

# ADS<sup>®</sup> FlowShark<sup>®</sup> Installation, Operation, and Maintenance Manual

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## CHAPTER 1

# Introduction

The ADS® *FlowShark*® long-term flow monitor measures open channel flow in sanitary sewers, storm sewers, and other environments to assist municipalities and other industry in addressing the following issues:

- Planning sewer systems (sizing and rehabilitation)
- Reducing infiltration and inflow (I/I)
- Monitoring combined sewer overflows (CSOs)
- Detecting and monitoring surcharges
- Managing inner-agency billing
- Monitoring sewage handling facilities (wastewater treatment plants and pump stations)

The battery- or externally-powered, microprocessor-based FlowShark monitor displays exceptional accuracy and reliability in measuring flow depth and velocity to determine flow rate (quantity) in sewer lines. This flow data is the essential element required to successfully perform investigative, analytical, and reporting activities. The FlowShark also supports dual monitoring points, water quality sampling, event notification, rain measurement, and SCADA applications.

This manual offers detailed instructions on installing the FlowShark flow monitor and sensors, providing communication with the monitor (remotely, via land-line or wireless modem, or locally, via serial connection), and performing routine maintenance and troubleshooting on the system.

## Warnings and FCC Compliance

Manhole and sewer system work involves confined space entry and is inherently dangerous. Therefore, installers and technicians should comply with all federal, state, and municipal regulations concerning confined space entry.

In addition, personnel installing and maintaining this equipment should follow all guidelines presented in this manual concerning monitor installation and maintenance. Failure to strictly adhere to these guidelines can result in personal injury and/or damage to the monitor.

**Note:** The FlowShark monitors described in this manual are not intrinsically safe. The intrinsically safe FlowShark monitors (ADS p/n 5000-IS1) are described in a separate manual, *FlowShark Flow Monitor Installation, Operation, and Maintenance Manual – Intrinsically Safe Model (QR 775003\*\*)*.

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## FCC Part 68 Compliance

To comply with the Federal Communications Commission (FCC), ADS provides the following information concerning FlowShark flow monitor installation and operation.

This equipment complies with FCC Rules, Part 68. It bears a label displaying the FCC Registration Number. The user must provide this information to the telephone company if requested.

This equipment uses threaded-type posts for hardware connection to the telephone network.

The telephone company may make changes in its facilities, equipment, operations, or procedures that could affect the operation of this equipment. If this occurs, the telephone company will

provide advance notice so you can make necessary modifications to maintain uninterrupted service.

In the unlikely event that this equipment harms the telephone network, the telephone company will notify you that temporarily discontinuing telephone service may be required. Notification will occur in advance of discontinuation, or as soon as practically possible. They will also inform you of your right to file a complaint with the FCC if necessary.

This equipment may not be used on public coin phone service provided by the telephone company. Connection to party line service is subject to state tariffs.

# Installation and Configuration

Following is the general procedure for installing and configuring a FlowShark monitor. *Refer to Chapters 3 through 7 for more details. Chapters 8 and 9 contain additional installation instructions for FlowShark monitors supporting analog inputs and/or outputs or Modbus communications.*

- **Investigate Site Characteristics**
  - Flow Hydraulics
  - Pipe and Manhole Characteristics
- **Install the Sensors in the Pipe**
  - Assemble Ring (*when applicable*)
  - Mount Sensors to Ring or Special Bands
  - Secure Sensor Cables to Ring or Special Bands
  - Install Ring or Band in Pipe
  - Secure Sensor Cables Along Pipe and Up Manhole
- **Connect Sensors to Monitor**
- **Attach Dryer Tube to Monitor**
- **Establish Telephone, Wireless, or On-Site Communication with Monitor**
- **Configure Monitor (*using Profile<sup>®</sup> Software*)**
  - Create Monitor Location
  - Create Installation Table
  - Select and Edit Devices
- **Set Communication Parameters (*Profile*)**
- **Activate Monitor (*Profile*)**
- **Run Diagnostics and Perform Confirmations (*Profile*)**
- **Install Monitor in Manhole**

## Product Warranty

This section includes the warranty information for the ADS FlowShark.

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### New Product Warranty

All new products manufactured by ADS will be free from defects in material and workmanship for up to one (1) year following the date of shipment from ADS. During this warranty period, upon satisfactory proof of a defect, the product may be returned for repair or replacement, at ADS's sole option. No returns will be accepted unless the Owner has prepaid shipping and has received a prior authorization return number from ADS. Please contact ADS to obtain an authorization return number. Warranty repairs and replacements will be performed only by ADS. Any unauthorized repair or replacement will void this product warranty. Any repair or replacement will be covered by this new product warranty for ninety (90) days from the date that such repaired or replaced product is shipped from ADS. This warranty is available only if the product has been installed and operated in accordance with the procedures outlined in the ADS Operations and Maintenance Manual. This warranty does not apply to damage by catastrophes of nature, fire, explosion, acts of God (including, but not limited to, lightning damage and power surges), accidents, improper use or service, damage during transportation, or other similar causes beyond ADS's control.

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### Out-of-Warranty Product Repairs

After the new product warranty expires, a product may be returned, at the owner's prepaid expense, to ADS for repair. The owner will pay for all parts and labor associated with the repair. Any repair part

will be covered by the new product warranty for 90 days from the date of shipment from ADS.

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## Troubleshooting Fee

ADS will charge a troubleshooting fee if the reported product defect cannot be found and/or the reported defect is not due to a defect in materials or workmanship.

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## Shipping

All repaired products will be returned via surface transportation prepaid by ADS. Import duties, fees, taxes, and other related charges are the responsibility of the owner.

**THIS IS THE ONLY WARRANTY FOR ADS PRODUCTS. NO OTHER WARRANTY IS EXPRESSED OR IMPLIED, INCLUDING FITNESS FOR A PARTICULAR PURPOSE OR MERCHANTABILITY. PRODUCT REPAIR OR REPLACEMENT IS THE ONLY REMEDY. IN NO EVENT WILL ADS BE RESPONSIBLE FOR ANY DIRECT, INDIRECT, CONSEQUENTIAL, OR SPECIAL DAMAGES.**

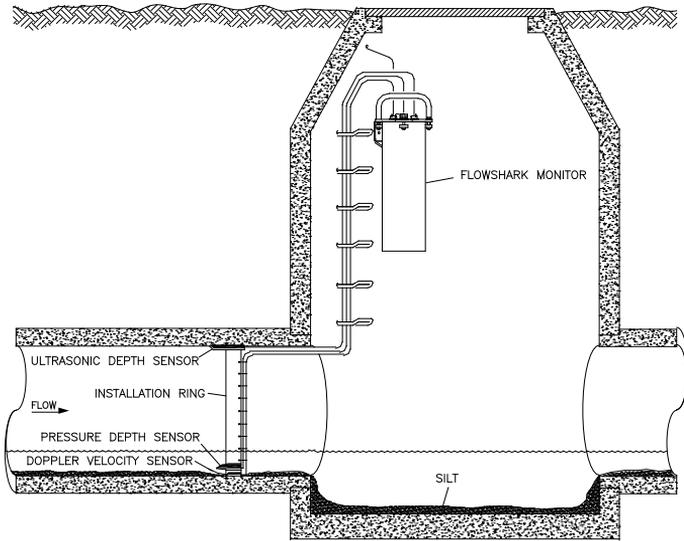
## CHAPTER 2

# System Overview

The ADS® FlowShark® flow monitor uses three flow measurement devices to gather raw flow data: a quadredundant ultrasonic depth sensor, a pressure depth sensor, and a Doppler peak velocity sensor. The ultrasonic and pressure depth sensors apply independent measurement techniques to collect information used in flow depth calculations. The Doppler velocity sensor gathers peak flow velocity data.

The monitor receives the raw flow depth and velocity data from the sensors based on a defined time interval and then processes the data, which may involve calculating the flow rate. The monitor memory can store over 140 days of data logged at a 15-minute sample rate. This data is available to the user for collection, further processing, analysis, and reporting. These reports can assist municipalities and other industry in planning improvements and additions to sewer systems, improving the accuracy of billing information, and providing information for the overall management of sewer systems.

The FlowShark monitor and sensors are primarily designed for monitoring flow in sanitary and storm sewers. The monitor mounts to the manhole rim or wall slightly below the manhole cover; the sensors typically attach to a ring installed in the sewer pipe a short distance upstream from the manhole invert. The FlowShark monitor can support a complete complement of flow sensors at a single or dual monitoring points. These sensors display exceptional durability and accuracy, even under harsh and turbulent flow monitoring conditions.



Typical FlowShark flow monitoring system installation

Communication between the monitor and the user's office or field computer can occur over a telephone line (*remote, land-line communication*), GPRS (*remote, wireless communication*), or direct connection cable (*on-site communication*).

Special software called **Profile**<sup>®</sup> enables the user to configure and communicate with the monitor for activation, data collection, and diagnostic purposes. Configuration involves defining the location information file (LIF) for storage in the user's local directory and building the code and variables for the site. The LIF contains information such as pipe characteristics, monitor identification, selected devices, sensor offsets, data log rate, and other parameters necessary for measuring the flow both accurately and efficiently.

Activation involves downloading the firmware (embedded software) code and site-specific information from the LIF (stored in the user's local directory or network drive) to the monitor. It also includes initiating monitor activities such as taking sensor readings, logging flow data, recording pulses from a rain gauge, sending signals to a sampler, and managing event notification.

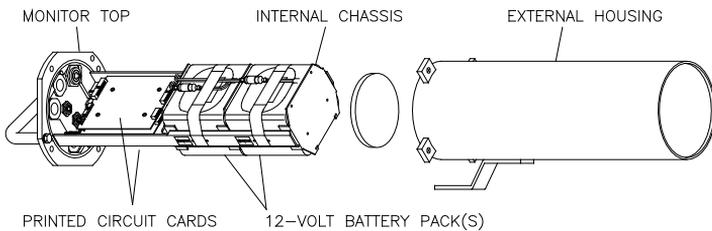
**Profile** also enables the user to process the flow data, generate graphical and tabular reports, organize data in the user's local directory, and maintain logs of communication between the monitor and the user's PC.

**Note:** Refer to the *Profile User's Guide* (#950015\*\*) for more information.

## ADS FlowShark Flow Monitor

The ADS FlowShark flow monitor is a waterproof, airtight, cylindrical, marine-grade aluminum canister housing a chassis securing multiple printed circuit boards and a portable power source, when applicable. The one-piece internal chassis, attached to the inside of the monitor lid, provides a mounting surface for the following boards:

- Digital Signal Processing Board (*now available only in B series and earlier A and C series monitors*)
- Digital Signal Processing Board w/ Communications (*now available only in later A and C series monitors*)
- Analog Board supporting Depth, Velocity, Pressure, and Rain
- Communications Board (*now available only in B series and earlier A and C series monitors*)
- Modem or Radio Board
- Voltage Regulator Board
- Analog Input/Output Board (*available only in CG, CG-1, CL, and CS models*)



Typical FlowShark flow monitor with chassis (left)  
removed from enclosure (right)

## Available FlowShark Monitors

The following table lists the part numbers and descriptions for all models of the FlowShark monitor currently available through ADS.

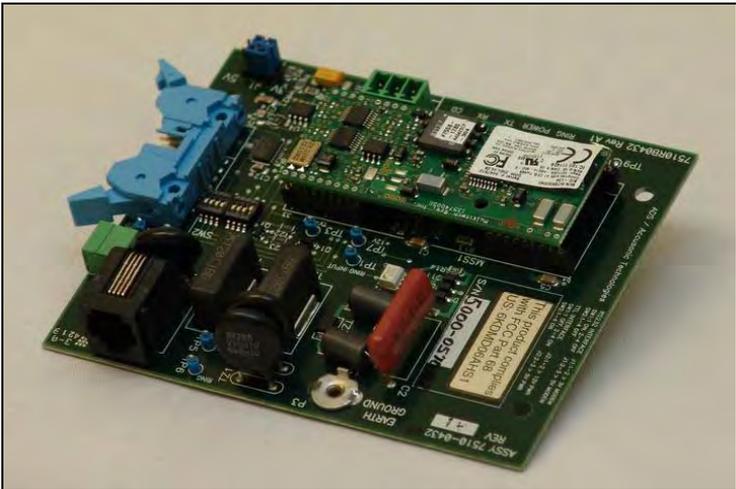
Part Number	Description
5000-AS	Internal Battery, Serial
5000-AL	Internal Battery, Landline Modem
5000-AG	Internal Battery, Wireless Modem
5000-AG-M	External Power or Internal Battery, Wireless Modem, Modbus
5000-BL	External Power or Internal Battery, Dual, Landline Modem
5000-BG	External Power or Internal Battery, Dual, Wireless Modem
5000-CS	External Power, Serial, Modbus, 4-20mA
5000-CL	External Power, Landline Modem, Modbus, 4-20mA
5000-CG	External Power, Wireless Modem, Modbus, 4-20mA
5000-CG-1	External and Internal Battery Power, Wireless Modem, Modbus, 4-20mA

## Communications

ADS offers two remote communication options for the FlowShark monitor. The first option involves telephone communication over land lines through the modem in the monitor (models AL, BL and CL). The second option involves wireless communication over the cellular network using *GPRS* (General Packet Radio Service) through the modem in the monitor (models AG, AG-M, BG, CG, and CG-1). GPRS facilitates high-speed, low-cost, efficient TCP/IP communication in areas with AT&T/Cingular wireless coverage. The following images portray the PCB boards supporting the two remote communication options.



FlowShark radio board (ADS p/n 5000-0761)



FlowShark modem board (ADS p/n 5000-0570)

Local communication with all FlowShark monitors is available through a direct serial cable connected to the **Comm** port.

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## Digital Signal Processor

The Digital Signal Processor (DSP) board (ADS p/n 5000-0514) contains the central processing unit (CPU). As the source of all monitor activity, the processor board is responsible for all of the monitor's high-level functions, including the following:

- Scanning the sensor interface boards and the rain gauge input to retrieve and store data
- Maintaining the monitor time and date
- Performing power management
- Providing each board with the parameters required to carry out the associated operations
- Outputting a discrete signal pulse to a sampler
- Transmitting the stored and current data to the user's PC via the Communications board
- Initiating event notification through alarms
- Requests readings from Analog I/O board and provides information for analog outputs.

The board allocates portions of memory to firmware (permanently stored software) and data storage. A seven-segment (SS) light-emitting diode (LED) located on the processor board indicates the current monitor communication and operational activity. The board also includes the monitor clock, random access memory (RAM), and Flash. The monitor uses RAM while taking readings and processing the flow data. The RAM then downloads the data to Flash, *or non-volatile memory*, which also stores the monitor firmware and configuration information. Flash ensures the monitor maintains the data during battery pack replacement or a power failure.



FlowShark DSP board (ADS p/n 5000-0514)

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## Digital Signal Processor with Communication

For later models of the *A* and *C* series FlowShark monitors, ADS has merged the functionality and circuitry of the DSP and Communication boards into one DSP/Communication board (ADS p/n 5000-0514-01) . Refer to *Digital Signal Processor* on page 2-7 and *Communications Board* on page 2-10 for descriptions of the broad capabilities associated with this integrated board design.

The following table indicates the monitor serial number at which each model incorporates the new board design. Monitors with serial numbers greater than or equal to the numbers in the table include this new board.

FlowShark Monitor Model/Part Number	Starting Serial Number for the Monitor with the Combined Board Design
5000-AS	14242
5000-AL	15148
5000-AG	30000

FlowShark Monitor Model/Part Number	Starting Serial Number for the Monitor with the Combined Board Design
5000-AG-M	26200
5000-CS	24215
5000-CL	23141
5000-CG	22098
5000-CG-1	25000

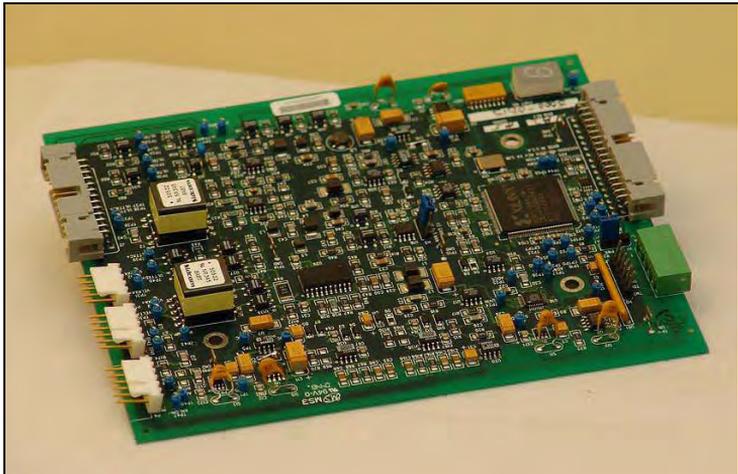


FlowShark DSP board with communications (ADS p/n 5000-0514-01)

**Note:** All B series FlowShark monitors that support dual monitoring points retain the existing design of independent DSP and Communication boards.

## Analog Board

The Analog board (ADS p/n 5000-0515) controls the sampling of the FlowShark sensors. It receives signals from the DSP board telling it when to initiate sensor readings for the Ultrasonic, Pressure, and Velocity sensors. Once the sensor readings are acquired, the Analog board sends the readings to the DSP for storage in the FlowShark monitor memory. A seven-segment (SS) light-emitting diode (LED) located on the Analog board indicates the current operational activity.



FlowShark analog board (ADS p/n 5000-0515)

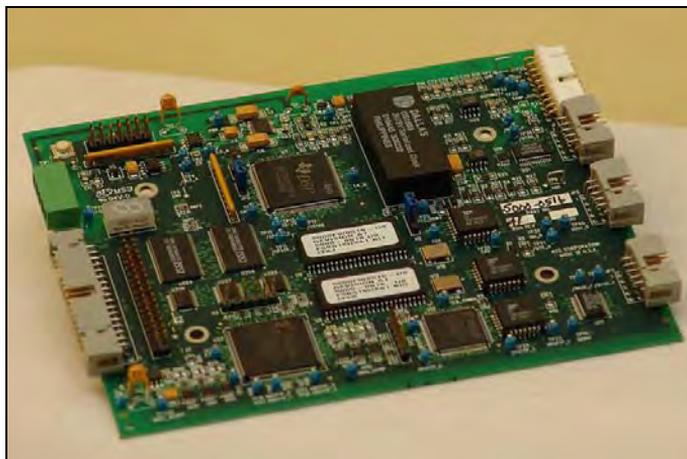
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## Communications Board

**Note:** This board is present only in B series monitors (regardless of serial number) and certain A and C series monitors based on the serial number for the particular model. Refer to the table on page 2-8 to determine whether the monitor serial number corresponds to a unit with this independent Communications board.

The Communications board (ADS p/n 5000-0516) provides multi-tasking/handling of all communications processes. It interfaces with the land-line or wireless modems, as well as manages local serial communication requests. A seven-segment (SS) light-emitting diode (LED) located on the Communications board indicates the current monitor communication activity.

The Communications board also is responsible for gathering real-time information from the other boards, and then, as a Modbus slave device, for making that information available (provided the monitor is configured to support Modbus communications). All Modbus Holding Register mapping and communication requests are managed by the Communications board.

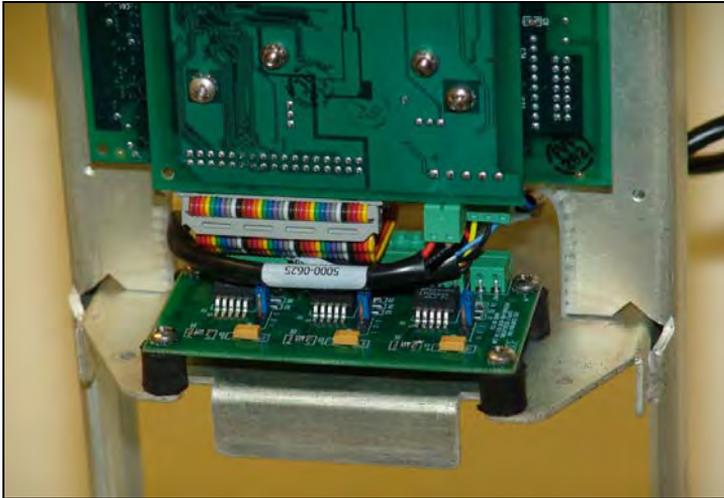


FlowShark Communications Board (ADS p/n 5000-0516)

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## Voltage Regulator Board

The Voltage Regulator board (ADS p/n 5000-0518) regulates and distributes power to the Analog, Comm, DSP, and Analog I/O (if installed) boards. It regulates the voltage supplied from the internal battery or external power to the FlowShark boards.

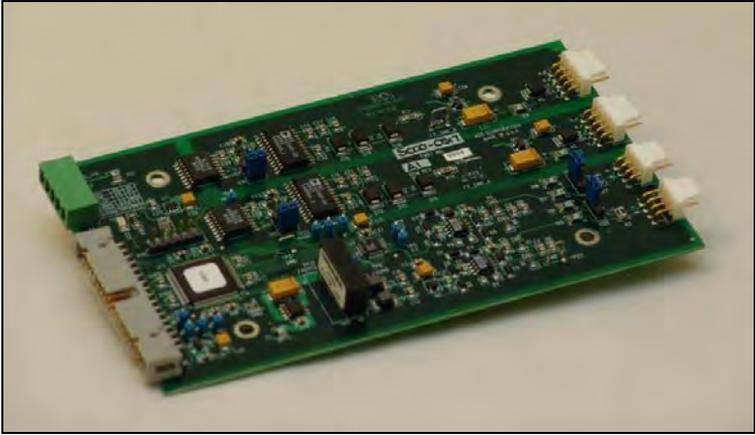


Voltage Regulator Board (ADS p/n 5000-0518)

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## Analog 4-20mA I/O Board

The ADS Analog I/O board (ADS p/n 5000-0517) is responsible for receiving information from 2 analog inputs and/or outputting information via 2 analog outputs. These I/O channels use a current loop (4 to 20 mA) to receive or send information. Analog input processing consists of measuring the input current, converting it to digital information and transferring it to the DSP board for storage. Analog outputs are processed by receiving digital information from the DSP and converting/scaling it to an analog output. The board also receives external DC power and uses it to power the analog output signal loop (separate from the external monitor power).



FlowShark Analog Input/Output Board (ADS p/n 5000-0517)

## Connectors

Connectors located on top of the monitor receive the following cabling and components:

**Note:** The connectors available depend on the FlowShark model. Refer to Appendix B, *FlowShark Models and Capabilities* for specifics on different model types and functionality.

- Ultrasonic depth sensor(s) (ADS p/n 103262A-30)
- Doppler velocity sensor(s) (ADS p/n 103260A-35)
- Pressure depth sensor(s) (ADS p/n 3704-00xx-35/40)

**Note:** Where xx is 41, 42, or 16, representing the pressure sensor ranges of 0 to 5, 10, or 30 PSI, respectively. The 5- and 10-PSI pressure depth sensors come with a standard 35-foot cable; the 30-PSI sensors are equipped with a standard 40-foot length cable.

- Telephone or direct (on-site) communication
- Antenna for wireless communication
- Digital input/output – rain gauge (tipping bucket) and/or water quality sampler
- Analog input/output – 4/20 mA inputs and outputs (supports two of each)
- External power
- Air pressure valve (*for testing purposes only*)

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## Power

The FlowShark flow monitor can be powered internally or externally. Both options are described below.

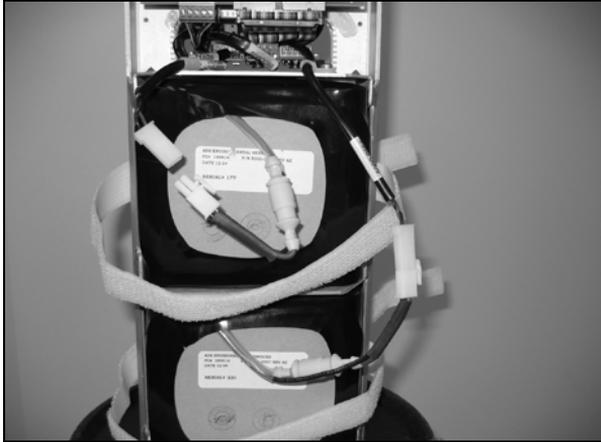
### Internal Power

ADS offers several models of FlowSharks powered by internal batteries: AG, AL, AS, AG-M, BL, BG, and CG-1 (*see note below*). Power is supplied by two 12-volt alkaline battery packs (ADS p/n 5000-0557) mounted at the bottom of the chassis. These battery packs provide the power for operating the monitor, running the communication hardware, and sustaining the monitor memory (RAM) through the power supply on the processor board. The monitor measures the battery voltages, and **Profile** provides a user-defined setting to ensure the monitor signals a warning when the available power is low.

**Note:** The externally-powered FlowShark CG-1 includes the 12-volt battery pack as an available alternative to external power.

The two battery packs function in parallel to power all operations for A series, B series (except BG), and CG-1 monitors. For BG monitors, one battery pack provides power for monitor operations and the other provides power to the wireless modem in the monitor.

Battery voltages are logged during most communication sessions, and are also available on demand when performing diagnostics.



FlowShark 12-volt battery packs

## External Power

ADS offers several models of the FlowShark monitor (AG-M, BL, BG, CG, CL and CS) that can receive power from an external DC power source, such as a power supply, solar power, or rechargeable battery. External power requires a power source running 12 volts at 1.2 amperes of continuous current. Refer to *Chapter 5, External Power*, for more information about powering an ADS FlowShark monitor via an external DC power source.

## Sensors

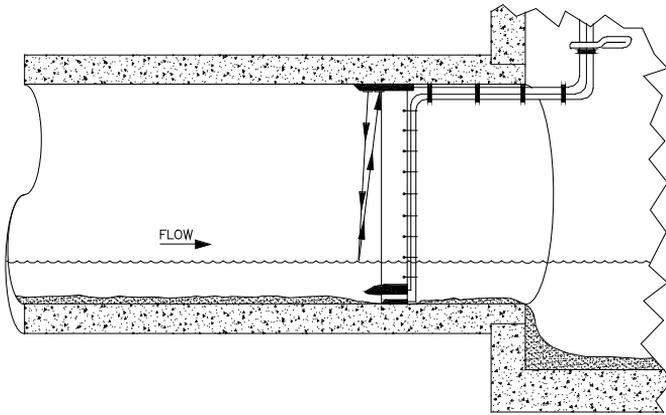
The FlowShark flow monitor uses the sensors to gather raw flow data. The ultrasonic and pressure depth sensors use independent measurement techniques to collect information concerning the depth of the flow. The Doppler velocity sensor gathers peak flow velocity data.

A sewer system's hydraulics are much more stable and uniform in the incoming pipe than in the manhole invert or outgoing pipe. Therefore, the sensors mount to a stainless steel expandable ring or stainless steel bands installed in the pipe upstream from the manhole. Installing them upstream minimizes hydraulic effects and erroneous data readings caused by foamy waters, flow waves, sewer noise, non-laminar flow, and obstructions in the manhole.

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### Ultrasonic Depth Sensor

The ultrasonic depth sensor (ADS p/n 103262A-30), which mounts at the crown of the pipe, transmits sound waves from the sensor face to the surface of the flow. It then measures the time elapsed between transmission and reception of the sound signal. The distance between the sensor face and flow surface is the *range*. Based on the elapsed time and the speed of sound, the monitor calculates the depth of the flow by subtracting the range from the pipe diameter. The monitor compensates for the speed of sound in the air using the temperature recorded by one of two temperature sensors housed within the ultrasonic depth sensor. The second temperature sensor serves as a backup.



Ultrasonic depth sensor sending signals to flow surface to determine range

## Quadredundancy

Each ultrasonic depth sensor contains four ultrasonic transducers for taking readings to give the sensor *quadredundancy*, which ensures greater sensor reading reliability. To take a reading, one transducer transmits a sound wave while a second transducer listens for the returning echo. Each transducer has its own electronic circuitry and dedicated wiring for true redundancy.

## Ultrasonic Depth Processing

The standard method for processing ultrasonic depth involves firing the sensor once to take readings for predefined transducer pairs. The monitor performs a detailed analysis of all the returning echoes, which involves amplifying the good readings and attenuating the false and multiple echoes representing noise and other erroneous readings. It then discards the questionable data, averages the good readings to arrive at a final reading for each of the designated pairs, and logs the final readings in the monitor memory to be available during data collection activities.

## Data Scrubbing

Flow conditions and internal structures introduce many potential obstacles to obtaining accurate flow data in sewer systems and manholes. Some of these obstacles may include noise, turbulent or wavy flow, a foamy flow surface, side connections, rungs, broken pipes, or drop connections.

To minimize these effects, ADS uses a process of eliminating erroneous data called *data scrubbing*. Initial data scrubbing occurs routinely in the following way as the monitor takes readings:

- The monitor fires each sensor pair and averages the multiple readings.
- The monitor discards the clearly erroneous readings (i.e., readings well outside the range of the majority of the readings).
- The monitor records the percentage of all acceptable readings used to arrive at the average value.

Secondary scrubbing also can occur during data collection from the monitor to the analyst's PC using the **Profile** software. Refer to the *Profile User's Guide* (950015\*\*) for more information.

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## Pressure Depth Sensor

The pressure depth sensor (ADS p/n 3704-00\*\*-35/40) typically mounts at the bottom of the pipe. While the ultrasonic depth sensor can only measure depths up to slightly below full pipe capacity, the pressure depth sensor can measure depths greater than a full pipe that might extend up into the manhole (surcharges). The FlowShark supports pressure sensors with ranges from 0-5 (11.5'), 0-15 (34.5'), and 0-30 (69.0') PSI.

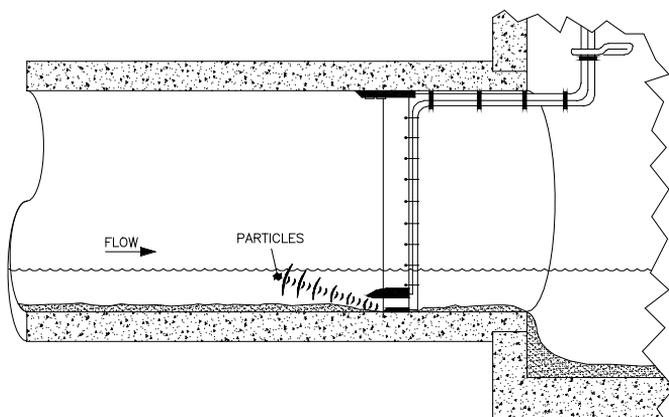
The pressure depth sensor contains a differential pressure transducer that transmits an output voltage corresponding to the difference between the water pressure and the air pressure in the sewer. It measures water pressure through a port on the underside of the sensor and air pressure using an integral vent tube running to the top of the manhole. The monitor calculates the depth of the flow by

reading the difference in pressures. Temperature compensation occurs through a temperature sensor located within the pressure depth sensor housing.

## Doppler Velocity Sensor

The Doppler velocity sensor (ADS p/n 103260A-35) mounts at the bottom of the pipe. It emits a wide, omnidirectional sound wave at a specific frequency upward into the flow. The sound wave bounces off particles in the flow and returns to the sensor. The velocity sensor measures the change in the sound wave's frequency from transmission to reception. This change is used to determine the velocity of the flow based on the *Doppler* effect.

The Doppler effect describes the shift in frequency of a sound wave emitted by a moving object in relation to a stationary point. In this case, the moving objects are particles in the flow, the stationary point is the velocity sensor, and the received signal is the reflection of the sound wave (emitted by the velocity sensor) off the particles.



Doppler velocity sensor sending signals reflecting off particles in the flow

## Inputs/Outputs

ADS FlowShark monitors support several different inputs and outputs. One digital pulse counter input is available for connection to a rain gauge tipping bucket, and two analog 4-20mA inputs are available for connection to third-party process instruments. One digital pulse output is available for driving a water quality sampler, and two isolated analog 4-20mA outputs are available for sending information to third-party systems. Output information is also available via Modbus for retrieval by third-party systems.

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### Digital I/O

FlowShark models that support only one set of sensors (AG, AG-M, AL, AS, CG, CG-1, CL, and CS) record pulses from a rain gauge tipping bucket and/or send output pulses to a water quality sampler. Monitors can be setup to trigger water quality samplers to take samples at the monitor sample rate when flows exceed a user-defined threshold based on level, velocity, or flow rate. Samplers also can be triggered by the monitor based on designated flow volumes (flow proportional sampling).

Refer to the *Profile User's Guide* (950015\*\*) for more information on configuring rain gauge inputs and sampler outputs.

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### Analog 4-20mA I/O

Several models of ADS FlowShark (CG, CG-1, CL, and CS) monitors can monitor signals from other equipment via analog inputs and send signals or information to other equipment via analog outputs. The FlowShark monitor can support two 4-20mA analog inputs and two 4-20mA analog outputs. Refer to *Chapter 8, Analog Input/Output Installation and Configuration*, for more information.

## Modbus

Modbus is a protocol that allows for communication between multiple devices connected to the same network, and is often used to connect a supervisory computer with a remote terminal unit (RTU) in supervisory control and data acquisition (SCADA) systems. ADS uses Modbus to make information available to RTUs or SCADA systems directly.

FlowShark models AG-M, CG, CG-1, CL, CS, BG, and BL support Modbus ASCII communication. Refer to *Chapter 9, Modbus*, for more information on the installation and configuration of a FlowShark monitor supporting Modbus communications.

**Note:** FlowShark models AG, AL, and AS can support Modbus with the installation of a retrofit kit to add external power and provide external cabling.

## CHAPTER 3

# Sensor Installation and Connection

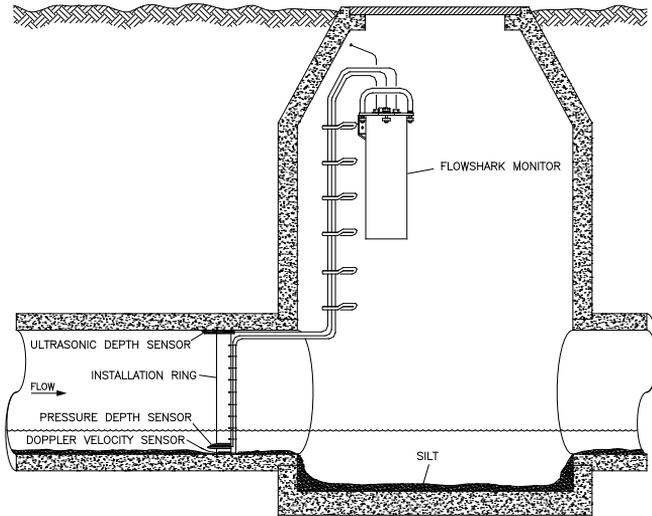
The ADS® FlowShark® flow monitor and sensors are primarily designed for monitoring flow in sanitary, combined, and storm sewers. The monitor mounts to the manhole rim or wall slightly below the manhole cover.

A sewer system's hydraulics are much more stable and uniform in the incoming pipe than in the manhole invert or outgoing pipe. Therefore, the sensors mount to a stainless steel expandable ring or stainless steel bands installed in the sewer pipe a short distance upstream from the manhole invert. Installing the sensors upstream minimizes the hydraulic effects and erroneous data readings caused by foamy waters, waves in the flow, sewer noise, non-laminar flow, and obstructions in the manhole.

Following is the basic procedure for installing the FlowShark monitor and sensors at a location:

- **Investigate the Site Characteristics** These characteristics include pipe size and shape, silt level, flow depth, and hydraulic conditions.
- **Install the Sensors in the Pipe** This process primarily includes assembling the ring (for standard installations) or preparing the bands (for special installations) to which the sensors attach, securing the sensor cables to the ring or band, and installing the ring or bands in the pipe.

- **Secure and Connect the Cables** This procedure involves securing the sensor cables from the ring or band to the monitor location in the manhole and connecting the sensors to the FlowShark monitor.



Typical FlowShark flow monitor and sensor installation

This chapter contains detailed instructions for properly installing the sensors in sanitary, storm, and combined sewer lines and manholes. It also includes instructions for connecting the monitor to an external DC power source.

**Note:** Manhole and sewer system work involves confined space entry and is inherently dangerous. Therefore, installers and technicians must comply with all federal, state, and municipal regulations concerning confined space entry. ADS is not responsible for any injuries, damages, claims, or liability resulting directly or indirectly from the use of this installation guide or the installation of any ADS equipment.

## Investigating Site Characteristics

Before beginning installation activities, conduct a thorough investigation of hydraulic and site conditions.

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### Flow Hydraulics

The hydraulics of a site directly affect the monitor's ability to accurately measure flow depth and velocity. The following characteristics indicate when a site exhibits hydraulic conditions favorable for effective flow monitoring activities:

- **Smooth Flow with Central Peak Velocities** The potential site should exhibit minimal ripples or waves. Choppy or foamy flow will adversely affect sensor accuracy. Bulging pipe joints, upstream curves, or upstream merging of pipes can contribute to choppy and off-center peak flows.
- **Absence of Significant Silt Buildup at Pipe Bottom** Silt present at an otherwise favorable site must be accounted for to obtain accurate flow measurements. Therefore, the field crew must measure the silt depth with a ruler and record the results in the **Profile**<sup>®</sup> software.
- **Evidence of Surcharging** Debris present on ladder rungs or joints in the manhole may indicate the site experiences surcharging. If this occurs on a regular basis, consider finding an alternate location for monitoring the flow.
- **Relatively Quiet Pipe** A monitoring point in a pipe experiencing loud noises, such as active drop connections, can adversely affect the accuracy of ultrasonic depth measurements.
- **Flow Traveling at Least One Foot Per Second** Slower flows enable debris to settle in the pipe, limiting the accuracy of flow measurements.

- **Higher Elevation than High Water Level that Occurs in Wet Well at Downstream Pump Station** Pipes that are below the high water level of the pump station wet well could experience frequent backup and surcharging, increasing sensor maintenance and possibly reducing data accuracy.

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## Pipe and Manhole Characteristics

The physical characteristics of the pipe affect the flow and determine the procedure for installing the sensors. Consider the following factors and perform the following activities when installing the sensors and monitor:

- **Sensor Installation Method** Pipe size and shape determine the installation method employed for installing the sensors.
  - ❑ **Standard Installation** Select this option to install sensors in *round pipes from 8 to 48 inches in diameter*. *Standard installations* involve attaching sensors to an adjustable stainless steel ring that mounts inside the pipe.
  - ❑ **Special Installation** Select this option to install sensors in *non-round pipes or round pipes larger than 48 inches in diameter*. *Special installations* involve attaching sensors to steel bands secured to the inside of the pipe.
- **Pipe Height and Width** Measure and record the horizontal and vertical pipe dimensions carefully. Even slightly inaccurate pipe dimensions can significantly skew and misrepresent flow data.
- **Pipe Shape** Taking the appropriate measurements that precisely reflect the exact pipe shape is essential to obtaining accurate flow calculations. Therefore, irregular-shaped pipes will require additional measurements. Refer to the *Profile User's Guide* (#950015\*\*) for more information.

**Note:** All relevant pipe dimensions and measurements are must be entered into the **Profile** software during monitor configuration and activation.

- **Manhole Depth** Measure the distance from the top of the manhole to the bottom of the manhole invert. For distances beyond 30 feet, the sensors will require extension cables.

## Installing the Sensors in the Pipe

This chapter includes the procedures for performing sensor installations using one of the following methods:

- Standard Installations
- Special Installations

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### Standard Installation

Performing a standard sensor installation involves the following process:

- Gathering the parts and supplies
- Gathering the tools and equipment
- Assembling the ring
- Mounting the sensors on the ring
- Securing the cables to the ring
- Installing the ring in the pipe

### Gathering Parts and Supplies

Obtain the following supplies before installing the ring and sensors to prevent any costly delays. When ordering, specify the FlowShark flow monitor ring-mounted installation hardware.

Quantity	Description	ADS Part Number
1	FlowShark flow monitor	varies with configuration
1	monitor mounting bracket	I40-0003
1	ultrasonic depth sensor	103262A-30

Quantity	Description	ADS Part Number
as needed	Ultrasonic depth sensor extension cable	103228A-xxx <sup>1</sup>
1	Doppler velocity sensor with two 4-40 x 5/16-inch stainless steel screws	103260A-35
as needed	Doppler velocity sensor extension cable	103180A-xxx <sup>1</sup>
1	pressure depth sensor (0 – 5 psi) with two 4-40 x 5/16-inch stainless steel screws	3704-0041-35 <sup>2</sup>
as needed	Pressure depth sensor extension cable	103277A-xxx <sup>1</sup>
1	replacement dryer tube	3704-0032
1	direct connection cable	5000-0601
15	¼- x 2 ¼-inch stainless steel anchor bolts	101-0002
1	3/8-inch x 3-inch anchor bolt and nut	101-0003
2	3/8-inch x 1-inch stainless steel hex bolts	101-0001
4	3/8 – 16 stainless steel hex nuts	115-0002
5	3/8-inch stainless steel flat washers	155-0001
1	3/8-inch x 2-inch studs	101-0009
15	plastic push mounts	101-0006
15	11-inch cable ties	105-0003
25	4-inch cable ties	105-0001
15	8-inch cable ties	105-0002
15	anchor cable ties	105-0004
1	stainless steel ring (sized for pipe)	125-0081 to 0094 <sup>3</sup>
1	18-inch stainless steel crank handle	110-0012

<sup>1</sup> Extension cables can be ordered in specific lengths up to 300 feet. Note the desired length (in feet) in the xxx portion of the part number. For

example, if the application requires a 50-foot extension cable for an ultrasonic depth sensor, the part number would be 103228A-050.

<sup>2</sup> Pressure depth sensors also are available in 0–15 PSI (p/n 3704-0042-35) and 0–30 PSI (p/n 3704-0016-40).

<sup>3</sup> The stainless steel ring includes the ring stabilizer bracket (p/n I25-0002), spreader mechanism (p/n I10-0003), and sliding ultrasonic sensor bracket (p/n I25-0001).

## **Gathering Tools and Equipment**

Gather the following tools for the installation:

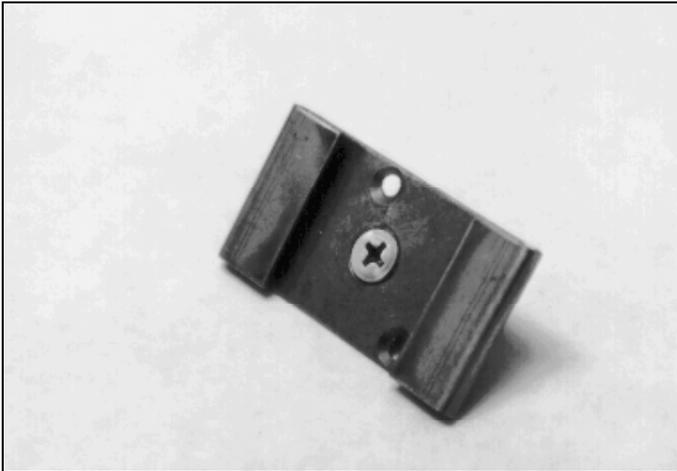
- Battery-powered hammer drill with assorted bits, including the following at a minimum:
  - ❑ 1/4-inch x 6-inch masonry bit
  - ❑ 3/8-inch x 4-inch (minimum length) masonry bit
  - ❑ 5/16-inch carbide-tipped bit (include smaller bits)
- 4-pound hammer
- Rubber mallet
- 24-inch carpenter's level
- 7/16-inch nut driver
- Wrenches
- Screwdrivers (flathead and Phillips head of assorted sizes)
- 3/8-inch x 16-inch threads tap
- Diagonal wire cutters
- Folding carpenter's rule with a brass slide
- Rubber stretch tape

## Assembling the Ring

The flow sensors mount to a stainless steel ring that is installed in the pipe. Several different ring sizes exist, and each ring is adjustable within about 3 inches to fit pipes of different diameters. Assemble the ring in the following way:

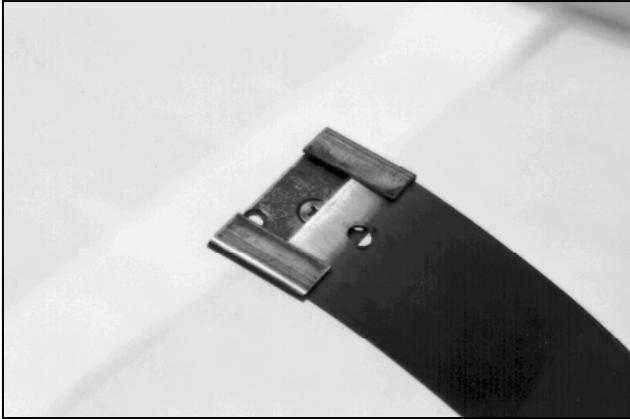
**Note:** These instructions generally apply to overlapping rings. However, the 6-, 8-, 10-, and 12-inch rings do not have an overlapping section. Therefore, these non-overlapping rings will require small modifications to the assembly process. To assemble a non-overlapping ring, proceed directly to step 4.

1. Insert the spreader mechanism screw through the hole in the center of the ring stabilizer. Ensure that the head of the screw fits into the countersunk hole.



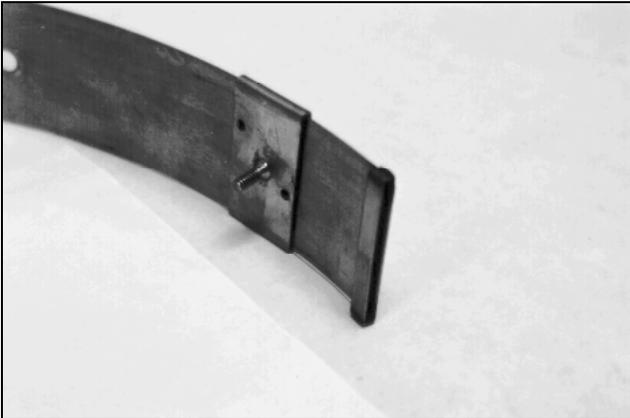
Ring stabilizer with spreader mechanism screw

2. Slide the open end of the ring (end without the welded metal band) through the flanges in the ring stabilizer, making sure the flanges face the outside of the ring and the spreader mechanism screw faces the inside of the ring.



Sliding the ring stabilizer onto the ring

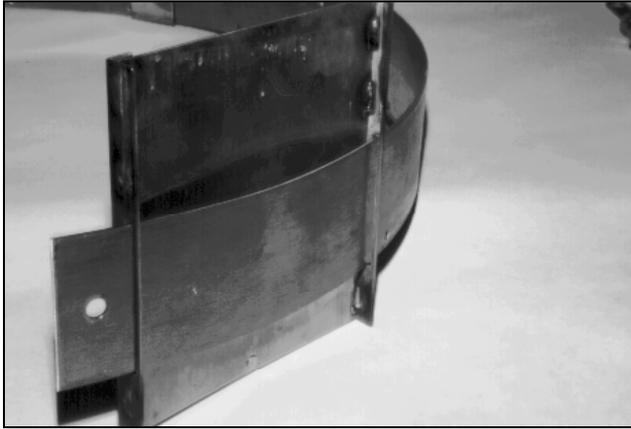
3. Slide the ring stabilizer all the way around the ring until it is about 4 inches from the welded metal band at the other end of the ring.



Moving the ring stabilizer into position

4. Position the ring with the downstream edge (edge with the holes) facing you.

5. Slide the ultrasonic sensor mount onto the open end of the ring with the back of the ultrasonic mount (side with the slots) facing the outside of the ring. The side with the backstop should face the inside of the ring.

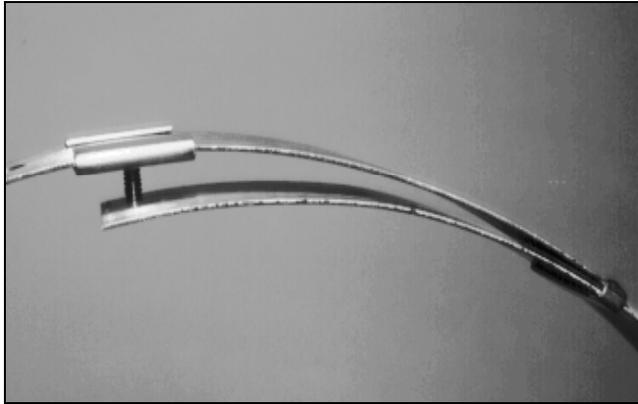


Sliding the ultrasonic sensor mount onto the ring

6. Move the ultrasonic sensor mount around the ring.

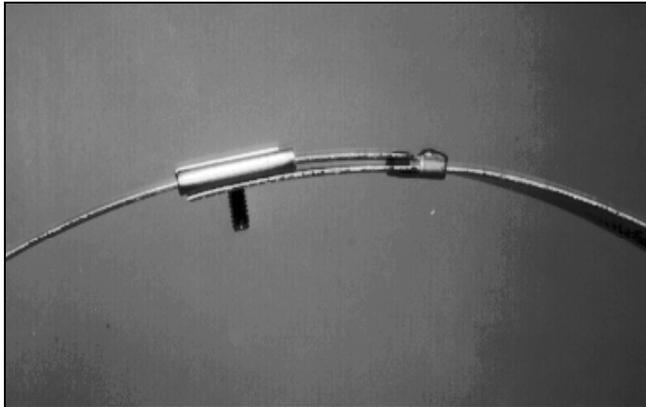
**Note:** Steps 7 and 8 apply only to overlapping rings. Proceed directly to step 9 for non-overlapping rings.

7. Slide the open end of the ring through the slot in the welded band of the ring until it overlaps about 4 inches.
8. Spread the ring sections apart so that you can slide the ring stabilizer with the spreader mechanism screw into the gap.



Moving the ring stabilizer into position

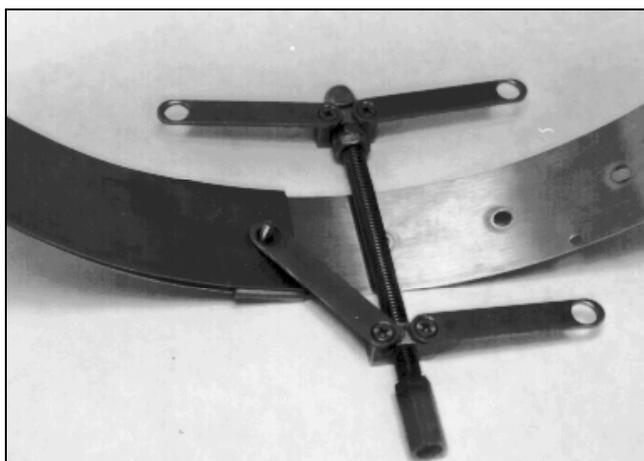
9. Perform the following based on the ring type:
- Overlapping** Insert the spreader mechanism screw completely through the hole at the open end of the ring.
  - Non-Overlapping** Insert a spreader mechanism screw through the hole at the left end of the ring so that the end of the screw extends inside the ring.



Ring stabilizer fully connected

10. Place the ring on a flat surface with the spreader mechanism screw facing up.

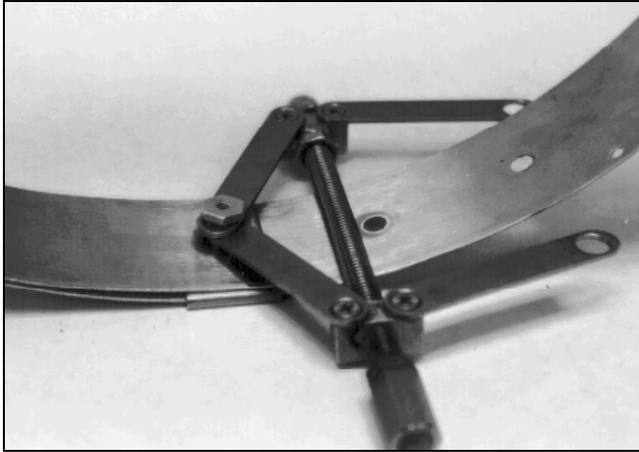
11. Orient the ring with the downstream edge (edge with small holes) facing you.
12. Lay the spreader mechanism across the inside of the ring with the downstream end of the mechanism (end with the large welded nut) facing you, the four spreader bars facing toward the inside of the ring, and the shoulder bolts pointed outside the ring.
13. Place a washer and then the downstream, left spreader bar over the spreader mechanism screw.



Orienting and attaching the spreader mechanism

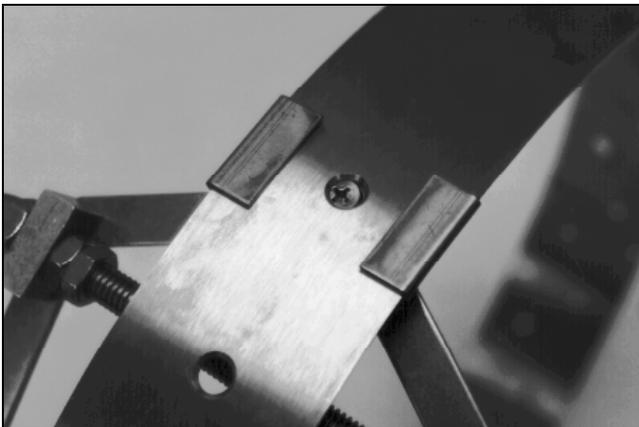
14. Place the upstream, left spreader bar onto the same screw.
15. Lightly turn the hex nut onto the screw, ensuring that it passes through the holes in the end of the spreader bar.

**Note:** Steps 16 through 18 apply only to overlapping rings. For a non-overlapping ring, proceed to step 19.



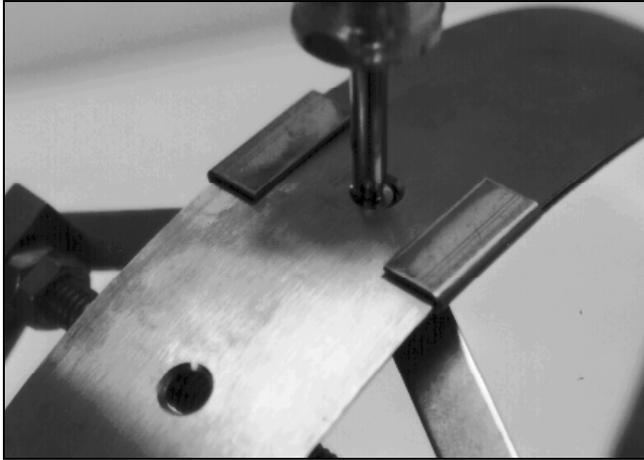
Attaching the spreader bars

16. Turn the ring until the spreader mechanism is in the 12:00 position.
17. Align the spreader mechanism screw so that the head is visible through one of the ring size adjustment holes.



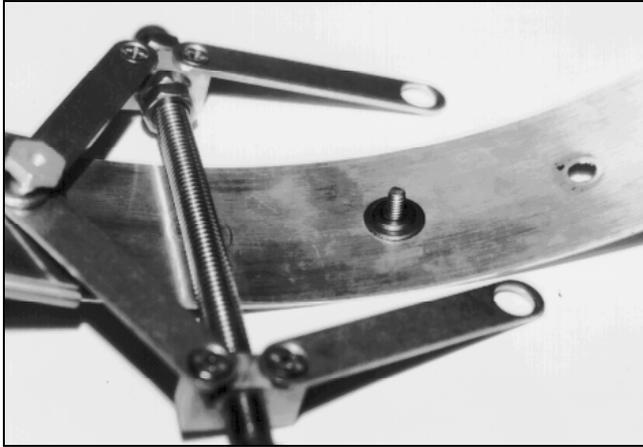
Aligning the screw head and adjustment hole

18. Tighten the screw through the hole using a Phillips-head screwdriver while holding the hex nut with a 1/2-inch nut driver.



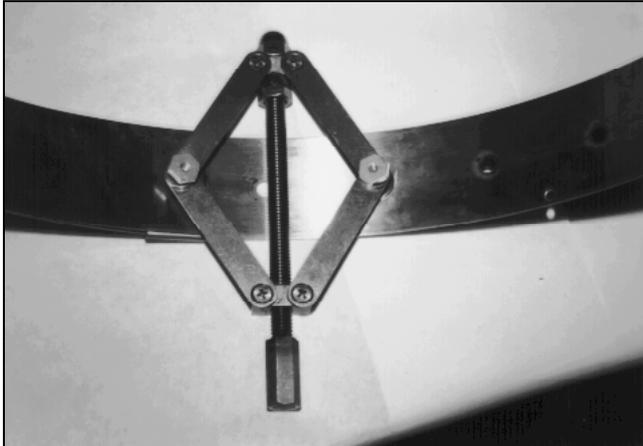
Tightening the spreader mechanism screw and hex nut

19. Insert the second spreader mechanism screw through the following hole based on the ring type:
  - Overlapping** Appropriate ring size adjustment hole on the outside of the ring
  - Non-overlapping** Last hole on the other free end of the ring (inserting the screw from the outside of the ring)
20. Slip the large washer onto the screw on the inside of the ring.



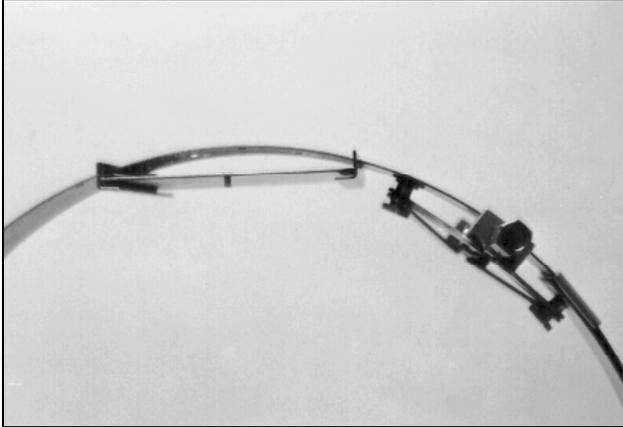
Place the washers onto the second spreader mechanism screw

21. Place the spreader bars over the screw, and tighten a hex nut on the screw.



Spreader mechanism attached to the ring (view from inside the ring)

Although the spreader mechanism fits snugly against the inside of the ring, the spreader mechanism may seem loose on the hex nuts. Do not be concerned. The spreader mechanism will tighten once the ring is installed and tightened inside the pipe. The following picture displays how a properly assembled ring should look.



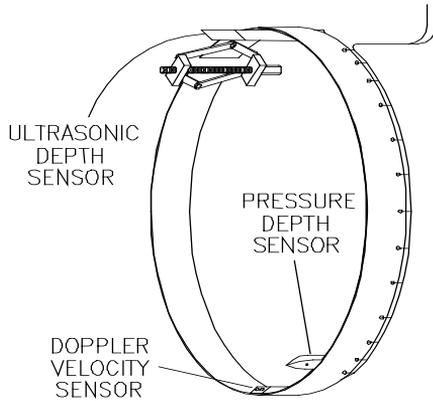
Properly attached spreader mechanism

## Mounting the Sensors to the Ring

The following sections provide instructions on mounting the ultrasonic depth, velocity, and pressure depth sensors to the ring. To ensure the most accurate flow data, standard pipe installations require proper positioning of the sensors on the ring as well as in the pipe. When facing the downstream edge of the ring, the sensors should be mounted on the ring in the following locations:

- **Ultrasonic Depth Sensor** Twelve o'clock position (top of the pipe) when the spreader mechanism is in the one o'clock position
- **Doppler Velocity Sensor** As close as possible to the six o'clock position (bottom), provided it is mounted above the level of any silt present at the bottom of the pipe. (Any silt covering the sensor could interfere with the sensor signals, potentially producing inaccurate or erroneous readings.)

- **Pressure Depth Sensor** Bottom of the ring slightly to the left of the Doppler velocity sensor (when present)



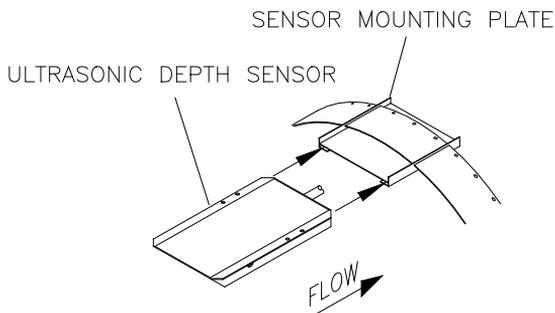
Proper positioning of sensors on the ring

**Caution:** Handle all sensors and cables with extreme care. The sensors and cables contain delicate mechanisms and electronics. Keep sharp objects away from sensor cables, and avoid stepping or placing heavy objects on the cable during installation.

### ***Mounting the Ultrasonic Depth Sensor***

Mount the ultrasonic depth sensor to the ring in the following way:

- Note:** Handle the ultrasonic depth sensor with care, and do not expose it to extreme temperatures for an extended period of time. Keep the sensor in its protective packaging until it is time for installation.
1. Slide the sensor into the grooves on the sensor mount (at the top of the ring) from the upstream end of the mount until the sensor contacts the backstop. The sensor cable should exit the downstream edge of the ring. Orient the sensor with the four transducers facing downward toward the inside of the ring (flow surface).



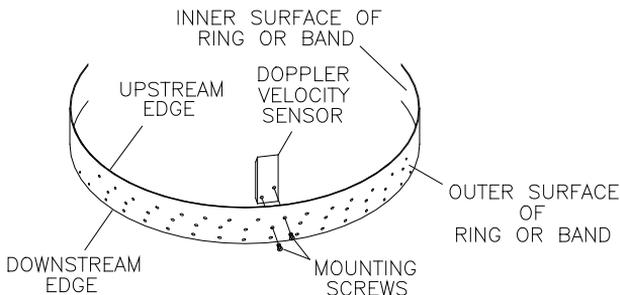
Mounting the ultrasonic depth sensor to the mounting plate on the ring

2. Verify that the ultrasonic depth sensor mounts to the ring at the crown of the pipe.

### ***Mounting the Doppler Velocity Sensor***

Mount the Doppler velocity sensor to the ring in the following way:

1. Use two 4-40 x 5/16-inch stainless steel screws (do not substitute any other screws) to mount the sensor at the bottom of the ring opposite the ultrasonic depth sensor with the beveled edge of the sensor facing upstream.



Mounting the Doppler velocity sensor to the ring

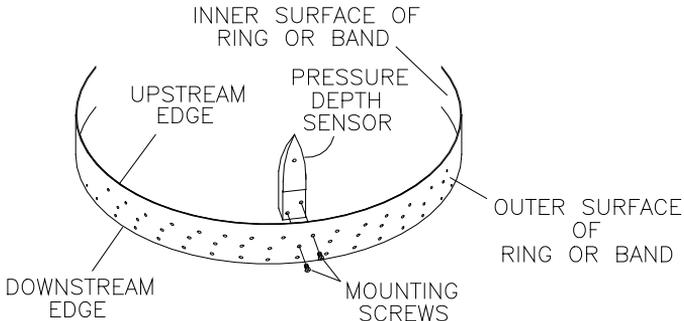
2. Secure the sensor cable to the ring. Refer to *Securing the Cables to the Ring* on page 3-21 for instructions on properly securing the cable.

**Note:** If the installation includes a pressure depth sensor, wait to secure the sensor cables until both sensors are installed on the ring.

### **Mounting the Pressure Depth Sensor**

Mount the pressure depth sensor to the ring in the following way:

1. Orient the ring so that the ultrasonic depth sensor is directly on top. If an ultrasonic depth sensor is not in use, make sure the spreader assembly is directly on top.
2. Use two 4-40 x 5/16-inch stainless steel screws (do not substitute any other screws) to mount the pressure depth sensor on the bottom inside of the ring with the pointed end of the sensor facing upstream. Mount the pressure depth sensor about 2 inches to the left of the velocity sensor (when present).



Mounting the pressure depth sensor to the ring

3. Secure the sensor cable to the ring. Refer to *Securing the Cables to the Ring* on page 3-21 for instructions on properly securing the cable.

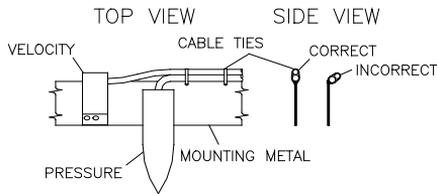
## Securing the Cables to the Ring

Securing the Doppler velocity sensor and pressure depth sensor cables to the ring helps prevent debris from collecting between the cable and the ring or catching on the loose cable. It also prevents the loose cables from disrupting the flow.

Secure the Doppler velocity and pressure depth sensor cables in the following way:

1. Starting at the appropriate sensor location, begin securing the sensor cable with 4-inch x 0.08-inch cable ties through the pre-drilled holes along the downstream trailing edge of the ring up the side of the ring. Run the cable up the side of the ring opposite the spreader mechanism (the left side of the ring when facing the downstream edge of the ring).

**Note:** When securing both a pressure depth sensor and a Doppler velocity sensor cable to the ring, place the velocity cable on top of the pressure cable and secure both together.



Sensor cabling

2. Continue securing the cables until reaching the ultrasonic depth sensor or the top of the pipe.
3. Pull the ties until they are taut.

**Warning:** *Do not over-tighten the cable ties or kink the sensor cables!* The pressure depth cable sheathes two components: the electrical cables that operate the sensor and an air tube that ventilates the sensor. Over-tightening the ties or kinking the cable can damage or restrict the air tube, causing incorrect pressure depth readings. In

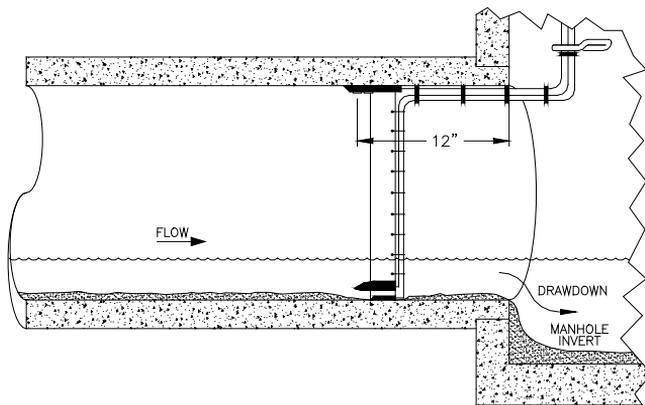
addition, make sure the connector-end of the sensor is not kinked, does not contain moisture, and includes an attached dryer tube filled with active *blue* desiccant.

4. Use the diagonal cutters to cut off the excess portion of the cable ties.

## Installing the Ring in the Pipe

The ring must fit securely in the pipe with the sensors properly positioned to ensure the most accurate monitoring results. Install the ring in the pipe in the following way:

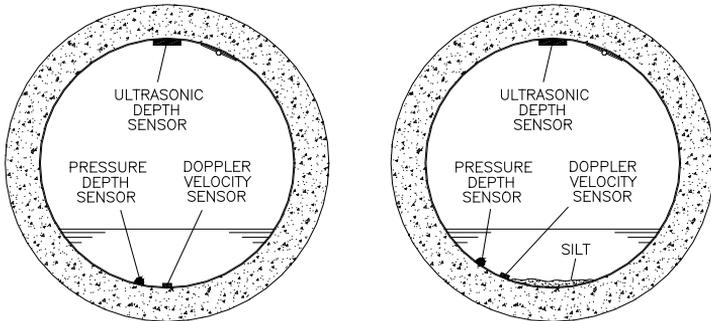
1. Examine the pipe for possible obstructions to the flow or issues that may inhibit proper ring installation.
2. Adjust the ring size to slightly less than the pipe diameter before placing the ring in the pipe by turning the spreader mechanism adjustment nut clockwise.
3. Place the ring in the input pipe at least 12 inches upstream from the manhole or edge of the pipe with the sensors facing upstream toward the oncoming flow. It must be located far enough upstream from the manhole to minimize the effect of the draw-down caused by a possible drop in the manhole invert.



Installing the ring at least 12 inches upstream from the manhole invert

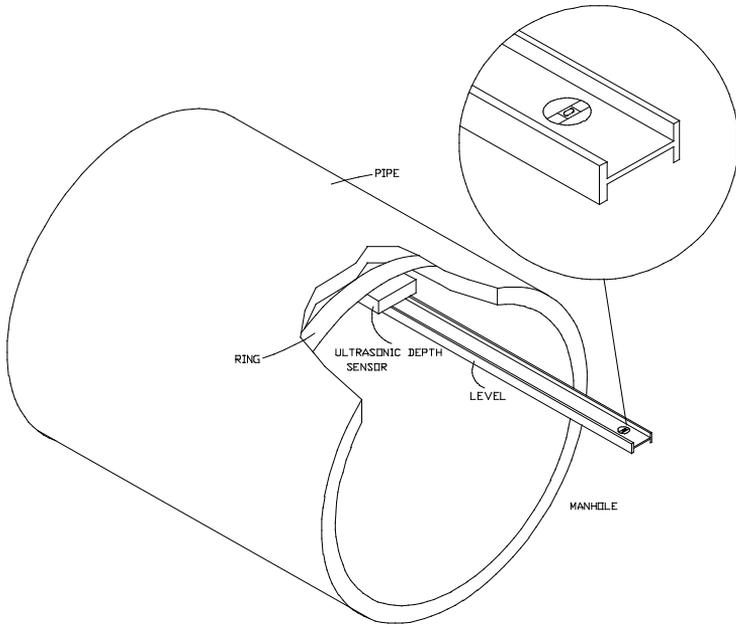
Keep the following in mind:

- ❑ Make sure the ultrasonic depth sensor is at the top (crown) of the pipe, the Doppler velocity sensor is at the bottom of the pipe *above* any silt present and *below* the flow surface (during minimum flows), and the pressure depth sensor is near the bottom.



Proper orientation of the ring with the sensors in the pipe with and without silt present

- ❑ If necessary, temporarily clear away silt to install the ring. Restore the silt after fully securing the ring (step 7).
  - ❑ Make sure the ring is flat (flush) against the inside wall of the pipe to avoid obstructing the flow or catching debris.
4. Expand the ring by turning the spreader mechanism nut counter-clockwise with the crank handle or socket. *However, do not tighten the ring against the pipe completely at this point.*
  5. Use the 24-inch carpenter's level, orient the ultrasonic depth sensor at the top of the pipe so that the sensor face is parallel and level (from side to side) with the flow surface and pipe crown.



Leveling the ultrasonic depth sensor

If necessary, adjust the level in the following way:

- Remove the ultrasonic depth sensor from the mount.
- Loosen the ring slightly to allow the plate to move on the ring.
- Tap the sensor mount to the right or left with a rubber mallet until it is level.

**Warning:** Tapping the sensor mount with the sensor attached could damage the sensor. Always remove the sensor before tapping the mount with a mallet.

- Reattach the sensor to the mount, and recheck the level.
6. Fully tighten the ring until it fits securely and completely flush against the pipe wall.

**Warning:** Avoid over-tightening the ring. This could bend the crank assembly.

7. Restore any silt moved to its previous level, and confirm that the Doppler velocity sensor is still above the silt level.
8. Measure the physical offsets for the ultrasonic and pressure depth sensors.
  - Ultrasonic Offset** Measure the distance from the crown (top) of the pipe to the face of the ultrasonic depth sensor.
  - Pressure Offset** Measure the vertical distance from the bottom of the pressure depth sensor to the bottom, center of the pipe.

**Note:** These values will be required when configuring the monitor using the **Profile** software.

9. Secure the sensor cables from the ring to the future monitor location in the manhole. Refer to *Securing the Sensor Cables in the Pipe and Manhole* page 3-43 for more information.

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## Special Installations

A special installation requires two independent installations: one for the ultrasonic depth sensor and one for the Doppler velocity and pressure depth sensors.

**Note:** Special installations do not involve spreader mechanisms or rings. All hardware mounts directly to the pipe surface with anchor bolts.

Performing a special installation involves the following process:

- Gathering the parts and supplies
- Gathering the tools and equipment
- Mounting the ultrasonic depth sensor
- Mounting the Doppler velocity sensor
- Mounting the pressure depth sensor
- Securing the cables to the band

Before beginning the installation, conduct a thorough investigation of hydraulic and other site conditions. The hydraulics of a site directly affect the monitor's ability to accurately measure flow depth and velocity. In addition, measure the horizontal and vertical pipe dimensions carefully. Even slightly inaccurate pipe dimensions can significantly skew and misrepresent flow data.

**Caution:** Handle all sensors and cables with extreme care. The sensors and cables contain delicate mechanisms and electronics. Keep sharp objects away from sensor cables, and avoid stepping or placing heavy objects on the cable during installation.

## Gathering Parts and Supplies

Be sure to obtain the following supplies before performing a special installation to prevent any costly delays. When ordering, specify the FlowShark flow monitor special installation hardware.

Quantity	Description	ADS Part Number
1	FlowShark flow monitor	varies with configuration
1	monitor mounting bracket	I40-0003
1	ultrasonic depth sensor	103262A-30
as needed	ultrasonic depth sensor extension cable	103228A-xxx <sup>1</sup>

## Sensor Installation and Connection 3-27

Quantity	Description	ADS Part Number
1	Doppler velocity sensor with two 4-40 x 5/16-inch stainless steel screws	103260A-35
as needed	Doppler velocity sensor extension cable	103180A-xxx <sup>1</sup>
1	pressure depth sensor with two 4-40 x 5/16-inch stainless steel screws	3704-0041-35 <sup>2</sup>
as needed	Pressure depth sensor extension cable	103277A-xxx <sup>1</sup>
1	replacement dryer tube	3704-0032
1	direct connection cable	5000-0601
15	11-inch cable tie	105-0003
25	4-inch cable tie	105-0001
15	8-inch cable tie	105-0002
10	anchor cable tie	105-0004
15	¼- × 2 ¼-inch anchor bolt (with 7/16-inch nut and washer)	101-0002
1	3/8- × 2-inch stud	101-0009
1	3/8-inch x 3-inch anchor bolt and nut	101-0003
2	3/8-inch x 1-inch stainless steel hex bolts	101-0001
4	3/8 – 16 stainless steel hex nuts	115-0002
5	3/8-inch stainless steel flat washers	155-0001
2	4-40 × 5/16-inch screw	135-0001
8	6-32 washer	155-0002
4	6-32 × 1-inch machine screw	135-0004
4	6-32 × 5/16 inch nut	115-0003
15	plastic push mounts	101-0006
1	12-inch stainless steel mounting band	125-0080
1	sliding ultrasonic plate	125-0001

Quantity	Description	ADS Part Number
as required	ultrasonic depth sensor surcharge mounting bracket	140-0010
1	special predrilled 8-foot metal band	140-0007

<sup>1</sup> Extension cables can be ordered in specific lengths up to 300 feet. Note the desired length (in feet) in the xxx portion of the part number. For example, if the application requires a 50-foot extension cable for an ultrasonic depth sensor, the part number would be 103228A-050.

<sup>2</sup> Pressure depth sensors also are available in 0–15 PSI (p/n 3704-0042–35) and 0–30 PSI (p/n 3704-0016–40).

## Gathering the Tools and Equipment

Gather the following tools for the installation:

- Battery-powered hammer drill with assorted bits, including the following at a minimum:
  - ❑ 3/8-inch x 4-inch (minimum length) masonry bit
  - ❑ 1/4-inch masonry bit (F35-0018)
  - ❑ 5/16-inch carbide-tipped drill bit (include smaller bits)
- 4-pound hammer
- Rubber mallet
- 24-inch carpenter’s level
- Wrenches
- Screwdrivers (flathead and Phillips head of assorted sizes)
- 3/8-inch x 16-inch threads tap
- Diagonal wire cutters
- Folding carpenter’s rule with a brass slide
- Mastic tape (ADS p/n 507193) or rubber coaxial stretch tape

## Mounting the Ultrasonic Depth Sensor

Two special installation methods are available for mounting the ultrasonic depth sensor:

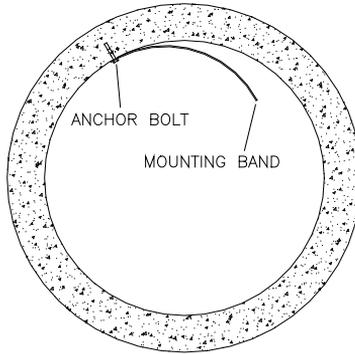
- **Standard Ultrasonic Mount** This option, the most common method employed today, is used for mounting the ultrasonic depth sensor in the pipe during special installations.
- **Surcharge Mount** This mount primarily is used for mounting the ultrasonic depth sensor in the manhole at a site where the flow continually occurs within 2 inches of the top of the pipe or sites where a pressure sensor is not available and *surcharges* frequently occur. Surcharges are conditions where the flow completely fills the pipe and extends up into the manhole.

### ***Standard Ultrasonic Mount***

Mount the ultrasonic depth sensor using this method in the following way:

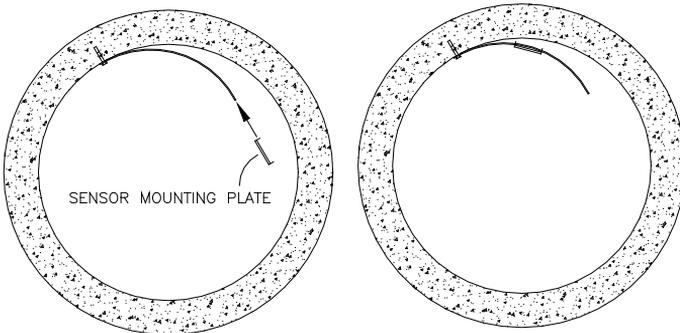
**Note:** Handle the ultrasonic depth sensor with care, and do not expose it to extreme temperatures for an extended period of time. Keep the sensor in its protective packaging until it is time for installation.

1. Position the sliding ultrasonic plate in the center apex of the pipe, and scribe a mark on both sides of the ultrasonic plate.
2. Center the 12-inch mounting band, allowing the band to extend about 4 inches beyond each side of the scribed location.
3. Conform one end of the curved band to the pipe configuration, and spot drill to mark the bolt location.
4. Remove the curved band, drill an anchor bolt hole, and gently tap a ¼-inch x 2 ¼-inch anchor bolt into the hole.
5. Mount the curved band to the anchor bolt through the pre-drilled hole on the band, and hand-tighten a nut with washer to the anchor bolt to secure the band.



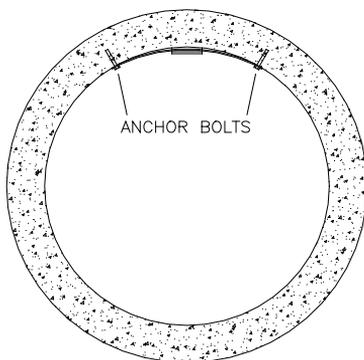
Securing one end of the ultrasonic depth sensor mounting band

6. Slide the adjustable ultrasonic plate onto the band with the backstop edge closest to the invert and the two band slots facing up.



Sliding the ultrasonic depth sensor mounting plate onto the band

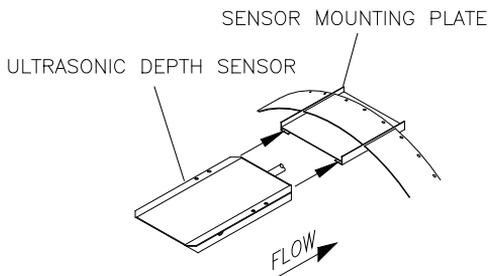
7. Align the sliding ultrasonic plate with the scribe marks, and conform the other end of the curved band with the pipe.
8. Spot drill to mark an anchor bolt location, and mount another 1/4-inch x 2 1/4-inch anchor bolt to the pipe.
9. Hand-tighten a nut with washer to secure the other end of the band.



Securing the other end of the band

**Note:** If the plate has too much play, attach another anchor bolt approximately 1 inch from the plate.

10. Slide the ultrasonic plate along the metal band until it is level (from side to side) with the flow surface and pipe crown, and tighten the nuts securely with a nut driver. Refer to the illustration *Leveling the Ultrasonic Depth Sensor* on page 3-24.
11. Slide the ultrasonic depth sensor into position from the upstream end of the ultrasonic plate until the back of the sensor comes in contact with the backstop.



Sliding the ultrasonic depth sensor into place

12. Confirm the ultrasonic depth sensor is still level.

13. Measure the physical offset for the ultrasonic depth sensor (the distance from the crown (top) of the pipe to the face of the sensor).

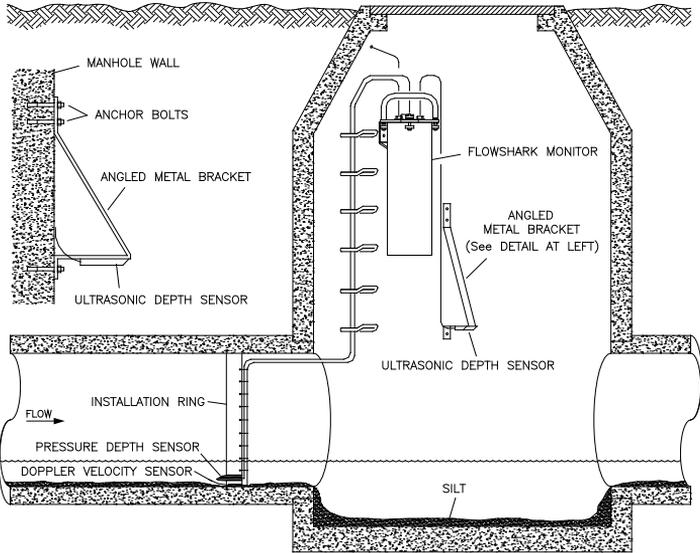
**Note:** This value will be necessary when configuring the monitor using the **Profile** software.

### **Surcharge Mount**

For a site that may experience surcharge conditions, mount the ultrasonic depth sensor on the manhole wall using a special surcharge bracket (ADS p/n I40-0010) directly above the opening of the incoming pipe. This will ensure the sensor measures the range above the flow surface at the location the flow enters the manhole. Mount the ultrasonic depth sensor in the following way:

**Note:** Handle the ultrasonic depth sensor with care, and do not expose it to extreme temperatures for an extended period of time. Keep the sensor in its protective packaging until it is time for installation.

1. Determine the appropriate height at which to mount the ultrasonic depth sensor portion of the surcharge bracket (*The sensor slides into the grooves of the mounting plate at the lower portion of the bracket.*) When making this determination, keep in mind that the maximum range of the sensor is 12.5 feet (3.8 m).



Surcharge mount

2. Press the bracket firmly against the manhole wall.
3. Identify the three pre-drilled holes at the top of the bracket, and spot drill the manhole wall through the middle hole with a drill.
4. Remove the bracket, and drill and mount a 1/4-inch x 2 1/4-inch (M6 x 55-mm) anchor bolt.
5. Secure the top of the bracket to the manhole wall with a washer and nut.
6. Push up on the bottom portion of the bracket until the sensor portion of the bracket is level.
7. Hold the bracket firmly in place against the manhole wall.
8. Identify the three pre-drilled holes at the bottom of the bracket, and spot drill the manhole wall through the middle hole with a drill.
9. Rotate the bracket 90 degrees, and drill and mount a 1/4-inch x 2 1/4-inch anchor bolt.

10. Secure the bottom of the bracket with a washer and nut.
11. Slide the sensor into the bracket, and secure the sensor with cable ties to keep the sensor in place.
12. Verify that the sensor portion of the bracket is level using the 24-inch carpenter's level held to the face of the sensor. If it is slightly out of level, make horizontal adjustments to the bottom portion of the bracket by moving it to the left or right. The oval bottom mounting holes allow minor horizontal adjustments.
13. Drill and mount a ¼-inch x 2 ¼-inch anchor bolt in one of the other pre-drilled holes at the top portion of the bracket for added security.
14. Confirm that the sensor is level.
15. Measure the physical offset for the ultrasonic depth sensor (the distance from the crown (top) of the pipe to the face of the sensor). Enter this distance as negative value when editing the parameters for the *Ultrasonic Device* in **Profile**. For example, if it is 24 inches (610 mm) from the top of the pipe to the face of the sensor in the manhole, the physical offset would be -24 inches.

**Note:** This value will be necessary when configuring the monitor using the **Profile** software.

## Mounting the Doppler Velocity and Pressure Depth Sensors

Two special installation methods are available for mounting the Doppler velocity and pressure depth sensors:

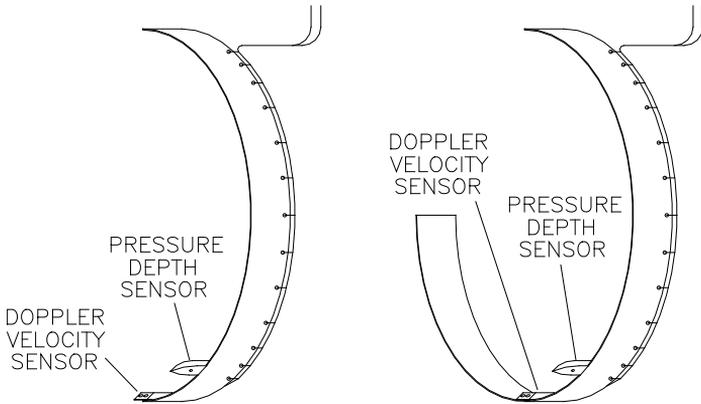
- ¾-band mount
- ½-band mount

Both mounts require almost identical installation methods. The only significant differences are that the ¾-band mount allows the installer to secure the band to both sides of the pipe wall and to position the Doppler velocity sensor at the bottom center of the pipe. These options are not possible using the ½-band mount.

Therefore, the  $\frac{3}{4}$ -band mount is the preferable method for mounting the sensors.

However, a  $\frac{1}{2}$ -band mount may be appropriate for monitoring under the following circumstances:

- Large pipes with deep minimum flows
- Large pipes with excessive silt present



$\frac{1}{2}$ - (left) and  $\frac{3}{4}$ -band (right) mounts

### **$\frac{3}{4}$ -Band Mount**

Perform the following procedure to mount the Doppler velocity sensor and pressure depth sensor (when applicable) in a pipe using the  $\frac{3}{4}$ -band mount:

1. Use a hacksaw to cut the band to the appropriate length. Cut the band so that, when installed, it will run approximately  $\frac{3}{4}$  of the length around the inside of the pipe.

**Note:** The metal bands come in 8-foot lengths. Some larger pipes may require attaching two bands together. In addition, for square-shaped pipes, use an 8-foot straight metal strip.

2. Determine which end of the band will be the long end (end extending almost completely up one side of the pipe). For cable routing purposes, ADS recommends reserving the left side of the pipe (upstream from the manhole) for the long end of the band.

**Note:** Position the edge of the band with the cable tie holes (edge with small holes) facing downstream.

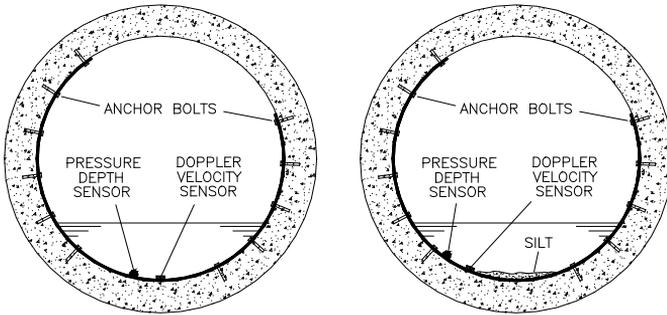
3. Determine the appropriate location on the band to mount the Doppler velocity sensor, making sure the sensor will be both *above* the silt level and *below* the flow surface during minimum flows.
  - If silt is not present, locate the sensor on the band so it will be at the bottom center of the pipe once installed.
  - If silt is present, locate the sensor slightly up the long end of the band so it will be above the silt level once installed.
4. Mount the sensor onto the inside of the band with two 4-40 x 5/16-inch countersink screws, making sure the beveled end of the sensor faces the upstream edge of the ring (edge opposite cable tie holes). If holes do not exist on the band at or near the desired mounting location for the sensor, drill holes in the band using a 7/32-inch drill bit.
5. When applicable, mount the pressure depth sensor to the band in the following way:
  - Mount the pressure depth sensor 2 inches to the left of the Doppler velocity sensor. *Make sure the sensor will be underneath the flow once installed.*
  - Secure the pressure depth sensor to the band using two 4-40 x 5/16-inch countersink screws. If the sensor does not have screw inserts, use two medium-sized cable ties to secure the sensor to the ring. Crisscross the cable ties across the top of the sensor and underneath the band.
6. Secure the sensor cables along the downstream edge of the long end of the band according to the instructions in *Securing the Cables to the Band* on page 3-41.

7. Place the band in the pipe upstream at least 12 inches (same distance as ultrasonic depth sensor, when present) from the manhole invert. Position the band in the pipe so that the sensors will remain below the flow surface (even during minimum flows) and above the silt level.
8. Make sure two pre-drilled holes are visible above the flow surface on the short end of the band. Maneuver the band so that the lowest hole is almost at the flow surface.
9. Mark the pipe wall through the lowest hole with a drill, and install a 1/4-inch x 2 1/4-inch anchor bolt with a pneumatic drill.
10. Secure the band to the anchor bolt with a washer and nut.
11. Conform the band to the pipe wall around to the long end of the band so that it is flush with the pipe wall.

**Note:** Temporarily remove any silt preventing the band from sitting flush against the bottom of the pipe.

12. Install a 1/4-inch x 2 1/4-inch anchor bolt through the pre-drilled hole closest to the flow surface on the *long* end of the band, and secure the band with a washer and nut.
13. Make sure the band and sensors are flush against the pipe wall with no gaps, and conform the rest of the band to the pipe wall.
14. Install 1/4-inch x 2 1/4-inch anchor bolts, nuts, and washers at the pre-drilled hole at the short end of the band and at the pre-drilled holes along the long end of the band (above the flow surface) approximately every 12 to 24 inches to the top end of the band.

**Note:** Whenever possible, secure the band with an additional anchor bolt approximately 3 inches below the flow surface on each side of the pipe. This will help ensure that the band remains flush against the bottom of the pipe below the flow surface.



Sensors mounted using a  $\frac{3}{4}$ -band mount in the pipe with and without silt

15. Measure the physical offset for the pressure depth sensor (the vertical distance from the bottom of the pressure depth sensor to the bottom, center of the pipe).

**Note:** This value will be necessary when configuring the monitor using the **Profile** software.

16. Run the sensor cables from the sensor location in the pipe to the monitor location in the manhole according to the instructions in *Securing the Sensor Cables in the Pipe and Manhole* on page 3-43.

### ***$\frac{1}{2}$ -Band Mount***

Perform the following procedure to mount the Doppler velocity sensor and pressure depth sensor (when applicable) in a pipe using the  $\frac{1}{2}$ -band mount:

1. Use a hacksaw to cut the band to the appropriate length. Cut the band so that, when installed, it will run almost completely down the left side of the pipe.
2. Determine the best location on the band to mount the Doppler velocity sensor. The sensor should mount as close as possible to the bottom of the band, making sure the sensor will be both *above* the silt level and *below* the flow surface once installed.
3. Mount the sensor onto the inside of the band with two 4-40 x 5/16-inch countersink screws, making sure the beveled end of

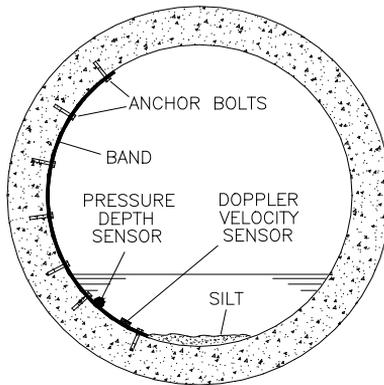
the sensor faces the upstream edge of the ring. If holes do not exist on the band at or near the desired mounting location for the sensor, drill holes in the band using a 7/32-inch drill bit.

**Note:** The edge of the band with the cable tie holes is the downstream edge.

4. When applicable, mount the pressure depth sensor to the band as follows:
  - ❑ Mount the pressure depth sensor 2 inches to the left of the Doppler velocity sensor. *Make sure the sensor will be underneath the flow once installed.*
  - ❑ Secure the pressure depth sensor to the band using two 4-40 x 5/16-inch countersink screws. If the sensor does not have screw inserts, use two medium-sized cable ties to secure the sensor to the ring. Crisscross the cable ties across the top of the sensor and underneath the band.
5. Secure the sensor cables along the downstream edge of the band according to the instructions in *Securing the Cables to the Band* on page 3-41.
6. Place the band in the pipe upstream at least 12 inches (same distance as ultrasonic depth sensor, when present) from the manhole invert. Position the band on the left side of the pipe so that the sensors will remain below the flow surface (during minimum flows) and above the silt level.
7. Orient the band so that one of the pre-drilled anchor bolt holes is just above the flow surface.
8. Spot drill the pipe wall through the hole, install a 1/4-inch x 2 1/4-inch anchor bolt, and secure the band to the anchor bolt with a washer and nut.

**Note:** Make sure the submerged portion of the band is flush with the pipe wall. If it is not, remove the band and conform the band to the pipe.

9. Install a 1/4-inch x 2 1/4-inch anchor bolt, washer, and nut below the flow surface 1 to 3 inches away from the Doppler velocity sensor on each side. This will hold the sensor securely against the pipe wall and prevent the end of the band from twisting in the flow or catching debris.
10. Conform the portion of the band above the flow surface to the pipe wall, and install an 1/4-inch x 2 1/4-inch anchor bolt, nut, and washer every 12 to 24 inches up to the top of the band.



Completed 1/2-band mount in pipe

11. Measure the physical offset for the pressure depth sensor (the vertical distance from the bottom of the pressure depth sensor to the bottom, center of the pipe).

**Note:** This value will be necessary when configuring the monitor using the **Profile** software.

12. Run the sensor cables from the sensor location in the pipe to the monitor location in the manhole according to the instructions in *Securing the Sensor Cables in the Pipe and Manhole* on page 3-43.

**Note:** If the pipe is large and the Doppler velocity sensor and pressure depth sensor cables cannot reach the pipe crown, attach the sensor cables to 1/2-inch PVC tubing and

anchor the tubing to the wall. This will help prevent sensor damage during heavy flow.

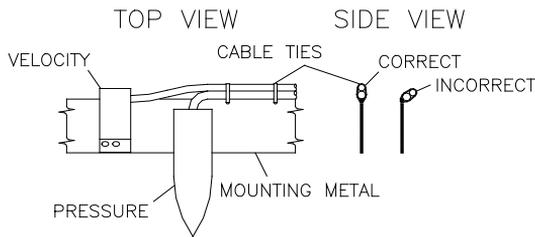
## Securing the Cables to the Band

Securing the Doppler velocity sensor and pressure depth sensor cables to the band helps prevent debris from collecting between the cable and the band or catching on the loose cable. It also prevents the loose cables from disrupting the flow.

Secure the Doppler velocity and pressure depth sensor cables in the following way:

1. Starting at the appropriate sensor location, begin securing the sensor cable with 4-inch x 0.08-inch cable ties through the pre-drilled holes along the downstream trailing edge of the band up the side of the band. Run the cable up the left side of the band (when facing the downstream edge of the band).

**Note:** When securing both a pressure depth sensor and a Doppler velocity sensor cable to the band, place the velocity cable on top of the pressure cable and secure both together.



Sensor cabling

2. Continue securing the cables until reaching the ultrasonic depth sensor or the top of the pipe.
3. Pull the ties until they are taut.

**Warning:** Do not over-tighten the cable ties or kink the sensor cables! The pressure depth cable sheathes two

components: the electrical cables that operate the sensor and an air tube that ventilates the sensor. Over-tightening the ties or kinking the cable can damage or restrict the air tube, causing incorrect pressure depth readings. In addition, make sure the connector-end of the sensor is not kinked, does not contain moisture, and includes an attached dryer tube filled with active *blue* desiccant.

4. Use the diagonal cutters to cut off the excess portion of the cable ties.

## Securing the Sensor Cables in the Pipe and Manhole

Securing the sensor cables from the ring (or band, when applicable), along the pipe crown, and up the manhole helps prevent debris from collecting on sagging cables or between the cables and the pipe crown.

Do not allow sensor cables to hang down in the pipe or sag in the manhole. Loose cables could present a safety hazard in the manhole or increase the potential for sensor or monitor damage to occur. The cables should be secured along the pipe crown and manhole wall under *all* circumstances.

**Note:** Do not secure a wireless communication antenna cable with the sensor cables! Refer to *Setting Up Wireless Communication* in *Chapter 4, Communication*, for information on securing the antenna cable in the manhole.

Secure the cables from the ring (or band) to the monitor location in the manhole in the following way:

1. Neatly bundle the cables together with an 8-inch by 0.14-inch cable tie attached to a plastic anchor installed at the top of the pipe.

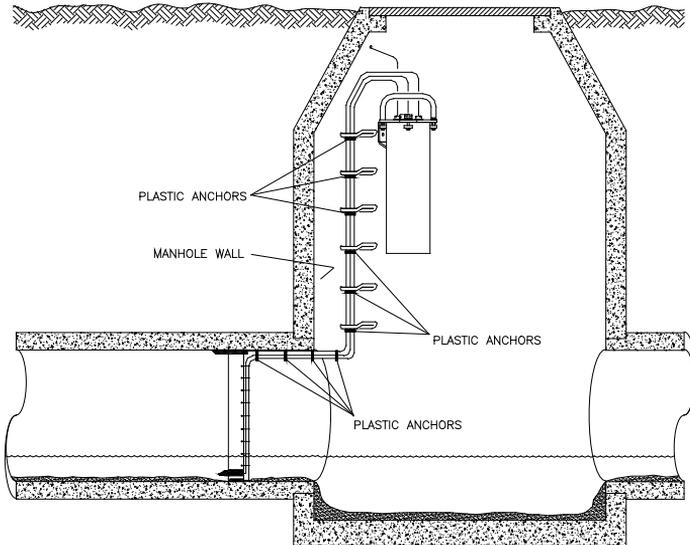
**Note:** If a plastic anchor will not serve as an adequate anchor for securing the cable bundle based on the structure of the pipe, install a 1/4-inch x 2 1/4-inch bolt instead.

- Drill a 3/8-inch hole in the pipe crown.
- Drive the plastic anchor into the pipe with a hammer until flush and secure.
- Run the cable tie through the loop in the plastic anchor and around the cables.

- ❑ Tighten the cable tie around the cables, and cut off the excess cable tie material.

**Warning:** Over-tightening the cable ties may damage the sensor cables.

2. Secure the cables with a cable tie and plastic anchor every 18 to 24 inches along the pipe crown (when necessary) from the ring to the manhole. *If plastic anchors will not serve as adequate anchors based on the structure of the pipe, install 1/4-inch x 2 1/4-inch bolts instead.*
3. Secure the cables every 18 to 24 inches up the side of the manhole to the monitor location. Loose cables could present a manhole safety hazard or increase the potential for sensor or monitor damage to occur. *If plastic anchors will not serve as adequate anchors based on the structure of the manhole wall, install 1/4-inch x 2 1/4-inch bolts instead.*



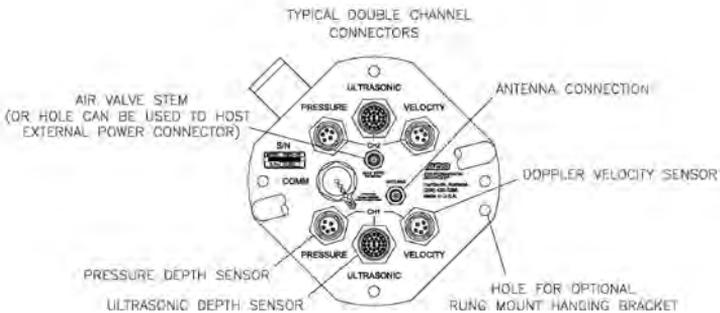
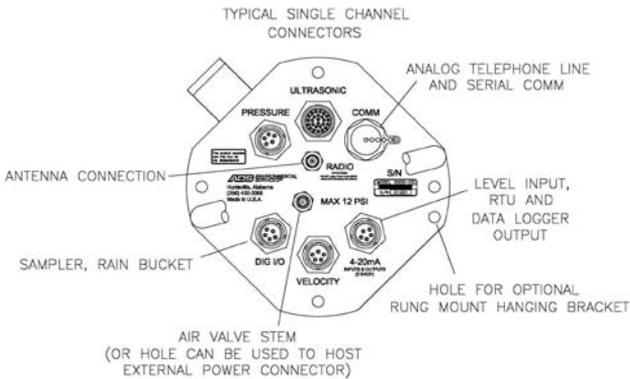
Securing the sensors cables along the pipe and into the manhole

# Connecting Sensors to the Monitor

After installing the ring and sensors and securing the sensor cables to the pipe and manhole wall, connect the sensor cables to the appropriate ports on the top of the monitor. The ports are labeled to identify the appropriate connection for each sensor.

Connect the sensor cables to the monitor ports in the following way:

1. Place the monitor in an upright position to view the monitor connector ports.



Cable connector ports for single (top) and dual monitoring points (bottom)

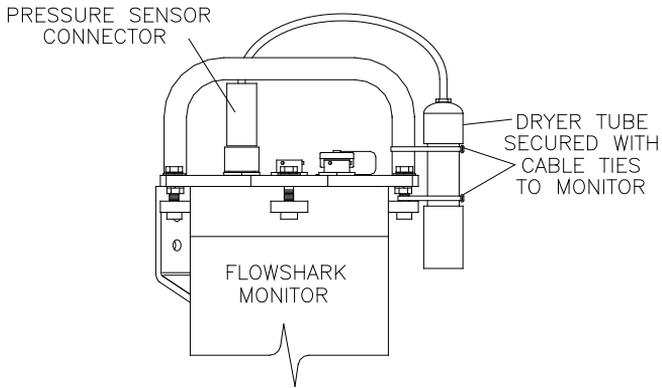
2. Visually inspect each sensor connector and monitor connector port for damaged or broken pins. Replace a monitor or sensor with defective ports or connectors.
3. Visually inspect each sensor and monitor connector port for debris and moisture. Clean off any debris, and dry any surface moisture. Compressed air is useful for removing moisture from the inside of the connectors or ports (pin and socket surfaces).
4. Verify that the waterproof seal is present inside each connector port. The bright orange, rubber seal should sit at the bottom of the connector port with the pins protruding through the seal.
5. Connect each sensor cable to the appropriate port. Tighten each connector in a clockwise direction until it clicks, and verify that it is seated correctly. While the Doppler velocity sensor and pressure depth sensor have identical pin configurations, they are *not* interchangeable when connecting to the monitor. Therefore, be careful to connect the sensors to their *assigned* ports on the monitor. The monitor will not operate properly if these sensors are interchanged.
6. For locations exhibiting the presence of hydrogen sulfide and/or high moisture, provide added protection by wrapping the connection with rubber stretch tape.
7. Seal any unused connectors with a cap. If necessary, obtain additional caps from the regional ADS representative.

**Note:** An air valve is present in the center of the monitor top. This valve exists only for testing purposes during the manufacturing process. *Please do not attempt to fill the monitor with air or pressurize the monitor!*

## Securing the Dryer Tube to the Monitor

Secure the dryer tube to the monitor in the following way:

1. Attach the dryer tube from the pressure depth sensor in the vertical position to the monitor handle and chassis bolt using cable ties.



Securing the dryer tube to the monitor using cable ties

2. Make sure the black end cap on the dryer tube is removed before installing the monitor in the manhole.

## CHAPTER 4

# Communication

After installing the sensors in the pipe and connecting the sensors to the monitor, it is necessary to establish communication with the monitor (through telemetry or the direct serial connection) and activate the monitor. This chapter contains instructions on establishing telephone service or a wireless connection at the monitor location for communicating with the monitor remotely and using the direct serial cable to communicate with the monitor on-site. It also includes basic information concerning monitor activation.

**Note:** Manhole and sewer system work involves confined space entry and is inherently dangerous. Therefore, installers and technicians must comply with all federal, state, and municipal regulations concerning confined space entry. ADS® is not responsible for any injuries, damages, claims, or liability resulting directly or indirectly from the use of this installation guide or the installation of any ADS equipment.

## Providing Telephone Service

Providing telephone service to the monitor involves the following steps:

- Running the telephone cable between the monitor and service locations
- Mounting the lightning protection module
- Preparing the telephone cable
- Wiring the telephone cable to the monitor
- Wiring the telephone cable to the lightning protection module
- Wiring the lightning protection module to the network interface box

**Warning:** To avoid possible shock, make all connections to the monitor before wiring to the lightning protection module and the telephone company's network interface box.

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## Running the Telephone Cable Between the Monitor and Service Locations

The first step in establishing telephone service involves running the telephone cable between the monitor and service locations. However, before this can occur, the installer must evaluate the most suitable location for the service pedestal and the most appropriate route for running the cable. Pedestal location and cable route evaluation criteria may include issues such as the monitor's location in relation to the closest service pole or pedestal, existing landscape, utilities present, and excavation costs.

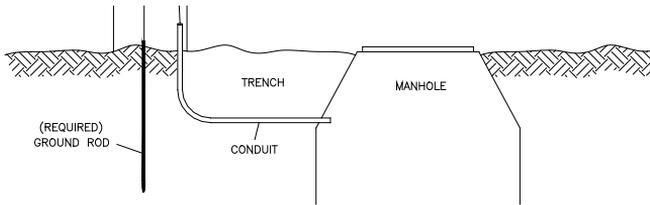
**Note:** For more information on determining the most suitable pedestal location and cable route, consult your ADS representative.

In addition, notify the local underground utilities locating service concerning the desired pedestal location and cable route. Typically, notification must occur 2 to 3 days before excavation activities are scheduled to begin.

After finalizing the pedestal location and cable route, run the telephone cable between the monitor location and the designated pedestal location as follows:

1. Excavate a trench at least 12 inches deep from the designated telephone service pedestal location to the monitor location. Consult the local regulations to verify the required trench depth for the area.
2. Drill a hole in the corbel (structural foundation holding the manhole cover) of the manhole large enough to accommodate the diameter of ¾-inch electrical conduit plus an extra ½ inch.
3. Run the telephone cable from the monitor location in the manhole to the telephone service pedestal location through ¾-inch electrical conduit. Consider the following parameters and recommendations when running the cable:
  - Use four-conductor Belden® cable.
  - Do *not* use plumbing conduit or water fittings.
  - Run the telephone cable through the conduit one section at a time as you lay the conduit in the trench and connect the sections of conduit together. When necessary, use fish tape to feed the telephone cable through the conduit.
  - Provide enough slack in the cable at the manhole end to allow removal of the monitor from the manhole during service activities.
  - Provide approximately 12 to 15 inches of excess cabling at the telephone service pedestal.

- ❑ Create a drip loop for any wires or cables that may be subject to condensation to prevent moisture from entering the electrical or telephone boxes.
- ❑ Extend the conduit through the hole in the corbel of the manhole at the monitor location.
- ❑ Extend the conduit approximately 12 inches vertically out of the trench (from the ground surface) at the designated pedestal location.



Running conduit from the telephone service location to the manhole

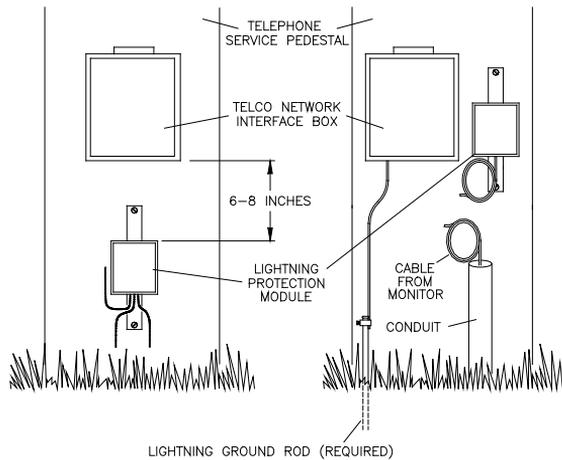
4. Use urethane foam to seal the space between the conduit and the corbel to prevent infiltration into the manhole.
5. Use urethane foam or a weatherhead to form a seal between the telephone cable and conduit at each end of the conduit. This will prevent sewer gases from entering the telephone service pedestal, moisture from entering the conduit during a surcharge, and inflow from entering the manhole.
6. Backfill the trench, and restore the landscape as necessary.
7. Install a service pedestal at the designated location based on the manufacturer's instructions.
8. Make sure the telephone company installs a network interface box inside the pedestal.
9. Make sure a ground rod (stake) is buried inside the pedestal. This rod is critical to ensuring proper lightning protection. If one does not exist, bury an 8-foot copper-coated steel rod vertically into the ground inside the pedestal until it is completely submerged. Refer to the National Fire Protection Association (NFPA) Standard 70 National Electrical Code

(NEC) Article 250 for detailed instructions on proper grounding when an 8-foot vertical depth is not available.

## Mounting the Lightning Protection Module

The next step in establishing telephone service is mounting the lightning protection module to the service pedestal. Mount the module as follows:

1. Remove the front cover from the pedestal.
2. Use the screws included with the lightning protection module to mount the module on the pedestal at *least* 12 inches above the ground surface and next to or 6 to 8 inches below the network interface box.



Positioning of the lightning protection module and network interface box in the pedestal

## Preparing the Telephone Cable

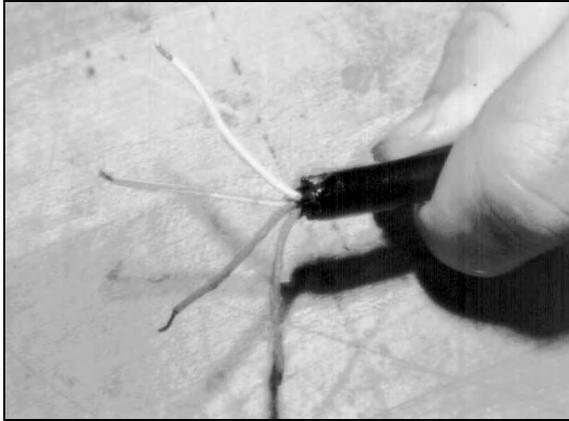
The next step in establishing telephone service is preparing the telephone cable for connection to the monitor and lightning protection module. Prepare the cable as follows:

1. Carefully strip about 3 inches of the external insulation from each end of the telephone cable.



Stripping the external insulation from the telephone cable

2. Remove the internal braiding, and separate the four insulated wires.



Separating the insulated wires

3. Strip  $\frac{1}{2}$  inch of insulation from the blue and the blue/white-striped wires.



Stripping  $\frac{1}{2}$  inch of insulation from each wire

4. Cut off both the two remaining wires down to the level of the external insulation. These wires will not be used in this application.

**Note:** The wire colors referenced in this manual are based on the telephone cable recommended for use in these applications. However, the wires inside some telephone cables may vary in color and number. Therefore, when the actual wire colors and number differ from those designated in this manual, connect the available wiring in reference to ground, ring, and tip.

5. At the *pedestal* end of the cable, fold over both exposed wires (doubling the thickness). Insert each wire into a non-insulated #10 ring terminal lug (22-18 gauge), and crimp the wires to the lugs.

## Wiring the Telephone Cable to the Monitor

After preparing the telephone cable, wire the telephone cable to the monitor as follows:

1. Identify the communications port (**COMM**) on top of the monitor.



COMM (communications) port on top of the monitor

2. Seat and secure the mating telephone cable connector onto the communications port (**COMM**).



Telephone connector secured into **COMM** port on monitor

3. Insert the telephone cable through the plastic potting collar past the loose wires.



Inserting the telephone cable through the plastic potting

4. Apply solder to the end of each wire by heating the wire with a soldering iron and contacting the wire with the solder. This will cause the solder to flow onto the heated wire.



Applying solder to the wire ends

5. Fill the wire sockets on the connector labeled A and D with solder by heating each socket with the soldering iron and contacting the socket with the solder. This will cause the solder to flow into the socket.



Filling the wire sockets in the connector with solder

6. Heat the socket until the solder inside melts, and then insert the wire into the socket:
  - Insert the *blue* wire into socket *A* (tip)
  - Insert the *blue/white-stripped* wire into socket *D* (ring)



Soldering the wires to the designated sockets

7. Wrap the exposed wire ends with small pieces of plastic or tape to prevent a possible short from occurring if they contact during the potting process.
8. Slide the plastic potting collar over the soldered wires, and secure the collar onto the threaded portion of the metal connector.



Sliding the potting collar over the soldered wires

**Note:** Consider wrapping tape around the joint where the plastic collar and moveable metal locking collar meet for protection against resin that may spill during the process.

9. Mix the epoxy compound to pot the connector. Cold weather conditions may prevent the epoxy from curing properly. If this occurs, mix the epoxy in the vehicle.
10. Centering the telephone cable in the plastic collar, pour the epoxy compound into the collar.
  - Pour slowly to avoid air pockets.
  - Pour in only a little at a time to allow the resin time to flow around the wires and completely fill the connector.

**Note:** The final potted connector should have a bead of resin rising slightly above the top of the collar, appearing slightly overfilled.

11. Use 3M™ Linerless Rubber Splicing Tape to secure the cable to prevent it from moving during the curing process. Wrap the tape around the entire connector/cable assembly and about 1 inch up the telephone cable beyond the assembly.

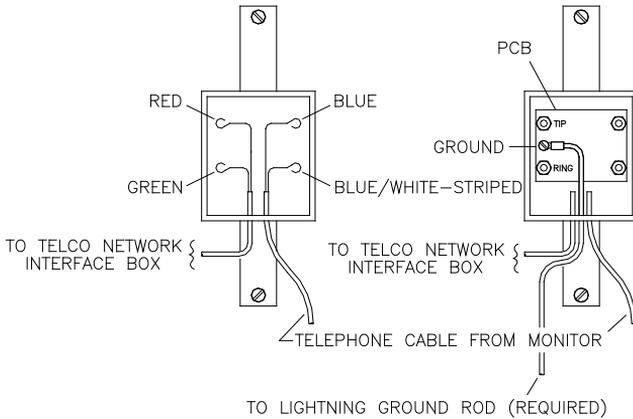
**Note:** Support the telephone cable during the curing process by running a cable tie between the telephone cable and the monitor flange. Curing typically requires about 25 minutes. However, colder temperatures can extend that time up to 2 hours.

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## Wiring the Telephone Cable to the Lightning Protection Module

Next, wire the telephone cable to the lightning protection module (ADS p/n 103313) as follows:

1. Open the front cover of the lightning protection module, and remove the nuts, washers, and card from the posts inside the module. Leave only the bottom-most nut on each post.
2. Slice a hole in the grommet in the bottom of the module, and run the telephone cable up through the grommet into the module.
3. Place the lugs for the following wires onto the designated posts, and then re-place a washer and nut onto each post:
  - Red wire to Telco network interface — Top left post (tip)
  - Green wire to Telco network interface — Bottom left post (ring)
  - Blue wire from monitor — Top right post (tip)
  - Blue/white-stripped wire from monitor — Bottom right post (ring)



Lightning protection module wiring diagram

**Note:** Remember, the wire colors referenced in this manual are based on the telephone cable ADS recommends for these applications. However, the wires inside some telephone cables may vary in color and number. Therefore, when the actual wire colors and number differ from those designated in this manual, connect the available wiring in reference to ground, ring, and tip.

4. Run the two wires (secured to the posts on the left) down and out through the grommet in the bottom of the module.
5. Place a washer onto each post, and replace the card.
6. Securely tighten a washer and nut onto each post over the card.
7. Make sure the ground wire (included with the lightning protection module) is secured at the designated location on the front left side of the card, and run the wire down through the bottom grommet of the module.
8. Close and secure the front cover of the module.
9. Cut 1/2 inch of insulation from the loose end of the black ground wire running from the lightning protection module.

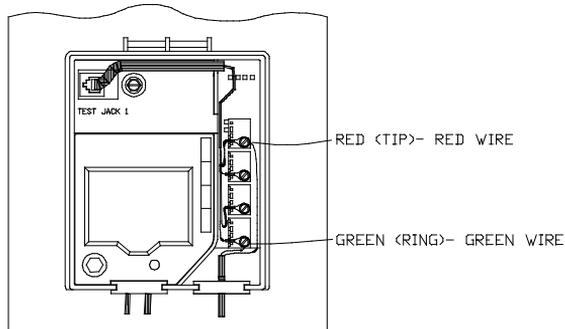
10. Clamp the exposed wire to the ground rod protruding from the ground inside the pedestal or to the telephone company's existing ground wire (when properly connected to the ground rod).

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## Wiring the Lightning Protection Module to the Network Interface Box

The final step in establishing telephone service is wiring the lightning protection module to the telephone company's network interface box. Accomplish this task in the following way:

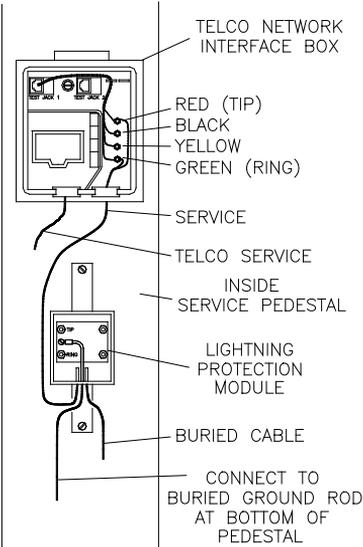
1. Open the front cover of the telephone company's network interface box, and temporarily disconnect the test plug. Opening some network interface boxes may require a special tool available only through the telephone company.
2. Remove 3 inches of insulation from the lightning protection module service cable to expose the four insulated wires.
3. Cut off the black and yellow wires (running from the lightning protection module) down to the level of the external insulation.
4. Strip  $\frac{1}{2}$  inch of insulation from the green and red wires.
5. Slice a hole in the rubber grommet in the bottom of the network interface box (when necessary), and run the wires up through the grommet into the box.
6. Loosen the screws for tip and ring in the network interface box. Wrap the following wires around the designated posts and then re-tighten the screws until snug:
  - Red wire — tip
  - Green wire — ring



Wiring diagram of a typical telephone company network interface box

**Note:** Since the colors inside some boxes vary, this manual does not reference colored posts for connection. The installer should connect the wires to the posts in reference to ring and tip.

7. Use urethane foam to seal the space between the telephone cable coming from the manhole and the conduit. This prevents sewer gases from traveling through the conduit from the manhole into the pedestal. These gases could produce a potentially explosive environment inside the service pedestal.
8. Re-connect the test plug.
9. Close and secure the cover of the network interface box.



Complete wiring diagram

## Setting Up Wireless Communication

Setting up wireless communication involves installing the antenna at the monitor location and connecting the antenna to the monitor.

**Note:** ADS wireless communication products use static IP address network services provided by AT&T (formerly Cingular Wireless). Therefore, any installation location designated for wireless communication must have access to AT&T 850 or 1900 MHz service. Each wireless device will be fitted with a SIM (Subscriber Identity Module) card that is provisioned by AT&T with specific account and network information for use with ADS software.

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## Installing the Antenna

ADS provides four options for installing the wireless antenna:

- **In Road** This option involves installing the antenna directly in the road.
- **Pedestal** This option involves securing the antenna inside a telecom pedestal installed off the road.
- **Stub** This option involves mounting the antenna to an enclosure, conduit, or antenna mast.
- **Magnetic Whip** This option involves securing the antenna to a roof or other protected structure where only a minimal opportunity exists for theft or vandalism.

**Note:** While this manual describes the installation process for each antenna option, detailed installation instructions also accompany all wireless antennas received from ADS.

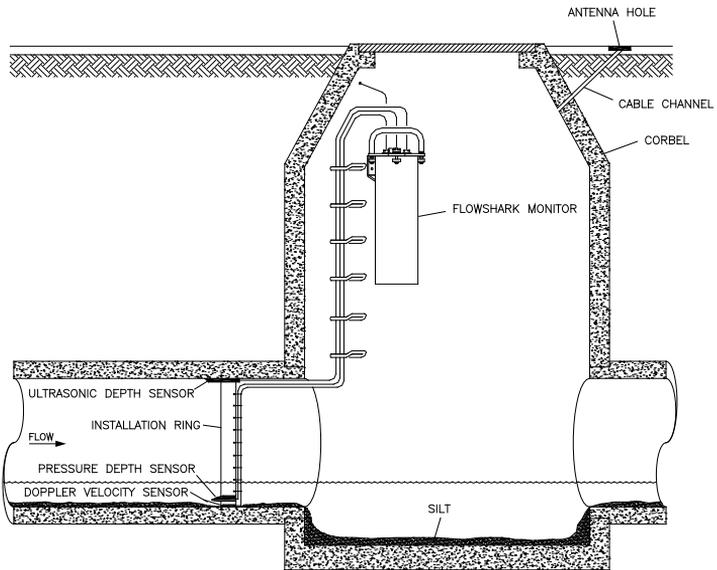
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## Installing a Wireless Antenna in the Road

Install a wireless antenna in the road as follows:

1. Gather the following parts and tools:
  - Wireless antenna (ADS p/n 3800-0137 for SMA connector; #3800-0139 for TNC connector)
  - SMA-to-TNC adaptor (ADS p/n 507173) for antennas with the SMA connector
  - Medium-sized non-rotating demolition hammer with a 1-, 1 ½-, or 2-inch spade bit and bushing tool (sharpen the spade bit before use)
  - Medium to heavy duty hammer drill (*if no hammer/drill mode is available on the demolition hammer*)
  - Generator or other power source to power hammer
  - 5/8-inch x 36-inch (minimum length) masonry drill bit (for hammer drill)
  - 1 ¼-inch x 12-inch masonry drill bit (for hammer drill)
  - Carpenter's rule
  - Pen, pencil, or chalk for marking asphalt or concrete
  - Shop vacuum
  - Wire brush
  - Alcohol wipes
  - Disposable latex gloves
  - Sikaflex<sup>®</sup> AnchorFix<sup>®</sup>-1 masonry adhesive (included with kit)
  - Heavy duty, high-quality caulking gun (for regular-sized tubes)
  - Masonry drill bit and screws (included with kit)
  - Dry sand
  - Commercial asphalt cold patch compound

- Electrical duct seal
  - Rubber stretch tape
2. Determine the appropriate location in the road near the manhole to install the antenna:
    - Locate the antenna in the road no closer than 18 inches and no further than 30 inches from the manhole in which the monitor is installed.
    - Choose a location that is as flat as possible with stable base material.
    - If possible, select a location where the antenna would experience minimal direct impact from road traffic.
    - Make sure the location exists beyond the manhole's iron rim beneath the road surface. This will enable you to access the manhole corbel when drilling the channel for the antenna cable.
  3. Mark the square for the antenna installation, and then mark location to drill corbel hole 2.5 to 3 inches back from edge of antenna hole.
  4. Drill a hole from the marked corbel hole location in the road, through the corbel, and into the manhole using the 5/8-inch by 36 hammer drill bit. This will serve as the channel for the antenna cable running from the antenna to the monitor in the manhole. Be careful to avoid any cables in the manhole, and restart hole slightly to the right or left if mesh is encountered or resistance occurs.
  5. Cut a 5.5-inch long by 5.5-inch wide by 1.63-inch deep hole in the road using the non-rotating demolition hammer (in the hammer only mode) with the 2-inch spade bit. This will serve as the installation location for the antenna. The corbel hole should travel under the center of this hole.
  6. Level the bottom of the hole using the demolition hammer with a bushing tool.
  7. Drill a hole from the center of the antenna hole to intersect with the corbel hole using the 1.25-inch by 12-inch hammer drill bit.



Hole running from antenna installation location to manhole

8. Thoroughly clean out the hole for the antenna of all debris using a shop vacuum with a brush.
9. If the protective cap is not present on the connector at the end of the antenna cable, clean the connector and tape it up with rubber stretch tape to protect it from damage and debris while it is traveling through the channel.
10. Feed the antenna cable into the hole, through the channel, and into the manhole until the antenna is seated firmly inside the hole in the road. Be careful not to crimp or crush the cable.
11. Holding the antenna in place, drill through the holes in the corners of the antenna into the ground the entire depth of the drill bit.
12. Pull the antenna out of the hole, vacuum out the dust from inside the screw holes, and clean the antenna with an alcohol wipe. Let the antenna air dry.
13. Put on protective latex gloves.

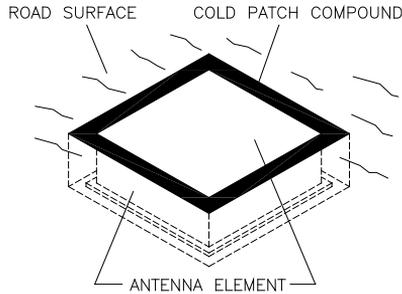
14. Insert a Sikaflex® cartridge into the caulking gun, pull off the tip of the cartridge, and then attach the mixing nozzle.

**Warning:** Once the epoxy mixes in the nozzle, the material will set quickly (as short as 3 minutes in hot weather conditions). Therefore, it is essential that all fasteners, tools, and materials are available for securing the antenna in the hole.

15. Apply the epoxy in a ¾- to 1-inch wide by ½-inch high bead completely around the bottom edge of the antenna hole, and then pressure squirt the epoxy into the 4 screw holes. This process should require the majority of the epoxy in the tube.
16. Pull the antenna cable completely through to firmly seat the antenna in the center of the hole, and then quickly secure the antenna with the screws until tight.

**Note:** The screws can strip easily. Therefore, if using a drill, use the lowest torque available and turn the screw in slowly.

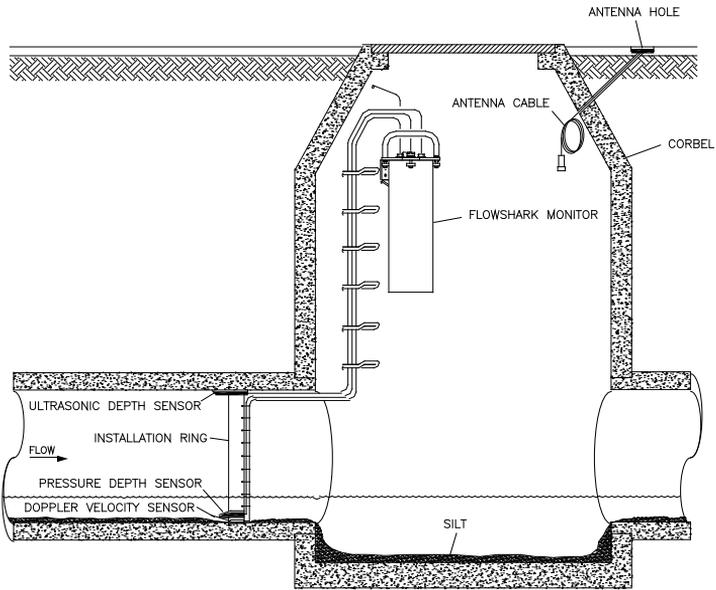
17. Apply any remaining epoxy around the antenna.
18. Allow the epoxy to cure for at least 10 minutes, and then use commercial asphalt cold patch compound to fill the cavity around the antenna and to cover the outer ridge of the antenna. *However, do not cover the element; that could significantly impede reception.*



Antenna in cavity with patch

19. Tamp the compound surrounding and partially covering the antenna in the hole until it is flush with the road surface, and then sprinkle sand onto the compound surface to prevent the material from adhering to vehicle tires.
20. Coil the slack antenna cable and secure it against the *opposite* side of the manhole from the sensor cables. Slack enables the technicians to remove the monitor from the manhole for maintenance or service activities with the antenna cable still connected. *Do not bundle the antenna and sensor cables together! This can significantly diminish antenna and sensor signal strength, disrupting communications and limiting sensor accuracy.*

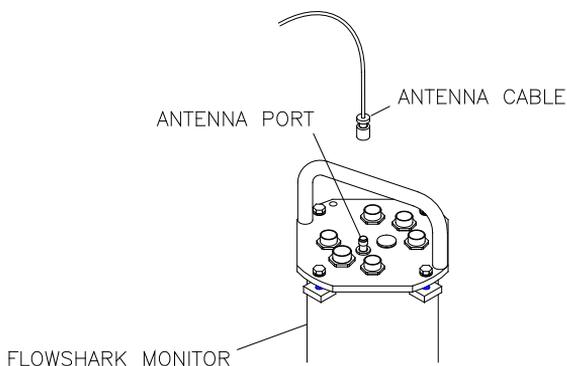
**Note:** To prevent damage to the cable and antenna, do not kink or bend the antenna cable when coiling.



Installation with antenna cable coiled in manhole

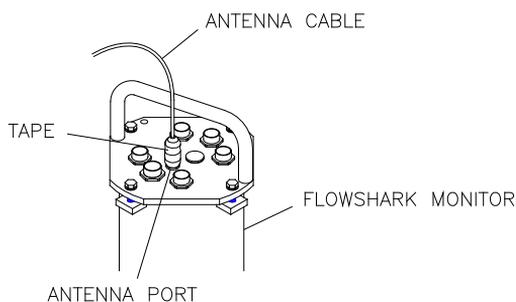
21. Seal the space between the antenna cable and the corbel hole with electrical duct seal or as required to prevent infiltration into the manhole.
22. Attach the connector at the end of the antenna cable to the **RADIO** connector port on top of the monitor.

**Note:** If the antenna cable has the SMA connector, first attach the SMA-to-TNC adaptor to the **RADIO** connector port on the monitor and then attach the cable connector to the adaptor.



Top of monitor and antenna cable with connectors labeled

23. Wrap rubber stretch tape around the entire cable connection, extending onto the cable approximately 2 inches beyond the connection.



Cable connected to monitor with stretch tape properly applied

## Installing a Wireless Antenna in a Telephone Pedestal Off the Road

Install a wireless antenna in a telephone pedestal located off the road as follows:

1. Gather the following parts, supplies, and tools:
  - ❑ Wireless antenna and pedestal (ADS p/n 3800-0133/0134/0135/0136 based on application)

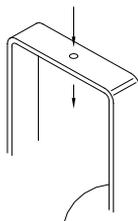
- SMA-to-TNC adaptor (ADS p/n 507173) for antennas with the SMA connector
- Portable electric drill with assorted bit sizes (include 1/2-inch and 3/8-inch bits)
- 8-inch cable ties
- Post hole digger
- Shovel
- Sledge hammer
- 7/16-inch nut driver
- Corbel drill with a 1/2-inch by 36-inch bit
- Hacksaw
- Commercial asphalt cold patch compound
- Electrical duct seal
- Rubber stretch tape

2. Mount the antenna to the pedestal:

**Note:** Some assembly may be complete upon delivery. If this occurs, proceed to the next applicable step in the installation process.

- Drill a 1/2-inch hole in the center of the horizontal top portion of the bracket attached to the base of the pedestal.

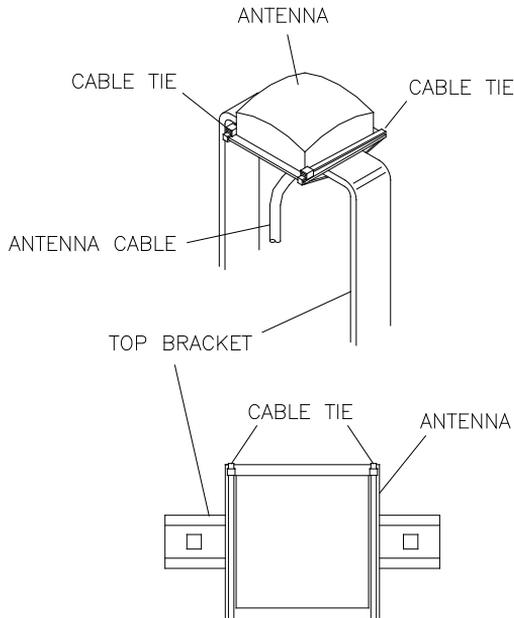
DRILL HOLE FROM TOP



TOP BRACKET

Drilling hole in top bracket

- ❑ Run the antenna cable through the hole from the top of the bracket until the antenna rests flat on the bracket.
- ❑ Secure the antenna to the bracket using two cable ties, and then secure the cable down a vertical portion of the bracket using cable ties.

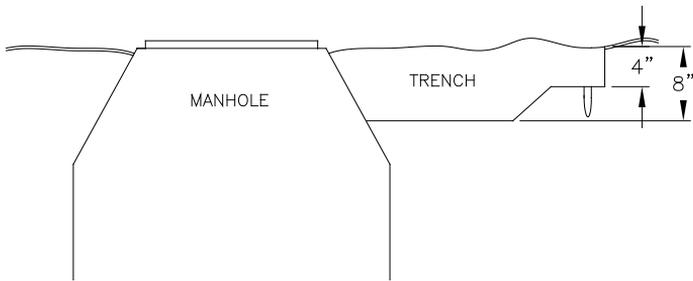


Using cable ties to secure antenna and cables to bracket assembly

- ❑ Tape up the connector on the end of the antenna cable with the rubber stretch tape to protect it from damage and debris during installation.
3. Determine the appropriate location to install the pedestal based on the following factors:
- ❑ Locate the pedestal between 3 to 10 feet from the manhole in which the monitor is installed.
  - ❑ Evaluate the most suitable location for the service pedestal and the most appropriate route for running the cable. Pedestal location and cable route evaluation criteria may

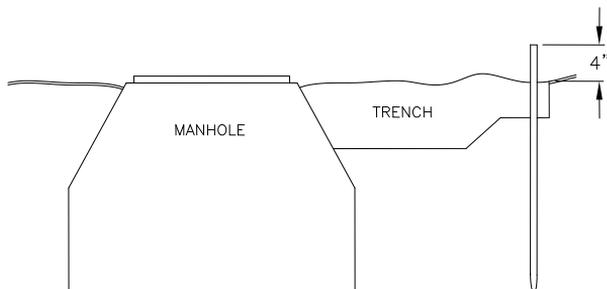
include issues such as the manhole location in relation to the pedestal, existing landscape, utilities present, and excavation costs.

- ❑ Notify the local underground utilities locating service concerning the desired pedestal location and antenna cable route. Typically, notification must occur 2 to 3 days before excavation activities are scheduled to begin.
4. Using a post hole digger or shovel, dig a hole at the designated pedestal location approximately 4 inches deep and slightly larger than the diameter of the pedestal base to accommodate the base and the stake.
  5. Dig a trench at least 8 inches deep between the hole and the manhole, tapering down from the pedestal location.



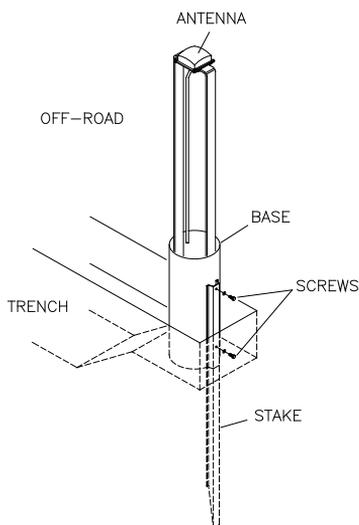
Hole, trench, and manhole

6. Drill a hole at least a ½ inch in diameter in the corbel of the manhole as close as possible to the bottom of the trench using a corbel drill.
7. Drive the stake of the pedestal into the ground at the designated location until approximately 4 inches of the stake remain above ground level. Be sure to avoid driving the stake in at an angle; the pedestal should not be tilted once attached to the stake.



Stake with 4 inches remaining above ground level

8. Attach the base to the stake using the accompanying screws and washers. The pre-drilled holes in the stake and base must line up to secure them together.

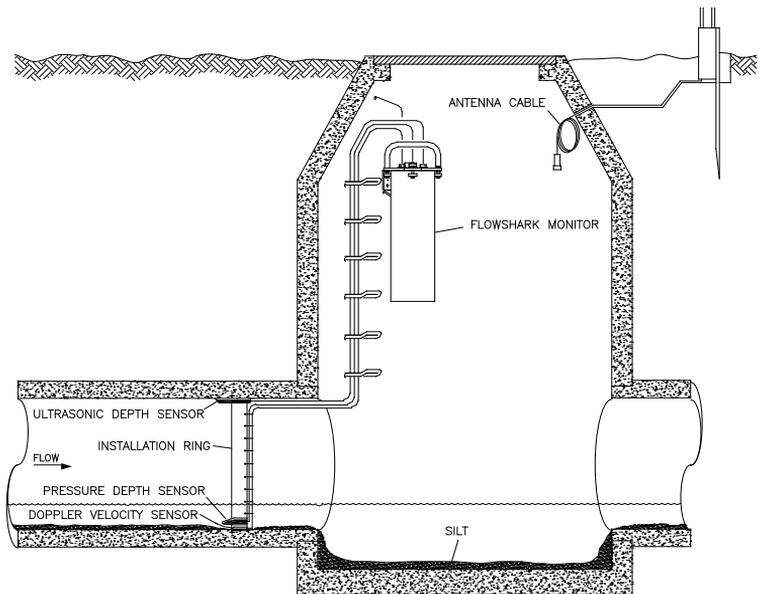


Securing the pedestal base to the stake

**Note:** If you cannot get the stake down to the depth required to align the holes together, use a hacksaw to remove some of the length of the stake and drill new holes with a 3/8-inch bit.

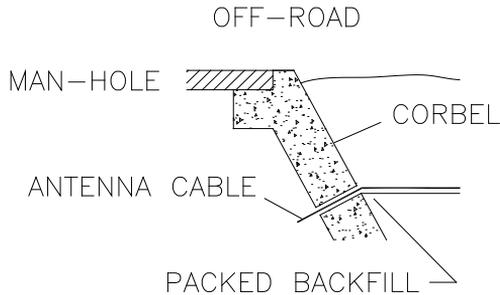
9. Run the antenna cable through the bottom of the base into the trench.
10. Lay the cable in the trench, and run the cable through the pre-drilled hole in the corbel.
11. Coil the slack antenna cable and secure it against the *opposite* side of the manhole from the sensor cables. Slack enables the technicians to remove the monitor from the manhole for maintenance or service activities with the antenna cable still connected. *Do not bundle the antenna and sensor cables together! This can significantly diminish antenna and sensor signal strength, disrupting communications and limiting sensor accuracy.*

**Note:** To prevent damage to the cable and antenna, do not kink or bend the antenna cable when coiling.



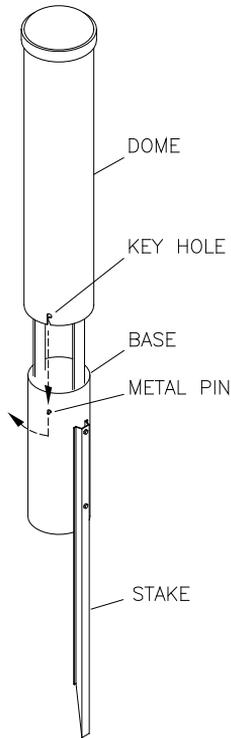
Installation with monitor and antenna cable in manhole

12. Seal the space between the antenna cable and the corbel hole with electrical duct seal or as required to prevent infiltration into the manhole.
13. Backfill the trench, the area surrounding the base, and the inside of the base to ground level. Make sure you firmly pack the backfill in the trench beneath the cable at the corbel hole. This provides a firm surface to protect the cable from possible crimping as the backfill accumulates and packs over the cable.



Backfill in trench protecting cable

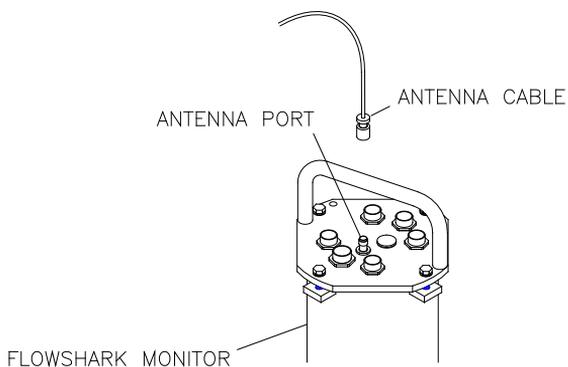
14. Install the dome onto the base by sliding the dome over the bracket and base and then aligning the metal pins in the base with the cutouts on the bottom edge of the dome. Once the dome is seated in the cutouts, turn it to lock it into place.



Sliding the dome over the bracket and base

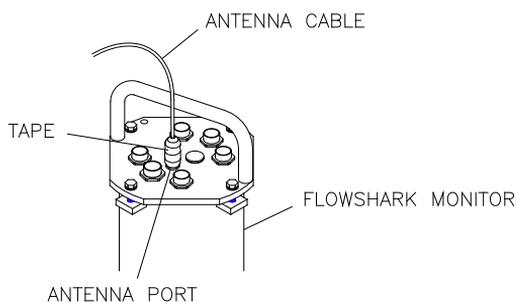
15. Connect the coaxial connector at the end of the antenna cable to the **RADIO** connector port on top of the monitor.

**Note:** If the antenna cable has the SMA connector, first attach the SMA-to-TNC adaptor to the **RADIO** connector port on the monitor and then attach the cable connector to the adaptor.



Top of monitor and antenna cable with connectors labeled

16. Wrap rubber stretch tape around the entire cable connection, extending onto the cable approximately 2 inches beyond the connection.



Cable connected to monitor with stretch tape properly applied

**Warning:** Never use the pedestal as an anchor for equipment or personnel when conducting maintenance or service operations at the site.

## Mounting a Wireless Antenna to an Enclosure, Conduit, or Antenna Mast

This installation involves mounting a stub antenna to an enclosure, conduit end, or antenna mast. The antenna is a threaded-mount, encapsulated, 2 1/2-inch diameter Antenex TRA1503P Stub with a 5/8-inch – 24 threaded mounting stud (ADS p/n 3800-0140 for SMA connector; 3800-0141 for TNC connector). The antenna requires a separate cable (ADS p/n 507176) that attaches to the mounting stud. Mount the stub antenna based on the object to which it will be secured.

- **Enclosure** Mount the stub antenna to an existing enclosure as follows:
  - ❑ Drill a 5/8-inch diameter hole through the top of the enclosure.
  - ❑ Place the o-ring (included) over the mounting stud, and then insert the mounting stud through the hole in the top of the enclosure.
  - ❑ Secure the stub antenna to the closure using the washer and nut from the bottom.
  - ❑ Attach the large male N-type connector from the antenna cable to the threaded stud on the antenna, and use rubber stretch tape and sealer at the connection.
  - ❑ Run the other end of the cable to the monitor, and attach the connector to the **RADIO** port on top of the monitor.

**Note:** If the antenna cable has the SMA connector, first attach the SMA-to-TNC adaptor (ADS p/n 507173) to the **RADIO** connector port on the monitor and then attach the cable connector to the adaptor.

- ❑ Wrap rubber stretch tape (ADS p/n 507193) around the entire cable connection, extending onto the cable approximately 2 inches beyond the connection.

- **Conduit** Mount the stub antenna to the end of a section of conduit as follows:
  - ❑ Obtain a section of conduit with a 5/8-inch (or slightly greater) internal diameter.
  - ❑ Determine the appropriate length of conduit required.
  - ❑ Route the antenna cable through the conduit, and attach the large male N-type connector from the antenna cable to the threaded stud on the antenna.
  - ❑ Use rubber stretch tape and sealer to attach and secure the antenna to the conduit.
  - ❑ Raise the conduit to the required height, and secure it to the side of the manhole or wall using off-the-shelf clamps or fittings.
  - ❑ Run the other end of the cable to the monitor, and attach the connector to the **RADIO** port on top of the monitor.

**Note:** If the antenna cable has the SMA connector, first attach the SMA-to-TNC adaptor (ADS p/n 507173) to the **RADIO** connector port on the monitor and then attach the cable connector to the adaptor.

- ❑ Wrap rubber stretch tape around the entire cable connection, extending onto the cable approximately 2 inches beyond the connection.
- **Antenna Mast** Mount the stub antenna to an antenna mast as follows:
  - ❑ Attach the large male N-type connector from the antenna cable to the threaded stud on the stub antenna.
  - ❑ Use rubber stretch tape and sealer to secure the connection.
  - ❑ Secure the antenna to the mast using clamps or other applicable hardware.
  - ❑ Run the other end of the cable to the monitor, and attach the connector to the **RADIO** port on top of the monitor.

**Note:** If the antenna cable has the SMA connector, first attach the SMA-to-TNC adaptor (ADS p/n 507173) to the **RADIO** connector port on the monitor and then attach the cable connector to the adaptor.

- ❑ Wrap rubber stretch tape around the entire cable connection, extending onto the cable approximately 2 inches beyond the connection.

## Mounting a Wireless Antenna on a Roof or Other Protected Structure

This installation involves securing a wireless whip antenna with a magnetic base (ADS p/n 3800-0127 for TNC connector; 3800-0128 for SMA connector) to a roof or other protected magnetic structure. Roof or outdoor cabinet applications also require a lightning protection device (ADS p/n 507180 SMA or ADS p/n 507179 TNC).

Mount the whip antenna as follows:

**Warning:** Never place a magnetic mount antenna on top of or near a office or field (laptop) computer. The strong magnet in the antenna base immediately will corrupt the computer's hard drive.

1. Identify an anchored or heavy steel surface at least 4 inches by 4 inches to serve as the grounding plate. Do not consider using a manhole cover as a grounding plate to secure the antenna unless it exists in a remote or fenced location.

**Note:** If the appropriate location for mounting the antenna is a manhole cover, do not run the antenna cable through a hole in the cover to avoid damage when removing the cover.

2. If the whip antenna is not attached to the magnetic base, screw the antenna onto the base using any sealing washers or o-rings included in the packaging.

3. Seat the antenna base to the steel grounding plate surface selected.
4. (*For applications requiring lightning protection only.*) Install lightning protection as follows:
  - ❑ Gather wire strippers, crimpers, ground wire junction lugs, and 10-gauge wire.
  - ❑ Connect the SMA or TNC connector from the antenna cable to the terminal on the lightning protection device.
  - ❑ Run the 10-gauge ground wire from the appropriate terminal in the lightning protection device to the building's grounding system (*for roof-top applications*) or to a ground rod installed next to the outdoor cabinet.
5. Run the antenna cable to the monitor location, and attach the connector to the **RADIO** port on top of the monitor.

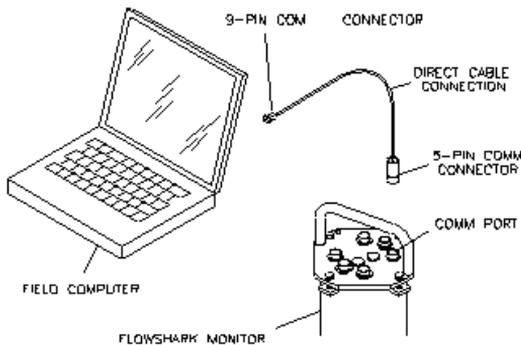
**Note:** If the antenna cable has the SMA connector, first attach the SMA-to-TNC adaptor (ADS p/n 507173) to the **RADIO** connector port on the monitor and then attach the cable connector to the adaptor.

6. Wrap rubber stretch tape around the entire cable connection, extending onto the cable approximately 2 inches beyond the connection.

## Connecting to the Monitor in the Field

Communicating with the monitor on-site requires a direct serial cable (ADS p/n 5000-0601) and a field computer running the **Profile**® software. The direct serial cable provides communication between the user's computer and the monitor without the need of telemetry.

To use the cable for performing on-site communication, connect the cable's 9-pin connector to the field computer's serial communication port and the 5-pin connector to the monitor's **COMM** communication port. Refer to the *Profile User's Guide* (#950015\*\*) for using the **Profile** software to designate the appropriate local port for serial communication.



Connecting the field computer to the monitor in the field

**Note:** If your computer only has a USB port and no serial port, use a USB to Serial adapter cable (and driver software) to perform serial communications. Ensure that the appropriate port for the USB adapter has been designated in **Profile** (it will be different than the serial port) before attempting communications. ADS recommends the following USB adapters: Dynex™ – model DX-UBDB9, and Keyspan® – model USA-19S.

## CHAPTER 5

# External Power

Many FlowShark® models are capable of receiving power from an external DC power source (AC to DC converter, solar panel, other existing converters, etc).

External power is required at locations when the FlowShark will be supplying signals to other equipment via analog outputs or Modbus ASCII. External power is also recommended for FlowSharks operating at fast sample rates, when frequent wireless communication is expected, and/or at locations that will be installed for several years.

The following FlowShark models support external power:

- 5000-AG-M
- 5000-BG
- 5000-BL
- 5000-CG
- 5000-CG-1
- 5000-CL
- 5000-CS

The following FlowShark models support external power with an upgrade kit:

- 5000-AG
- 5000-AL
- 5000-AS

**Note:** The battery packs must be disconnected and removed prior to powering the EMU and FlowShark using external power.

**Note:** None of these models provide backup power in the event that the external power source is interrupted. Data will not be lost if power is lost, however the unit will stop taking readings until power is restored.

---

## Typical Installation

A typical external power installation includes the following:

- Bringing a single phase, 120 volt AC power line terminated at a pole or post close to the manhole (work done by others).
- Installing an AC disconnect/fuse box on the pole (work done by others).
- Installing a ground rod installed next to the pole bonded to the disconnect/fuse box (work done by others).
- Installing a box on the pole containing the AC to 12V DC converter (refer to *Installation of the ADS<sup>®</sup> Power Supply* on page 5-4 for more information).
- Installing a cable (ADS p/n 5000-0697) connecting the DC supply power to the monitor.

**Note:** All work necessary to run AC power to the pole and wire it into an approved AC distribution device (disconnect, fuse or breaker) should be done by a licensed electrician. An electrical permit from the collection system owner or power authority is typically required to place a pole and electrical equipment next to the site.

---

## DC Power Requirements

The monitor requires a power source capable of supplying 1.2 amperes of 12 volt regulated DC power (as measured/available at the monitor, not as available at the power source output). If long cable runs are used, the supply and cabling must be sized to ensure that line losses do not reduce the net power available to the monitor.

## Installation of the ADS Power Supply

The 12VDC power supply is housed in a 5.1" x 5.1" x 5.1" NEMA 4X polycarbonate enclosure suitable for outdoor mounting. Panel mounting is via four 0.175" holes located under the corner cover screws.

The power supply comes with a 6' long AC power cord, or can alternatively be powered via user-supplied cabling. A cable grip fitting is provided to seal the exit of the DC output cabling (cable grip is sized for 0.125" to 0.375" OD cable). Replace the cable grip fittings if needed for custom AC supply or DC output wiring.



12VDC power supply

**Note:** Never drill any holes through the housing for mounting! This will expose the internals of the enclosure to moisture and create an unsafe operating condition! It will also void the product warranty. Only use the mounting holes provided under the corner cover screws to facilitate mounting to a panel or other mounting surface.

The internals of the power supply are shown below (as fitted with an AC power cord and the ADS 5000-0697 External Power Cable). After termination and testing, securely tighten the cable grip fittings and install the enclosure cover. Be sure the cover aligns with the gasket evenly, and that all screws are tightened equally (snug but not overly tight).



12 VDC power supply (inside view)

---

## Installation of the External Power Cable

The ADS External Power Cable (p/n 5000-0697) is required to connect external power to the monitor. The ADS cable is 0.25" in diameter with an ethylene/propylene copolymer jacket, 10 feet long, and suitable for direct burial. If additional length is required, an appropriate gauge of cable for the end run to the power source must be selected.

Install the External Power cable and connect it to the external DC power source as follows:

1. Connect the External Power cable to the FlowShark by aligning the pins and inserting the connector into the External Power (EXT PWR) port on top of the monitor.



External power cable

2. Tighten the connector in a clockwise direction until it clicks, and verify that it is seated correctly.
3. From the monitor location in the manhole, feed the end of the ADS External Power cable with the exposed wires out of the manhole through a hole drilled in the corbel of the manhole.
4. Run the External Power cable from the manhole to the location of the external DC power source. If additional cable length is required, use an appropriate gauge cable and join it to the ADS cable inside a sealed junction box or other sealed fitting.

**Note:** ADS recommends that no connections are made to additional cable inside the manhole due to moisture and safety concerns. Any cables splices should use a junction box. The method used must be suitable for outdoor, wet and/or buried environments.

5. Connect the wires from the external power cable to the DC power source, observing the labels on the external power cable, in the following configuration:
  - Green/White** ⇒ *Negative (-)*
  - Red/Black** ⇒ *Positive (+)*

**Warning:** Turn off power to the DC power source before connecting the External Power cable wires.

6. Turn on power to the DC power source and test FlowShark monitor by calling the FlowShark monitor using the **Diagnostics** feature of the **Profile**<sup>®</sup> software. Perform a **Monitor Status** and verify that the monitor battery voltage is approximately 12 volts. Refer to *Chapter 6, Configuration and Activation*, for additional information.

---

## Upgrade Kit to Convert from Battery Power to External Power

For existing FlowShark installations with battery power, modifications are required to the monitor before external power can be connected. An upgrade kit must be ordered (ADS p/n 5000-0730). Detailed instructions are included in the kit to perform the upgrade.

## CHAPTER 6

# Configuration and Activation

After installing the FlowShark<sup>®</sup> monitor and sensors and setting up communication, it is necessary to configure and activate the monitor to begin taking flow measurements and recording data at the monitor location. This chapter contains general instructions on the following activities concerning monitor configuration and activation:

- Creating a monitor location
- Creating an installation (pipe) table
- Selecting and editing devices
- Setting the communication parameters
- Activating the monitor

This chapter also includes the procedure for running diagnostics on the sensor devices, collecting data from the monitor, and upgrading the firmware (embedded software) in the monitor.

Refer to the *Profile<sup>®</sup> User's Guide* (#950015\*\*) for more detailed instructions on installing the software, collecting monitor data, and configuring, activating, and confirming the monitor.

Refer to *Chapters 8 and 9* of this manual for additional configuration steps required when setting up FlowShark monitors to receive analog input signals or send analog output signals or Modbus ASCII to customer equipment for real-time monitoring.

**Note:** To configure or activate a FlowShark monitor with analog inputs, outputs, or Modbus ASCII output, **Profile** version 3.4 or greater is required as well as FlowShark firmware versions Comm 155 and DSP 200-10 (or greater). Contact ADS<sup>®</sup> Client Services if a software or firmware upgrade is needed before proceeding.

## Configuring the Monitor Location

To ensure the most accurate results for each monitor location, the user must activate the FlowShark monitor with the proper configuration information to satisfy the specific monitoring needs of the project and to reflect actual site conditions. The configuration information includes critical details such as specific pipe characteristics, location description, device assignment and parameters, log rates, and other items relevant to the site and project requirements.

The configuration information is stored in a Location Information File (LIF) in the user's local directory or network drive. Certain elements of the LIF are saved to the monitor memory during monitor activation.

This section includes instructions on performing the following activities required for monitor configuration:

- Creating a Monitor Location in the **Profile** database
- Creating an Installation Table for the Monitor Location
- Selecting and Editing Devices

**Note:** If remote (*landline or wireless*) communications already have been established for the location, these activities can be performed in cooperation between field and office personnel. If remote communication is not available, perform configuration and activation on-site through direct communication with the monitor.

---

## Launching the Profile Software

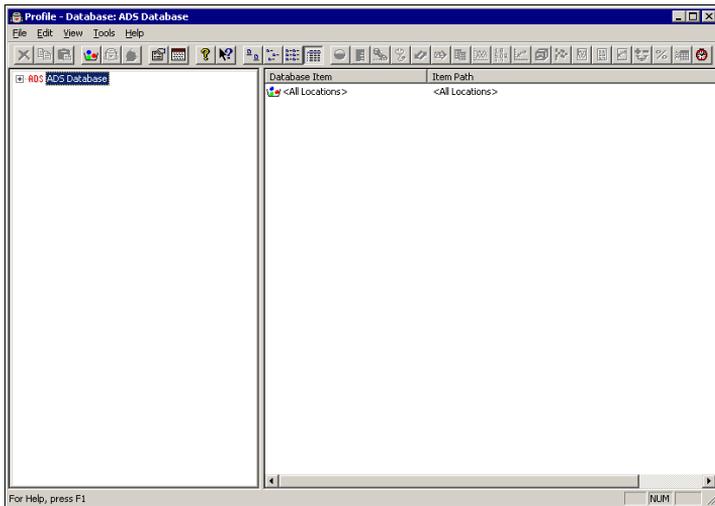
Before traveling to the field for installation, configuration, and activation activities, install the **Profile** software on the field computer.

Once installed, launch the **Profile** software from an office or field computer by selecting **Start > Programs > ADS Corporation > Profile** from the **Microsoft® Windows®** start menu or double-clicking on the **Profile** icon on the **Windows** desktop.



**Profile** icon on desktop

*The **Profile** main screen displays.*



**Profile** main screen

The left pane provides the capability to display all the levels and current details for the selected database on a tree. These levels and details are accessible by expanding and collapsing the entries on the tree. Click the plus symbol (+) next to an entry to display the items contained under that level of the tree; click on the minus symbol (-) next to an entry to collapse the items under that entry level.

Select an entry or level name in the left pane to display the details of that entry in the right pane of **Profile**.

The toolbar provides access to various functions and tools in **Profile** based on the item selected in the left or right pane.

## Creating a Monitor Location

Creating a new location includes entering and setting up the location information as follows:

1. Select the <All Locations> group located under the database level.
2. Select the **Edit > New > Location** option or the **New Location** toolbar button.

A new location named **New Location #1** is added to the <All Locations> group and displays the *Properties* dialog.

The screenshot shows a dialog box titled "Properties for location New\_Loc1". It contains several sections of controls:

- Location Name:** Text box containing "New\_Loc1".
- Description:** Empty text box.
- Baud Rate:** Dropdown menu set to "0".
- IP Address:** Empty text box.
- Series:** Dropdown menu set to "FlowShark".
- Serial Number:** Empty text box.
- Auto Collection:**
  - Autocollect
  - Start time: 2/7/2011 12:00
  - Time Zone: 0
- Manual Collection:**
  - Start time: 1/1/1970 12:00:00 A
  - End time: 1/1/1970 12:00:00 A
- Monitor Data:**
  - Start Time: 1/1/1970 12:00:00
  - End Time: 1/1/1970 12:00:00
- Icon:** A small icon labeled "RDS" with a red background.
- Connect Using:** Dropdown menu set to "TCP/IP".
- Manhole Depth:** Text box containing "0" followed by "in".
- Sample Rates:**
  - Normal: 15 mins
  - Fast: 2 mins

At the bottom of the dialog are "Cancel" and "OK" buttons.

**Properties** dialog for the new FlowShark location

3. Enter the new **Location Name**. Do not duplicate more than the first 7 characters for multiple monitors names.

4. (optional) Enter the new location **Description**.
5. Verify that the monitor **Series** is **FlowShark**. If the monitor will be involved in *Modbus* communications, select **FlowShark RT** from the **Series** drop-down list.
6. Select the appropriate method of communication from the **Connect Using** drop-down list. When choosing the **MODEM** option, select the appropriate **Baud Rate**.
7. Enter the monitor location **Telephone Number** or the **IP Address** for the wireless connection.

**Note:** When entering an IP Address, do not include leading zeroes in the address. For example, an IP Address of 166.213.008.063 should be entered as 166.213.8.63. If leading zeroes are included in the address, monitor communications will not be successful.

8. Enter the monitor **Serial Number**.
9. Enter the number of hours difference between your location (or the location of the computer on which the database resides) and the location of the monitor in the **Time Zone** field. For a monitor in a time zone earlier than the time zone in which you are located, enter a minus sign before the number of hours difference. For example, if you are in the *Central* time zone and the monitor is located in the *Eastern* time zone, select **1** from this field.
10. (optional) Enter the vertical distance from the manhole rim to the manhole invert in the **Manhole Depth** field.
11. Select the rate at which you want the monitor to log data from the **Normal** drop-down list.
12. Select the increased rate at which you want the monitor to log data for the duration of an event from the **Fast** drop-down list. *This designation applies only when implementing the Dual Data Rate feature in the Advanced Configuration options.*

**Note:** Refer to *Chapter 9, Modbus*, for instructions on setting the **ID** and **Delay Response** parameters in the **Modbus** section, when applicable.

13. Select **OK** to create a LIF for the location in the database and exit the dialog.

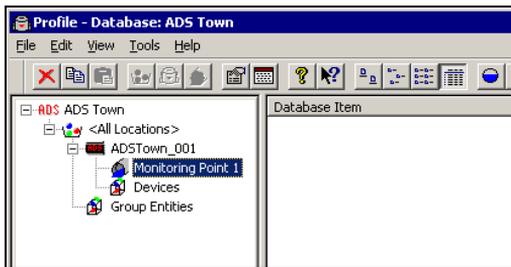
*The new monitor location with a single monitoring point is now created and configured in the database.*

## Creating an Installation Table

Creating an installation table involves defining the size, shape, and physical characteristics of the monitoring point in order to allow the software to properly calculate the correct depths and corresponding quantities.

The user can create an installation table using the **Installation Generator** in the **Profile** software as follows:

1. Select the monitoring point for which you want to create the installation.



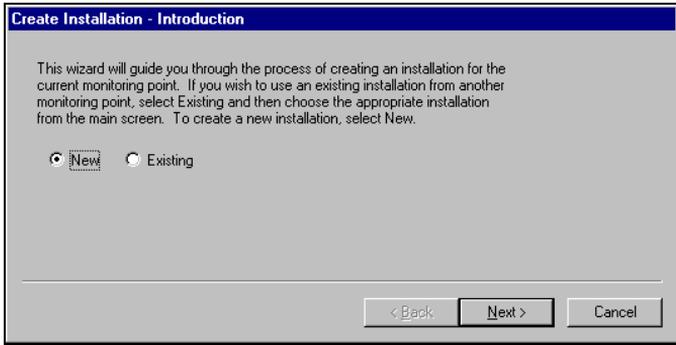
Monitoring Point 1 selected from Location ADSTown\_001

2. Select **Tools > Installation Generator** from the main menu *or* click on the **Installation Generator** toolbar button on the **Profile** main screen.



**Installation Generator** toolbar button

*The Create Installation – Introduction dialog in the wizard displays.*



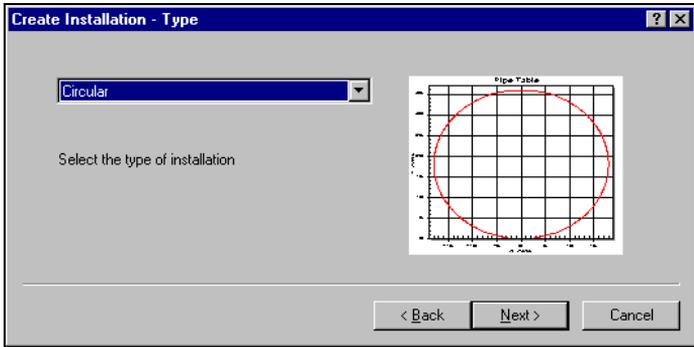
**Create Installation – Introduction dialog in the wizard**

3. Select the **New** radio button and then click on the **Next** button.



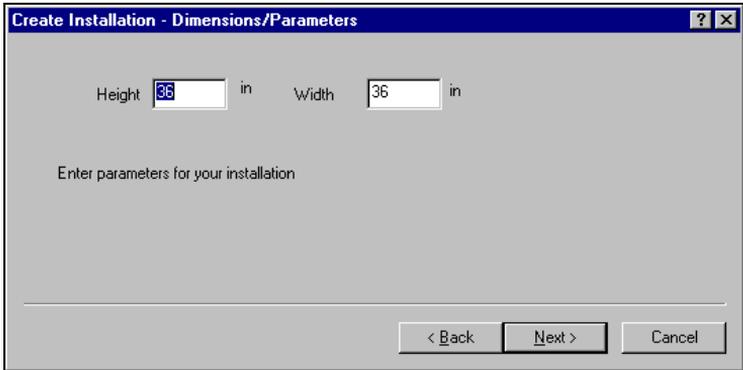
**Create Installation – Installation dialog**

4. Select the **Pipe** radio button, and then click on the **Next** button.



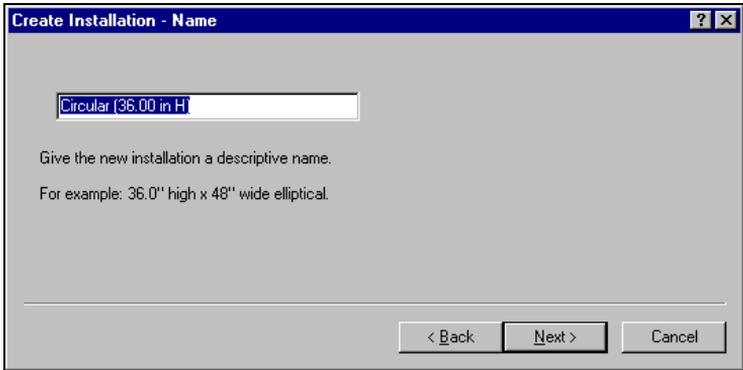
**Create Installation – Type dialog**

5. Select the type or shape of the pipe from the drop-down list, and then click on the **Next** button.



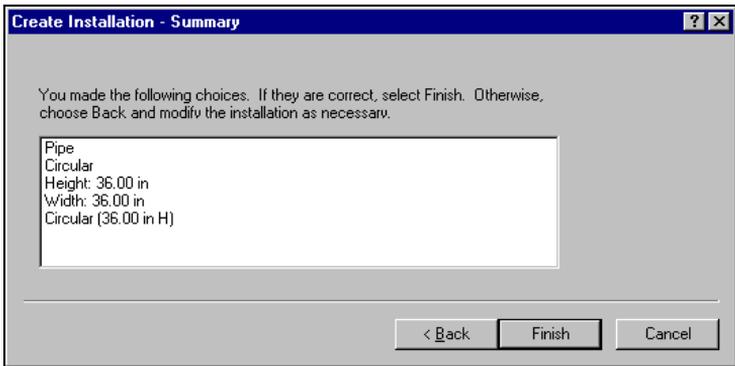
**Create Installation – Dimension/Parameters dialog**

6. Enter the proper pipe dimensions in the corresponding fields, and then click on the **Next** button.



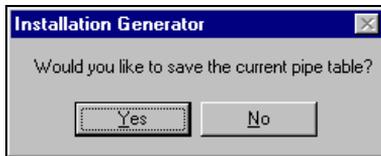
**Create Installation – Name dialog**

7. Enter an appropriate name for the installation in the text field, and then click on the Next button.



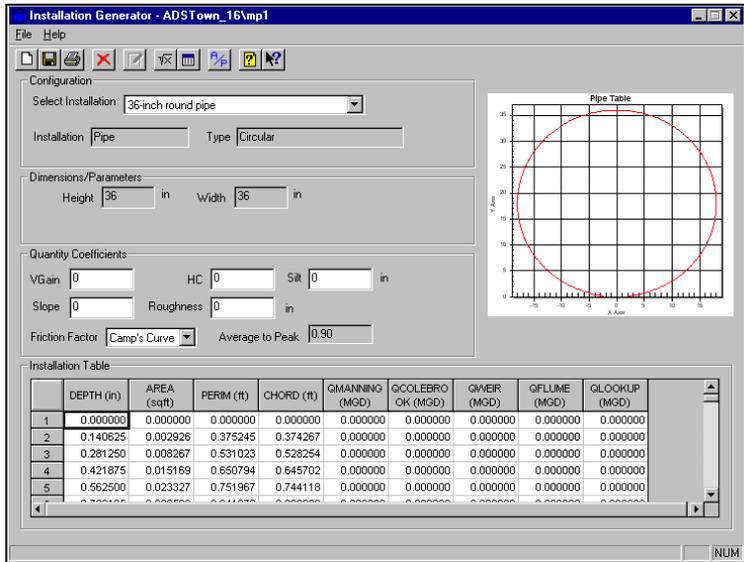
**Create Installation – Summary dialog**

8. Review the installation table selection summary, and then click on the **Finish** button. Select the **Back** button to return to previous dialogs to edit any of the existing selections.



**Option to save pipe table dialog**

- Click on the **Yes** button save the installation table to the **Profile** database for the selected location.



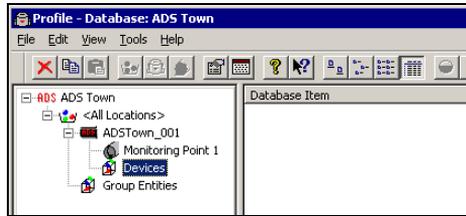
Installation Generator dialog

- Select **File > Exit** to close the **Installation Generator**.

## Selecting and Editing Devices

Select and edit the devices corresponding to the new monitor location to log the desired data. Editing the devices involves setting specific parameters to ensure the monitor and **Profile** properly obtain and process the data. Perform the following steps to properly select and edit devices:

- Select the location for selecting/editing devices from the database.
- Expand the location contents (monitoring point and devices) by selecting the expansion symbol corresponding to the location, and then select **Devices**.



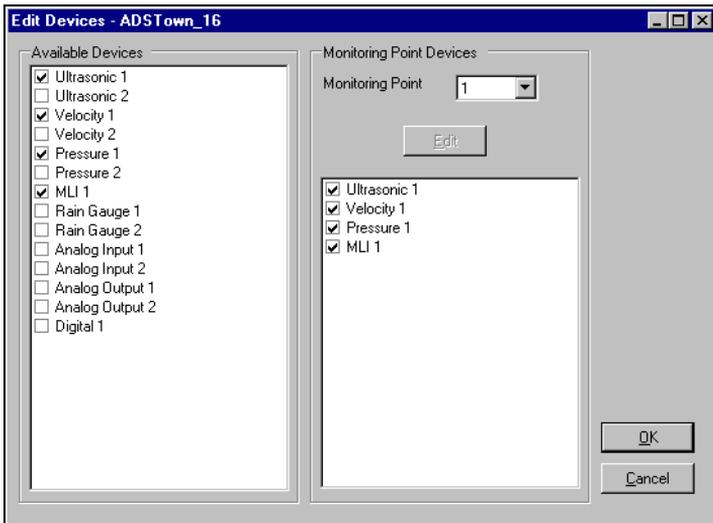
Devices selected for ADSTown\_001

3. Select the **Edit > Properties** option *or* the **Properties** toolbar button.



Properties toolbar button

The **Edit Devices** dialog displays the available devices and devices selected by default for Monitoring Point 1.



Edit Devices dialog

4. Select the monitoring point to which you want to assign the devices from the **Monitoring Point** drop-down list.

5. Select the checkboxes corresponding to the devices you want to assign to the designated monitoring point from the **Available Devices** selection box. A checkmark *must* display beside a device in the **Monitoring Point Devices** section to ensure **Profile** includes the device in the LIF. *Deselect* the checkboxes corresponding to the devices you want to remove from association with the selected monitoring point from the **Available Devices** section.

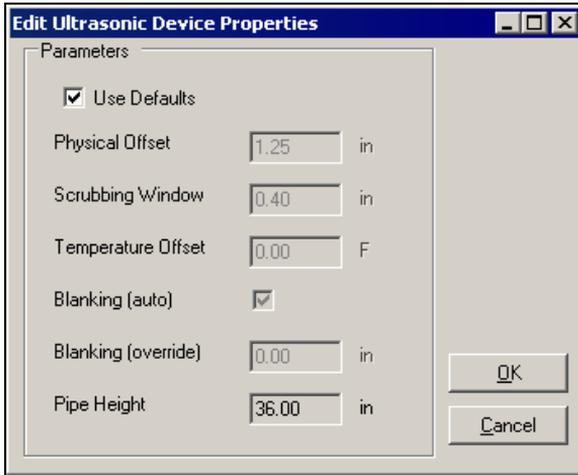
**Note:** **Profile** selects the Ultrasonic 1, Velocity 1, Pressure 1, and MLI 1 devices for the FlowShark monitor by default. The MLI device is not associated specifically with a sensor. It represents special software included in the monitor firmware that supports activities such as water quality sampling and event notification.

*The selected devices display in the **Monitoring Point Devices** section.*

6. Repeat steps 4 through 5 to assign devices to Monitoring Point 2, when applicable.
7. As necessary, edit the parameters specific to each device as follows:
  - Access the device parameters by selecting (*highlighting*) the device you want to edit in the **Monitoring Point Devices** section and then selecting the **Edit** button.
  - Refer to the following sections for details concerning the specific device parameters.
8. Once you have edited the devices as necessary, select the **OK** button to save the devices to the LIF.

## Editing the Ultrasonic Device

Edit the ultrasonic device as follows, and select **OK** when complete:



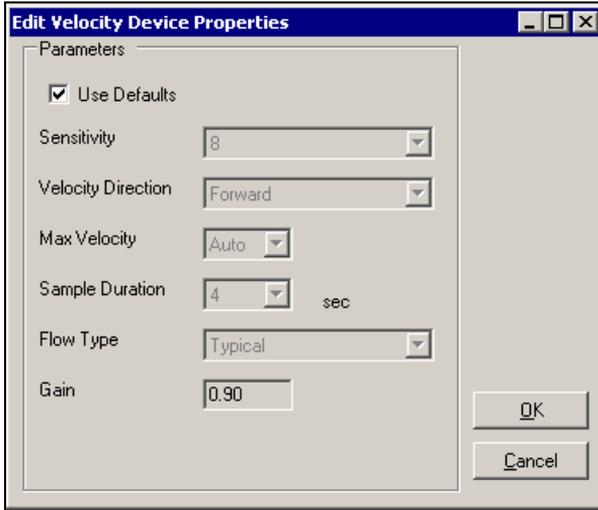
**Edit Ultrasonic Device Properties** dialog

- **Use Defaults** Select this checkbox to apply the default parameters to the ultrasonic device. Deselecting this option enables the parameter fields for editing.
- **Physical Offset** Enter the physical distance between the face of the ultrasonic depth sensor and the top (crown) of the pipe.
- **Scrubbing Window** Enter the allowable difference between individual ultrasonic pair readings and the average reading of all the pairs. If any single pair exceeds the difference, the pair will be flagged and removed from the calculation. The remaining pairs will be averaged to calculate the depth readings.
- **Temperature Offset** This field should not require modification for the FlowShark monitor. No additional temperature compensation is necessary.

- **Blanking (auto)** Select this checkbox to ensure the monitor disregards depths occurring within a distance from the face of the ultrasonic depth sensor equivalent to 5 percent of the range from the sensor face to the bottom of the pipe. This (*default*) setting effectively represents the vast majority of pipe/flow conditions. *Therefore, ADS strongly recommends selecting this option for most applications.*
- **Blanking (override)** Enter the distance from the face of the ultrasonic depth sensor within which to ignore data potentially representing erroneous readings. Use this option in place of the *auto-blanking* option (above) to designate a distance *greater than* 5 percent of the range from the face of the sensor to the bottom of the pipe. Do not choose a distance shorter than 5 percent of the range. *ADS recommends using this option only when spikes in the data are occurring beyond the 5 percent range and under direct consultation with an ADS representative.*
- **Pipe Height** This field represents the height of the pipe in which the sensor is installed. *This parameter is not editable from this location.*

## Editing the Velocity Device

Edit the velocity device in the following way, and select **OK** when complete:



**Edit Velocity Device Properties** dialog

**Note:** Typically, the velocity device should not require editing. However, when editing is necessary, ADS does not recommend changing velocity parameters without proper training or assistance.

- **Use Defaults** Select this checkbox to apply the default parameters to the velocity device. Deselect this option to enable the fields to allow editing of the velocity device parameters.
- **Sensitivity** Select the appropriate velocity sensor sensitivity from the drop-down. A sensitivity that is too high may produce noise, causing interference in the signal and resulting in spikes in the data. A low sensitivity can produce readings that are low in comparison with confirmation readings.
- **Velocity Direction** Select the direction in which the flow occurs or the velocity sensor is positioned.

- Bidirectional** Choose this option to enable the monitor to properly log reverse flow when it occurs at the monitoring point.
- Forward** Choose this option to read only positive flows when the sensor is positioned to fire upstream (*sensor crystals facing upstream*).
- Backward** Choose this option to read downstream flow when the sensor is installed in the outgoing line and positioned in the opposite direction to fire downstream (*sensor crystals facing downstream*). For example, this option may be used when two pipes converge, and the sensor is installed in the single outgoing line.
- Backward Bidirectional** Choose this option to read both downstream and reverse flows when the sensor is installed in the outgoing line and positioned in the opposite direction to fire downstream (*sensor crystals facing downstream*). For example, this option may be used when a weir is installed to measure overflows that may experience river intrusion.
- **Max Velocity** Select the appropriate option from this drop-down list to fine tune the maximum velocity value at the selected monitoring point for greater accuracy in the velocity data. An **Auto** option is available that allows the monitor to dynamically modify the optimal maximum velocity based on the current velocity readings to enhance the precision in processing velocity data. It can read velocities up to 30 feet per second (fps). However, ADS recommends using a fixed value for monitoring points that typically remain dry, such as overflows or sites downstream from pump stations. For these applications, consider choosing the **10** or **15 fps** option, particularly where a sudden surge of flow traveling at more than 3 fps can occur within a single interval.
- **Sample Duration** Select the duration of time for the sensor to fire based on the noise present at the location. This interval should increase with elevated noise levels. ADS recommends restricting the selected interval between 3 and 8 seconds.

- **Flow Type** Select the option corresponding to the conditions that generally reflect the monitoring point at which the Doppler velocity sensor is installed.
  - Typical** Choose this option for locations that consistently experience continuous flow.
  - Wet/Stagnant** Choose this option for locations that experience pooling, with only limited movement in the flow.
  - Usually Dry** Choose this option for locations that are characterized by a absence of flow.
- **Gain** This represents the factor that is applied to raw velocity to determine average velocity for receiving diagnostic readings and calculating quantity and typical days in the monitor. This parameter is editable through the **Quantity Coefficient Generator**.

## Editing the Pressure Device

Edit the pressure device as follows, and select **OK** when complete:

**Edit Pressure Device Properties** dialog

- **Serial Number** Enter the serial number listed on the pressure depth sensor.

**Note:** It is essential that you enter the pressure depth sensor's serial number and download the pressure coefficients to ensure the monitor logs accurate pressure depth data.

- **Coefficients** Select the **Load** button to browse to the folder in the local directory containing the coefficients for the pressure depth sensor (based on the sensor's serial number). These coefficients also can be entered manually. Download the

file containing the pressure coefficients to the local directory from the ADS website in the following way:

- Access the ADS website at [www.adsenv.com](http://www.adsenv.com) on the Internet.
  - Select **Environmental Services > Support > Client Services**.
  - Click on the **Download pressure coefficients...** link.
  - Right-click on the year in which the sensor was manufactured, and select the **Save Target As** option.
  - Rename the file to reflect the following format: *pressure.xx*, where xx represents the last two digits of the year in which the sensor was manufactured. *Remove the .txt extension!*
  - Save the file to the appropriate location in the local file system.
- **Pipe Height** This field displays the pipe height at the monitor location. *This parameter is not editable from this location.*
  - **Physical Offset** Enter the vertical distance from the bottom of the pressure depth sensor to the bottom center of the pipe. ADS recommends measuring this distance manually during the monitor installation or confirmation process. **Profile** defaults to *0 inches*.
  - **Electronic Offset** Enter the difference that exists between the pressure depth sensor readings and the manually measured depth. The default value is *0 inches*.

## Editing the MLI Device

Typically, the MLI device will not require editing. However, if the monitor will be supporting activities such as water quality sampling, event notification, or dual data rates, refer to the *Profile User's Guide* (#950015\*\*) for detailed instructions on properly setting the applicable parameters.

## Setting the Communication Parameters

Setting the communication parameters involves designating the modem, communication ports, and temperature, battery, and signal thresholds to ensure proper communication, measurement, and maintenance of the FlowShark monitor. Modify the communication parameters as necessary.

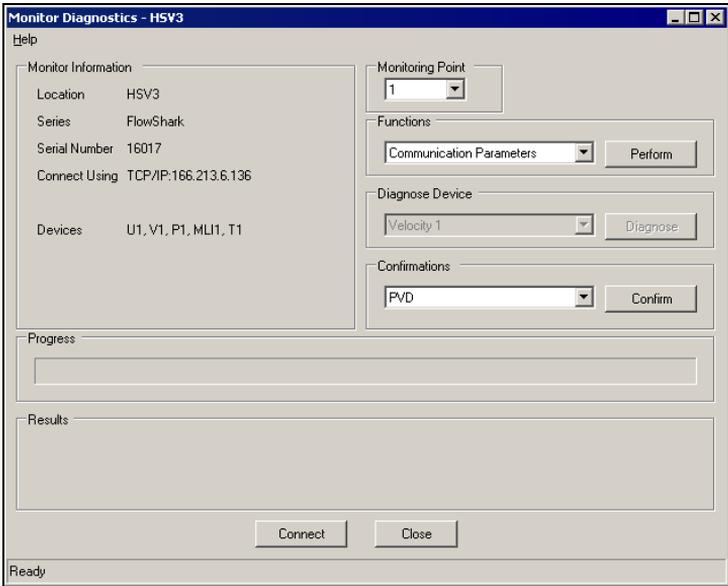
**Note:** Typically, the default settings should not require modification.

1. Select a monitor location from the **Profile** main screen, and then select **Tools > Diagnostics** from the main menu *or* click on the **Diagnostics** toolbar button.



**Diagnostics** toolbar button

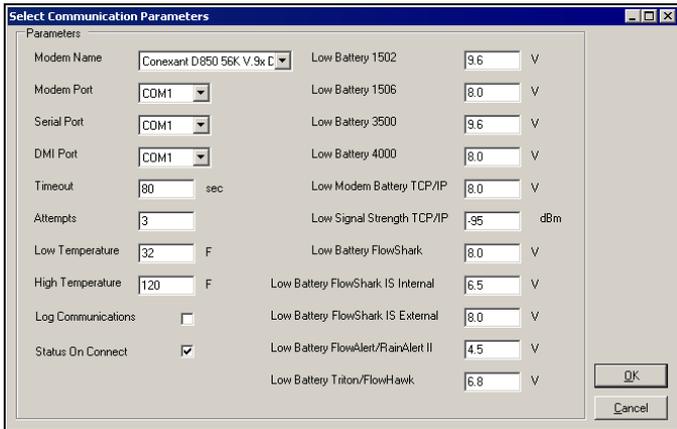
*The Monitor Diagnostics dialog displays.*



Monitor Diagnostics dialog

2. Select **Communication Parameters** from the **Functions** drop-down list, and click on the **Perform** button.

*The Select Communication Parameters dialog displays.*



Select Communication Parameters dialog

3. Select or enter the communication parameters as necessary:
  - Modem Name** Select the modem you want to use during modem communication from the drop-down list. This list should include all available modems on your computer.
  - Modem Port** Select the proper port for modem communication from this drop-down list. This list should include all available ports on your computer.
  - Serial Port** Select the proper port for serial communication from this drop-down list. This list should include all available ports on your computer.
  - DMI Port** Select the proper port for communication using the DMI from this drop-down list. This list should include all available ports on your computer.
  - Timeout** Enter the number of seconds you want your local computer to wait for a response from the monitor once communication has been initiated.
  - Attempts** Enter the number of times you want your local PC to request data from the monitor following failed attempts while the monitor is still on line.
  - Low Temperature** Enter the temperature reading from the monitor, ultrasonic depth sensor, and pressure depth sensor below which you want **Profile** to provide notification.
  - High Temperature** Enter the temperature reading from the monitor, ultrasonic depth sensor, and pressure depth sensor above which you want **Profile** to provide notification.
  - Log Communications** Select this checkbox to record all communication activities with the monitor.
  - Status On Connect** Select this checkbox to view details concerning the current state of the monitor once communication with the monitor has been established.
  - Low Battery 1502, 1506, 3500, 4000** *(These parameters do not apply to the FlowShark monitor)*

- Low Modem Battery TCP/IP** Enter the voltage from the battery pack powering wireless communications (for BG monitors with a battery pack dedicated to powering the wireless modem alone) below which you want **Profile** to provide notification. This setting also applies to the voltage from the battery packs found in monitors equipped with battery packs that work in parallel to power all monitor functions, including wireless communications. *ADS recommends leaving the default battery setting unchanged.*
- Low Signal Strength TCP/IP** Enter the signal strength (in dBm) below which you want **Profile** to provide notification for the wireless communication unit, when applicable. *ADS recommends using -95 dBm for the low signal strength.*
- Low Battery FlowShark** Enter the voltage supplied by one (powering the monitor) or both battery packs (powering both the monitor and wireless communications), based on the model, below which you want **Profile** to provide notification for FlowShark monitors. The *ADS recommends leaving the default battery voltage unchanged.*

**Note:** Notification of low battery voltage or signal strength occurs during the data collection process, during monitor activation, and when receiving TCP/IP communication status. View the associated logs through the **Diagnostics** tool and **Log Viewer** in **Profile**.

- Low Battery FlowShark IS Internal** *(This parameter does not apply to the FlowShark monitor.)*
  - Low Battery FlowShark IS External** *(This parameter does not apply to the FlowShark monitor.)*
  - Low Battery FlowAlert/RainAlert II** *(This parameter does not apply to the FlowShark monitor)*
  - Low Battery Triton/FlowHawk** *(This parameter does not apply to the FlowShark monitor)*
4. Select the **OK** button.

## Activating the Monitor

After configuring the monitor, *activate* the monitor to initiate the flow monitoring process based on the monitor configuration. Monitor activation involves generating the activation data using the **Profile** software, downloading this data to the monitor, and initiating flow data measurement and logging. The activation data includes the current monitor firmware (embedded software) and relevant portions of the LIF and other configuration parameters necessary to ensure monitoring activities reflect the specific site conditions and project requirements. The monitor requires these files and information to properly measure and record the flow.

Activating the monitor also tests communication between the user's computer and the monitor. To test communication, connect to the monitor on-site (*using the Direct Connection cable*) or have an analyst call the monitor from any telephone or computer at a remote location while a technician is on-site to verify that the monitor modem responds. This also will verify the monitor telephone number entered in **Profile**.

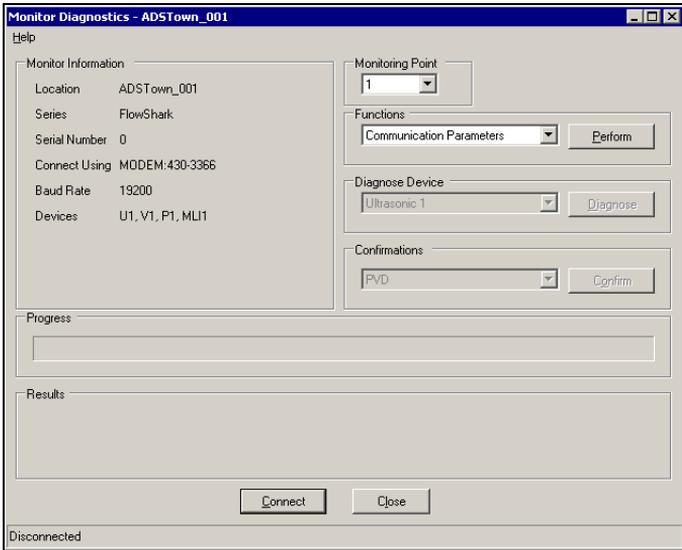
**Note:** If the monitor has been deactivated (configured to no longer wake up and take measurements), the user must communicate directly with the FlowShark monitor via a serial connection before remote communications can be resumed.

Monitor activation occurs through the **Diagnostics** tool in **Profile**. Activate the monitor as follows:

1. Select the monitor location for activation from the **Profile** main screen, and then click on the **Diagnostics** toolbar button.



The **Diagnostics** dialog displays.



Diagnostics dialog

2. Select the **Connect** button to establish communication with the monitor.

*Profile* initiates communication with the monitor and establishes a connection.

3. Select **Activate** from the **Functions** drop-down list, and then select the **Perform** button.

*Profile* downloads the configuration and installation information, activates the monitor, and begins logging data based on the selected configuration.

**Note:** All logged data stored in the monitor memory must be deleted before reactivating a FlowShark monitor if any devices have been modified, added, or removed from the location information file (LIF). **Profile** will detect if the devices in the LIF differ from the active devices in the FlowShark monitor and delete the FlowShark memory as part of the activation if differences are detected. Therefore,

ADS recommends collecting all data from the monitor before reactivating.

4. Click on the **Disconnect** button once activation is successful (designated in the **Results** section) and complete.

*The local computer disconnects from the monitor.*

5. Click on the **Close** button to exit the **Monitor Diagnostics** dialog.

# Running Device Diagnostics

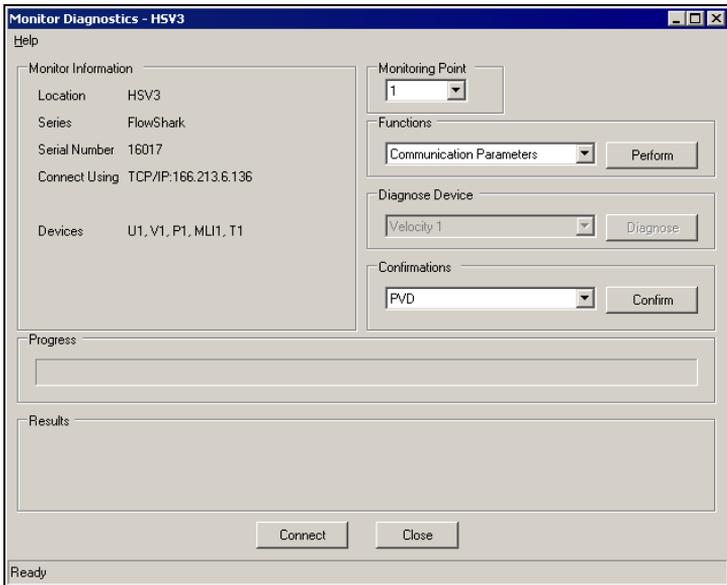
**Profile's** diagnostics tool enables the user to verify the proper operation of sensors, obtain current readings and status, adjust settings, and identify, diagnose, and troubleshoot potential problems with ultrasonic, velocity, and pressure devices. Run diagnostics for the system devices as follows:

1. Select the monitor location for which you want to run diagnostics on a device from the **Profile** main screen, and then select **Tools > Diagnostics** or click on the **Diagnostics** toolbar button.



**Diagnostics** toolbar button

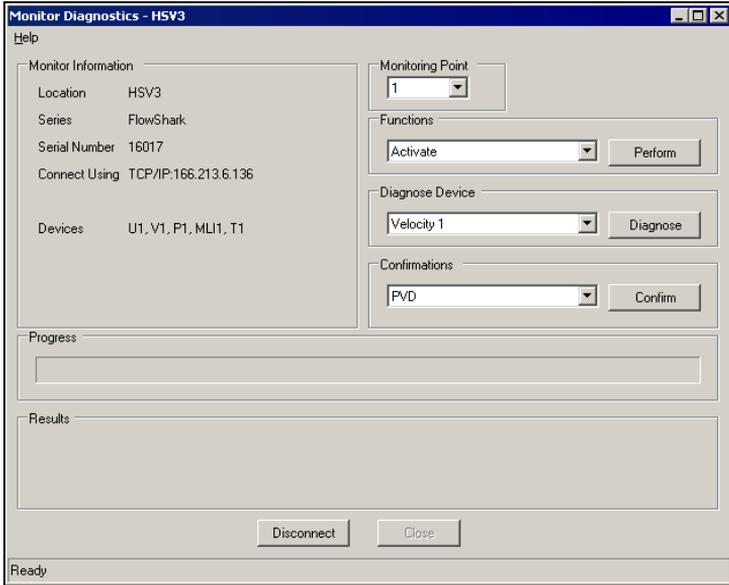
*The **Monitor Diagnostics** dialog displays.*



**Monitor Diagnostics** dialog

2. Select the **Connect** button to establish communication with the monitor.

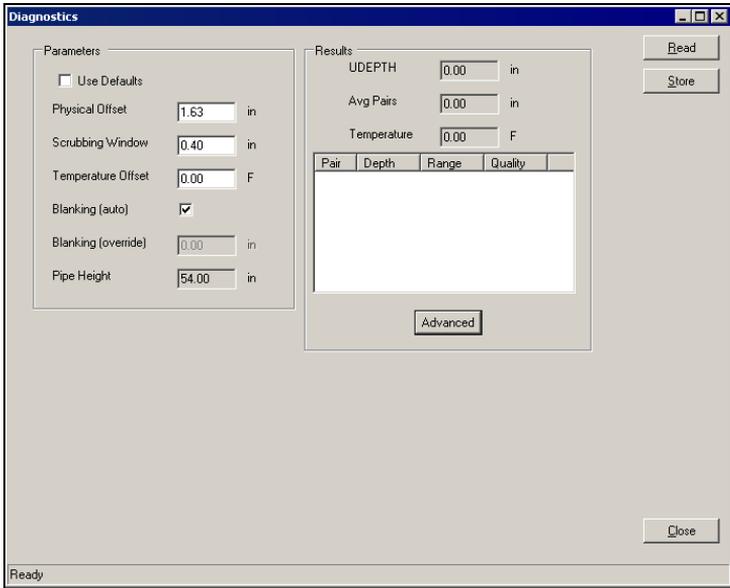
*Profile* initiates communication with the monitor and establishes a connection.



**Monitor Diagnostics** dialog during communication with a monitor

3. (*Diagnostics for Ultrasonic Device only*) Run diagnostics on the *ultrasonic* device as follows:
  - Select the **Ultrasonic 1** device from the **Diagnose Device** drop-down list, and then select the **Diagnose** button.

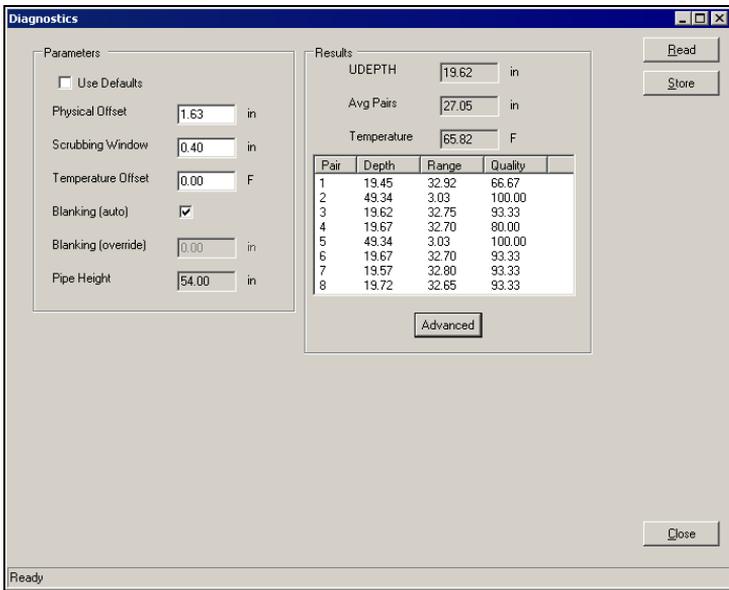
*The Diagnostics dialog displays the current configuration parameters stored in the LIF for the Ultrasonic 1 device.*



**Diagnostics** dialog for the Ultrasonic 1 device

- ❑ Click on the **Read** button.

The **Results** section displays the current *depth* and *temperature* readings measured by the ultrasonic depth sensor.



**Diagnostics** dialog for the Ultrasonic 1 device following sensor firing

- Click on the **Advanced** button to view more detailed diagnostic information.
- Verify the accuracy, consistency, and quality of the readings, and edit the configuration parameters as necessary.

**Note:** Refer to *Editing the Ultrasonic Device* on page 6-14 for descriptions of the individual configuration parameters.

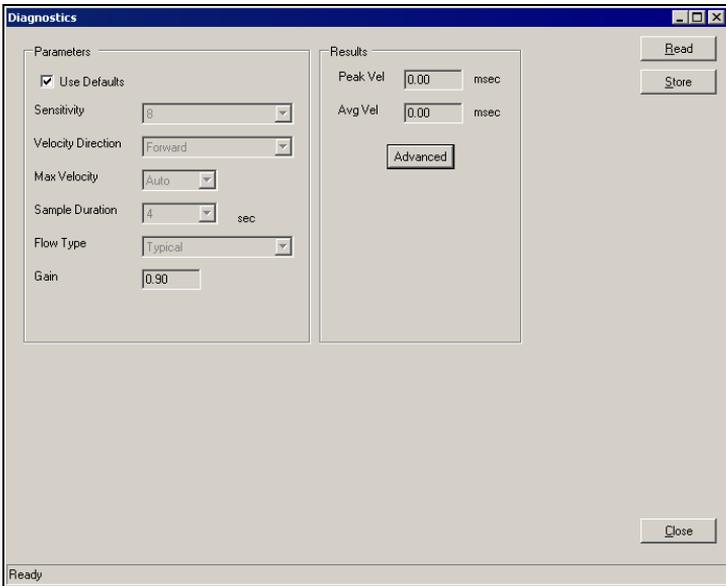
- Select the **Store** button to save any changes made in the device parameters to the LIF in the database.

**Note:** When running diagnostics on multiple devices for the same monitor, consider waiting to reactivate the monitor with the new LIF until the device diagnostics on all the selected devices are complete. However, save the

changes to the database before exiting each device window.

- Select the **Close** button to exit the Ultrasonic 1 device dialog and return to the **Monitor Diagnostics** dialog.
4. (*Diagnostics for Velocity Device only*) Run diagnostics on the velocity device as follows:
- Select the **Velocity 1** device from the **Diagnose Device** drop-down list, and then select the **Diagnose** button.

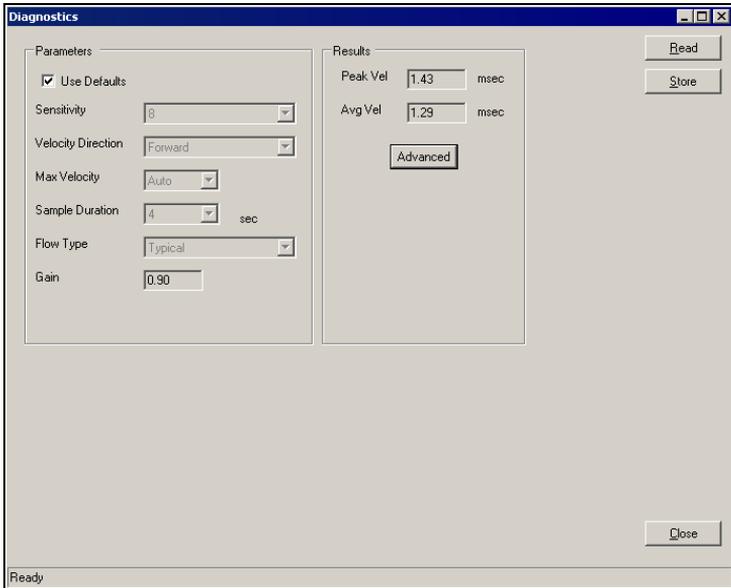
*The **Diagnostics** dialog displays the current configuration parameters stored in the LIF for the Velocity 1 device.*



**Diagnostics** dialog for the Velocity 1 device

- Click on the **Read** button.

*The **Results** section displays the current peak and average velocity of the flow measured by the velocity sensor.*



**Diagnostics** dialog for the Velocity 1 device following sensor firing

- Click on the **Advanced** button to view more detailed diagnostic information.
- Verify the accuracy of the reading, and edit the configuration parameters as necessary.

**Note:** Refer to *Editing the Velocity Device* on page 6-16 for descriptions of the individual configuration parameters. Save these modifications to the LIF in the monitor as follows:

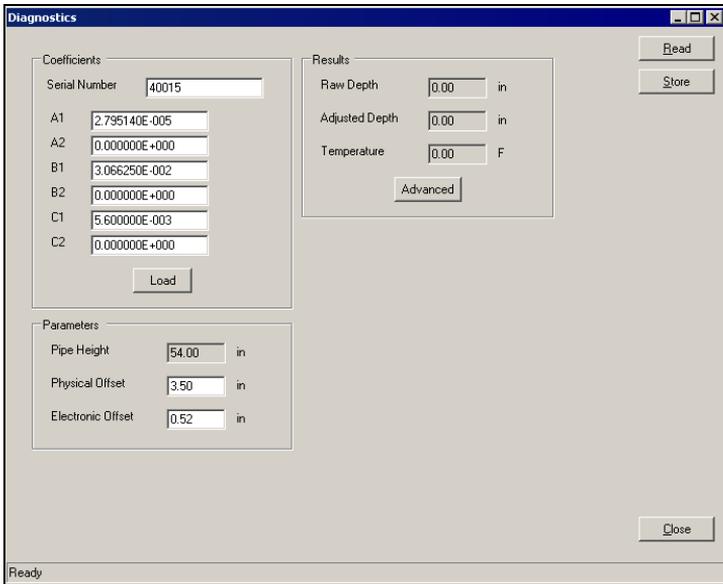
- Select the **Store** button to save any changes made in the device parameters to the LIF in the database.

**Note:** When running diagnostics on multiple devices for the same monitor, consider waiting to reactivate the monitor with the new LIF until the device diagnostics on all the selected devices are complete. However, save the

changes to the database before exiting each device window.

- Select the **Close** button to exit the Velocity 1 device dialog and return to the **Monitor Diagnostics** dialog.
5. (Diagnostics for Pressure Device only) Run diagnostics on the pressure device as follows:
- Select the **Pressure 1** device from the **Diagnose Device** drop-down list, and then select the **Diagnose** button.

The **Diagnostics** dialog displays the current configuration parameters stored in the LIF for the Pressure 1 device.

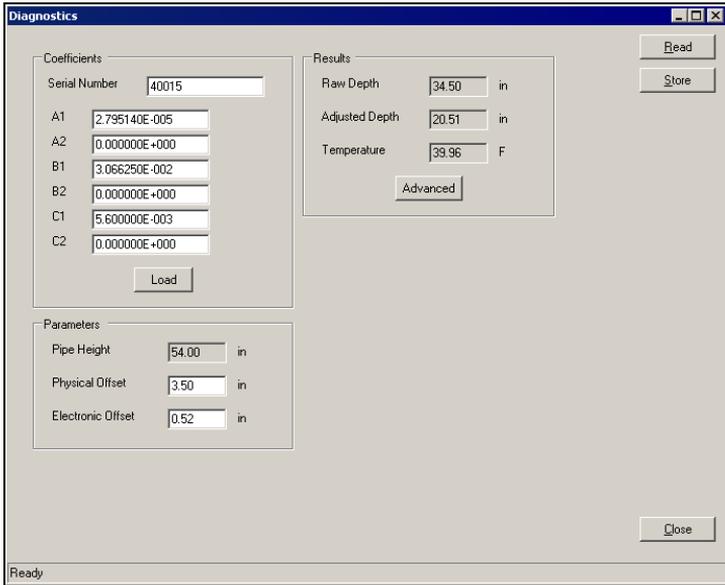


**Diagnostics** dialog for the Pressure 1 device

- Click on the **Read** button.

The **Results** section displays the current raw and adjusted depths and temperature reading measured by the pressure depth sensor. The Adjusted Depth represents a depth value established by applying a linear offset (Press K) to a raw pressure depth reading.

*Press K compensates for drift in the pressure depth sensor and generally reflects an average difference recorded over a designated time period between pressure depth measurements and reliable ultrasonic depth readings at the same monitoring point..*



**Diagnostics** dialog for the Pressure 1 device following sensor firing

- Click on the **Advanced** button to view more detailed diagnostic information.
- Verify the accuracy of the pressure depth and temperature readings, and edit the configuration parameters as necessary.

**Note:** Refer to *Editing the Pressure Device* on page 6-19 for descriptions of the individual configuration parameters. Save these modifications to the LIF in the monitor as follows:

- Select the **Store** button to save any changes made in the device parameters to the LIF in the database.

- ❑ Select the **Close** button to exit the Pressure 1 device dialog and return to the **Monitor Diagnostics** dialog.
- 6. Select **Activate** from the **Functions** drop-down list, and then select the **Perform** button. For more information on activating a monitor, refer to *Activating the Monitor* on page 6-25.
- 7. Select the **Disconnect** button to discontinue communication with monitor when finished running diagnostics on the system devices.

**Note:** ADS also recommends performing confirmations to verify the accuracy of the data and equipment. Confirmations involve comparing manual flow depth, temperature, and velocity measurements taken in the field against monitor readings taken electronically. The technician or analyst confirms the accuracy of the data based on the difference between the monitor and field readings. For more information, refer to the *Profile User's Guide* (#950015\*\*).

## Collecting Data from the Monitor

The data collection function available through **Diagnostics** provides enhanced features for viewing and analysis. Once the collection process is complete, **Profile** displays the data in both hydrograph and scattergraph formats based on the entities collected. In addition to the scattergraph displaying the depth-to-velocity relationship, it also displays a scattergraph illustrating the correlation between depth entities.

For analysis purposes, the **Diagnostics** tool automatically processes the data using **Site DR** (data review). This feature identifies issues concerning data quality or missing information and offers recommendations (when necessary) for conducting further review, investigation, or analysis. Collect data from the monitor as follows:

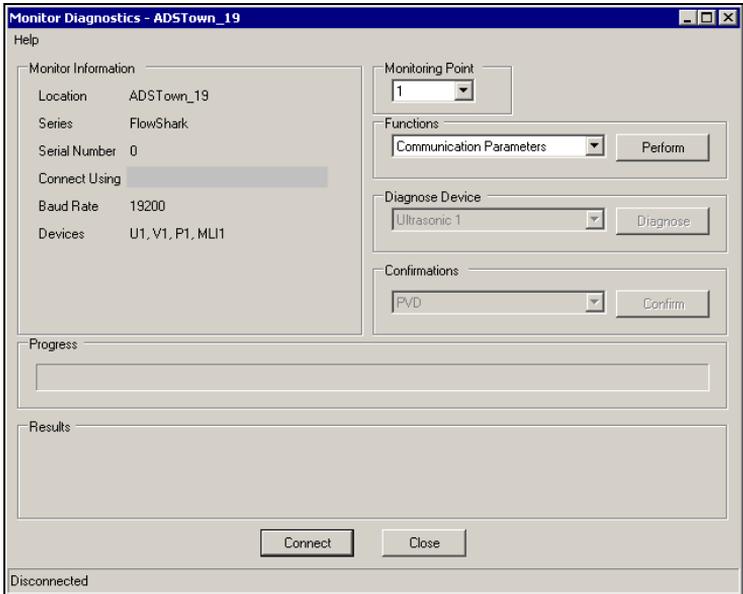
**Note:** Perform group and scheduled collects using the **Communications** tool.

1. Select the monitor location from which you want to collect data, and then select **Tools > Diagnostics** from the main menu *or* click on the **Diagnostics** toolbar button.



**Diagnostics** toolbar button

*The **Monitor Diagnostics** dialog displays.*



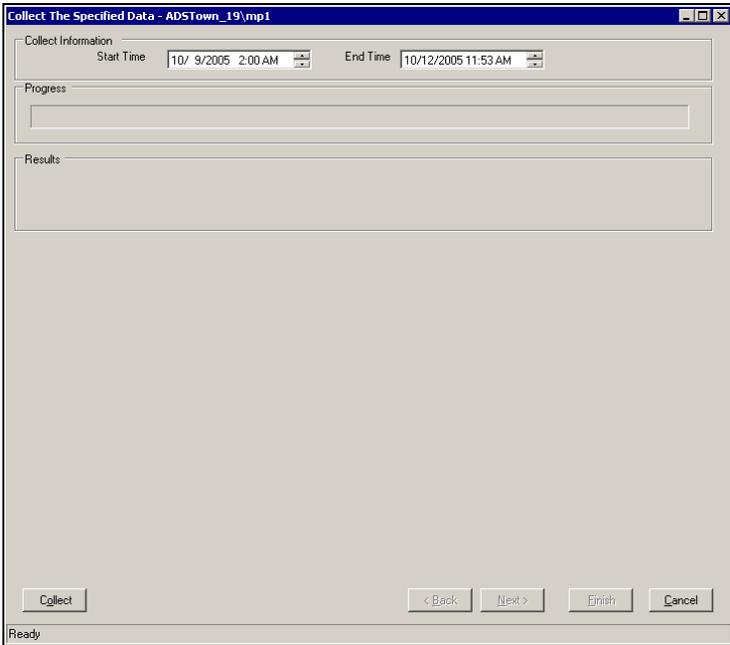
**Monitor Diagnostics** dialog

2. Select the **Connect** button to establish communication with the monitor.

*Profile* initiates communication with the monitor and establishes a connection.

3. Select **Collect** from the **Functions** drop-down list, and then select the **Perform** button.

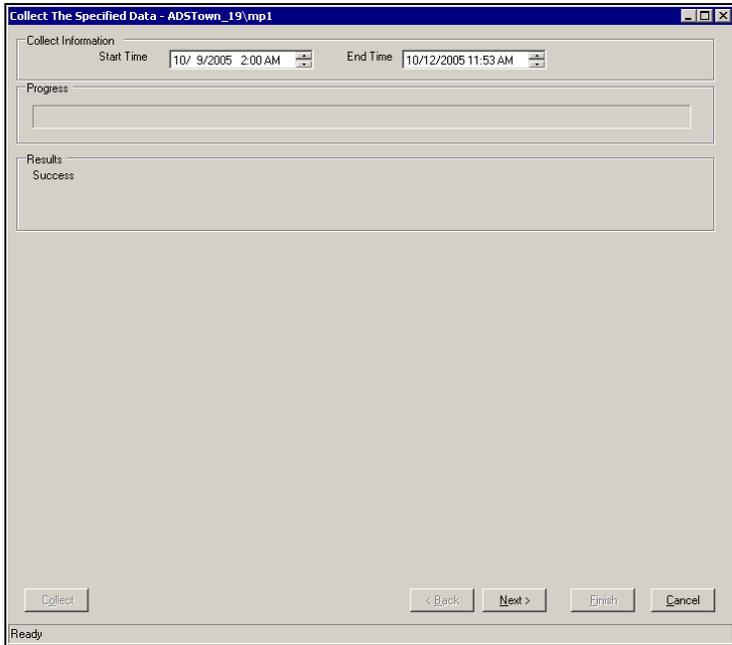
*Profile* displays the *Collect the Specified Data* dialog.



**Collect the Specified Data** dialog

4. Designate the range of data you want to collect from the monitor by editing the **Start** and **End Time** fields in the **Collect Information** in the section. Edit these fields directly by selecting the portion of the date or time stamp you want to change and then entering the appropriate designation or using the arrows to scroll up and down in the range. *If you do not edit the range, the start date and time automatically default to the **Auto Collect Start Date** in the LIF.*
5. Select the **Collect** button.

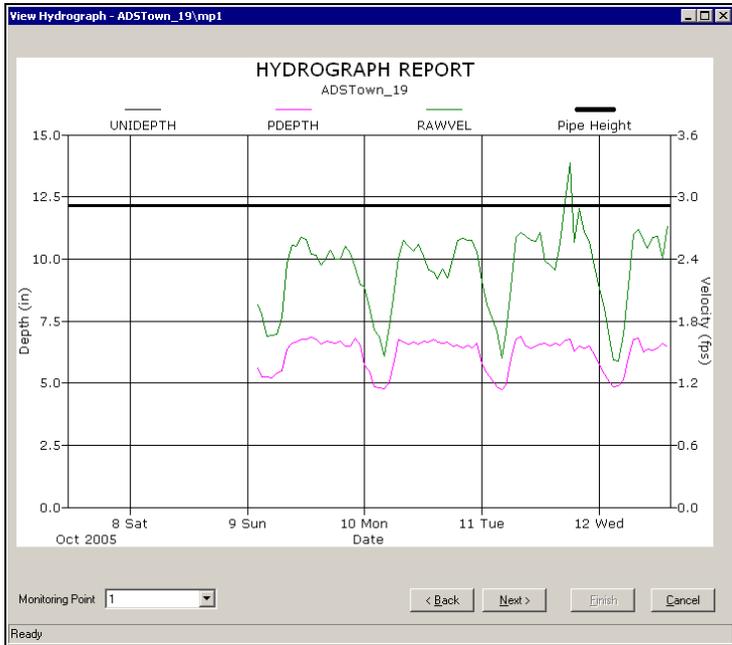
*The **Results** section displays the status of the collect. **Profile** collects all entity data from the monitor for the selected date/time range and stores it in the currently selected database.*



**Collect The Specified Data** dialog indicating data collection was a success

6. Click on the **Next** button.

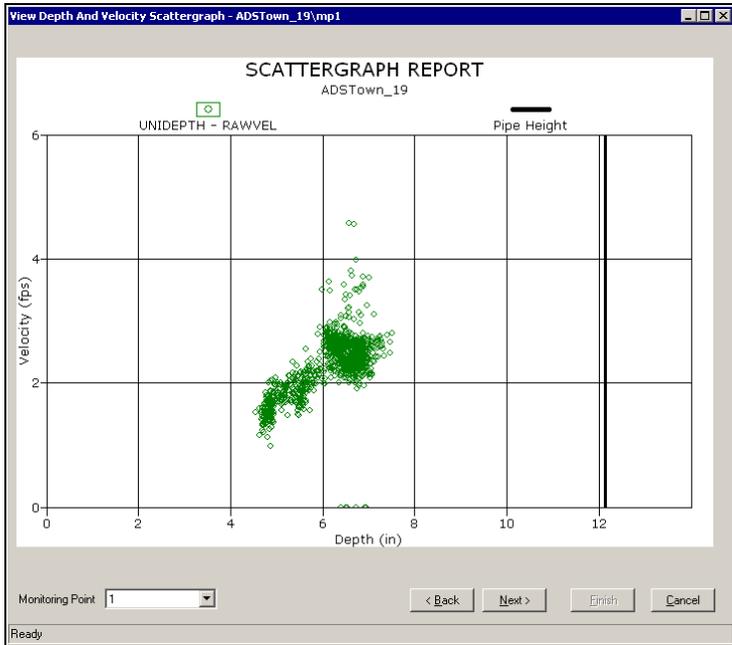
*The **View Hydrograph** – [location name] dialog displays the collected data in hydrograph format.*



**View Hydrograph – [location name] dialog**

7. Review the data on the hydrograph, and then click on the **Next** button. Under optimal conditions, the depth and velocity data should reflect a consistent diurnal pattern.

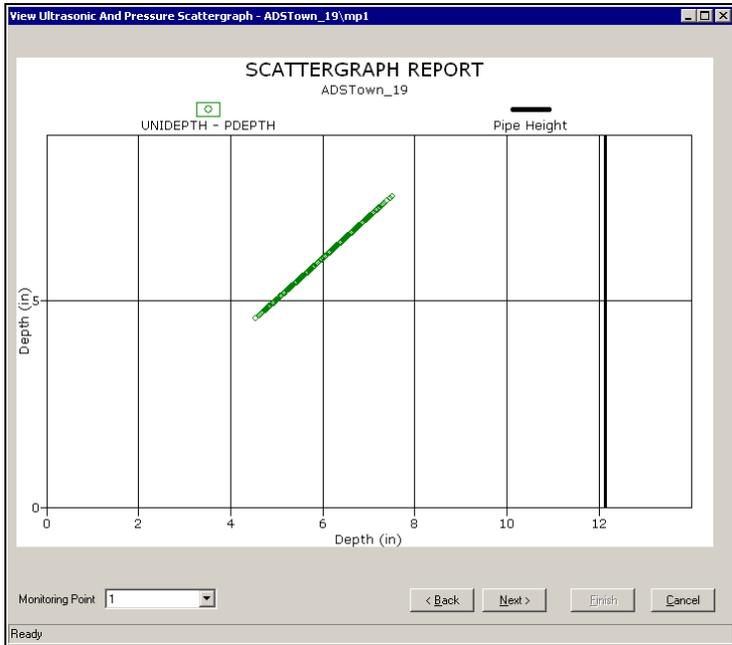
*The **View Depth and Velocity Scattergraph – [location name]** dialog displays the collected depth and velocity data in scattergraph format.*



**View Depth and Velocity Scattergraph – [location name] dialog**

8. Review the data on the scattergraph, and then click on the **Next** button. Under optimal conditions, the data on the graph should reveal velocity increasing with depth.

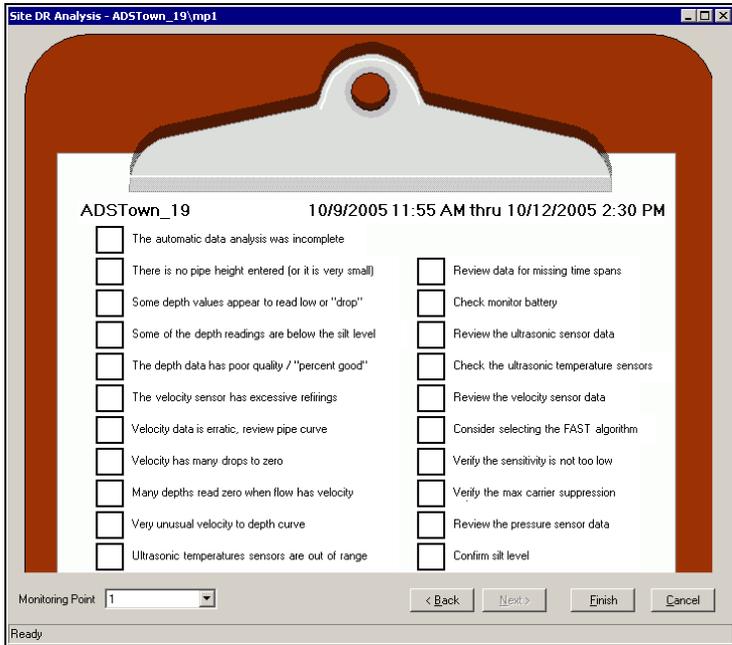
*The **View Ultrasonic and Pressure Scattergraph – [location name]** dialog displays the collected ultrasonic and pressure depth data in scattergraph format.*



**View Ultrasonic and Pressure Scattergraph – [location name] dialog**

9. Review the data on the scattergraph, and then click on the **Next** button. A properly performing pressure depth sensor should display a one-to-one relationship with the UNIDDEPTH data.

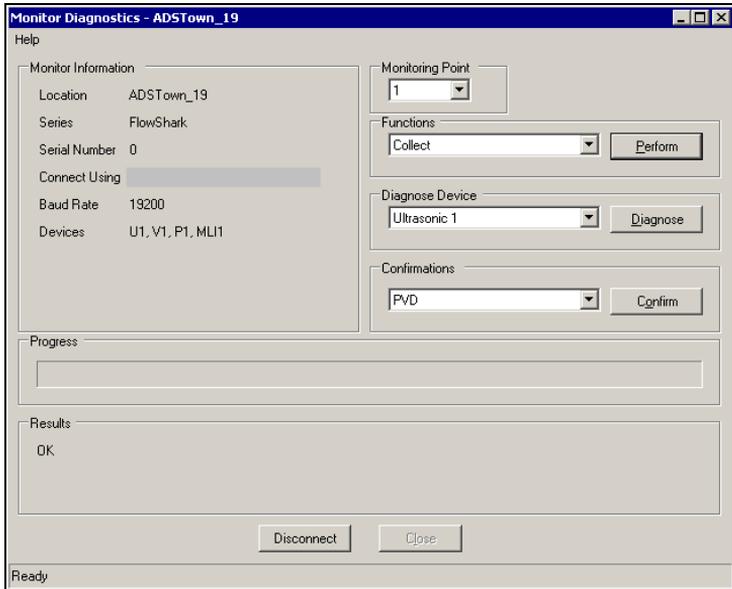
*The **Site DR Analysis** – [location name] dialog displays the results of the site data review analysis of the collected data and any recommendations for resolving identified issues.*



Site DR Analysis – [location name] dialog

10. Review any issues identified and the suggested actions, and then click on the **Finish** button.
11. Click on the **Close** button.

*The **Monitor Diagnostics** dialog displays. The **Results** section displays the recommendations from **Site DR Analysis** when applicable.*



**Monitor Diagnostics** dialog displaying good results without recommendations

## Upgrading the Monitor Firmware

**Profile** enables you to download updated firmware to a FlowShark monitor that may include new features and capabilities or performance improvements and enhancements in functions such as data processing, analysis, or communications.

ADS recommends collecting the data from the monitor *before* updating the firmware in the monitor to avoid losing the flow data stored in the monitor memory. Refer to the *Profile User's Guide* (#950015\*\*) for information on collecting data from the monitor. ADS also requires that you reactivate the monitor *after* updating the firmware.

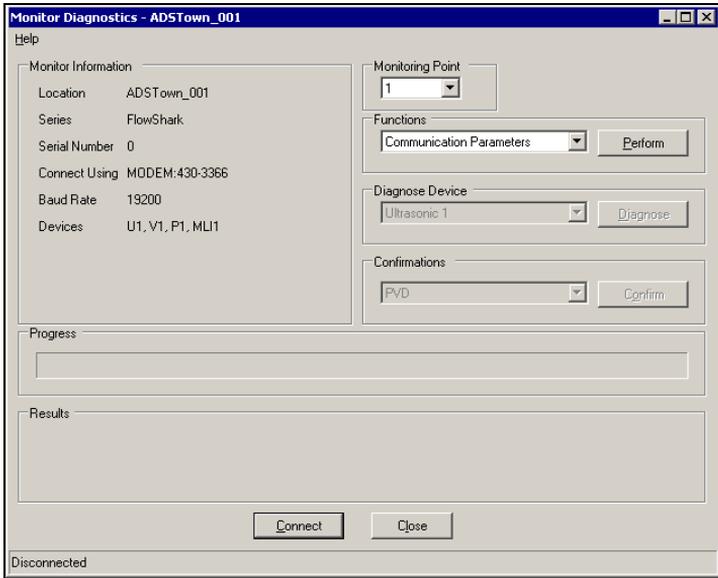
Upgrade the firmware in the FlowShark monitor memory as follows:

1. Select the monitor location for which you want to upgrade the firmware, and select **Tools > Diagnostics** from the main menu or click on the **Diagnostics** toolbar button.



**Diagnostics** toolbar button

*The **Monitor Diagnostics** dialog displays.*



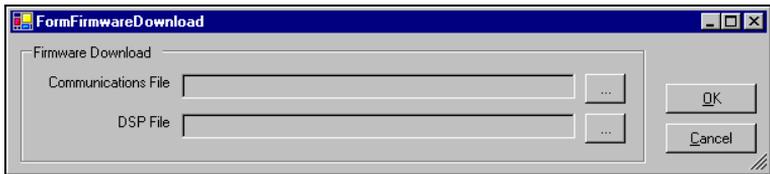
**Monitor Diagnostics** dialog

2. Select the **Connect** button to establish communication with the monitor.

*Profile* initiates communication with the monitor and establishes a connection.

3. Select **Update Firmware** from the **Functions** drop-down list, and then select the **Perform** button.

*The Form Firmware Download* dialog displays.



The **Form Firmware Download** dialog

4. Select the **Browse** button corresponding to **Communications File** to locate and designate the communications file applicable

to the firmware download. This program file represents the firmware containing the updated communications code.

**Note:** You can upgrade either firmware component (Communications or DSP) independently or both components at the same time. The option to download a Communications File is not available on newer FlowShark monitors.

5. Select the **Browse** button corresponding to **DSP file** to locate and designate the DSP file applicable to the firmware download. This program file represents the firmware containing the updated code for data processing activities.
6. Select the **OK** button.

*Profile downloads the new firmware to the monitor.*

7. Select **Activate** from the **Functions** drop-down list, and then select the **Perform** button.

*Profile activates the monitor with the updated firmware.*

## Viewing Diagnostic and Data Logs

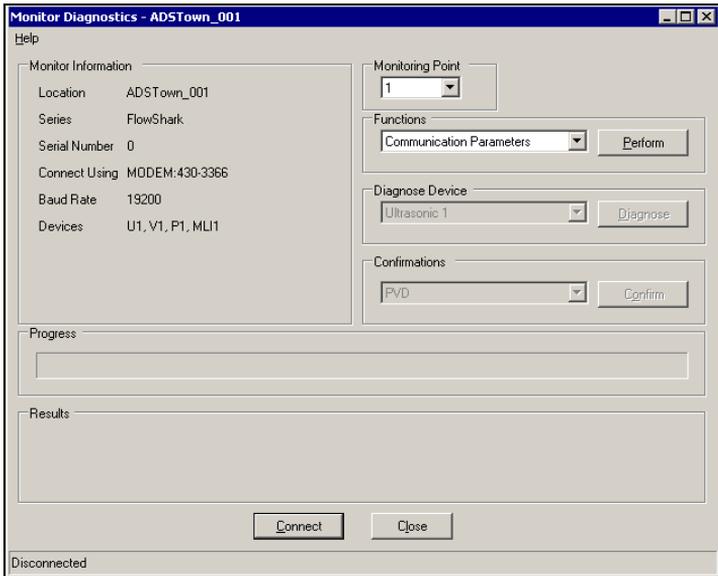
**Profile** generates detailed logs for many activities performed through **Diagnostics**, such as monitor activation, data collection, and firmware downloading. These logs are available immediately following the activity and for future access to historical information.

1. Select the monitor location for which you want to view an activity log from the **Profile** main screen, and then click on the **Diagnostics** toolbar button.



**Diagnostics** toolbar button

*The **Monitor Diagnostics** dialog displays.*

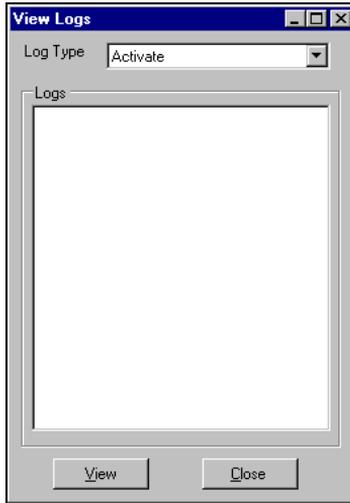


**Monitor Diagnostics** dialog

2. Select the monitoring point for which you want to view a log from the **Monitoring Point** drop-down list.

3. Select **Logs** from the **Functions** drop-down list.
4. Click on the **Perform** button.

The **View Logs** dialog displays.



**View Logs** dialog

5. Select the kind of log you want to view from the **Log Type** drop-down list.

The **Logs** section displays all logs available for the selected location and log type.

6. Select the specific log you want to view, and select the **View button**.

The **View Logs** dialog displays the logs available for viewing corresponding to the selected log type.

7. (optional) Select the **Print** button to print the log file contents.

## CHAPTER 7

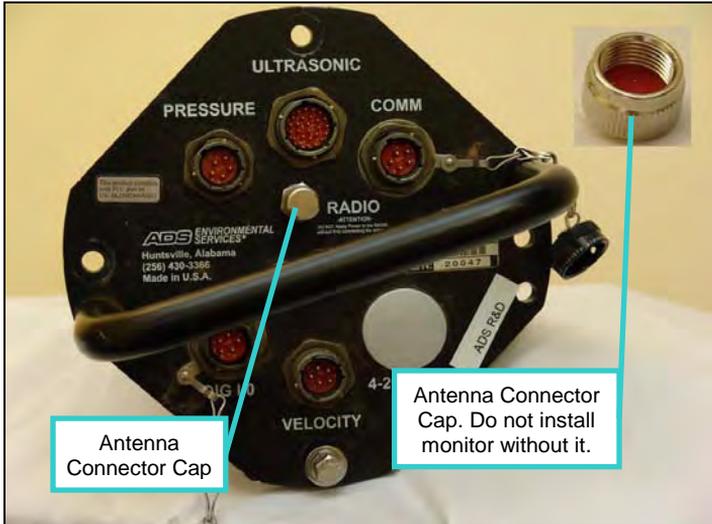
# Monitor Installation

After installing the sensors and establishing communications, install the FlowShark<sup>®</sup> monitor in the manhole. The monitor mounts inside the manhole by an aluminum mounting bracket attached to the monitor and bolted to the manhole wall or rim. The following procedures for monitor installation apply to most sites. However, because manholes differ in many ways, some sites may require the installer to implement slight modifications to the standard installation technique.

Before installing the monitor at the site, activate the monitor to verify that the monitor is configured correctly for the application and that the battery packs (or external power) are operating at an adequate voltage. Make any necessary changes to the configuration *before* mounting the unit. Refer to *Chapter 10, Maintenance and Troubleshooting*, for information on replacing the battery packs, if necessary.

**Note:** Manhole and sewer system work involves confined space entry and is inherently dangerous. Therefore, installers and technicians must comply with all federal, state, and municipal regulations concerning confined space entry. ADS<sup>®</sup> is not responsible for any injuries, damages, claims, or liability resulting directly or indirectly from the use of this installation guide or the installation of any ADS equipment.

**Warning:** Leaving a wireless monitor without an antenna connected to the monitor will quickly drain the monitor (or radio) battery packs.



FlowShark antenna connector cap

**Note:** When temporarily installing a wireless FlowShark monitor without an antenna, designate *Serial* for the **Communication Type** through the **Diagnostics** tool in **Profile**® and use a Y-cable for power (ADS p/n 5000-0559). This will double the battery life because both battery packs will be working in parallel to power the monitor. Refer to *Chapter 10, Maintenance and Troubleshooting*, for information on accessing the battery pack corresponding to the radio. The Y-cable is applicable only to *earlier* versions of the FlowShark monitor and the *current* version of *Model 5000-BG* monitors. All newer monitors equipped with the combined DSP/communication board contain battery packs that function in parallel.



Y-cable for power

**Note:** Make sure the antenna connector cap is installed before hanging the monitor in the manhole.

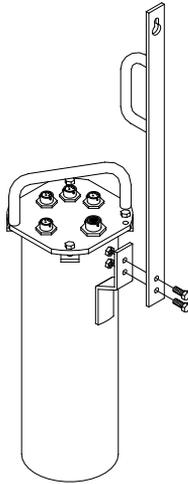
## Mounting the Monitor to the Manhole Wall

Mount the monitor to the manhole wall using the monitor bracket as follows:

1. Determine the appropriate location to mount the monitor bracket to the manhole wall. Consider the following when selecting the proper location:
  - Select a location that will allow you to remove the monitor easily during service visits using the mounting bracket (extension handle).
  - Select a location that provides only a minimal potential for the monitor to experience surcharge conditions.
  - Select a location that will prevent the manhole lid from potentially damaging the monitor during removal or when rotating in the opening.
  - Select a location that will allow personnel to enter/exit the manhole without removing the monitor.
2. Hold the top end of the mounting bracket against the manhole wall, and mark the location for the mounting hole through the keyhole in the bracket.
3. Drill a hole 2½ inches deep at the mark, and install a 3/8-inch x 3-inch anchor bolt in the hole.

**Note:** Make sure all anchor bolts, studs, nuts, and washers used in mounting the monitor are stainless steel.

4. Twist a nut onto the anchor bolt, but do not tighten it down. Leave enough space between the nut and the wall for the thickness of the mounting bracket.
5. Mount the bottom of the bracket onto the monitor flange with two 3/8-inch x 1-inch hex bolts, 3/8 – 16 hex nuts, and 3/8-inch washers.

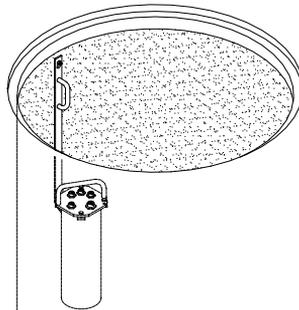


Bolting the mounting bracket to the flange welded to the monitor

6. Carefully lower the monitor into the manhole, and place the keyhole of the mounting bracket over the anchor bolt.

**Note:** ADS strongly recommends attaching a security line to the monitor before lowering it into the manhole to prevent the monitor from accidentally dropping down the manhole during installation.

7. Tighten and secure the bolt against the mounting bracket.



Monitor installed in the manhole

8. Neatly coil and secure the excess sensor and telephone cables in the manhole to simplify future monitor service activities. Secure the cables to plastic anchors or ¼-inch x 2 ¼-inch anchor bolts using 14-inch cable ties.

**Note:** Be careful to avoid damaging the sensor cables during installation activities. Even small pinholes in the cable can cause a sensor to malfunction or fail.

## Mounting the Monitor to the Manhole Rim

Mount the monitor to the manhole rim using the monitor bracket as follows:

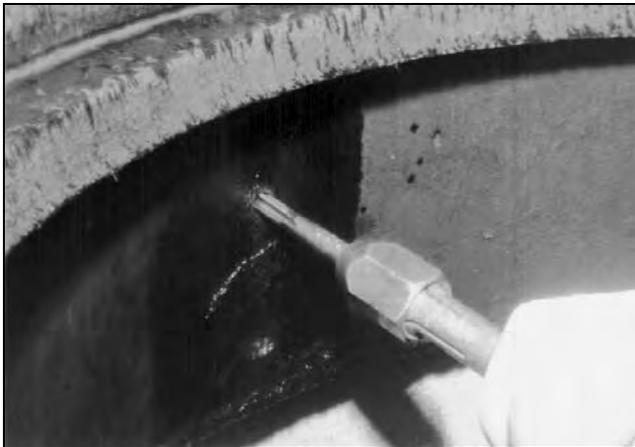
1. Determine the appropriate location to mount the monitor bracket to the inside of the iron manhole rim. Consider the following when selecting the proper location:
  - Select a location that will allow you to remove the monitor easily during service visits using the mounting bracket (extension handle).
  - Select a location that provides only a minimal potential for the monitor to experience surcharge conditions.
  - Select a location that will prevent the manhole lid from potentially damaging the monitor during removal or when rotating in the opening.
  - Select a location that will allow personnel to enter/exit the manhole without removing the monitor.
2. Hold the keyhole at the top end of the bracket against the lower inner rim of the manhole, and mark the location for the stainless steel stud through the keyhole in the bracket. Make sure there will be enough room to lift the bracket up and over the stud when installed.
3. Drill a hole(s) into the manhole rim 1 inch deep using a 5/16-inch carbide-tipped drill bit.

**Note:** Consider starting the hole using smaller bits to make pilot holes and increasing up to a 5/16-inch bit. In addition, spray cutting oil or another lubricant into the hole while drilling and tapping.



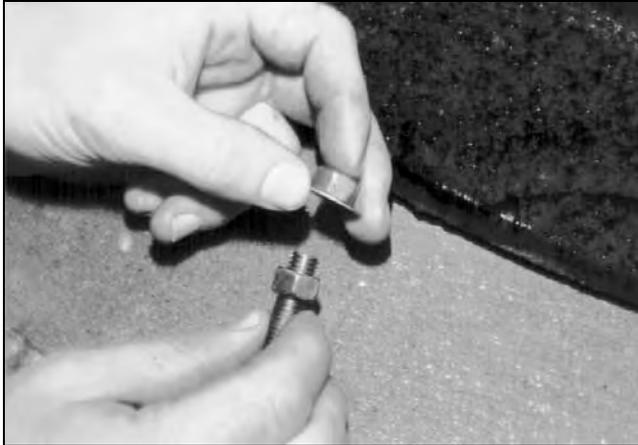
Drilling the hole in the manhole rim

4. Use a 3/8-inch x 16 threads-per-inch tap to cut threads in the hole. Twist the tap clockwise  $\frac{3}{4}$  turn, and then back out  $\frac{1}{2}$  turn before continuing deeper.



Using the tap to thread the hole

5. Chase the threading action at intervals to clear the metal debris by backing the tap almost completely out of the hole and then screwing it back into the hole. Lubricate the hole between threading.
6. Place two 3/8 – 16 hex nuts (with a 3/8-inch washer in between) onto one end of a 3/8- × 2-inch stud.



Placing two nuts and a washer onto the stud

7. Using two wrenches, turn the inner nut counter-clockwise and the outer nut clockwise simultaneously to bind the two nuts together on the stud.



Binding the nuts together with the washer in between

8. Install the stud into the tapped hole using the outer nut to engage the wrench. Continue turning the nut clockwise until the stud is seated at least  $\frac{3}{4}$  inch deep in the hole.



Installing the stud into the hole in the manhole rim

9. Separate the nuts, and turn the inner nut until it is flush against the rim.
10. Slide the washer against the inner nut, and turn the outer nut toward the edge of the stud.



Positioning the nuts on the stud to receive the mounting bracket

11. Mount the bottom of the mounting bracket onto the monitor flange with two 3/8-inch x 1-inch hex bolts, 3/8 – 16 hex nuts, and 3/8-inch washers. It may be necessary to drill new holes in the flange.
12. Carefully lower the monitor into the manhole, and place the keyhole in the bracket over the outer nut on the stud.

**Note:** ADS strongly recommends attaching a security line to the monitor before lowering it into the manhole to prevent the monitor from accidentally dropping down the manhole during installation.

13. Slide the bracket against the inner nut and washer, and tighten and secure the outer nut against the bracket.
14. Neatly coil and secure the excess sensor and telephone cables in the manhole to simplify future monitor service activities. Secure the cables to plastic anchors or 1/4-inch x 2 1/4-inch anchor bolts using 14-inch cable ties.

**Note:** Be careful to avoid damaging the sensor cables during installation activities. Even small pinholes in the cable can cause a sensor to malfunction or fail.

## CHAPTER 8

# Analog Input/Output Installation and Configuration

Several models of ADS® FlowShark® flow monitors are available for monitoring signals from other equipment via analog inputs and sending signals or information to other equipment via analog outputs. This chapter describes how these inputs and outputs are used and configured and provides some typical connection configurations. It also includes the power requirements for the analog outputs.

The following FlowShark models support analog inputs and outputs:

- 5000-CG
- 5000-CG-1
- 5000-CL
- 5000-CS

**Warning:** Never attempt to connect to a third party system or connect/interrupt the supply of a signal to another system without having an owner representative present. In some cases, these activities may disable or interrupt a critical automated process (e.g., pump control), cause a dangerous condition (e.g., overpressure), or generate false alarms.

**Note:** Due to the diversity of signal sources and frequently undocumented cabling and wiring at remote monitoring locations, ADS strongly recommends that a qualified electrician, instrumentation technician, or owner representative perform connection of ADS equipment to the signal source. The examples and typical installation steps included in this section illustrate considerations for a successful installation.

## Analog Inputs

FlowShark models 5000-CG, 5000-CG-1, 5000-CL, and 5000-CS support the monitoring of two analog input 4-20mA signals from other instruments. These signals typically represent measurements made by other devices, such as flow meters, pressure sensors, or level transducers. To properly configure the monitor using **Profile**<sup>®</sup>, you must know the signal scale and engineering units (e.g., 4 to 20mA = 0 to 20MGD).

Perform the following steps to connect analog inputs (maximum of two) to the ADS FlowShark monitor.

---

## Gathering Tools and Equipment

Gather the following tools and materials in preparation for analog input connection:

- Laptop with **Profile** 3.4 or greater
- LIF configured with analog parameters, sample rate, etc.
- PC comm cable (ADS p/n 5000-0601)
- Analog I/O cable (ADS p/n 5000-0698)
- Electrical tape
- Cable ties
- Cable grip fitting with gland for .4" cable
- Hole saw or punch to fit cable gland
- Pilot drill if punch used
- Drill
- Vacuum (to remove cuttings from box if hole saw used)
- Hand tools (strippers, screwdrivers, wrenches, etc.)
- Digital multimeter

## Connecting Analog Inputs

Follow the steps in this section to complete a typical analog input connection to an ADS FlowShark monitor. Refer to the cable pin-outs on pages 8-11 and 8-12. The two analog inputs use pairs 1 and 2 of the cable; these pairs use the same colors on both the Belden and Alpha cables.

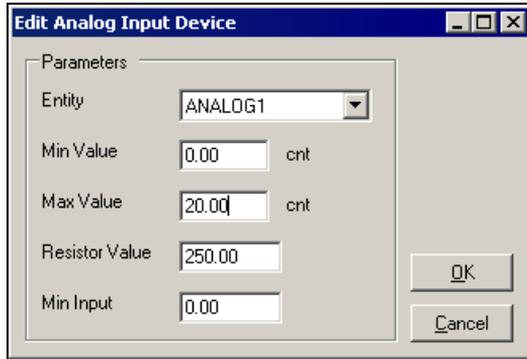
**Note:** Be sure that external power is available to the monitor prior to connection of the signal wiring. If it is not ready, testing cannot be completed and may result in return visits by the owner representative and/or electrician or instrument technician for wiring problems.

1. Determine where to connect to the analog signal wiring. Always keep the distance from the signal source to the ADS FlowShark monitor as short as possible, and avoid any cable runs that would run parallel to switching panels or other control components. These can create electrical noise that will interfere with the signal and create false readings.

Following are common connection points:

- Inside the transmitter that supplies the signal
  - SCADA I/O termination panel
  - PLC analog I/O terminals
  - RTU analog I/O terminals
  - Strip chart recorder I/O terminals
  - Integrator/totalizer I/O terminals
  - Front panel display I/O terminals
2. Create and configure the new FlowShark location with analog input parameters as follows:
    - Follow the steps listed in *Chapter 6, Configuration and Activation*, to create a new monitoring location.

- ❑ Edit the analog input device supported by the FlowShark monitor as follows, and select OK when complete.



**Edit Analog Input Device** dialog (*FlowShark*)

- **Entity** Select the entity for which to input data through the analog input device.
  - **Min Value** Enter the reading to correspond to 4 mA.
  - **Max Value** Enter the reading to correspond to 20 mA.
  - **Resistor Value** Enter the nominal value in ohms for the 4/20 mA circuit.
  - **Min Input** Enter the value to serve as the cutoff value for the input. If a reading falls below this setting, the value recorded will reflect this setting.
3. Follow the remainder of the steps listed in *Chapter 6* through *Activating the Monitor* to fully configure the FlowShark.
  4. Determine whether the addition of the ADS equipment will add too much “load” to the analog signal “loop.” The ADS monitor adds 250 ohms to the loop. If too much load is added, the signal will “clip” and cause the data to flat line at a lower level than the true peak, which will result in understated peak levels or flows. If only one device is connected to the analog signal, sufficient current is probably available to drive the ADS input.

If more than two devices are attached to the analog signal loop, ADS strongly recommends load testing the loop.

Perform the following to determine whether too much load exists on the analog signal:

- ❑ Connect the laptop to the ADS FlowShark monitor and activate it (provided it is not already activated) with the analog input parameters (as configured previously).
- ❑ Establish a **Diagnostic** session with the monitor and observe the analog input value.
- ❑ Have the owner representative simulate a full-scale event that causes the signal to go to 20mA with the ADS FlowShark connected. The full-scale event may be simulated via utilities in the transmitter that supplies the signal or, in the case of a depth sensor, by placing a target under the sensor that will indicate a maximum reading. Magmeters usually have a utility to drive the output to full scale. However, each device is different and, in some cases, there is no way to simulate maximum output. In this scenario, calculate the load by measuring the voltage that drives the loop and then measuring the resistance added by each device on the loop. This load calculation should be performed by the owner's instrumentation representative because it requires toggling power to different devices and disconnecting/reconnecting the signal and possibly power wiring.

**Note:** If the load is too great and/or the analog signal is controlling the customer equipment, a loop isolator must be installed before proceeding.

5. Install and connect the FlowShark monitor to the analog signal as follows:
  - ❑ Run the analog I/O cable (ADS p/n 5000-0698) from the ADS monitor to the signal source. This usually entails creating an entry into an enclosure. Therefore, the owner representative will need to be present to power off the

equipment while a hole is drilled and a cable gland is installed. The cable gland must accommodate the 0.40-inch diameter ADS cable.

- ❑ Connect the ADS cable. *However, before beginning this step, have the owner representative turn off the power to the equipment and to any other connected devices that may provide power through other means!* There are two “pairs” of the cable used for analog inputs. Input #1 (also called channel #1) uses the red/black pair. Input #2 uses the white/black pair. Black is always negative. Place these wires in series with the signal wiring to become part of the loop. The negative from the signal source usually connects to the positive of the ADS cable. However, under some conditions, these are reversed. No damage will occur if these are connected backwards; however, the readings will be negative. Reverse the connection if the readings are negative or zero after checking the readings through **Diagnostics**.

**Note:** Tape the ends of all unused wires in the ADS cable to avoid shorting anything in the connection area.

## Verifying the Analog Input Values

Verify the analog input values recorded by the FlowShark as follows:

1. Check the readings using **Diagnostics** in the **Profile** software (refer to *Chapter 6*). If possible, simulate different levels to make sure the signal changes and compare it to a local display, if available.
2. Check for proper operation by collecting data from the monitor after a day of operation and comparing it to other historical data. Use both the trend and daily total to be sure no changes to the measurement system occurred after introducing the ADS FlowShark into the loop.

## Analog Outputs

The ADS FlowShark models 5000-CL, 5000-CS, 5000-CG, and 5000-CG-1 can be configured to perform synchronous or real-time measurement of depths, velocities, and flow rate and provide any two of these measurements to third-party equipment via 4-20mA analog signal output.

Real-time measurement means the monitor measures depth and velocity and calculates quantity (if required) continuously. The monitor must receive external power to support analog output operation. In some cases, a 24VDC power supply will be required to provide power to drive the analog outputs. An ADS 12/24V Power Supply (p/n 5000-0728) can power both the monitor and analog output loop. Refer to pages 8-11 and 8-12 for cable pin outs and signal definitions. Refer to page 8-15 and 8-16 to view the ADS Power Supply. Refer to page 8-17 for a typical analog output wiring diagram.

Use **Profile** (Version 3.4 or greater) to configure the two outputs assign them to represent the following measurements or calculated values:

- Ultrasonic Depth
- Pressure Depth
- Unidepth
- Velocity (Average Velocity)
- Flow Rate (Qcontinuity)

The most common use for analog outputs is to provide flow and depth information to SCADA systems through Remote Terminal Units (RTUs) or Programmable Logic Controllers (PLCs). Other possible uses are to drive chart recorders, totalizers, samplers, and local displays.

---

## Loop Power

In many cases, a 24VDC power supply must be provided to excite the current loop. ADS highly recommends using the ADS Power Supply (ADS p/n 5000-0728), which provides both the 12VDC external monitor power and the 24VDC loop power from a single sealed enclosure. If customer equipment, such as an RTU, PLC, or chart recorder, already supplies loop power, an external 24VDC supply is not required. A customer-supplied loop power supply can be used if the power available to the monitor is at least 1A *at the monitor*.

---

## Signal Connection

**Warning:** ADS uses Belden and Alpha cables to manufacture I/O cables (ADS P/N 5000-0698). Each manufacturer uses unique colors for the internal conductor insulation of the analog output wires. Failure to observe this difference could result in damage to the system. Therefore, before making any connections, identify the cable type based on the permanent labels (reading *BELDEN* or *ALPHA*) affixed to the cable jacket. Refer to one of the following color code charts based on the cable type:

### ALPHA Cable Type

Pin	Pair	Wire Color <sup>1</sup>	Function	Notes
A	1	Shield	Analog Input Channel #1 Ground	Connect to shield of end-run cable
B	1	Red	Channel #1 4-20mA Input +	
C	1	Black	Channel #1 4-20mA Input -	
D	2	Shield	Analog Input Channel #2 Ground	Connect to shield of end-run cable
E	2	White	Channel #2 4-20mA Input +	
F	2	Black	Channel #2 4-20mA Input -	
G	3	Black	0 - 5 VDC Output #1	Jumper Selectable, default is 4-20mA output
H	4	Blue	+24VDC Power (for Output #1) <sup>2</sup>	+24VDC not needed if user supplies loop power
J	4	Black	Output #1 Ground	
K	3	Green	4-20mA, Output #1	
L	5	Black	0 - 5 VDC Output #2	Jumper Selectable, default is 4-20mA output
M	6	Yellow	+24VDC Power (for Output #2) <sup>2</sup>	+24VDC not needed if user supplies loop power
N	6	Black	Output #2 Ground	
P	N/C	N/A	N/A	
R	5	Brown	4-20mA, Output #2	

<sup>1</sup> This represents the color wire inside the associated pair.

<sup>2</sup> +24VDC power for outputs 1 and 2 can be common if isolated operation is not required.

### BELDEN Cable Type

Pin	Pair	Wire Color <sup>1</sup>	Function	Notes
A	1	Shield	Analog Input Channel #1 Ground	Connect to shield of end-run cable
B	1	Red	Channel #1 4-20mA Input +	
C	1	Black	Channel #1 4-20mA Input -	
D	2	Shield	Analog Input Channel #2 Ground	Connect to shield of end-run cable
E	2	White	Channel #2 4-20mA Input +	
F	2	Black	Channel #2 4-20mA Input -	
G	3	Black	0 - 5 VDC Output #1	Jumper Selectable, default is 4-20mA output
H	4	Blue	+24VDC Power (for Output #1) <sup>2</sup>	+24VDC not needed if user supplies loop power
J	4	Black	Output #1 Ground	
K	3	Green	4-20mA, Output #1	
L	5	Black	0 - 5 VDC Output #2	Jumper Selectable, default is 4-20mA output
M	6	Brown	+24VDC Power (for Output #2) <sup>2</sup>	+24VDC not needed if user supplies loop power
N	6	Black	Output #2 Ground	
P	N/C	N/A	N/A	
R	5	Yellow	4-20mA, Output #2	

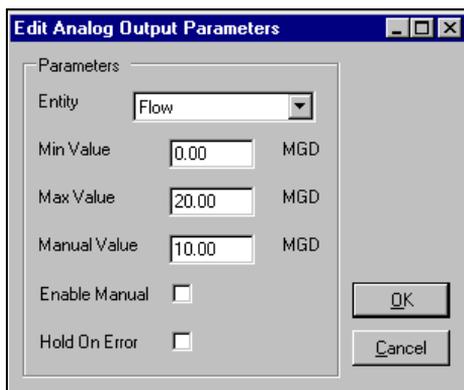
<sup>1</sup> This represents the color wire inside the associated pair.

<sup>2</sup> +24VDC power for outputs 1 and 2 can be common if isolated operation is not required.

## Typical Analog Output Installation

Most installations involve supplying loop power to the ADS monitor and using analog outputs to represent flow rate and depth. Typically, the monitor will be located in the manhole, with all physical connections to the analog signal and external power wiring occurring outside the manhole (inside a sealed junction box or through a potted, spliced connection). A common installation involves the following procedure:

1. Make sure the instrument receiving the analog signals is set up to receive the signal wiring (e.g., box penetrations have been completed, conduit has been run, and sealing glands are in place).
2. Install FlowShark monitor and sensors as described in *Chapters 3 through 7*.
3. Establish the range and engineering units (4 to 20mA = 0 to X units) for the analog outputs.
4. Edit the analog output card device supported by the FlowShark monitor as follows using the **Profile** software, and select **OK** when complete.



Edit Analog Output Parameters dialog (*FlowShark*)

- Entity** Select the entity for which to output entity data through the Analog Output.
- Min Value** Enter the data value that will correspond to the weakest signal available in the scale (4 mA). This value should reflect the lowest value possible for the data.
- Max Value** Enter the data value that will correspond to the strongest signal available in the scale (20 mA). This value should reflect the highest value possible for the data.
- Manual Value** Enter the value that will represent the output when the **Enable Manual** option is selected. *This parameter applies only for testing purposes; therefore, ADS does not recommend editing this value.*
- Enable Manual** Select this checkbox to output the value designated in the **Manual Value** field. *ADS provides this option only for testing purposes.*

**Note:** Activate the monitor with the **Enable Manual** option selected to perform the test based on the designated **Manual Value**. Once the test is complete, disable this option and reactivate the monitor to implement the **Min** and **Max Values** entered for the output device.

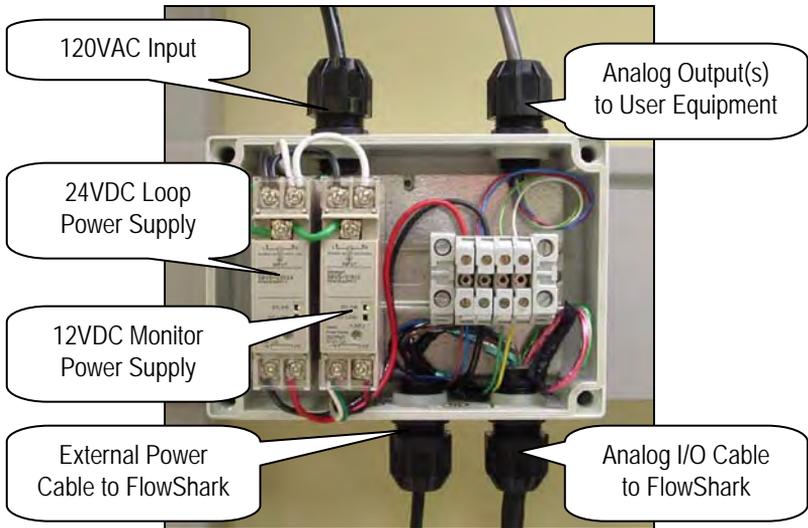
- Hold On Error** Select this checkbox to maintain the last output reading when the current value is in error.
5. Set up receiving instrument with ranges and units to match the monitor outputs.
  6. Mount the loop/monitor power supply outside the manhole, and provide AC power.
  7. Run the power and signal cables from the monitor to outside the manhole, and then splice/seal to the end-run cables (i.e., the loop power supply and signal terminations).

**Note:** Refer to the images on pages 8-15 and 8-16 and the diagram on page 8-17 for additional details on typical loop power and analog output connections.

8. Connect +24VDC from the loop power supply to the *blue* and *brown* wires (for *Alpha cable*) or to the *blue* and *yellow* wires (for *Belden cable*).
9. Connect the power supply ground to the *black* wires that were twisted with the *blue/brown* (Belden) or *blue/yellow* (Alpha) pairs.
10. Activate the monitor with the monitoring point and analog output configuration.
11. Using the Analog Output Diagnostic tools in **Profile**, manually drive the outputs to 4, 12, and 20mA and confirm that each channel is the correct value at the receiving instrument.
12. Return the monitor to normal mode, and confirm outputs are changing and roughly match actual values.

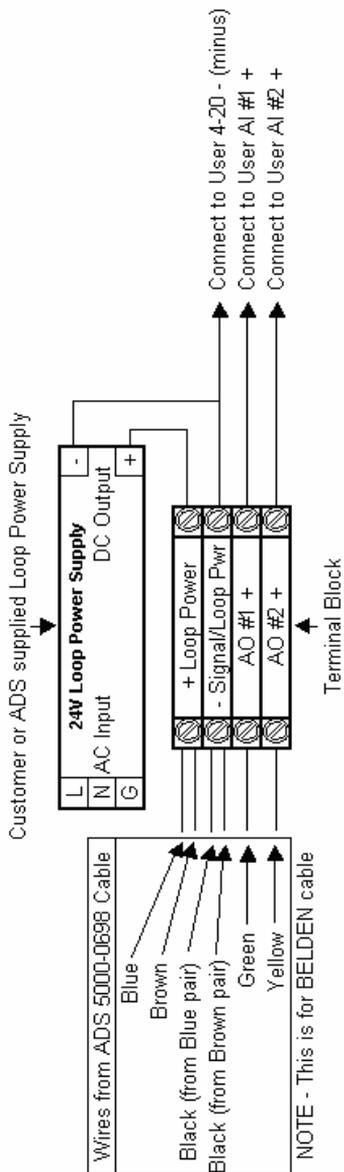


ADS 12/24VDC power supply cover (P/N 5000-0728)



Internal view of 12/24VDC power supply

**Typical Installation of ADS Analog Outputs - Recommended Power and Wiring Breakout**  
 (NOTE - For fully isolated outputs, use separate power supplies and separate DC wiring)



Typical installation of ADS analog output

## CHAPTER 9

# Modbus

Many newer SCADA and Process Control systems utilize a direct serial connection to measurement devices to provide an efficient means to access process values. One of the many industry standard protocols that use this serial connection is Modbus. There are currently several versions of Modbus (ASCII, RTU, TCP/IP, and others). Currently, ADS<sup>®</sup> provides data using ASCII. Other versions of Modbus may be available in the future. The ADS monitor serves as a Modbus slave device and provides process values via Modbus Holding Registers.

The following ADS FlowShark<sup>®</sup> models support real-time operation using Modbus ASCII to interface with third party equipment:

- FlowShark-AG\*
- FlowShark-AG-M
- FlowShark-AL\*
- FlowShark-AS\*
- FlowShark-BG
- FlowShark-BL
- FlowShark-CG
- FlowShark-CG-1

- FlowShark-CL
- FlowShark-CS

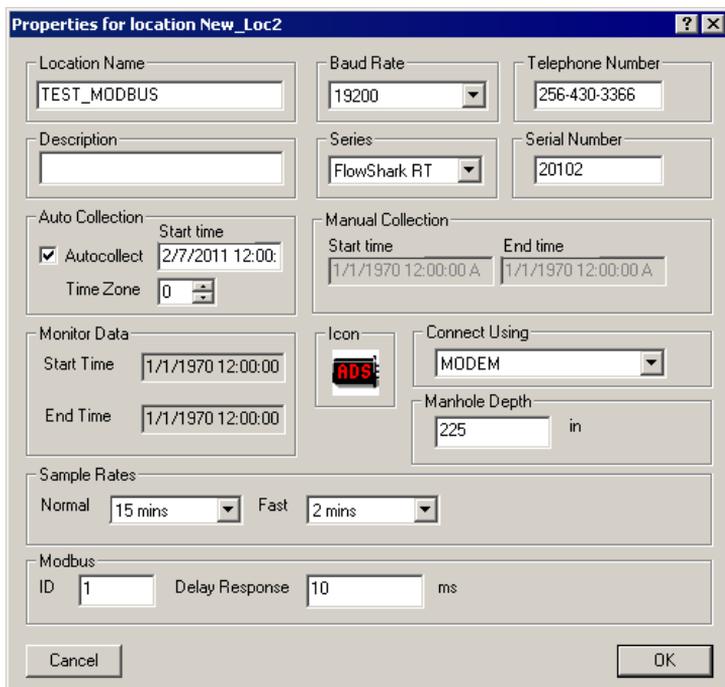
\* Requires retrofit kit to add external power and provide external cabling to support Modbus communication

This chapter contains the steps for configuring and installing the Modbus interface between the ADS FlowShark monitor and the customer's receiving process control system.

## Configuring the FlowShark Monitor to Operate in Real-Time

Follow the steps listed in *Chapter 6, Configuration and Activation*, to create a new monitoring location with the following modifications:

1. Select **FlowShark RT** (Real -Time) from the **Series** drop-down list.
2. Enter a slave address number from 2 to 57, 59 to 96, or 98 to 247 in the **ID** field that will be used when facilitating communication. The numbers 1, 58 and 97 are used for other addressing purposes and will not be recognized. The **Modbus Slave ID** number is downloaded to the FlowShark during activation and is used during handshaking for real-time communications.
3. In **Delay Response** field, enter the amount of time, in milliseconds, following a request before the monitor returns the requested data.



Properties dialog for a FlowShark RT location

4. Follow the remainder of the steps listed in *Chapter 6* to fully configure and activate the **FlowShark RT** location.

## Defining the Modbus Register Values

Use the information provided in the following table to select the FlowShark output values to be received by the control system. This table contains the most commonly configured value names and associated register addresses.

Holding Register Definitions			
Description	Profile <sup>®</sup> Entity	Units of Measure	Registers
Flow	FLOW1 (QCONTINUITY)	MGD	40001-40002
UniDepth	UNIDEPH	Inches	40005-40006
Ultrasonic Depth	UDEPTH	Inches	40007-40008
Pressure Depth	PDEPTH	Inches	40053-40054
Peak Velocity	RAWVEL	FPS	40003-40004
Average Velocity	N/A (VELOCITY)	FPS	40061-40062
Rain Intensity	RAINI	Inches/Unit Time	40019-40020
Rain	RAIN	Inches	40031-40032
Number of Samples	SAMPLES	N/A	40077-40078
Analog Input 1	Varies	Varies	40087-40088
Analog Input 2	Varies	Varies	40089-40090
Analog Output 1	Varies	Varies	40091-40092
Analog Output 2	Varies	Varies	40093-40094
Monitor Battery	BTYVOLT	Volts	40025-40026
Radio Battery	BTY_RADIO	Volts	40029-40030

Additional entities and values are available. Refer to *Appendix C, Modbus Output Registry Entities and Values*, for a complete list.

---

## Modbus Data Type

All values are floating point and two Modbus registers wide.

---

## Connecting the FlowShark to Modbus

Connect the ADS FlowShark to Modbus using the ADS Modbus RS232 cable (ADS p/n 5000-0726). The standard cable comes in a 10-foot length. This length extends the signal outside the manhole to merge with the home-run cable to the customer's equipment. The maximum length of the line can be 50 feet, based on 10 feet of ADS added to 40 feet of user-supplied cable. If additional cable is required, connect to the ADS cable inside a sealed junction box or using other sealed, waterproof methods.

**Note:** The RS232 line driver in the monitor is not intended to power any RS232 port devices (e.g., a line powered RS485 device). If the Modbus signal requires long haul, the user must provide a powered RS232-to-RS485 converter and supply power to the converter. Other methods for extending the RS232 line are available; however all require some kind of power.

---

### RS232 Port Settings

The Modbus Master port must be set to 19,200 baud, 8 data bits, 1 stop bit, and no parity.

## Verifying Modbus Output Values

Perform the following to verify the accuracy of the Modbus output values:

1. After the FlowShark RT has been activated and the Modbus interface is live, allow an adequate period of time for the FlowShark to take and store several data samples.
2. Collect the stored data following the procedure described in *Collecting Data from the Monitor* in Chapter 6, *Configuration and Activation*.
3. Compare the collected data to the Modbus output values. While the values should be similar, but not exact. The values stored to the FlowShark RT monitor memory and collected by **Profile** are an average of the readings taken between the data storage intervals. Therefore, the values will not be equal to the real-time values provided through the Modbus interface.

## CHAPTER 10

# Maintenance and Troubleshooting

While the ADS® FlowShark® flow monitor and sensors are designed for dependability and durability, all electronic devices are vulnerable to wear, malfunction, or failure, particularly in a harsh sewer environment. However, many system problems can be avoided altogether by performing routine maintenance and inspections. The design of the monitor enables the user to perform general diagnostics and troubleshooting to prevent, isolate, and correct many problems easily. These serve to minimize unnecessary monitor downtime and data loss.

This chapter provides routine maintenance instructions as well as general diagnostic and troubleshooting guidelines for isolating and correcting monitoring system problems.

**Warning:** Remove the monitor from the manhole before replacing the battery packs or performing service activities which may involve disconnecting cables from the monitor. In addition, disconnect telephone service at the network interface box before disconnecting cables from the monitor lid. These activities help prevent possible shock or injury to personnel as well as damage to the equipment during service visits at the monitor location.

## Maintaining the System Components

The FlowShark flow monitor and sensors should receive routine on-site inspections and remote confidence checks to maintain the equipment in optimal working condition, minimize monitor downtime, and prevent possible data loss.

ADS recommends performing these inspections following initial system installation, during site visits, and on a scheduled interval (i.e., quarterly or during battery pack replacement).

**Note:** The only service or maintenance activity ADS permits within the monitor chassis is battery pack replacement. Therefore, please do not handle, alter, modify, remove, or replace any other components inside the monitor. This may void the monitor warranty agreement.

---

## Gathering Replacement Parts and Supplies

Gather the following replacement parts and supplies for performing routine maintenance:

- Dryer tube or desiccant for the pressure depth sensor
- Battery packs (replace both at the same time)
- Ultrasonic depth, pressure depth, and Doppler velocity sensors
- Soft bristle brush
- Paper towels
- Compressed air
- Flat head screwdriver and assorted wrenches (including torque wrench)

## Inspecting the Monitor

Perform the following inspections during site visits or from a remote location (when applicable):

- Inspect the monitor mounting bracket to verify that the bracket and bolts are free of heavy corrosion and the bolts are tightened and secure.
- Verify that the four bolts holding the monitor together are snug, and tighten any loose bolts.
- Verify that the monitor is mounted securely in the manhole.
- Inspect the monitor for general integrity. Verify that nothing more than surface corrosion is present and that the monitor has no obvious mechanical defects. Replace the monitor if necessary.
- Perform monitor data confirmations. These should occur from a remote location when telephone communication is available.
- Review the applicable logs in **Profile**<sup>®</sup> to verify the status of the monitor clock, communications, firmware, battery pack(s), and temperatures.
- Clean the monitor and sensors regularly with a soft bristle brush and paper towels. *However, do not use detergent!*
- Make sure all connector ports on the monitor top are dry. Use compressed air or paper towels to dry out wet or damp connectors.

## Confirming the Monitor

Confirm the accuracy of the sensor subsystems in the monitor on a regular basis. Confirmation involves comparing manually-measured depth of flow and velocity readings to the monitor's readings. This process also verifies sensor parameters. Refer to the *Profile User's Guide* (#950015\*\*) for detailed information on performing confirmation procedures.

## Replacing the Monitor Battery Packs

Check the battery voltage using **Profile** before installing the monitor and after collecting data. Replace the battery packs as soon as possible whenever the voltage reads below 8.0 volts or **Profile** provides a **Low** battery status.

**Warning:** Batteries reading below 8.0 volts may prevent communication with and data collection from the monitor.

Check the current battery voltage in the monitor using the **Diagnostics** tool in **Profile** in the following way:

1. From the **Profile** software main screen, select the monitor and then select the **Diagnostics** toolbar button (or select **Tools > Diagnostics** from the main menu).
2. On the **Diagnostics** dialog, select the **Connect** button to establish communication with the monitor.
3. Once communication is established, select **Monitor Status** from the **Functions** drop-down list and then select the **Perform** button.

*The **Print Preview** dialog displays the current system information, including the monitor battery voltage, in printable format. Select the **Print** button to print the report contents.*



**Print preview dialog (battery pack voltage displays under Voltage)**

When necessary, replace the battery packs in the monitor as follows:

**Warning:** During rainy or snowy conditions, disconnect the cables from the monitor and move to a dry area before changing batteries; the circuit boards are exposed and must be kept dry. If the monitor is moved indoors from a cold, outdoor environment, wait for the entire chassis (inside and out) to warm to the inside temperature before changing batteries. Opening the chassis too quickly could result in condensation damage to the boards.

**Note:** The chassis includes a special Velcro® strap for securing the chassis cables within the enclosure to prevent damage or pinching between the monitor top and enclosure. Inspect the strap whenever you open the monitor to replace the battery packs.

**Note:** The only service or maintenance activity ADS permits within the monitor chassis is battery pack replacement. Therefore, please do not handle, alter, modify, remove, or replace any other components inside the monitor. This may void the monitor warranty agreement.

1. Collect the data from the monitor.
2. Loosen bolts and remove the monitor lid with chassis from the aluminum canister.

**Note:** Removing the monitor chassis during battery pack replacement increases the risk of damaging internal components or introducing debris or moisture to the monitor electronics. Make every effort to prevent water, dirt, and debris from contacting the monitor's internal components during routine maintenance.

3. Release the Velcro straps securing the battery packs at the bottom of the chassis.
4. Disconnect the wires connecting the battery packs to the monitor chassis.



Disconnecting the wiring between the battery packs and the monitor

5. Remove the battery packs from the chassis.

6. Place the new battery packs into the chassis.
7. Attach the connectors running from the new battery packs to the monitor chassis.
8. Secure the new battery packs and cables with the Velcro straps, trapping the cables between the battery packs and straps. Strap length should be consistent on both sides once pulled and secured.



Securing the battery packs to the monitor chassis

9. Call the monitor or connect to the monitor on site using a serial communication cable to verify communication.

10. Carefully replace the monitor chassis into the enclosure, and torque down the bolts securing the chassis to the enclosure to 35 inch pounds (+/- 5 inch pounds).

---

## Checking the Sensors

Perform the following sensor inspections during regular site visits:

- Verify that the installation ring or bands are secure and clear of debris.
- Clean the face of the ultrasonic sensor gently with a soft brush, and wipe the sensor with a clean, moist cloth.
- Verify that the face of the ultrasonic depth sensor is horizontally level with the flow. Reposition, if necessary, according to the procedures in *Chapter 3, Sensor Installation and Connection*.
- Scrub the pressure sensor and face of the velocity sensor with a soft bristle brush.
- Confirm that all sensor cables are neatly arranged, securely fastened, and free of debris, cuts, and breaks that may affect performance. Replace sensors that exhibit damaged cables.

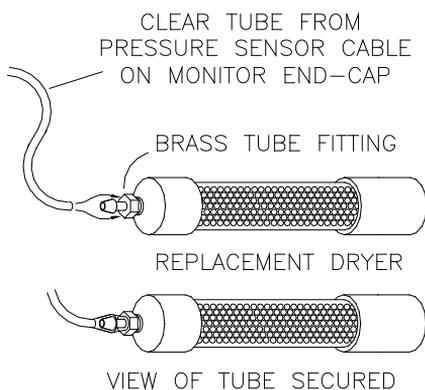
## Replacing the Pressure Depth Sensor Dryer Tube or Desiccant

The pressure depth sensor's dryer tube contains desiccant that absorbs the moisture from the air traveling through the dryer tube into the clear plastic tubing leading to the pressure depth sensor in the pipe. Replace the dryer tube or the desiccant contained within the dryer tube on a regular basis or as necessary. Desiccant can absorb moisture only when it is blue in color. Pink desiccant indicates that it can no longer absorb moisture. Therefore, if the desiccant appears either colorless or pink upon inspection, replace the dryer tube or desiccant immediately.

## Replacing the Dryer Tube

Replace the pressure depth sensor dryer tube (ADS p/n 3704-0032) in the following way:

1. Clip the cable ties securing the dryer tube to the monitor.
2. Cut the clear flexible tubing running from the dryer tube to the pressure depth sensor connector at a location close to the brass barbed fitting on the dryer tube.
3. Place the dryer tube with the used desiccant aside, but do not discard.
4. Attach a new dryer tube to the pressure depth sensor by inserting the brass barbed fitting into the open end of the plastic tubing running from the sensor connector. Make sure the tubing seats firmly against the fitting to prevent air or moisture transfer.



Inserting the brass barbed fitting into the tube

5. Secure the new dryer tube to the monitor.
6. Remove the black end cap from the dryer tube before re-installing the monitor in the manhole.

**Caution:** If the cap is not removed, air will not be able to enter the dryer tube, adversely affecting the pressure depth sensor.

7. Evaluate the pressure depth sensor performance for a limited time to ensure no damage has occurred to the sensor electronics.

### ***Replacing the Desiccant***

When replacing the desiccant inside the pressure depth sensor dryer tube, use indicating beads that are approximately 0.16 inches in diameter. Smaller beads may be able to escape the dryer tube, entering the clear plastic tubing leading to the sensor connector. The desiccant beads of the appropriate size for this dryer tube are available through ADS (p/n 901-11055-00).

Replace the desiccant in the following way:

1. Clip the cable ties securing the dryer tube to the monitor, when applicable.
2. Use a 16-mm nut driver to remove the inset nut at the free end of the dryer tube (end of the tube opposite the brass barbed fitting). *Do not use pliers to remove this nut from the tube!*

**Warning:** Do not attempt to access the desiccant in the dryer tube through the end of the tube with the brass fitting! This fitting is not designed for removal. Removing the fitting will damage the dryer tube and break the moisture seal on that end of the tube.

3. Use needle-nose pliers to gently remove the black foam packing material just inside the opening.
4. Pour out the old desiccant beads from the dryer tube.
5. Refill an equivalent amount of new desiccant beads into the tube.
6. Carefully replace the foam packing into the dryer tube.
7. Replace and tighten the nut on the dryer tube.
8. Secure the dryer tube to the monitor using cable ties, when applicable.

**Note:** Some desiccant may be reused following a special process designed to remove the moisture from the beads. Please consult the desiccant manufacturer for instructions on performing this procedure, when applicable.

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## Checking Communication Devices

Inspect the following communication devices during site visits:

- **Lightning Protection Module** Check the lightning protection module for lightning strikes (visible arcing), damaged or poor connections, or corrosion. Replace a burned out module, and repair any bad or corroded connections in the wiring.
- **Network Interface Box** If any problems exist with the network interface box, check the connectors to ensure that the cable entries are tight and waterproof. If this does not resolve the problem, contact the telephone company.

**Note:** Make sure both the lightning protection module and network interface box are still waterproof.

- **Antenna Cable** Check the cable for damage, kinks, or breaks in the cable. Make sure the connector between the antenna cable and the monitor is dry and sealed with rubber stretch tape.

## Troubleshooting

The FlowShark flow monitoring system contains several different components that perform many different functions. Since a malfunctioning component increases the risk of losing data, isolating the part containing the problem quickly is essential to performing troubleshooting activities efficiently. Minimizing monitor downtime is critical.

Consider the following when trying to isolate the component or subsystem exhibiting the problem:

- Problems affecting only one of the sensor subsystems are usually caused by one subsystem alone. The problem may exist in the board, sensor (or other input device), or cabling.
- Problems affecting more than one subsystem usually can be traced to a problem with the processor board, power source, or communication lines. Problems in one subsystem can create problems in other subsystems when the power source or communication lines are faulty.
- Problems with communication lines, clock readings, time stamps, and data storage intervals usually arise from faulty processor boards, incorrect information entered on the user's PC, or low batteries.
- Failures occurring outside a connector (i.e., between a connector and the field input or output device) may arise from problems with the field unit or component cabling. Failures occurring on the *inside* (i.e., between a connector and the printed circuit boards) may arise from problems with boards or their cabling.

**Note:** If possible, collect all monitor data prior to swapping sensors or troubleshooting a monitor to prevent possible data loss. Swapping sensors or batteries does *not* result in stored data loss. In addition, remove the monitor from the manhole before disconnecting cables from the monitor to avoid possible hazards.

Some problems that occur will not require a site visit, such as incorrect equipment identification numbers or other system parameters the user can re-enter on the local PC. However, many problems will require a site visit. When this is necessary, inform the data analyst any time a field crew is en route to a monitor site to troubleshoot problems so that the analyst can attempt to collect the monitor data before the crew arrives. If the problem is a faulty monitor and the analyst cannot collect the data remotely, replace the monitor and deliver the faulty monitor to the office so the analyst can attempt to collect the data directly. Then, send the monitor to ADS<sup>®</sup> for repair.

This chapter provides general guidelines for troubleshooting and correcting problems with the FlowShark monitor and sensor subsystem.

## General Monitor Problems

The following tables contain general troubleshooting techniques for the ADS FlowShark flow monitor.

<b>Problem</b>	Monitor does not answer a telephone call.
<b>Possible Causes</b>	<p>Telephone connection at monitor may be damaged, loose, or leaking.</p> <p>Telephone cable may be noisy, damaged, or dead.</p> <p>Lightning protection module may be damaged.</p> <p>Battery pack(s) may be dead or below minimum voltage requirement (8.0 volts).</p> <p>Monitor may be defective.</p> <p>Modem in monitor may be defective.</p> <p>Modem in office or field computer may be defective.</p> <p>Telephone service may not be working.</p>
<b>Possible Solutions</b>	<p>Make sure phone cable connection at monitor base is secure and dry.</p> <p>Check telephone cable for damage.</p> <p>Use voltmeter to check voltage on telephone cable and at lightning protection module. Voltage should be approximately 48 Vdc on hook.</p> <p>Replace 12-volt battery packs if below 8.0 volts.</p> <p>Attempt to direct connect to monitor.</p> <p>Contact telephone company for repair if noise, no tone, or constant busy signal occurs at network interface box or if service does not seem to be working.</p> <p>Replace the monitor.</p>

<b>Problem</b>	Monitor does not answer through wireless communication.
<b>Possible Causes</b>	Signal strength to the modem may be insufficient. Battery pack may be dead or below minimum voltage requirement (8.0 volts). Monitor may be defective. Modem in monitor may be defective. Internet connection in office or field computer may be down. Port 2100 may be blocked by IT department.
<b>Possible Solutions</b>	Direct connect to monitor on site, and request the signal strength. If the signal strength falls between -51 and -91, communication should be available. If it reads below -91, relocate the antenna. If relocation is not an option, install a land line or perform all communications on-site. Replace the 12-volt battery pack if below 8.0 volts. Replace the monitor. Restore Internet connection. Restore/establish permission to pass TCP/IP traffic via Port 2100.

<b>Problem</b>	Busy signal occurs when calling the monitor.
<b>Possible Causes</b>	Someone else may be communicating with monitor. Monitor may be calling out an alarm. Telephone cable may be damaged. Lightning protection module may be damaged. Telephone cable may have shorted. Modem in monitor may be damaged. Telephone service may not be working.
<b>Possible Solutions</b>	Wait a few minutes, and attempt to communicate with monitor again. Connect at the site using the serial cable, and try to communicate with monitor. Use voltmeter to check voltage on telephone cable. Voltage should be approximately 48 Vdc on hook. If it is not, disconnect phone line at the lightning protection module and check the voltage at the network interface box. Make sure telephone cable is not damaged or severed, and repair or replace cable if necessary. Check telephone connector for moisture. Contact the telephone company to report service is not working. Replace the monitor.

<b>Problem</b>	Monitor establishes a connection, but does not respond to any message.
<b>Possible Causes</b>	<p>Cabling may be loose.</p> <p>Lightning protection module may be damaged.</p> <p>Modem in monitor may be faulty.</p>
<b>Possible Solutions</b>	<p>Listen for noise at the site using a field phone. If noise is present, inspect the wirings and replace wiring if necessary.</p> <p>Replace the lightning protection module.</p> <p>Contact telephone company.</p> <p>Collect the data from the monitor on site using the serial cable, and replace monitor if defective.</p> <p>Contact your regional ADS representative.</p>

<b>Problem</b>	Time stamp on the collected data is incorrect.
<b>Possible Causes</b>	<p>PC clock may read incorrect time.</p> <p>Monitor clock may be faulty.</p>
<b>Possible Solutions</b>	<p>Verify the time on the PC clock and correct if necessary.</p> <p>Reactivate the monitor to enable the clock.</p> <p>Collect the data from the monitor and replace monitor if defective.</p>

<b>Problem</b>	Time on the monitor clock is incorrect.
<b>Possible Causes</b>	Monitor clock may be faulty. PC clock may read incorrect time.
<b>Possible Solutions</b>	Verify the time on the PC clock and correct if necessary. Reactivate the monitor to enable the clock. Collect the data from the monitor and replace monitor if defective.

<b>Problem</b>	You receive a <b>Device Time Out</b> message in <b>Profile</b> .
<b>Possible Cause</b>	Analog board may be faulty.
<b>Possible Solutions</b>	Re-attempt communication with monitor. Replace the monitor if defective. Contact your regional ADS representative.

<b>Problem</b>	Gap exists within the collected data.
<b>Possible Cause</b>	Monitor time may be incorrect. Monitor firmware or variable file may be corrupt.
<b>Possible Solutions</b>	Check monitor time, and reset clock if necessary. Attempt to collect data within the gap. Contact your regional ADS representative.

<b>Problem</b>	Data is missing at the beginning or end of the date range following data collection.
<b>Possible Causes</b>	Monitor activation may have failed. Monitor time may be incorrect. Monitor's firmware or variable file may be corrupt.
<b>Possible Solutions</b>	Verify whether the monitor has been activated, and activate if necessary. Check monitor time, and reset clock if necessary. Run diagnostics in <b>Profile</b> to verify whether a firmware problem may exist. Contact your regional ADS representative.

<b>Problem</b>	An I/O error message displays when communicating with the monitor.
<b>Possible Cause</b>	Processor or analog board may be faulty.
<b>Possible Solutions</b>	Re-attempt communication with the monitor. Replace the monitor if defective. Contact your regional ADS representative.

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## External Power

The following table contains troubleshooting techniques for problems with the ADS External Power Supply. If another power supply is being used, similar troubleshooting may still apply, but the manufacturer's product documentation should be consulted prior to beginning the troubleshooting process.

<b>Problem</b>	No DC power at EMU.
<b>Possible Cause</b>	Breaker has tripped. Station power is off. Power supply has failed. Power supply wiring has become disconnected.
<b>Possible Solutions</b>	Restore main power source to station (have owner perform this). Check for wiring faults and then reset breaker. Look for "DC ON" LED on front of ADS Power Supply module. If off, but AC power is live, replace power supply. Contact your regional ADS representative.

## Ultrasonic Depth Subsystem

The following tables contain general troubleshooting techniques for problems with the ultrasonic depth subsystem.

**Note:** Contact your regional ADS representative for further diagnosis prior to replacing a sensor.

<b>Problem</b>	Range from ultrasonic depth subsystem is slightly inconsistent with manually measured range.
<b>Possible Causes</b>	Temperature or physical offset(s) may be incorrect. Pipe height may be incorrect.
<b>Possible Solutions</b>	Verify the temperature and physical offsets, and adjust offsets if necessary. Verify the pipe height.

<b>Problem</b>	Range from ultrasonic depth subsystem is significantly greater than manually measured range.
<b>Possible Causes</b>	<p>Temperature or physical offset(s) may be incorrect.</p> <p>Pipe height may be incorrect.</p> <p>Sensor may not be level.</p> <p>Foam or other substance may be absorbing the pulse.</p> <p>Sensor may be faulty.</p>
<b>Possible Solutions</b>	<p>Verify the temperature and physical offsets.</p> <p>Verify the pipe height.</p> <p>Make sure the sensor is level and in good condition.</p> <p>Check the hydraulic conditions in the pipe.</p> <p>Fire the ultrasonic depth sensor at a shorter distance onto a hard surface to confirm accuracy.</p> <p>Replace the sensor.</p> <p>Contact your regional ADS representative.</p>

<b>Problem</b>	Range from the ultrasonic depth subsystem is too short (but not zero).
<b>Possible Causes</b>	<p>Temperature or physical offset(s) may be incorrect.</p> <p>Pipe height may be incorrect.</p> <p>Ultrasonic depth sensor may be dirty.</p> <p>Ultrasonic depth sensor may be faulty.</p>
<b>Possible Solutions</b>	<p>Verify the temperature and physical offsets.</p> <p>Verify the pipe height.</p> <p>Clean the ultrasonic depth sensor.</p> <p>Replace the ultrasonic depth sensor.</p> <p>Contact your regional ADS representative.</p>

<b>Problem</b>	Raw ultrasonic depth data shows depths greater than the pipe diameter.
<b>Possible Causes</b>	<p>Temperature or physical offsets may be incorrect.</p> <p>Pipe height may be incorrect.</p> <p>Pipe may be surcharged.</p> <p>Ultrasonic depth sensor may be dirty.</p> <p>Ultrasonic depth sensor may be faulty.</p>
<b>Possible Solutions</b>	<p>Verify the physical and temperature offsets.</p> <p>Verify the pipe height.</p> <p>Clean the ultrasonic depth sensor.</p> <p>Replace the ultrasonic depth sensor.</p> <p>Contact your regional ADS representative.</p>

<b>Problem</b>	Depth data indicates a surcharged pipe, but the pipe is free flowing.
<b>Possible Causes</b>	<p>Temperature or physical offsets may be incorrect.</p> <p>Pipe height may be incorrect.</p> <p>Ultrasonic depth sensor may be dirty.</p> <p>Ultrasonic depth sensor may be faulty.</p> <p>Analog board may be faulty.</p>
<b>Possible Solutions</b>	<p>Verify the temperature and physical offsets.</p> <p>Verify the pipe height.</p> <p>Clean the ultrasonic depth sensor.</p> <p>Contact your regional ADS representative.</p> <p>Replace the ultrasonic depth sensor.</p> <p>Replace the monitor if defective.</p>

<b>Problem</b>	Ultrasonic depth readings are erratic.
<b>Possible Causes</b>	Noise may exist in the sewer pipe. Ultrasonic depth sensor may be dirty. Flow may be choppy or foamy. Ultrasonic depth sensor may not be level.
<b>Possible Solutions</b>	Check the flow conditions. Clean the ultrasonic depth sensor. Check the level of the ultrasonic depth sensor.

<b>Problem</b>	Ultrasonic depth sensor reports abnormal temperatures.
<b>Possible Causes</b>	Ultrasonic depth sensor connection to monitor may be loose. Temperature sensor may be faulty. Temperature offset may be incorrect. Ultrasonic depth sensor may be faulty.
<b>Possible Solutions</b>	Secure ultrasonic depth sensor connection to monitor (if necessary). Verify temperature offset. Replace the ultrasonic depth sensor.

## Doppler Velocity Subsystem

The following tables contain general troubleshooting techniques for the Doppler velocity subsystem.

**Note:** Contact your regional ADS representative for further diagnosis prior to replacing a sensor.

<b>Problem</b>	Monitor often provides a velocity reading of 0.
<b>Possible Causes</b>	<p>Doppler velocity sensor may be dirty or broken.</p> <p>Cabling between the analog board and the velocity sensor may be bad.</p> <p>Velocity parameters may require adjustment.</p>
<b>Possible Solutions</b>	<p>Clean the velocity sensor.</p> <p>Check the velocity parameters.</p> <p>Inspect the velocity sensor cables for tightness.</p> <p>Check for moisture in the connector.</p> <p>Contact your regional ADS representative.</p> <p>Replace the velocity sensor.</p> <p>Replace the monitor if defective.</p>

<b>Problem</b>	Velocity data does not fluctuate much (but is not 0).
<b>Possible Cause</b>	<p>Doppler velocity sensor may be dirty</p> <p>Velocity sensor may be broken.</p>
<b>Possible Solutions</b>	<p>Clean the velocity sensor.</p> <p>Check the velocity sensor connections.</p> <p>Check the velocity parameters.</p> <p>Contact your regional ADS representative.</p> <p>Replace the velocity sensor.</p>

<b>Problem</b>	Velocity data seems erratic.
<b>Possible Causes</b>	Velocity sensor may be dirty. Velocity sensor may be faulty. Analog board may be faulty.
<b>Possible Solutions</b>	Clean the velocity sensor. Check the sensor connections. Check the velocity parameters. Contact your regional ADS representative. Replace the velocity sensor. Replace the monitor if defective.

<b>Problem</b>	Velocity readings are abnormally high.
<b>Possible Causes</b>	Doppler velocity sensor may be covered with silt. Velocity sensor may be out of the flow. Flow may be reversed or slower than 0.5 ft/s (0.15 m/s).
<b>Possible Solutions</b>	Check the site conditions, and relocate the velocity sensor if necessary.

## Pressure Depth Subsystem

The following tables contain general troubleshooting techniques for the pressure depth subsystem.

**Warning:** Contact your regional ADS representative for further diagnosis before replacing a sensor.

<b>Problem</b>	Temperature reading from the pressure depth sensor shows a value of -273° C (-459° F).
<b>Possible Causes</b>	Cable connecting the pressure sensor to the monitor may be loose or broken. Pressure sensor may be faulty. Analog board is not responding or may be faulty.
<b>Possible Solutions</b>	Secure pressure sensor connection to monitor (if necessary). Replace the pressure sensor. Replace the monitor if defective.

<b>Problem</b>	Pressure depth readings are consistently incorrect.
<b>Possible Causes</b>	Coefficients may be incorrect. Pressure dryer tube may not be functioning properly.
<b>Possible Solutions</b>	Retrieve or enter the correct coefficients, and reactivate the monitor. Inspect color of desiccant in dry tube and replace the dryer tube or desiccant (if necessary).

<b>Problem</b>	Pressure depth readings are consistently off by up to 3 inches, but temperature readings are accurate.
<b>Possible Cause</b>	Monitor may be configured with an incorrect pressure sensor offset.
<b>Possible Solution</b>	Re-measure pressure sensor physical offset and enter correct value in Profile. Reactivate the monitor. Enable Auto-Pressure Calibration feature in Profile to calibrate the pressure sensor data to the ultrasonic data during non-surcharge conditions.

## APPENDIX A

# Specifications

This appendix contains specifications for the ADS® FlowShark® flow monitor, associated processor, modems, sensors, lightning protection module, and wireless communication antenna (when applicable).

## ADS FlowShark Flow Monitor

The following section contains specifications for the FlowShark flow monitor, processor board, and modem board.

**Note:** The FlowShark flow monitors referenced in this manual (including all associated circuit boards and assemblies) are *not* intrinsically safe.

<b>Enclosure</b>	Cylindrical 0.13-inch thick seamless, marine-grade aluminum with stainless steel hardware
<b>Dimensions</b>	20 inches long by 6.38 inches diameter
<b>Weight</b>	35 pounds (monitor with battery)
<b>Operating Temperature</b>	32° to 140° F (0° to 60° C)

<p><b>Internal Power</b></p>	<p>A and B series monitors: Two 12-volt alkaline battery packs operating in parallel</p> <p>BG monitors: One 12-volt alkaline battery pack powering the monitor and one 12-volt alkaline battery pack powering the wireless modem.</p>
<p><b>Battery Configurations and Battery Life</b></p>	<p>Monitor Battery Life Matrix (months)-Weekly Collects</p> <p>Sample Rate =&gt; 5 minutes, 15 minutes          FlowShark AL =&gt; 6, 18          FlowShark AG =&gt; 4, 12          FlowShark AS (stand alone) =&gt; 6, 18          FlowShark BL =&gt; 3, 9          FlowShark BG =&gt; 1.5, 4.5.</p> <p>Radio Battery Life – Weekly Collects (<i>BG monitors only</i>)</p> <p>2 – 3 months. Actual battery life will vary depending on operating temperature and frequency of communications. Higher capacity battery options will be available in the future.</p>
<p><b>External Power Option</b></p>	<p>Requires an external DC power source running between 12 volts at 1.2 amperes of continuous current</p>
<p><b>Connectors</b></p>	<p>U.S. MIL-C-26482 series 1, for environmental sealing, with gold-plated contacts</p>
<p><b>Inputs and Outputs</b></p>	<ul style="list-style-type: none"> <li>• Ultrasonic depth sensor input</li> <li>• Doppler velocity sensor input</li> <li>• Pressure depth sensor input</li> <li>• Sampler output/rain gauge input</li> <li>• External power input</li> <li>• SCADA 4-20 mA I/O or MODBUS</li> <li>• Communication (telemetry or serial cable)</li> <li>• Antenna (GPRS wireless)</li> <li>• Air pressure valve (<i>for testing purposes only</i>)</li> </ul> <p><b>Note:</b> Inputs/Outputs (number and type) supported will vary on the model FlowShark ordered.</p>

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## Boards

### Digital Signal Processor Board (5000-0514)

This board supports B series and *earlier* A and C series FlowShark monitors. Refer to the table in the *Digital Signal Processor* section in *Chapter 2, System Overview*, to determine the serial numbers for monitors that contain this DSP board.

<b>Processor</b>	Texas Instruments VC33 DSP (Digital Signal Processor)
<b>Functions</b>	Performs and processes all requests for sensor and diagnostic information from analog board, executes all math calculations and performs MLI related functions based on user configuration
<b>Memory</b>	1 megabyte non-volatile (program, configuration, and data storage); 512 kilobytes static RAM
<b>Data Storage</b>	140 days (1 velocity and 2 depth readings at a 15-minute sample rate)
<b>Clock</b>	Battery backed RTC Module
<b>Inputs/Outputs</b>	Accubus High-Speed I/O (to other internal PCBs) Power from Voltage Regulator Board

## Digital Signal Processor Board with Communications (5000-0514-01)

This board supports *later A* and *C* series FlowShark monitors. Refer to the table in the *Digital Signal Processor* section in *Chapter 2, System Overview*, to determine the serial numbers for monitors that contain this DSP board.

<b>Processor</b>	Texas Instruments VC33 DSP (Digital Signal Processor)
<b>Functions</b>	Performs and processes all requests for sensor and diagnostic information from analog board; supports Real-Time operation, alarm handling, and multi-tasking monitor operations; manages all Modbus protocol requests; executes all math calculations; performs MLI related functions based on user configuration
<b>Memory</b>	1 megabyte non-volatile (program, configuration, and data storage); 512 kilobytes static RAM
<b>Data Storage</b>	140 days (1 velocity and 2 depth readings at a 15-minute sample rate)
<b>Communication Protocol</b>	Enhanced AccuYapp for modem, wireless, and serial communications
<b>Clock</b>	Battery backed RTC Module
<b>Inputs/Outputs</b>	<ul style="list-style-type: none"> <li>• Accubus High-Speed I/O (to other internal PCBs)</li> <li>• Power from Voltage Regulator Board</li> <li>• Serial RS232 communication (external)</li> <li>• TTL serial communication (internal)</li> </ul>

### Analog Board (5000-0515)

<b>Inputs/Outputs</b>	<ul style="list-style-type: none"> <li>• ADS ultrasonic sensor input(s)</li> <li>• ADS velocity sensor input(s)</li> <li>• ADS pressure sensor input(s)</li> <li>• Internal regulated power</li> <li>• Tipping bucket input</li> <li>• Sampler pulse output</li> <li>• Accubus High-Speed I/O (to other internal PCBs)</li> </ul>
<b>Comm Protocol</b>	Enhanced AccuYapp
<b>A/D Conversion</b>	12 bit, 8 channel, 500KHz sample rate

### Communication Board (5000-0516)

This board supports B series and *earlier* A and C series FlowShark monitors.

<b>Processor</b>	Texas Instruments VC33 DSP (Digital Signal Processor)
<b>Functions</b>	Supports Real-Time operation, alarm handling, and multi-tasking monitor operations and provides handling of all Modbus protocol requests
<b>Memory</b>	2 megabytes non-volatile (program, configuration, and data storage) – 8 megabytes static RAM
<b>Comm Protocol</b>	Enhanced AccuYapp for modem, wireless, and serial communications
<b>Clock</b>	Battery backed RTC Module
<b>Inputs/Outputs</b>	<ul style="list-style-type: none"> <li>• Accubus High-Speed I/O (to other internal PCBs)</li> <li>• Power from Voltage Regulator Board</li> <li>• Serial RS232 communication (external)</li> <li>• TTL serial communications (internal)</li> </ul>

### GPRS Wireless Modem Board (5000-0761)

<b>Inputs/Outputs</b>	<ul style="list-style-type: none"> <li>• Power from Voltage Regulator Board</li> <li>• TTL serial data</li> </ul>
<b>External Connections</b>	Modem antenna connection via a TNC female connector on chassis top
<b>Modem Power</b>	Internal 12-volt alkaline battery pack, or external power – power to modem can be continuous or managed via duty cycles for power saving (when using battery)
<b>Wireless Modem</b>	<p>Quad-Band GSM/GPRS (850/900/1850/1900 MHz)</p> <p>Sensitivity: -106 dBm (typical)</p> <p>Transmit power: Class 4 (2W@850/900 MHz, Class 1 (1W@1800/1900 MHz)</p> <p>Remote SIM: 1.8/3V SIM</p>
<b>FCC ID</b>	FCC ID MIVGSM0308
<b>Antenna</b>	ADS whip, stub, flush mount or pedestal antennas
<b>Protocol</b>	Accuyapp over TCP/IP internet connection
<b>Addressing</b>	Fixed address via AT&T Custom APN
<b>Network Attach</b>	Refreshed every 4 hours via hard-reattach

### Land-line Modem Board (5000-0570)

<b>Inputs/Outputs</b>	Land-line modem interfaces with Communications board via TTL serial connection
<b>External Connections</b>	Connection to the PSTN telephone connection via potted, field-fabricated connector
<b>Modem Power</b>	Parallel battery packs in the monitor or external power
<b>Modem</b>	Multitech Model MT5600SMI
<b>FCC ID</b>	FCC ID 6KDMD06AHS1

<b>Operating Speed</b>	19.2K baud with fallback to 9600 and 1200 as required for reliable communication
<b>Protocol</b>	Accuyapp over analog modem connection
<b>Service Type</b>	Regular 2-wire voice grade POTS line

### **Analog 4-20mA I/O Board (5000-0517)**

<b>Inputs/Outputs</b>	<ul style="list-style-type: none"> <li>• Accubus High-Speed I/O (to other internal PCBs)</li> <li>• Power from Voltage Regulator Board</li> </ul>
<b>Analog Inputs</b>	Number - Two 4-20mA Inputs Load Resistance – 100 ohms Accuracy – 0.5% FS Maximum voltage relative to ground – 240Vrms
<b>Analog Outputs</b>	Number - Two fully isolated 4-20mA Outputs (optional 0-5V and 0-20mA configuration) Isolation - 1500Vrms common mode relative to ground Maximum Load – 1000 ohms (using 24VDC external loop supply) Linearity and Stability - +/- 0.01mA Resolution – 0.005mA
<b>I/O- Loop Power Connection</b>	I/O and external output loop power supplied via ADS cable p/n 5000-0698

### **Voltage Regulator Board (5000-0518)**

<b>Inputs</b>	7.5 to 12 volts (from internal or external source)
<b>Outputs</b>	Regulated 6v and 12v to DSP, Comm, Analog, and 4-20mA Analog I/O PCBs

## ADS Power Supply (5000-0727)

<b>Size</b>	5.1 inches long x 5.1 inches wide x 5.1 inches high
<b>Material</b>	Polycarbonate
<b>Rating</b>	NEMA 4X
<b>Mounting</b>	Panel mounting via four 0.175" holes
<b>Input Voltage</b>	100-240VAC, 50/60Hz
<b>Output Voltage</b>	12V DC, 1.2A
<b>Connection</b>	AC: Supplied 6' Line Cord (US) or hardwire to AC input terminals DC: Hardwire to DC output terminals

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## Sensors

The following includes specifications for the ultrasonic depth sensor, Doppler velocity sensor, and pressure depth sensor.

### Ultrasonic Depth Sensor (103262A-30)

<b>Housing</b>	Marine-grade aluminum/epoxy
<b>Dimensions</b>	7.13 inches long x 4.20 inches wide x 0.86 inches high
<b>Accuracy</b>	0.125 inches
<b>Deadband</b>	Less than 1 inch
<b>Frequency</b>	40 kHz
<b>Range</b>	0.5 inches to 12.5 feet

<b>Resolution</b>	0.01 inches
<b>Drift</b>	0.0 inches
<b>Cable</b>	Standard size: 30 feet long x 0.50 inches diameter OD polyurethane jacket  Extension cables available up to 300 feet

**Pressure Depth Sensor (3704-0041/42/16-35/40)**

<b>Enclosure</b>	Solid machined PVC/stainless steel
<b>Dimensions</b>	5.25 inches long x 1.40 inches wide x 1.15 inches high
<b>Range</b>	0.0 to 5.0 psi: up to 11.5 feet 0.0 to 15.0 psi: up to 34.5 feet 0.0 to 30.0 psi: up to 69.0 feet
<b>Accuracy</b>	<u>0.50% of full scale for these ranges:</u>  0.1-5.0 psi: 0.25-11.5 feet 0.1-15.0 psi: 0.25-34.5 feet  <u>0.75% of full scale for these ranges:</u>  1.0-30.0 psi: 2.3-69.0 feet
<b>Resolution</b>	0.025% of full scale
<b>Cable</b>	Standard size: 35 feet long x 0.29 inches diameter OD polyurethane jacket  Extension cables available up to 300 feet

### Doppler Velocity Sensor (103260A-35)

<b>Enclosure</b>	Solid machined PVC/epoxy
<b>Dimensions</b>	2.35 inches long x 1.13 inches wide x 0.49 inches high
<b>Accuracy</b>	± 0.2 feet per second or 4% of actual peak velocity (whichever is greater) in flow velocities from -20 .0 to 20.0 fps
<b>Resolution</b>	0.04 feet per second
<b>Cable</b>	Standard size: 35 feet long x 0.25 inches diameter OD polyurethane jacket Extension cables available up to 300 feet

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### Lightning Protection Module (103313)

The following table contains the specifications for the lightning protection module at the service location.

<b>Housing</b>	Gray PVC
<b>Dimensions</b>	4.13 inches high x 3.25 inches wide x 1.88 inches deep
<b>Polyswitch</b>	600-volt 150-milliamps over-current protector
<b>Varistor</b>	240-volt over-voltage protector
<b>Sidactor</b>	280-volt over-voltage protector
<b>Ground Wire</b>	12 AWG black stranded
<b>Service Wire</b>	22 AWG 4-conductor gray unshielded

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**Antennas (for Wireless Communication)**

<b>Stub</b>	SMA: ADS part #3800-0140 TNC: ADS part #3800-0141
<b>Flush Mount</b>	SMA: ADS part #3800-0137 TNC: ADS part #3800-0139
<b>Magnetic Whip</b>	SMA: ADS part #3800-0128 TNC: ADS part #3800-0127
<b>Pedestal</b>	With 15-foot cable: ADS part #3800-0134 With 50-foot cable: ADS part #3800-0136

## APPENDIX B

# FlowShark Models and Capabilities

This appendix contains tables detailing the capabilities of the different models of ADS<sup>®</sup> FlowShark<sup>®</sup> monitors.

<b>Model 5000-AG (Single Pipe, Wireless Modem)</b>
Modbus ASCII (Supported if external power is made available using upgrade kit.)
Modem - wireless
Power, internal – two 12-volt alkaline batteries operating in parallel
Rain Gauge (using I/O connector.)
Sensors – one each - pressure, ultrasonic & velocity
Water Quality Sampler (using I/O connector)

<b>Model 5000-AL (Single Pipe, Land Line Modem)</b>
Modbus ASCII (Supported if external power is made available using upgrade kit)
Modem – land line
Power, internal – two 12-volt alkaline batteries operating in parallel
Rain Gauge (using I/O connector)
Sensors – one each - pressure, ultrasonic & velocity
Water Quality Sampler (using I/O connector)

<b>Model 5000-AG-M (Single Pipe, Wireless Modem, Real-Time Ready)</b>
Modbus ASCII
Modem - wireless
Power, external – running 12 volts at 1.2A
Power, internal – two 12-volt alkaline batteries operating in parallel (to be used until Modbus-ready and external power required)
Rain Gauge (using I/O connector)
Sensors – one each - pressure, ultrasonic & velocity
Water Quality Sampler (using I/O connector)

<b>Model 5000-AS (Single Pipe without Modem)</b> <i>(This model is typically deployed in a FlowShark – Telog system.)</i>
Modbus ASCII (Supported if external power is made available using upgrade kit)
Modem - none
Power, internal – two 12-volt alkaline batteries operating in parallel
Rain Gauge (using I/O connector)
Sensors – one each - pressure, ultrasonic & velocity
Water Quality Sampler (using I/O connector)

<b>Model 5000-BG (Dual Pipe, Wireless Modem)</b>
Modbus ASCII (requires external power)
Modem - wireless
Power, external – available as an option running 12 volts at 1.2A
Power, internal – two 12-volt alkaline batteries – one for powering monitor one for powering wireless modem
Sensors – two each - pressure, ultrasonic & velocity

<b>Model 5000-BL (Dual Pipe, Land Line Modem)</b>
Modbus ASCII (Supported if external power is available.)
Modem - land line
Power, external - available as an option running 12 volts at 1.2A
Power, internal - two 12-volt alkaline batteries operating in parallel
Sensors - two each - pressure, ultrasonic & velocity

<b>Model 5000-CG (Single Pipe, 4-20 mA, Wireless Modem)</b>
4-20mA input/output - supports two each
Modbus ASCII
Modem - wireless
Power, external (required) - running 12 volts at 1.2A
Rain Gauge (using I/O connector)
Sensors - one each - pressure, ultrasonic & velocity
Water Quality Sampler (using I/O connector)

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<b>Model 5000-CG-1 (Single Pipe, 4-20 mA, Wireless Modem)</b>
4-20mA input/output – supports two each
Modbus ASCII
Modem - wireless
Power, external (required) - running 12 volts at 1.2A
Power, internal – available as an option running two 12-volt alkaline batteries operating in parallel
Rain Gauge (using I/O connector)
Sensors - one each - pressure, ultrasonic & velocity
Water Quality Sampler (using I/O connector)

<b>Model 5000-CL (Single Pipe, 4-20 mA, Land Line Modem)</b>
4-20mA input/output – supports two each
Modbus ASCII
Modem – land line
Power, external (required) – running 12 volts at 1.2A
Rain Gauge (using I/O connector)
Sensors – one each – pressure, ultrasonic & velocity
Water Quality Sampler (using I/O connector)

<b>Model 5000-CS (Single Pipe, 4-20 mA, No Modem)</b>
4-20mA input/output - supports two each
Modbus ASCII
Modem - none
Power, external (required) - running 12 volts at 1.2A
Rain Gauge (using I/O connector)
Sensors - one each - pressure, ultrasonic & velocity
Water Quality Sampler (using I/O connector)

## APPENDIX C

# Modbus Output

## Registry Entities and Values

This appendix contains FlowShark<sup>®</sup> Modbus output registry entities and values.

Description	Profile Entity <sup>®</sup>	Units of Measure	Registers
Flow	FLOW1	MGD	40001-40002
Peak Velocity	RAWVEL	FPS	40003-40004
UniDepth	UNIDDEPTH	Inches	40005-40006
Ultrasonic Depth	UDEPTH	Inches	40007-40008
Unadjusted Pressure Depth	N/A	Inches	40009-40010
Ultrasonic Range 0	U2	Inches	40011-40012
Ultrasonic Range 1	U3	Inches	40013-40014
Ultrasonic Range 2	U4	Inches	40015-40016
Ultrasonic Range 3	U5	Inches	40017-40018
Rain Intensity	RAINI	Inches/Unit Time	40019-40020
Ultrasonic Range (Arbitrated)	Diagnostic	Inches	40021-40022
Ultrasonic Temperature	Diagnostic	Degrees F	40023-40024
Monitor Voltage	BTYVOLT	Volts	40025-40026
QThreshold	QTHRESHOLD	MGD	40027-40028

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Description	Profile Entity <sup>®</sup>	Units of Measure	Registers
Radio Voltage	BTY_RADIO	Volts	40029-40030
Rain	RAIN	Inches	40031-40032
MLI Averaged Flow Rate	QMLI_AVG	MGD	40045-40046
MLI Averaged Depth	DMLI_AVG	Inches	40047-40048
Monitor Sample Rate	Diagnostic	N/A	40049-40050
ENS Event Status	Various	0 (off) or 1 (on)	40051-40052
Pressure Depth (Adjusted)	PDEPTH	Inches	40053-40054
Volume	N/A	Million Gallons	40055-40056
DThreshold (Depth Pattern Trigger)	DTHRESHOLD	Inches	40057-40058
Average Velocity	N/A	FPS	40061-40062
Number of Samples	SAMPLES	N/A	40077-40078
Pressure Adjustment Value	PRESSK	Inches	40081-40082
Rain Accumulator (total rain tips since the last "reset")	Diagnostic	Inches	40085-40086
Analog Input 1	Varies	Varies	40087-40088
Analog Input 2	Varies	Varies	40089-40090
Analog Output 1	Varies	Varies	40091-40092
Analog Output 2	Varies	Varies	40093-40094
Surcharged	Diagnostics	0 or 1	40095-40096
Spares[7]	N/A	N/A	40119-40120
Spares[8]	N/A	N/A	40121-40122
Spares[9]	N/A	N/A	40123-40124
Spares[10]	N/A	N/A	40125-40126
Spares[11]	N/A	N/A	40127-40128

## APPENDIX D

# Part Numbers

This appendix contains the part numbers for the most commonly used and ordered ADS<sup>®</sup> FlowShark<sup>®</sup> system parts.

<b>Monitors</b>	
ADS5000-AG	MON, FLOWSHARK, SGL CH, WIRELESS
ADS5000-AG-M	MON, FLOWSHARK, SGL CH, WIRELESS, MODBUS RDY
ADS5000-AL	MON, FLOWSHARK, SGL CH, LANDLINE MODEM
ADS5000-AS	MON, FLOWSHARK, SGL CH, SERIAL ONLY
ADS5000-BG	MON, FLOWSHARK, DUAL CH, WIRELESS
ADS5000-BL	MON, FLOWSHARK, DUAL CH, LAND LINE MODEM
ADS5000-CG	MON, FLOWSHARK, SGL CH, WIRELESS, 4-20I/O
ADS5000-CG-1	MON, FLOWSHARK, SGL CH, WIRELESS, 4-20I/O, W/BAT
ADS5000-CL	MON, FLOWSHARK, SGL CH, LAND LINE MODEM, 4-20I/O
ADS5000-CS	MON, FLOWSHARK, SGL CH, SERIAL ONLY, 4-20I/O

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<b>Sensors and Cables</b>	
103262A-30	SENSOR, 103, ULTRASONIC, 30'
103260A-35	SENSOR, 103, VELOCITY, 35'
3704-0041-35	SENSOR, PRESSURE, 103, 0-5PSI, 35'
3704-0042-35	SENSOR, PRESSURE, 103, 0-15PSI, 35'
3704-0016-40	SENSOR, PRESSURE, 103, 0-30PSI, 40'
5000-0601	CABLE, COMM, DIRECT CONNECT
5000-0762-xxx	CABLE, ISCO/SIGMA - SAMPLER/FLOW PROPORTIONAL ( <i>xxx represents the cable length</i> )
5000-0747-xxx	CABLE, ISCO/SIGMA – SAMPLER/LEVEL ACTUATED ( <i>xxx represents the cable length</i> )
5000-0664	CABLE, RS232 WITHOUT PHONE LINE, 5000
5000-0697	CABLE, EXT POWER, FLOWSHARK, 10'
5000-0698	CABLE, EXT 4-20 I/O, FLOWSHARK, 10'
5000-0726	CABLE, MODBUS, FLOWSHARK, 10'
3704-0032	REPLACEMENT VENT DRYER TUBE
901-11055-00	DESICCANT, INDICATING BEADS
<b>Monitor Replacement PCBs</b>	
5000-0514	PCB, ASSY, DSP, 5000
5000-0514-01	PCB, ASSY, DSP W/COMM, 5000
5000-0515	PCB, ASSY, ANALOG PROCESSOR, 5000
5000-0516	PCB, ASSY, COMM, 5000
5000-0517	PCB, ASSY, ANALOG 4-20 I/O, 5000
5000-0518	PCB, ASSY, REGULATOR, 5000
5000-0761	PCB, ASSY, GSM III MODEM, 5000
5000-0570	PCB, ASSY, LANDLINE MODEM, 5000

## Part Numbers D-3

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<b>Monitor Replacement Battery Pack</b>	
5000-0557	BATTERY, PACK, 5000
<b>ADS Power Supplies</b>	
5000-0727	12VDC Power Supply
5000-0728	12/24VDC Power Supply

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