EchoSmart

Operation & Installation

Manual

Version A2.3

EchoSmart Sensor **EchoSmart Controller**

EchoSmart Power Supply Unit

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Table of Contents

Table of Figures

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), EchoSmart Power Supply Unit (ESP), and EchoSmart 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:

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 are to 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.

For **CE and safety compliance**, adequate grounding and shielding is required. All EchoSmart system cables are to be installed in metal conduit that is properly grounded and shielded utilizing EMC compliant methods. Each conduit should be individually shielded and grounded. Where metal

enclosures are supplied, each enclosure should be grounded and shielded to each individual conduit.
External chassis components cannot 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 Analytical Technology, 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. Equipment is optionally available and can be ordered for use with 24VDC power. Caution must be taken to supply main power in the form for which the equipment is designed.

A protective earth should be provided for all installations.

WARNING ⚠

If this equipment is used in a manner not specified by Analytical Technology, 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 enclosure is made of epoxy-filled ABS. Some sensor models include additional wetted parts. Make sure that the model which you have selected is chemically compatible with the application media, temperatures, and pressures to which it will be exposed.

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 digital sensors in an architecture that locates microprocessor signal control, enhancement, and interpretation in the ultrasonic sensor rather than in a remote analyzer. The sensor is 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 an indication of the dispersed solids Level above the primary interface. Optional sensors are available that additionally provide surface back scatter turbidity measurements.

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 as discussed below.

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 or wireless Field Network. In either arrangement, the network is fully integrated and requires no software integration by the customer.

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.

1.3. Network Integrated to Customer Data Acquisition and Controls

EchoSmart Field Networks can be integrated to the customer's data acquisition and control system via two-wire RS-485, Modbus RTU protocol. See Section 8.2.1 for additional information.

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. Sensors with optional turbidity measurement are available for applications in which a 0-50 NTU turbidity indication at the location of the sensor is desired. 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.

Instruments are also effective in granular media gravity and pressure filters for conditional backwash control. Measurements include media level and expansion, and above filter turbidity (backwash turbidity).

2.2. Industrial Wastewater and Raw Water Treatment

EchoSmart is 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 Analytical Technology, 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.

Sensors with a 90° surface back-scatter turbidity meter integrated into the ESS are available. This option can be beneficial and cost effective in applications where a turbidity measurement at the location of the sensor is desired. It is often used in secondary clarifiers and similar applications to alert process upset conditions. It is also employed in water and wastewater treatment media filters as part of an effective conditional backwash control system.

3.2. Specifications

POWER REQUIREMENT	15VDC Standard Sensor: 2.4W Wiper Sensor: 3W
RANGE	1.0 to 32 ft. (0.305 to 10.0 m)
SENSOR MEAS. RESOLUTION	0.1 Unit of measure
ACCURACY	0.2 in at 10.0 ft (5mm at 3.05m)
OPERATING TEMPERATURE	34 to 125 °F (1 to 52 °C)
CONFIGURATION BACKUP	Settings stored in FLASH memory

SENSOR CONSTRUCTION	IP68, ABS and epoxy Stainless steel and rubber (wiper only)
TURBIDITY (OPTIONAL)	Measurement Principle: 90-degree scattered light, pulsed LED Range: 0 to 50 NTU
WEIGHT	Standard Sensor: 2.25 lb (1.02 kg) Wiper Sensor: 2.75 lb (1.25 kg) Wiper Sensor with Turbidity: 2.75 lb (1.25 kg)
CERTIFICATIONS	CE

4. EchoSmart Controller (ESC)

The EchoSmart Controller allows for programming and 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 1 points out the functional sections of the screen and the location of the Soft Keys and Navigation Keys.

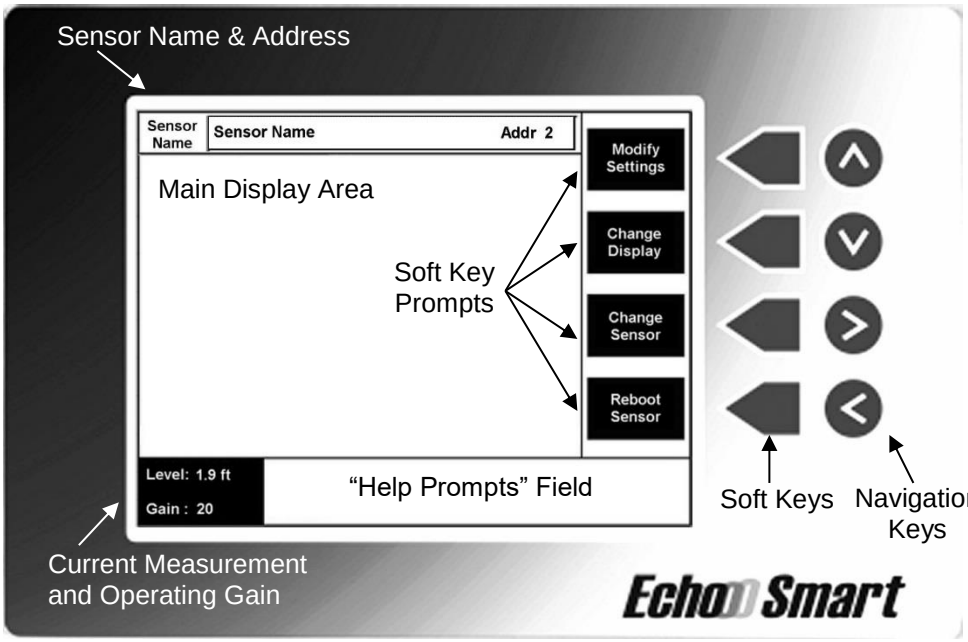


Figure 1: LCD Display

4.1.1. Operator Interface Overview

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 20). Use the Navigation Keys to select the desired sensor and press *Select Sensor*.

Current Measurement and Operating Gain

The current measurement, operating gain (signal amplification), and turbidity value (when applicable) are conveniently available in the lower left corner of all displays. Additionally, messages regarding external communication (see Section 8.2) taking place and error messages (see Section 10.2) associated with the active sensor are displayed in this section.

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.

4.1.3. Screen Navigation Overview

An overview of the organizational structure of the available screens is shown in Figure 2 below.

Note: Functionality for the Relay Setup and Digital to Analog Converter Setup requires purchase of the associated hardware.

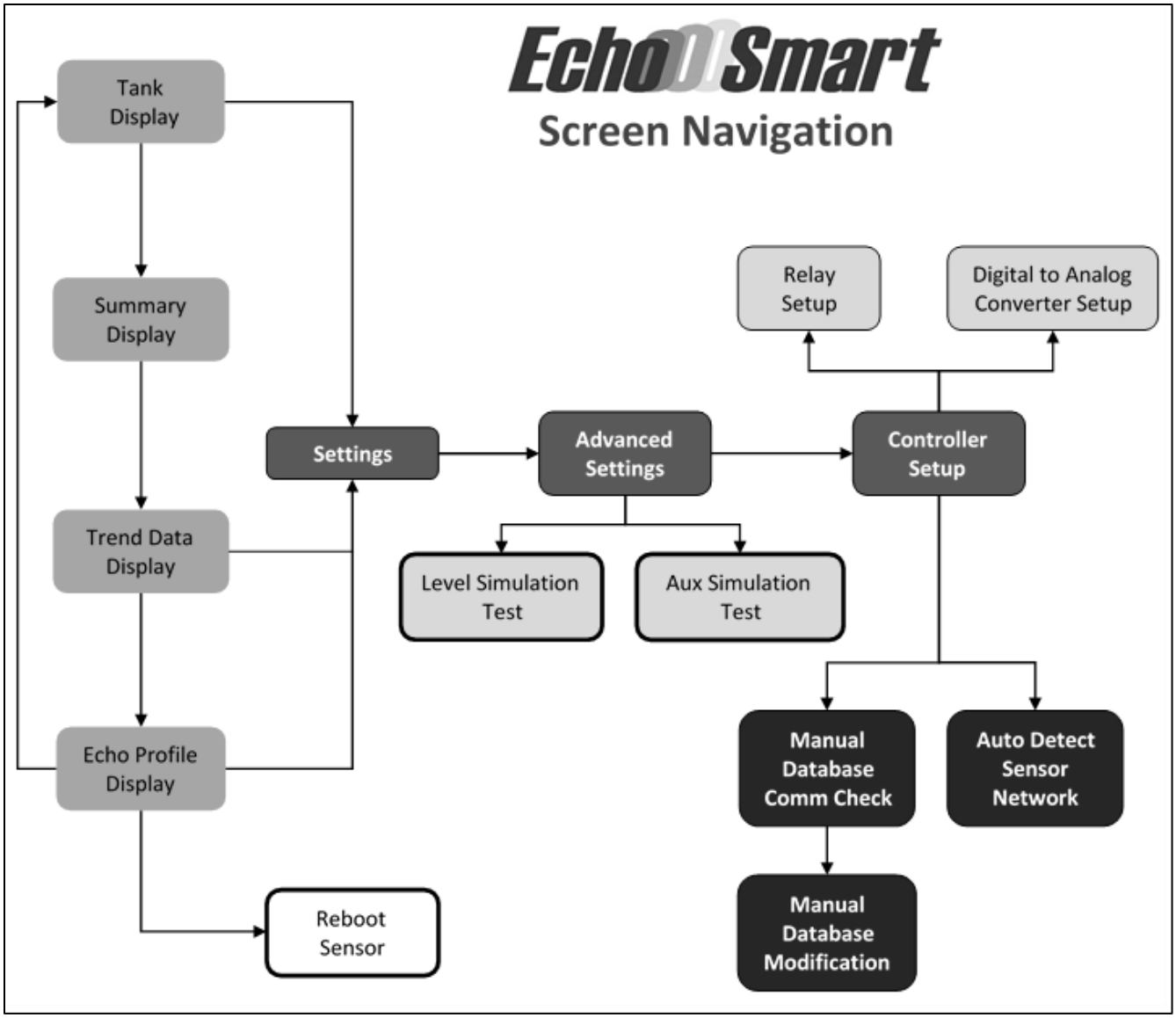


Figure 2: Screen Navigation Overview

4.2. Specifications and Connections

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. Specifications

INPUT POWER	100-240 VAC, 50/60 Hz – 1.5A, 65W Optional 24 VDC: 19 – 42 VDC
SUPPLY CABLE	10-18 AWG, -40 to +140 F

FUSE	1.25A 250V 5x20mm T-lag UL approved fuse
ANALOG LOOPS	(2) 4-20mA Outputs 15 – 24 VDC (provided by ESC for local sensor)
AMBIENT TEMPERATURE	-40 to +140 °F (-40 to +60 °C)
DISPLAY	Graphical backlit monochrome screen Resolution: 320 x 240 pixels Viewing Area: 2.6 x 3.45 in (92 x 122 mm)
REPORTED MEAS. RESOLUTION	1.0 (in & cm), 0.1 (ft), 0.01 (m)
RF MODULE (OPTIONAL)	900MHz frequency band Self-healing mesh network Approvals: FCC Part 15C, Industry Canada
RELAYS (OPTIONAL)	(4) Relays: 10A @ 250 VAC; 10A @ 30VDC
ENCLOSURE	NEMA 4X, IP65; Polycarbonate
WEIGHT	Approx. 3.0 lb (1.36 kg) depending on configuration
CERTIFICATIONS	CE

Caution must be taken to supply main power in the form for which the equipment is designed.

4.2.2. Connections Overview

The ESC circuit board contains four screw-terminal connectors as well as additional plug-in connectors as shown in Figure 3. 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 3 below. The table in Figure 4 contains a functional description of the screw terminal connectors.

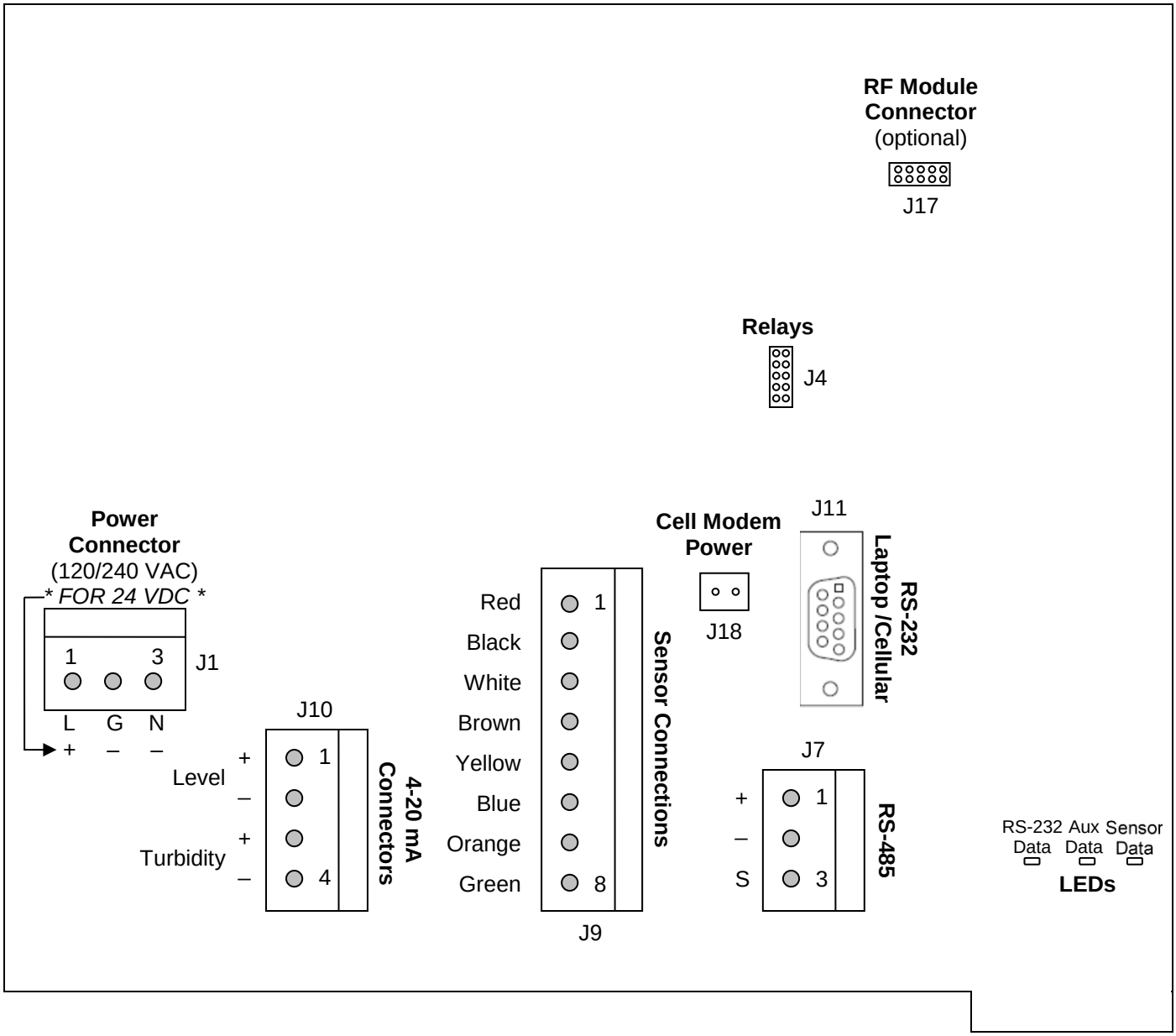


Figure 3: Connections for Controller

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 (–)		
*** FOR 24 VDC * (J1)**				5	4-20mA Level		
1	+			6	4-20mA Level		
2	–			7	4-20mA Turbidity		
3	–			8	4-20mA Turbidity		

Figure 4: Table of Connections for Controller

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 loops are internally powered, grounded, and galvanically isolated.

4.3. Initializing and Configuring EchoSmart System

IMPORTANT: Disconnect any outside RS-485 device prior to initiating Controller Setup to avoid communication errors.

4.3.1. Initial Controller Setup Display

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 also Section 4.3.2). 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 4.3.2 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 and address.

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

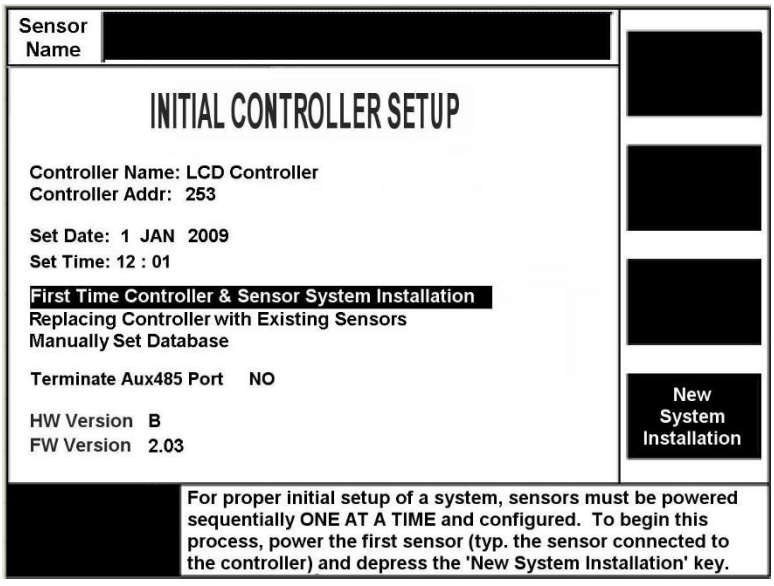


Figure 5: Initial Controller Setup

4.3.2. First Time Controller & Sensor System Installation

If this is a new installation, select First Time Controller & Sensor System Installation and press the Soft Key next to New System Installation (Figure 5). 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 6).

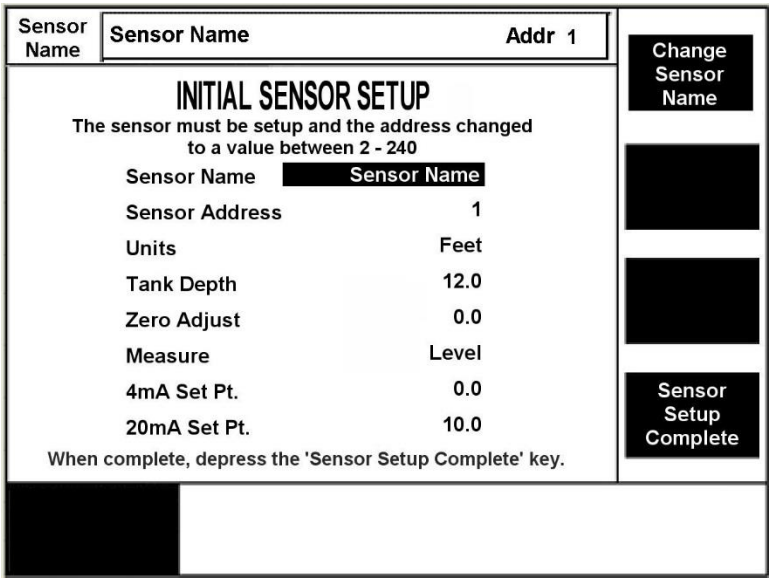


Figure 6: Initial Sensor Setup

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.

CAUTION: All sensors are supplied from the factory with the Sensor Address set at 01. A unique address must be assigned to each sensor as it is added to the network (powered ON). This procedure allows the Controller to establish communication and provide a unique address for each sensor as it is added to the network. Failure to follow this procedure will result in multiple sensors having the same address and will prevent communication.

Press the Soft Key next to Sensor Setup Complete to finalize setup of the sensor. The Power Next Sensor Screen (Figure 7) will appear. Apply power to the EchoSmart Power Supply Unit connected to the next sensor and repeat the steps above.

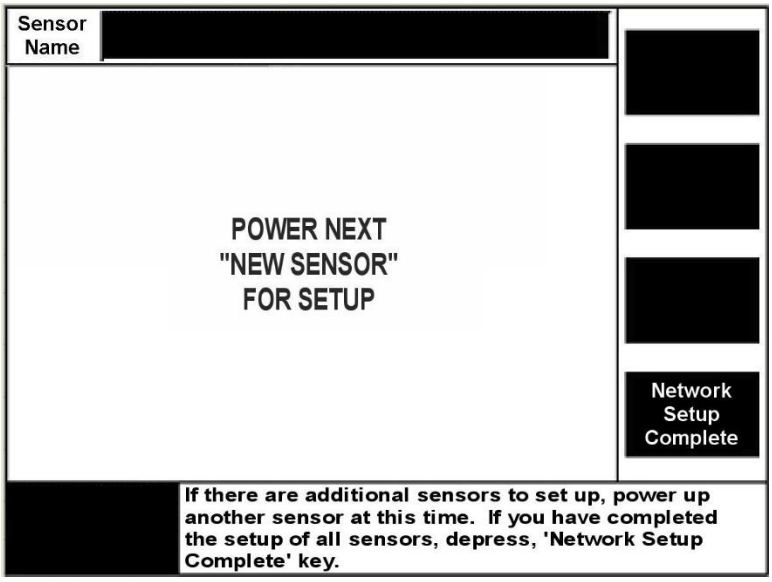


Figure 7: Power Next Sensor

After all sensors have been initialized, Press the Soft Key next to the Network Setup Complete prompt (Figure 7). The Controller will then begin to poll all the EchoSmart Sensors and display current measurements.

See also the Quick Start Guide in Section 12 of this manual for step-by-step instruction on configuring a single sensor or a network of sensors.

4.3.3. Replacing a Controller with Existing Sensor(s)

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.

4.4. 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.

4.4.1. Echo Profile Display

The Echo Profile Display (Figure 8) 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*.

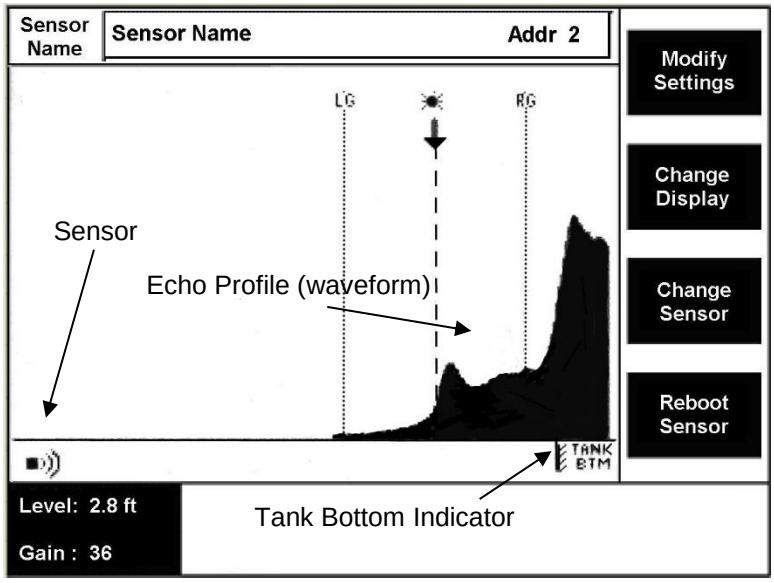


Figure 8: Echo Profile Display

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

The horizontal x-axis is a distance axis based on the span between the sensor (lower, left side of the screen) and the bottom of the tank (lower, 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.

4.4.2. Sensor Register Displays

This display consists of a table that shows the name of each sensor and its Current Measurement and Operating Gain value. If the Controller is communicating with four or fewer sensors, information is presented as shown in Figure 9.

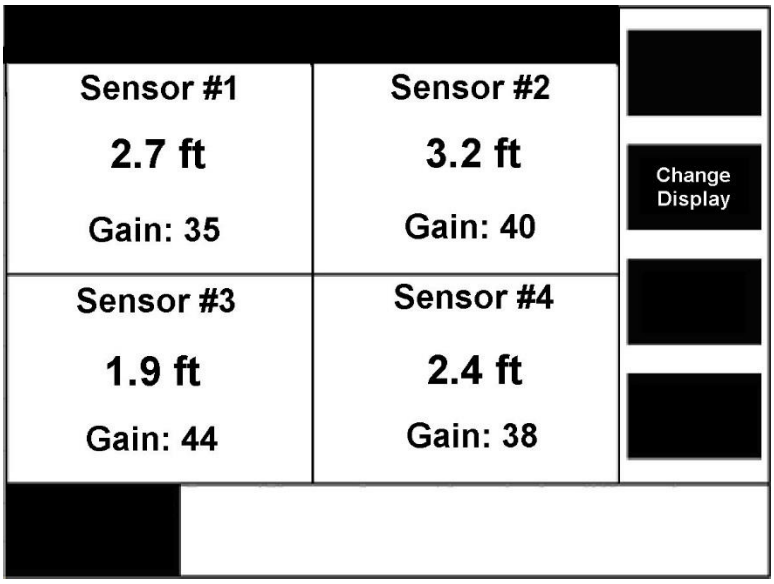


Figure 9: Four Sensor Field Network Display

With five or more sensors, information is presented as shown in Figure 10.

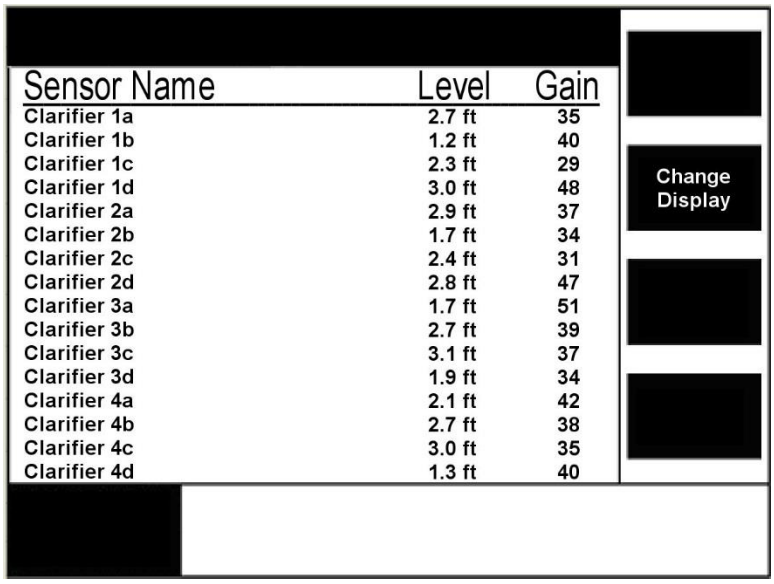


Figure 10: Multiple Sensor Field Network Display

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

4.4.3. Tank View Display

The Tank View Display (Figure 11) 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.

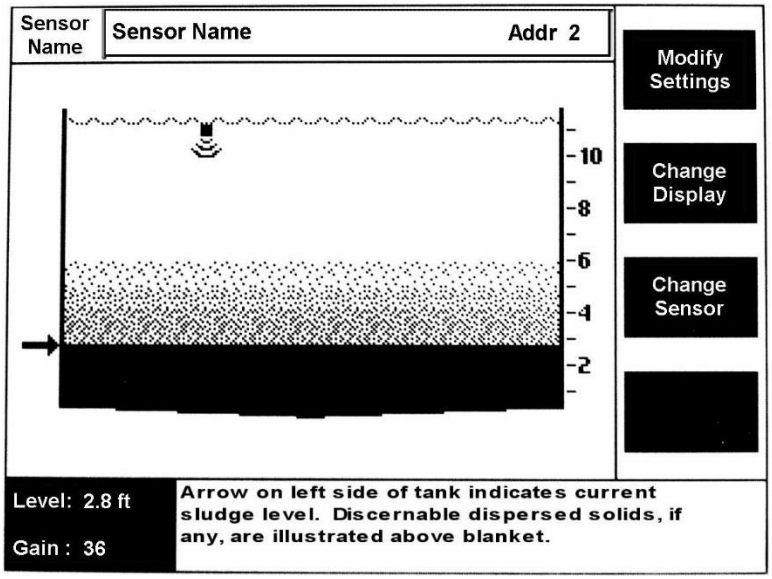


Figure 11: Tank View Display

The Tank View Display is enabled at the Modify Settings Display. Optional diagrams are available to correspond with the specific application (Figure 12).

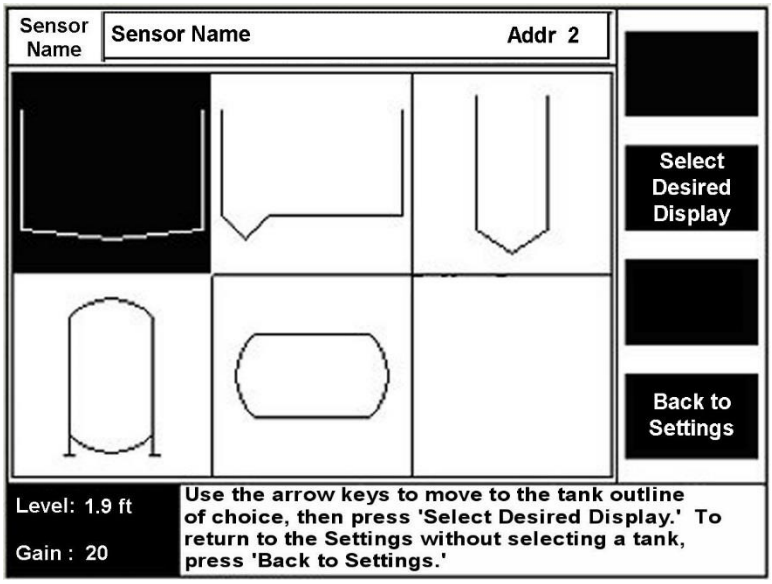


Figure 12: Tank Options

4.4.4. Historical Trend Display

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. Newest data is reported on the right side of the screen.

The Historical Trend Display (Figure 13) provides a graphical illustration of stored measurements for the selected sensor. The user may choose to view from one to seven days of data.

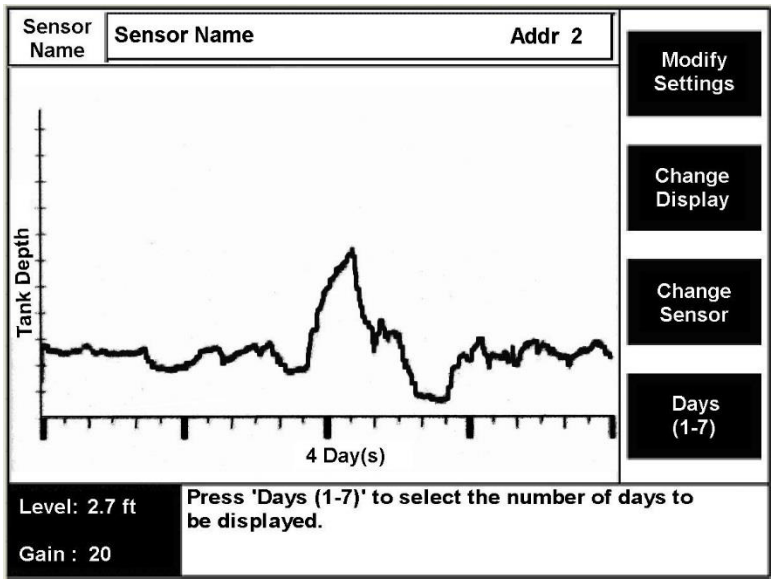


Figure 13: Historical Trend Display

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

4.4.5. Modify Settings Display

This display (Figure 14) 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 9.1.

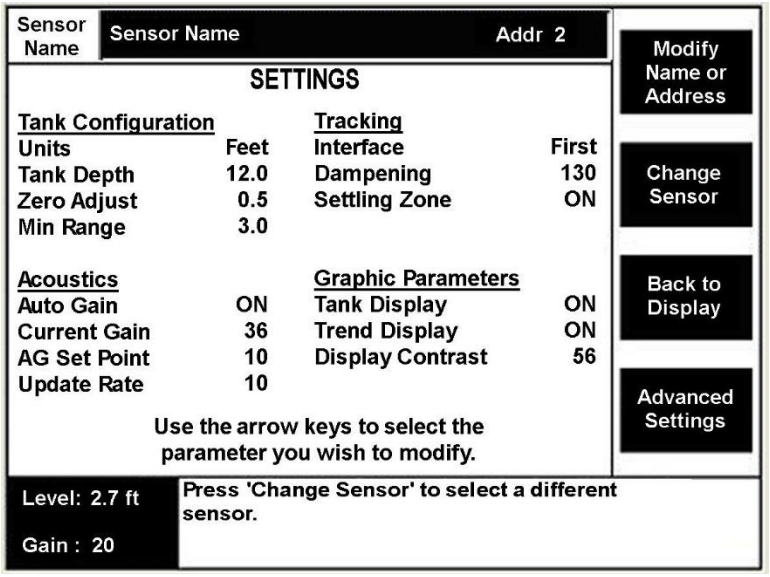


Figure 14: Modify Settings Display

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 (Figure 15).

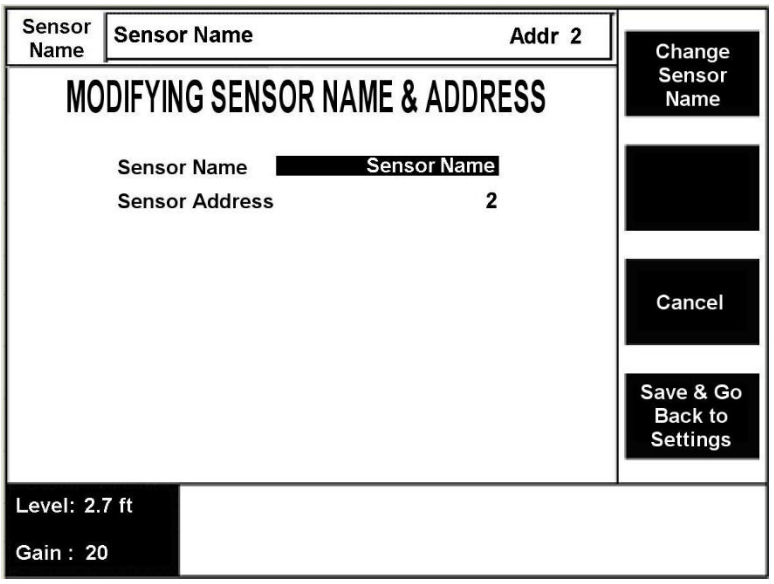


Figure 15: Modifying Sensor Name and Address Display

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

4.4.6. Advanced Settings Display

This display (Figure 16) 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.

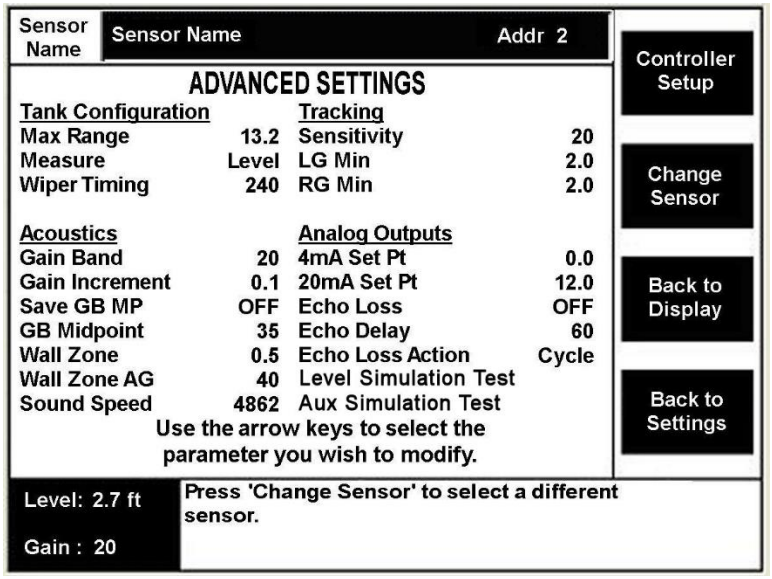


Figure 16: Advanced Settings Display

Descriptions of parameter functions are found in Section 9.2.

4.4.7. Controller Setup Display

The purpose of this display (Figure 17) is to change the Current Date and Time, and to initiate either a manual or automatic establishment of the sensor network. Actual Hardware and Firmware version will be displayed on the setup screen.

Setup screens for the optional relays and optional Digital to Analog Converter are available from this screen. The functionality of these options requires the purchase of the associated hardware.

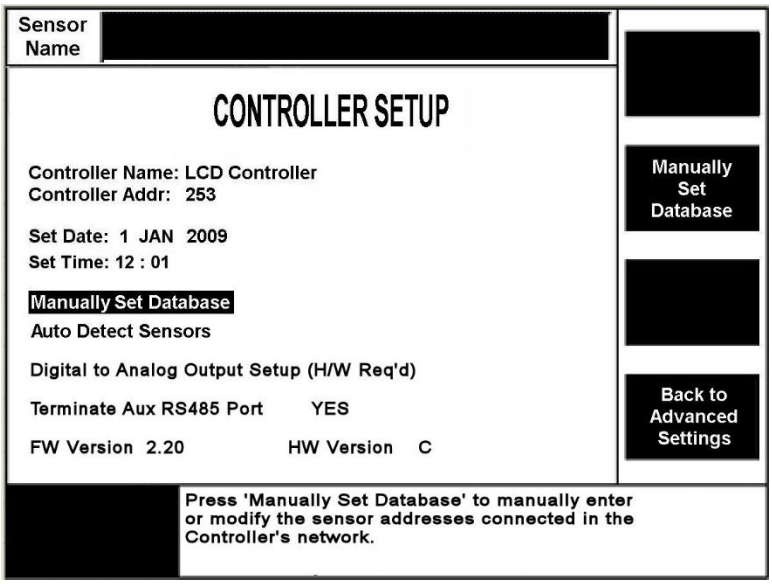


Figure 17: Controller Setup Display

Auto Detect Sensors begins a search for sensors that are directly connected to the Controller and are part of a Field Network of sensors. This option is used to initialize a new instrument and to add sensors from an existing network.

Manually Set Database (Figure 18) allows the user to specify sensor addresses and establishes the order in which the addresses will appear in the Sensor Register Display. Manually setting the database causes the Controller to persist in attempts to detect listed sensors in cases where Auto Detect has failed to locate all sensors.

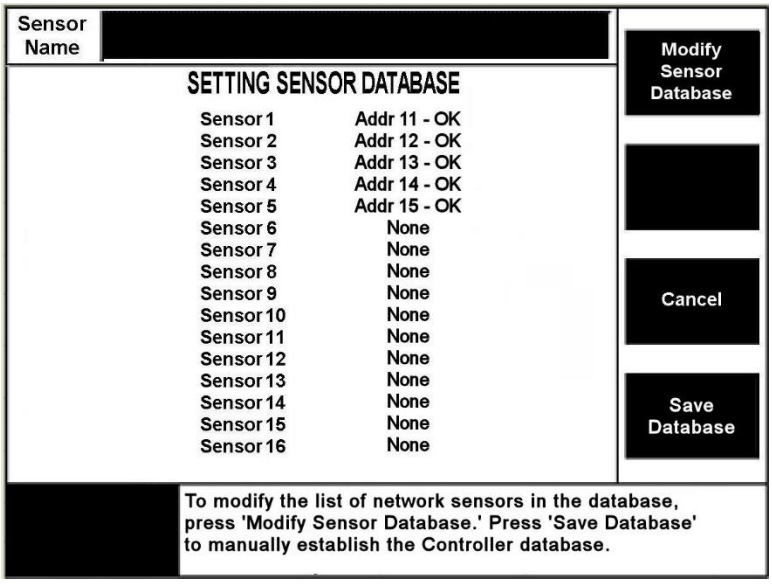


Figure 18: Sensor Database Display

When *Manually Set Database* is selected, a quick check of the network sensors is performed. When communication is verified, "OK" is placed next to the sensor address. If communication cannot be verified, "??" is displayed next to the address.

Any needed modifications to the database can be performed once *Modify Sensor Database* is selected. From the Modifying Sensor Database Display (
Figure 19), network addresses to be polled by the Controller can be changed, the sensor display order can be modified, and a sensor can be deleted.

IMPORTANT**:** Changes made from this menu are ONLY used to modify the existing network of sensor addresses to be polled by the Controller and DOES NOT change the sensor's address. Any changes to the sensor address parameter contained in the sensor must be performed from the Modifying Sensor Name and Address screen (Section 4.4.5).

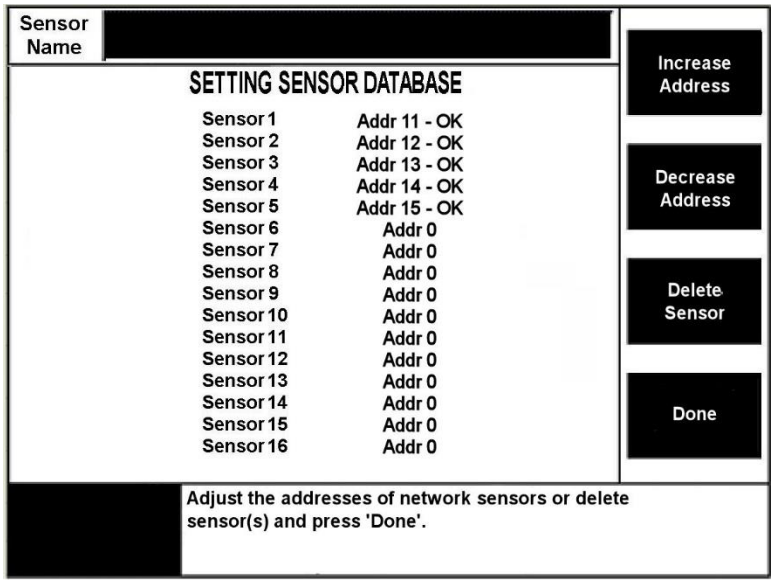


Figure 19: Modifying Sensor Database Display

Once desired changes are complete, press *Done* to return to the Sensor Database Display. If any changes were made, the *Save Database* key (Figure 18) must be pressed for the modifications to take effect.

After initiating either the *Auto Detect Sensors* or the *Manually Set Database* command, the Help Prompt field (lower right portion of display area) will report the number of sensors found, followed by the number of sensors validated. The display will then redirect to the Echo Profile screen and begin polling all the sensors in the database.

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

4.4.8. Sensor Selection Menu

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 20).

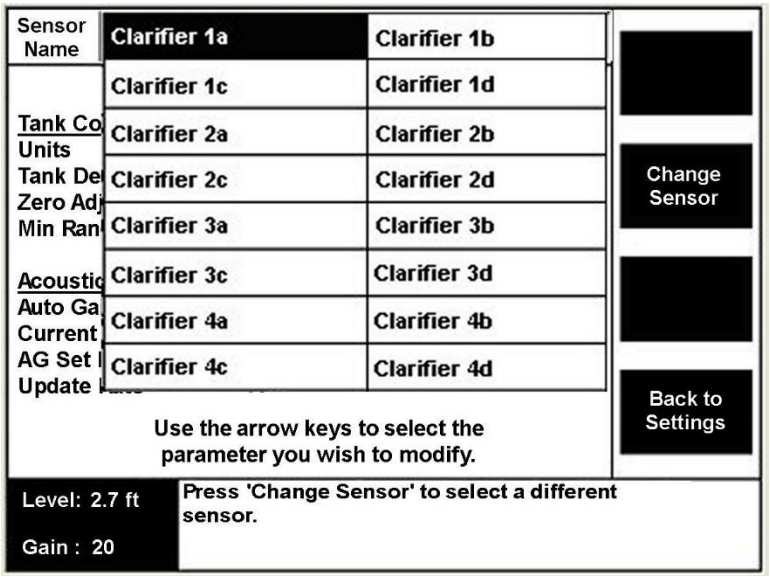


Figure 20: Sensor Selection Drop-down Window

4.5. Automatic Initialization and Reboot

EchoSmart performs automatic initialization 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) and determines current measurement values and signal outputs. It is advisable to re-initialize a sensor that has been out of service or has been operating while not submerged in the process water. Re-initializing the sensor after a process upset has stabilized will quickly return the sensor to normal operation.

5. EchoSmart Power Supply (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. Specifications and Connections

This section pertains to the physical layout of the ESP terminal connectors and how they are implemented. 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. Specifications

INPUT POWER	100-240 VAC, 50/60 Hz – 1A, 20W Optional 24 VDC: 18 – 36 VDC
SUPPLY CABLE	10-18 AWG, -40 to +140 F
FUSE	0.250A, 250V 5x20mm T-lag UL approved fuse
ANALOG LOOPS	15 – 24 VDC (provided by ESP for local sensor) (2) 4-20mA Outputs
AMBIENT TEMPERATURE	-40 to +140 °F (-40 to +60 °C)
RF MODULE (OPTIONAL)	900MHz frequency band Self-healing mesh network Approvals: FCC Part 15C, Industry Canada
ENCLOSURE	NEMA 4X, IP65; Polycarbonate
WEIGHT	Approx. 1.5 lb (0.68 kg)
CERTIFICATIONS	CE

Caution must be taken to supply main power in the form for which the equipment is designed.

5.1.2. Connections Overview

The ESP circuit board contains four screw-terminal connectors as well as additional plug-in connectors as shown in Figure 21. 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 by color code as shown in Figure 21 below. The table in Figure 22 contains a functional description of the screw terminal connectors.

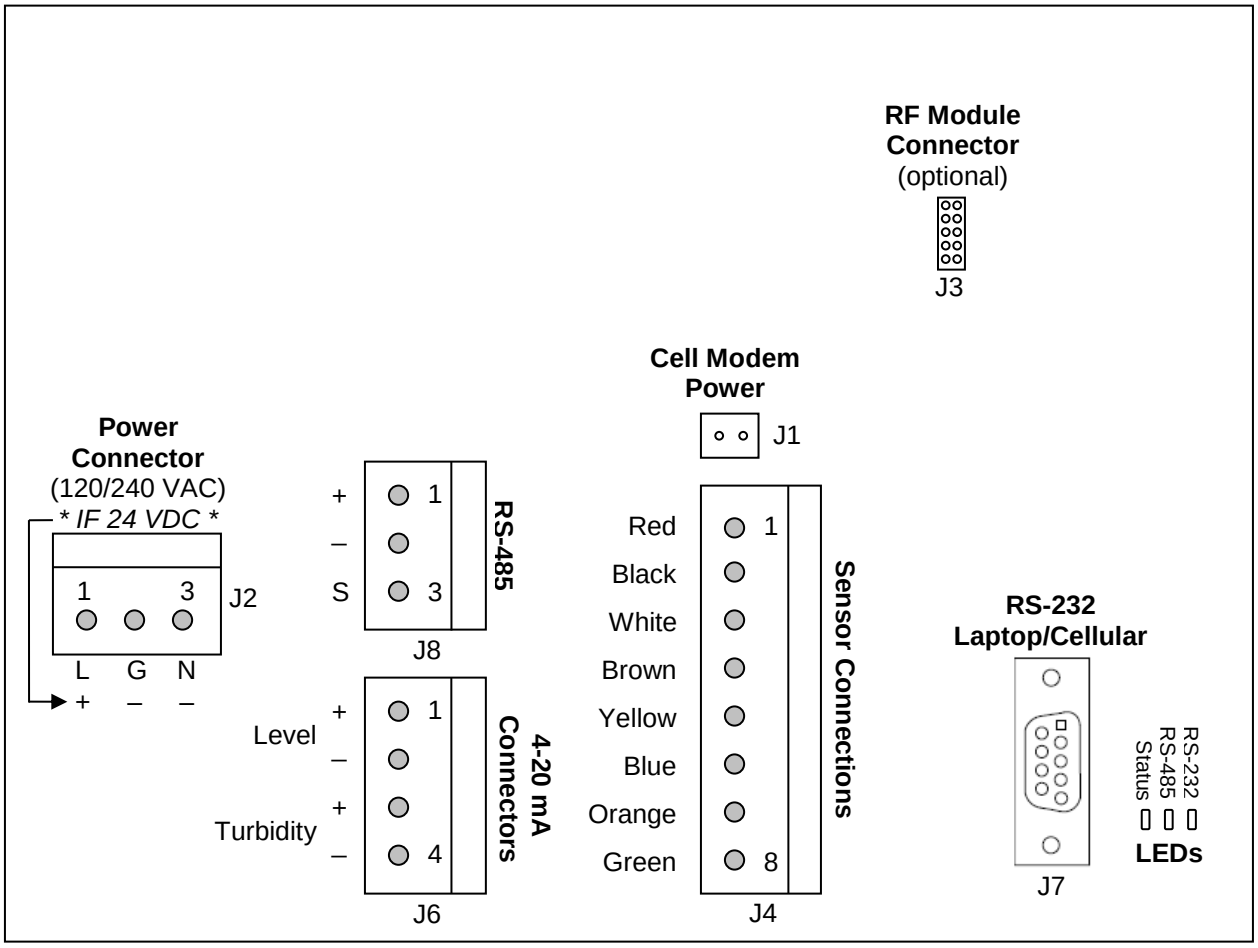


Figure 21: Connections for Power Supply

Power Connector (J2) FOR 100-240 VAC		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 (–)		
*** FOR 24 VDC * (J2)**				5	4-20mA Level		
1	+			6	4-20mA Level		
2	–			7	4-20mA Turbidity		
3	–			8	4-20mA Turbidity		

Figure 22: Table of Power Supply Connections

Notes:

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

4-20mA current loops are internally powered, grounded, and galvanically isolated.

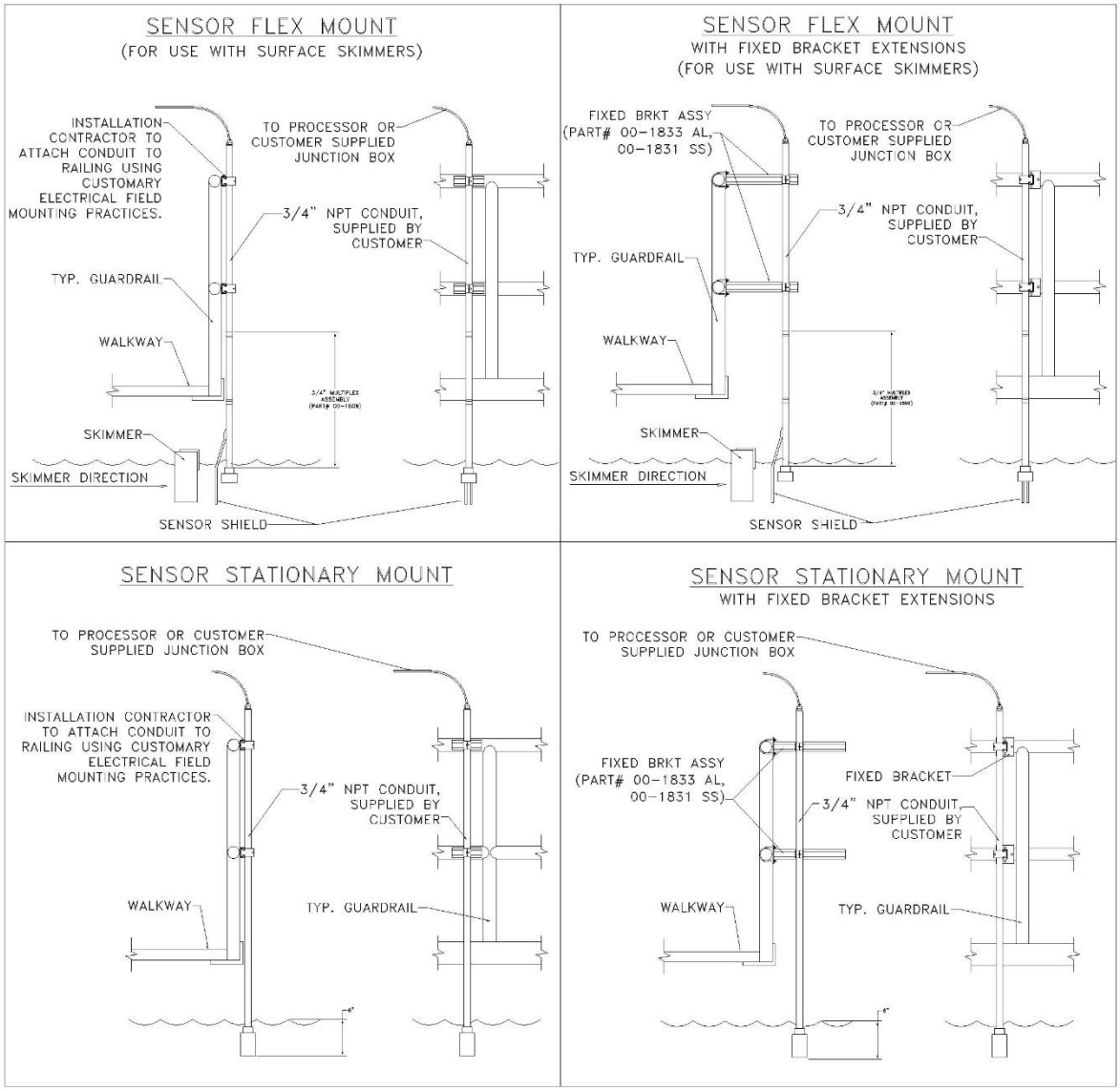
6. Installation of Equipment

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 (Multi-flex Assembly, Part No. 00-1809).

Orient the sensor such that the path 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 23.



Sensor Installation Notes:
1. Position sensor shield such that it makes first contact with surface skimmer. Ensure the skimmer structure does not contact the sensor or the Multiflex assembly above the sensor shield.
2. Position sensor so that it is fully submerged under water (typically 6" below surface).
3. See Multiflex Assembly drawing for detail
4. See Fixed Bracket Assembly drawing for detail

ANALYTICAL TECHNOLOGY INC. 1-800-959-0298	
SCALE: N/A	DRAWN BY: TODD McCLENDON
DATE: 10-26-20	
SENSOR INSTALLATION	
ECHO SMART	DRAWING NO.

Figure 23: EchoSmart Sensor Installation 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 Air/Gas Bubbles and Turbulence

Avoid locating the sensor in areas where there are high concentrations of air/gas bubbles or suspended solids in the supernatant. When possible, select sensor locations to avoid these conditions.

6.2.5. Typical Circular Clarifier

The recommended sensor location for most circular clarifiers is outlined in Figure 24 below.

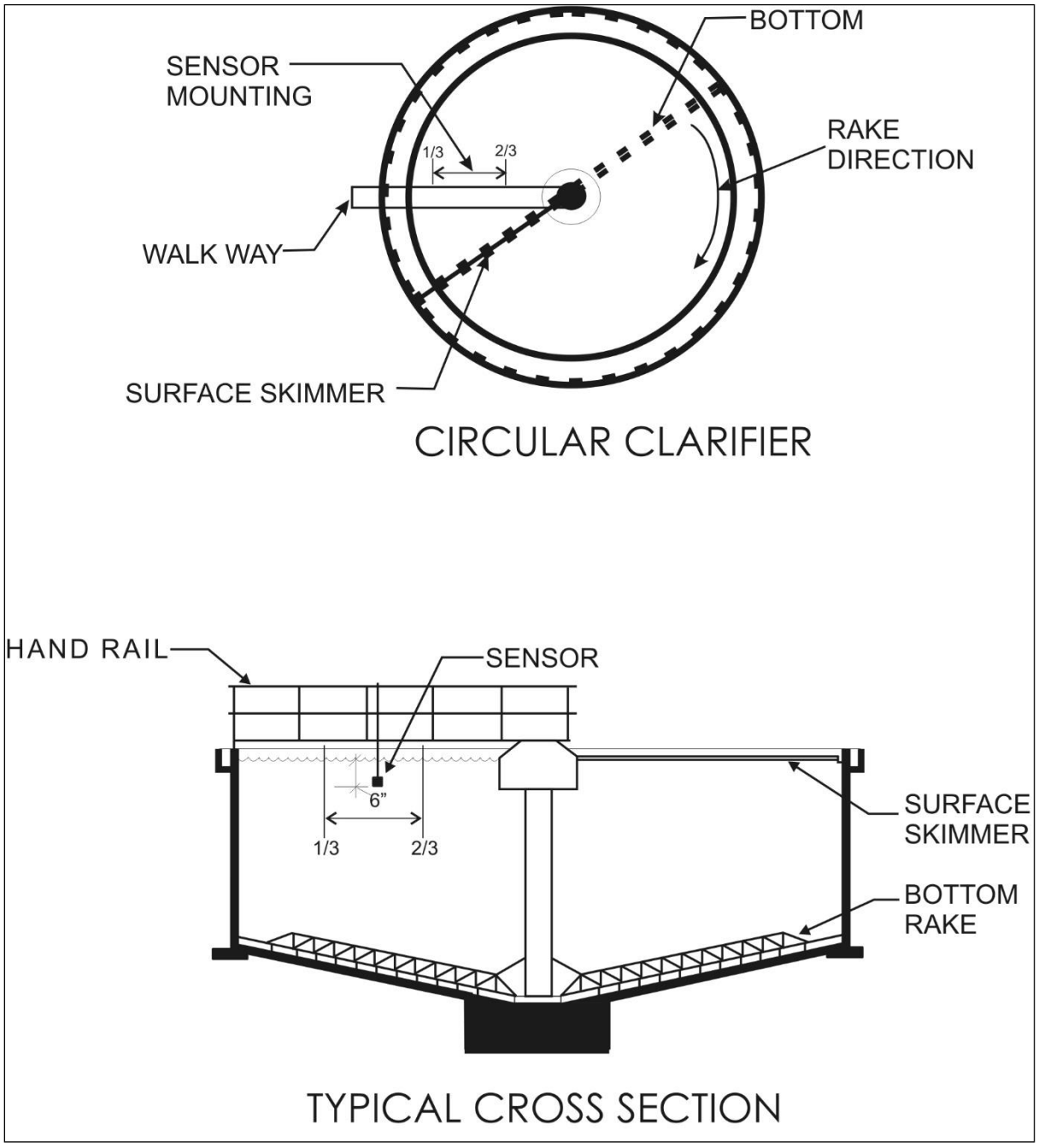


Figure 24: Typical 1/3 – 2/3 Location in Circular Clarifier

6.2.6. Typical Rectangular Clarifier

Sensors may be located along the length of the clarifier or in the area of the sludge sump. Care should be taken to consider inlet flow and the design of the sludge collection system. Contact Analytical Technology factory service for specific recommendations regarding sensor location to assure optimal performance.

6.2.7. Sensors in Applications with Surface Skimmers

Surface skimmers are common in many municipal and industrial clarifiers and thickeners. Skimmer sweep arms typically pass in the area of installed sensors and special mounting equipment is required. The Sensor Multi-flex Assembly provides a safe, durable and maintenance-free solution in most installations. The standard Multi-flex Assembly must be installed in accordance with manufacturer recommendations and cannot be used if the skimmer sweep rises more than six inches above the operating water line in the application or in cases where multiple structural members or supports prevent sensors from returning to the water without striking one of these objects. Special mounting arrangements and assemblies are available for virtually all applications with surface skimmers. Contact Analytical Technology for additional information.

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.

Typically, locate the Controller or Power Supply Unit within 20.0 ft. of the sensor, as illustrated in Figure 25 and Figure 26 below. Sensor cables may be extended at water-tight junction boxes using manufacturer specified cables or by special order of sensors with continuous cable of longer lengths.

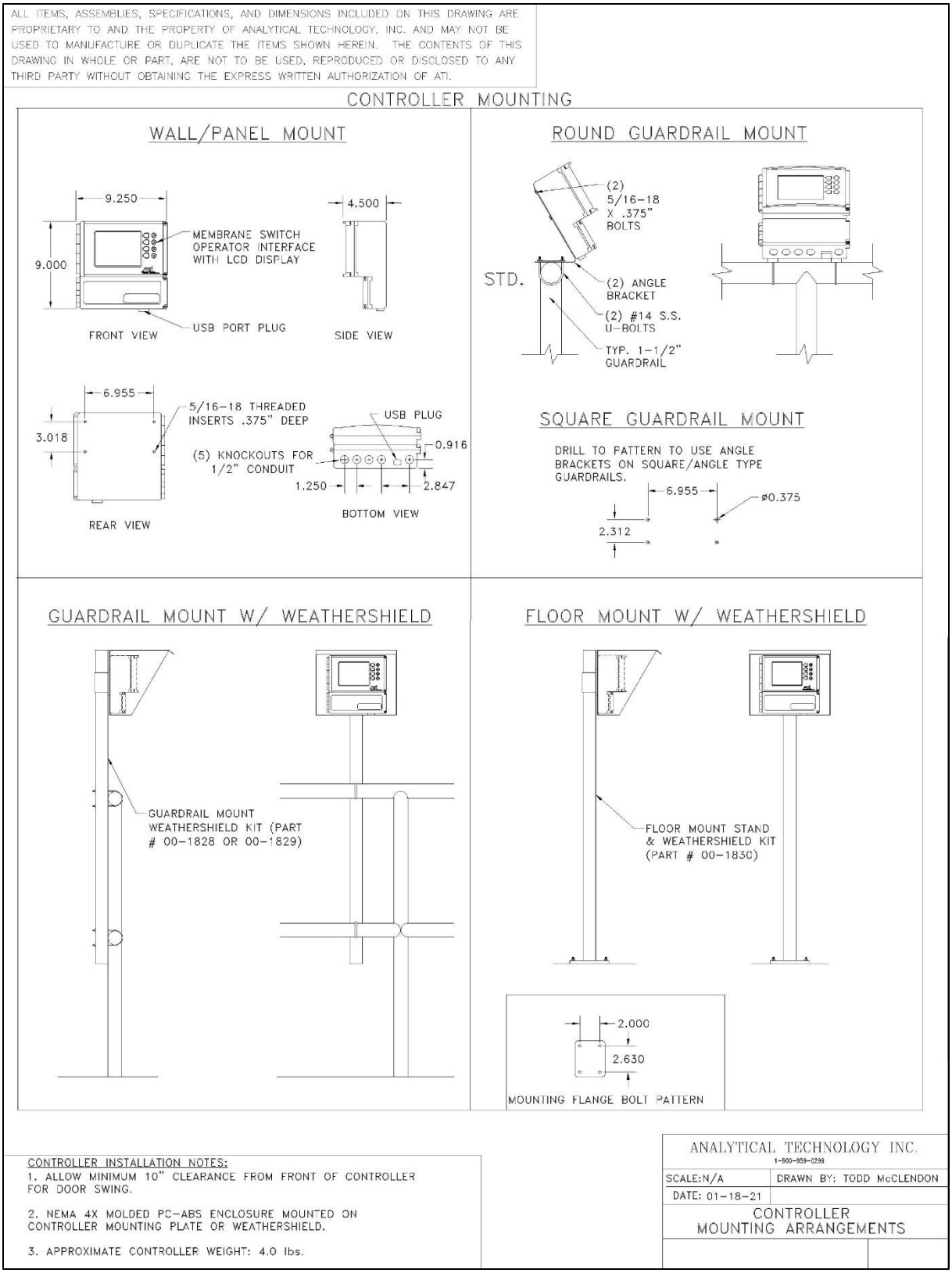


Figure 25: Controller Installation Drawing

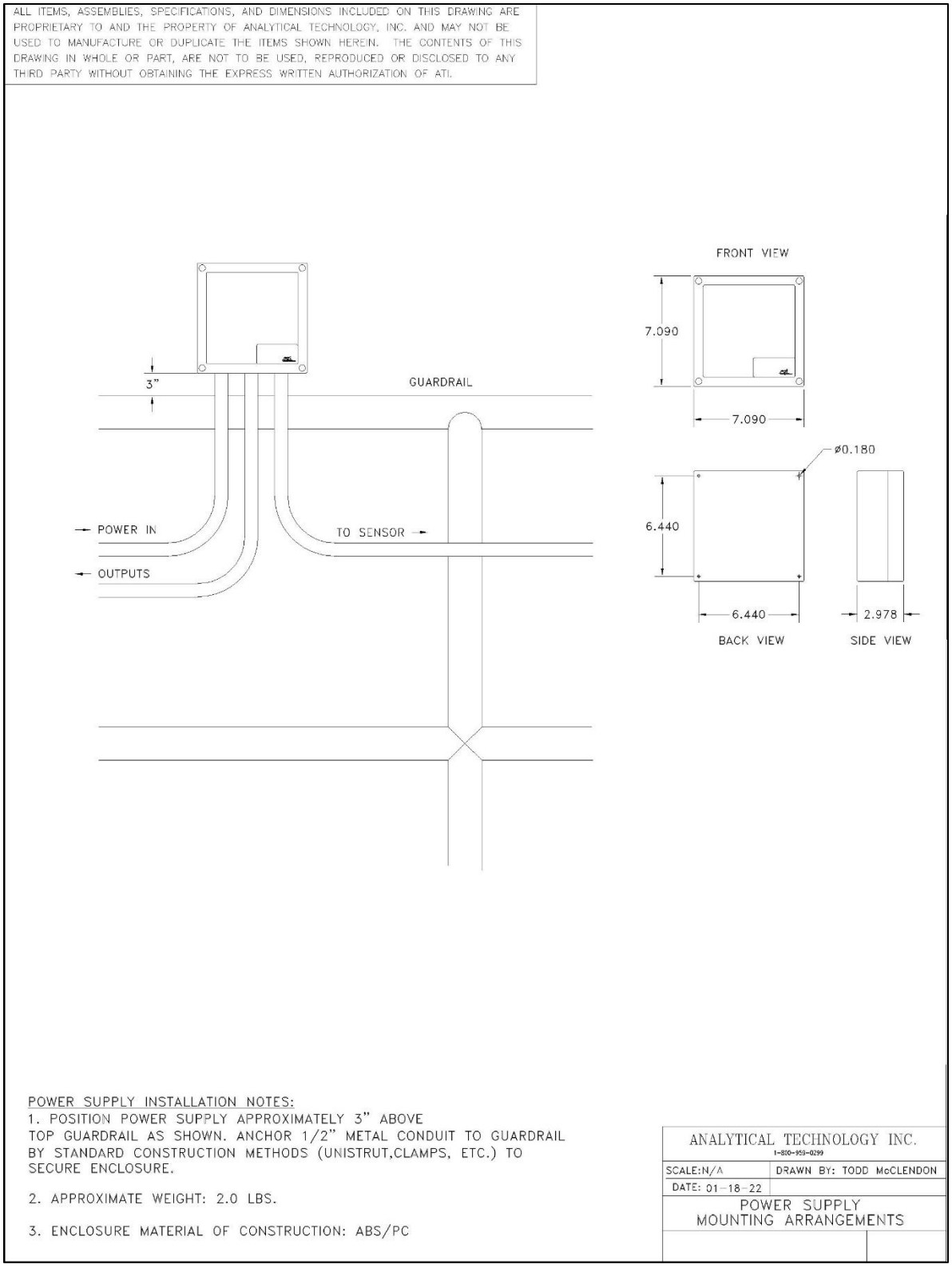


Figure 26: Power Supply Unit Installation Drawing

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

Tank Depth and Zero Adjust parameters (see also 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 (see Figure 27).

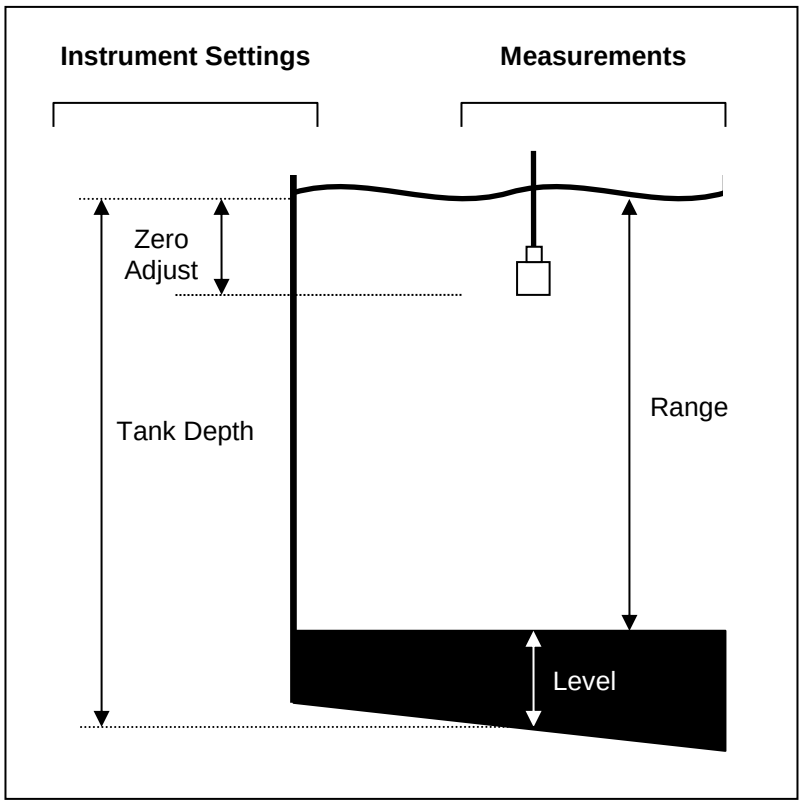


Figure 27: Tank Configuration

7.2. Waveform Analysis

The EchoSmart Sensor produces a signal waveform (Figure 28) that is used to produce LEVEL and RANGE measurements. The waveform is available to the user as a diagnostic tool in the Echo Profile Display, as illustrated here.

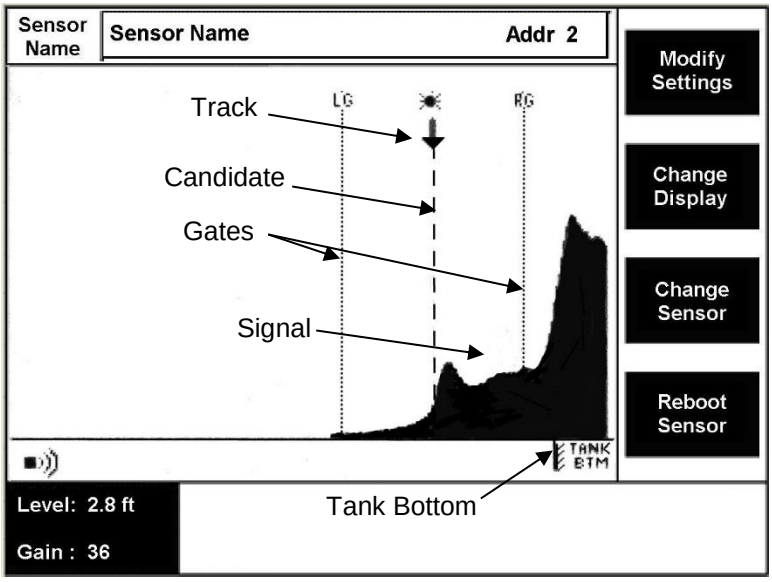


Figure 28: Echo Profile Display

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 dashed 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.

7.3.1. Gates

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 9.2.12 LG Min and 9.2.13 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 the 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 the 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. An Echo Loss message will accompany the output measurement on the Controller if it persists longer than the Echo Delay setting. Loss of Echo will be reported on the 4-20mA circuit if the Loss of Echo parameter has been activated (See 9.2.16 – 9.2.18).

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. Configuration of Individual Units and Networks

Multiple configurations are possible for the EchoSmart equipment.

8.1.1. Stand-Alone Instrument

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

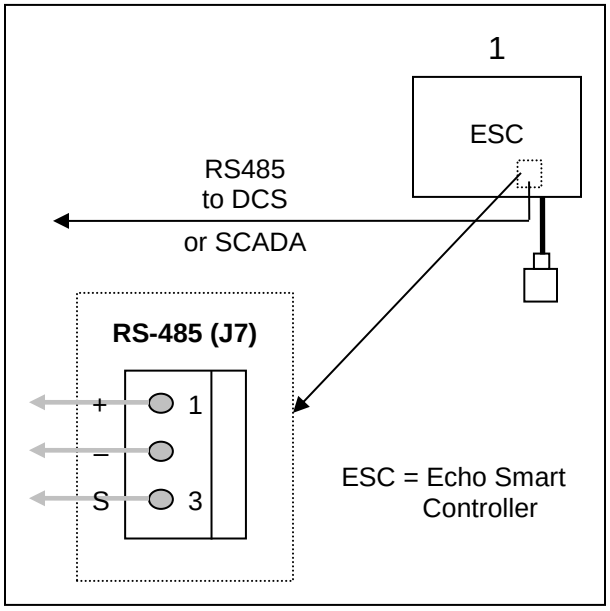


Figure 29: Controller with Single Sensor

8.1.2. Wired RS-485 Field Network

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.

To create the wired network, a shielded two-wire twisted pair (recommended Belden 9463) should be used between each ESP and to the ESC. Connections for the RS-485 communication line are made at the 3-pin terminal strip (J8) on each ESP and at the 8-pin sensor connector (J9) on the ESC as shown in Figure 30 below.

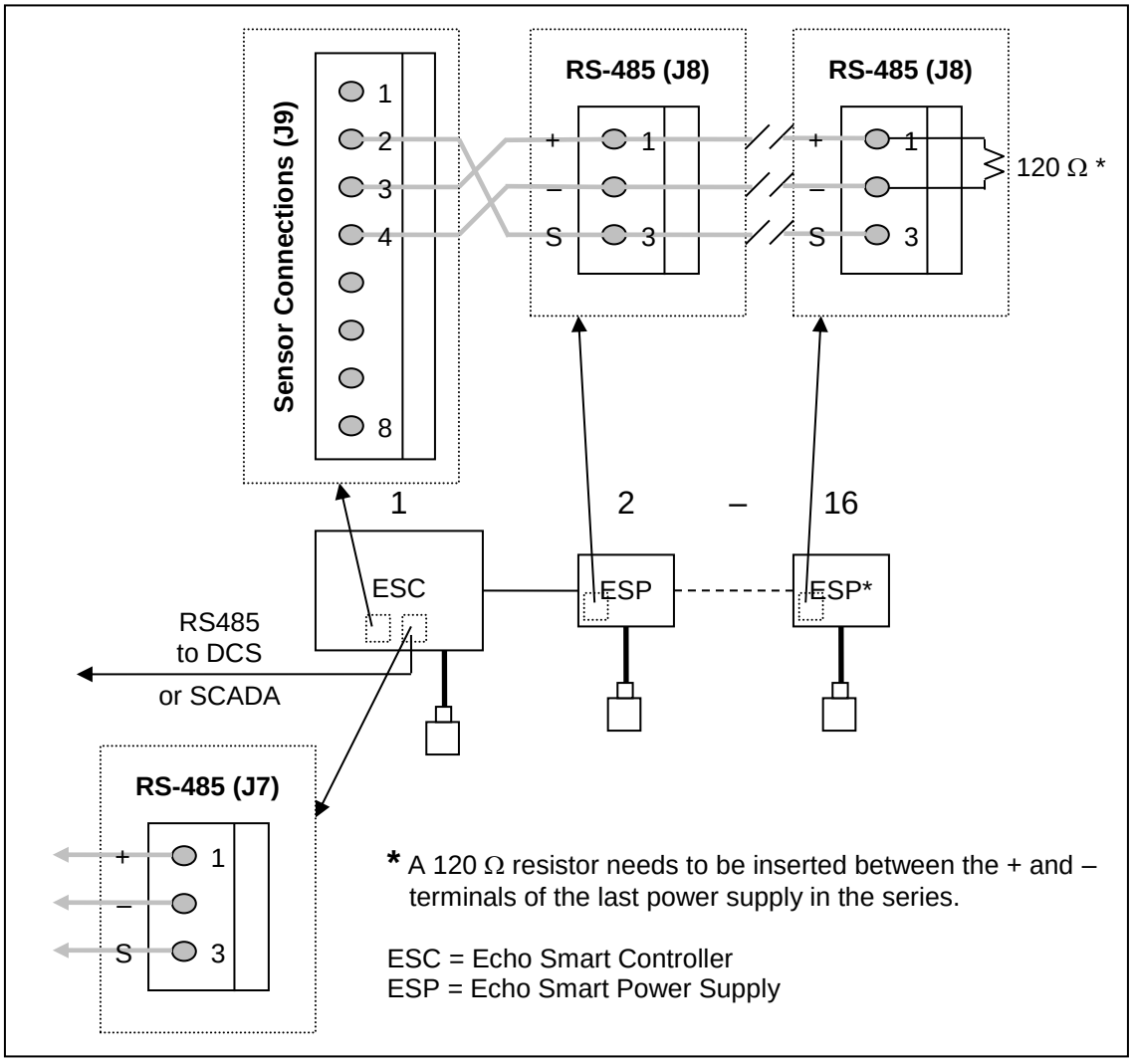


Figure 30: Single Wired Field Network

8.1.3. Wireless (RF) Field Network

Field Networks as described and configured in Section 8.1.2 can be implemented using optional fully integrated Radio Frequency (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 31 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 31.

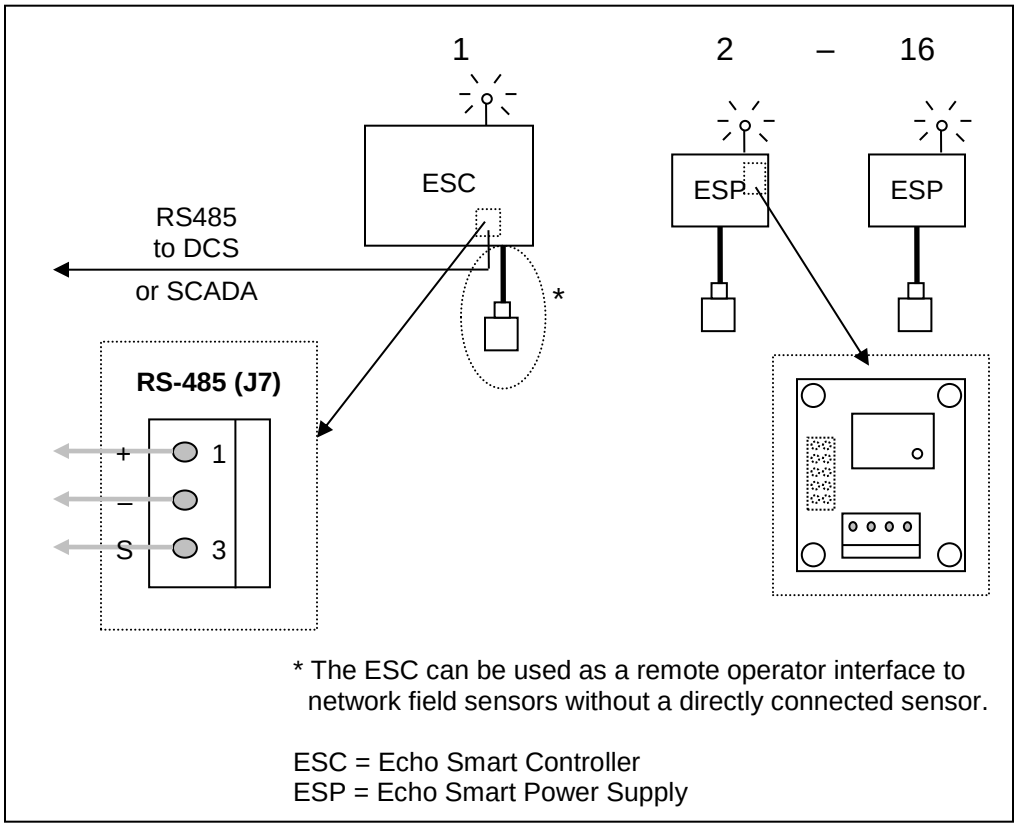


Figure 31: Single RF Field Network

8.1.4. Integrated Field Networks

EchoSmart Controllers operating Field Networks may be interconnected in an integrated two-wire RS-485 Network of up to 240 Smart Sensors. Each Controller can maintain a network of up to sixteen sensors utilizing either wired connections or the wireless radio modules. The Controllers can then be connected using a two-wire twisted pair so that only one cable run has to be made to the control system. Customer Modbus RTU integration is required.

IMPORTANT: The two-wire cable to the control system should not be connected to the ESC until all sensors are installed and communicating with the local ESC.

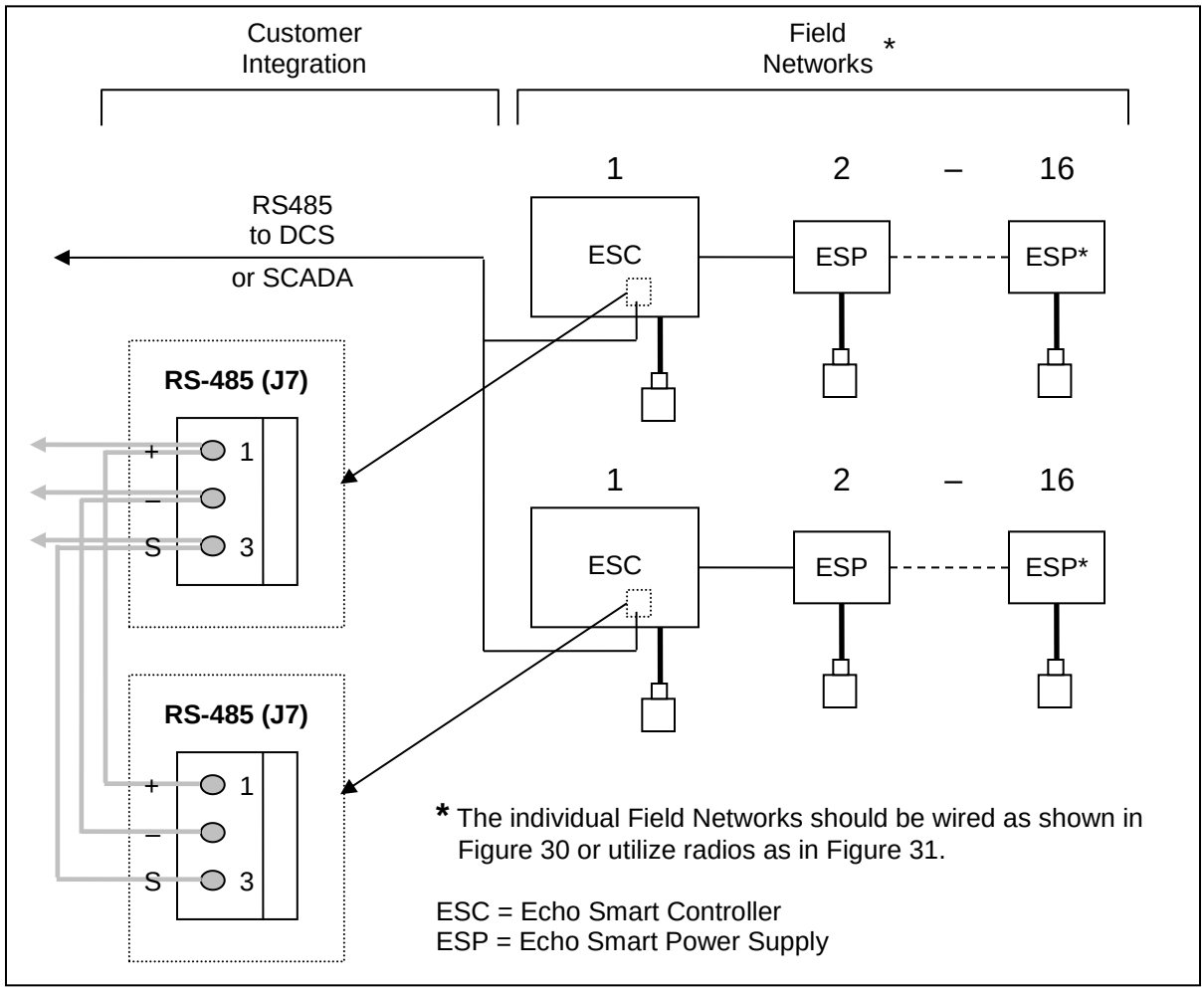


Figure 32: Integrated Wired Field Network

8.2. Outputs & Communication Options

Current measurements from each sensor can be accessed through a Modbus RTU command request or an analog 4-20 mA current loop in addition to the measurement displayed on the installed ESC.

Factory Remote Service is additionally available (see Section 8.2.3).

8.2.1. RS-485 Modbus RTU

EchoSmart sensors respond to Modbus RTU command requests via the local ESC that is monitoring the sensor(s).

Connection

A shielded two-wire twisted pair (recommended Belden 9463) should be used between the RS-485 3-pin connector (J7) of the ESC and the local control system.

IMPORTANT: This two-wire cable should not be connected to the ESC until all sensors are installed and communicating with the local ESC.

When communication is occurring through the RS-485 connection, an "RS-485" message will appear in the lower left portion of most display screens.

Polling Basics

The supported baud rate is 9600 and the RTU format is 8 bits, no parity, 1 start, and 1 stop bit.

The slave address used for polling will be each sensor's unique address that was entered when the EchoSmart equipment was commissioned. When multiple sensors are communicating with the ESC, each sensor's address must be polled separately for the desired Modbus value(s).

Recommended Polling

The current measurement can be obtained by utilizing Function Code 03 and polling for Register 40001. The returned value will be in the sensor's selected Units and will be reported as the base measurement times ten (i.e. 42 = 4.2 units).

If the EchoSmart sensor is equipped with the Turbidity add-on, additionally poll Register 40036 for the current turbidity value. The returned value will be the current NTU value times 100 (i.e. 135 = 1.35 NTU).

For the most up-to-date information, it is recommended that only the desired data be retrieved from each sensor.

Additional Information

The information provided in this manual only serves as a brief overview of the capabilities and data available via Modbus. See the OEM Smart Sensor Probe

(SSP) Communications Protocol for further detailed information on available commands, settings, and programming.

8.2.2. Analog 4-20 mA Current Loop

Two 4-20 mA proportional current loop signals are generated by each sensor. These signals are accessed through the 4-pin 4-20 Loop connector on the ESC (J10) or ESP (J6) that is supplying power to the sensor. One current loop is assigned to the Level or Range measurement and the other to either the turbidity measurement (when applicable) or the secondary interface.

The sensor's 4 mA Set Point and 20 mA Set Point (see Section 9.2.14 and 9.2.15) should be scaled to represent the installation environment with consistent scaling at the control device. Set Points for the primary Level measurement are automatically assigned to the output for the secondary interface measurement and no additional assignment is required or available.

The turbidity 4-20 mA current loop output is factory scaled from 0.0 to 50 NTU and is not user-adjustable.

8.2.3. Factory Remote Service

EchoSmart Controllers are designed for optional installation of a cellular service modem. With the user's authorization, this facility enables startup and service by expert factory technicians. Cellular connectivity is included with the service and is limited to areas where cell service is available.

This service utilizes the onboard RS-232 serial connection. When communication is occurring through this port, a "Maint Port" message will appear in the lower left portion of most display screens.

See Figure 33 below for instructions on how to properly install and remove the modem from an ESC.

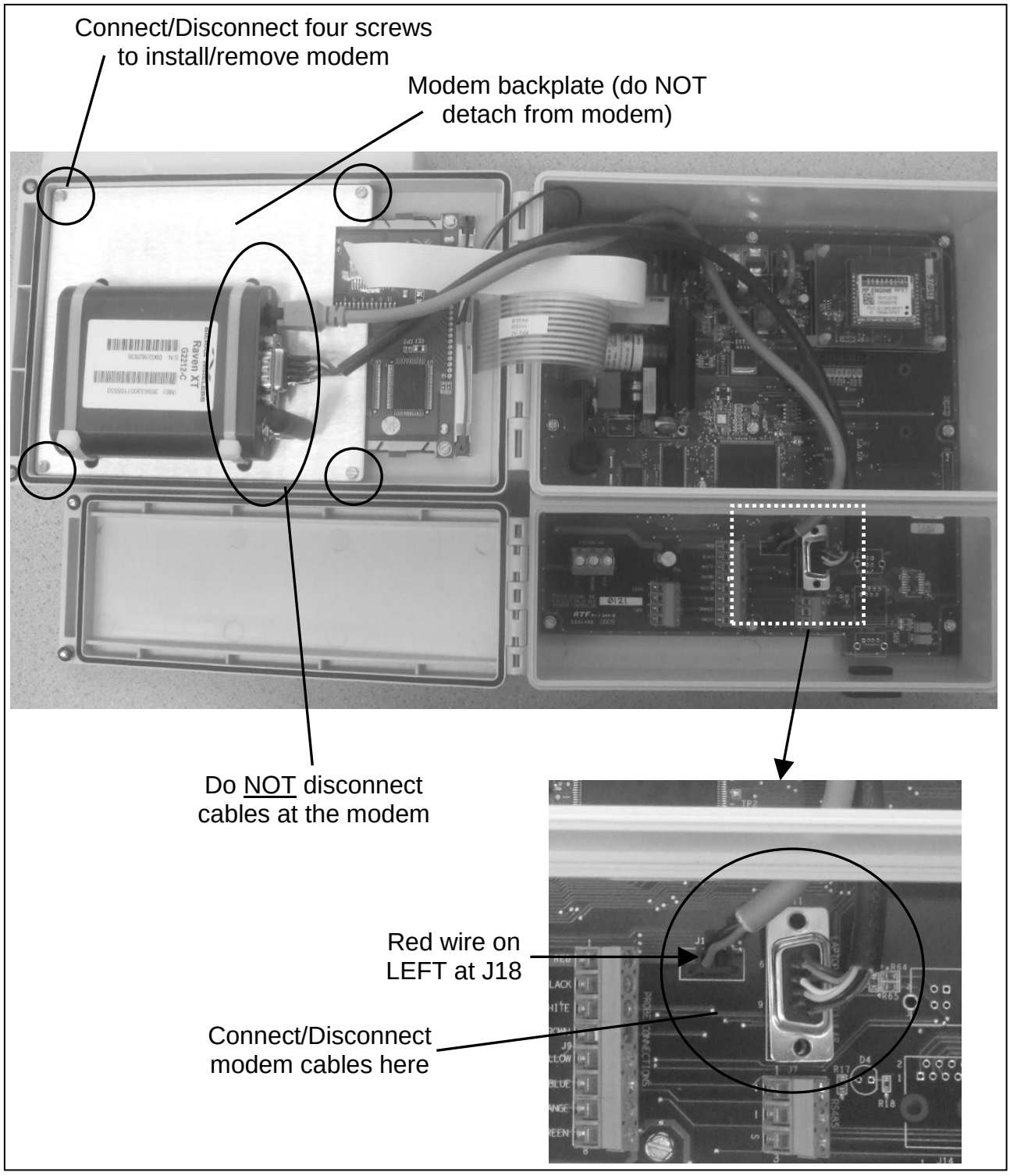


Figure 33: Proper Installation and Removal of Modem

9. Instrument Programming Parameters

Controller and Smart Sensor parameter settings are established at the Modify Settings and Advanced Settings displays. 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 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 27)

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 27)

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.

Min Range must be at least the value of Zero Adjust plus 1 foot.

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 (10)

The AG Set Point (Auto Gain 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.

The range for Update Rate is: 1 to 20

9.1.9. Interface (*First*)

The Interface parameter establishes the primary Level or Range measurement algorithm.

FIRST Interface causes the instrument to respond to a signal that is nearest to the sensor (typically lighter density material). LAST Interface causes the instrument to respond to a signal that is furthest from the sensor when multiple interfaces are present.

FIRST is the typical selection for wastewater and water treatment clarifiers, thickeners, sedimentation basins and similar processes.

Select LAST algorithm for filter applications to prevent the adverse effect of suspended solids and air-bubbles in the filter water column during backwash.

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*)

When Settling Zone is ON the instrument ignores 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 4.4.3 and Figure 12)

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 4.4.4 and Figure 13)

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.

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.

When the Tank Depth parameter is changed, Max Range is automatically set to 110% of the Tank Depth value.

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 sensor wiper will also operate automatically on detection of signal loss regardless of the selected Wiper Timing setting. This reduces the need to establish a short wiper timing sequence and prolongs the life of the wiper mechanism.

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

9.2.4. Gain Band (*20*)

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

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. Save GB Midpoint (MP) *(OFF)*

When turned ON, the Save Gain Band Midpoint option allows the user to manually set the gain midpoint

The options for Save GB MP are: ON and OFF

9.2.7. GB Midpoint *(Auto set)*

Automatic sensor initialization establishes the initial signal amplification (Gain) that is appropriate for the process environment. This value is held in the GB Midpoint register.

With Auto Gain ON, Gain increases and decreases around the Midpoint to maintain optimal signal amplification. The Gain Band Parameter establishes the maximum increase or decrease in Gain above and below the Midpoint.

With Save GB Midpoint (MP) set to ON, the midpoint can be manually set by the user.

The range for GB Midpoint is: 0 to 100

9.2.8. 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

9.2.9. Wall Zone AG (*40*)

This parameter limits gain amplification when the primary signal is a reflection from the tank bottom. Since the desire is to track blankets, it prevents over-amplification of the signal in applications with light-density material, or when the tank bottom is the only signal present (tank has no suspended solids blanket or settled solids).

The range for Wall Zone AG is: 0 to 100

9.2.10. 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

9.2.11. 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

9.2.12. 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

9.2.13. 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

9.2.14. 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 (*OFF*)

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

The options for Echo Loss are: ON and 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. When Cycle is selected, the output continually alternates between 4mA and 20mA until the loss of echo condition ceases.

9.2.19. Level Simulation Test

Selecting the Level Simulation Test option provides access to the Simulation Test Setup page. The simulation test provides an opportunity to verify proper operation of the Level analog output loop. The analog loop settings (specifically the 20mA Set Point) should be configured prior to simulation for a test reflective of the desired configuration. The test value carries the sensor's specified units. The allowable test range is from a zero value (output of 4mA) to the sensor's 20mA Set Point value (output of 20mA).

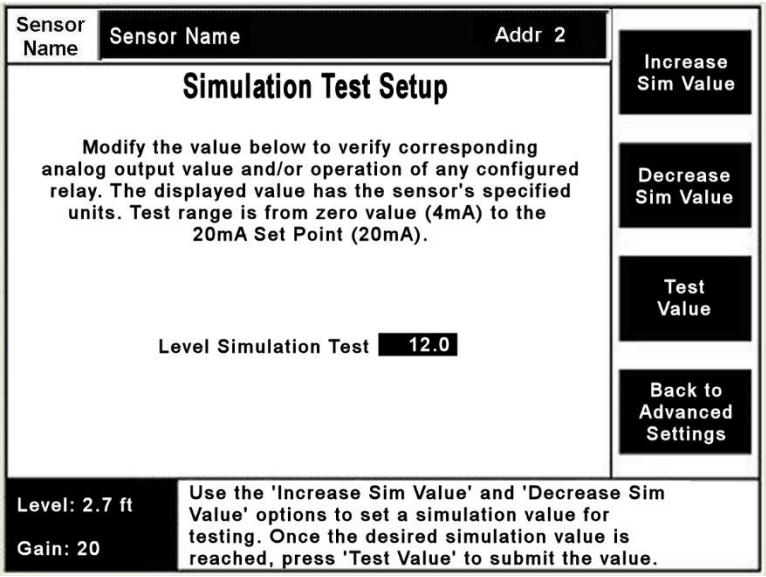


Figure 34: Level Simulation Test Setup Screen

The “Increase Sim Value” and “Decrease Sim Value” options can be used to modify the simulation value. Once the desired output is reached, pressing the “Test Value” option sends the value to the sensor and the scaled analog value will be output on the Level current loop.

For units purchased with integrated relays, the level simulation value will also impact the status of any relays configured for level or range. The relays must be activated and configured prior to performing the simulation test (see Section 11.3 for details on the relays).

Note: This functionality is available on Controller firmware version 2.21 and later in conjunction with Sensor firmware version 39 and later.

9.2.20. Aux Simulation Test

Selecting the Aux Simulation Test option provides access to the Simulation Test Setup page. The simulation test provides an opportunity to verify proper operation of the Auxiliary analog output loop. For sensors equipped with turbidity, the scaled NTU value will be output on the auxiliary loop and for all other sensors, the dispersed solids level will be output. When the dispersed solids level is output, the test value will carry the sensor’s specified units and will be scaled from a zero value (output of 4mA) to the sensor’s 20mA Set Point value (output of 20mA). When turbidity is output, the value will be scaled from 0 NTU to 50 NTU.

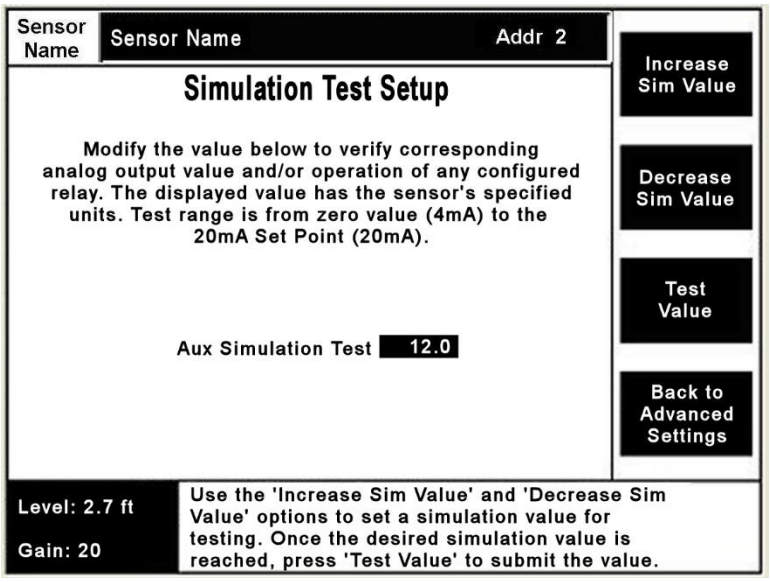


Figure 35: Aux Simulation Test Setup Screen

The “Increase Sim Value” and “Decrease Sim Value” options can be used to modify the simulation value. Once the desired output is reached, pressing the “Test Value” option sends the value to the sensor and the scaled analog value will be output on the Aux current loop.

For units purchased with integrated relays, the simulation value will also impact the status of any relays configured for turbidity. The relays must be activated and configured prior to performing the simulation test (see Section 11.3 for details on the relays).

Note: This functionality is available on Controller firmware version 2.21 and later in conjunction with Sensor firmware version 39 and later.

10. Maintenance and Troubleshooting

10.1. Preventative Maintenance

10.1.1. Sensor Cleaning and Maintenance

1. Standard Sensor (Non Self-Cleaning)

Non Self-Cleaning Sensors are typically used in applications in which the sensor is regularly and periodically rotated out of the water by the action of a surface skimmer. It is expected that this action will provide sufficient cleaning of the face of the sensor to prevent signal degradation for an extended period. However, it is recommended that the sensor face be inspected and cleaned at regular three (3) month intervals to prevent buildup of material, or as needed to preserve signal integrity. 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 Analytical Technology at (800) 959-0299 for details.

2. Wiper Sensors (Self-Cleaning, including sensors with turbidity option)

The Wiper mechanism and blade are designed to remove air/gas bubbles and light suspended solids that may collect on the face of the sensor and degrade signal quality. Supplemental manual cleaning may be required in processes in which suspended solids attach aggressively to the face of the sensor.

Wiper blade and motor life will vary with process conditions and the user established frequency of operation (Wiper Timing parameter, Section 9.2.3). It is generally expected that the wiper blade assembly will require replacement yearly and the wiper motor will require replacement every two years in typical water and wastewater treatment applications.

It is recommended that the sensor be inspected frequently during the initial three (3) to six (6) months of operation to determine whether supplemental cleaning is needed and that the wiper blade assembly is intact. From these observations, an ongoing preventive maintenance schedule suitable for the application can be established.

CAUTION: Unless determined to be insufficient for the process environment, Wiper Timing (Advanced Settings) should be set to 240 to reduce wiper blade and motor wear. Lowering this parameter will reduce motor assembly life proportionately.

Wiper Assembly Replacement:
The EchoSmart Sensor Wiper Blade Assembly (Part No. 03-0497) is field replaceable.

Remove the wiper by unscrewing in counter-clockwise direction. Secure and retain the stainless steel spacing washer from the wiper shaft for use with the replacement wiper.

Screw the new wiper clockwise until the arm makes contact with the seated spacing washer, plus 1/8th of a turn. **DO NOT OVER TIGHTEN**. Over-tightening may result in the wiper not operating. A ***Wiper Stall*** message will be indicated at the EchoSmart Controller.

3. Sensor Cleaning and Inspection

Remove the sensor from the process using safety procedures, protective clothing and equipment appropriate for the process environment. Protective gloves and eyewear should always be used when there is the possibility of exposure to dangerous or unsanitary materials or conditions.

Carefully remove larger debris, rags and similar material that may have attached to the sensor. Do not rotate the wiper blade by hand. Algae, slime and accumulations of suspended solids in the process liquid should be brushed away using a soft to medium bristle non-metallic brush or soft cloth and mild detergent. For disinfection, use 8 oz. of regular bleach (sodium hypochlorite 8.25% solution) to one gallon of water.

Before returning the sensor for service, operate the wiper system to observe that it rotates in the expected manner and that the wiper blade is secure. In normal operation, the wiper blade with make 1-3 rotations when power is supplied or when the wiper timing setting is changed.

10.1.2. Other Routine Maintenance

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 (see Section 10.1.1 Sensor Cleaning and Maintenance).

If your clarifier employs 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. Ensure that the shield is aligned to prevent the skimmer from making contact with the sensor.

10.2. Troubleshooting

The following recommendations address the most often encountered troubleshooting needs with the EchoSmart equipment. If the described procedure does not resolve the problem, contact Analytical Technology for further assistance.

10.2.1. Comm Error Message

A *Comm Error* message indicates that communication between the Controller and Sensor(s) has been interrupted for an extended period of time. Verify that the sensor associated with the alarm is properly powered and that all sensor and communication cables are connected correctly.

In the case of a Wireless Field Network of Sensors, consider metal structures, cabinets and mounting fixtures that may intervene in the path of the RF signal.

For detailed testing and resolution steps, refer to the Communication Troubleshooting document available from the Support → Troubleshooting section of the Entech Design website (www.entechdesign.com). Contact Analytical Technology for further assistance.

10.2.2. Echo Loss Message

An *Echo Loss* message indicates that the instrument does not have a signal that is reliable for measurement. This can occur as a result of the sensor not being submerged in water or as a result of an abnormal process condition (sludge level too near the sensor, excessive off-gassing, unsettled suspended solids in the supernatant, or material or bubbles collecting on the face of the sensor). It can also be the result of incorrect operating parameters installed in the sensor.

Corrective action includes a physical inspection of the sensor(s) and process to determine whether any of the above referenced conditions exist. If a Wiper Sensor is in use, confirm that the wiper arm is in place and that the wiper turns when (1) power is cycled, (2) the sensor Reboot command is called, or (3) the Wiper Timing setting is changed.

Check instrument parameters. Confirm that the Tank Depth, Zero Adjust, Min Range and Max Range settings are correct and that Auto Gain is ON.

For detailed testing and resolution steps, refer to the Echo Loss Troubleshooting document available from the Support → Troubleshooting section of the Entech Design website (www.entechdesign.com). Contact Analytical Technology for assistance if the problem is not resolved.

10.2.3. Validating Message

Validating is the "handshake" process that occurs when an EchoSmart Controller initiates communication with the sensor(s). This takes place when the Controller is initialized or when a sensor is manually added to the sensor database. This step is normally completed rapidly and may not be noticed by the user. If the Validating message continues for an extended period of time, there is a communication problem that may require corrective action (See Section 10.2.4).

10.2.4. Validation Failure Message

If a sensor does not validate as expected, the Controller has been unable to communicate with the sensor, and the Validation Failure message will be displayed. Check all sensor and network cabling and connections and re-check main power to the Controller and all Power Supply Units. If a wireless sensor network is in use, investigate possible impediments to network communications.

10.2.5. Wiper Stalled Message

A Wiper Stalled message will appear if the wiper does not operate when expected or if rotation of the wiper blade is not detected. It may also indicate drag on the wiper motor as a result of debris being attached to the wiper blade or shaft. Visually inspect the sensor to determine that the wiper blade and shaft are free of debris. Verify that the wiper is securely connected to the wiper shaft and that it turns freely (1-3 revolutions) when power is cycled to the sensor or the Wiper Timing parameter is changed. Replace the wiper blade, as indicated in Section 10.1.1.

10.2.6. Wiper Motor Failure Message

This message indicates an internal electronic failure of the wiper motor. Contact Analytical Technology for repair or replacement options.

Note: Wiper motor failure may cause unreliable measurements.

10.2.7. Analog Output Discrepancy

EchoSmart 4-20 mA devices are active (powered) and isolated current loops. Check that no other power or isolation is present on the loop, and confirm that no other electronic devices or electrical elements intervene on the current loop. Check that appropriate signal cable is in use.

EchoSmart allows the user to span the 4-20 mA signal with reference to Level (depth of sludge) or Range (distance from water surface to top of sludge). Confirm that the correct parameter has been entered.

The maximum span is 0.0 to Tank Depth. The 4mA Set Point and 20mA Set Point must be correctly entered to establish the desired span. Check that corresponding Set Point values are entered in the customer data acquisition system.

Disconnect loop cables from the EchoSmart equipment and measure the current output to determine whether it corresponds with the measurement indication from the instrument.

For detailed testing and resolution steps, refer to the Analog Output Troubleshooting document available from the Support → Troubleshooting section of the Entech Design website (www.entechdesign.com). Contact Analytical Technology for assistance if the problem is not resolved.

10.2.8. Sensors Not Detected

If sensors are not detected or a *No Sensors Found* message is reported, confirm that all sensor and communication cables are securely landed at the respective Controller or Power Supply Unit(s) and that main power is ON.

If a Controller operates more than one sensor, confirm that all sensors have been added to the Network as directed in *12.2 Configuring a Sensor Network*, and that each has a unique address designation. If multiple sensors have the same address number, the Controller will not be able to establish communication with those sensors. If unique sensor addresses have not been assigned, power OFF the equipment and follow the steps in 12.2.

If a wired field network is being used, refer to Section 8.1.2, to verify that all connections are made at the proper terminals.

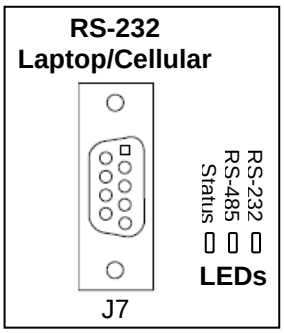
10.2.9. Radio Communications

<u>System-wide communications troubleshooting:</u>

Ensure the radio in the Controller is fully seated. If an external antenna is being utilized, verify the antenna is hand tight and the connecting cable is properly connected to the radio and the antenna. If the Controller is using an external radio unit, ensure the cable connections are made as outlined in Section 11.2.3.

Sensor specific communications troubleshooting:

LEDs located near the serial port of each ESP give an indication of the communication that is occurring in the network. The *Status* LED should be on solid and the *RS-485* LED should flash with each transmitted message.



If the *Status* LED is flashing, cycle power on the ESP.

If the *Status* LED is on solid and the *RS-485* LED is not flashing, verify that the radio is seated properly and cycle power to determine if communication can be re-established.

10.2.10. Persistent "Acquiring Waveform" Message

If an "acquiring waveform" message appears for an extended period of time on the **Echo Profile** screen, a search of the network may be necessary to establish proper communication with the sensor. Go to *Modify Settings* → *Advanced Settings* → *Controller Setup*, select the "Auto Detect Sensors" option and press *Auto Detect Sensors*. After a few seconds, the display will redirect to the **Echo Profile** screen.

This persistent message can also appear if an external device, such as an integrated control system, is constantly requesting information from the sensor(s). Temporarily disconnect the external device to see if waveform data can then be gathered from the sensor. If this resolves the issue, modifications to the external device's polling routine are likely needed.

11. System Options

11.1. Self-Cleaning Wiper Sensor with Turbidity Measurement

This sensor incorporates a scattered light turbidity meter into the EchoSmart Wiper Sensor to provide continuous Level and Turbidity measurements.

11.1.1. Application

This sensor is recommended for use in applications in which there is need for a Level and Turbidity measurements at the location of the sensor. It is specifically recommended for use in water and wastewater treatment clarifiers and thickeners to continuously monitor sludge level and to provide an indication of turbidity at the location of the sensor – typically near the effluent weir.

The Level and Turbidity Sensor is also recommended to measure Media Level, Backwash Expansion and Backwash Turbidity in granular media filters. It may be used separately or in conjunction with the available in-air Water Level Sensor for effective conditional control of filter backwashing.

11.1.2. Principle of Operation

Sludge level measurements use the EchoSmart ultrasonic time-in-flight measurement technique as with all EchoSmart interface level sensors.

Turbidity measurements are provided by a 90º scattered-light turbidity meter located in the combined sensor housing. Sensors are factory calibrated from 0 – 50 NTU. Power to the sensor is provided by an EchoSmart Controller or Power Supply Unit to which it is connected. The measurement indication is displayed on the Controller. Output signals include a 4-20mA proportional signal and RS-485 Modbus RTU digital.

11.1.3. Sensor Cleaning

Sensing surfaces of the sludge level and turbidity sensor are automatically cleaned by a fully integrated wiper system with a replaceable rubber wiper blade. The wiper is operated by an internal motor powered by the EchoSmart Controller or Power Supply Unit.

11.1.4. Installation

The sensor has a ¾ in. NPT female threaded connection to provide simple attachment to a user supplied mounting pipe. 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 Section 0. Additionally, the sensor may be located near an effluent weir to

optimize the effluent turbidity measurement without adversely affecting sludge level measurements.

In filter applications, sensors are located immediately below the top of the backwash trough to secure measurements during active backwashing and while the filter is on-line. Contact Analytical Technology for additional instructions for proper installation.

11.1.5. Connections

The sensor connection is made in the same manner as an EchoSmart sensor. Refer to Section 4.2.2, Figure 3, and Figure 4 for further connection details when operated by an EchoSmart Controller, or Section 5.1.2, Figure 21, and Figure 22 when operated by an EchoSmart Power Supply Unit.

11.1.6. Turbidity Sensor Calibration

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

11.2. Integrated Wireless Radio (RF) Modules

Communication between the Controller and associated Power Supply Units can be achieved with integrated wireless radio modules to eliminate the need for cabling and conduit between units.

11.2.1. General Overview

The radios use a proprietary message structure for communication between units and utilize mesh networking capabilities to achieve redundancy and reliability.

11.2.2. Internal Configuration

In this configuration, the radio module is mounted inside the Controller or Power Supply enclosure. An external antenna is then affixed to the outside of the enclosure with a U.FL to RP-SMA cable connecting the antenna to the module. The module additionally requires a two-wire cable to be connected between the radio's 4-pin terminal strip (J2) and the 8-pin terminal strip on the associated Controller (J9) or Power Supply (J4). The cable should link red to red terminal locations and black to black (see Figure 36).

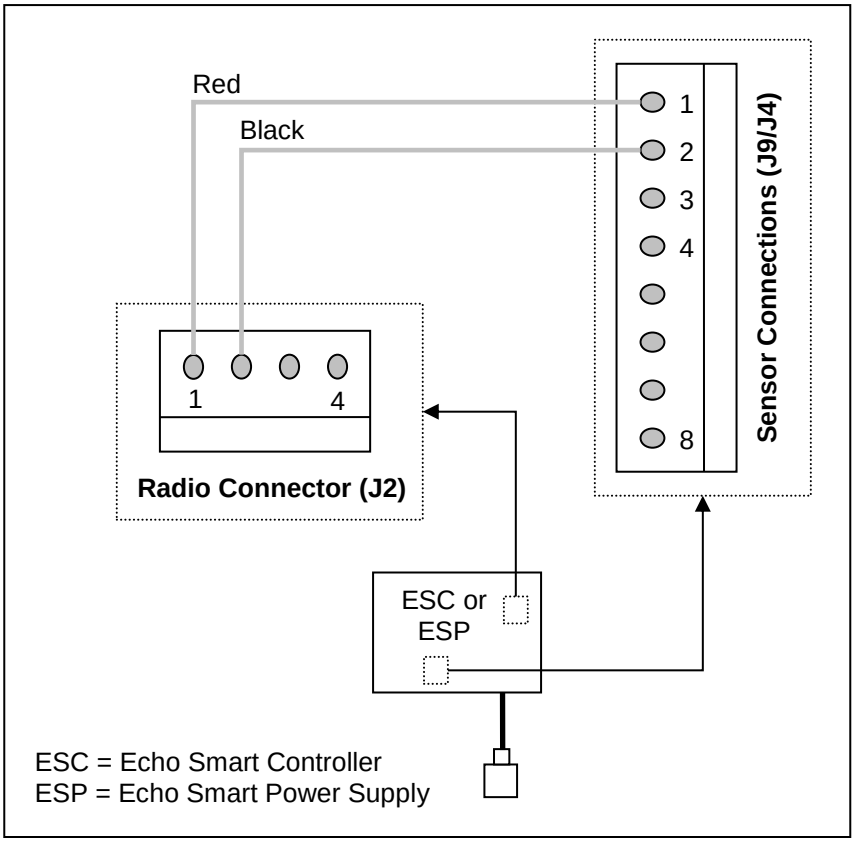


Figure 36: Connections for Wireless Radio Module (Internal)

11.2.3. External Configuration

In this configuration, the radio module is mounted in a separate enclosure that can be located in an optimal location. An external antenna is affixed to the outside of the enclosure with a U.FL to RP-SMA cable connecting the antenna to the module. A four-wire cable is required to connect the radio's 4-pin terminal strip (J2) and the 8-pin terminal strip on the associated Controller (J9) or Power Supply (J4). The cable should link red to red terminal locations, black to black, white to white, and brown to brown (see Figure 37).

This configuration is ideal when Controllers or other units are placed in buildings or other locations that may create less than ideal paths for radio transmissions. The radio can then be located in a more optimal location.

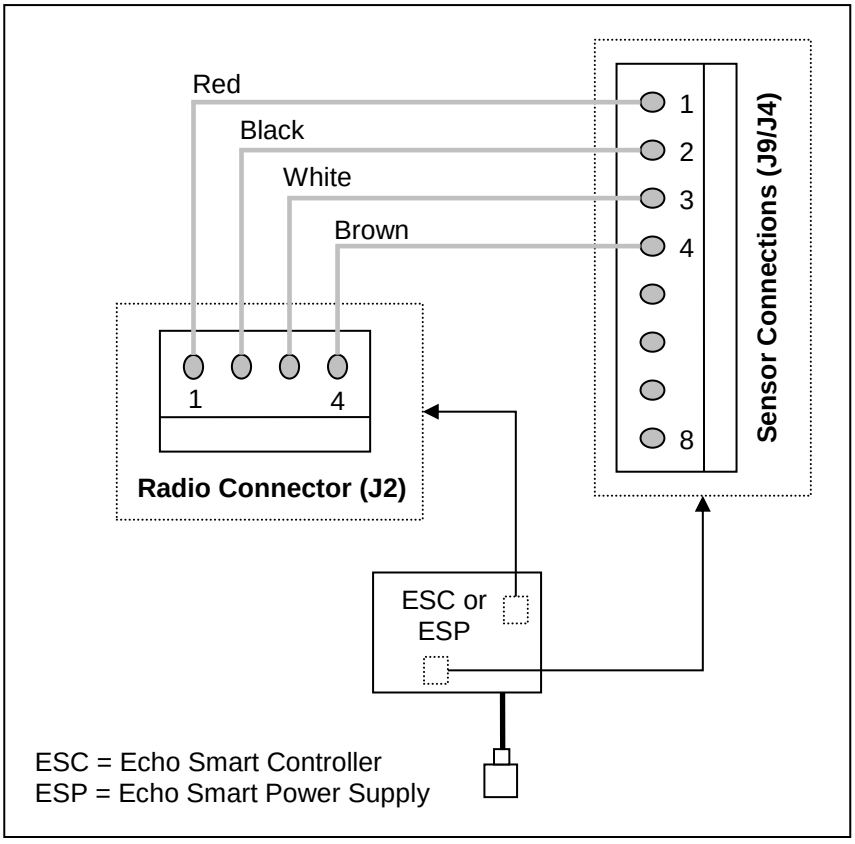


Figure 37: Connections for Wireless Radio Module (External)

11.2.4. Equipment Orientation for Units with Integrated Wireless Radio Modules

Equipment containing the integrated wireless radio modules should be oriented such that the antenna mounting location is on the side of the enclosure with the antenna pointed in the upward direction. See Figure 38.

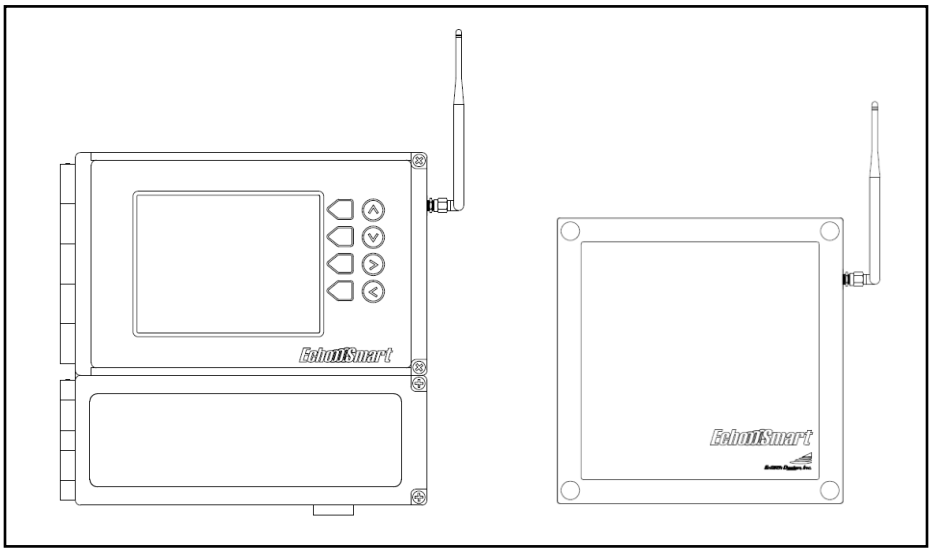


Figure 38: Orientation of Units with Wireless Radio Modules

11.3. Relays

Relays require an additional circuit board installation in the EchoSmart Controller. Relays are not available in the EchoSmart Power Supply Unit.

11.3.1. General Overview

Four SPDT relays may be added as an option to a Controller. Each relay is capable of monitoring the sludge level, turbidity (with optional sensor), or can be configured as a fail-safe alarm. The relays can be assigned to separate sensors or multiple relays can be assigned to one sensor.

11.3.2. Operation

Relay controls (Figure 39) are accessed by pressing the *Set Up Relays* soft key from the Controller Setup Display (Figure 17).

The relay Status must be set to ON in order for the relays to operate. The sensor associated with each relay is listed below the "Status" setting. Each relay can be set to monitor the sludge level, the turbidity value (when installed), or can be set as a fail-safe alarm by cycling through the "Change Assignment" options.

When monitoring sludge level or turbidity, 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.

When set as a fail-safe alarm, pins 2 and 3 of the relay are energized under normal operating conditions. Pins 2 and 3 are de-energized when the EchoSmart

Controller is powered off or a fault due to loss of echo or a communication error is detected on the associated sensor.

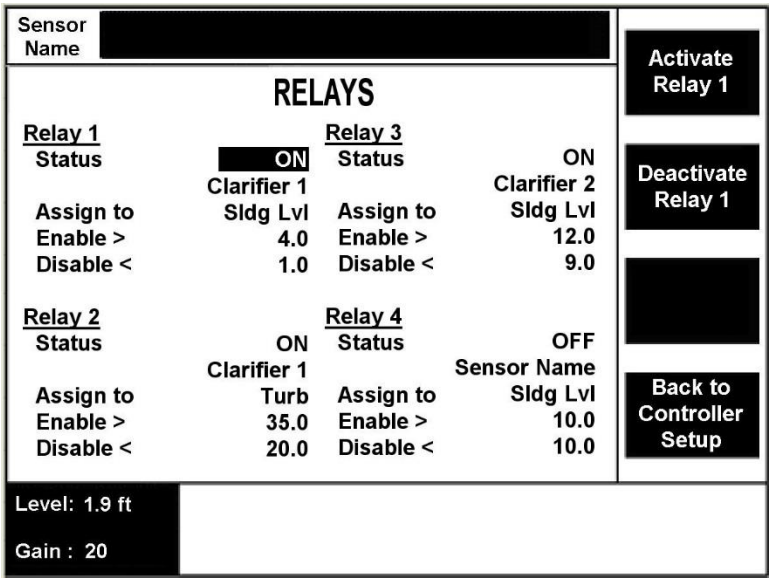


Figure 39: Relays Display

11.3.3. Cabling and Connections

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

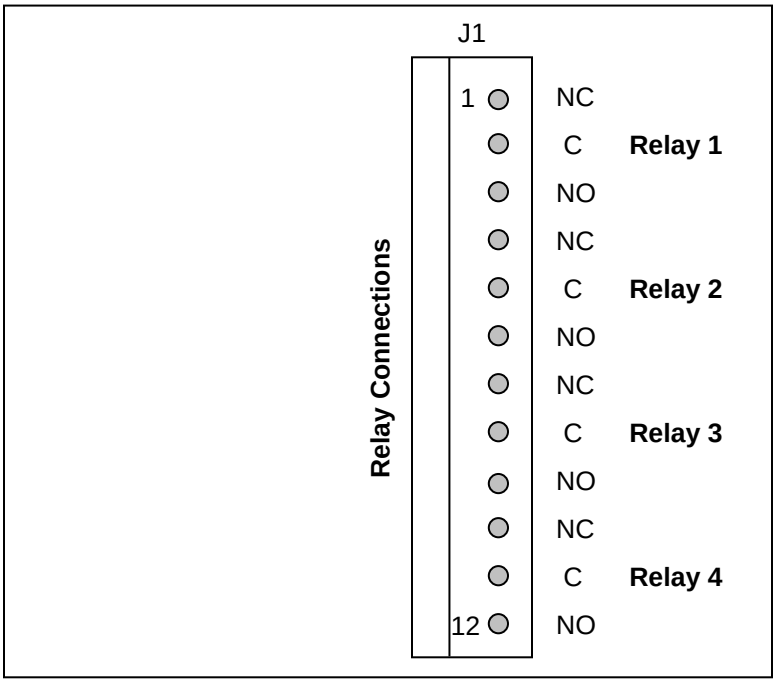


Figure 40: Connections for Relay Board

Relay Connections (J1)

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

Figure 41: Table of Relay Connections

11.4. Digital (RS-485) to Analog (4-20mA) Converter

The EchoSmart Controller can be paired with Analytical Technology, Inc.'s Analog Output Module to obtain analog measurements from all networked sensors in one location. (Compatible with EchoSmart Controller Firmware Version 2.20 and later.)

11.4.1. General Overview

The Digital to Analog Converter can be configured with up to sixteen (16) outputs. The Converter utilizes the RS-485 Modbus data from the Controller and generates the corresponding analog output. Each channel can be customized with the sensor address and output value (level, dispersed solids level, or turbidity when applicable).

11.4.2. Specifications

INPUT POWER	18 - 30 VAC
MOUNTING	DIN Rail Mount
OUTPUTS	Up to 16 isolated analog outputs

11.4.3. Cabling and Connections

A shielded two-wire twisted pair should be used between the Controller's RS-485 connector (J7) and the Converter's Serial RS-485 terminal location.

Refer to Figure 42 below for information related to powering and connecting all cables to the Converter.

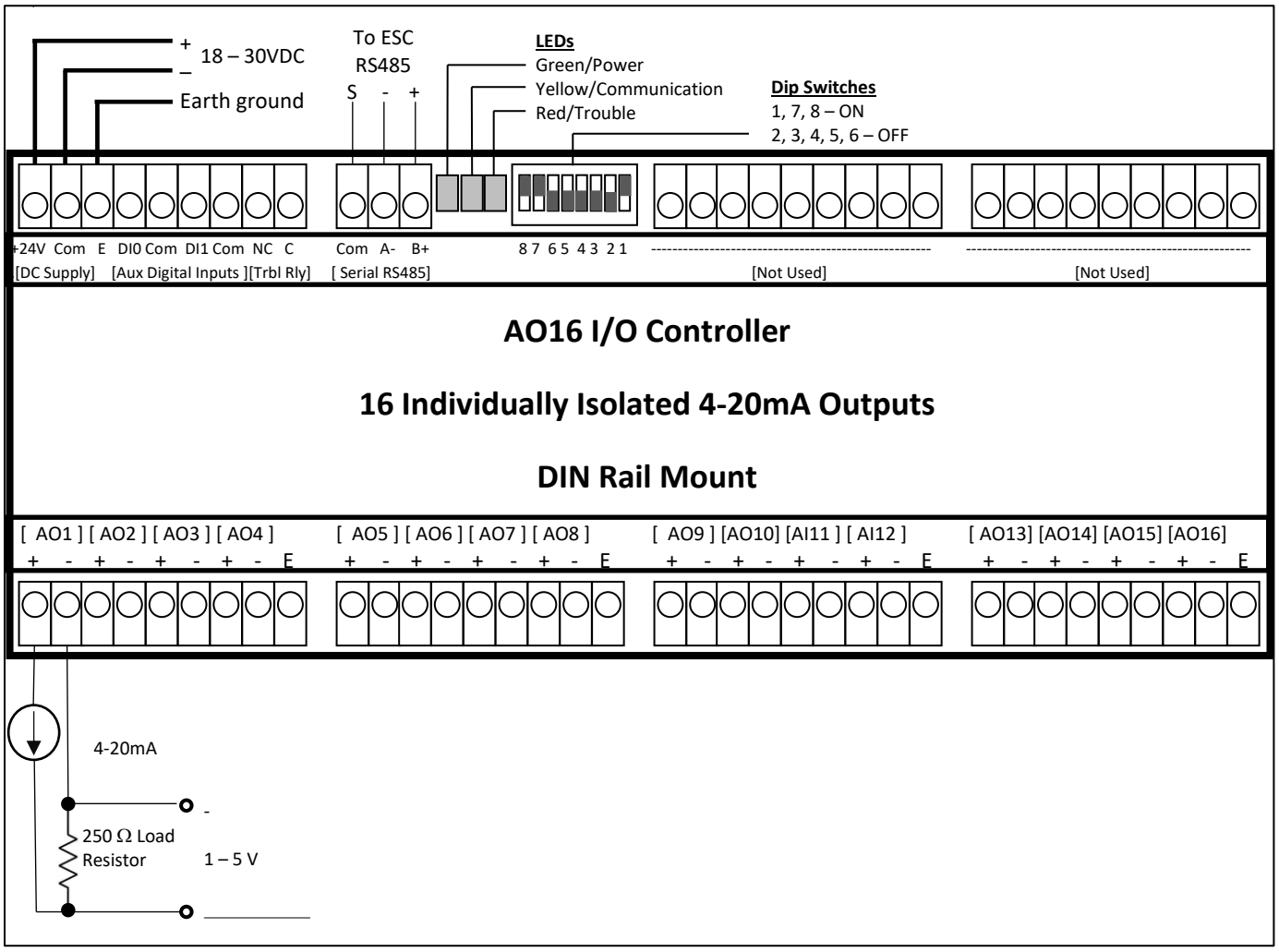


Figure 42: Analog Output Module Connections

11.4.4. Configuring the Converter

The setup menu is accessed from the Controller Setup screen by highlighting the "Digital to Analog Output Setup" option and pressing the button next to "D to A Output Setup". A screen similar to Figure 43 below will appear.

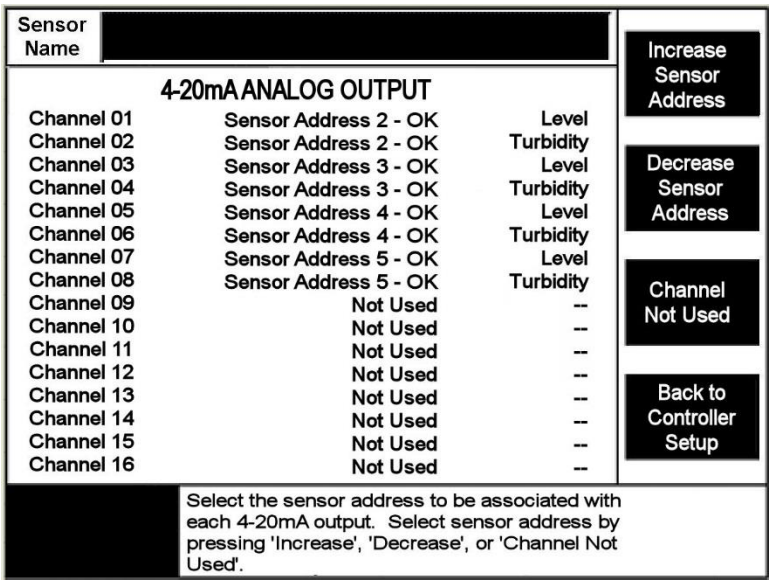


Figure 43: Digital to Analog Converter Setup Screen

Use the “Increase Sensor Address” and “Decrease Sensor Address” options to select which sensor’s data is output on each channel. When scrolling through the addresses, an “OK” message will be reported next to the address when that sensor is in the Controller’s database. Two question marks (??) will be appended to the address when that address is not present in the Controller’s database of sensors, indicating that no value is available for the analog output. In this case, communication needs to be established with the sensor or another address should be selected.

The measurement to be output on each channel can be selected by navigating to the right column. The options are: Level, Dispersed Solids Level, and Turbidity (when applicable).

While any sensor’s output can be assigned to any channel, each unique output can only be assigned to one channel (Ex: the Level output for Sensor Address 2 can only be configured on one of the channels). Only one channel will be updated with each unique output.

Note: If a sensor’s address is changed after configuration of the Analog to Digital Converter has been performed, the configuration will have to be updated to reflect the address change. Sensor address changes cannot be automatically updated on this configuration screen.

11.4.5. Analog Outputs

Each independent analog output is factory calibrated and is optically isolated from the DC Supply and from each other.

The sensor's 4 mA Set Point and 20 mA Set Point (see Section 9.2.14 and 9.2.15) should be scaled to represent the installation environment with consistent scaling at the control device. Set Points for the primary Level measurement are automatically assigned to the output for the dispersed solids level and no additional assignment is required or available. The turbidity value is factory scaled from 0 NTU to 50 NTU and is not user-adjustable.

Figure 44 below describes the analog output value that is reported under various sensor operating conditions.

Condition	**Output**
Normal	Current Scaled Value
Sensor Initializing	Cycle
Loss of Communication with Sensor	2 mA
Echo Loss	4mA, 20mA, or Cycle (see Echo Loss Action setting)
Channel Not Configured	0 mA

Figure 44: Table of Analog Output Behavior

12. Quick Start Guide

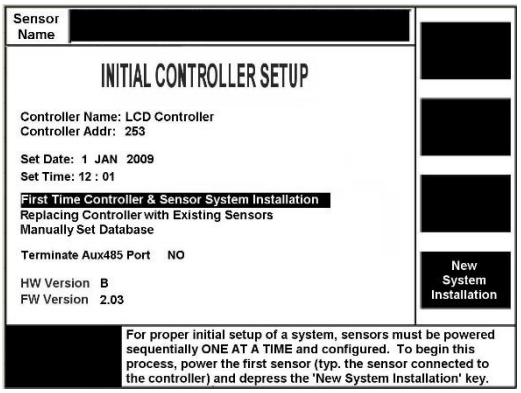
12.1. Configuring a Single Sensor

Follow these instructions when only one sensor is to be operated by the EchoSmart Controller.

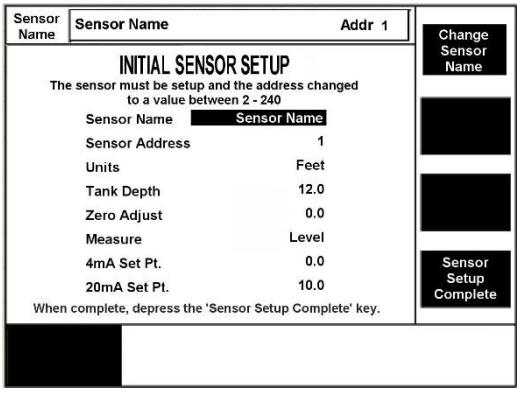
1. Ensure all sensor connections are correct and that power is properly applied to the device.

   IMPORTANT: Disconnect any outside RS-485 device from the ESC prior to initiating Controller Setup to avoid communication errors.

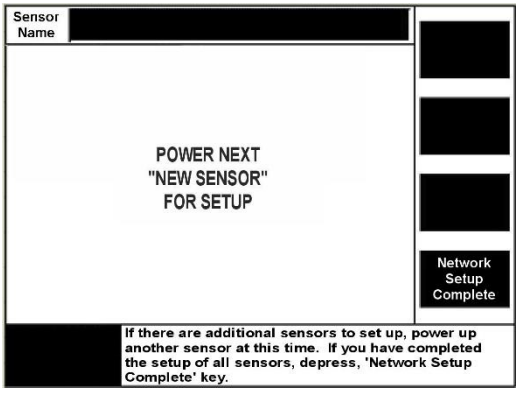
2. From the **Initial Controller Setup** screen, press *New System Installation*. This routine will take approximately 20 seconds to complete.



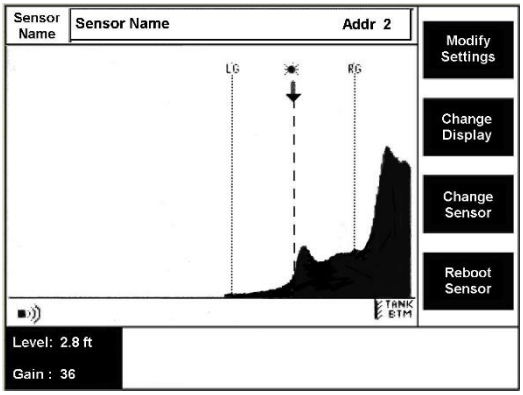
3. Change the Sensor Address to a unique value other than 1 and enter the correct parameters associated with the sensor on the **Initial Sensor Setup** screen – most importantly the Tank Depth, Zero Adjust, and 4-20mA Set Points (if being used). See Section 7.1 for help in determining correct values for Tank Depth and Zero Adjust. Press *Sensor Setup Complete*.



4. When a screen appears with instructions to “Power Next New Sensor for Setup,” press *Network Setup Complete*.



5. You will be directed to the **Echo Profile** screen. The sensor will go through an initialization process and then begin to report the current interface location.



6. If an external RS-485 polling device is to be used, it can now be connected. See Section 8.2.1 for recommendations and information regarding an RS-485 connection.

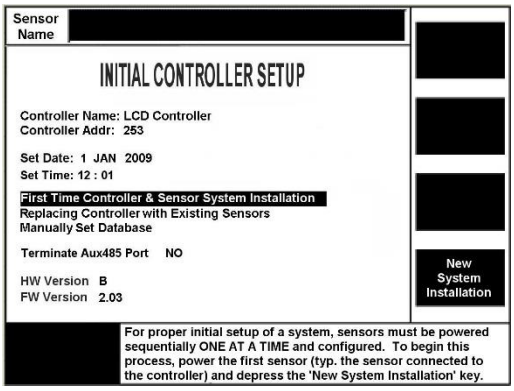
12.2. Configuring a Sensor Network

Follow these instructions when an EchoSmart Controller will communicate with more than one sensor in a Network arrangement.

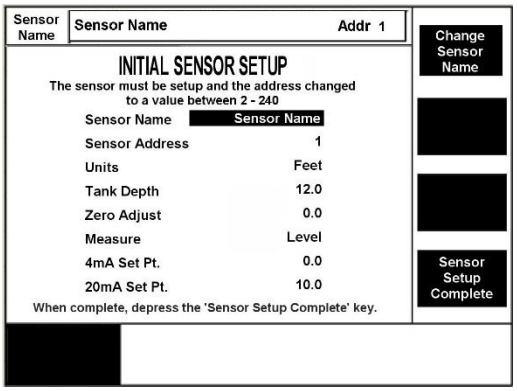
1. Ensure all sensor connections are correct and that power is properly applied to the EchoSmart Controller. If a sensor is not directly connected to the Controller, additionally power the first EchoSmart Power Supply with its sensor. **Sensors must be powered and added to the network one at a time.**

   IMPORTANT: Disconnect any outside RS-485 device from the ESC prior to initiating Controller Setup to avoid communication errors.

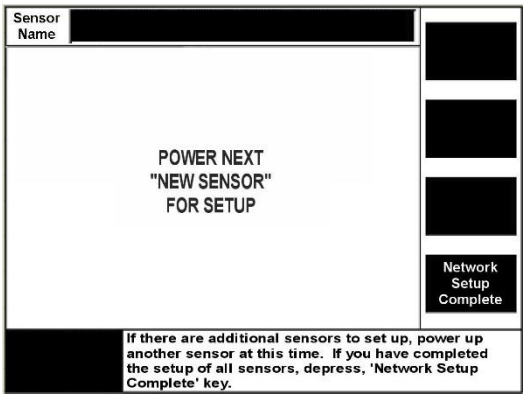
2. From the **Initial Controller Setup** screen, press *New System Installation*. This routine will take approximately 20 seconds to complete.



3. Change the Sensor Address to a unique value other than 1 and enter the correct parameters associated with the sensor on the **Initial Sensor Setup** screen – most importantly the Tank Depth, Zero Adjust, and 4-20mA Set Points (if being used). See Section 7.1 for help in determining correct values for Tank Depth and Zero Adjust. Press *Sensor Setup Complete*.

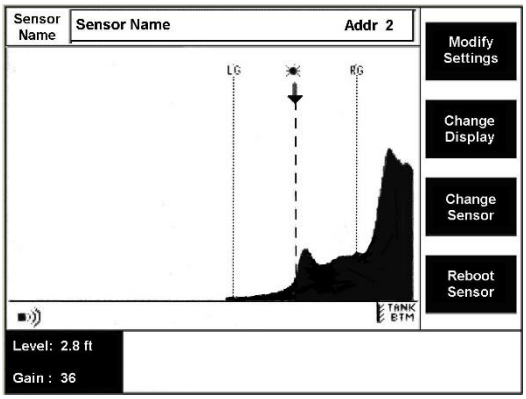


4. When a screen appears with instructions to "Power Next New Sensor for Setup," apply power to the next sensor that needs to be configured.



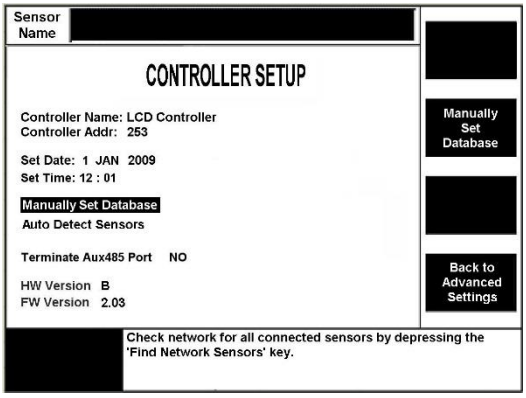
5. Repeat steps 3 and 4 for all sensors in the network, ensuring that each sensor has a unique Sensor Address. Once all have been setup, press *Network Setup Complete*.

6. You will then be directed to the **Echo Profile** screen. The sensors will go through an initialization process and then begin to report the current interface location.



7. To see the sensor name, current measurement, gain value, and turbidity output (when applicable) of all connected sensors, press *Change Display* from the **Echo Profile** screen.

8. If a sensor is not automatically found (once powered) during the network setup process or needs to be added later, go to *Modify Settings* → *Advanced Settings* → *Controller Setup*, highlight the Auto Detect Sensors option, and press *Auto Detect Sensors*.



9. If an external RS-485 polling device is to be used, it can now be connected. See Section 8.2.1 for recommendations and information regarding an RS-485 connection.

12.3. Special Settings for Filter Applications

Two dimensions are needed to set up the EchoSmart unit for filter applications: the distance from the Sensor to the Media (SM), and the Depth of the expandable Media (DM). Installation recommendations and a guide to help determine correct input dimensions are found in Figure 45 below. SM should be measured after installation of the sensor. The setup parameters can then be implemented as follows:

- ☐ **Units**: Set to Inches (or Centimeters)
  A smaller measurement unit provides finer resolution in the output measurement.
- ☐ **Tank Depth**: SM + DM
  (The measured distance from the Sensor to the Media (SM) plus the Depth of the Media (DM)).

- ☐ **Zero Adjust**: Set to zero (0.0)
- ☐ **Min Range**: Set to 12 inches
- ☐ **Update Rate**: Set to 8
- ☐ **Interface**: Set to LAST
- ☐ **Dampening**: Set to 5
- ☐ **Max Range**: SM + 4 inches
  (The measured distance from the Sensor to the Media plus 4 inches)
- ☐ **4mA Set Point**: 0.0
  (This locates the zero Level at the bottom of the expandable media. See Figure 45)
- ☐ **20mA Set Point**: Tank Depth (SM + DM, Figure 45)

Additional notes:

- ☐ The initial measurement and 4-20 mA output should equal the depth of the expandable media (DM). If the output does not match the known media depth, check the SM measurement and adjust the Tank Depth value accordingly.
- ☐ Depth of Media is NOT a directly measured value. Accuracy of this measurement and changes over time depend on a correct starting DM provided by the user.
- ☐ If the Tank Depth value is changed, Max Range will need to be re-calculated and set to the new value **after** the new Tank Depth is entered.
- ☐ If a narrower 4-20 mA span is desired, caution should be taken not to reduce the span such that it does not allow for media expansion during backwash or loss of media over time. The 4-20mA set points for turbidity are factory set to 0-50 NTU. Any data collection devices should be scaled accordingly.
- ☐ All other parameters should be left at factory defaults unless directed by Analytical Technology or one of their representatives.

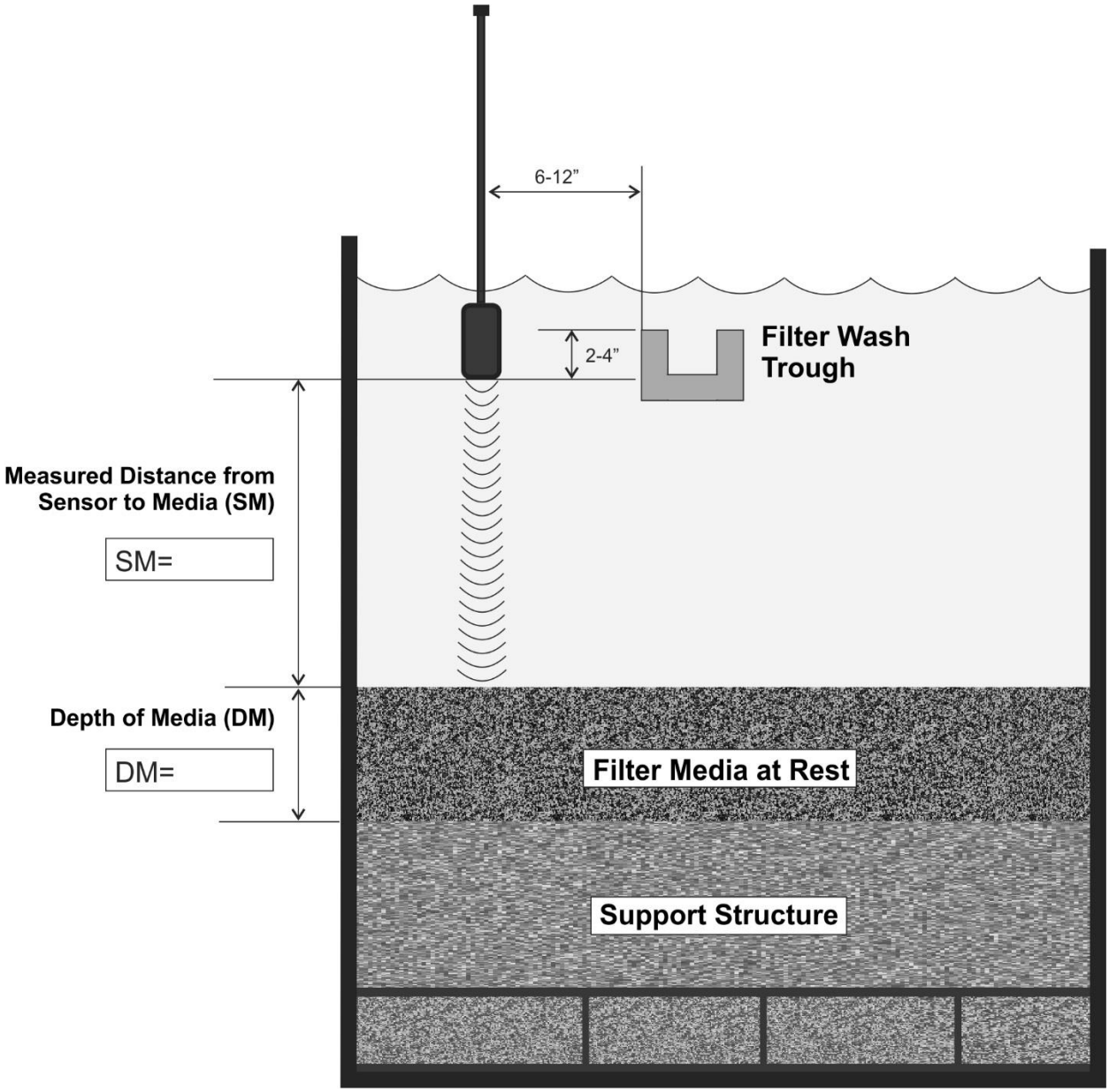


Figure 45: Installation Recommendations for Filter Applications

13. Warranty

Analytical Technology, Inc. (Manufacturer) warrants to the Customer that if any part(s) of the Manufacturer's equipment proves to be defective in materials or workmanship within the earlier of 18 months of the date of shipment or 12 months of the date of start-up, such defective parts will be repaired or replaced free of charge. Inspection and repairs to products thought to be defective within the warranty period will be completed at the Manufacturer's facilities in Collegeville, PA. Products on which warranty repairs are required shall be shipped freight prepaid to the Manufacturer. The product(s) will be returned freight prepaid and allowed if it is determined by the manufacturer that the part(s) failed due to defective materials or workmanship.

This warranty does not cover consumable items, batteries, or wear items subject to periodic replacement including lamps and fuses.

Gas sensors carry a 12 months from date of shipment warranty and are subject to inspection for evidence of misuse, abuse, alteration, improper storage, or extended exposure to excessive gas concentrations. Should inspection indicate that sensors have failed due to any of the above, the warranty shall not apply.

The Manufacturer assumes no liability for consequential damages of any kind, and the buyer by acceptance of this equipment will assume all liability for the consequences of its use or misuse by the Customer, his employees, or others. A defect within the meaning of this warranty is any part of any piece of a Manufacturer's product which shall, when such part is capable of being renewed, repaired, or replaced, operate to condemn such piece of equipment.

This warranty is in lieu of all other warranties (including without limiting the generality of the foregoing warranties of merchantability and fitness for a particular purpose), guarantees, obligations or liabilities expressed or implied by the Manufacturer or its representatives and by statute or rule of law.

This warranty is void if the Manufacturer's product(s) has been subject to misuse or abuse or has not been operated or stored in accordance with instructions, or if the serial number has been removed.

Analytical Technology, Inc. makes no other warranty expressed or implied except as stated above.

WATER QUALITY MONITORS

Dissolved Oxygen
Free Chlorine
Combined Chlorine
Total Chlorine
Residual Chlorine Dioxide
Potassium Permanganate
Dissolved Ozone
pH/ORP
Conductivity
Hydrogen Peroxide
Peracetic Acid
Dissolved Sulfide
Residual Sulfite
Fluoride
Dissolved Ammonia
Turbidity
Suspended Solids
Sludge Blanket Level
MetriNet Distribution Monitor

GAS DETECTION PRODUCTS

NH_3	Ammonia
CO	Carbon Monoxide
H_2	Hydrogen
NO	Nitric Oxide
O_2	Oxygen
CO	Cl2 Phosgene
Br_2	Bromine
Cl_2	Chlorine
ClO_2	Chlorine Dioxide
F_2	Fluorine
I_2	Iodine
H_X	Acid Gases
C_2H_4O	Ethylene Oxide
C_2H_6O	Alcohol
O_3	Ozone
CH_4	Methane (Combustible Gas)
H_2O_2	Hydrogen Peroxide
HCl	Hydrogen Chloride
HCN	Hydrogen Cyanide
HF	Hydrogen Fluoride
H_2S	Hydrogen Sulfide
NO_2	Nitrogen Dioxide
NO_x	Oxides of Nitrogen
SO_2	Sulfur Dioxide
H_2Se	Hydrogen Selenide
B_2H_6	Diborane
GeH_4	Germane
AsH_3	Arsine
PH_3	Phosphine
SiH_4	Silane
HCHO	Formaldehyde
$C_2H_4O_3$	Peracetic Acid
DMA	Dimethylamine