Fisher™ FIELDVUE™ DLC3100 and DLC3100 SIS Digital Level Controllers

Contents

This quick start guide applies to:

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

X1456

Notes

This guide describes how to install, setup, and calibrate the DLC3100 or DLC3100 SIS using the local user interface. For all other information on this product, including reference materials, manual setup information, maintenance procedures and replacement part details, refer to the DLC3100 and DLC3100 SIS Instruction Manual (D104213X012). If a copy of this document is required contact your Emerson sales office or go to Fisher.com.

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.

Using this Guide

This guide describes how to install the DLC3100 digital level controller, and setup and calibrate using the local user interface. The interface consists of a liquid crystal display and four push buttons. The instrument must be powered with at least 12 volts to operate the local user interface.

You can also setup and calibrate the instrument using an Emerson handheld communicator, AMS Suite: Intelligent Device Manager or a non-Emerson host via Device Description.

Do not install, operate, or maintain a DLC3100 digital level controller without being fully trained and qualified in valve, actuator, and accessory, and 249 sensor installation, operation, and maintenance. **To avoid personal injury or property damage, it is important to carefully read, understand, and follow all of the contents of this manual, including all safety cautions and warnings.** Refer to the appropriate supplement listed below for hazardous area approvals and special instructions for "safe use" and installations in hazardous locations. If you have any questions about these instructions, contact your Emerson sales office before proceeding.

Related documents:

- CSA (United States and Canada) Hazardous Area Approvals - DLC3100 Digital Level Controller (D104232X012)
- ATEX and IECEx Hazardous Area Approvals - DLC3100 Digital Level Controller (D104233X012)

Other related documents include:

- Fisher DLC3100 and DLC3100 SIS Digital Level Controllers Instruction Manual (D104213X012)
- Safety Manual for Fisher DLC3100 SIS Digital Level Controller (D104215X012)
- 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)

All documents are available from your Emerson sales office or at Fisher.com. Contact your Emerson sales office for all other approval/certification information.

Installation

WARNING

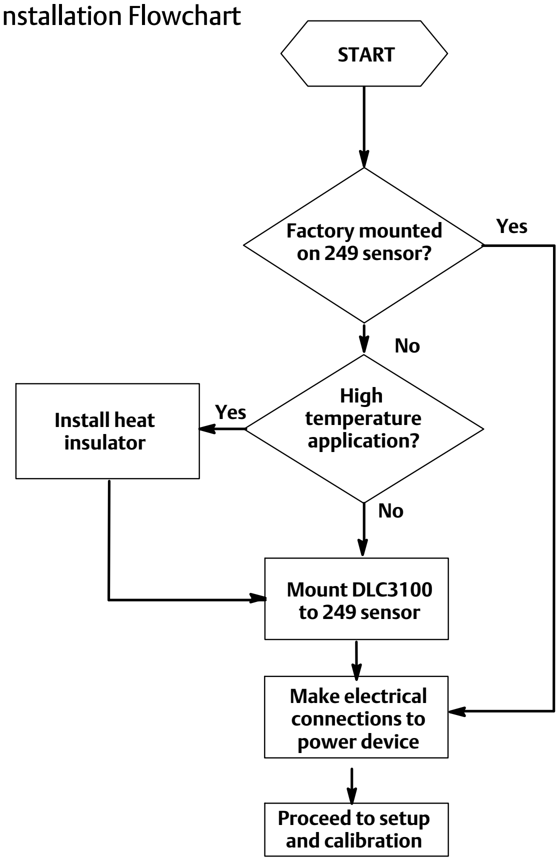
To avoid personal injury, always wear protective gloves, clothing, and eyewear when performing any installation operations.

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

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

This section contains digital level controller installation information, including an installation flowchart (figure 1), mounting and electrical installation information, and failure mode (Alarm High/Low setting) switch.

Figure 1. Installation Flowchart



Protecting the Coupling and Flexures

Note

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

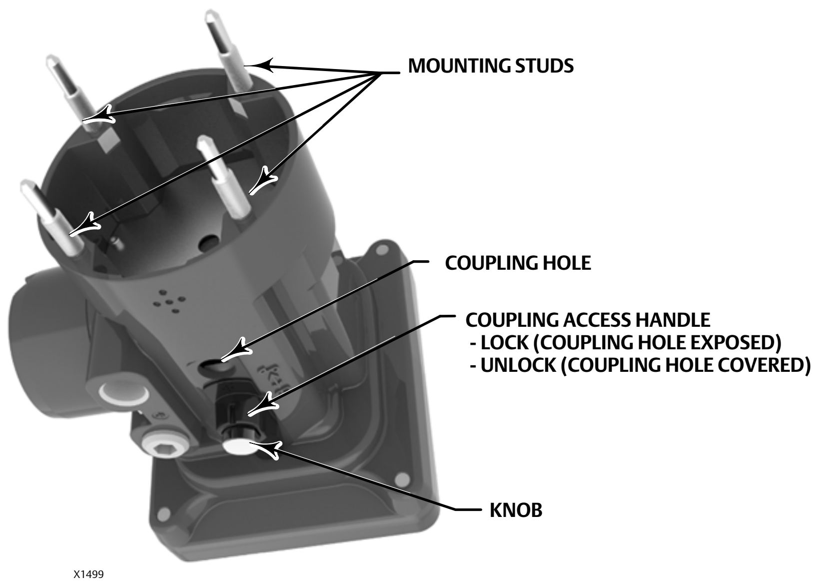
Lever Lock

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

A DLC3100 controller will have one of the following mechanical configurations when received:

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

Figure 2. Sensor Connection Compartment



NOTICE

When shipping an instrument mounted on a sensor, if the lever assembly is coupled to the torque tube assembly, and the displacer is secured by movement blocks, use of the lever lock may result in damage to the lever assembly flexure.

- If the displacer cannot be blocked because of cage configuration or other concerns, the transmitter is uncoupled from the torque tube by loosening the coupling nut. The coupling access handle will be in the locked position. Before placing such a configuration into service, perform the Coupling procedure.
- For a cageless system where the displacer is not connected to the torque tube during shipping, the torque tube itself stabilizes the coupled lever position by resting against a physical stop in the sensor. The access handle will be in the unlocked position. Mount the sensor and hang the displacer. The coupling should be intact.
- If the digital level controller was shipped alone, the access handle will be in the locked position. Perform the Mounting, Coupling and Calibration procedures.

Mounting the DLC3100

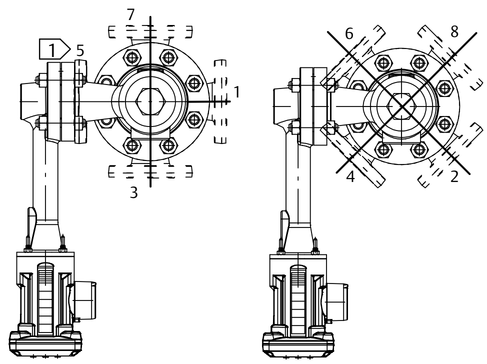
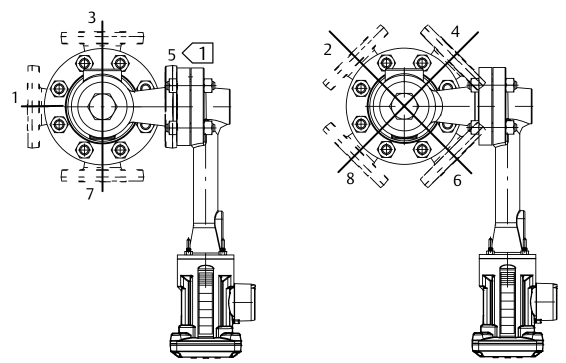
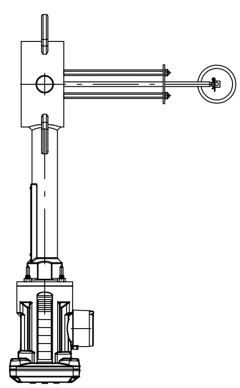
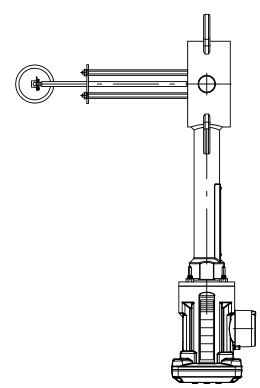
DLC3100 Orientation

Mount the digital level controller with the torque tube assembly coupling access hole (the coupling access handle in figure 2) pointing downward.

The digital level controller and torque tube arm are attached to the sensor either to the left or right of the displacer, as shown in figure 3. This can be changed in the field on a 249 sensor (refer to the appropriate sensor instruction manual). Changing the mounting also changes the effective action, because the torque tube rotation for increasing level, (looking at the protruding shaft), is clockwise when the unit is mounted to the right of the displacer and counter-clockwise when the unit is mounted to the left of the displacer.

All caged 249 sensors have a rotatable head. That is, the digital level controller can be positioned at any of eight alternate positions around the cage as indicated by the position numbers 1 through 8 in figure 3. To rotate the head, remove the head flange bolts and nuts and position the head as desired.

Figure 3. Typical Mounting Positions for Digital Level Controller on Fisher 249 Sensor

SENSOR	LEFT-OF-DISPLACER	RIGHT-OF-DISPLACER
CAGED		
CAGELESS		
1 NOT AVAILABLE FOR 249C AND 249K.		

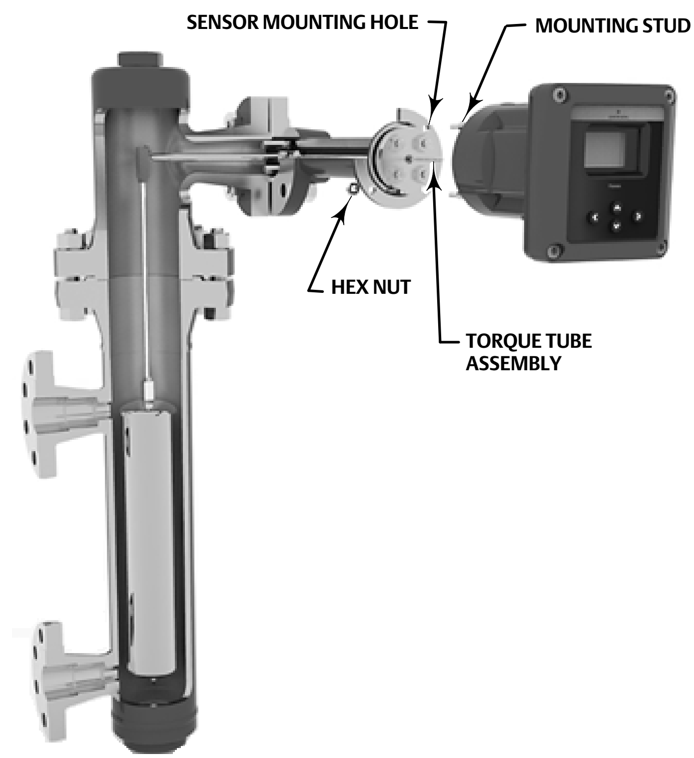
E1700

On a 249 Sensor

Refer to figure 2 unless otherwise indicated.

1. Press the knob and slide the coupling access handle to the locked position to lock the lever assembly in place and to expose the access hole.
2. Using a 10 mm deep well socket inserted through the access hole, loosen the shaft clamp. This clamp will be re-tightened during the Coupling procedure.
3. Remove the four hex nuts from the mounting studs (see figure 4).

Figure 4. Mounting



Note

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

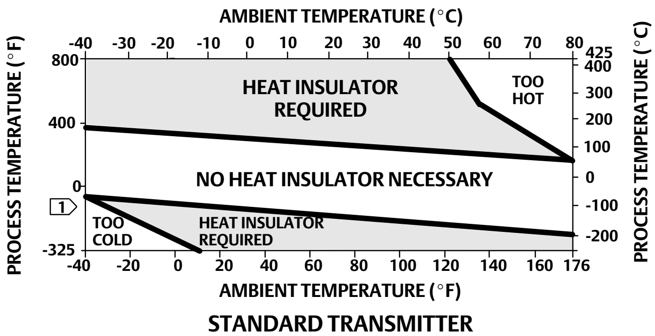
4. Position the digital level controller so the access hole is at the bottom of the instrument.
5. Carefully slide the mounting studs into the sensor mounting holes until the digital level controller is snug against the sensor (figure 4)
6. Reinstall the four hex nuts on the mounting studs and tighten to 10 N•m (88.5 lbf•in).
7. Follow the Coupling procedure to couple the DLC3100 digital level controller to 249 sensor.

On a 249 Sensor in Extreme Temperature Applications

The digital level controller requires an insulator assembly when temperatures exceed the limits shown in figure 5. A torque tube shaft extension is required for a 249 sensor when using an insulator assembly (see figure 6).

1. Mount the DLC3100 on a 249 sensor by securing the shaft extension to the sensor torque tube shaft via the shaft coupling and set screws, with the coupling centered as shown in figure 6.

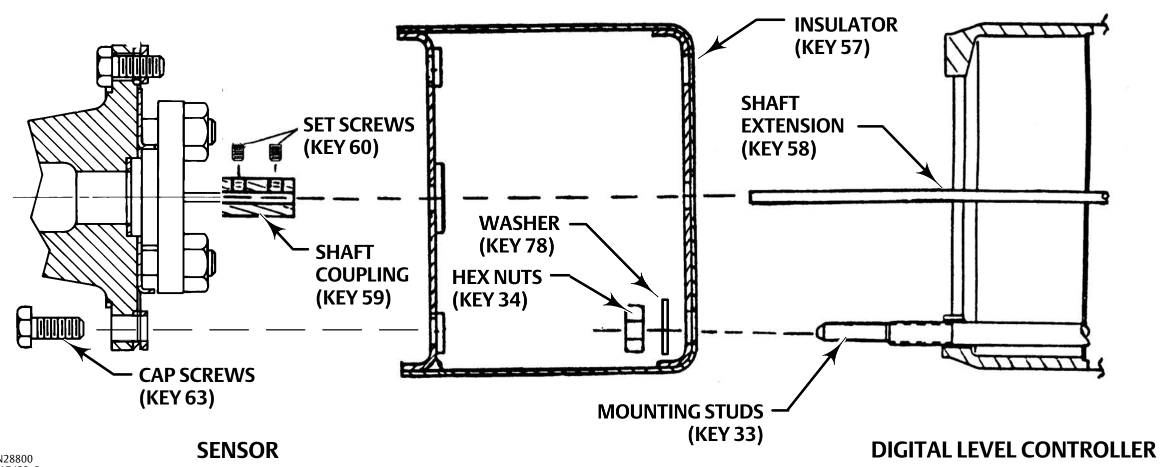
Figure 5. Guidelines for Use of Optional Heat Insulator Assembly



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 FISHER BULLETIN 34.2:2500 (D200037X012).
2. IF AMBIENT DEW POINT IS ABOVE PROCESS TEMPERATURE, ICE FORMATION MIGHT CAUSE INSTRUMENT MALFUNCTION AND REDUCE INSULATOR EFFECTIVENESS.

39A4070-B
A5494-1

Figure 6. Mounting on Sensor in High Temperature Applications



MN28800
20A7423-C
B2707

2. Slide the coupling access handle to the locked position to expose the access hole. Press on the knob of the handle, shown in figure 2, then slide the handle toward the front of the unit. Be sure the locking handle drops into the detent.
3. Remove the hex nuts from the mounting studs.
4. Position the insulator on the digital level controller, sliding the insulator straight over the mounting studs.
5. Re-install the four hex nuts on the mounting studs and tighten the nuts to 10 N•m (88.5 lbf•in).
6. With the access hole at the bottom of the instrument exposed, carefully slide the instrument with the attached insulator over the shaft extension.
7. Secure the instrument and insulator to the torque tube arm with four cap screws.
8. Tighten the cap screws to 10 N•m (88.5 lbf•in).
9. Follow the Coupling procedure below to couple the DLC3100 digital level controller to 249 sensor.

Coupling

If the digital level controller is not already coupled to the sensor, perform the following procedure.

1. Press the knob on the coupling access handle, shown in figure 2, then slide the handle towards the front of the DLC3100 to expose the access hole and lock lock the lever assembly in place. Be sure the locking handle drops into the detent; the DLC3100 LCD will display “Lever Locked”.
2. If in the actual process condition, set the displacer to the lowest possible process condition (lowest fluid level for level application, or fill with fluid with minimum specific gravity for interface application). If on the bench, ensure the displacer is dry and the displacer rod lever arm is not hitting a travel stop. Alternatively, the heaviest calibration weight can be used to replace the displacer to simulate the dry displacer condition.

Note

Interface or density applications with displacer/torque tube sized for a small total change in specific gravity are designed to be operated with the displacer always submerged. In these applications, the torque rod is sometimes resting on a stop while the displacer is dry. The torque tube does not begin to move until a considerable amount of liquid has covered the displacer. In this case, couple with the displacer submerged in the fluid with the lowest density and the highest process temperature condition, or with an equivalent condition simulated with calculated weights.

If the sizing of the sensor results in a proportional band greater than 100% (total expected rotational span greater than 4.4 degrees), couple the transmitter to the pilot shaft while at the 50% process condition to make maximum use of available transmitter travel (±6°). The Trim Zero procedure can be performed at the zero buoyancy (or zero differential buoyancy) condition.

3. Insert a 10 mm deep well socket through the access hole and onto the torque tube shaft clamp nut. Tighten the clamp nut to a maximum torque of 2.1 N•m (18 lbf•in).
4. Press the knob on the coupling access handle, shown in figure 2, then slide the handle towards the rear of the unit to unlock the lever assembly. Be sure the locking handle drops into the detent; “Lever Locked” on the DLC3100 LCD will be cleared.

Electrical Connections

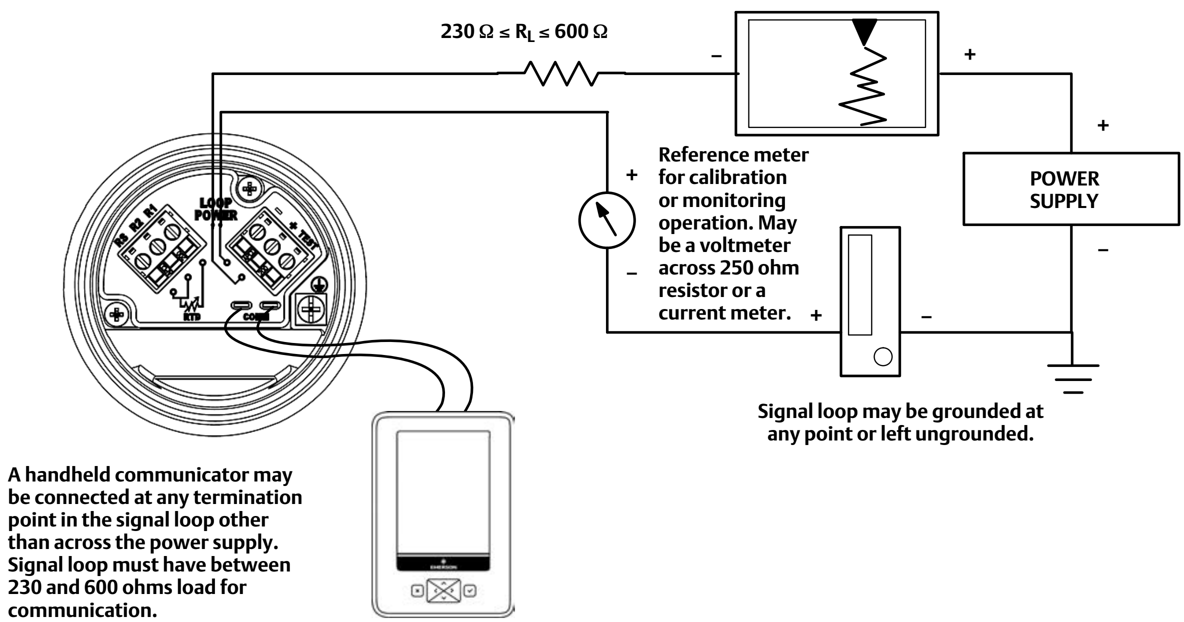
⚠ WARNING

Select wiring with temperature rating of > 85°C and/or cable glands that are rated for the environment of use (such as hazardous area, ingress protection and temperature). Failure to use properly rated wiring and/or cable glands can result in personal injury or property damage from fire or explosion.

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

Proper electrical installation is necessary to prevent errors due to electrical noise. A resistance between 230 and 600 ohms must be present in the loop for communication with a handheld communicator. Refer to figure 7 for current loop connections.

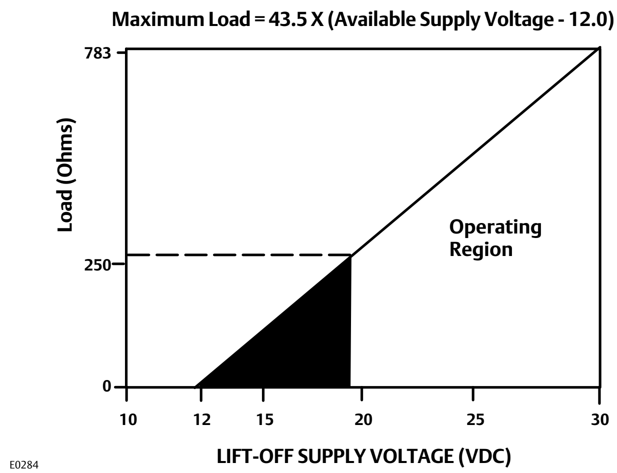
Figure 7. Connecting a Handheld Communicator to the Digital Level Controller Loop



Power Supply

To communicate with the digital level controller, minimum 17.75 VDC power supply is required. The power supplied to the transmitter terminal is determined by the available supply voltage minus the product of the total loop resistance and the loop current. The available supply voltage should not drop below the lift-off voltage. The lift-off voltage is the minimum available supply voltage required for a given total loop resistance. Refer to figure 8 to determine the required lift-off voltage.

Figure 8. Power Supply Requirements and Load Resistance



If the power supply voltage drops below the lift-off voltage while the transmitter is being configured, the transmitter may output incorrect information.

The DC power supply should provide power with less than 2% ripple. The total resistance load is the sum of the resistance of the signal leads and the load resistance of any controller, indicator, or related pieces of equipment in the loop. Note that the resistance of intrinsic safety barriers, if used, must be included.

Field Wiring

⚠ WARNING

To avoid personal injury or property damage caused by fire or explosion, remove power to the instrument before removing the digital level controller cover in an area which contains a potentially explosive atmosphere or has been classified as hazardous.

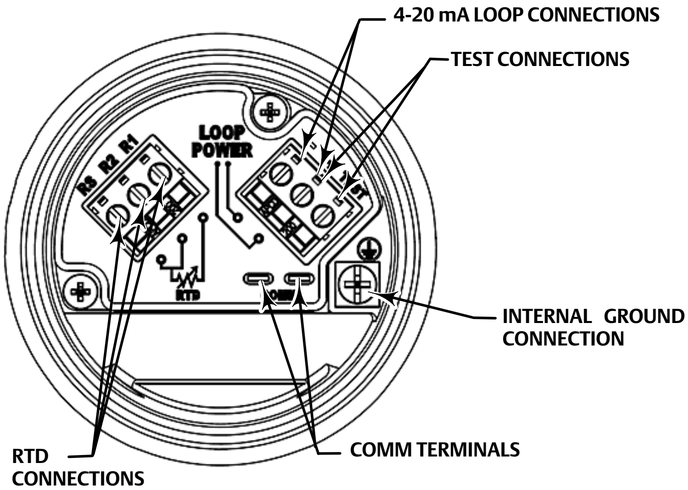
All power to the digital level controller is supplied over the signal wiring. The conductor size shall be of the range 16-24 AWG. Signal wiring need not be shielded, but use twisted pairs for best results. Do not run unshielded signal wiring in conduit or open trays with power wiring, or near heavy electrical equipment. If the digital controller is in an explosive atmosphere, do not remove the digital level controller covers when the circuit is alive, unless in an intrinsically safe installation. Avoid contact with leads and terminals. To power the digital level controller, connect the positive power lead to the + terminal and the negative power lead to the - terminal (see figure 9).

Grounding

⚠ WARNING

Personal injury or property damage can result from fire or explosion caused by the discharge of static electricity when flammable or hazardous gases are present. Connect a 14 AWG (2.1 mm^2) ground strap between the digital level controller and earth ground when flammable or hazardous gases are present. Refer to national and local codes and standards for grounding requirements.

Figure 9. Digital Level Controller Terminal Box



The digital level controller operates with the current signal loop either floating or grounded. However, the extra noise in floating systems affects many types of readout devices. If the signal appears noisy or erratic, grounding the current signal loop at a single point may solve the problem. The best place to ground the loop is at the negative terminal of the power supply. As an alternative, ground either side of the readout device. Do not ground the current signal loop at more than one point.

Shielded Wire

To achieve EMC immunity, the recommended grounding techniques for shielded wire usually call for dual grounding points for the shield. The shield can be connected at the power supply and the grounding terminals (internal or external at the instrument terminal box, shown in figure 9).

Power/Current Loop Connections

Use ordinary copper wire of sufficient size to ensure that the voltage across the digital level controller terminals does not go below 12.0 volts DC. Connect the current signal leads as shown in figure 7. After making connections, recheck the polarity and correctness of connections, then turn the power on.

RTD Connections

An RTD that senses process temperatures may be connected to the digital level controller. This permits the instrument to automatically make density corrections for temperature changes. For best results, locate the RTD as close to the displacer as practical. For optimum EMC performance, use shielded wire no longer than 3 meters (9.8 feet) to connect the RTD. Connect only one end of the shield. Connect the shield to either the internal ground connection in the instrument terminal box or to the RTD thermowell. Wire the RTD to the digital level controller as follows (refer to figure 9):

Two-Wire RTD Connections

1. Connect a jumper wire between the RS and R2 terminals in the terminal box.
2. Connect the RTD to the R1 and R2 terminals.

Three-Wire RTD Connections

1. Connect the 2 wires which are connected to the same end of the RTD to the RS and R1 terminals in the terminal box. Usually these wires are the same color.
2. Connect the third wire to terminal R2. The resistance measured between this wire and either wire connected to terminal RS or R1 should read an equivalent resistance for the existing ambient temperature. Refer to the RTD manufacturer's temperature to resistance conversion table. Usually this wire is a different color from the wires connected to the RS and R1 terminals.

Communication Connections

⚠ WARNING

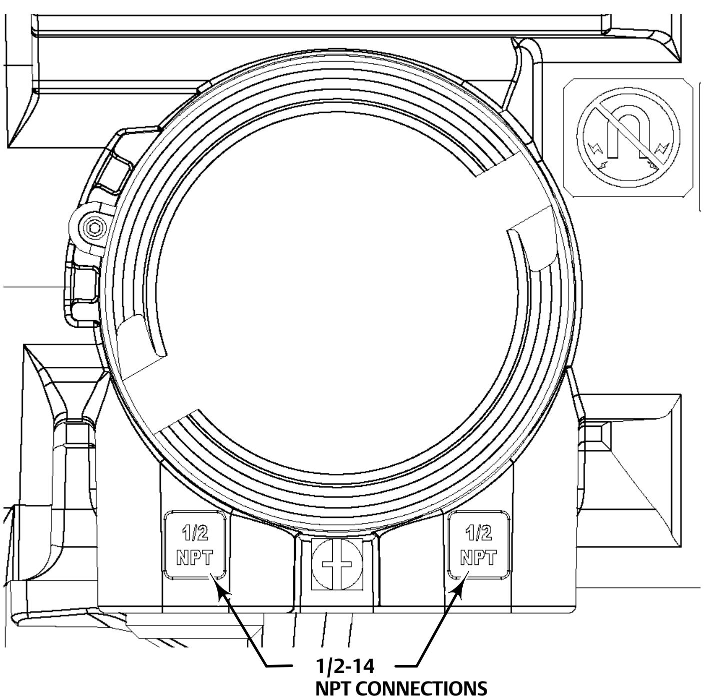
Personal injury or property damage caused by fire or explosion may occur if this connection is attempted in an area which contains a potentially explosive atmosphere or has been classified as hazardous. Confirm that area classification and atmosphere conditions permit the safe removal of the terminal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

The handheld communicator interfaces with the DLC3100 directly via the COMM terminals inside the terminal box, as shown in figure 9.

Entries

Two 1/2-14 NPT entries are available for conduit connections, as shown in figure 10.

Figure 10. Internal Conduit Connections



Alarm Switch

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 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 digital level controller 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.

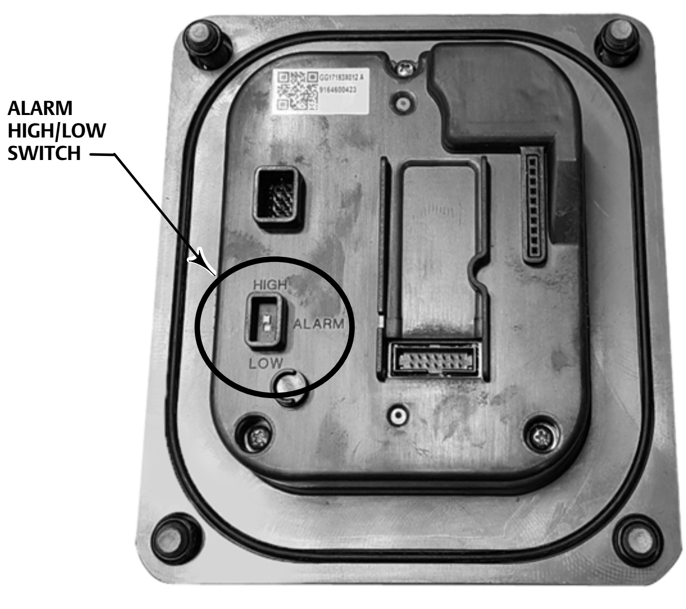
⚠ WARNING

Personal injury or property damage caused by fire or explosion may occur if the following procedure 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 instrument cover before proceeding.

Use the following procedure to change the position of the alarm switch:

1. If the digital level controller is installed, set the loop to manual.
2. Remove the front cover. Do not remove the cover in an explosive atmosphere when the circuit is alive.
3. Move the switch to the desired position (figure 11).
4. Replace the front cover. All covers must be fully engaged to meet explosion-proof requirements.

Figure 11. Alarm High/Low Switch



Local User Interface

Buttons

Four buttons (◀, ▶, ▲ or ▼) are available for navigation to setup and calibrate the DLC3100. In addition to menu navigation, there are two actions for the buttons:

- Short Press: A short press is a press and release button action for ≤ 3 seconds. The short press applies to all four buttons.

- Long Press: A long press is a press, hold and release button action for ≥ 3 seconds. The long press only applies to the ◀ or ▶ buttons. A long press option will be displayed as “HOLD TO...”.

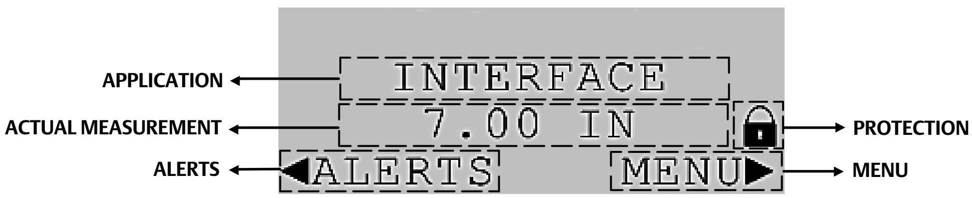
Button Shortcut (◀▶)

Pressing ◀▶ at the same time is a shortcut to:

Shortcut Function	Condition
Cancel Setup/Calibration and put instrument back In Service	During Setup or Calibration task and instrument is Not In Service
Enable protection	At Home Screen and instrument is In Service
Change LUI language	Instrument is In Service and: 1. Not at Home Screen 2. Not at Squawk Screen for locating device function 3. Not at message screens that do not require user interaction.

Home Screen

Figure 12. Home Screen



Name	Description
Application	Displays the type of measurement in use; Level, Interface or Density.
Actual Measurement	Display the actual measurement in unit, percentage (%), and milliamp (mA) form.
Protection	A lock icon is shown if the instrument is protected from setup and calibration.
Alerts	Alert Screen shows all active alerts in the instrument.
Menu	Proceed to Menu Screen to setup and calibrate the instrument.

Alert Screen

Figure 13. Alert Screen

Name	Description
Active Alerts	Any of the alerts listed in the below table will be displayed if active.
Home	Return to Home Screen.
Reset	Indicates the instrument is in the safe state. If the alert is safety related and has been cleared, press to take the instrument out of the safe state.

Alerts

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

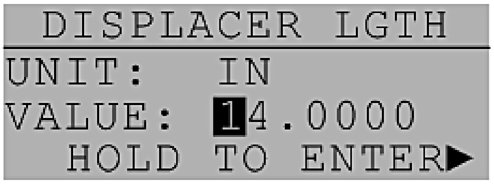
Menu Screen

Figure 14. Menu Screen

Name	Description
Menu Selection	Select from the features below: • Device Setup • Calibration • Level Offset • Range Setup • Density Setup • Alert Setup • Force Mode • Protection • Setup Review • LCD Test • HART Setup • Language
Home	Return to Home Screen.
Enter	Select the highlighted selection and proceed to the next screen.

Numeric Input Screen

Figure 15. Numeric Input Screen



In the numeric input screen:

- Short Press
  a. The Left/Right buttons move the cursor to select the digit/unit (unit is only applicable to certain screens).
  b. The Up/Down buttons changes the digit/unit (unit is only applicable to certain screens) selected by the cursor.
- Long Press
  a. The Right button allows you to enter and confirm the value.
  b. The Left button returns you to the previous screen.

Configuration and Calibration

Device Setup

If a DLC3100 digital level controller ships from factory mounted on a 249 sensor initial setup and calibration is not 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 sensor 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 0 and 100% water level inputs). If the displacer is not connected, hang the displacer on the torque tube.

If the digital level controller is mounted on the torque tube arm and the displacer is not blocked (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 sensor 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. Go the Menu screen and select Setup Review.

You will need to do the Device Setup procedure for instruments not mounted on a 249 sensor or when replacing an instrument.

Configuration Advice

Device Setup guides 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 249 construction. Consequently, 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.

Write Protection

Local User Interface	Menu > Protection

To setup and calibrate the instrument, write protection must be disabled.

Level Offset

Local User Interface	Menu > Level Offset

Set Level Offset to zero before running Device Setup.

Setting up the DLC3100 after mounting on 249 sensor

Local User Interface	Menu > Device Setup

Note

The DLC3100 must be out of service during Device Setup. Place the loop into manual operation before setting the device out of service as the DLC3100 output may not be valid.

Follow the prompts on the LCD display to set up the DLC3100.

Refer to table 1 for information required to setup the DLC3100. Most of the information is available from the sensor nameplate. Refer to table 2 for information on specific unit settings when imperial/metric units are selected. 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 3 to determine driver rod (moment arm) length.

Table 1. Setup Information

Description	Value	Units Available in LUI
Displacer Length		mm, in
Displacer Volume		cm^3, in^3
Displacer Weight		kg, lb
Driver Rod (Moment Arm) Length		
Mounting		
249 Sensor		
Torque Tube Material		
Torque Tube Wall		
Measurement Application		
Analog Output Action		
Fluid Density		SGU

Table 2. Unit Settings

Description	Imperial	Metric
Length Unit	inch	mm
Weight Unit	lb	kg
Volume Unit	In^3	Cm^3
Density Unit	SGU	SGU
Temperature Unit	Deg F	Dec C
Torque Rate Unit	Lb • in/deg	Nm/deg

Table 3. Driver Rod Length(1)

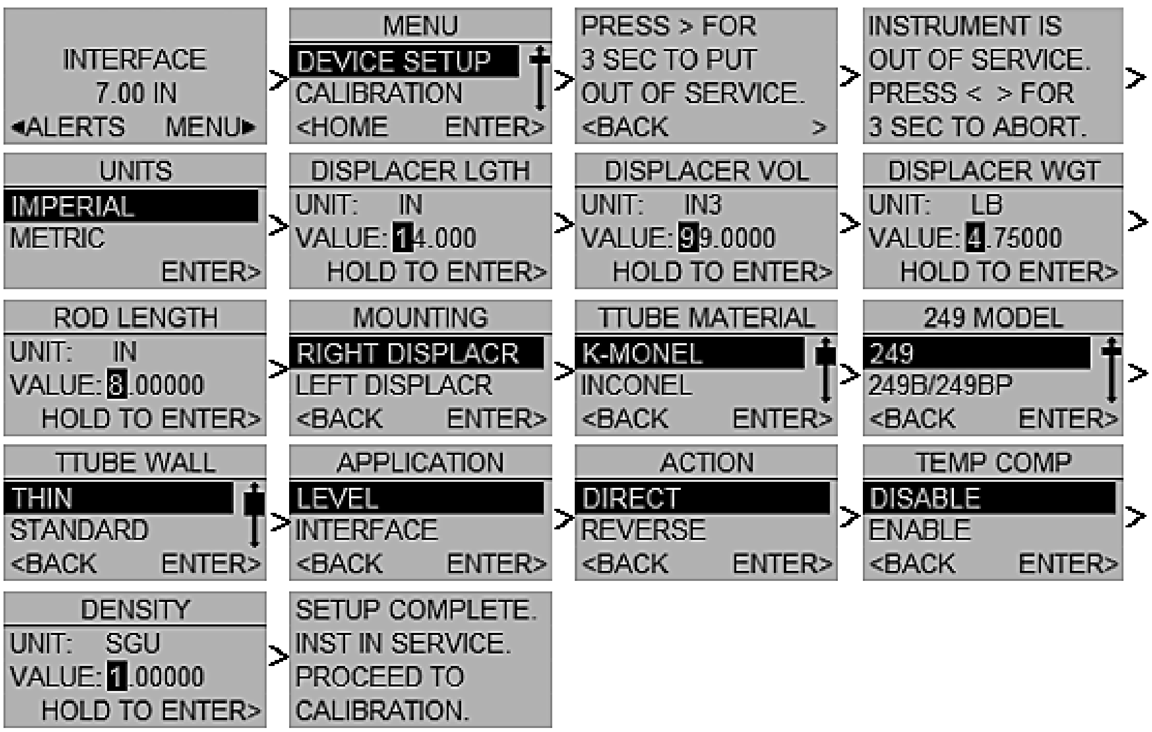
SENSOR TYPE(2)	MOMENT ARM	
	mm	Inch
249	203	8.01
249B	203	8.01
249BF	203	8.01
249BP	203	8.01
249C	169	6.64
249CP	169	6.64
249K	267	10.5
249L	229	9.01
249N	267	10.5
249P (CL125-CL600)	203	8.01
249P (CL900-CL2500)	229	9.01
249VS (Special)(1)	See serial card	See serial card
249VS (Std)	343	13.5
249W	203	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. 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.

- For Level application

Menu > Device Setup > Put OOS > Unit selection (Imperial/Metric) > Displacer Length > Displacer Volume > Displacer Weight > Driver Rod Length > Mounting > Torque Tube Material > 249 Model > Torque Tube Wall Thickness > Application (Level) > Action > Temp Comp (Disable) > Density > Setup Complete

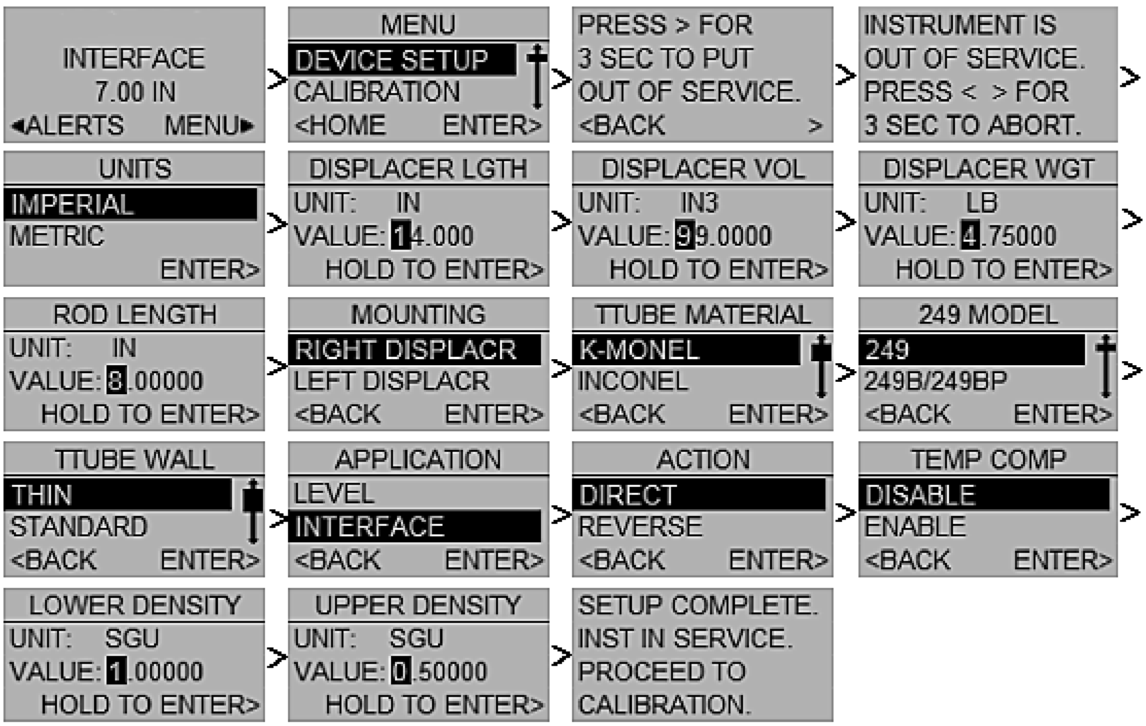
Figure 16. Level Application Calibration LUI Screens



- For Interface application:

  Menu > Device Setup > Put OOS > Unit selection (Imperial/Metric) > Displacer Length > Displacer Volume > Displacer Weight > Driver Rod Length > Mounting > Torque Tube Material > 249 Model > Torque Tube Wall Thickness > Application (Interface) > Action > Temp Comp (Disable) > Lower Density > Upper Density > Setup Complete

Figure 17. Interface Application Calibration LUI Screens



Calibration

Local User Interface	Menu > Calibration

Note

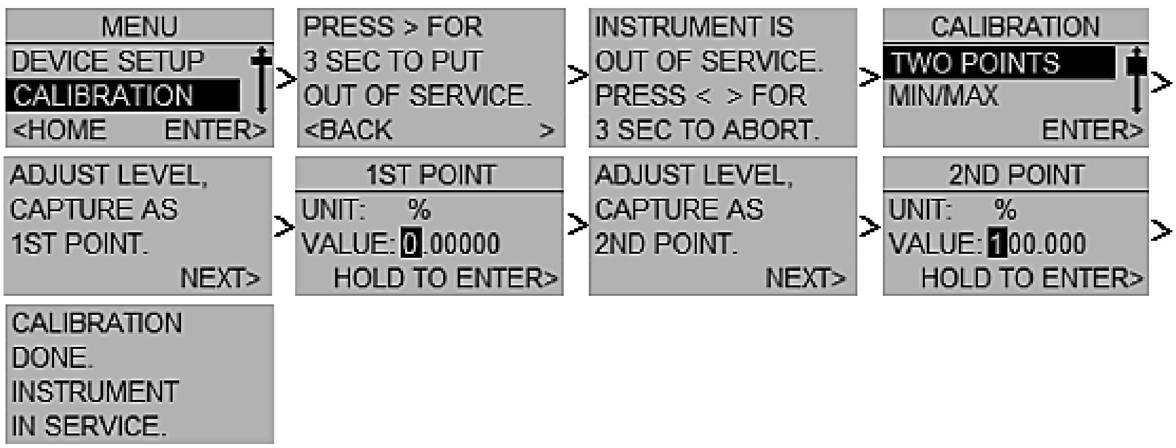
The DLC3100 must be out of service during calibration. Place the loop into manual operation before putting device out of service as the output will not be valid.

Two Points Calibration

The 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).

Menu > Calibration > Put OOS > Two Point Calibration > Adjust Level > 1st Point input > Adjust Level > 2nd Point input > Calibration Done

Figure 18. Two Point Calibration LUI Screens



Min/Max Calibration

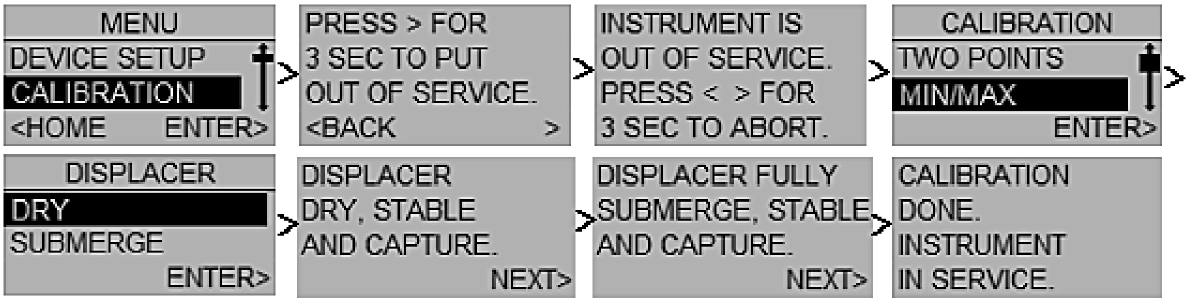
Min/Max Calibration can be used to calibrate the sensor if the process condition can be changed to the equivalent of a completely dry and completely submerged displacer (level application), or equivalent of displacer completely submerged with upper fluid and with lower fluid (interface application),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

- Device is setup in a Level Application. Capture the first calibration point either with displacer dry condition or with the displacer totally submerged.

  Menu > Calibration > Put OOS > Min/Max Calibration > Displacer Dry and Stable > Displacer Fully Submerge and Stable > Calibration Done

  Menu > Calibration > Put OOS > Min/Max Calibration > Displacer Fully Submerge and Stable > Displacer Dry and Stable > Calibration Done

Figure 19. Min/Max Calibration LUI Screens for Level Application

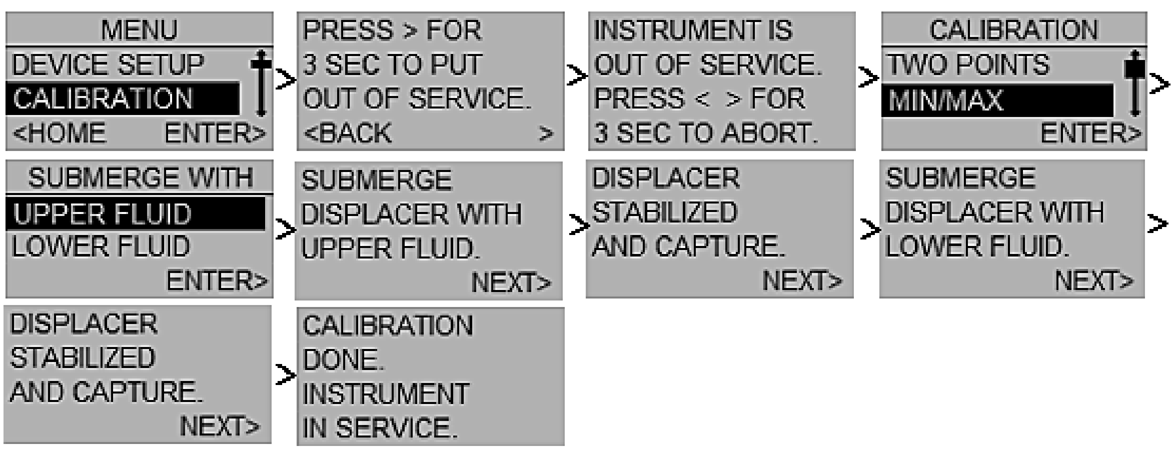


- Device is setup in an Interface Application. Capture the first calibration point either with displacer totally submerged in the lower fluid or totally submerged in the upper fluid.

  Menu > Calibration > Put OOS > Min/Max Calibration > Lower Fluid > Displacer Submerge with Lower Fluid > Displacer Stable & Capture > Displacer Submerge with Upper Fluid > Displacer Stable & Capture > Calibration Done

  Menu > Calibration > Put OOS > Min/Max Calibration > Upper Fluid > Displacer Submerge with Upper Fluid > Displacer Stable & Capture > Displacer Submerge with Lower Fluid > Displacer Stable & Capture > Calibration Done

Figure 20. Min/Max Calibration LUI Screens for Interface Application



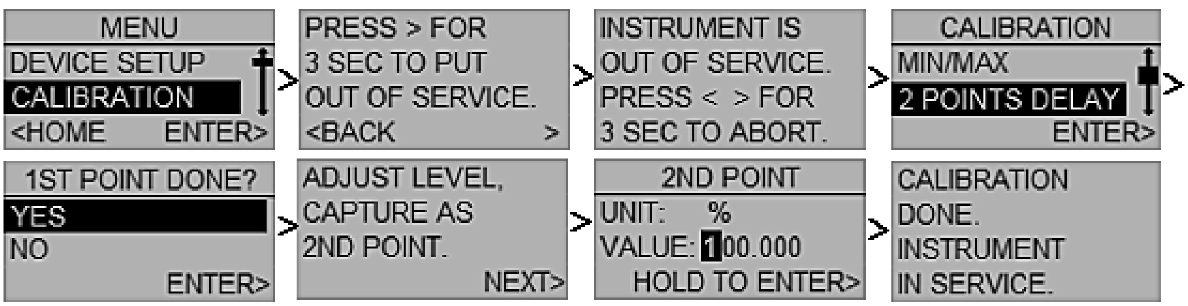
Two Points Time Delay Calibration

Two Points Time Delay is a two point calibration in which the two points captured can be taken some time apart. The first point is captured and stored indefinitely until the second point is captured. The two data points can be separated by any span between 5% and 100% within the displacer. All instrument configuration data is needed to perform a Two Points Time Delay Calibration.

- If the first calibration point has been captured previously:

  Menu > Calibration > Put OOS > Two Point Time Delay Calibration > 1^{st} Point Done > Adjust Level > 2^{nd} Point Input > Calibration Done

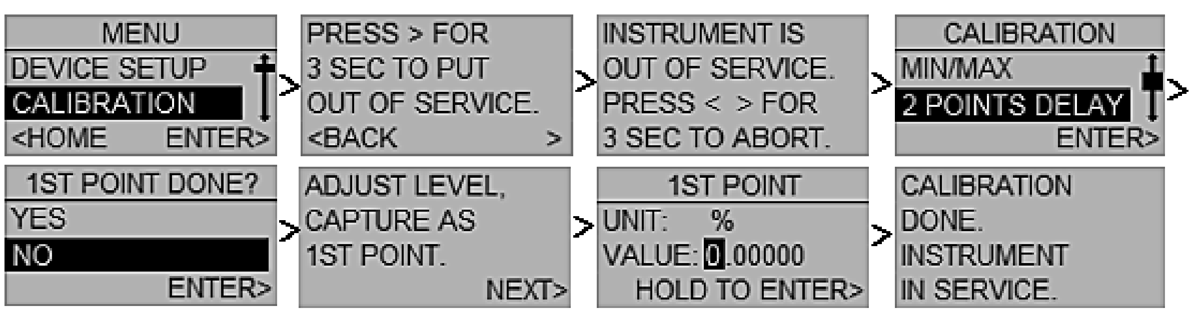
Figure 21. Two Point Time Delay Calibration LUI Screens—First Point Done



- If the first calibration point has not been captured previously:

  Menu > Calibration > Put OOS > Two Point Time Delay Calibration > Check Coupling/Lever > 1^{st} Point Not Done > Adjust Level > 1^{st} Point Input > Instrument In Service

Figure 22. Two Point Time Delay Calibration LUI Screens—First Point Not Done



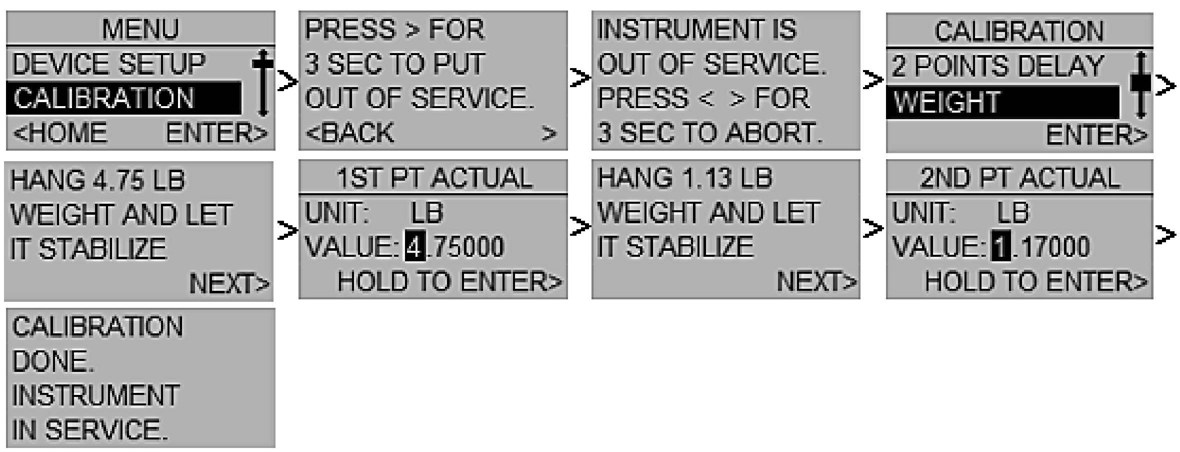
Weight Calibration

Weight Calibration may be used on the bench or with a calibration jig that is capable of applying 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. However, 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 be sized properly for the expected service, so that the chosen process conditions are in the free motion linear range of the sensor.

Menu > Calibration > Put OOS > Weight Calibration > Check Coupling/Lever > Weight Type (Weight) > Hang Weight > 1st Point Input > Hang Weight > 2nd Point Input > Calibration Done

Menu > Calibration > Put OOS > Weight Calibration > Check Coupling/Lever > Weight Type (Counter Weight) > Upward Force > 1st Point Input > Upward Force > 2nd Point Input > Calibration Done

Figure 23. Weight Calibration LUI Screens

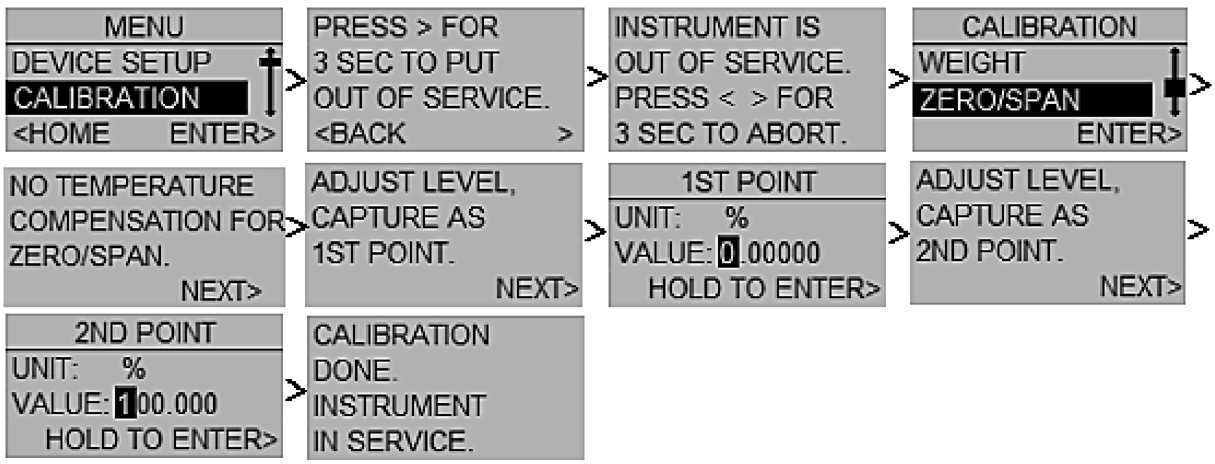


Simple Zero/Span

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

Menu > Calibration > Put OOS > Simple Zero/Span > Check Coupling/Lever > No Temp Comp > Adjust Level > 1st Point Input > Adjust Level > 2nd Point Input > Calibration Done

Figure 24. Simple Zero/Span LUI Screens

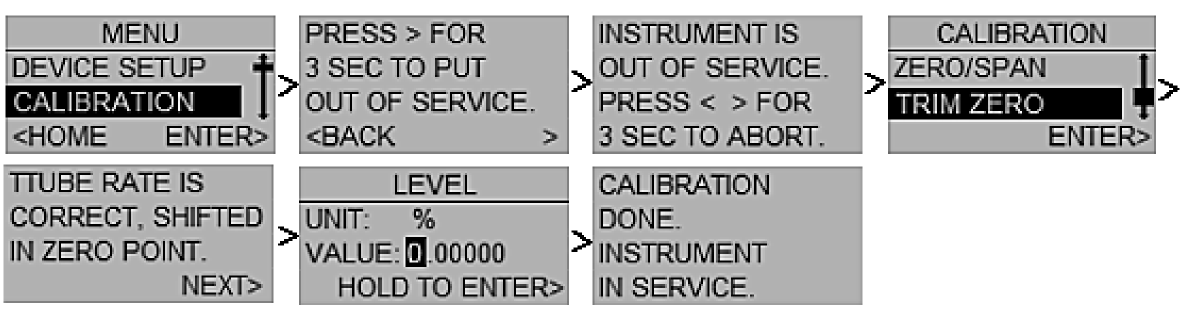


Trim Zero

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. Trim Zero assumes that the calibration gain is accurate.

Menu > Calibration > Put OOS > Trim Zero > Zero Shift > Level Input > Calibration Done

Figure 25. Trim Zero LUI Screens

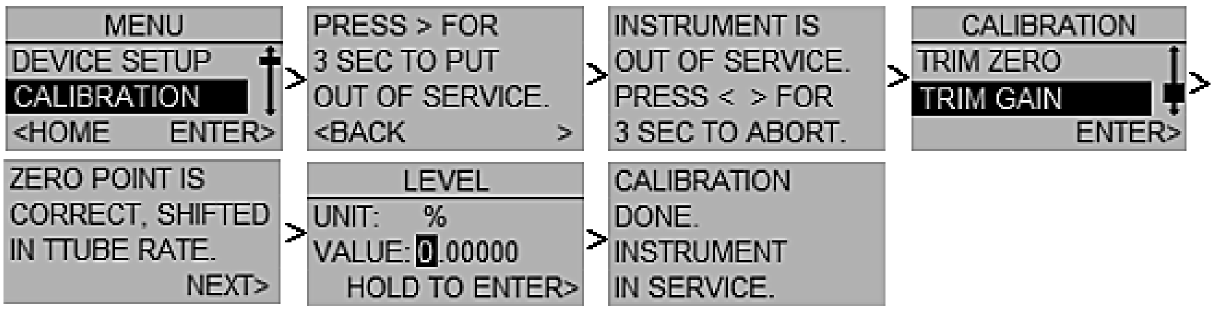


Trim Gain

Trim Gain 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.

Menu > Calibration > Put OOS > Trim Gain > Torque Tube Rate Shift > Level Input > Calibration Done

Figure 26. Trim Gain LUI Screens

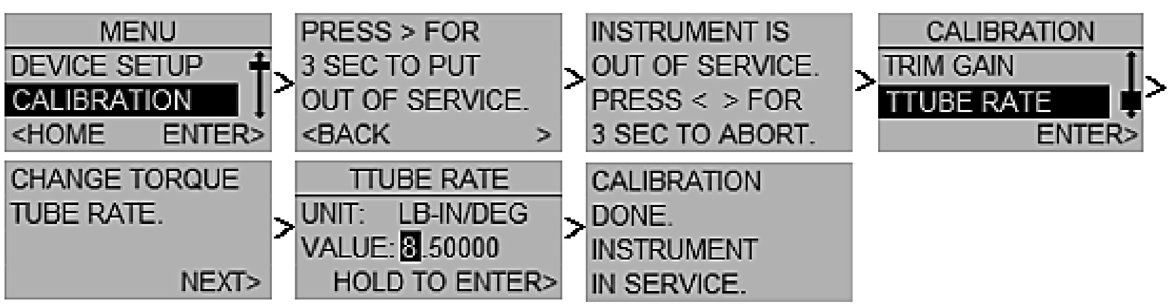


Torque Rate

The following allows you to input the torque rate.

Menu > Calibration > Put OOS > Torque Rate > Change Torque Rate > Rate input > Calibration Done

Figure 27. Torque Rate LUI Screens



Level Offset

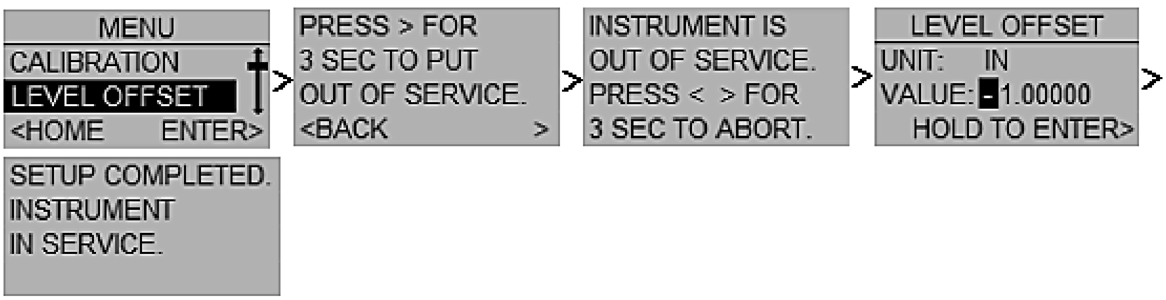
Local User Interface	Menu > Level Offset

Input the primary variable value that you want the device to report when physical level is at the bottom of the displacer. This affects the URV/LRV, PV Hi/Lo, PV HiHi/LoLo alerts . Changing PV alert points assumes you have already considered Level Offset into alert points.

Note

The DLC3100 must be out of service when setting Level Offset. Place the loop into manual operation before putting device out of service as the output will not be valid.

Figure 28. Level Offset LUI Screens



Range Setup

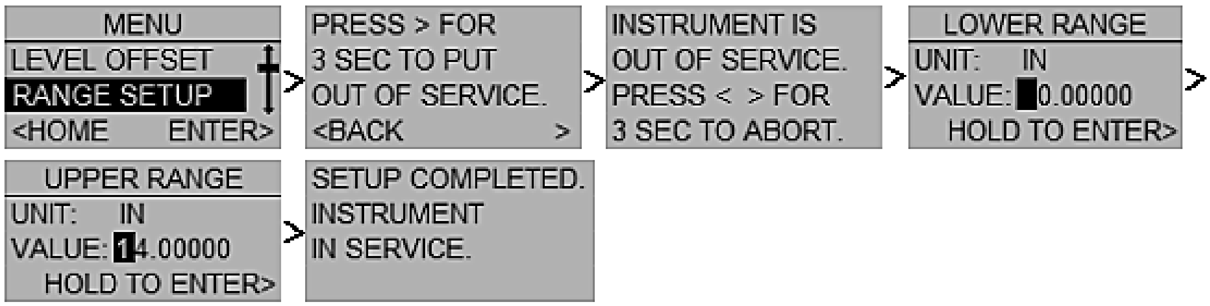
Local User Interface	Menu > Range Setup

Range Setup allows you to set the lower and upper range values; this determines the 4 - 20 mA.

Note

The DLC3100 must be out of service when setting Range Setup. Place the loop into manual operation before putting device out of service as the output will not be valid.

Figure 29. Range Setup LUI Screens



Density Setup

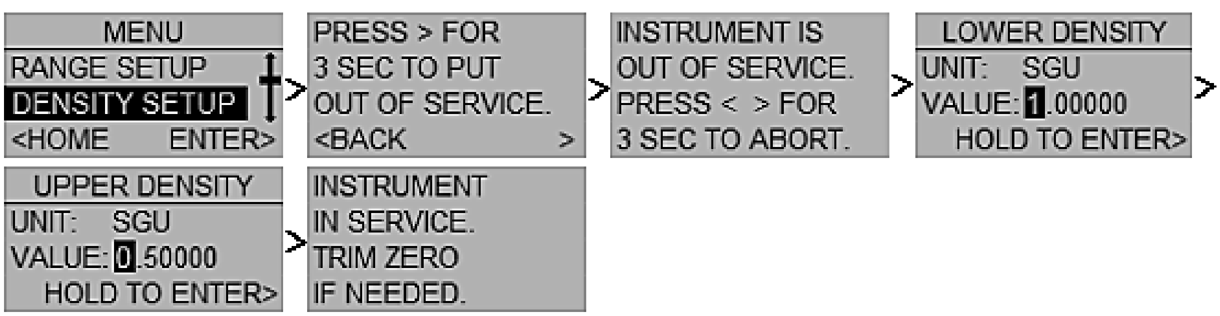
Local User Interface	Menu > Density Setup

Density setup allows you to change the density value of the fluid if the process fluid has changed (different fluid or density varies due to temperature change). Trim Zero is required to have a valid measurement.

Note

The DLC3100 must be out of service when setting Density Setup. Place the loop into manual operation before putting device out of service as the output will not be valid.

Figure 30. Density Setup LUI Screens



Alert Setup

Local User Interface	Menu > Alert Setup

Note

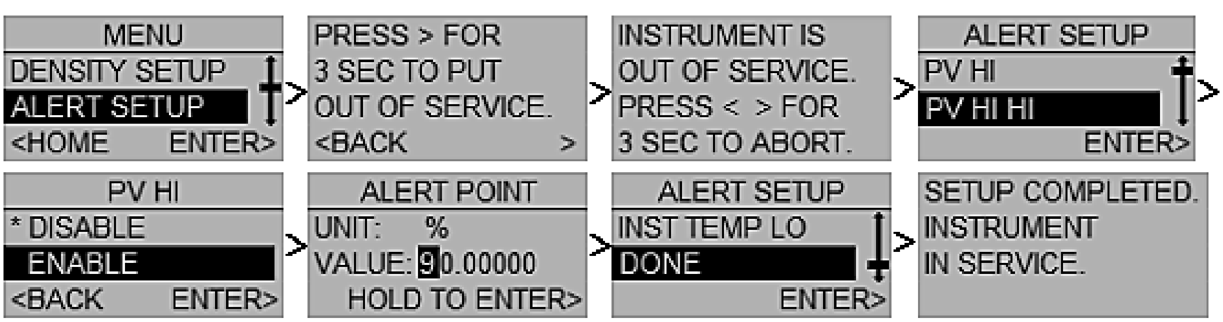
The DLC3100 must be out of service during Alert Setup. Place the loop into manual operation before putting device out of service as the output will not be valid.

You can enable/disable the below alerts using the local user interface:

- PV High
- PV High High
- PV Low
- PV Low Low
- Process Temperature High
- Process Temperature Low
- Instrument Temperature High
- Instrument Temperature Low

Once Alert Setup is completed, select DONE at the bottom of the list to exit and put the device in service.

Figure 31. Alert Setup LUI Screens



Force Mode

Local User Interface	Menu > Force Mode

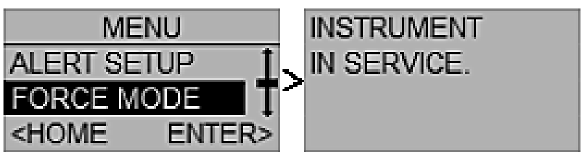
When the DLC3100 is out of service, it is locked for exclusive access by the Primary/Secondary master that put it out of service. The same master must be used to put the instrument back in service; another master will not be able to change anything on the device and the LCD will return a “Locked by HART”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

Figure 32. Force Mode LUI Screens

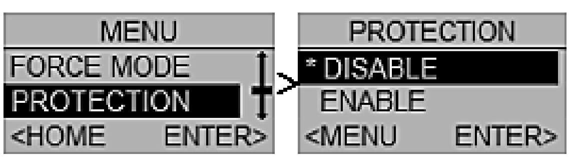


Protection

Local User Interface	Menu > Protection

When Protection is enabled you will not be able to configure and calibrate the DLC3100, including setting alerts.

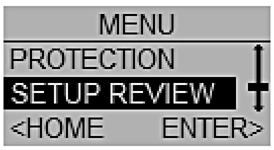
Figure 33. Protection LUI Screens



Setup Review

Local User Interface	Menu > Setup Review

Figure 34. Setup Review LUI Screen



Setup Review allows review of the below settings:

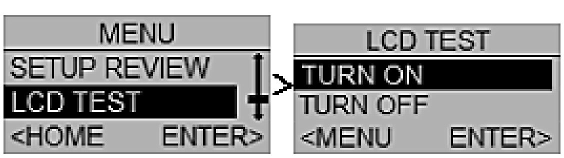
- Displacer length
- Displacer volume
- Displacer weight
- Drive rod length
- Lower density
- Upper density
- Alerts being enabled via Local User Interface
- Level offset
- Lower range value
- Upper range value
- Application
- Action
- Mounting
- Torque Tube Material
- 249 Model
- Torque Tube Wall
- Torque Tube Rate
- Temperature Compensation
- Temperature Input
- HART Version

LCD Test

Local User Interface	Menu > LCD Test

The LCD Test menu allows you to see if all of the pixels on the LCD are working. Select TURN ON to turn on all of the pixels; Select TURN OFF to turn off the pixels.

Figure 35. LCD Test LUI Screens



HART Setup

Local User Interface	Menu > HART Setup

HART Setup allows you to change from HART 5 to HART 7 and vice versa.

Note

The DLC3100 must be out of service during HART Setup. Place the loop into manual operation before putting device out of service as the output will not be valid.

If Device Description (DD) is used to communicate with the instrument, ensure that the correct DD is available. Without the correct DD, the communication will be lost.

Figure 36. HART Setup LUI Screens

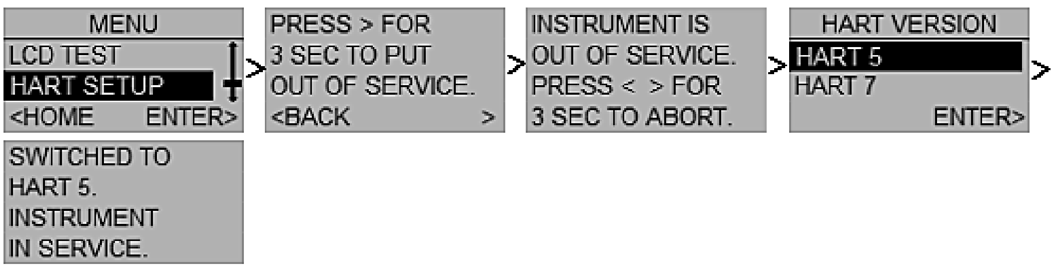


Table 4. Specifications

Available Configurations

Mounts on caged and cageless 249 sensors

Function: Transmitter

Communications Protocol: HART

Input Signal

Level, Interface, or Density[1]**:** Rotary motion of torque tube shaft proportional to changes in liquid level, interface level, or density that change the buoyancy of a displacer

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

Output Signal

Analog: 4 to 20 mA DC

■ Direct action—increasing level, interface, or density increases output; or

■ Reverse action—increasing level, interface, or density decreases output

High saturation: 20.5 mA
Low saturation: 3.8 mA
High alarm[2]*:* > 21.0 mA
Low Alarm[2]*:* < 3.6 mA

Digital: HART 1200 Baud Frequency Shift Keyed (FSK)

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.

The transmitter HART receive impedance is defined as:
Rx: 30.2k ohms and
Cx: 5.45 nF

-continued-

Table 4. Specifications (continued)

Supply Requirements

12 to 30 volts DC; 25 mA
Instrument has reverse polarity protection

A minimum compliance voltage of 17.75 VDC (due to HART impedance requirement) is required to guarantee HART communication.

Transient Voltage Protection

Pulse Waveform		Max V_{CL} @ I_{pp} (Clamping Voltage) (V)	I_{pp} (Peak Pulse Current) (A)
Rise Time (μs)	Decay to 50% (μs)		
10	1000	48.4	12.4

Electrical Classification

Overvoltage Category II per IEC 61010 clause 5.4.2d

Pollution Degree 4

For ATEX/IECEx application equipment shall be used in an area of at least Pollution Degree 2

Altitude Rating

Up to 2000 meters (6562 feet)

Ambient Temperature:

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)

LCD operating temperature limits: -20 to 70°C (-4 to 158°F)(3)

Process Temperature

The process density and torque rate are affected by the process temperature. Temperature compensation can be implemented to correct for process density changes.

Hazardous Area

CSA
Class/Division: Intrinsically Safe, Explosion-proof(4), 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, Type n and Dust by Enclosure

Other Classifications / Certifications

CML— Certification Management Limited (Japan)

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

ESMA—Emirates Authority for Standardization and Metrology - ECAS-Ex (UAE)

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

PESO CCOE—Petroleum and Explosives Safety Organization - Chief Controller of Explosives (India)

Electrical Housing

IP66, Type 4X

Electrical Connections
Two 1/2-14 NPT internal conduit connections. Both are at the bottom of terminal box (figure 10).

Electromagnetic Compatibility

DLC3100 meets EN61326-1:2013
DLC3100 SIS meets EN61326-3-2:2008

DLC3100 SIS
Safety Instrumented System Classification

SIL2 capable - certified by exida Consulting LLC

Performance

Performance Criteria	DLC3100 Digital Level Controller(1)	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

NOTE: At full design span, reference conditions.
1. To lever assembly rotation inputs.

At effective proportional band (PB)<100%, linearity, dead band, and repeatability are derated by the factor (100%/PB)

Minimum Differential Specific Gravity

0.05 SGU

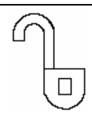
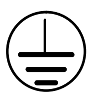
-continued-

Table 4. Specifications (continued)

Construction Materials	Weight
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	Less than 3.45 kg (7.57 lb) **Options** ■ Sunshade ■ Heat insulator[5] ■ Mountings for Masoneilan, Yamatake and Foxboro-Eckhardt sensors

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.
5. If the DLC3100 and a 249 sensor are ordered as an assembly, and a heat insulator is required for the application, order the heat insulator as a 249 sensor option.
If the DLC3100 is ordered separately, the heat insulator is available as a kit. Refer to figure 5 for use guidelines.

Instrument Symbols

Symbol	Description	Location on Instrument
	Lever Lock	Handle
	Lever Unlock	Handle
	Earth	Terminal Box Housing

Symbol	Description	Location on Instrument
NPT	National Pipe Thread	Terminal Box Housing
T	Test	Inside Terminal Box
+	Positive	Inside Terminal Box
–	Negative	Inside Terminal Box
COMM	HART Communication	Inside Terminal Box
RS	RTD Connection	Inside Terminal Box
R1	RTD Connection 1	Inside Terminal Box
R2	RTD Connection 2	Inside Terminal Box

Emerson Automation Solutions
Marshalltown, Iowa 50158 USA
Sorocaba, 18087 Brazil
Cernay, 68700 France
Dubai, United Arab Emirates
Singapore 128461 Singapore

www.Fisher.com

EMERSON