

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®

Non-Intrusive RF Capacitance Level Switch

LP50 Series Owner's Manual

Provided by:

www.KTHSales.com



NRTL/C

Version 5.0A

© 1999 FLOWLINE Inc.

All rights reserved.

Manual # LP900002

5/99



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 MERCHANTABILITY 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

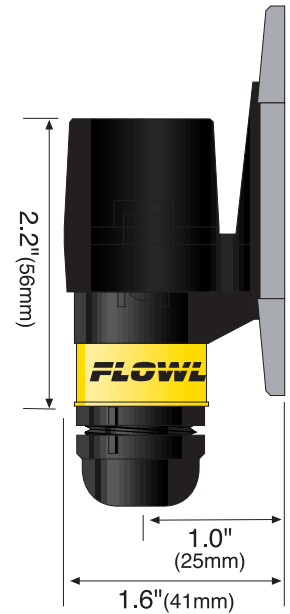
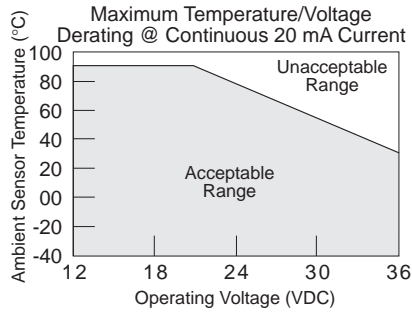
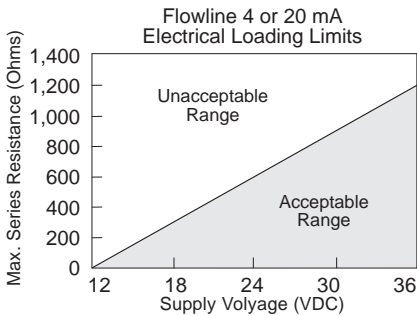
Step One

Accuracy:	±1 mm in water
Repeatability:	± .5 mm in water
Dielectric range:	> 10 constants
Conductive range:	> 100 micromhos
Supply voltage:	12 - 36 VDC
Consumption:	Relay: 25 mA FET: 5mA (dry) 19 mA (wet)
Relay rating:	60 VDC/VAC @ 1A
FET rating:	36 VDC @ 100 mA
Switch output:	Selectable NO or NC
Temperature range:	F: -40° to 194° C: -40° to 90°
Tank Compatibility:	Non-metallic
Tank wall thickness:	Up to 1" (25 mm) max.
Enclosure material:	Polysulfone (PSO)
Enclosure rating:	NEMA 4X (IP 65)
Bracket material:	Standard: PE Option: PP
Bracket mounting:	3M adhesive or thermal weld
Conduit connection:	1/2" NPT
Cable type:	8 ft. (2.5 m), 4-wire (relay) or 3-wire (FET), 22 gauge with ground, shield & PP jacket
CSA approval:	Class I, Groups A, B, C & D
CSA entity parameters:	$V_{max} = 32$ VDC $I_{max} = 0.5$ A $C_i = 0$ μ F $L_i = 0$ mH
CSA certificate:	LR 79326-4
CE compliance:	EN 50082-2 immunity EN 55011 emission

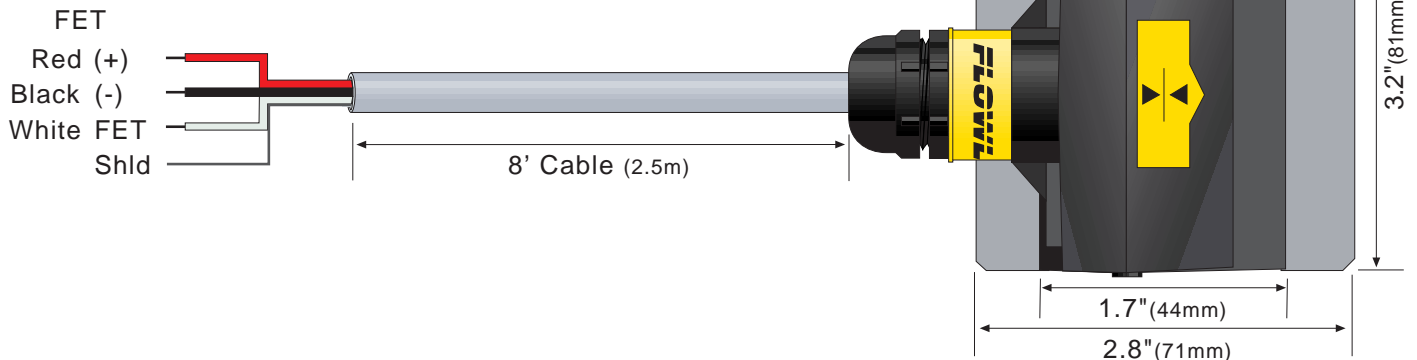
Capacitance Switch	
LP50 - 6 0 0	
Switch Output	
0 -	Intrinsically Safe
2 -	FET, N-Channel
3 -	FET, P-Channel
5 -	Relay
LP95 - 0 0 1	
Bracket Mat'l	
1 -	PP
5 -	PVDF
6 -	PE
7 -	PVC

Technology:

The non-intrusive RF capacitance switch detects the presence of liquid or air by measuring the conductive or dielectric values which are present in all materials. An electrical capacitor is formed between the level switch and the outer tank wall. As liquid rises and falls against the inner wall, the capacitance effect is greatly increased and the FET switch changes state.



Dimensions:



SAFETY PRECAUTIONS

Step Two

⚠ About this Manual:

PLEASE READ THE ENTIRE MANUAL PRIOR TO INSTALLING OR USING THIS PRODUCT. This manual includes information on all models of Non-Intrusive RF Capacitance level switches from Flowline, LP50-600_. Please refer to the part number located on the switch 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 sensors is designed to operate in a wide variety of applications, it is the user's responsibility to select a sensor model 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:

Because this is an electrically operated device, only properly-trained staff should install and/or repair this product. The adhesive on the fitting is for temporary installation only. For permanent installation, the fitting for the sensor should be welded, glassed or strapped to the tank itself using approved plastic welding techniques. Do not install the LP50 series sensor on a metal tank, or within 6" of any metal pipe or fitting.

⚠ Mounting Bracket:

The LP50 series sensor may be mounted in four different fittings. A PE bracket (polyethylene, colored white), model LP95-6001 is provided with the LP50. Other brackets available are LP95-1001 (PP, polypropylene), LP95-5001 (PVDF, polyvinylidene fluoride) or LP95-7001 (PVC, polyvinylchloride). Make sure that the fitting which you have selected is compatible with the tank it will be applied to.

⚠ Material Compatibility:

The sensor itself is not designed to be immersed. It should be mounted in such a way that it does not normally come into contact with fluid. Its case is made out of Polysulfone (PSO). Refer to an industry reference such as the Compass Corrosion Guide (available from Compass Publications, phone 619-589-9636) to ensure that compounds that may splash onto the controller housing will not damage it. Such damage is not covered by the warranty.

⚠ Wiring and Electrical:

The supply voltage used to power the LP50 series sensor should never exceed a maximum of 36 volts DC. Electrical wiring of the sensor should be performed in accordance with all applicable national, state, and local codes.

⚠ Flammable, Explosive and Hazardous Applications:

Only the LP50-6000 series switch is rated for use in hazardous locations. Refer to the certificate of Compliance for all applicable intrinsically safe ratings and entity parameters for the LP50-6000. Refer to the National Electric Code (NEC) for all applicable installation requirements in hazardous locations. DO NOT USE THE LP50-6002, LP50-6003 or LP50-6005 GENERAL PURPOSE SWITCH IN HAZARDOUS LOCATIONS.

⚠ WARNING ⚠

Do not install the LP50 level switch on a metallic tank, or within 6" of any metallic object. Metal will adversely affect the dielectric sensitivity of the sensor.

The maximum current draw on the FET switch is 100 mA.

INTRODUCTION

Step Three

About Non-Intrusive RF Capacitance Technology:

FLOWLINE's LP50 series sensor generates a high radio frequency signal from the capacitance electrode on the tank side of each sensor. Depending on the thickness of the tank wall and the material of which it is made, there is a particular minimum dielectric value the electrode measures when there is no liquid on the other side of the tank wall from the sensor. When liquid is on the other side of the wall, the dielectric value rises. The LP50's sophisticated electronics sense this change between minimum and maximum capacitance value and convert it into a simple two-wire, 4 or 20 mA output as well as a FET switch or Relay output, which indicates whether the sensor's point of actuation is wet or dry.

The LP50 has a patented calibration circuit that overcomes many of the disadvantages of previous non-intrusive capacitance sensors. As part of installation, a two-step calibration procedure ensures that the threshold between wet and dry is set at the ideal point for your particular tank and application fluid, without the use of any external test equipment.

The sensor's operation and point of actuation may vary based on the dielectric properties of various application liquids, tank materials and thicknesses. The LP50 series sensor is intended to be used with liquids with a dielectric value between 10 and 80. For example, if the application liquid is acetal (with a dielectric constant of about 3.6), the sensor will not detect its presence when it is wet. However, if the application liquid is glycol (with a dielectric constant of about 35) the sensor will reliably detect its presence when wet. Due to its user calibration capability it may be able to detect liquids below a dielectric constant of 10 under certain conditions, but this must be verified by experimentation.

WARNING: Do not install the LP50 series sensor within 6 inches of any metallic object. Metal will adversely affect the dielectric sensitivity of the sensor.

FLOWLINE's LP50 series sensors are not recommended for use with electrically charged application liquids. For most reliable operation, the liquid being measured may need to be electrically grounded.

Table of Common Dielectric Constants

NOTE: Liquids with a conductivity value > 100 μU are fine if coating is not an issue. Liquids with a dielectric constant less than 20 may not be reliably detected by an LP50 series sensor, depending on conditions.

Acetone	21	Ethylene dichloride	11 to 17	N-butyl formate	2.4
Acetaldehyde	22.2	Ethylene chloride	10.5	Nitrobenzene	26 to 35
Acetyl methyl hexyl ketone	28	Ethyl acetate	6.4	Nitrotoluene	2.5
Alcohol	16 to 31	Ethyl salicylate	8.6	Oils, vegetable	2.5 to 3.5
Ammonia	15 to 25	Ethyl stearate	2.9	Oils, mineral	2.3 to 2.4
Acetic acid	4.1 to 6.2	Ethyl silicote	4.1	Oils, petroleum	1.8 to 2.2
Butyl chloride	9.6	Formic acid	59	Oleic acid	2.5
Barium chloride	9 to 11	Ferric oleate	2.6	Propane, liquid	1.8 to 1.9
Benzene	2.3	Freon	2.2	Potassium nitrate	
Benzine	2.3	Glycerine	47		5.0 to 5.9
Barium nitrate	5.6	Glycol	30	Potassium chloride	5.0
Bromine	3.1	Glycol nitrite	27	Stearic acid	2.3
Chlorobenzene	4.7 to 6	Gasoline	2 to 2.2	Toluene	2.4
Chlorotoluene	4.7	Hydrochloric acid	4.6	Trichloroethylene	3.4
Chloroform	4.5 to 5.0	Isobutyric acid	2.7	Trichloroacetic acid	4.5
Chlorine, liquid	2.0	Isobutyl methyl ketone	13	Terephthalic acid	
Carbon tetrachloride	2.2	Jet fuel	1.7		1.5 to 1.7
Cyan	2.6	Lead carbonate	18	Thinner	3.7
Cyclohexanemethanol	3.7	Lead nitrate	38	Urea	3.5
D.I. Water	20	Methyl salicylate	9.0	Vinyl chloride	2.8 to 6
Ethyl toluene	2.2	Methanol	33	Vinyl alcohol	1.8 to 2.0
Ethyl alcohol	23	Methyl alcohol	33 to 3.8	Water, 20°C	80
Ethylene glycol	37	Margarine, liquid	2.8 to 3.2	Water, 100°C	48
Ethylene oxide	14	Methyl acetate	7.3		

INSTALLATION

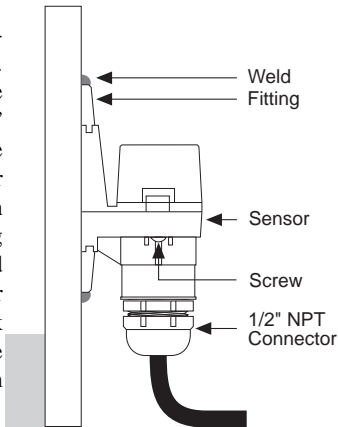
Step Four

FLOWLINE's LP50 series sensors may be installed anywhere on a tank wall using a PE or PP fitting that the sensor slides into. The fitting comes with adhesive on the tank side that is sufficient to hold the sensor in position temporarily while the installation is tested, but for permanent installation the fitting must be welded, glassed or strapped to the tank. Extra fittings are available from Flowline, so that the sensor may be moved to different locations on the tank by sliding it into other fittings.

Attach the fitting to the tank:

1. Determine whether the tank is polyethylene (PE) or polypropylene (PP). The slide-in fitting shipped with the sensor is PE, and is colored white. If necessary, obtain the PP fitting model LP95-1001, which is colored black.

2. Determine the mounting location of the sensor on the tank. The point of actuation (where the sensor will send a "wet" signal) is most often at the center of the sensor; however the actual Point of Actuation (POA) may differ depending on the application liquid and tank wall characteristics. After positioning the fitting to check clearances, etc., remove the paper protective strips from the adhesive of the fitting.



3. Press the fitting into place. The adhesive provides a seal between the sensor and the tank wall, and will hold it in place during testing and installation.

If desired, the sensor may be installed temporarily without welding the fitting to the wall. If several different locations must be tried before permanent installation, use double-sided foam stick tape designed for PP and PE such as Arclad type PE-6024, CO#7331 (from Adhesive Research Inc., Glen Rock PA 17327) or equivalent.

4. After the sensor has been tested to verify the POA, weld, glass or strap the fitting to the tank using standard industrial plastic techniques.

Special note for small round tanks:

The fitting may be attached to small, round tanks, as long as the majority of the fitting is firmly attached to the wall. However, extreme installations may effect the switches performance.

Mount the sensor in the fitting:

1. Slide the sensor into the fitting.
2. After trimming the sensor wire to length if needed by the installation, thread the sensor wire into a plastic flexible conduit with a 1/2" male fitting. Screw the conduit into the sensor, being careful not to cross the threads. Do not over tighten the conduit in the sensor as this may break the fitting. Such damage is not covered by the warranty. Take care while pulling the wire through conduit that no excessive tension is placed on the sensor end of the wire, so that the wire is not broken from the sensor housing.
3. Connect the sensor wire to the controller following the instructions in its manual. See the following Electrical connection section for detailed wiring instructions.

ELECTRICAL

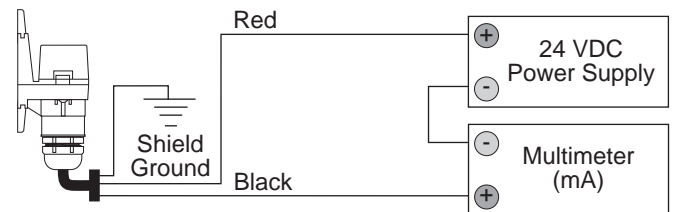
Step Five

Supply Voltage: The supply voltage to the LP50 series sensor should never exceed a maximum of 36 VDC. Flowline controllers have a built-in 13.5 VDC power supply which provides power to all of FLOWLINE's electrically powered sensors. Alternative controllers and power supplies, with a minimum output of 12 VDC up to a maximum output of 36 VDC, may also be used with the LP50 series sensor.

Required Cable Length: Determine the length of cable required between the LP50 series sensor and its point of termination. Allow enough slack to ensure the easy installation, removal and/or maintenance of the sensor. The cable length may be extended up to a maximum of 1000 feet, using a well-insulated, 20 gauge shielded wire.

Wire Stripping: Using a 10 gauge wire stripper, carefully remove the outer layer of insulation from the last 1-1/4" of the sensor's cable. Unwrap and discard the exposed foil shield from around the signal wires, leaving the drain wire attached if desired. With a 20 gauge wire stripper, remove the last 1/4" of the colored insulation from the signal wires.

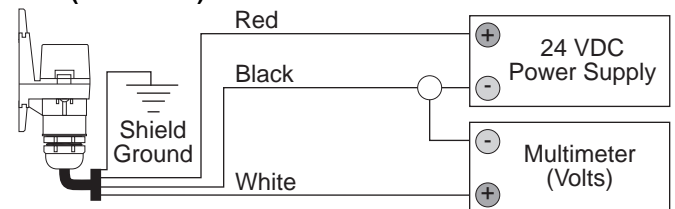
Signal Outputs (Current sensing): The standard method used by Flowline controllers; this technology uses only two wires (Red and Black). The sensor draws 5 mA when it is dry, and 19 mA when wet.



NC/NO status must be set by the controller. The White wire is not used.

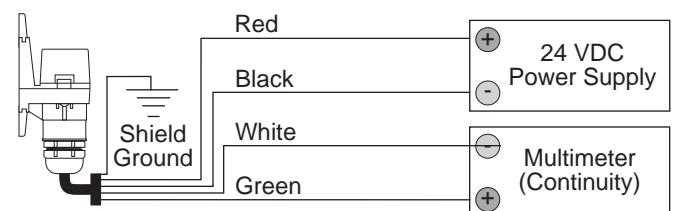
Signal Outputs (FET switching): Allows the sensor to switch a small load on or off directly, using all three wires. Model LP50-6002 is a NPN type switch, which toggles the negative side of the load; model LP50-6003 is a PNP type switch for applications where the switch must be on the positive side of the load. In both FET models,

PNP (LP50-6003) Shown



the NO/NC status is set by the polarity of the voltage feeding the Red and Black wires, and the White wire connects to the load.

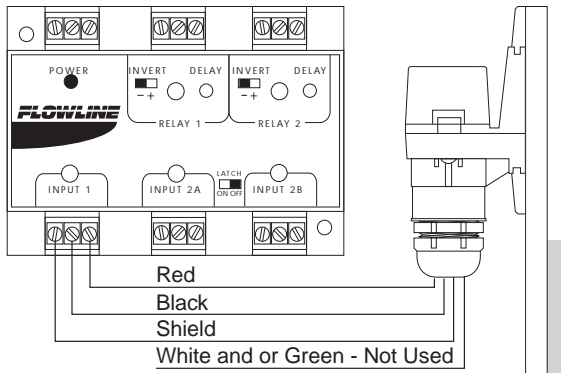
Signal Outputs (Relay switching): Allows the sensor to switch a small load on or off directly, using an internal 1 A relay (60 VAC/60 VDC). Only model LP50-6005 uses the relay and features 4 wires (red, black, white and green) and a shield wire. The NO/NC status is



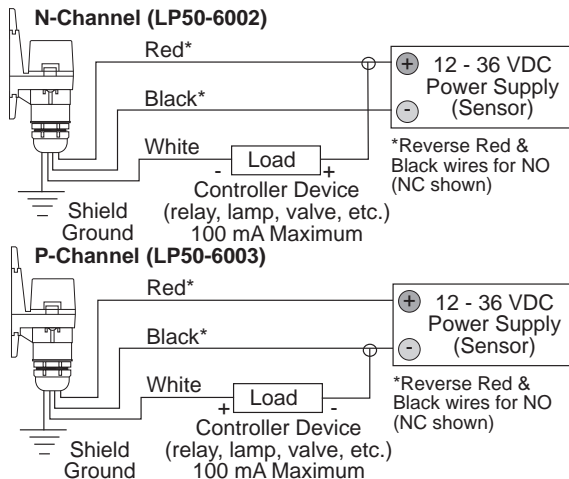
WIRING

Step Six

Models LP50-6002, LP50-6003 & LP50-6005 Only Wiring to a Flowline Controller LC40 Series Controller (4 or 20 mA signal output)



Models LP50-6002 & LP50-6003 Only Wiring direct to a load, NC operation (FET signal output)

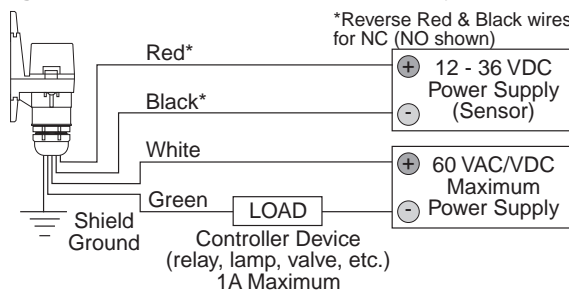


Wiring direct to load, Normally Open operation: LP50-6002 and LP50-6003 (FET outputs only):

This is the same as the wiring for Normally Closed operation, except the polarity of the Red and Black connections to the sensor is reversed. The other connections remain the same; the sensor and device power supplies remain tied in the same polarity as before. This method will turn the load on when the sensor is wet.

Model LP50-6005 Only

Wiring direct to a load, NO operation (Relay Output Only):



Wiring direct to load, Normally Closed operation: LP50-6005 (Relay outputs only):

This is the same as the wiring for Normally Open operation, except the polarity of the Red and Black connections to the sensor is reversed. The other connections remain the same; the sensor and device power supplies remain tied in the same polarity as before. This method will turn the load on when the sensor is dry.

WIRING

Step Seven

Models LP50-6000 Only:

The LP50-6000 level switch has been approved for use in Class I, Groups A, B, C & D; UNDER CERTIFICATE NUMBER LR 79326-4. DO NOT USE THE LP50-6002, LP50-6003 AND LP50-6005 IN INTRINSICALLY SAFE APPLICATIONS. The Entity parameters for the LP50-6000 are:

$$V_{max} = 32 \text{ VDC}$$

$$I_{max} = 0.5 \text{ A}$$

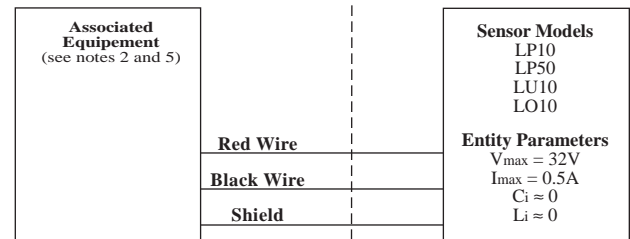
$$C_i = 0 \mu\text{F}$$

$$L_i = 0 \text{ mH}$$

Intrinsically Safe Control Diagram

NON-HAZARDOUS LOCATION

HAZARDOUS LOCATION
Class I, Groups A, B, C, and D
Class II, Groups E, F, and G
Class III, (see note 1)

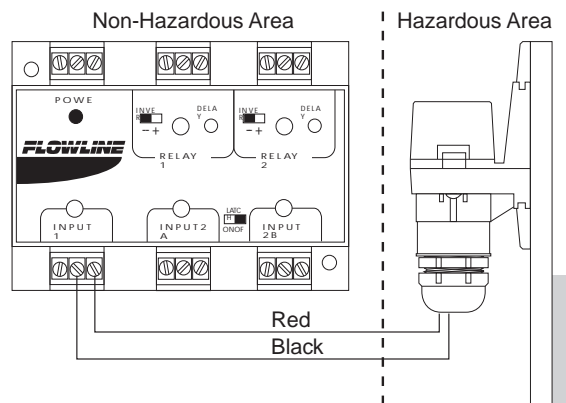


Notes:

- LP50 series sensor suitable for Class I, Groups A, B, C, and D locations only.
- CSA certified associated equipment with entity parameters.
- $V_{max} \geq V_{oc}$, $I_{max} \geq I_{sc}$, $C_i + C_{cable} \leq C_a$, $L_i + L_{cable} \leq L_a$.
- Installation should be in accordance with CEC Part I, or NFPA 70.
- Associated equipment must be installed per manufacturers instructions

Sensor Drawing: LSD1
Rev. A 7-21-95

Wiring to a Flowline Controller LC90 Series Controller 4 or 20 mA Signal Output



$$V_{oc} = 17.47 \text{ Vdc}$$

$$I_{sc} = 0.4597 \text{ A}$$

$$C_a = 0.494 \mu\text{F}$$

$$L_a = 0.119 \text{ mH}$$

$$V_{max} = 32 \text{ Vdc}$$

$$I_{max} = 0.5 \text{ A}$$

$$C_i = 0 \mu\text{F}$$

$$L_i = 0 \text{ mH}$$

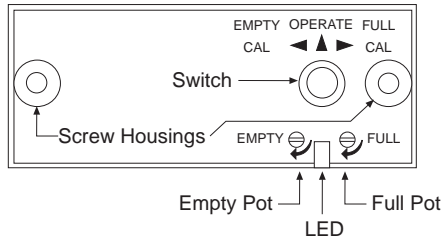
CALIBRATION

Step Eight

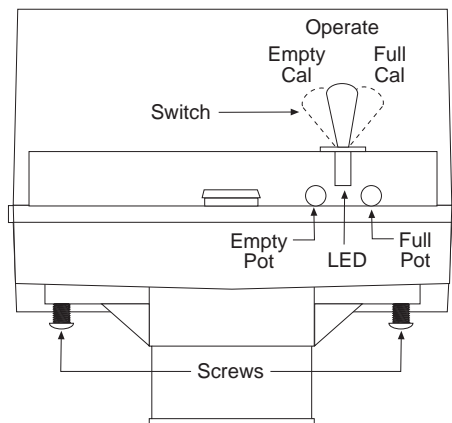
After it is installed in place, the LP50 must be calibrated by the user before operation. Everything needed for the procedure is self-contained within the electronics of the LP50. Two dielectric states—full condition and empty condition—are measured by the LP50, and then averaged to set the threshold between “wet” and “dry” at the sensor. The empty state must be at least 6" below the bottom of the sensor. The full state must be to the top of the sensor (not just to the point of actuation). The actual application fluid at its intended operating temperature must be used during calibration. Use the following procedure assumes that the sensor has already been wired to the controller power supply.

1. Remove the cap from the sensor body by loosening the two screws located below the sensor. Do not remove the screws from the sensor. Insert a small screwdriver into the small slot at the edge of the cap and gently pry upwards.
2. Looking down from above, you will see a small three-position switch and two trimpots marked Full (F) and Empty (E). You may start with whatever state the tank is in.

3. Full state: With the tank filled to the top of the sensor, set the switch to the F position (right). Make sure your hands or any other objects are not touching the sensor while calibrating because this will cause a false reading. Using a small nonmetallic screwdriver or alignment tool, turn trimpot F until the LED just lights, and no farther. Note the position. Now turn the trimpot back until the LED turns off. The ideal setting for the trimpot is midway between these on and off points.



4. Empty state: With the tank drained to a point no closer than 6 inches below the bottom of the sensor, set the switch to the E position (left). Set the E trimpot as in Step 3.
5. After completing calibration, make sure to return the switch to the center position. Snap the cap back on by pressing down, and tighten the two screws.



CALIBRATION

Step Nine

Checking the Point of Actuation:

Raise the fluid level to the point where the sensor sends a “wet” signal (in Flowline controllers, the Input LED will turn amber). The “dry” signal should be sent when the fluid level is lowered. The actual point of actuation depends on many variables. If the tank wall is thick, the point of actuation may be at the top of the sensor; if the wall is thin, it may be at the bottom of the sensor.

If the point of actuation needs to be changed, measure the distance and remount the sensor in a new location. Do not attempt to change the point of actuation by intentional miscalibration.

If the sensor does not signal wet and dry reliably, it may be that:

- the dielectric constant of the application fluid is too low
- the tank wall is too thick for the application fluid
- there are static or other electrical charges in the fluid
- metal objects are within 6" of the sensor
- calibration was performed incorrectly

Try the calibration procedure again, after making corrections if possible. If the full and empty states are too similar dielectrically, it may not be possible to use a capacitance sensor.

Testing the Sensor:

1. Power: Apply power to sensor, by connecting power to the controller and/or power supply.
2. Full condition: Fill the tank with the application liquid, by filling the tank up to the sensor's point of actuation.
3. Test: With the sensor being fluctuated between wet and dry states, use a voltmeter to ensure that the correct signals are being produced by the LP50 series sensor, or observe the sensor indicator light in the controller.
4. Point of Actuation: Observe the point at which the rising or falling fluid level causes the sensor to change state, and move the installation of the sensor if necessary.

Maintenance:

The LP50 sensor itself requires no periodic maintenance except cleaning as required. However, periodically clean any coating or scaling on the tank wall the sensor is attached to and check the calibration. It is the responsibility of the user to determine the appropriate maintenance schedule, based on the specific characteristics of the application liquids. In addition, any dripping or condensation between the sensor and the tank wall fitting may need to be periodically cleaned to maintain accuracy.

