

EchoSwitch®

Ultrasonic Level Switch and Transmitter

LU74, LU77 & LU78 Series Manual



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The EchoSwitch® is a general-purpose ultrasonic level switch that provides the end user the ability to control up to three unique devices (pump, valves and/or alarms) through an advanced non-contact technology. EchoSwitch® features push button configuration that uses real engineering values for setting up the relay operation(s). One relay has SPDT Form “C” contacts useful for controlling a valve and the other two relays are SPST Form “A”. All of the relays can be used for controlling valves, pumps or alarms.

Features

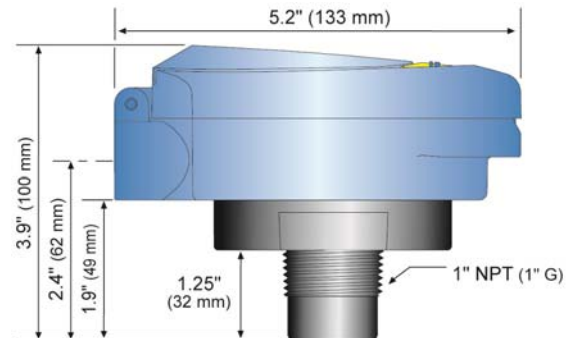
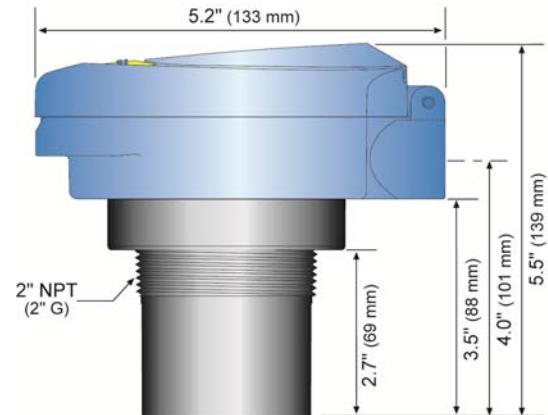
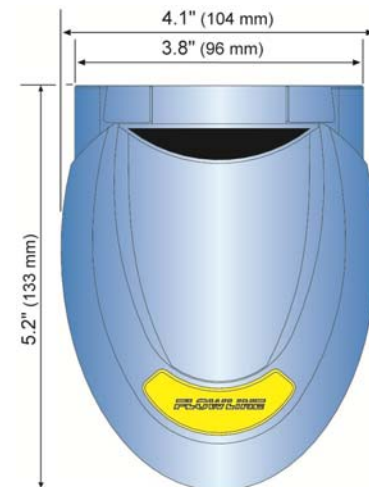
- Simple digital push button configuration.
- Pump simplex, duplex and triplex option.
- Integrated timer for pump / valve delay and pump alternation.
- Available in a 3m (9.8’), 5.5m (18.0’) or 8m (26.2’) maximum range.
- Isolated 4/20 mA loop output for indicating level.
- AC powered

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SPECIFICATIONS/DIMENSIONS**Step Two**

Range:	LU74: 8" to 18.0' (20 cm to 5.5m)	LU77: 4" to 9.8' (10 cm to 3m)	LU78: 8" to 26.2' (20 cm to 8m)
Repeatability:	0.25" (6.35 mm)		
Loop Output:	Isolated, Sinking 12 to 28 VDC		
Dead band:	LU74: 8" (20 cm) LU77: 4" (10 cm) LU78: 8" (20 cm)		
LCD indication:	Level and relay status, 6 character		
Configuration:	Push button, digital (3)		
Supply voltage:	95-250 VAC, 20W @ 120 VAC		
Contact type:	Relay 1, SPDT relays Relay 2 and 3, SPST, N.O. All commons connected together		
Contact rating:	2A, 30 VDC 60 W (DC), 125 VA 220 VDC, 250 VAC		
Contact fail-safety:	Programmable / selectable		
Temp. comp.:	Automatic		
Electronics temp.:	F: -40° to 140° C: -40° to 60°		
Pressure:	MWP = 30 PSI		
Enclosure rating:	NEMA 4X (IP65)		
Enclosure vent:	Water tight membrane		
Encl. material:	Polycarbonate		
Encl. hardware:	Brass and stainless		
Trans. material:	PVDF		
Process mount:	LU74: 2" NPT (G) LU77: 1" NPT (G) LU78: 2" NPT (G)		
Mount. gasket:	Viton®		
Conduit entrance:	Dual, 1/2" NPT		
Classification:	General purpose		
Compliance:	RoHS		
Approvals:	CE (pending)		

**Side View
LU77 Series****Side View
LU74 & LU78 Series****Top View
All Models**

⚠ About this Manual: PLEASE READ THE ENTIRE MANUAL PRIOR TO INSTALLING OR USING THIS PRODUCT. This manual includes information on the EchoSwitch® series ultrasonic level switch and transmitter from FLOWLINE. Please refer to the part number located on the switch label to verify the exact model configuration, which you have purchased.

⚠ User's Responsibility for Safety: FLOWLINE manufactures a broad range of level sensing 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: Only properly trained staff should install and/or repair this product. Install the switch with the included Viton® gasket and never over tighten the switch within the fitting. Always check for leaks prior to system start-up.

⚠ Wiring and Electrical: A supply voltage of 95-250 VAC is used to power the EchoSwitch®. Electrical wiring of the switch should be performed in accordance with all applicable national, state, and local codes.

⚠ Material Compatibility: The enclosure is made of Polycarbonate (PC). The transducer is made of Polyvinylidene Fluoride (PVDF). Make sure that the model, which you have selected, is chemically compatible with the application media.

⚠ Enclosure: While the switch housing is liquid-resistant the EchoSwitch® is not designed to be operational when immersed. It should be mounted in such a way that the enclosure and transducer do not come into contact with the application media under normal operational conditions.

The enclosure has a flip cover with dual 1/2" NPT female conduit ports and an internal terminal strip for wiring. To open the enclosure, you will need a small insertion tool such as a screwdriver. Loosen the locking screw located at the top front of the enclosure. Rotate the hinged cover up for 135° access to the faceplate and terminal strips. Before closing the enclosure, make sure that the enclosure gasket is properly seated, and that any conduit fittings, cable connectors or plugs are installed correctly and sealed.

⚠ Handling Static-Sensitive Circuits/Devices: When handling the transmitter, the technician should follow these guidelines to reduce any possible electrostatic charge build-up on the technician's body and the electronic part.

1. Always touch a known good ground source before handling the part. This should be repeated while handling the part and more frequently after sitting down from a standing position, sliding across the seat or walking a distance.
2. Avoid touching electrical terminals of the part unless making connections.
3. DO NOT open the unit cover until it is time to calibrate.
4. Wipe unit with a damp cloth when cleaning.

Make a Fail-Safe System: Design a fail-safe system that accommodates the possibility of switch and/or power failure. FLOWLINE recommends the use of redundant backup systems and alarms in addition to the primary system. Adding a redundant high level float switch to the system is a cost effective means to prevent costly tank overflows.

The switch has (3) relay channels. Normally open (NO) or normally closed (NC) operation is user selected based on the desired system control and fail-safe logic when the ultrasonic instrument loses its return signal due to situations such as foam or condensation in the tank. Always design a fail-safe system that accommodates for the possibility of functional and/or power failure to the instrument. The "normal" relay state is where the relay coil is de-energized and the relay indicator is OFF. Therefore, if power is cut OFF to the switch it will de-energize the relay. Make sure that the de-energized state is the safe state in your system design. As such, if switch power is lost, a pump will turn OFF if it is connected to the normally open side of the relay.

Flammable, Explosive or Hazardous Applications: *EchoSwitch® should not be used within classified hazardous environments.*

Components: EchoSwitch® is offered in three different models. Depending on the model purchased, you may or may not have been shipped all the components shown below.

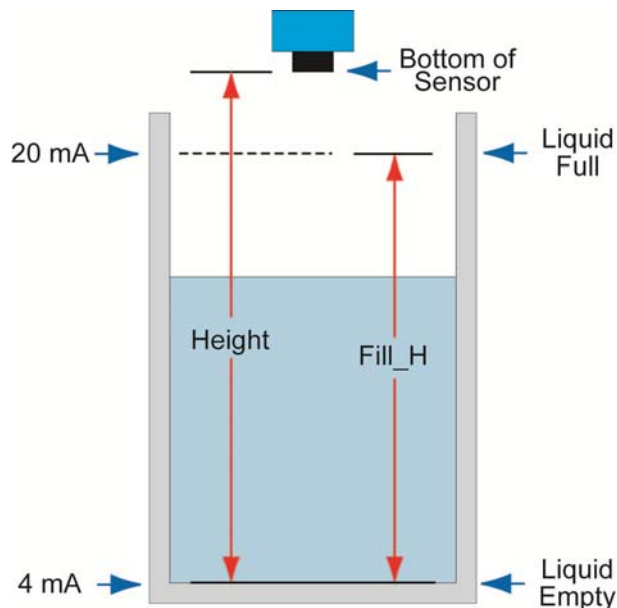
- EchoSwitch®

P/N	Max. Range	Dead Band	Enclosure	Thread
LU74-5004 LU74-5064	18.0' (5.5m)	8" (20cm)	Type 4X	2" NPT 2" G
LU77-5004 LU77-5064	9.8' (3m)	4" (10cm)	Type 4X	1" NPT 1" G
LU78-5004 LU78-5064	26.2' (8m)	8" (20cm)	Type 4X	2" NPT 2" G

- Viton® Gasket
 - Part #200128 for LU77 series
 - Part #220129 for LU74 or LU78 series
- Quick Start Guide

EchoSwitch® can be configured before installation. The switch features non-volatile memory, so the set points configured before installation will not be lost when the switch is powered down. To start, all you need is the following information:

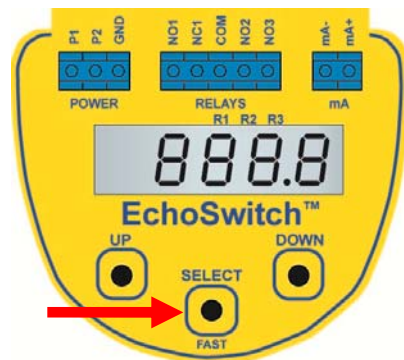
- Basic Tank Information
 - o HEIGHT – Distance from the transducer face to the bottom of the tank.
 - o FILL-H – Maximum fill height of the liquid from the bottom of the tank.
- Set Points:
 - o You will need the measured distance from the bottom of the tank to each set point. These values will all be in the same distance value (inches, centimeters, feet or meters) and will all be measured from the bottom of the tank.
- Power:
 - o Provide input power to the EchoSwitch®



Note: The Height and Fill-Height settings also determine the 4 to 20 mA current span. The Height setting determines the 4mA position and the Fill-H setting determines the 20 mA position.

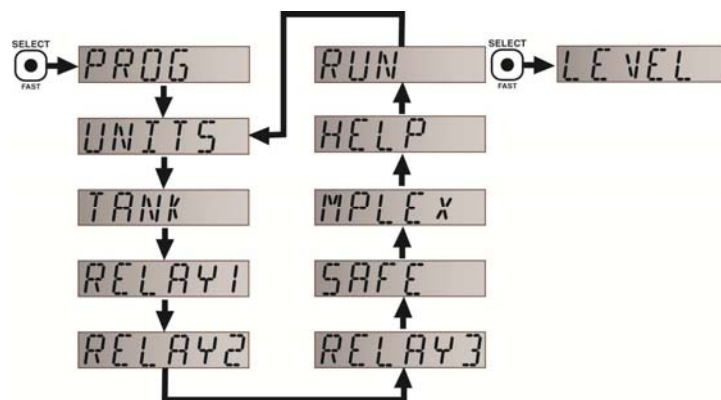
Getting Around the TOP-LEVEL MENU: EchoSwitch® is configured by the use of three push buttons (UP, DOWN and SELECT) and a LCD display.

As a lockout feature, the buttons are inactive until the SELECT button is held down for 5 seconds, and then the display will begin to scroll through the top level of the configuration menu.



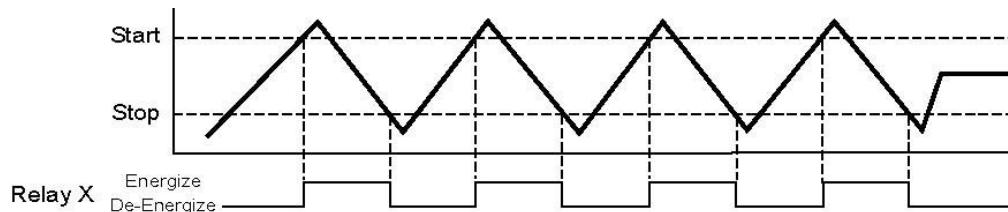
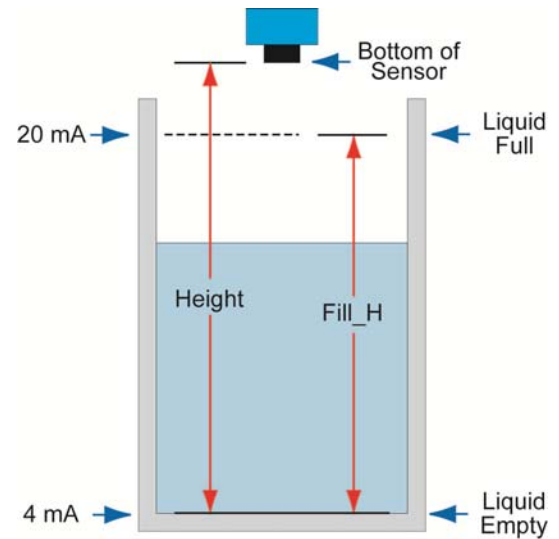
TOP-LEVEL MENU

- The TOP-LEVEL MENU will continue to scroll through the items listed to the right until the **SELECT** button is pressed.
- To return to the Normal / Operational mode of EchoSwitch®, press SELECT while RUN appears in the display.



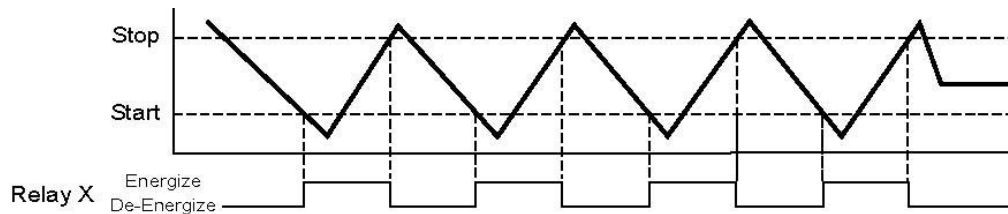
TOP-LEVEL MENU Descriptions

- **UNITS** – Allows end user to select the units for configuration and operation.
 - o Select between Inches, Centimeters, Feet, Meters or Percent.
 - o Press EXIT to return to the TOP-LEVEL MENU.
- **TANK** – Allows the end user to configure the operational range for the switch as well as the 4-20 mA output signal.
 - o **HEIGHT** – Distance from the transducer face to the bottom of the tank.
 - o **FILL-H** – Maximum fill height of the liquid from the bottom of the tank.
 - o **Note:** The 4 and 20 mA points are set by setting these two points.
 - The 20 mA point is at the Fill-H and the 4 mA point is at the bottom of the tank.
 - The 4 and 20 mA set points cannot be reversed.
 - o Press Exit to return to the TOP-LEVEL MENU
 - o **Note:** if UNITS is set to Percent, then TANK will not appear. To view TANK, set UNITS to any of the following: Inches, Centimeters, Feet or Meters
- **RELAY 1, RELAY 2 or RELAY 3** – Allows end user to configure the function and operation of each relay. Each relay has a small black circle that appears when the relay is energized. When the relay is de-energized, the black circle disappears.
 - o **PUMP** – Pump operation allows for two separate level set points (Relay ON and Relay OFF). Choose between the EMPTY or FILL operation. Both operations require setting a level for ON and another level for OFF
 - **EMPTY** – used to control a pump that empties a tank.



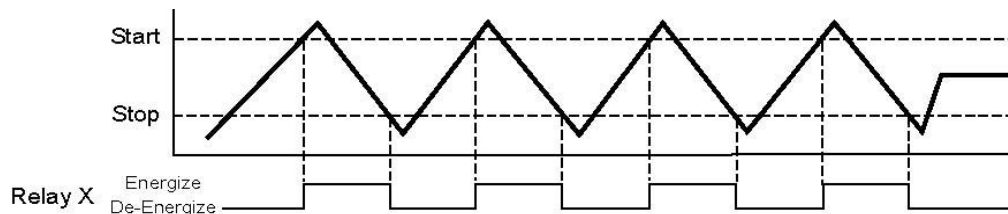
- Typically, Relay ON is the HIGH set point and Relay OFF the LOW set point. Relay will energize at the high set point (ON) and remain on until the level reaches the low set point (OFF). It will remain off until the level returns to the high set point (ON).

- **FILL** – used to control a pump that fills a tank.

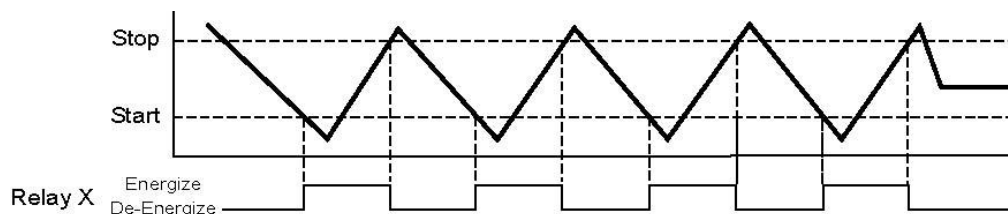


- Typically, Relay ON is the LOW set point and Relay OFF the HIGH set point. Relay will energize at the low set point (ON) and remain on until the level reaches the high set point (OFF) and will remain off until the level returns to the low set point (ON).
- **DELAY** – used as a start pump delay when the ON setting is reached. The delay pump (in seconds) will delay the start of the value for this period.
- o **VALVE** – Valve operation allows for two separate level set points (Relay ON and Relay OFF). Choose between the EMPTY or FILL operation. Both operations require setting a level for ON and another level for OFF

- **EMPTY** – used to control a valve that empties a tank.

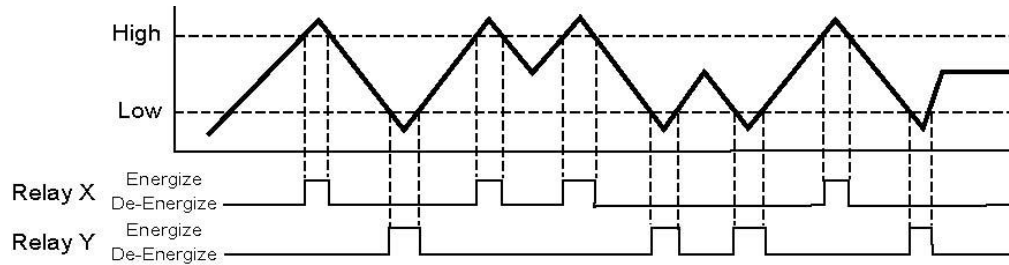


- Typically, Relay ON is the HIGH set point and Relay OFF the LOW set point. Relay will energize at the high set point (ON) and remain on until the level reaches the low set point (OFF) and will remain off until the level returns to the high set point (ON).
- **FILL** – used to control a valve that fills a tank.



- Typically, Relay ON is the LOW set point and Relay OFF the HIGH set point. Relay will energize at the low set point (ON) and remain on until the level reaches the high set point (OFF) and will remain off until the level returns to the low set point (ON).
- **DELAY** – used as a start valve delay when the ON setting is reached. The delay value (in seconds) will delay the start of the value for this period.

- o **ALARM** – Alarm operation allows for a single set point (Relay ON and OFF at the same level). Choose between HIGH and LOW operation. Both operations will require a single set point and a setting for the Hysteresis (HYSTER)



- **HIGH** – used to control a High Level alarm. Relay will energize (ON) when the level is above the setting and will de-energize (OFF) when the level falls below the setting plus the added distance from the hysteresis (HYSTER).
- **LOW** – used to control a Low Level alarm. Relay will energize (ON) when the level is below the setting and will de-energize (OFF) when the level rises above the setting plus the added distance from the hysteresis (HYSTER).
- **HYSTER** – Used to reduce chatter by creating a hysteresis or differential for the Alarm set point. The HYSTER value will adjust the OFF position of the Alarm setting by the HYSTER value.
- **SAFE** – Each relay can be individually configured to its own fail-safe setting. Choose between ON, OFF or HOLD.
 - o **ON** – Energizes the relay when a fail-safe condition occurs
 - o **OFF** – De-energizes the relay when a fail-safe condition occurs
 - o **HOLD** – Keeps the relay in its current state when a fail-safe condition occurs
 - o **OUTPUT** – Sets the 4/20 mA output state when the echo is lost. The options are 4mA, 21mA and hold last value.
- **M-PLEX** – when two or three relays are configured as pumps, they can be inter-connected to alternate between each cycle.
 - o M-PLEX is only available when 2 or more relays are set for pumps.
 - o M-PLEX will not appear when only 1 relay is set for a pump or when the relay functions do not match (ex: Relay 1 set for a filling pump and Relay 2 set for an emptying pump).
 - o Selecting NO-ALT will turn OFF the M-PLEX.
- **HELP** – Provides setup information, the ability to reset the EchoSwitch® and a simulation mode to test the relay function
 - o **SETUP** – Will display the setting for all functions of EchoSwitch®
 - o **RESET** – Will reset the EchoSwitch® back to its original factory setting
 - o **SIM-T** – SIM (ulation)-T(est) will allow the end user to simulate changes to level to verify the relay settings. Using the UP and DOWN buttons will increase
 - o **TEST P** – This is a production test feature used by the factory to confirm operation. ***This mode should only be used when supervised by a Flowline representative.***
- **RUN** – Returns the unit to normal measurement and control mode

This section will take you through the key steps in the setup and configuration of the EchoSwitch®:

- 1) *Select the units for configuration.*
 - a. Determine the measurement units that will be used to configure the sensor.
- 2) *Measure the distance from the bottom of the tank (empty level) to the bottom of the sensor.*
 - a. Be sure to include the added height of installation fittings.
- 3) *Measure the distance from the bottom of the tank (empty level) to the full level of liquid.*
 - a. Take into account the dead band of the sensor.
- 4) *Determine how many relays you will use and what each of their functions will be.*
 - a. Example: relay will fill a tank with a pump and relay 2 will provide a high alarm.
- 5) *Measure the distances from the bottom of the tank (empty level) to the positions for all of the relay functions.*
 - a. Pump and Valve functions will have typically have two set points, the level where the pump turns on and where it turns off or the level where the valve opens and closes.

How to enter the TOP-LEVEL MENU

1. Press and hold SELECT (approximately 5 seconds) until PROG is displayed.
2. The TOP-LEVEL MENU items will rotate through display.
3. Use SELECT to choose a MENU item.

How to exit the TOP-LEVEL MENU

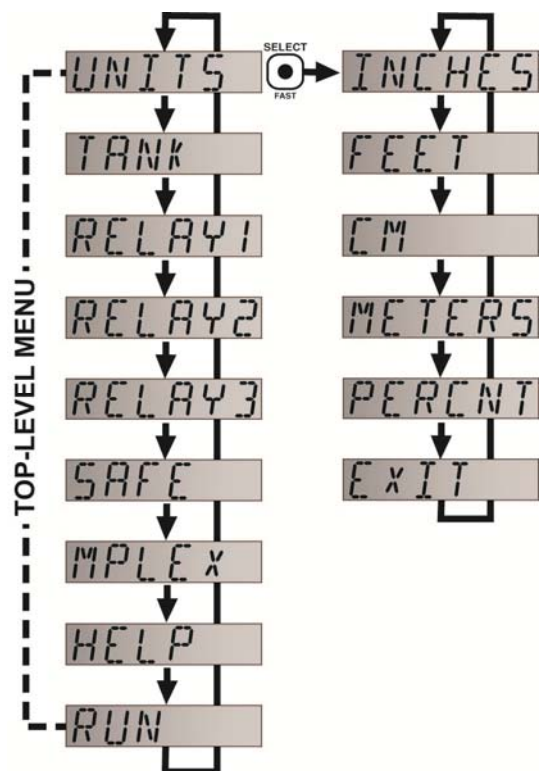
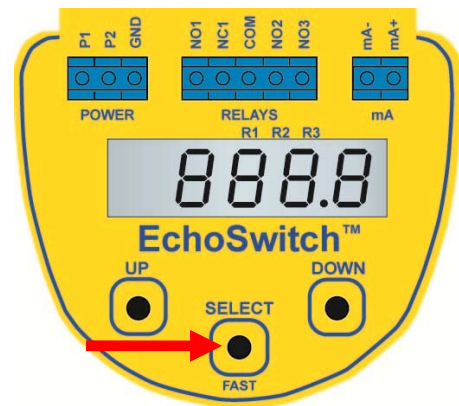
In TOP-LEVEL MENU, press SELECT when RUN appears.

How to configure UNITS

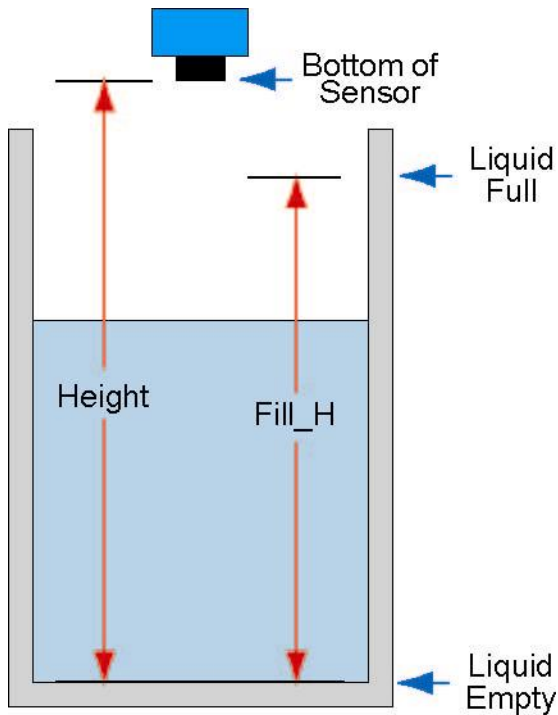
1. In the TOP-LEVEL MENU mode, press select when
2. Press SELECT to choose between INCHES, CM (centimeter), FEET, METERS or PERCENT.
3. Select EXIT to return to the TOP-LEVEL MENU.

Note: Reading the level of liquid in Percent

- Flowline recommends that when selecting PERCENT, configure the Height and Fill_H settings before selecting PERCENT in order to span the EchoSwitch® for your application requirements.
- When in PERCENT, the operational span will be based upon the last TANK settings, 100% will occur at the Fill-H level and 0 percent at the bottom of the tank.
- When PERCENT is selected, the TANK settings (Height and Fill_H) will be disabled.



How to configure the Operational range of EchoSwitch®

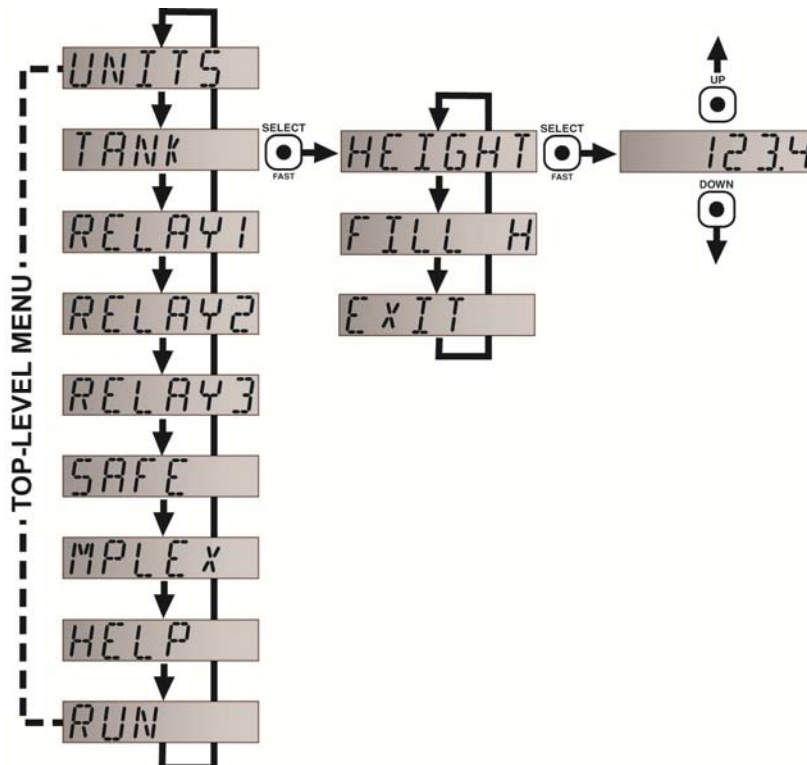


Before starting, take two measurements. 1) Measure the distance from the bottom of the sensor (transducer face) to the bottom of the tank. This will be the HEIGHT setting. 2) Measure the distance from the bottom of the tank to the Maximum Level of Liquid (Full). This will be the FILL-H setting.

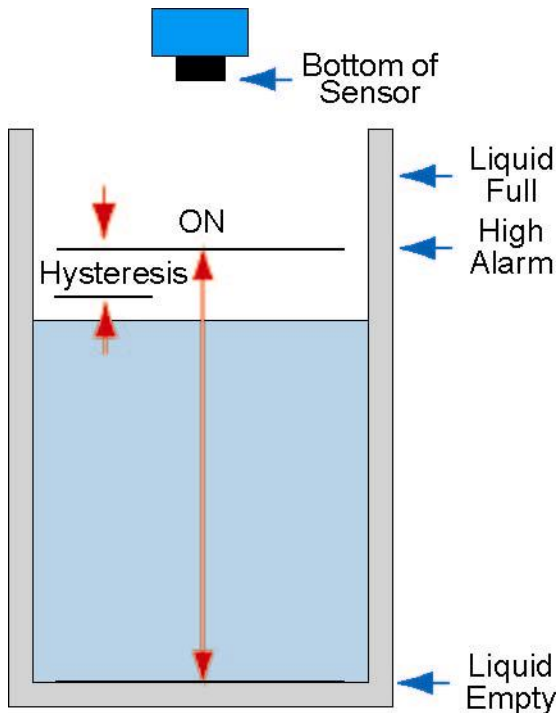
1. In TOP-LEVEL MENU mode, select TANK.
2. Select HEIGHT.
3. Using the UP and DOWN buttons, set the HEIGHT of the tank (transducer face to the bottom of the tank).
4. To enter the value, press and hold SELECT for 2 seconds and release. SAVED will display.
5. When FILL-H appears, press SELECT.
6. Using the UP and DOWN buttons, set the Fill Height (FILL-H) of the tank (max. level of liquid to the bottom of the tank).
7. To enter the value, press and hold SELECT for 2 seconds and release. SAVED will display.
8. Select EXIT to return to TOP-LEVEL MENU.

Note: The Height and Fill-Height (Fill-H) settings also determine the 4 to 20 mA current span. The Height setting determines the 4mA position and the Fill-H setting determines the 20 mA position.

Note: To speed up the scrolling of the values on the display, hold down the SELECT button while holding down the UP or DOWN buttons.



How to set a HIGH ALARM

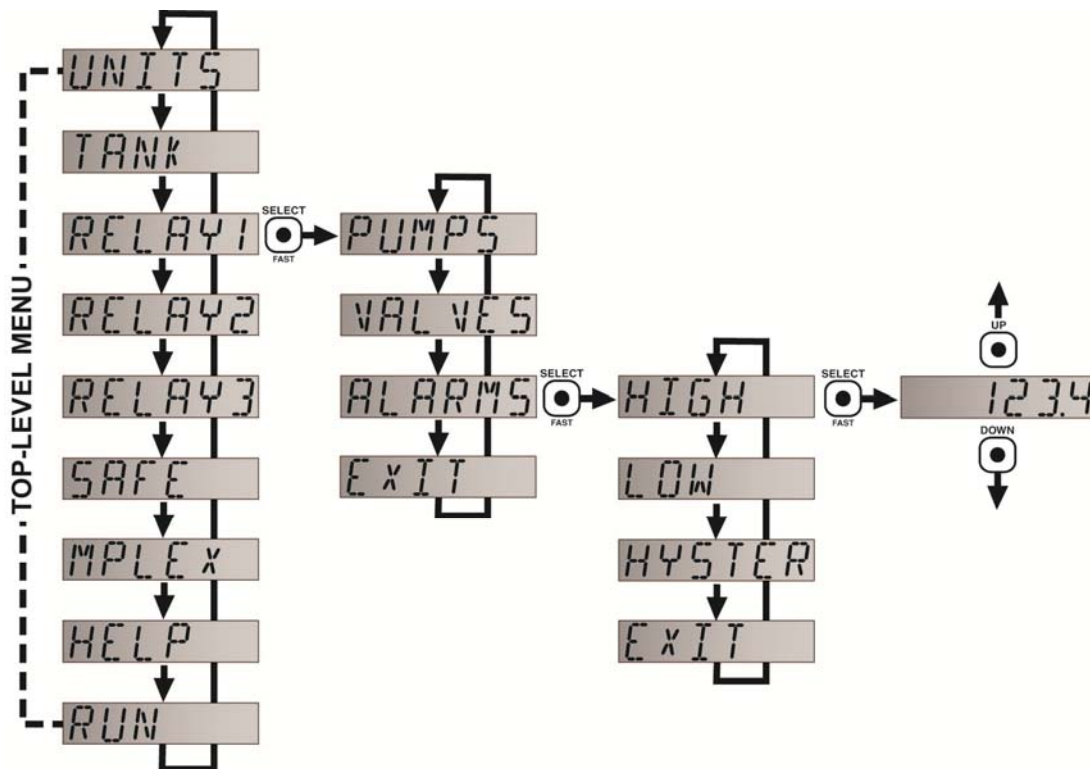


Before starting, measure the distance from the bottom of the tank to the High Alarm position (ON) in the tank.

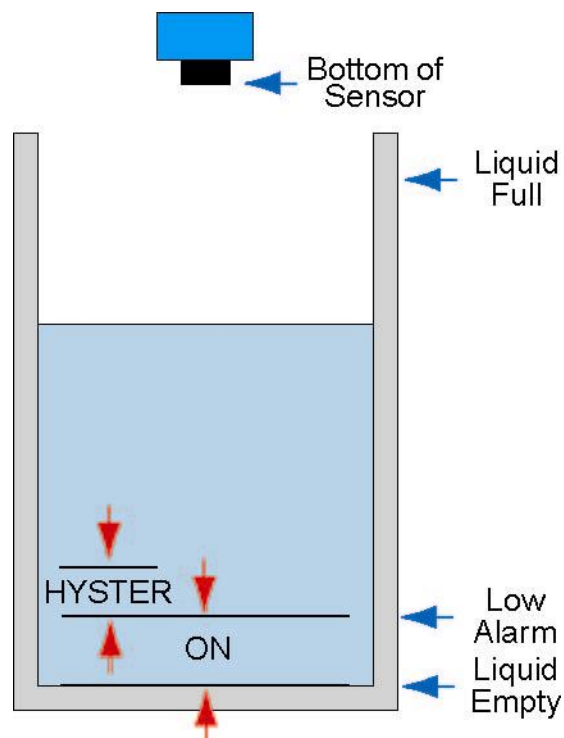
1. In TOP-LEVEL MENU mode, select RELAY1, RELAY2 or RELAY3.
2. Select ALARM.
3. Select HIGH.
4. Using the UP and DOWN buttons, set the HIGH (ON) set point for the relay.
5. To enter the value, press and hold SELECT for 2 seconds and release. SAVED will display.
6. Select HYSTER to set the Hysteresis.
 - a. Hysteresis is the distance away from the original ON setting where the Alarm will turn OFF.
7. Using the UP and DOWN buttons, set the HYSTER (OFF) set point for the relay.
8. To enter the value, press and hold SELECT for 2 seconds and release. SAVED will display.
9. Select EXIT to return to TOP-LEVEL MENU.

Note: The hysteresis (HYSTER) setting can be used to eliminate chattering of the relay.

Note: To speed up the scrolling of the values on the display, hold down the SELECT button while holding down the UP or DOWN buttons.



How to set a LOW ALARM

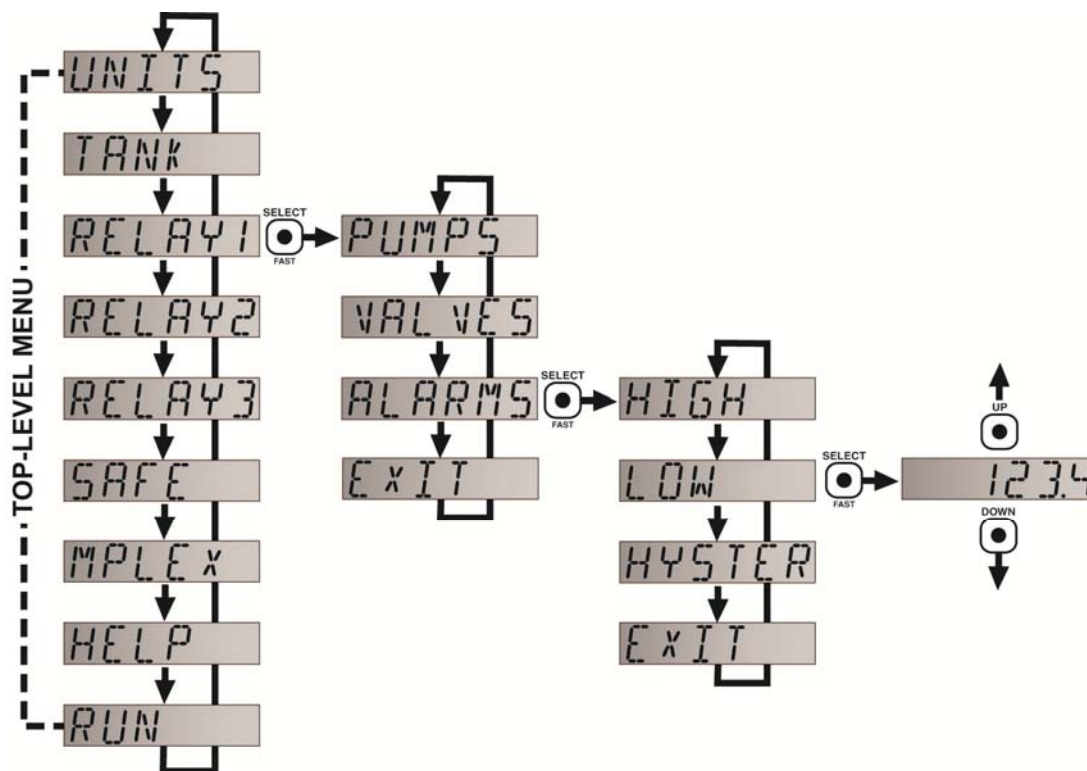


Before starting, measure the distance from the bottom of the tank to the Low Alarm position (ON) in the tank.

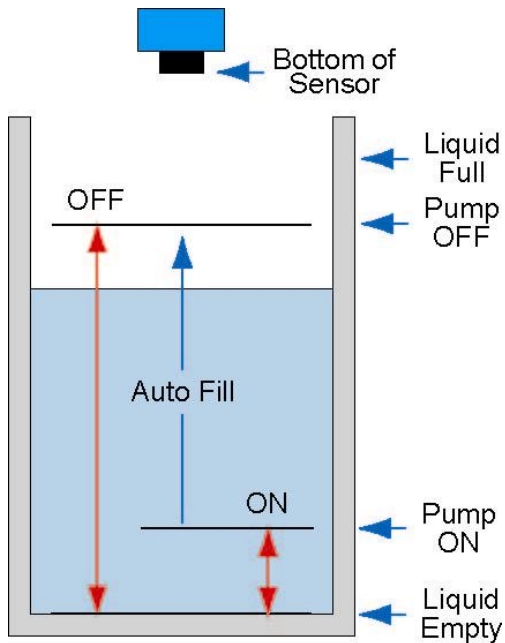
1. In TOP-LEVEL MENU mode, select RELAY1, RELAY2 or RELAY3.
2. Select ALARM.
3. Select LOW.
4. Using the UP and DOWN buttons, set the LOW (ON) set point for the relay.
5. To enter the value, press and hold SELECT for 2 seconds and release. SAVED will display.
6. Select HYSTER to set the Hysteresis.
 - a. Hysteresis is the distance away from the original ON setting where the Alarm will turn OFF.
7. Using the UP and DOWN buttons, set the HYSTER (OFF) set point for the relay.
8. To enter the value, press and hold SELECT for 2 seconds and release. SAVED will display.
9. Select EXIT to return to TOP-LEVEL MENU.

Note: The hysteresis (HYSTER) setting can be used to eliminate chattering of the relay.

Note: To speed up the scrolling of the values on the display, hold down the SELECT button while holding down the UP or DOWN buttons.



How to set a PUMP to FILL



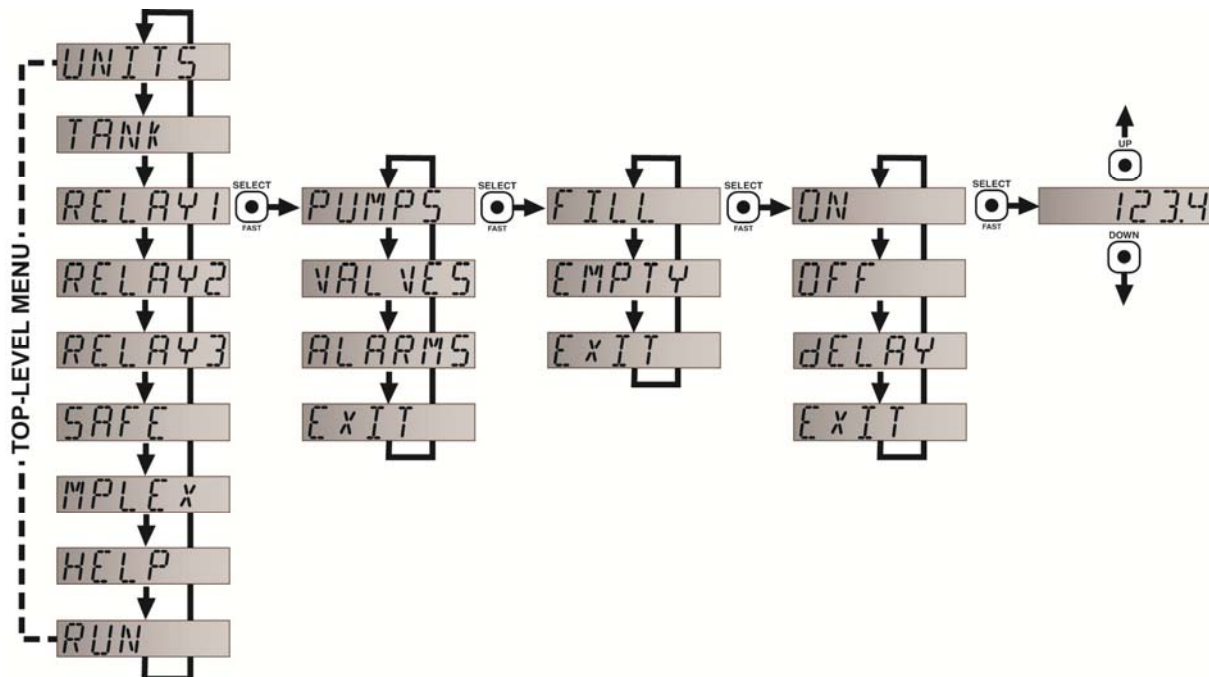
Before starting, take two measurements. 1) Measure the distance from the bottom of the tank to the Pump ON position. 2) Measure the distance from the bottom of the tank to the Pump OFF position. Pump ON will be physically lower than the Pump OFF position.

1. In TOP-LEVEL MENU mode, select RELAY1, RELAY2 or RELAY3.
2. Select PUMP.
3. Select FILL.
4. Select ON.
5. Using the UP and DOWN buttons, set the ON set point for the relay.
6. To enter the value, press and hold SELECT for 2 seconds and release. SAVED will display.
7. Select OFF.
8. Using the UP and DOWN buttons, set the OFF set point for the relay.
9. To enter the value, press and hold SELECT for 2 seconds and release. SAVED will display.

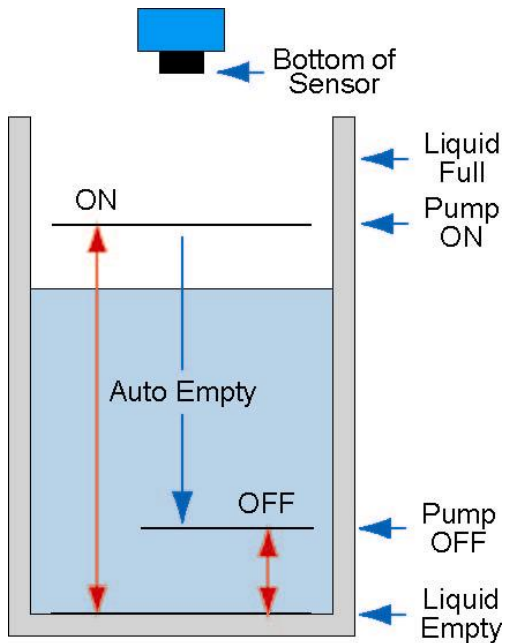
Note: If you want to add a delay when the PUMP starts, continue on to step 10. If no delay is required, jump to step 13.

10. Select DELAY.
11. Using the UP and DOWN buttons, set the DELAY time in seconds.
 - a. Pump delay can be set from 0 to 600 seconds.
12. To enter the value, press and hold SELECT for 2 seconds and release. SAVED will display.
13. Select EXIT to return to TOP-LEVEL MENU.

Note: To speed up the scrolling of the values on the display, hold down the SELECT button while holding down the UP or DOWN buttons.



How to set a PUMP to EMPTY



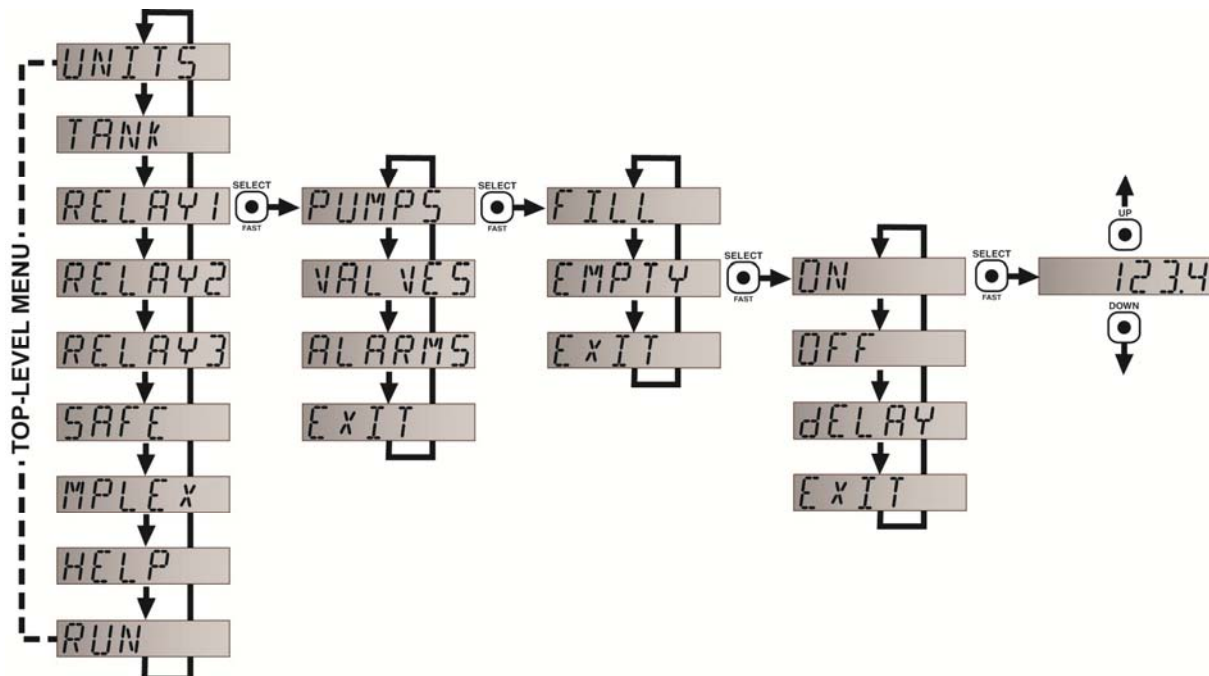
Before starting, take two measurements. 1) Measure the distance from the bottom of the tank to the Pump ON position. 2) Measure the distance from the bottom of the tank to the Pump OFF position. Pump ON will be physically higher than the Pump OFF position.

1. In TOP-LEVEL MENU mode, select RELAY1, RELAY2 or RELAY3.
2. Select PUMP.
3. Select EMPTY.
4. Select ON.
5. Using the UP and DOWN buttons, set the ON set point for the relay.
6. To enter the value, press and hold SELECT for 2 seconds and release. SAVED will display.
7. Select OFF.
8. Using the UP and DOWN buttons, set the OFF set point for the relay.
9. To enter the value, press and hold SELECT for 2 seconds and release. SAVED will display.

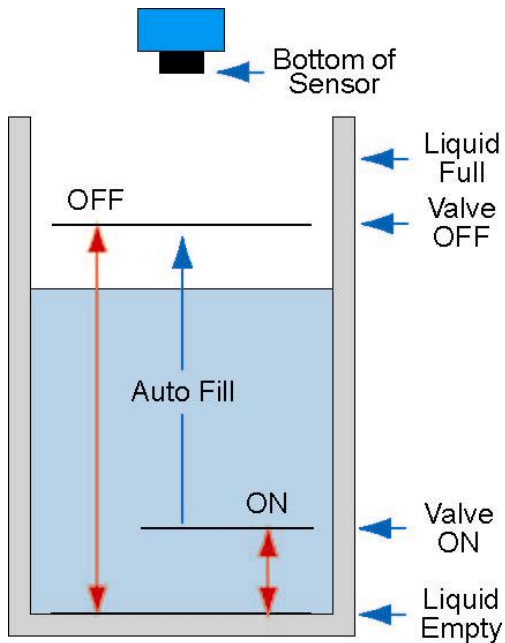
Note: If you want to add a delay when the PUMP starts, continue on to step 10. If no delay is required, jump to step 13.

10. Select DELAY.
11. Using the UP and DOWN buttons, set the DELAY time in seconds.
 - a. Pump delay can be set from 0 to 600 seconds.
12. To enter the value, press and hold SELECT for 2 seconds and release. SAVED will display.
13. Select EXIT to return to TOP-LEVEL MENU.

Note: To speed up the scrolling of the values on the display, hold down the SELECT button while holding down the UP or DOWN buttons.



How to set a VALVE to FILL



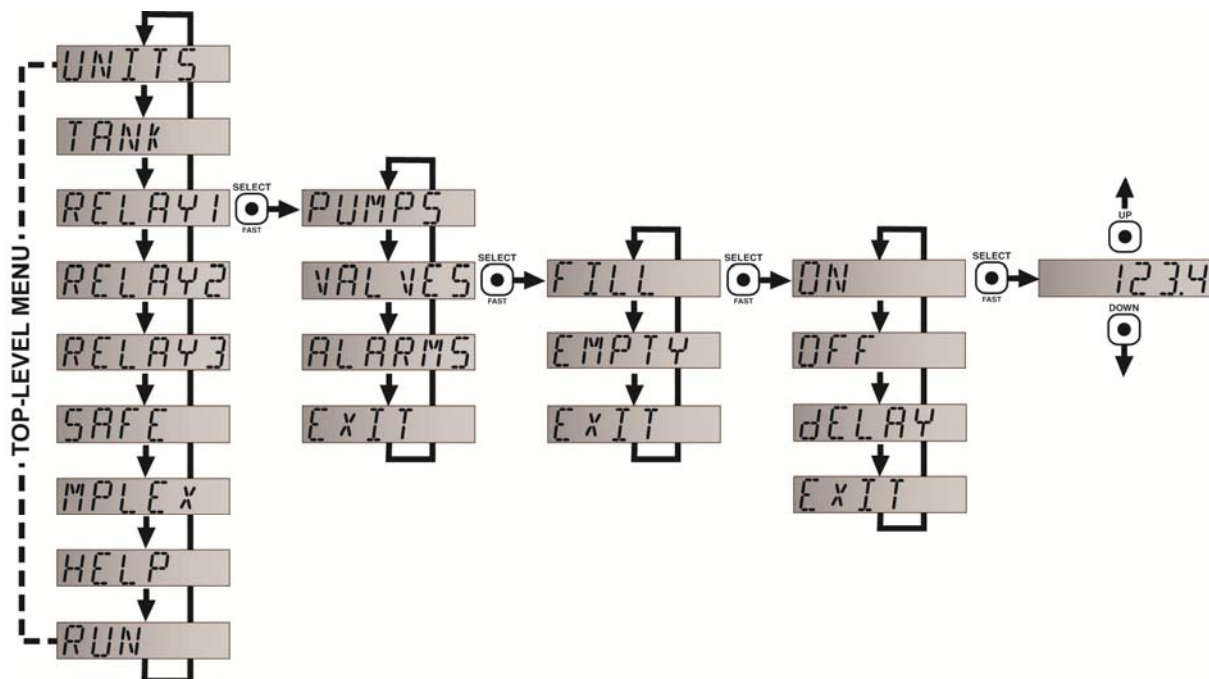
Before starting, take two measurements. 1) Measure the distance from the bottom of the tank to the Valve ON position. 2) Measure the distance from the bottom of the tank to the Valve OFF position. Valve ON will be physically lower than the Valve OFF position.

1. In TOP-LEVEL MENU mode, select RELAY1, RELAY2 or RELAY3.
2. Select VALVE.
3. Select FILL.
4. Select ON.
5. Using the UP and DOWN buttons, set the ON set point for the relay.
6. To enter the value, press and hold SELECT for 2 seconds and release. SAVED will display.
7. Select OFF.
8. Using the UP and DOWN buttons, set the OFF set point for the relay.
9. To enter the value, press and hold SELECT for 2 seconds and release. SAVED will display.

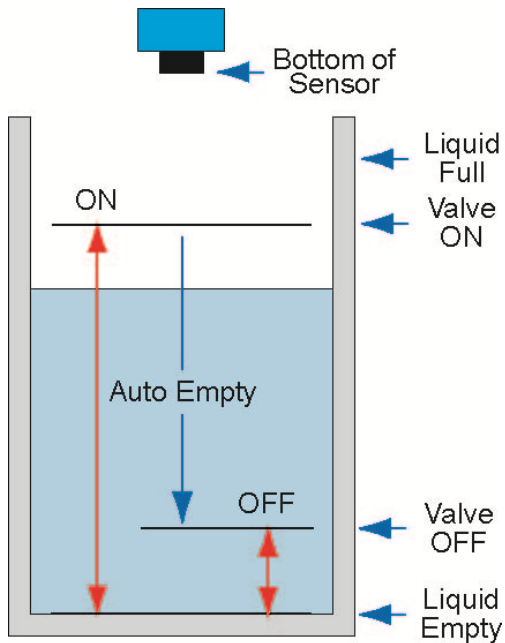
Note: If you want to add a delay when the VALVE starts, continue on to step 10. If no delay is required, jump to step 13.

10. Select DELAY.
11. Using the UP and DOWN buttons, set the DELAY time in seconds.
 - a. Valve delay can be set from 0 to 600 seconds.
12. To enter the value, press and hold SELECT for 2 seconds and release. SAVED will display.
13. Select EXIT to return to TOP-LEVEL MENU.

Note: To speed up the scrolling of the values on the display, hold down the SELECT button while holding down the UP or DOWN buttons.



How to set a VALVE to EMPTY



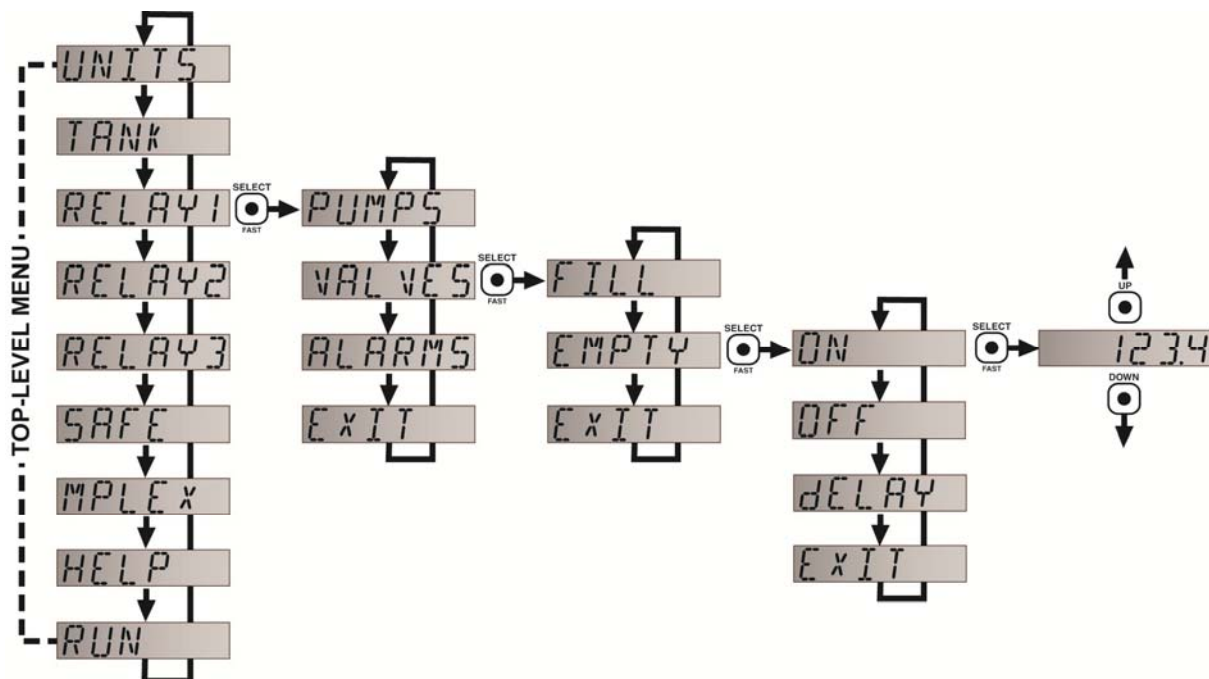
Before starting, take two measurements. 1) Measure the distance from the bottom of the tank to the Valve ON position. 2) Measure the distance from the bottom of the tank to the Valve OFF position. Valve ON will be physically higher than the Valve OFF position.

1. In TOP-LEVEL MENU mode, select RELAY1, RELAY2 or RELAY3.
2. Select VALVE.
3. Select EMPTY.
4. Select ON.
5. Using the UP and DOWN buttons, set the ON set point for the relay.
6. To enter the value, press and hold SELECT for 2 seconds and release. SAVED will display.
7. Select OFF.
8. Using the UP and DOWN buttons, set the OFF set point for the relay.
9. To enter the value, press and hold SELECT for 2 seconds and release. SAVED will display.

Note: If you want to add a delay when the VALVE starts, continue on to step 10. If no delay is required, jump to step 13.

10. Select DELAY.
11. Using the UP and DOWN buttons, set the DELAY time in seconds.
 - a. Valve delay can be set from 0 to 600 seconds.
12. To enter the value, press and hold SELECT for 2 seconds and release. SAVED will display.
13. Select EXIT to return to TOP-LEVEL MENU.

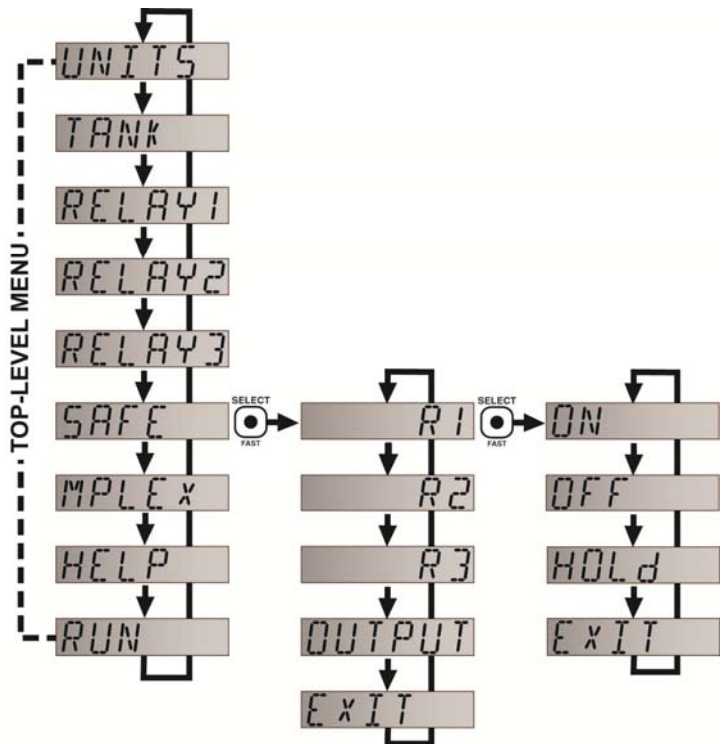
Note: To speed up the scrolling of the values on the display, hold down the SELECT button while holding down the UP or DOWN buttons.



How to set Relay Fail-Safe / LOST: In the event the sensor does not receive an echo, the Fail-Safe Output or LOST setting can be set to turn each relay ON, OFF or HOLD (to last state) to achieve the desired fail-safe condition. During fail-safe, the display will read LOST.

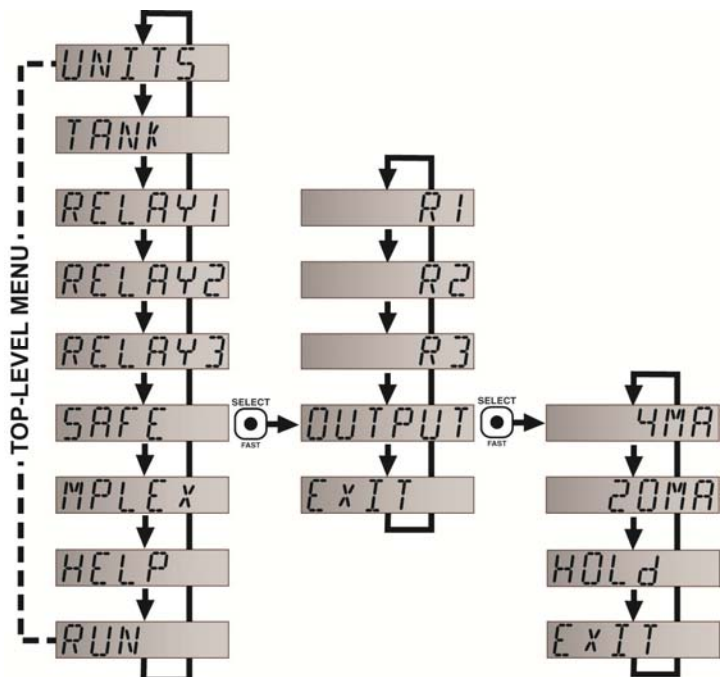
1. In TOP-LEVEL MENU mode, select SAFE.
2. Select R1 (Relay 1), R2 (Relay 2) or R2 (Relay 3).
3. Select ON, OFF, or HOLD.
4. Select EXIT to return to TOP-LEVEL MENU.

Power Outage: If power to the EchoSwitch® is removed (intentionally or accidentally), the relays will return to the normal state. Thus, in Relay 1, NC terminal will be closed and NO terminal will be open. Also, the NO terminals in relays 2 and 3 will also be open. Make sure that the de-energized state is the safe state in your system design. The EchoSwitch® does use non-volatile memory so any power loss will not affect the settings or configuration of the sensor.

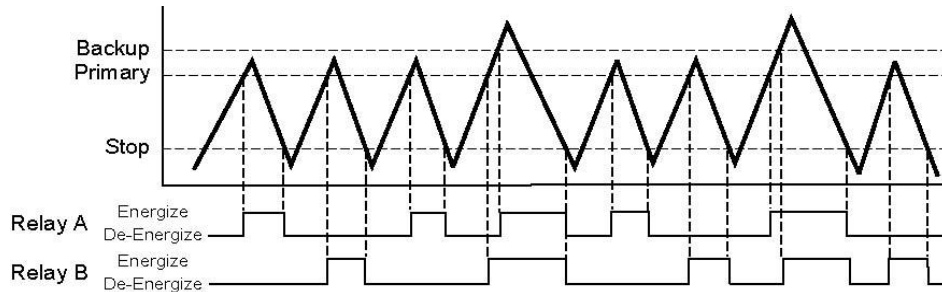


How to select Fail-Safe Current Output / LOST: In the event the sensor does not receive an echo, the Fail-Safe Current Output or LOST setting can be set to output a current of 4mA, 21mA or Hold (last known value). During fail-safe, the display will read LOST.

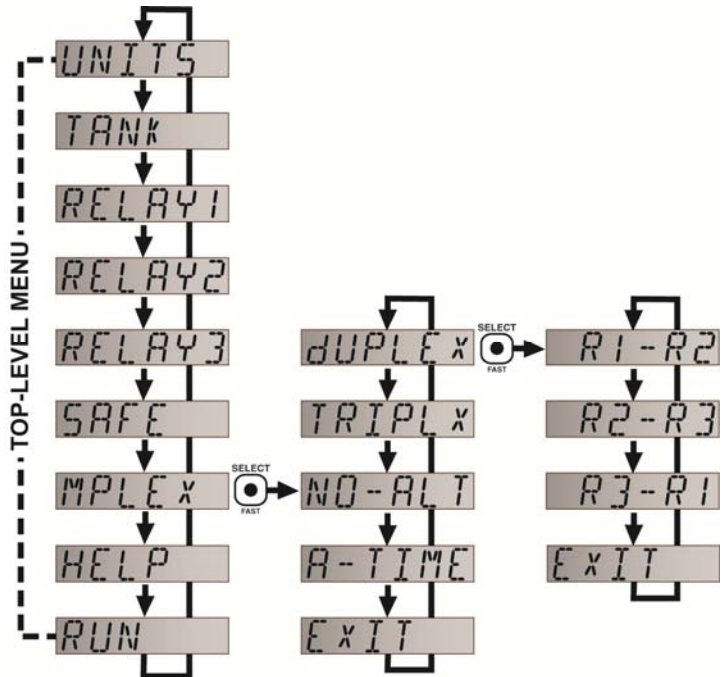
1. In TOP-LEVEL MENU mode, select SAFE.
2. Select OUTPUT.
3. Select 4mA, 21mA, or HOLD.
4. Select EXIT to return to TOP-LEVEL MENU.



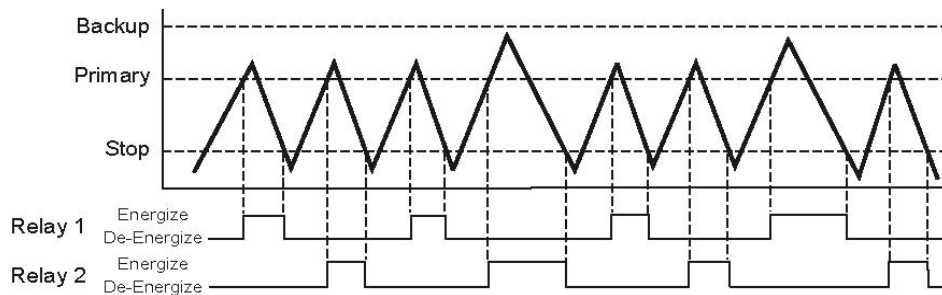
How to Duplex two relays: Duplex enables EchoSwitch® to use two relays to alternate after each cycle while performing a lead-lag operation. To begin, configure two relays in the same mode (ex: two relays are set as PUMPS that FILL or two relays set as PUMPS that EMPTY). Be sure to set one relay with an ON Set Point at the Primary Level and the other relay ON Set Point at the Backup Level. Setting the relays with the same ON level will have caused both relays to turn on at the same time. Once this is completed, see the steps below. Example below shows two relays (A and B) used to Auto Empty a tank:



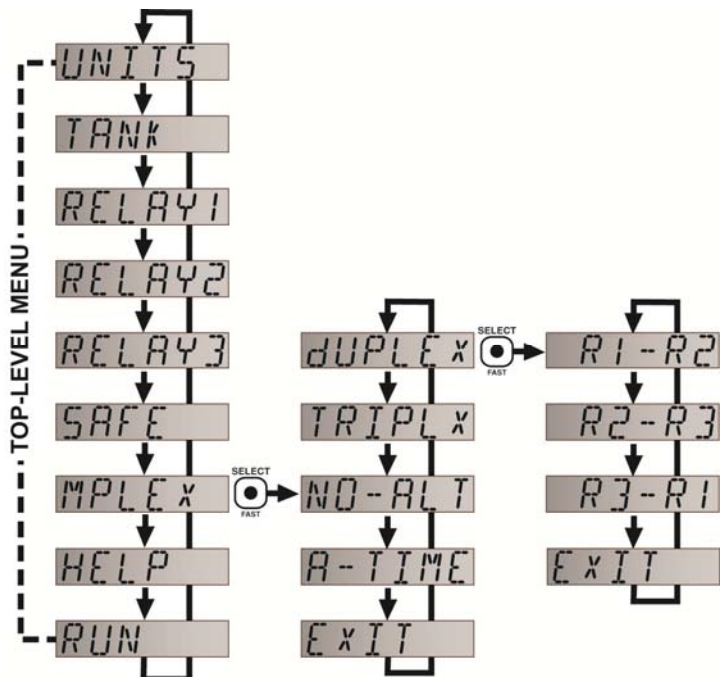
1. Make sure at least two relays are in the same mode for pumps.
 - a. If this is not true, then M-PLEX will not appear.
2. In TOP-LEVEL MENU mode, select M-PLEX.
3. Select DUPLEX.
 - a. If three relays are configured in the same mode, continue to step 4.
 - b. If only two relays are configured, jump to step 5.
4. Select R1_R2 (Relay 1 & 2), R2_R3 (Relay 2 & 3) or R1_R3 (Relay 1 & 3).
 - a. EchoSwitch® will allow you to select two of three relays to duplex.
5. Select EXIT to return to TOP-LEVEL MENU.



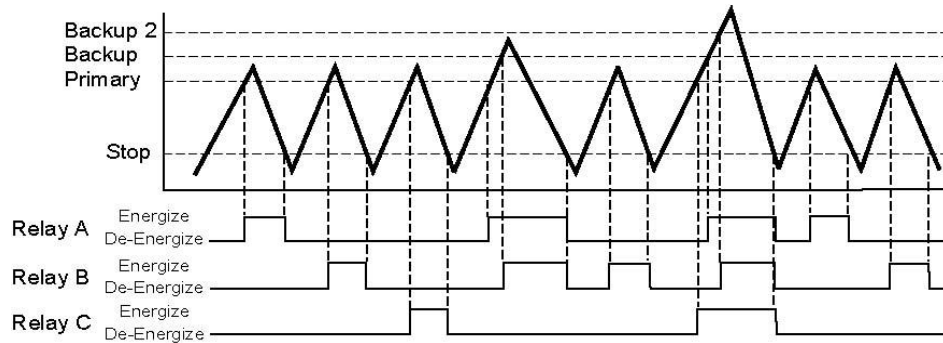
How to Alternate two relays: Alternate enables EchoSwitch® to use two relays to alternate after each cycle. The configuration of Alternate is identical to Duplex with the exception of the Backup level is at a setting where the level will never achieve set point. To begin, configure two relays in the same mode (ex: two relays are set as PUMPS that FILL or two relays set as PUMPS that EMPTY). Be sure to set one relay with an ON Set Point at the Primary Level and the other relay ON Set Point at the Backup Level. Setting the relays with the same ON level will have cause both relays to turn on at the same time. The Backup level must be set to a level out of range (level will never reach this setting). Once this is completed, see the steps below. Example below shows two relays (A and B) used to Auto Empty a tank:



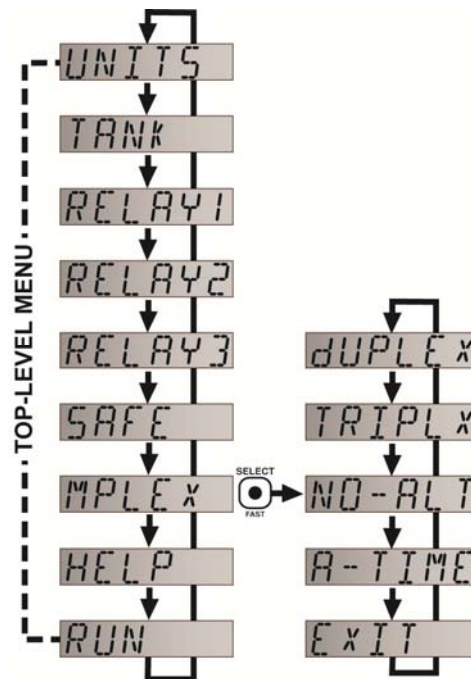
1. Make sure at least two relays are in the same mode for pumps.
 - a. If this is not true, then M-PLEX will not appear.
2. In TOP-LEVEL MENU mode, select M-PLEX.
3. Select DUPLEX.
 - a. If three relays are configured in the same mode, continue to step 4.
 - b. If only two relays are configured, jump to step 5.
4. Select R1_R2 (Relay 1 & 2), R2_R3 (Relay 2 & 3) or R1_R3 (Relay 1 & 3).
 - a. EchoSwitch® will allow you to select two of three relays to duplex.
5. Select EXIT to return to TOP-LEVEL MENU.



How to Triplex three relays: Triplex enables EchoSwitch® to use three relays to alternate after each cycle while performing a lead lag-lag operation. To begin, configure all three relays in the same mode (ex: all relays are set as PUMPS that FILL or all relays set as PUMPS that EMPTY). Be sure to set all three relay with different ON Set Point, one for Primary, one for Backup and the other for Backup 2). Setting all three relays with the same ON level will cause the relays to all turn on at the same time. Example below shows three relays (A, B and C) used to Auto Empty a tank:



1. Make sure all three relays are in the same mode. If this is not true, then TRIPLX will not appear.
2. In TOP-LEVEL MENU mode, select M-PLEX.
3. Select TRIPLX.
4. Select EXIT to return to TOP-LEVEL MENU.

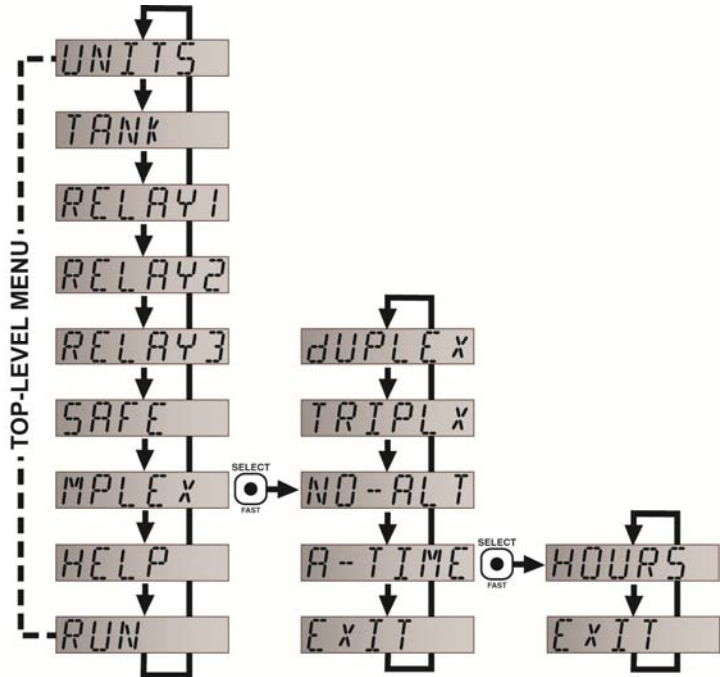


How to turn off M-PLEX (DUPLEX or TRIPLEX)

1. In TOP-LEVEL MENU mode, select M-PLEX.
2. Select NO ALT.
3. Select EXIT to return to TOP-LEVEL MENU.

How to Time Alternate relays: This function is only operational when two or more relays are configured as pumps performing the same function (either filling or emptying). This function is useful when a complete cycle of the pumps cannot be guaranteed such as a continuous inflow to a sump. Thus one pump may run longer than the other pump. To insure equal wear of both pumps, the alternating cycle can be set up on a timer. Thus the lead and lag pumps will be switched based on time rather than a cycle basis.

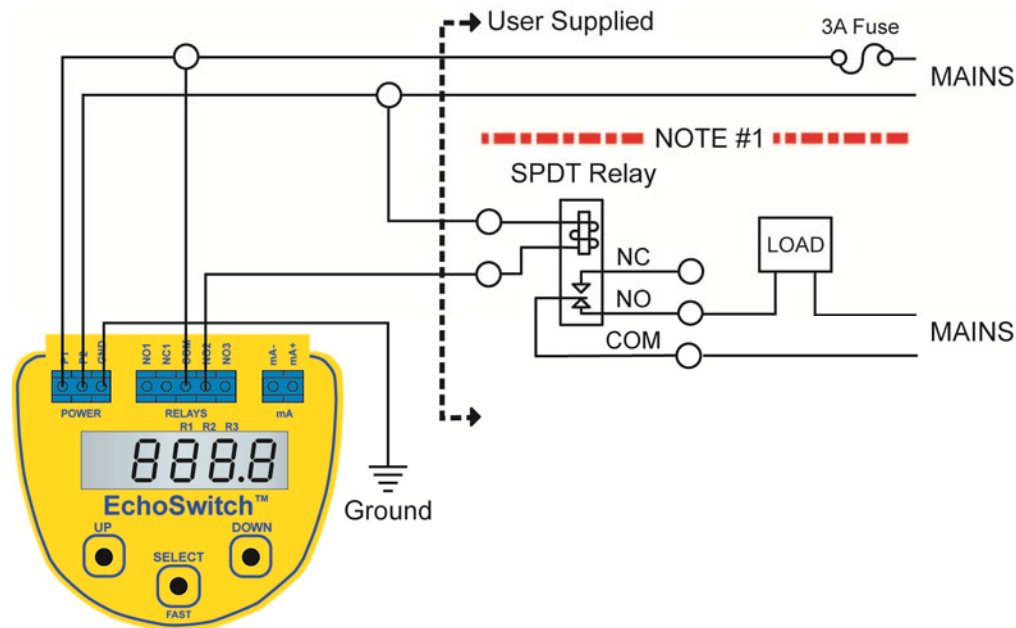
1. Make sure at least two relays are in the same mode.
 - a. Example: two relays are set as PUMPs that FILL or three relays are set as PUMPs that EMPTY).
 - b. If this condition is not met, M-PLEX will not appear.
2. In TOP-LEVEL MENU mode, select M-PLEX.
3. Select DUPLEX or TRIPLX.
4. Select A-TIME.
5. Select HOURS.
6. Using the UP and DOWN buttons, set the Alternating Time in Hours.
 - a. Alternating Time can be set from 0 to 600 hours.
7. To enter the value, press and hold SELECT for 2 seconds and release. SAVED will display.
8. Select EXIT to return to TOP-LEVEL MENU.



Input Power and Relay Connections: The EchoSwitch® is powered from 95 to 250 VAC power. Power is applied to the L1 and L2 terminals. Typically, Hot is applied to L1 and Neutral to L2. The Gnd terminal should be connected to a solid earth ground to help shield the sensor from external EMI/RFI interference.

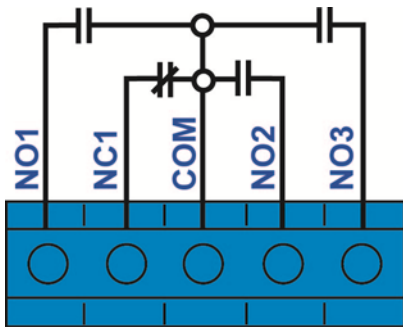
The EchoSwitch® features three 60 VA, 2A max relays. Relay 1 has both the Normally Open and Normally Closed contacts available. Relays 2 and 3 have the Normally Open contacts available. All three relays have their commons connected and are isolated. The example below shows Relay 2 wired NO. Make sure to select a relay state that is fail-safe and takes into account when power is lost to the EchoSwitch®.

The switching of heavy inductive loads such as pump motors can create voltage spikes in the many thousands of volts. It is recommended that the power to the EchoSwitch® and to the coils of the isolation relays be sourced from a main that is not switching inductive loads as shown below.



- **Note #1** – Isolate power to instrument from power to load (pumps, etc.) as much as possible by running power to the sensor directly from main power source.

Relay Configuration:

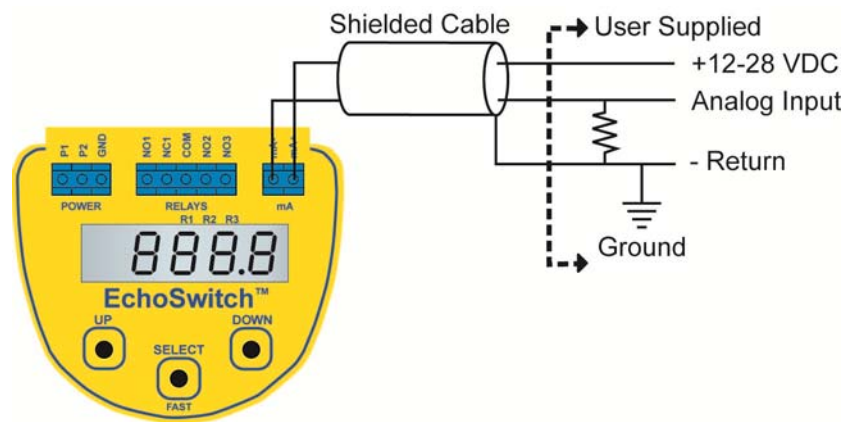


All three (3) EchoSwitch® relays share the common relay terminal.

- **Relay #1** is a Form “C” SPDT contact.
 - It is useful for controlling a valve which requires a contact to open and a contact to close.
- **Relays #2 & #3** are Form “A” SPST contacts.
 - These two relays (#2 & #3), in addition to relay #1, can be used for controlling valves, pumps or alarms.

Note: Because all three (3) relays share the common relay terminal, the relays must all switch the same power.

Analog Output (4/20 mA): The analog output of the EchoSwitch® is a sinking 4/20 mA control circuit. The typical way to use this feature is to connect a positive supply to the MA+ input and to sense the current flow out of the MA- output with a sampling resistor as shown in the following diagram.

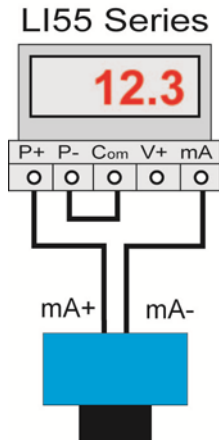


The cabling should be a shielded twisted pair to minimize EMI interference. Typically 20 to 24 gauge wire is used in this application. The analog output of the EchoSwitch® is isolated from the AC power via optocoupler isolation.

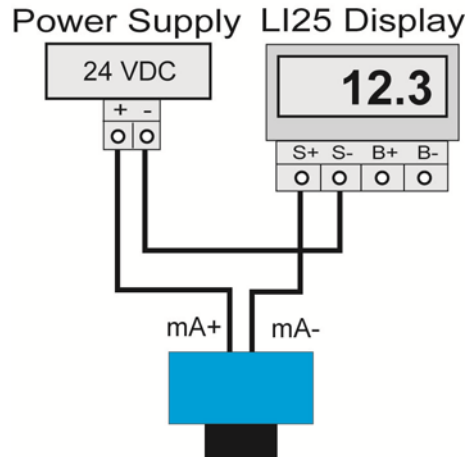
- **Note** – 95 to 250 VAC power is required to provide power to the EchoSwitch® for basic operation.

Wiring to Common Flowline Displays & Controller: Below is a quick review of wiring to the most common Flowline Displays & Controllers.

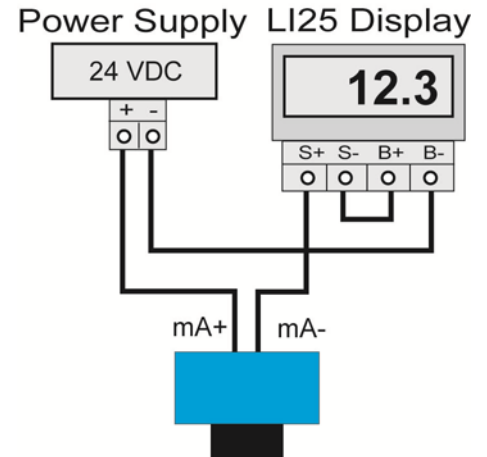
**DataView™ LI55 Series
Level Controller**



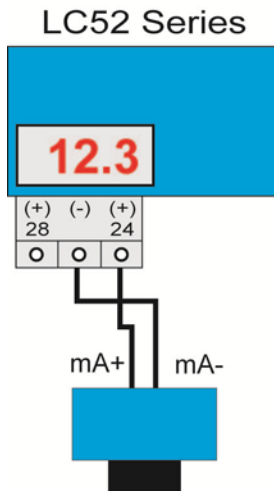
**DataLoop™ LI25 Series
Level Indicator
without the backlight**



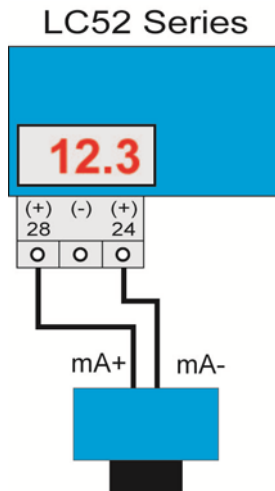
**DataLoop™ LI25 Series
Level Indicator
with the backlight**



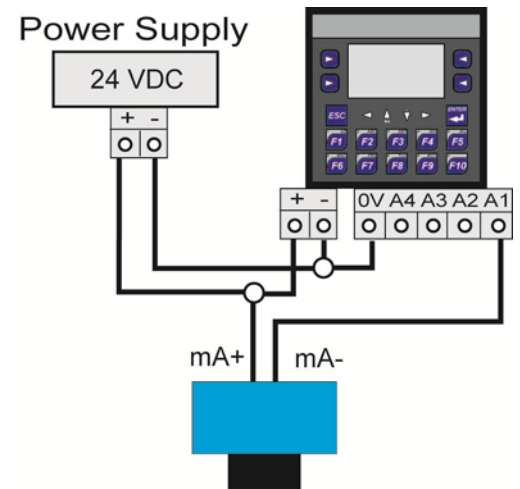
**DataPoint™ LC52 Series
Level Controller
JWA mode (Factory Setting)**



**DataPoint™ LC52 Series
Level Controller
JWB mode**



**Commander™ LI90 Series
Multi-Tank Level
Controller**



The EchoSwitch® should always be mounted perpendicular to the liquid surface and installed using the provided Viton® mounting gasket. Make sure that the fitting and transmitter threads are not damaged or worn. Always *hand-tighten* the transmitter within the fitting. Perform an installed leak test under normal process conditions prior to system start up. **Note:** *The preferred mounting fitting for the LU77 Series is the LM52-1400 (2" thread x 1" thread) reducer bushing.*

Mounting Guide

1. Do not mount at an angle.
2. Liquid should never enter the dead band.
3. Side Wall:
 - a. Mount at least 3" from the side wall.
 - b. For LU77 Series - mount at least 2" from the side wall.
4. Do not mount where obstacles will intrude into sensor's beam width.
 - a. Beam Width: 3" (7.6cm) diameter [2" (5cm) for LU77 series].
5. Do not mount in a vacuum.
6. Avoid mounting in the center of a dome top tank.
7. In cone bottom tank, position the sensor over the deepest part of the tank.

Installation in existing fittings: If the existing fitting is larger than the threads of the EchoSwitch®, select a reducer bushing such as the LM52-1400 (2" thread x 1" thread) or LM52-2400 (3" thread x 2" thread).



LM52-1400



LM52-2400

Do not install at angle relative to the liquid.	
Do not install within 2" of tank sidewall. (3" for DL34 series)	
Do not install with objects in the beam.	
Do not install in applications with vacuum.	

Metal Tanks (LU77 Series Only): Flowline ultrasonic sensors have been optimized for use in non-metallic fittings.

1. For best performance, avoid the use of metallic fittings.
 - a. Use a plastic 2" x 1" reducer bushing, such as the LM52-1400 or a plastic 1" flange, such as the LM52-1850 for metallic tanks.
2. While installations directly into a 1" metal fitting are not recommended, acceptable results may be obtained if the 1" fitting is a half coupling in form and the outer diameter of the coupling is tightly wrapped in vinyl tape to dampen vibration.

Fitting Selection: Check the part number to determine the required fitting mount size and thread type. EchoSwitch® is commonly installed in tank adapters, flanges, brackets or standpipes. **Note:** Always include the gasket when installing the EchoSwitch®.

1. **Tank Adapter:** Select a tank adapter fitting, such as the LM52-1890 for the LU74 Series or the LM52-2890 for the LU74 & LU78 Series.
 - a. For best results, select a 2" tank adapter and add a reducer bushing such as the LM52-1400, thread x thread, reducer bushing.
 - b. Avoid tank adapter (thread x thread) styles and/or pipe stops forward of the installed transducer.
 - c. Always mount the tank adapter so the majority of the fitting is outside the tank.
 - i. Never mount the tank adapter upside down or the bulk of the material is inside the tank.

**2" Tank Adapter
Socket x Thread**



**Tank Adapter
w/ 2"x 1" Reducer Bushing**

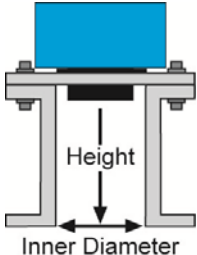


**Tank Adapter
Thread x Thread**



Do not use thread x thread

2. **Riser:** Installations with tall, narrow risers can impede the acoustic signal.
 - a. **Core Out Concrete:** Applications where tank a concrete tank ceiling that has been cored out can also be considered as a riser type application. In these applications a 2:1 ratio (Inner Diameter to Core Height) for the diameter of the core.
 - b. **LU74 & LU78 Series:** 2" (5 cm) diameter risers should be no taller than 5" (12.7 cm). Larger diameter risers should be no taller than 12" (30.5 cm).
 - c. **LU77 Series:**

	Riser Specifications	
	Inner Diameter	Maximum Height
	2" (5cm)	3" (7.6cm)
	4" (10cm)	8" (20cm)
	6" (15cm)	12" (30cm)

Note: Do not exceed the dimensions listed above.



Note: If attempting to raise the sensor above the top of the tank to allow for a higher fill capacity, avoid the use of tall and narrow risers. The example to the left exceeds the dimensions listed in the **Riser Specifications** chart. Use a larger tank adapter which takes into account the **Riser Specifications**.

3. **Flange (LU77 Series):** If installing on a flange, select a flange with a thread that is above the plane of the flange, such as the LM52-1850.

- a. *The LU74 & LU78 series works well with Flange installations.*
- b. Avoid the use of blind flanges with tapped threads or flanges where the threads are even with the plane of the flange, such as the Banjo 1" Poly ANSI Flange (series AF100).
- c. Use a flange with a 2" thread and add a 2" to 1" reducer bushing to complete the installation.

2" Flange w/
thread out of plane



2" Flange w/
thread in plane



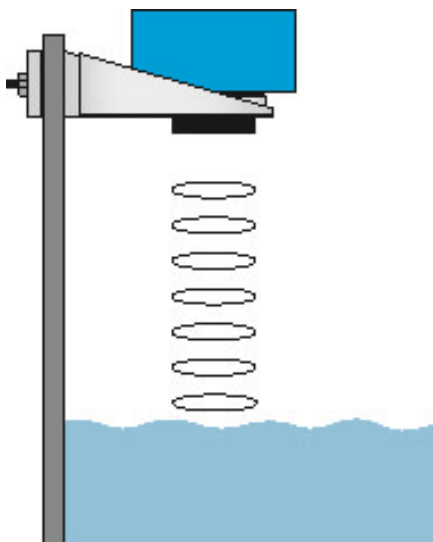
Do not use thread in plane

2" Flange w/
Reducer Bushing



4. **Side Mount Bracket:** For installations in open tanks and sumps, use the LM50 series side mount bracket.

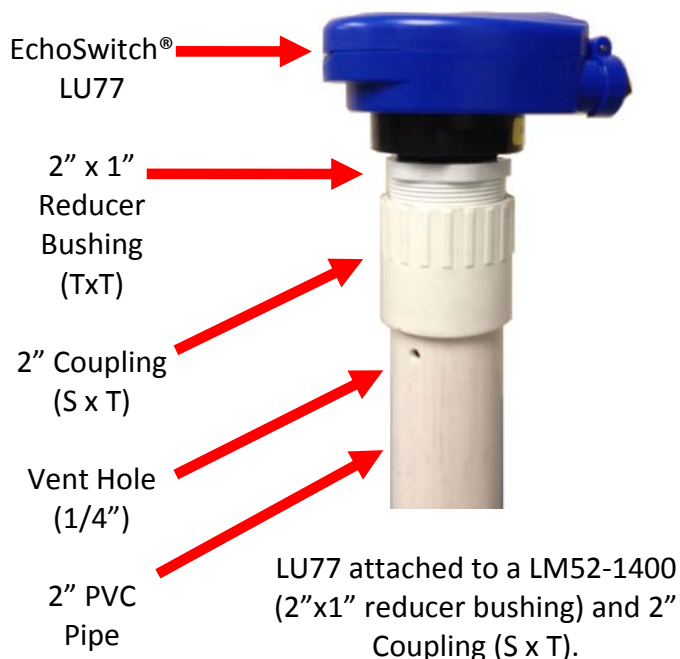
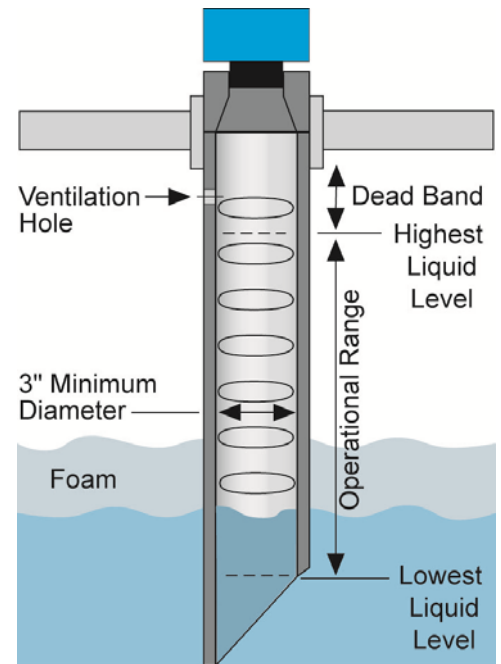
- a. For the LU77 series, order the LM50-1001-1, which includes a 2" thread x 1" thread reducer bushing.
- b. For the LU74 & LU78, Series, order the LM50-1001 side mount bracket.



LM50-1001 Shown

5. Stand Pipe: A standpipe maybe used to dampen turbulence or separate surface foam from the point of measurement in the application.

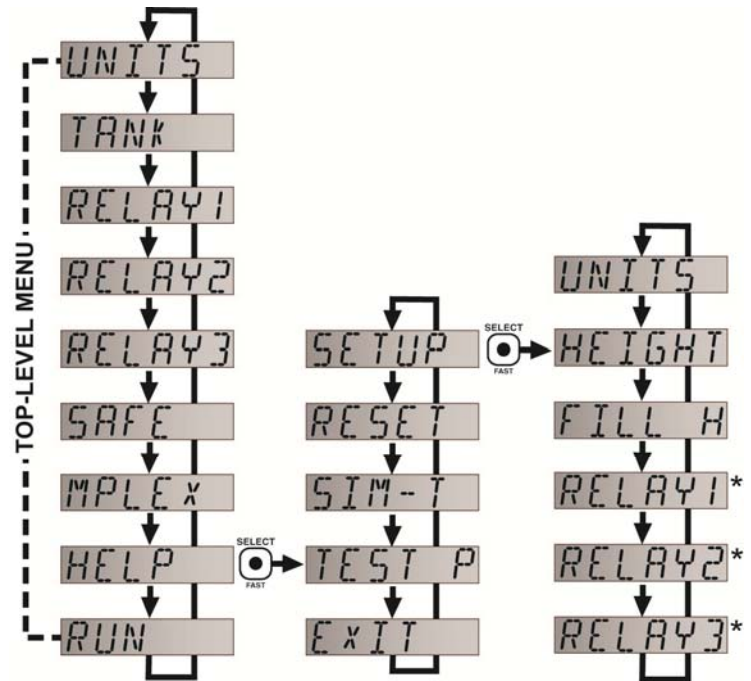
- a. Pipe can be made of any material.
- b. Select a minimum 3" ID pipe for the stand pipe.
 - i. A 2" pipe is usable with the LU77 series, but this is the minimum size.
 - ii. Pipe sizes larger than 3" can also be used.
- c. Use a coupling and reducer bushing to attach the EchoSwitch® to the pipe.
 - i. With the LU77 series, use a plastic reducing bushing such as LM52-1400 2" T x 1" T fitting or the LM52-1410 2" S x 1" T fitting.
- d. The pipe length should run the measurement span and the bottom of the pipe should remain submerged at all times to prevent foam from entering the pipe.
- e. Cut a 45° notch at the bottom of the pipe and drill a 1/4" pressure equalization hole within the dead band of the sensor.
- f. The pumps should not drive liquid past the open end of the stand pipe which causes the liquid in the pipe to oscillate.



Avoid the use of a tee within the stand pipe. A tee can create false signals that will negatively effect the sensor's performance.

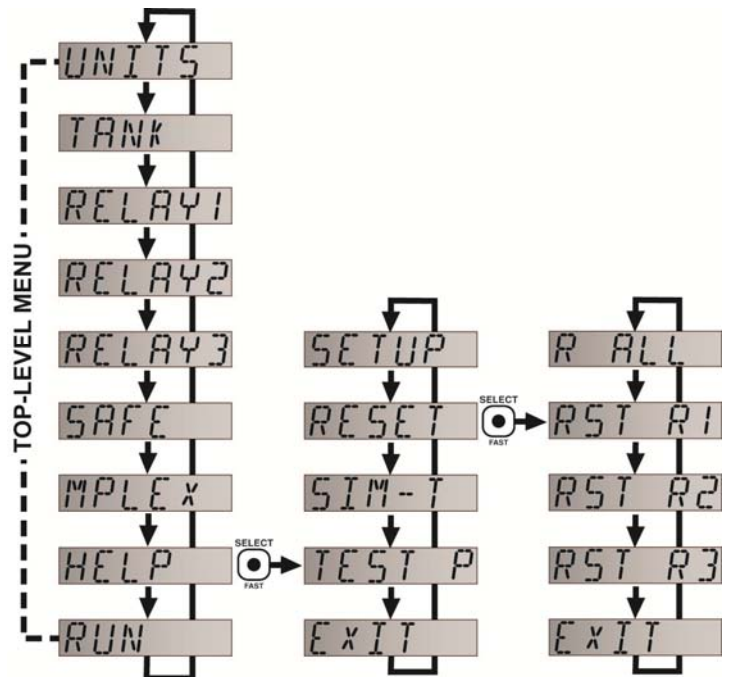
Setup: Setup will display setting for all functions of EchoSwitch®. Use this feature to confirm the configuration of the sensor.

1. In TOP-LEVEL MENU, select HELP.
2. Select SETUP.
3. Setup will list the following settings:
 - a. UNITS, HEIGHT, FILL_H, RELAY1*, RELAY2*, RELAY3*.
 - b. * Each relay will list the following settings:
 - i. Relay Function, On Setting, Off Setting, Safe Setting and Delay
4. Select EXIT to return to TOP-LEVEL MENU.



Reset: Reset enables the entire sensor or specific relays to be reset to factory settings.

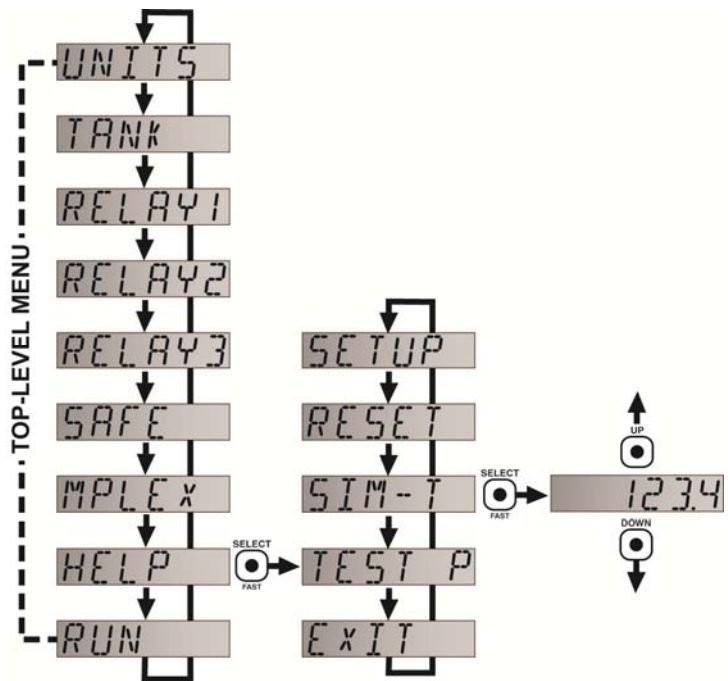
1. In TOP-LEVEL MENU, select HELP.
2. Select RESET.
3. Select R ALL, RST 1, RST 2 or RST 3.
 - a. **R All** – Resets the entire EchoSwitch®
 - b. **RST R1** – Resets only the settings associated with Relay 1
 - c. **RST R2** – Resets only the settings associated with Relay 2
 - d. **RST R3** – Resets only the settings associated with Relay 3
4. Select EXIT to return to TOP-LEVEL MENU.



Simulation (SIM-T): This mode enables the end user to simulate changes in level without having the level of liquid move. The display will simulate level of liquid and will turn the relays ON and OFF according to how they were configured. Example: If Relay 1 is set as a High Alarm with an ON setting for 100.0 inches and a Hysteresis of 2.0 inches, then when the display goes above 100.0, Relay 1 will energize and when the level falls below 98.0, Relay 1 will de-energize. Use this function to test the wiring and to verify the sensor's configuration.

Please note: Simulation mode will energize and de-energize all configured relays. Any devices wired to the relays will become active during simulation mode.

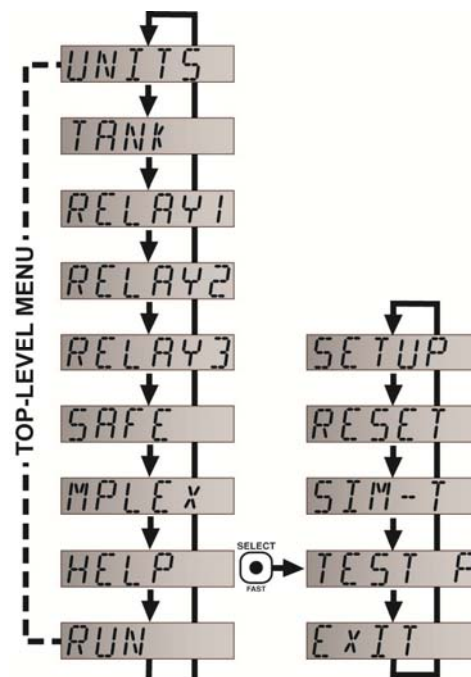
1. In TOP-LEVEL MENU, select HELP.
2. Select SIM-T.
3. The display will start at 0.0.
 - a. Press and hold the UP button to begin increasing the level of liquid.
 - b. Use the DOWN button to simulate the lowering of liquid in the tank.
 - c. To increase speed, hold the SELECT button while hold the UP or DOWN keys.
4. Test the functionality of the relays confirming their ON and OFF levels.
5. To exit, press and hold the SELECT key.
6. Select EXIT to return to TOP-LEVEL MENU.



Test Parameters: This mode runs diagnostic tests that confirm operation of EchoSwitch®. This is a production test feature used by the factory to confirm operation.

1. In TOP-LEVEL MENU, select HELP.
2. Select TEST P.
3. TEST P will perform the following test:
 - a. Run a LCD Check
 - b. Turn ON all three relays
 - c. Turn OFF all three relays.
4. TEST P will also list the following settings:
5. Select EXIT to return to TOP-LEVEL MENU.

Note: This mode should only be used when supervised by a Flowline representative.



Troubleshooting

PROBLEM	SOLUTION
TANK does not appear on the main menu	Units function is set for PERCENT on EchoSwitch®: When Units is set for PERCENT, the TANK function is disabled. To re-enable TANK, change units to INCHES, CM, FEET or METERS.
Display always jumps to the LOST condition	Check the dimensional configuration (Height and Fill-H) of the EchoSwitch®. Make sure that the Fill-H setting corresponds to the full level of liquid (from the bottom up) and not the distance from the sensor to the liquid (top down).
M-PLEX does not appear on the main menu	None of the relays are configured the same: M-PLEX will only appear when 2 or 3 relays are configured as the same function. For example, two or more relays are configured as Pumps that Auto Fill. M-PLEX will not appear if a relay is configured as an Auto Empty Pump and an Auto Empty Valve.
Display shows FULL	Level of liquid is above the FILL_H setting: Check the FILL_H setting, making sure the FILL_H setting is high enough so the level of liquid is below the FILL_H setting
Display shows EMPTY	Level of liquid is beyond the HEIGHT setting: Check the HEIGHT setting, making sure the HEIGHT setting is low enough so the level of liquid is above the HEIGHT setting
Pumps or Valves do not alternate	1. M-PLEX is set for NO-ALT or A-TIME is set above 0: a. If M-PLEX is set for NO-ALT, then the relays will not alternate. Change M-PLEX to either DUPLEX or TRIPLX to begin alternation. b. If A-TIME is set for anything above 0 hours, then the pumps will only alternate after the A_TIME set has been reached. For example, if A-TIME is set for 3 hours, then the relays will only switch after each 3 hour period. To alternate after each cycle, change A-TIME to 0 hours 2. The ON levels for the relays are set to the same setting. Change the ON set point to another value. 3. The DELAY is set for a period of time that has not been reached. Example: if delay was set to 600, you must wait 10 minutes before the relay will trigger.
Relay closes, but does not open again	An inductive kick may be holding the relay closed. If switching 24 VDC, make sure a diode has been installed to act as a snubber.
Relay chatters on and off repeatedly	Most likely the turbulence in the tank is causing the chatter. Increase the Hysteresis setting to correct.
Relay does not initially switch.	Check the DELAY setting for the relay. The delay time must be met before the relay switches. Example: if delay was set to 600, you must wait 10 minutes before the relay will trigger.

User Settings:

Fill out the chart below and keep as a record of your configuration.

Tank

Height =	Fill-H =
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Relay #1

Pump		Valve		Alarm	
Fill	Empty	Fill	Empty	High	Low
ON =		ON =		ON =	
OFF =		OFF =		Hysteresis =	
Delay =		Delay =			

Relay #2

Pump		Valve		Alarm	
Fill	Empty	Fill	Empty	High	Low
ON =		ON =		ON =	
OFF =		OFF =		Hysteresis =	
Delay =		Delay =			

Relay #3

Pump		Valve		Alarm	
Fill	Empty	Fill	Empty	High	Low
ON =		ON =		ON =	
OFF =		OFF =		Hysteresis =	
Delay =		Delay =			

M-Plex

No-Alt	Duplex	Triplex
Relays 1 & 2	Relays 2 & 3	Relays 3 & 1
A-Time	ON	OFF
Hours:		

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 in accordance with instructions furnished by Flowline for a period of two years from the date of manufacture of such products. 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, which Flowline's examination determines to its satisfaction to be defective in material or workmanship within the warranty period. Flowline must be notified pursuant to the instructions below of any claim under this warranty within thirty (30) days of any claimed lack of conformity of the product. Any product repaired under this warranty will be warranted only for the remainder of the original warranty period. Any product provided as a replacement under this warranty will be warranted for the full two years from the date of manufacture.

Returns

Products cannot be returned to Flowline without Flowline's prior authorization. To return a product that is thought to be defective, go to www.flowline.com, and submit a customer return (MRA) request form and follow the instructions therein. All warranty and non-warranty product returns to Flowline must be shipped prepaid and insured. Flowline will not be responsible for any products lost or damaged in shipment.

Limitations

This warranty does not apply to products which: 1) are beyond the warranty period or are products for which the original purchaser does not follow the warranty procedures outlined above; 2) have been subjected to electrical, mechanical or chemical damage due to improper, accidental or negligent use; 3) have been modified or altered; 4) anyone other than service personnel authorized by Flowline have attempted to repair; 5) have been involved in accidents or natural disasters; or 6) are damaged during return shipment to Flowline. Flowline reserves the right to unilaterally waive this warranty and dispose of any product returned to Flowline where: 1) there is evidence of a potentially hazardous material present with the product; or 2) the product has remained unclaimed at Flowline for more than 30 days after Flowline has dutifully requested disposition. This warranty contains the sole express warranty made by Flowline in connection with its products. ALL IMPLIED WARRANTIES, INCLUDING WITHOUT LIMITATION, THE WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, ARE EXPRESSLY DISCLAIMED. The remedies of repair or replacement as stated above are the exclusive remedies for the breach of this warranty. IN NO EVENT SHALL FLOWLINE BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES OF ANY KIND INCLUDING PERSONAL OR REAL PROPERTY OR FOR INJURY TO ANY PERSON. THIS WARRANTY CONSTITUTES THE FINAL, COMPLETE AND EXCLUSIVE STATEMENT OF WARRANTY TERMS AND NO PERSON IS AUTHORIZED TO MAKE ANY OTHER WARRANTIES OR REPRESENTATIONS ON BEHALF OF FLOWLINE. This warranty will be interpreted pursuant to the laws of the State of California. If any portion of this warranty is held to be invalid or unenforceable for any reason, such finding will not invalidate any other provision of this warranty.

For complete product documentation, video training, and technical support, go to www.flowline.com.

For phone support, call 562-598-3015 from 8am to 5pm PST, Mon - Fri.

(Please make sure you have the Part and Serial number available.)