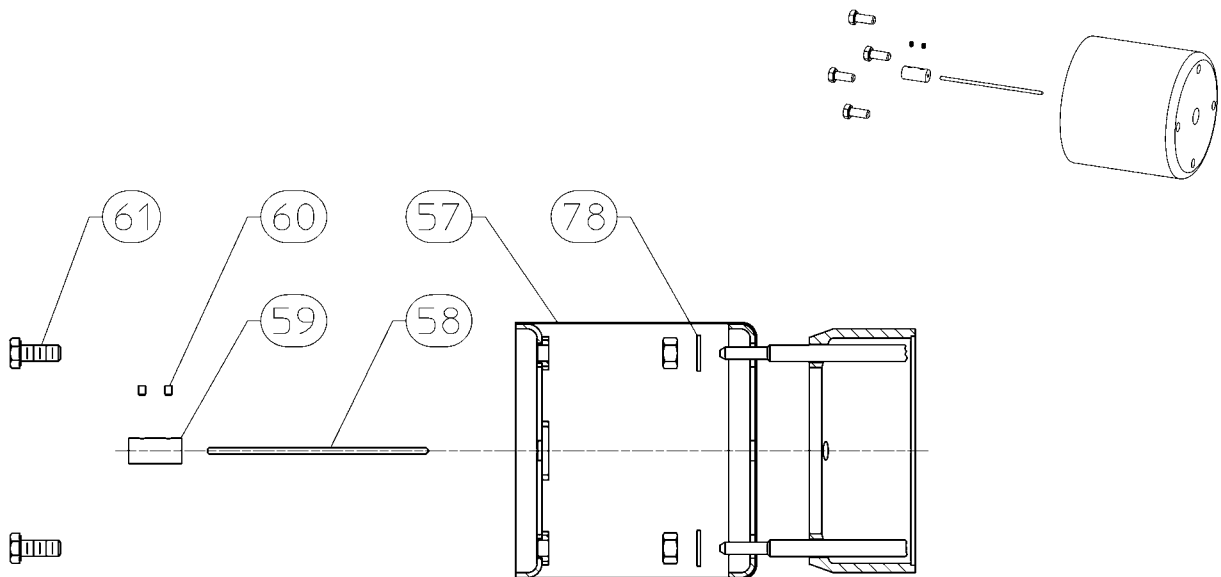
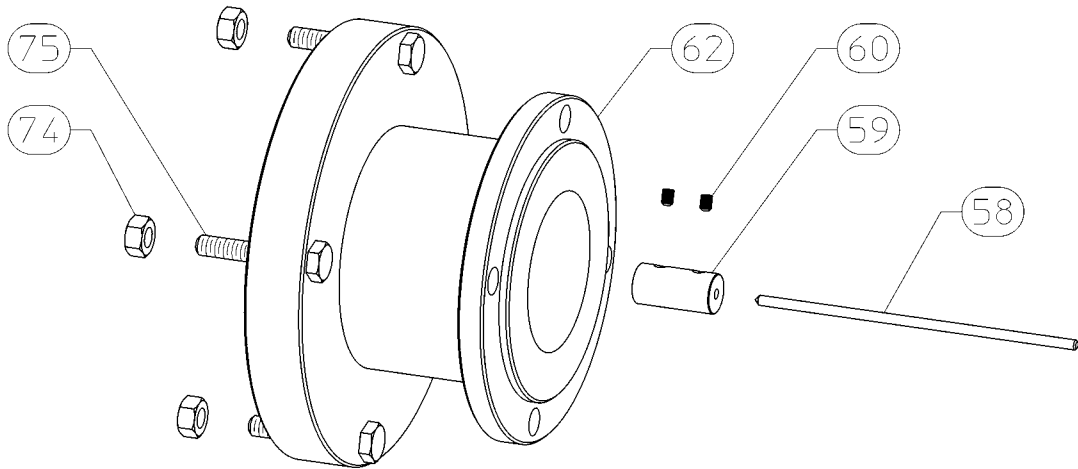


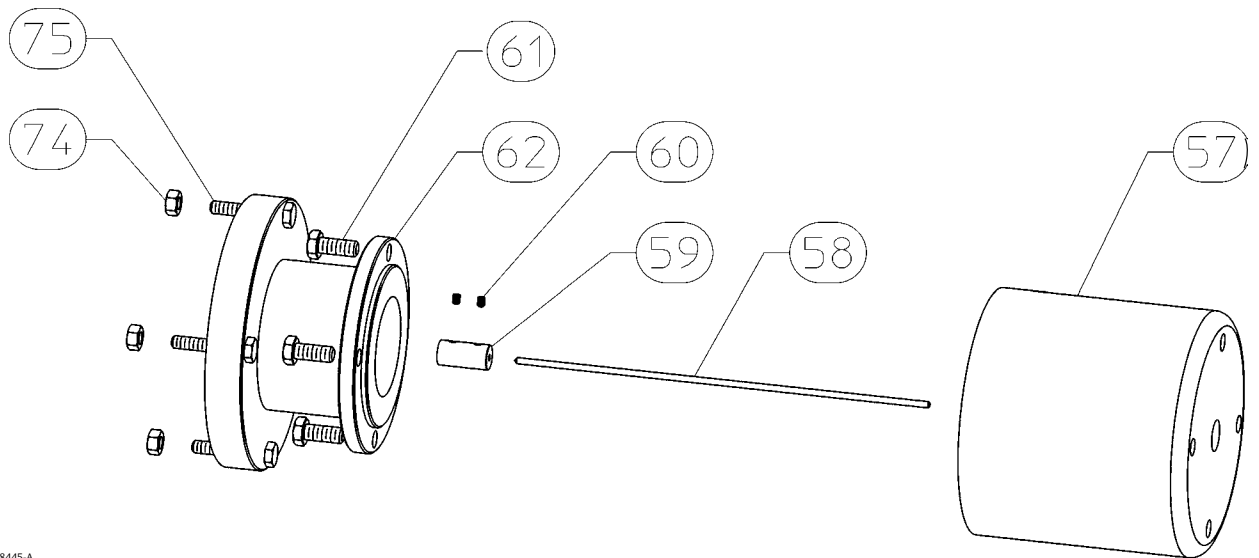


Figure 17. Mounting Kit for Masoneilan 12200 and 12300 Sensor without Heat Insulator



2988444-A

Figure 18. Mounting Kit for Masoneilan 12200 and 12300 Sensor with Heat Insulator



2988445-A

**Key Description**

**12200 or 12300 without Heat Insulator**

- 58 Shaft Extension
- 59 Shaft Coupling
- 60 Hex Socket Screw (2 req'd)
- 62 Mounting Adaptor
- 74 Hex Nut (4 req'd)
- 75 Hex Cap Screw (4 req'd)

**12200 or 12300 with Heat Insulator**

- 57 Heat Insulator
- 58 Shaft Extension
- 59 Shaft Coupling
- 61 Hex Cap Screw (4 req'd)
- 60 Hex Socket Screw (2 req'd)
- 62 Mounting Adaptor
- 74 Hex Nut (4 req'd)
- 75 Hex Cap Screw (4 req'd)
- 78 Washer, plain (4 req'd) not shown

**Yamatate NQP Sensor**

**Without Heat Insulator**

- 58 Shaft Extension
- 59 Shaft Retainer
- 60 Hex Socket Screw
- 62 Mounting Adaptor
- 63 Hex Socket Screw(3 req'd)
- 71 Hex Socket Screw (3 req'd)
- 72 Shaft Adapter
- 73 Hex Socket Screw (2 req'd)

**With Heat Insulator**

- 57 Heat Insulator
- 58 Shaft Extension
- 59 Shaft Retainer
- 60 Hex Socket Screw
- 61 Hex Cap Screw (4 req'd)
- 62 Mounting Adaptor
- 63 Hex Socket Screw (3 req'd)
- 71 Hex Socket Screw (3 req'd)
- 72 Shaft Adapter
- 73 Hex Socket Screw (2 req'd)
- 78 Washer, plain (4 req'd)

**Key Description**

**Foxboro-Eckardt Sensors**

**144LD without Heat Insulator**

- 58 Shaft Extension
- 59 Shaft Coupling
- 60 Set Screw, hex socket (2 req'd)
- 62 Mounting Adapter
- 74 Hex Nut (4 req'd)
- 75 Hex Cap Screw (4 req'd)

**144LD with Heat Insulator**

- 57 Heat Insulator
- 58 Shaft Extension
- 59 Shaft Coupling
- 60 Set Screw, hex socket (2 req'd)
- 61 Screw, hex hd (4 req'd)
- 62 Mounting Adapter
- 74 Hex Nut (4 req'd)
- 75 Hex Cap Screw (4 req'd)
- 78 Washer, plain (4 req'd)

**LP167 without Heat Insulator**

- 58 Shaft Extension
- 59 Shaft Coupling
- 60 Set Screw, hex socket (2 req'd)
- 62 Mounting Adapter
- 63 Screw, hex socket (4 req'd)

**Sunshade**

Sunshades are available in two materials and orderable as a kit.

Description	Part Number
Sunshade	
316 SST kit (see figure 19)	GG44394X012
Glass Reinforced Plastic (GRP) kit (see figure 20)	GG43970X012
<b>Kits Include</b>	<b>Qty/kit</b>
Hex head cap screw, key S1	2
Flanged hex nut, key S2	2
Sunshade, key S3	1
Mounting bracket, key S4	1

Figure 19. FIELDVUE DLC3100 with 316 SST Sunshade

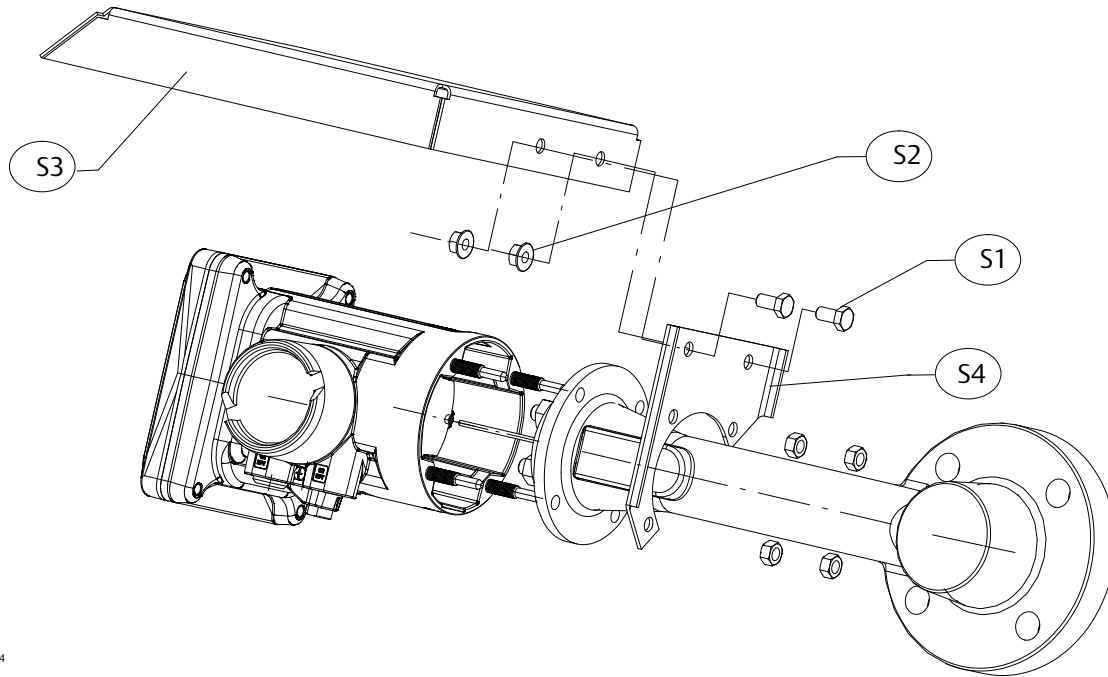
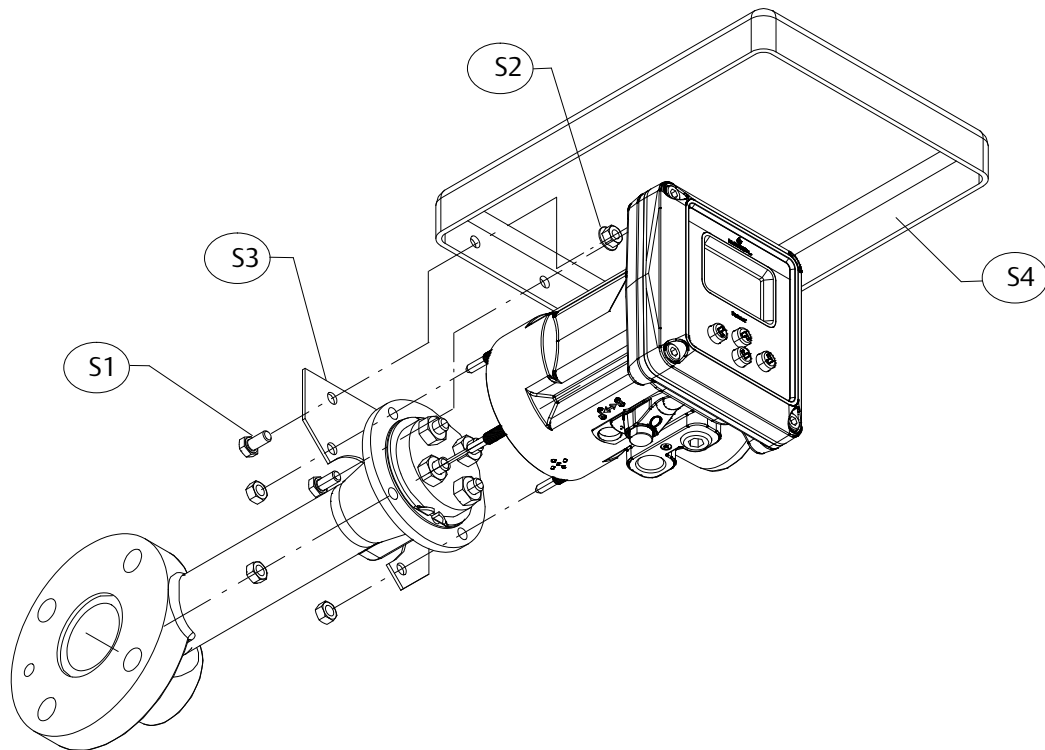


Figure 20. FIELDVUE DLC3100 with Glass Reinforced Plastic (GRP) Sunshade



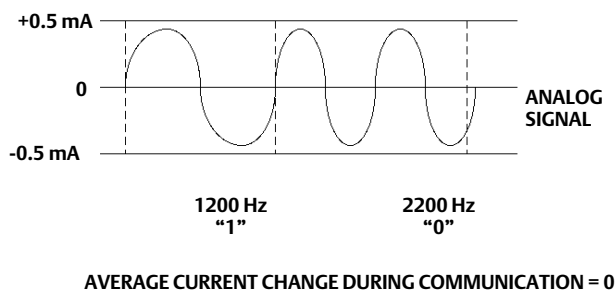
## Appendix A Principle of Operation

### HART Communication

The HART (Highway Addressable Remote Transducer) protocol gives field devices the capability of communicating instrument and process data digitally. This digital communication occurs over the same two-wire loop that provides the 4-20 mA process control signal, without disrupting the process signal. In this way, the analog process signal, with its faster update rate, can be used for control. At the same time, the HART protocol allows access to digital diagnostic, maintenance, and additional process data. The protocol provides total system integration via a host device.

The HART protocol uses the frequency shift keying (FSK) technique based on the Bell 202 communication standard. By superimposing a frequency signal over the 4-20 mA current, digital communication is attained. Two individual frequencies of 1200 and 2200 Hz are superimposed as a sinewave over the 4-20 mA current loop. These frequencies represent the digits 1 and 0 (see figure 21). The average value of this sinewave is zero, therefore no DC value is added to the 4-20 mA signal. Thus, true simultaneous communication is achieved without interrupting the process signal.

Figure 21. HART Frequency Shift Keying Technique



A6174

The HART protocol allows the capability of multidropping, networking several devices to a single communications line. This process is well suited for monitoring remote applications such as pipelines, custody transfer sites, and tank farms.

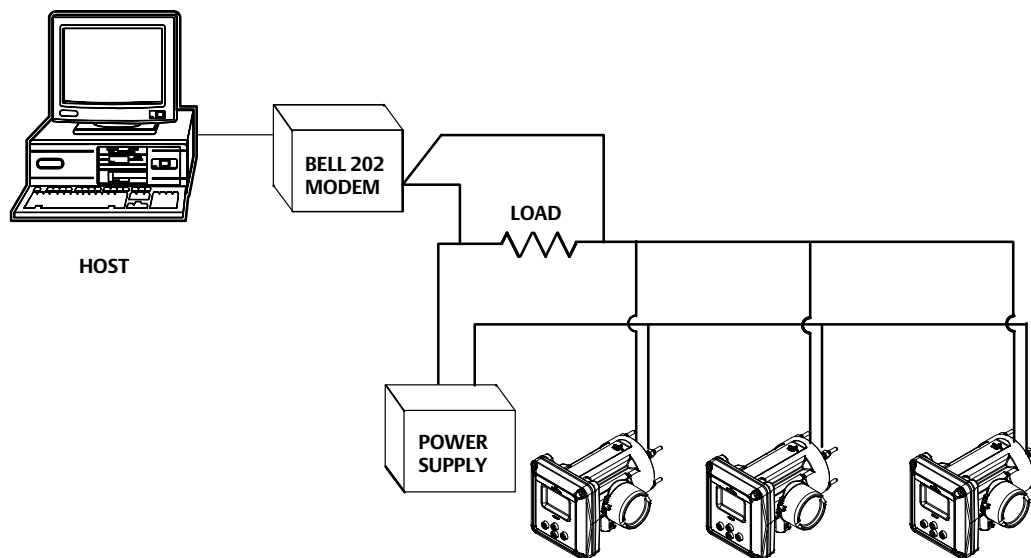
### Multidrop Communication

“Multidropping” refers to the connection of several digital level controllers or transmitters to a single communications transmission line. Communication between the host and the field instruments takes place digitally with the analog output of the instruments deactivated. With the HART communications protocol, up to 15 field instruments can be connected on a single twisted pair of wires or over leased phone lines. Multidrop installations are not recommended where intrinsic safety is a requirement.

The application of a multidrop installation requires consideration of the update rate necessary from each instrument, the combination of instrument models, and the length of the transmission line. Communication with the field instruments can be accomplished with commercially available Bell 202 modems and a host implementing the HART protocol. Each instrument is identified by a unique address (1-15) and responds to the commands defined in the HART protocol.

Figure 22 shows a typical multidrop network. Do not use this figure as an installation diagram. Contact your [Emerson sales office](#) with specific requirements for multidrop applications.

Figure 22. Typical Multidropped Network



The Field Communicator can test, configure, and format a multidropped DLC3100 digital level controller in the same way as in a standard point-to-point installation, provided that it has been configured to scan for multiple polling addresses.

#### Note

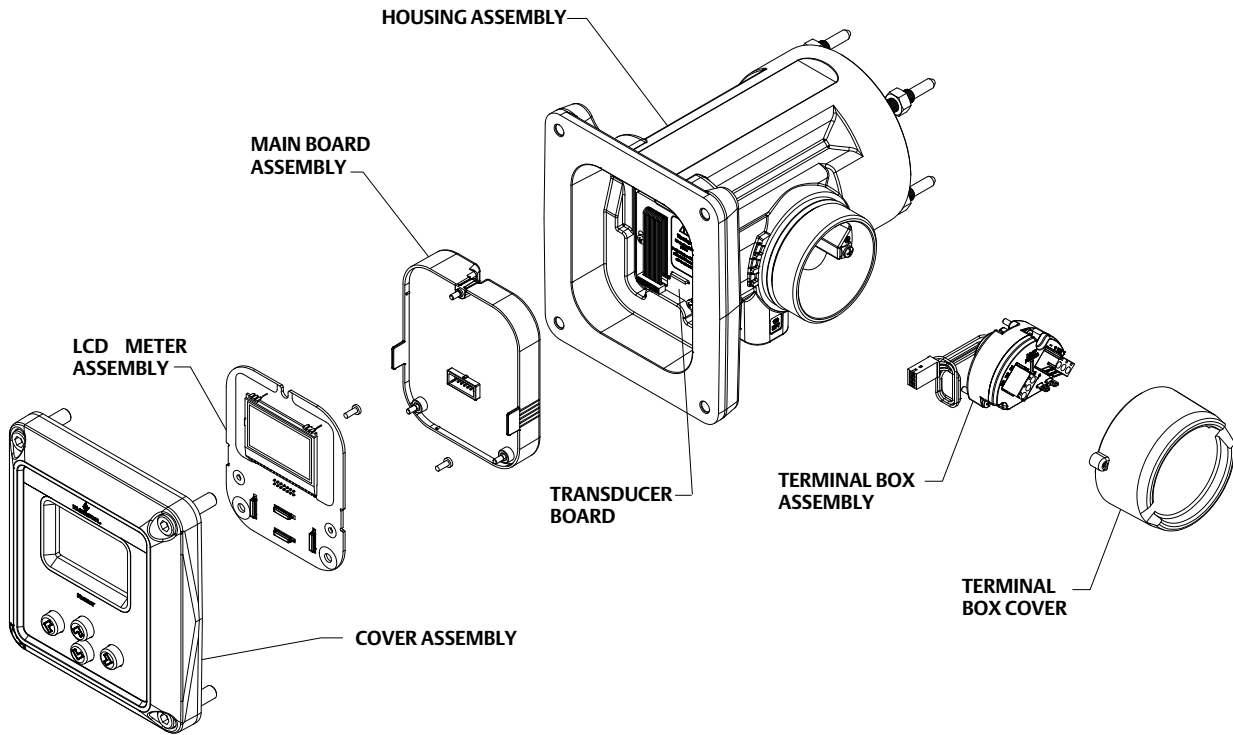
DLC3100 digital level controllers are set to address 0 at the factory, allowing them to operate in the standard point-to-point manner with a 4-20 mA output signal. To activate multidrop communication, the address must be changed to a number between 1 and 15. This change deactivates the 4-20 mA analog output, sending it to 4 mA. The failure mode current also is disabled.

## Digital Level Controller Operation

The DLC3100 digital level controller is a loop-powered instrument that measure changes in liquid level, level of an interface between two liquids, or density of a liquid. Changes in the buoyancy of a displacer suspended in a vessel vary the load on a torque tube. The displacer and torque tube assembly constitute the primary mechanical sensor. The angular deflection of the torque tube is measured by the instrument transducer, which consists of a magnet system moving over a Hall effect device. A liquid crystal display (LCD) meter can display the analog output or process variable (level, interface level, or density) in units or percent range.

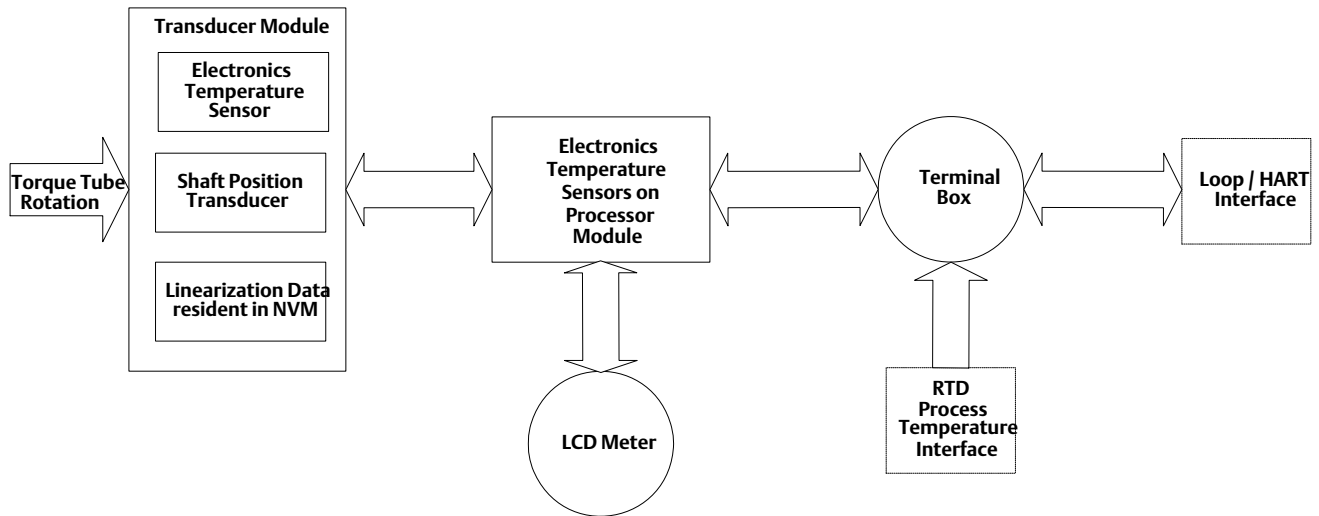
The instrument uses a microcontroller and associated electronic circuitry to measure the process variable, provide a current output, drive the LCD meter, and provide HART communications capability. Figure 23 shows the digital level controller assembly. Figure 24 is a block diagram of the main components in the instrument electronics; the LCD meter, the processor module, the transducer board, and the terminal board. The processor module contains the microprocessor, the analog-to-digital (A/D) converters, loop interface, signal conditioning, the digital-to-analog (D/A) output, power supply and interfaces to other boards.

Figure 23. FIELDVUE DLC3100 Digital Level Controller Assembly



GG25866

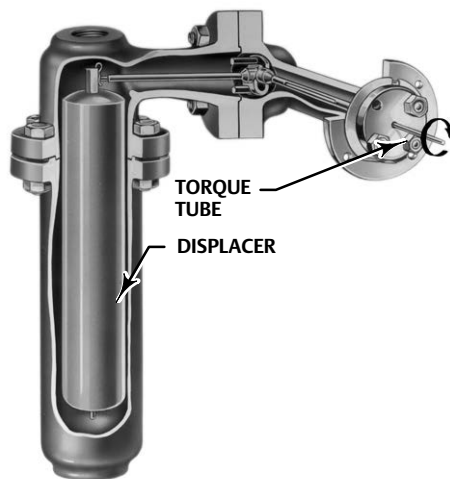
Figure 24. FIELDVUE DLC3100 Digital Level Controller Principle of Operation



The transducer board contains the Hall sensor, a temperature sensor to monitor the Hall sensor temperature, and an EEPROM to store the coefficients associated with the Hall sensor. The terminal board contains the EMI filters, the loop connection terminals, and the connections for the optional RTD used to measure process temperature.

A level, density, or interface level change in the measured fluid causes a change in the displacer position (figure 25). This change is transferred to the torque tube assembly. As the measured fluid changes, the torque tube assembly rotates up to 4.4 degrees for a 249 sensor, varying the digital level controller output between 4 and 20 mA.

Figure 25. Typical Sensor Operation



249 SENSOR (SIDE VIEW)

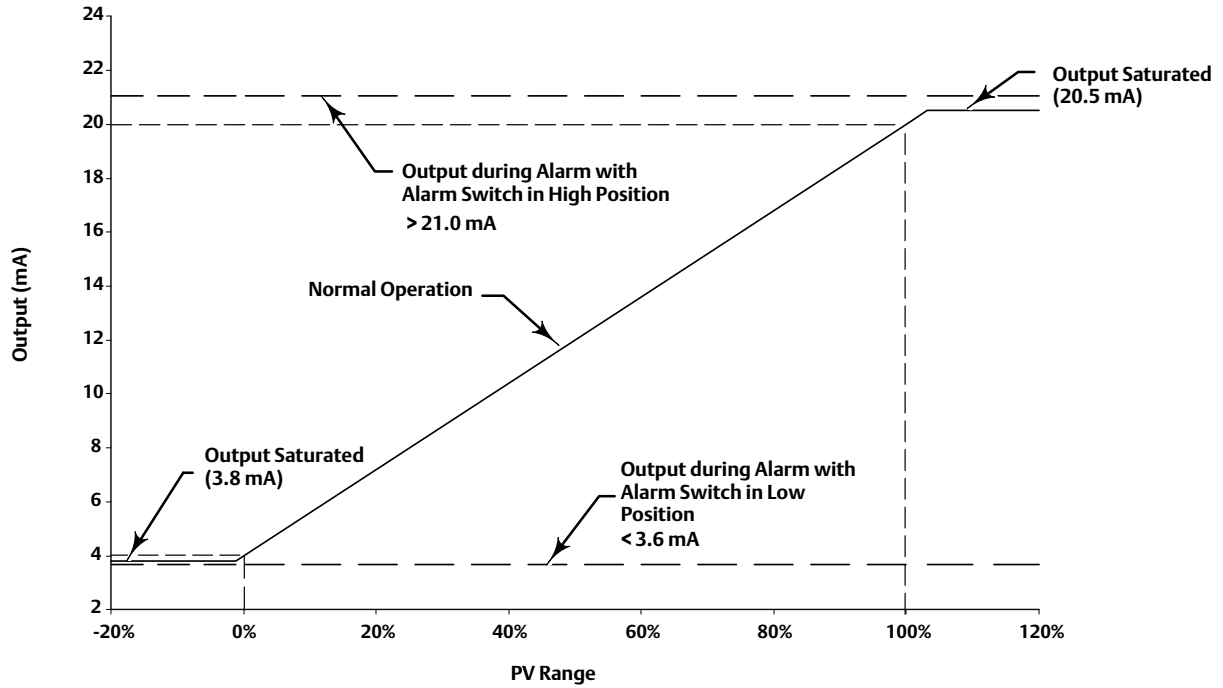
W1389-1

The rotary motion of the torque tube is transferred to the digital level controller lever assembly. The rotary motion moves a magnet attached to the lever assembly, changing the magnetic field that is sensed by the Hall effect sensor. The sensor converts the magnetic field signal to an electronic signal.

The microcontroller accepts the electronic signal, which is ambient-temperature-compensated and linearized. The microcontroller can also actively compensate for changes in liquid specific gravity due to changes in process temperature based on an input via HART protocol or via an optional RTD, if it is connected. The D/A output circuit accepts the microcontroller output and provides a 4 to 20 mA current output signal.

During normal operation, when the input is between the lower and upper range values, the digital level controller output signal ranges between 4 and 20 mA and is proportional to the input. See figure 26. If the input should exceed the lower and upper range values, the output will continue to be proportional to the input until the output reaches either 3.8 or 20.5 mA. At this time the output is considered saturated and will remain at this value until the input returns to the normal operating range. However, should an alarm occur, the output is driven to either > 21 mA or < 3.6 mA, depending on the Alarm High/Low switch setting.

Figure 26. Digital Level Controller Analog Output Signal



**Note**

The alarm values are compliant with NAMUR NE-43.

Other circuits in the digital level controller provide reverse polarity protection, transient power surge protection, and electromagnetic interference (EMI) protection.



## Appendix B Field Communicator Fast-Key Sequence and Menu Tree

### Fast-Key Sequence

Function/Variable	Fast-Key-Sequence
Active Alerts	3-1-1
Alarm Switch	1-7-3-1-1
Alarm/Sat Levels	1-7-3-1-3
Alert Record Full	2-4-9-5
Alerts Recorded	2-4-9-4
Analog Output	1-2-3
	3-2-1-5
	3-3-2
Analog Output Action	2-3-2-2
AO Fixed	2-4-4-4
AO Readback Fail	2-4-4-6
AO Saturated	2-4-4-3
Application	Hot Key - 3
	1-3
	2-3-2-1-1
	3-2-1-1
Assembly Code	1-7-1-5-3
Calibration	Hot Key - 6
	2-5-1
Cal in Progress	2-4-4-9
Calibration in Use	2-5-3
	3-4-1-1
Calibration Invalid	2-4-4-8
Calibration Method	2-5-3-2
	3-4-1-1-2
Calibration/Setup Logs	3-4-1
Change AO Action	2-3-2-3
Change Application	Hot Key - 4
	2-3-2-1-2
Change Fluid	Hot Key - 5
	2-3-4-1-3
Change Level Offset	2-3-2-1-7
Change PV Range	2-3-2-1-5
Change/Sec Limit	2-4-2-2
Clear Alert Record	2-4-9-2

Function/Variable	Fast-Key-Sequence
Clear Rate Alert	2-4-2-1
Cold Start	2-4-5-1
Comm Status	1-1-2
Communication	2-3-5-1
Comp. Torque Rate	2-3-3-3-1
	3-2-1-4
Compensation	2-3-4-3-1
	3-2-2-3-1
	2-3-3-3-4
Config Changed	2-4-5-2
Daily Write Accum	2-4-8-6
Date	2-3-1-2
Density, PrcFld	1-4-2
	2-3-4-1-2
	3-2-1-3-2
Descriptor	2-3-1-3
DD Information	1-7-2-5
Dev Config Locked	2-4-5-4
Device ID	1-7-1-4
Device Malfunction	2-4-4-5
Device Revision	1-7-2-2
Device Setup	2-2-1
Device Status	1-1-1
Displacer Length	2-3-3-2-1
Displacer Volume	2-3-3-2-2
Displacer Weight	2-3-3-2-3
Distributor	1-7-1-2
Driver Rod Length	2-3-3-2-4
Fall Rate Alert	2-4-2-4
Firmware, Revision	1-7-2-4
Fluid Density Table	2-3-4-1-4
Fluid Density Units	2-3-3-1-5
	2-3-4-1-5
Fluid Values Crossed	2-4-6-3

Function/Variable	Fast-Key-Sequence
Gain Trim	2-5-2-2
Hall Diagn Fail	2-4-7-4
Hall Sensor Alert	2-4-7-5
Hardware, Revision	1-7-2-3
Help, Device Setup	2-2-4
HW Information	2-3-3-4
Input Filter Time	2-3-2-5-2
Inst Temp D/band	2-4-3-4
Inst Temp Hi Alert	2-4-3-7
Inst Temp Lo Alert	2-4-3-8
Inst Temp Snsr Alert	2-4-7-6
Inst Temperature	2-4-3-2
	3-2-2-1-1
	3-3-3
Inst Time Not Set	2-4-9-3
Instrument Date	2-3-1-5
Instrument Mounting	2-3-3-2-5
Instrument SN	2-3-1-7-1
	1-7-1-5-1
Instrument Time	2-3-1-6
Invalid Custom Table	2-4-6-1
LCD Test	3-4-2-1
Length Units	2-3-3-1-1
Level Offset	2-3-2-1-6
Lever Assy Locked	2-4-4-7
LOOP Test	3-4-2-2
Lower Range Value	2-3-2-1-4
	2-4-1-2
Max Recorded, Temperature Limit	3-2-2-1-2
Message	2-3-1-4
Min/Max, Calibration	2-5-1-1
Min Recorded, Temperature Limit	3-2-2-1-3
Mode	Hot Key - 1
	1-1-3
	2-1
Model	1-7-1-3
Mounting Illustration	2-3-3-2-6
Non-PV Out of Limits	2-4-4-2
NVM Error	2-4-8-1
Out of Service	2-4-5-3
Polling Address	2-3-5-2
Primary Variable	3-3-1

Function/Variable	Fast-Key-Sequence
Proc Temp D/band	2-4-3-3
Proc Temp Hi Alert	2-4-3-5
Proc Temp Input	1-5
	2-3-4-2
	3-2-2-2
Proc Temp Lo Alert	2-4-3-6
Process Density	3-2-1-3-1
Process Fluid	2-3-4-1-1
	1-4-1
Process Setup	2-2-3
Process Temperature	2-3-4-3-2
	2-4-3-1
	3-2-2-3-2
Prog Memory Failed	2-4-8-4
Program Flow Error	2-4-8-5
Protection	Hot Key - 2
	1-7-3-2
PV	3-2-1-2-2
PV Alert Units	2-4-1-3
PV Damping	2-3-2-5-1
PV Deadband	2-4-1-4
PV Hi Alert	2-4-1-6
PV Hi Hi Alert	2-4-1-5
PV Lo Alert	2-4-1-7
PV Lo Lo Alert	2-4-1-8
PV Lower Sensor Limit	2-3-2-4-2
PV Out of Limits	2-4-4-1
PV Setup	2-2-2
PV Upper Sensor Limit	2-3-2-4-1
PV Value	1-2-2
	3-2-1-2-1
RAM Test Error	2-4-8-2
Ref Voltage Fail	2-4-7-3
Refresh Switch	1-7-3-1-2
Reset Device	3-4-3-2
Rise Rate Alert	2-4-2-3
RTD Diagn Fail	2-4-7-2
RTD Sensor Alert	2-4-7-1
Sensor SN	1-7-1-5-2
	2-3-1-7-2
Sensor Type	2-3-3-3-6
Set Factory Defaults	3-4-3-1
Simple Zero/Span	2-5-1-5

Function/Variable	Fast-Key-Sequence
Tag	1-7-1-1
	2-3-1-1
Temp Compensation	1-6
Temp Out of Comp	2-4-6-2
Temperature Limit	3-2-2-1
Temperature Units	2-3-3-1-4
	2-3-4-3-3
Torque Rate Units	2-3-3-1-6
Torque Tube Gain	2-3-3-3-2
	2-5-2-3
Torque Tube Wall	2-3-3-3-5
Tube Material	2-3-3-3-3
Two-Point, Calibration	2-5-1-2
Two-Point Time Delay	2-5-1-3
Universal Revision	1-7-2-1
Upper Range Value	2-3-2-1-3
	2-4-1-1

Function/Variable	Fast-Key-Sequence
Variable Mapping	2-3-5-3
Volume Units	2-3-3-1-2
Watchdog Executed	2-4-8-3
Weight, Calibration	2-5-1-4
Weight Units	2-3-3-1-3
Write Accum Alert	2-4-87
View Record	2-4-9-1
Zero Trim	2-5-2-1

## Menu Tree

Figure 27. Hot Key

- Hot Key**
- 1 Mode
  - 2 Protection
  - 3 Application
  - 4 Change Application
  - 5 Change Fluid
  - 6 Calibration

Figure 28. Overview

- 1 Overview
  - 1 Status
  - 2 PV
  - 3 Application
  - 4 Fluid Type
  - 5 Proc Temp Input
  - 6 Temp Compensation
  - 7 Device Information
- 1-1 Status
  - 1 Device Status
  - 2 Comm Status
  - 3 Mode
- 1-2 PV
  - 1 PV
  - 2 PV Value
  - 3 Analog Output
- 1-4 Fluid Type
  - 1 Process Fluid
  - 2 Density, PrcFld
- 1-6 Temp Compensation
  - 1 Compensation
  - 2 Process Temperature
- 1-7 Device Information
  - 1 Identification
  - 2 Revisions
  - 3 Alarm Type and Security
- 1-1-1 Device Status
  - 1 Refresh Alerts
  - 2 No Active Alerts
- 1-7-1 Identification
  - 1 Tag
  - 2 Distributor
  - 3 Model
  - 4 Device ID
  - 5 Serial Numbers
- 1-7-2 Revisions
  - 1 Universal Revision
  - 2 Device Revision
  - 3 Hardware
  - 4 Firmware
  - 5 DD Information
- 1-7-3 Alarm Type and Security
  - 1 Alarm Configuration
  - 2 Protection
- 1-7-1-5 Serial Numbers
  - 1 Instrument SN
  - 2 Sensor SN
  - 3 Assembly Code
- 1-7-3-1 Alarm Configuration
  - 1 Alarm Switch
  - 2 Refresh Switch
  - 3 Alarm/Sat Levels
- 1-7-3-2 Protection
  - 1 Protection
  - 2 Change Protection

Figure 29. Configure > Mode, Guided Setup & Manual Setup

<ul style="list-style-type: none"> <li><b>2</b></li> <li><b>Configure</b></li> <li>1 Mode</li> <li>2 Guided Setup</li> <li>3 Manual Setup</li> <li>4 Alert Setup</li> <li>5 Calibration</li> </ul>	<ul style="list-style-type: none"> <li><b>2-1</b></li> <li><b>Mode</b></li> <li>1 Mode</li> <li>2 Change Mode</li>   <li><b>2-2</b></li> <li><b>Guided Setup</b></li> <li>1 Device Setup</li> <li>2 PV Setup</li> <li>3 Process Setup</li> <li>4 Help</li>   <li><b>2-3</b></li> <li><b>Manual Setup</b></li> <li>1 General</li> <li>2 Device</li> <li>3 Sensor</li> <li>4 Process</li> <li>5 HART</li> <li>6 Safety Recovery (only available for DLC3100 SIS)</li> </ul>	<ul style="list-style-type: none"> <li><b>2-3-1</b></li> <li><b>General</b></li> <li>1 Tag</li> <li>2 Date</li> <li>3 Descriptor</li> <li>4 Message</li> <li>5 Instrument Date</li> <li>6 Instrument Time</li> <li>7 Serial Numbers</li>   <li><b>2-3-2</b></li> <li><b>Device</b></li> <li>1 Primary Variables</li> <li>2 Analog Output Action</li> <li>3 Change AO Action</li> <li>4 Sensor Limits</li> <li>5 Damping</li>   <li><b>2-3-3</b></li> <li><b>Sensor</b></li> <li>1 Units</li> <li>2 Dimensions</li> <li>3 Torque Tube</li> <li>4 HW Information</li>   <li><b>2-3-4</b></li> <li><b>Process</b></li> <li>1 Process Fluid</li> <li>2 Proc Temp Input</li> <li>3 Compensation</li>   <li><b>2-3-5</b></li> <li><b>HART</b></li> <li>1 Communication</li> <li>2 Polling Address</li> <li>3 Variable Mapping</li> </ul>	<ul style="list-style-type: none"> <li><b>2-3-1-7</b></li> <li><b>Serial Numbers</b></li> <li>1 Instrument SN</li> <li>2 Sensor SN</li>   <li><b>2-3-2-1</b></li> <li><b>Primary Variables</b></li> <li>1 Application</li> <li>2 Change Application</li> <li>3 Upper Range Value</li> <li>4 Lower Range Value</li> <li>5 Change PV Range</li> <li>6 Level Offset</li> <li>7 Change Level Offset</li>   <li><b>2-3-2-4</b></li> <li><b>Sensor Limits</b></li> <li>1 PV Upper Sensor Limit</li> <li>2 PV Lower Sensor Limit</li>   <li><b>2-3-2-5</b></li> <li><b>Damping</b></li> <li>1 PV Damping</li> <li>2 Input Filter Time</li>   <li><b>2-3-3-1</b></li> <li><b>Units</b></li> <li>1 Length Units</li> <li>2 Volume Units</li> <li>3 Weight Units</li> <li>4 Temperature Units</li> <li>5 Fluid Density Units</li> <li>6 Torque Rate Units</li>   <li><b>2-3-3-2</b></li> <li><b>Dimensions</b></li> <li>1 Displacer Length</li> <li>2 Displacer Volume</li> <li>3 Displacer Weight</li> <li>4 Driver Rod Length</li> <li>5 Instrument Mounting</li> <li>6 Mounting Illustration</li>   <li><b>2-3-3-3</b></li> <li><b>Torque Tube</b></li> <li>1 Comp. Torque Rate</li> <li>2 Torque Tube Gain</li> <li>3 Tube Material</li> <li>4 Compensation Table</li> <li>5 Torque Tube Wall</li> <li>6 Sensor Type</li>   <li><b>2-3-4-1</b></li> <li><b>Process Fluid</b></li> <li>1 Process Fluid</li> <li>2 Density, PrcFld</li> <li>3 Change Fluid</li> <li>4 Fluid Density Table</li> <li>5 Fluid Density Units</li>   <li><b>2-3-4-3</b></li> <li><b>Compensation</b></li> <li>1 Compensation</li> <li>2 Process Temperature</li> <li>3 Temperature Units</li> </ul>
--	---	--	--

Figure 30. Configure > Alert Setup

2			
Configure	2-4	2-4-1	2-4-1-5
1 Mode	Alert Setup	Primary Variable	PV Hi Hi Alert
2 Guided Setup	1 Primary Variable	1 Upper Range Value	1 PVHiHi St
3 Manual Setup	2 Rate Limit	2 Lower Range Value	2 Priority
4 Alert Setup	3 Temperature	3 PV Alert Units	3 Enable Alert
5 Calibration	4 Operational	4 PV Deadband	4 Hi Hi Alert Point
	5 Informational	5 PV Hi Hi Alert	5 Enable Trip Current
	6 Input Compensation	6 PV Hi Alert	
	7 Hardware	7 PV Lo Alert	2-4-1-6
	8 Program and Memory	8 PV Lo Lo Alert	PV Hi Alert
	9 Alert Record		1 PVHi St
		2-4-2	2 Priority
		Rate Limit	3 Enable Alert
		1 Clear Rate Alert	4 Hi Alert Point
		2 Change/Sec Limit	5 Trip Alarm OFF
		3 Rise Rate Alert	2-4-1-7
		4 Fall Rate Alert	PV Lo Alert
			1 PVLo St
			2 Priority
			3 Enable Alert
			4 Lo Alert Point
			5 Trip Alarm OFF
			2-4-1-8
			PV Lo Lo Alert
			1 PVLoLo St
			2 Priority
			3 Enable Alert
			4 Lo Lo Alert Point
			5 Enable Trip Current
			2-4-2-3
			Rise Rate Alert
			1 RiseRate St
			2 Priority
			3 Enable Alert
			4 Trip Alarm OFF
			2-4-2-4
			Fall Rate Alert
			1 FallRate St
			2 Priority
			3 Enable Alert
			4 Trip Alarm OFF

**Alert Setup**  
Continued on next page

Figure 30. Configure > Alert Setup (continued)

2

Configure

- 1 Mode
- 2 Guided Setup
- 3 Manual Setup
- 4 Alert Setup
- 5 Calibration

2-4

Alert Setup

- 1 Primary Variable
- 2 Rate Limit
- 3 Temperature
- 4 Operational
- 5 Informational
- 6 Input Compensation
- 7 Hardware
- 8 Program and Memory
- 9 Alert Record

2-4-3

Temperature

- 1 Process Temperature
- 2 Inst Temperature
- 3 Proc Temp D/band
- 4 Inst Temp D/band
- 5 Proc Temp Hi Alert
- 6 Proc Temp Lo Alert
- 7 Inst Temp Hi Alert
- 8 Inst Temp Lo Alert

2-4-4

Operation

- 1 PV Out of Limits
- 2 Non-PV Out of Limits
- 3 AO Saturated
- 4 AO Fixed
- 5 Device Malfunction
- 6 AO Readback Fail
- 7 Lever Assy Locked
- 8 Calibration Invalid
- 9 Cal in Progress

2-4-3-5

Proc Temp Hi Alert

- 1 ProcTempHi St
- 2 Priority
- 3 Enable Alert
- 4 ProcTempHi Limit
- 5 Trip Alarm OFF

2-4-3-6

Proc Temp Lo Alert

- 1 ProcTempLo St
- 2 Priority
- 3 Enable Alert
- 4 ProcTempLo Limit
- 5 Trip Alarm OFF

2-4-3-7

Inst Temp Hi Alert

- 1 InstTempHi St
- 2 Priority
- 3 Enable Alert
- 4 InstTempHi Limit
- 5 Trip Alarm OFF

2-4-3-8

Inst Temp Lo Alert

- 1 InstTempLo St
- 2 Priority
- 3 Enable Alert
- 4 InstTempLo Limit
- 5 Trip Alarm OFF

2-4-4-1

PV Out of Limits

- 1 PVLimitOut St
- 2 Priority
- 3 Enabled
- 4 Trip Alarm OFF

2-4-4-2

Non-PV Out of Limits

- 1 NonPVLimitOut St
- 2 Priority
- 3 Enabled
- 4 Trip Alarm OFF

2-4-4-3

AO Saturated

- 1 AOSaturated St
- 2 Priority
- 3 Enabled
- 4 Trip Alarm OFF

2-4-4-4

AO Fixed

- 1 AOFixed St
- 2 Priority
- 3 Enabled
- 4 Trip Alarm OFF

2-4-4-5

Device Malfunction

- 1 DevMalf St
- 2 Priority
- 3 Enabled
- 4 Enable Trip Current

2-4-4-6

AO Readback Fail

- 1 AORead Fail St
- 2 Priority
- 3 Enable Alert
- 4 Enable Trip Current

2-4-4-7

Lever Assy Locked

- 1 LeverAssyLocked St
- 2 Priority
- 3 Enable Alert
- 4 Trip Alarm OFF

2-4-4-8

Calibration Invalid

- 1 CallInvalid St
- 2 Priority
- 3 Enable Alert
- 4 Trip Alarm OFF

2-4-4-9

Cal in Progress

- 1 CalProgress St
- 2 Priority
- 3 Enable Alert
- 4 Trip Alarm OFF

**Alert Setup  
Continued on next page**

Figure 30. Configure > Alert Setup (continued)

2			
Configure			
1 Mode			
2 Guided Setup			
3 Manual Setup			
4 Alert Setup			
5 Calibration			
	2-4	2-4-5	2-4-5-1
	Alert Setup	Informational	Cold Start
	1 Primary Variable	1 Cold Start	1 ColdStart St
	2 Rate Limit	2 Config Changed	2 Priority
	3 Temperature	3 Out of Service	3 Enabled
	4 Operational	4 Dev Config Locked	4 Trip Alarm OFF
	5 Informational		
	6 Input Compensation	2-4-6	2-4-5-2
	7 Hardware	Input Compensation	Config Changed
	8 Program and Memory	1 Invalid Custom Table	1 ConfigChange St
	9 Alert Record	2 Temp Out of Comp	2 Priority
		3 Fluid Values Crossed	3 Enabled
			4 Trip Alarm OFF
			2-4-5-3
			Out of Service
			1 OutofService St
			2 Priority
			3 Enabled
			4 Trip Alarm OFF
			2-4-5-4
			Dev Config Locked
			1 DevConfigLock St
			2 Priority
			3 Enabled
			4 Trip Alarm OFF
			2-4-6-1
			Invalid Custom Table
			1 InvCustomTbl St
			2 Priority
			3 Enable Alert
			4 Trip Alarm OFF
			2-4-6-2
			Temp Out of Comp
			1 TempCompOut St
			2 Priority
			3 Enable Alert
			4 Trip Alarm OFF
			2-4-6-3
			Fluid Values Crossed
			1 FluidValueX St
			2 Priority
			3 Enable Alert
			4 Trip Alarm OFF

**Alert Setup**  
Continued on next page

Figure 30. Configure > Alert Setup (continued)

2			
Configure	2-4	2-4-7	2-4-7-1
1 Mode	Alert Setup	Hardware	RTDSensor Alert
2 Guided Setup	1 Primary Variable	1 RTD Sensor Alert	1 RTD Sensor St
3 Manual Setup	2 Rate Limit	2 RTD Diagn Fail	2 Priority
4 Alert Setup	3 Temperature	3 Ref Voltage Fail	3 Enable Alert
5 Calibration	4 Operational	4 Hall Diagn Fail	4 Enable Trip Current
	5 Informational	5 Hall Sensor Alert	
	6 Input Compensation	6 Inst Temp Snsr Alert	2-4-7-2
	7 Hardware		RTD Diagn Fail
	8 Program and Memory		1 RTDDiagFail St
	9 Alert Record		2 Priority
			3 Enable Alert
			4 Enable Trip Current
			2-4-7-3
			Ref Voltage Fail
			1 RefVoltFail St
			2 Priority
			3 Enable Alert
			4 Enable Trip Current
			2-4-7-4
			Hall Diagn Fail
			1 HallDiagFail St
			2 Priority
			3 Enable Alert
			4 Enable Trip Current
			2-4-7-5
			Hall Sensor Alert
			1 HallSensor St
			2 Priority
			3 Enable Alert
			4 Enable Trip Current
			2-4-7-6
			Inst Temp Snsr Alert
			1 InstTempSensor St
			2 Priority
			3 Enable Alert
			4 Enable Trip Current

**Alert Setup**  
Continued on next page



Figure 30. Configure > Alert Setup (continued)

2

Configure

- 1 Mode
- 2 Guided Setup
- 3 Manual Setup
- 4 Alert Setup
- 5 Calibration

2-4

Alert Setup

- 1 Primary Variable
- 2 Rate Limit
- 3 Temperature
- 4 Operational
- 5 Informational
- 6 Input Compensation
- 7 Hardware
- 8 Program and Memory
- 9 Alert Record

2-4-8

Program and Memory

- 1 NVM Error
- 2 RAM Test Error
- 3 Watchdog Executed
- 4 Prog Memory Failed
- 5 Program Flow Error
- 6 Daily Write Accum
- 7 Write Accum Alert

2-4-9

Alert Record

- 1 View Record
- 2 Clear Alert Record
- 3 Inst Time Not Set
- 4 Alerts Recorded
- 5 Alert Record Full

2-4-8-1

NVM Error

- 1 NVMError St
- 2 Priority
- 3 Enable Alert
- 4 Enable Trip Current

2-4-8-2

RAM Test Error

- 1 RAMTestError St
- 2 Priority
- 3 Enable Alert
- 4 Enable Trip Current

2-4-8-3

Watchdog Executed

- 1 WatchdogExec St
- 2 Priority
- 3 Enable Alert
- 4 Enable Trip Current

2-4-8-4

Prog Memory Failed

- 1 ProgMemFail
- 2 Priority
- 3 Enable Alert
- 4 Enable Trip Current

2-4-8-5

Program Flow Error

- 1 ProgFlowError St
- 2 Priority
- 3 Enable Alert
- 4 Enable Trip Current

2-4-8-6

Daily Write Accum

- 1 WriteDaily St
- 2 Priority
- 3 Enable Alert
- 4 Trip Alarm OFF

2-4-8-7

Write Accum Alert

- 1 WriteAccum St
- 2 Priority
- 3 Enable Alert
- 4 Trip Alarm OFF

2-4-9-3

Inst Time Not Set

- 1 InstTimeNoSet St
- 2 Priority
- 3 Enable Alert
- 4 Trip Alarm OFF

2-4-9-4

Alert Recorded

- 1 AlertRecord St
- 2 Priority
- 3 Enable Alert
- 4 Trip Alarm OFF

2-4-9-5

Alert Record Full

- 1 AlertRecFull St
- 2 Priority
- 3 Enable Alert
- 4 Trip Alarm OFF

Figure 31. Calibration

<b>2</b>		
<b>Configure</b>		
1 Mode		
2 Guided Setup		
3 Manual Setup		
4 Alert Setup		
5 Calibration		
	<b>2-5</b>	
	<b>Calibration</b>	
	1 Calibration	
	2 Trim Current Calibration	
	3 Calibration in Use	
		<b>2-5-1</b>
		<b>Calibration</b>
		1 Min/Max
		2 Two-Point
		3 Two-Point Time Delay
		4 Weight
		5 Simple Zero/Span
		<b>2-5-2</b>
		<b>Trim Current Calibration</b>
		1 Zero Trim
		2 Gain Trim
		3 Torque Tube Gain
		<b>2-5-3</b>
		<b>Calibration in Use</b>
		1 Name
		2 Calibration Method
		3 Hours
		4 Minutes
		5 Calibration Date
		6 Calibrator

**Figure 32. Service Tools**

<p><b>3</b>  <b>Service Tools</b>          1 Alerts          2 Variables          3 Trends          4 Maintenance</p>	<p><b>3-1</b>  <b>Status</b>          1 Active Alerts</p> <p><b>3-2</b>  <b>Variables</b>          1 Process          2 Temperature</p> <p><b>3-3</b>  <b>Trends</b>          1 Primary Variable          2 Analog Output          3 Inst Temperature</p> <p><b>3-4</b>  <b>Maintenance</b>          1 Calibration/Setup Logs          2 Tests          3 Rest/Restore Device</p>	<p><b>3-1-1</b>  <b>Active Alerts</b>          1 Refresh Alerts          2 No Active Alerts</p> <p><b>3-2-1</b>  <b>Process</b>          1 Application          2 Primary Value          3 Process Fluid          4 Comp. Torque Rate          5 Analog Output</p> <p><b>3-2-2</b>  <b>Temperature</b>          1 Temperature Limit          2 Proc Temp Input          3 Compensation</p> <p><b>3-3-1</b>  <b>Primary Variable</b>          1 Graph          2 PV</p> <p><b>3-3-2</b>  <b>Analog Output</b>          1 Graph          2 Analog Output</p> <p><b>3-3-3</b>  <b>Inst Temperature</b>          1 Graph          2 Inst Temperature</p> <p><b>3-4-1</b>  <b>Calibration/Setup Logs</b>          1 Calibration in Use</p> <p><b>3-4-2</b>  <b>Tests</b>          1 LCD Test          2 LOOP TEST</p> <p><b>3-4-3</b>  <b>Reset/Restore Device</b>          1 Set Factory Defaults          2 Reset Device</p>	<p><b>3-2-1-2</b>  <b>Primary Value</b>          1 PV Value          2 PV</p> <p><b>3-2-1-3</b>  <b>Process Fluid</b>          1 Process Density          2 Density, PrcFld</p> <p><b>3-2-2-1</b>  <b>Temperature Limit</b>          1 Inst Temperature          2 Max Recorded          3 Min Recorded</p> <p><b>3-2-2-3</b>  <b>Compensation</b>          1 Compensation          2 Process Temperature</p> <p><b>3-4-1-1</b>  <b>Calibration in Use</b>          1 Name          2 Calibration Method          3 Hours          4 Minutes          5 Calibration Date          6 Calibrator</p>
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