Acu-Trac™ Level Sensor Configuration Kit with RS-232 Adapter User's Guide

SSI Technologies – Application Note AT-AN11
Acu-Trac™ Level Sensor Configuration Kit with RS-232 Adapter
User's Guide

Acu-Trac™ Technical Assistance

We can be reached online, via email, or by telephone and will be happy to assist you with any question you may have installing or using this product.

Online

If you're looking for more information, technical data, application notes, or would like to see how the product is applied please view our website at:

http://ssitechnologies.com

On our website you'll find a comprehensive technical library containing, product data sheets and application notes covering all of our Acu-Trac™ products.

Email

If your question is technical in nature, and you can afford to wait for one business day, then we recommend emailing our technical service engineers. They can be reached via email at:

Acu_service@ssitech.com

Please include your phone number, availability and a detailed description of your question and we'll get back to you with in one business day.

Direct

If your need immediate assistance please call us direct. Our service engineers can be reached Monday through Friday from 8:00 AM to 5:00 PM CST.

(608) 758-1500

Ask For

Acu-Trac™ Technical Assistance

The Information in this document is supplied for the express purpose of installing and using the Acu-Trac™ Sensor. SSI is not an expert in your technical field and therefore does not warrant the suitability of this product, software or information for your intended application. SSI accepts no responsibility for misuse, misapplication or unauthorized modification of its products. SSI's obligation is limited to the Acu-Trac® sensor per the following terms and conditions:

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1 Introduction

Thank you for purchasing a SSI Acu-Trac™ Level Sensor Configuration Kit. The system provides the user the following flexibility:

- The ability to re-configure the Acu-Trac™ Level Sensor to support virtually any tank/barrel size or shape.

- The ability to easily set up the Acu-Trac™ Level Sensor's analog output to drive any gauge.

- The ability to setup the communications mode and response time parameter.

SSI's Acu-Trac™ technology automatically optimizes the level sensor's operating parameters for level, motion, and ambient temperature, which improves performance, while delivering accurate level measurements day in and day out.
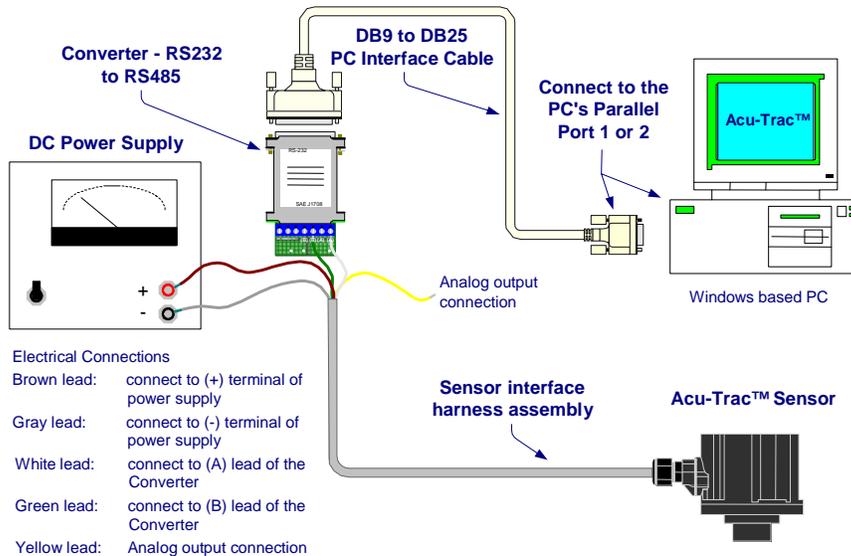
Converter - RS232 to RS485

DB9 to DB25 PC Interface Cable

Connect to the PC's Parallel Port 1 or 2

Acu-Trac™

DC Power Supply

Windows based PC

Analog output connection

Electrical Connections

Brown lead: connect to (+) terminal of power supply
Gray lead: connect to (-) terminal of power supply
White lead: connect to (A) lead of the Converter
Green lead: connect to (B) lead of the Converter
Yellow lead: Analog output connection

Sensor interface harness assembly

Acu-Trac™ Sensor

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2 Acu-Trac™ Level Sensor Configuration Kit Overview

The Acu-Trac™ Level Sensor Configuration Kit is designed to allow you to set up the Acu-Trac™ level sensor's tank configuration and gauge drive from the convenience of your desk using a conventional Windows based PC. The kit comes complete with hardware, software, and application information.

2.1 Hardware

The hardware items included in this kit are a RS485 to RS232 Converter and a Level Sensor Interface Harness.

2.2 Software

The kit contains an easy to use Acu-Trac™ Level Sensor Configuration software package that can be simply installed off of the Acu-Trac™ Level Sensor Configuration Software CD ROM supplied with your kit. The software provides you with the ability to reconfigure the sensor for different barrel/tank sizes, and reconfigure the sensor for different gauge interfaces. The software application tools contained within this kit are as follows:

Acu-Trac™ Level Sensor Configuration Install Program:

Provides a standard Windows® install shield used to install the software, and setup the PC's serial ports.

Acu-Trac™ Level Sensor Configuration Software:

The main application allows the user to:

- *Read* the sensor's current configuration.
- Change the settings for the tanks size and shape, communications mode, and response time.
- *Write* the changes back to the sensor.

Learn Gauge: This window allows you to change the sensor's analog output to correctly drive the fuel gauge.

Setup: This window allows you to change the RS232 serial port selection.

Monitor: This window allows you to monitor the outputs of the level sensor.

2.3 Documentation

Acu-Trac™ technical documents are available on our website www.ssitechnologies.com

3 System **Requirements**

The Acu-Trac™ Level Sensor Configuration software requires that you have a minimum system, which meets or exceeds the following:

    Pentium® Processor-based personal computer or Laptop
    Windows® NT or Windows® 95 and above operating system
    CD-ROM Drive
    64 MB of RAM memory

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4 Acu-Trac™ Level Sensor Configuration Kit Contents & Description

The Acu-Trac™ Level Sensor Configuration Kit contains the following components:

- RS485 to RS232 Adapter
- Acu-Trac™ Level Sensor Configuration CD ROM
- DB9 to DB25 PC Interface Cable
- Documentation

4.1 Acu-Trac™ Ultrasonic Level Sensor (Sold Separately)

The Acu-Trac™ sensor is the heart of the level measurement system. The sensor calculates the distance to the target by generating a sound wave and then measuring the time necessary for the sound wave to travel from the sensor to the target and then back to the sensor again. The time of flight of the sound wave, or echo, provides the basis for the distance measurement. The speed of sound is constant; therefore, the distance is directly proportional to the measured time.

The Acu-Trac™ Ultrasonic Level Sensor used with this kit provides a RS485 digital communications output in addition to a re-configurable current or voltage output.

Acu-trac™ Sensor

Echo

Sound Wave
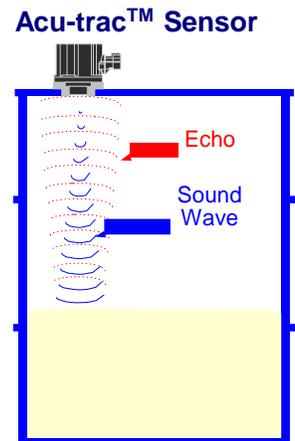
4.2 RS485 to RS232 Adapter

The RS485 to RS232 Adapter converts the RS485 sensor broadcasts into a conventional RS232 signal readable through your computer's serial I/O port.

4.3 Acu-Trac™ Level Sensor Configuration CD-ROM

The Acu-Trac™ Level Sensor Configuration CD provides the software tools which will enable you to reconfigure the sensor for different tank sizes and gauges.

The Software Installation Guide in section 7 provides a step by step tutorial to guide you through the installation process.

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4.4 DB9 to DB25 PC Interface Cable

Provides the RS232 serial data connection between your PC and the RS485 to RS232 Adapter.
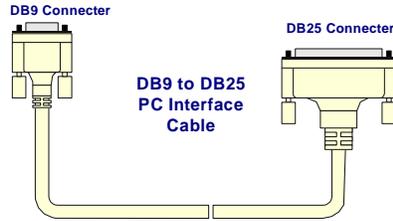
4.5 Documentation

The following documents are available on line at our website, www.ssitechnologies.com

- Acu-Trac™ Level Sensor Product Application Notes

- Acu-Trac™ Level Sensor Configuration Kit User's Guide – This manual.

5 Mounting the Sensor to the Tank
5.1 Mounting the Sensor to the Tank using the SAE bolt pattern

Position the level sensor gasket over the Acu-Trac™ level sensor assuring the proper screw hole alignment.
Note: On a cylindrical tank the gasket is thinner in the middle than on the ends. Gasket alignment can be assured by holding the level sensor and gasket up to the light and rotate the gasket until light can be seen through all of the holes.

Insert the Acu-Trac® level sensor into the tank with the metal can facing down. Align the screw holes to the existing holes in the tank. Attach the level sensor to the tank using five screws.

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5.2 Mounting the Sensor to the Tank using the 1" or ¾" NPT Thread.

The Acu-Trac™ level sensor can also be mounted using the optional 1" (NEMA6 sensor) or ¾" (NEMA4 sensor) NPT Thread. First adapt the opening in the tank to a 1" or ¾" NPT thread using an adapter. Next, thread the level sensor into the adapter hand tight.

Warning - Do not over tighten the sensor. Over tightening the sensor can cause permanent irreversible damage to the housing.

5.3 Checking the installation

The Acu-Trac™ level sensor uses sound wave reflections to measure the level of the tank. For proper operation, the sensor must be mounted perpendicular to the target with a clear line of sight to the target.

To assure proper operation, verify the tank is not tilted by using a level. Check to see that the level sensor is level with respect to the tank. The suggested angle of tilt should be less than 5 degrees. If the sensor is more than 5 degrees off of level, the tank must be rotated to assure proper performance from the level sensor.

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6 Electrical Connections

The electrical interface connection to the Acu-Trac™ level sensor is illustrated below.   Figure 1 is for Acu-Trac™ with integral harness and Figure 2 is for Acu-Trac™ with Packard connector and Harness P/N 2436.3 (supplied in the configuration kit).

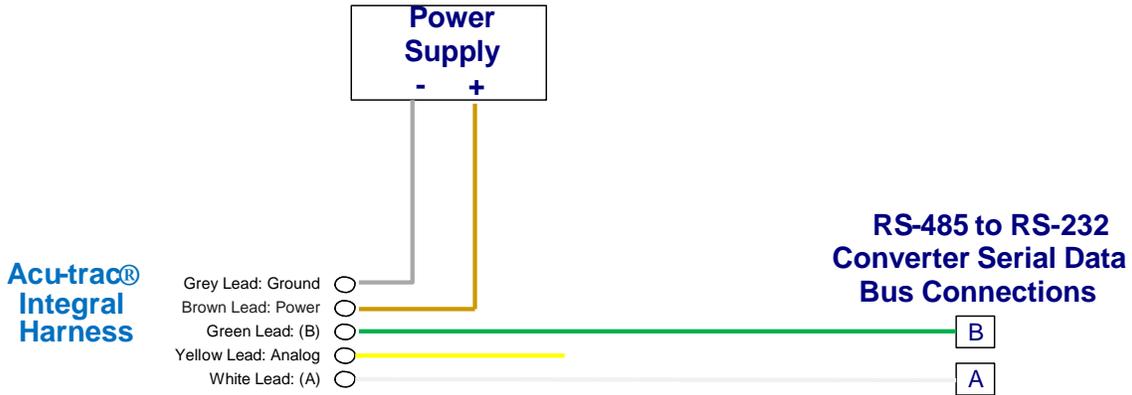**Figure 1 Acu-Trac™ with integral harness**
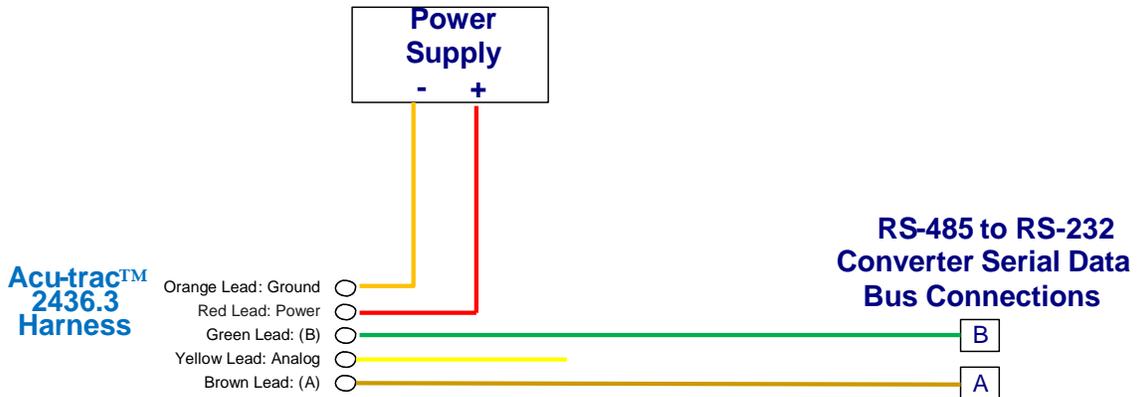
Figure 2 Acu-Trac™ with Packard connector

6.1 Ground

The ground lead must be connected to ground (battery negative) for the level sensor to function. The level sensor's internal electronics are ground isolated from the tank to prevent ground loops.   All sinked current will be returned through this connection.

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6.2 Supply Voltage

The power lead must be connected to DC Power (Battery Positive) for the level sensor to function. The power source to the level sensor should contain a fuse with minimum amperage rating of 1 Amp and maximum amperage rating of 5 Amps. The level sensor will function when the supply voltage is between 11 and 16 Volts for the 12 Volt sensor and between 11 and 34 Volts for the 24 Volt sensor. This connection is protected from over voltage, load dumps, and other electrical transients.

6.3 Analog Output Connection

The Yellow lead is the analog output. Two different analog outputs are available depending on which level sensor was purchased. The voltage output part is primarily used to drive a gauge. The current output part is primarily used to interface with industrial equipment.

6.4 Data Link Positive (A) Connection

Connect the Data Link Positive (A) wire to the data link positive (A) connection on the RS-485 to RS-232 adapter (A) position.

6.5 Data Link Negative (B) Connection

Connect the data link negative (B) wire to the data link negative (B) connection on the RS-485 to RS-232 adapter (B) position.

6.6 Data Link Adapter to PC Connection

Prior to using the Level Sensor Configuration software, connect the DB25 Connector to the adapter and the DB9 Connector to your PC.
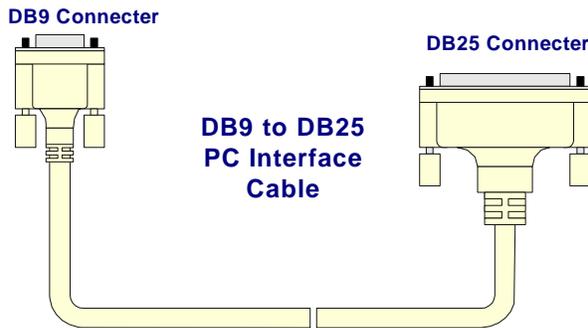
DB9 Connecter

DB25 Connecter

DB9 to DB25 PC Interface Cable

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7 Installing the Acu-Trac™ Level Sensor Configuration Software

To Install the **Level Sensor Configuration Software,** insert the Acu-Trac™ Level Sensor Configuration CD into your CD ROM drive. Double click on the CD ROM drive icon located in **MY Computer;** the setup *Welcome* window will immediately appear with the following display:
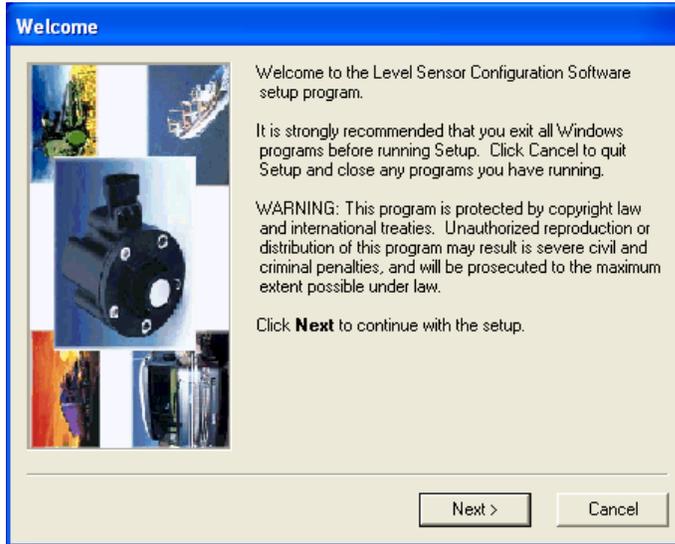
We recommend that you close all Windows® applications before proceeding with the setup. To begin the installation process click *next* which will bring up the **Software License Agreement** window.

7.1 License Agreement

This program is protected by copyright law and international treaties. The unauthorized reproduction and distribution of this program may result in sever civil and criminal penalties and will be prosecuted to the maximum extent possible under law. Please read the licensing agreement carefully. Click *Accept* to continue the installation.

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7.2 COM Port Selection

This window sets up the communications between your PC and the Acu-Trac™ sensor. Determine the correct COM port by looking on the back of your computer at the DB9 connector location that you used to plug in the PC Interface Cable during hardware setup. Next to, or above, the connector you will find a serial port designation that defines the communications port. It will either be COM 1 or COM2. Click on the correct **COM** port selection in the setup screen to retain your entry. Click *next* to continue the installation.
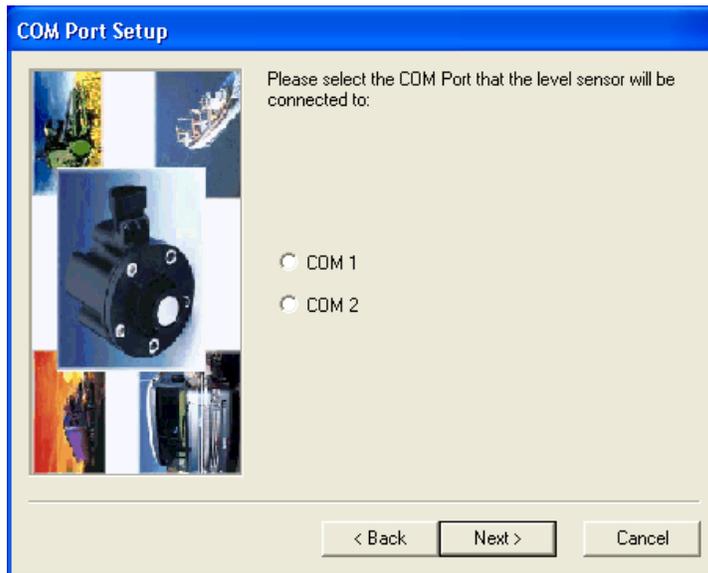
Note:
The COM port selection can be changed after installation by clicking on the Setup button from the Acu-Trac™ Level Sensor Configuration Software window. See section 9.2 for additional details.

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7.3 Directory Location

The installation software provides a directory and folder recommendation for installing the Level Sensor Configuration software based on your system. If acceptable, click on **Next** to continue.

Note: If you wish to change the location that the software is installed you may do so by clicking on the Browse button.
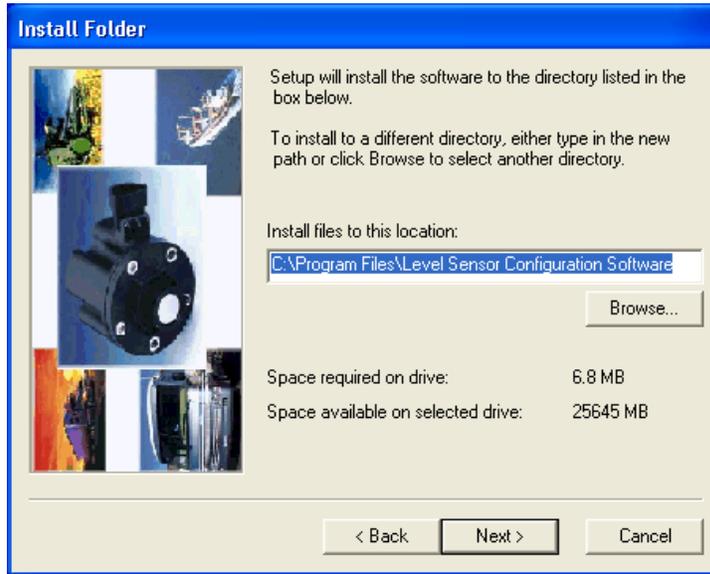
7.4 Short Cut Folder Name

The installation software allows you to select your own name for the Application's short cut folder. Key in the application name that you would like to appear in your PC's Programs listing and press **Next** to continue.
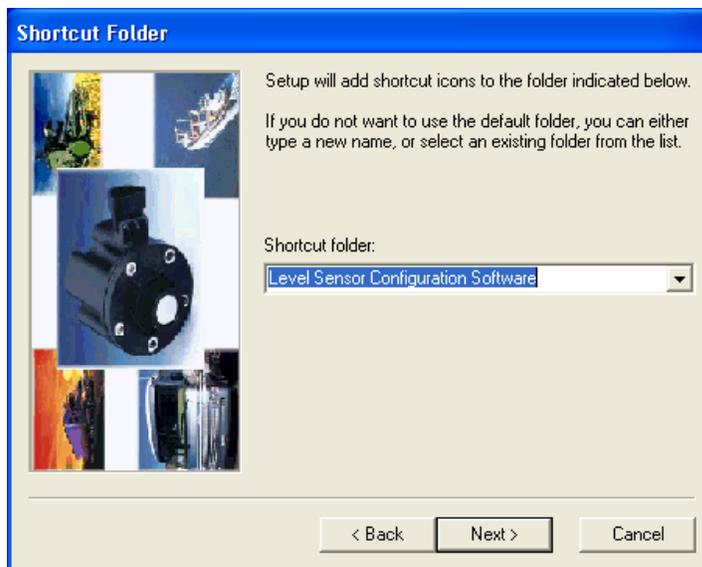
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7.5 Load On Hard Drive

At this point the installation software has enough information to install the Level Sensor Configuration software onto your hard drive. Click on *Install* to automatically load the Level Sensor Configuration software onto your system and create an icon in your start menu.
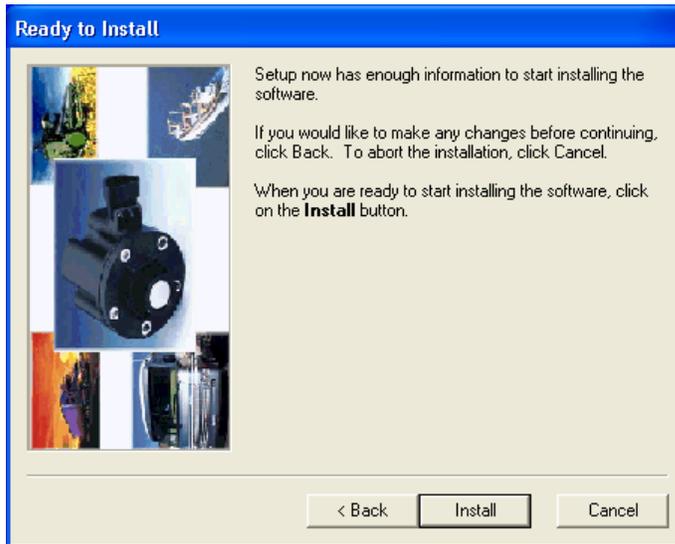
7.6 Complete the Installation

The installation software will display the message *Updating Your System* while the installation proceeds. Upon completion the finished window will appear indicating that the installation has been completed.

Remove the Acu-Trac™ Level Sensor Configuration CD ROM from your CD ROM drive and click on *Finish* button when ready.
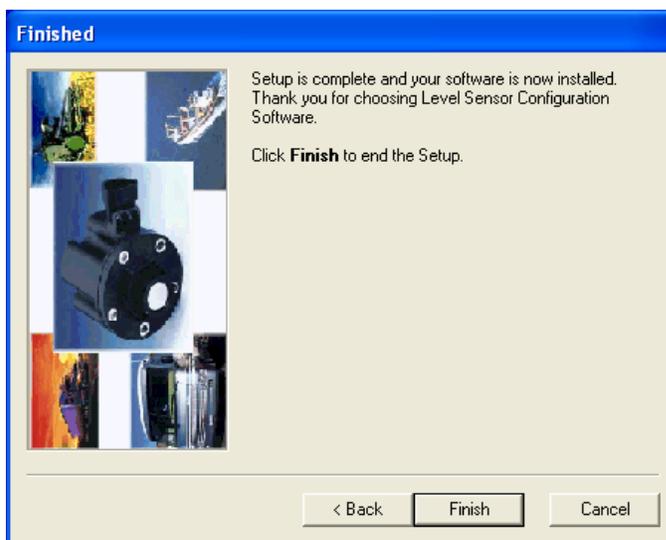
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7.7 Restart Selection

Depending on your PC's operating system, the installation may require you to restart your system to save the installed settings. You have the option to restart your system through the installation window by clicking on the *Ok* button or to restart your system manually using your *Shut Down* button at a later time.

Click on the *Ok* button to bring up the restart window. Click *Ok* to restart your system. The installation is now complete. The software will automatically shut down and restart your computer.

> **Note:**
> *The Level Sensor Configuration software is installed onto your hard drive under the shortcut Name which was entered during this installation.*

8 Starting the Acu-Trac™ Level Sensor Configuration Software

If you haven't already installed the Acu-Trac™ Level Sensor Configuration software, you'll need to do so before you can bring up the application. For installation instructions reference section 7.

To Start the Acu-Trac™ Level Sensor Configuration software on the Windows® Taskbar, click the **Start** button, point to **Programs**, point to the shortcut name you entered during installation and click on the **Level Sensor Configuration Software.exe** The Acu-Trac™ Level Sensor Configuration Software window will automatically open up providing the following display:
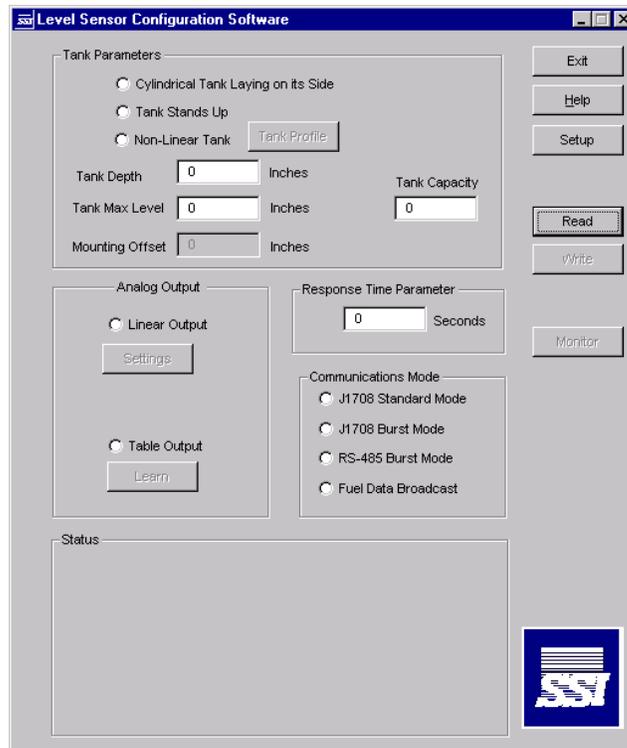
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The Level Sensor Configuration Software allows you to change the tank's size, depth and to compensate for offset mounting conditions. The picture below illustrates a typical tank application.
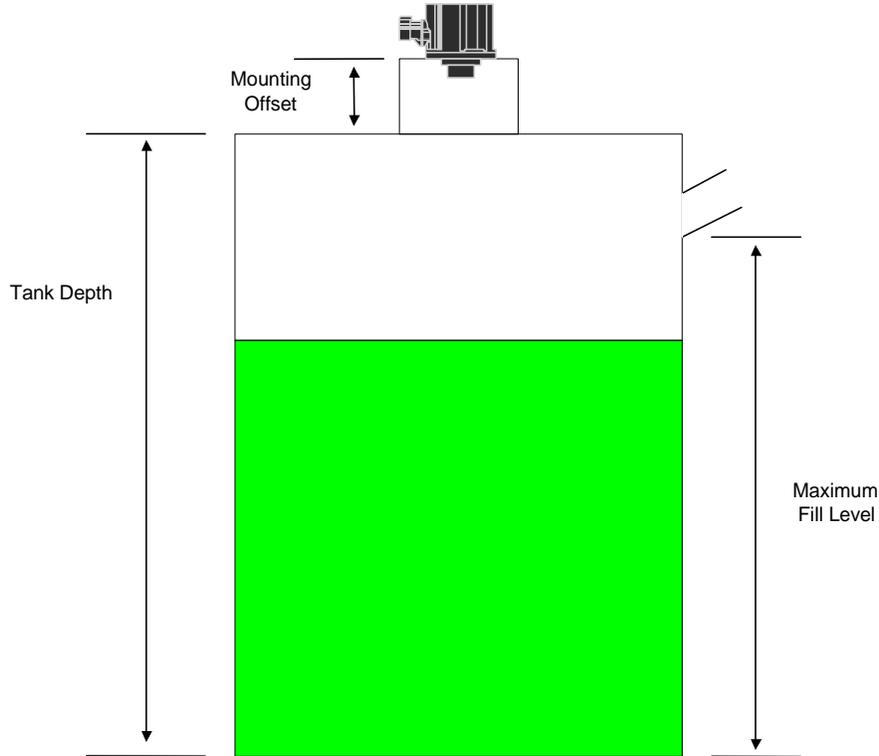
9 Acu-Trac™ Level Sensor Configuration Software Features & Description
9.1 Main Window Selection

Cylindrical Tank Lying on its side:	For cylindrical tanks lying on their sides. The volume is not proportional to distance.
Tank Stands Up:	For Cylindrical or Rectangular tanks standing up. The volume of the tank is linear with respect to the distance from the top of the tank.
Non-Linear Tank	The volume versus the distance relationship can also be specified in table form. Select "Non-Linear Tank" and click the "Tank Profile" button. Enter the volume for the tank in 5% increments and press "Okay"

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Tank Depth: The distance from the mounting surface of the Level Sensor to the bottom of the tank in inches. For a Cylindrical tank lying on its side, use the tank diameter in inches. The Level Sensor will indicate 0% at this distance.

Tank Max Level: The distance in inches from the bottom of the tank to the top of the tank or from the bottom of the tank to the fill/drain nozzle. The Level Sensor will indicate 100% at this distance.

Mounting Offset: The distance in inches from the mounting face of the level sensor to the top of the tank. Calculation of Percentage of capacity excludes this distance.

Tank Capacity: The total tank volume in gallons. Tank capacity can be set from 1 to 8191 gallons.

Response Time Parameter: Programs the period of time over which the level sensor averages the level readings. Note: If set to 0 the level sensor will perform no filtering of the readings.

Analog Output Linear Output: The "Linear Output" Radio Button is typically used for programming the analog output for interfacing with test equipment. Reference the "Settings" button in section 9.2.

Analog Output Table Output: The "Table Output" Radio Button is typically used for programming the analog output for interfacing with an analog gauge. Reference the "Learn" button in section 9.2.

Communications J1708 Standard The "J1708 Standard Mode" should be used when the sensor is connected to a SAE-J1708 data link commonly used by diesel engine powered equipment. Reference SSI's AT-AN7 J1708 Mode Messaging Application Note on our website (www.ssitechnologies.com)

Communications J1708 Burst The "J1708 Burst Mode" is used to test the level sensor and should not be used in normal operation. (Level sensor uses MID 143).

Communications RS-485 Burst The "RS-485 Burst Mode" is commonly used to interface to other instrumentation. Reference SSI's AT-AN5 RS-485 Mode Messaging Application Note on our website (www.ssitechnologies.com) for protocol information.

Communications Fuel Data Broadcast The "Fuel Data Broadcast Mode" is used to test the level sensor and should not be used in normal operation (Level sensor uses MID 41).

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9.2 User Buttons

Exit	The **Exit** button is used to close the Acu-Trac™ Level Sensor Configuration window.
Help	The **Help** button brings up the User Manual.
Setup	The **Setup** button is used to change the COM port selection.
Read	The **Read** button is used to read the current configuration of the level sensor.
Tank Profile	The **Tank Profile** button brings up the "Tank Profile" dialog. The Tank Profile dialog is used to enter a look up table that relates distance to volume. The **Tank Profile** button is initially "grayed out" to make sure the part is read prior to making changes to the settings.
Learn	The **Learn** button brings up the "Learn Gauge dialog" described in section 9.6. The Learn Gauge dialog is used to set the analog output to drive a custom gauge. The **Learn** button is initially "grayed out" to make sure the part is read prior to making changes to the settings.
Settings	The **Settings** button brings up the "Linear Settings" dialog. The Linear Settings dialog is commonly used to set the analog output to interface with test equipment. The **Settings** button is initially "grayed out" to make sure the part is read prior to making changes to the settings.
Monitor	The **Monitor** button brings up the "Level Sensor Monitor" dialog. The Level Sensor Monitor dialog can be used to monitor the Fuel Level Sensor outputs using your PC. Reference the Monitor section 9.3 for more information.
Write	The **Write** button is used to write the settings (including the learned analog output settings) to the level sensor. It is initially "grayed out" to make sure the part is read prior to making changes to the settings.
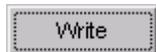
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9.3 System Setup Dialog

When the setup button is pressed the System Setup Dialog is displayed as follows:
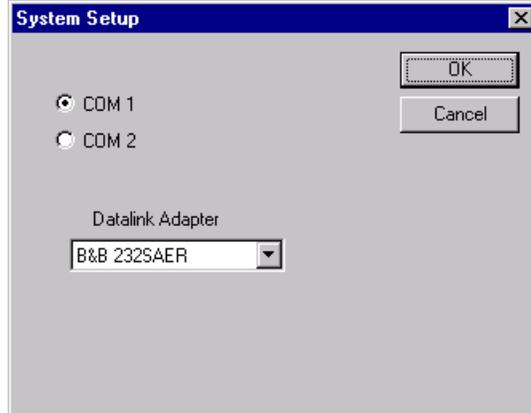
The system setup dialog provides the means to change the communications port on your PC or the RS-485 to RS-232 adapter being used. The default settings are for COM 1 and the SSI supplied B&B 232SAER adapter provided with this kit.

9.4 Level Sensor Monitor Dialog

When the *Monitor* button is pressed the Level Sensor Monitor Dialog is displayed as follows:
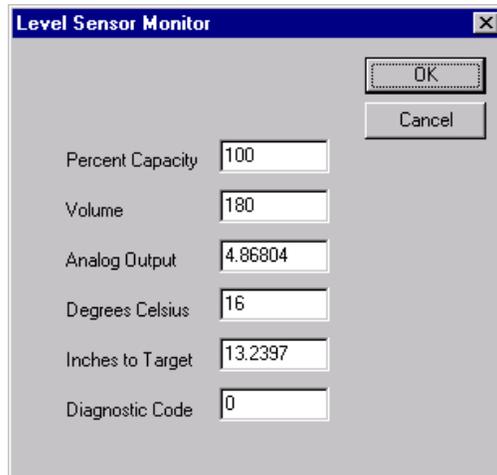
Percent Capacity: The percentage of the current tank volume of the full tank volume.

Volume: The current tank volume typically in gallons.

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Analog Output: The analog output setting for the sensor. This value is in Volts for a voltage output sensor or in milli-Amps for a current output sensor.

Degrees Celsius: The temperature at the front face of the sensor.

Inches to Target: The distance from the mounting face of the sensor to top of the liquid being measured.

Diagnostic Code: The level sensor contains built in tests to determine the health of the sensor.
A zero (0) indicates "No Faults".
A one (1) indicates "Active Fault".
A two (2) indicates "Inactive Fault".

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9.5 Tank Profile Dialog

The Tank Profile Dialog provides a method to enter a distance to volume "look-up" table into the level sensor. Commonly called a strapping table, the percent of volume versus the percent of distance is entered for each 5% change in distance.

The Tank Profile dialog is shown below for a Tank Depth of 23 inches and Tank Capacity of 180 gallons. The default values for this table were determined by dividing Tank Depth and Tank Capacity by 20. Modify the gallons setting using the edit boxes and click "OK" to save the results.

Non-Linear Tank Profile		
Tank Depth	Volume	
0.00 Inches	0	Gal
1.15 Inches	9	Gal
2.30 Inches	18	Gal
3.45 Inches	27	Gal
4.60 Inches	36	Gal
5.75 Inches	45	Gal
6.90 Inches	54	Gal
8.05 Inches	63	Gal
9.20 Inches	72	Gal
10.35 Inches	81	Gal
11.50 Inches	90	Gal
12.65 Inches	99	Gal
13.80 Inches	108	Gal
14.95 Inches	117	Gal
16.10 Inches	126	Gal
17.25 Inches	135	Gal
18.40 Inches	144	Gal
19.55 Inches	153	Gal
20.70 Inches	162	Gal
21.85 Inches	171	Gal
23.00 Inches	180	Gal

OK   Cancel

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9.6 Analog Output Linear Settings

Select the "Linear Output" Radio button and click on the "Settings" button to bring up the Analog Output Linear Settings Dialog. This dialog supports both voltage and current output sensors. Using this dialog, the user can set the voltage or current when the Percent of Capacity is 100% (i.e. Full) and 0% (i.e. Empty).

This dialog also provides a method to configure the sensor for "Guard Banding". If the user would like the analog output to indicate full when the level is above 95% of capacity, then 95 would be entered into the Guard Band High Edit Box. If the user would like the analog output to indicate empty below 5%, then the user would enter 5 into the Guard Band Low Edit Box.

Press the "OK" button to return to the main dialog and save the settings.
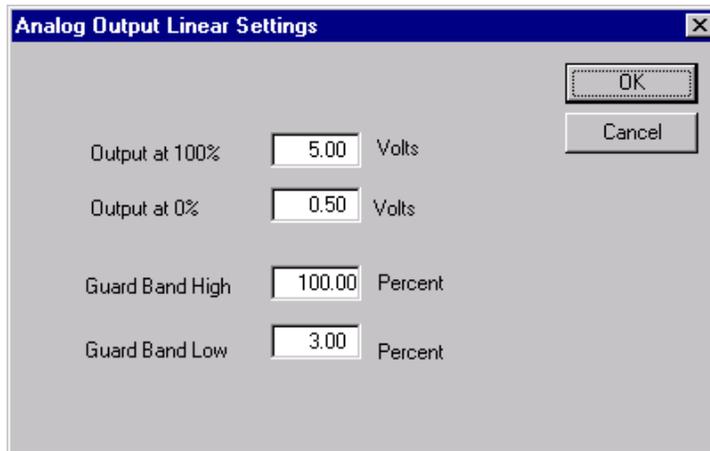
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9.7 Learn Gauge

Select the "Table Output" Radio button and click on the "Learn" button to bring up the Learn Gauge Dialog. The current analog output settings will be shown as below:
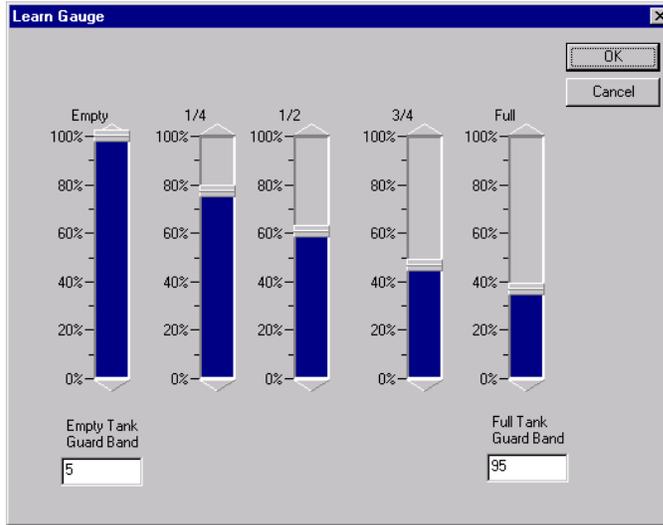
This dialog can be used to establish five different set points for the analog output corresponding to ¼ tank increments. This dialog is typically used with an installed gauge. Connect the yellow analog output wire from the sensor to the sensor input on the gauge (usually labeled with an "S"). Adjust the **Empty** slide bar until the gauge reads empty. Adjust the **1/4** slide bar until the gauge reads ¼. Repeat for ½, ¾, and full.

This dialog also provides a method to configure the sensor for "Guard Banding". If the user would like the analog output to indicate full when the level is above 95% of capacity, then 95 would be entered into the Full Tank Guard Band Edit Box. If the user would like the analog output to indicate empty below 5%, then the user would enter 5 into the Guard Band Low Edit Box.

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10 Error Messages

The Acu-Trac™ Level Sensor Configuration software provides the following error messages in response to the conditions noted below:

10.1 COM Port Connection Failure!!

The COM Port Connection Failure!! error message occurs when the Acu-Trac™ Level Sensor Configuration software is unable to communicate with the COM port. The software requires exclusive use of the COM port in order to communicate with the sensor. This error will occur if the COM port you selected is in use by another program. Typically Palm pilot software and some modem drivers automatically engage the COM port when your PC is turned on.

To correct click *Ok* on the error message and close out the Acu-Trac™ Level Sensor Configuration software. Locate and close out any Palm pilot, PDA, modem or any other applications that may be running that shares the COM port you selected at install. Reopen the Acu-Trac™ Level Sensor Configuration window and resume operation.

To avoid this occurrence in the future, close out any applications that share the COM port prior to pulling up the Acu-Trac™ Level Sensor Configuration software.

10.2 Send Parameter Data Failed!!

The Send Parameter Data Failed!! error message occurs when the Level Sensor Configuration software is unable to read or write the configuration parameters.

If this error message occurs, check to make sure that all the electrical connections are present and that the sensor that you wish to configure is powered up. Unplug all other sensors on the data link, bring up the Acu-Trac™ Level Sensor Software window and click on the *Read* button. Re-enter the variables and retry the configuration.

10.3 Failure reading Level Sensor. Check Connections!!!

The Failure reading Level Sensor Check Connections!!! error message occurs when the Level Sensor Configuration software is unable to communicate with the sensor.   Check the following:

- **No Electrical Power** - Check the DC power to the level sensor. DC power can be measured between pins A and B of the level sensor harness.

- **COM Port Selection entered incorrectly during installation-** Bring up the Acu-Trac™ Level Sensor configuration software window and click on the *Setup* button. From the Setup window click on the correct *COM* port selection and click *Ok.* (See section 7 titled Installing the Acu-Trac™ Level Sensor Configuration Software for further information regarding the sensor's identification label.)

- **Level Sensor Harness Damaged or Unplugged** – Check the level sensor harness and the connection from the RS485 to RS232 Adapter to the level sensor harness to make sure that the harness is not damaged. Check that it is plugged into the sensor.

- **RS232 Interface Cable Damaged or Unplugged** – Check the RS232 Interface Cable connections from the RS485 to RS232 Adapter to your PC.

- **Bad PC Communications Port** – Switch the RS232 Interface Cable connection to another COM port on your PC. Bring up the Acu-Trac™ Level Sensor Configuration Software and click on the *Setup* button. From the Setup Window click on the new *COM* port selection and click *Ok*.

- **Damaged or Bad Sensor** – Disconnect the sensor and replace.

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Appendix A: Acu-Trac™ Ultrasonic Sensor Family Analog Output Options

The Acu-Trac™ family of sensors offers a voltage, and current loop analog output option. Each option provides an analog output, which is proportional to the measured volume. The following is a brief description of the various output options.

❑ **Voltage Output**

The Voltage Output is a highly accurate voltage drive capable of sourcing 5 mA's of current. The output is pre set for 0.5 to 4.5 volt operation as delivered from the factory. The voltage output is also field configurable and can be programmed for operation between .5 to 9.5 volts.

The Voltage Output is ratio-metric with respect to the input supply voltage provided to the sensor. In effect the output will rise and fall proportional to fluctuations in the supply voltage. This feature allows the user to compensate and correct for supply variations as they occur which is useful when operating in a noisy environment.

❑ **Current Loop Output**

The Current Loop Output configuration is a highly accurate 4 to 20 mA instrumentation current loop. The Current Loop Output can drive resistive loads ranging from 100 to 410 ohms.

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Glossary

COM Port	Common PC term used to designate a RS232 serial interface port built into a personal computer.
DB9	D Series 9 pin subminiature electrical connector.
DB25	D Series 25 pin subminiature electrical connector.
Diagnostics	Term used to designate the testing of a products operational status.
Echo	Refers to the returned sound wave after it reflects off an object.
Percent of Capacity	Numeric value applied to level sensing applications wherein the level is reported as a percentage of the vessel's total capacity.
RS232	Common PC based serial interface protocol enabling communications between microcomputers.
RS485	TIA/EIA Standard defining the communications protocol for sending messages over a 2 wire bi-directional serial data interface. See TIA/EIA Standard TIA/EIA-485-A, "Electrical Characteristics of Generators and Receivers for Use in Balanced Digital Multipoint Systems."
Serial Number	Refers to the 8-digit identification number which is uniquely coded into every Acu-Trac® sensor.
Serial port	Same as COM Port