

# SSI Technologies - Application Note AT-AN12

## Acu-Trac® Smart 485 Liquid Level Transducers

### Family Overview

#### Product Description

The Acu-Trac® Smart 485 family ultrasonic liquid level transducers are designed for continuous level monitoring and liquid level control applications. These non-contact continuous level transducers can monitor tanks or storage containers that have a depth of up to 1.9 meters (75.69 inches) for gasoline and 2.5 meters (98.4 inches) for other media.

The Acu-Trac® Smart 485 ultrasonic transducers incorporate a RS-485 bus for real time processing of liquid levels in two messaging formats.

The Smart 485 liquid level transducers offers three electrical outputs for level control in the following forms:

- 4-20 mA Current (12V or 24V input)
- Ratiometric Voltage 0.5 to 9.0 Volt (12V input)
- Non-Ratiometric 0.5 to 9.5 Volt (24 Volt input).

The Smart 485 liquid level transducer is designed with power up self diagnostics and allows the user flexibility through programmable features:

- Tank Configuration Profiling
- Digital Filtering
- Gauge Drive Output (full and empty endpoints)
- Communication Mode.

Note: An Acu-Trac® Smart 485 Configuration Kit is required to program the liquid level transducer.

#### Product Features

- **Accuracy:** 2 % full scale of tank volume
- **Reliability:** Acu-Trac® Smart 485 liquid level transducers are non-contacting. Resistive float senders have a wiper that slides across a resistive strip that with time can wear out and cause intermittent or complete loss of the signal.



- **Non-Invasive:** Acu-Trac® Smart 485 mounts to the same opening as the resistive float sender, but does not protrude into the tank.
- **Digital Filtering:** User programmable time constant in digital filtering eliminates errors due to fluids sloshing in mobile tanks.
- **Tank Profiling:** User programmable strapping tables for unique tank shapes.
- **Chemical compatibility:** Acu-Trac® Smart 485 works with a wide variety of media including diesel, gasoline, motor oil, hydraulic fluid, black water, and more.
- **Self Test/Diagnostics:** Internal Power Up Test verifies transducer is operating properly.
- **Continuous Real Time Liquid Level Monitoring:** Electrical output and RS-485 messaging data.
- **RS-485 Messaging:** Two types of messages – programming commands and timed data broadcast messages. (See AT-AN14 for more details)
- **NEMA 4 Rating**

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Page 1

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#### Measurement Technology

Acu-Trac® Smart 485 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 transducer to the fuel is calculated based on the speed of sound. The measured distance is converted into either a voltage or current output.

The electrical output can be used to drive an analog fuel gauge vehicle communication systems, based on a programmed table contained in the level transducer.

The measured distance is converted into a percentage of tank capacity (Full to Empty), and volumes in gallons based on the geometry of the tank. This capacity is sent out digitally.

The Acu-Trac® Smart 485 uses a J1708 data link for communication to either vehicle communication systems or liquid level control systems. RS-485 messaging includes programming commands and timed data broadcast messages. (See AT-AN 14 for more details)

#### Electrical Interface

The Acu-Trac® Smart 485 liquid level transducer is available for use with either a 12V or 24V operating input voltage.

Three electrical outputs for level control are available:

- 4-20 mA Current (12V or 24V input)
- Ratiometric 0.5 to 9.0 Volt (12V input)
- Non-Ratiometric 0.5 to 9.5 Volt (24 Volt input).

A 9600 Baud RS-485 serial data interface is provided for transmission of liquid level data on the RS-485 bus.

#### Electrical Connection Options

##### Electrical Connection Options Include:

- Integral Packard Electric connector which mates with Packard part number 12148045 and Packard Terminal 12048074.
- 2.5 meter cable with pig tail connections
- MIL STD connector MIL-C-26482 Series 1 Type (PT06E-10-6P).

##### Electrical Connections:

- Electrical Ground
- Supply Power
- (B) RS485 Serial Data
- Analog Output
- (A) RS485 Serial Data

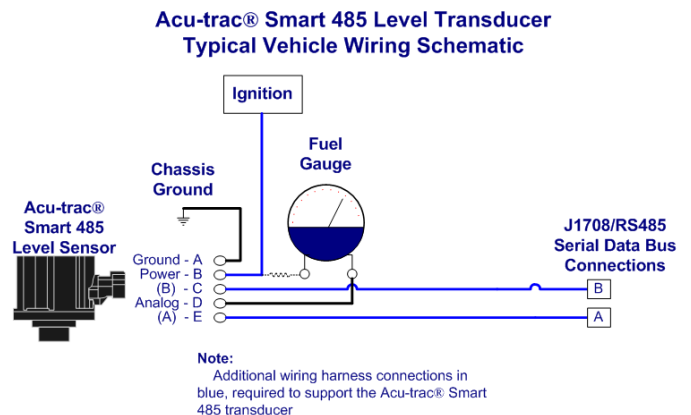


Figure 1, Typical Acu-Trac® Smart 485 Wiring



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#### Mounting

SAE 1810 - 5 hole bolt pattern is the standard mounting. (Refer to the photo on page 1)

When mounting, it is important to place the liquid level transducer in the center of the tank parallel to the liquid level and with no obstructions in the beam path to the liquid inside the tank.

SSI offers an adapter for 6 hole mounts that mate to the SAE J1810 Adapter.

Note: SSI can provide other mounting options (i.e. NPT mountings) for large volume OEM orders.

#### Cone Angle

Acu-Trac® Smart 485 liquid level transducer mounting that is not perpendicular to the liquid causes a reduction in transducer performance. As shown in Figure 2, the amount of returned sound energy is dependent on mounting cone angle.

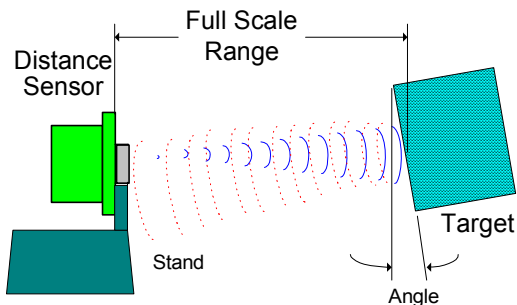


Figure 2. Mounting Considerations.

The Acu-Trac® Smart 485 liquid level transducer's maximum operating range (tank depth) decreases with angle. The maximum cone angle is 6°.

If the Acu-Trac® Smart 485 liquid level transducer, is pointed into free space (outside of operating cone angle), no echo will be received. Under this no echo condition, the Acu-Trac® Smart 485 level transducer

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Page 3

will set both the electrical output and the digital word to empty.

#### Deadband

A deadband is an area of a signal range where the ultrasonic sensor cannot detect an object (the system is dead). The deadband defines the minimum distance for target detection.

The Acu-Trac® Smart 485 has a 4 inch deadband for the 1 meter part and an 8 inch deadband for the 2.5 meter part.

#### User Programmable Parameters

The Acu-Trac® Smart 485 liquid level transducer can be uniquely configured using a standard Windows™ based PC and the Acu-Trac® Smart USB to J1708 converter, Acu-Trac® Smart 485 Configuration Tools Software and instructions. The configuration tools software allows each system to be customized to accommodate any tank size or shape up to 2.5 meters in depth.

#### Digital Filtering Time Constant

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

The Acu-Trac® Smart 485 liquid level transducer has a user programmable digital filter to reduce error caused by sloshing liquids.

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# SSI Technologies - Application Note AT-AN12

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#### Tank Configuration

The tank's capacity, depth, shape and orientation can be programmed into the level transducer enabling volumetric liquid level quantity or depth.

#### Gauge Full and Empty Endpoints

The gauge drive outputs full and empty endpoints can be independently programmed. The user has the option of programming either a linear output mode or a table output mode.

In the linear output mode, the transducer automatically proportions the output to a linear straight line fit based on the transducer distance to the full and empty levels. The distances are referenced from the face of the part as shown in Figure 2.

In the table output mode, the user sets up a look up table in the transducer. This mode of operation is typically used to set up a non-linear gauge or tank. The user would enter the distance and output settings for empty,  $\frac{1}{4}$ ,  $\frac{1}{2}$ ,  $\frac{3}{4}$ , and full in the Acu-Trac® Smart 485 Level Transducer Configuration Software to create the tank profile. The distances are referenced from the face of the part as shown in Figure 2.

#### Real Time Data Transmission

The Acu-Trac® Smart 485 liquid level transducer operates in a RS-485 Burst Communication Mode to other modules on the data link. Message id (MID) 143 is used.

The liquid level transducer is continuously monitoring the liquid level of the tank. In addition to the electrical output a digital value is broadcasted over the RS-485 bus.

The standard RS-485 serial data bus enables the transducer to communicate and share data in real time with the other modules on the bus with Message Transmitter Identifications (MID)  $\geq 128$ .

The liquid level transducer has two types of messages:

- 1) Setup and Programming Commands
- 2) Timed Broadcast Data Message

The Setup and Programming Commands are used to program the liquid level transducer for the tank's particular size, shape and installation.

The Timed Broadcast Data Message transmits measurement data from the liquid level transducer to the other modules on the RS-485 bus two times a second. Refer to the Acu-Trac® Smart 485 Application Note (AT-AN14) on our website for a detailed description of the RS-485 burst communication mode and messages.



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#### Electrical Specifications

Supply Voltage	12V (10-16 V) 24V (11-34V)
Output Options	Ratiometric Voltage (12V Input) (0.5 to 9.5 Vdc)  Non-Ratiometric Voltage (24V)  Current (4-20 mA)
Range (Gasoline)	1.9 Meter (75.7 inches)
Range (Other Media)	2.5 Meter (98.4 inches)
Dead-band (near field detectable distance)	8 inches for the 2.5M part 4 inches for the 1.0M part
Accuracy	2 % of volume
Resolution	0.04 V for voltage part 0.09 mA for current part
Operating Temp Range	-40 to 85 ° C
Storage Temp Range	-50 to 105 ° C
Output Sink Current	50 mA max

#### Other Specifications

SAE 5 Bolt Torque	10-15 in/lbs
Cone Angle	+/- 6 degrees

#### Tested Conditions

Input Supply Transients	Reverse Battery -2x Volts Over Voltage 2x Volts
Transients	ESD 15 KV
EMI (ISO 13766 test specification)	Conducted Transients Radiated Immunity Radiated Emissions
Mechanical Shock	20 G Shock (each axis)
Vibration	6 Grms 12 hrs each axis
Humidity	95% 240 hrs
Thermal Cycle	25 cycles (-40 to 85°C)
Salt Fog	96 hours
Thermal Shock	36 cycles (-40 to 85°C)
Chemical Compatibility	Gasoline, Diesel Fuel, Motor Oil, urea (ADBLUE), Water, Potable Water, Ethanol, Hydraulic Fluid, Engine Coolant.

**Note:** Acu-Trac® Smart 485 is NEMA4 (National Electrical Manufacturers Association Accreditation) Certified.

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Page 5

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