Echo Smart

Entech Design, Inc.

Operation & Installation

Manual

Version 1.16

Echo Smart Sensor

Echo Smart Controller

Echo Smart Power Supply

Entech Design, Inc.
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Safety Precautions

About this Manual: PLEASE READ THE ENTIRE MANUAL PRIOR TO INSTALLING OR USING THIS PRODUCT.

The following safety precautions should be observed in the implementation and use of this product.

The EchoSmart Controller (ESC), Power Supply (ESP), and Sensor (ESS) are intended for use by qualified personnel who recognize shock hazards and are familiar with the safety precautions required to avoid possible injury. Read the operating information carefully before using the product.

User's Responsibility for Safety: The types of product users are:

Responsible body: this is the individual or group responsible for the use and maintenance of equipment, and for ensuring that operators are adequately trained. Operators use the product for its intended function. They should not be allowed access to the electrical connections within the control box, and would normally only operate the external keypad and monitor the display.

Maintenance personnel perform routine procedures on the product to keep it operating, for example, checking the line voltage or checking electrical connections, replacing main fuses, etc. Only service personnel should perform other tasks.

There are no user serviceable parts on the main PCB section of the EchoSmart ESC or ESP. Service personnel are trained to work on live circuits, and perform safe installations and repairs of products. Only properly trained service personnel may perform installation and service procedures.

Wiring and Electrical: Users of this product must be protected from electric shock at all times. The responsible body must ensure that users are prevented access and/or insulated from every connection point. Product users must be trained to protect themselves from the risk of electric shock.

Before operating an instrument, make sure the line cable is connected to a properly grounded power receptacle. Inspect the connection cables for possible wear, cracks, or breaks before each use. When fuses are used in a product, replace with same type and rating for continued protection against fire hazard.

All EchoSmart system cables are to be installed in grounded metal conduit.

External chassis components can not be used as safety earth ground connections.

Standard fuses, with applicable national safety approvals, may be used if the rating and type are the same. If you are unsure about the applicability of a replacement component,

call Entech Design, Inc. for information. Only use the EchoSmart ESC or ESP with the sensor supplied. Replace Fuse with: 1.25A 5x20mm T-Lag UL approved.

This equipment is suitable for use with 110-240 Volts AC power at 50-60 Hz. No internal changes are required within this range.

A protective earth should be provided for all installations.

WARNING ⚠

If this equipment is used in a manner not specified by Entech Design, Inc., the protection provided may be impaired. The EchoSmart ESC, ESP, and ESS are regarded as permanently installed equipment and as such a switch or circuit breaker must be included in the installation. This should be in close proximity to the equipment, it should be marked as the disconnecting device, and it should disconnect both current carrying conductors.

WARNING ⚠

CHECK THAT THE POWER SUPPLY IS SUITABLE BEFORE SWITCHING POWER ON.

Proper Installation and Handling: The normal application for the EchoSmart ESC or ESP requires it to be installed at industrial installations including water and wastewater treatment plants. While the ESC and ESP enclosures are liquid-resistant (IP65), they are not designed to be immersed. These items should be mounted in such a way that the enclosure does not come into contact with the application media under normal operational conditions. The ESS (sensor) and its cabling are designed to be submerged without hazard to the equipment or to operators when correctly connected as described in this manual.

To clean the instrument, use a damp cloth or mild, water based cleaner. Clean the exterior of the instrument only. Do not apply cleaner to the inside of the instrument or allow liquids to enter or spill on the instrument.

Material Compatibility: The ESC and ESP enclosures are made of flame retardant Polycarbonate (PC/ABS FR). The ESS is made of Polyvinyl Chloride (PVC) and Polyurethane. Make sure that the model which you have selected is chemically compatible with the application media.

WARNING WHEN APPLICABLE ⚠

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator and your body. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

1. Product Description

EchoSmart™ is an exciting new development in liquid/solid interface level analyzers. Instruments employ a totally new system architecture that locates microprocessor signal control, enhancement and interpretation in the ultrasonic sensor rather than in a remote analyzer. The sensor is truly a Smart device. When connected to a power source and instrument programmer (typically EchoSmart Controller or EchoSmart Power Supply Unit), it produces the Level or Range measurement and provides digital and analog communication signals.

This equipment design opens the door for a wide range of flexible installation configuration options. The Controller is the operator graphical user interface device and power source to a sensor. It is also a communication hub for analog and digital communication outputs to the customer data acquisition system. EchoSmart can be implemented as a stand-alone instrument (Controller + Smart Sensor) or with numerous sensors networked together and operated by a single Controller.

1.1. Stand-Alone Instrument Option

When connected to an EchoSmart Controller, the instrument has all the functionality of a complete measurement system. The Controller provides power to the sensor and is the user interface for instrument programming and communication with the sensor. Customer terminations for digital and analog communications to the customer's data acquisition and control system are provided inside the Controller.

A large graphical LCD with control keypad provides a simple and intuitive platform to implement Sensor Parameters, configure communications, view current and historical measurements, and perform system diagnostics. HELP PROMPTS are automatically displayed for each parameter and system function.

1.2. Field Network Option

Up to 16 EchoSmart Sensors can be operated by a single Controller in a wired (two-wire RS-485) or wireless (ZigBee Compliant® RF Module) Field Network. In either arrangement, the network is fully integrated and requires no software integration by the customer. One Smart Sensor is typically connected to the Controller with the remaining sensors connected to EchoSmart Power Supply Units.

The Controller handles all programming and monitoring functions for all sensors in the network. Power Supply Units provide power to associated sensors and are fitted with integrated two-way transmitter modules when used in an RF network. Terminations for analog communication (4-20mA signal) are also at the Power Supply Unit.

Each Smart Sensor in the network operates independently and continuously. There is no delay in measurement updating with multiple sensors in the network.

1.3. Network Integrated to Customer Data Acquisition and Controls

An EchoSmart Field Network (See Section 1.2) can be integrated to a customer data acquisition and control system via two-wire RS-485, Modbus RTU protocol. Two options are available. See Section 8.4 for additional information.

1.3.1. EchoSmart Console Program

The Console Program is a Windows® compatible proprietary software program that can be used on PC or Laptop computers with RS-485 or RS-232 communication capabilities. The Console Program provides a platform for operating and monitoring all Smart Sensors in a network. Most functions of an EchoSmart Controller are available through this program. (Refer to the manual addendum for further details.)

1.3.2. Customer Data Acquisition and Control Integration

Individual integration to the customer control system is available over two-wire RS-485 using Modbus RTU protocol. Customer software integration is required.

2. Applications

EchoSmart is suitable for most municipal and industrial liquid/solid separation processes in which a reliable measurement of the level of a solids or suspended-solids blanket is desired. Typical applications include municipal and industrial wastewater and water treatment clarifiers and gravity thickeners. A broad range of industrial process applications are also appropriate. Self-cleaning sensors and special design sensors to accommodate high temperature and exposure to chemical environments are available.

2.1. Wastewater and Water Treatment Clarifiers and Thickeners

EchoSmart instruments are most frequently implemented to provide reliable sludge blanket level measurements in municipal wastewater and water treatment operations. Instruments are suitable for circular and rectangular basins, uncovered and covered tanks, and those with both fixed and traveling bridge arrangements. Mounting arrangements easily accommodate surface skimmers and rakes. Automatic signal control functions adapt to differences in sludge density that typically occur in primary, secondary and final clarifiers, and gravity thickeners.

2.2. Industrial Wastewater and Raw Water Treatment

EchoSmart is equally effective in providing sludge level measurements in a wide range of industrial water treatment applications. Raw water from a surface water source is often sent to a clarifier for particulate removal prior to introduction to plant processes. Water spent in plant processes often requires primary, and even secondary treatment prior to being directed to a municipal plant for further processing or being discharged in the environment. EchoSmart sludge level measurements can be used to effectively control clarifier solids blow-down, optimize chemical application, and limit solids discharge in the effluent stream.

2.3. Industrial Process Applications

Suitable process applications are found in the Power Generation, Mining and Mineral Processing, Chemical, Pulp and Paper and other process industries. Contact Entech Design, Inc. or an authorized representative for further information on the characteristics and requirements for successful implementation of EchoSmart equipment in these environments.

3. EchoSmart Sensor (ESS)

The EchoSmart Sensor is a microprocessor controlled piezoelectric transducer designed specifically for operation under water (submerged in the process liquid).

3.1. General Overview

The EchoSmart Sensor generates an ultrasonic sound wave that propagates through a liquid medium and is reflected back from material that is present in the vessel (Typically: settled solids, suspended solids, and/or the tank bottom). The sound wave travels at known velocities providing the ability to convert elapsed time into Range and Level measurements.

The EchoSmart Sensor does more than just produce a raw signal. It is equipped with an advanced programmable microprocessor and dynamic memory. Through these facilities, the sensor provides all signal control, enhancement and interpretation, and determines the final process measurement. The Smart Sensor communicates with an EchoSmart Controller via digital communication. The sensor also generates a 4-20 mA proportional current loop signal. Customer connections are provided at the Controller. If a Smart Sensor is part of a field network, connections are made at the Controller or Power Supply Unit that is supplying power to the sensor.

4. EchoSmart Controller – Graphical User Interface (ESC)

The EchoSmart Controller allows for local monitoring of one to sixteen EchoSmart Sensors.

4.1. General Overview

The Controller display consists of a graphical backlit LCD (2.6 x 3.45 inch viewing area) that is divided into five functional sections. Soft Keys and Navigation Keys located to the right of the screen are used for data entry and other operations. Figure 4.1 points out the functional sections of the screen and the location of the Soft Keys and Navigation Keys.

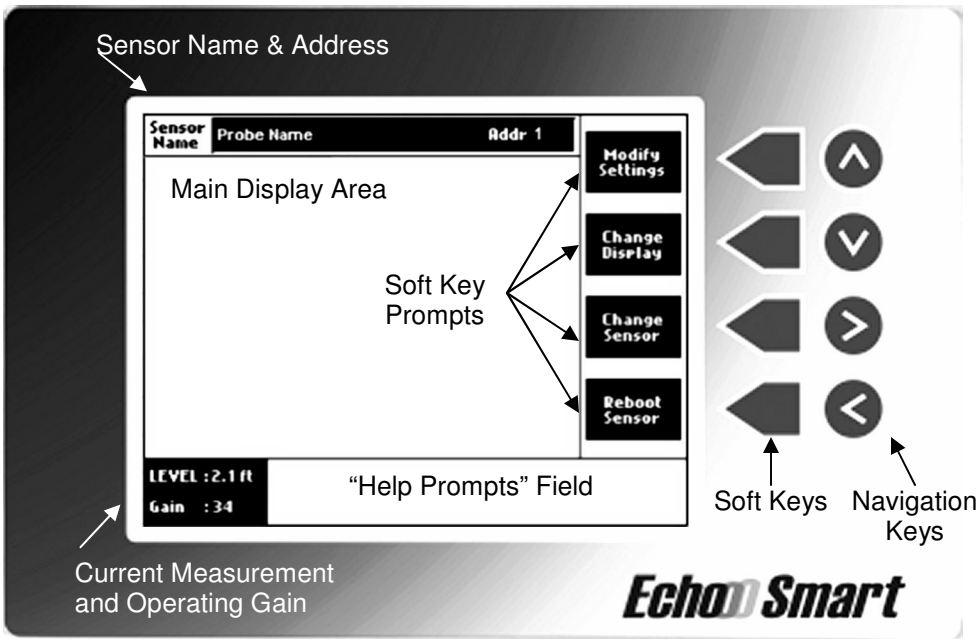

Figure 4.1: The LCD Display

4.1.1. Operator Interface Overview (Figure 4.1)

The display has five informative sections:

Smart Sensor Name & Address

The bar at the top of the display shows the name and network address that has been assigned to the sensor. This is the sensor that is currently being interrogated. Information on this and all other displays relates to this sensor.

If the Controller is operating a multi-sensor field network, other sensors are available by pressing the *Change Sensor* soft key. A listing of network sensors will appear (See Figure 4.12). Use the Navigation Keys to select the desired sensor and press *Select Sensor*.

Current Measurement and Operating Gain

The current measurement and operating gain (signal amplification) are conveniently available in the lower left corner of all displays.

Help Prompts Field

The Help Prompts Field across the lower section of each display provides an explanation of the screen, or the highlighted parameter. Help Prompts reduce the need for reference to the print operating manual.

Main Display Area

The area has both digital and graphical capabilities. The content changes with the functionality of the selected display.

Soft Key Prompts

The vertical bar on the right side of the display consists of four boxes. Each box contains text that describes the function of the Soft Key that is located next to that box. The text changes when the user selects a different function or navigates to a different instrument parameter.

4.1.2. Keypad

The Echo Smart Controller has four Soft Keys and four Navigation Keys.

Soft Keys

The function of a Soft Key is described by the Soft Key Prompt located immediately to the left of the key. Soft Keys are used to change instrument settings, switch to a different display, or trigger other actions.

When using a soft key to increase or decrease a value, the key can be held down in order to quickly modify the value.

Navigation Keys

Navigation Keys advance the instrument cursor to the desired location on the display for operation by Soft Key commands.

4.2. Power, Cabling, and General Electrical Connections for the ESC

This section pertains to the physical layout of the Controller terminal connectors and how they are connected as a stand-alone system. If you are wishing to network the Controller with other devices (Ex: ESP, SCADA Systems, etc), see Section 8 for sample connection diagrams.

4.2.1. Power Requirements

100-240 VAC, 50/60 Hz – 1.5A
Supply cable: 10-18 AWG, -40 to +140 F
65 W (fused) 1.25A 250V 5x20mm T-lag UL approved fuse
Optional: 24 VDC
4-20 mA Current Loop: 9 – 15 VDC (provided by ESC)

4.2.2. Connections Overview (Figure 4.2 and Table 4.1)

The ESC circuit board contains four screw-terminal connectors as well as additional plug-in connectors as shown in Figure 4.2. Use caution in tightening the screw terminals to prevent damage from over-tightening.

Ensure the power cable (10-18 AWG) is connected to the power connector properly. A breaker should be installed to fully remove power from the unit in the event that repairs to the unit are required. Sensors (ESS) should be connected to the controller by color code as shown in Figure 4.2 below. Table 4.1 contains a functional description of the screw terminal connectors.

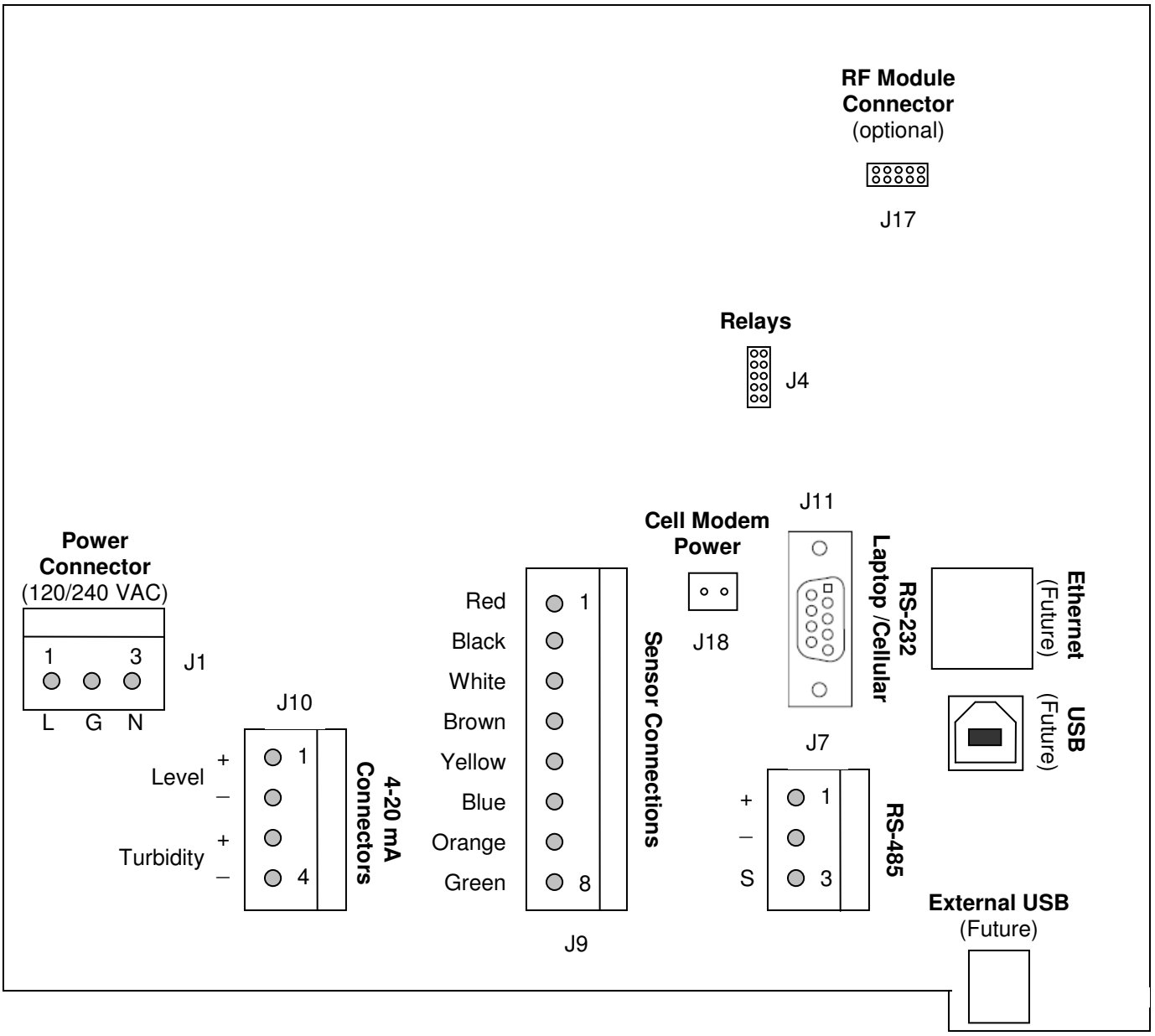

Figure 4.2: Connections for Controller

Table 4.1: Connections

Power Connector (J1)		**4-20 Analog Connectors (J10)**		**Sensor Connections (J9)**		**RS-485 Connector (J7)**	
Pin #	*Description*	*Pin #*	*Description*	*Pin #*	*Description*	*Pin #*	*Description*
1	Live	1	Level +	1	15 V	1	Sensor Comm
2	Ground	2	Level –	2	Ground	2	Sensor Comm
3	Neutral	3	Turbidity +	3	Sensor Comm (+)	3	Ground
		4	Turbidity –	4	Sensor Comm (–)		
				5	4-20mA Level		
				6	4-20mA Level		
				7	4-20mA Turbidity		
				8	4-20mA Turbidity		

Notes:

Sensor Connector (J9): Use Pin 3 and Pin 4 to link the Sensor Communication cable from the Controller to the next Power Supply Unit in a Wired RS-485 Field Network. Conductors are ganged with those from the sensor. Connection at the associated Power Supply Unit is at the RS-485 Connector (J8).

RS-485 Connector (J7): Use this connector when integrating a Field Network to the customer data acquisition and control system. This is the communication link between the Controller and an outside device. It is not used to interconnect Controllers and Power Supply Units.

4-20mA current loop is internally powered and grounded. For proper operation, customer should provide an isolated input.

4.3. Utilization of Informational Displays

The Controller has four informational displays: Echo Profile Display, Sensor Register Display, Tank View Display, and Historical Trend Display. Selections are made by pressing the *Change Display* Soft Key. At power up, the system defaults to the Echo Profile Display.

There are also three displays that are used to enter instrument settings: Modify Settings Display, Advanced Settings Display and Controller Setup Display.

4.3.1. Echo Profile Display (Figure 4.3)

The Echo Profile Display shows the echo waveform generated by the selected sensor. To view the waveform of another sensor, press the *Change Sensor* soft key, select the desired sensor from the dropdown list, and press *Select Sensor*.

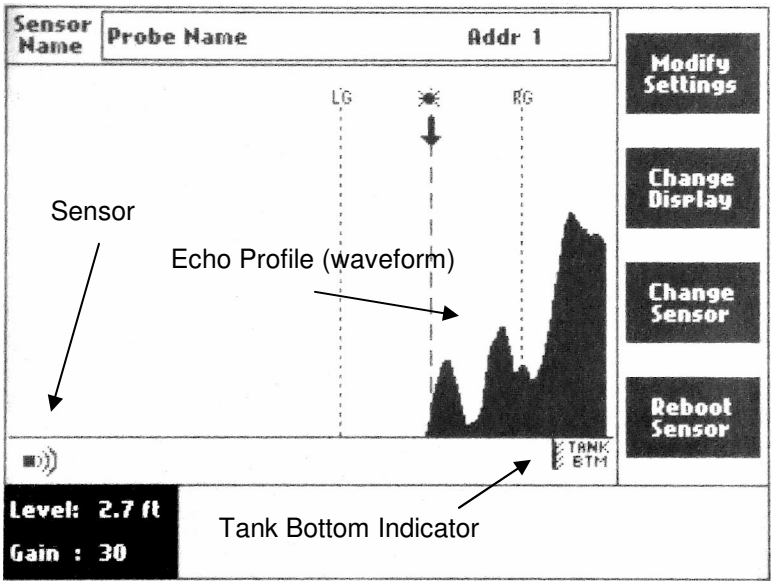

Figure 4.3: Echo Profile Display

This display presents the actively updated signal waveform generated by the sensor and used to determine the current measurement.

The horizontal x-axis is a distance axis based on the span between the sensor (bottom, left side of the screen) and the bottom of the tank (bottom, right side of the screen). The vertical y-axis corresponds to the strength of signal at locations between the sensor and the tank bottom. EchoSmart proprietary interpretive algorithms are applied to the signal waveform to determine the position of an interface – typically between a supernatant liquid and settled solids or suspended solids.

4.3.2. Sensor Register Displays (Figure 4.4 and 4.5)

This display consists of a table that shows the name of each sensor and its Current Measurement and Operating Gain value. The sensors are listed in consecutive order according to the sensor's address value. If the Controller is communicating with four or fewer sensors, information is presented as shown in Figure 4.4.

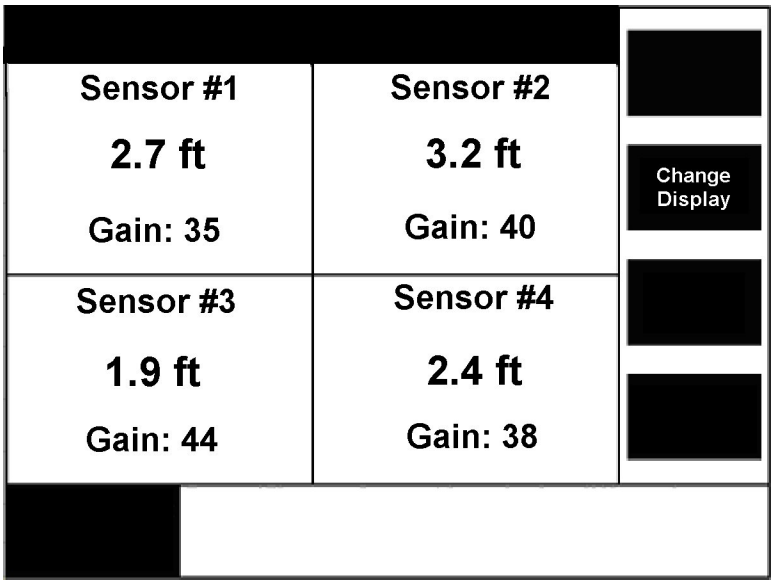

Figure 4.4: Four Sensor Field Network Display

With five or more sensors, information is presented as shown in Figure 4.5.

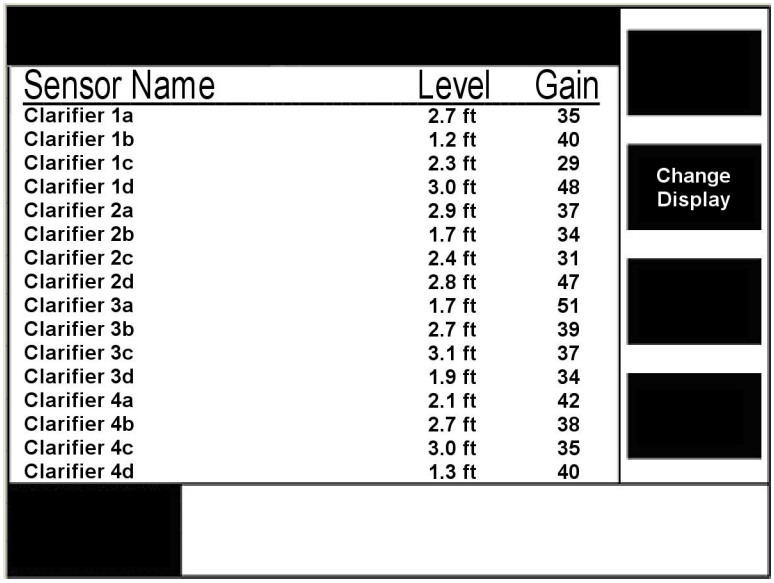

Figure 4.5: Multiple Sensor Field Network Display

These displays are not available when only one sensor is in use.

4.3.3. Tank View Display (Figure 4.6)

The Tank View Display shows a scaled cross-sectional view of the tank. The arrow on the left side of the tank provides a visual indication of the current fill Level. Dispersed solids that may be indicated in the echo waveform are represented by pixilated gradients above the primary interface.

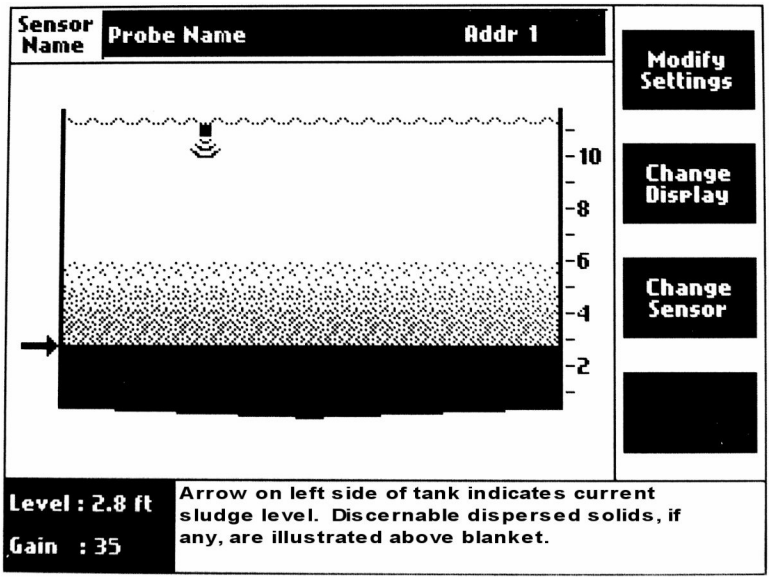

Figure 4.6: Tank View Display

The Tank View Display is enabled at the Modify Settings Display. Optional diagrams are available to correspond with the specific application (Figure 4.7).

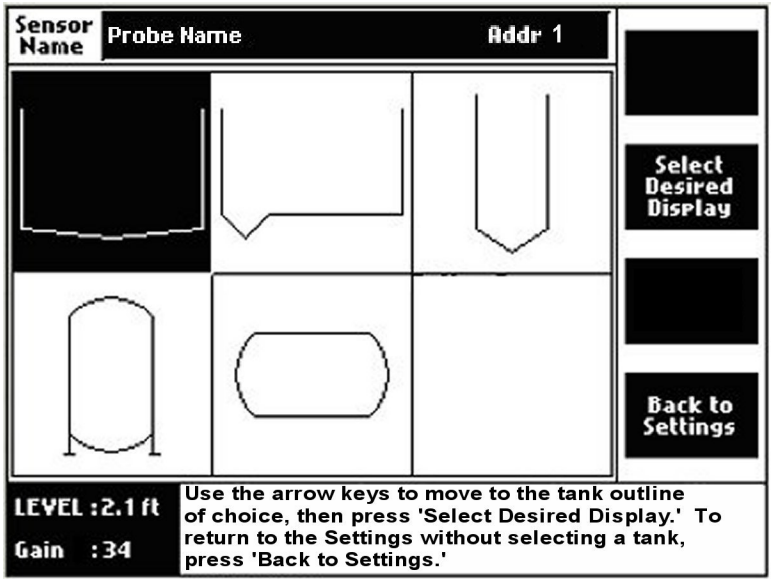

Figure 4.7: Tank Options

4.3.4. Historical Trend Display (Figure 4.8)

The EchoSmart Controller captures and stores the current measurement value every six minutes. The database is updated on a “first in/first out” basis to maintain a continuous register of the most recent seven days of data for all sensors.

The Historical Trend Display provides a graphical illustration of stored measurements for the selected sensor. The user may choose to view from one to seven days of data.

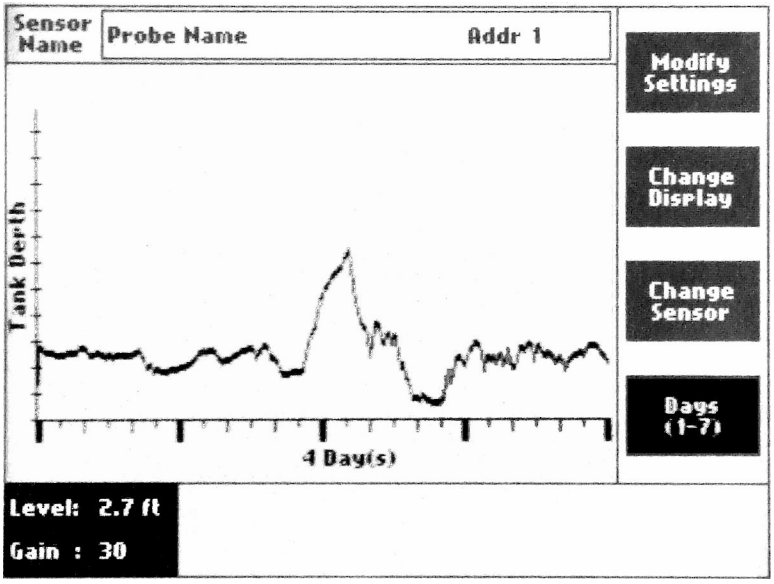

Figure 4.8: Historical Trend Display

The Historical Trend Display is enabled at the Modify Settings Display.

4.3.5. Modify Settings Display (Figure 4.9)

This display is used to enter the primary parameter settings for each sensor and to enable the Historical Trend Display and the Tank View Display. A Display Contrast adjustment function is also found here.

Changes are implemented once entered and the user exits the display. No confirming command is required.

Descriptions of parameter functions are found in Section 9.0.

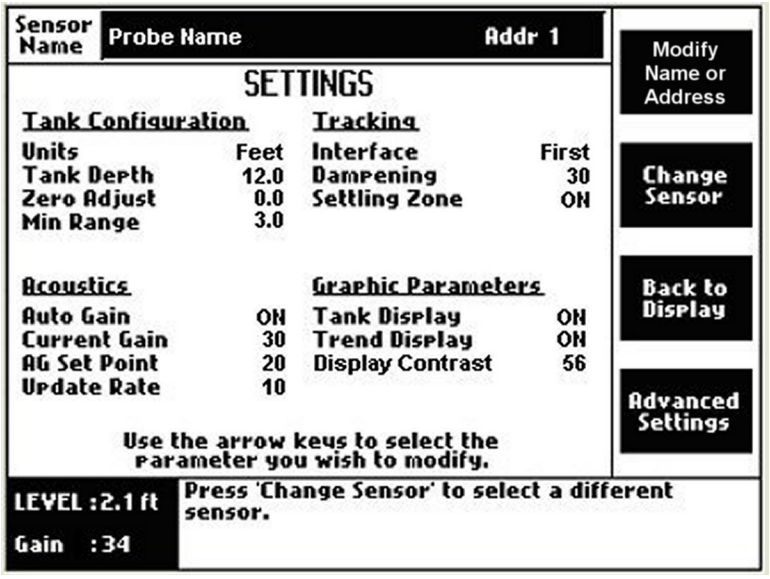

Figure 4.9: Modify Settings Display

A unique Alpha-Numeric name may be assigned to the sensor and its identifier address can be changed by pressing the Soft Key next to the *Modify Name or Address* prompt (See Figure 4.10).

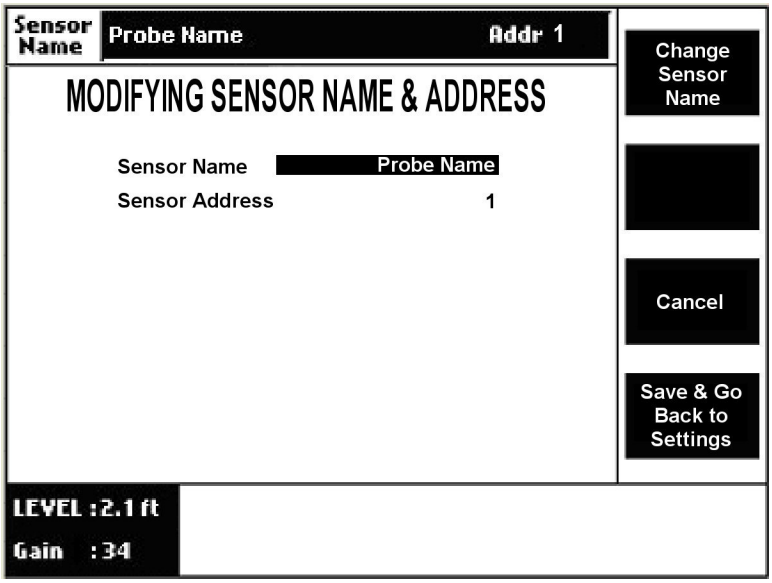

Figure 4.10: Modifying Sensor Name and Address Display

Navigation:
Navigation Keys are used to scroll to selected letters, numbers and symbols to enter the desired sensor name. Soft Keys assist with other functions, as indicated by the Soft Key Prompts.

4.3.6. Advanced Settings Display (Figure 4.11)

This display is used to enter additional parameter settings for each sensor. It is also used to establish the Analog Output parameters for the sensor.

The Advanced Settings Display is accessed by Soft Key function from the Modify Settings Display.

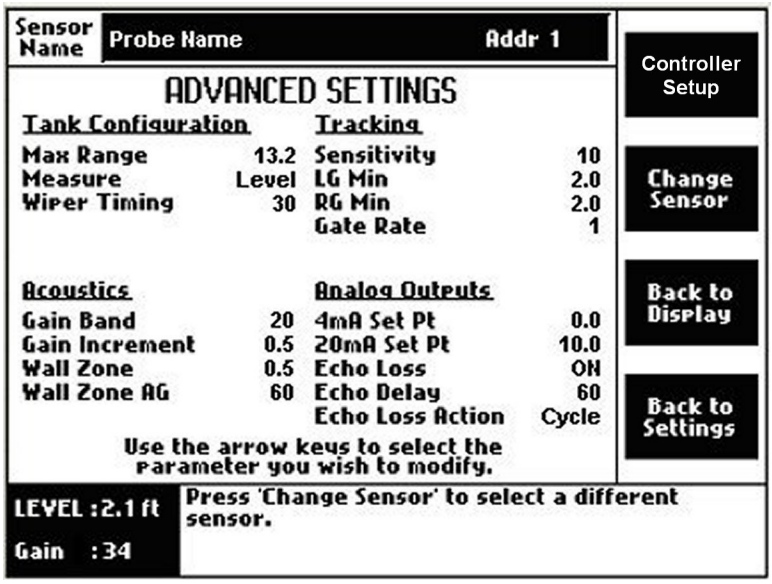

Figure 4.11: Advanced Settings Display

Descriptions of parameter functions are found in Section 9.0.

4.3.7. Controller Setup Display (Figure 4.12)

The purpose of this display is to change the Current Date and Time, and to initiate either a manual or automatic establishment of the sensor network.

The *Auto Detect Sensors* command begins a search for a sensor that is directly connected to the Controller and all sensors on a wired or wireless RF network. Select this option when adding or removing sensors from an existing network or to automatically rebuild the sensor address database.

The *Manually Set Database* command provides a prompt (Figure 4.13) where the sensor addresses of all powered and connected sensors can be entered in order to build the sensor network database. Like the auto detect feature, this option allows for the adding or removing of sensors from an existing database. This manual alternative can be beneficial especially in wireless RF network installations.

The Controller Setup Display is accessed from the Advanced Settings Display by pressing the *Controller Setup* soft key.

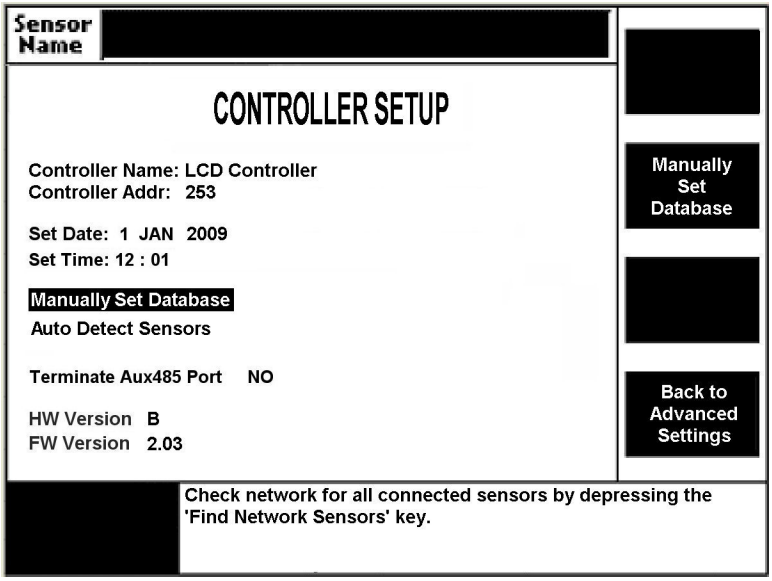

Figure 4.12: Controller Setup Display

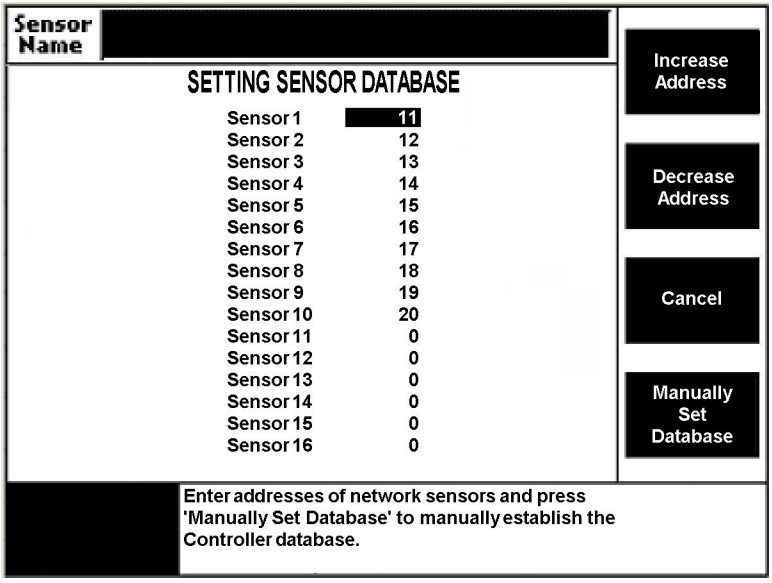

Figure 4.13: Sensor Database Prompt

4.3.8. Sensor Selection Drop-down Window (Figure 4.14)

To change the sensor that the Controller is currently displaying, press the *Change Sensor* Soft Key (available at any informational display and the settings displays). Use the Navigation Keys to move to the desired sensor and press the *Select Sensor* key.

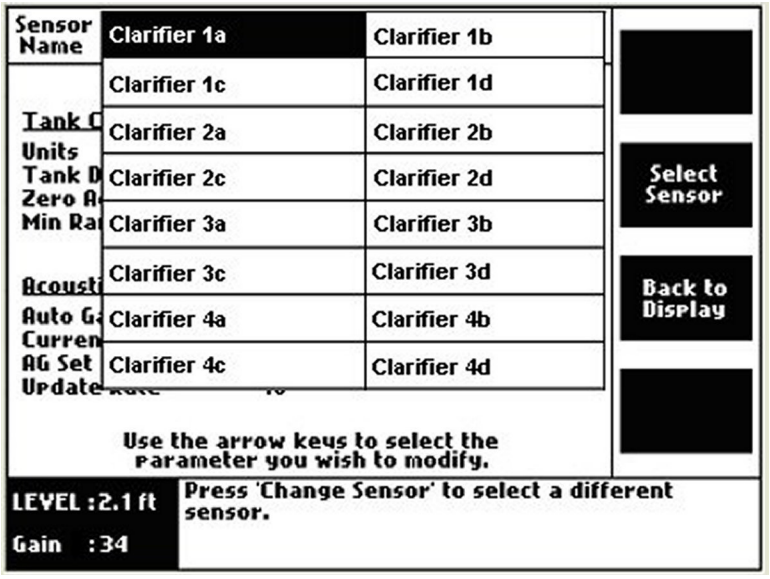

Figure 4.14: Sensor Selection Drop-down Window

4.4. Initializing and Configuring Controller and Smart Sensor(s)

4.4.1. Initial Controller Setup Display (Figure 4.15)

The Initial Controller Setup Screen will appear when power is applied to a Controller with an empty sensor register.

EchoSmart instruments employ Smart Sensor technology and are often implemented with multiple sensors operating in union with one Controller. To establish communication, each Smart Sensor must be assigned a unique address during initialization (See Sections 4.4.1 and 4.4.2). This address is held in the memory of both the Controller and the Smart Sensor(s).

IMPORTANT: All Smart Sensors are shipped from the factory with the pre-assigned address of *01*. In multiple sensor Network installations it is imperative that sensors be added to the Network one at a time as further described in Section 4.4.2, below. The address of each sensor must be changed to a unique number from 2 – 240. The sensor that is directly connected to the Controller must be initialized first. Power and initialize additional sensors one at a time, carefully noting the location of the tank and the corresponding sensor name.

Also enter Current Date and Time at this screen using the Navigation and Soft Keys.

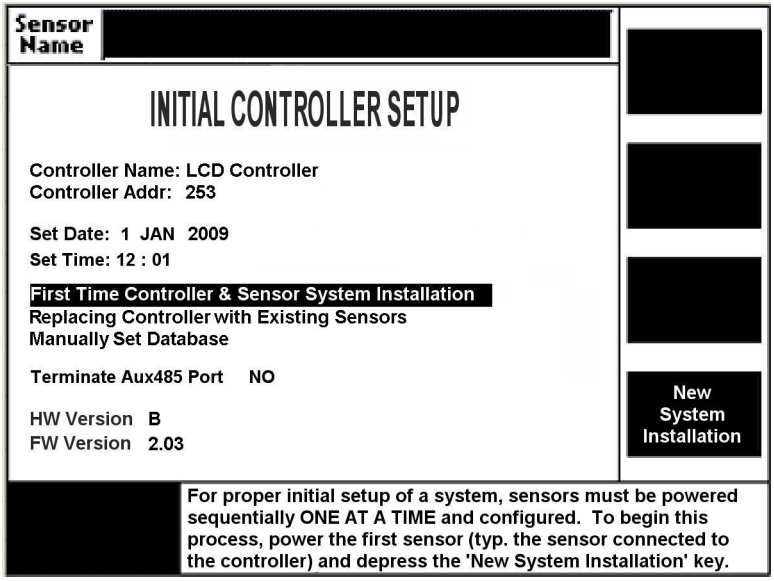

Figure 4.15: Initial Controller Setup

4.4.2. First Time Controller & Sensor System Installation (Figure 4.16 and 4.17)

If this is a new installation, select *First Time Controller & Sensor System Installation* and press the Soft Key next to *New System Installation* (Figure 4.15). The Controller will automatically locate the Smart Sensor that has been powered (this will take a few seconds) and will open the Initial Sensor Setup Display (Figure 4.16).

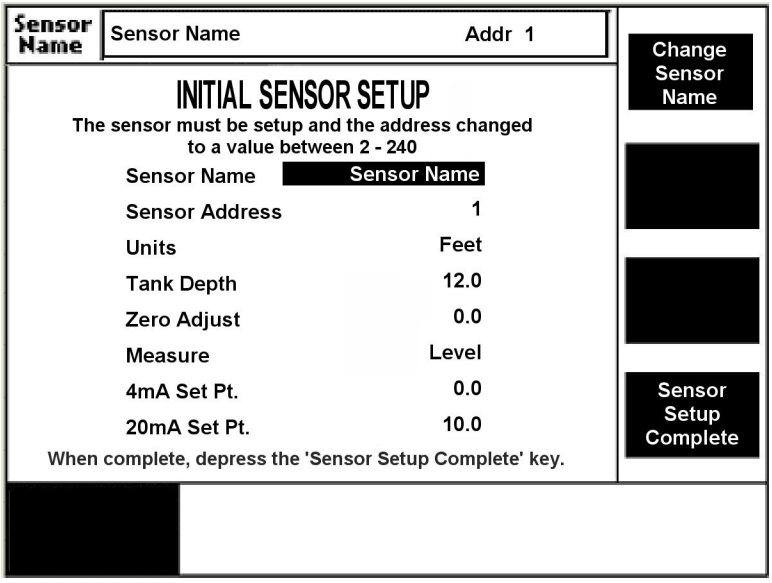

Figure 4.16: Initial Sensor Setup

Follow the Soft Key Prompts and use the Navigation Keys to enter the Sensor Name and Sensor Address. It is imperative that the Sensor Address be changed from 01 to any unrepeated number from 2 – 240 before initializing the next sensor in a network.

Press the Soft Key next to *Sensor Setup Complete* to finalize setup of the sensor. The *Power Next Sensor Screen* will appear. Apply power to the EchoSmart Power Supply Unit connected to the next sensor and repeat the steps above.

After all sensors have been initialized, Press the Soft Key next to the *Network Setup Complete* prompt (Figure 4.17).

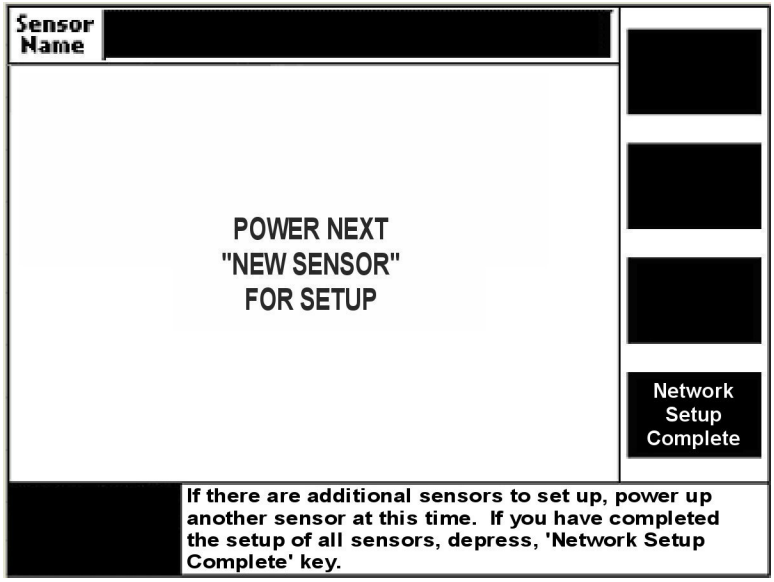

Figure 4.17: Power Next Sensor

All EchoSmart Sensors are now operational.

4.4.3. Replacing a Controller with Existing Sensor(s) (Figure 4.15)

If Smart Sensors have previously been initialized and the Controller is being replaced, select *Replacing Controller with Existing Sensors* and press the Soft Key next to *Replace Controller Only*. The Controller will automatically detect the existing sensors and return to full operation after the initialization routine is completed.

4.5. Automatic Initialization and Reboot Sensor

EchoSmart performs an automatic initialization routine whenever power is applied to the sensor or the *Reboot Sensor* command is selected at the Echo Profile Display. Instrument settings are not lost as a result of power interruption.

Automatic Initialization establishes Operating Gain (signal amplification), locates the measurement *Track* (interface measurement), and establishes the starting location of

the tracking Gates (margins of the area within which the interface measurement has been located). See Section 7, Tank Configuration, Waveform Analysis, and Tracking.

5. EchoSmart Power Supply Unit (ESP)

The Echo Smart Power Supply Unit provides power to an EchoSmart Sensor and acts as a communication hub to facilitate analog, digital and Wireless RF communications from an EchoSmart Sensor.

EchoSmart Power Supply Units do not have display monitors or data entry keypads. They are typically used in a Field Network arrangement in which an EchoSmart Controller provides the user interface function for setup and monitoring of EchoSmart Sensors. See Section 8, Communications, Outputs, and Networking.

5.1. Power, Cabling, and General Electrical Connections for the ESP

This section pertains to the physical layout of the ESP terminal connectors and how they are implemented as a stand-alone system. If you are wishing to network the ESP with other devices (Ex: ESC, other ESPs, SCADA Systems, etc), see Section 8 for sample connection diagrams.

5.1.1. Power Requirements

100 to 240 VAC, 50/60 Hz – 1 A
Supply cable: 10-18 AWG, -40 to +140 F
Power 20 W (fused) 0.250A, 250V 5x20mm T-lag UL approved
Optional: 24 VDC
4-20 mA Current Loop: 9 – 18 VDC (provided by the ESP)

5.1.2. Connections Overview (Figure 5.1 and Table 5.1)

The ESP circuit board contains four screw-terminal connectors as well as additional plug-in connectors as shown in Figure 5.1. Use caution in tightening the screw terminals to prevent damage from over-tightening.

Ensure the power cable (10-18 AWG) is connected to the power connector properly. Sensors (ESS) should be connected to the power supply color code as shown in Figure 5.1 below. Table 5.1 contains a functional description of the screw terminal connectors.

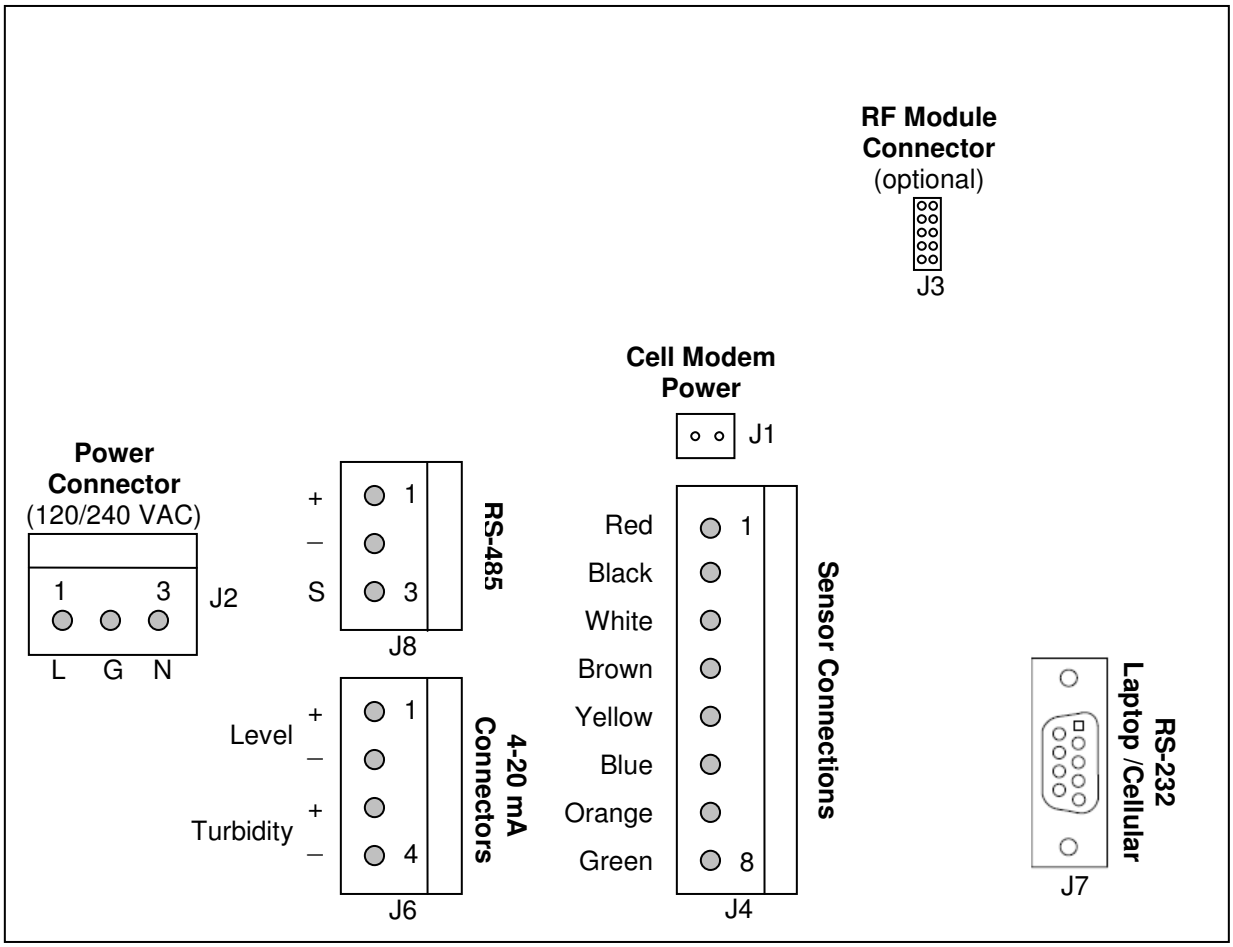

Figure 5.1: Connections for Power Supply

Table 5.1: Connections

Power Connector (J2)		**4-20 Analog Connectors (J6)**		**Sensor Connections (J4)**		**RS-485 Connector (J8)**	
Pin #	*Description*	*Pin #*	*Description*	*Pin #*	*Description*	*Pin #*	*Description*
1	Live	1	Level +	1	15 V	1	Sensor Comm
2	Ground	2	Level –	2	Ground	2	Sensor Comm
3	Neutral	3	Turbidity +	3	Sensor Comm (+)	3	Ground
		4	Turbidity –	4	Sensor Comm (–)		
				5	4-20mA Level		
				6	4-20mA Level		
				7	4-20mA Turbidity		
				8	4-20mA Turbidity		

Notes:

RS-485 Connector (J8): Attach the Sensor Communication cables from a Controller or a Power Supply Unit in a Wired RS-485 Field Network to this connector. Connection at an associated Controller is made at Pin 3 and Pin 4 of the Sensor Connector (J9).

4-20mA current loop is internally powered and grounded. For proper operation, customer should provide an isolated input.

6. Installation of Equipment

6.1. Installation of EchoSmart Sensor

The EchoSmart Sensor must be fully submerged in the supernatant process liquid during operation. It is not capable of transmitting a signal through gas (air) or solid materials.

Mount the sensor using a rigid pipe or conduit to minimize excessive side-to-side sway or other avoidable movement. If a surface skimmer is present, install using a sensor mounting fixture that rotates the sensor out of the path of the skimmer (EDI Transducer Multi-flex Assembly, Part No. 9300-13-13).

Orient the sensor such that the trajectory of the transmit pulse is at 90˚ with respect to the surface of the sludge blanket or other material that is to be measured, as illustrated in Figure 6.1 (Entech Design Drawing #ESS-210).

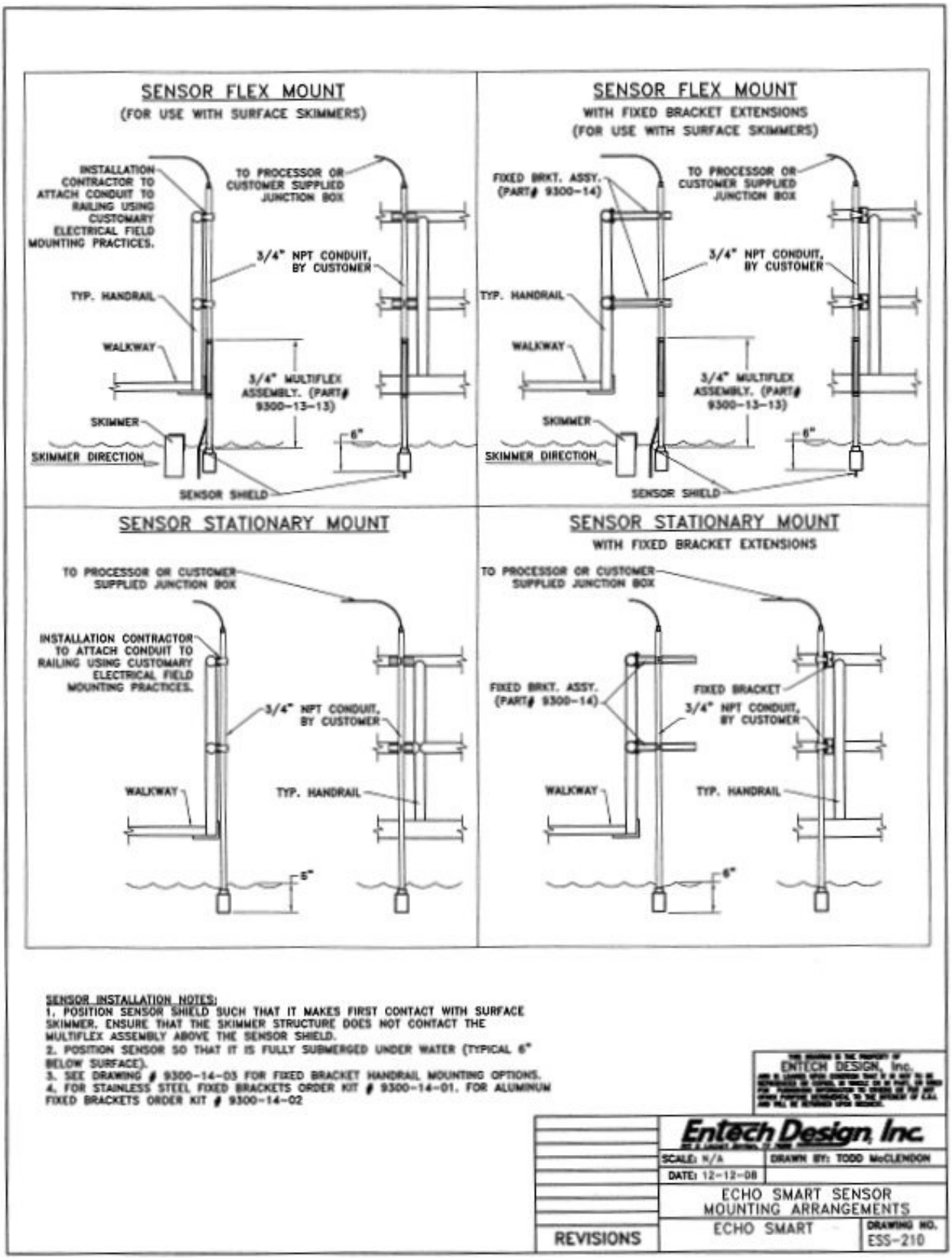

Figure 6.1 EchoSmart Sensor Mounting Arrangements

6.2. Sensor Location Selection Criteria

Optimal performance depends on: (1) acceptable process liquid (supernatant) in which the ultrasonic pulse is to be transmitted, (2) responsive interface material (suspended solids blanket, other settled solids), (3) freedom from objects encroaching into the path of the transmit pulse, and (4) avoiding areas of excessive turbulence.

6.2.1. Acceptable Process Liquid

Most relatively uniform and homogeneous liquids found in water and wastewater treatment applications and many industrial process applications are suitable for transmitting the ultrasonic pulse. Excessive amounts of suspended solids, gas or air bubbles or other concentrations of solids in the supernatant may inhibit or obstruct the signal. The sensor should be positioned to avoid these conditions if possible.

6.2.2. Responsive Interface Material

The EchoSmart Sensor relies on minimal qualifying characteristics of the material that is it measuring. Relatively dense, well-settled suspended solids form a well-defined interface and are effective in reflecting signal to the sensor. Light density material (< 0.5% solids) that is not well-settled does not form a well-defined interface and is less effective in reflecting signal to the sensor. If possible, locate the sensor in an area that minimizes exposure to these conditions. Attempt to position the sensor in an area where the material (sludge) is relatively deep in the tank under normal process operating conditions.

6.2.3. Stationary Objects in Path of Transmit Pulse

Do not locate the sensor near piping, tank structural elements or other objects that encroach on the signal trajectory. Continuously moving rakes and skimmers found in water and wastewater treatment applications typically do not interfere with measurements.

6.2.4. Areas of Excessive Turbulence

Avoid locating the sensor in the path of inlet flow, in areas where solids are being introduced into the tank, or near other sources of high turbulence.

6.2.5 Typical Circular Clarifier Installation (Figure 6.2)

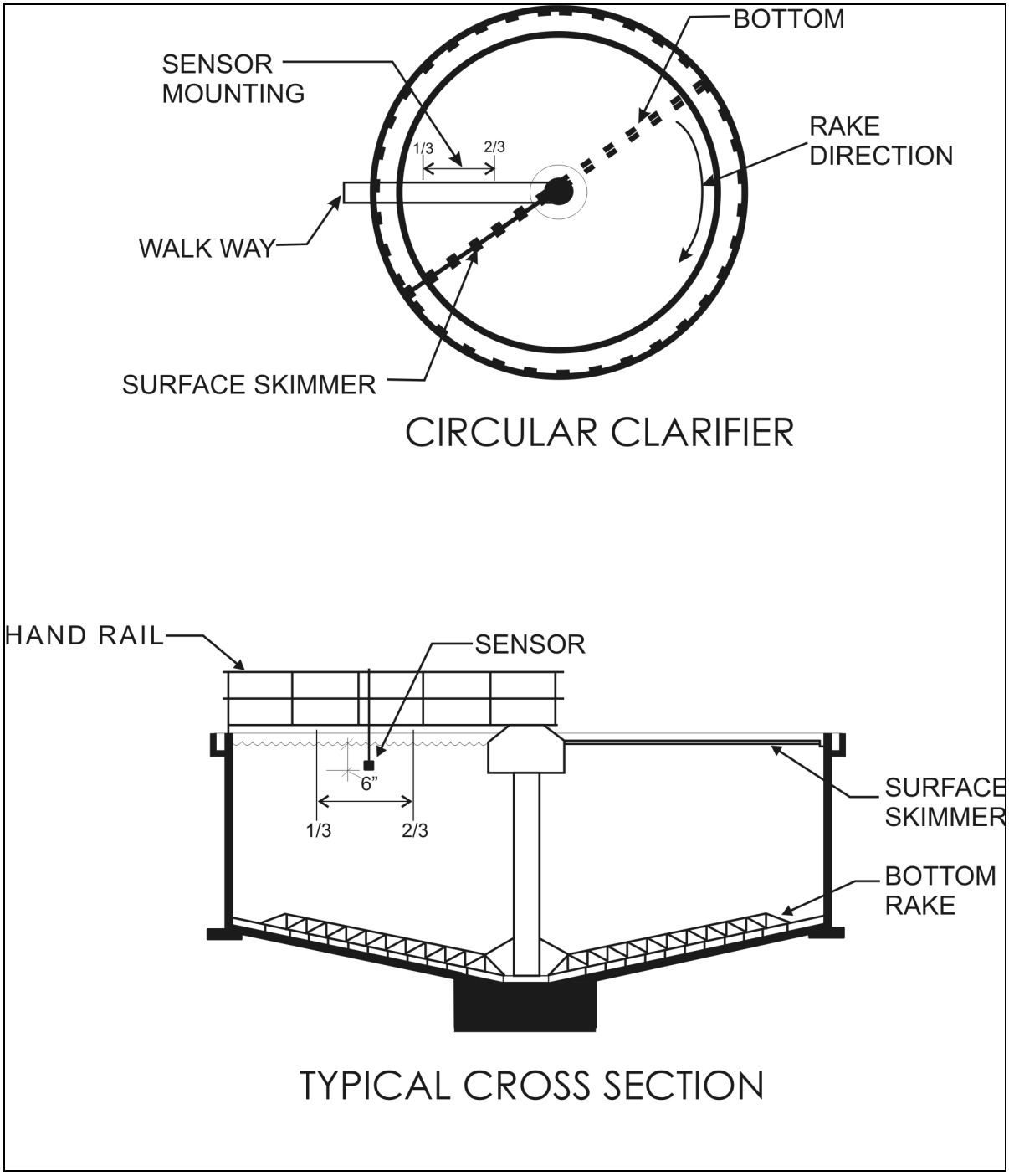

Figure 6.2: Typical 1/3 – 2/3 Location in Circular Clarifier

6.2.6 Typical Rectangular Clarifier Installation (Figure 6.3)

Figure 6.3: Typical Locaton in Rectangular Clarifier – Side vs. Sump

Contact Entech Design, Inc. Factory Service for specific recommendations regarding sensor location to assure optimal performance.

6.3. Installation of EchoSmart Controller and EchoSmart Power Supply Unit

The EchoSmart Controller and EchoSmart Power Supply Unit are designed for outdoor installation and are typically attached to safety railing or other structure.

Locate the Controller or Power Supply Unit within 20.0 ft. of the sensor, as illustrated in Figures 6.4 (Entech Design Drawing #ESC-211) and Figure 6.5 (Entech Design Drawing #2107-52), below.

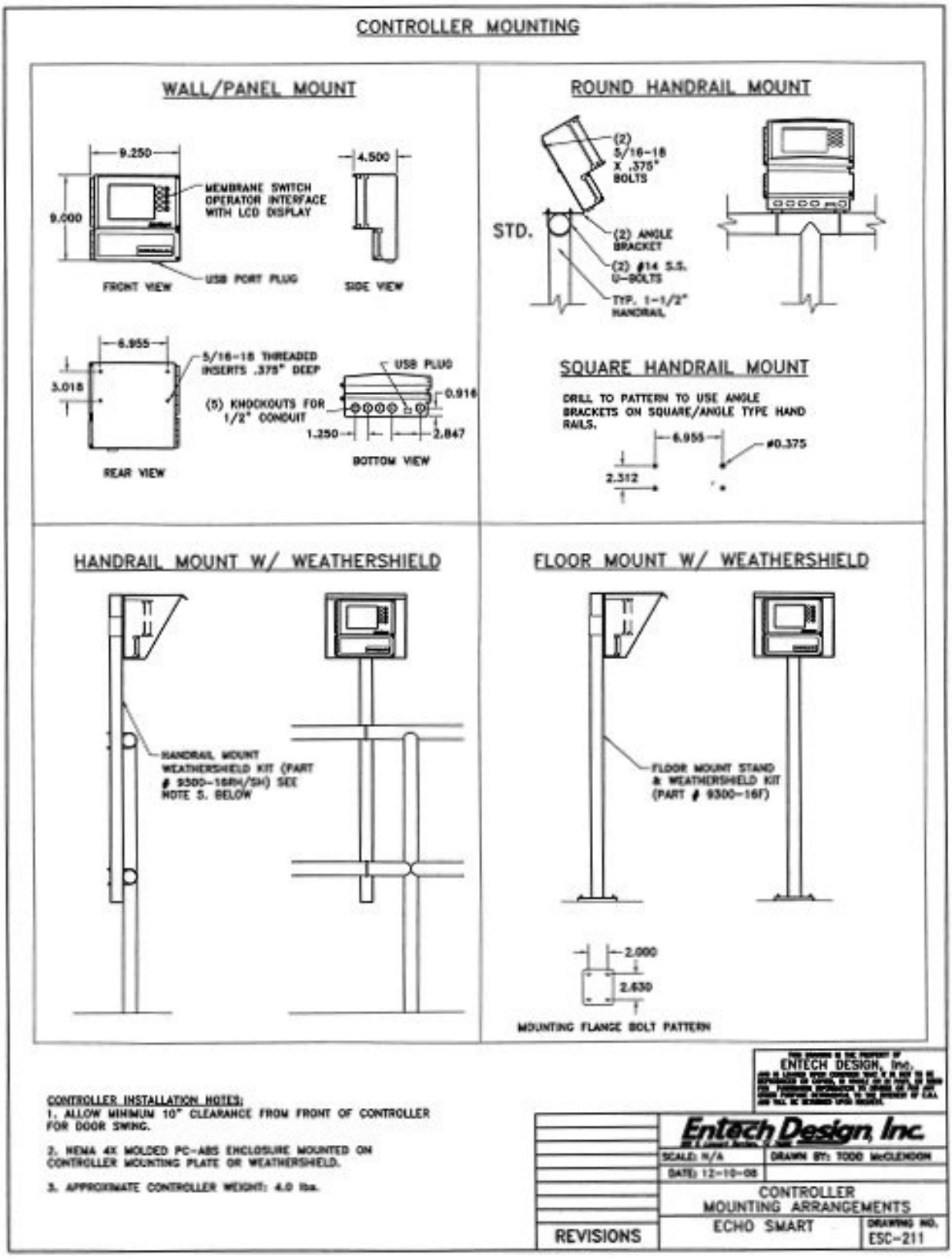

Figure 6.4: Controller Installation Drawing

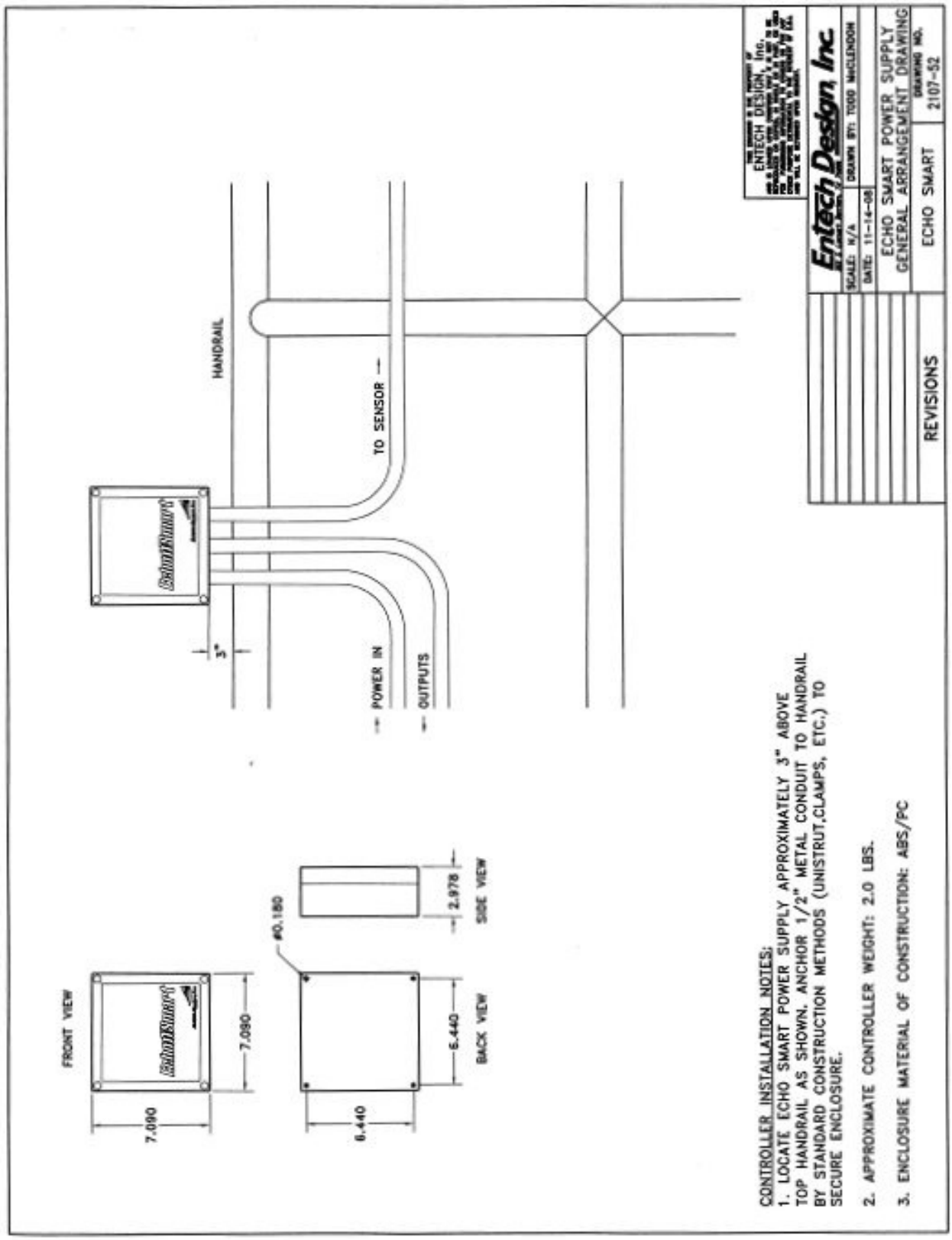

Figure 6.5: EchoSmart Power Supply Unit Installation Drawing

7. Tank Configuration, Waveform Analysis, and Tracking

EchoSmart applies advanced proprietary echo waveform analysis and filtering routines to provide reliable and repeatable measurements. For proper operation, instrument settings must conform to the dimensions of the tank in which the sensor is installed.

7.1. Tank Configuration (Figure 7.1)

Tank Depth and Zero Adjust parameters (See Sections 9.1.2 and 9.1.3) orient the instrument to the dimensions of the tank and assure that the echo waveform corresponds with tank dimensions at the location of the sensor.

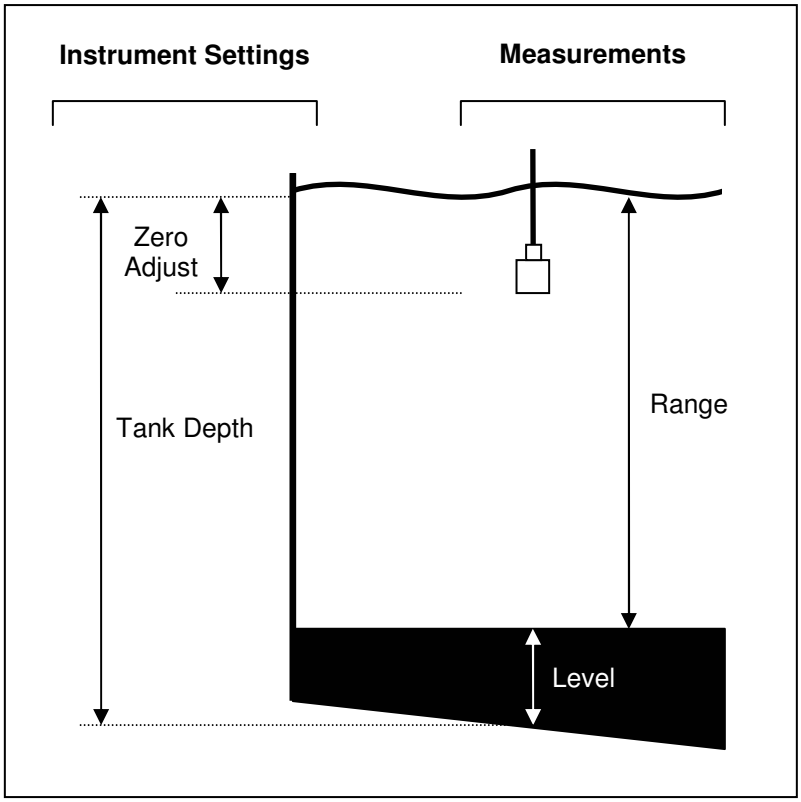

Figure 7.1: Tank Configuration

7.2. Waveform Analysis (Figure 7.2)

The EchoSmart Sensor produces a signal waveform that is used to produce the primary measurement. The waveform is available to the user as a diagnostic tool in the Echo Profile Display, as illustrated here.

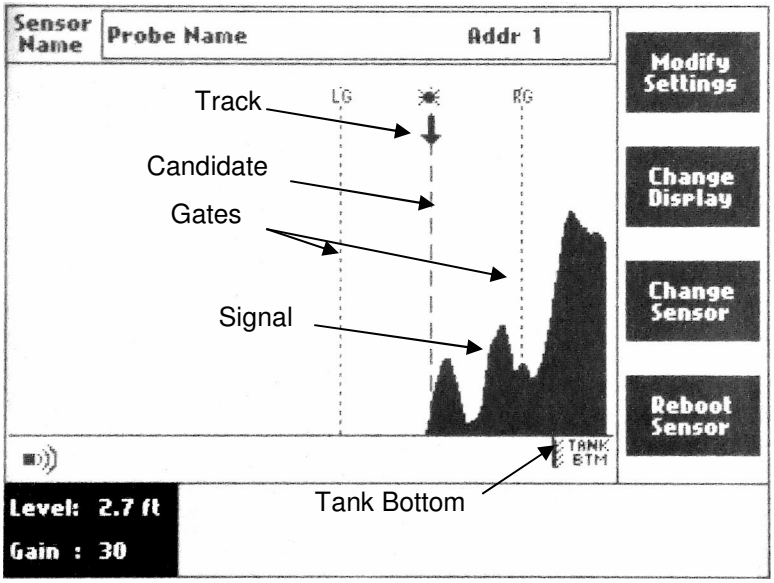

Figure 7.2: Echo Profile Display

The signal waveform is presented graphically with the horizontal x-axis representing the Tank Depth and the vertical y-axis as the strength of signal at positions along the dimensional axis. The Sensor is identified by symbol in the lower left corner of the graph, and the Tank Bottom is indicated in the lower right corner.

An interface is generally identified as a rising slope (left side) of the curve of a signal. This reflects a significant increase in the amplitude of signal at a particular location (distance from the sensor). Stable and repeated signals are given preference over more transient ones.

The selected signal is identified on the waveform by a solid vertical line that is called a Candidate.

7.3. Tracking

Tracking is the term EchoSmart uses to specify the process of producing the primary measurement and following (tracking) its progress over time. The "Track" is the position of the Current Measurement on the Waveform graphic and is identified by a downward pointing arrow at the top of the screen. Tracking is influenced by instrument parameters: Interface and Dampening, and operation of the Gate.

7.3.1. Gate

EchoSmart employs enhanced algorithms that operate to stabilize measurements and prevent inadvertent tracking to transient or spurious signals. One of these is referred to as the Gate mechanism. The Gate is a stable yet dynamic area around the Current Measurement. Signal that is inside the Gate is given preferential consideration. Signal outside the Gate must persist in order to be considered valid. It is seen on the waveform graphic as dotted lines on either side of the Track. See: 9.2.11 LG Min and 9.2.12 RG Min for parameters that establish the dimensions of the Gate.

7.3.2. Signal Waveform Symbols

↓ The Down Arrow points to the current Track (See Section 7.2). This position corresponds with the Current Measurement.
→ The Right Arrow indicates that a signal meeting tracking criteria is located outside the Gate, to the right. The measurement will only be affected by this signal if it persists for repeated Updates.
← The Left Arrow indicates that a signal meeting tracking criteria is located outside the Gate, to the left. The measurement will only be affected by this signal if it persists for repeated Updates.
! ! The Double Exclamation Mark indicates that the current signal is insufficient for tracking purposes. The Current Measurement will be held until sufficient signal returns. Loss of Echo will be reported if the 4-20mA Loss of Echo routine has been activated (See Section 9.2.16-18).

8. Communications, Outputs, and Networking

EchoSmart may be implemented as a stand-alone instrument, or it may be configured in a Wired or Wireless RF Field Network arrangement. In a stand-alone environment Communication refers to analog signal outputs and digital communication with external devices. (See Section 1.1)

When implemented in a Field Network arrangement, Communication additionally refers to information exchange and control functions between EchoSmart devices, as well as communication and output signals that are connected to the customer data and control systems. (See Section 1.2)

8.1. Stand-Alone Instrument (Figure 8.1)

A stand-alone instrument consists of an EchoSmart Controller with a Smart Sensor connected to the Controller.

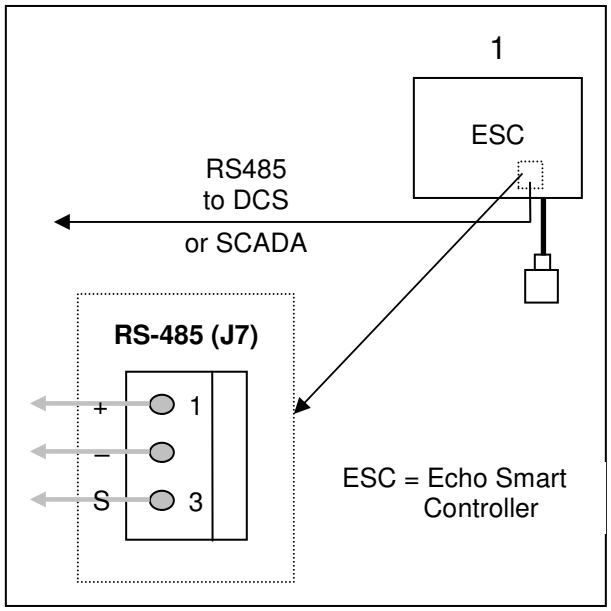

Figure 8.1: Controller with Single Sensor

8.2. Wired RS-485 Field Network (Figure 8.2)

Up to sixteen Smart Sensors can be operated with one EchoSmart Controller via two-wire RS-485 from a Controller to each Power Supply Unit. No user programming or other integration is required.

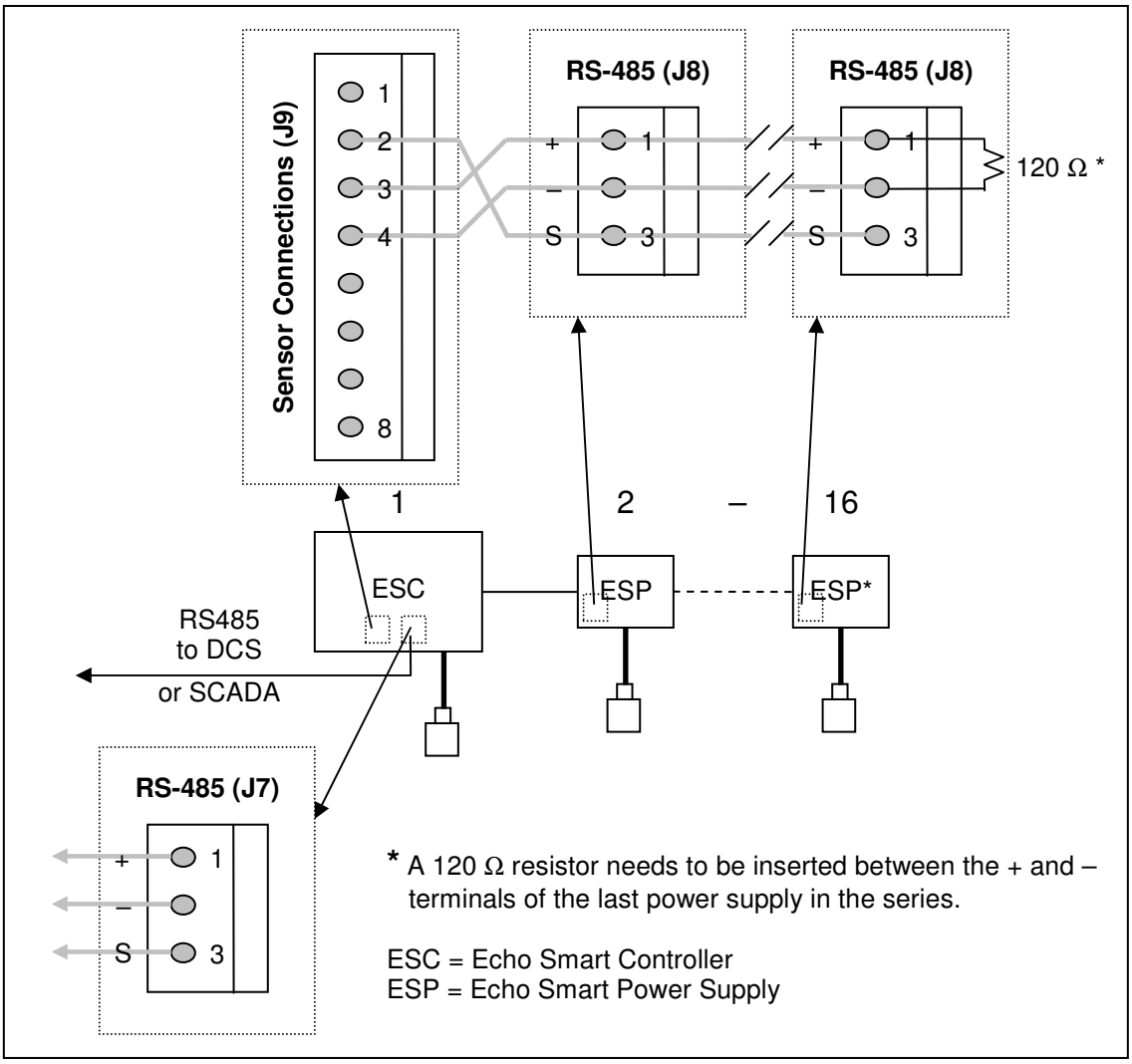

Figure 8.2: Single Wired Field Network

8.3. Integrated Wired Field Networks (Figure 8.3)

EchoSmart Controllers operating Field Networks may be interconnected in an integrated two-wire RS-485 Network of up to 240 Smart Sensors. Customer Modbus RTU integration is required.

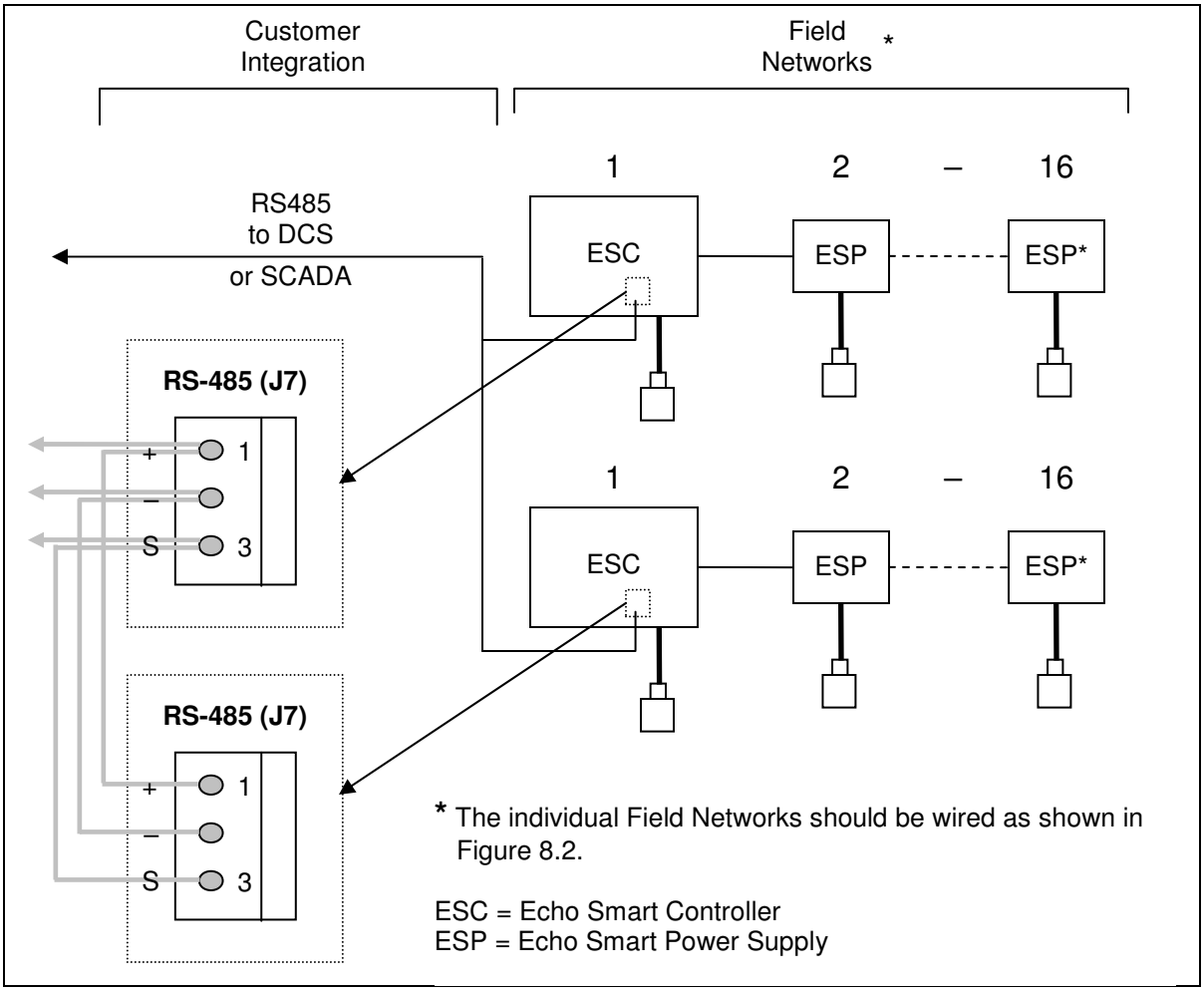

Figure 8.3: Integrated Wired Field Network

8.3.1. Modbus RTU Integration

See OEM Smart Sensor Probe (SSP) Communications Protocol.

8.4. Wireless Radio Frequency (RF) Field Network (Figure 8.4)

Field Networks as described and configured in Section 8.2 can be implemented using optional fully integrated ZigBee Compliant® RF Modules without the installation of field interconnection cabling and conduit. The Controller and each Power Supply Unit in the Field Network must be equipped with an RF Module. No user programming or other integration is required.

Figure 8.4 illustrates a single wireless RF Field Network configuration. Multiple RF Field Networks may be integrated to a SCADA system by connecting Controllers as shown in the "Customer Integration" section of Figure 8.3.

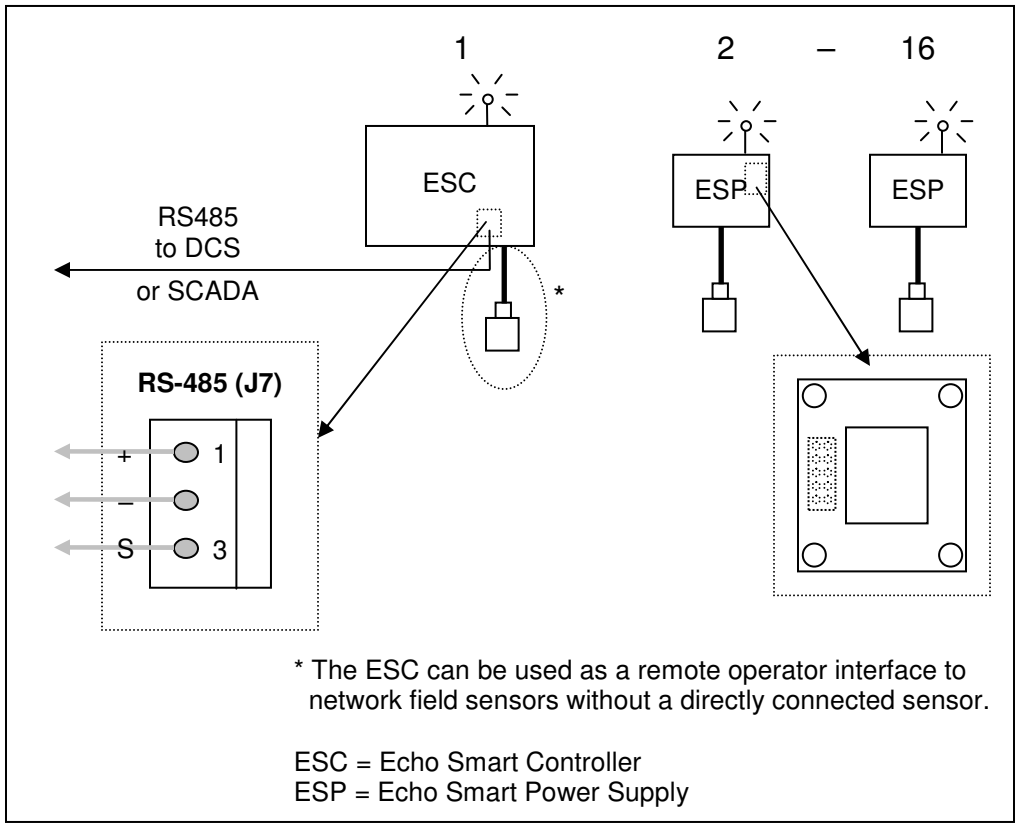

Figure 8.4: Single RF Field Network

8.5. Other Communication Options and Facilities

8.5.1. RS-232 Serial Communication

Controllers and Power Supply Units have RS-232 capabilities that enable communication with instruments via a laptop computer operating the EchoSmart Console Program (See Section 1.3.1). The RS-232 facility also enables communication with an optional Data Cell Modem for Remote Factory Start-up Support and Service.

8.5.2. Factory Remote Data Cellular Modem

EchoSmart Controllers are designed for optional installation of a data cellular modem. With the user's authorization, this facility enables Remote Factory Startup and Service by expert factory technicians.

9. Instrument Programming Parameters

Controller and Smart Sensor parameter settings are established at the Modify Settings and Advanced Settings Display. Standard default parameters exist in all instruments until modified by the user.

Some settings, as noted below (Ex: Tank Depth, Zero Adjust), require site-specific values. Other parameters may be changed for convenience or preference (Ex: Units, Interface, Dampening). However, most parameters should be left at the default value unless changed in response to observed measurement failure or when instructed by a factory technician.

Default values for each parameter discussed below are indicated by parenthesis ( ).

9.1. Modify Settings Display Parameters

Parameters found at this display are the primary instrument settings and may require adjustment to meet the requirements of the installation and process environment.

Note: Accurate values for Tank Depth and Zero Adjust must be entered in order to secure reliable measurements.

9.1.1. Units (*ft*)

The Units parameter establishes the desired engineering units that the instrument will use for all calculations and displayed values.

Options for Units are: Feet (ft), Inches (in), Meters (m), and Centimeters (cm)

9.1.2. Tank Depth (*10.0*)

Tank Depth is the distance from the top of the tank (Typically the surface of the water) to the bottom of the tank at the location of the sensor. Tank Depth is used in conjunction with Zero Adjust to establish the correct empty distance and ensure that the instrument signal corresponds with tank dimensions. (See Figure 6.1)

The range for Tank Depth is: 3.0 to 32.0 ft

Note: Accurate values for Tank Depth and Zero Adjust must be entered in order to secure reliable measurements.

9.1.3. Zero Adjust (*0.5*)

Zero Adjust locates the sensor position relative to the top of the tank. Use a positive value for Zero Adjust when the sensor is located below the top of the tank. (See Figure 6.1)

The range for Zero Adjust is: -32.0 to 32.0 ft

Note: Accurate values for Tank Depth and Zero Adjust must be entered in order to secure reliable measurements.

9.1.4. **Min Range** (*3.0*)

Min Range establishes the dimension of the measurement blanking-zone near the sensor. It is referenced to the top of the tank.

The range for Min Range is: 1.0 ft to 32.0 ft

9.1.5. **Auto Gain** (*ON*)

This parameter determines whether the Auto Gain function is operational. When activated, Auto Gain continually monitors signal characteristics and adjusts signal amplification in response to changes in the process environment. It is recommended that Auto Gain remain ON unless otherwise advised by a factory-trained technician.

The options for Auto Gain are: ON and OFF

9.1.6. **Current Gain** (*30*)

With Auto Gain ON, Current Gain is established automatically and is not accessible as a parameter that can be modified manually. With Auto Gain OFF, this parameter establishes the constant level of signal amplification at which the instrument will operate.

The range for Current Gain is: 0 to 100

9.1.7. **AG Set Point (Auto Gain Set Point)** (*10*)

The AG Set Point determines the relative signal strength that the Auto Gain routine will seek. Increase this parameter to cause Auto Gain to seek a generally higher level of signal amplification. Decrease this parameter to cause Auto Gain to seek a generally lower level of signal amplification.

The range for AG Set Point is: 5 to 50

9.1.8. **Update Rate** (*10*)

Update Rate determines the number of signal data sets used to develop the current signal waveform and update the current measurement. This setting effectively establishes the instrument response time, ranging proportionately from approximately 2 – 10 seconds.

Note: Smart Sensors operating in a multi-sensor network arrangement update continuously and independently. Application in a network does not reduce measurement response time.

The range for Update Rate is: 1 to 20

9.1.9. Interface (*First*)

The Interface parameter establishes the primary measurement algorithm. It is used to select between optional measurement points (interfaces) when present in the process.

Select *FIRST* to measure an interface consisting of light-density material that is at a higher elevation in the tank.

Select *LAST* to measure an interface consisting of denser material that is nearer the bottom of the tank.

The options for Interface are: FIRST or LAST

9.1.10. Dampening (*130*)

Dampening establishes the number of Updates that are averaged to determine the Current Measurement. This parameter is used to remove the effects of random fluctuations caused by settling or disturbed material and prevents sudden changes in the measurement resulting from the action of rakes and skimmers.

The range for Dampening is: 5 to 255

9.1.11. Settling Zone (*ON*)

Settling Zone *ON* causes the instrument to ignore signal originating to the left of LG Min. This enables the sensor to disregard suspended solids, air/gas bubbles and similar sources of disturbance in the supernatant.

The options for Settling Zone are: ON and OFF

9.1.12. Tank Display (*ON*)

Tank Display allows the user to select a tank diagram for the Tank View Display. There are five common tank designs from which to choose. (See Section 4.3.3 and Figure 4.7)

The options for Tank Display are: ON and OFF

9.1.13. Trend Display (*ON*)

Trend Display allows the user to activate the Historical Trend Display. (See Section 4.3.4 and Figure 4.8)

The options for Trend Display are: ON and OFF

9.1.14. Display Contrast (*55*)

Display Contrast allows the user to adjust the LCD Contrast for optimal visibility.

The range for Display Contrast is: 0 to 255

9.2. Advanced Settings Display Parameters

Additional parameters, including those used to set up Analog Output Signals are found at this display. Access this display by pressing the Soft Key next to the *Advanced Settings* prompt at the Modify Settings Display.

* The default value for each parameter is listed in parenthesis ( ).

9.2.1. Max Range (*11.0*)

Max Range establishes an optional measurement blanking-zone near the bottom of the tank. Its location is referenced from the top of the tank.

The range for Max Range is: 1.0 to 35.2 ft

9.2.2. Measure (*Level*)

Measure determines whether the calculated measurement is the depth of the material (*LEVEL*) or the distance from the top of the tank to the material (*RANGE*).

The options for Measure are: LEVEL and RANGE

9.2.3. Wiper Timing (*240*)

Wiper Timing establishes the time (minutes) between wiper cycles.

The range for Wiper Timing is: 0 [OFF] to 240 minutes

9.2.4. Gain Band (*20*)

Gain Band establishes the maximum amount that Current Gain (with Auto Gain ON) can vary once the initial gain level has been established. At the default value, Current Gain can increase or decrease by 20.

The range for Gain Band is: 5 to 30

9.2.5. Gain Increment (*0.1*)

Gain Increment determines the rate of change in gain as Auto Gain operates to change the Current Gain level over time.

The range for Gain Increment is: 0.1 to 5.0

9.2.6. Wall Zone (*0.5*)

This parameter establishes a zone near the bottom of the tank that permits special handling of a dominant signal that originates from the tank floor. The instrument differentiates this signal from other signals in order to correctly calculate measurements.

The range for Wall Zone is: 0.0 to 32.0

9.2.7. Wall Zone AG (*40*)

This parameter limits gain amplification when the primary signal is a reflection from the tank bottom. It operates to prevent over-amplification of the signal in applications with light-density material, or when the tank is empty (has no suspended solids blanket or settled solids).

Increase this parameter to allow Current Gain to rise. Lower it to restrict the level of Current Gain.

The range for Wall Zone AG is: 0 to 100

9.2.8. Sound Speed (*4862 fps*)

Sound Speed is the transmit velocity the instrument uses to calculate Level and Range Measurements. Changes to Sound Speed may be required to calibrate the instrument for use if the process liquid is extreme in temperature or pressure, or is other than water.

The range for Sound Speed is: 1000 to 6000 fps

9.2.9. Mode (*Average*)

The selected Mode determines the method by which raw signal data is handled to produce a signal waveform. Multiple data sets are processed to create a waveform (See Update Rate, 9.1.8, above). *Average* instructs the instrument to apply the arithmetic mean value for each data cell in the waveform spectra. *Composite* selects the highest value of multiple data sets for each cell.

The options for Mode are: Average and Composite

9.2.10. Sensitivity (*20*)

Sensitivity determines whether a signal is sufficient for tracking. Lower Sensitivity to promote tracking a less well-defined signal (gradual slope or low amplitude signal). Increase Sensitivity to produce the opposite effect.

The range for Sensitivity is: 0 to 100

9.2.11. LG Min (*2.0*)

LG Min establishes the margin of the left side of the *Gate* (See Section 7.3 for a description of the *Gate* and its function).

The range for LG Min is: 0.0 to 32.0

9.2.12. RG Min (*2.0*)

RG Min establishes the margin of the right side of the *Gate* (See Section 7.3 for a description of the *Gate* and its function).

The range for RG Min is: 0.0 to 32.0

9.2.13. Gate Rate (*1*)

Gate Rate determines the response time with respect to the dynamic movements of the *Gate*. Increase Gate Rate to cause the gate to open faster. (See Section 7.3 for a description of the *Gate* and its function)

The range for Gate Rate is: 0 to 255

9.2.14. 4mA Set Point (*0.0*)

The 4mA Set Point establishes the instrument measurement value at which the user expects the sensor to output a current of 4mA. Establish the same Set Point value in the control device that the instrument is connected to.

The range for 4mA Set Point is: 0 to Tank Depth

9.2.15. 20mA Set Point (*10.0*)

The 20mA Set Point establishes the instrument measurement value at which the user expects the sensor to output a current of 20mA. Establish the same Set Point value in the control device that the instrument is connected to.

The range for 20mA Set Point is: 0 to Tank Depth

9.2.16. Echo Loss (*ON*)

Echo Loss provides an alarm function through the 4 – 20mA current loop signal. The selected Echo Loss Action is executed after loss of echo persists for the time lapse defined in Echo Delay setting.

The options for Echo Loss are: ON, OFF

9.2.17. Echo Delay (*60*)

Echo Delay establishes the amount of time (in minutes) that the sensor must experience a loss of echo before initiating the Echo Loss Action.

The range for Echo Delay is: 0 to 255 minutes

9.2.18. Echo Loss Action (*Cycle*)

Echo Loss Action determines the state that the current loop adopts in response to loss of echo when the Echo Loss alarm function is activated.

The options for Echo Loss Action are: 4mA, 20mA, and Cycle

10. Maintenance and Troubleshooting

10.1. Preventative Maintenance

It is recommended that the sensor face be inspected and cleaned at regular three (3) month intervals to prevent buildup of material. When the buildup of material becomes too great, it can adversely affect performance.

If you find that cleaning must take place on a very frequent basis (daily/weekly) or cleaning is more frequent than desired, self-cleaning sensors with wipers are available. Please contact Entech Design at (940) 898-1173 for details.

As a general practice, visually inspect the analyzer monthly during normal clarifier "walk downs," to determine that there are no obvious signs of damage to the equipment and that mounting brackets and hardware are secure. Tighten mounting bolts as may be required.

Observe the sensor to assure that it is fully submerged below the surface of the water and that there are no rags or similar debris wrapped around it. Clear rags and debris from the sensor with an extension brush or by flushing with water.

If your clarifier employees a surface skimmer, watch skimmer flights as they pass the location of the sensor to assure that the flights contact the sensor shield-rod allowing it to flex freely and rotate the sensor out of the path of the flights.

10.2. Radio Layout Recommendations

If you plan on using radios you need to carefully read this section before you begin installation.

Our system uses a Master/Slave communication protocol. The master initiates all communications and the slaves respond as requested.

10.2.1. Master vs. Slaves

The Master radio is located in the EchoSmart Controller, and initiates all communications. It is generally located nearest the customer's control system (SCADA) on a tank, near a sensor, or indoors.

The Slave radios are located in the EchoSmart Power supply units.

The radios in a network form a "mesh" with each other and calculate the fastest route to transfer data. If a radio transmission fails across that routing, the mesh will choose another route to transmit data. The re-meshing process can take a few seconds and can stop data flow temporarily. The best possible mesh is to have all slave radios transmitting directly to the master without having to route through one of the slaves. Despite this meshing ability there are still optimization techniques that should be understood.

10.2.2. Directional Issues

The radios used in the EchoSmart system have a distinct directional transmission pattern. As a result, some logical installation and equipment layout is recommended to achieve the most robust network possible.

As shown in Figure 10.1, the radiation and sensitivity is strongest from the front and rear faces of the radios and weakest from the edges.

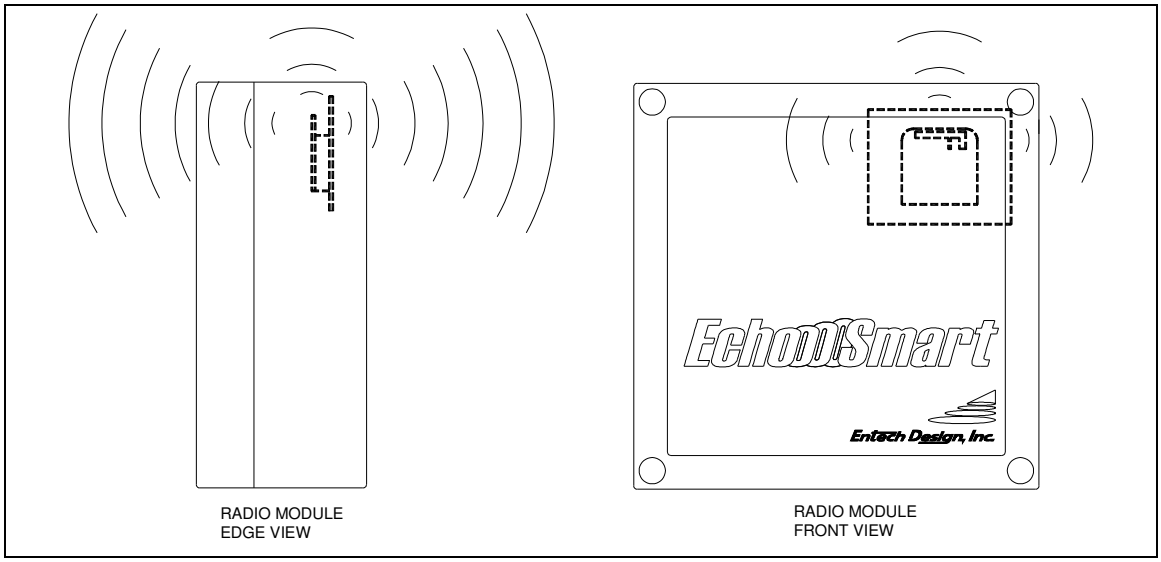

Figure 10.1: Radiation Pattern

10.2.3. Line of Sight

The radios are designed to communicate along a line sight of each other. Handrails and other small obstructions will not cause significant signal loss, but a building might. Other problems might exist if a slave or master is located in a low area, below grade level, or deep in a building. Also metal mounting plates supporting the master or slave, or metal siding on a building will cause signal loss. The use of metal mounting plates is discouraged.

10.2.4. Installation Recommendations

The following are recommendations that will help optimize radio performance:

1. **Optimal Directional layouts**
   One way to maximize radio communication is to ensure the master and slaves are “facing” each other. It is most critical that the slaves farthest from the master be positioned properly.

   Below are some examples of proper layouts:

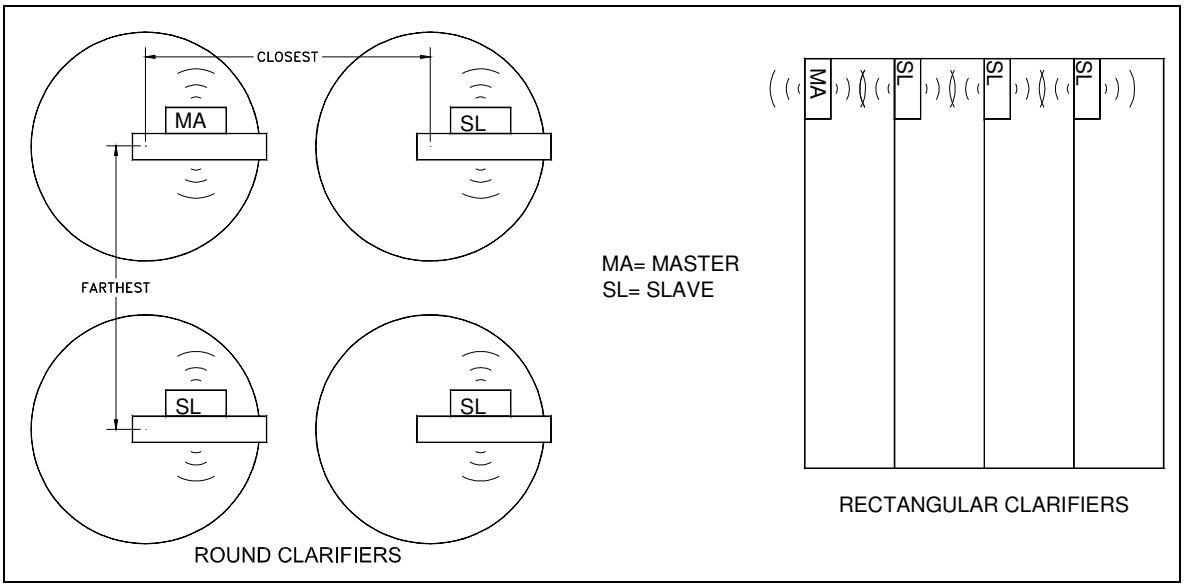

Figure 10.2: Radio Layout Recommendations

2. **Use of Antennas**
   A slave can generally be relocated on a clarifier to resolve a line of sight issue. If a slave cannot be relocated or in the case of a master in a building, an external antenna may be required. The external antenna is omni-directional and as such is not subject to the same directional problems as the standard radio. Generally an antenna on the master is sufficient; however some difficult installations may require antennas on some or all of the slaves.

3. **Remote master radio**
   If an external antenna cable greater than 6 feet in length is required, a remote master radio may be used. This will allow placement of the master radio up to 1000' from the master. The Remote radio can also have an external antenna installed to further enhance the signal strength. The remote radio can be powered by the master or by a local 110VAC source.

10.3. Troubleshooting

Loss of Echo

Comm Error

11. System Options

11.1. Sludge Level and Effluent Turbidity Sensor (ETS)

The ETS sensor combines ultrasonic sludge level and scattered light turbidity measurement technologies in a single sensor when used with an EchoSmart Controller (ESC) or Power Supply unit (ESP).

11.1.1. Application

This sensor is recommended for use in applications in which there is the combined need for sludge level and low range turbidity measurement at the location of the dual-purpose sensor. It is specifically recommended for use in water and wastewater treatment clarifiers and thickeners to continuously monitor sludge level and provide an indication of turbidity at the location of the sensor – typically near the supernatant effluent weir.

11.1.2. Principle of Operation

Sludge level measurements are provided by an ultrasonic sensor element that is integrated with an ESC or ESP.

Turbidity measurements are provided by an independent, 90º scattered-light turbidity sensor that is fully self-contained in the combined sensor housing. Sensors are factory calibrated from 0 – 50 NTU. Power to the sensor is provided by the ESC or ESP. The measurement indication is a proportional 4-20mA signal that is supplied to a user supplied device capable of interpreting the analog signal.

11.1.3. Sensor Cleaning

Sensing surfaces of the sludge level and effluent turbidity sensor are automatically cleaned by a fully integrated wiper system with replaceable rubber wiper blades. The wiper is operated by an internal motor.

11.1.4. Installation

The transducer has a ¾ in. NPT female thread connection to provide simple attachment to a user supplied mounting pipe or conduit. The connection is a direct replacement for the standard EchoSmart sensor. In general, locate the sensor in accordance with instructions for ultrasonic sensors as otherwise described in the Operation and Installation Manual. Additionally, the sensor may be located near an effluent weir to optimize the effluent turbidity measurement without adversely affecting sludge level measurements.

11.1.5. Connections

The sensor connection is made in the same manner as an EchoSmart sensor. Refer to Section 4.2.2, Figure 4.2, and Table 4.1 of the Operation and Installation Manual for further connection details when using in conjunction with an ESC or Section 5.1.2, Figure 5.1, and Table 5.1 when using with an ESP.

11.1.6. Turbidity Sensor Calibration

The ETS sensor is factory calibrated using a resin emulsion turbidity conforming solution.

11.2. Relays

Relays require an additional circuit board that is installed in the ESC.

11.2.1. General Overview

There are four (4) optional relays that can be utilized on one (1) ESC. Each relay is capable of monitoring the sludge level or turbidity (when applicable) and can be assigned to separate sensors, or multiple relays can be assigned to one sensor.

11.2.2. Operation (Figure 11.1)

The relay controls are accessed by pressing the *Set Up Relays* soft key from the Controller Setup Display (Figure 4.12).

In order for a relay to be operational, the status must be set to ON. The sensor associated with each relay is designated below the "Status" setting. Each relay is capable of monitoring the sludge level or the turbidity value (when installed) by selecting the desired setting under the "Assign to" option. The "Enable >" parameter determines the value at which the relay will be energized and change states while the "Disable <" determines the value at which the relay will de-energize and change states.

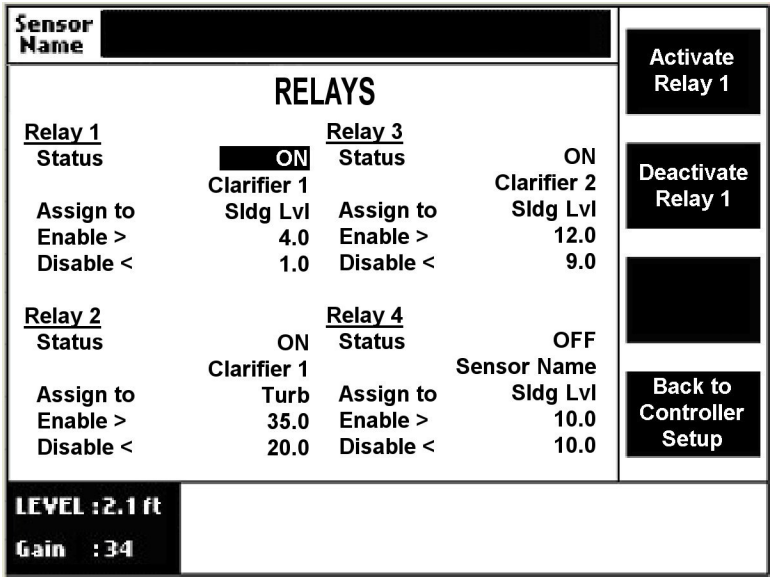

Figure 11.1: Relays Display

11.2.3. Cabling and Connections for Relays (Figure 11.2 and Table 11.1)

This section pertains to the physical layout and terminal connections for the relays.

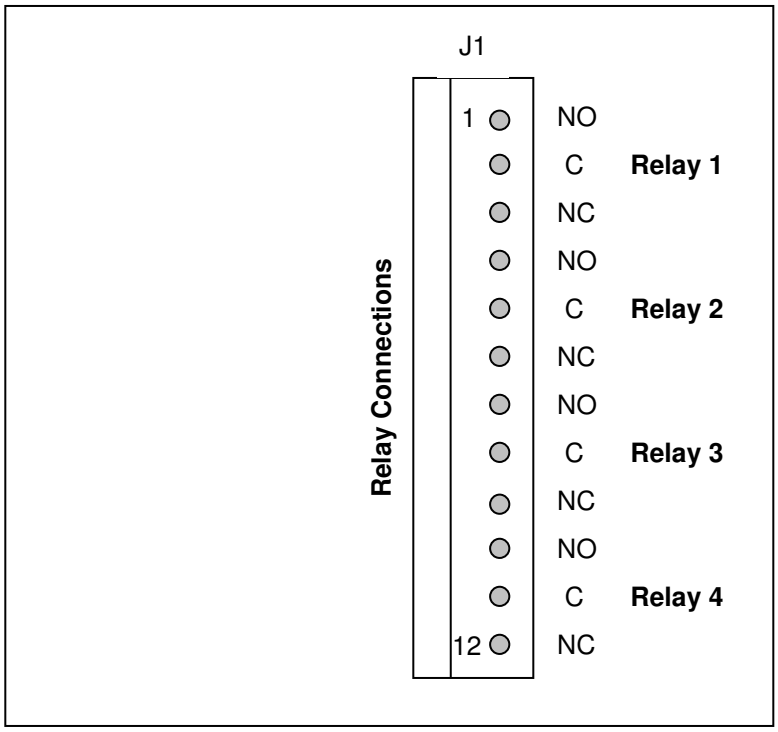

Figure 11.2: Connections for Relay Board

Table 11.1: Connections

Relay Connections (J1)		
Pin #	*Relay*	*Description*
1	1	Normally Open
2		Common
3		Normally Closed
4	2	Normally Open
5		Common
6		Normally Closed
7	3	Normally Open
8		Common
9		Normally Closed
10	4	Normally Open
11		Common
12		Normally Closed

12. Warranty

ONE YEAR PRODUCT WARRANTY

Entech Design, Inc. products will be replaced, put in good operating condition, or the purchase price refunded, at the option of Entech Design, Inc., free of charges except transportation, if defective in their manufacture, labeling, packaging, or shipping, and if notice of said defect is received by Entech Design, Inc. within one year from the date of shipment. The cost of such replacement, repair, or refund of purchase price shall be the exclusive remedy for any breach of warranty, and Entech Design, Inc. shall not be liable to any person for consequential damages or injury or commercial loss resulting from any breach of warranty of fitness for a particular purpose, and makes no other warranty, express or implied, including implied warranty arising from course of dealing or usage of trade.

Warranty for Auto Clean Wiper Transducer is void if the wiper blade is rotated by hand.

13. Quick Start Guide