



Operation & Installation
Manual

Version A1.4



FilterSmart Sensor FilterSmart Controller
FilterSmart Power Supply Unit

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Safety Precautions

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

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

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

User's Responsibility for Safety:

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

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

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

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

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

For **CE and safety compliance**, adequate grounding and shielding are required. All FilterSmart system cables are to be installed in metal conduit that is properly grounded and

shielded utilizing EMC compliant methods. Each conduit should be individually shielded and grounded. Where metal enclosures are supplied, each enclosure should be grounded and shielded to each individual conduit.

External chassis components cannot be used as safety earth ground connections.

Standard fuses, with applicable national safety approvals, may be used if the rating and type are the same. If you are unsure about the applicability of a replacement component, call Analytical Technology, Inc. for information. Only use the FilterSmart FSC or FSP with the sensor supplied. Replace Fuse with: 1.25A 5x20mm T-Lag UL approved.

This equipment is suitable for use with 110-240 Volts AC power at 50-60 Hz. No internal changes are required within this range. Equipment is optionally available and can be ordered for use with 24VDC power. Caution must be taken to supply main power in the form for which the equipment is designed.

A protective earth should be provided for all installations.

WARNING 

If this equipment is used in a manner not specified by Analytical Technology, Inc., the protection provided may be impaired. The FilterSmart FSC, FSP, and FSS 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 FilterSmart FSC or FSP requires it to be installed at industrial installations including water and wastewater treatment plants. While the FSC and FSP 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 FSS (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 FSC and FSP enclosures are made of flame retardant Polycarbonate (PC/ABS FR). The FSS enclosure is made of epoxy-filled ABS. Some sensor models include additional wetted parts. Make sure that the model which you have selected

is chemically compatible with the application media, temperatures, and pressures to which it will be exposed.

WARNING WHEN APPLICABLE 

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 23cm between the radiator and your body. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

1. Product Description

FilterSmart™ is an application-specific version of the FilterSmart™ ultrasonic interface level analyzer. Implementations typically employ a sensor that includes a fully integrated scattered light turbidity meter.

The operating system was developed to address the unique measurement requirements of granular media filters during backwash. Primary measurement indications are Media Level, Media Expansion in engineering units and as a percentage of expandable media, and Backwash Turbidity in the range of 0.0 to 50.0 NTU. Together, these measurements give the operator the essential information necessary for effective backwash control.

FilterSmart can be implemented as individual, stand-alone instruments or with numerous sensors networked together and operated by a single Controller as discussed below.

1.1. Stand-Alone Instrument Option

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

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

1.2. Field Network Option

Up to 16 FilterSmart Sensors can be operated by a single Controller in a wired or wireless Field Network. In either arrangement, the network is fully integrated and requires no software integration by the customer.

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

1.3. Network Integrated to Customer Data Acquisition and Controls

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

2. Applications

FilterSmart is suitable for most municipal and industrial granular media gravity filters. It may also be used in granular media pressure filters subject to certain mechanical, pressure, physical and installation limitations (Contact Analytical Technology technical support for details).

2.1. Drinking Water and Wastewater Treatment Filters

FilterSmart instruments are most frequently implemented in granular media gravity filters in drinking water treatment plants to provide the essential information necessary for the effective control of filter backwashing. Media expansion measurements help operators optimize the scrubbing effect of agitated media grains produced by the correct and consistent wash water flow. Turbidity measurements in the top of the filter, during backwash, provide critical information for correcting and fine-tuning wash duration often resulting in dramatic savings of wash water usage and related pumping and manpower cost.

2.2. Tertiary Filters in Wastewater Treatment

Cost savings can be equally important in wastewater treatment tertiary filters in plants, especially in cases that treated water is sold for reuse. Uses and benefits are the same as found for drinking water applications.

2.3. Granular Media Pressure Filter

As with drinking water and wastewater treatment applications, pressure filters benefit from the effective control of media expansion during backwash. Often considered equally important in these applications is the continuous monitoring of Media Level (depth of media) since these filters typically remain online for extended periods of time, and there is no way to know whether media has been lost and may be at critically low levels.

Due to physical filter design features and pressure limits, application suitability is subject to special sensor installation arrangements and engineering approval by the factory. Self-cleaning Wiper Sensors and sensors that include turbidity measurements are generally not suitable in pressurized applications.

3. FilterSmart Sensor (FSS)

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

3.1. General Overview

The FilterSmart Sensor generates an ultrasonic sound wave that propagates through the filter water above the filter media and is reflected back. The sound wave travels at known velocities providing the ability to convert elapsed time into Media Level and Expansion measurements. With a known dimension to the bottom of the expandable media, the measurement can be expressed in terms the depth of the filter media, and the amount of expansion during backwash can be calculated both in engineering units and as a percent of the total media depth.

Sensors that include a scattered light turbidity measurement are frequently used. This provides a highly useful additional measurement of backwash turbidity. This measurement is used to assist the operator in determining the optimal filter wash duration.

3.2. Specifications

POWER REQUIREMENT	15VDC; 3W
RANGE	1.0 to 32 ft. (0.305 to 10.0 m)
SENSOR MEAS. RESOLUTION	0.1 Unit of measure
ACCURACY	0.2 in at 10.0 ft (5mm at 3.05m)
OPERATING TEMPERATURE	34 to 125 °F (1 to 52 °C)
CONFIGURATION BACKUP	Settings stored in FLASH memory
SENSOR CONSTRUCTION	IP68, ABS and epoxy Stainless steel and rubber (wiper only)
TURBIDITY	Measurement Principle: 90-degree scattered light, pulsed LED Range: 0 to 50 NTU Repeatability: 1% @ 50 NTU*
WEIGHT	2.75 lb (1.25 kg)
CERTIFICATIONS	CE

* Accuracy has been tested under controlled conditions using a Formazine solution and field results of $\pm 2\%$ across the measurement range can be expected with an installation on a properly grounded circuit. Since the sensor is installed in an active filter, turbidity readings can be affected by bubbles, poor electrical grounding, localized flow rate at the sensor, and heavier suspended solids that may be present dynamically.

4. FilterSmart Controller (FSC)

The FilterSmart Controller allows for programming and local monitoring of one to sixteen FilterSmart Sensors.

4.1. General Overview

The Controller display consists of a graphical backlit LCD (2.6 x 3.45 inch viewing area) that is divided into five functional sections. Soft Keys and Navigation Keys located to the right of the screen are used for data entry and other operations. Figure 1 points out the functional sections of the screen and the location of the Soft Keys and Navigation Keys.

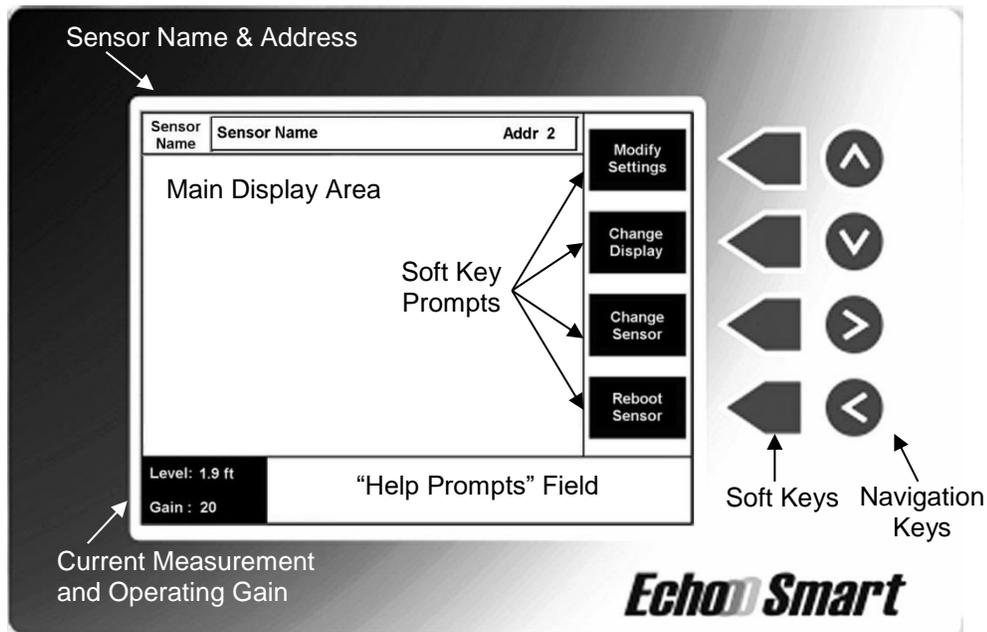


Figure 1: The LCD Display

4.1.1. Operator Interface Overview

The display has five informative sections:

Smart Sensor Name & Address

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

If the Controller is operating a multi-sensor field network, other sensors are available by pressing the *Change Sensor* soft key. A listing of network sensors will appear (See Figure 18). Use the Navigation Keys to select the desired sensor and press *Select Sensor*.

Current Measurement and Operating Gain

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

Help Prompts Field

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

Main Display Area

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

Soft Key Prompts

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

4.1.2. Keypad

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

Soft Keys

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

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

Navigation Keys

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

4.1.3. Screen Navigation Overview

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

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

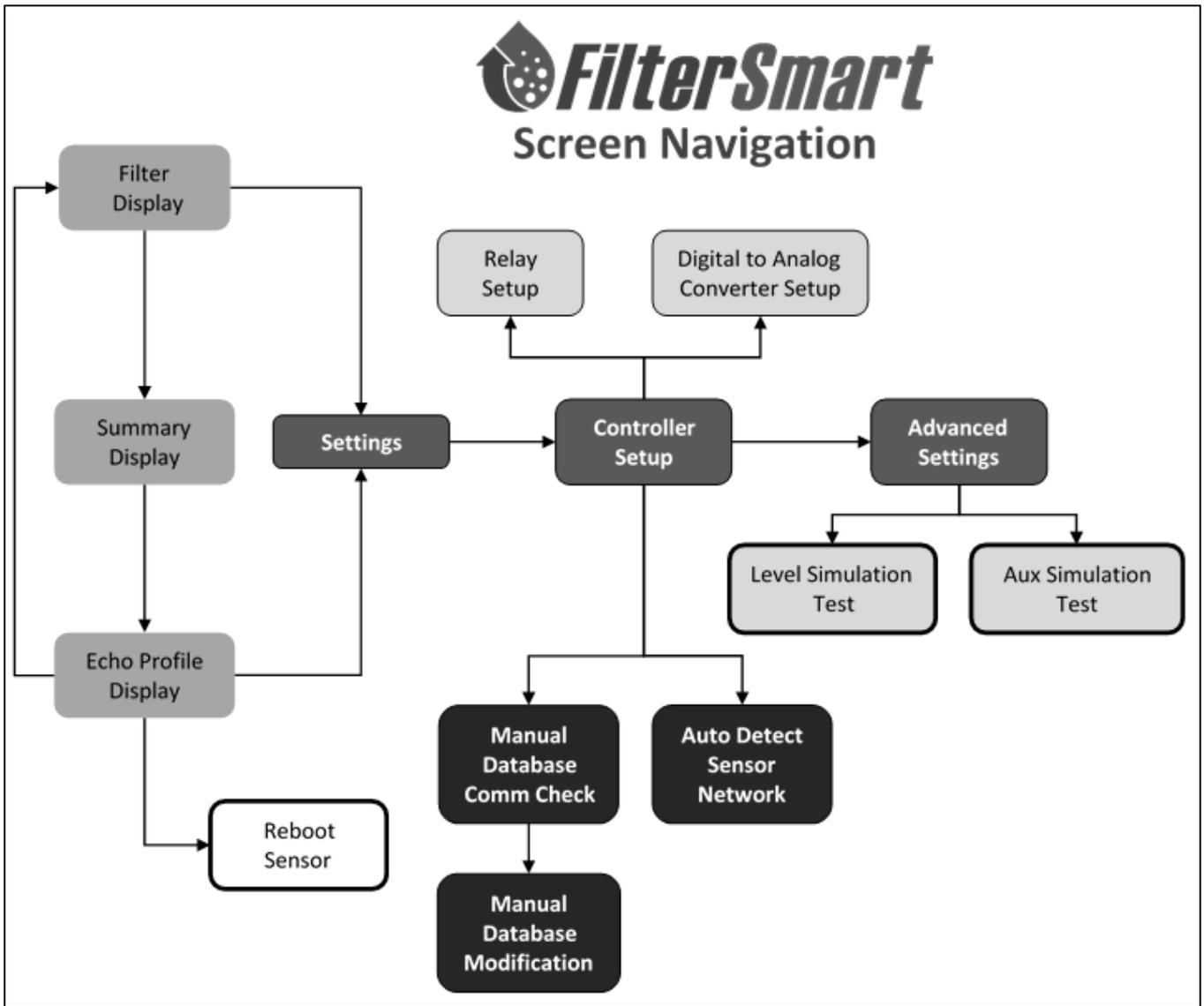


Figure 2: Screen Navigation Overview

4.2. Specifications and Connections

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

4.2.1. Specifications

INPUT POWER	100-240 VAC, 50/60 Hz – 1.5A, 65W Optional 24 VDC: 19 – 42 VDC
SUPPLY CABLE	10-18 AWG, -40 to +140 F
FUSE	1.25A 250V 5x20mm T-lag UL approved fuse
ANALOG LOOPS	(2) 4-20mA Outputs 15 – 24 VDC (provided by FSC for local sensor)
AMBIENT TEMPERATURE	-40 to +140 °F (-40 to +60 °C)
DISPLAY	Graphical backlit monochrome screen Resolution: 320 x 240 pixels Viewing Area: 2.6 x 3.45 in (92 x 122 mm)
REPORTED MEAS. RESOLUTION	1.0 (in & cm), 0.1 (ft), 0.01 (m)
RF MODULE (OPTIONAL)	900MHz frequency band Self-healing mesh network Approvals: FCC Part 15C, Industry Canada
RELAYS (OPTIONAL)	(4) Relays: 10A @ 250 VAC; 10A @ 30VDC
ENCLOSURE	NEMA 4X, IP65; Polycarbonate
WEIGHT	Approx. 3.0 lb (1.36 kg) depending on configuration
CERTIFICATIONS	CE

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

4.2.2. Connections Overview

The FSC circuit board contains four screw-terminal connectors as well as additional plug-in connectors as shown in Figure 3. Use caution in tightening the screw terminals to prevent damage from over-tightening.

Ensure the power cable (10-18 AWG) is connected to the power connector properly. A breaker should be installed to fully remove power from the unit in the event that repairs to the unit are required. Sensors (FSS) should be connected to the controller by color

code as shown in Figure 3 below. The table in Figure 4 contains a functional description of the screw terminal connectors.

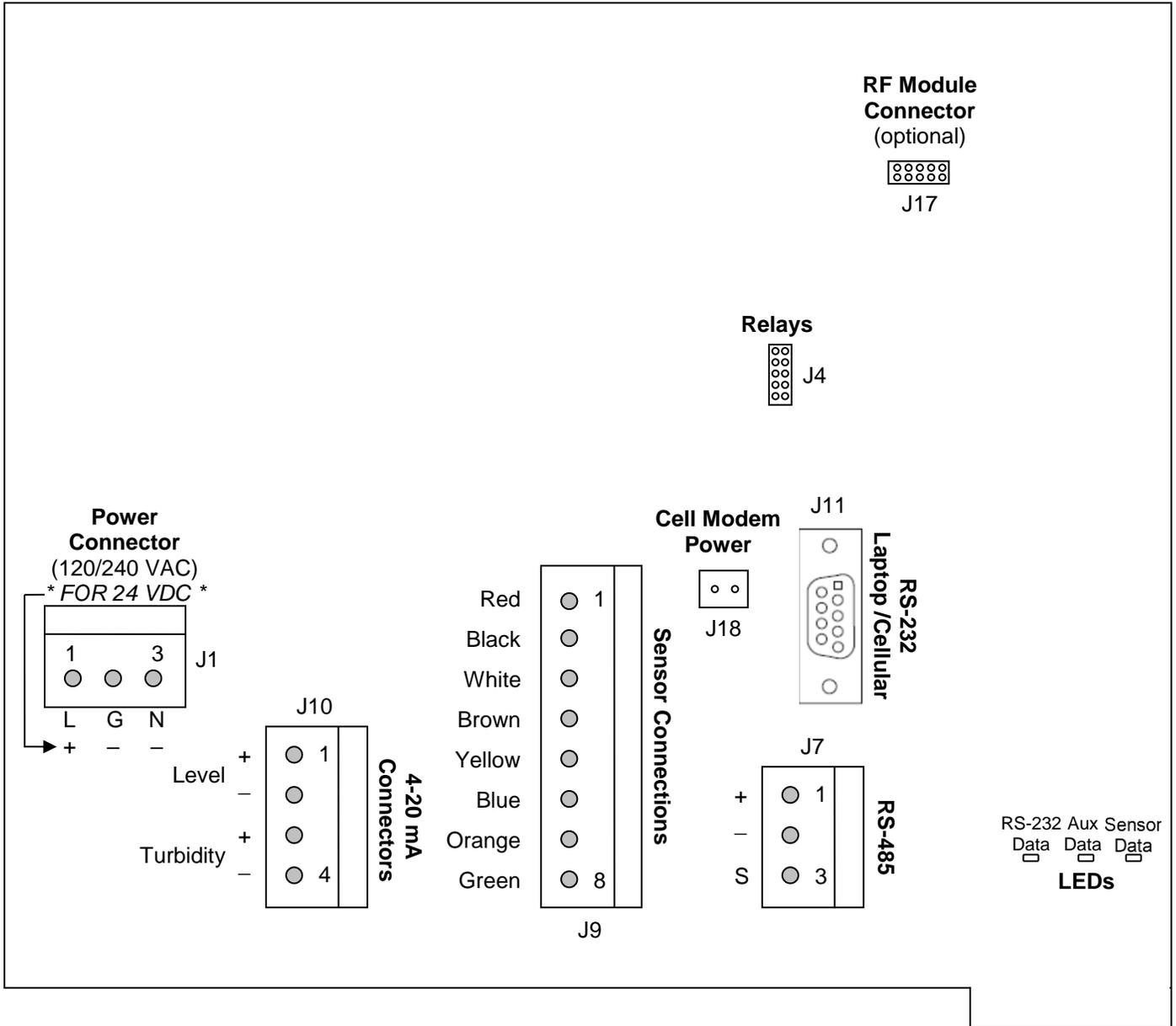


Figure 3: Connections for Controller

Power Connector (J1) *FOR 110-240 VAC*		4-20 Analog Connectors (J10)		Sensor Connections (J9)		RS-485 Connector (J7)	
Pin #	Description	Pin #	Description	Pin #	Description	Pin #	Description
1	Live	1	Level +	1	15 V	1	Sensor Comm
2	Ground	2	Level –	2	Ground	2	Sensor Comm
3	Neutral	3	Turbidity +	3	Sensor Comm (+)	3	Ground
		4	Turbidity –	4	Sensor Comm (–)		
				5	4-20mA Level		
				6	4-20mA Level		
				7	4-20mA Turbidity		
				8	4-20mA Turbidity		

(J1) * FOR 24 VDC *	
Pin #	Description
1	+
2	–
3	–

Figure 4: Table of Controller Connections

Notes:

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

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

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

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

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

4.3.1. Initial Controller Setup Display

The Initial Controller Setup Screen (Figure 5) will appear when power is applied to a Controller with an empty sensor register.

FilterSmart instruments employ Smart Sensor technology and are often implemented with multiple sensors operating in union with one Controller. To establish communication, each Smart Sensor must be assigned a unique address during initialization (see also Section 4.3.2). This address is held in the memory of both the Controller and the Smart Sensor(s).

IMPORTANT: All Smart Sensors are shipped from the factory with the pre-assigned address of 01. In multiple sensor Network installations it is imperative that sensors be added to the Network one at a time as further described in Section 4.3.2 below. The address of each sensor must be changed to a unique number from 2 – 240. The sensor that is directly connected to the Controller must be initialized first. Power and initialize additional sensors one at a time, carefully noting the individual filter with its corresponding sensor name and address.

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

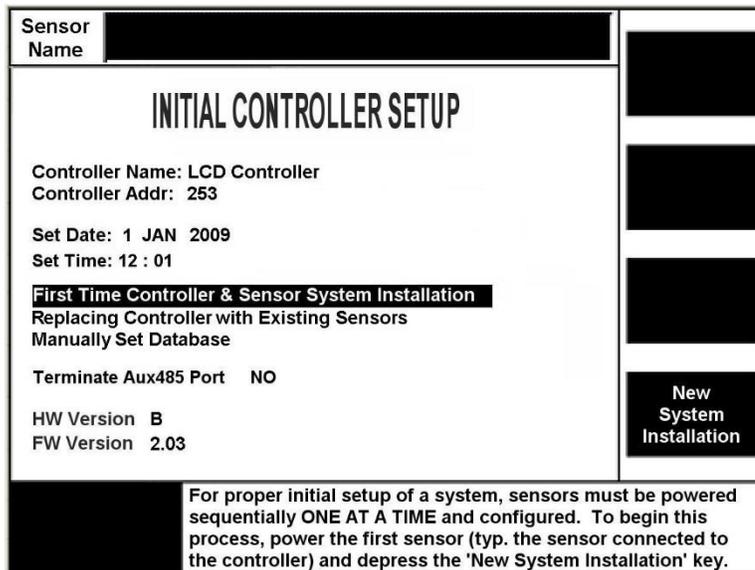


Figure 5: Initial Controller Setup

4.3.2. First Time Controller & Sensor System Installation

If this is a new installation, select First Time Controller & Sensor System Installation and press the Soft Key next to New System Installation (Figure 5). The Controller will automatically locate the Smart Sensor that has been powered (this will take a few seconds) and will open the Initial Sensor Setup Display (Figure 6).

Sensor Name	Sensor Name	Addr 1	Change Sensor Name
INITIAL SENSOR SETUP			
The sensor must be setup and the address changed to a value between 2 - 240			
Sensor Name	Filter Name		
Sensor Address		2	
Units		Inch	
Media Depth		36.0	
Primary 4-20mA	Media Level		
4mA Set Pt.		0.0	
20mA Set Pt.		60.0	
When complete, depress the 'Sensor Setup Complete' key.			Sensor Setup Complete

Figure 6: Initial Sensor Setup

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

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

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

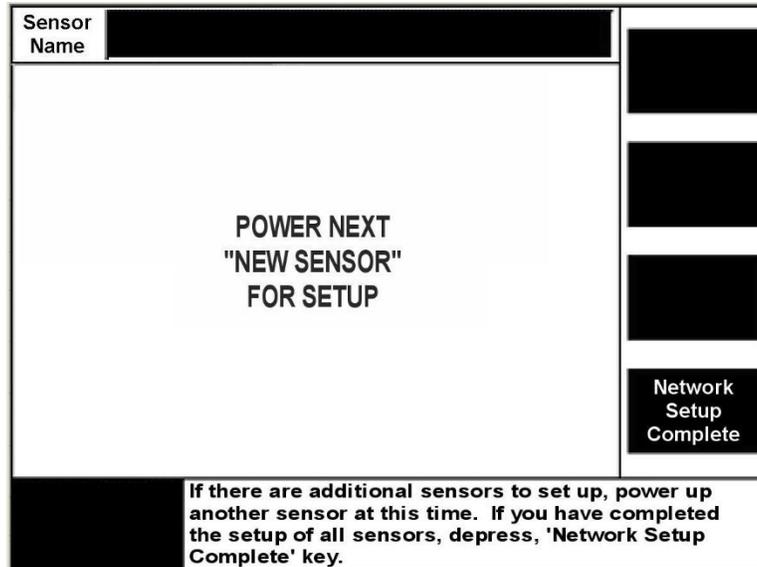


Figure 7: Power Next Sensor

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

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

4.3.3. Replacing a Controller with Existing Sensor(s)

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

4.4. Utilization of Informational Displays

The Controller has four informational displays: Filter View Display, Echo Profile Display, and Sensor Register Displays (Multiple sensor networks only). Selections are made by pressing the *Change Display* Soft Key. At power up, the system defaults to the Filter View Display.

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

4.4.1. Filter View Display

The Filter View Display (Figure 8) shows a scaled cross-sectional view of the filter. The displayed measurements are:

- A – Calculated expansion percentage
- B – Amount of expansion (in selected engineering units)

- C – Current turbidity
- D – Current media depth (Note: Media Depth is established and maintained from user-entered depth at initialization of the instrument)
- E – User-entered media depth

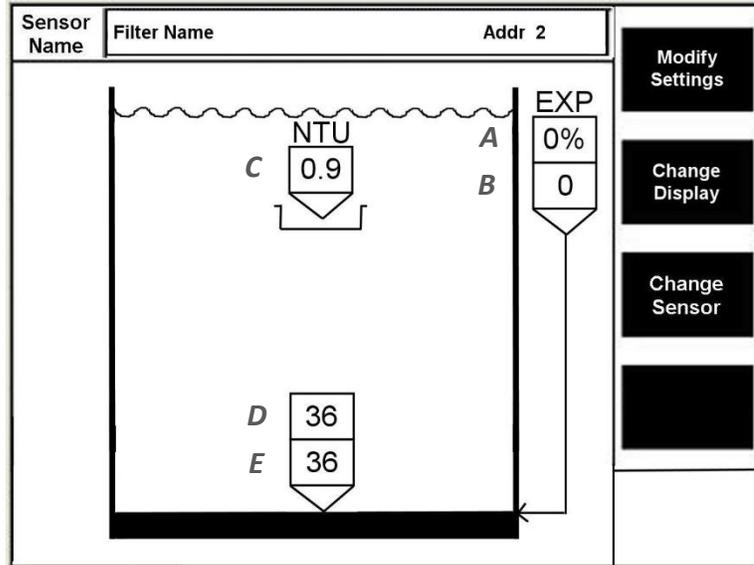


Figure 8: Filter View Display

4.4.2. Echo Profile Display

The Echo Profile Display (Figure 9) shows the echo waveform generated by the selected sensor. To view the waveform of another sensor, press the *Change Sensor* soft key, select the desired sensor from the dropdown list, and press *Select Sensor*.

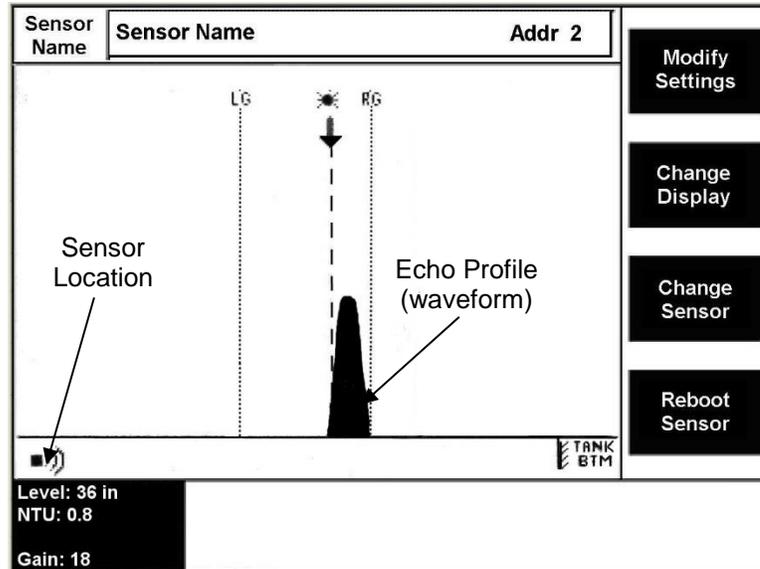


Figure 9: Echo Profile Display

This display presents the actively updated signal waveform generated by the sensor that is used to determine the media level.

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. FilterSmart proprietary interpretive algorithms are applied to the signal waveform to determine the position of the expandable media.

4.4.3. Sensor Register Displays

This display consists of a table that shows the name of each sensor and its Current Measurement and Operating Gain value. If the Controller is communicating with four or fewer sensors, information is presented as shown in Figure 10.

Filter 1 36 in Gain: 18 NTU:0.9	Filter 2 30 in Gain: 16 NTU:1.1	Change Display
Filter 3 28 in Gain: 11 NTU:1.4	Filter 4 34 in Gain: 9 NTU:0.8	

Figure 10: Four Sensor Field Network Display

With five or more sensors, information is presented as shown in Figure 11.

Sensor Name	Level	Turb	Gain
Filter 1	36 in	1.2	11
Filter 2	34 in	0.8	0
Filter 3	34 in	1.1	8
Filter 4	36 in	1.0	20
Filter 5	35 in	0.9	17
Filter 6	34 in	0.7	10
Filter 7	35 in	1.0	2
Filter 8	44 in	50.0	20
Filter 9	36 in	0.7	13
Filter 10	37 in	0.9	0
Filter 11	35 in	1.2	12
Filter 12	36 in	1.0	9
Filter 13	36 in	0.8	11
Filter 14	34 in	1.1	5
Filter 15	36 in	0.7	14
Filter 16	35 in	0.9	16

* = Loss of Echo ** = Communication Error
VS = Validating Sensor VF = Validation Failure

Figure 11: Multiple Sensor Field Network Display

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

4.4.4. Modify Settings Display

This display (Figure 12) is used to enter the primary parameter settings for each sensor. A Display Contrast adjustment function is also found here.

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

Descriptions of parameter functions are found in Section 9.

Sensor Name	Filter Name	Addr 2	
SETTINGS			Modify Name or Address
Units	Inch		Change Sensor
Media Depth	36.0		
Wiper Timing	240		
Primary 4-20mA	Media Level		Back to Display
4mA Set Pt	0.0		
20mA Set Pt	60.0		Controller Setup
Echo Loss	OFF		
Echo Delay	60		
Echo Loss Action	Cycle		
Display Contrast	56		
Use the arrow keys to select the parameter you wish to modify.			
Level: 36 in NTU: 0.8 Gain: 18	Press 'Change Sensor' to select a different sensor.		

Figure 12: Modify Settings Display

A unique Alpha-Numeric name may be assigned to the sensor and its identifier address can be changed by pressing the Soft Key next to the *Modify Name or Address* prompt (See Figure 13).

Sensor Name	Sensor Name	Addr 2	Change Sensor Name Cancel Save & Go Back to Settings
MODIFYING SENSOR NAME & ADDRESS			
Sensor Name	Sensor Name		
Sensor Address	2		
Level: 2.7 ft			
Gain : 20			

Figure 13: Modifying Sensor Name and Address Display

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

4.4.5. Controller Setup Display

The purpose of this display (Figure 14) is to change the Current Date and Time, and to initiate either a manual or automatic establishment of the sensor network. Actual Hardware and Firmware version will be displayed on 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.

Sensor Name	
CONTROLLER SETUP	
Controller Name: LCD Controller Controller Addr: 253	
Set Date: 1 JAN 2009 Set Time: 12 : 01	
Manually Set Database	
Auto Detect Sensors	
Digital to Analog Output Setup (H/W Req'd)	
Terminate Aux RS485 Port	YES
FW Version 2.20	HW Version C
Press 'Manually Set Database' to manually enter or modify the sensor addresses connected in the Controller's network.	
	Manually Set Database Advanced Settings Back to Settings

Figure 14: Controller Setup Display

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

Manually Set Database (Figure 15) allows the user to specify sensor addresses and establishes the order in which the addresses will appear in the Sensor Register Display. Manually setting the database causes the Controller to persist in attempts to detect listed sensors in cases where Auto Detect has failed to locate all sensors.

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

Sensor Name		
SETTING SENSOR DATABASE		
Sensor 1	Addr 11 - OK	
Sensor 2	Addr 12 - OK	
Sensor 3	Addr 13 - OK	
Sensor 4	Addr 14 - OK	
Sensor 5	Addr 15 - OK	
Sensor 6	None	
Sensor 7	None	
Sensor 8	None	
Sensor 9	None	
Sensor 10	None	
Sensor 11	None	
Sensor 12	None	
Sensor 13	None	
Sensor 14	None	
Sensor 15	None	
Sensor 16	None	
<p>To modify the list of network sensors in the database, press 'Modify Sensor Database.' Press 'Save Database' to manually establish the Controller database.</p>		

Figure 15: Sensor Database Display

Any needed modifications to the database can be performed once *Modify Sensor Database* is selected. From the Modifying Sensor Database Display (Figure 16), network addresses can be changed, the sensor display order can be modified, and a sensor can be deleted.

IMPORTANT: Changes made from this menu are **ONLY** used to modify the existing network of sensor addresses to be polled by the Controller and **DOES NOT** change the sensor's address. Any changes to the sensor address parameter contained in the sensor must be performed from the Modifying Sensor Name and Address screen (Section 4.4.4).

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

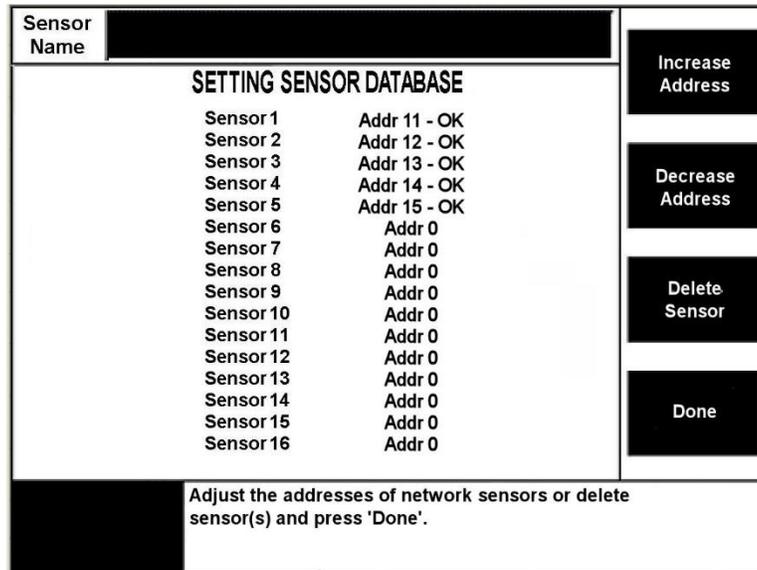


Figure 16: Modifying Sensor Database Display

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

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

4.4.6. Advanced Settings Display

This display (Figure 17) is used to enter additional parameter settings for each sensor. It is recommended that no changes to these setting be made without instruction from Analytical Technology or a representative.

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

Sensor Name	Filter Name	Addr 2
ADVANCED SETTINGS		
* These parameters should not be modified without instruction from Entech Design or a representative. *		
Auto Gain		ON
Current Gain		20
Total Measurement Range		105.0
Sensor Blanking Zone		12.0
Sensor Measurement Limit		73.0
Level Simulation Test		
Aux Simulation Test		
Set Sensor to Default Settings		
Use the arrow keys to select the parameter you wish to modify.		
Level: 36 in NTU: 0.8 Gain: 18	Press 'Change Sensor' to select a different sensor.	

Figure 17: Advanced Settings Display

Descriptions of parameter functions are found in Section 9.

4.4.7. Sensor Selection Menu

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

Sensor Name	Clarifier 1a	Clarifier 1b
	Clarifier 1c	Clarifier 1d
Tank Co Units	Clarifier 2a	Clarifier 2b
Tank De Zero Adj	Clarifier 2c	Clarifier 2d
Min Ran	Clarifier 3a	Clarifier 3b
Acoustic	Clarifier 3c	Clarifier 3d
Auto Ga Current	Clarifier 4a	Clarifier 4b
AG Set Update	Clarifier 4c	Clarifier 4d
Use the arrow keys to select the parameter you wish to modify.		
Level: 2.7 ft Gain : 20	Press 'Change Sensor' to select a different sensor.	

Figure 18: Sensor Selection Drop-down Window

4.5. Automatic Initialization and Reboot Sensor

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

Automatic Initialization establishes operating gain (signal amplification) and determines current measurement values and signal outputs.

4.6. Returning Sensor to Default Settings

If a sensor has been relocated or repositioned in a filter, it may be beneficial to return all of the sensor settings to default values. From the *Advanced Settings* screen (Figure 17), select "Set Sensor to Default Settings." A warning will appear to confirm that this action is desired. Once confirmed, the *Initial Sensor Setup* screen (Figure 6) will appear so that the critical parameters can be easily modified. Select *Sensor Setup Complete* to initiate the automatic initialization and calibration routine.

5. FilterSmart Power Supply Unit (FSP)

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

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

5.1. Specifications and Connections

This section pertains to the physical layout of the FSP terminal connectors and how they are implemented. If you are wishing to network the FSP with other devices (Ex: FSC, other FSPs, SCADA Systems, etc.), see Section 8 for sample connection diagrams.

5.1.1. Specifications

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

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

5.1.2. Connections Overview

The FSP circuit board contains four screw-terminal connectors as well as additional plug-in connectors as shown in Figure 19. Use caution in tightening the screw terminals to prevent damage from over-tightening.

Ensure the power cable (10-18 AWG) is connected to the power connector properly. Sensors (FSS) should be connected to the power supply by color code as shown in Figure 19 below. Figure 20 contains a functional description of the screw terminal connectors.

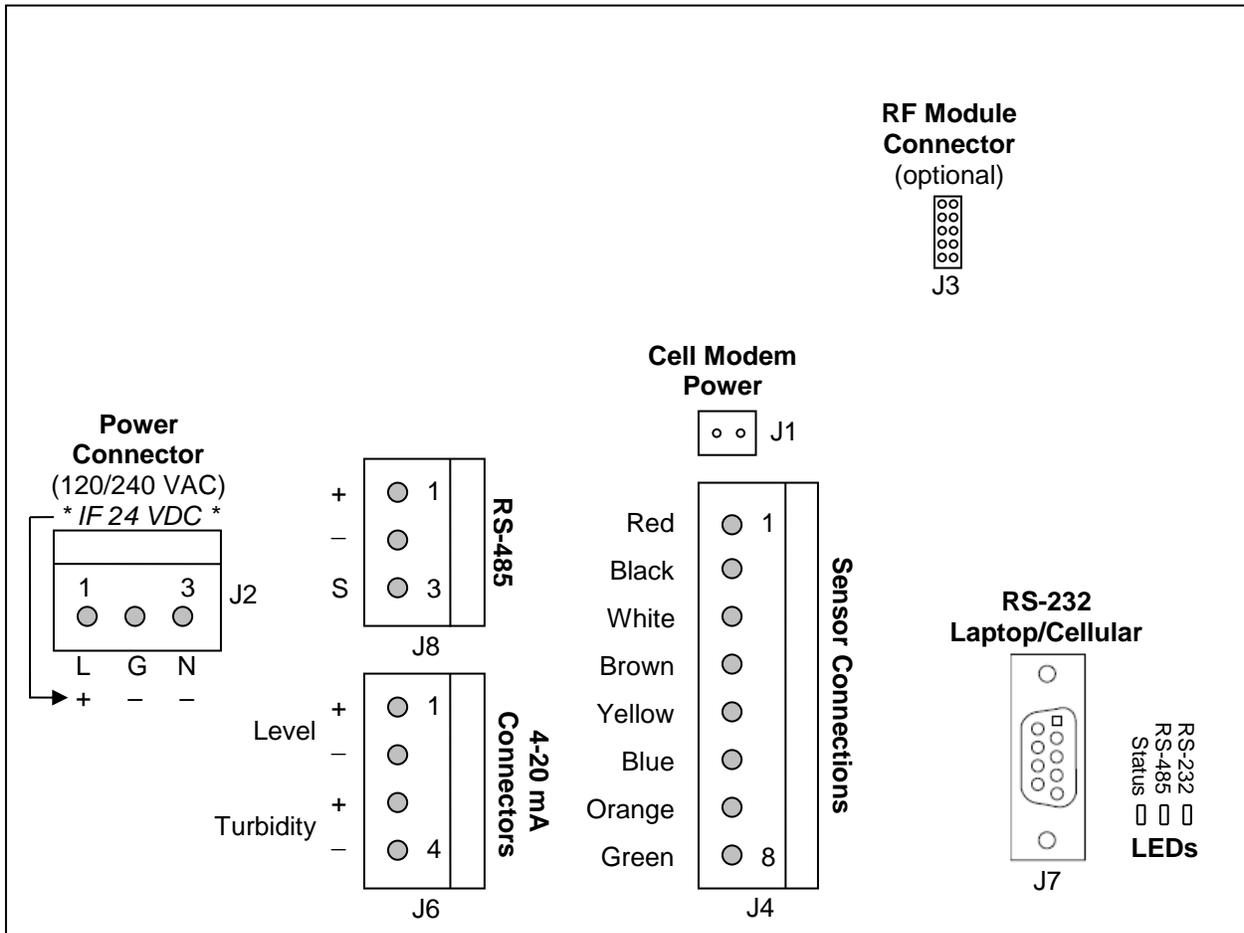


Figure 19: Connections for Power Supply

Power Connector (J2) *FOR 100-240 VAC*		4-20 Analog Connectors (J6)		Sensor Connections (J4)		RS-485 Connector (J8)	
<i>Pin #</i>	<i>Description</i>	<i>Pin #</i>	<i>Description</i>	<i>Pin #</i>	<i>Description</i>	<i>Pin #</i>	<i>Description</i>
1	Live	1	Level +	1	15 V	1	Sensor Comm
2	Ground	2	Level –	2	Ground	2	Sensor Comm
3	Neutral	3	Turbidity +	3	Sensor Comm (+)	3	Ground
		4	Turbidity –	4	Sensor Comm (–)		
				5	4-20mA Level		
				6	4-20mA Level		
				7	4-20mA Turbidity		
				8	4-20mA Turbidity		

(J2) * FOR 24 VDC *	
1	+
2	–
3	–

Figure 20: Table of Power Supply Connections

Notes:

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

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

6. Installation of Equipment

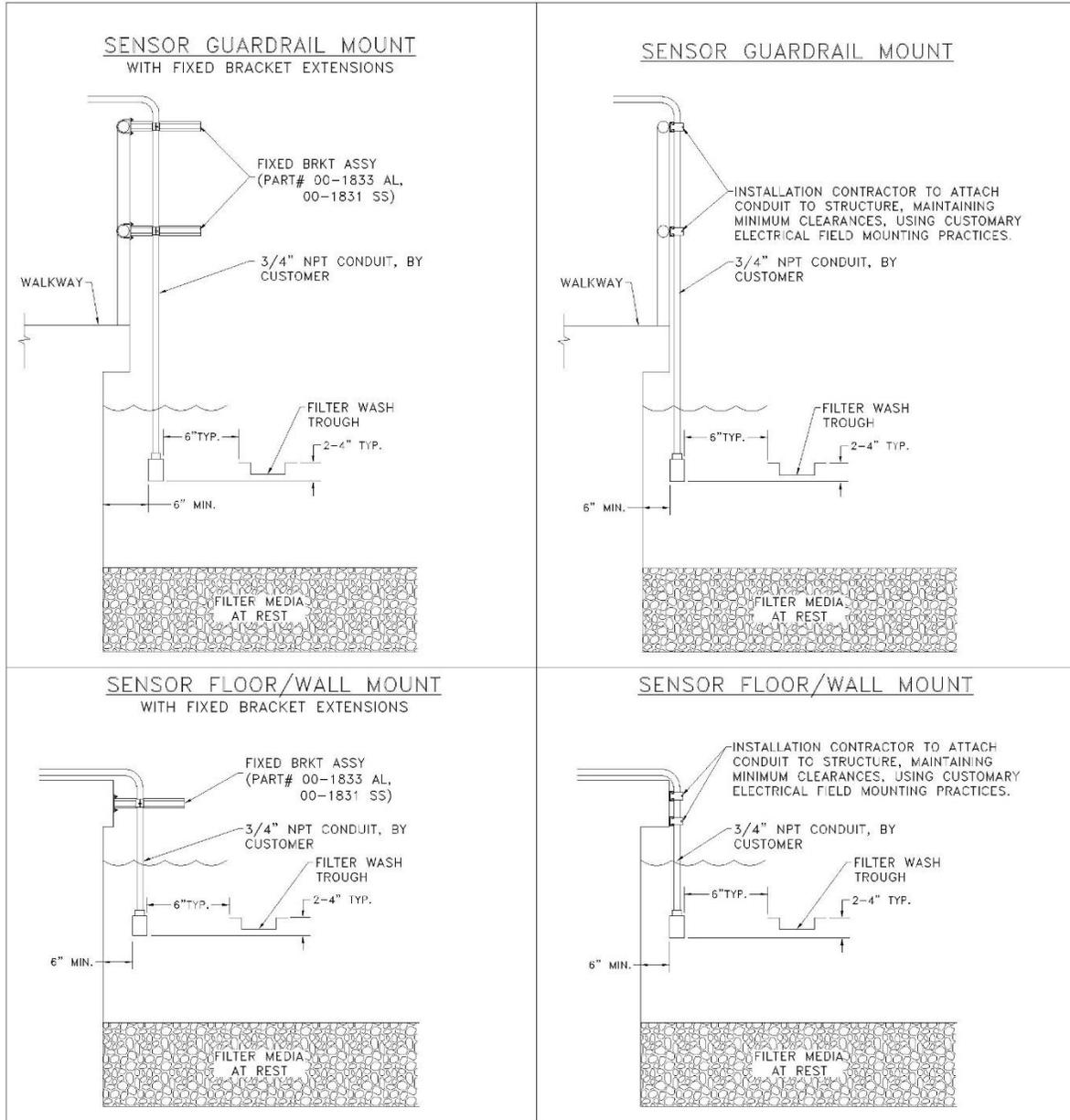
6.1. Installation of FilterSmart Sensor

Mount the sensor so that the face of the sensor is slightly below the TOP of the wash trough, as illustrated in Figure 21. It is recommended to locate the sensor about 6 inches from the trough, as water flowing into the trough during backwash has more velocity and helps keep the sensor face clear of bubbles or debris. Locating the face of the sensor slightly below the top of the trough maximizes the freeboard, or distance from the sensor face to the static media, and provides maximum measurement range for the sensor (keep in mind there is a 12-inch blanking zone extending from the sensor face). Locating the sensor face close to the top of the trough also provides a more real-time measurement of the turbidity of the water as it leaves the filter.

It is best to avoid locating the sensor close to the filter wall, as the filter wall can affect the behavior of the expanded media and there is the possibility of the sensor picking up irregularities or structural elements on the filter wall. If possible, locate the sensor where there is an overhang, keeping in mind the guidance above. If no overhang is available or accessible, consider using longer mounting brackets to locate the sensor farther out from the filter wall.

It is normal for the sensor to be above the water during air-scour or surface wash. During these times the sensor holds its last media level measurement until the water level rises and starts to enter the trough (the turbidity measurement continues when the sensor is out of the water, but it's simply measuring the turbidity of air). At this time, the sensor resumes tracking of both the media level and the turbidity of the water.

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SENSOR INSTALLATION NOTES:

1. See Fixed Bracket Assembly drawing for detail.
2. Each Fixed Bracket Assembly includes two brackets. If only one bracket is required for each sensor installation, order one (1) kit for every two (2) sensors.

ANALYTICAL TECHNOLOGY INC. <small>1-800-999-0299</small>	
SCALE: N/A	DRAWN BY: TODD McCLENDON
DATE: 10-26-20	
SENSOR INSTALLATION	
FilterSmart	DRAWING NO.

Figure 21: FilterSmart Sensor Installation Arrangements

6.1.1. Stationary Objects in Path of Transmit Pulse

Do not locate the sensor immediately above piping, filter structural elements, or other objects that encroach on the signal trajectory. Continuously moving surface wash arms typically do not interfere with measurements but should be avoided when possible.

6.1.2. Areas of Excessive Air/Gas Bubbles and Turbulence

Avoid locating the sensor in areas where there are high concentrations of air/gas bubbles. Air from air-scouring that is discontinued prior to high rate wash is typically not a problem. FilterSmart is generally NOT appropriate for filters with continuous air-scouring due to excessive air-bubbles in the filter during times that are critical for reliable measurements.

6.2. Installation of FilterSmart Controller and Power Supply Unit

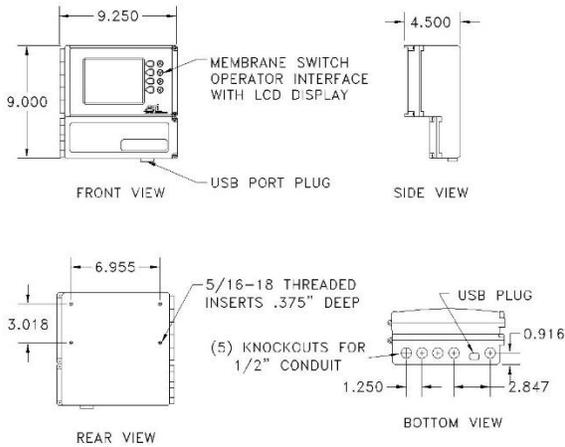
The FilterSmart Controller and FilterSmart Power Supply Unit are designed for indoor and outdoor installation and are typically attached to safety railing or other structure.

Typically, locate the Controller or Power Supply Unit within 20.0 ft. of the sensor, as illustrated in Figure 22 and Figure 23 below. Sensor cables may be extended at water-tight junction boxes using manufacturer specified cables or by special order of sensors with continuous cable of longer lengths.

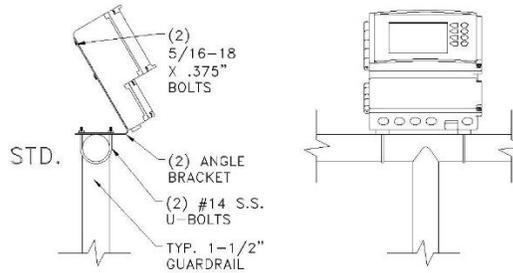
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CONTROLLER MOUNTING

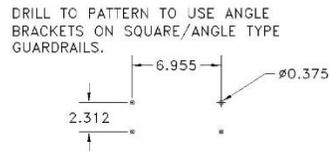
WALL/PANEL MOUNT



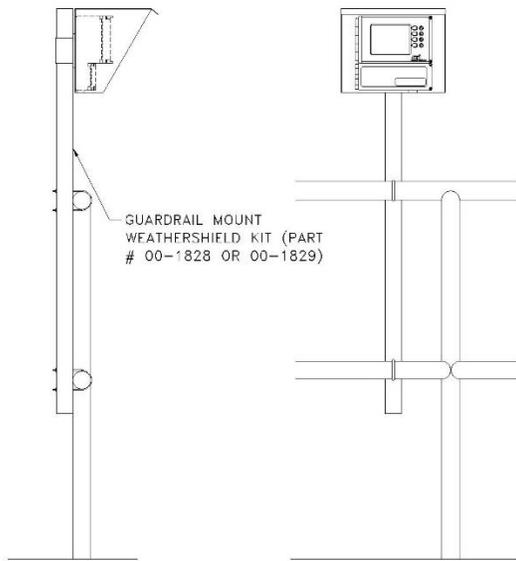
ROUND GUARDRAIL MOUNT



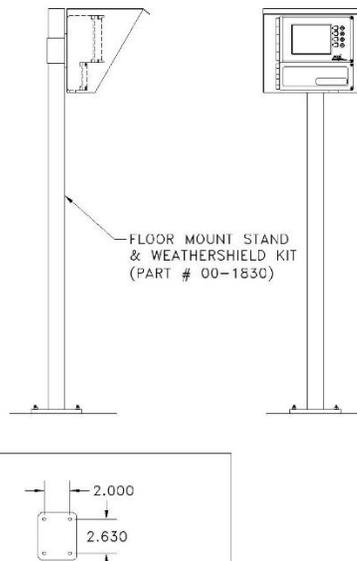
SQUARE GUARDRAIL MOUNT



GUARDRAIL MOUNT W/ WEATHERSHIELD



FLOOR MOUNT W/ WEATHERSHIELD



- CONTROLLER INSTALLATION NOTES:**
1. ALLOW MINIMUM 10" CLEARANCE FROM FRONT OF CONTROLLER FOR DOOR SWING.
 2. NEMA 4X MOLDED PC-ABS ENCLOSURE MOUNTED ON CONTROLLER MOUNTING PLATE OR WEATHERSHIELD.
 3. APPROXIMATE CONTROLLER WEIGHT: 4.0 lbs.

ANALYTICAL TECHNOLOGY INC.

1-800-959-0299

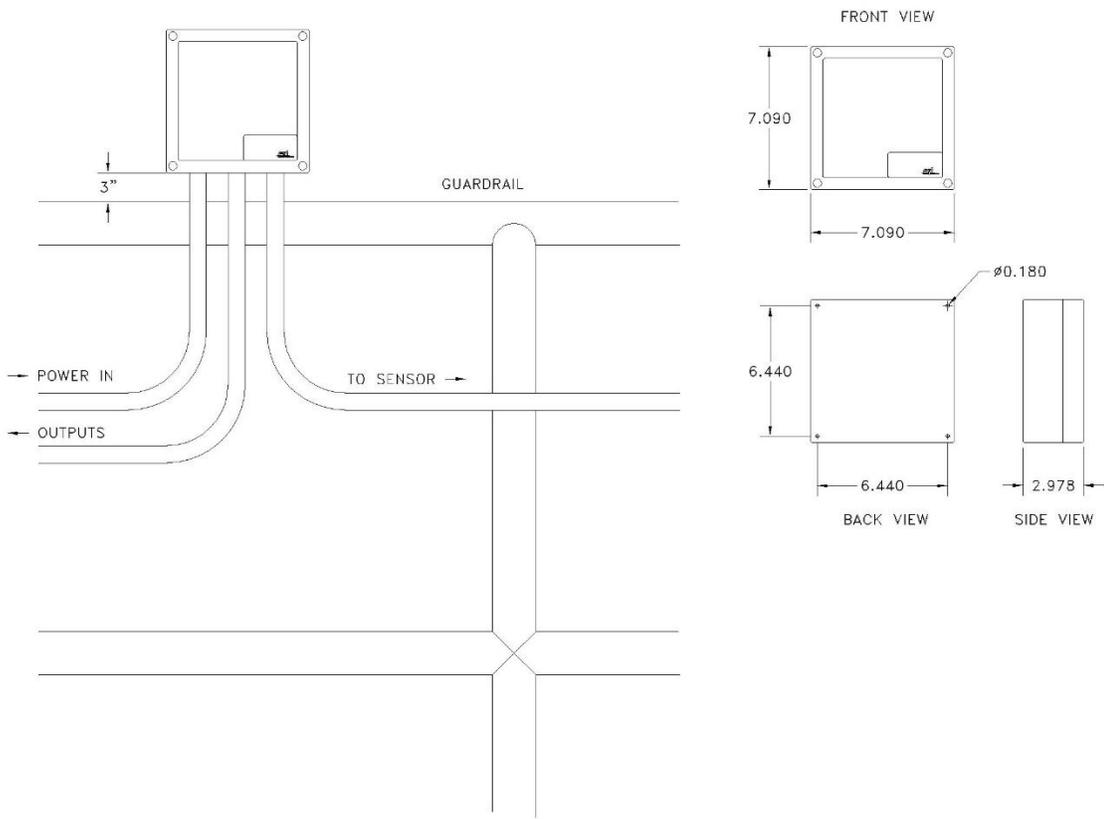
SCALE: N/A DRAWN BY: TODD McCLENDON

DATE: 01-18-21

CONTROLLER MOUNTING ARRANGEMENTS

Figure 22: Controller Installation Drawing

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POWER SUPPLY INSTALLATION NOTES:

1. POSITION POWER SUPPLY APPROXIMATELY 3" ABOVE TOP GUARDRAIL AS SHOWN. ANCHOR 1/2" METAL CONDUIT TO GUARDRAIL BY STANDARD CONSTRUCTION METHODS (UNISTRUT, CLAMPS, ETC.) TO SECURE ENCLOSURE.
2. APPROXIMATE WEIGHT: 2.0 LBS.
3. ENCLOSURE MATERIAL OF CONSTRUCTION: ABS/PC

ANALYTICAL TECHNOLOGY INC.	
<small>1-800-959-0293</small>	
SCALE: N/A	DRAWN BY: TODD McCLENDON
DATE: 01-18-22	
POWER SUPPLY MOUNTING ARRANGEMENTS	

Figure 23: Power Supply Unit Installation Drawing

7. Filter Configuration, Waveform Analysis, and Tracking

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

7.1. Filter Configuration

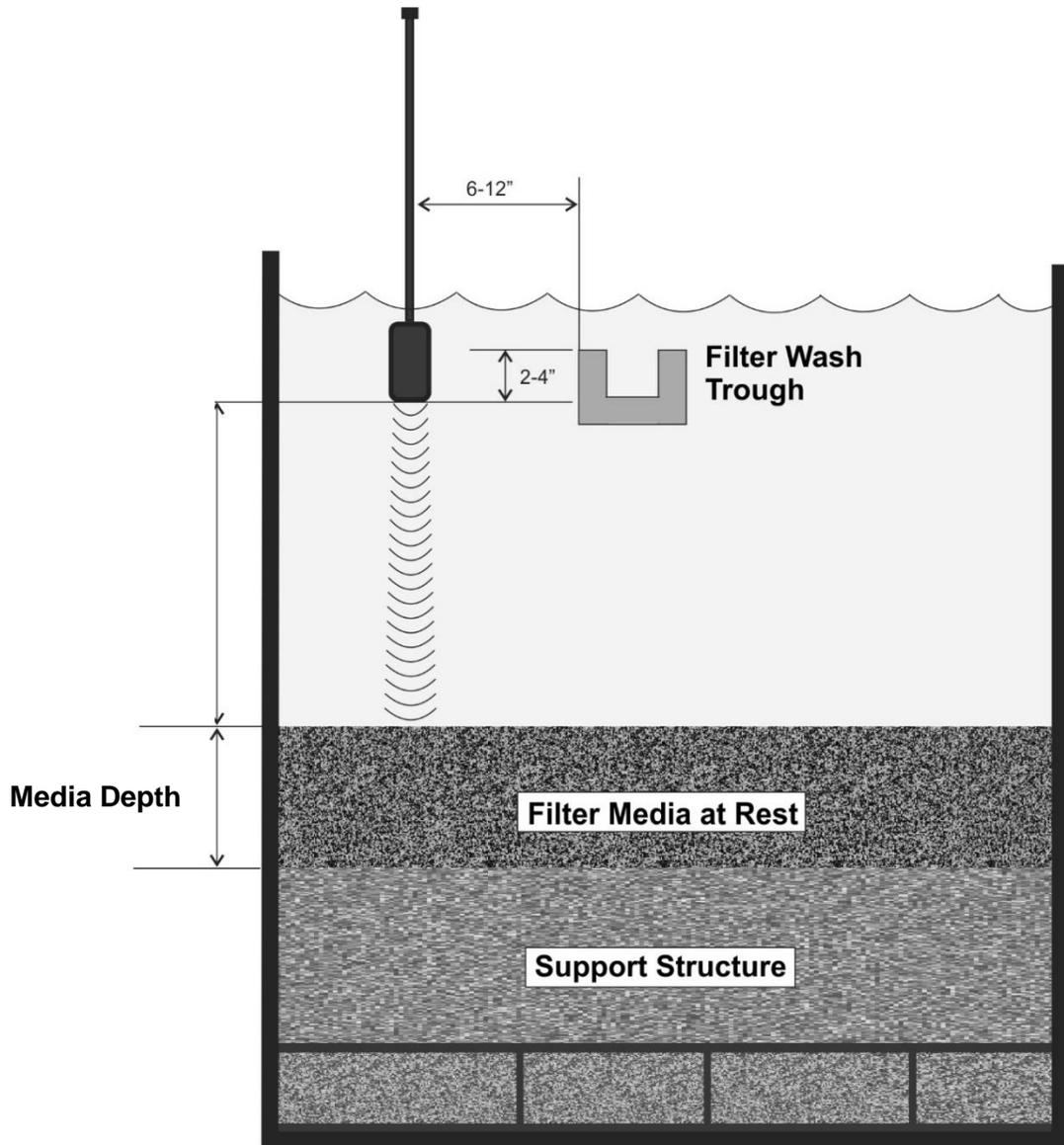


Figure 24: Filter Configuration

7.2. Waveform Analysis

The FilterSmart Sensor produces a signal waveform (Figure 25) that is used to produce the media level measurement. The waveform is available to the user as a diagnostic tool in the Echo Profile Display, as illustrated here.

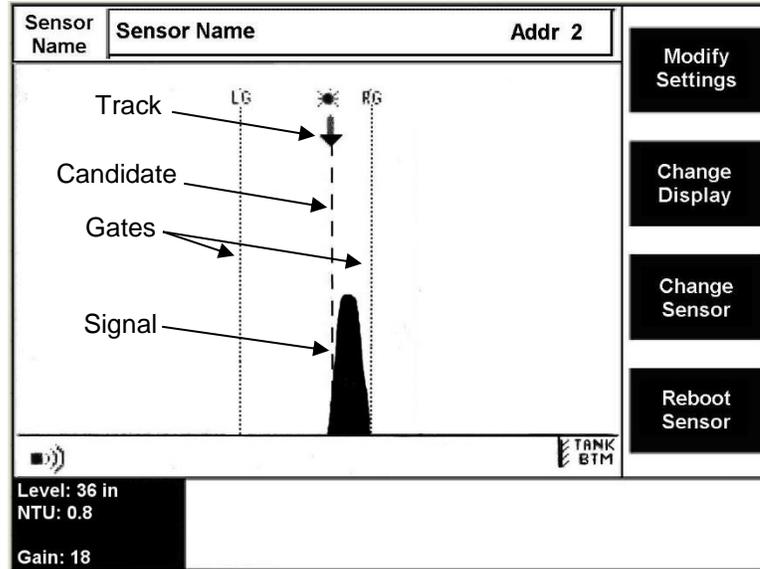


Figure 25: Echo Profile Display

The signal waveform is presented graphically with the horizontal x-axis representing the filter 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 bottom of the expandable media is indicated in the lower right corner.

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

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

7.2.1. 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 will only be affected by this signal if it persists for repeated updates.

← The Left Arrow indicates that a signal meeting the tracking criteria is located outside the Gate, to the left. The measurement will only be affected by this signal if it persists for repeated updates.

!! The Double Exclamation Mark indicates that the current signal is insufficient for tracking purposes. The Current Measurement will be held until sufficient signal returns. An Echo Loss message will accompany the output measurement on the Controller if it persists longer than the Echo Delay setting. Loss of Echo will be reported on the 4-20mA circuit if the Loss of Echo parameter has been activated (See 9.1.7 – 9.1.9).

8. Communications, Outputs, and Networking

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

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

8.1. Configuration of Individual Units and Networks

Multiple configurations are possible for the FilterSmart equipment.

8.1.1. Stand-Alone Instrument

A stand-alone instrument consists of a FilterSmart Controller with a Smart Sensor connected to the Controller as shown below in Figure 26.

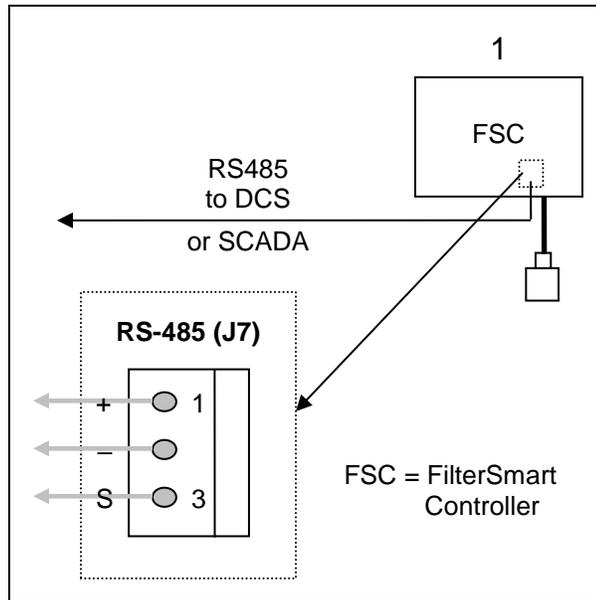


Figure 26: Controller with Single Sensor

8.1.3. Wireless (RF) Field Network

Field Networks as described and configured in Section 8.1.2 can be implemented using optional fully integrated RF Modules without the installation of field interconnection cabling and conduit. The Controller and each Power Supply Unit in the Field Network must be equipped with an RF Module. No user programming or other integration is required.

Figure 28 illustrates a single wireless RF Field Network configuration. Multiple RF Field Networks may be integrated to a SCADA system by connecting Controllers as shown in the “Customer Integration” section of Figure 29.

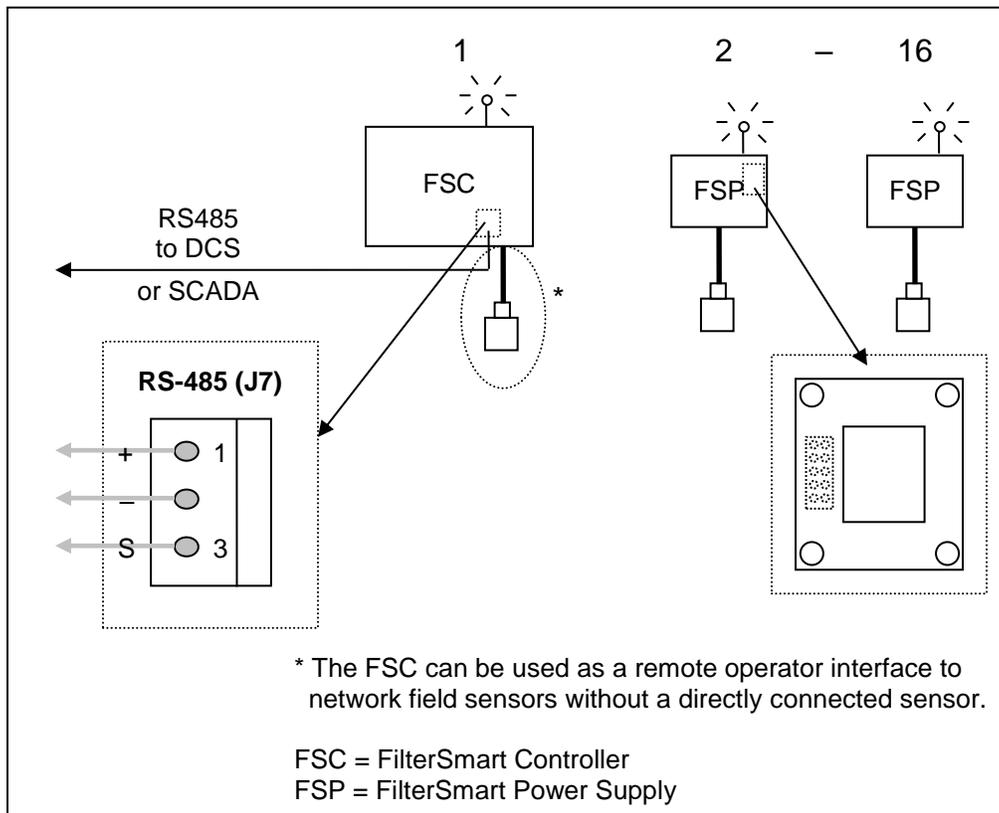


Figure 28: Single RF Field Network

8.1.4. Integrated Field Networks

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

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

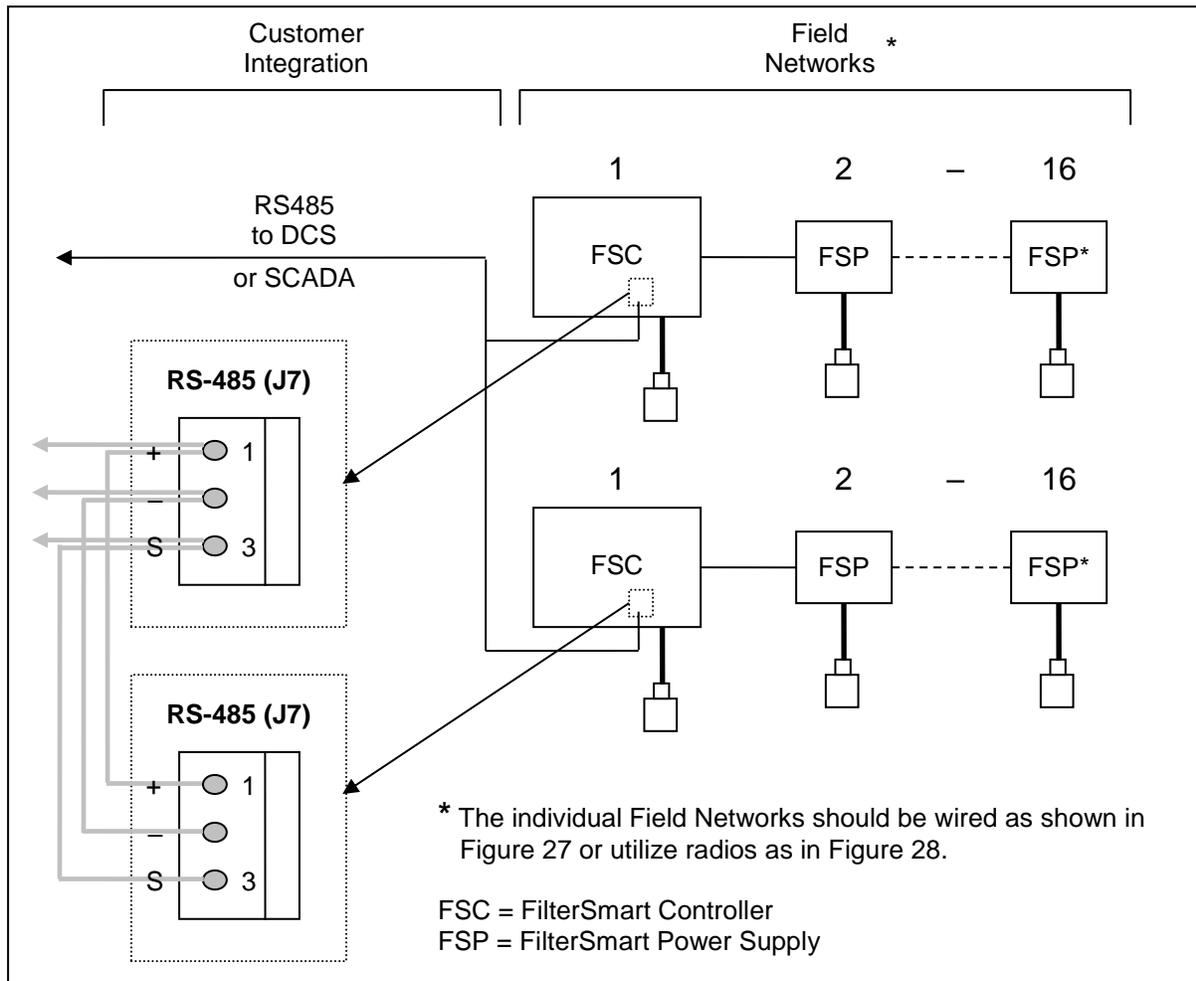


Figure 29: Integrated Wired Field Network

8.2. Outputs & Communication Options

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

Factory Remote Service is additionally available (see Section 8.2.4).

8.2.1. RS-485 Modbus RTU

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

Connection

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

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

When communication is occurring through the RS-485 connection, a notification message will appear on most display screens.

Polling Basics

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

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

Recommended Polling

The current measurements can be obtained by utilizing Function Code 03 and polling for the following registers as desired:

Register 40001 for Media Level

Register 40002 for Turbidity

Register 40003 for Expansion

Register 40004 for Expansion Percentage

The returned value for Media Level and Expansion will be in the sensor's selected Units and will be reported as the base measurement times ten (i.e. 42 = 4.2 units). The returned value for Turbidity will be the current NTU value times 100 (i.e. 135 = 1.35 NTU). The returned value for Expansion Percentage will be the percentage value times 10 (i.e. 154 = 15.4%).

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

Additional Information

The information provided in this manual only serves as a brief overview of the capabilities and data available via Modbus. See the OEM Smart Sensor Probe (SSP) Communications Protocol for further detailed information on available commands, settings, and programming.

8.2.2. Primary Analog Current Loop

The 4-20 mA proportional current loop signal is generated by the sensor. The signal is accessed at pins 1 & 2 of the 4-pin 4-20 Loop connector on the FSC (J10) or FSP (J6) that is supplying power to the sensor. The Primary Current Loop is user-assigned for Media Level, Expansion (engineering units) or Expansion %. The Turbidity current loop is not assignable to a different function.

The Primary Current Loop 4 mA Set Point and 20 mA Set Point (see Section 9.1.5 and 9.1.6) should be scaled to represent the installation environment with consistent scaling at the control device.

8.2.3. Turbidity Analog Current Loop

The turbidity 4-20 mA current loop output is factory scaled from 0.0 to 50 NTU and is not user-adjustable. The signal is accessed at pins 3 & 4 of the 4-pin 4-20 Loop connector on the FSC (J10) or FSP (J6) that is supplying power to the sensor.

8.2.4. Factory Remote Service

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

This service utilizes the onboard RS-232 serial connection. When communication is occurring through this port, a notification message will appear on most display screens.

See Figure 30 below for instructions on how to properly install and remove the modem from an FSC.

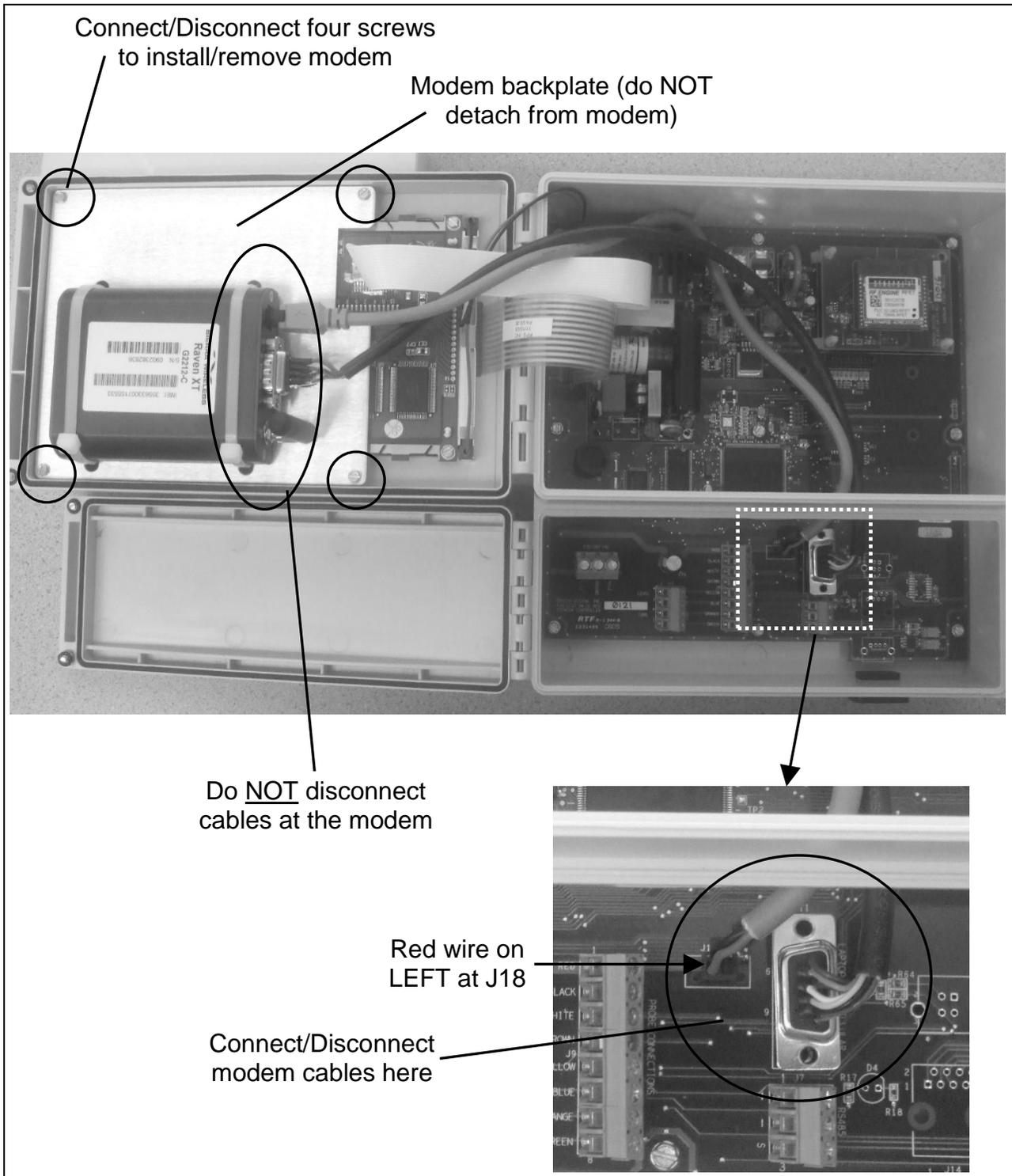


Figure 30: Proper Installation and Removal of Modem

9. Instrument Programming Parameters

Controller and Smart Sensor parameter settings are established at the Modify Settings and Advanced Settings displays. Standard default parameters exist in all instruments until modified by the user. Most parameters should be left at the default value unless instructed by a factory technician.

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

9.1. Modify Settings Display Parameters

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

9.1.1. Units (*in*)

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

Options for Units are: Inches (in), and Centimeters (cm)

9.1.2. Media Depth (*36*)

Media Depth is the amount of expandable media in the filter. An accurate value must be entered during setup for the correct Media Level to be reported and for accurate expansion percentage calculations.

The range for Media Depth is: 0 to 240 inches

9.1.3. Wiper Timing (*240*)

Wiper Timing establishes the time (minutes) between wiper cycles. The sensor wiper will also operate automatically on detection of signal loss regardless of the selected Wiper Timing setting. This reduces the need to establish a short wiper timing sequence and prolongs the life of the wiper mechanism.

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

9.1.4. Primary 4-20mA (*Media Level*)

The Primary 4-20mA setting determines what measurement is output on the primary 4-20mA connection. (Turbidity is always output on the secondary connection.)

Options for Primary 4-20mA are: Media Level, Expansion (Selected Engineering Units), and Expansion % (Percent of media bed depth)

9.1.5. 4mA Set Point (0.0)

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

The range for 4mA Set Point is: 0 to Total Measurement Range or 0 to 50% depending on the option selected in Section 9.1.4 Primary 4-20mA.

9.1.6. 20mA Set Point (60.0)

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

The range for 20mA Set Point is: 0 to Total Measurement Range or 0 to 50% depending on the option selected in Section 9.1.4 Primary 4-20mA.

9.1.7. Echo Loss (OFF)

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

The options for Echo Loss are: ON and OFF

9.1.8. Echo Delay (60)

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

The range for Echo Delay is: 0 to 255 minutes

9.1.9. Echo Loss Action (Cycle)

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

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

9.1.10. Display Contrast (55)

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

The range for Display Contrast is: 0 to 255

9.2. Advanced Settings Display Parameters

Additional parameters are found at this display. Access this display by pressing the Soft Key next to the *Advanced Settings* prompt at the Controller Setup Display.

9.2.1. Auto Gain (ON)

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

The options for Auto Gain are: ON and OFF

9.2.2. Current Gain (*varies*)

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

The range for Current Gain is: 0 to 100

9.2.3. Gain Midpoint (30)

The Gain Midpoint is the central value around which the gain is permitted to fluctuate as determined by the signal characteristics.

For applications with entrained air or other environmental factors causing signal energy dispersion, this value can be increased and then the sensor should be rebooted. These steps allow the sensor to initialize and operate at a higher gain value to compensate for the energy being dispersed.

The range for Gain Midpoint is: 30 to 100

9.2.4. Total Measurement Range (*Auto Calculated*)

Total Measurement Range is the distance from the face of the sensor to the bottom of the expandable media. This value is automatically set during the sensor initialization process based on the user's entry of Media Level. Changes to this parameter value after initialization will impact the indicated Media Level. Increase the value to increase Media Level; decrease to decrease Media Level.

The range for Total Measurement Range is: 36 to 384 inches

9.2.5. Sensor Blanking Zone (12.0 inch)

Sensor Blanking Zone is the area near the sensor that will not produce measurements.

The Sensor Blanking Zone must be at least 12 inches.

9.2.6. Sensor Measurement Limit (Auto Calculated)

Sensor Measurement Limit sets the total measurement span. It is automatically set to 4 inches greater than the location of the media (Total Measurement Range minus Media Depth) on initialization and should generally be maintained at 4 to 6 inches deeper than the media location.

The range for Sensor Measurement Limit is: 12 to 384 inches

9.2.7. Level Simulation Test

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

Sensor Name	Filter Name	Addr 2
Simulation Test Setup		
Modify the value below to verify corresponding analog output value and/or operation of any configured relay. The displayed value has the sensor's specified units. Test range is from zero value (4mA) to the 20mA Set Point (20mA).		
Level Simulation Test		12.0
Increase Sim Value		
Decrease Sim Value		
Test Value		
Back to Advanced Settings		
Level: 36 in NTU: 0.8 Gain: 18	Use the 'Increase Sim Value' and 'Decrease Sim Value' options to set a simulation value for testing. Once the desired simulation value is reached, press 'Test Value' to submit the value.	

Figure 31: Level Simulation Test Setup Screen

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

For units purchased with integrated relays, the level simulation value will also impact the status of any relays configured for media level, media expansion, or expansion percentage. The relays must be activated and configured prior to performing the simulation test (see Section 11.2 for details on the relays).

Note: This functionality is available on Controller firmware version 1.06 and later in conjunction with Sensor firmware version 38 and later.

9.2.8. Aux Simulation Test

Selecting the Aux Simulation Test option provides access to the Simulation Test Setup page. The simulation test provides an opportunity to verify proper operation of the Auxiliary analog output loop. Turbidity is always output on the Auxiliary analog loop for FilterSmart sensors. The test range is from 0 NTU to 50 NTU.

Sensor Name	Filter Name	Addr 2
Simulation Test Setup		
Modify the value below to verify corresponding analog output value and/or operation of any configured relay. The displayed value has the sensor's specified units. Test range is from zero value (4mA) to the 20mA Set Point (20mA).		
Aux Simulation Test 12.0		Increase Sim Value Decrease Sim Value Test Value Back to Advanced Settings
Level: 36 in NTU: 0.8 Gain: 18	Use the 'Increase Sim Value' and 'Decrease Sim Value' options to set a simulation value for testing. Once the desired simulation value is reached, press 'Test Value' to submit the value.	

Figure 32: Aux Simulation Test Setup Screen

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

For units purchased with integrated relays, the simulation value will also impact the status of any relays configured for turbidity. The relays must be activated and configured prior to performing the simulation test (see Section 11.2 for details on the relays).

Note: This functionality is available on Controller firmware version 1.06 and later in conjunction with Sensor firmware version 38 and later.

9.2.9. Set Sensor to Default Settings

Since the FilterSmart sensor auto-configures to its environment during initialization, setting the sensor back to default values can be utilized if the sensor is moved or relocated. When selected, a screen requiring confirmation of the selection will appear. All parameters including Media Depth, Sensor Name, and the auto-set dimensional parameters will be reset to default values. The sensor address will be maintained.

10. Maintenance and Troubleshooting

10.1. Preventative Maintenance

10.1.1. Sensor Cleaning and Maintenance

1. All Sensors with Self-Cleaning Wipers

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

Wiper blade and motor life will vary with process conditions and the user established frequency of operation (Wiper Timing parameter, Section 9.1.3). It is generally expected that the wiper blade assembly will require replacement yearly and the wiper motor will require replacement every two years in typical municipal water and wastewater treatment filter applications.

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

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

Wiper Assembly Replacement:

The FilterSmart Sensor Wiper Blade Assembly (Part No. 03-0497) is field replaceable. Remove the wiper by unscrewing in counter-clockwise direction. Secure and retain the stainless steel spacing washer from the wiper shaft for use with the replacement wiper.

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

2. Sensor Cleaning and Inspection

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

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

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

10.1.2. Other Routine Maintenance

Visually inspect the instrument 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 may be required.

Observe the sensor to assure that it is fully submerged below the top of the filter wash trough and that there are no rags or similar debris wrapped around it.

10.2. Troubleshooting

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

10.2.1. Comm Error Message

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

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

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

10.2.2. Echo Loss Message

An *Echo Loss* message indicates that the instrument does not have a signal that is reliable for measurement within the current parameter range. This can be the result of improper installation, configuration changes, or process conditions.

Installation and Basic Operation

- Ensure the black protective cover has been removed from the face of the sensor.
- Ensure the sensor is submerged in water.
Please note that temporary loss of signal during filter draw-down, surface-wash, or air-scouring conducted as preparatory steps to the backwash may cause loss of signal. Loss of signal at these times is expected and does not interfere with measurement performance.
- Confirm that the wiper arm is in place and that the wiper turns 1–3 revolutions when (1) power is cycled, (2) the sensor Reboot command is called, or (3) the Wiper Timing setting is changed.

Configuration

- Loss of signal can be the result of incorrect operating parameters in the sensor. This can typically be identified by a return echo peak that is located to the right of the “RG” line on the Echo Profile screen (see Figure 9). Since the FilterSmart sensor auto-configures the dimensional parameters during initialization, if the sensor was recently relocated or moved, the sensor may need to be allowed to adjust to the new location. This can be achieved by initiating the Set Sensor to Factory Defaults option (see 9.2.9) or by extending the Sensor Measurement Limit (see 9.2.6) and then rebooting the sensor (available from the Echo Profile screen).

Process Conditions

- If the above items have been checked after installation and echo loss is still present, there may be entrained air in the process or another process condition that is causing the sensor’s energy to be dispersed. This can typically be identified by no return echo (or very little) on the Echo Profile screen even after the steps in the “Configuration” section above have been attempted. Increase the Gain Midpoint value (see 9.2.3) then reboot the sensor (available from the Echo Profile screen). If the media level is still not shown on the Filter View screen (see Figure 8) after the initialization process completes, further increase the Gain Midpoint parameter and reboot again.

Contact Analytical Technology for assistance if the problem is not resolved.

10.2.3. Validating Message

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

10.2.4. Validation Failure Message

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

10.2.5. Wiper Stalled Message

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

10.2.6. Wiper Motor Failure Message

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

Note: Wiper motor failure may cause unreliable measurements.

10.2.7. Analog Output Discrepancy

FilterSmart 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.

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

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

10.2.8. Sensors Not Detected

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

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

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

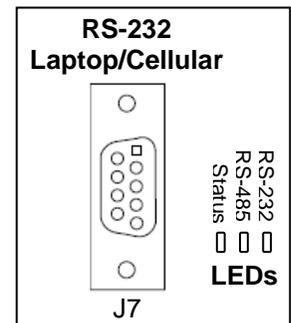
10.2.9. Radio (RF) Communications

Sensor specific communications troubleshooting:

LEDs located near the serial port of each FSP 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 FSP.

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



10.2.10. Persistent “Acquiring Waveform” Message

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

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

11. System Options

11.1. Integrated Wireless Radio (RF) Modules

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

11.1.1. General Overview

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

11.1.2. Internal Configuration

In this configuration, the radio module is mounted inside the Controller or Power Supply enclosure. An external antenna is then affixed to the outside of the enclosure with a U.FL to RP-SMA cable connecting the antenna to the module. The module additionally requires a two-wire cable to be connected between the radio's 4-pin terminal strip (J2) and the 8-pin terminal strip on the associated Controller (J9) or Power Supply (J4). The cable should link red to red terminal locations and black to black (see Figure 33).

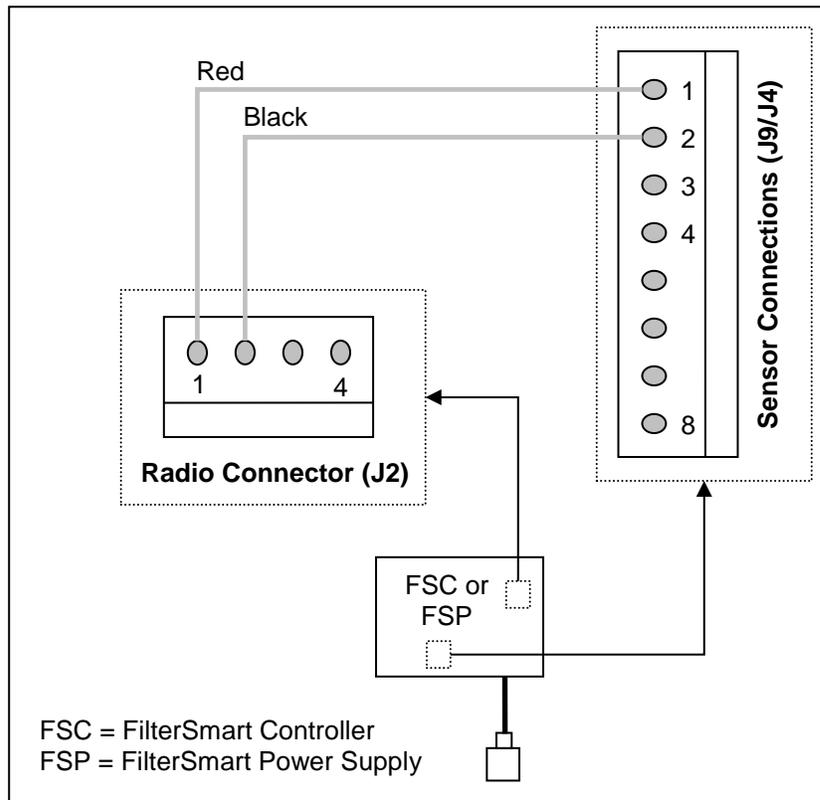


Figure 33: Connections for Wireless Radio Module (Internal)

11.1.3. External Configuration

In this configuration, the radio module is mounted in a separate enclosure that can be located in an optimal location. An external antenna is affixed to the outside of the enclosure with a U.FL to RP-SMA cable connecting the antenna to the module. A four-wire cable is required to connect the radio's 4-pin terminal strip (J2) and the 8-pin terminal strip on the associated Controller (J9) or Power Supply (J4). The cable should link red to red terminal locations, black to black, white to white, and brown to brown (see Figure 34).

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.

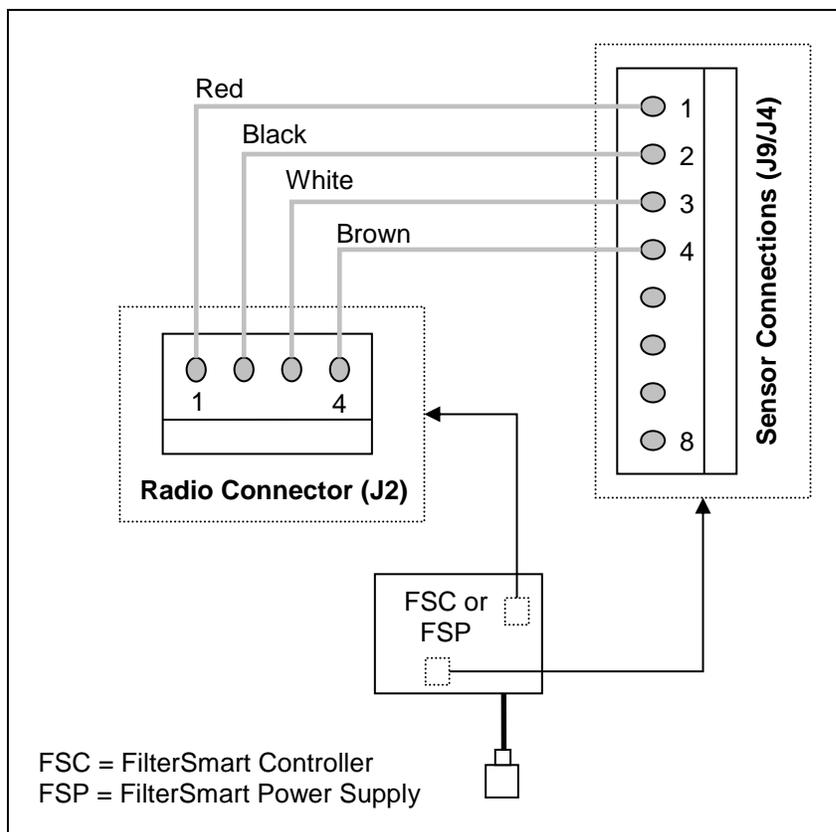


Figure 34: Connections for Wireless Radio Module (External)

11.1.4. Equipment Orientation for Units with Integrated Wireless Radio Modules

Equipment containing the integrated wireless radio modules should be oriented such that the antenna mounting location is on the side of the enclosure with the antenna pointed in the upward direction. See Figure 35.

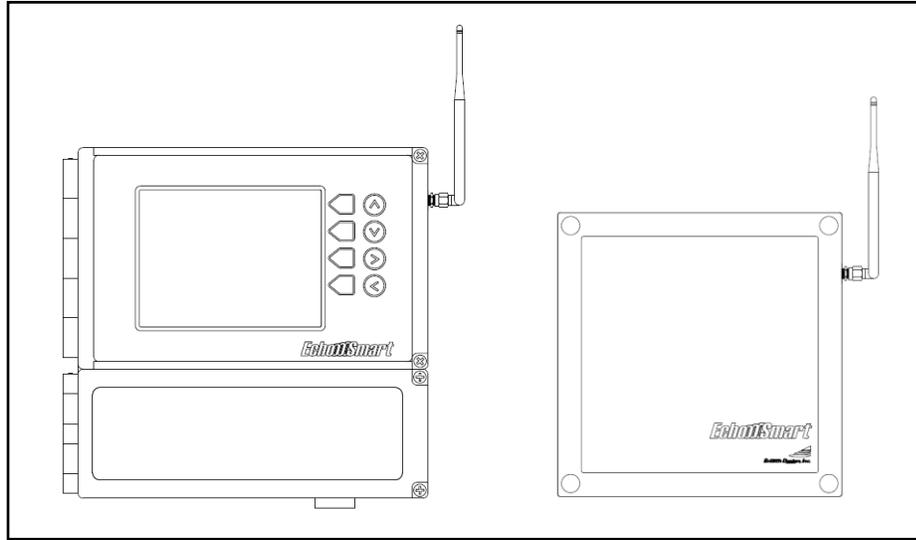


Figure 35: Orientation of Units with Wireless Radio Modules

11.2. Relays

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

11.2.1. 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.

11.2.2. Operation

Relay controls are accessed by pressing the Set Up Relays soft key from the Controller Setup Display (Figure 14).

The relay Status must be set to ON in order for the relays to operate. The sensor associated with each relay is listed below the “Status” setting. Each relay can be set to monitor the 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 >” parameter determines the value at which the relay will be energized and change states while the “Disable <” determines the value at which the relay will de-energize and change states.

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

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

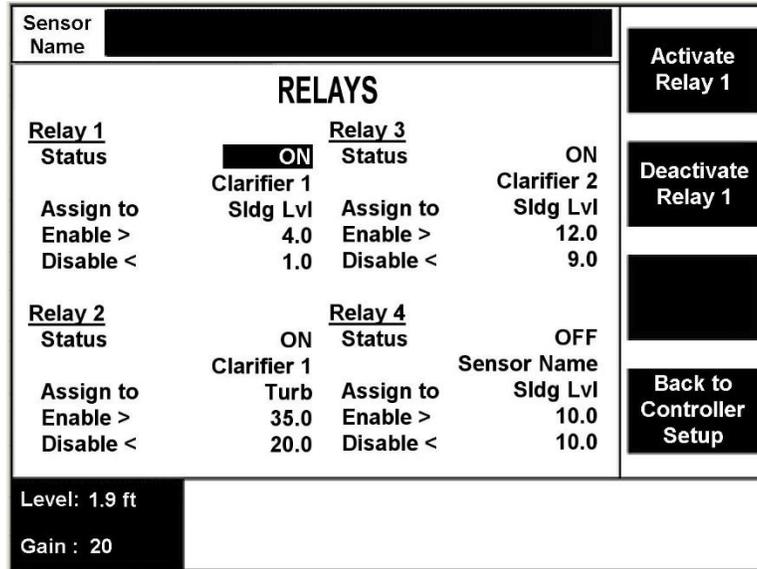


Figure 36: Relays Display

11.2.3. Cabling and Connections for Relays

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

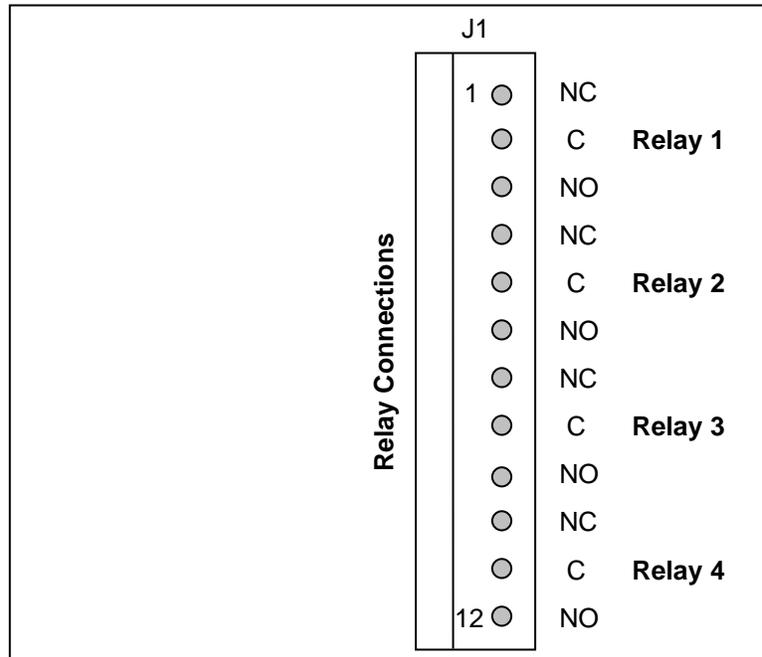


Figure 37: Connections for Relay Board

Relay Connections (J1)		
<i>Pin #</i>	<i>Relay</i>	<i>Description</i>
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 38: Table of Relay Connections

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

The FilterSmart Controller can be paired with Analytical Technology, Inc.'s Analog Output Module to obtain analog measurements from all networked sensors in one location. (Compatible with FilterSmart Controller Firmware Version 1.05 and later.)

11.3.1. General Overview

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

11.3.2. Specifications

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

11.3.3. Cabling and Connections

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

Refer to Figure 39 below for information related to powering and connecting all cables to the Converter.

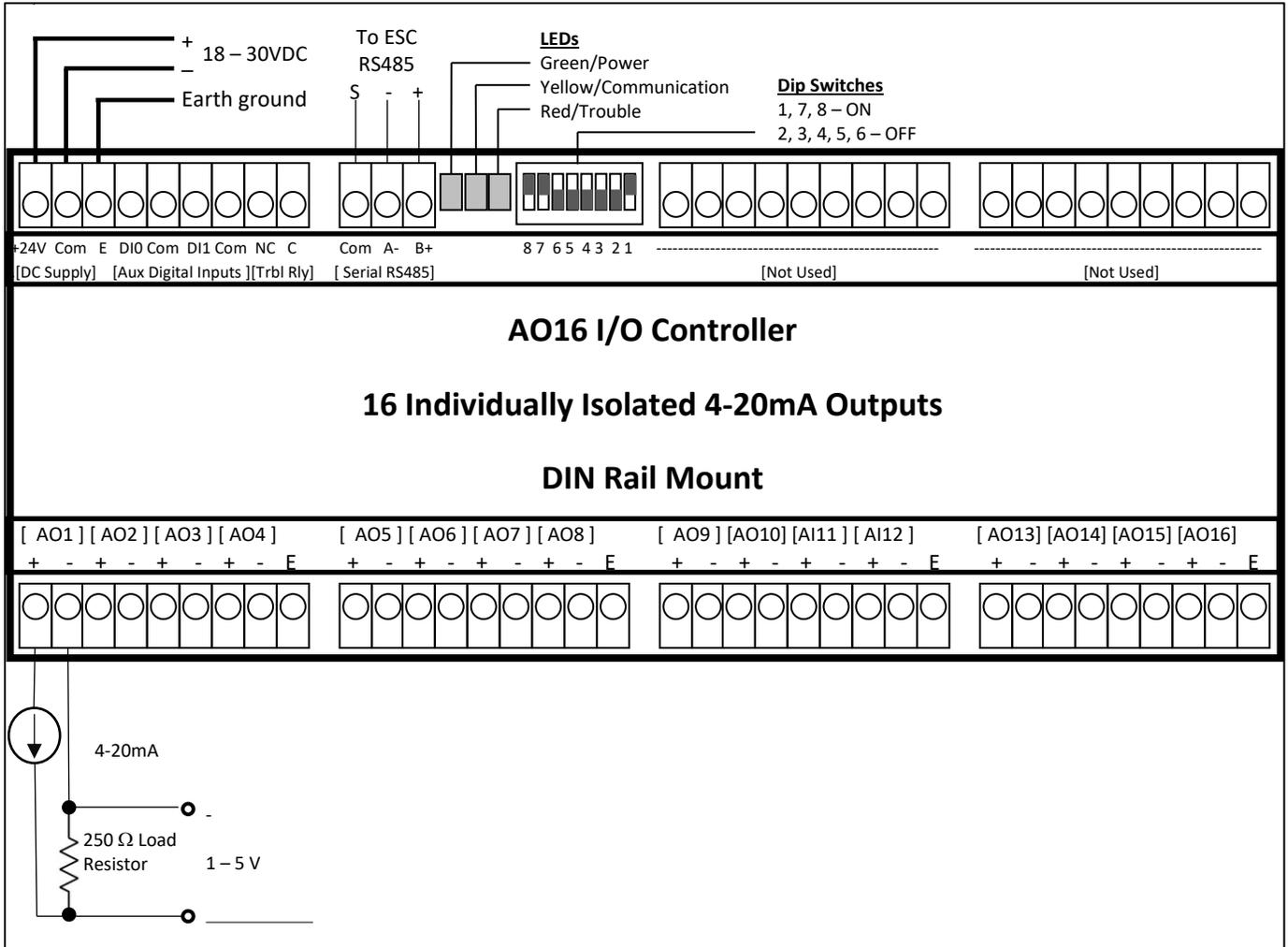


Figure 39: Analog Output Module Connections

11.3.4. Configuring the Converter

The setup menu is accessed from the Controller Setup screen by highlighting the “Digital to Analog Output Setup” option and pressing the button next to “D to A Output Setup”. A screen similar to Figure 40 below will appear.

Sensor Name	4-20mA ANALOG OUTPUT		Increase Sensor Address
Channel 01	Sensor Address 2 - OK	Level	Decrease Sensor Address
Channel 02	Sensor Address 2 - OK	Turbidity	
Channel 03	Sensor Address 3 - OK	Level	Decrease Sensor Address
Channel 04	Sensor Address 3 - OK	Turbidity	
Channel 05	Sensor Address 4 - OK	Level	Channel Not Used
Channel 06	Sensor Address 4 - OK	Turbidity	
Channel 07	Sensor Address 5 - OK	Level	Channel Not Used
Channel 08	Sensor Address 5 - OK	Turbidity	
Channel 09	Not Used	--	Back to Controller Setup
Channel 10	Not Used	--	
Channel 11	Not Used	--	Back to Controller Setup
Channel 12	Not Used	--	
Channel 13	Not Used	--	
Channel 14	Not Used	--	
Channel 15	Not Used	--	
Channel 16	Not Used	--	

Select the sensor address to be associated with each 4-20mA output. Select sensor address by pressing 'Increase', 'Decrease', or 'Channel Not Used'.

Figure 40: Digital to Analog Converter Setup Screen

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

The measurement to be output on each channel can be selected by navigating to the right column. The options are: Primary 4-20 Value (this value is set from the Settings page with options of Media Level, Expansion, and Expansion % – see Section 9.1.4) and Turbidity.

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

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

11.3.5. Analog Outputs

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

The sensor's 4 mA Set Point and 20 mA Set Point (see Section 9.1.5 and 9.1.6) should be scaled to represent the installation environment with consistent scaling at the control device. The turbidity value is factory scaled from 0 NTU to 50 NTU and is not user-adjustable.

Figure 41 below describes the analog output value that is reported under various sensor operating conditions.

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

Figure 41: Analog Output Behavior Table

12. Quick Start Guide

12.1. Configuring a Single Sensor

1. Refer to the Installation of Equipment section (Section 0) and the FilterSmart Sensor Mounting Arrangements drawing (Figure 21) BEFORE INSTALLING SENSORS.
2. Ensure all sensor connections are correct and that power is properly applied to the device.

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

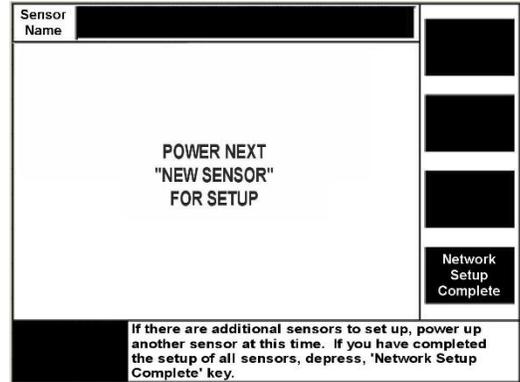
3. From the **Initial Controller Setup** screen, press *New System Installation*. This routine will take approximately 20 seconds to complete.

Sensor Name		
INITIAL CONTROLLER SETUP		
Controller Name: LCD Controller Controller Addr: 253		
Set Date: 1 JAN 2009 Set Time: 12 : 01		
First Time Controller & Sensor System Installation Replacing Controller with Existing Sensors Manually Set Database		
Terminate Aux485 Port NO		
HW Version B FW Version 2.03		
		New System Installation
For proper initial setup of a system, sensors must be powered sequentially ONE AT A TIME and configured. To begin this process, power the first sensor (typ. the sensor connected to the controller) and depress the 'New System Installation' key.		

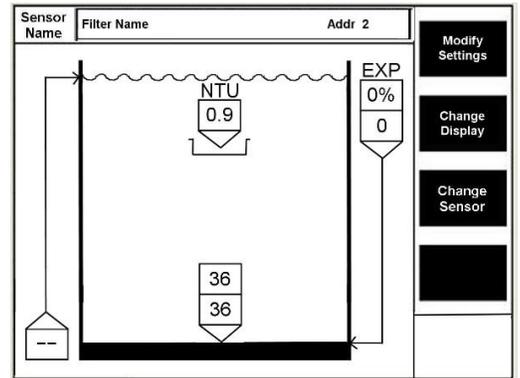
4. Change the Sensor Address to a unique value other than 1 and change the *Media Depth* setting to the amount of expandable media in the filter. If analog outputs are going to be used, also set the 4-20mA Set Points and the desired output for the Primary 4-20mA current loop.

Sensor Name	Sensor Name	Addr 1	
INITIAL SENSOR SETUP			
The sensor must be setup and the address changed to a value between 2 - 240			
Sensor Name	Filter Name		
Sensor Address	2		
Units	Inch		
Media Depth	36.0		
Primary 4-20mA	Media Level		
4mA Set Pt.	0.0		
20mA Set Pt.	60.0		
When complete, depress the 'Sensor Setup Complete' key.			
		Sensor Setup Complete	

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



- You will be directed to the **Filter View** screen. The sensor will go through an auto-setup initialization process and then begin to report the current measurements.



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

12.2. Configuring a Sensor Network

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

- Refer to the Installation of Equipment section (Section 6) and the FilterSmart Sensor Installation Arrangements drawing (Figure 21) BEFORE INSTALLING SENSORS.**
- Ensure all sensor connections are correct and that power is properly applied to the FilterSmart Controller. If a sensor is not directly connected to the Controller, additionally power the first FilterSmart 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 FSC prior to initiating Controller Setup to avoid communication errors.

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

Sensor Name		
INITIAL CONTROLLER SETUP		
Controller Name: LCD Controller Controller Addr: 253		
Set Date: 1 JAN 2009 Set Time: 12 : 01		
First Time Controller & Sensor System Installation Replacing Controller with Existing Sensors Manually Set Database		
Terminate Aux485 Port NO		
HW Version B FW Version 2.03		
New System Installation		
For proper initial setup of a system, sensors must be powered sequentially ONE AT A TIME and configured. To begin this process, power the first sensor (typ. the sensor connected to the controller) and depress the 'New System Installation' key.		

- Change the Sensor Address to a unique value other than 1 and change the *Media Depth* setting to the amount of expandable media in the filter. If analog outputs are going to be used, also set the 4-20mA Set Points and the desired output for the Primary 4-20mA current loop.

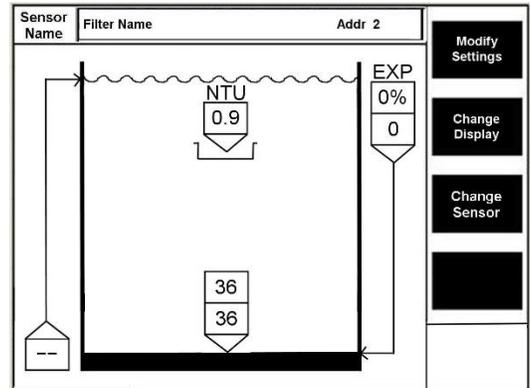
Sensor Name	Sensor Name	Addr 1	
INITIAL SENSOR SETUP			
The sensor must be setup and the address changed to a value between 2 - 240			
Sensor Name	Filter Name		
Sensor Address		2	
Units		Inch	
Media Depth		36.0	
Primary 4-20mA	Media Level		
4mA Set Pt.		0.0	
20mA Set Pt.		60.0	
When complete, depress the 'Sensor Setup Complete' key.			
			Sensor Setup Complete

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

Sensor Name		
POWER NEXT "NEW SENSOR" FOR SETUP		
Network Setup Complete		
If there are additional sensors to set up, power up another sensor at this time. If you have completed the setup of all sensors, depress, 'Network Setup Complete' key.		

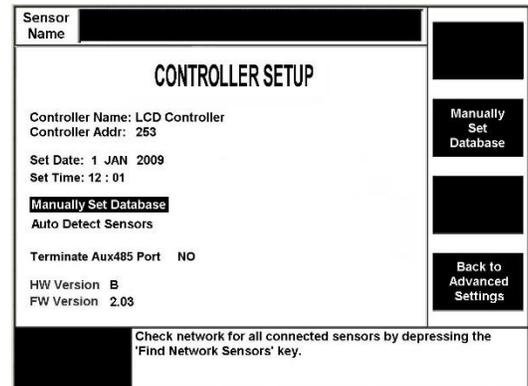
- Repeat steps 3 and 4 for all sensors in the network, ensuring that each sensor has a unique Sensor Address. Once all have been setup, press *Network Setup Complete*.

- You will be directed to the **Filter View** screen. The sensor will go through an auto-setup initialization process and then begin to report the current measurements.



- To see the sensor name, current Media Level, gain value, and Turbidity NTU of all connected sensors, press *Change Display* from the **Filter View** screen.

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



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

13. Product Warranty

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

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

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

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

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

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

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

WATER QUALITY MONITORS

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

MetriNet Distribution Monitor

GAS DETECTION PRODUCTS

NH ₃	Ammonia
CO	Carbon Monoxide
H ₂	Hydrogen
NO	Nitric Oxide
O ₂	Oxygen
CO	Cl ₂ Phosgene
Br ₂	Bromine
Cl ₂	Chlorine
ClO ₂	Chlorine Dioxide
F ₂	Fluorine
I ₂	Iodine
H _x	Acid Gases
C ₂ H ₄ O	Ethylene Oxide
C ₂ H ₆ O	Alcohol
O ₃	Ozone
CH ₄	Methane (Combustible Gas)
H ₂ O ₂	Hydrogen Peroxide
HCl	Hydrogen Chloride
HCN	Hydrogen Cyanide
HF	Hydrogen Fluoride
H ₂ S	Hydrogen Sulfide
NO ₂	Nitrogen Dioxide
NO _x	Oxides of Nitrogen
SO ₂	Sulfur Dioxide
H ₂ Se	Hydrogen Selenide
B ₂ H ₆	Diborane
GeH ₄	Germane
AsH ₃	Arsine
PH ₃	Phosphine
SiH ₄	Silane
HCHO	Formaldehyde
C ₂ H ₄ O ₃	Peracetic Acid
DMA	Dimethylamine