A Badger Meter® Brand

Water Quality Monitor

EchoSmart Sludge Blanket Monitor

Badger Meter

ATI-UM-04417-EN-02 (August 2025)

User Manual

CONTENTS

SAFETY PRECAUTIONS

About this Manual

PLEASE READ THIS ENTIRE MANUAL PRIOR TO INSTALLING OR USING THIS PRODUCT.

Observe the following safety precautions 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 making sure 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 and so on). 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 make sure 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 are required. All EchoSmart system cables are to be installed in metal conduit that is properly grounded and shielded using 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 Badger Meter for information. Only use the EchoSmart ESC or ESP with the sensor supplied. Replace Fuse with 1.25A 5 × 20 mm T-Lag UL approved.

This equipment is suitable for use with 110…240V 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 24V DC 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 BADGER METER, 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 you select 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 20 CM BETWEEN THE RADIATOR AND YOUR BODY. THIS TRANSMITTER MUST NOT BE CO-LOCATED OR OPERATING IN CONJUNCTION WITH ANY OTHER ANTENNA OR TRANSMITTER.

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.

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 automatically display for each parameter and system function.

Field Network Option

A single controller can operate up to 16 EchoSmart Sensors 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…20 mA signal) are also at the power supply unit.

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 *"RS-485 Modbus RTU" on page 38* for additional information.

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.

Wastewater and Water Treatment Clarifiers and Thickeners

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 into 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.

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 Badger Meter or an authorized representative for further information on the characteristics and requirements for successful implementation of EchoSmart equipment in these environments.

ECHOSMART SENSOR (ESS)

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

Sensor 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 supplies 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.

Sensor Specifications

Power Requirement	15V DC Standard Sensor: 2.4W Wiper Sensor: 3W
Range	1.0…32 ft (0.305…10.0 m)
Sensor Meas. Resolution	0.1 unit of measure
Accuracy	0.2 in. @ 10.0 ft (5 mm at 3.05 m)
Operating Temperature	34…125° F (1…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° scattered light, pulsed LED Range: 0…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

ECHOSMART CONTROLLER (ESC)

The EchoSmart Controller allows for programming and local monitoring of 1…16 EchoSmart Sensors.

Controller Overview

The controller screen consists of a graphical backlit LCD (2.6 × 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.

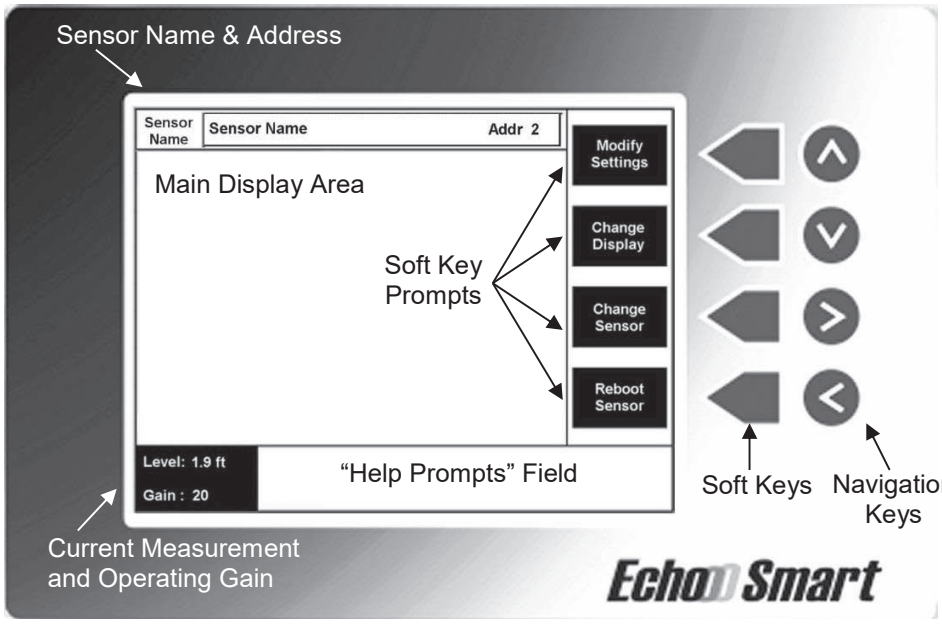


Figure 1: LCD display

Operator Interface Overview

The screen has five informative sections:

- Smart Sensor Name and Address
- Current Measurement and Operating Gain
- Help Prompts Field
- Main Display Area
- Soft Keys

Smart Sensor Name and Address

The bar at the top of the screen 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 screens relates to this sensor.

If the controller is operating a multi-sensor field network, press the **Change Sensor** soft key to see the other sensors. A listing of network sensors appears (see *Figure 17 on page 23*). Use the navigation keys to select the desired sensor and press the **Select Sensor** soft key.

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 screens. Additionally, messages regarding external communication (see *"Outputs and Communication Options" on page 38*) taking place and error messages (see *"Troubleshooting" on page 49*) associated with the active sensor screen in this section.

Help Prompts Field

The *Help Prompts Field* across the lower section of each screen provides an explanation of the screen or the highlighted parameter. *Help Prompts* reduce the need for referencing the printed user manual.

Main Display Area
The area has both digital and graphical capabilities. The content changes with the functionality of the selected screen.

Soft Key Prompts
The vertical bar on the right side of the screen consists of four boxes. The text in each box describes the function of the *Soft Key* located next to that box. The text changes when you select a different function or navigate to a different instrument parameter.

Keypad

The EchoSmart 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. Use the soft keys to change instrument settings, switch to a different screen or trigger other actions.

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

Navigation Keys
Navigation Keys advance the instrument cursor to the desired location on the screen for operation by soft key commands.

Screen Navigation Overview
An overview of the organizational structure of the screens is shown in *Figure 2*.

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

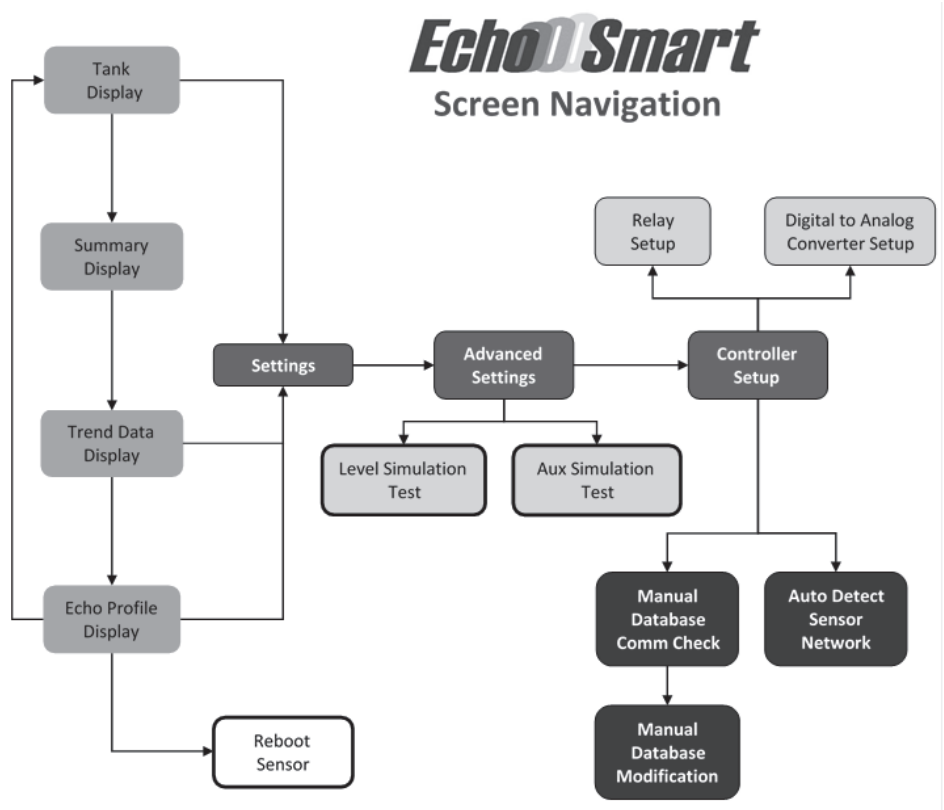


Figure 2: Screen navigation overview

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 want to network the controller with other devices (like ESP or SCADA Systems), see *"Communications, Outputs and Networking" on page 35* for sample connection diagrams.

Controller Specifications

Input Power	100…240V AC, 50/60 Hz – 1.5A, 70W Optional 24V DC: 19…42V DC
Supply Cable	10…18 AWG, – 40…140° F
Fuse	1.25A 250V 5 × 20 mm T-lag UL approved fuse
Analog Loops	(2) 4…20 mA Outputs 15…24V DC (provided by ESC for local sensor)
Ambient Temperature	– 40…140° F (– 40…60 °C)
Display	Graphical backlit monochrome screen Resolution: 320 × 240 pixels Viewing Area: 2.6 × 3.45 in. (92 × 122 mm)
Reported Meas. Resolution	1.0 (in. and cm), 0.1 (ft), 0.01 (m)
RF Module for Europe (Optional)	868 MHz frequency band Self-healing mesh network Approvals: CE RED
RF Module for North America (Optional)	900 MHz frequency band Self-healing mesh network Approvals: FCC Part 15C, Industry Canada
Relays (Optional)	(4) Relays: 10A @ 250V AC; 10A @ 30V DC
Enclosure	NEMA 4X, IP65; Polycarbonate
Weight	Approx. 3.0 lb (1.36 kg) depending on configuration
Certifications	CE

⚠CAUTION

SUPPLY MAIN POWER IN THE FORM FOR WHICH THE EQUIPMENT IS DESIGNED.

Controller Connections

- The ESC circuit board contains four screw-terminal connectors as well as additional plug-in connectors (see *Figure 3*). To prevent damage, do not over-tighten the screw terminals.
- Verify the power cable (10…18 AWG) is properly connected to the power connector.
- Install a breaker to fully remove power from the unit in the event that repairs to the unit are required.
- Connect sensors (ESS) to the controller by color (see *Figure 3*).
- The table in *Figure 4 on page 16* contains a functional description of the screw terminal connectors.

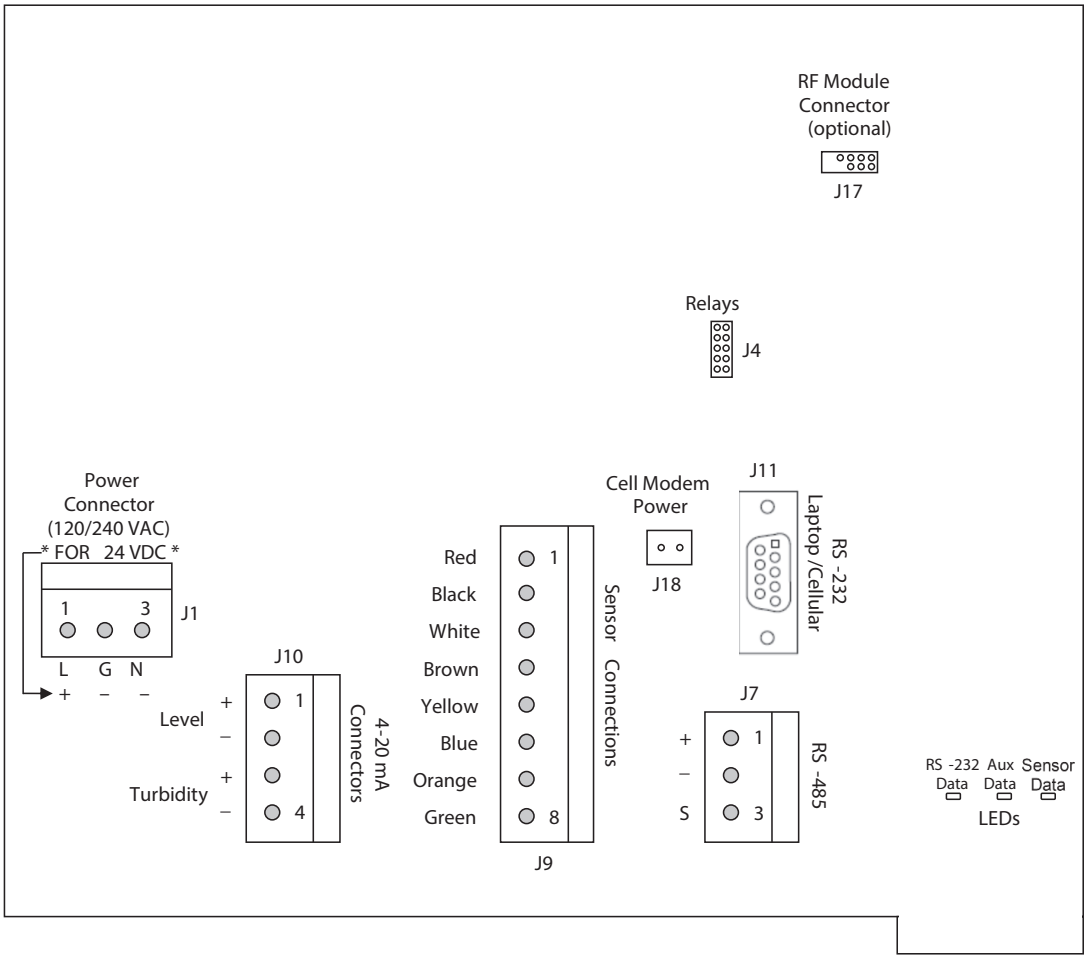


Figure 3: Controller connections

Power Connector (J1)		4…20 Analog Connectors (J10)		Sensor Connections (J9)		RS-485 Connector (J7)	
Pin	Description	Pin	Description	Pin	Description	Pin	Description
1	Live	1	Level +	1	15V	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 (–)		
(J1) for 24V DC				5	4…20 mA Level		
1	+			6	4…20 mA Level		
2	–			7	4…20 mA Turbidity		
3	–			8	4…20 mA Turbidity		

Figure 4: Table of controller connections

NOTE: 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).

NOTE: 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.

NOTE: 4…20 mA current loops are internally powered, grounded and galvanically isolated.

Initializing and Configuring EchoSmart System

IMPORTANT

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

Initial Controller Setup Screen

The *Initial Controller Setup* screen (see *Figure 5 on page 17*) appears 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, you must assign a unique address to each Smart Sensor during initialization (see also *"First Time Controller and Sensor System Installation" on page 17*). The assigned 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 you add sensors to the network one at a time. See "First Time Controller and Sensor System Installation" on page 17. Change the address of each sensor to a unique number from 2…240. Initialize the sensor that is directly connected to the controller 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.

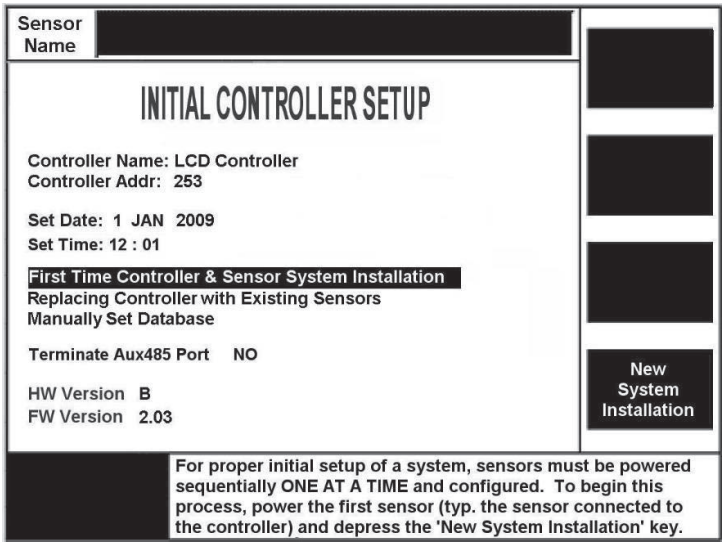


Figure 5: Initial controller setup

First Time Controller and Sensor System Installation

If this is a new installation, select **First Time Controller & Sensor System Installation** and press the **New System Installation** soft key (see *Figure 5*). The controller automatically locates the Smart Sensor that has been powered (this takes a few seconds) and opens the *Initial Sensor Setup* screen (see *Figure 6*).

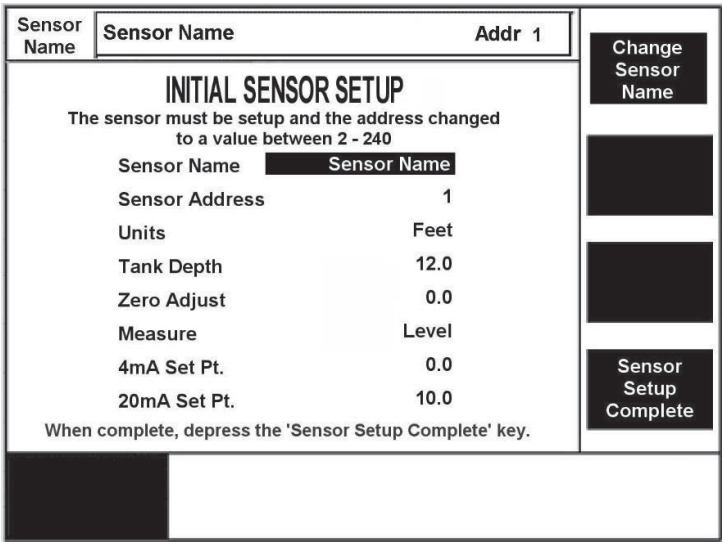


Figure 6: Initial sensor setup

Follow the soft key prompts and use the navigation keys to enter the *Sensor Name* and *Sensor Address*.

IMPORTANT

You must change the Sensor Address 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. YOU MUST ASSIGN A UNIQUE ADDRESS TO EACH SENSOR AS YOU ADD IT TO THE NETWORK (POWERED ON). THIS PROCEDURE ALLOWS THE CONTROLLER TO ESTABLISH COMMUNICATION AND PROVIDE A UNIQUE ADDRESS FOR EACH SENSOR. FAILURE TO FOLLOW THIS PROCEDURE WILL RESULT IN MULTIPLE SENSORS HAVING THE SAME ADDRESS AND WILL PREVENT COMMUNICATION.

Press the **Sensor Setup Complete** soft key to finalize setup of the sensor. The *Power Next Sensor* screen (*Figure 7*) appears. Apply power to the EchoSmart Power Supply Unit connected to the next sensor and repeat these steps.

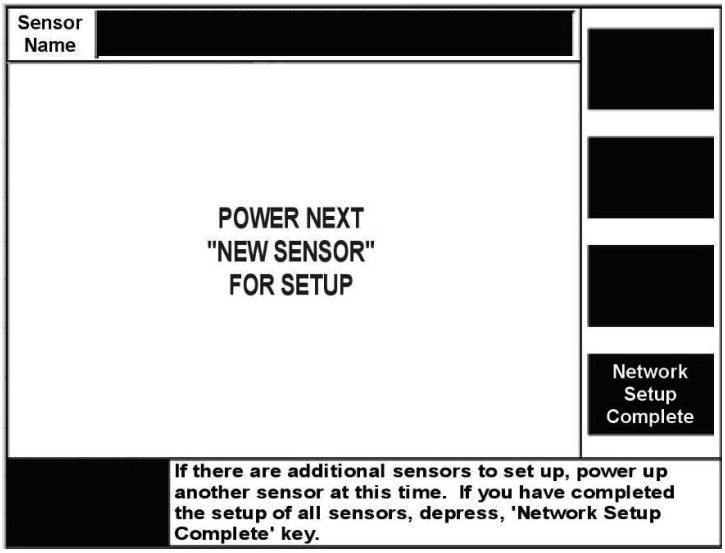


Figure 7: Power next sensor

After all sensors have been initialized, press the **Network Setup Complete** soft key (see *Figure 7*). The controller begins to poll all the EchoSmart Sensors and display current measurements.

See *"Quick Start Guide" on page 58* for step-by-step instructions on configuring a single sensor or a network of sensors.

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 **Replace Controller Only** soft key. The controller automatically detects the existing sensors and returns to full operation after the initialization routine is completed.

Using Informational Screens

The controller has these informational screens:

- *Echo Profile* screen
- *Sensor Register* screen
- *Tank View* screen
- *Historical Trend* screen

Press the **Change Display** soft key to make a selection. At power up, the system defaults to the *Echo Profile* screen.

There are also screens for entering instrument settings:

- *Modify Settings* screen
- *Advanced Settings* screen
- *Controller Setup* screen

Echo Profile Screen

The *Echo Profile* screen (*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 the **Select Sensor** soft key**.**

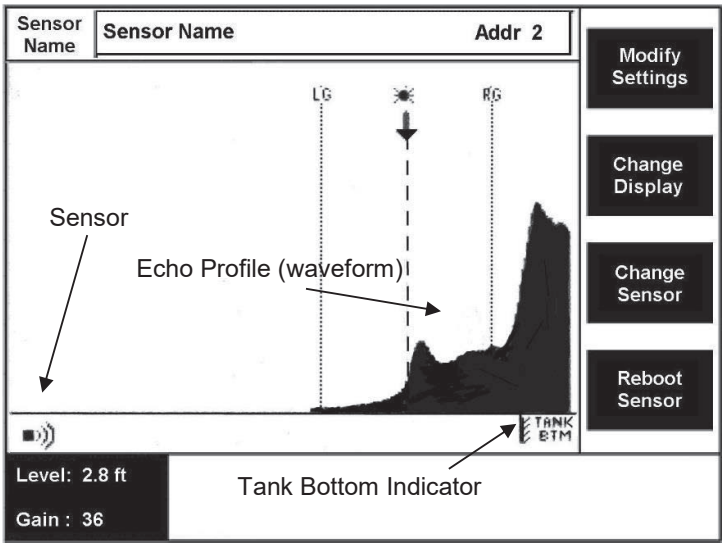


Figure 8: Echo profile screen

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 expandable media (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..

Sensor Register Screens

This screen 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*.

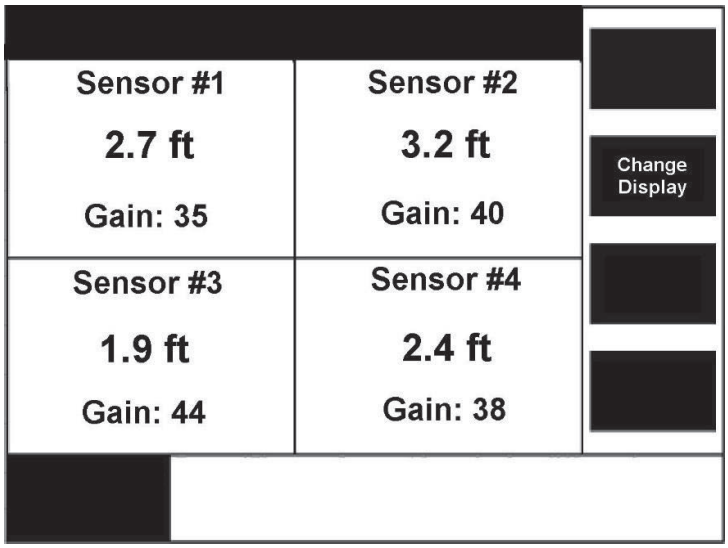


Figure 9: Four sensor field network screen

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

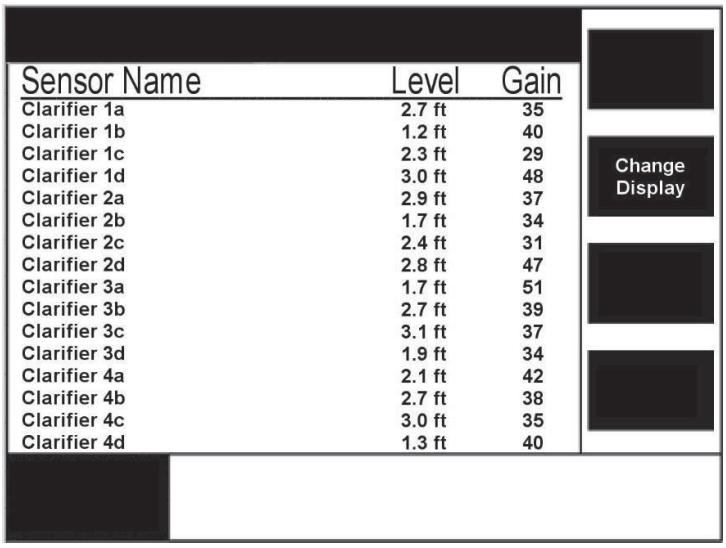


Figure 10: Multiple sensor field network screen

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

Tank View Screen

The *Tank View* screen (*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.

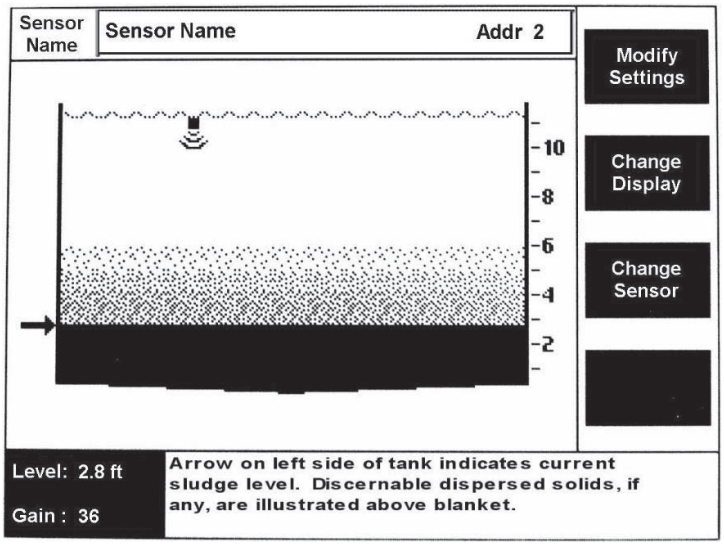


Figure 11: Tank view screen

Use the *Modify Settings* screen to enable the *Tank View* screen. Optional diagrams are available to correspond with the specific application (see *Figure 12*).

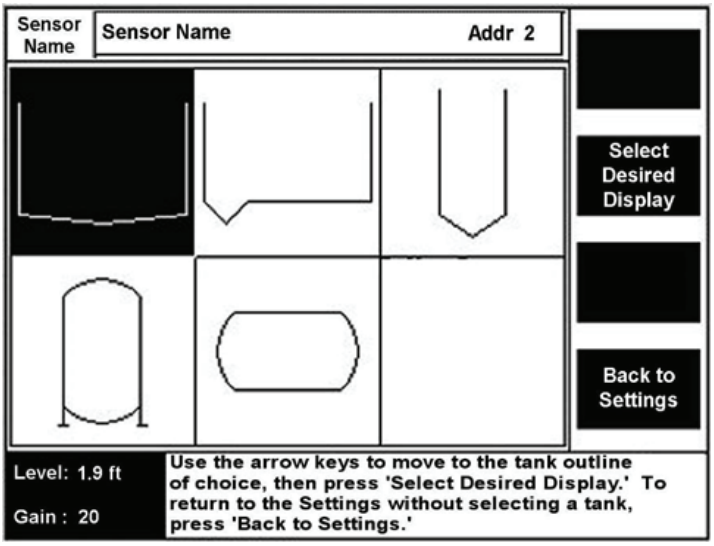


Figure 12: Tank options

Historical Trend Screen

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* screen (see *Figure 13*) provides a graphical illustration of stored measurements for the selected sensor. The user may choose to view from 1…7 days of data.

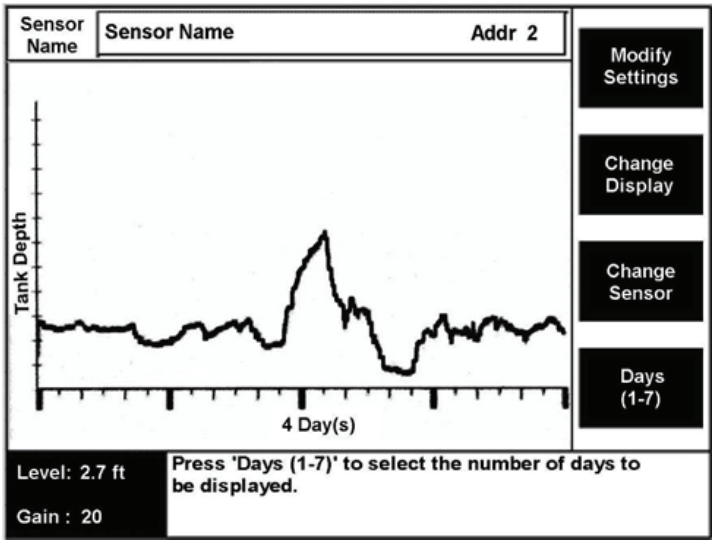


Figure 13: Historical trend screen

Use the *Modify Settings* screen to enable the *Historical Trend* screen.

Modify Settings Screen

Use this screen (*Figure 14*) to enter the primary parameter settings for each sensor and to enable the *Historical Trend* screen and the *Tank View* screen. A *Display Contrast* adjustment function is also found here. A *Display Contrast* adjustment function is also found here.

Changes are implemented when you enter them and exit the screen. No confirming command is required.

Descriptions of parameter functions are in *"Instrument Programming Parameters" on page 41*.

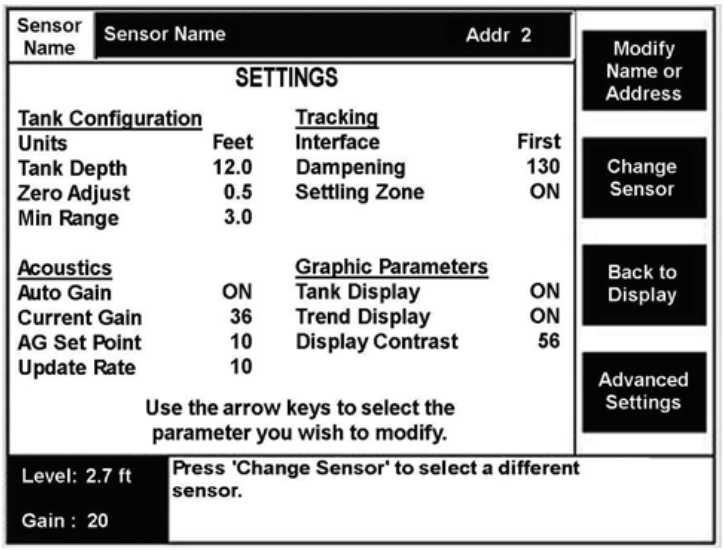


Figure 14: Modify settings screen

To assign a unique alphanumeric name and change its identifier address, press the **Modify Name or Address** soft key (see *Figure 15*).

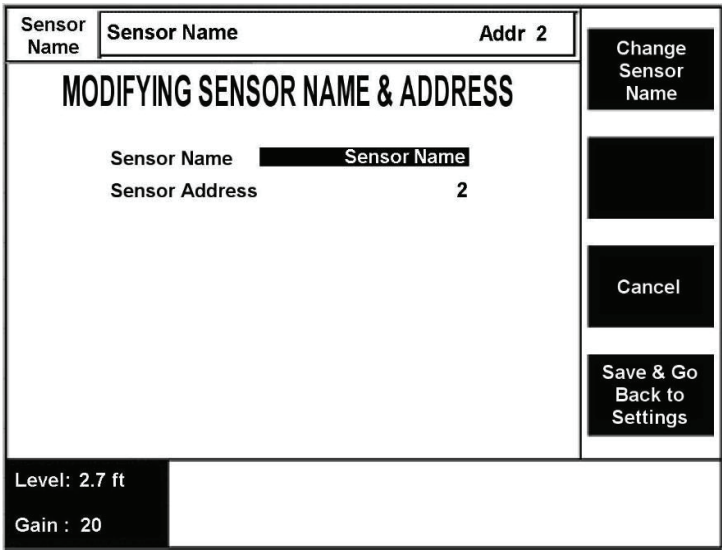


Figure 15: Modifying sensor name and address screen

When modifying the sensor name, use the navigation keys 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.

Advanced Settings Screen

Use the *Advanced Settings* screen (see *Figure 16*) to enter additional parameter settings for each sensor. Do not change these settings without instruction from Badger Meter or a representative.

To access the *Advanced Settings* screen, press the **Modify Settings** soft key.

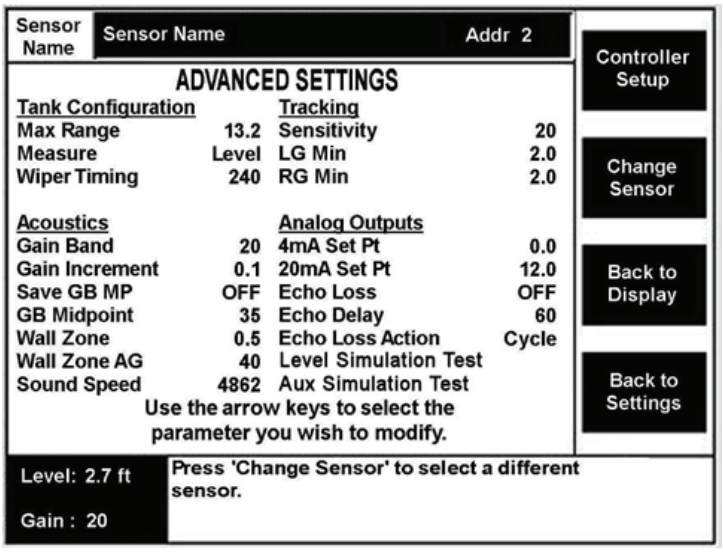


Figure 16: Advanced settings

See *"Instrument Programming Parameters" on page 41* for display descriptions of parameter functions.

Controller Setup Screen

Use this screen (see *Figure 17*) 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 displays 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.

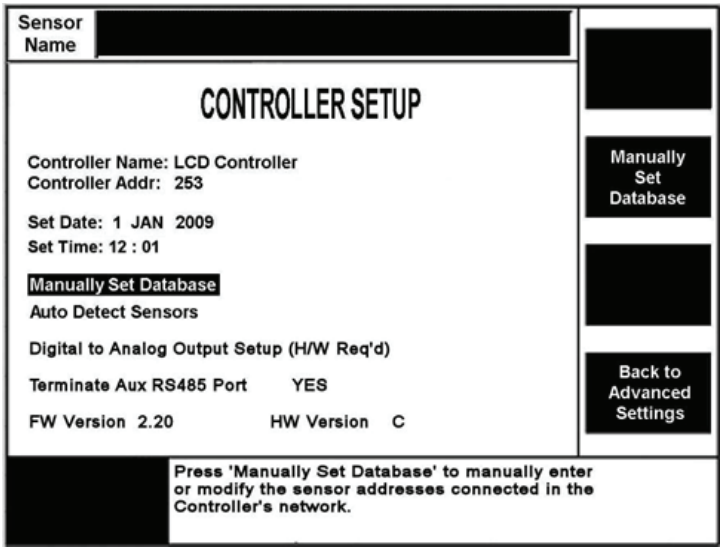


Figure 17: Controller setup screen

The *Auto Detect Sensors* option begins a search for sensors that are directly connected to the controller and are part of a field network of sensors. Use this option to initialize a new instrument and to add sensors from an existing network.

Use the *Manually Set Database* option (see *Figure 18*) to specify sensor addresses and establish the order in which the addresses appear in the *Sensor Database* screen. 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.

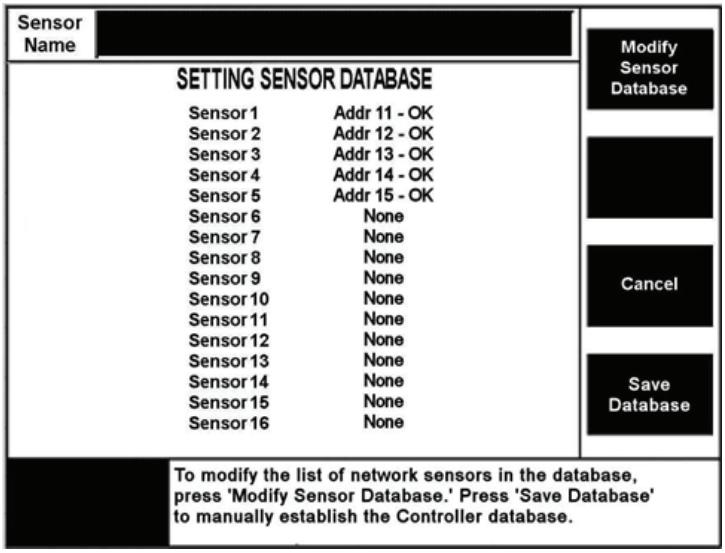


Figure 18: Sensor database screen

Select the **Manually Set Database** soft key to perform a quick check of the network sensors. When communication is verified, "OK" displays next to the sensor address. If communication cannot be verified, "??" displays next to the sensor address.

Select the **Modify Sensor Database** soft key to perform modifications to the database. From the *Modifying Sensor Database* screen (see *Figure 19*), you can change the network addresses to be polled by the controller, modify the sensor display order and delete a sensor.

IMPORTANT

Changes made from this menu are ONLY used to modify the existing network of sensor addresses to be polled by the controller and DO NOT change the sensor's address. You must make any changes to the sensor address parameter from the Modifying Sensor Name and Address screen (see Figure 15 on page 22).

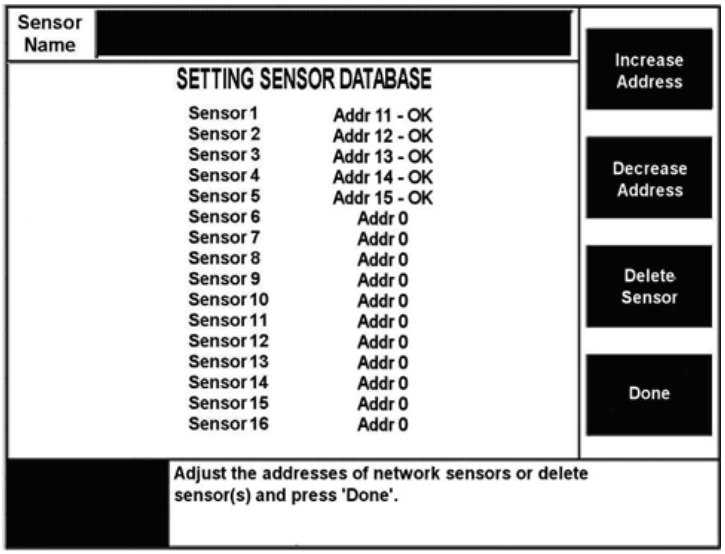


Figure 19: Modify the sensor database screen

When the changes are complete, press **Done** to return to the *Sensor Database* screen. Press the **Save Database** soft key (see *Figure 18 on page 24*) 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) reports the number of sensors found, followed by the number of sensors validated. The display then redirects to the *Echo Profile* screen and begins polling all the sensors in the database.

To access the *Controller Setup* screen, press the **Controller Setup** soft key from the *Advanced Settings* screen.

Sensor Selection Menu

To change the sensor that the controller is currently displaying, press the **Change Sensor** soft key (available on any informational and settings screens). Use the navigation keys to move to the sensor and press the **Select Sensor** soft key (see *Figure 20*).

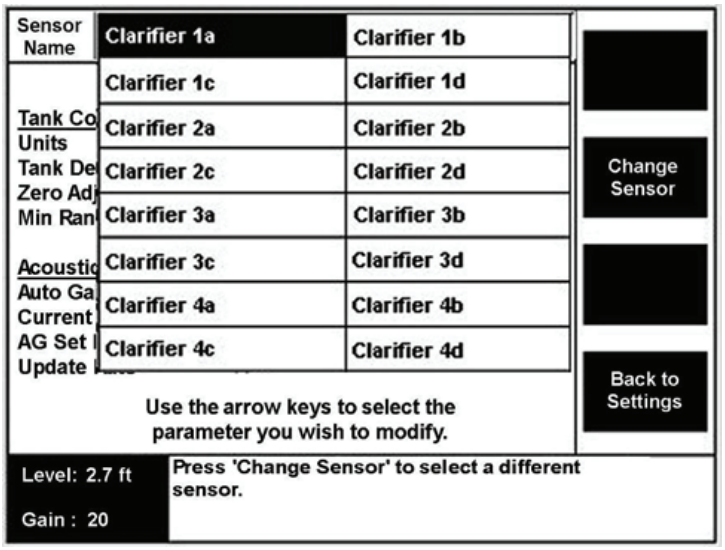


Figure 20: Sensor selection dropdown window

Automatic Initialization and Reboot Sensor

EchoSmart performs automatic initialization whenever you apply power to the sensor or select the **Reboot Sensor** command from the *Echo Profile* screen. 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. Re-initialize any 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 quickly returns the sensor to normal operation.

ECHOSMART POWER SUPPLY UNIT (ESP)

The EchoSmart 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 setting up and monitoring EchoSmart Sensors. See *"Communications, Outputs and Networking" on page 35*.

Specifications and Connections

This section describes the physical layout of the ESP terminal connectors and how to implement them. If you want to network the ESP with other devices (like ESC, other ESPs, SCADA Systems and so on), see *"Communications, Outputs and Networking" on page 35* for sample connection diagrams.

Power Supply Unit Specifications

Input Power	100…240V AC, 50/60 Hz, 1A, 20W Optional 24V DC: 18…36V DC
Supply Cable	10…18 AWG, – 40…140° F
Fuse	0.250A, 250V 5 × 20 mm T-lag UL approved fuse
Analog Loops	15…24V DC (provided by ESP for local sensor) (2) 4…20 mA Outputs
Ambient Temperature	– 40…140° F (– 40…60° C)
RF Module for Europe (Optional)	868 MHz frequency band Self-healing mesh network Approvals: CE RED
RF Module for North America (Optional)	900 MHz 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

MAKE SURE YOU SUPPLY MAIN POWER IN THE FORM FOR WHICH THE EQUIPMENT IS DESIGNED.

Power Supply Connections

The ESP circuit board contains four screw-terminal connectors as well as additional plug-in connectors. See *Figure 21 on page 27*. Use caution in tightening the screw terminals to prevent damage from over-tightening.

Make sure the power cable (10…18 AWG) is connected to the power connector properly. Connect sensors (ESS) to the power supply by color code. See *Figure 21 on page 27*. See *Figure 22 on page 27* for a functional description of the screw-terminal connectors.

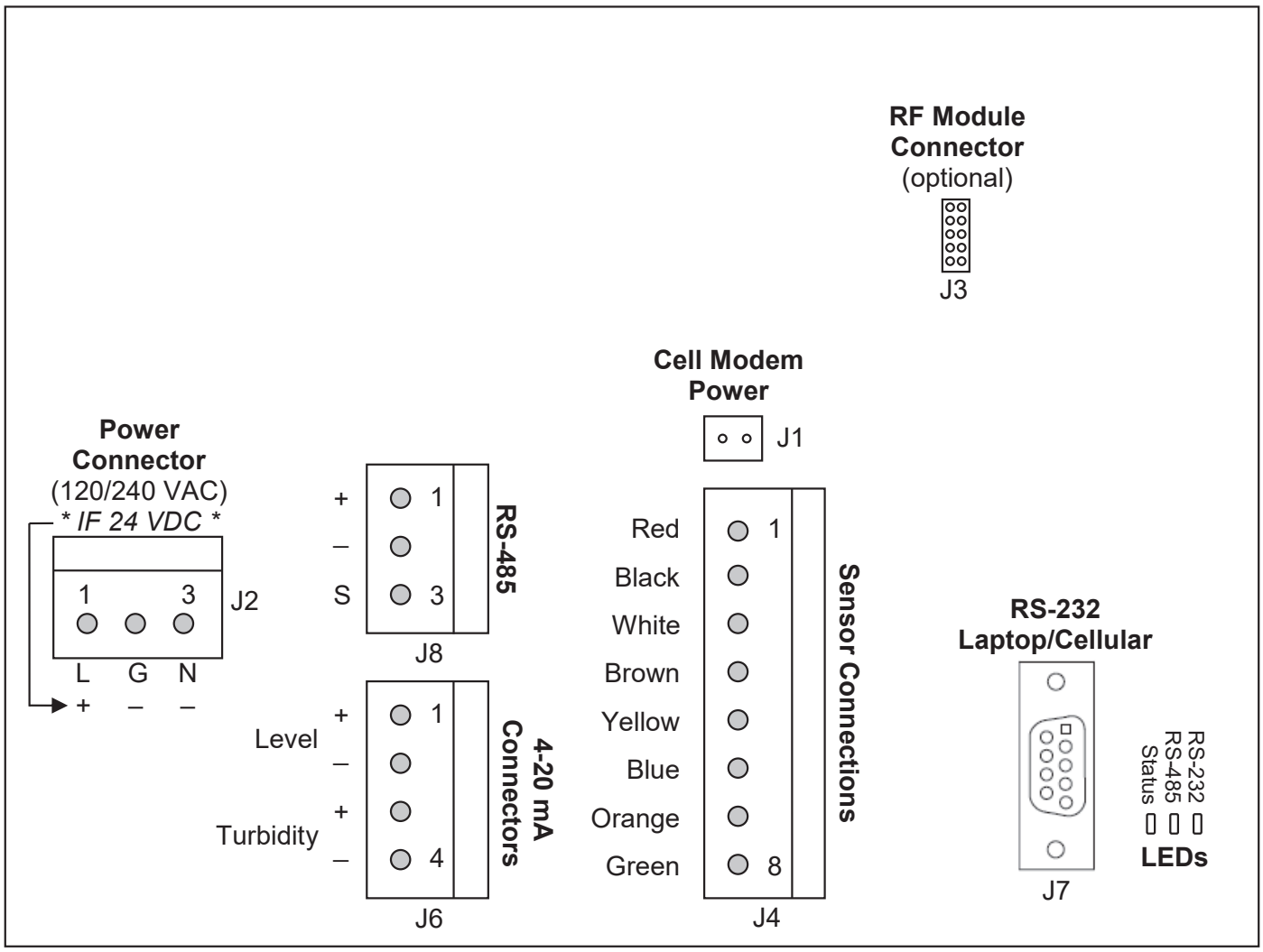


Figure 21: Connections for power supply

Power Connector (J2) for 100…240V AC		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	15V	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 (–)		
(J2) for 24V DC				5	4…20 mA Level		
1	+			6	4…20 mA Level		
2	–			7	4…20 mA Turbidity		
3	–			8	4…20 mA Turbidity		

Figure 22: Table of power supply connections

NOTE: 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.
Connect the controller at Pin 3 and Pin 4 of the sensor connector (J9).

NOTE: 4…20 mA current loops are internally powered, grounded and galvanically isolated.

INSTALLATION OF EQUIPMENT

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 (Multiflex 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 on page 29*.

Sensor Location Selection Criteria

Optimal performance depends on:

- Acceptable process liquid (supernatant) in which the ultrasonic pulse is to be transmitted
- Responsive interface material (suspended solids blanket, other settled solids)
- Freedom from objects encroaching into the path of the transmit pulse
- Avoiding areas of excessive turbulence.

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. Position the sensor to avoid these conditions, if possible.

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.

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.

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.

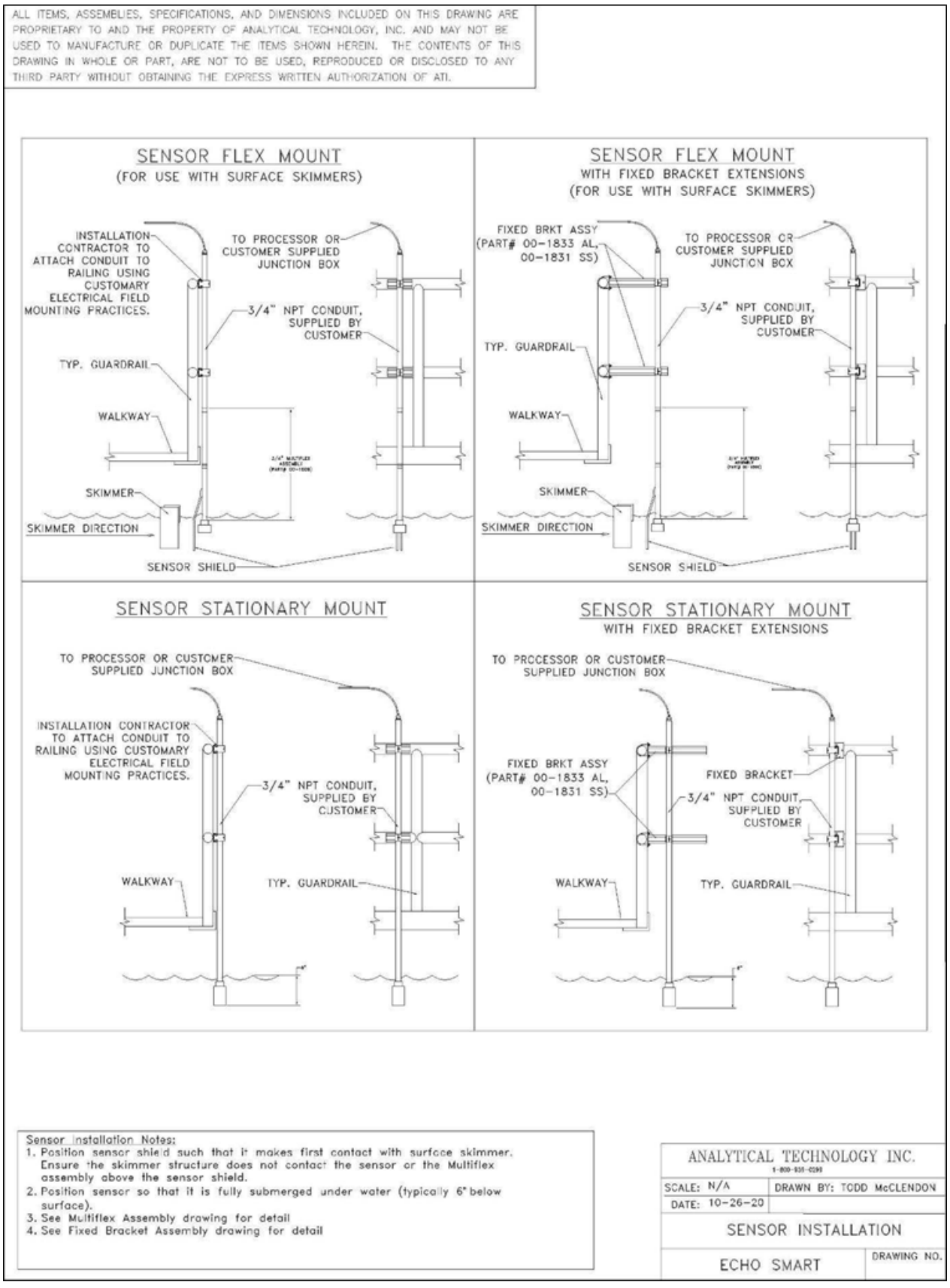
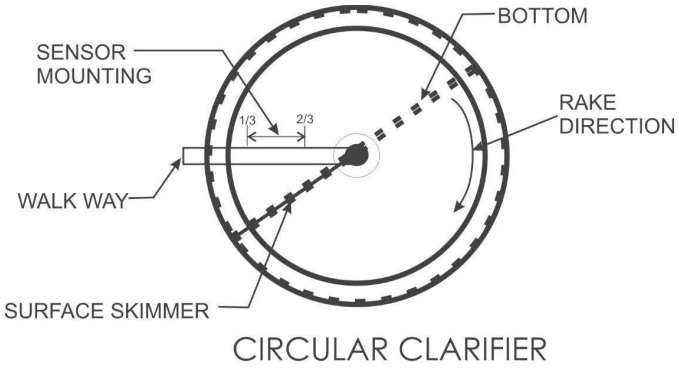


Figure 23: EchoSmart sensor installation arrangements

Typical Circular Clarifier

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



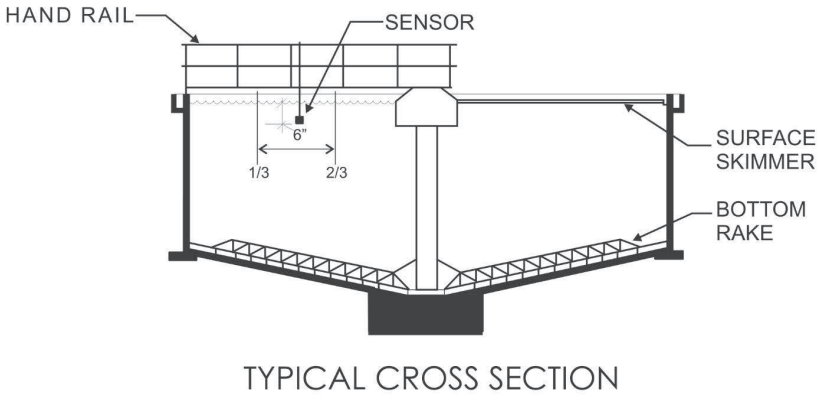


Figure 24: Typical 1/3… 2/3 location in circular clarifier

Typical Rectangular Clarifier

You may locate sensors along the length of the clarifier or in the area of the sludge sump. Take care to consider inlet flow and the design of the sludge collection system. Contact Badger Meter for specific recommendations regarding sensor location to provide optimal performance.

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 *Sensor 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 Badger Meter for additional information.

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 feet of the sensor. See *Figure 25* and *Figure 26*. Sensor cables may be extended at watertight junction boxes using manufacturer-specified cables or by special order of sensors with continuous cable of longer lengths.

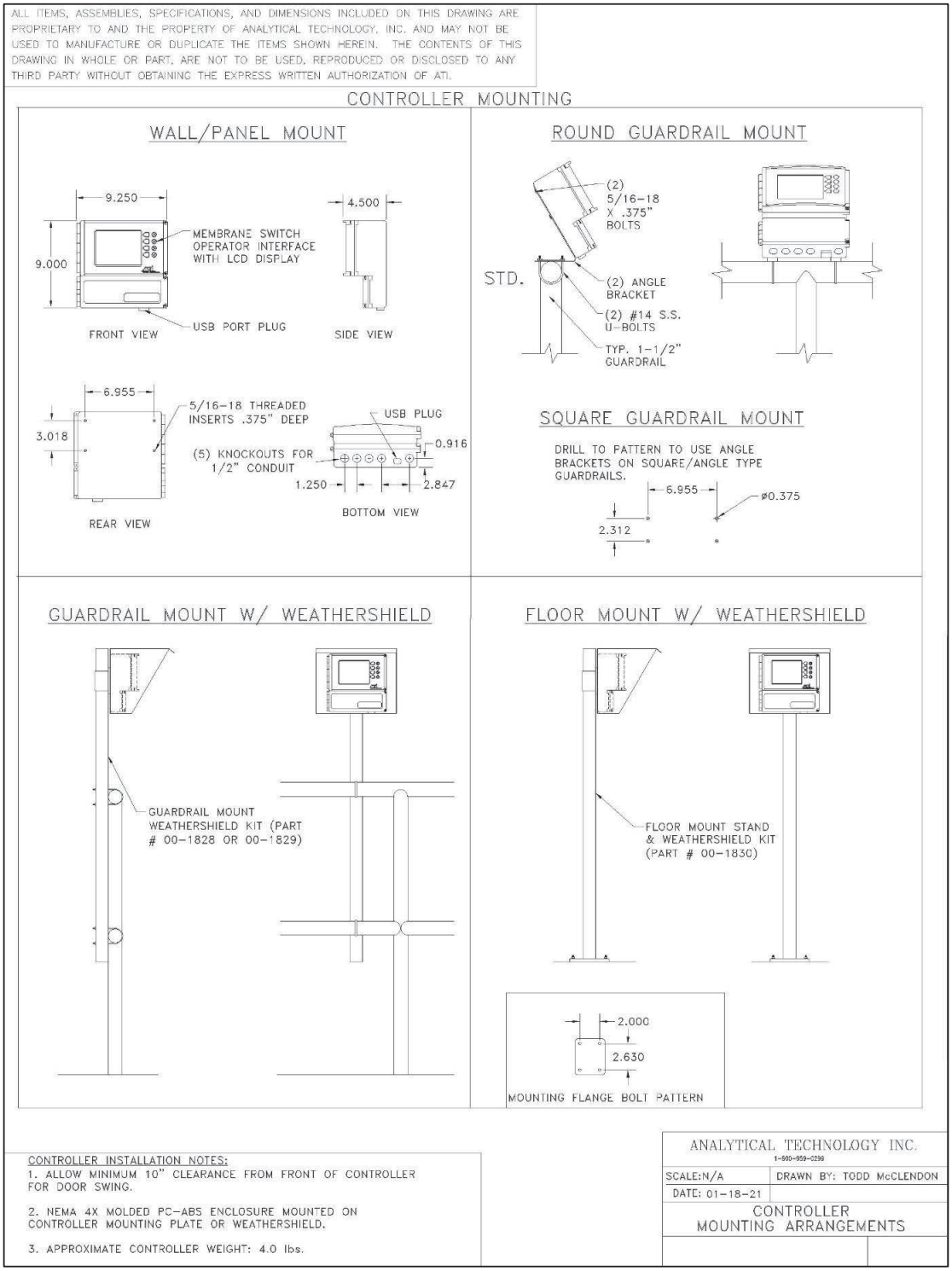


Figure 25: Controller installation drawing

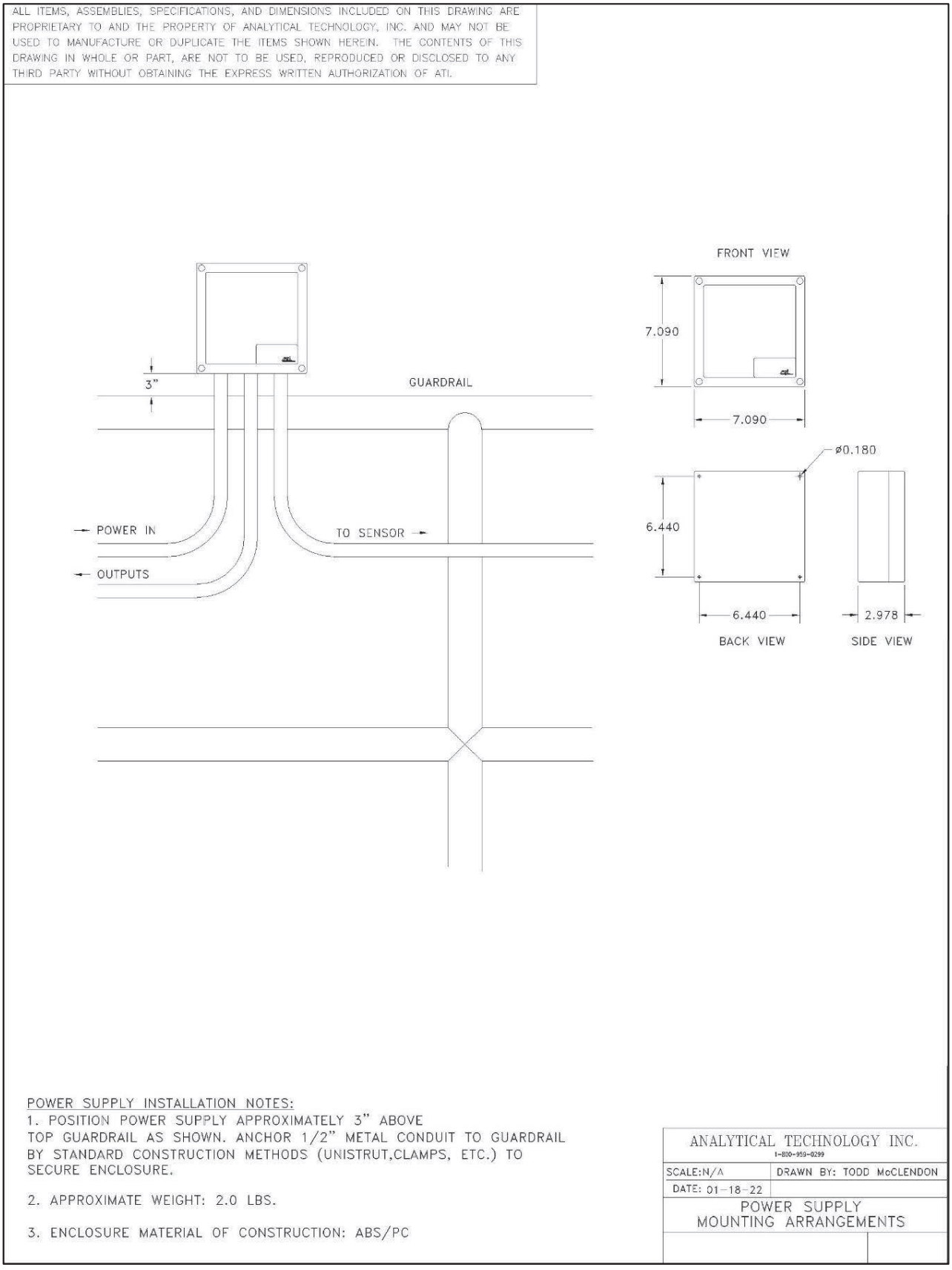


Figure 26: Power supply unit installation drawing

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, make sure the instrument settings match the dimensions of the tank in which you install the sensor.

Tank Configuration

Tank Depth and *Zero Adjust* parameters (see *"Tank Depth (10.0)" on page 41* and *"Zero Adjust (0.5)" on page 41*) orient the instrument to the dimensions of the tank and make sure that the echo waveform corresponds with tank dimensions at the location of the sensor (see *Figure 27*).

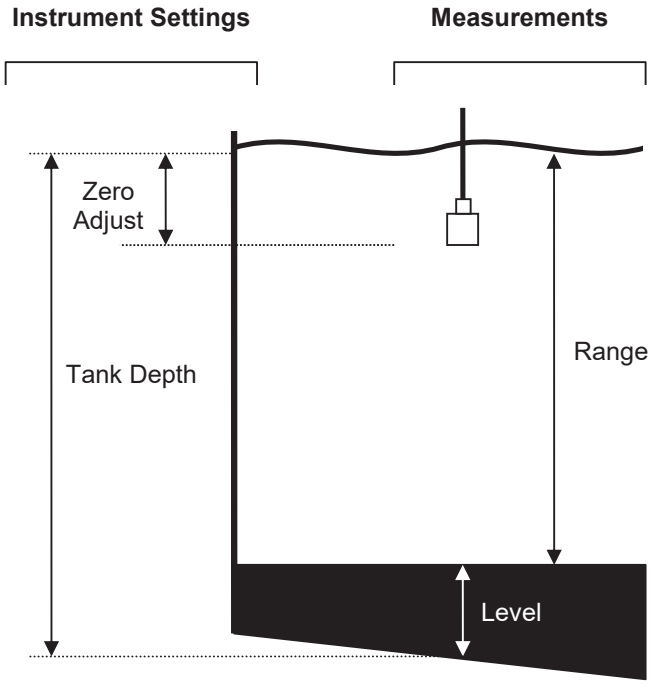


Figure 27: Tank configuration

Waveform Analysis

The EchoSmart Sensor produces a signal waveform (*Figure 28*) that is used to produce the *Level* and *Range* measurement. The waveform is available as a diagnostic tool in the *Echo Profile* screen. See *Figure 28*.

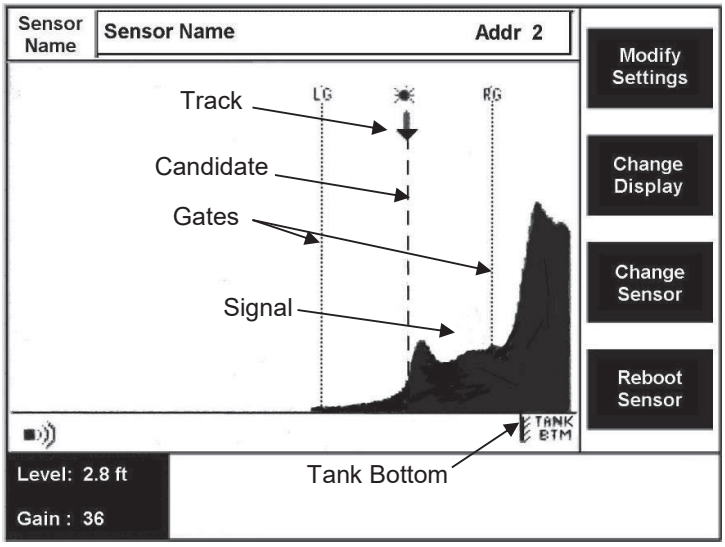


Figure 28: Echo profile screen

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*.

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.

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 *"LG Min (2.0)" on page 44* and *"RG Min (2.0)" on page 44* for parameters that establish the dimensions of the *Gate*.

Signal Waveform Symbols

↓ The *Down Arrow* points to the current track. 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 is only affected by this signal if the signal 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 is only affected by this signal if the signal persists for repeated updates.

!! The *Double Exclamation Mark* indicates that the current signal is insufficient for tracking purposes. The *Current Measurement* is held until sufficient signal returns. An "Echo Loss" message accompanies the output measurement on the controller if it persists longer than the *Echo Delay* setting. *Loss of Echo* is reported on the 4…20 mA circuit if the *Loss of Echo* parameter is activated (see *"Echo Loss (OFF)"*, *"Echo Delay (60)"* and *"Echo Loss Action (Cycle)" on page 44*).

COMMUNICATIONS, OUTPUTS AND NETWORKING

You may implement EchoSmart as a stand-alone instrument, or configure it 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 *"Stand-Alone Instrument Option" on page 9*.)

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 *"Field Network Option" on page 9*.)

Configuration of Individual Units and Networks

Multiple configurations are possible for the EchoSmart equipment.

Stand-Alone Instrument

A stand-alone instrument is an EchoSmart Controller with a Smart Sensor connected to the controller (see *Figure 29*).

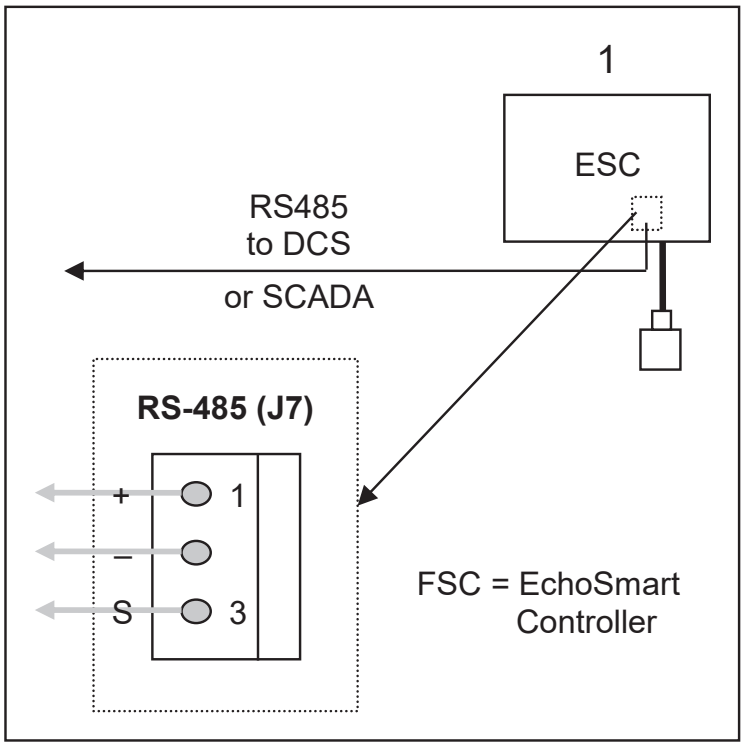


Figure 29: Controller with single sensor

Wired RS-485 Field Network

You can operate up to 16 Smart Sensors 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, use a shielded two-wire twisted pair (recommended Belden 9463) between each ESP and to the ESC. Make connections for the RS-485 communication line 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*.

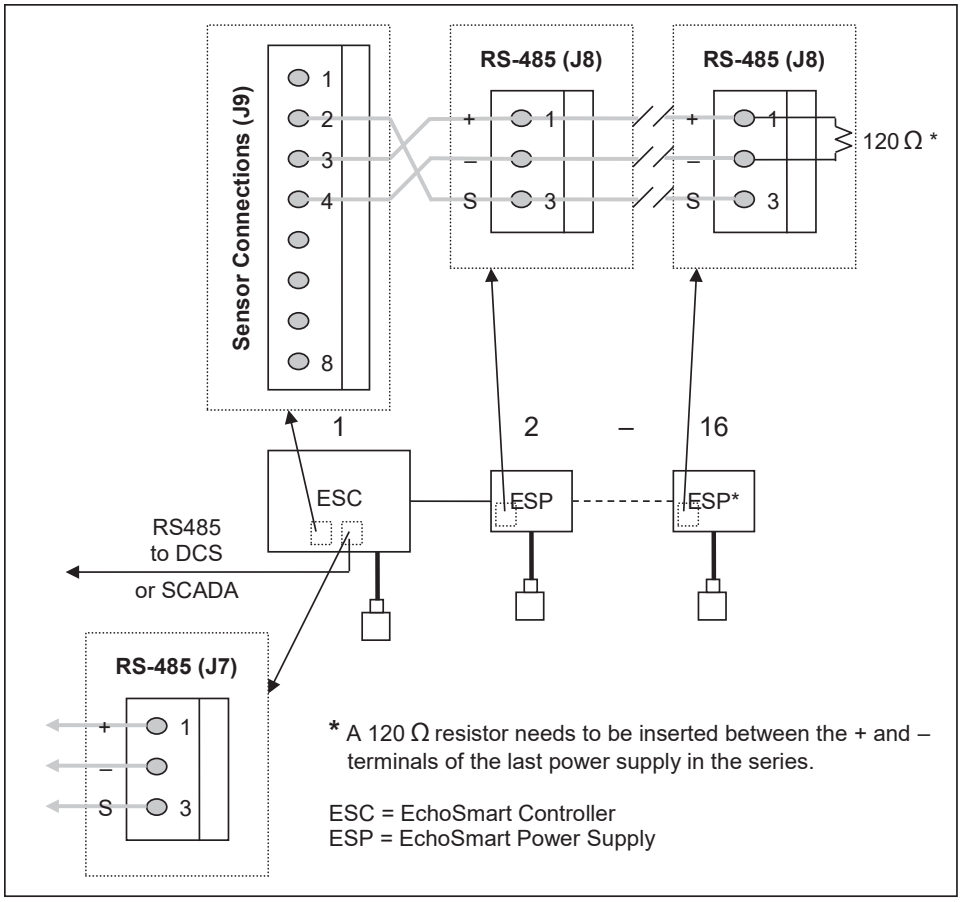


Figure 30: Single wired field network

Wireless (RF) Field Network

You can implement field networks as described and configured in *"Wired RS-485 Field Network" on page 36* using optional fully integrated RF modules without installing field interconnection cabling and conduit. Equip the controller and each power supply unit in the field network with an RF module. No user programming or other integration is required.

Figure 31 illustrates a single wireless RF field network configuration. You can integrate multiple RF Field Networks into a SCADA system by connecting controllers as shown in the "Customer Integration" section of *Figure 32 on page 38*.

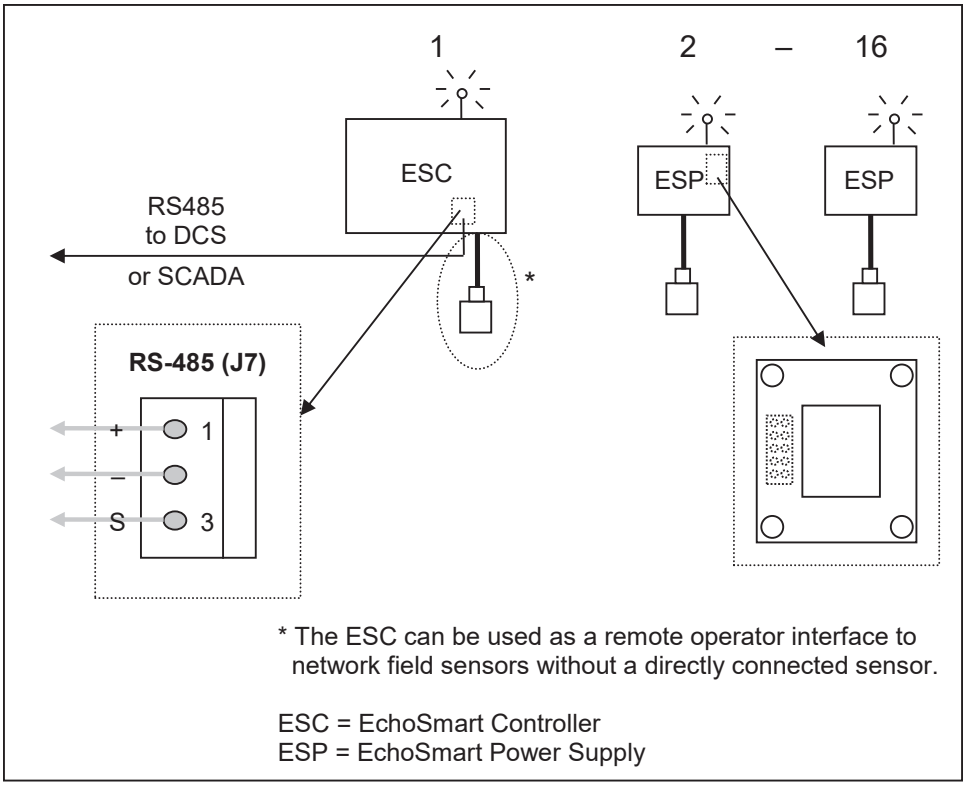


Figure 31: Single RF field network

Integrated Field Networks

You can interconnect EchoSmart controllers operating field networks in an integrated two-wire RS-485 network of up to 240 Smart Sensors. Each controller can maintain a network of up to 16 sensors using either wired connections or the wireless radio modules. Connect the controllers 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

Do not connect the two-wire cable to the control system to the ESC until all sensors are installed and communicating with the local ESC.

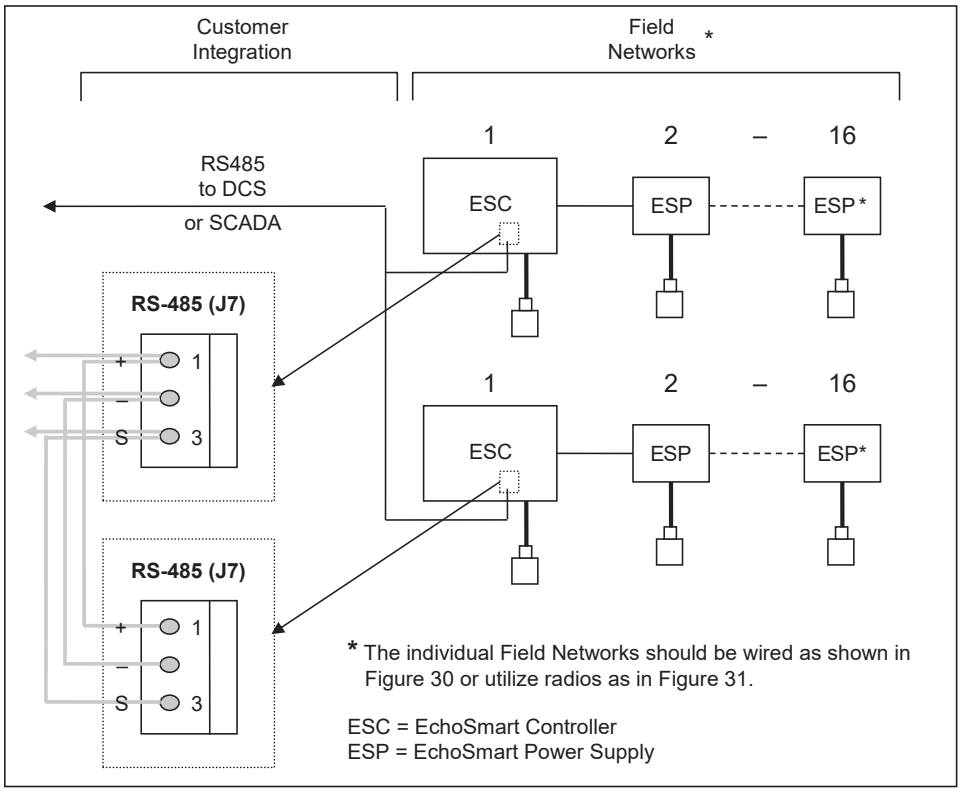


Figure 32: Integrated wired field network

Outputs and Communication Options

You can access current measurements from each sensor 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 *"Factory Remote Service" on page 40*).

RS-485 Modbus RTU

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

Connection

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

IMPORTANT

Do not connect this two-wire cable 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 appears 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 is each sensor's unique address entered when the EchoSmart equipment was commissioned. When multiple sensors are communicating with the ESC, poll each sensor's address separately for the desired Modbus value(s).

Recommended Polling

To obtain the current measurements, use Function Code 03 and poll for register 40001.

The returned values are reported in the sensor's selected *Units* as the base measurement multiplied by 10 (for example, 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 is the current NTU value multiplied by 100 (for example, 135 = 1.35 NTU).

For the most up-to-date information, retrieve only the desired data 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 "Modbus for EchoSmart" user manual for further detailed information on available commands, settings, and programming.

Analog 4…20 mA Current Loop

Each sensor generates two 4…20 mA proportional current loop signals. Access the signal 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.

Scale the sensor's 4 mA Set Point and 20 mA Set Point to represent the installation environment with consistent scaling at the control device. See *"4 mA Set Point (0.0)" on page 44* and *"20 mA Set Point (10.0)" on page 44*. 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…50 NTU and is not user-adjustable.

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 uses the onboard RS-232 serial connection. When communication occurs through this port, a "Maint Port" message appears in the lower left of most display screens.

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

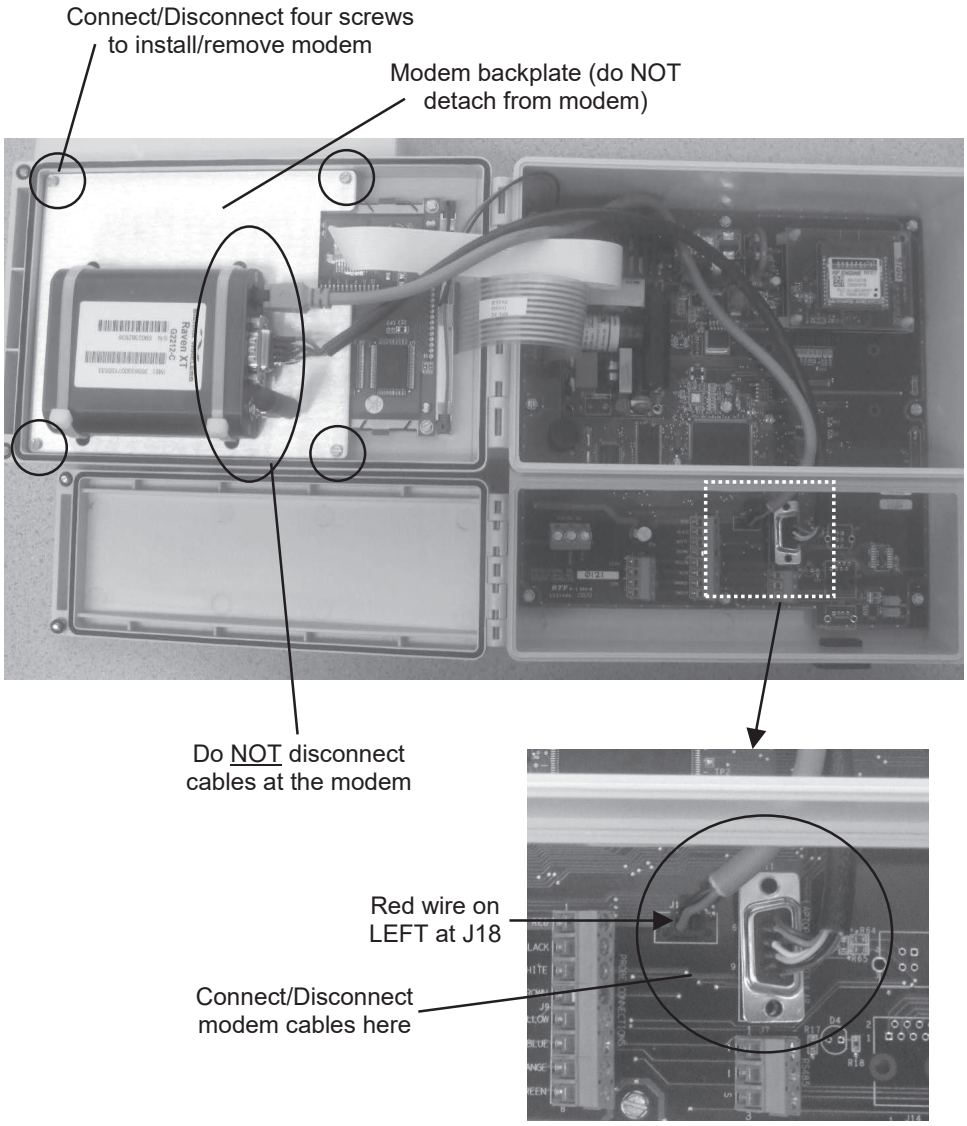


Figure 33: Proper installation and removal of modem

INSTRUMENT PROGRAMMING PARAMETERS

Controller and Smart Sensor parameter settings are established at the *Modify Settings* and *Advanced Settings* screens. Standard default parameters exist in all instruments until they are modified.

Some settings, as noted below (for example *Tank Depth* and *Zero Adjust*) require site-specific values. Other parameters may be changed for convenience or preference (for example *Units*, *Interface* and *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 ( ).

Modify Settings Parameters

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

NOTE: You must enter accurate values for *Tank Depth* and *Zero Adjust* to secure reliable measurements.

Units (ft)

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

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

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 make sure that the instrument signal corresponds with tank dimensions. See *Figure 27 on page 33*.

The range for *Tank Depth* is 3.0…32.0 feet.

NOTE: You must enter accurate values for *Tank Depth* and *Zero Adjust* to secure reliable measurements.

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 on page 33*.

The range for *Zero Adjust* is – 32.0…32.0 feet.

NOTE: You must enter accurate values for *Tank Depth* and *Zero Adjust* to secure reliable measurements.

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…32.0 feet.

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. Keep *Auto Gain* ON unless otherwise advised by a factory-trained technician.

The options for *Auto Gain* are ON and OFF.

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 operates.

The range for *Current Gain* is 0…100.

AG Set Point (10)

The *AG Set Point* (Auto Gain Set Point) determines the relative signal strength that the *Auto Gain* routine seeks. 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…50.

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…20.

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.

Dampening (130)

Dampening establishes the number of updates that are averaged to determine the *Current Measurement*. Use this parameter 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…255.

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.

Tank Display (ON)

Tank Display allows you to select a tank diagram for the *Tank View* screen. There are five common tank designs from which to choose. See *"Tank View Screen" on page 20* and *Figure 12 on page 21*.

The options for *Tank Display* are ON and OFF.

Trend Display (ON)

Trend Display allows you to activate the *Historical Trend* screen. See *"Historical Trend Screen" on page 21* and *Figure 13 on page 21*.

The options for *Trend Display* are ON and OFF.

Display Contrast (55)

Display Contrast allows you to adjust the *LCD Contrast* for optimal visibility.

The range for *Display Contrast* is 0…255.

Advanced Settings Display Parameters

Additional parameters, including those used to set up Analog Output Signals are found at this display. To access this display, press the **Advanced Settings** soft key prompt at the *Modify Settings* screen.

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…35.2 feet.

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.

Wiper Timing (240)

Wiper Timing establishes the time (in minutes) between wiper cycles. The sensor wiper operates 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.

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…30.

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…5.0.

Save GB Midpoint (MP) (OFF)

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

The options for *Save GB MP* are ON and OFF.

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, you can manually set the midpoint.

The range for *GB Midpoint* is 0…100.

Wall Zone (0.5)

Wall Zone 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…32.0.

Wall Zone AG (40)

Wall Zone AG 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…100.

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…6000 fps.

Sensitivity (20)

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

The range for *Sensitivity* is 0…100.

LG Min (2.0)

LG Min establishes the margin of the left side of the *Gate*. See *"Gates" on page 34* for a description of the *Gate* and its function.

The range for *LG Min* is 0.0…32.0.

RG Min (2.0)

RG Min establishes the margin of the right side of the *Gate*. See *"Gates" on page 34* for a description of the *Gate* and its function.

The range for *RG Min* is 0.0…32.0.

4 mA Set Point (0.0)

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

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

20 mA Set Point (10.0)

The *20 mA 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 to which the instrument is connected.

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

Echo Loss (OFF)

Echo Loss provides an alarm function through the 4…20 mA current loop signal when *Echo Loss* 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.

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…255 minutes.

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: 4 mA, 20 mA and Cycle. When *Cycle* is selected, the output continually alternates between 4 mA and 20 mA until the loss of echo condition ceases.

Level Simulation Test

Select the **Level Simulation Test** option to access the *Simulation Test Setup* page. The simulation test provides an opportunity to verify proper operation of the Level analog output loop. Configure the analog loop settings (specifically the *20 mA Set Point*) 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 zero (output of 4 mA) to the sensor's *20 mA Set Point* value (output of 20 mA).

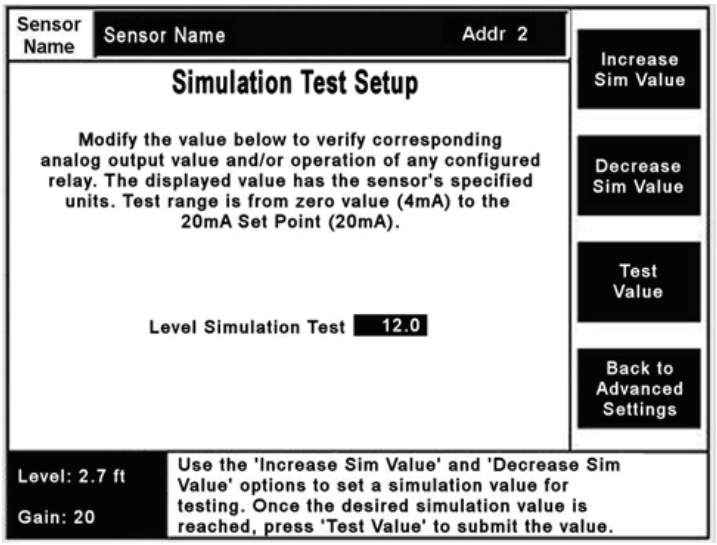


Figure 34: Level simulation test setup screen

Use the *Increase Sim Value* and *Decrease Sim Value* options to modify the simulation value. Once the desired output is reached, press the **Test Value** option to send the value to the sensor. The scaled analog value is output on the *Level* current loop.

For units purchased with integrated relays, the level simulation value also impacts the status of any relays configured for *Level* or *Range*. You must activate and configure the relays prior to performing the simulation test. See *"Relays" on page 54*.

NOTE: This functionality is available on controller firmware version 2.21 and later in conjunction with sensor firmware version 39 and later.

Aux Simulation Test

Select the **Aux Simulation Test** option to access 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 is output on the auxiliary loop. For all other sensors, the dispersed solids level is output. When the dispersed solids level is output, the test value carries the sensor's specified units and is scaled from a zero value (output of 4 mA) to the sensor's *20 mA Set Point* value (output of 20 mA). When turbidity is output, the value is scaled from 0…50 NTU.

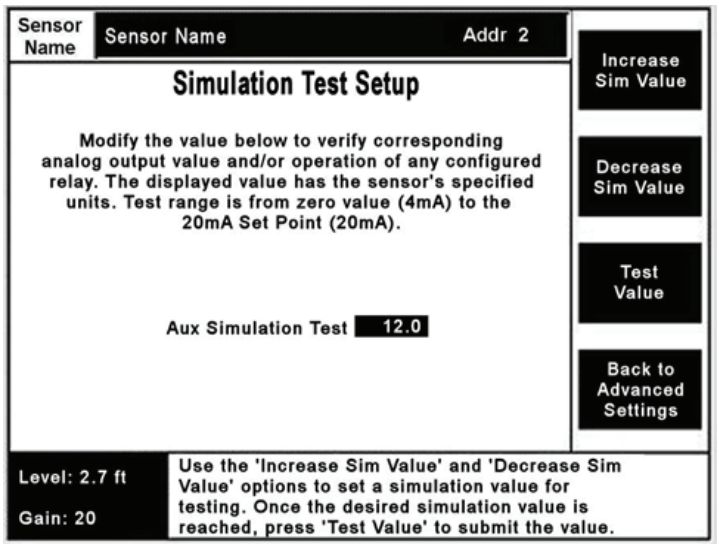


Figure 35: Aux simulation test setup screen

Use the *Increase Sim Value* and *Decrease Sim Value* options to modify the simulation value. Once the desired output is reached, press the **Test Value** option to send the value to the sensor. The scaled analog value is output on the Aux current loop.

For units purchased with integrated relays, the simulation value also impacts the status of any relays configured for turbidity. Activate and configure the relays prior to performing the simulation test. See *"Relays" on page 54*.

NOTE: This functionality is available on controller firmware version 2.21 and later in conjunction with sensor firmware version 39 and later.

MAINTENANCE AND TROUBLESHOOTING

Preventive Maintenance

Sensor Cleaning and Maintenance

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. This action provides sufficient cleaning of the face of the sensor to prevent signal degradation for an extended period. However, inspect and clean the sensor face at regular 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 Badger Meter for details.

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 varies with process conditions and the user-established frequency of operation. See*"Wiper Timing (240)" on page 43*. The wiper blade assembly requires replacement yearly and the wiper motor requires replacement every two years in typical water and wastewater treatment applications.

Inspect the sensor frequently during the initial 3…6 months of operation to determine whether supplemental cleaning is needed and that the wiper blade assembly is intact. From these observations, extablish an ongoing preventive maintenance schedule suitable for the application.

⚠CAUTION

UNLESS DETERMINED TO BE INSUFFICIENT FOR THE PROCESS ENVIRONMENT, SET WIPER TIMING (ADVANCED SETTINGS) TO 240 TO REDUCE WIPER BLADE AND MOTOR WEAR. LOWERING THIS PARAMETER REDUCES MOTOR ASSEMBLY LIFE PROPORTIONATELY.

Wiper Assembly Replacement

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

1. Remove the wiper by unscrewing in counter-clockwise direction.
2. Secure and retain the stainless steel spacing washer from the wiper shaft for use with the replacement wiper.
3. 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. In this case, a "Wiper Stall" message displays at the EchoSmart Controller.

Sensor Cleaning and Inspection

1. Remove the sensor from the process using safety procedures, protective clothing and equipment appropriate for the process environment. Use protective gloves and eyewear when there is the possibility of exposure to dangerous or unsanitary materials or conditions.
2. Carefully remove debris, rags and similar material that may have attached to the sensor. Do not rotate the wiper blade by hand.
3. Use a soft to medium bristle non-metallic brush or soft cloth and mild detergent to wipe away algae, slime and accumulations of suspended solids in the process liquid. For disinfection, use 8 ounces of regular bleach (sodium hypochlorite 8.25% solution) to one gallon of water.
4. Before returning the sensor for service, operate the wiper system to make sure that it rotates in the expected manner and that the wiper blade is secure. In normal operation, the wiper blade makes 1…3 rotations when power is supplied or when the wiper timing setting is changed.

Other Routine Maintenance

- Visually inspect the instrument's electronic components monthly during normal filter "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 required.
- Observe the sensor to make sure 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 *"Sensor Cleaning and Maintenance" on page 47*.
- If your clarifier employs a surface skimmer, watch skimmer flights as they pass the location of the sensor to so that the flights contact the sensor shield-rod allowing it to flex freely and rotate the sensor out of the path of the flights. Make sure that the shield is aligned to prevent the skimmer from making contact with the sensor.

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 Badger Meter for further assistance.

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.

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.

Validating Message

"Validating" is the "handshake" process that occurs when an EchoSmart Controller initiates communication with the sensor(s). This happens 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 *"Validation Failure Message"*).

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 displays. 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.

Wiper Stalled Message

A "Wiper Stalled" message appears 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 *"Preventive Maintenance" on page 47*.

Wiper Motor Failure Message

The "Wiper Motor Failure" message indicates an internal electronic failure of the wiper motor. Contact Badger Meter for repair or replacement options.

NOTE: Wiper motor failure may cause unreliable measurements.

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 you 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 *4 mA Set Point* and *20 mA 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.

Sensors Not Detected

If sensors are not detected or a "No Sensors Found" message displays, 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 *"Configuring a Sensor Network" on page 60* and that each has a unique address designation. If multiple sensors have the same address number, the controller is not able to establish communication with those sensors. If unique sensor addresses have not been assigned, power OFF the equipment and follow the steps in *"Configuring a Sensor Network" on page 60*.

If a wired field network is being used, see *"Wired RS-485 Field Network" on page 36* and verify that all connections are made at the proper terminals.

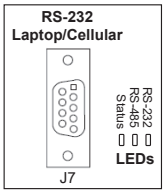
Radio (RF) Communications

System-wide Communications Troubleshooting

Make sure the radio in the controller is fully seated. If an external antenna is being used, 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, verify that the cable connections are made as outlined in *"External Configuration" on page 52*.

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.

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 the **Auto Detect Sensors** soft key. After a few seconds, the display redirects to the *Echo Profile* screen.

A persistent message appears 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 be gathered from the sensor. If this resolves the issue, modifications to the external device's polling routine are likely needed.

SYSTEM OPTIONS

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.

Application

Use this sensor 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. You may use it separately or in conjunction with the available in-air Water Level Sensor for effective conditional control of filter backwashing.

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…20 mA proportional signal and RS-485 Modbus RTU digital.

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.

Installation

The sensor has a 3/4 inch NPT female threaded connection for 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. See *"Sensor Location Selection Criteria" on page 28*. 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, locate sensors immediately below the top of the backwash trough to secure measurements during active backwashing and while the filter is online. Contact Badger Meter for additional instructions for proper installation.

Connections

The sensor connection is made in the same manner as an EchoSmart sensor. See *"Sensor Register Screens" on page 19*, *Figure 3 on page 15* and *Figure 4 on page 16* for further connection details when operated by an EchoSmart Controller

See *"Power Supply Connections" on page 26*, *Figure 21 on page 27* and *Figure 22 on page 27* when operated by an EchoSmart Power Supply Unit.

Turbidity Sensor Calibration

The turbidity sensor is factory-calibrated using using AMCO clear turbidity standards.

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.

General Overview

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

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 that a two-wire cable 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*).

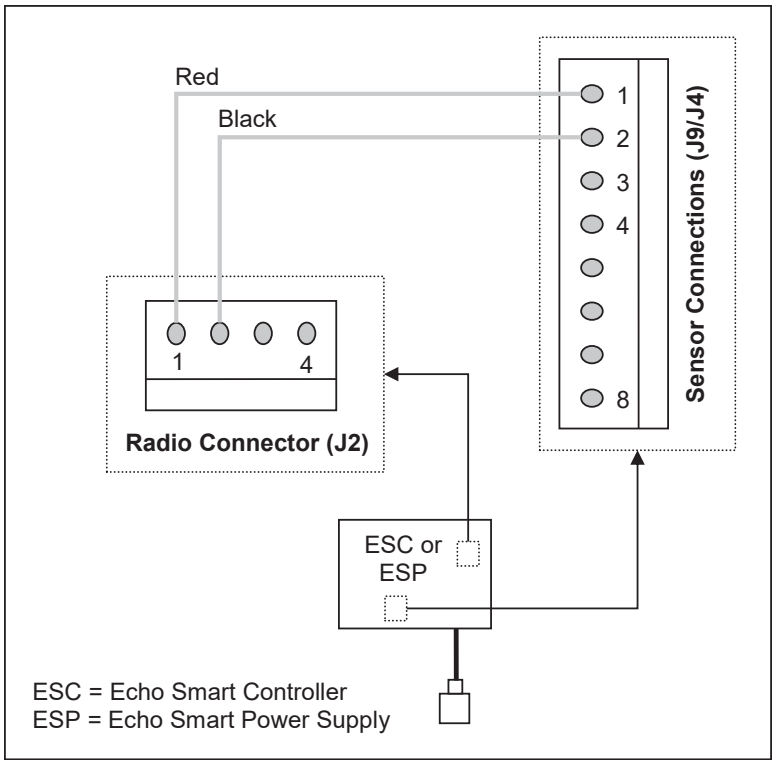


Figure 36: Connections for wireless radio module (internal)

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 4-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 on page 53*).

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.

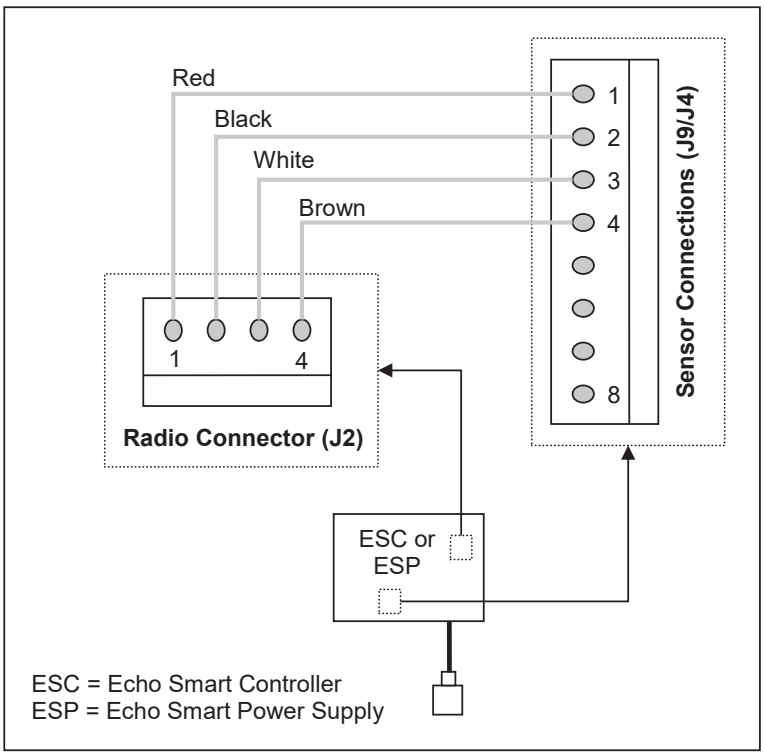


Figure 37: Connections for wireless radio module (external)

Equipment Orientation for Units with Integrated Wireless Radio Modules

Orient equipment containing the integrated wireless radio modules so that the antenna mounting location is on the side of the enclosure with the antenna pointed in the upward direction. See *Figure 38*.

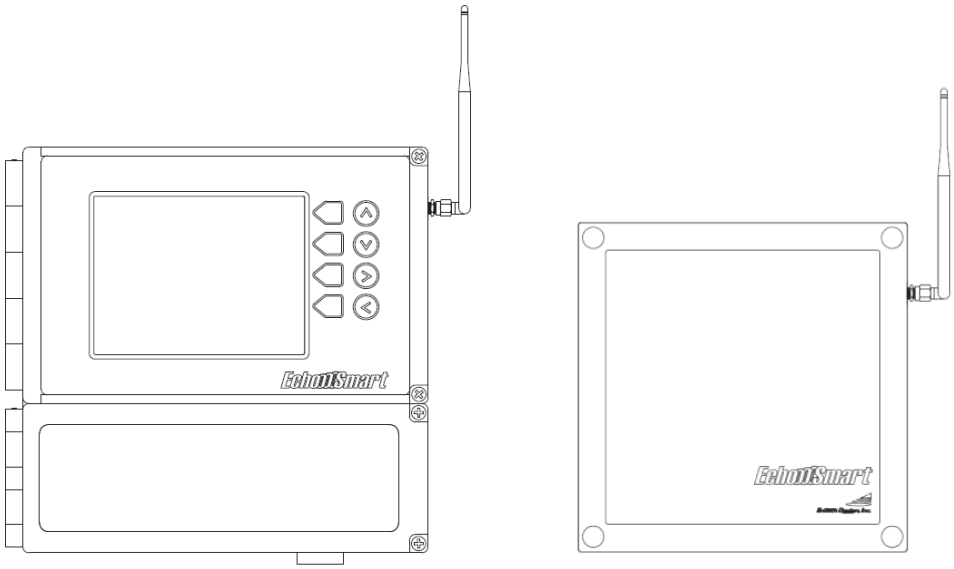


Figure 38: Orientation of units with wireless radio modules

Relays

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

General Overview

Four SPDT relays may be added as an option to a controller. Each relay is capable of monitoring the media level, turbidity, media expansion, expansion percentage 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.

Operation

To access relay controls, press the **Set Up Relays** soft key from the *Controller Setup* screen (see *Figure 17 on page 23*).

The relay *Status* must be set to **ON** 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 media level, turbidity, media expansion, expansion percentage, or can be set as a fail-safe alarm by cycling through the *Change Assignment* options.

When monitoring media level, media expansion, expansion percentage or turbidity, the *Enable* > option determines the value at which the relay is energized and changes states. The *Disable* < option determines the value at which the relay de-energizes and changes 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.

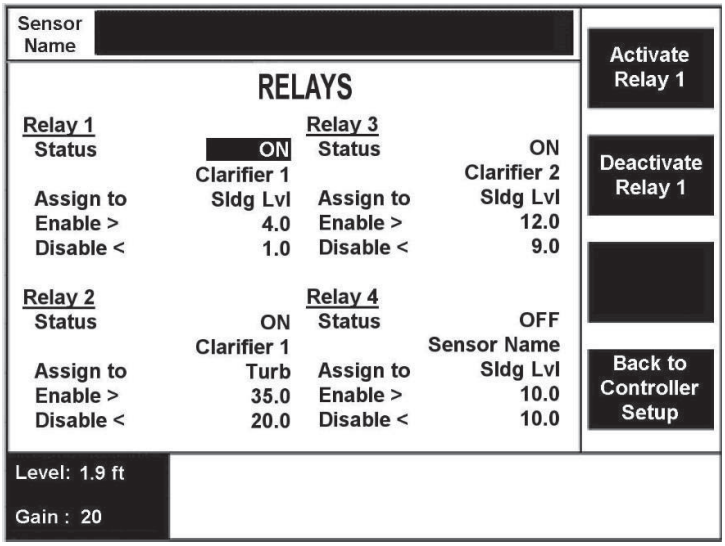


Figure 39: Relays screen

Cabling and Connections for Relays

This section describes the physical layout and terminal connections for the relays.

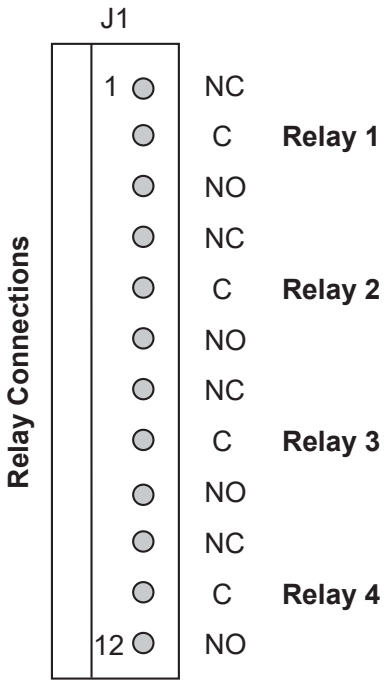


Figure 40: Connections for relay board

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

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

The EchoSmart Controller can be paired with the Badger Meter Analog Output Module to obtain analog measurements from all networked sensors in one location. Compatible with EchoSmart Controller Firmware Version 2.20 and later.

Converter Overview

The Digital-to-Analog Converter can be configured with up to 16 outputs. The converter uses 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 (media level, media expansion, expansion percentage or turbidity).

Converter Specifications

Input Power	18…30V AC
Mounting	DIN rail mount
Outputs	Up to 16 isolated analog outputs

Converter 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.

See *Figure 42* for information related to powering and connecting all cables to the converter.

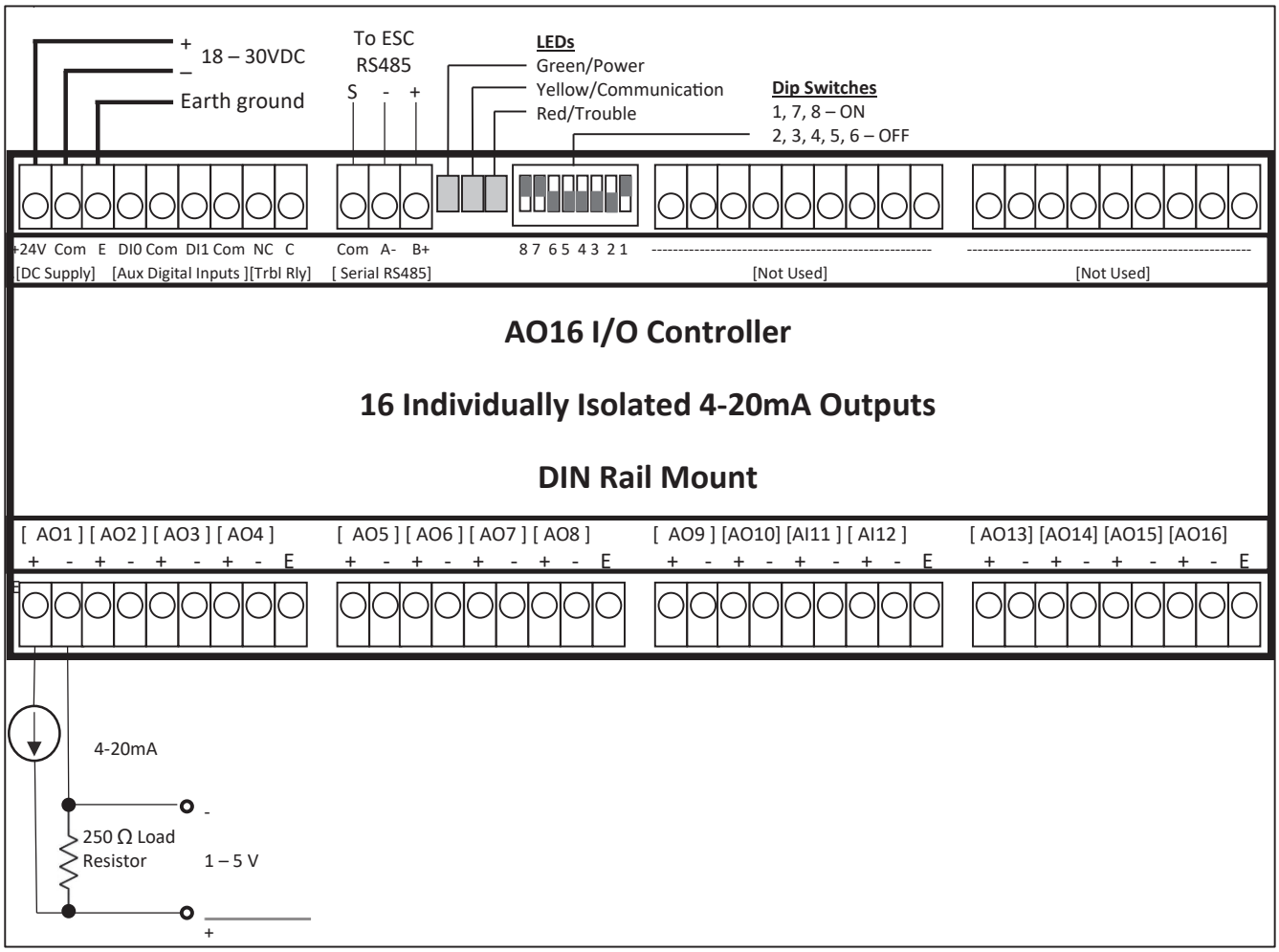


Figure 42: Analog output module connections

Configuring the Converter

To access the setup menu, from the *Controller Setup* screen, highlight the *Digital to Analog Output Setup* option and press the **D to A Output Setup** soft key. A screen similar to *Figure 43* appears.

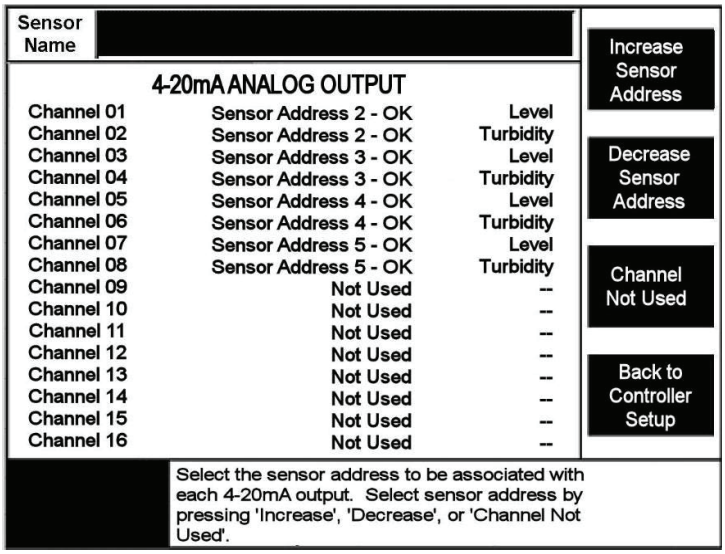


Figure 43: Digital to analog converter setup screen

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 is reported next to the address when that sensor is in the controller's database. Two question marks (??) are 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, establish communication with the sensor or select another address.

Navigate to the right column to select the measurement to be output on each channel. 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 (for example, the *Level* output for Sensor Address 2 can only be configured on one of the channels). Only one channel is updated with each unique output.

NOTE: If a sensor's address is changed after configuration of the Analog-to-Digital Converter is performed, update the configuration to reflect the address change. Sensor address changes cannot be automatically updated on this configuration screen.

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 *"4 mA Set Point (0.0)"* and *"20 mA Set Point (10.0)" on page 44*) 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…50 NTU and is not user-adjustable.

Figure 44 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	4 mA, 20 mA, or Cycle (see *"Echo Loss Action (Cycle)" on page 44*)
Channel Not Configured	0 mA

Figure 44: Analog output behavior table

QUICK START GUIDE

Configuring a Single Sensor

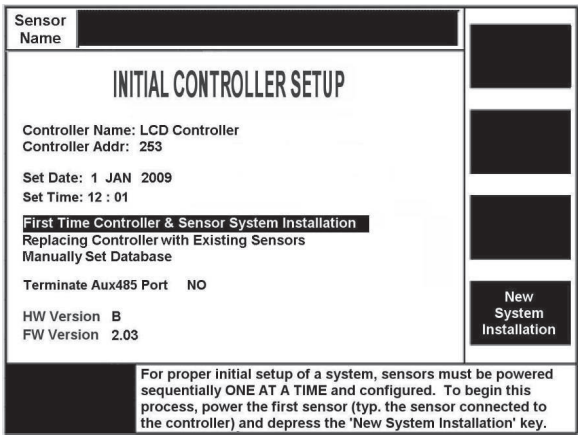
Follow these instructions when only one sensor is to be operated by the EchoSmart Controller.

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

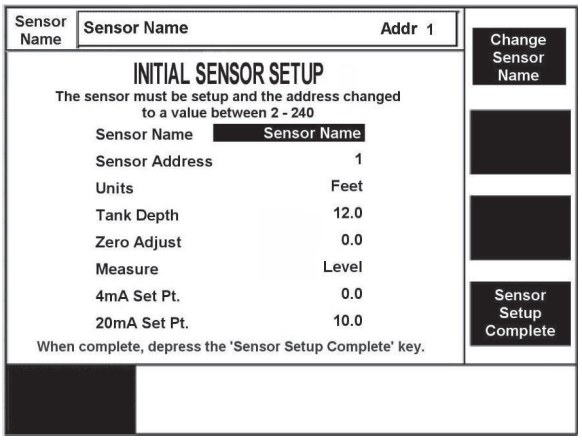
IMPORTANT

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

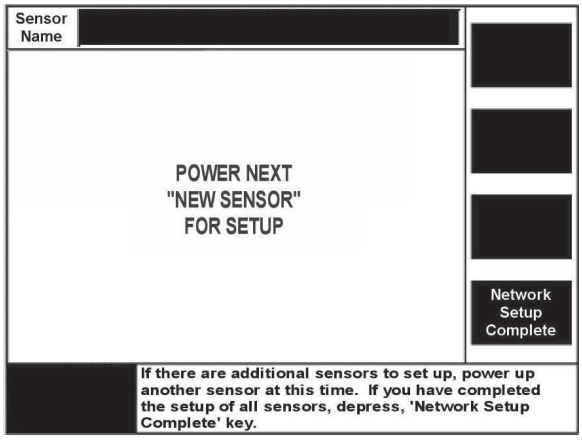
2. From the *Initial Controller Setup* screen, press the **New System Installation** soft key. This routine takes approximately 20 seconds to complete.



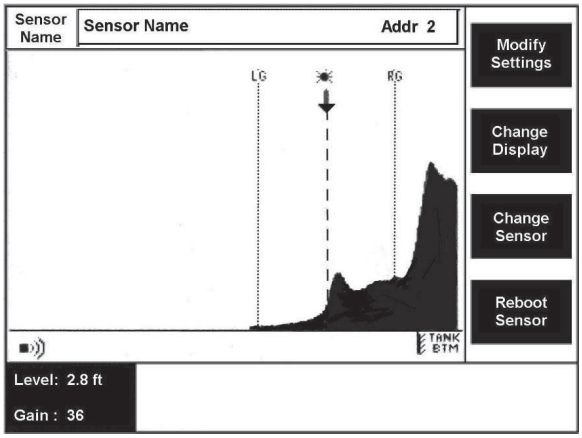
3. Change the *Sensor Address* to a unique value other than 1 and enter the correct parameters associated with the sensor on the *Initial Sensor Setup* screen, especially the *Tank Depth*, *Zero Adjust* and *4…20 mA Set Points* (if being used). See *"Tank Configuration" on page 33* for help in determining correct values for *Tank Depth* and *Zero Adjust*.
   Press the **Sensor Setup Complete** soft key.



4. When the message "Power Next New Sensor for Setup" displays, press the **Network Setup Complete** soft key.



5. You will be directed to the *Echo Profile* screen. The sensor goes through an auto-setup initialization process and then begins to report the current measurements.



6. If using an external RS-485 polling device, connect it now. See *"RS-485 Modbus RTU" on page 38* for recommendations and information regarding an RS-485 connection.

Configuring a Sensor Network

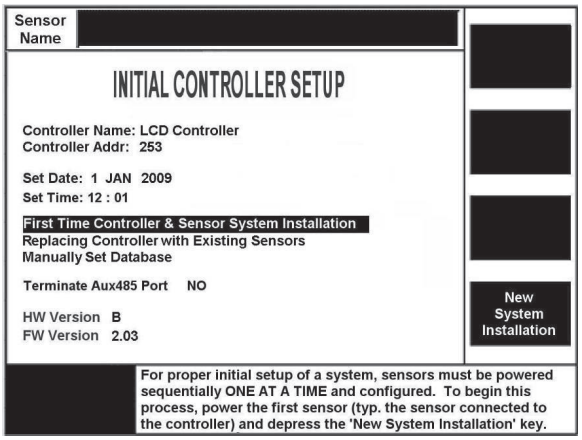
Follow these instructions for an EchoSmart Controller to communicate with more than one sensor in a network arrangement.

1. Make sure 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, power the first EchoSmart Power Supply with its sensor. Sensors must be powered and added to the network one at a time.

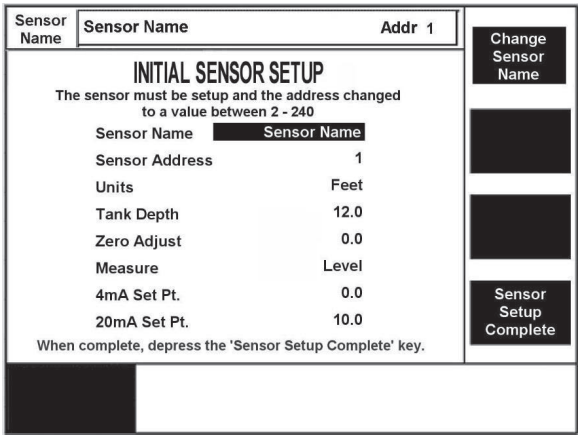
IMPORTANT

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

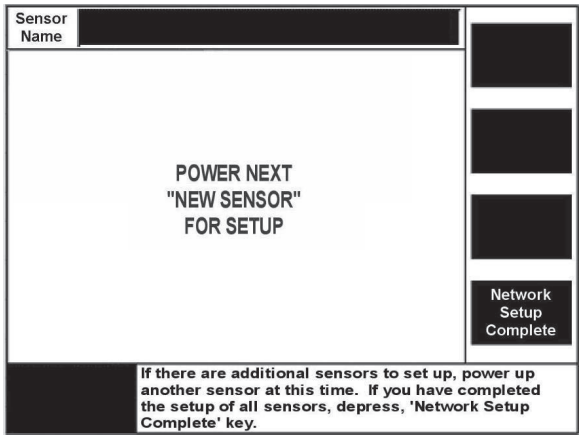
2. From the *Initial Controller Setup* screen, press the **New System Installation** soft key. This routine takes approximately 20 seconds to complete.



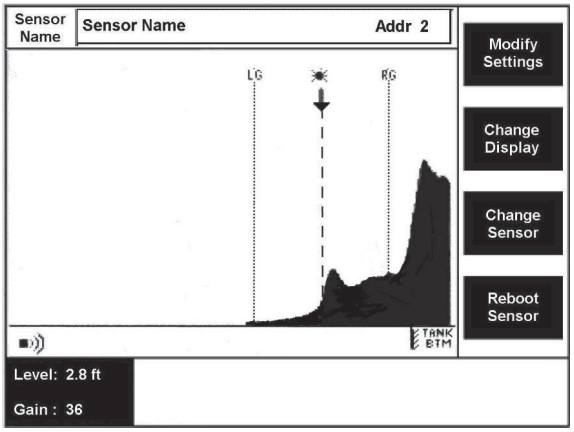
3. Change the *Sensor Address* to a unique value other than 1 and enter the correct parameters associated with the sensor on the *Initial Sensor Setup* screen, especially the *Tank Depth*, *Zero Adjust*, and *4…20 mA Set Points* (if being used). See *"Tank Configuration" on page 33* for help in determining correct values for *Tank Depth* and *Zero Adjust*.
   Press the **Sensor Setup Complete** soft key.



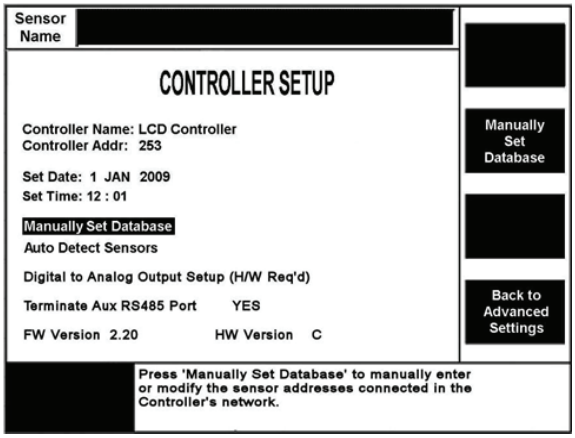
4. When the message "Power Next New Sensor for Setup" displays, apply power to the next sensor to be configured.



5. Repeat steps 3 and 4 for all sensors in the network, making sure that each sensor has a unique *Sensor Address*. When all sensors are set up, press the **Network Setup Complete** soft key.
6. You are directed to the *Echo Profile* screen. The sensor goes through an initialization process and then begins to report the current interface location.



7. From the *Echo Profile* screen, press the **Change Display** soft key to see the *Sensor Name*, *Current Media Level*, *Gain Value*, and *Turbidity* output of all connected sensors.
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 the **Auto Detect Sensors** soft key.



9. If using an external RS-485 polling device, connect it now. See *"RS-485 Modbus RTU" on page 38* for recommendations and information regarding an RS-485 connection.

INTENTIONAL BLANK PAGE

INTENTIONAL BLANK PAGE