

Warranty, Service & Repair

To register your product with the manufacturer, fill out the enclosed warranty card and return it immediately to:

Flowline Inc.
10500 Humbolt Street
Los Alamitos, CA 90720.

If for some reason your product must be returned for factory service, contact Flowline Inc. to receive a Material Return Authorization number (MRA) first, providing the following information:

1. Part Number, Serial Number
2. Name and telephone number of someone who can answer technical questions related to the product and its application.
3. Return Shipping Address
4. Brief Description of the Symptom
5. Brief Description of the Application

Once you have received a Material Return Authorization number, ship the product prepaid in its original packing to:

Flowline Factory Service
MRA _____
10500 Humbolt Street
Los Alamitos, CA 90720

To avoid delays in processing your repair, write the MRA on the shipping label. Please include the information about the malfunction with your product. This information enables our service technicians to process your repair order as quickly as possible.

FLOWLINE®

Pressure Transmitters LD10 & LD20 Series Owner's Manual



Version 1.0A

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Manual # LD900001

05/05

WARRANTY

Flowline warrants to the original purchaser of its products that such products will be free from defects in material and workmanship under normal use and service for a period which is equal to the shorter of one year from the date of purchase of such products or two years from the date of manufacture of such products.

This warranty covers only those components of the products which are non-moving and not subject to normal wear. Moreover, products which are modified or altered, and electrical cables which are cut to length during installation are not covered by this warranty.

Flowline's obligation under this warranty is solely and exclusively limited to the repair or replacement, at Flowline's option, of the products (or components thereof) which Flowline's examination proves to its satisfaction to be defective. FLOWLINE SHALL HAVE NO OBLIGATION FOR CONSEQUENTIAL DAMAGES TO PERSONAL OR REAL PROPERTY, OR FOR INJURY TO ANY PERSON.

This warranty does not apply to products which have been subject to electrical or chemical damage due to improper use, accident, negligence, abuse or misuse. Abuse shall be assumed when indicated by electrical damage to relays, reed switches or other components. The warranty does not apply to products which are damaged during shipment back to Flowline's factory or designated service center or are returned without the original casing on the products. Moreover, this warranty becomes immediately null and void if anyone other than service personnel authorized by Flowline attempts to repair the

defective products.

Products which are thought to be defective must be shipped prepaid and insured to Flowline's factory or a designated service center (the identity and address of which will be provided upon request) within 30 days of the discovery of the defect. Such defective products must be accompanied by proof of the date of purchase.

Flowline further reserves the right to unilaterally waive this warranty and to dispose of any product returned to Flowline where:

- a. There is evidence of a potentially hazardous material present with product.
- b. The product has remained unclaimed at Flowline for longer than 30 days after dutifully requesting disposition of the product.

THERE ARE NO WARRANTIES WHICH EXTEND BEYOND THE DESCRIPTION ON THE FACE OF THIS WARRANTY. This warranty and the obligations and liabilities of Flowline under it are exclusive and instead of, and the original purchaser hereby waives, all other remedies, warranties, guarantees or liabilities, express or implied. EXCLUDED FROM THIS WARRANTY IS THE IMPLIED WARRANTY OF FITNESS OF THE PRODUCTS FOR A PARTICULAR PURPOSE OR USE AND THE IMPLIED WARRANTY OF MERCHANT ABILITY OF THE PRODUCTS.

This warranty may not be extended, altered or varied except by a written instrument signed by a duly-authorized officer of Flowline, Inc.

SPECIFICATIONS

Step One

Range:	LD10: 0 to 7.5 psi (0 to 0.5 bar) LD11: 0 to 15 psi (0 to 1 bar) LD12: 0 to 30 psi (0 to 2 bar) LD20: 0 to 2.5 psi (0 to 0.2 bar) LD21: 0 to 5 psi (0 to 0.3 bar) LD22: 0 to 10 psi (0 to 0.7 bar) LD23: 0 to 15 psi (0 to 1.0 bar)
Accuracy:	± 0.25% of span
Supply voltage:	LD10: 7-35 VDC LD20: 9-32 VDC
Loop resist.:	LD10: (Vs-7) x 50 ohms LD20: 100 MegaOhm @ 50 VDC
Signal output:	4-20 mA, two-wire
Calibration:	None, fixed span
Process temp.:	LD10: F: -5° to 125°, C: -20° to 50° LD20: F: -5° to 140°, C: -20° to 60°
Temp. comp.:	Automatic
Proof pressure:	LD10: 2 x full span LD20: 4 x full span
Burst pressure:	LD10: > 35 x full span LD20: <10 psi: >10 x full span >10 psi: > 6 x full span
Enclosure rating:	NEMA 6X (IP68)
Probe material:	LD10: 316 ss and 17-4 PH ss LD20: Titanium
Cable material:	LD10: Polyurethane LD20: Tefzel
Cable type:	2-conductor, shielded
Cable length:	LD10: 0 to 32' (0 to 9.8 m) LD11: 0 to 32' (0 to 9.8 m) LD12: 0 to 48' (0 to 14.6 m) LD20: 0 to 8' (0 to 2.4 m) LD21: 0 to 14' (0 to 4.3 m) LD22: 0 to 25' (0 to 7.6 m) LD23: 0 to 37' (0 to 11.3 m)
Weight:Approx.:	LD10: 100 grams LD20: 142 grams (approx.)
Classification:	LD10: General purpose LD20: Intrinsically Safe
Approvals (LD20 only):	FM: Class I, Division I, Groups A, B, C and D; Class II, Division I, Groups E, F and G; Class III
Parameters (LD20 only):	FM: Vmax < 30 V; Imax < 100 mA; Ci = 0.068 µF; Li = 0 mH
CE compliance:	EN 50082-2 immunity EN 55011 emission

Part Numbers:

Model Number	Pressure Range	Level Range	Cable Length
LD10-S041	0 to 7.5 psi	0 - 17.3' (0 - 5.3 m)	32' (9.8 m)
LD11-S041	0 to 15 psi	0 - 34.6' (0 - 10.6 m)	32' (9.8 m)
LD12-S041	0 to 30 psi	0 - 69.3' (0 - 21.1 m)	48' (14.6 m)
LD20-T041	0 to 2.5 psi	0 - 5.8' (0 - 1.8 m)	8' (2.4 m)
LD21-T041	0 to 5 psi	0 - 11.6' (0 - 3.5 m)	14' (4.3 m)
LD22-T041	0 to 10 psi	0 - 23.1' (0 - 7.0 m)	25' (7.6 m)
LD23-T041	0 to 15 psi	0 - 34.6' (0 - 10.6 m)	37' (11.3 m)
LD90-1001	N/A	N/A	N/A
LD90-5001	N/A	N/A	N/A

Choosing the Correct Pressure Range:

The DeltaSpan and DeltaRange level transmitters are fixed range transmitters, similar to Flowline's Ricochet family of ultrasonic level transmitters. At 0 psi (no liquid), the current output will be 4 mA. At max. pressure, the current output will be 20 mA. Readings between 0 and the max. pressure will be proportional to the 4-20 mA output. Since the density of liquid will have an influence on the range of the LD10 series, follow these simple instruction to insure the correct pressure range has been selected.

1. Determine the Specific Gravity (SG) of the liquid to be measured.
2. Determine the maximum height of liquid (H) to be measured in feet.
3. Use to following equation to determine the maximum required pressure (P):

$$P = H / [(SG) * 2.31(\text{feet/psi})]$$

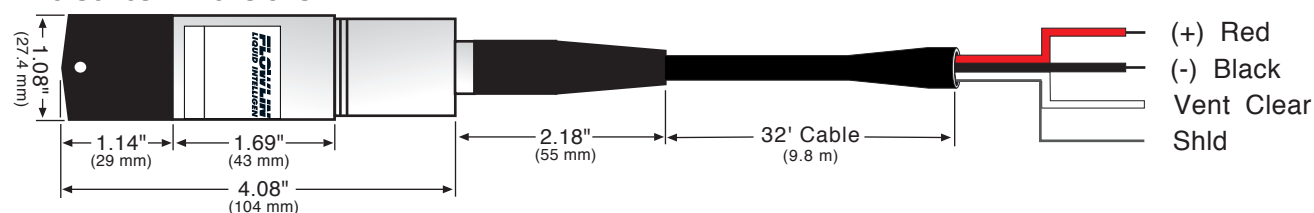
4. Compare the max. required pressure (P) to the pressure ranges listed above.

For example, a 16' tall tank contains a liquid with a SG of 0.9:

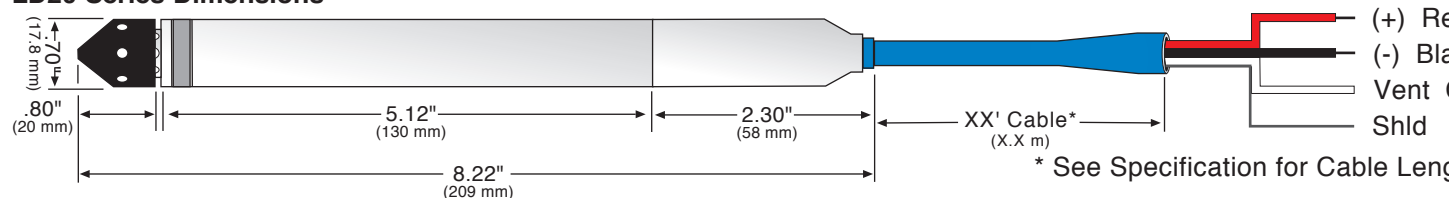
$$P = 16.0 \text{ feet} / [(0.9) * 2.31(\text{feet/psi})] = 7.69 \text{ psi}$$

The max. required pressure is 7.69 psi, which is above the 7.5 psi range for the LD10-S041. To read the full range of the tank, choose the LD11-S041.

LD10 Series Dimensions



LD20 Series Dimensions



SAFETY PRECAUTIONS

Section Two

⚠ About this Manual:

PLEASE READ THE ENTIRE MANUAL PRIOR TO INSTALLING OR USING THIS PRODUCT. This manual includes information on all versions of the DeltaSpan and DeltaRange Differential Pressure Level Transmitter from Flowline; models LD1_-S041 and LD2_-T041. Please refer to the part number located on the transmitter label to verify the exact model which you have purchased.

⚠ User's Responsibility for Safety:

Flowline manufactures a wide range of liquid level sensors and technologies. While each of these technologies are designed to operate in a wide variety of applications, it is the user's responsibility to select a technology that is appropriate for the application, install it properly, perform tests of the installed system, and maintain all components. The failure to do so could result in property damage or serious injury.

⚠ Proper Installation and Handling:

Only properly-trained staff should install and/or repair this product. Use a proper sealant with all installations. Always check for leaks prior to system start-up.

⚠ Wiring and Electrical:

A supply voltage of 7 to 35 VDC is used to power the LD1_-S041 transmitter. A supply voltage of 9 to 32 VDC is used to power the LD2_-T041 transmitter. Electrical wiring of the sensor should be performed in accordance with all applicable national, state, and local codes.

⚠ Temperature and Pressure:

The LD10 series is designed for use in application temperatures from -20° to 50° C (-5° to 125° F), and for use at pressures up to 2 x the full span of the LD10 series. The LD20 series is designed for use in application temperatures from -20° to 60° C (-5° to 140° F), and for use at pressures up to 4 x the full span of the LD20 series.

⚠ Material Compatibility:

The differential pressure level transmitter, LD10 series, is made of two materials. The enclosure is of both 316 ss and 17-4 PH ss and the cable is made from Polyurethane. The LD20 series is also made of two materials. The enclosure is of Titanium and the cable is made from Tefzel. Make sure that the model which you have selected is chemically compatible with the application liquids.

⚠ Flammable, Explosive and Hazardous Applications:

Only the DeltaRange, LD20 Series, level transmitter is rated for use in hazardous locations. Refer to the Certificate of Compliance for all applicable intrinsically safe ratings and entity parameters for the LD20 series. Refer to the National Electrical Code (NEC) for all applicable installation requirements in hazardous locations. DO NOT USE THE DELTASPAN, LD10 SERIES LEVEL TRANSMITTER IN HAZARDOUS LOCATIONS.



Make a Fail-Safe System:

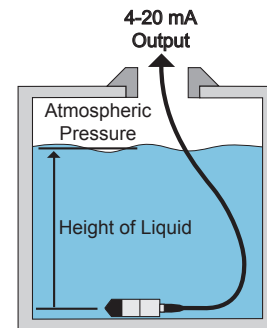
Design a fail-safe system that accommodates the possibility of transmitter failure or battery power loss. In critical applications, Flowline recommends the use of redundant backup systems and

DEFINITIONS

Section Three

Principle of Operation:

Differential pressure measures the changes in pressure at the bottom of a tank with respect to a reference pressure. Typically, the reference pressure is atmospheric pressure. The difference between the reference pressure and the measure pressure can be related to the height of the liquid.



Functionality:

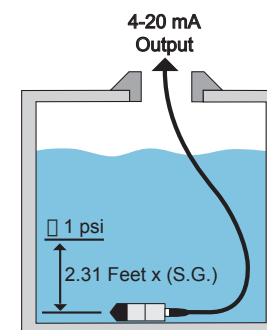
A sealed pressure transmitter is placed near or on the bottom of the tank. A stainless steel pressure diaphragm within the pressure transmitter is exposed on one side to the application liquid. The other side is exposed to the reference pressure via a small ventilation tube located inside of the Polyurethane cable. A difference in pressure between liquid and reference pressures will slightly deflect the diaphragm. The deflection of the diaphragm is measured by a built-in microprocessor, that provides greater linearity correction over common thermal compensation methods. A 4-20 mA current signal proportional to the height of the liquid is generated from the microprocessor.

Effects of Specific Gravity:

The LD10 and LD20 series has a fixed span with 4 mA equal to 0 psi and 20 mA equal to the maximum psi setting. Each unit is calibrated for use in liquids with a specific gravity (SG) of 1.000. Pressure transducers may be used in liquids with a SG other than 1.000. Please note the following relationship between the pressure range and specific gravity:

$$1 \text{ psi} = 2.31 \text{ feet @ SG} = 1.000$$

For example, the LD10-S041 has a range of 0 to 7.5 psi. The maximum depth the transmitter can read in water (SG = 1.000) is 7.5 psi x (2.31 feet / 1 psi) = 17.3 feet.



For liquids with a different SG, simply multiply 2.31 by the new SG to determine the new ratio. For example, the LD10-S041 is installed in a liquid with a SG = 0.85. The new ratio is as follows:

$$1 \text{ psi} = 2.31 \text{ feet} * (0.85) = 1.964 \text{ feet}$$

Multiply 7.5 psi by the new ratio to determine the maximum depth:

$$7.5 \text{ psi} * (1.964 \text{ feet} / 1 \text{ psi}) = 14.7 \text{ feet}$$

A lower SG will reduce the maximum depth for the transmitter.

WIRING

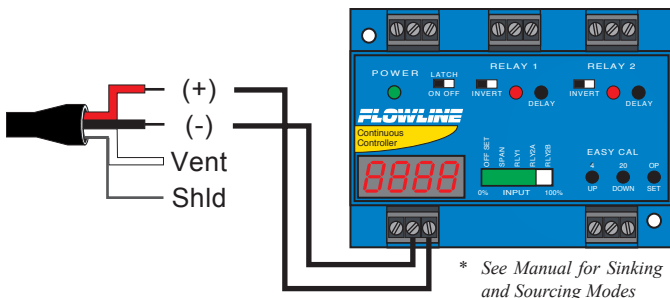
Section Four

Power Requirements:

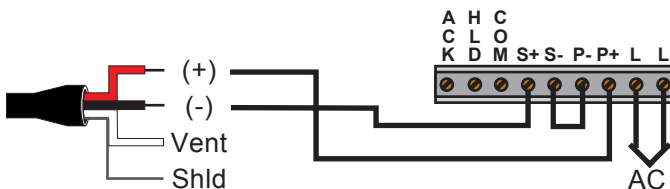
The DeltaSpan (LD10 series) level transmitters requires 7 to 35 VDC power with at least 25 mA supply in order to operate. The total resistive load in the loop (to include all the cable resistance) can be from “zero to 50 x (supply volts - 7) ohms” e.g. with a 24 VDC supply the permissible load is from zero up to 850 Ohms.

The DeltaRange (LD20 series) level transmitters requires 9 to 32 VDC power with at least 25 mA supply in order to operate. The total resistive load in the loop is 100 Megaohms at 50 VDC.

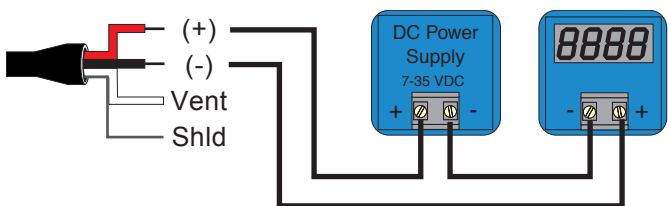
1. Wiring to a Flowline Continuous Controller (LC52 Series):



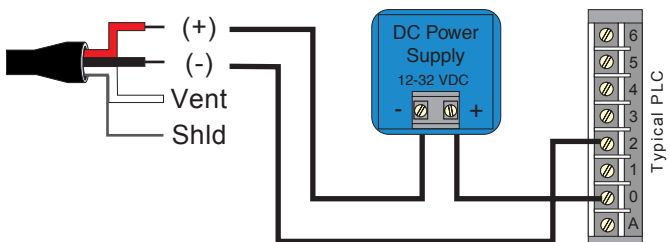
2. Wiring to a Universal Panel Meter (LI10 Series):



3. Wiring to a Loop Powered Indicator:



4. Wiring to a PLC:

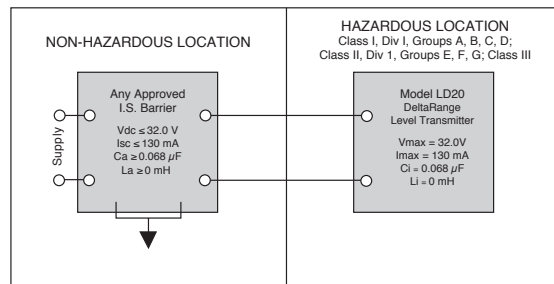


INSTALLATION

Section Five

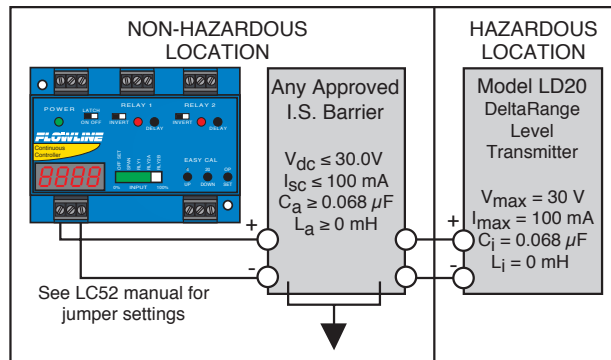
The DeltaRange (LD20 series) level transmitters requires 9 to 32 VDC power with at least 25 mA supply in order to operate. The following provides an overview of wiring to various devices. Please note that a barrier must be installed between the DeltaRange and the device and the barrier must be located within the non-hazardous area. See **Barrier Notes** in Section Nine for further information.

1. Hazardous System Diagram:

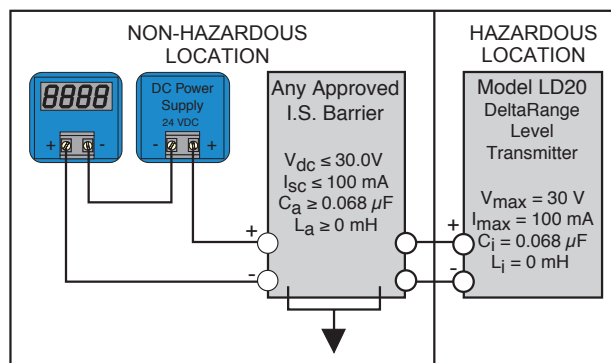


Control drawing for the LD20 Series DeltaRange level transmitters Rev. 4-24-02
approved under the entity concept as an I.S. apparatus Control Drawing: LD20CD

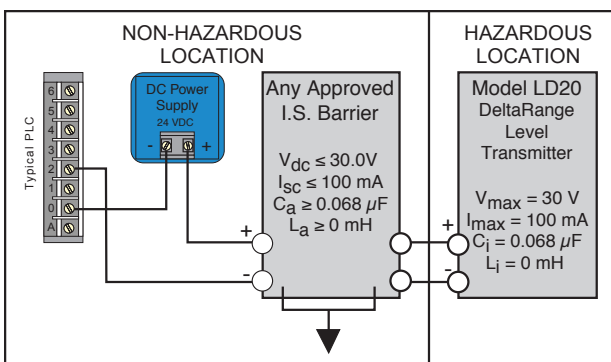
2. Wiring to a Flowline Continuous Controller (LC52 Series):



3. Wiring to a Loop Powered Indicator:



4. Wiring to a PLC:

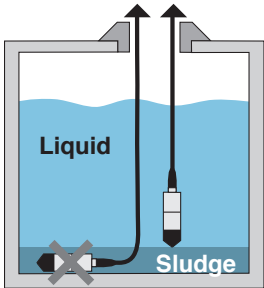
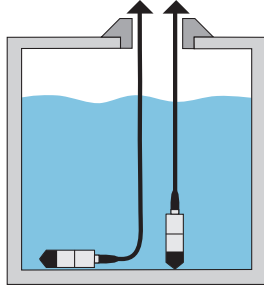


INSTALLATION

Section Six

Introduction:

The LD10 and LD20 series will be submersed within the application fluid. The level transmitters can either rest along the bottom of the tank or be suspended at any desired level within the tank. Please note that the physical location of the level transmitter will indicate the lowest level of measurement within the tank. For example: mounting the transmitter 1 foot from the bottom of the tank, then the lowest reading of liquid will be 1 foot from the bottom.



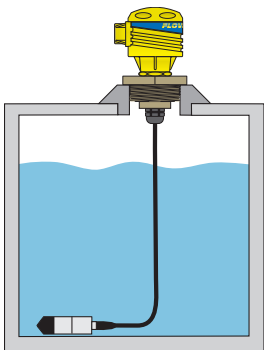
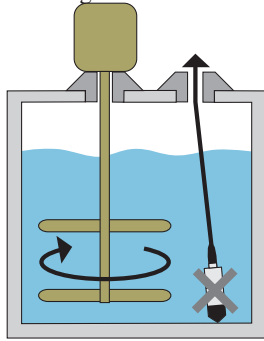
Installation Depth:

The LD10 & LD20 series is designed to operate while submerged in the actual application liquid. Avoid installing the level transmitter along the bottom of the tank is materials such as sludge will build up and coat/cover the transmitter. This also includes any debris that will settle along the bottom of the tank. In these applications, it is best to suspend

the transmitter above the highest level of sludge/debris that will occur.

Interference:

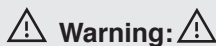
The DeltaSpan and DeltaRange is designed to operate under the surface of the liquid in the tank. Avoid installations where other tank requirements will cause the transmitter to move or swing. For example: a mixer blade could cause the level transmitter to whip around within the tank. An alternative would be to move the transmitter to a more stable section of the tank or to install the LD10 and LD20 series inside a still well/drop tube. The still well/drop pipe will minimize the effects created by the mixer.



Termination:

The cable for the DeltaSpan is typically terminated at a junction box located on top of the tank. Since the vent tube is contained within the cable, the pressure within the junction box must always be the same as the reference (typically atmospheric) pressure for the liquid. The inside of the junction box must be clean, dry and free of moisture. Add the optional pressure fitting (LD90-_001)

to complete the package. The LD90-_001 features a 2" NPT thread



Warning:

Use caution when sealing the cable at the top of the tank. The ventilation tube must be open and free to allow air to flow back to the pressure diaphragm. Avoid blocking the ventilation tube by compressing the cable.

Always keep the cable termination clean, dry and free of moisture and prevent liquid from entering the vent tube.

CALIBRATION

Section Seven

To Universal Panel Meter (LI10 Series):

The DeltaSpan and DeltaRange level transmitters can be calibrated for use with the LI1_ series of Universal Panel Meters. Before calibrating the LI1_ series, identify the following values:

H - Measure the height of liquid (in inches or meters) from the LD10 series to the highest level of liquid (full level).

P - Pressure range for the DeltaSpan (in psi or bar).

LD10-S041 = 7.5 psi (.517 bar),

LD11-S041 = 15 psi (1.034 bar) and

LD12-S041 = 30 psi (2.086 bar).

SG - Specific gravity for the fluid.

Also determine the engineering units you would like the panel meter to display (ex. inches, meters, gallons, liters, etc.).

The display calibration for the LI1_ series requires four settings :

INPT 1 - Current reading at lowest level of liquid

DSPY 1 - Display value at lowest level of liquid

INPT 2 - Current reading at highest level of liquid (full level)

DSPY 2 - Display value at highest level of liquid (full level)

If the LD10 series is located at the bottom of the tank, then use the factory default setting for INPT 1 and DSPY 1 (INPT 1 = 04.000 and DSPY 1 = 000.00). Your INPT 2 is typically the current reading at the full level of liquid. For US units, use the following formula to calculate INPT 2 value:

$$INPT\ 2 = 4 + 0.5772 * H / (P * SG)$$

For metric units, use the following formula to calculate INPT 2 value:

$$INPT\ 2 = 4 + 1.5668 * H / (P * SG)$$

Your DSPY 2 value is typically the full level reading in the engineering units of your choice.

For example: a LD10-S041 is installed on a 108" tall tank with a LI10-1001 panel meter. The liquid has a SG of 0.95 and the volume at 108" of liquid is 1900 gallons.

$$H = 108 \text{ inches}$$

$$P = 7.5 \text{ psi}$$

$$SG = 0.95$$

Using the above values, the display calibration values are:

$$INPT\ 1 = 04.000\ mA$$

$$DSPY\ 1 = 0000.0\ gallons$$

$$INPT\ 2 = 4 + 0.5772 * 108 / (7.5 * 0.95) = 12.791\ mA$$

$$DSPY\ 2 = 1900.0\ gallons$$

Follow the instructions in the Universal Panel Meter manual for

CALIBRATION

Section Eight

To Continuous Controller (LC52 Series):

The DeltaSpan and DeltaRange level transmitters can be calibrated for use with the LC52 series Continuous Relay Controller. The steps for calibration are listed below:

1. Determine the input values for the LC52.
2. Program the LC52.
3. Set liquid to highest level (full level).
4. Perform EasyCal20 on the LC52.
5. Set lock out for the LC52.

To complete the calibration, the liquid level must be at the full point in the tank.

1. Determine the input values for the LC52.

Before calibrating the LI1_ series, identify the full level of liquid in the desired engineering units. The LC52 series requires the following values for calibration:

- OFFSET** - Display value at lowest level of liquid
- SPAN** - Display value at highest level of liquid (full level)
- RLY1** - Actuation level for Relay 1
- RLY2A** - Actuation level for Relay 2 with latch OFF.
- RLY2B** - Second actuation level for Relay 2 with latch ON. Latch is used primarily for automatic fill/empty operations.

2. Program the LC52

Program the OFFSET, SPAN, RLY1, RLY2A and RLY2B settings. Before programming, perform a factory reset to the relay controller. Instructions for a Factory reset can be found in the instruction manual for the LC52 series.

3. Set liquid to highest level (full level)

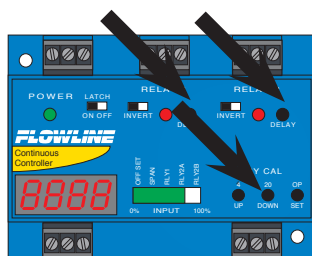
4. Perform EasyCal20 on the LC52.

Once the level is at its full level, press the 20 button once. An "E" (for Easy) will appear on the display. Press the 20 button a second time and "C" (for Cal) will appear. The LC52 series is now programmed to operate with the continuous relay controller.



5. Set lock out for the LC52.

To prevent the values from being changed, the LC52 series has a Lock Out feature. To activate the Lock Out, press both delay (Relay 1 and Relay 2) and the DWN buttons at the same time (shown to the right). To unlock the Lock Out, press both delay and the UP buttons at the same time.



NOTES

Section Nine

Application Notes:

1. Pressure transducers are molecularly bonded high output strain gauges.
2. Pressure transmitters are fitted with a hybrid amplifier providing 4-20 mA current outputs capable of being used in control and indicating loops without further amplification.
3. Maintain electrical termination and breather tube in clean, dry environment.
4. We recommend you install this in a weatherproof NEMA 4X grade type enclosure where out cable end terminates. Furthermore, it is also important that the cables entering and exiting the NEMA enclosures are sealed. This action should help ensure efficient and effective life of the depth units.

Barrier Notes:

1. Output current must be limited by a resistor such that the output voltage vs. current plot is a straight line between V_{oc} and I_{sc} .
2. Barrier must be installed as instructed by the manufacturer.
3. Selected barrier intrinsically safe circuits shall be approved for connection Class I, II, III; Div 1 & 2; groups A-G.
4. Terminate barrier earth ground to the ground bus of the power distribution panel. Resistance to ground must not be greater than 1 ohm.
5. Installation should be in accordance with ANSI/ISA RP 12.6 installation of intrinsically Safe systems for hazardous (classified) locations and the national electric code (ANSI/NFPA 70).
6. Any FMRC approved barriers whose parameters meet the following requirements can be connected.

$$V_{max} \geq V_{oc}, I_{max} \geq I_{sc}, C_i + C_{cable} \leq C_a, L_i + L_{cable} \leq L_a$$

Where cable parameters are as follows:

$$C_{cable} = 25 \text{ pF / ft} \text{ \& } L_{cable} = 0.2 \text{ } \mu\text{H / ft.}$$

Entity parameters for the DeltaRange are as follows:

$$V_{max} = 30 \text{ V}, I_{max} = 100 \text{ mA}, C_i = 0.068 \text{ } \mu\text{F}, L_i = 0 \text{ mH}$$