

# SSI Technologies - Application Note FT-AN2

## Fluid-Trac® 3-Wire Level Sensor (Voltage Output)

### Product Description

The Fluid-Trac® 3-wire ultrasonic level sensor is a non-contact liquid level sensor that offers a wide variety of input and output options which enables it to interface with many different microprocessor-controlled fuel gauges or digital instrumentation.

The Fluid-Trac® 3-wire level sensor can be factory programmed to have a ratio-metric output to drive 12V fuel electronic gauges (automotive applications).

The Fluid-Trac® 3-wire level sensor can also be factory programmed to provide a non-ratiometric voltage output (0.5 to 4.5 V) for interfacing to control modules, PLC controllers, digital instrumentation, or DAQ systems to indicate tank volume levels.



### Measurement Technology

The traditional resistive float sender uses a potentiometer attached to a float at the end of an actuating arm to provide a level indication. This technology interfaces with the instrument cluster's fuel gauge which is typically a coil driven needle gauge. As the resistive float sender's resistance changes with level, the current through the coil in the gauge changes causing a deflection of the needle. This approach has been used for many years.

Fluid-Trac® uses ultrasonic technology to generate a high frequency sound wave and measure the time for the echo to reflect off of the liquid's surface and return. The distance from the level sensor to the fuel is calculated based on the speed of sound. The measured distance is converted into a voltage that drives the fuel gauge based on a strapping table contained in the level sensor.

### Product Features

- **More Accurate:** Distance accuracy of +/- 2.5% full scale span of distance.
- **More Reliable:** Fluid-Trac® is non-contacting. Resistive float sender have a wiper that slides across a resistive strip that with time can wear and cause intermittent or complete loss of the signal.
- **Non-Invasive:** Fluid-Trac® mounts to the same opening as the resistive float sender, but does not protrude into the tank.
- **Easier to Install or Service:** Fluid-Trac® has no components to protrude into the tank that need to be bent for removal.
- **Digital Filtering:** Digital filtering eliminates errors due to liquids sloshing in mobile tanks.
- **Tank Profiling:** Factory programmable strapping tables for unique tank shapes.



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- **Chemical compatibility:** Fluid-Trac® works with a wide variety of media including gasoline, diesel, urea (ADBLUE), oils, hydraulic fluid, black/gray water
- **Tank Volumetric Error Detection:** Optional factory programmed non-ratiometric voltage output with “in range” values for error detection.
- **Minimal Dead Band:** No bottom dead band like on other senders. Optional Fluid-Trac® mounting adapter can be used to reduce or potentially eliminate the top dead band of 2 inches.
- **American Boat and Yacht Council (ABYC) Certified**

### Electrical Interface

The Fluid-Trac® 3-wire level sensor has a factory programmable voltage output. The Fluid-Trac® 3-wire level sensor can be programmed to have a ratio-metric output to emulate a 30-240 ohm resistive float sender. The Fluid-Trac® 3-wire level sensor interfaces to the microprocessor-controlled fuel gauges using three wires – power, ground and output as shown below:

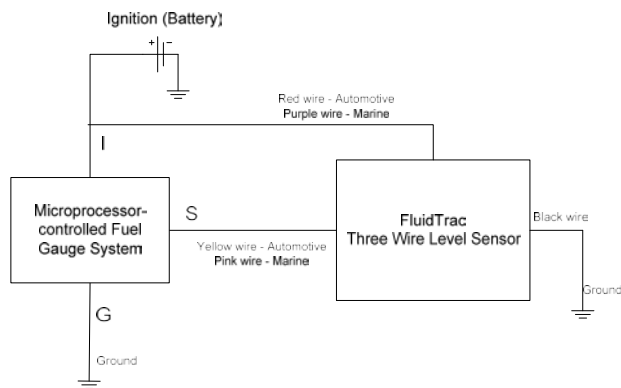


Figure 1. Fluid-Trac® 3-wire level sensor interface to Microprocessor-Controlled Fuel Gauge

The Fluid-Trac® 3-wire level sensor has an internal feedback system to allow for non-ratiometric voltage outputs. It can be factory programmed to work with non-regulated input voltage microprocessor control modules.

The Fluid-Trac® 3-wire level sensor can also be programmed for error detection of tank volumetric levels for use by digital instrumentation, control modules, PLC controllers, or DAQ systems. The 0.5 Vdc to 4.5 Vdc voltage range would be factory programmed for “in range” values instead of as “full” or “empty” indicators. An error would be indicated anytime the voltage output was outside of range.

### Mounting

The Fluid-Trac® 3-wire level sensor can mount in a variety of ways. Common mounting styles use 1 3/16<sup>th</sup> machine threaded or the standard SAE 1810 5-bolt pattern. When mounting the Fluid-Trac®, it is important to place the Fluid-Trac® level sensor’s face in the center of the tank perpendicular to the liquid level and with no obstructions in the beam path to the liquid.

In low clearance applications, the Fluid-Trac® 3-wire level sensor bolts in and bolts out quickly. There are no extended swing arms or tubes to bend or cut as with the resistive float or reed switch senders.

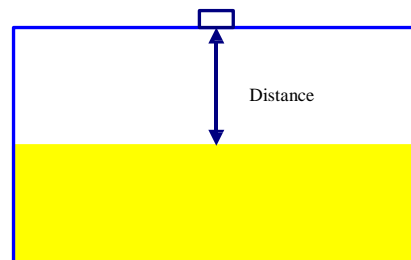


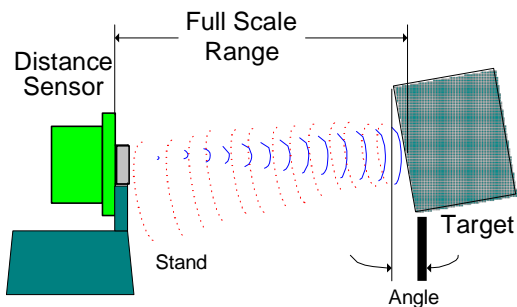
Figure 2. Fluid-Trac® Tank Mounting

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### Operating Angle

Fluid-Trac® level sensor mounting that is not perpendicular to the fluid causes a reduction in sensor performance. As shown in Figure 3, the amount of returned sound energy is dependent on target angle.



**Figure 3. Mounting Considerations.**

The Fluid-Trac® 3-wire level sensor maximum operating range (tank depth) decreases with angle. The maximum operating angle is 6 ° but can be increased to 15° with an optional focus tube.

If the Fluid-Trac® liquid level sensor is pointed into free space (outside of the maximum operating angle) no echoes will be received. Under this no echo condition the sensor will hold its last valid output voltage until valid echoes are received.

### Response Time

Fluid-Trac® 3-wire level sensor has a factory programmed digital filter to reduce error caused by sloshing fluids.

Motion of the liquid media can impact the performance of a level sensor. Wave motion creates noise in the measured data because the level sensor measures one distance at the wave peak and another distance during the wave troughs.

In certain highway and marine applications, this difference can be as high as 30% of full scale especially when traveling on curvy roads or in choppy waters. For fuel level applications, the liquid level changes at a much slower rate (fuel consumption) than 1 inch per second. A four minute filter may be factory programmed for this high slosh condition.

Note: When filling a tank with a Fluid-Trac® 3-wire level sensor containing a digital filter, the level sensor will not indicate an instantaneous level change. The output voltage will be updated at the response time corresponding to the programmed digital filter.

SSI engineering works with customers to assure the correct digital filtering is applied for their specific application needs.

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#### Electrical Specifications

Supply Voltage	9-30 VDC
Voltage Output	Ratiometric OR Non-Ratiometric (0.5 to 4.5 Vdc)
Range	2 inches to 32 inches
Range (Gasoline*)	2 inches to 24 inches
Distance Resolution	0.07 inches
Distance Tolerance	+/- 2.5% of span
Operating Temp Range	-40 to 85 ° C
Storage Temp Range	-50 to 100 ° C
Output Sink Current	20mA max (12 V) 25mA max (24 V)

**\*Note:** Gasoline range is different due to the density of gasoline vapors. Gasoline vapors are denser as the temperature increases which results in the speed of sound being slower.

#### Tested Conditions

Input Supply Transients	Reverse Battery -48 Volts Over Voltage 60 Volts
Transients	Load Dump 120 Volts ESD 15 KV
EMI	100 V/m
Mechanical Shock	18 G Shock
Drop Test	4 Ft. Drop Test
Vibration	4 Grms 8 hrs each axis
Humidity	85% humidity @ 85 ° C for 1000 hrs
Chemical Compatibility	Gasoline, Diesel Fuel, Motor Oil, urea (ADBLUE), Water, Potable Water, Ethanol, Hydraulic Fluid, Engine Coolant.

**Note:** Fluid-Trac® is American Boat and Yacht Council (ABYC) Certified.

#### Other Specifications

SAE 5 Bolt Torque	10-15 in/lbs
1 3/16 <sup>th</sup> Threaded Torque	3-5 ft/lbs

Packard Electric Part	FluidTrac P/N	Mating P/N
Connector Assembly	12129615	12110293
Terminal	12045773	12048074
Seal	12048086	12048086
Terminal Position Assurance (clip)	12052845	12052845

**Note:** The Fluid-Trac® 3-wire level sensor comes with an integral gasket that must be used when mounting. Mating connector parts and bolts are not included. A mating connector kit P/N 24564.3 is available.

