
ADS® Intrinsically-Safe *TRITON+*® Installation, Operation, and Maintenance Manual

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CHAPTER 1

Introduction

The Intrinsically-Safe ADS **TRITON+**[®] flow monitor measures open channel flow in sanitary sewers, storm sewers, combined 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 inter-agency billing
- Monitoring sewage handling facilities (wastewater treatment plants and pump stations)

The **TRITON+** monitor provides exceptional accuracy and reliability in measuring open-channel flow depth and velocity to determine flow rate (quantity) in pipes. This flow data is the essential element required to successfully perform investigative, analytical, and reporting activities.

This manual offers detailed instructions on installing, operating, maintaining, and troubleshooting the **TRITON+** flow monitor, sensors, and communication hardware.

Intrinsic Safety

Intrinsic safety is an electronic hardware protection concept that ensures there are no conditions under which the equipment can operate that could cause a release of energy sufficient to ignite a hazardous gas or dust mixture. Devices that meet the low power, current-limited design criteria are deemed Intrinsically Safe (IS). Special design, testing, quality, and inspection rules apply to manufacturers and users of IS equipment due to the critical nature of its deployment in hazardous areas. Areas where hazardous conditions can be expected to be present on a constant basis are classified (rated) as Zone 0 (equivalent to Class I, Division 1, in North America).

The *TRITON+* flow monitor (Model 8000-FST-IM) has been certified and tested to worldwide IECEx (International Electrotechnical Commission Explosive) standards. The IECEx scheme allows demonstrated compliance for use in Zone 0 (equivalent to Class I, Division 1 in North America) areas in the following countries:

United States	Germany	Poland
Australia	Hungary	Romania
Brazil	India	Russia
Canada	Italy	Singapore
China	Japan	Slovenia
Croatia	Korea	South Africa
Czech Republic	Malaysia	Sweden
Denmark	Netherlands	Switzerland
Finland	New Zealand	Turkey

The *TRITON+* has also been certified under the ATEX European Intrinsic Safety standards for Zone 0 rated hazardous areas.

The *TRITON+* flow monitor has been CSA (Canadian Standards Association) certified to CLASS 2258 03 – Process Control Equipment, Intrinsically Safe and Non-Incendive Systems – For Zone 0 Hazardous Locations, Ex ia IIB T3 (152°C) areas in Canada; and CSA certified to CLASS 2258 83 – Process Control Equipment, Intrinsically Safe and Non-Incendive Systems – For Class I Zone 0 Hazardous Locations, AEx ia IIB T3 (152°C) areas in the USA (equivalent to Class I, Division 1, Groups C & D).

It is the customer's responsibility to ensure that the certification(s) provided for the ADS equipment meets applicable regulatory requirements.

Note: *TRITON+* models include the 8000-FST-IM-4WW, 8000-FST-IM-4VZ, 8000-FST-IM-EP-4VZ, 8000-FST-IM-GL, and 8000-FST-IM-EP-GL.

TRITON+ System Certification

The *TRITON+* unit and associated telemetry equipment are certified for use only with approved ADS battery packs, sensors, communication cables, and telemetry equipment. Connection of any non-approved devices could result in unsafe operation and will immediately void the warranty and IS certification.

Note: Connecting the Telog Ru-33 or Ru-35 or the Ayyeka Wavelet 4R to the ADS *TRITON+* is an approved application and, therefore, will not void the *TRITON+* warranty. However, because the Telog and Ayyeka units are not IS certified, the installation will not be considered intrinsically safe if an Ru-33, Ru35 or Wavelet monitor is installed in the manhole with the monitor.

Sensors

The **TRITON+** monitor supports several approved IS sensors that vary in measurement methodology, redundancy, and other features. The monitor is approved for accommodating up to two of the same or different types of IS sensors. Following are the approved IS sensors:

- **AV|Gated Sensor** Performs upward ultrasonic depth, pressure depth, gated velocity, and water temperature measurements and mounts at the bottom of the pipe under the flow surface (ADS p/n 8K-CS7-10-35).
- **AV|Max Sensor** Performs upward ultrasonic depth, pressure depth, peak velocity, and water temperature measurements and mounts at or near the bottom of the pipe under the flow surface (ADS p/n 8K-CS9-10-35).
- **Inclinometer** Utilizes an integrated accelerometer in a sealed and intrinsically safe housing to accurately determine state of flood gate positioning in water control and management systems (ADS p/n 8K-0528).
- **Long Range Depth Sensor** Performs downward ultrasonic depth measurement and air temperature measurements and mounts within 12 inches (305 mm) of the underside of the manhole cover (ADS p/n 8K-CS6-C1-10).
- **ParaDepth Sensor** Performs downward ultrasonic depth and air temperature measurements and mounts at the top (or crown) of the pipe above the flow (ADS p/n 8K-CS8-D1-00-30-IS). It can also be mounted in the manhole using the ADS Topside Retrieval System (ADS p/n 8000-0597, 8000-0598, 8000-0654).
- **ParaFlow Sensor** Performs downward ultrasonic depth, surcharge pressure depth, surface velocity, surcharge velocity, and air temperature measurements and mounts at top (or crown) of the pipe above the flow (ADS p/n 8K-CS8-V2-10-30-IS). It can also be mounted in the manhole using the ADS Topside Retrieval System (ADS p/n 8000-0597, 8000-0598, 8000-0654).
- **Peak Combo Sensor** Performs upward ultrasonic depth, pressure depth, peak velocity and water temperature measurements and mounts at or near the bottom of the pipe under the flow surface (ADS p/n 8K-CS4-05-35, 8K-CS4-15-35, or 8K-CS4-30-1H).
- **Surface Combo Sensor** Performs downward ultrasonic depth, surcharge pressure depth, surcharge peak velocity, and surface velocity measurement and mounts at the top (or crown) of the pipe above the flow (ADS p/n 8K-CS5-V2-05-30, 8K-CS5-V2-15-30, or 8K-CS5-V2-30-1H).
- **Ultrasonic Depth Sensor** Performs downward ultrasonic depth measurement and mounts at the top (or crown) of the pipe above the flow (ADS p/n 8K-CS5-D1-00-30).

Extension cables are available for these sensors in lengths up to a maximum of 300 feet (91 m).

Note: Detailed descriptions and specifications for the sensors are available in *Chapter 2, System Overview*, and *Appendix A, Specifications*

Power

The **TRITON+** flow monitor is powered by an internal 12-volt IS battery pack (ADS p/n 8000-0043) or an external DC power source through an external power and communications unit (ExPAC, ADS p/n 8000-0377), external Modbus interface unit (XBUS™, ADS p/n 9000-0427), or an external input/output device (XIO™, ADS p/n 8000-0400).

Note: Using a battery pack that is *not* supplied by ADS will void the warranty and IS certification of the monitor.

Telemetry

Wireless communication is available to the **TRITON+** monitor through an antenna and internal UMTS/HSPA+/GSM, Verizon LTE-M modem or the WorldWide LTE-M modem. The antenna through which wireless communication occurs may be located either inside or outside the manhole; however, installing the antenna outside the manhole will maximize signal strength.

ADS p/n 9000-0094 antenna is the recommended antenna for use with the **TRITON+** monitor. Customers also may obtain their own antennas to accommodate specific project needs or requirements. However, when assessing a third-party antenna, please consult an ADS representative prior to installing the antenna to verify the antenna can adequately support monitor communications.

Connecting the **TRITON+** to the Telog RTU (Model Ru-33) also supports wireless communication via the Telog “passthrough” mode. The Telog is mounted next to the **TRITON+** in the hazardous area and connected to the monitor using the Triton-Telog Comm Cable (ADS p/n 8000-0054-01). *However, please note that, because the Telog unit does not possess IS certification, the installation will not be considered intrinsically safe if the Telog unit is installed in the manhole with the monitor.*

Installation and IS Considerations

When installing the **TRITON+** flow monitor, carefully follow any local regulations for the installation of IS equipment. For example, many clients only allow the use of special *hazardous area* tools (flashlights, radios, etc.) in manholes. Some clients will not allow the use of an electric drill, either battery-powered or AC-powered, in a manhole. In this case, air (i.e., pneumatic) tools must be used. When in doubt as to the applicable regulations, check with the client or the client’s designated safety representative.

Specific Conditions of Use

During the ATEX/IECEX/CSA/UKCA approval process, certain conditions are set forth that must be observed when using the certified equipment. These *Specific Conditions of Use* can be found in the body of each certification (referenced in this manual), as well as on a page attached to the Declaration of Conformity. Following is a summary of these Safe Use Instructions:

- Parts of the enclosure may be non-conducting and may generate an ignition-capable level of electrostatic charge under certain extreme conditions. The user should ensure that the equipment is not installed in a location where it may be subjected to external conditions (such as high-pressure steam), which might cause a build-up of electrostatic charge on non-conducting surfaces.
- As aluminum is used at the accessible surface of this unit, in the event of rare incidents, ignition sources due to impact and friction sparks may occur. This shall be considered when it is being installed, particularly in locations that require equipment with a Group II Ga level of protection.
- Measures shall be taken to limit transient over voltages to the USB Serial Interface to an appropriately low level, in accordance with Overvoltage Category I (IEC 60664-1).
- This equipment (ADS Model 8000-FST-IM) shall only be used in the hazardous area when it has been fully assembled; no maintenance of internal parts or battery changes shall be undertaken unless the unit is located in a safe area.
- The 8000-FHK/FST-IM Monitor Assembly common line is connected to the metal enclosure, therefore when it is powered by the “External Power and Communications Unit” (ExPAC), the Monitor Assembly shall be bonded to the ExPAC earth with a conductor having a minimum cross-sectional area of 4 mm², to achieve a resistance $\leq 1 \Omega$.
- Applicable to the USB Serial Interface: Measures shall be taken to limit transient over voltages to the USB Serial Interface to an appropriately low level, in accordance with Overvoltage Category 1 (IEC 60664-1).
- The equipment shall be installed as per installation drawing 8000BK0009.
- The External Power and Communications Unit (ExPAC) may only be mounted in a non-hazardous location.
- The 8000-FST-IM Monitor Assembly common line is connected to the metal enclosure. Therefore, when it is powered by the “External Power and Communications Unit” (ExPAC), the Monitor

Assembly shall be bonded to the ExPAC earth with a conductor having a minimum cross-sectional area of 4 mm², to achieve a resistance $\leq 1 \Omega$.

Other Conditions for Safe Use

- The ADS Model 8000-FST-IM shall use only the 12-volt IS Battery Pack (ADS p/n 8000-0043) for internal power.
- Only ADS-approved sensors shall be connected to the ADS Model 8000-FST-IM: ADS sensor types CSX series.
- The only communication devices that may be connected to the **COMM + EXT PWR** connector on the **TRITON+** are the USB Serial Interface (ADS p/n 8000-0337), the ExPAC/XBUS/XIO power cable (ADS p/n 8000-378-10/25), the Direct Connect Interface (ADS p/n 8000-0054), the Inclinator (ADS p/n 8000-0528), and the Sampler Cable (ADS p/n 8000-0348-01).

Note: The Triton-Telog Comm Cable (ADS p/n 8000-0054-02) also may be connected to the **COMM + EXT PWR** connector on the **TRITON+** to provide communication between the Telog Ru-33 or Ru-35 and the monitor. However, because the Ru-33 nor Ru-35 are not certified for IS operation, an installation involving a connection between these units will not be considered intrinsically safe, unless the Telog unit is installed outside the hazardous area.

Note: The Ayyeka Wavelet 4R Comm Cable (ADS p/n 8000-0054-03) also may be connected to the **COMM + EXT PWR** connector on the **TRITON+** to provide communication between the Ayyeka Wavelet 4R monitor and the **TRITON+**. However, because the Wavelet 4R is not certified for IS operation, an installation involving a connection between this unit will not be considered intrinsically safe, unless the Ayyeka unit is installed outside the hazardous area.

Maintenance Restrictions

As mentioned earlier, all ADS *TRITON+* flow monitors are manufactured to meet IS standards. ***The monitor's IS certification can be voided instantly if proper maintenance and service procedures are not followed.*** ADS must restrict certain maintenance tasks to ADS IS-certified technicians.

ADS-certified technicians carefully inspect and document their repairs of IS monitors. This inspection and documentation process provides legal protection should the monitor's performance or safety be in question.

If you experience trouble with this equipment, please refer to this manual for troubleshooting guidelines. The following maintenance procedures may be performed in the field, but they must be performed as described in this manual:

- Installing and swapping monitor
- Installing and swapping sensors
- Installing and swapping battery pack
- Swapping fuses in power regulator in monitor
- Installing and swapping SIM card on monitor port
- Replacing pressure depth sensor dryer tube and desiccant beads
- Installing and swapping ExPAC (*applicable only when not housed within an XBUS or XIO*), XBUS, or XIO
- Cleaning sensors
- Confirming sensors

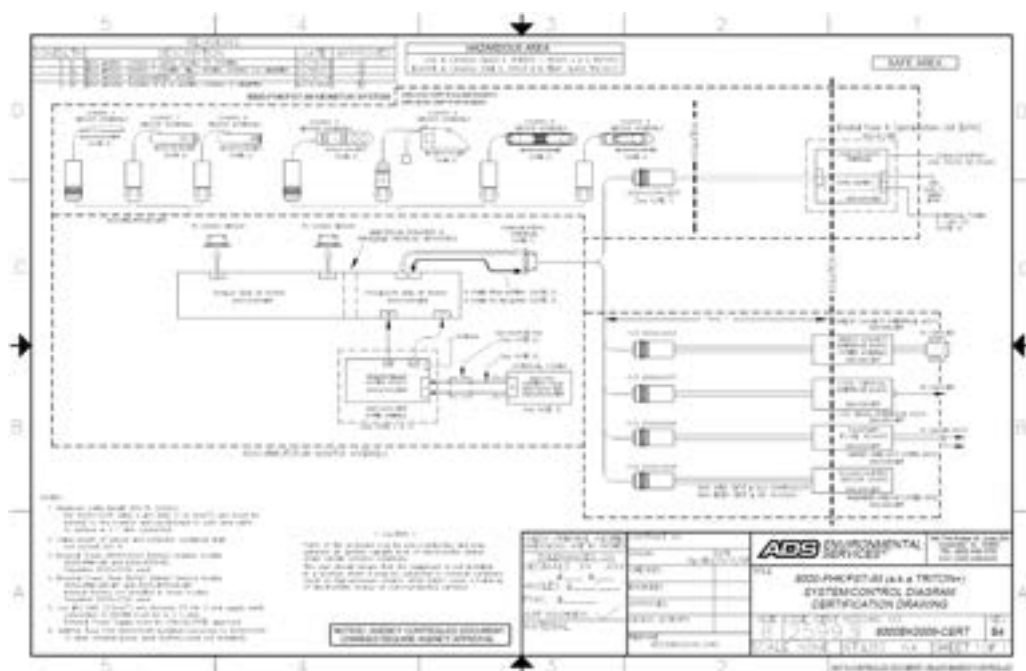
Note: Please note that, in all applications, only ADS IS-certified Service Technicians are authorized to perform component-level service on the *TRITON+*.

If you have any questions about the procedures, warranty information, or level of service you are allowed to perform on a monitor, please contact ADS through the contact information listed at the end of this chapter.

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.

The **TRITON+** flow monitor is designed to be installed in combined and sanitary sewer lines and manholes. This installation work is inherently dangerous. All applicable safety guidelines should be followed and carried out by at least two fully trained and qualified persons.

This drawing depicts the interconnections allowed for the **TRITON+**. It is intended for use by inspection professionals for audit certificate compliance; however, it is a good tool for understanding the structure of the **TRITON+** flow monitoring system.



Control Drawing

Note: This is an excerpt from an agency-controlled document for illustration purposes only. Changes to the base controlled document require agency approval. For a full-size copy of this drawing, please contact ADS and request drawing number *8000BK0009-CERT*.

Note: The Telog Ru-33 and Ru-35 can be connected to the **COMM + EXT PWR** port on the *TRITON+* monitor using the Telog-Triton Comm Cable (ADS p/n 8000-0054-02). However, this configuration has not been included on this drawing because the Telog unit is not certified for IS operation. Therefore, an installation involving this configuration will not be considered intrinsically safe, unless the Ru-33 or Ru-35 is installed outside the hazardous area.

Cellular Modem Information and Compliance

Wireless telemetry is provided via a third-party, FCC- and carrier-approved, commercial HSPA+/GSM, Verizon LTE-M, or WorldWide LTE_M modem inside the *TRITON+* monitor and a corresponding antenna. Two antenna options are available through ADS. However, customers may obtain their own antennas to accommodate specific needs or requirements. If a customer-supplied antenna is preferable or required, consult an ADS representative prior to installing the antenna to ensure it will adequately support *TRITON+* monitor communications and compliance.

European ATEX Hazardous Area Compliance

The following instructions apply to equipment covered by the certificate numbered Sira 09ATEX2027X (*TRITON+*, USB Serial Interface, Combo Sensors CSX Series, IS PSTN modem, and IS modem DAA). Reference European ATEX Directive 2014/34/EU, Annex II, 1.0.6:

- The equipment may be used with flammable gases and vapors with apparatus groups IIA and IIB and with temperature classes T3 (152°C), T4, T5, and T6.
- The equipment is only certified for use in ambient temperatures in the range of -20°C to +60°C and should not be used outside this range.
- The certificate number has an 'X' suffix, which indicates that special conditions apply to installation and use. Those installing or inspecting this equipment must have access to the contents of the certificate.
- Installation shall be carried out in accordance with the applicable code of practice by suitably-trained personnel.
- Repair of this equipment shall be carried out in accordance with the applicable code of practice.
- If the equipment is likely to come into contact with aggressive substances, then it is the responsibility of the user to take suitable precautions that prevent it from being adversely affected, thus ensuring that the type of protection is not compromised.
 - ☐ Aggressive substances such as acidic liquids or gases that may attack metals, or solvents that may affect polymeric materials
 - ☐ Suitable precautions such as regular checks as part of routine inspections or establishing from the material's data sheet that it is resistant to specific chemicals
- There are no special inspections or maintenance conditions other than a periodic check.
- *TRITON+* monitors delivered outside the U.S. must bear the following label to substantiate conformance to ATEX, IECEx and CSA standards as certified through Sira Certification Services:



TRITON+ ATEX, IECEx, CSA, UKCA Certification Label



Combo Sensor ATEX, IECEx, CSA, UKCA CSX Series Certification Label



Long Range Depth (CS6) ATEX, IECEx, CSA, UKCA Certification Label



Inclinometer ATEX, IECEx, CSA, UKCA Certification Label



Sampler Cable ATEX, IECEx, CSA, UKCA Certification Label



USB Serial Interface ATEX, IECEx, CSA, UKCA Certification Label



ExPAC ATEX, IECEx, CSA, UKCA Certification Label



Direct Connect Interface Cable ATEX, IECEx, CSA, UKCA Certification Label



Battery ATEX, IECEx, CSA, UKCA Certification Label

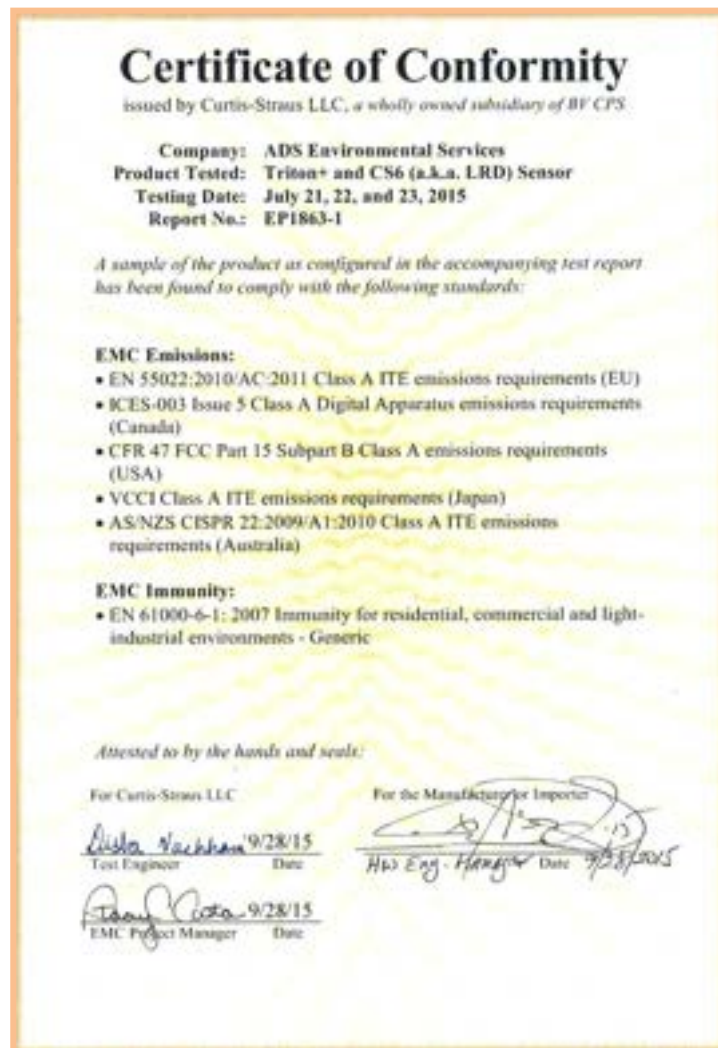
EC Type Examination Certificate Sira 09ATEX2027X can also be used to substantiate conformance to applicable EU laws for IS equipment.

Note: To access the latest version of the certificate, please contact ADS.

IECEx (International Electrotechnical Commission Explosive) Hazardous Area Compliance

The **TRITON+** is covered by certificate IECEx SIR 09.0020X (**TRITON+**). Reference IECEx standards IEC 60079-0 : Edition 7.0 2017-12; IEC 60079-11 : Edition 6.0 2011-06; and IEC 60079-26 : Edition 4.0 2021-02. This IECEx certificate can also be used to substantiate conformance to applicable international standards for IS equipment.

Note: To access the latest version of the certificate, please contact ADS.



CS6 (LRD Sensor) Certificate of Conformity

CSA Hazardous Area Compliance

The *TRITON+* is covered by certificate CSA 2671180 (*TRITON+* and Combo Sensors, ExPAC, Sampler Cable and USB Serial Interface). Reference CSA requirements C22.2 No. 0:20; CAN/CSA C22.2 No. 61010-1-12 + Amd 1-18; CAN/CSA-C22.2 No. 60079-0:19; CAN/CSA-C22.2 No. 60079-11:14; UL 61010-1-2018 Third Edition UL 60079-0 Seventh Edition; and UL 60079-11 Sixth Edition

The following CSA certificate can also be used to substantiate conformance to applicable Canadian standards for IS equipment:

Note: To access the latest certificates, please contact ADS.

UKCA Hazardous Area Compliance

The **TRITON+** is covered by certificate CSAE 22UKEX1159X.

The following instructions apply to equipment covered by the certificate numbered CSAE 22UKEX1159X (**TRITON+**, USB Serial Interface, Direct Connect Interface, Sampler Cable, External Power and Communications unit, Combo Sensors CSX Series, and I9 (Inclinometer)). Reference EN IEC 60079-0: 2018 EN 60079-11: 2012 :

- The user should ensure that the **TRITON+** is not installed in a location where it may be subjected to external conditions (such as high-pressure steam), which might cause a build-up of electrostatic charge on non-conducting surfaces.
- Ignition due to impact and friction shall be considered when The **TRITON+** is being installed, particularly in locations that require equipment with a group II Ga level of protection.
- The **TRITON+** shall only be used in hazardous areas when it has been fully assembled. No maintenance of internal parts or battery changes shall be undertaken unless the unit is located in a safe area.
- When powered by the “External Power and Communications Unit” (ExPAC), the **TRITON+**’s Monitor Assembly shall be bonded to the ExPAC earth with a conductor having a minimum cross-sectional area of 4 mm², to achieve a resistance $\leq 1 \Omega$.

Note: To access the latest certificates, please contact ADS.

Declaration of Conformity

For European (EU member country) applications, a Declaration of Conformity (DoC) must be kept on file at the facility responsible for repair and maintenance of this equipment. A copy of the relevant DoC also must be shipped with each product. If you have any questions about the DoC, please contact ADS LLC by telephone at 1-877-237-9585 or email at adssupportcenter@idexcorp.com.

Product Serial Number	
EU Declaration of Conformity	
ADS LLC 140 The Bridge St. Suite 204, Huntsville, AL 35894 Phone (800) 613-7346, FAX (256) 436-6833	
Product Name:	Triton+
Model Number:	8000-FST-EM, 8000-FST-EM-EP
Options:	Declaration covers all options of the above product(s)
Document Number:	8000-A0104 Rev. A3, Page 1 of 2
Via, ADS LLC, declare under our sole responsibility that the above named product(s) are in conformity with the following standards and other normative documents:	
Explosive Atmospheres (Directive 2014/34/EU)	
EN 60079-0:2018 + EN 60079-1:2012 Following the provisions of Directive 2014/34/EU and certificate number 09ATEX04178 this product is excluded from the scope of Directive 2014/34/EU. Issued by: CSA Group Netherlands B.V. Notified Body Number 2813 Location: 310 (842) 6812 AR Arnhem, Netherlands +31 26 356 2856	
Electromagnetic Compatibility (Directive 2004/108/EC)	
EN 55011 (EMC A2:2009/A2:2012) + EN 61000-6-1:2007 Following the provisions of EMC Directive 2004/108/EC and in conformity with current harmonized standards EN 55011:2009/A1:2018	
EU Radio 2 (Directive 2011/65/EU)	
Following the provisions of Directive 2011/65/EU, and in conformity with current harmonized standards EN 55011:2012 + EN 61000-6-1:2007	
Proper use and handling information is found in the associated product manual(s). Special Conditions for safe use are found on sheet 2 of this document.	
The undersigned hereby declares that the product listed above conforms to the above Directives and Standards. Authorized: _____ Date: _____ Name: ADS LLC, ATEX Authorized Person, Huntsville, AL, USA	
The undersigned (Ipsos, Inc., 301 West Technology Dr., Madison, AL 37178 USA (256) 773-1987) hereby declares that the product listed above was built and tested (where required) in accordance with manufacturing documentation provided by ADS LLC. Authorized: _____ Date: _____ Name: Ipsos, Inc., VP Quality Management Eng. Madison, AL	

Sample **TRITON+** Declaration of Conformity – Page 1

Product Warranty

This section includes the warranty information for the ADS® **TRITON+** flow monitor.

New Product Warranty and Out-of-Warranty Product Repairs

All new products manufactured by ADS carry a warranty as specified in the Terms and Conditions available on the [ADS website](#). Likewise, after the new product warranty expires, a product may be returned to ADS for repair, pursuant to the Terms and Conditions. Any repairs or replacements deemed necessary shall be covered as described therein.

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.

Shipping

All repaired products will be returned via 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.

Warranty Return Information for International Customers

Please use **U.S. Harmonized Schedule Number 9801.00.1012** on your shipping documents and customs forms to indicate “**U.S. made goods being returned for repair**”.

Service

For service or warranty issues, please contact ADS customer support:

Telephone: 1-877-237-9585

Email: adssupportcenter@idexcorp.com.

CHAPTER 2

System Overview

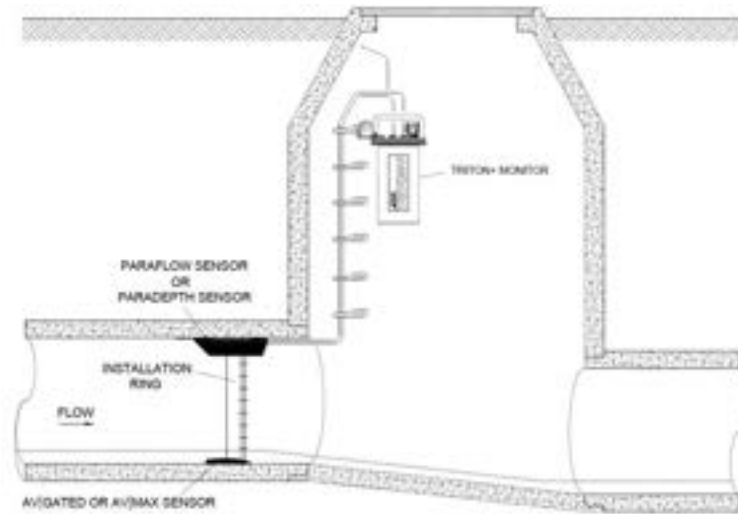
The ADS *TRITON*+® flow monitor supports nine (9) flow measurement devices for gathering flow data:

- **AV|Gated Sensor** This sensor, which mounts at the bottom of the pipe, contains an upward-looking ultrasonic depth sensor, a gated Doppler velocity sensor which measures flow velocity at multiple discrete points to measure average velocity, a pressure depth sensor, and a water temperature sensor. It also contains an Accelerometer sensor to measure sensor rotation and slope for ease and accuracy of installation.
- **AV|Max Sensor** This sensor, which mounts at the bottom of the pipe, contains an upward-looking ultrasonic depth sensor, a continuous wave Doppler peak velocity sensor, a pressure depth sensor, and a water temperature sensor. It also contains an Accelerometer sensor to measure sensor rotation and slope for ease and accuracy of installation.
- **Inclinometer** This sensor, which mounts on any flat surface of the wastewater collection side of the flood gate, allows angle measurements to accurately determine the state of the flood gate positioning.
- **Long Range Depth Sensor** This sensor, which is secured to an accompanying mounting bar beneath the manhole cover, contains an ultrasonic transducer housed within the integral parabolic reflector. The transducer and reflector work in tandem to measure the depth of flow in the manhole. The Long Range Depth Sensor also includes a magnetic Submersion Sensor that affixes to the manhole frame. It detects the water level above the parabolic enclosure up near the manhole lid.
- **ParaDepth Sensor** This sensor can be mounted at the crown (top) of the pipe or in the manhole structure using the ADS Topside Retrieval System. It contains a downward looking ultrasonic depth sensor and air temperature sensor. It differs from the standard Ultrasonic Depth Sensor listed below in that it leverages the parabolic reflector design developed in the ADS Long Range Depth sensor to more accurately and reliably measure flow level. It also contains an Accelerometer to measure sensor rotation and slope for ease and accuracy of installation.
- **ParaFlow Sensor** This sensor can be mounted at the crown (top) of the pipe or in the manhole structure using the ADS Topside Retrieval System. It contains a downward looking ultrasonic sensor, a surcharge pressure depth sensor, a surface velocity sensor, a surcharge velocity sensor and an air temperature sensor. It differs from the standard Surface Combo Sensor listed below in that it leverages the parabolic reflector design developed in the ADS Long Range Depth sensor for both depth and velocity to more accurately and reliably measure flow level and velocity. It also contains an Accelerometer to measure sensor rotation and slope for ease and accuracy of installation.
- **Peak Combo Sensor** This sensor, which mounts at or near the bottom of the pipe, contains an upward-looking ultrasonic depth sensor, a continuous wave Doppler peak velocity sensor, pressure depth sensor and a water temperature sensor.
- **Surface Combo Sensor** This sensor, which mounts at the top of the pipe, contains an ultrasonic depth sensor, a surface velocity sensor, a surcharge peak velocity sensor, surcharge pressure depth sensor and an air temperature sensor.
- **Ultrasonic Depth Sensor** This sensor, which mounts at the top of the pipe, is a standalone ultrasonic depth sensor and also includes an air temperature sensor.

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 up to 150 days of data based on logging 6 entities at a 15-minute sample rate. The storage capacity varies according to the number of sensors attached to the monitor, the number of entities stored, the rate at which the entity data is

logged, and the functions activated for the sensors. This data is available to the user for collection, further processing, analysis, and reporting. These reports include critical information that can assist municipalities and other industries in planning improvements and additions to sewer systems, improving the accuracy of billing information, and providing overall management of sewer systems.

The **TRITON+** 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 or to a rung on the ladder; the sensors attach to a ring or band installed in the sewer pipe a short distance upstream of the manhole invert or to a mounting bar installed below the manhole cover. The **TRITON+** monitor can support up to two sensors at one or two separate locations in the pipe. These sensors display exceptional durability and accuracy, even under harsh and turbulent flow monitoring conditions.



Typical **TRITON+** flow monitoring system installation

Communication between the monitor and the user's office or field computer can occur over TCP/IP (remote, wireless communication) or a USB serial interface cable (on-site communication).

The **TRITON+** is powered by a 12-volt IS battery pack or through external power. Externally-powered units receive power from an independent source through an intermediate ExPAC (external power and communications unit), XBUST™, (external Modbus interface unit), or an XIO™ (external input/output) device.

The ExPAC and XBUS also serve as Modbus interfaces to provide real-time data from the monitor to a SCADA (supervisory control and data acquisition) or other process control system through an RTU (remote terminal unit) or another comparable instrument. The XIO also serves as an analog and digital I/O (input/output) interface that can support non-ADS sensors, switches, and various third-party equipment.

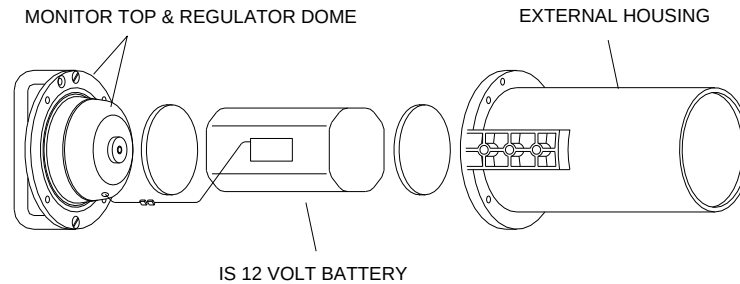
The ADS **Qstart**^{XML} software application enables the user to configure and communicate with the monitor for activation, data collection, and diagnostic purposes. Configuration involves defining the information file (XML) for storage in the user's local directory and building the necessary code and variables for the site. The XML file contains information such as pipe characteristics, monitor identification, active sensors, sensor offsets, data log rate, and other parameters necessary for measuring the flow both accurately and efficiently.

Activation involves downloading the site-specific information from the XML (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, and managing event notification.

Note: Refer to the **Qstart**^{XML} online help for more information.

TRITON+ Flow Monitor

The **TRITON+** flow monitor is contained in a waterproof, airtight, cylindrical, high-impact ABS plastic canister housing. It contains a single processor board attached to the inside of the aluminum monitor top, a power regulator and cellular modem built into a protective dome, and a replaceable battery pack.



Exploded view of **TRITON+** (processor board resides between the monitor top and protective regulator dome)

Communications

ADS offers remote (*wireless*) and on-site (*direct*) communication options for the **TRITON+** monitor.

Wireless Communication

Wireless communication occurs over the 3G/4G UMTS/HSPA+ network, the Verizon® LTE-M network, or the AT&T LTE-M network using *TCP/IP* (Transmission Control Protocol/Internet Protocol). The TCP/IP networks facilitate high-speed, low-cost, efficient digital communication in coverage areas using static and dynamic IP address services. ADS **TRITON+** monitors supporting Verizon network services have been approved through the Verizon Wireless Open Development program.

Remote communication with the monitor occurs over the network through an internal modem located in the monitor's regulator dome, provided a *static* IP address is in use. If the monitor is using a *dynamic* IP address, the user cannot communicate directly with monitor over the wireless network.

Direct Communication

On-site (or *direct*) communication with all monitors is available through an IS USB serial interface (direct connect) cable (ADS p/n 8000-0337) for battery-powered units or through a standard A-to-B USB cable when using external power.

Processor Board



TRITON+ top with processor board attached

The processor board is the source of all monitor activity. The board is responsible for all of the monitor's high-level functions, including the following:

- Managing user communication with the monitor
- Controlling the timing at which the sensors fire (i.e., take readings)
- Retrieving and storing sensor data
- Maintaining the monitor time and date
- Performing power management
- Storing the parameters required to accomplish the associated system operations
- Transmitting the stored and current data to the user's PC or FTP site
- Outputting a discrete signal pulse to a water quality sampler
- Displaying system power and operational status and diagnostic codes
- Initiating event notification through alarms
- Transmits readings and signals through analog and digital outputs and requests and receives data and status information through analog and digital inputs

The board allocates portions of memory to firmware (embedded software in the monitor that can be upgraded remotely) and data storage. 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 NVRAM or *non-volatile memory*, which is backed up by an on-board battery. Firmware programs concerning operation are stored in Flash.

Connector Ports



Monitor top with sensor and communication/power/sampler connector ports (no SIM card enclosure)
(ADS Model 8000-FST-IM-4WW-GBL)

The connector ports located on top of the monitor can receive up to two sensors, a communication device and/or power cable, and an antenna:

- **CHANNEL 1 and CHANNEL 2 Ports** These ports can receive up to two of the following sensors:
 - ☐ AV|Gated sensor
 - ☐ AV|Max sensor
 - ☐ Long Range Depth sensor
 - ☐ ParaDepth sensor
 - ☐ ParaFlow sensor
 - ☐ Peak Combo sensor
 - ☐ Surface Combo sensor
 - ☐ Ultrasonic Depth sensor

Note: The channel ports on the **TRITON+** receive any combination of two sensors, including two of the same sensor type. However, the sensors attached to the channel ports must accurately reflect the channel assignments for the sensor devices in **Qstart^{XML}**. In addition, two sensors of the same type may not be assigned to the same monitoring point. Refer to *Connecting Sensors to the Monitor* in Chapter 3, *Sensor Installation and Connection*, for more information.

- **COMM+ EXT PWR (Communication and External Power) Port** This port supports one of the following: communication, power, sensor, or sampling options at a time:
 - ☐ Direct, on-site communications with the *TRITON+* monitor through the *Qstart^{XML}* software installed on a field computer using a USB serial interface cable
 - ☐ External power from an external source through an ExPAC, XBUS, or XIO
 - ☐ Flow proportional or level-based water quality sampling through a third-party sampler
 - ☐ ADS Inclinator sensor
- **ANTENNA Port** This port receives the antenna supporting wireless communications with the *TRITON+* monitor.

The connector ports are keyed to receive only the proper sensor, antenna, or communication cables.

Some wireless *TRITON+* models also have a SIM card enclosure (described in the following section) that contains a *removable* SIM card for wireless communications. An air pressure valve also resides within this enclosure that exists only for factory and maintenance testing.

Power

Internal Power

Power is supplied to the *TRITON+* flow monitor by an internal 12-volt IS battery pack (ADS p/n 8000-0043-02/04). The battery pack resides within the *TRITON+* enclosure and powers monitor operations. A battery fuse board is attached to the battery pack to achieve intrinsic safety.



TRITON+ 12-volt battery

The power regulator, built into the dome assembly that covers and protects the processor board, is critical to intrinsically safe operation. It regulates the voltage supplied from the internal IS battery pack to the *TRITON+*, ensuring that the monitor always operates within its IS certification requirements. It also includes replaceable fuses and current-limiting components that will limit and/or interrupt power if a fault condition occurs.



Power regulator dome with IS regulator board

The user receives a warning when the internal 12-volt IS battery pack drops below a specified threshold (*ADS recommends 7.5 volts*).

External Power

The **TRITON+** also can receive power from an external AC or DC source through an *external power and communications unit* (ExPAC, ADS p/n 8000-0377), *external Modbus interface unit* (XBUS, ADS p/n 8000-0427), or *external input/output device* (XIO, ADS p/n 8000-0400) located outside the manhole near the power source. These units regulate the power coming to the monitor and can provide Modbus (ExPAC or XBUS) and analog and digital input and output interfaces (XIO) between the monitor and third-party equipment. The XBUS enclosure includes an ExPAC and power supply. The XIO enclosure includes an ExPAC, power supply, I/O module, and I/O interface terminals.



ExPAC



XBUS



XIO

External power requires a power source running 9 to 36 volts at 1.2 amperes of peak current. AC power must first come through a power supply for DC conversion prior to entering the ExPAC. ADS recommends using a 24-VDC module (ADS, p/n 508293). DC power can come directly from the power supply, a solar source, or rechargeable battery to the ExPAC.

Note: The ADS *TRITON+* (ADS p/n 8000-FST-IM-EP-4WW-GBL) is specifically designed for receiving external DC power that do not include the battery pack. However, battery-powered *TRITON+* monitors (ADS p/n 8000-FST-IM-4WW-GBL) may be converted to receive external power using a special kit available through ADS (p/n 8000-0434-xxx).

Powering the monitor through an external source is particularly advantageous at a location that requires logging an extensive amount of data on a short interval and eliminates the periodic need for battery replacement and disposal.

Refer to *Chapter 6, External Power*, for more information on powering a *TRITON+* through an external source.

Sensors

The **TRITON+** flow monitor can support up to two (2) of the eight (8) sensor types at one time to gather raw flow data. It also can support two (2) of the same sensor type at one time, configured on separate mounting points. Using independent measurement techniques, ultrasonic and pressure depth sensors collect information used to determine the depth of the flow. Velocity sensors also use different methods to determine the average and peak velocity of the flow. This variety of sensor options provides the versatility of measuring the depth and velocity of the flow from the top or bottom of the pipe and/or from within or outside of the flow.

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

If the purpose of the installation is to monitor for manhole surcharging or overflow, and not accurate flow-rate, the sensor can be mounted in the manhole structure. ADS recommends using the Long Range Depth sensor for this application.

AV|Gated Sensor

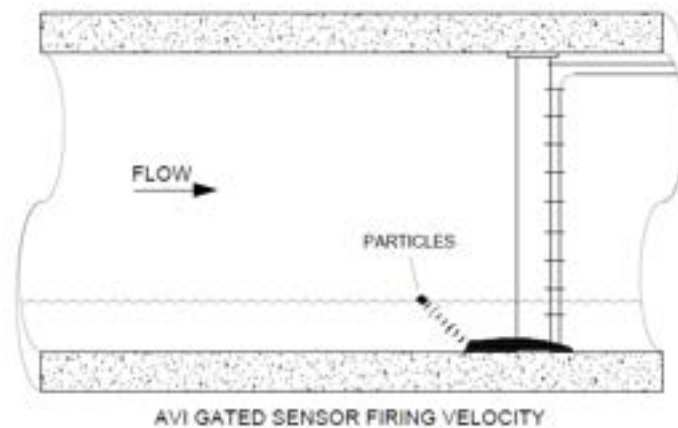
The AV|Gated sensor (ADS p/n 8K-CS7-10-35) mounts at the bottom center of the pipe and measures ultrasonic depth, average velocity, pressure depth, and water temperature. The sensor leverages dual depth technology and provides ultrasonic depth measurements to full pipe and pressure depth measurements during surcharge conditions.



AV|Gated Sensor

Velocity Sensor

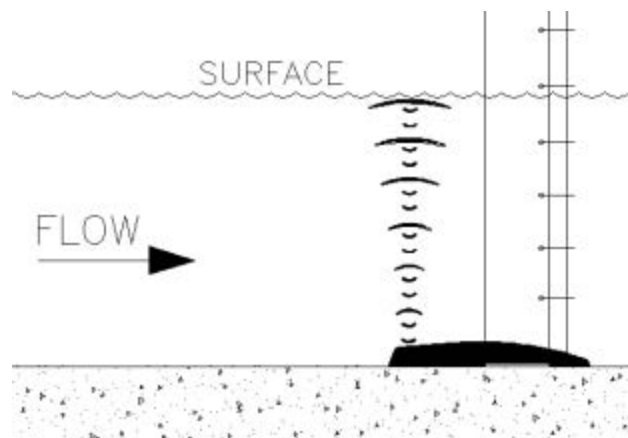
The AV|Gated sensor measures average velocity by measuring velocity at multiple discrete points within the flow and the returning reflected signal is processed using a digital signal processor from which average velocity is calculated.



Ultrasonic Depth Sensor

The AV|Gated sensor leverages dual depth technology and provides ultrasonic depth measurements to full pipe and pressure depth measurements during surcharge conditions.

To provide the depth of the flow, the sensor sends an ultrasonic signal upward that bounces off the water surface – air interface. The travel time from the sensor to the flow surface and back is converted to distance, which translates into the depth of the flow.



AV|Gated upward looking ultrasonic depth signals bouncing off water surface

Pressure Depth Sensor

A pressure transducer in the AV|Gated sensor measures the depth of the flow over the sensor. The monitor can use this data for comparison with other depth measurement devices in less than full-pipe conditions. The pressure depth sensor also can measure depths greater than full pipe that may extend up into the manhole during surcharge conditions.

Water pressure impacts a diaphragm in the transducer that varies an electrical current. This current is digitized by a sensor processor board and the value is sent to the monitor processor board. A vent tube on the back of the diaphragm equalizes for atmospheric pressure. The pressure transducers used in the AV|Gated sensor is a 0 - 10 PSI (0 - 0.68 Bar).

AV|Max Sensor

The AV|Max sensor with a standard 35-foot (10.6 m) (ADS p/n 8K-CS9-10-35) mounts at the bottom center of the pipe and measures ultrasonic depth, peak velocity, pressure depth, and water temperature.

The sensor leverages dual depth technology and provides ultrasonic depth measurements to full pipe and pressure depth measurements during surcharge conditions.



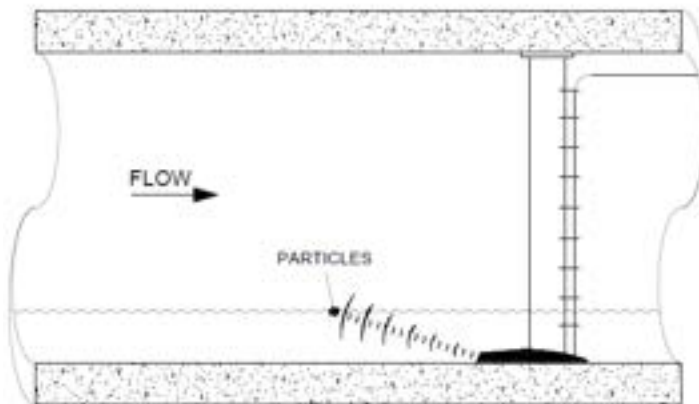
AV|Max Sensor

Velocity Sensor

The AV|Max sensor measures peak velocity by sending an ultrasonic signal at an angle up through the velocity layers in the oncoming flow. It emits a wide, omni-directional 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 peak 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. The moving objects represent particles in the flow. The stationary point is the velocity sensor, and the signal received is the reflection of the sound wave (emitted by the velocity sensor) off the particles.

Based on this information, the sensor determines the peak velocity of the oncoming flow. The peak velocity is then converted to average velocity by applying a user-defined average-to-peak ratio.

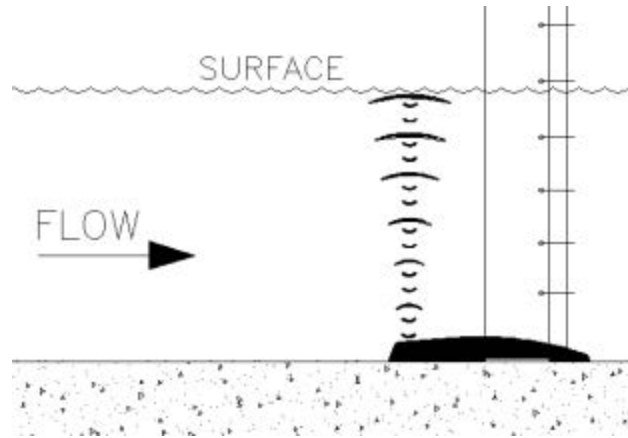


AV|Max Sensor firing velocity

Ultrasonic Depth Sensor

The AV|Max sensor leverages dual depth technology and provides ultrasonic depth measurements to full pipe and pressure depth measurements during surcharge conditions.

To provide the depth of the flow, the sensor sends an ultrasonic signal upward that bounces off the water surface – air interface. The travel time from the sensor to the flow surface and back is converted to distance, which translates into the depth of the flow.



AV|Max upward looking ultrasonic depth signals bouncing off water surface

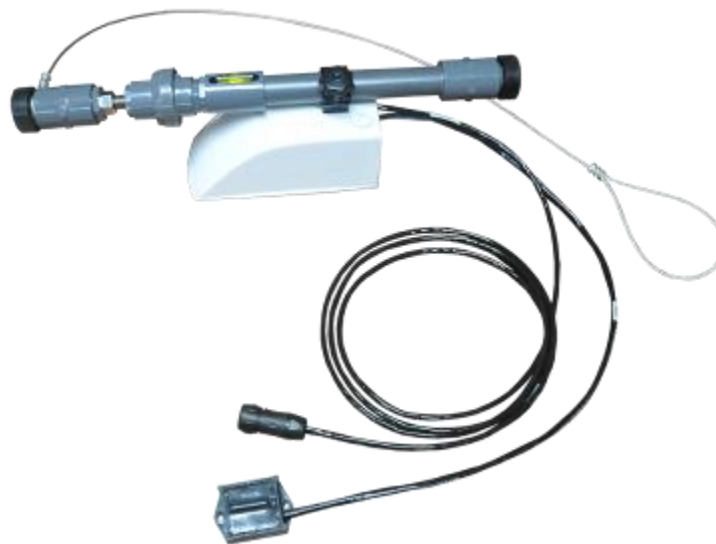
Pressure Depth Sensor

A pressure transducer in the AV|Max sensor measures the depth of the flow over the sensor. The monitor can use this data for comparison with other depth measurement devices in less than full-pipe conditions. The pressure depth sensor also can measure depths greater than full pipe that may extend up into the manhole during surcharge conditions.

Water pressure impacts a diaphragm in the transducer that varies an electrical current. This current is digitized by a sensor processor board and the value is sent to the monitor processor board. A vent tube on the back of the diaphragm equalizes for atmospheric pressure. The pressure transducers used in the AV|Max sensor is a 0 - 10 PSI (0 - 0.68 Bar).

Long Range Depth Sensor

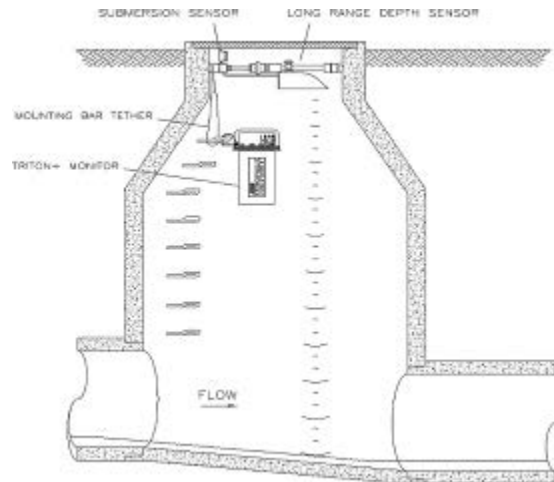
The Long Range Depth sensor (ADS p/n 8K-CS6-C1-10) with a standard adjustable Mounting Bar (ADS p/n 8000-0484) attaches beneath the manhole cover and measures ultrasonic depth.



Long Range Depth Sensor

This sensor has an ultrasonic transducer with a glass reinforced epoxy acoustic window and is located inside the integral parabolic reflector. It first transmits an ultrasonic signal horizontally from the transducer to the optimized reflector, focusing a very narrow beam downwards. The signal bounces off the flow and returns to the reflector where it is concentrated and aimed at the same transducer. The monitor measures the travel time elapsed between transmission and reception of the reflected sound signal. Based on the elapsed time and the speed of sound, the monitor determines the air range. The range represents the distance between the sensor face and flow surface. The monitor calculates the depth of the flow by subtracting the range from the manhole depth.

It computes the speed of sound in the air using the temperature recorded by a temperature sensor housed within the ultrasonic depth sensor.



Long Range Depth sensor ultrasonic signals

The Long Range Depth sensor also includes a magnetic Submersion Sensor that affixes to the manhole frame. It detects the water level above the parabolic enclosure up near the manhole lid. The Submersion sensor is a reliable digital capacitive sensor that triggers an alarm when fully submerged.

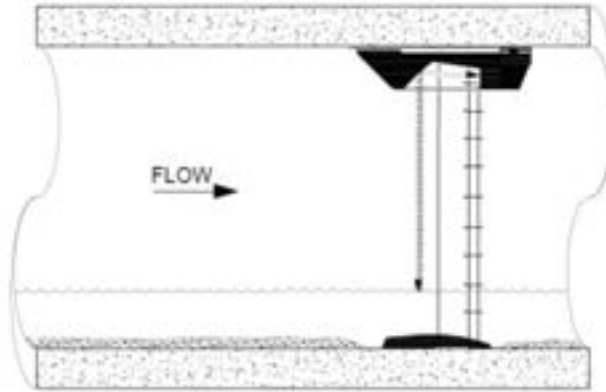
ParaDepth Sensor

The ParaDepth sensor with a standard 30-foot (9.1-m) cable (ADS p/n 8K-CS8-D1-00-30-IS) mounts at the crown of the pipe and measures ultrasonic depth and air temperature (Patent Number: 10648847). It can also be mounted in the manhole using the ADS Topside Retrieval System.



ParaDepth Sensor

The ultrasonic depth sensor is located in the parabolic reflector of the sensor body. This sensor transmits an ultrasonic signal horizontally from the transducer that is reflected off the parabolic mirror vertically towards the surface of the flow and returns along the same path. The monitor measures the time of flight between transmission and reception of the reflected sound signal. Based on the elapsed time and the speed of sound, the monitor calculates the air range to the surface. The range represents the distance between the bottom of the sensor and flow surface. The monitor calculates the depth of the flow by subtracting the range from the pipe diameter and the height of the sensor. It compensates for the speed of sound in the air using a temperature sensor housed within the ultrasonic depth sensor.



ParaDepth sensor sending signals to flow surface to determine range

ParaFlow Sensor

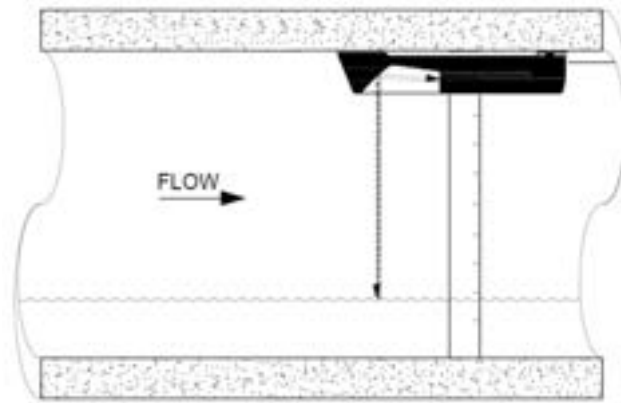
The ParaFlow sensor with a standard 30-foot (9.1-m) cable (ADS p/n 8K-CS8-V2-10 -30-IS) mounts at the top of the pipe. It can also be mounted in the manhole using the ADS Topside Retrieval System. The ParaFlow sensor measures ultrasonic depth, surcharge pressure depth, surface velocity, surcharge peak velocity and air temperature using five (5) independent sensors (Patent Numbers: 10648847 and 11029190).



ParaFlow Sensor

Ultrasonic Depth Sensor

The Ultrasonic Depth sensor is located in the front parabolic reflector of the sensor body. It transmits an ultrasonic signal horizontally from the transducer that is reflected off the parabolic mirror vertically towards the surface of the flow and returns along the same path. The monitor measures the time of flight between transmission and reception of the reflected sound signal. Based on the elapsed time and the speed of sound, the monitor calculates the air range to the surface. The range represents the distance between the bottom of the sensor and flow surface. The monitor calculates the depth of the flow by subtracting the range from the pipe diameter and the height of the sensor. It compensates for the speed of sound in the air using a temperature sensor housed within the ultrasonic depth sensor.

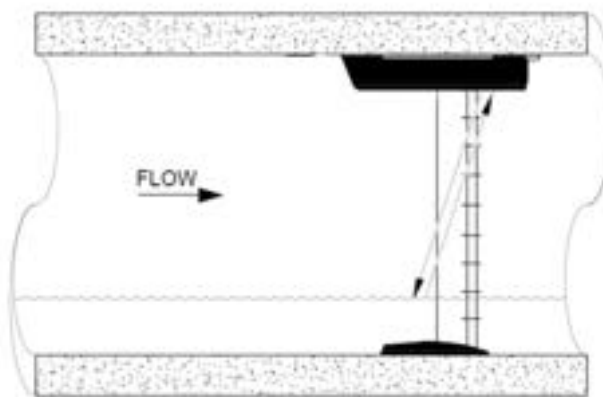


ParaFlow sensor sending signals to flow surface to determine range

Surface Velocity Sensor

The Surface Velocity sensor resides in the rear parabolic cavity of the sensor body. This sensor measures the velocity of the flow by bouncing signals off the flow surface using a method similar to the ultrasonic depth sensor, but the velocity signals are angled toward the flow surface. The surface velocity transducer is rear-firing aimed toward the back parabolic reflector. The surface velocity uses rapid pulses to measure the motion of the surface.

ADS does not recommend using this sensor for measuring velocity at locations with smooth flow surfaces or velocities of less than 1 foot per second (0.3 m/s). When pipe diameters are less than or equal to 10" (254 mm), it is recommended that the ParaFlow Sensor be installed in the manhole structure using an ADS Topside Bracket System.



ParaFlow sensor measuring surface velocity

Surcharge Peak Velocity Sensor

The Surcharge Peak Velocity sensor resides in the angled, front portion of the sensor in front of the ultrasonic depth parabolic cavity. It measures the velocity of the flow during surcharge conditions using the

same methodology as the Peak Combo Velocity Sensor. Therefore, it will measure velocity *only* when the pipe is full.

Surcharge Pressure Depth Sensor

The surcharge pressure depth sensor in the ParaFlow Sensor measures pressure depth using the same technique as the other combo sensors, except from the top of the pipe. Since it can provide an accurate depth only when submerged, the data from this sensor is useful only under full-pipe or surcharge conditions. The ParaFlow Sensor supports pressure measurement of 0 - 10 PSI (0 - 0.68 Bar).

Peak Combo Sensor

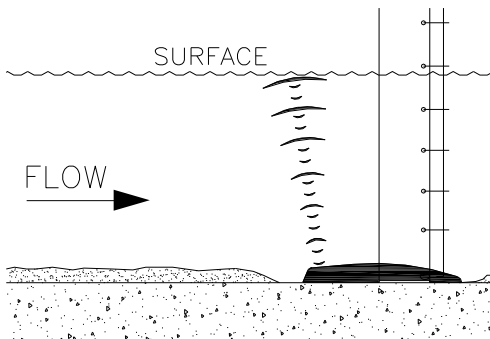
The Peak Combo Sensor with a standard 35-foot (10.6-m) or 100-foot (30.5-m) cable (ADS p/n 8K-CS4-XX-35/1H) typically mounts at the bottom of the pipe and measures ultrasonic depth, pressure depth, peak velocity and water temperature using four independent sensors.



Peak Combo Sensor

Ultrasonic Depth Sensor

To provide the depth of the flow, the sensor sends an ultrasonic signal upward that bounces off the water surface – air interface. The travel time from the sensor to the flow surface and back is converted to distance, which translates into the depth of the flow.



Upward ultrasonic depth signals bouncing off water surface

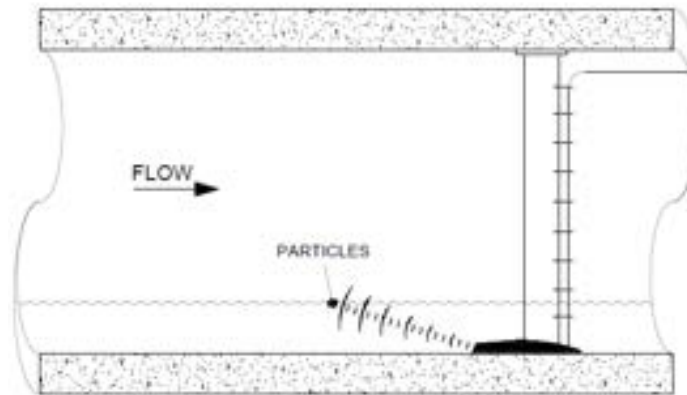
Pressure Depth Sensor

A pressure transducer in the Peak Combo Sensor also measures the depth of the flow over the sensor. The monitor can use this data for comparison with other depth measurement devices in less than full-pipe conditions. The pressure depth sensor also can measure depths greater than full pipe that may extend up into the manhole during surcharge conditions.

Water pressure impacts a diaphragm in the transducer that varies an electrical current. This current is digitized by a sensor processor board and the value is sent to the monitor processor board. A vent tube on the back of the diaphragm equalizes for atmospheric pressure. Three versions of pressure transducers are available with this combo sensor: 0 - 5 PSI (0 - 0.34 Bar), 0 - 15 PSI (0 - 1.03 Bar), and 0 - 30 PSI (0 - 2.07 Bar).

Peak Velocity Sensor

To obtain peak velocity, this sensor sends an ultrasonic signal at an angle up through the velocity layers in the oncoming flow. It emits a wide, omni-directional 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 peak velocity of the flow based on the *Doppler* effect.



Peak Combo sensor Peak Velocity transducer

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

Based on this information, the sensor determines the peak velocity of the oncoming flow. ADS's analytical and data processing software calculates an average velocity from this peak by applying a user-defined average-to-peak ratio.

Ultrasonic Depth Sensor

The Ultrasonic Depth Sensor with a standard 30-foot (9.1-m) cable (ADS p/n 8K-CS5-D1-00-30) mounts at the crown of the pipe and measures ultrasonic depth and air temperature.



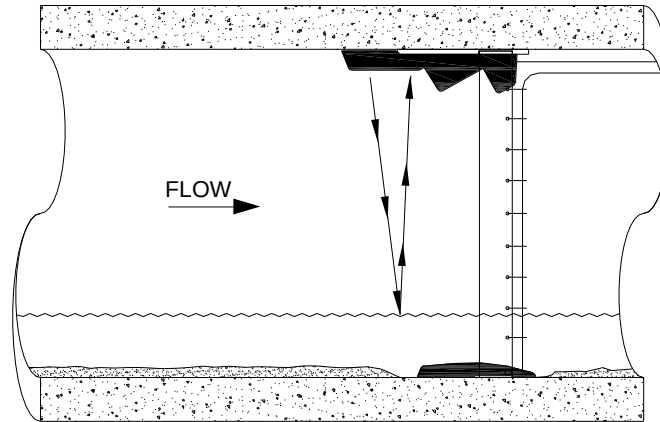
Ultrasonic Depth Sensor

Note: An End of Life for the Smart Depth sensor (ADS p/n 8K-CS5-D1-00-30) was issued effective February 1, 2025. The information contained herein is intended to support legacy users.

This sensor first transmits an ultrasonic signal downward from one of the crystals on the sensor face that bounces off the flow surface and returns to the other crystal. The monitor measures the travel time elapsed

between transmission and reception of the reflected sound signal. Based on the elapsed time and the speed of sound, the monitor determines the range. The range represents the distance between the sensor face and flow surface. The monitor calculates the depth of the flow by subtracting the range from the pipe diameter. It compensates for the speed of sound in the air using the temperature recorded by a temperature sensor housed within the ultrasonic depth sensor.

The ultrasonic depth sensor is located in the front, horizontal portion of the sensor and has two downward-facing ultrasonic crystals covered with a clear, moisture-shedding Teflon® coating.



Ultrasonic Depth sensor sending signals to flow surface to determine range

Surface Combo Sensor

The Surface Combo sensor with a standard 30-foot (9.1-m) cable (ADS p/n 8K-CS5-V2-XX-30) mounts at the top of the pipe and measures ultrasonic depth, surcharge pressure depth, surface velocity, surcharge peak velocity and air temperature using five (5) independent sensors.



Surface Combo Sensor

Ultrasonic Depth Sensor

This sensor first transmits an ultrasonic signal downward from one of the crystals on the sensor face that bounces off the flow surface and returns to the other crystal. The monitor measures the travel time elapsed between transmission and reception of the reflected sound signal. Based on the elapsed time and the speed of sound, the monitor determines the range. The range represents the distance between the sensor face and flow surface. The monitor calculates the depth of the flow by subtracting the range from the pipe diameter. It compensates for the speed of sound in the air using the temperature recorded by a temperature sensor housed within the ultrasonic depth sensor.

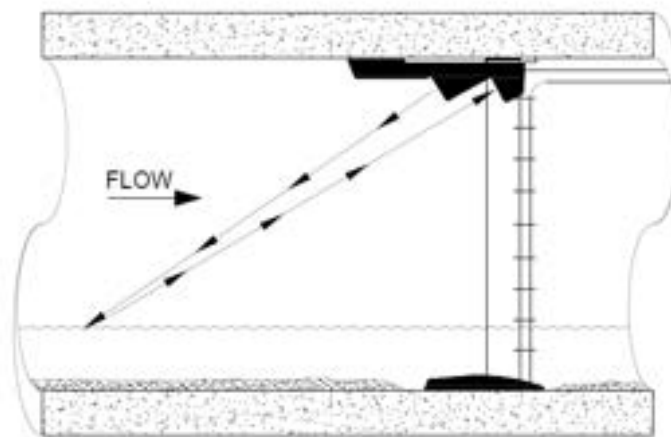
The ultrasonic depth sensor is located in the front, horizontal portion of the sensor and has two downward-facing ultrasonic crystals covered with a clear, moisture-shedding Teflon® coating.

Surface Velocity Sensor

This sensor measures the velocity of the flow also by bouncing signals off the flow surface using a method similar to the ultrasonic depth sensor, but the velocity signals are angled toward the oncoming flow surface.

The surface velocity sensor crystals reside in the two descended portions toward the rear end of the sensor.

ADS does not recommend using this sensor for measuring velocity at locations with smooth flow surfaces or velocities of less than 1 foot per second (0.3 m/s).



Measuring velocity using the surface velocity sensor

Surcharge Peak Velocity Sensor

This sensor measures the velocity of the flow during surcharge conditions using the same methodology as the Peak Combo Velocity Sensor. Therefore, it will measure velocity *only* when the pipe is full.

The surcharge peak velocity sensor resides in the angled, front portion of the sensor in front of the ultrasonic depth crystals.

Surcharge Pressure Depth Sensor

The surcharge pressure depth sensor in the Surface Combo sensor measures pressure depth using the same technique as the other combo sensors, except from the top of the pipe. Since it can provide an accurate depth only when submerged, the data from this sensor is useful only under full-pipe or surcharge conditions. The Surface Combo Sensor offers two options for pressure measurement: 0 - 5 PSI (0 - 0.34 Bar) and 0 - 15 PSI (0 - 1.03 Bar).

Inclinometer Sensor

The Inclinometer sensor utilizes an integrated accelerometer in a sealed and intrinsically safe housing to accurately determine angle measurements for ascertaining orientation of flood gates. Mounting is on any flat surface of the wastewater collection side of the flood gate.



Inclinometer Sensor

I/O and Modbus Capability

The **TRITON+** supports several different inputs and outputs through the ADS XIO interface unit. The monitor facilitates Modbus communications through the ADS ExPAC or ADS XBUS.



Inside of XIO showing I/O terminal block, power supply, and ExPAC

Analog Inputs and Outputs

The monitor can support up to two 4-20mA analog inputs and two 4-20mA analog outputs. The analog output capability may be used to provide information or signals to third-party systems, such as monitors from other vendors. The **TRITON+** sends out information through the outputs at the same interval used when taking sensor readings.

The analog inputs are designed to store specific data received from third-party instruments, such as sensors, every 15 seconds.

Digital Inputs and Outputs

The monitor can support up to two digital inputs and two digital outputs. The digital inputs receive pulses corresponding to switches that indicate the presence or absence of a particular condition, such as an alarm occurring through a third-party system. The **TRITON+** records the state of these inputs at an interval equivalent to the monitor's sample rate.

The digital outputs serve as relays to notify other third-party systems concerning certain flow conditions detected by the **TRITON+**. Conditions typically involve flows crossing established thresholds that trigger events. The **TRITON+** refreshes the state of these outputs every 15 seconds.

Modbus

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

The ExPAC represents the interface through which Modbus communications occur.

Project Organization Checklist

In order to set up the **TRITON+** monitor to successfully communicate and record flow information, the following steps must be performed. Refer to the chapters identified for more detailed information.

Perform these steps prior to the field installation:

- Activate the SIM card and get the IP address (**TRITON+** 8000-FST-IM-4WW-GBL and FST-IM-EP-4WW-GBL) (*Refer to Chapter 3, Activating the SIM Card*)

Note: Request the SIM activation **within 48 hours** of monitor installation and **before** heading to the field to install the **TRITON+**.

- Configure and activate the monitor (in-office) (*Refer to Chapter 4, Configuring the Monitor Location and Activating the Monitor*)

Perform these steps in the field once the above steps are complete:

- Install the Sensors (*Refer to Chapter 5, Sensor Installation and Connection*)
- Install and connect the wireless antenna (*Refer to Chapter 3, Installing the Wireless Antenna*)
- Install the monitor (*Refer to Chapter 7, Monitor Installation*)
- Connect to the monitor for on-site communication (*Refer to Chapter 4, Activating the Monitor*)

CHAPTER 3

Communication

All methods of communication with the **TRITON+** require a field (laptop) computer or office computer equipped with the ADS **Qstart^{XML}** software.

Wireless, remote communication occurs through a wireless antenna and an internal modem housed inside the monitor.

Direct, on-site communication with the monitor is possible through an intrinsically-safe (IS) USB serial interface connection between the monitor and a laptop computer.

As well as providing an overview of communications, this chapter contains information and instructions concerning the following:

- Activating the SIM card
- Installing the Antenna
- Replacing the SIM card, as necessary (**TRITON+** 8000-FST-IM-4WW-GBL and 8000-FST-IM-EP-4WW-GBL come with the SIM cards pre-installed.
- Connecting the antenna for wireless communication
- Connecting a USB interface cable directly to the monitor for on-site communication

Note: Manhole and sewer system work involves confined space entry and is inherently dangerous. Therefore, installers and technicians must comply with all national, 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.

Warning: The *TRITON+*'s internal modem requires connection to an external antenna. ADS recommends using ADS antenna p/n 9000-0094 or 0096 with the *TRITON+* monitor. This antenna supports the frequencies used by all *TRITON+* models available on the ADS storefront. **The user must maintain a distance of 9 inches (229 mm) from the antenna whenever the modem is in operation.**

Note: The ADS antenna comes with two options for cable length: 12 feet (4.39 m), ADS p/n 8000-0094, and 3 feet (0.91 m), ADS p/n 8000-096. The shorter antenna cable should provide better signal strength and is recommended for use when the antenna will be installed in the manhole.



ADS *TRITON+* Antenna

Cellular-Based Wireless Communication Overview

The ADS **TRITON+** monitoring system supports cellular wireless communication through an internal Telit UMTS/HSPA+/GSM modem (in **TRITON+** monitors supporting global 3G network services, ADS p/n 8000-FST-IM-GBL or 8000-FST-IM-EP-GBL), or the WorldWide 4G LTE-M modem, using static or dynamic IP address network services. Any location considered for wireless communication installation must have access to at least one of the following LTE-M bands: B1 (2100), B2 (1900), B3 (1800), B4 (AWS 1700), B5 (850), B8 (900), B12 (700), B13 (700), B18 (800), B19 (800), B20 (800), B26 (850), B28(700) and/or one of the following 2G bands: B2 (1900), B3 (1800), B5 (850), B8 (900). The wireless device must contain a SIM (Subscriber Identity Module) card provisioned with specific account and network information.

Wireless communications and the quality of service depend on local conditions and service providers. An optimal location for flow monitoring may not offer the best wireless network coverage. The user is responsible for finding the most reliable network for the project area. Therefore, perform a signal survey to ensure that the monitoring site has adequate reception for wireless communications. Consider consulting local wireless providers for assistance.

Note: Do not rely solely on coverage maps. These can provide misleading information for specific areas. Typically, sewer systems exist in low-lying areas in which network access can be the most difficult to obtain.

Certain static IPs may be used for communicating wirelessly through the **Qstart^{XML}** software platform or networks supporting ADS hosted system software. The service must support Mobile Terminated service as well as Mobile-Originated (*for alarm cryout*) functionality. Remote communication with a **TRITON+** requires entering the IP address for the location into the **Qstart^{XML}** software.

When using a static IP with a *public* IP address, the PC must have internet connectivity. When using a static IP with a *private* IP address, the PC first must establish a VPN connection with the provider. (*Please consult ADS Client Services for more information on using private addresses.*) Then, the user can connect to a monitor through **Qstart^{XML}**, provided the location has been properly configured. Consult the **Qstart^{XML}** online help for further information on wireless setup and use.

Currently, dynamic IPs may be used only for uploading data wirelessly from the monitor to an FTP site or an ADS Web-based software database. Communicating directly through ADS software to set up and activate monitors equipped with dynamic IPs must occur over a direct connection using the ADS USB Serial Interface cable (ADS p/n 8000-0337).

Activating the SIM Card

TRITON+ monitor uses a SIM card which must be activated (to allow for wireless communication) before heading to the field to install the monitor.

Use the following to activate the SIM card:

1. Order the appropriate SIM card (ADS p/n 8000-0702-GSIM or ADS p/n 8000-0702-CSIM for global or Canadian, respectively). Once received, install the SIM card in the SIM Card Holder. Refer to *Replacing the SIM Card* in *Chapter 11* for more information on replacing the SIM card in monitors with a SIM card enclosure on the monitor top.
2. Request activation of the new ADS SIM card by emailing adssupportcenter@idexcorp.com. Include the serial number of the specific *TRITON+* monitor and the SIM card number (the 20-digit number found on the attached SIM punch-out card) as well as the name of the municipality or company requesting the activation. ADS employees should also include the project name and job number as part of the request.



SIM Punch-out Card for KORE

3. Wait for a return email from ADS. The email will contain the IP address of the SIM card and its associated phone number. Using a permanent marker, write the IP address and its associated phone number on empty space on the card and save the card for future reference, as needed.
4. Wait at least 15 minutes from receipt of email before proceeding to the next section.

Installing the Antenna

Establishing remote, wireless communications with a **TRITON+** monitor containing an *internal* modem involves installing a wireless antenna and connecting the antenna to the monitor.

Depending on the **TRITON+** monitor's wireless signal strength at the install site, the antenna may be installed inside or outside the manhole. If the wireless signal strength is between -50dB and -85dB, then the monitor's antenna can possibly be installed inside the manhole. The following sections detail gathering the tools and equipment needed for *in-manhole* or *out-of-manhole* antenna installations.

Note: Wireless monitor communications will not occur if the antenna is underwater. Therefore, consider whether the monitor needs to communicate during surcharge conditions when deciding on the antenna placement.

Note: For wireless communication, it is very important to test the **TRITON+** to verify the *entire system* functions and confirm network quality of service. Perform this validation *before* deploying to the field and again at the monitoring site before installing the monitor.

Gathering Parts and Supplies

Determine the tools and equipment needed for the antenna installation using the following lists for *in-manhole* and *out-of-manhole* antenna installations.

Parts and Supplies for *Inside-the-Manhole* Antenna Installation

When the antenna can be installed inside the manhole, it can be mounted from the monitor's mounting bracket, a manhole rung, or an L-bracket can be installed. Obtain the following items for an in-manhole antenna installation:

- ADS wireless antenna (p/n 9000-0094 or 0096)
- Cable ties to secure the antenna
- Lag bolt, L-bracket and masonry drill bits for drilling through manhole wall, corbel, and other materials when there is no rung or mounting bracket from which to hang the antenna

Tools and Equipment for *Outside-of-the-Manhole* Antenna Installation

Obtain the following items for an *outside-of-the-manhole* antenna installation:

- ADS wireless antenna (p/n 9000-0094 or 0096) or a customer-supplied antenna verified by ADS for successful monitor communications
- Extension cables (16-foot (4.9-m): ADS p/n 509154; 49-foot (14.9-m): ADS p/n 509155) for antenna, as needed
- 8-mm anchor bolts with washers and nuts
- Medium-sized non-rotating demolition hammer with a 0.5-inch (13-mm), 0.75-inch (19-mm), or 1-inch (25-mm) masonry chisel (sharpen the chisel before use) and bushing tool, or an abrasive saw or grinder
- Masonry drill bits for drilling through manhole wall, corbel, and other materials. Include the following:
 - ❑ 0.5-inch (13-mm) diameter (*minimum*) x 12-inch (305-mm) long (*minimum*) bit
 - ❑ 0.5-inch (13-mm) diameter x 36-inch (914-mm) long (*minimum*) bit
 - ❑ 1.25-inch (32-mm) diameter x 12-inch (305-mm) bit
- Standard drill bits and masonry bits up to 0.6 inches (15 mm) in diameter

- Medium- to heavy-duty hammer drill (*if no hammer/drill mode is available on the demolition hammer*)
- Trowel or putty knife for scooping asphalt
- Hammer
- Carpenter's rule
- Pen, pencil, or chalk for marking asphalt or concrete
- Shop vacuum
- Wire brush
- Alcohol wipes
- Leather work gloves
- Protective goggles
- Heavy-duty, high-quality caulking gun (for regular-sized tubes)
- Appropriate tools for cutting and removing tarmac or dirt for burying antenna
- Patching and sealing materials for tarmac and for sealing the cable hole into the manhole
- Cable ties for securing cable coils
- Generator or other power source (*for hammer drill*)
- Dry sand
- Commercial asphalt cold patch compound (*approximately 1 cup*)
- Scotch-kote electrical sealing compound or similar
- Scotch 130C rubber stretch tape or similar

Installing the Wireless Antenna

Use the following instructions for installing the wireless antenna to the **TRITON+** monitor *inside* the manhole or *outside* the manhole.

Inside the Manhole Antenna Installation

The **TRITON+** using LTE-M communication can often provide enough wireless signal strength to install the antenna inside the manhole with the monitor. Use the following installation instructions for installing the antenna inside the manhole when the monitor wireless signal strength is between -50dB and -85dB while the antenna is inside the manhole with the manhole lid closed.

Note: The antenna should be installed as close to the manhole lid as possible.

Note: The antenna must be installed horizontally for optimal signal strength with ADS logo facing upwards.

1. Use a cable tie to secure the antenna to a manhole rung or monitor mounting bracket, if available. Position the antenna as flat and parallel to the manhole lid as possible with the ADS logo facing upwards.
2. If no manhole rung or mounting bracket exists in the manhole, install an L-bracket (using a lag bolt) to the manhole wall just below the manhole rim and secure the antenna to the L-bracket. Ensure the antenna is positioned as flat and parallel to the manhole lid as possible with the ADS logo facing upwards.



In-Manhole Antenna Installed to Mounting Bar with Cable Tie

Outside the Manhole Antenna Installation

These installation instructions are applicable for installing the antenna in the road, ground, or under other paving materials.



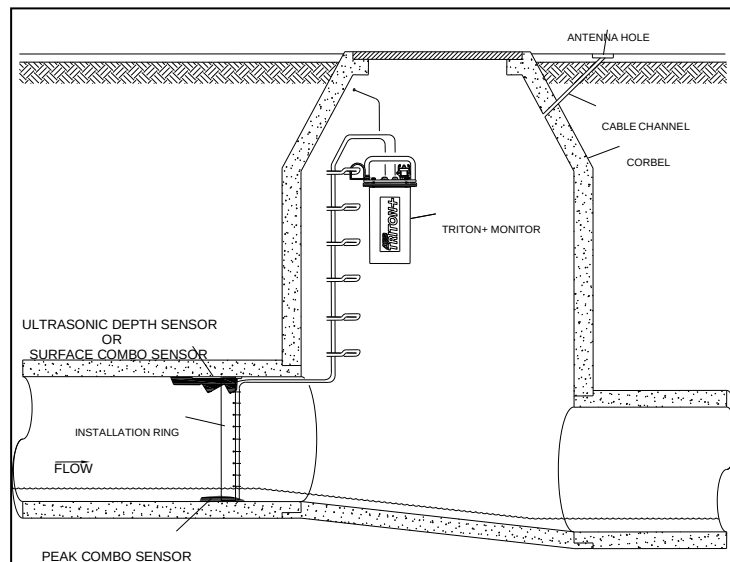
ADS **TRITON+** Antenna

Install a wireless antenna in the road, in the dirt, or under other paving materials in the following way:

Note: While this section describes the process for installing this antenna, all wireless antennas provided through ADS also include detailed installation instructions.

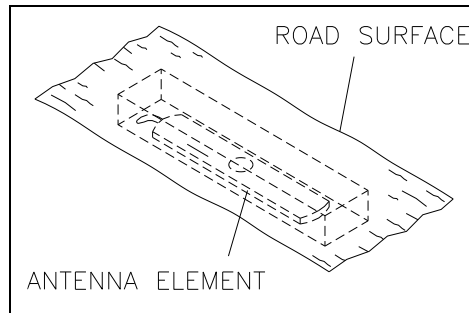
1. Determine the appropriate location in the road near the manhole to install the antenna:
 - ☐ Locate the antenna in the road between 18 and 30 inches (457 and 762 mm) from the manhole in which the monitor is installed. Position the antenna as far as possible from the massive iron frame and buried flange to prevent shunting of the RF signal.
 - ☐ Avoid locations at which cars will remain parked over the antenna for extended periods (hampering the signal strength).
 - ☐ Select a location that drains well so that water will not collect over the antenna, blocking the signal.
 - ☐ Choose a location that is as flat as possible with stable base material.
 - ☐ Select a location where the antenna will experience minimal direct impact from road traffic, where possible.
 - ☐ 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.
 - ☐ Verify that no buried utility cables exist in the area in which drilling will occur for the antenna installation. Consider contacting a Underground Utility Locating Service for assistance.

2. Mark the location for the antenna installation, and then mark the location to drill the corbel hole 2.5 to 3 inches (64 to 76 mm) back from the edge of the antenna hole.
3. Cut a 9-inch (229-mm) long by 4-inch (102-mm) wide by 0.75-inch (19-mm) deep hole in the road using the non-rotating demolition hammer (*in the hammer only mode*) with the chisel/grinder. This will serve as the installation location for the (mastic covered version) antenna. The corbel hole should be at the end closest to the manhole cover.
4. Drill a hole in the end of the cut closest to the manhole cover through the corbel, and into the manhole using the ½-inch (13-mm) by 36-inch (914-mm) hammer drill bit. This will serve as the channel for the antenna cable extending from the antenna to the monitor in the manhole. Be careful to avoid any cables in the manhole, and restart the hole slightly to the right or left if mesh is encountered or resistance occurs.



Hole Running from Antenna Installation Location to Manhole

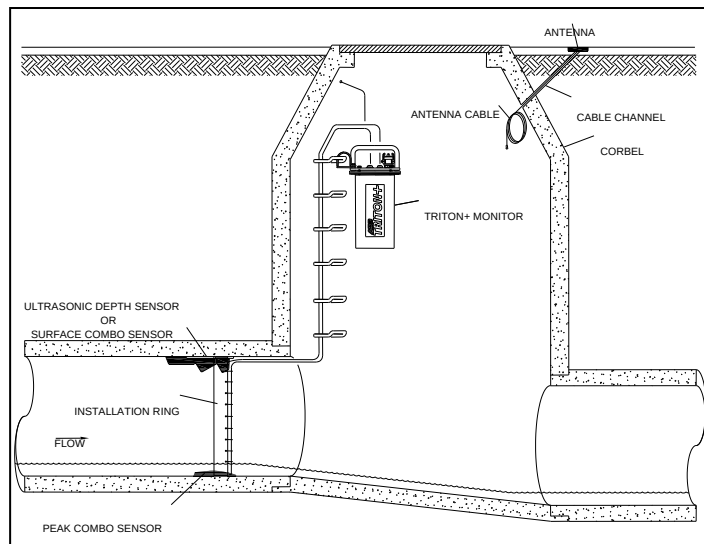
5. Thoroughly clean out the hole for the antenna of all debris using a shop vacuum with a brush.
6. If the protective cap is not present on the connector at the end of the antenna cable, clean the connector and tape it up with rubber stretch tape for protection against damage and debris while it is being fed through the channel.
7. Feed all of the antenna cable into the hole, through the channel, and into the manhole. Smooth any rough edges where the cable enters the corbel hole with the chisel or rubber stretch tape. In addition, pack rubber stretch tape into the cable hole to prevent asphalt or sealer from entering the cable hole.
8. Apply the asphalt on top of the antenna element. When using asphalt, scoop the warm material into the hole and then pound it in using a hammer. Place a piece of wood or metal between the asphalt and the hammer to prevent the hammer from sticking to the asphalt. Make sure the asphalt protrudes slightly above the level of the road surface.
9. Sprinkle a thick (approximately 1/8-inch) layer of sand over the asphalt, and then pound the sand lightly into the surface. The sand must be used to ensure the asphalt does not adhere to objects, such as vehicle tires, while drying. ADS recommends dusting the surface with sand once again before leaving the site.



Antenna in cavity with patch

10. Coil the slack antenna cable and secure it away from the other cables in the manhole. 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 signal loss and damage to the cable and antenna, do not kink or bend the antenna cable when coiling.



Installation with Antenna Cable Coiled in Manhole

11. Seal the space between the antenna cable and the corbel hole with electrical duct seal or as required to prevent infiltration into the manhole.

Note: Do not connect the antenna cable to the monitor until after installing the SIM card (when applicable).

Installing (Replacing) the SIM Card

NOTE: This instruction *only* applies when the *TRITON+* monitor will not be using the SIM card that comes pre-installed in the monitor. This generally applies to our international customers. All monitors shipped by ADS contain a SIM card either in the Regulator/Modem bowl inside the monitor or in the SIM card enclosure on the monitor top.

The modems in the *TRITON+* monitors require a SIM card for establishing communication. This modem supports SIM cards provisioned by many different carriers, including SIM cards provisioned by AT&T and Verizon for public and private, *static* IP address operations as well as SIM cards provisioned by other carriers for dynamic IP address operation. Please contact ADS if you have specific questions about your SIM card provider and compatibility of the provider's SIM card with the *TRITON+* monitor.

The *TRITON+* monitor performs wireless communications through an internal modem that is supported by a SIM card located in the Regulator/Modem bowl (or on older models of the 8000-FST-IM-4WW monitors, a SIM card enclosure on top of the monitor canister). If a SIM card not supplied by ADS is to be used, the installed SIM card will need to be removed. The section below refers to replacing the SIM card in the Regulator/Modem bowl. Refer to *Replacing the SIM Card* in *Chapter 11* for more information on replacing the SIM card in monitors with a SIM card enclosure on the monitor top.

Note: The SIMs in the 8000-FST-IM-4WW-VZW, 8000-FST-IM-EP-4WW-VZW are specifically linked to the modem in the monitor, therefore, DO NOT attempt to remove or swap the SIM card from these monitors prior to contacting ADS Customer Support.

Replacing the SIM Card in Regulator/Modem Bowl

Note: The only service or maintenance activities ADS permits within the monitor chassis are battery pack, battery PCB, regulator/modem unit, SIM card replacement (as applicable) and fuse replacement. Therefore, do not handle, alter, modify, remove, or replace any other components inside the monitor. Such actions will void the monitor warranty agreement and the IS certification.

Note: Move the monitor away from the hazardous area before opening the monitor to replace the battery.

Note: To replace a SIM card in a *TRITON+* monitor which has a SIM card holder on the monitor top, refer to Chapter 11 Maintenance and Troubleshooting: Replacing the SIM Card for instructions.

Replace the SIM card in the *TRITON+* monitor Regulator/Modem bowl on the monitor top in the following way:

1. (*applies only to static IP SIM cards*) Record the number of the new SIM card (i.e., the IP address) on the site report. You will need this address to reconcile billing and when setting up the monitor configuration in the *Qstart^{XML}* software. The IP address is printed directly on the SIM card or on a label affixed to the card.



Example of SIM Card

2. Brush off the monitor enclosure and remove the 4 bolts securing the top to the canister using a 13-mm nut driver.

Note: Make a note of the orientation of the monitor top to the canister before removing the bolts. Keeping proper orientation between the canister and the top is critical to maintaining the water and airtight seal on the monitor.

3. Wipe away any debris or moisture that could enter the chassis once the unit is opened.
4. Remove the top (with the attached power regulator dome) by pulling it straight up from the canister. The battery rests at the bottom of the canister, and an 18-inch long cable extends from the battery pack to the top.

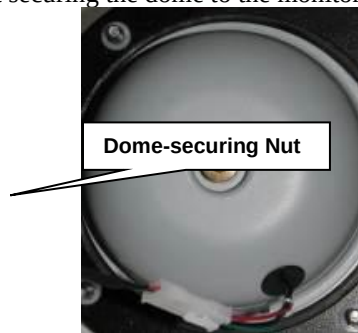


Placing the top next to the monitor (left) and disconnecting the cables at the plastic white connectors (right)

5. Place the top next to the canister, and then disconnect the battery cable from the dome cable and set the top/power regulator dome assembly aside.

Note: Keep the underside of the top, the regulator dome, and the top gasket free of dirt, mud, and other debris. Debris and dirt can compromise the seal of the monitor once it is reassembled. In addition, inspect the monitor seal for damage.

6. Remove the brass thumb nut securing the dome to the monitor top.



Removing nut securing regulator dome to monitor top

7. Carefully lift off the dome from the top (as if opening like a book).



8. The SIM card holder in the enclosure functions based on spring action. Therefore, press the exposed edge of the SIM card into the holder and release. The card should pop out slightly, freed from its secured position.
9. Slide the SIM card completely out of the holder.
10. Insert the new SIM card into the groove in the holder on the inside of the enclosure, notched edge first with the contacts facing the pressure valve. Slide the SIM card *all the way* into the holder, and press down to lock it into place. The holder's spring mechanism should secure the card in the holder.
11. Once SIM card is firmly seated, close up Regulator/Modem Bowl tightening brass nut finger tight. Ensure no cables are caught between bowl and monitor top.
12. (*applicable only to battery-powered monitors*) Reconnect the battery cable to the cable exiting from the hole in the top/dome assembly.
13. Coil the excess cabling around the inner wall of the canister (*when applicable*), and carefully lower the top/dome assembly back onto the canister. Keeping the proper orientation between the canister and the top is critical to maintaining the watertight and airtight seal on the monitor. Once the top has been torqued down after manufacture, the sealing gasket develops a memory profile of the canister lip. Reassembling the two pieces in the same orientation as before helps the gasket mate correctly with the canister lip.

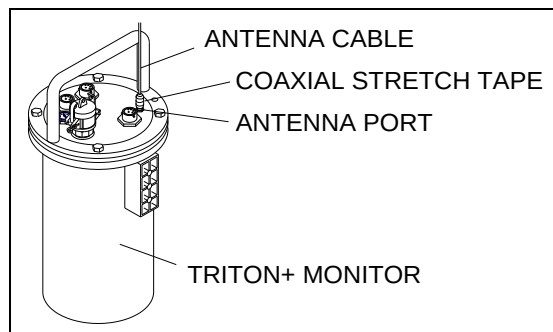
Note: Be careful to avoid pinching the battery cable (*when applicable*) between the canister sealing lip and the gasket on the monitor top during reassembly. The cable also can get trapped between the two parts while tightening the bolts on the monitor top, preventing an effective air/watertight seal and potentially damaging the battery cable and/or the gasket.

Connecting the Antenna to the Monitor

Note: ADS recommends installing the antenna prior to connecting the antenna to the monitor.

Connect the antenna to the monitor in the following way:

1. Attach the antenna cable connector to the **ANTENNA** port on the monitor top (first removing the electrical tape from the cable end, when applicable).
2. Wrap rubber stretch tape around the entire cable connection, extending onto the cable approximately 2 inches (50 mm) beyond the connection with the antenna cable.



Antenna Cable Connected to **Antenna** Port on Monitor with Stretch Tape Properly Applied

3. Carefully coil and secure the remaining slack antenna cabling as necessary. Slack enables the technicians to remove the monitor from the manhole for maintenance or service activities with the antenna still connected.

Note: Remember to avoid bundling the antenna and sensor cables together! This can significantly diminish antenna and sensor signal strength, disrupting communications and limiting sensor accuracy. In addition, avoid kinking and bending the cables when coiling to prevent signal loss and damage to the cables and corresponding equipment.

Connecting to the Monitor in the Field

ADS offers two methods for communicating with the monitor on-site or in the field: *direct* connection or *indirect* connection.

Direct connection allows you to connect directly to the **TRITON+** with a laptop (or office) computer for on-site communications. This type of communication occurs through the **ADS USB Serial Interface cable** (ADS p/n 8000-0337). This interface cable consists of two parts: the primary 10-foot (3.1-m) cable, which includes the interface box and the potted, 10-pin metal cable connector, and the 6-foot (1.8-m) standard USB A-to-B cable.



USB Serial Interface Cable

Note: A Direct Serial Interface cable (ADS p/n 8000-0054) also may be used to connect directly to the **TRITON+**. However, using this cable may result in significantly slower data transmission than when using the USB Serial Interface cable. In addition, the Direct Serial Interface cable may require a USB-to-serial converter cable to enable you to connect to a USB port when a legacy RS-232 port is not available.

Indirect connection enables you to connect to externally-powered **TRITON+** monitors through the ADS ExPAC with a laptop computer via a standard A-to-B USB cable for on-site communications. This method must be used for externally-powered monitors because the port on the monitor through which direct connection typically occurs is reserved for receiving power from the ExPAC/XBUS™/XIO™ in these applications.

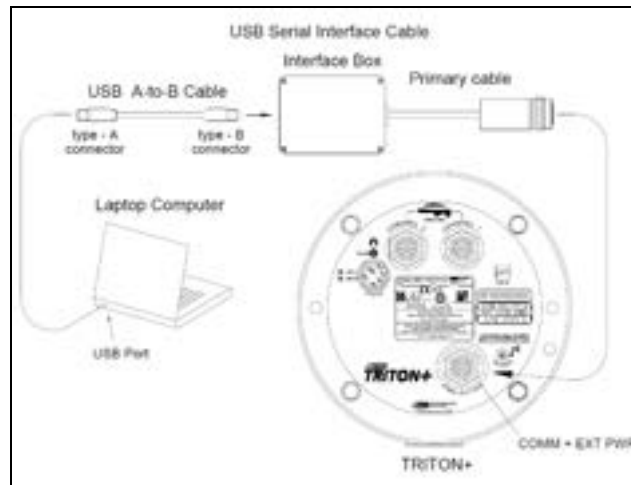
Before you can communicate with the monitor through your computer using the ADS USB Serial Interface cable or a standard USB cable, you must install a special driver on your computer. The instructions for installing the driver are printed on the label on the bottom of the cable's interface box *or* on the top, left side of the ExPAC. When selecting the driver from the website, ADS recommends clicking on the **setup executable** link in the **Comments** column corresponding to your operating system to initiate the installation process. Then, simply follow the installation steps as instructed.

Once the driver is installed, connect from a laptop (or office) computer to the monitor in one of the following ways, based on the application.

Connecting Directly to the Monitor

1. Attach the two cables comprising the USB Serial Interface cable together by inserting the *Type B connector* from the standard USB A-to-B cable into the corresponding port on the interface box of the primary cable.
2. Insert the *Type A connector* from the USB Serial Interface cable into the proper USB port on the computer.

3. Attach the metal cable connector from the USB Serial Interface cable to the corresponding **COMM + EXT PWR** port on the top of the monitor.



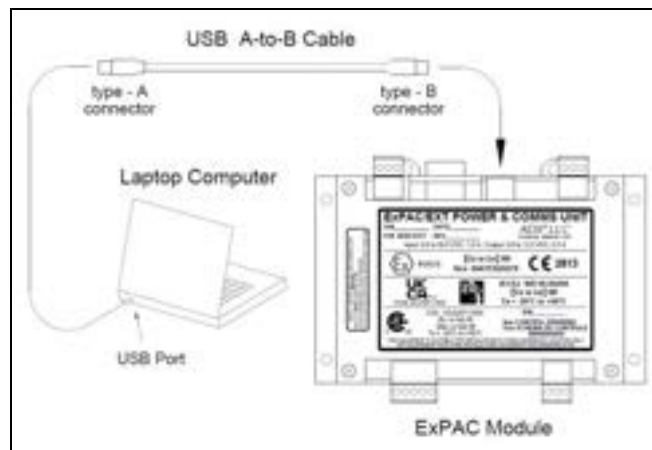
Connecting the USB Serial Interface Cable to a Laptop and Monitor

Note: When using the optional extension cable (ADS p/n 8000-0044-25), run it *between* the monitor and the USB Serial Interface cable.

4. Designate the appropriate local USB port on the computer for communication through the **Qstart^{XML}** software. For more information, refer to the **Qstart^{XML} online help**.

Connecting to the Monitor through the ExPAC

1. Insert the *Type A connector* from the standard USB cable into the proper USB port on the computer.
2. Insert the *Type B connector* from the other end of the USB cable into the **USB** port on the top of the ExPAC.



Connecting the Standard USB Cable to a Laptop and ExPAC

3. Designate the appropriate local USB port on the computer for communication through the **Qstart^{XML}** software. For more information, refer to the **Qstart^{XML} online help**.

CHAPTER 4

Configuration and Activation

In order to get the monitor to begin taking flow measurements and recording flow data, it is necessary to configure and activate the monitor.

NOTE: ADS recommends that the initial configuration and activation of the **TRITON+** occur in the office prior to the field installation. Refer to *Chapter 2, Project Organization Checklist*, for more information.

This chapter contains general instructions on the following activities concerning monitor configuration and activation:

- Starting and configuring **Qstart^{XML}**
- Creating and configuring a monitor location
- Configuring the monitoring point installation (pipe) table (including setting Gain)
- Selecting and editing devices (usually attached sensors)
- Activating the monitor

This chapter also includes the procedures for running diagnostics and performing confirmations on the sensors, collecting data from the monitor, and upgrading the firmware (embedded software) in the monitor using the ADS **Qstart^{XML}** software. You can also consult the **Qstart^{XML}** online help within the application.

Hardware and Software Compatibility

Please note the following compatibility requirements for using the **TRITON+** with the ADS **Qstart^{XML}** software:

- **Qstart^{XML}** is supported on computers running **Microsoft® Windows 11**.
- **Qstart^{XML}** supports all **TRITON+** and hardware devices for activation, diagnostics, and data collects.

Starting **Qstart^{XML}**

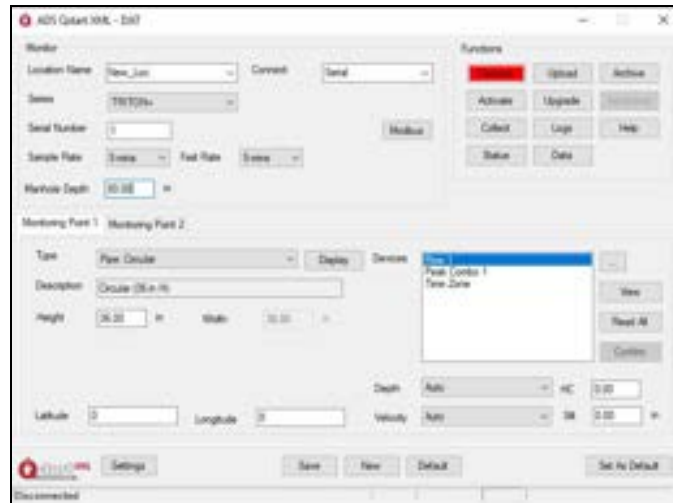
Before traveling to the field for installation, configuration, and activation activities, install the **Qstart^{XML}** software on the field computer.

Once installed, start the **Qstart^{XML}** software from an office or field computer by selecting **Start > All Programs > ADS LLC > Qstart^{XML}** from the **Microsoft Windows** start menu or double-clicking on the **Qstart^{XML}** icon on the **Windows** desktop.



Qstart^{XML} icon on desktop

The Qstart^{XML} main screen displays.



Qstart^{XML} main screen

Setting Up the Qstart^{XML} Parameters

The **Settings** dialog displays the first time you run Qstart^{XML} following installation and can also be accessed through the main ADS Qstart^{XML} dialog. The **Settings** dialog allows you to designate settings corresponding to configuration and data files.

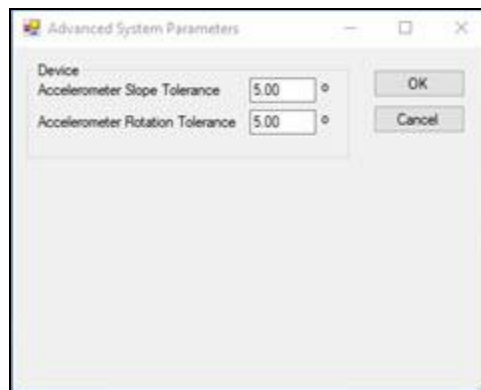


Qstart^{XML} Settings dialog

Complete the **Settings** dialog in the following way:

1. Enter the path or browse to the directory to which you want to save location information files (XMLs) and collected flow data in the **Data Path** field.
2. Select the port on your computer through which you will connect directly to the monitor from the **Serial Port** drop-down list.
3. Select the port on your computer through which you will perform **Bluetooth** communications from the drop-down list (*not applicable to TRITON+ monitors*).
4. Select the units of measure (US or Metric) you want to use throughout Qstart^{XML} when entering values, saving data, and displaying data from the **Units** drop-down list. The **US** units report quantity in MGD, depth in inches, and velocity in feet per second. The **Metric** units report quantity in liters per second, depth in millimeters, and velocity in meters per second.
5. Select the format in which you want to save data *collected* from the monitor from the **Data Format** drop-down list. **ADS** represents the ADS proprietary **Bin** format; **CSV** (comma-separated value)

- represents a format generally compatible with most spreadsheet applications, such as **Microsoft® Excel®**. Select **Both** to collect both the **ADS** and **CSV** file formats.
6. Select the **Always use monitor XML as preferred configuration** checkbox to ensure **Qstart^{XML}** automatically overwrites the local configuration with the XML stored in the monitor memory when an **Upload** is performed. Choosing this option also automatically updates the local serial number with the serial in the monitor (when an inconsistency exists between the monitor and computer) whenever communication is established with a monitor.
 7. Select the **Use ADS Dates for CSV** checkbox to store *collected* data in CSV files using the ADS date format. When this option is *not* selected, **Qstart^{XML}** stores the CSV data in the local **Windows**-configured regional date format.
 8. Select the appropriate CSV file column break indicator from the **CSV Delimiter** drop-down which you want **Qstart^{XML}** to use in *all* CSV files. This selection should be appropriate for the current **Windows** regional setting on the local computer. A comma separated values (CSV) file is sometimes called a character-separated values file because the field separators used to organize the data into columns does not always have to be a comma (commas indicate the columns are separated by commas). For example, users with the regional setting of English (United States) will use the default of , (**comma**). However, users located in other regions of the world (Germany, Spain, Portugal, Russia, etc.) will choose . (**period**), or ; (**semicolon**) in order to conform to the CSV format of their region.
 9. Select the CSV decimal placeholder from the **CSV Decimal** drop-down which you want **Qstart^{XML}** to use in *all* CSV files. This selection should be appropriate for the current **Windows®** regional setting on the local computer and will be used in all **Qstart^{XML}** generated CSV files to indicate the appropriate decimal placeholder for numerical values. For example, users with the English (United States) regional setting will use the default of . (**period**) to indicate a period symbol should be used for decimal placeholders (123.45 for example) in number values included in their **Qstart^{XML}** generated CSV files. **Qstart^{XML}** users in other regions of the world (Germany, Spain, Portugal, Russia, etc.) can choose , (**comma**) to use a comma (123,45 for example) for decimal positions in the numbers included in their CSV files.
 10. Select the **Advanced** button to access the settings for the AV|Gated, AV|Max, ParaDepth and ParaFlow **Accelerometer Slope** and **Accelerometer Tolerance**. Based on the entries in these fields a warning message will be displayed when the ultrasonic sensor is read during monitor diagnostics if the **Accelerometer** readings exceed these values.



Advanced System Parameters

- ☐ **Accelerometer Slope Tolerance** This field displays the threshold beyond which the user will see a warning that the AV|Gated, AV|Max, ParaDepth or ParaFlow sensor has too much slope. This field defaults to 5.00°.
 - ☐ **Accelerometer Rotation Tolerance** This field displays the threshold beyond which the user will see a warning that the AV|Gated, AV|Max, ParaDepth or ParaFlow sensor has too much rotation. This field defaults to 5.00°.
11. The **Default Location** field indicates the location which **Qstart^{XML}** will use as a template from which to create all new locations (when users choose the **New** button). If you have not designated a default

location, clicking **New** will populate the parameters based on **Qstart^{XML}**'s default configuration. This field remains blank until you designate the default location on the **Settings** dialog.

12. Click on the **OK** button to save the settings from this dialog to the designated local directory or network.

*The ADS **Qstart^{XML}** window displays the default monitor information.*

Note: You can access the data and communication settings at any time by clicking on the **Settings** button on the ADS **Qstart^{XML}** dialog.

Configuring the Monitor Location

To ensure the most efficient and useful results for each monitor location, the user must activate the **TRITON+** flow 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 the monitor name, series, pipe size and shape, sensor assignment and parameters, and data sample rate.

Users input the configuration details for each monitor into **Qstart^{XML}**. The configuration details for each are stored in an information file (XML) on the user's local directory or network drive. After the monitor configuration process is completed, users must then perform a monitor activation to download the specific elements of the XML to the monitor memory in order to initiate monitor operations. Following is the general process for creating a new monitor location.

- Create and configure a monitor location in **Qstart^{XML}**
- Configure the monitoring point(s) for the monitor location
- Select and edit devices for the monitor location

Note: If remote communication already has 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.

Create and Configure the Monitor Location

Entering the monitor information is the first step to creating a new monitor location. The following steps describe the process for entering the information and designating the parameters for an existing location:

The screenshot shows the 'ADS Qstart XML - Edit' dialog box. It has several sections: 'Monitor' with fields for Name, Series, Device, Serial Number, Sample Rate, and Workable Depth; 'Monitoring Point 1' and 'Monitoring Point 2' with fields for Type, Description, Height, and Depth; and a 'Functions' section with buttons for Upload, Activate, Upgrade, Collect, Logs, Help, Status, and Table. A list of devices is shown on the right, and buttons for 'New', 'Reset All', and 'Confirm' are at the bottom right.

Creating and Configuring a Monitor Location

1. (applies only when establishing a new location) Click on the **New** button on the ADS **Qstart^{XML}** dialog to set up the monitor information for a new location. Using this option displays the parameters corresponding to the **Default Location** identified on the **Settings** dialog.

Note: If you have not designated or established a default location, clicking **New** will populate the parameter fields based on **Qstart^{XML}**'s default monitor configuration.

*The ADS **Qstart^{XML}** dialog displays the default parameters for a new location.*

2. Enter a name for the new location in the **Location Name** field or select an existing location from the drop-down list. This list contains all the locations available in the local or network directory designated previously on the **Settings** dialog as the **Data Path**. A location name may be up to 19 characters in length.

Note: You can click on the **Default** button to update the parameters for the current location on the **ADS Qstart^{XML}** dialog based on the **Default Location** (designated on the **Settings** dialog), without changing the location name.

3. Select **TRITON+** as the type of monitor the location from the **Series** drop-down list. If you selected an existing site from the **Location Name** drop-down list, this field will automatically display the monitor series corresponding to that location.
4. Enter or edit the monitor serial number in the **Serial Number** field.
5. Verify or select the interval at which you want the monitor to take measurements and log data from the **Sample Rate** drop-down list.
6. Verify or select the interval at which you want the monitor to take measurements and log data when a threshold has been crossed from the **Fast Rate** drop-down list.
7. Verify or select the interval at which you want the monitor to scan the sensors to detect whether a threshold has been crossed in the **Scan Rate** drop-down list.
8. Enter or edit the distance (in inches or mm) from the manhole rim to the bottom center of the invert for the **Manhole Depth**.
9. Verify or select the method through which you will communicate with the monitor from the **Connect** drop-down list.

☐ **Serial** Choose this option to perform direct, serial communication with the monitor.

Note: Always use **Serial** communications to perform the *initial monitor activation or after a deactivation*.

☐ **Wireless** Choose this for **TRITON+** monitors with SIMs with static IP addresses for performing wireless communication.

10. (*applicable only to **Wireless** communications*) Enter the IP address corresponding to the monitor in the **IP Address** field. The field designation displayed depends on the method of communication selected in the **Connect** field.
11. (*applicable only to monitors supporting Modbus and Telog Ru-33 operations*) Click on the **Modbus** button and complete the **Modbus Parameters** dialog in the following way:

☐ Select the **Enable** checkbox.

☐ Enter the slave address number in the **ID** field to be used when facilitating communication between the monitor/EMUX (FlowShark Triton) or monitor/ExPAC/XBUS (ADS **TRITON+** and the third-party system (e.g., a SCADA system, RTU, or process control system). For **TRITON+**, **FlowShark Triton** and **FlowHawk** monitors, choose a number from 2 to 57, 59 to 96, or 98 to 247. For installations involving Telog RU-33, ADS recommends using 1 as the ID.

☐ Enter the amount of time, in milliseconds, following a request you want the monitor to wait before returning the requested data to the third-party system in the **Delay Response** field. (This field typically does not need editing.)

☐ Click on the **OK** button.

12. Select the **Save** button to save the current parameters on the dialog to the local directory or network.
13. Continue to enter the monitoring point information and assign and edit the devices.

Configure the Monitoring Point(s)

The second step in configuring a monitor is entering the monitoring point information. This involves designating the pipe characteristics at the monitoring point and assigning and editing the devices corresponding to the monitoring point.

The monitoring point represents the physical location at which the sensors are installed. The sensors A monitor location can support up to two monitoring points, and the settings must be designated for each monitoring point.

Enter the information for each monitoring point in the following way:

1. Select the type or shape of the pipe or channel in which the sensors are installed from the **Type** drop-down list on the ADS *Qstart^{XML}* dialog.
2. Enter the installation information in the corresponding fields based on the selected pipe or installation type.

☐ Pipe

- **Height** Enter the distance from the bottom of the pipe to the crown (i.e., top or peak).
- **Width** Enter the horizontal distance across the widest portion of the pipe.

Note: If the width measurement does not equal the height measurement, select *Elliptical* for the pipe shape.

☐ Weir

- **Depth Range** If the ultrasonic depth sensor is installed upstream from the weir wall, enter the distance from the face of the sensor to the bottom of the channel. If the ultrasonic depth sensor is mounted directly over the weir wall, enter the distance from the face of the sensor to the crest of the weir.
- **Const K** This field is read-only for most weir installations, except *Rectangular* and *Trapezoidal weirs with Constant K values*. The monitor uses the default Constant K value to convert weir flows to CFS (cubic feet per second) and to calculate quantity. Entering a different Constant K value will modify the weir equation, potentially resulting in inaccurate CFS quantities. Therefore, please verify all manual modifications to this value.
- **Capacity** Enter the maximum capacity of the weir based on the type of weir and any parameters applied and/or measurements taken at the location for the application.
- **Length** Enter the total length of the wall, from one side of the chamber to the other.
- **Height** Enter the distance from the bottom of the channel to the initial elevation on the crest wall at which the flow will begin to traverse (or flow over) the wall.
- **Breadth** Enter the *thickness* of the crest wall from the upstream edge of the weir to the downstream edge.

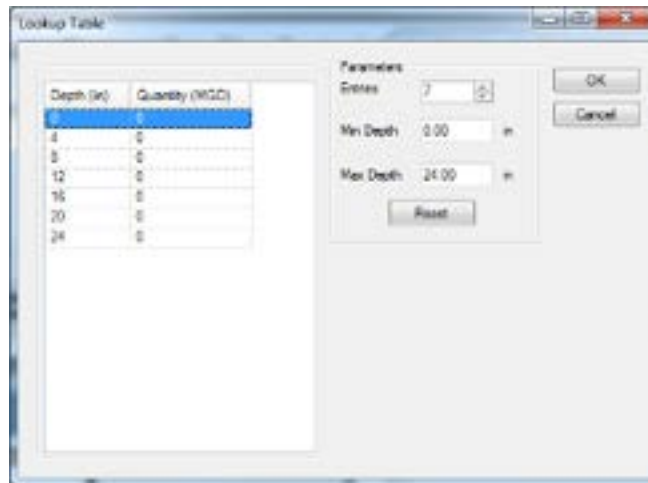
☐ Flume

- **Range** Enter the distance from the face of the sensor to the bottom (i.e., floor) of the flume at the designated measurement point for the flume.
- **Width** Enter the distance across the *throat* of the flume.
- **Capacity** Enter the maximum capacity of the flume based on any parameters applied and/or measurements taken at the location for the application.

☐ Lookup

- **Height** Enter the distance from the bottom of the pipe to the crown of the pipe.

Click on the **Display** button to open the **Lookup Table** dialog and enter the following parameters on the dialog:



Lookup Table dialog

- **Entries** Enter the number of depth values you want to display.
- **Min Depth** Enter the minimum depth possible at the monitoring point. This parameter defaults to zero and does not require modification.
- **Max Depth** Enter the maximum depth possible at the monitoring point. This parameter defaults to the value designated in the Height field and does not require editing.
- **Quantity (MGD)** Enter the quantity that will correspond to each depth on the Lookup table.

Click on the **OK** button to save any changes and entries made on the **Lookup Table** dialog and exit the dialog.

Note: Clicking on the **Reset** button will set all quantities designated in the Lookup table to 0.00. This will not modify the values entered in the **Entries**, **Min Depth**, or **Max Depth** fields. Clicking on the **Cancel** button will close the **Lookup Table** dialog without saving any of the modifications.

The **Description** field indicates the physical description for the monitoring point based on the selected pipe/installation type, dimensions, and other characteristics (when applicable).

3. (optional) Click on the **Display** button to show a simple illustration of the pipe based on the current parameters.
4. Assign the appropriate devices to the monitoring point, and edit each device as necessary. Refer to *Assigning and Editing Devices* on page 4-9 for more information and instructions.
5. Enter or edit the current location's USGS latitude and longitude coordinates in the **Latitude** and **Longitude** fields.
6. Select the combo sensor containing the depth sensor you want to use for the UNIDEPth entity from the **Depth** drop-down list. ADS recommends using the default of **AUTO**.
7. Select the combo sensor containing the velocity sensor you want to use for VELOCITY entity from the **Velocity** drop-down list. ADS recommends using the default of **AUTO**.
8. Enter the depth of the silt at the bottom of the pipe at the monitoring point in the **Silt** field.
9. Enter the Hydraulic Coefficient in the **HC** to be used in the Manning equation, as appropriate.
10. (applies only to a second monitoring point) Click on the **Monitoring Point 2** tab, and repeat steps 1 through 7.
11. Click on the **Save** button to store the new information and changes to your local directory or network.

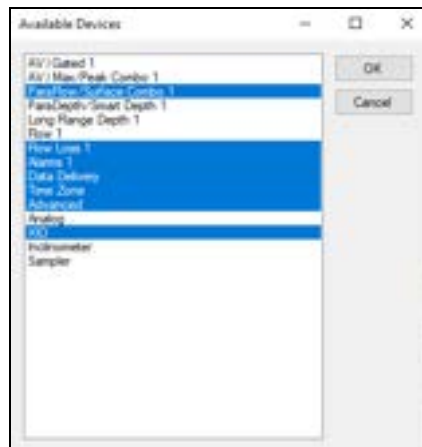
Note: Once you have finished entering and/or editing the monitor and monitoring point, you must activate (or reactivate) the monitor.

Assigning and Editing Devices

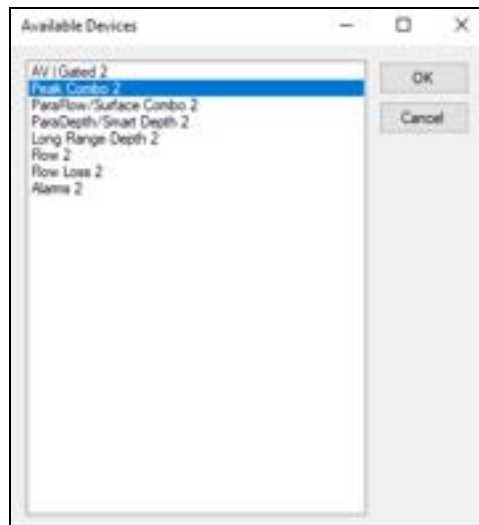
As part of entering the monitor and monitoring point information, you must assign and edit the devices for each monitoring point. Most devices should require only minimal, if any, modification to the associated parameters.

1. Click on the browse button located to the right of the **Devices** list box.

The **Available Device** list box displays the devices applicable to the **TRITON+** monitor series.



TRITON+ Monitoring Point 1 - Available Devices list



TRITON+ Monitoring Point 2 - Available Devices list

2. Select the devices that you want to assign to **Monitoring Point 1**. To select multiple devices simultaneously, press and hold down the **Control (Ctrl)** key while selecting the individual devices. To choose consecutive devices in the list, select the first device you want to assign, press and hold down the **Shift** key, and then click on the last device you want to include.

Note: Do not assign two devices of the same type to the same monitoring point. When data collection occurs, **Qstart^{XML}** will overwrite the collected data from the first device with the data from the second device of the same type. This also will occur when collecting data using other

ADS software products. Therefore, assign only one of the two devices (of the same type) to a single monitoring point.

3. Click on the **OK** button.
4. Select a device in the **Devices** box, and click on the **View** button.
The device dialog displays the default or existing parameters for the selected device.
5. Edit the parameters for the selected device as necessary, and then click **OK** on the device dialog when complete.
6. Repeat steps 4 and 5 for each additional device in the **Devices** box and then click **Save** to store the changes to your local directory or network.

Refer to the following alphabetical device listing for more information on editing devices:

<i>Device:</i>	<i>See Page:</i>
Advanced – Diagnostic	4-11
Advanced – Modem Setup	4-12
Advanced – Notification	4-13
Analog	4-14
Alarms	4-15
AV Gated	4-16
Data Delivery	4-22
Flow	4-24
Flow Loss	4-25
Inclinometer	4-25
Long Range	4-27
AV Max/Peak Combo	4-29
Sampler	4-36
ParaDepth/Smart Depth	4-37
ParaFlow/Surface Combo	4-40
Time Zone	4-47
XIO	4-48

Editing the Advanced Device - Diagnostic Tab



Advanced Device – Diagnostic tab

Edit the parameters of the **Diagnostic** tab using the following information:

- **Battery Voltage** Select the frequency in which to store the monitor battery voltage readings.
 - ☐ **Store Only at Midnight** Select this option to store the monitor's battery voltage at midnight. This option is selected by default and should be sufficient for most applications.
 - ☐ **Store Every Reading** Select this option to store the monitor's battery voltage at the monitor's configured sample rate.
- **Temperature** Select the **Store** checkbox to store internal temperature, TEMP, at the monitor's configured sample rate.

Editing the Advanced Device - Modem Setup Tab

Note: The default setting for the Advanced Device is ADSENV.com. AT&T and Verizon SIM cards use the APN provider of ADSENV.COM. The KORE global SIM card uses the APN of data.name.apn.

Users are required to configure the monitor modem with the appropriate APN (Access Point Name) information corresponding to the carrier's SIM card to ensure access to the provider's network.



Advanced Device - Modem Setup dialog

Edit the **Modem Setup** device using the following information:

- **Provider** Identify the host name of your ADS supplied private static SIM or your non-ADS supplied SIM. If the host name you want is not included on the list, use the Edit button to add a new **Provider**.
- **Username** This field is read-only and displays the username associated with the selected **Provider**. This information is given to you by your wireless SIM host to gain access to the wireless network. If the value in this field is incorrect, change it using the **Edit** button.
- **Password** This field is read-only and displays the password associated with the selected Provider. This information is given to you by your wireless SIM provider to gain access to the wireless network. If the value in this field is incorrect, change it using the **Edit** button.
- **Authentication** Select **PAP** for *Password Authentication Protocol* in which the **Username** and **Password** are used for communication authentication. Select **CHAP** for *Challenge Handshake Authentication Protocol* in which a challenge string is used for authentication. Select **None** in cases where the authentication protocol is unknown or not required. This information will be given to you by your wireless SIM provider. ADS recommends using the default selection, **None**.
- **Edit** Select **Edit** to edit an existing APN or Provider.



Select the **Edit** button to modify or add an APN

- Highlight the corresponding row and then edit the **Parameters** listed at the lower portion of the screen.
- Add a new VPN (SIM host) or Provider by entering the correct **Parameter** information and then choosing the **Add** button
 - ☐ **Type** Select **APN** from the drop-down list. If an existing APN requires modification, select the appropriate APN from the **Type** column in the table of available APNs and providers.
 - ☐ **Description** Enter the name of the APN or edit the existing name as necessary.
 - ☐ **Value 1 (Username)** Enter or edit the wireless carrier's Username, if applicable
 - ☐ **Value 2 (Password)** Enter or edit the wireless carrier's Password, if applicable.

Editing the Advanced Device – Notification Tab

TRITON+ monitors can provide alarm notifications through email and cellular phones with text messaging (SMS) capability. The **Notification** tab allows users to configure up to five (5) email and phone numbers to receive email or SMS alerts directly from the monitor when the following conditions arise:

- Alarm events, when configured
- Alarm Return-to-Normal, when configured
- Daily Check-in (optional)

Text messages from the **TRITON+** contain basic information concerning the event; emails include this basic event information as well as the last (i.e., most recent) few readings from the monitor.

The screenshot shows the 'New_Device - Advanced' window with the 'Notification' tab selected. The 'Check In' section has a checkbox and a 'Hour' dropdown set to '12AM'. The 'Email' section has five 'Recipient' fields and a frequency dropdown set to 'Normal'. The 'SMS' section has five 'Recipient' fields, each with a 'Start Hour' and 'End Hour' dropdown, all set to '12AM' and '11PM' respectively.

Advanced Device – Notification tab

- **Check-in** Sends a daily notification at the configured time and is an optional configuration. This notification includes battery voltage and current monitor status information. If selected, select the check-in time from the **Hour** drop-down.
- **Email** Configure up to five (5) email addresses to receive the notification.

SMTP Information This section contains the outgoing SMTP server information for the wireless provider used by the monitor, and email address from which the email notification will be sent. Please contact ADS to obtain this information.

- **SMTP Server** Enter the name of the server through which the monitor sends notification to the recipient(s).
- **SMTP Username** Enter user name for the server through which the monitor sends notification to the recipient(s).
- **SMTP Password** Enter the password for the server through which the monitor sends notification to the recipient(s).
- **Email Address** Enter designated email address for the monitor. *The default value of TRITONPlus@adsmonitors.com does not need to be changed.*

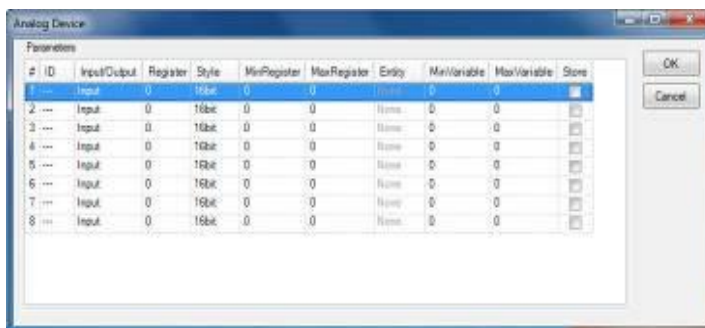
SMS Enter up to five (5) phone numbers for SMS text notification. The default **Start Hour** and **End Hour** allow each **Recipient** to receive all notifications, regardless of time of occurrence. To limit the timeframe that notifications can be sent to certain phone numbers, select the desired **Start Hour** and **End Hour**.

- **Recipient 1 through 5** Enter the corresponding phone number for each contact you want the monitor to notify when one of the events included in the **Event Strings** section occurs. Enter both the area code and the phone number for the cellular phone (example: 2561234567).

Editing the Analog Device

Use the analog device for **TRITON+** monitors to configure up to eight 4-20mA analog channels in any combination of analog inputs or analog outputs. Define incoming analog signals and store the value as AI_1 through AI_8 (at the monitor's sample interval). Define analog outputs from a list of available data entities and output the corresponding data value to an external analog device.

Note: The analog device is a custom configuration. Please consult ADS prior to wiring and configuring this device.



Analog Device properties dialog

Configure the analog device for a **TRITON+** using the following information:

- **#** Displays the channel number associated with the analog input or output. Can be modified, if necessary.
- **ID** Input the Modbus identification corresponding to the external analog Modbus module. This value is typically found in the customer's external analog module's user guide.
- **Input/Output** Select whether the attached analog device is for analog inputs or analog outputs.
- **Register** Enter the Modbus register corresponding to the external analog Modbus module. This value is typically found in the customer's external analog module's user guide.
- **Style** Choose the correct register size for your external analog Modbus module.
- **MinRegister** Enter the minimum scaling values corresponding to the external Modbus module. This value is typically found in the customer's external analog module's user guide.

- **MaxRegister** Enter the maximum scaling values corresponding to the external Modbus module. This value is typically found in the customer's external analog module's user guide.
- **Entity** (for analog *outputs*) Select the monitor data entity whose value should be output (as analog signal) to an external analog device.
- **MinVariable** Enter the value corresponding to the minimum data value for the selected **Entity** for analog outputs or for the minimum data value corresponding to an analog input. This value is used for scaling the data value.
- **MaxVariable** Enter a value corresponding to the maximum data value for the selected **Entity** for analog outputs or for the maximum data value corresponding to an analog input. This value is used for scaling the data value.
- **Store** (for analog inputs) Choose this checkbox to store the corresponding analog input to the monitor memory.

Editing the Alarms Device

This section describes the parameters of the Alarms device.

GLaDOS - Alarm 1

Undeprth Averaging
Readings To Average: 1

Low Level
Enable ☐ Threshold: 0.00 in

Full Pipe
Enable ☐ Threshold: 11.50 in

High Level
Enable ☐ Threshold: 2.00 in

High High
Enable ☐ Threshold: 0.00 in

High Flow
Enable ☐ Threshold: 0.00 MGD

Overflow
Enable ☐

Battery Low
Enable ☐ Threshold: 7.50 V

OK
Cancel

The **Alarms** device parameters

- **Readings to Average** Select the number of consecutive *Undeprth* readings you want the monitor to average to minimize the impact of erroneous readings on the data.
- **Enable** Select the checkbox corresponding to any alarm which should be configured in the monitor.
- **Low Level** Define the depth at which the monitor will trigger a *Low Level* alarm to indicate that the flow depth (at the location) has fallen below a predefined threshold. ADS recommends entering a Low Level depth threshold to a value below the lowest depth that typically occurs at the location.

- **Full Pipe** The *Full Pipe* alarm triggers when the depth in the manhole is measured at greater than or equal to the pipe height (as defined in the location's monitoring point properties).
- **High Level** Define the depth at which the monitor will trigger a *High Level* alarm.
- **High High** Define the depth at which the monitor will trigger a *High High* alarm. The *High High* value must set to zero (0) when this feature is not in use, or greater than the value entered for the *High Level* alarm when in use. ADS recommends setting the *High High* value at least 2 inches higher than the *High Level* value.
- **High Flow** Define the depth at which the monitor will trigger a *High Flow* alarm. *High Flow* alarm will Return to Normal once flow falls below ninety percent of the alarm threshold.
- **Overflow** This event indicates that the **TRITON+** monitor's internal pressure sensor has detected the site is experiencing overflow conditions where the flow is above the manhole rim. **NOTE:** The **TRITON+** desiccant tube must be installed outside the manhole if you are going to use the *Overflow Alarm*.
- **Battery Low** Define the voltage at which the monitor will trigger a battery low alarm. ADS recommends using the default value.

Editing the AV|Gated Sensor

This section describes the parameters for the AV|Gated device.



Edit the **AV|Gated 1** parameters showing the **Ultrasonic** tab

Edit the **Device Parameters** located at the bottom of the dialog, and then edit the individual tabs as described in the following sections.

- **Physical Offset** The **Physical Offset** for the AV|Gated sensor should always be 0.00 as the sensor should always be installed at the bottom center of the pipe unless mounted on a Silt Mount Adapter.
- **Channel** Select the channel number of the port on top of the monitor to which the device is physically connected.
- **Pipe Height** This field displays the pipe height at the monitoring point, based on the installation table. *This parameter is not editable from this location.*

Note: Under normal conditions, the remaining parameters corresponding to the AV|Gated device should not require modification. However, if additional adjustments are necessary, the following sections provide a detailed description of each parameter.

Ultrasonic tab – AV|Gated

Edit the following parameters corresponding to the upward-looking ultrasonic depth sensor in the AV|Gated sensor:

- **Enable** Select this checkbox to ensure the monitor begins taking upward ultrasonic depth readings at the designated interval upon activation. This option is selected by default.
- **Flow Type** Select the option that best reflects the kind of flow conditions that typically occur at the monitoring point from the drop-down list:
 - ☐ **Typical** Flow exhibits a typical diurnal pattern. *This is the default setting.*
 - ☐ **Wet/Stagnant** Flow remains in the pipe, but moves only during wet weather events.
 - ☐ **Usually Dry** Pipe typically remains dry, except under wet weather conditions.
- ☐ **Electronic Offset** Enter the difference that exists between the depth sensor readings and the manually measured depth. *The default value is 0.*
- ☐ **Deadband** Select the distance from the sensor face within which readings received will be ignored. The default value (Auto) represents a percentage of the flow depth and should be sufficient under normal circumstances. It also is the best option for handling shallow flows. However, consider another value when the sensor readings reveal a potential problem with false dropouts. Choose a value for the deadband that is sufficiently below the minimum depths that legitimately occur at the monitoring point, yet above the confirmed drop-outs that have been detected.
- ☐ **Store Data** Select this checkbox to ensure the monitor logs the depth data to memory. *This option is selected by default.*
- ☐ **Advanced** Select this button to access the Advanced Parameters dialog.



Advanced Parameters dialog

Note: Modifications made to the Advanced Parameters should be performed only by or under the guidance of trained ADS personnel. Therefore, ADS recommends leaving the default settings (**Auto**) in place.

Modify the parameters as necessary, and then select **OK** once complete.

- ☐ **DAC Gain** Choose the method for managing the amplification of the analog signal that returns to the sensor:
 - **Auto** Select this option to allow the monitor to automatically optimize the amplification of the signal.
 - **Manual** Select this option to enter a fixed value between -12db (lower amplification) and +12db (high amplification) at which to amplify the signal.

- ❑ **Ping Amplitude** Choose the method for managing the amplification of the analog signal that is sent out, or transmitted from, the sensor. Smaller pipes typically require weaker (quieter) amplification; larger pipes typically require stronger (louder) amplification.
 - **Auto** Select this option to allow the monitor to automatically optimize the amplification of the signal.
 - **Manual** Select this option to enter the percentage of full amplification at which to transmit the signal. Enter a percentage between 10 and 100 percent, where 100 percent represents maximum amplification.

Pressure tab – AV|Gated

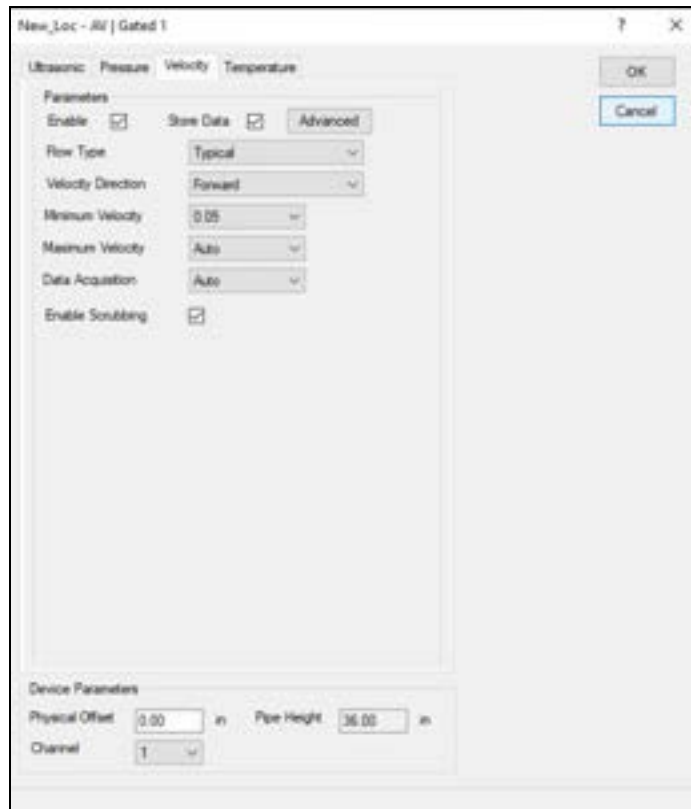


Edit **AV|Gated 1** dialog displaying the **Pressure** tab

Edit the following parameters corresponding to the pressure depth sensor in the AV|Gated sensor:

- **Enable** Select this checkbox to ensure the monitor begins taking pressure depth readings at the designated interval once activated. This option is selected by default.
- **Electronic Offset** Enter the difference that exists between the pressure depth sensor readings and the manually measured depth. *The default value is 0.*
- **Store Data** Select this checkbox to ensure the monitor logs pressure depth data to memory. *This option is selected by default.*
- **Automatic Calibration** Select this checkbox to ensure the monitor automatically calibrates questionable or erroneous pressure depth data to read consistently with the ultrasonic depth data. The monitor will maintain a running average of the difference between the pressure depth and the ultrasonic depth data throughout the day. At midnight each day, the monitor applies a new offset based on the most recent difference in the running average.

Velocity tab – AV|Gated



Edit AV|Gated 1 dialog displaying the **Velocity** tab

Edit the following parameters corresponding to the Doppler velocity sensor in the AV|Gated sensor:

Note: The velocity parameters corresponding to the AV|Gated sensor typically should not require editing. However, if modifications are necessary, ADS does not recommend making changes to these parameters without proper training or assistance.

- **Enable** Select this checkbox to ensure the monitor begins taking velocity readings at the designated interval once activated. This option is selected by default.
- **Flow Type** Select the option that best reflects the kind of flow conditions that typically occur at the monitoring point from the drop-down list:
 - ☐ **Typical** Flow exhibits a typical diurnal pattern. *This is the default setting.*
 - ☐ **Wet/Stagnant** Flow remains in the pipe, but moves only during wet weather events.
 - ☐ **Usually Dry** Pipe typically remains dry, except under wet weather conditions.
- **Velocity Direction** Select one of the following options that reflects the general direction of the flow at the monitoring point and position of the velocity sensor. *The default is **Forward**.*
 - ☐ **Bidirectional** Choose this option for monitoring points that potentially experience reverse flows. The AV|Gated sensor typically is positioned facing upstream into the flow. Choosing this ensures the monitor analyzes both positive and negative values returned from the velocity sensor.
 - ☐ **Forward** Choose this option for monitoring points where reverse flows are *not* expected and to ensure the monitor only analyzes positive values returned from the velocity sensor. The AV|Gated sensor is typically positioned facing upstream into the flow. This is the most common, and the default, option for selection. ADS recommends using this setting for most monitoring applications. **Forward** is the default selection for **Velocity Direction**.

- ☐ **Backward** Choose this option for monitoring points where the AV|Gated is installed facing downstream (backwards) from the oncoming flow. In locations where there is high risk of debris hitting the sensor, this might be the desired option.
- ☐ **Backward Bidirectional** Choose this option when the AV|Gated Sensor is installed facing downstream and to ensure the monitor analyzes flows moving both away from and toward the face of the sensor. This option would be beneficial, for example, when using a weir to measure overflows with the potential of river intrusion.
- **Minimum Velocity** Select the minimum expected velocity that may occur at the site for the monitor to use in fine-tuning the velocity data. The default setting is 0.05 and should be used in most instances. The monitor compares the **Minimum Velocity** value to the actual velocity readings before storing to the monitor memory. Any actual velocity reading falling within a plus or minus range of zero using the **Minimum Velocity** value will be set to zero. For example, using a **Minimum Velocity** of 0.05, and getting an actual velocity reading of -0.03 causes the monitor to store a velocity reading of 0. Using a **Minimum Velocity** of 0.05 and getting an actual velocity reading of 0.06 causes the monitor to store a 0.06 velocity reading.
- **Maximum Velocity** Select the maximum expected velocity that will occur at the site for the monitor to use in fine-tuning the velocity data. The default setting is **Auto**, which serves to optimize the range and resolution of the velocity data samples to match the characteristics of the flow.
- **Data Acquisition** Select the length of time to allow the monitor to get a velocity reading. The default of **Auto** should be used in most instances. Use **Low** to shorten the length of time or use **Medium** or **High** to increase the amount of time. Using **Medium** or **High** results in smoother velocity data but also requires extra battery consumption.
- **Store Data** Select this checkbox to ensure the monitor logs the velocity data to memory. *This option is selected by default.*
- **Enable Scrubbing** Select this checkbox to ensure the monitor confirms questionable or erroneous velocity readings based on the historical relationship between the ultrasonic depth and velocity data for the location.
- **Advanced** Select this button to access the **Advanced Parameters** dialog.



Advanced Parameters dialog

Note: Modifications made to the **Advanced Parameters** should be performed only by or under the guidance of trained ADS personnel. Therefore, ADS recommends leaving the default settings (**Auto**) in place.

Modify the parameters as necessary, and then select **OK** once complete.

- ☐ **DAC Gain** Choose the method for managing the amplification of the analog signal that returns to the sensor:
 - **Auto** Select this option to allow the monitor to automatically optimize the amplification of the signal.
 - **Manual** Select this option to enter a fixed value between -12db (lower amplification) and +12db (high amplification) at which to amplify the signal.

- ❑ **Ping Amplitude** Choose the method for managing the amplification of the analog signal that is sent out, or transmitted from, the sensor. Smaller pipes typically require weaker (quieter) amplification; larger pipes typically require stronger (louder) amplification.
 - **Auto** Select this option to allow the monitor to automatically optimize the amplification of the signal.
 - **Manual** Select this option to enter the percentage of full amplification at which to transmit the signal. Enter a percentage between 10 and 100 percent, where 100 percent represents maximum amplification.

Temperature tab – AV|Gated

The temperature sensor measures the temperature of the flow at the location at which the sensor is installed. The temperature is logged at the same interval as the other entity data. The AV|Gated sensor uses temperature data to calculate the speed of sound in water.



Edit AV|Gated 1 dialog displaying the **Temperature** tab

Edit the following parameters corresponding to the temperature sensor in the AV|Gated sensor:

- **Sensor** Select the source from which to measure the temperature used when compensating for temperature in Peak Combo Sensor readings. The channels correspond to the sensors connected to those channels (ports) on the monitor. The option selected here should be consistent with the option selected for the **Channel** in the **Device Parameters** section at the bottom of the dialog.

Note: The *stored* temperature value is the actual water temperature reading from the AV|Gated sensor.

- **Store Data** Select this checkbox to ensure the monitor logs the temperature data to memory. *This option is selected by default.*

Editing the Data Delivery Device

The **Data Delivery** device enables the monitor to upload flow data stored in the monitor memory to an **ADS** hosted system database or to an FTP site at a user-designated interval. To upload the data to an FTP site, you must know the address of the FTP site, the folder at the FTP site in which you want the monitor to place the data, and the username and password the monitor must use to access the site.

The screenshot shows the 'GilaDOS - Data Delivery' configuration window. It has a title bar with a question mark and a close button. The window is divided into two main sections for 'FTP Setup 1' and 'FTP Setup 2'. Each section contains fields for 'Mode' (Passive), 'Normal' interval (1 hr), 'Fast' interval (15 min), 'Server', 'Folder', 'Username', 'Password', and 'CSV Format' (ADS). There are also checkboxes for 'Enable FTPs'. At the top, there is a 'PRISM' section with a 'Server' field (13.82.147.225) and 'Normal' (6 hr) and 'Fast' (Off) intervals. 'OK' and 'Cancel' buttons are located on the right side of the window.

Section	Mode	Normal	Fast	Server	Folder	Username	Password	CSV Format
PRISM		6 hr	Off	13.82.147.225				
FTP Setup 1	Passive	1 hr	15 min					ADS
FTP Setup 2	Passive	1 hr	15 min					ADS

Edit the **Data Delivery** device

Edit the data delivery device in the following way:

PRISM

- **Server** Enter IP address 13.82.147.226 to deliver data to the ADS database at the user selected intervals.
- **Normal** Select the data delivery rate for non-alarm conditions
- **Fast** Select the data delivery rate to use to deliver data to the ADS database when alarm conditions exist at the monitor. Data delivery will continue at this interval until the alarm conditions return to normal.

FTP Setup 1/ FTP Setup 2

- **Mode** Select either **Active** or **Passive** to configure the manner of communication with the FTP site. Passive is the recommended selection.
- **Normal** Select the rate at which you want the monitor to upload data to the selected destination during non-alarm conditions. Determine the appropriate interval based on the sample rate for the monitor and the number of entities for which the monitor records data. A faster sample rate and/or a greater number of entities may require a more frequent interval for data delivery.
- **Fast** Select the interval at which you want the monitor to upload data to the selected FTP destination while under alarm conditions.
- **Server** Enter the IP address or URL of the FTP site to which you want the monitor to send the data.
- **Folder (optional)** Enter the name of the folder at the FTP site to which you want the monitor to upload the data. If this field is left blank, files will be delivered to the root folder.

Note: *Qstart^{XML}* does not create a folder automatically. Therefore, if you want the monitor to deliver the data to a specific folder, you must create the folder through the FTP site manually before the monitor begins uploading data to the site. For successful data delivery, folder names on the FTP server cannot have spaces within the name. For example, “My_Folder” will work and “My Folder” will not.

- **Username** Enter the username through which the monitor can access the FTP site.
- **Password** Enter the password through which the monitor can access the FTP site.

Note: The **Username** and **Password** must contain 20 characters or less. Characters beyond this limit will be truncated and result in *Data Delivery* failure.

- **CSV Format** Select the desired format of the data delivery file. ADS format will show all available entities. GE format will group readings and their corresponding quality values in rows rather than displaying all stored values in column format.

Editing the Flow Device

Configure the following parameters when you want the monitor to calculate and record flow rate so that it is included when you collect the data from the monitor.



Edit Flow Device Properties dialog

Edit the *Flow* device in the following way:

- **Flow Type** Select the method through which you want the monitor to calculate flow rate based on depth and velocity or depth only data from this drop-down list. Available options include QContinuity, QWeir, QFlume, QLookup, or QManning dependent upon the pipe installation selected and the parameters entered.
- **Store Data** Select this checkbox to ensure the monitor stores the flow data to memory. This option is selected by default.

Editing the Flow Loss Device

Use the following information to configure the Flow Loss device for **TRITON+** Flow Loss alarms.



Editing the **Flow Loss** device

Edit the parameters of the Flow Loss device in the following way:

- **Type** Choose type of flow loss (flow or depth) alarm you want to configure for the **TRITON+**. Select *Flow* (default to trigger an alarm based on a flow rate calculated by the monitor). An alarm is triggered if the flow rate falls below the threshold for typical flow rates. Select *Depth* to trigger an alarm based on flow depths. An alarm is triggered if the flow depth level measured by the monitor falls below the threshold of typical depth levels.
- **Percentage** Choose the percentage of the average daily flow rates or depths you want to set as the threshold for the flow rate or depth alarm. If the measured values are above this threshold percentage, then the monitor will trigger the alarm. Choose between 20 and 80 percent (default is 25).
- **Sensitivity** Choose between Low, Medium, or High to determine the sensitivity to which the **TRITON+** should trigger the *Flow Loss* alarm. ADS recommends leaving this setting to the default of Medium. Choosing *Low* has the lowest potential to trigger false Flow Loss alarms, but there is more of a potential to miss an actual alarm. Conversely, choosing *High* has a higher potential to trigger false *Flow Loss* alarms, but the least potential to miss an actual alarm.
- **Clear Pattern History** Choose this checkbox to clear (at activation) the historical flow or depth pattern in the monitor and recreate a new flow or depth pattern history.

Editing the Inclinator Device

Edit the parameters of the **Inclinometer** device using the following information.

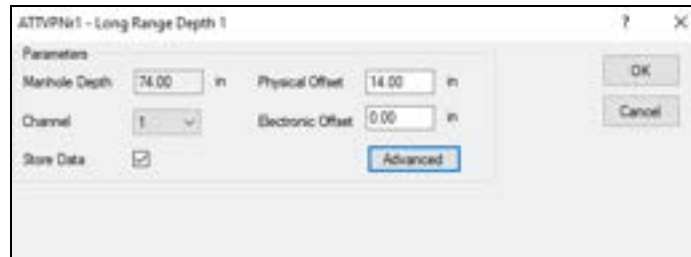


Edit the parameters of the **Inclinometer** device

- **Store Data** Choose this checkbox when you want to store data from the Inclinometer device attached to the monitor. (Selected by default.)
- **Threshold** Enter the degrees which will trigger a *Tilt* alarm for the **TRITON+** monitor. This value defaults to 5.

Editing the Long Range Device

This section describes the parameters for the Long Range Depth device.

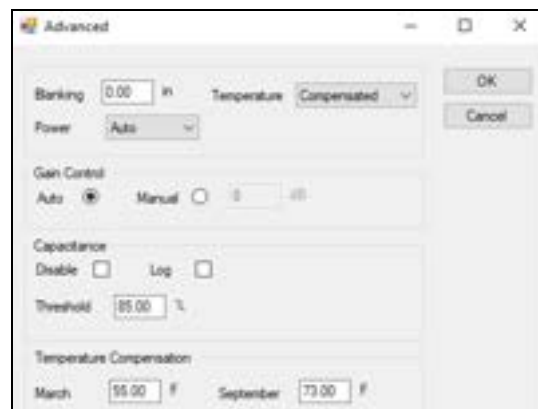


[location name] Long Range dialog

Edit the parameters in the following way:

- **Manhole Depth** This is a read-only field. Manhole Depth is entered on the Main screen of *Qstart^{XML}*.
- **Physical Offset** Distance (in inches or millimeters) from the manhole rim to the bottom of the Long Range Depth sensor. Reference Chapter 3 for more detailed instructions on how to take this measurement.
- **Channel** Select the channel number of the port on the top of the monitor to which the sensor device is connected.
- **Electronic Offset** (optional) Enter the difference that exists between the Long Range Depth readings and manually measured depth within the invert. *The default value is 0.*
- **Store Data** Select this checkbox to ensure the monitor logs to depth data to memory. *This option is selected by default.*
- **Advanced** Select this button to access the Advanced Parameters dialog.

Note: Modifications to the **Advanced Parameters** should be performed only by or under the guidance of trained ADS personnel. Therefore, ADS recommends leaving the default settings in place.



Advanced Parameters dialog

- **Blanking** helps prevent pops in installations where there are problems with the sensor reading near-ranges (nearly full manhole depths). Leaving **Blanking** at the default value of 0.00 allows the monitor to use a built-in function of the manhole depth. A **Blanking** value other than 0.00 represents the distance (in inches or millimeters) from the face of the sensor which will be used to calculate those ranges the monitor should

ignore while the sensor is firing. For example, choosing a value of 10 will cause all ranges measured within ten inches (254 millimeters) from the face of the sensor to be ignored.

- **Temperature** Choose the method for computing the air temperature in the manhole as it relates to sensor signal. ADS recommends leaving this at the default *Compensated* setting.
 - ☐ **Compensated** Select this option to use a normalized temperature setting to approximate the difference between the top and bottom of the manhole. This setting is the default setting and is sufficient in most cases.
 - ☐ **Sensor** Select this setting in cases where the temperature is uniform throughout the manhole.
 - ☐ **Targeted** Select this setting in cases where ADS temperature targets are in place such that the temperature can be calculated based on known distances. This option is not implemented at this time.
- **Power** Choose the level of power supplied to the sensor:
 - ☐ **Auto** Select this option to allow the monitor firmware to determine the amount of power supplied to the sensor. This option is a function of the total range (manhole depth). ADS recommends using the default of Auto. *This option is selected by default.*
 - ☐ **1 to 11** Select 1 for the lowest power setting, which would be most useful in short range installations with no interference. Select 11 for the highest power setting, which would be most useful in long range installations with interference.
- **Gain Control** Choose the method for managing the amplification of the analog signal that returns to the sensor:
 - ☐ **Auto** Select this option to allow the monitor to automatically optimize the amplification of the signal. (Recommended)
 - ☐ **Manual** Select this option to enter a fixed value between -12db (lower amplification) and +12db (higher amplification) at which to amplify the signal.
- **Capacitance**
 - ☐ **Disable** Select this checkbox to disable the **Submersion** sensor which detects submersion when fully covered with liquid.

Note: Disabling the **Submersion** sensor will also disable SUBMERGED alarms.

- ☐ **Log** Select this checkbox to store the **Submersion** sensor readings (*Capacitance*) to monitor memory.
- ☐ **Threshold** – This is the percentage of the factory submerged value that will be considered a submerged sensor. The default value is 85%.
- **Temperature Compensation** – The Long Range Depth sensor compensates for the change in temperature at the top of the manhole as compared to the bottom when determining a depth measurement. The values below are default values and should suffice for most installations. If monitoring in an extremely cold or hot zone, they may need to be adjusted. If monitoring in the southern hemisphere, these values should be reversed.
 - ☐ **March** – Default assumed temperature at the bottom of manhole in March (winter). The default is 55° F (13° C).
 - ☐ **September** – Default assumed temperature at the bottom of the manhole in September (summer). The default is 73° F (23° C).

Editing the AV|Max/Peak Combo Device

This section describes the parameters for the AV|Max/Peak Combo device.



Edit AV|Max/Peak Combo 1 Parameters dialog showing the **Ultrasonic** tab

Edit the **Device Parameters** located at the bottom of the dialog, and then edit the individual tabs as described in the following sections.

- **Physical Offset** Enter the measured physical offset for the sensor at the time of installation if it was installed offset from the bottom center of the pipe. Refer to Chapter 3, *Sensor Installation and Connection*, for instructions on measuring the physical offset. The default physical offset is 0.
- **Channel** Select the channel number of the port on top of the monitor to which the device is physically connected.
- **Pipe Height** This field displays the pipe height at the monitoring point, based on the installation table. *This parameter is not editable from this location.*

Note: Under normal conditions, the remaining parameters corresponding to the AV|Max or Peak Combo device should not require modification. However, if additional adjustments are necessary, the following sections provide a detailed description of each parameter.

Ultrasonic tab – AV|Max or Peak Combo

Edit the following parameters corresponding to the upward-looking ultrasonic depth sensor in the AV|Max or Peak Combo Sensor:

- **Enable** Select this checkbox to ensure the monitor begins taking upward ultrasonic depth readings at the designated interval upon activation. This option is selected by default.
- **Flow Type** Select the option that best reflects the kind of flow conditions that typically occur at the monitoring point from the drop-down list:
 - ☐ **Typical** Flow exhibits a typical diurnal pattern. *This is the default setting.*
 - ☐ **Wet/Stagnant** Flow remains in the pipe but moves only during wet weather events.
 - ☐ **Usually Dry** Pipe typically remains dry, except under wet weather conditions.

- **Electronic Offset** Enter the difference that exists between the depth sensor readings and the manually measured depth. The default value is 0.
- **Deadband** Select the distance from the sensor face within which readings received will be ignored. The default value (Auto) represents a percentage of the flow depth and should be sufficient under normal circumstances. It also is the best option for handling shallow flows. However, consider another value when the sensor readings reveal a potential problem with false dropouts. Choose a value for the deadband that is sufficiently below the minimum depths that legitimately occur at the monitoring point, yet above the confirmed dropouts that have been detected.
- **Store Data** Select this checkbox to ensure the monitor logs the depth data to memory. This option is selected by default.
- **Advanced** Select this button to access the Advanced Parameters dialog.



Advanced Parameters dialog

Note: Modifications made to the Advanced Parameters should be performed only by or under the guidance of trained ADS personnel. Therefore, ADS recommends leaving the default settings (**Auto**) in place.

Modify the parameters as necessary, and then select **OK** once complete.

- ❑ **DAC Gain** Choose the method for managing the amplification of the analog signal that returns to the sensor:
 - **Auto** Select this option to allow the monitor to automatically optimize the amplification of the signal.
 - **Manual** Select this option to enter a fixed value between -12db (lower amplification) and +12db (high amplification) at which to amplify the signal.
- ❑ **Ping Amplitude** Choose the method for managing the amplification of the analog signal that is sent out, or transmitted from, the sensor. Smaller pipes typically require weaker (quieter) amplification; larger pipes typically require stronger (louder) amplification.
 - **Auto** Select this option to allow the monitor to automatically optimize the amplification of the signal.
 - **Manual** Select this option to enter the percentage of full amplification at which to transmit the signal. Enter a percentage between 10 and 100 percent, where 100 percent represents maximum amplification.

Pressure tab – AV|Max/Peak Combo



Edit AV|Max/Peak Combo 1 Parameters dialog displaying the **Pressure** tab

Edit the following parameters corresponding to the pressure depth sensor in the AV|Max or Peak Combo Sensor:

- **Enable** Select this checkbox to ensure the monitor begins taking pressure depth readings at the designated interval once activated. This option is selected by default.
- **Electronic Offset** Enter the difference that exists between the pressure depth sensor readings and the manually measured depth. *The default value is 0.*
- **Store Data** Select this checkbox to ensure the monitor logs pressure depth data to memory. *This option is selected by default.*
- **Automatic Calibration** Select this checkbox to ensure the monitor automatically calibrates questionable or erroneous pressure depth data to read consistently with the ultrasonic depth data. The monitor will maintain a running average of the difference between the pressure depth and the ultrasonic depth data throughout the day. At midnight each day, the monitor will apply a new offset based on the most recent difference in the running average. If the firmware detects a sufficient difference between the ultrasonic depth and pressure depth, an offset may be applied every four (4) hours.

Velocity tab – AV|Max/Peak Combo



Edit AV|Max/Peak Combo 1 Parameters dialog displaying the **Velocity** tab

Edit the following parameters corresponding to the Doppler velocity sensor in the AV|Max or Peak Combo Sensor:

Note: The velocity parameters corresponding to the AV|Max and Peak Combo Sensors typically should not require editing. However, if modifications are necessary, ADS does not recommend making changes to these parameters without proper training or assistance.

Note: When using an AV|Max or Peak Combo Sensor and a Surface Combo Sensor at the same monitoring point, ADS recommends maintaining the same settings for all of the parameters corresponding to both Peak Velocity (**Velocity** tab on the **Edit Peak Combo Parameters** dialog) and Surge Peak Velocity (**Peak Velocity** tab in the **Edit Surface Combo Parameters** dialog) to ensure consistency between the velocity readings.

- **Enable** Select this checkbox to ensure the monitor begins taking velocity readings at the designated interval once activated. This option is selected by default.
- **Store Data** Select this checkbox to ensure the monitor logs the velocity data to memory. *This option is selected by default.*
- **Flow Type** Select the option that best reflects the kind of flow conditions that typically occur at the monitoring point from the drop-down list:
 - ☐ **Typical** Flow exhibits a typical diurnal pattern. *This is the default setting.*
 - ☐ **Wet/Stagnant** Flow remains in the pipe but moves only during wet weather events.
 - ☐ **Usually Dry** Pipe typically remains dry, except under wet weather conditions.
- **Sensitivity** Select the appropriate velocity sensor sensitivity from the drop-down list. A sensitivity that is too high may produce noise, causing interference in the signal and resulting in spikes in the data. A sensitivity that is too low can produce readings that are low in comparison with confirmation readings. *The default sensitivity is 10.*
- **Velocity Direction** Select one of the following options that reflects the general direction of the flow at the monitoring point and position of the velocity sensor. *The default is **Forward**.*

- ❑ **Bidirectional** Choose this option for monitoring points that potentially experience reverse flows. The AV|Max and Peak Combo Sensors typically are positioned facing upstream into the flow. Choosing this ensures the monitor analyzes both positive and negative values returned from the velocity sensor.
- ❑ **Forward** Choose this option for monitoring points where reverse flows are *not* expected and to ensure the monitor only analyzes positive values returned from the velocity sensor. The AV|Max and Peak Combo Sensor typically are positioned facing upstream into the flow. This is the most common, and the default, option for selection. ADS recommends using this setting for most monitoring applications. **Forward** is the default selection for **Velocity Direction**.
- ❑ **Backward** Choose this option for monitoring points at which the AV|Max or Peak Combo Sensor has been positioned facing downstream and to ensure the monitor only analyzes flows moving away from the face of the sensor. One application in which this would be the preferable option would be for measuring velocity in an outgoing line following two incoming lines in the manhole.
- ❑ **Backward Bidirectional** Choose this option when the AV|Max or Peak Combo Sensor is installed facing downstream and to ensure the monitor analyzes flows moving both away from and toward the face of the sensor. This option would be beneficial, for example, when using a weir to measure overflows with the potential of river intrusion.
- **Maximum Velocity** Select the maximum expected velocity that will occur at the site for the monitor to use in fine-tuning the velocity data. The default setting is **Auto**, which serves to optimize the range and resolution of the velocity data samples to match the characteristics of the flow. However, if the velocity readings at the location measure at least 10 feet per second (fps) on a regular basis, ADS recommends choosing the **15 fps** option for this parameter. If the location is downstream from a pump station and displays rapid changes in velocity from reading to reading, ADS also recommends changing the **Maximum Velocity** setting from **Auto** to a setting slightly above the maximum recorded velocity.
- **Transmit Frequency** Select the frequency at which to transmit the signal. ADS recommends leaving the default setting (**High**) selected.
- **Gain** This value represents the factor applied to raw velocity (RAWVEL entity in **Qstart^{XML}**) to determine average velocity and to calculate quantity for the Flow 1(2) device. **Qstart^{XML}** does not apply Gain to the velocity readings reported in **Diagnostics**, where the raw velocity readings are used for comparison against the manual measurements.
- **Enable Scrubbing** Select this checkbox to ensure the monitor confirms questionable or erroneous velocity readings based on the historical relationship between the ultrasonic depth and velocity data for the location.
- **Advanced** Select this button to access the **Advanced Parameters** dialog.



Advanced Parameters dialog

Note: Modifications made to the **Advanced Parameters** should be performed only by or under the guidance of trained ADS personnel. Therefore, ADS recommends leaving the default settings (**Auto**) in place.

Modify the parameters as necessary, and then select **OK** once complete.

- ☐ **DAC Gain** Choose the method for managing the amplification of the analog signal that returns to the sensor:
 - **Auto** Select this option to allow the monitor to automatically optimize the amplification of the signal.
 - **Manual** Select this option to enter a fixed value between -12db (lower amplification) and +12db (high amplification) at which to amplify the signal.
- ☐ **Ping Amplitude** Choose the method for managing the amplification of the analog signal that is sent out, or transmitted from, the sensor. Smaller pipes typically require weaker (quieter) amplification; larger pipes typically require stronger (louder) amplification.
 - **Auto** Select this option to allow the monitor to automatically optimize the amplification of the signal.
 - **Manual** Select this option to enter the percentage of full amplification at which to transmit the signal. Enter a percentage between 10 and 100 percent, where 100 percent represents maximum amplification.

Temperature tab – AV|Max/Peak Combo

The temperature sensor measures the temperature of the flow at the location at which the sensor is installed. The temperature is logged at the same interval as the other entity data. The Peak Combo Sensor uses temperature data to calculate the speed of sound in water.



Edit AV|Max/Peak Combo 1 Parameters dialog displaying the **Temperature** tab

Edit the following parameters corresponding to the temperature sensor in the AV|Max or Peak Combo Sensor:

- **Sensor** Select the source from which to measure the temperature used when compensating for temperature in AV|Max or Peak Combo Sensor readings. The channels correspond to the sensors connected to those channels (ports) on the monitor. The option selected here should be consistent with the option selected for the **Channel** in the **Device Parameters** section at the bottom of the dialog.

Note: The *stored* temperature value is the actual water temperature reading from the AV|Max or Peak Combo Sensor.

- **Store Data** Select this checkbox to ensure the monitor logs the temperature data to memory. *This option is selected by default.*

Editing the Sampler Device

Use the following information when you want to edit the parameters for water quality sampling activities associated with a **TRITON+**.



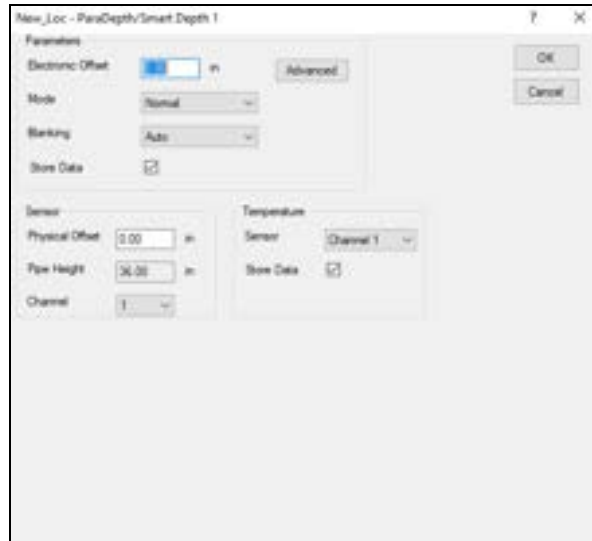
Edit the **Sampler** device

Note: When performing water quality sampling using externally powered **TRITON+** monitors, you must configure one of the analog output devices on the XIO device dialog with the appropriate entity for the sampling application through **Qstart^{XML}** and connect the XIO directly to the sampler.

- **Type** Select the triggering method you want to use to initiate sampling operations from **Depth**, **Flow Rate**, or **Flow Total**. Trigger values are based on readings returned from the selected sensors in the **Depth** and **Velocity** fields on the main **Qstart^{XML}** configuration screen. Choose **Depth** to initiate sampling based on UNIDEPTH readings from the selected depth combo sensor. **Flow Rate** and **Flow Total** are instantaneous calculations based on the selected depth and velocity sensors in the **Combo Sensor to Use**.
- **Trigger** Enter the sampling trigger threshold corresponding to the selected **Type** for which you want the sampler activities to initiate. For example, if **Depth** is the selected **Type**, enter the corresponding threshold value in inches (or millimeters) at which you want the monitor to pulse the sampler.
- **Samples per wakeup** Select and enter or use the up/down arrows to indicate the total, consecutive number of times you want the monitor to pulse the sampler within a single interval each time the trigger condition is met.
- **Pulse Length** Enter the duration of the pulse you want to send to the sampler once sampling activities begin.

Editing the ParaDepth/Smart Depth Device

Use the following information to edit the parameters of the **ParaDepth/Smart Depth** device.



Edit ParaDepth/Smart Depth 1 Parameters dialog

Edit the following parameters corresponding to the downward-looking ultrasonic (smart) depth sensor as necessary:

Note: Edit the parameters for an Ultrasonic Depth Sensor equipped with *the pressure option* through the *Surface Combo Sensor* device. Refer to page 4-40 for more information.

Parameters

Note: Under normal conditions, the parameters in this section (**Parameters**) should not require modification. However, if additional adjustments are necessary, refer to the detailed description of each parameter.

- **Electronic Offset** Enter the difference that exists between the smart depth sensor readings and the manually measured depth, when applicable. *The default value is 0.*
Note: An electronic offset is rarely needed. An offset greater than +/- 0.5 inches (13 mm) typically indicates that the physical offset or pipe height has been measured or recorded incorrectly.
- **Mode** Select the mode in which you want the smart depth sensor to operate based on environmental factors or site constraints. The default setting is **Normal** power. However, if erratic *Smart Depth* readings occur, consider changing the **Power** setting to **High** power.
- **Blanking** Select the distance from the horizontal face of the ultrasonic depth sensor within which to ignore data potentially representing erroneous readings. Select the **Auto** option (*default*) to ensure the monitor disregards depths occurring within a distance from the horizontal face of the sensor equivalent to 5 percent of the range from the sensor face to the bottom of the pipe. This option represents most pipe/flow conditions; therefore, ADS strongly recommends leaving this option selected for most applications. *Choose one of the other options only when spikes in the data are occurring beyond 5 percent of this range and under direct consultation with an ADS representative.*
- **Store Data** Select this checkbox to ensure the monitor logs the smart depth data to memory. *This option is selected by default.*

- **Advanced** Select this button to access the **Advanced Parameters** dialog.



Advanced Parameters dialog

Note: Modifications made to the Advanced Parameters should be performed only by or under the guidance of trained ADS personnel. Therefore, ADS recommends leaving the default settings (**Auto**) in place.

Modify the parameters as necessary, and then select **OK** once complete.

- ☐ **DAC Gain** Choose the method for managing the amplification of the analog signal that returns to the sensor:
 - **Auto** Select this option to allow the monitor to automatically optimize the amplification of the signal.
 - **Manual** Select this option to enter a fixed value between -12db (lower amplification) and +12db (high amplification) at which to amplify the signal.
- ☐ **Surcharge Detection** Select the Disable checkbox to prevent the monitor from implementing the Surcharge Detection function when processing Smart Depth data. For locations that typically do not experience surcharge, disabling Surcharge Detection eliminates the processing time required for this function and, as a result, conserves monitor power.

Sensor

- **Physical Offset** Enter the physical distance from the face of the sensor to the crown (top) of the pipe. *Refer to Chapter 5, Sensor Installation and Connection, for instructions on measuring the physical offset.*
- **Pipe Height** This field displays the pipe height at the monitor location, based on the installation table. *This parameter is not editable from this location.*
- **Channel** Select the channel number of the port on top of the monitor to which this device is connected.

Temperature

The temperature sensor measures the air temperature in the pipe to apply when calculating the speed of sound in air.

Note: Under normal conditions, the parameters in the **Temperature** section should not require modification. However, if additional adjustments are necessary, refer to the detailed description of each parameter.

- **Sensor** Select the source from which to measure the temperature used when compensating for temperature in Ultrasonic Depth Sensor readings. The channels correspond to the sensors connected to those channels (i.e., ports) on the monitor. The option selected here should be consistent with the option selected for the **Channel** in the **Sensor** section to the left of the **Temperature** section.

Note: The *stored* temperature value is the actual air temperature reading from the Ultrasonic Depth Sensor.

- **Store Data** Select this checkbox to ensure the monitor logs the temperature data to memory. *This option is selected by default.*

Editing the ParaFlow/Surface Combo Sensor Device

The following section provides descriptions for the parameters corresponding to the ParaFlow/Surface Combo Sensor device.



Edit ParaFlow/Surface Combo 1 Parameters dialog (Smart Depth tab)

Edit the following **Device Parameters** at the bottom of the dialog, and then edit the individual tabs as described in the following sections:

- **Physical Offset** Enter the physical distance from the face of the sensor to the crown (top) of the pipe. *Refer to Chapter 5, Sensor Installation and Connection, for instructions on measuring the physical offset.*
- **Channel** Select the channel number of the port on top of the monitor to which this device is connected.
- **Pipe Height** This field displays the pipe height at the monitor location, based on the installation table. *This parameter is not editable from this location.*

Note: Under normal conditions, the remaining parameters corresponding to the *Surface Combo* device should not require modification. However, if additional adjustments are necessary, the following sections provide a detailed description of each parameter.

Smart Depth (Ultrasonic) tab – ParaFlow/Surface Combo

The Smart Depth sensor measures the distance (or range) from the crown of the pipe to the surface of the flow.

Edit the following parameters corresponding to the downward-looking ultrasonic (smart) depth sensor in the ParaFlow and Surface Combo Sensors:

- **Electronic Offset** Enter the difference that exists between the smart depth sensor readings and the manually measured depth, when applicable. *The default value is 0.*

Note: An electronic offset is rarely needed. An offset greater than +/- 0.5 inches (13 mm) typically indicates that the physical offset or pipe height has been measured or recorded incorrectly.

- **Mode** Select the mode in which you want the smart depth sensor to operate based on environmental factors or site constraints. The default setting is **Normal** power. However, if erratic *Smart Depth* readings occur, consider changing the **Power** setting to **High** power.

Note: The ParaFlow sensor can use the **Normal** setting across its full sensor range in most installations. In rare instances if the flow is quite choppy or has foam, the **High** setting may be better.

- **Blanking** Select the distance from the horizontal face of the ParaFlow or Surface Combo Sensor within which to ignore data potentially representing erroneous readings. Select the **Auto** option (*default*) to ensure the monitor disregards depths occurring within a distance from the horizontal face of the sensor equivalent to 5 percent of the range from the sensor face to the bottom of the pipe. This option typically represents the vast majority of pipe/flow conditions; therefore, ADS strongly recommends leaving this option selected for most applications. *Choose one of the other options only when spikes in the data are occurring beyond 5 percent of this range and under direct consultation with an ADS representative.*
- **Store Data** Select this checkbox to ensure the monitor logs the smart depth data to memory. *This option is selected by default.*
- **Advanced** Select this button to access the **Advanced Parameters** dialog.



Advanced Parameters dialog

Note: Modifications made to the Advanced Parameters should be performed only by or under the guidance of trained ADS personnel. Therefore, ADS recommends leaving the default settings (**Auto**) in place.

Modify the parameters as necessary, and then select **OK** once complete.

- ❑ **DAC Gain** Choose the method for managing the amplification of the analog signal that returns to the sensor:
 - **Auto** Select this option to allow the monitor to automatically optimize the amplification of the signal.
 - **Manual** Select this option to enter a fixed value between -12db (lower amplification) and +12db (high amplification) at which to amplify the signal.
- ❑ **Surcharge Detection** Select the **Disable** checkbox to prevent the monitor from implementing the Surcharge Detection function when processing smart depth data. For locations that typically do not experience surcharges, disabling Surcharge Detection eliminates the processing time required for this function and, as a result, conserves monitor power.

Surface Velocity tab – ParaFlow/Surface Combo

[location name] – ParaFlow/Surface Combo dialog displaying **Surface Velocity** tab

Edit the parameters corresponding to the surface velocity sensor in the ParaFlow or Surface Combo Sensor.

- **Enable** Select this checkbox to ensure the monitor begins taking velocity readings at the designated interval once activated. *This option is selected by default.*
- **Store Data** Select this checkbox to ensure the monitor logs the velocity data to memory. *This option is selected by default.*
- **Transmit Frequency** Select the frequency at which to transmit the signal. ADS recommends leaving the default setting (**Low**) for most applications. However, if hydraulic conditions at the site are resulting in questionable or erroneous readings, consider applying one of the other frequency options. Contact ADS for assistance when necessary.
- **Sensitivity** Select the appropriate velocity sensor sensitivity from the drop-down list. A sensitivity that is too high may produce noise, causing interference in the signal and resulting in spikes in the data. A sensitivity that is too low can produce readings that are low in comparison with confirmation readings. *The default sensitivity is 12.*
- **Velocity Direction** Select one of the following options that reflects the general direction of the flow at the monitoring point and position of the velocity sensor. Medium and High Transmit Frequency require the Velocity Direction be correct. *The default is **Forward**.*
 - ☐ **Forward** Choose this option for monitoring points where reverse flows are *not* expected and to ensure the monitor only analyzes positive values returned from the velocity sensor. The ParaFlow and Surface Combo Sensor typically are positioned facing upstream toward the oncoming flow. This is the most common option for selection. ADS recommends using this setting for most monitoring applications. It also requires less processing time and conserves power.
 - ☐ **Backward** Choose this option for monitoring points at which the ParaFlow or Surface Combo Sensor has been positioned facing downstream and to ensure the monitor only analyzes flows moving away from the face of the sensor. One application in which this would be the preferable option would be for measuring velocity in an outgoing line following two incoming lines in the manhole.

- **Maximum Velocity** Select the maximum expected velocity that will occur at the site for the monitor to use in fine-tuning the velocity data. The **Auto** option serves to optimize the range and resolution of the velocity data samples to match the characteristics of the flow. *The default setting is **Auto**.*
- **Duration** Select the amount of time for the sensor to transmit and receive the velocity signal based on the noise present at the monitoring point. The default setting is a 3 second interval. However, sites that experience elevated noise levels or velocity dropouts to zero require a longer interval (4 or 5).
- **Gain** This value represents the factor applied to raw velocity (RAWVEL entity in **Qstart^{XML}**) to determine average velocity and to calculate quantity for the Flow 1(2) device. **Qstart^{XML}** does not apply the Gain to the velocity readings reported in **Diagnostics**, where the raw velocity readings are used for comparison against the manual measurements.
- **Enable Scrubbing** Select this checkbox to ensure the monitor confirms questionable or erroneous velocity readings based on the historical relationship between the depth and velocity data for the location.
- **Advanced** Select this button to access the **Advanced Parameters** dialog.



Advanced Parameters dialog

Note: Modifications made to the Advanced Parameters should be performed only by or under the guidance of trained ADS personnel. Therefore, ADS recommends leaving the default settings (**Auto**) in place.

Modify the parameters as necessary, and then select **OK** once complete.

- ❑ **DAC Gain** Choose the method for managing the amplification of the analog signal that returns to the sensor:
 - **Auto** Select this option to allow the monitor to automatically optimize the amplification of the signal.
 - **Manual** Select this option to enter a fixed value between -12db (lower amplification) and +12db (high amplification) at which to amplify the signal.
- ❑ **Ping Amplitude** Choose the method for managing the amplification of the analog signal that is sent out, or transmitted from, the sensor. Smaller pipes typically require weaker (quieter) amplification; larger pipes typically require stronger (louder) amplification.
 - **Auto** Select this option to allow the monitor to automatically optimize the amplification of the signal.
 - **Manual** Select this option to enter the percentage of full amplification at which to transmit the signal. Enter a percentage between 10 and 100 percent, where 100 percent represents maximum amplification.

Peak Velocity tab – ParaFlow/Surface Combo



Edit ParaFlow/Surface Combo 1 Parameters dialog displaying the **Peak Velocity** tab

Edit the parameters corresponding to the (surcharge) peak velocity sensor in the ParaFlow and Surface Combo Sensors in the following way:

Note: When using a Peak Combo sensor and Surface Combo sensor at the same monitoring point or an AV|Max sensor and ParaFlow, ADS recommends maintaining the same settings for all the parameters corresponding to both Peak Velocity (**Velocity** tab on the **Edit Peak Combo Parameters** dialog) and Surcharge Peak Velocity (**Peak Velocity** tab in the **Edit Surface Combo Parameters** dialog) to ensure consistency between the velocity readings. However, you may consider disabling this sensor when both are present to conserve battery life, monitor memory, and data collection time.

- **Enable** Select this checkbox to enable the parameters for modification and to ensure the monitor begins taking velocity readings at the designated interval once activated. This option is selected by default.
- **Store Data** Select this checkbox to ensure the monitor logs the velocity data to memory. *This option is selected by default.*
- **Sensitivity** Select the appropriate velocity sensor sensitivity from the drop-down list. A sensitivity that is too high may produce noise, causing interference in the signal and resulting in spikes in the data. A sensitivity that is too low can produce readings that are low in comparison with confirmation readings. *The default sensitivity is 10.*
- **Velocity Direction** Select one of the following options that reflects the general direction of the flow at the monitoring point and position of the velocity sensor. *The default is **Forward**.*
 - ☐ **Bidirectional** Choose this option for monitoring points that potentially experience reverse flows. The Paraflow and Surface Combo Sensors typically are positioned facing upstream toward the oncoming flow. Choosing this ensures the monitor analyzes both positive and negative values returned from the velocity sensor.
 - ☐ **Forward** Choose this option for monitoring points where reverse flows are *not* expected and to ensure the monitor only analyzes positive values returned from the velocity sensor. The ParaFlow and Surface Combo Sensor typically are positioned facing upstream toward the oncoming flow. This is the most common option for selection. ADS recommends using this setting for most monitoring applications.

- ☐ **Backward** Choose this option for monitoring points at which the ParaFlow or Surface Combo Sensor has been positioned facing downstream and to ensure the monitor only analyzes flows moving *away* from the face of the sensor. One application in which this would be the preferable option would be for measuring velocity in an outgoing line following two incoming lines in the manhole.
- ☐ **Backward Bidirectional** Choose this option when the ParaFlow or Surface Combo Sensor is installed facing downstream and to ensure the monitor analyzes flows moving both away from and toward the face of the sensor. This option would be beneficial, for example, when using a weir to measure overflows with the potential of river intrusion.
- **Maximum Velocity** Select the maximum expected velocity that will occur at the site for the monitor to use in fine-tuning the velocity data. The **Auto (default)** option serves to optimize the range and resolution of the velocity data samples to match the characteristics of the flow. However, if the velocity readings at the location measure at least 10 feet per second (fps) on a regular basis, ADS recommends choosing the **15 fps** option for this parameter.
- **Transmit Frequency** Select the frequency at which to transmit the signal. ADS recommends leaving the default setting (**High**) for most applications. However, if hydraulic conditions at the site are resulting in questionable or erroneous readings, consider applying the other frequency option. Contact ADS for assistance when necessary.
- **Gain** This value represents the factor applied to *raw* velocity (RAWVEL entity in **Qstart^{XML}**) to determine average velocity and to calculate quantity for the Flow 1(2) device.
- **Enable Scrubbing** Select this checkbox to ensure the monitor confirms questionable or erroneous velocity readings based on the historical relationship between the ultrasonic depth and velocity data for the location.
- **Advanced** Select this button to access the **Advanced Parameters** dialog.



Advanced Parameters dialog

Modify the parameters as necessary, and then select **OK** once complete.

- ☐ **DAC Gain** Choose the method for managing the amplification of the analog signal that returns to the sensor:
 - **Auto** Select this option to allow the monitor to automatically optimize the amplification of the signal.
 - **Manual** Select this option to enter a fixed value between -12db (lower amplification) and +12db (high amplification) at which to amplify the signal.
- ☐ **Ping Amplitude** Choose the method for managing the amplification of the analog signal that is sent out, or transmitted from, the sensor. Smaller pipes typically require weaker (quieter) amplification; larger pipes typically require stronger (louder) amplification.
 - **Auto** Select this option to allow the monitor to automatically optimize the amplification of the signal.
 - **Manual** Select this option to enter the percentage of full amplification at which to transmit the signal. Enter a percentage between 10 and 100 percent, where 100 percent represents maximum amplification.

Pressure tab – ParaFlow/Surface Combo

The pressure sensor measures the height of the water above the sensor (mounted at the crown of the pipe) under surcharge conditions where the flow has completely filled the pipe and is rising in the manhole.



Edit ParaFlow/Surface Combo 1 dialog displaying the **Pressure** tab

Edit the following parameters corresponding to the pressure depth sensor in the ParaFlow or Surface Combo Sensor:

- **Enable** Select this checkbox to ensure the monitor begins taking pressure depth readings at the designated interval once activated. This option is selected by default.
- **Electronic Offset** Enter the difference that exists between the pressure depth readings and the value equal to the pipe height minus the physical offset of the ParaFlow or Surface Combo Sensor. *However, ADS recommends leaving this value at zero.*
- **Store Data** Select this checkbox to ensure the monitor logs pressure depth data to memory. This option is selected by default.
- **Automatic Calibration** (only applicable to ParaFlow sensors) Select this checkbox to ensure the monitor automatically calibrates questionable or erroneous pressure depth data to read consistently the Pipe Height minus the Physical Offset when the manhole is not surcharged.

Note: Do not reactivate the **ADS TRITON+** monitor when the manhole is surcharged. The Pressure sensor will not work properly if this is done. If it is imperative that the monitor be reactivated, disable **Automatic Calibration** before reactivating.

Temperature tab – ParaFlow/Surface Combo

Edit the parameters corresponding to the temperature sensor in the ParaFlow or Surface Combo Sensor in the same way in which you edited the parameters for the temperature sensor in the Peak Combo Sensor. Refer to the parameter descriptions and instructions for the *Temperature* tab on page 4-34 for detailed information on the individual parameters on the **Temperature** tab.

Editing the Time Zone Device

The following section provides descriptions for the parameters corresponding to the Time Zone device.



Edit the Time Zone device parameters

Select the Time Zone of the *monitor*, not the *Qstart^{XML}* host computer. Enable the **Daylight Savings Rule** to adjust the time for Daylight Saving. Disable to **Daylight Saving Rule** to maintain standard time throughout the year.

When applicable, select the **Sync Time to Cellular Tower** checkbox when you want the monitor time to adjust to the nearby cellular tower time every 12 hours (based on activation time). This option is selected by default.

Editing the XIO Device

Use the following information to configure the externally powered XIO™ device for the **TRITON+** monitor for up to two analog inputs, two analog outputs, two digital inputs and two digital outputs:



XIO Device properties dialog

Note: There is a single XIO device limit per **TRITON+**.

Analog Input 1 (2) Configure the values in this section to specify how to process the incoming analog signal from an analog device connected to the **XIO** device.

- **Entity** Select the entity *type* corresponding to the incoming analog signal to ensure the correct unit of measure is applied to the resulting data. The XIO device supports the following analog inputs: depth (DEPTH_A1), velocity (VEL_A1), quantity (Q_A1), temperature (TMP_A1), PH (PH_A1), as well as a generic analog input (AI_A1). For example, choose DEPTH_A1 to record incoming analog depth values to a DEPTH_A1 entity which uses corresponding units of measure in inches (or millimeters).
- **Min Value** Input the minimum value for the incoming analog signal which will be used to scale the data values. This value represents the weakest signal corresponding to the incoming 4mA signal. For example, enter the value corresponding to the lowest depth reading for a DEPTH_A1 input.
- **Max Value** Input the maximum value for the incoming analog signal which will be used to scale the data values. This value represents the strongest signal corresponding to the incoming 20mA signal. For example, enter the value corresponding to the highest depth reading for a depth (DEPTH_A1) input.

The monitor temporarily stores all incoming analog input readings which occur between each monitor storage interval.

- **Average** Select this checkbox to store the analog input signal value as an average of all analog input readings since the last monitor storage interval. If this checkbox is not selected, the stored analog input value (when the **Store Data** checkbox is selected) will be the most recent analog input reading. *Checkbox is selected by default.*
- **Store Data** Select this checkbox when to store the analog input to the monitor memory at the monitor's storage interval. (This value is *averaged* or *actual* value depending on whether the **Average** checkbox is selected.) *Checkbox is selected by default.*
- **Store Min** Choose this checkbox to store the lowest analog input reading which occurs within each sample interval as the MIN_A1 data entity. *Checkbox is selected by default.*
- **Store Max** Choose this checkbox to store the highest analog input reading which occurs within each sample interval as the MAX_A1 data entity. *Checkbox is selected by default.*
- **Store Avg** Select this checkbox to store an averaged value of the analog input signal as the AVG_A1 data entity. *Checkbox is selected by default.*

Analog Output 1 (2) Configure the following values for each analog output device (maximum of two) connected to the XIO device.

- **Entity** Select the data entity whose value you want the XIO device to output as an analog signal. While the list contains all entities, choose only those entities which the monitor is currently generating.
- **Min Value** Enter the data value (for the selected entity) which will correspond to the weakest analog output signal. The **Min Value** will be used to translate actual data into analog output signals and should correspond to the lowest possible entity value (weakest) in the scale (4mA).
- **Max Value** Enter the data value (for the selected entity) which will correspond to the strongest analog output signal. The **Max Value** will be used to translate actual data values into analog output signals and should correspond to the highest possible entity value (strongest) in the scale (20mA).
- **Manual** Enter the value to use when manually testing the analog output signal. *This value will be used with the **Enable Manual** checkbox for testing the analog output signal.*

Important: Be sure to activate the monitor after changing the **Manual** or **Enable Manual** parameter in order for the new parameter to take effect.

- **Enable Manual** Select this checkbox when you want to manually test the analog output signal to output the value designated in the **Manual** field.

Digital Input 1 (2) Configure the following values for each digital input device (maximum of two) connected to the XIO device.

- **Entity** Select **DI1 (DI2)** from the drop-down list to enable the associated digital input device connected to the **XIO** device.
- **Store Data** Select this checkbox to store the *most current* digital input value (0 or 1) at each monitor wakeup to the monitor as DI1 (DI2). Digital input channels are scanned continuously, however, only the most current input signal is stored at the monitor sample interval.

Digital Output 1 (2) Configure the parameter for the **Digital Output** device.

Entity Choose the corresponding MLI event to which you want to relay (output) the current status to a digital device. The current event status will be updated and output at each monitor sample interval.

Activating the Monitor

Note: ADS recommends the initial **TRITON+** monitor activation be performed in the office prior to installing the monitor in the field. Attach the wireless antenna before attempting to connect wirelessly with the **TRITON+**. Once the activation is successful, leave the wireless antenna attached during transport to the field.

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 **Qstart^{XML}** software, downloading this data to the monitor, and initiating flow data measurement and logging. The activation data includes relevant portions of the XML 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.

Activate the monitor in the following way:

1. Attach the wireless antenna to the monitor.
2. Select the monitor you want to activate from the **Location Name** drop-down list in the **Monitor** section on the ADS **Qstart^{XML}** dialog.
3. Verify that the configuration parameters and **Connect** type for the monitor and monitoring point are correct and make modifications, as necessary. The initial monitor activation (or an activation which follows a *deactivation*) must be performed using the **SERIAL** communication.
4. Click on the **Activate** button in the **Functions** section.

*The computer connects to the monitor and downloads the appropriate information and files. Once activation is complete, the status bar reads **Activate successful**.*

5. Continue with other activities that require communication with the monitor or disconnect from the monitor by clicking on the green **Hangup** button in the **Functions** section. If applicable to the connection type, consider checking the monitor status to verify the monitor is active and the data storage interval reflects the sample rate selected for the monitor.

Important Note: When installing a **TRITON+** monitor with an AV|Gated, AV|Max, ParaDepth or ParaFlow sensor, the next step after the monitor activation and sensor installation is to verify the sensor is installed properly with a *Sensor Rotation* and *Sensor Slope* of no more than +/- 5 degrees. The closer the *Rotation* and *Slope* are to zero, the better. Proceed to *Running Sensor Diagnostics* on page 4-52 for more details.

Qstart^{XML} generates a log entry of the activation event which is available for viewing through the log viewer in **Qstart^{XML}**.

Setting Up the RTU to Retrieve the Current Data through Modbus

Following monitor activation, you must program the RTU with the appropriate Modbus register addresses corresponding to the current entity and monitor data you want to retrieve from the monitor. ADS also recommends verifying that the RTU is retrieving the desired output data shortly following monitor activation.

Note: The Telog Ru-33/Ru-35 does not require programming with the Modbus register addresses to ensure it retrieves the correct data. However, consider verifying whether the Telog unit is successfully retrieving data following monitor activation and Telog connection.

Designating the Data for Retrieval

Use the appropriate software application supporting the RTU to designate the entity and monitor data you want the unit to retrieve for the SCADA or other process control system. Refer to *Chapter 9, Modbus*, to view the entity and monitor data available for retrieval and to determine the associated register addresses required for obtaining the selected data.

Verifying the Modbus Output Data

Perform the following to verify the accuracy of the Modbus output values, when applicable:

1. Verify that the monitor has been activated, the RTU has been programmed to retrieve the desired data, and the applicable Modbus application has been launched.
2. Allow the **TRITON+** monitor to log data for an appropriate amount of time to obtain an adequate amount of data. Please note the interval at which the monitor takes readings for Modbus output is based on the *Scan* rate.
3. Collect the data from the monitor. Refer to *Collecting Data from the Monitor* on page 4-57 for detailed instructions.
4. Compare the data collected from the monitor to the output values obtained through Modbus. The data collected through **Qstart^{XML}** reflects an average of the readings taken over a specific interval; the values retrieved through the Modbus interface represent the current (*persistent*) data in the monitor from the last interval (*readings*). Therefore, the values compared may not be exactly the same, but should be similar.

Running Sensor Diagnostics

Qstart^{XML}'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 depth, velocity, and pressure sensors. Run diagnostics for the system sensors in the following way:

Note: Device diagnostics for **TRITON+** monitors equipped with SIMs with dynamic IP addresses is only available when connected serially.

Perform diagnostics on a device in the following way:

1. Select the monitor for which you want to run diagnostics on a sensor from the **Location Name** field in the **Monitor** section on the **ADS Qstart^{XML}** dialog.
2. Click on the **Connect** button in the **Functions** section.

***Qstart^{XML}** initiates and establishes communication with the monitor. The status bar displays **Ready** once a connection has been successfully made.*

3. Select the **Monitoring Point 1** or **Monitoring Point 2** tab which contains the device you want to diagnose.
4. Select the device representing the individual sensor(s) on which you want to perform diagnostics from the **Devices** list.
5. Click on the **View** button.

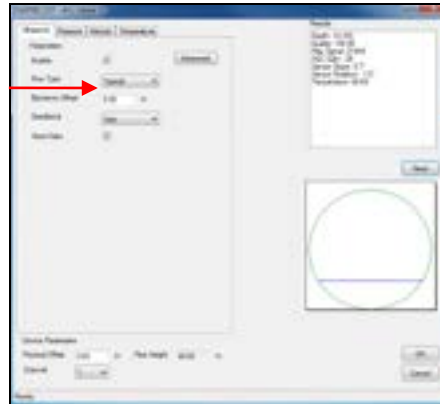
The device dialog corresponding to the selected device displays.

6. When applicable, click on the tab corresponding to the particular sensor on which you want to run diagnostics.
7. Click on the **Read** button below the **Results** window.

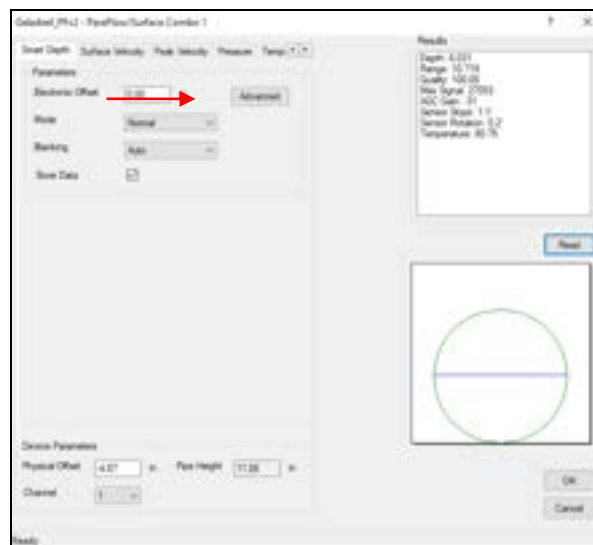
*The monitor takes the sensor measurements and displays the readings in the **Results** window. The results may include the specific reading (e.g., depth or velocity), the quality of the reading, the maximum signal strength, and the temperature. When taking depth measurements, the dialog also displays a cross section of the pipe, offering a visual perspective of the depth of the flow.*

Note: Pressure depth readings compensate for the physical and electronic offsets, and the *Automatic Pressure Calibration* value (PRESSK and PRESSK2).

Note: After an AV|Gated, AV|Max, ParaDepth or ParaFlow sensor installation, the sensors must be verified as being properly installed within the +/- 5 degrees from the bottom center of the pipe. Following the monitor activation, get online with the monitor, select the AV|Gated or AV|Max/Peak Combo **Ultrasonic** tab or the **Smart Depth** tab for the ParaDepth or ParaFlow sensor and **Read**. Once the values display in the **Results**, review the **Sensor Slope** and **Sensor Rotation** values and determine if they are within +/- 5 degrees of 0 (as in the following picture). Strive to have **Sensor Slope** and **Sensor Rotation** as close to 0 degrees as possible.



Review the AV|Gated or AV|Max Ultrasonic **Sensor Slope** and **Sensor Rotation** values



Review the ParaDepth or ParaFlow **Sensor Slope** and **Sensor Rotation** values

8. Verify the accuracy, consistency, and quality of the readings, and then edit the corresponding device parameters as necessary.
 9. (optional) Repeat steps 3 through 10 for every other sensor on the device dialog on which you want to run diagnostics.
 10. Click on the **OK** button once you are finished running diagnostics for all the appropriate sensors corresponding to the current device. This saves any changes made to the parameters to the local directory or network. Clicking on the **Cancel** button closes the device dialog without saving any parameter modifications.
 11. If any changes have been made to *any* of the device parameters, you *must* reactivate the monitor by clicking on the **Activate** button in the **Functions** section.
- Note:** There is no need to reactivate a monitor if there were no parameter changes!
12. Once activation is complete, the status bar displays **Activate successful**.
 13. Click on the **Hangup** button in the **Functions** section when you are finished running diagnostics on sensors associated with the current monitor.
 14. Click on the **Save** button to save any changes in the device parameters to the local directory or network.
 15. **Qstart^{XML}** generates a log entry for each user-initiated diagnostic reading taken by the monitor that includes the sensor fired, date and time at which the measurement was taken, current device parameters

corresponding to the sensor, and readings and associated results. This entry (or entries) are available for viewing through the log viewer in **Qstart^{XML}**.

Performing Confirmations

Confirmations allow you to compare measurements taken by the sensors to measurements taken manually in the field. These comparisons help to verify that the sensors are functioning properly and determine whether specific device parameters may require modification.

Note: Confirmations for **TRITON+** monitors equipped with SIMs with dynamic IP addresses must be performed serially.

Confirmation Screen

Confirm the sensors in the following way:

1. Select the monitor for which you want to perform confirmations from the **Location Name** field in the **Monitor** section on the **ADS Qstart^{XML}** dialog.
2. Select the device with the sensor(s) you want to confirm from the **Devices** list.
3. Click on the **Confirm** button on the **Monitoring Point** tab.

Qstart^{XML} establishes a connection with the monitor and displays the **Confirm Device** dialog.

4. Select the point of reference from which to compare manual depth to the actual sensor readings from the drop-down list in the **Field Measurement** section.
 - ☐ **DOF** Represents the depth of the flow from the bottom of the pipe to the flow surface.
 - ☐ **Air DOF Crown** Represents the distance (or *range*) from the top (or *crown*) of the pipe to the flow surface.
 - ☐ **Air DOF Bat** Represents the distance (or *range*) from the ultrasonic depth sensor face (crystal surface) to the flow surface.
5. Enter the distance measured manually from the bottom of the pipe to the flow surface in the **Depth** field or the range from the pipe crown/sensor face (as applicable) to the flow surface in the **Range** field. The measurement perspective depends on the option selected in step 4. Enter any estimated deviation corresponding to the measurement in the **+/-** field.
6. Enter the velocity of the flow measured manually using a portable velocity meter in the **Velocity** field.
7. Enter the initials or designation for the field personnel in the **Crew** field.

8. As applicable, enter the Velocity Profile information. The average velocity will be automatically calculated by **Qstart^{XML}**.
9. Enter any information corresponding to the field measurements, the flow conditions, or location that may be relevant to the confirmations in the **Comments** field.
10. Click on the **Read** button to prompt the monitor to take depth and velocity measurements.

*The **Monitor Measurement** section displays the depth and velocity readings taken by the monitor.*

11. Compare the manual field measurements to the sensor readings. If a difference exists between the manual depth measurements and the depth sensor measurements, you can compensate for this difference by editing the *electronic offset* parameter for the appropriate depth sensor. Consider applying this offset to ensure the monitor produces the most accurate data. Use the following equation to determine the electronic offset:

$$\text{Field Depth} = \text{Sensor Depth} + \text{Electronic Offset}$$

12. If the sensor reading is *low*, add a *positive* (+) electronic offset.
13. If the sensor reading is *high*, add a *negative* (-) electronic offset.

Note: Exercise caution when applying an electronic offset. Use an offset only when you are confident in the accuracy and reliability of the manual measurements and physical offset of the sensor.

If a difference exists between the manual velocity measurements and the velocity sensor measurements, you can compensate for this difference by adjusting certain velocity sensor parameters, particularly Maximum Velocity and Sensitivity.

Note: If you change a device parameter, such as an electronic offset, you must reactivate the monitor.

14. (optional) Click on the **Read** button again to take additional measurements, if necessary.
15. Click on the **Close** button once you are finished performing confirmations for the selected device to exit the **Confirm Device** dialog.
16. Repeat steps 2 through 12 for each additional device that includes a sensor(s) you want to confirm.

Note: If the location supports a second monitoring point, remember to confirm the devices assigned to that monitoring point, as necessary.

17. If a change has been made to any sensor parameter, reactivate the monitor. See page 4-50 for more information on reactivating a monitor. **If you didn't change any device parameters, there is no need to reactivate the monitor.**
18. Click on the green **Hangup** button in the **Functions** section to disconnect from the monitor.

Qstart^{XML} generates a log entry of the confirmation activity, which includes the field and monitor readings, the name of the crew, and any associated comments, and saves it to the local directory or network. It also generates a log entry for each user-initiated reading taken by the monitor that includes the sensor fired, date and time at which the measurement was taken, current device parameters corresponding to the sensor, and reading and associated quality. These entries are available for viewing through the log viewer in **Qstart^{XML}**.

Collecting Data from the Monitor

Collect data from a monitor in the following way:

1. Select the monitor from which you want to collect data from the **Location Name** drop-down list in the **Monitor** section on the **ADS Qstart^{XML}** dialog.
2. Click on the **Collect** button in the **Functions** section.

*The **Collect Span** dialog displays for designating the date/time range for which you want to collect the data.*

3. Designate the date and time from which you want to begin collecting data from the monitor in the **Start** field. **Qstart^{XML}** defaults to a start date and time of one second past the last data point stored in the local directory or network for the current location. To edit a particular value in the **Start** date or time field, select the value and enter a new value *or* use the up/down arrows to advance through the numbers until you reach the desired value.
4. Designate the date and time up to which you want to collect data from the monitor in the **End** field. The end date and time in **Qstart^{XML}** default to the date and time on the local computer. To edit a particular value in the corresponding date or time, select the value and enter a new value *or* use the up/down arrows to advance through the numbers until you reach the desired value.
5. Click on the **OK** button.

***Qstart^{XML}** establishes communication with the monitor and initiates the data collection process. Refer to the status bar on the dialog to monitor the progress of the collect. The **View Data** dialog displays when data collection is complete.*

Note: You can discontinue the data collection process at any time by clicking on the **Abort** button.

6. View the data in tabular and graphical format on the **View Data** dialog. Modify the graph based on the time period and entities in the following ways:
7. Select the amount of data you want to display on the graph at one time by selecting the appropriate option from the **Report Type** drop-down list (**All**, **Day**, **Week**, or **Month**).
8. Limit the entities that display on the graph by clicking on the **Entities** button, selecting the entities you want to display, and clicking on the **OK** button. To select multiple entities, press and hold down the Control (**Ctrl**) key while selecting the individual entities. To choose consecutive entities in the list, select the first entity you want to display, press and hold down the **Shift** key, and then click on the last entity you want to include.
9. Zoom in on a particular portion of data on the graph by selecting the **Zoom** option from the **Report Type** drop-down list, clicking and dragging from the top left boundary of the data you want to view on the graph to the bottom right boundary of the data, and then releasing.
10. Use the scroll bars on the table to navigate to the specific data you want to view. Sort the data in the table by clicking on the heading corresponding to the data you want to sort. Clicking on the **DateTime** heading enables you to switch between viewing the most recent and the oldest data collected from the monitor. Clicking on an entity heading allows you to switch between viewing the readings in descending order (beginning with the highest value) and in ascending order (beginning with the lowest value).
11. Close the **View Data** dialog when you are finished viewing the data by clicking on the red  button at the top right corner of the dialog.
12. Click on the green **Hangup** button in the **Functions** section to discontinue communication with the monitor.

Qstart^{XML} generates a collect log entry corresponding to the data collect activity that includes a summary of the details associated with the collect and general monitor status information at the time of the collect. You can view the contents of the entry through the log viewer in **Qstart^{XML}**.

Upgrading the Monitor Firmware

Qstart^{XML} enables you to download updated firmware to the monitor that may include new monitor or device features and capabilities or performance improvements.

Upgrade the firmware in the monitor in the following way:

Note: ADS recommends collecting the monitor data *before* performing a firmware upgrade.

1. Select the monitor for which you want to upgrade the firmware from the Location Name field in the **Monitor** section on the **ADS Qstart^{XML}** dialog.
2. Click on the **Upgrade** button in the **Functions** section.

*The **Open** dialog displays.*

3. Browse to the firmware file and then click on the **Open** button.

***Qstart^{XML}** initiates and establishes communication with the selected monitor and downloads the new firmware to the monitor. The status bar indicates when the download is complete.*

4. Once the firmware download is complete, click on the green **Hangup** button in the **Functions** section to discontinue communication with the monitor.
5. Wait at least 30 seconds, and then click on the **Activate** button.

*The computer reconnects to the monitor and downloads the appropriate information and files. Once activation has completed, the status bar displays **Activate successful**.*

6. Click on the **Hangup** button to disconnect from the monitor.

***Qstart^{XML}** generates a log entry of the firmware upgrade that documents the date and time at which the upgrade occurred, the result (success or failure), the previous version of the firmware, and the name of the file downloaded during the upgrade.*

Viewing Diagnostic and Data Logs

The local directory or network contains detailed diagnostic, status, and data logs corresponding to many activities performed involving the monitor and sensors such as activation, data collection, firmware downloads, sensor diagnostics and confirmations. These logs are available immediately following the activity and for future access to historical information.

View a log(s) corresponding to a monitor location in the following way:

1. Select the location for which you want to view a log from the **Location Name** drop-down list in the **Monitor** section on the **ADS Qstart^{XML}** dialog.

2. Click on the **Logs** button in the **Functions** section.

The [location name]-Logs dialog displays.

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

*The **Logs** list box displays all the logs available in the local directory or network for the selected location and log type.*

4. Select the date and time corresponding to the log you want to view from the **Logs** box.

5. Click on the **View** button.

The selected log displays in printable format.

6. (optional) Click on the **Print** button to print the contents of the log file.

7. Repeat steps 3 through 6 for each additional log you want to view and/or print for the selected monitor location.

8. Click on the close button to exit the window.

CHAPTER 5

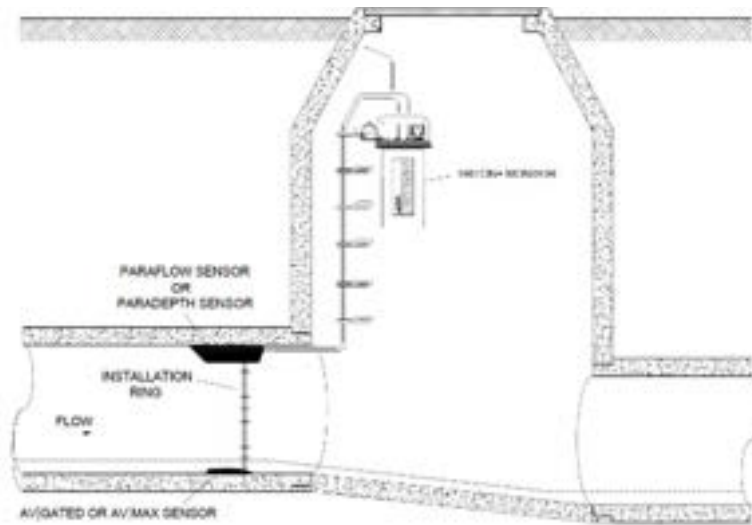
Sensor Installation and Connection

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

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 **TRITON**+ monitor and sensors at a location:

- **Investigate the Site Characteristics** These characteristics include pipe size and shape, silt level, flow depth, and hydraulic conditions.
- **Prepare the Equipment for Installation** The monitor, communication system, and sensors must be prepared and initialized for installation (*See Chapters 3 and 4 for communication and initial monitor setup*).
- **Install the Sensors in the Pipe** This process primarily includes assembling the ring (for standard installations) or preparing the bands to which the sensors attach, mounting the sensors to the ring or bands, securing the sensor cables to the ring or bands, and installing the ring or bands in the pipe.
- **Install the Long Range Depth Sensor in the Manhole Structure** This process involves installing the Mounting Bar near the top of the manhole, attaching the Long Range Depth Sensor to the Mounting Bar, and affixing the Submersion Sensor to the manhole frame.
- **Install the ParaDepth or ParaFlow Sensor in the Manhole using the ADS Topside Retrieval System** This process involves installing a Mounting Bracket in the manhole, installing the sensor on the Sensor Bracket, seating the Sensor Bracket on the Mounting Bracket. Once installed, the sensor can be retrieved topside using the Topside Retrieval Tool that comes as part of the Topside Retrieval System.
- **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 **TRITON**+ monitor. It also includes general instructions for connecting a third-party water quality sampler to the monitor.



Typical **TRITON+** flow monitor and sensor installation

This chapter contains instructions for properly installing the sensors in sanitary, storm, and combined sewer lines and manholes.

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.

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:

- **Relatively 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 surfaces and off-center peak flow velocities. However, please note that a limited degree of roughness in the flow is necessary to ensure the sensor signal can adequately reflect off the flow surface.
- **Absence of Significant Silt Buildup at Pipe Bottom** Silt present at an otherwise favorable site must be accounted for to obtain accurate flow measurements. The sensor may require positioning up the side of the pipe to ensure it remains out of the silt. (*Refer to Installing the Ring in the Pipe on page 5-17.*)
- **No 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 if mounting the sensors in the pipe to measure flow rate.
- **Relatively Quiet Pipe** A monitoring point in a pipe experiencing loud noises, such as active drop connections, can adversely affect the accuracy of air 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. This will increase sensor maintenance and possibly reduce data accuracy.

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 to employ for installing the sensors.
 - ☐ **Standard Installation** Select this option to install sensors in *round* pipes from 8 inches (200 mm) to 48 inches (1219 mm) in diameter. Standard installations involve attaching sensors to an adjustable stainless steel ring that mounts inside the pipe.
 - ☐ **Special Installation in the Pipe** Select this option to install sensors in *non-round pipes or round pipes larger than 48 inches (1219 mm) in diameter*. Special installations involve attaching sensors to steel bands secured to the inside of the pipe.
 - ☐ **Installation in the Manhole Structure** Select this option to install the Long Range Depth Sensor, the ParaDepth Sensor, the ParaFlow Sensor, the Surface Combo Sensor, or the Ultrasonic Depth Sensor in the manhole structure. This installation involves installing the Long Range Depth Sensor on a mounting bar near the top of the manhole or installing the ParaDepth, ParaFlow, Surface Combo, or Ultrasonic Depth Sensors on a special bracket positioned above the crown of the pipe on the manhole wall.

- **Pipe Height and Width** Measure and record the horizontal and vertical pipe dimensions carefully. Inaccurate pipe measurements—even slightly inaccurate measurements--can 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, irregularly shaped pipes will require additional measurements. Refer to the **Qstart^{XML}** online help for more information.

Note: All relevant pipe dimensions and measurements are required for entry in the **Qstart^{XML}** software during monitor configuration and activation. The software primarily requires pipe shape, height, and width during these activities.

- **Manhole Depth** Measure the distance from the rim to the manhole invert. Distances beyond 30 feet could require extension cables for the ParaDepth, ParaFlow, Peak Combo, Smart Depth and Surface Combo sensors. *See Appendix B.*

Installing the Sensors in the Pipe

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

- Standard Installations
- Special Installations

Note: When installing a monitor with wireless communications, it is very important to test the **TRITON+** with the SIM card installed to ensure the *entire system* functions and to verify network quality of service before installation. This check should be done *before* field deployment and again at the monitoring site before installing the monitor. Refer to *Chapter 3, Communication*, for more information.

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 **TRITON+** flow monitor installation hardware for ring mounting. In addition, please indicate the type of mounting hardware desired for mounting the monitor: *mounting bracket* (wall/rim mount) or *hook* (rung mount).

Quantity	Description	ADS P/N
1	TRITON+ flow monitor (<i>battery or externally-powered</i>)	8000-FST-IM-4WW-XXX , 8000-FST-IM-EP-4WW-XXX
1	Monitor mounting bracket/flange (<i>for mounting monitor to manhole rim or wall</i>)	I40-0009
3	Monitor mounting bracket bolt, hex, SS, M8 x 30mm	508058
3	Monitor mounting bracket washer, flat, SS	517-8001254-00
3	Monitor mounting bracket washer, split lock, SS	517-8001274-00
1 as needed	Hook, SS, 2-piece w/ hardware (<i>for hanging monitor on manhole rung; Alternative to ADS p/n I40-0009</i>)	8000-0021
1 as needed	Bracket, mounting, sliding, for ParaDepth, ParaFlow, Surface Combo or Ultrasonic Depth Sensors (mounting plate)	8000-0307-02
1 as needed	KIT, SYSTEM, MOUNTING BRACKETS, TOP-SIDE (includes Mounting Hardware Kit)	8000-0655-A
1 as needed	Tool, Retrieval, Extendable, 4-Section, Aluminum (part of the Topside Retrieval System for ParaDepth and ParaFlow Sensors)	8000-0654
1 as needed	Adapter, Silt Mount for AV Gated, AV Max or Peak Combo Sensors	8000-0271

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Quantity	Description	ADS P/N
1	Stainless steel ring (sized for pipe)	I25-0081 to 0094 <i>See Appendix B</i>
Up to 2 (1 per monitoring point)	AV Gated Sensor – upward ultrasonic depth sensor, surcharge pressure depth sensor, gated velocity sensor and water temperature sensor	8K-CS7-10-35 (35-ft./10.6-m or 100-ft./30.5-m cable)
Up to 2 (1 per monitoring point)	AV Max Sensor – upward ultrasonic depth, sensor, pressure depth sensor, peak velocity sensor, and water temperature sensor	8K-CS9-10-35 (35-ft./10.6-m or 100-ft./30.5-m cable)
1 as needed	Inclinometer - Angle/Tilt sensor installed on flood gates or other components where angle of change is needed	8000-0528
1 as needed	Long Range Depth Sensor – downward ultrasonic depth sensor typically installed near top of manhole structure	8K-CS6-C1-10 (10-ft/3.05-m cable)
Up to 2 (1 per monitoring point)	ParaDepth Sensor – downward ultrasonic depth sensor and air temperature sensor	8K-CS8-D1-00-30-IS (30-ft/9.1-m or 100-ft/30.5-m cable)
Up to 2 (1 per monitoring point)	ParaFlow Sensor – downward ultrasonic depth sensor, surcharge pressure depth sensor, surface velocity sensor, surcharge velocity sensor and air temperature sensor	8K-CS8-V2-10-30-IS (30-ft/9.1-m or 100-ft/30.5-m cable)
Up to 2 (1 per monitoring point)	Peak Combo Sensor – upward ultrasonic depth sensor, pressure depth sensor, peak velocity sensor and water temperature sensor	8K-CS4-xx-35/1H (35-ft./10.6-m or 100-ft./30.5-m cable) ²
Up to 2 (1 per monitoring point)	Surface Combo Sensor – downward ultrasonic depth sensor, surcharge pressure depth sensor, surface velocity sensor, surcharge peak velocity sensor, and air temperature sensor	8K-CS5-V2-xx-30/1H (30-ft./9.1-m or 100-ft./30.5-m cable) ²
1 as needed	IS standard or custom sensor extension cable for Ultrasonic Depth Sensor	8000-0023-xxx ³
1 as needed	IS Standard or Custom Sensor Extension Cable for Peak Combo and Surface Combo Sensors	8000-0025-xxx ³
as needed	¼- × 2 ¼-in. stainless steel anchor bolts w/ nut and washer	
1	3/8-inch x 3-inch stainless steel anchor bolt and nut	
1	Replacement dryer tube	3704-0032
1	IS PC communication USB Serial Cable	8000-0337
1	Antenna for wireless communication	9000-0096
1 as needed	Magnet (<i>for activating diagnostic codes in the monitor through the LED STATUS window</i>)	8000-0460
1 as needed	External Power and Communications Unit (ExPAC)	8000-0377
1 as needed	24V DC power supply	508293
1 as needed	External Modbus Interface Unit (XBUS)	8000-0427
1 as needed	External Input and Output Device (XIO)	8000-0400
1 as needed	External power/communications cable (<i>from ExPAC to monitor</i>)	8000-0378-xxx ⁴

Quantity	Description	ADS P/N
1 as needed	External power grounding kit <i>(also used to convert a battery-powered TRITON+ monitor to external power)</i>	8000-0434-xxx ⁴
1 as needed	Sampler cable <i>(for flow proportional sampling)</i>	8000-0348-01
1 as needed	Sampler cable <i>(for level activation sampling)</i>	8000-0348-02
4	M3 x 10mm flat head machine screw	507820
15	Plastic push mounts	
1	3/8-in. – 16 thread. X 2-in. (10mm x 55mm x 1.5mm thread) stainless steel stud	
1	3/8 in. – 16 thread (10mm x 1.5mm thread) stainless steel nut	
As needed	3/8 in. (10mm) stainless washer	
15	11-in. (5mm x 300mm) cable ties	
25	4-in. (2mm x 100mm) cable ties	
15	8-in. (4mm x 200mm) cable ties	
15	¼-in. (7mm x 400mm) anchor cable ties	

¹ Models 8000-FST-IM-4WW-XXX include the 12-volt battery pack; Models 8000-FST-IM-EP-4WW-XXX *(for external power)* do not include the battery pack.

² IS pressure depth transducers (indicated by —xx- in the part number) are available in Peak Combo Sensors and Surface Combo Sensors in 0 — 5 psi (0 — 0.34 Bar), 0 — 15 psi (0 — 1.03 Bar), and 0 — 30 psi (0 — 2.07 Bar) pressure ranges. Example: a Peak Combo Sensor with a 0 — 15 psi (0 — 1.03 Bar) pressure transducer would be specified in psi: **8K-CS4-15-35**.

³ Extension cables can be ordered to specific lengths up to 300 ft. (91m). Note the desired length *(in feet)* in the —xxx portion of the part number. **Standard** lengths are 10 ft. (3.0m), 25 ft. (7.6m), 50 ft. (15.2m), 75 ft. (22.8m), 100 ft. (30.5m), 125 ft. (38.1m), 150 ft. (45.7m), and 200 ft. (61.0m). All other lengths must be custom ordered.

⁴ The external power/communications cable and the ground cable included in the external power grounding kit can be ordered to specific lengths up to 800 ft. (243m). Note the desired length *(in feet)* in the —xxx portion of the part number. Standard lengths are 10 ft. (3.0m), 25 ft. (7.6m), and 100 ft. (30.5m). All other lengths must be custom ordered.

Gathering Tools and Equipment

Gather the following tools for the installation:

- Battery-powered hammer drill with assorted bits – including the following at a minimum:
 - ☐ ¼-inch (6-mm) x 6-inch (150-mm) masonry bit
 - ☐ 3/8-inch(10-mm) x 4-inch (100-mm) [minimum length] masonry bit
 - ☐ 5/16-inch (8-mm) carbide-tipped bit
- Heavy 4-pound (1.5-Kg) hammer
- Rubber mallet
- 24-inch (610-mm) carpenter's level
- Nut driver or socket set (English plus 13-mm for canister hardware)
- Wrenches (English plus 13-mm for canister hardware)
- Screwdrivers (flathead and Phillips head of assorted sizes)
- Thread tap compatible with the thread spec on the monitor mounting stud (3/8-in. standard)
- Diagonal wire cutters
- Folding carpenter's rule with a brass slide

- Mastic tape (ADS p/n 507193) or rubber coaxial stretch tape

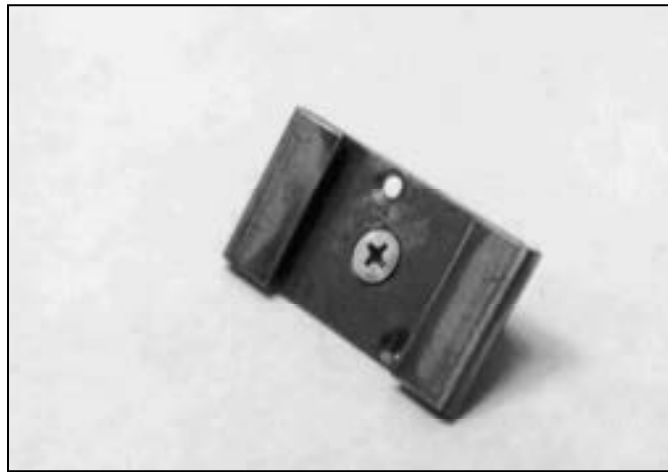
Assembling the Ring

The flow sensors mount to a stainless steel ring for installation in the pipe. Several different ring sizes exist, and each ring is adjustable within about 3 inches (76 mm) to fit pipes of different diameters.

Assemble the ring in the following way:

Note: These instructions generally apply to overlapping rings. However, the 6-inch (152-mm), 8-inch (178- to 211-mm), 10-inch (229- to 262-mm), and 12-inch (279 to 312-mm) rings do not have an overlapping section. Therefore, these non-overlapping rings will require small modifications during 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.



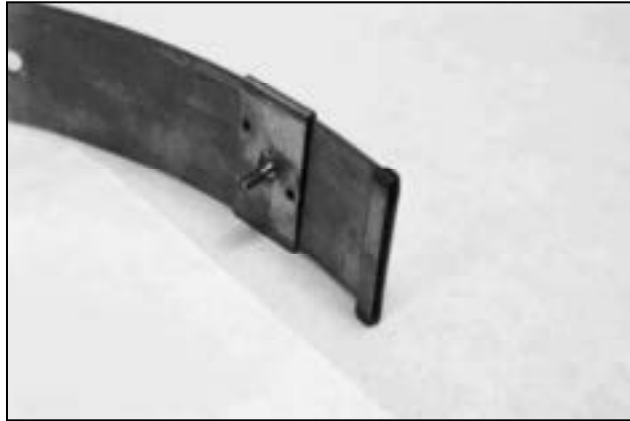
Ring stabilizer with spreader mechanism screw

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 (102 mm) from the welded metal band at the other end of the ring.



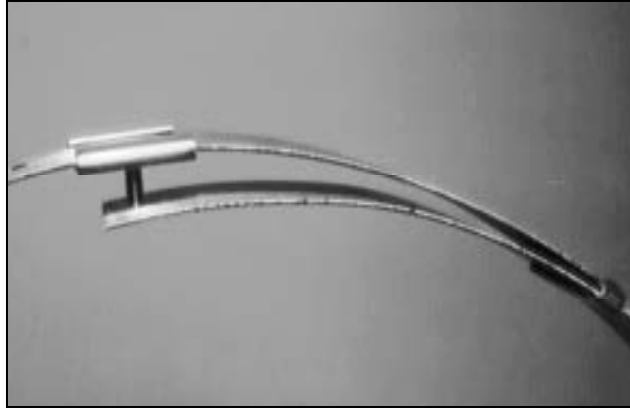
Moving the ring stabilizer into position

4. Position the ring with the downstream edge (edge with the holes) facing you.
5. Slide the ParaDepth/ParaFlow/Surface Combo/Ultrasonic Depth Sensor mounting plate onto the open end of the ring with the back of the mounting plate (side with the slots) facing the outside of the ring. The side with the keyholes should face the inside of the ring. The end of the plate with the keyholes should be extending out from the *upstream* edge of the ring (*opposite* the edge with the holes for securing the sensor cable).



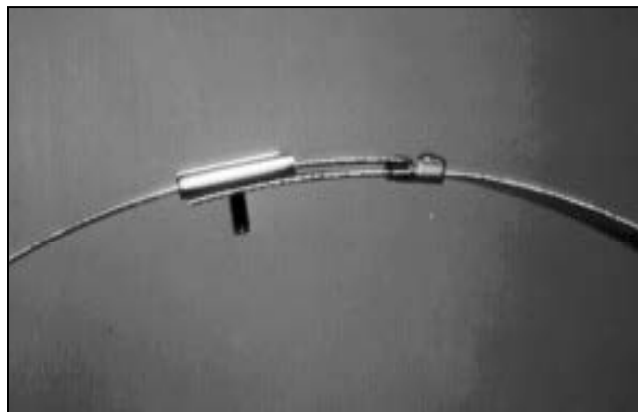
Sliding the Ultrasonic Depth Sensor mounting plate onto the ring, in the Surface Combo configuration

6. Move the sensor mounting plate 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 (102 mm).
 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

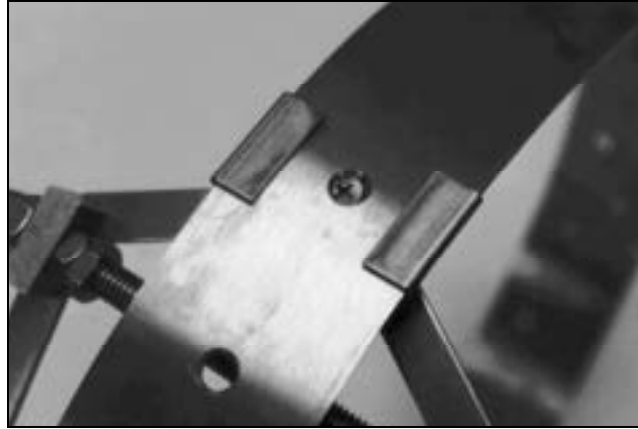
14. Place the upstream, left spreader bar onto the same screw.
15. Lightly turn the hex nut onto the screw, ensuring that it passes through the holes in the end of the spreader bar.

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.



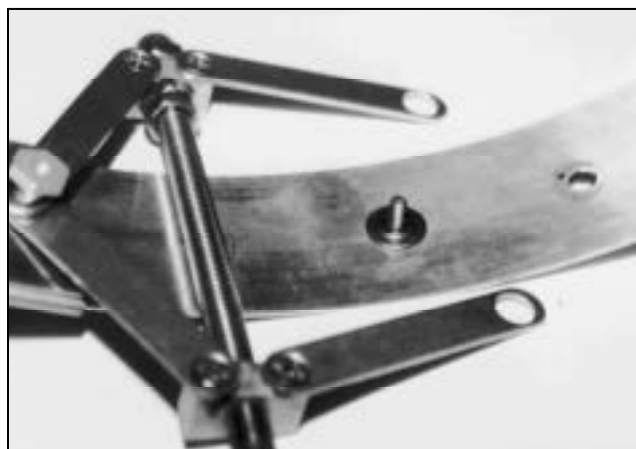
Aligning the screw head and adjustment hole

18. Tighten the screw through the hole using a Phillips-head screwdriver while holding the hex nut with a 0.5-inch (12-mm) nut driver.



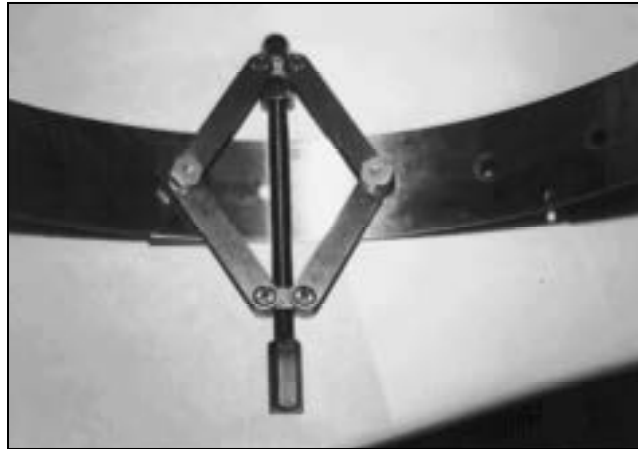
Tightening the spreader mechanism screw and hex nut

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 with the ultrasonic depth sensor mounting plate should look.



Properly attached spreader mechanism (with Ultrasonic Depth Sensor mounting plate on ring, configured for a Surface Combo)

Mounting the Sensors to the Ring

The following sections provide instructions on mounting the AV|Gated Sensor, the AV|Max Sensor and Peak Combo Sensor 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 upstream and viewing from the downstream edge of the ring, the sensors should be mounted on the ring in the following locations:

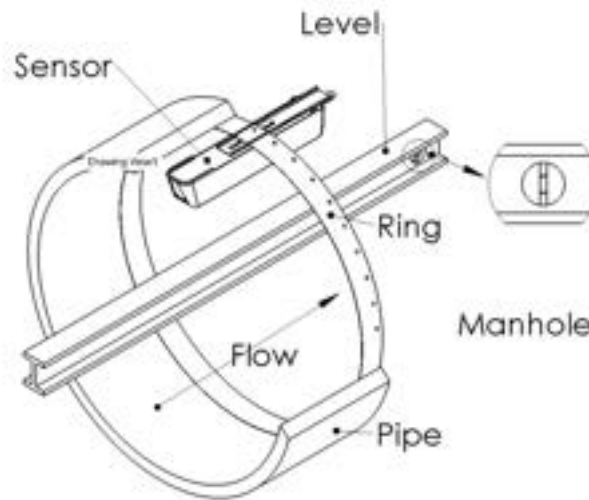
Important: If the only sensor to be installed on the ring is a single AV|Gated, AV|Max or Peak Combo, the sensor should be at the 6:00 position and the crank should be rotated left or right to the 10:00 or 2:00 position so as not to interfere with the Upward Ultrasonic reading during surcharge conditions.

- **AV|Gated Sensor** Mount the sensor as close as possible to the six o'clock position (bottom). *The sensor must be within +/- 5 degrees of the bottom center of the pipe.* AV|Gated sensors should not be installed in pipes with silt. If necessary, a *Silt Mount Adapter* can be used to mount the sensor 30 degrees up the left of the pipe (the 7:00 position) when a higher elevation is necessary. However, keep in mind that a physical offset measurement must be taken when mounting the sensor in any position outside the bottom of the pipe. Refer to *Installing the Ring in the Pipe* on page 5-17
- **AV|Max Sensor** Mount the 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.

To avoid silt, the AV|Max sensor can be rotated as much as 15 degrees up left side of the pipe without using a special mounting device. A *Silt Mount Adapter* can be used to mount the AV|Max sensor 30 degrees up the left side of the pipe (the 7:00 position) when a higher elevation is necessary. However, keep in mind that a physical offset measurement must be taken when mounting the sensor in any position outside the bottom of the pipe. Refer to *Installing the Ring in the Pipe* on page 5-17.

- **Peak Combo Sensor** Mount the 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.

A *Silt Mount Adapter* can be used to mount the sensor 30 degrees up the left side of the pipe (7:00 position) when a higher elevation is necessary. However, keep in mind that a physical offset measurement must be taken when mounting the sensor in any position outside the bottom of the pipe. Refer to *Installing the Ring in the Pipe* on page 5-17.



Proper positioning of sensors on the ring with Surface Combo, ParaDepth, or ParaFlow sensor at top. (AV|Gated, AV|Max or Peak Combo sensor would go at the bottom)

- **ParaDepth, ParaFlow, Surface Combo Sensor or Ultrasonic Depth Sensor** Mount the sensor at the twelve o'clock position (top of the pipe) with the spreader mechanism in the ten or two o'clock position.

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 AV|Gated, AV|Max or Peak Combo Sensors

Important: If the only sensor to be installed on the ring is a single AV|Gated, AV|Max or Peak Combo, the sensor should be at the 6:00 position and the crank should be rotated left or right to the 10:00 or 2:00 position so as not to interfere with the Upward Ultrasonic reading during surcharge conditions.

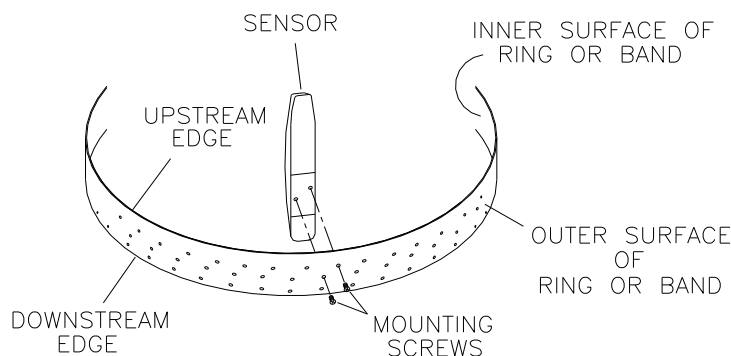
Mount the AV|Gated Sensor, the AV|Max Sensor, or the Peak Combo Sensor to the ring in the following way:

1. Use two M3 X 10mm stainless steel flathead screws (do not substitute any other screws) to attach the sensor at the bottom of the ring (opposite from the ParaDepth, ParaFlow or Surface Combo Sensor/Ultrasonic Depth Sensor).

- ☐ ADS recommends installing AV|Gated, AV|Max and the Peak Combo sensors within 5 degrees of the pipe centerline.

Important: If the AV|Gated, AV|Max or Peak Combo will be installed in pipes with very fast velocities or have potential for debris impact (a Combined Sewer Overflow), install the sensor with the blunt end facing downstream, preferably in the output pipe.

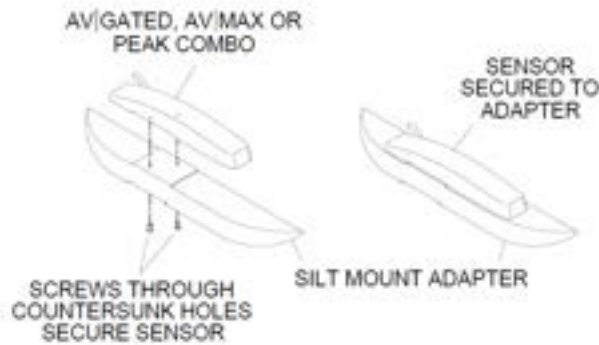
- ☐ The AV|Gated sensor must be installed within +/- 5 degrees from the bottom center of the pipe.



Mounting the AV|Gated, AV|Max or Peak Combo sensors to the ring

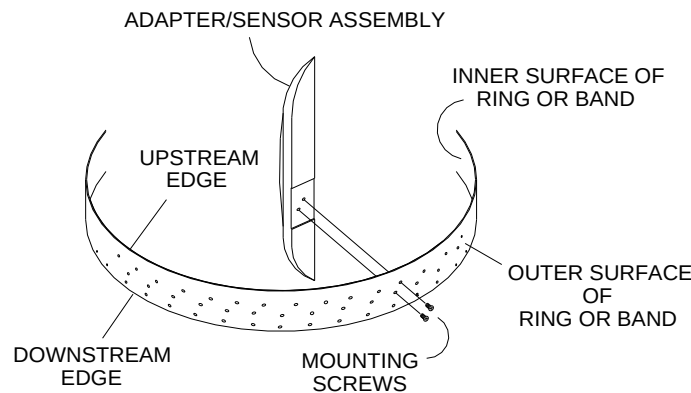
If the sensors require the use of a *Silt Mount Adapter* (ADS p/n 8000-0271) to install the sensor further up the left side of the pipe (up to 30 degrees) attach the AV|Gated, AV|Max or Peak Combo sensor to the ring in the following way:

- ☐ Seat the sensor onto the slightly elevated portion of the top of the Silt Mount Adapter. The elevated portion of the adapter should insert easily into the inset portion of the bottom of the sensor. Orient the sensor so that the sensor cable is exiting the sharp, or *wedged*, side of the adapter.
- ☐ From the bottom of the adapter, use two M3 X 10mm stainless steel flathead screws (*do not substitute any other screws*) to secure the sensor to the adapter. The pre-drilled screw holes in the adapter and in the bottom of the sensor should be in alignment if the sensor is seated properly on the adapter.



Properly seating and securing the AV|Gated/AV|Max/Peak Combo to the Silt Mount Adapter

- ❑ Use two M3 X 10mm stainless steel flathead screws (*do not substitute any other screws*) to secure the adapter to the ring at the appropriate location on the ring to ensure the sensor will be positioned at 30 degrees up the left side of the pipe and below the flow surface once installed. The nose of the sensor should be facing the same direction as the upstream edge of the ring.



Securing the AV|Gated, AV|Max or Peak Combo Sensor/Silt Mount Adapter assembly to the ring

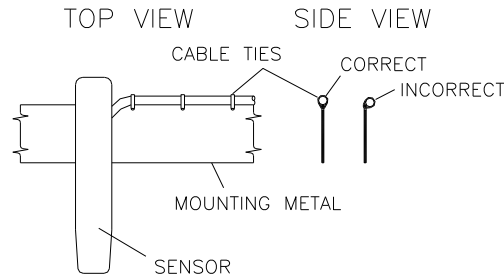
2. Orient the ring so that the ParaDepth, ParaFlow, Surface Combo sensor/Ultrasonic Depth sensor mounting plate is directly at the top. If no ParaDepth, ParaFlow, Surface Combo sensor or Ultrasonic Depth sensor will be used at the top of the pipe, make sure the spreader assembly is at the 2:00 or 10:00 position so as not to interfere with the underwater ultrasonic depth sensor reading in full pipe conditions.
3. Secure the sensor cable to the ring. Refer to *Securing the Cables to the Ring* on page 5-16 for instructions on properly securing the cable.

Securing the Cables to the Ring

Securing the AV|Gated, AV|Max or Peak Combo 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 cable in the following way:

1. Starting at the appropriate sensor location, begin securing the sensor cable with 4-inch (2-mm x 100-mm) 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 right side of the ring's downstream edge).



Sensor cabling

2. Continue securing the cables until reaching the ParaDepth, ParaFlow, Surface Combo sensor, Ultrasonic Depth sensor, or 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 sensor cable sheathes two components: the electrical cables that operate the sensor and an air tube that ventilates the pressure sensor (*when applicable*). Over-tightening the ties or kinking the cable can damage or restrict the air tube, causing erroneous 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.

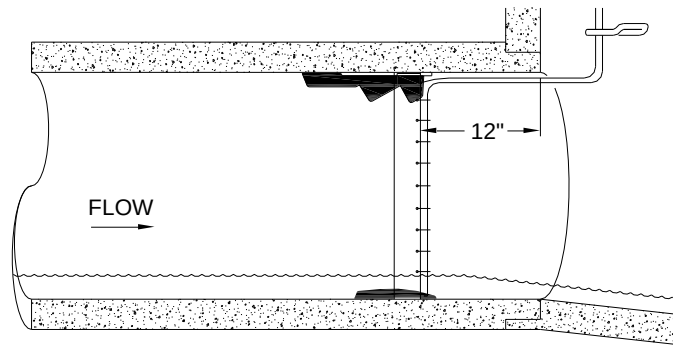
Mounting the ParaDepth, ParaFlow, Surface Combo Sensor or Ultrasonic Depth Sensor

The ParaDepth, ParaFlow Surface Combo/Ultrasonic Depth sensors are not mounted prior to installation of the ring. The ring mechanism and sensor mounting plate are assembled as detailed in *Assembling the Ring* beginning on page 5-8. After the ring is installed at the monitoring site, the sensor is inserted into the mounting plate and leveled (*as described in the following section*).

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:

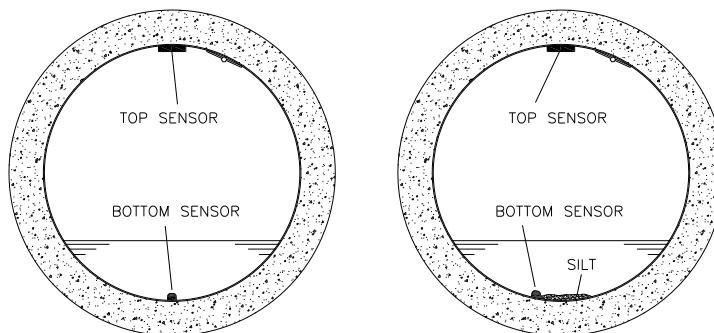
1. Examine the pipe for possible obstructions to the flow or inhibitors to ring installation.
2. Adjust the ring size to slightly less than the pipe diameter before placing the ring in the pipe by turning the spreader mechanism adjustment nut *clockwise* to *contract* it.
3. Place the ring in the input pipe *at least* 12 inches (305 mm) 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 (305 mm) upstream from the manhole invert

Keep the following in mind:

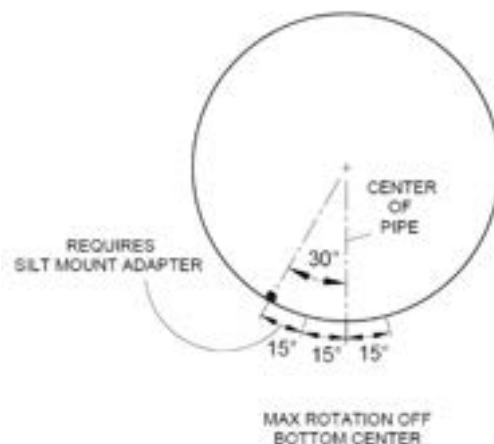
- ❑ The installed AV|Gated sensor must be positioned in the bottom, center of the pipe and **cannot exceed +/- 5 degrees from the 6:00 position**. If a greater rotation beyond +/- 5 degrees is needed, then a Silt Mount Adapter must be used. Install the AV|Gated sensor and then verify the sensor is correctly positioned. After activating the monitor, perform a Diagnostic reading on the AV|Gated Ultrasonic sensor and verify the **Sensor Slope** and **Sensor Rotation** values are not greater than 5.0. See *Chapter 4, Running Sensor Diagnostics* for more information.
- ❑ Be sure to mount the ParaDepth, ParaFlow, Surface Combo sensor/Ultrasonic Depth Sensor at the top (crown) of the pipe and to mount the AV|Gated, AV|Max, and Peak Combo sensors as close as possible to the bottom center of the pipe, *above* any silt present and *below* the flow surface (during minimum flows).



(Left) Proper orientation of the ring with the sensors in the pipe without silt present. (Right) Proper orientation of the ring with silt present (not applicable to AV|Gated). Note that the sensor mounting plate for the ParaDepth, ParaFlow and Surface Combo Sensor/Ultrasonic Depth Sensor is centered at the crown of the pipe and the crank spreader mechanism is offset to the side.

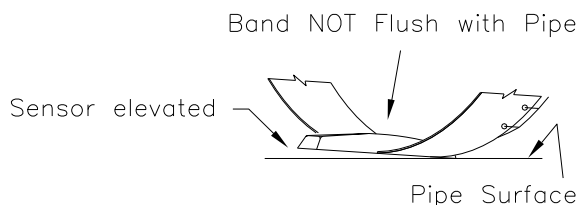
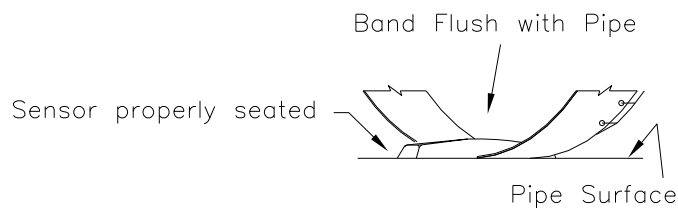
- ❑ The bottom sensors (AV|Max and Peak Combo) may be rotated off the bottom centerline up to 30 degrees up the left side of the pipe with the Silt Mount Adapter. For best performance, ADS recommends sensor rotation of less than 5 degrees when no adapter is used. After activating the monitor, perform a Diagnostic reading on the AV|Max Ultrasonic sensor and verify the **Sensor Slope** and **Sensor Rotation** values are not greater than 5.0. See *Chapter 4, Running Sensor Diagnostics* for more information. Rotating the sensor requires accurately measuring the physical offset.

Note: The Peak Combo sensor does not contain an Accelerometer to measure sensor slope and rotation. Its rotations will have to be estimated.

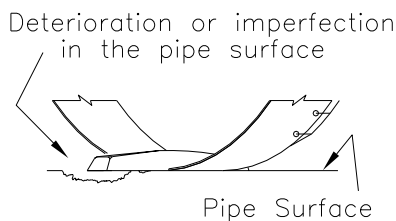


Rotating the AV|Max/Peak Combo sensor no more than 15 degrees up either side of the pipe or 30 degrees up the left side of the pipe using the Silt Mount Adaptor

- ❑ 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 surface of the pipe to avoid obstructing the flow or catching debris.
- ❑ Verify that the underwater sensor (with or without silt adapter) is flush with the pipe surface. Any elevation of the sensor or significant deterioration or imperfection in the pipe surface around the sensor can create an open space in which debris can become trapped. An elevated sensor also can misdirect the signal when taking measurements. These vulnerabilities can quickly result in potential damage or disruption to the sensor and/or erroneous data.



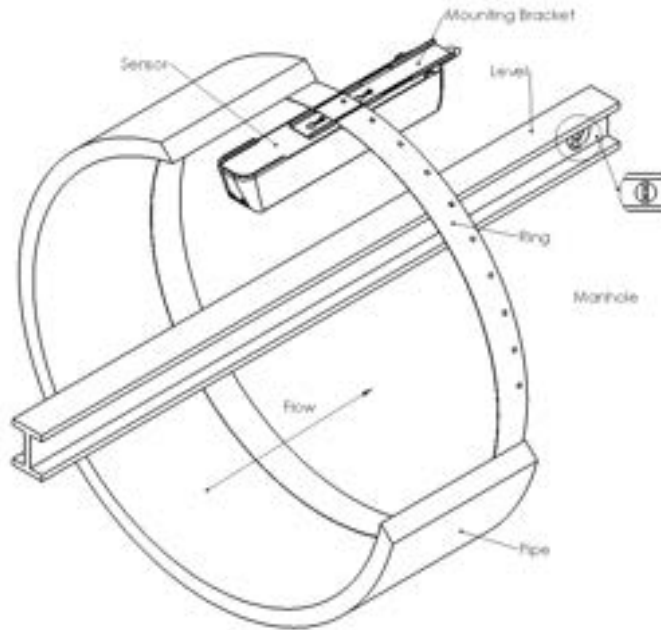
An elevated sensor provides a gap in which debris can collect



Deterioration in the pipe surface creates a space for debris to collect under the sensor

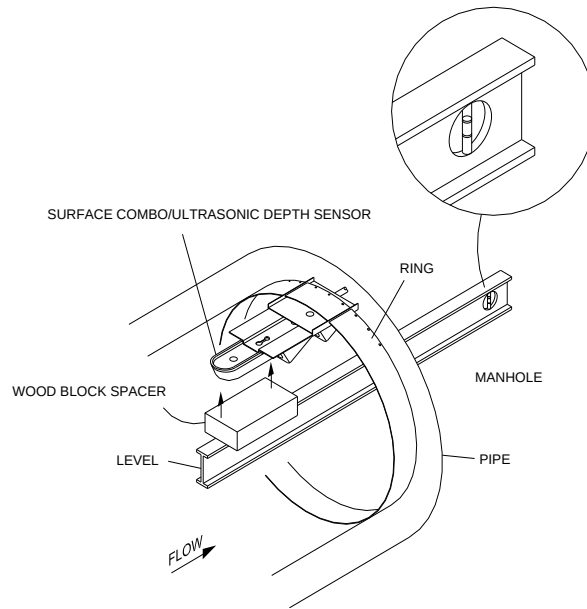
4. Expand the ring by turning the spreader mechanism nut counter-clockwise with the crank handle or socket. However, do not tighten the ring against the pipe completely at this point.

5. Mount the ParaDepth/ParaFlow/Surface Combo/Ultrasonic Depth sensor to the ring by inserting the studs on the back of the sensor into the keyholes on the sensor mounting plate (at the top of the ring) and sliding the sensor back (in a downstream direction) until it is fully in place. The sensor cable should exit the downstream edge of the ring. Orient the sensor with the depth crystals facing downward toward the inside of the ring (flow surface).



Mounting the ParaDepth/ParaFlow/Surface Combo/Ultrasonic Depth sensor to the mounting plate on the ring

- Note:** Handle the ParaDepth/ParaFlow/Surface Combo/Ultrasonic Depth sensors 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. Avoid contacting the metal connector at the end of the sensor cable (*or any other sharp object*) with the Teflon[®]-coated crystals on the sensor.
6. Using a 24-inch (500-mm or 1000-mm) carpenter's level, orient the ParaDepth/ParaFlow/Surface Combo/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. *To protect the crystals on the Surface Combo/Ultrasonic Depth sensor, use a block of wood of uniform dimensions between the level and the flat face of the horizontal, ultrasonic depth sensor portion of the sensor!*



Leveling the Surface Combo/Ultrasonic Depth sensor

If necessary, adjust the level in either sensor in the following way:

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

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

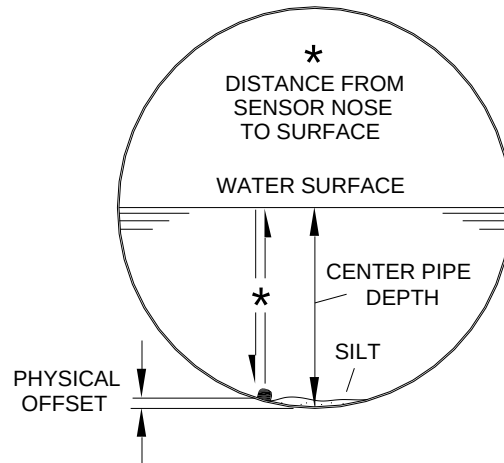
- ☐ Reattach the sensor to the mounting plate and recheck the level. For the ParaDepth and ParaFlow sensors, **Qstart^{XML}** can be used to determine sensor rotation and slope. See *Chapter 4, [Running Sensor Diagnostics](#)* for more information.

7. 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.

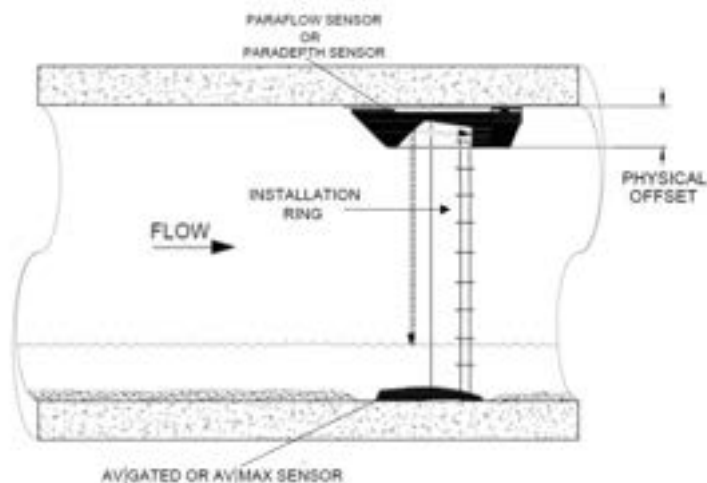
8. Install an anchor bolt in the manhole wall just above the pipe crown. Using an anchor cable tie, secure the Surface Combo sensor cable.
9. Restore any silt moved to its previous level and confirm that the Peak Combo sensor is still above the silt level.
10. Measure the physical offsets for the sensors in the following way.

- ☐ **AV|Gated Sensor** Since the AV|Gated sensor is always installed as close to 0 degrees rotation as possible, there should be no Physical Offset for this sensor unless a Silt Mount Adapter is being used.
- ☐ **AV|Max/Peak Combo Sensor Physical Offset** Manually measure the depth of the flow from the bottom of the pipe to the flow surface, and then measure the distance from the *nose* (i.e., front end) of the AV|Max/Peak Combo sensor to the flow surface. Subtract the second measurement from the initial depth of flow to determine the physical offset.
- ☐ **Physical Offset Measurement with Silt Mount Adapter** Manually measure the depth of the flow from the bottom of the pipe to the flow surface, and then slowly move the measuring device along the left-side of the ring until it reaches the edge of the Silt Mount Adapter. Measure the depth of flow at this point. Subtract the second measurement from the initial depth of flow to determine the physical offset.



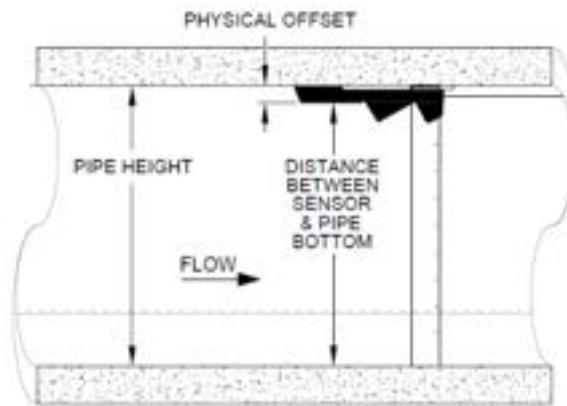
Illustrating the method for determining the physical offset for a rotated AV|Max/Peak Combo sensor

- ❑ **ParaDepth/ParaFlow Physical Offset** Measure the distance from the crown (top) of the pipe to the face of the sensor to determine the physical offset. *Typical offsets range from 2.63 to 2.75 inches (67 to 70 mm).*



Physical Offset of the ParaDepth/ParaFlow Sensor

- ❑ **Surface Combo Sensor/Ultrasonic Depth Sensor Physical Offset** Measure the distance from the crown (top) of the pipe to the face of the sensor (horizontal surface with the two depth crystals) to determine the physical offset. *Typical offsets range from 1.25 to 1.50 inches (32 to 38 mm).*



Physical Offset of the Surface Combo or Ultrasonic Depth Sensor

Note: These offsets are required when configuring the monitor using the **Qstart^{XML}** software.

11. Secure the sensor cables from the ring to the location at which the monitor is mounted in the manhole. Refer to *Securing the Sensor Cables in the Pipe and Manhole* on page 5-605-60 for more information.

Special Installations for AV|Gated, AV|Max, Peak Combo, Surface Combo, or Ultrasonic Depth Sensors

A special installation requires two independent installations: one for the Surface Combo Sensor or Ultrasonic Depth Sensor and one for the Peak Combo or AV|Gated sensor.

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 AV|Gated, AV|Max or Peak Combo sensor
- Mounting the ParaDepth, ParaFlow, Surface Combo or Ultrasonic 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. Avoid contacting the metal connector at the end of the Surface Combo or Ultrasonic Depth Sensor cable (*or any other sharp object*) with the Teflon-coated crystals on the sensor.

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 **TRITON+** monitor special installation hardware. In addition, please indicate the type of mounting hardware desired for mounting the monitor: *mounting bracket* (wall/ring mount) or *hook* (rung mount).

Quantity	Description	ADS P/N
1	TRITON+ flow monitor (<i>battery or externally-powered</i>)	8000-FST-IM-4WW(-XXX), 8000-FST-IM-EP-4WW(-XXX)
1	Monitor mounting bracket/flange (<i>for mounting monitor to manhole rim or wall</i>)	140-0009
3	Monitor mounting bracket bolt, hex, SS, M8 X 30mm	508058
3	Monitor mounting bracket washer, flat, SS	517-8001254-00
3	Monitor mounting bracket washer, lock, SS	517-8001274-00
1 as needed	Hook, SS, 2-piece w/ hardware (<i>for hanging monitor on manhole rung; Alternative to 140-0009</i>)	8000-0021
Up to 2 (1 per monitoring point)	AV Gated Sensor – upward ultrasonic depth sensor, pressure depth sensor, gated velocity sensor, and water temperature sensor	8K-CS7-10-35 (35-ft./10.6-m cable)
Up to 2 (1 per monitoring point)	AV Max Sensor – upward ultrasonic depth sensor, pressure depth sensor, peak velocity sensor, and water temperature sensor	8K-CS9-10-35 (35-ft./10.6-m or 100-ft./30.5-m cable)
1 as needed	Inclinometer – Angle/Tilt sensor installed on flood gates or other components where angle of change is needed	8000-0528
1 as needed	Long Range Depth Sensor – downward ultrasonic depth sensor typically installed near top of manhole structure	8K-CS6-C1-10 (10-ft./3.05-m cable)
Up to 2 (1 per monitoring point)	ParaDepth Sensor – downward ultrasonic depth sensor and air temperature sensor	8K-CS8-D1-00-30-IS (30-ft./9.1-m or 100-ft./30.5-m cable)
Up to 2 (1 per monitoring point)	ParaFlow Sensor – downward ultrasonic depth sensor, surcharge pressure depth sensor, surface velocity sensor, surcharge velocity sensor and air temperature sensor	8K-CS8-V2-10-30-IS (30-ft./9.1-m or 100-ft./30.5-m cable)
Up to 2 (1 per monitoring point)	Peak Combo Sensor – upward ultrasonic depth sensor, pressure depth sensor, peak velocity sensor, and water temperature sensor	8K-CS4-xx-35/1H (35-ft./10.6-m or 100-ft./30.5-m cable) ²
Up to 2 (1 per monitoring point)	Surface Combo Sensor – downward ultrasonic depth sensor, surcharge pressure depth sensor, surface velocity sensor, surcharge velocity sensor and air temperature sensor	8K-CS5-V2-xx-30/1H (30-ft./9.1-m or 100-ft./30.5-m cable) ²
1 as needed	IS Standard or Custom Sensor Extension Cable for Ultrasonic Depth Sensor	8000-0023-xxx ³
1 as needed	IS Standard or Custom Sensor Extension Cable for Peak Combo and Surface Combo Sensors	8000-0025-xxx ³
1 as needed	Bracket, mounting, sliding, for ParaDepth, ParaFlow, Surface Combo or Ultrasonic Depth Sensors (mounting plate)	8000-0307-02
1 as needed	Adapter, silt mount for Peak Combo Sensor	8000-0271
1 as needed	Special Surface Combo Sensor/Ultrasonic Depth Sensor install band, SS, 12 in. long (Use with corresponding mounting plate 8000-0307-02)	700-100238-00
As needed by length	Stainless steel mounting band	Contact ADS

Quantity	Description	ADS P/N
1 as needed	Sensor surcharge bracket (used only to mount Ultrasonic Depth Sensor in manhole)	140-0010
as needed	¼. In. x 2 ¼ in. (M6 x 55mm) stainless steel anchor bolts w/ nuts and washers	
1	Replacement dryer tube	3704-0032
1	IS PC Communication USB Serial Cable	8000-0337
1	Antenna for wireless communication	9000-0096
1 as needed	Magnet (<i>for activating diagnostic codes in the monitor through the LED STATUS window</i>)	8000-0460
1 as needed	External Power and Communications Unit (ExPAC)	8000-0377
1 as needed	24V DC power supply	508293
1 as needed	External Modbus Interface Unit (XBUS)	8000-0427
1 as needed	External Input and Output Device (XIO)	8000-0400
1 as needed	External power/communications cable (<i>from ExPAC to monitor</i>)	8000-0378-xxx ⁴
1 as needed	External power grounding kit (<i>also used to convert a battery-powered TRITON+ monitor to external power</i>)	8000-0434-xxx ⁴
1 as needed	Sampler cable (<i>for flow proportional sampling</i>)	8000-0348-01
1 as needed	Sampler cable (<i>for level activation sampling</i>)	8000-0348-02
4	M3 x 10mm flat head machine screws	507820
15	Plastic push mounts	
1	3/8 in. - 16 thread. x 2.in. (10mm x 55mm x 1.5mm thread) stainless steel stud	
1	3/8 in. – 16 thread (10mm x 1.5mm thread) stainless steel nut	
As needed	3/8 in. (10mm) stainless washer	
15	11-in. (5mm x 300mm) cable ties	
25	4-in. (2mm x 100mm) cable ties	
15	8-in. (4mm x 200mm) cable ties	
15	¼-in. (7mm x 400mm) anchor cable ties	

¹ Models 8000-FST-IM-4WW-XXX include the 12-volt battery pack; Models 8000-FST-IM-EP-4WW-XXX (*for external power*) do not include the battery pack.

² Pressure depth transducers (indicated by -xx- in the sample part number) are available in Peak Combo Sensors and Surface Combo Sensors 0 – 5 psi (0 - 0.34 Bar), 0 – 15 psi (0 - 1.03 Bar), and 0 - 30 psi (0 - 2.07 Bar) pressure ranges. Example, a Peak Combo Sensor with a 0 - 15 psi (0 - 1.03 Bar) pressure transducer would be specified in psi: **8K-CS4--15-35**.

³ Extension cables can be ordered to specific lengths up to 300 ft. (91m). Note the desired length (*in feet*) in the -xxx- portion of the part number. **Standard** lengths are 10 ft. (3.0m), 25 ft. (7.6m), 50 ft. (15.2m), 75 ft. (22.8m), 100 ft. (30.5m), 125 ft. (38.1m), 150 ft. (45.7m), and 200 ft. (61.0m). All other lengths must be custom ordered.

⁴ The external power/communications cable and the ground cable included in the external power grounding kit can be ordered to specific lengths up to 800 ft. (243m). Note the desired length (*in feet*) in the -xxx portion of the part number. Standard lengths are 10 ft. (3.0m), 25 ft. (7.6m), and 100 ft. (30.5m). All other lengths must be custom ordered.

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:
 - ❑ ¼-inch (6-mm) x 6-inch (150-mm) masonry bit
 - ❑ 3/8-inch (10-mm) x 4-inch (100-mm) [minimum length] masonry bit
 - ❑ 5/16-inch (8-mm) carbide-tipped bit
- Heavy 4-pound (1.5-Kg) hammer
- Rubber mallet
- 24-inch (610-mm) carpenter's level
- Nut driver set or socket set (English plus 13-mm for canister hardware)
- Wrenches (English plus 13-mm for canister hardware)
- Screwdrivers (flathead and Phillips head of assorted sizes)
- Threads tap compatible with the thread spec on the monitor mounting stud
- Diagonal wire cutters
- Folding carpenter's rule with a brass slide
- Mastic tape or rubber coaxial stretch tape

Mounting AV|Gated, AV|Max or Peak Combo Sensors

Note: Regardless of which band is used to install the AV|Gated sensor, *it must be installed no more than +/- 5 degrees from the bottom center of the pipe.* If further rotation is necessary, use a Silt Mount Adapter which will allow the sensor to be rotated 30 degrees from center (7:00 position).

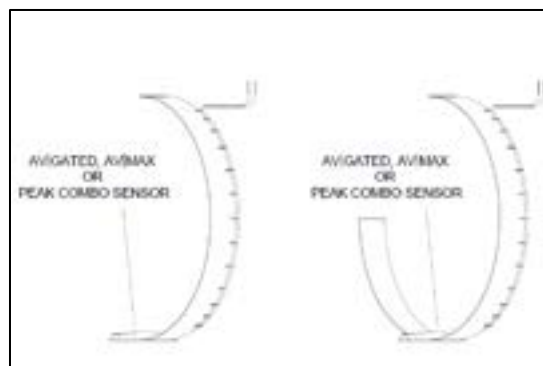
Two special installation methods are available for mounting these sensors.:

- 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 sensor at the bottom center of the pipe. These options are not possible using the ½-band mount. Therefore, the ¾-band mount is the preferable method for mounting the sensors.

However, a ½-band mount may be appropriate for monitoring under the following circumstances:

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



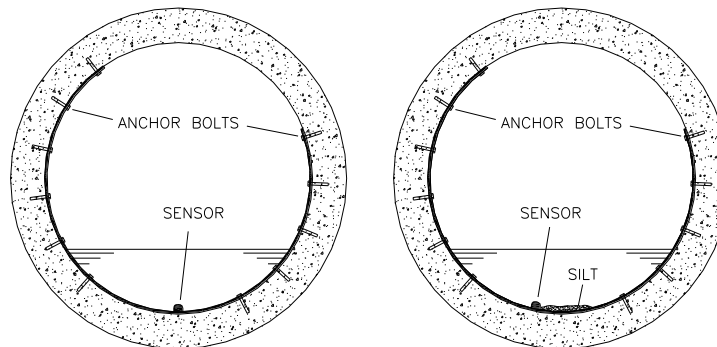
½- (left) and ¾-band (right) mounts

Note: When positioning the special mounting metal, ADS recommends reserving the *left* side of the pipe for the long end of the $\frac{3}{4}$ -band (end extending almost completely up one side of the pipe) and the $\frac{1}{4}$ -band for routing the sensor cable and accommodating the Silt Mount Adapter (*when necessary*). The AV|Gated, AV|Max and Peak Combo Sensors may be offset up to 30 degrees (7:00) up the left side of the pipe to account for silt with the use of the *Silt Mount Adapter* (ADS p/n 8000-0271).

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

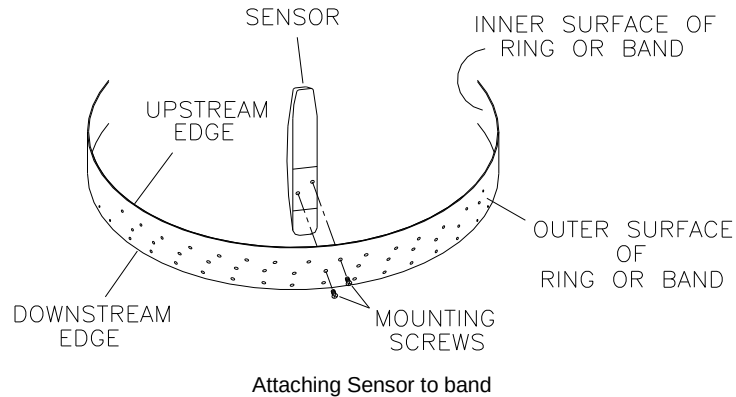
Perform the following procedure to mount the Peak Combo or AV|Gated sensor (when applicable) in a pipe using the $\frac{3}{4}$ -band mount:

1. Use a hacksaw to cut the band to the appropriate length. Cut the band so that, once installed, it will run approximately $\frac{3}{4}$ of the circumference of the pipe.
2. Locate the sensor at a position on the band based on installing the long end of the band (end extending almost completely up one side of the pipe) on the left side of the incoming pipe (upstream from the manhaole) and the existence of silt at the bottom of the pipe. ADS recommends reserving the left side of the pipe for the long end of the band to accommodate the sensor cable and a silt mount adapter, when applicable.
 - ❑ AV|Gated, AV|Max, or Peak Combo in pipes with no silt, locate the sensor on the band so the sensor is located at the bottom center of the pipe once installed. (The AV|Gated must be installed no more than +/- 5 degrees from the bottom center of the pipe.)
 - ❑ In pipes with silt present, locate the sensor slightly up the long end (left side) of the band so the sensor is above the silt level once installed. However, make sure it will not be more than 30 degrees from the bottom center of the pipe (7:00 position).

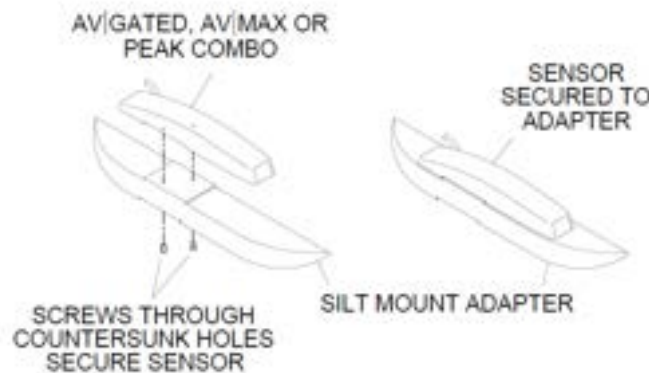


(Left) AV|Gated, AV|Max or Peak Combo sensor mounted using a $\frac{3}{4}$ -band mount in the pipe without silt. (Right) AV|Gated, AV|Max or Peak Combo sensor only mounted in pipe with silt.

3. (applies only when mounting the AV|Gated, AV|Max, or Peak Combo sensor within ± 5 degrees of the 6:00 position.) Mount the sensor onto the inside of the band with two M3 x 10-mm countersink screws, making sure the blunt end (i.e., nose) of the sensor is facing the upstream edge of the ring (edge opposite cable tie holes). If mounting 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 (3-mm) drill bit.

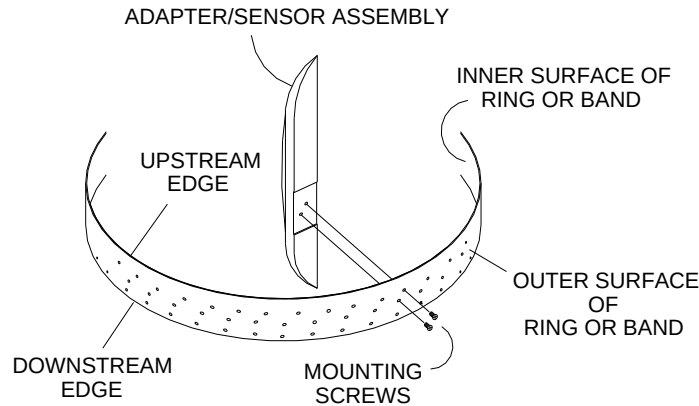


4. (applies only to AV|Gated, AV|Max or Peak Combo when mounting the sensor between 15 and 30 degrees up the side of the pipe) Use the Silt Mount Adapter (ADS p/n 8000-0271) to attach the sensor to the band in the following way:
- ❑ Seat the AV|Gated, AV|Max or Peak Combo sensor onto the slightly elevated portion of the top of the Silt Mount Adapter. The elevated portion of the adapter should insert easily into the inset portion of the bottom of the sensor. Orient the sensor so that the sensor cable is exiting the sharp, or wedged, side of the adapter.
 - ❑ From the bottom of the adapter, use two M3 x 10mm stainless steel flathead screws (do not substitute any other screws) to secure the sensor to the adapter. The predrilled screw holes in the adapter and in the bottom of the sensor should be in alignment if the sensor is seated properly on the adapter.



Seating and securing the AV|Gated, AV|Max, or Peak Combo Sensor to the Silt Mount Adapter

Use two M3 x 10mm stainless steel flathead screws (do not substitute any other screws) to secure the sensor/adapter assembly to the band at the appropriate location on the band to ensure the sensor will be positioned between 15 and 45 degrees up the left side of the pipe (6:30 to 7:30) and below the flow surface once installed. The nose of the sensor should be facing the same direction as the upstream edge of the band. If mounting holes do not exist on the band at or near the desired mounting location for the adapter/sensor, drill holes in the band using a 7/32-inch (3-mm) drill bit.



Attaching the Sensor/Silt Mount Adapter assembly to the band

5. 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 5-31.
6. 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.
7. Mark the pipe wall through the lowest hole with a drill, and install a ¼-inch x 2 ¼-inch (M6 x 55-mm) anchor bolt with a pneumatic drill.
8. Secure the band to the anchor bolt with a washer and nut.
9. Conform the band to the pipe wall around to the long end of the band so that it is flush with the pipe wall.
10. Install a ¼-inch x 2 ¼-inch (M6 x 55-mm) 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.
11. 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.
12. Install ¼-inch x 2 ¼-inch (M6 x 55-mm) 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 (305 to 610 mm) to the top end of the band.
13. Measure the physical offset for the sensor by manually measuring the depth of the flow from the bottom of the pipe to the flow surface and then measuring the distance from the *nose* (i.e., front end at the pipe surface) of the sensor to the flow surface. Subtract the second measurement from the initial depth of flow to determine the physical offset.
14. Run the sensor cables from the sensor location in the pipe to the monitor location in the manhole according to the instructions in on page 5-51.

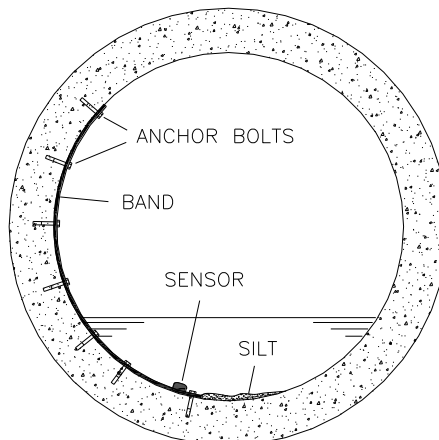
½-Band Mount

Perform the following procedure to mount an AV|Gated, AV|Max or Peak Combo sensor in a pipe using the ½-band mount:

1. Use a hacksaw to cut the band to the appropriate length. Cut the band so that, once installed, it will run almost completely down the left side of the pipe.
2. Determine the best location on the band to mount the sensor. Intend on installing the band on the left side of the incoming pipe (upstream from the manhaole) to accommodate the sensor cable and a Silt Mount Adapter. The sensor should mount as close as possible to the bottom (end) of the band, making sure the sensor will be both *above* the silt level and *below* the flow surface once installed.

Note: Mounting the AV|Gated, AV|Max or Peak Combo Sensor between 5 and 30 degrees up the side of the pipe from the centerline requires a special *Silt Mount Adapter*.

3. (applies only when mounting the AV|Gated, AV|Max, or Peak Combo sensor within +/- 5 degrees of the 6:00 position.) Mount the sensor onto the inside of the band with two M3 x 10-mm countersink screws, making sure the blunt end (i.e., nose) of the sensor is facing the upstream edge of the ring (edge opposite cable tie holes). If mounting 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 (3-mm) drill bit.
 4. (applies only to AV|Gated, AV|Max or Peak Combo when mounting the sensor between 15 and 30 degrees up the side of the pipe) Use the Silt Mount Adapter (ADS p/n 8000-0271) to attach the sensor to the band in the following way:
 - ❑ Seat the AV|Gated, AV|Max or Peak Combo sensor onto the slightly elevated portion of the top of the silt mount adapter. The elevated portion of the adapter should insert easily into the inset portion of the bottom of the sensor. Orient the sensor so that the sensor cable is exiting the sharp, or *wedged*, side of the adapter.
 - ❑ From the bottom of the adapter, use two M3 x 10mm stainless steel flathead screws (*do not substitute any other screws*) to secure the sensor to the adapter. The predrilled screw holes in the adapter and in the bottom of the sensor should be in alignment if the sensor is seated properly on the adapter.
 - ❑ Use two M3 x 10mm stainless steel flathead screws (*do not substitute any other screws*) to secure the adapter to the band at the appropriate location on the band to ensure the sensor will be positioned between 15 and 30 degrees up the side of the pipe (7:00 position) and below the flow surface once installed. The nose of the sensor should be facing the same direction as the upstream edge of 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 5-31.
 6. Place the band in the pipe upstream at least 12 inches (305 mm) 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 ¼-inch x 2 ¼-inch (M6 x 55-mm) 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 ¼-inch x 2 ¼-inch (M6 x 55-mm) anchor bolt, washer, and nut below the flow surface 30 to 80 mm away from the underwater 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 ¼-inch x 2 ¼-inch (M6 x 55-mm) anchor bolt, nut, and washer every 12 to 24 inches (305 to 610 mm) up to the top of the band.



Completed ½-band mount in pipe

11. Measure the physical offset for the sensor by manually measuring the depth of the flow from the bottom of the pipe to the flow surface and then measuring the distance from the *nose* (i.e., front end at the pipe surface) of the sensor to the flow surface. Subtract the second measurement from the initial depth of flow to determine the physical offset.

Note: This value will be necessary when configuring the monitor using the **Qstart^{XML}** 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 5-51.

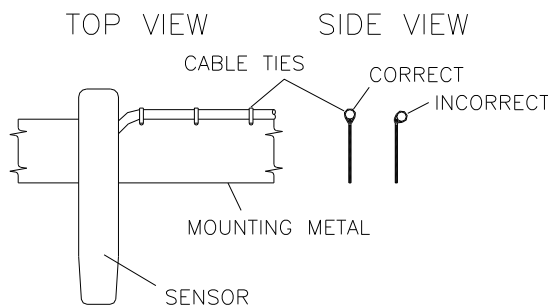
Note: If the pipe is large and the sensor cable cannot reach the pipe crown, attach the sensor cables to 0.5-inch (12-mm) PVC tubing and anchor the tubing to the wall. This will help prevent sensor damage during heavy flow.

Securing the Cables to the Band

Securing the underwater sensor cable 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 cable in the following way:

1. Starting at the appropriate sensor location, begin securing the sensor cable with 4-inch (2-mm x 100-mm) 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 right side of the band (on the downstream edge of the band).



Sensor cabling

2. Continue securing the cables until reaching the ParaDeph, ParaFlow, Surface Combo, or Ultrasonic Depth Sensor, or 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 depth cable sheathes two components: the electrical cables that operate the sensor and an air tube that ventilates the sensor (*when applicable*). 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.

Mounting the ParaDepth, ParaFlow, Surface Combo Sensor or Ultrasonic Depth Sensor

Three (3) special installation methods are available for mounting the ParaDepth and ParaFlow sensors. Two (2) special installation methods are available for mounting the Ultrasonic Depth sensor and one (1) for the Surface Combo Sensor:

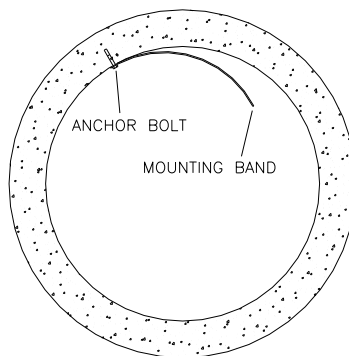
- **Standard Mount** This mount is used for mounting the ParaDepth, ParaFlow, Surface Combo or Ultrasonic Depth sensor *in the pipe* during special installations.
- **Topside Retrieval System** This mount supports the installation of the ParaDepth or ParaFlow sensor in the manhole structure and allows for easy retrieval of the sensor for maintenance purposes without descending the manhole. See *Installing the Sensors in the Manhole Structure* on page 5-36.

Standard Mount

Mount the ParaDepth, ParaFlow, Surface Combo or Ultrasonic Depth sensor using this method in the following way:

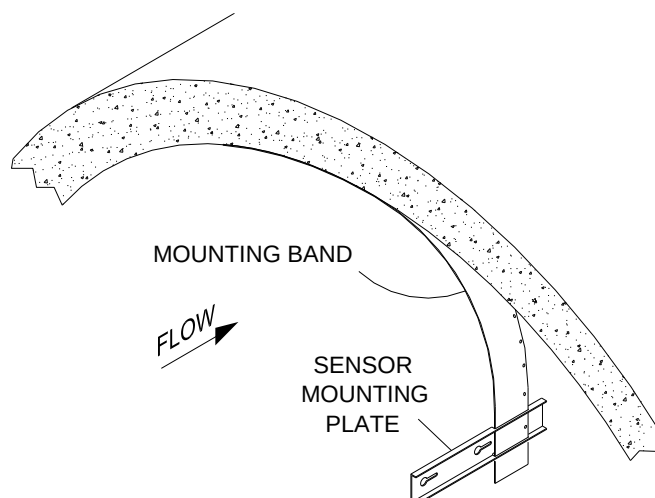
Note: Handle the sensor with care, and do not expose it to extreme temperatures for an extended period of time. Keep the sensor in its protective packaging until it is time for installation. Avoid contacting the metal connector at the end of the Surface Combo Sensor/Ultrasonic Depth Sensor cable (*or any other sharp object*) with the Teflon-coated crystals on the sensor.

1. Position the ParaDepth/ParaFlow/Surface Combo Sensor/Ultrasonic Depth sensor mounting plate in the center apex of the pipe, and scribe a mark on both sides of the mounting plate.
2. Center the 12-inch (305-mm) mounting band, allowing the band to extend about 5.25 inches (133 mm) 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 (M6 x 55-mm) 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.



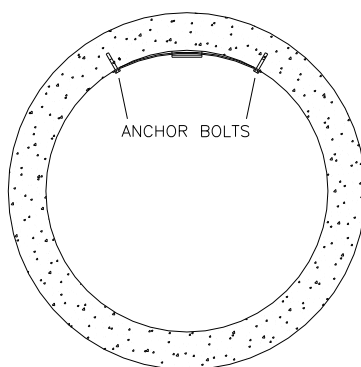
Securing one end of the sensor mounting band

6. Slide the sensor mounting plate (ADS p/n 8000-0307-02) onto the band with the end of the plate with the keyholes facing *upstream* and the two band slots facing up.



Sliding the mounting plate for the ParaDepth/ParaFlow/Surface Combo /Ultrasonic Depth Sensor onto the free end of the mounting band

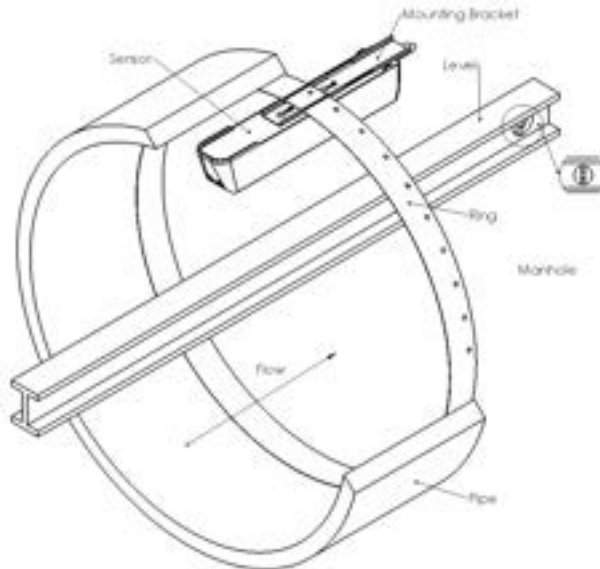
7. Align the sensor mounting plate with the scribe marks, and conform the other end of the curved band with the pipe.
8. Spot drill to mark an anchor bolt location, and mount another ¼-inch x 2 ¼-inch (M6 x 55-mm) anchor bolt to the pipe.
9. Hand-tighten a nut with washer to secure the other end of the band.



Securing the other end of the band

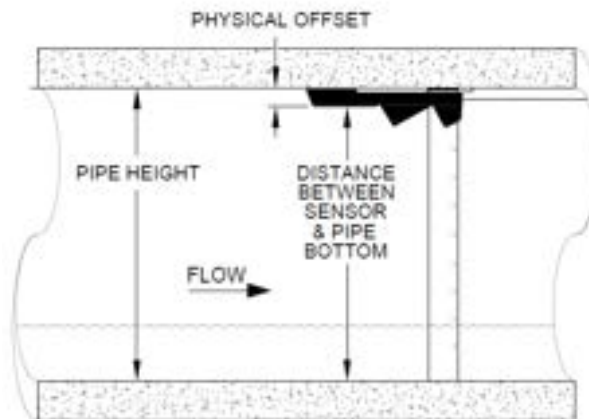
Note: If the mounting plate has too much side play, attach another anchor bolt approximately 1 inch (22 mm) from the plate.

10. Slide the sensor mounting 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. For more information, refer to the instructions on leveling this sensor in *Installing the Ring in the Pipe* beginning on page 5-17.
11. Install the ParaDepth/ParaFlow/Surface Combo /Ultrasonic Depth sensor onto the mounting plate by inserting the studs on the back of the sensor into the keyholes on the mounting plate and sliding the sensor back (in a *downstream* direction) until it is fully in place. The sensor cable should exit the downstream edge of the band.



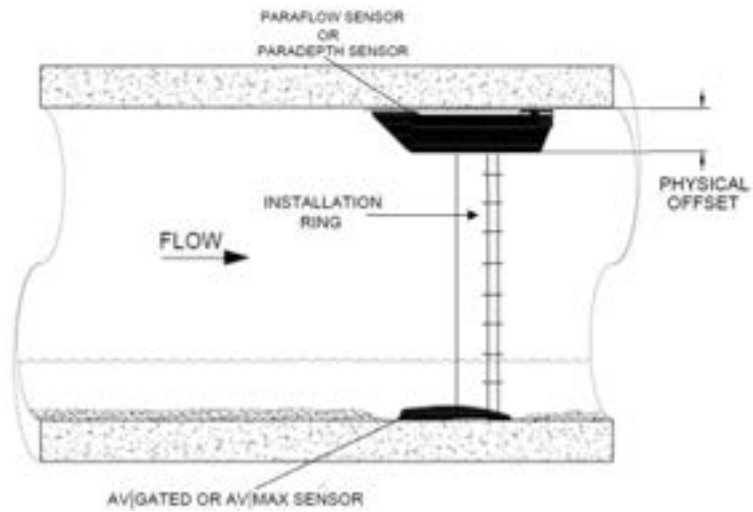
Fastening the downward looking sensor to the mounting plate on the band

12. Confirm the sensor is still level. For the ParaDepth or ParaFlow sensor refer to Chapter 4 *Running Sensor Diagnostics* for more information on determining how level the sensor is. For the Surface Combo or Ultrasonic Depth sensor, confirm level side to side and front to back as described on Page 5-20. *To protect the crystals on the sensor, use a block of wood of uniform dimensions between the level and the flat face of the horizontal, ultrasonic depth sensor portion of the sensor!*
13. Determine the **Physical Offset** for the Surface Combo sensor or Ultrasonic Depth sensor by measuring the distance from the crown (top) of the pipe to the face of the sensor (horizontal surface with the two ultrasonic crystals on either sensor). This value is required when configuring the monitor using the **Qstart^{XML}** software. *Do not measure in reference to the the angled surface velocity or surcharge velocity portions of the sensor.*



Measuring the Physical Offset of the Surface Combo or Ultrasonic Depth Sensor

14. Determine the Physical Offset for the ParaDepth/ParaFlow sensor by measuring the distance from the crown (top) of the pipe to the face of the sensor as shown in the picture below.



Measuring the Physical Offset of the ParaDepth or ParaFlow Sensors

Installing the Sensors in the Manhole Structure

This section includes the procedures for performing installations in the manhole structure for the following ADS TRITON+ sensors:

- Long Range Depth Sensor
- ParaDepth Sensor
- ParaFlow Sensor
- Surface Combo Sensor
- Ultrasonic Depth Sensor

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. Avoid contacting the metal connector at the end of the Surface Combo or Ultrasonic Depth Sensor cable (*or any other sharp object*) with the Teflon-coated crystals on the sensor.

Long Range Depth Sensor Installation

Performing a standard Long Range Depth Sensor installation involves the following process:

- Selecting an installation location
- Gathering parts and supplies
- Measuring manhole depth
- Installing the Mounting Bar
- Adding Extension Rods to the Mounting Bar (as needed)
- Installing Wall Mount Bar (as needed)
- Installing the sensor on the Mounting Bar
- Installing the Submersion Sensor
- Measuring the physical offset

Selecting an Installation Location

Manhole structures with the following characteristics facilitate the installation of Long Range Depth Sensor:

- Manhole depth between 3 and 21 feet (914 – 6400 mm)

Note: The maximum range of the Long Range Depth Sensor is 20 feet (6096 mm). Ensure the distance between the bottom of the sensor and the manhole invert does not exceed this distance.

- Manhole invert visible from street or ground surface
- Manhole with rungs (*If there are no rungs in the manhole, drill an anchor point into the manhole wall to secure the tether and therefore the Mounting Bar in case it becomes dislodged.*)
- An iron manhole frame with a diameter between 21 inches (530 mm) and 28 inches (710 mm) and a frame depth of 3 inches (76 mm) or more. Manhole frames greater than 28 inches (710 mm) in diameter require the use of Extension Rods. See page 5-38, [Installing the Mounting Bar](#), for more details.

Note: Manhole locations that do not meet characteristics mentioned above will require special mounting techniques and possible manhole descent.

Gathering Parts and Supplies

Gather the following equipment for the installation:

- Grade Pole
- J-Hook
- Folding Carpenter's Rule with a brass slide
- 36-inch (914-mm) Carpenter's Level

Obtain the following supplies from ADS before performing the Long Range Depth Sensor installation to prevent any costly delays. When ordering, specify the **TRITON+** monitor Long Range Depth Sensor installation hardware. In addition, please indicate the type of mounting hardware desired for mounting the monitor: *mounting bracket* (wall/rim mount) or *hook* (rung mount).

Quantity	Description	ADS P/N
1	TRITON+ flow monitor (<i>battery or externally-powered</i>)	8000-FST-IM-4WW(-XXX), 8000-FST-IM-EP-4WW(-XXX)
1	Monitor mounting bracket/flange (<i>for mounting monitor to manhole rim or wall</i>)	I40-0009
3	Monitor mounting bracket bolt, hex, SS, M8 X 30mm	508058
3	Monitor mounting bracket washer, flat, SS	517-8001254-00
3	Monitor mounting bracket washer, lock, SS	517-8001274-00
1 as needed	Hook, SS, 2-piece w/ hardware (<i>for hanging monitor on manhole rung; Alternative to I40-0009</i>)	8000-0021
1	Long Range Depth Sensor	8K-CS6-C1-10
1 as needed	Mounting Bar or Stainless Steel Wall Mount	8000-0450 or 8000-0484
1 as needed	Extension Rod	8000-0481
1 as needed	Wall Mount	8000-0484
1 as needed	IS Standard or Custom Sensor Extension Cable for Long Range Depth Sensor	8000-0023-xxx ²

¹ Models 8000-FST-IM-4WW-XXX include the 12-volt battery pack; Models 8000-FST-IM-EP-4WW-XXX (*for external power*) do not include the battery pack.

² Extension cables can be ordered to specific lengths up to 300 ft. (91m). Note the desired length (*in feet*) in the -xxx- portion of the part number. **Standard** lengths are 10 ft. (3.0m), 25 ft. (7.6m), 50 ft. (15.2m), 75 ft. (22.8m), 100 ft. (30.5m), 125 ft. (38.1m), 150 ft. (45.7m), and 200 ft. (61.0m). All other lengths must be custom ordered.

Measuring Manhole Depth

1. Tether Carpenter's level or other flat, rigid item to keep from losing it in the flow. This will be used as a measuring reference point.
2. Extend Grade Pole outside of the manhole and confirm all latches to keep from losing an unsecured section in the flow.
3. Double-check your Grade Pole scale. (*Many pole-scales display feet and inches while some are in fractions of feet.*)
4. Place tethered level or other flat, rigid item across the open manhole frame.



Placing Carpenter's level across open manhole frame

5. Insert extended Grade Pole into the invert ensuring that pole end is in contact with the absolute bottom surface through any silt or debris that may be present.



Extending Grade Pole to absolute bottom surface of invert

6. Read Grade Pole measurement from point where the Grade Pole crosses the bottom of level or other flat, rigid item. Record measurement.



Recording measurement for manhole depth

Installing the Mounting Bar

The Mounting Bar is designed to securely position the Long Range Depth Sensor within a standard manhole frame that is between 21 inches (533 mm) and 28 inches (711 mm).

Note: For installations within wider manhole frames, refer to [Adding Extension Rods to the Mounting Bar](#) for information on extending the mounting bar before proceeding with the installation. If the manhole or manhole frame will not accommodate a Mounting Bar with or without extensions, a Wall Mount Bar must be installed. Refer to [Installing the Wall Mount Bar](#) for installation instructions.

Perform the following procedure to install the Mounting Bar:

1. Hang large loop from the Mounting Bar tether behind top rung.



Passing Mounting Bar tether behind top rung

2. Use the J-Hook to pull the large loop under the rung and back up towards you.



Using J-Hook to pull tether up from top rung

3. Pass the un-tethered end of the Mounting Bar through the large loop, cinching the tether to the rung.



Passing un-tethered end through large loop

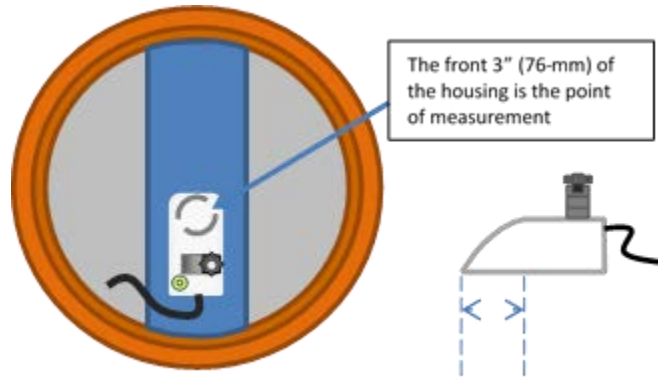


Cinching the tether to the top rung

4. Position the bar in the manhole frame so the sensor has a clear view of the manhole invert.

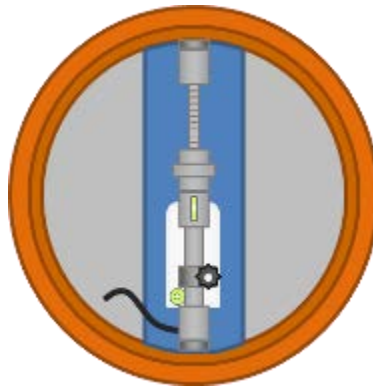
Perform the following adjustments to ensure proper sensor positioning:

- ☐ Ensure the point of measurement is properly positioned over the invert and flow.



Point of Measurement

- ☐ If the invert runs through the center of the manhole, the Mounting Bar should be installed parallel to the flow.



Parallel Mount

- ☐ If the invert is offset from the center, rotate the Mounting Bar appropriately so the sensor housing can be pointed directly at the invert.



Mount Rotation to Offset Accommodation

- ☐ If the invert takes a bend as it runs through the manhole, rotate the Mounting Bar appropriately to accommodate the bend.



Mount Rotation to Accommodate Bend

5. With the Mounting Bar in proper invert-orientation, turn knob to extend rod to just short of manhole frame walls. Position the bar so that the distance between it and the street surface is 8 inches (200 mm) to 12 inches (305 mm) and is mounted within the manhole frame.

Note: Mount the bar sufficiently deep to prevent it from being dislodged when the manhole lid is opened.



Positioning the Mounting Bar in the manhole frame

Note: The Mounting Bar may be positioned at greater than 12 inches (305 mm) from the street level; however, the goal of the installation should be to maximize the level of surcharge the sensor can measure.

6. Reference the bubble level **as** you tighten the knob on the Mounting Bar in the manhole frame to ensure that the bar will provide a level sensor mounting surface.



Ensuring Mounting Bar is level

7. Twist the locking nut counterclockwise to extend the mounting bar, spanning the diameter of the frame. Ensure the bar is secure by grabbing and vigorously pulling on it to confirm it will not move.



Confirming secure positioning

Adding Extension Rods to the Mounting Bar



Extension Rod

If the manhole is larger than standard-sized openings, utilize one Mounting Bar Extension Rod (ADS p/n 8000-0481) for frames extending 28 inches (711 mm) to 36 inches (914 mm) and two Mounting Bar Extension Rods for frames 36 inches (914 mm) to 44 inches (1118 mm).

Add Extension Rods to the Mounting Bar as follows:

1. From the un-tethered end of the Mounting bar, carefully pry the black rubber foot off the end of the gray threaded plug.



Removing the black rubber foot

2. Unscrew and remove the gray threaded plug.



Removing the gray threaded plug

3. Screw and hand-tighten the Extension Rod onto the end of the Mounting Bar.



Screwing the Extension Rod onto the Mounting Bar

4. Screw and tighten the gray plug onto the end of the Extension Rod.



Screwing the gray plug onto the Extension Rod

5. Replace the black rubber foot.



Replacing the black rubber foot

Note: When adding two Extension Rods, repeat the process on the tethered end, ensuring that the Mounting Bar tether remains secured at the end after the Rod is added.

Installing Wall Mount Bar



Wall Mount Bar with bracket

If the manhole or manhole frame will not accommodate a standard Mounting Bar with or without extensions, utilize the Wall Mount Bar (ADS p/n 8000-0484) for installation.

Install the Wall Mount Bar as follows:

1. Select location of Wall Mount Bar installation. Make sure the sensor will have a clear view of the invert. Refer to Step 4 of [Installing the Mounting Bar](#) to ensure proper sensor positioning.
2. Place the Wall Mount Bar bracket on selected location, ensuring bar will be level, and mark screw holes for drilling or screwing anchor points.
3. Secure the Wall Mount Bar bracket to the manhole wall with anchor screws for each of the bracket holes.



Securing bracket to the manhole wall

4. Screw the Wall Mount Bar into the bracket secured to the wall.



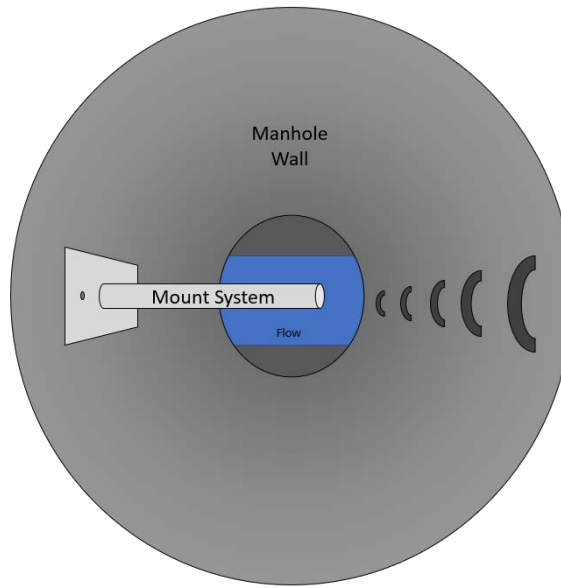
Screwing Wall Mount Bar into installed bracket

Installing the Stainless Steel Wall Mount Bar

The Stainless Steel Wall Mount Bar is designed as an alternative method of securely positioning the Long Range Depth Sensor in the manhole over the flow.

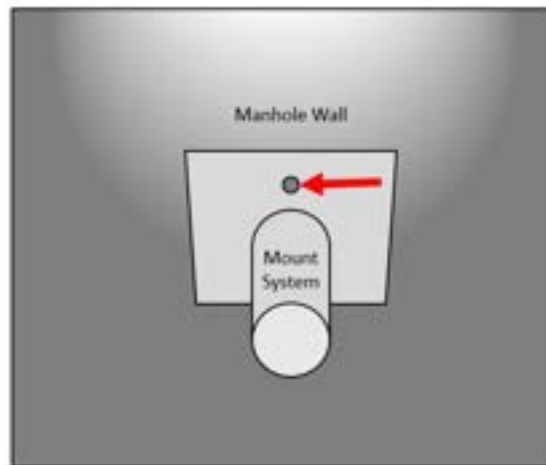
Perform the following procedure to install the Mounting Bar:

1. Position the bracket on the manhole wall, such that the ECHO or LRD it will support will overlook the flow. Refer to “Installing the Mounting Bar”, Step 4, for additional configurations to accommodate alternative flow paths.



Stainless Steel Mount Bar Over the Flow

2. Drill a 3/8-inch (0.95cm) diameter hole through the top mounting hole, into the manhole wall. The hole must have a minimum depth of 1 1/4 inches (3.18 cm).



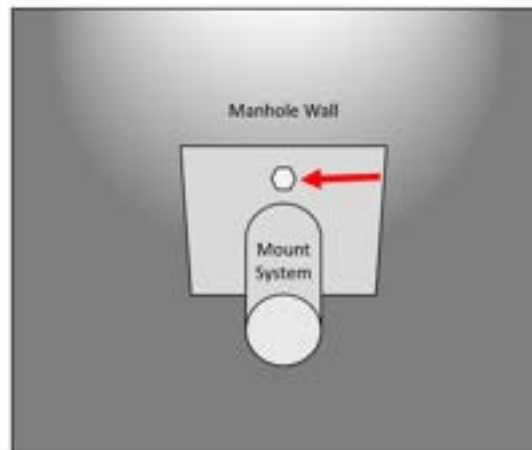
Drilling the First Hole

3. With the anchor nut threaded to approximately one thread from the end of the stud (to protect the threads), hammer one of the anchors from the mounting kit (included) into the drilled hole until seated, then remove the nut.



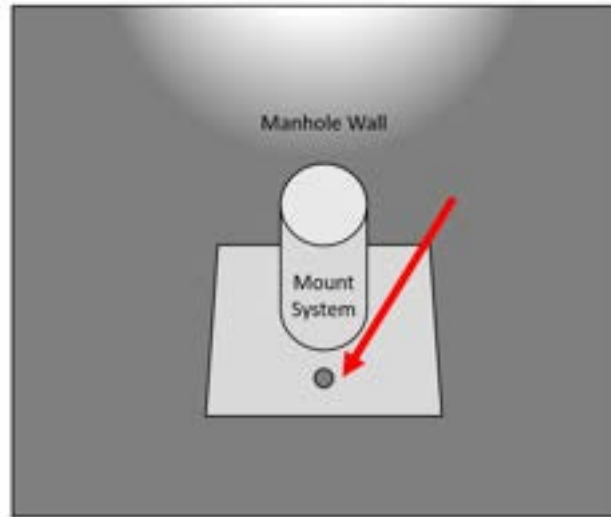
Installing the First Anchor Bolt

4. Place the top mounting hole of the bracket over the anchor stud and thread and tighten the nut.



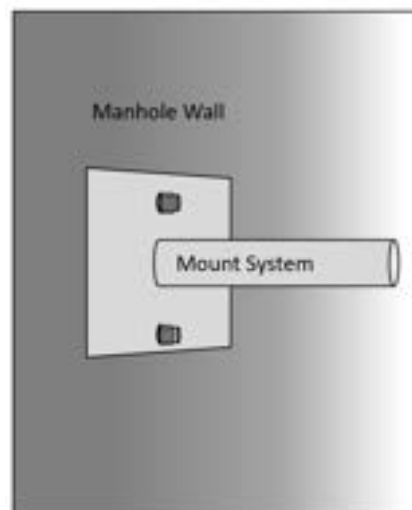
Securing the Stainless Steel Wall Mount With the First Nut

5. With the wall plate vertical, drill through the lower bracket hole, into the wall. Again, the hole must have a minimum depth of 1 ¼ inches (3.18 cm).



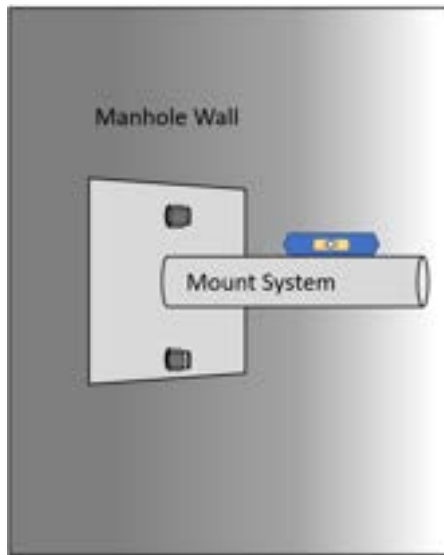
Drilling the Second Hole

6. As in Step 4, drive the remaining anchor stud through the bracket, into the drilled hole, until seated. Then thread and tighten the nut.



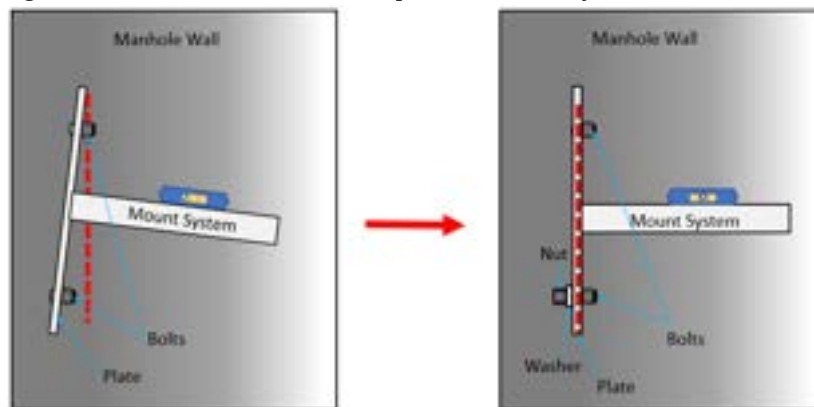
Securing the Stainless Steel Wall Mount With the Second Nut

7. Use a torpedo level (or similar) to verify the pipe portion of the Stainless Steel Wall Mount is horizontally level.



Checking Horizontal Alignment

8. If the Mount System is not completely level (due to the wall not being completely vertical), remove the nuts and bracket, then add a nut and flat washer from the mounting hardware kit to the uneven anchor stud before reinstalling the bracket. Recheck with the torpedo level and adjust the nut until the bracket is level.



Leveling the Stainless Steel Wall Mount Bar

Installing the Long Range Depth Sensor onto the Mounting Bar

The user-friendly design of the Long Range Depth Sensor is configured to facilitate easy installation.

Note: The same steps below also apply to installing the Long Range Depth Sensor on the Wall Mount Bar.

1. Open the Long Range Sensor thumb-screw and flip the top of the shroud bracket back.



Unscrewing and opening shroud bracket

2. Position sensor under Mounting Bar and bring hinge over bar and tighten thumb screw.



Positioning and tightening sensor bracket to Mounting Bar

3. Ensure that the bar remains level and the bubble on the sensor is centered.



Maintaining proper level

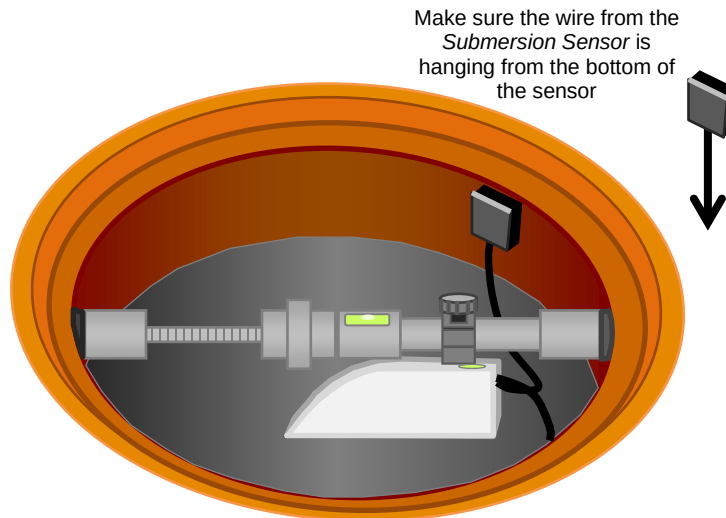
4. Double-check that the bar is suspended tightly at anchor points.



Long Range Sensor Fully Installed

Installing the Submersion Sensor on Manhole Frame

Attach the Submersion Sensor to the manhole frame as close to the top of the rim as possible. The Submersion Sensor senses when flow depths reach it and will cause the **TRITON+** to send out a Submerged alarm when the sensor goes under water.



Warning: The Submersion Sensor has a strong magnet for adherence to the manhole frame. Keep the sensor away from metal objects as it may potentially cause damage! Additionally, do not place the Submersion Sensor near a computerized device with a magnetic hard drive like PCs and laptops!

Measuring the Physical Offset

Be sure to tether level or other rigid straight item in a fixed position to keep from losing it in the manhole structure.

1. Place tethered level or other flat, rigid item across the open manhole frame.

Note: During installation, or if re-installation is required, always measure the physical offset making sure to reactivate the monitor if the measurement has changed. Refer to Chapter 4 [Configuration and Activation](#) for more information.

2. Place your fingers on the edge of the sensor and place Carpenter's Rule on your fingers so that the edge of the sensor and the end of the Carpenter's Rule are the same.



Placing Carpenter's Rule at base of sensor edge

3. Read the Carpenter's Rule measurement from point where the Carpenter's Rule crosses the bottom of level or other flat, rigid straight item. Record measurement.



Recording physical offset at measurement intersection

Topside Retrieval System (applies to ParaDepth and ParaFlow Sensors)

This section includes the procedure for installation of the ParaDepth and ParaFlow sensors using the ADS Topside Retrieval System. The installation involves:

- Installing the Topside Wall Mount Bracket in the manhole
- Securing the ParaDepth or ParaFlow sensor to the TopSide Sensor Bracket and installing on Wall Mount Bracket
- Measuring the Physical Offset of the ParaFlow or ParaDepth sensor once mounted on bracket
- Securing sensor cables
- Testing Removal and Reinstall of sensor from topside (*optional*)

Warning: When using the Retrieval Tool to either remove or re-install the sensor, care needs to be taken to avoid any overhead obstructions. Be especially aware of any overhead power lines.

Gathering Parts and Supplies

Gather the following parts and supplies before heading to the field to install the ADS Topside Retrieval System along with either the ParaDepth or ParaFlow sensor.

Gather the following equipment for the installation:

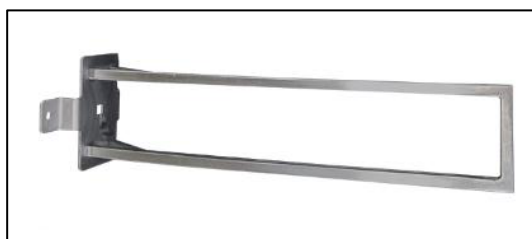
- Battery powered hammer drill
- $\frac{3}{8}$ " Masonry Bit
- 4-lb. Hammer
- $\frac{9}{16}$ " Nut Driver or Deep Well Socket & Wrench
- 12-inch (305-mm) Carpenter's Level
- Small Phillips Blade screwdriver
- Diagonal Wire Cutters
- Folding Carpenter's Rule with Brass Slide

NOTE: Tools are listed in standard (SAE) sizes. Select equivalent metric (SI) tools as needed.

All anchor bolts, nuts, and washers must be stainless steel.

Obtain the following supplies from ADS before performing the Topside Retrieval System installation to prevent any costly delays. The list below only covers the retrieval system; it does not include monitor installation parts and supplies.

Quantity	Description	ADS P/N
1	KIT, SYSTEM, MOUNTING BRACKETS, TOP-SIDE (includes Wall Mount Bracket, Sensor Bracket and Hardware Kit)	8000-0655-A
1 (as needed)	TOOL, RETRIEVAL, EXTENDABLE, 4-SECTION, ALUMINUM (Retrieval Tool for removing and re-installing the ParaDepth or ParaFlow Sensor on the Wall Mount Bracket from street-level)	8000-0654



Topside Wall Mount Bracket



Topside Sensor Bracket



Topside Retrieval Tool

Some things to consider before beginning the installation of the Topside Retrieval System:

- The ParaDepth and ParaFlow sensors can read depth and velocity with the sensor facing up or downstream. ADS recommends the sensor be placed in a position where the flow surface is the least turbulent, and the sensor has an unobstructed view of the flow in the manhole invert. ADS finds that often the output side of the invert best meets this criteria.
- If installing a ParaFlow sensor, position the Wall Mount Bracket immediately above (or as close as possible) to the crown of the pipe to ensure that the surcharge velocity sensor will be able to read flow velocity during surcharged conditions.

Warning: When using the Retrieval Tool to either remove or re-install the sensor, care needs to be taken to avoid any overhead obstructions. Be especially aware of any overhead power lines.

Installing ADS Topside Retrieval System

Follow the steps below to install the Topside Wall Mount and Sensor Bracket.

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.

1. Determine which wall, upstream or downstream the Wall Mount Bracket will be installed on.

2. Mark a spot approximately one inch (25.4 mm) above the crown of the pipe that is centered over manhole invert. This is where the lower tab of the Wall Mount Bracket will be placed.



Mark Lower Tab Position for Mounting Bracket

3. Drill a hole using the hammer drill and the ½" masonry bit.
4. Hammer the Lag Bolt into place.
5. Place the lower tab of the Wall Mount Bracket on the Lag Bolt and finger-tighten a washer and nut to loosely hold it in place.



Place Lower Tab of Bracket on Lag Bolt and Finger-Tightening Bolt

6. Use the level to confirm that the bracket is level side to side.



Confirm Level Side to Side

7. Drill a hole through the upper tab using the hammer drill and hammer the Lag Bolt into place.
8. Place a washer and nut on the Lag Bolt and finger-tighten.
9. Re-confirm that the Wall Mount Bracket is level in both front to back and side to side. Once confirmed, tighten nuts. The installation of the Wall Mount Bracket is now complete.



Confirm Level Front to Back



Installed ParaDepth/ParaFlow Wall Mount Bracket



Stainless Steel Nuts and Washers Behind Mounting Bracket Tab for Leveling Purposes

NOTE: In situations where the manhole wall surface is inconsistent/uneven, run stainless steel nuts onto the top and bottom Lag Bolts followed by stainless steel washers before placing the bracket on the bolts. Adjust the nuts behind the bracket to more easily level the bracket front to back.

10. Attach the ParaDepth/ParaFlow sensor to the Sensor Bracket taking care that the sensor is properly oriented for the position of the Wall Mount Bracket.



Attach ParaDepth/ParaFlow Sensor to Sensor Bracket

11. Cable tie the sensor cable to the Sensor Bracket threading the cable ties through the holes along the edge of the Sensor Bracket.



Cable Tie Sensor Cable to Sensor Bracket

12. Seat the Sensor Bracket on the Wall Mount Bracket.

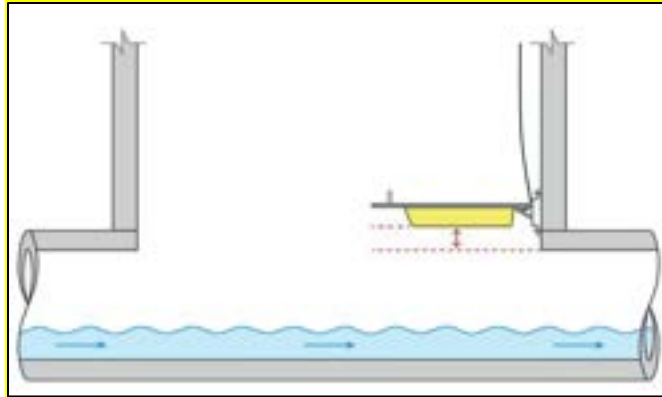


Installed Sensor Bracket on Wall Mount Bracket

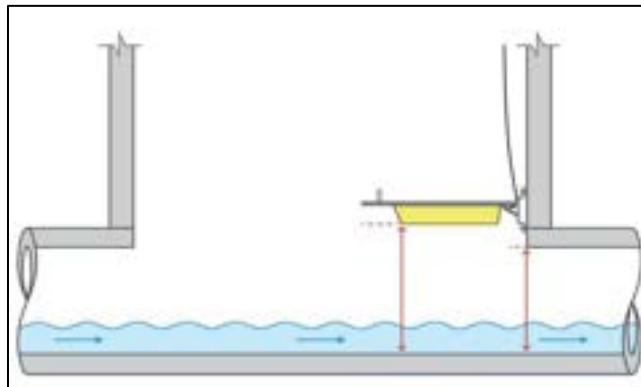
13. Lock the Sensor Bracket into place by turning the Sensor Bracket Loop clockwise.

Measuring the Physical Offset of the Sensor Prior to Exiting the Manhole

1. Once the sensor is positioned on the Topside Wall Mount, measure the Physical Offset of the sensor; the distance above the crown of the pipe. This distance will be input as a negative number when configuring the sensor in **Qstart^{XML}**. There are two ways to measure the Physical Offset. See illustrations below and refer to Chapter 4 [Configuration and Activation](#) for more information.



Directly Measure the Physical Offset
Sensor Face to Crown of Pipe = Physical Offset



Indirectly Measure the Physical Offset
Sensor Face to Invert – Pipe Height = Physical Offset

Securing Sensor Cable

1. To prevent debris from collecting on the cable during a surcharge vent, ensure the cable is relatively taut so that there is only a small amount of slack in the cable.



2. Coil any extra ParaDepth or ParaFlow cable and use a cable tie secure it to a manhole rung or the monitor handle.



Testing Removal and Reinstallation of Sensor Using Topside Retrieval Tool

1. Using the Topside Extendable Retrieval Tool, unhook the cable from the hook mounted on the manhole wall.

Warning: When using the Retrieval Tool to either remove or re-install the sensor, care needs to be taken to avoid any overhead obstructions. Be especially aware of any overhead power lines.

2. Run the Topside Extendable Retrieval Tool down the manhole to the Sensor Bracket; extending the pole as necessary.



Run the Topside Extendable Retrieval Tool Down the Manhole

3. Position the hook through the loop on the Sensor Bracket and turn counter-clockwise, then slowly raise the sensor to the top of the manhole.



Position the Hook Through the Loop on the Sensor Bracket



Turn the Hook Counter-Clockwise to Loosen and Raise Sensor Bracket

4. As a safeguard, as the sensor is being raised out of the manhole, simultaneously retrieve the sensor cable to minimize the distance the sensor could fall if it comes off the pole hook.
5. To reinstall, make sure the Sensor Bracket is securely looped on the pole hook, lower the Sensor Bracket down the manhole and seat the Sensor Bracket on the Wall Mount Bracket. Twist the Sensor Bracket loop clockwise to lock the bracket back in place.



Sensor Bracket Securely Looped on Pole Hook

6. Again, use caution when raising the Topside Retrieval Tool after the sensor reinstallation.

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.

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

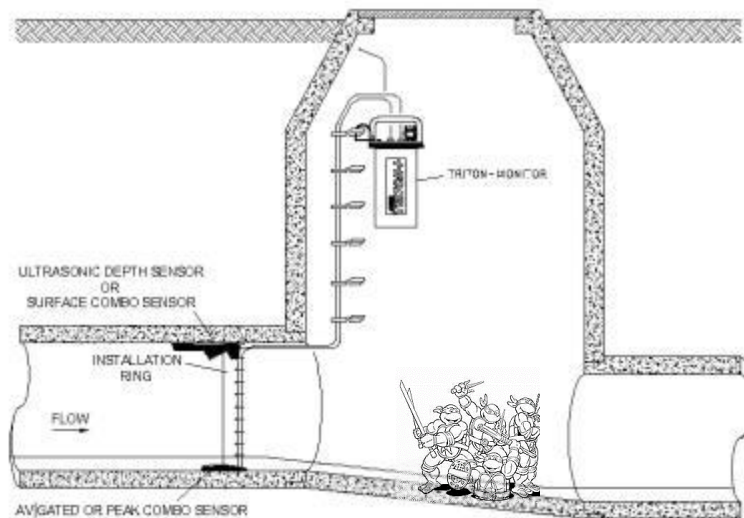
1. Neatly bundle the cables together with an 8-inch (4-mm x 200-mm) cable tie attached to a plastic anchor installed at the top of the pipe.
 - ☐ Drill a hole of the appropriate size for the shank of the plastic anchor in the pipe crown. *Refer to instructions with the anchors.*
 - ☐ Drive the plastic anchor into the pipe with a hammer until it is 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.

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 ¼-inch x 2 ¼-inch (M6 x 55-mm) anchor bolt instead.

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

2. Secure the cables with a cable tie and plastic anchor every 18 to 24 inches (457 to 610 mm) 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 M6 x 55-mm anchor bolts instead.*
3. Secure the cables every 18 to 24 inches (457 to 610 mm) 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 ¼-inch x 2 ¼-inch (M6 x 55-mm) anchor bolts instead.*

Warning: 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.



Securing the sensors cables along the pipe and into the manhole

Connecting the Sensors and Sampler 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 that receive the sensors are labeled **Channel 1** and **Channel 2**.

The **TRITON+** supports the connection of two sensors in any combination, including two of the same sensor type to the channel ports. However, to simplify the installation and configuration process, ADS recommends developing a system or convention to ensure consistency when attaching the sensors to the channel ports and assigning the corresponding channels to the sensor devices in **Qstart^{XML}**.

Establish a priority or order in which particular sensors are assigned to a specific channel and, when applicable and possible, correspond the channel number to the monitoring point. For example, consider always assigning the AV|Gated Sensor to Channel 1 and the second sensor to Channel 2.

The **TRITON+** also enables the user to connect a water quality sampler to the monitor for flow proportional or level-based sampling operations. ADS offers three 25-foot (7.6-m) cable options for connecting the sampler to the monitor based on the type of sampling. The No Pre-Wired Connector option can allow for other types of applications, such as triggering a camera.

- No Pre-Wired Connector (ADS p/n 8000-0348) on application (non-monitor) end of the cable
- Flow Proportional (ADS p/n 8000-0348-01)
- Level Actuation (ADS p/n 8000-0348-02)

Note: For more information on Sampler Cable connections and specifications, see *Appendix E*.

Note: A converter may be necessary to attach the sampler cable to the monitor.

Connect the sensor and sampler (when applicable) 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

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).

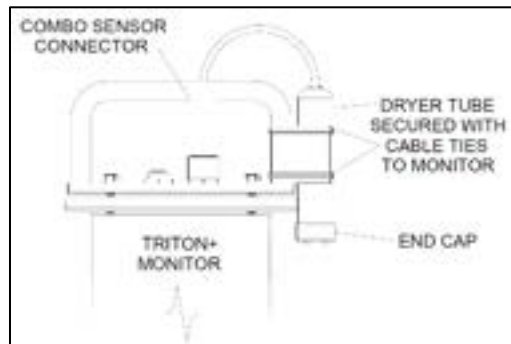
4. Verify that the waterproof seal is present inside each sensor cable end connector. The bright orange (or green), rubber seal should sit at the bottom of the connector with the pins protruding through the seal.
5. Connect each sensor cable to the appropriate port. Tighten each rotating connector collar in a clockwise direction until it clicks, and verify that it is seated correctly.
6. (*applicable only when performing water quality sampling*) Connect the appropriate sampler cable to the **COMM + EXT PWR** port. Tighten the rotating connector collar in a clockwise direction until it clicks, and verify that it is seated correctly.
7. For locations exhibiting the presence of hydrogen sulfide and/or high moisture, provide added protection by wrapping the connection with mastic tape.
8. Seal any unused connectors with protective caps. If necessary, obtain additional caps from ADS.

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

Securing the Dryer Tube to the Monitor

The Peak Combo, AV|Gated, and Surface Combo sensors each contain a pressure depth sensor with an associated dryer tube. For each combo sensor connected to the monitor, you must secure the corresponding dryer tube (attached to a cable running from the sensor connector) 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 using cable ties. Make sure the clear, flexible tubing coming from the sensor connector to the top of the dryer tube is not kinked. If necessary, use a loose cable tie to hold it in an unkinked position.



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.
3. (*applies only when a second dryer tube is present*) Repeat steps 1 and 2 for the other dryer tube, but attach it to the other vertical portion of the handle on the opposite side of the monitor.

CHAPTER 6

External Power

An ADS **TRITON**+® (models 8000-FST-IM-EP-4WW-XXX) supporting wireless communication can receive power from an external DC power source. However, any connection of external power to the monitor must occur through an external power and communication unit (ExPAC, ADS p/n 3800-0377), an external Modbus interface unit (XBUS™, ADS p/n 8000-0427), or an external input/output unit (XIO™, ADS p/n 8000-0400) for compliance with IS certification.

Note: When installing an ExPAC, XBUS, or XIO, ADS recommends locating the unit in close proximity to the DC power source to maximize the net power available to the unit.

Note: The externally-powered **TRITON**+, ExPAC, XBUS, and XIO are not equipped with backup power. Therefore, in the event of an interruption or loss of power at the power source, the monitor will discontinue taking readings until power is restored. However, a loss of power will *not* result in a loss of data. The monitor will retain all stored data in memory.

Installation

A typical field installation involving external power requires the following:

- An AC mains power line terminated at a pole or post close to the manhole in which the monitor is installed
- An AC distribution device (i.e., disconnect, fuse, or breaker box) on the pole/post
- An earth ground rod installed next to the pole/post bonded to the AC distribution device
- An AC to 24-volt DC converter (i.e., power supply). ADS recommends a power supply available through ADS (p/n 508293), which works with worldwide AC power (94 – 240 VAC, 50 – 60 Hz). This power supply is provided automatically as part of the XIO and XBUS, but must be ordered for the ExPAC, when a power supply is required. However, please note that the customer may use another AC-to-DC converter/power supply, if desired, to support the ExPAC, provided it can supply from 9 to 36 volts of power at a minimum of 15 watts.
- A power cable running between the external DC source (i.e., power supply) and the ExPAC power input. The customer must supply this cabling of the appropriate length and specifications
- A properly rated enclosure to house and protect the ExPAC and power supply

Note: Applications involving an XIO or XBUS do not require an additional power cable or an enclosure because they are included. The power is pre-run between the power supply and ExPAC inside the XIO enclosure.

- A communication cable (ADS p/n 8000-0378-xx, where xx represents the required length of the cable) running between the ExPAC/XBUS/XIO and the monitor
- A 10-gauge (4 mm²) earth ground wire (included in external power grounding kit, ADS p/n 8000-0434-xx, where xx represents the required length of the wire) running between the ExPAC/XBUS/XIO and the monitor

Note: All work required to run AC power to the pole and wire the power into an approved AC distribution device (i.e., a disconnect, fuse, or breaker) should be performed by a licensed electrician. Typically, an electrical permit from the owner of the collection system or local power authority is required to install a pole or electrical equipment next to a monitor location.

DC Power Requirements and Consumption

To run on external power, the *TRITON+* system requires a power source capable of supplying between 9 and 36 volts and a minimum of 15 watts as measured/available at the ExPAC (not at the power source output). ADS offers a power supply (ADS p/n 508293) for this application. However, if you choose not to use this recommended power supply, the alternate power supply must be a high-quality industrial-type power supply with ripple no greater than 250mV P-P. When long cable runs are required, size the supply and cabling to ensure that line losses do not reduce the net power available to the ExPAC.

To support *TRITON+* monitors running in continuous mode, the external DC power source must be capable of accommodating the following system requirements concerning power consumption:

Note: The power to the monitor is ATEX/IECEX I.S. compliant at 8 to 11.8 VDC.

Following are the power requirements for monitors that communicate wirelessly and obtain power through an ExPAC:

- **Monitor in Sleep Mode with Modem Power On** 26 mA
- **Monitor in Sleep Mode with Modem Power Off** 25 mA
- **Monitor Firing Sensors during Measurement Cycle without Wireless Communications** 110 mA

- **Monitor Firing Sensors during Measurement Cycle with Wireless Communications Idle** 140 mA
- **Monitor Firing Sensors during Measurement Cycle with Wireless Communications Active (<10 milliseconds)** 360 mA
- **Wireless Modem Communications Idle** 110 mA
- **Wireless Modem during Data Collection (147 blocks of data over 150 seconds)** 130 mA
- **RS-485 (ExPAC) Modbus Communications (updating every 2 seconds)** 81 mA
- **USB (ExPAC) Communications Idle** 86 mA
- **USB (ExPAC) Communications during Data Collection (147 blocks of data over 50 seconds)** 90 mA

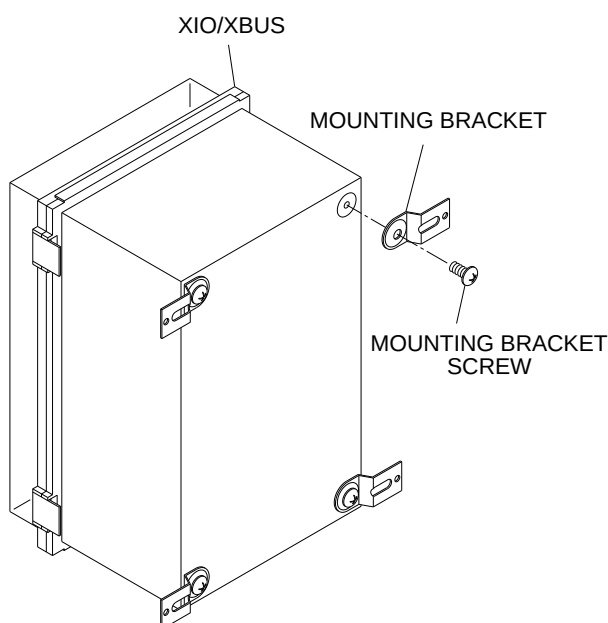
Note: Measurement cycle involves firing Peak Combo Sensor and Surface Combo Sensor and running MLI.

Mounting the XIO or XBUS

Note: These instructions apply only to applications involving an XIO or XBUS. If the monitor will not receive external power through an XIO or XBUS, proceed to the next section, *Mounting the Recommended Power Supply*.

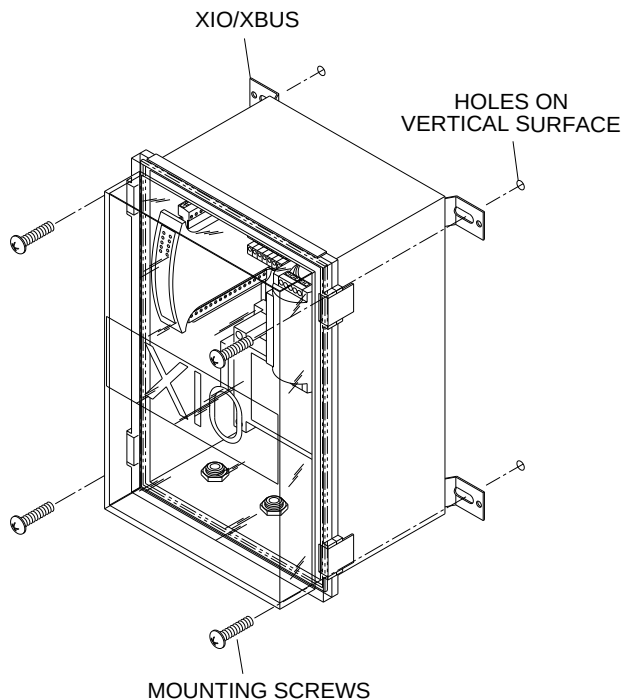
Mount and secure the XIO or XBUS in such a way that takes into account the specific environment in which it will be located. For *outdoor* installation, mount it in such a way that will provide the best protection against the elements and excessive heat or cold. The operating temperature range for the XIO/XBUS is -14° to 122° F (-10° to 50° C). Locate the enclosure under an awning or other structure to prevent direct sun exposure. For *indoor* installation, mount the XIO/XBUS in a location that prevents tampering or potential damage from occurring.

1. Turn over the XIO/XBUS, and locate the four holes on the back of the unit.
2. Attach the four mounting brackets to the back of the XIO/XBUS using the mounting bracket screws. The brackets and screws are included with the XIO/XBUS. Refer to the following figure for details on how to secure the mounting brackets to the unit.



Attaching the mounting brackets to the back of the XIO/XBUS

3. Identify the location on the wall, other solid structure, or rack at which you want to mount the XIO/XBUS.
4. Secure the XIO/XBUS to the surface or rack through the mounting brackets using appropriate fasteners (supplied by the customer).



Mounting the XIO/XBUS to the designated surface or structure

Mounting the Recommended Power Supply

Note: For applications involving an XIO or XBUS, you can disregard these instructions for mounting the power supply because both the XIO and XBUS come from the factory with the power supply pre-mounted to a DIN rail in the XIO/XBUS enclosure.

Mount and secure the power supply in such a way that takes into account the specific environment in which it will be located. For *outdoor* installation, mount it inside a secure, weatherproof enclosure (minimum NEMA IP66) that will provide the best protection against the elements and excessive heat or cold. The operating temperature range for the power supply is -40° to 158° F (-40° to 70° C). Locate the enclosure under an awning or other structure to prevent direct sun exposure. For *indoor* installation, mount the power supply inside an enclosure or in a location that prevents tampering or potential damage from occurring.

Note: ADS recommends mounting the power supply and the ExPAC in the same enclosure or in close proximity.

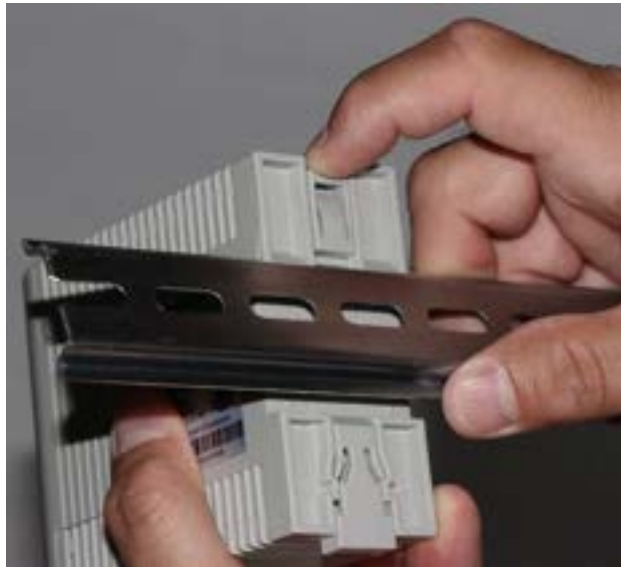
The power supply is designed for mounting on a 35- x 7.5-mm DIN rail in the following way:

1. Notice the inset on the back of the power supply that includes a wedge at the top and a small notch at the bottom to secure the power supply to the DIN rail. Slide the top edge of the DIN rail up into the top wedge on the back of the power supply.



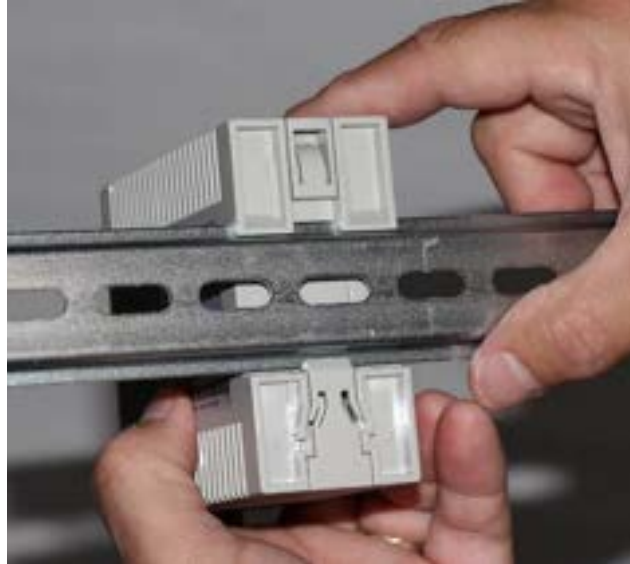
Sliding the top edge of the DIN rail into the wedge on the back of the power supply

2. Notice the sliding tab running down the middle of the back of the power supply. Press down on that tab to slide the tab down vertically. You also can slide the tab down using the end of a flathead screwdriver inserted into a slot on the tab located at the top of the power supply. Hold the tab down to prevent the notch at the bottom of the inset from blocking bottom of the DIN rail.



Pressing down the sliding tab from the top

3. Push the bottom edge of the rail into the inset on the back of the power supply and release the sliding tab. The spring mechanism will allow the notch to return to its original position, completely securing the power supply to the DIN rail.



Power supply firmly secured to the DIN rail



Front view of power supply mounted to DIN rail

Mounting the ExPAC

Note: For applications involving an XIO or XBUS, you can disregard these instructions for mounting the ExPAC because both the XIO and XBUS come from the factory with the ExPAC pre-mounted to a DIN rail inside the XIO/XBUS enclosure.

Mount and secure the ExPAC in such a way that takes into account the specific environment in which the unit will be located. For *outdoor* installation, mount it inside a secure, weatherproof enclosure (minimum NEMA IP66) that will provide the best protection against the elements and excessive heat or cold. The operating temperature range for the ExPAC is -4° to 122° F (-20° to 50° C). Therefore, make sure the enclosure is also located under an awning or other structure to prevent direct sun exposure. For *indoor* installation, mount the ExPAC inside an enclosure or in a location that prevents tampering or potential damage from occurring.

The ExPAC is designed for mounting on a 35- x 7.5-mm DIN rail *or* securing to another surface or structure through the four predrilled holes on the sides of the unit.

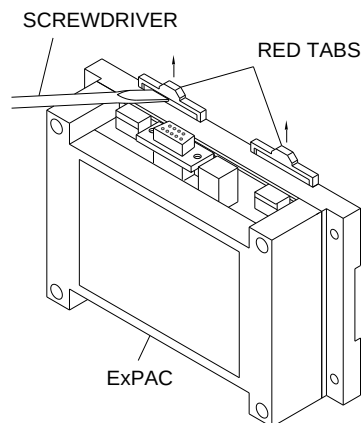
Mounting the ExPAC to a DIN Rail

Mount the ExPAC to an existing DIN rail in an enclosure or on a rack in the following way:

1. Make sure the red, plastic tabs on the back of the ExPAC are in the open (or *extended*) position. To open the tabs, insert a flathead screwdriver into the inset on the triangular portion of the tabs (from the front of the unit) and press upward until it clicks and pops up slightly.



ExPAC with red mounting tabs – left tab displayed in closed (locked) position; right tab displayed in open (released) position



Using a screwdriver to open (release) the red tabs

2. Notice the horizontal inset across the back of the ExPAC. Slide the lower edge of the DIN rail down into the small groove at the bottom of the inset on the back of the ExPAC.



Inserting the lower edge of the DIN rail into the bottom groove on the back of the ExPAC

3. Press the top edge of the DIN rail flush against the back of the ExPAC completely into the inset.



Pressing the upper edge of the DIN rail against the back of the ExPAC

4. Press down the red tabs (using your finger or a screwdriver) until they click into place, securing the ExPAC to the DIN rail.



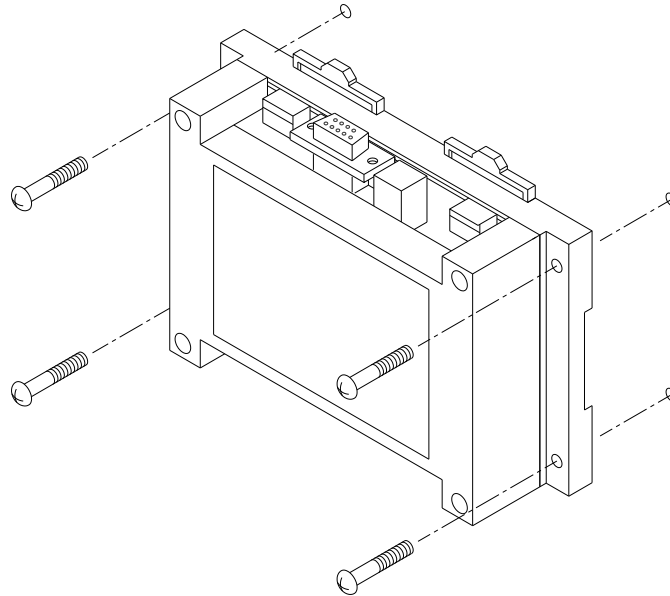
Tabs in closed (locked) position, securing the ExPAC to the DIN rail



Front view of ExPAC mounted to DIN rail

Securing the ExPAC using Fasteners

If a DIN rail is not available, secure the ExPAC to a solid surface or structure using suitable fasteners (i.e., screws) through the four predrilled holes on the outer edges of the unit.



Mounting the ExPAC directly to a wall or other structure using screws through the 4 pre-drilled holes in the unit

Wiring the AC Power Source to the Recommended Power Supply

Note: The following instructions apply only when using the ADS XIO, ADS XBUS, or the XP Power power supply recommended by ADS (p/n 508293). This power supply is also used in the XIO and XBUS. When using another third-party power supply, refer to the vendor's instructions for the proper connection procedures.

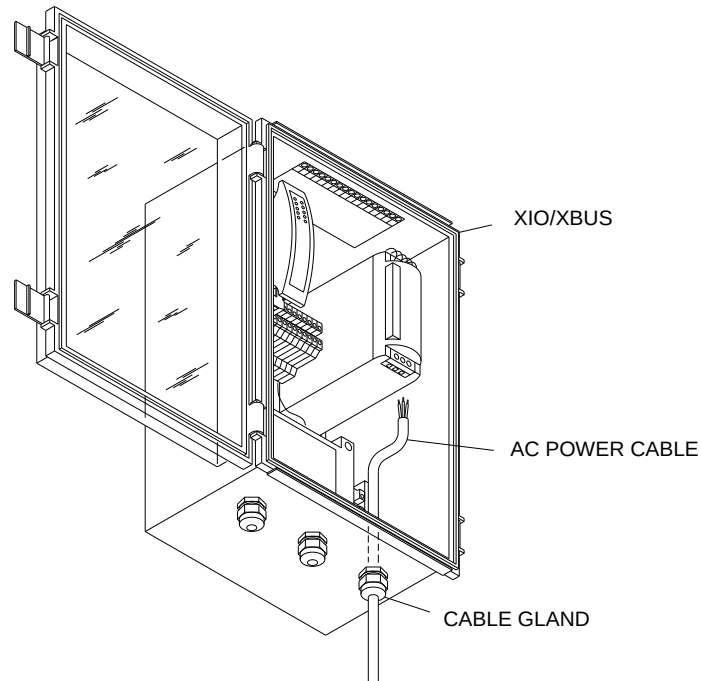
The first step in running external power to the monitor involves wiring the cable coming from the AC power source to the power supply.

Wire the AC power cable to the power supply in the following way:

1. Determine the appropriate length and construction of AC power cable required to run from the external power source to the power supply. Customer-supplied cabling may be used.

WARNING: When hard-wiring to the AC supply, ensure that the AC source is de-energized and that all applicable lockout/tagout and other electrical safety measures are followed. In addition, do not turn on power until all wiring and connections are complete, from the AC source to the **TRITON+** monitor.

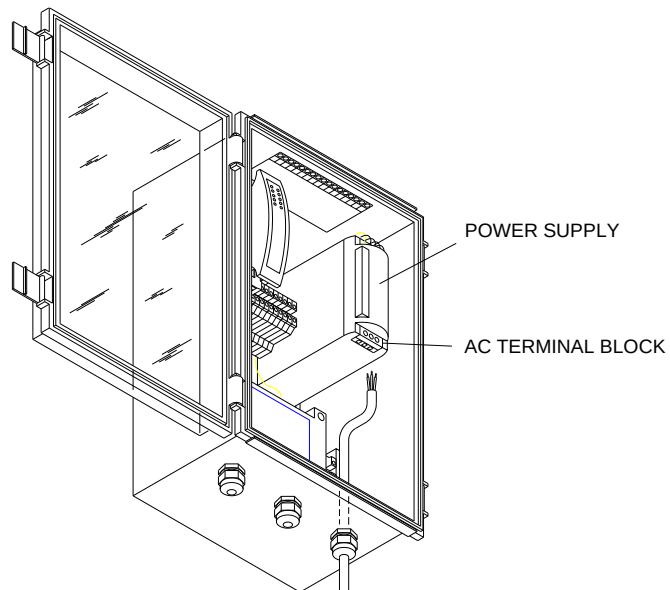
2. Run the cable from the AC power source to the power supply.
3. Loosen and prepare the wires from the cable for connection to the power supply.
4. Open the door to the XIO or XBUS by releasing the two latches or to the other enclosure housing the power supply, as applicable.
5. Feed the power cable up through a cable gland in the XIO/XBUS, or other enclosure. If the power supply is inside an XIO or XBUS, run the cable through the cable gland on the right. You may need to loosen the plastic nut on the cable gland to allow cable entry.



Feeding AC power cable through XIO/XBUS cable gland

Note: When positioning the cable inside the XIO, XBUS, or other enclosure, maintain a small space between the cable and the right side of the ExPAC.

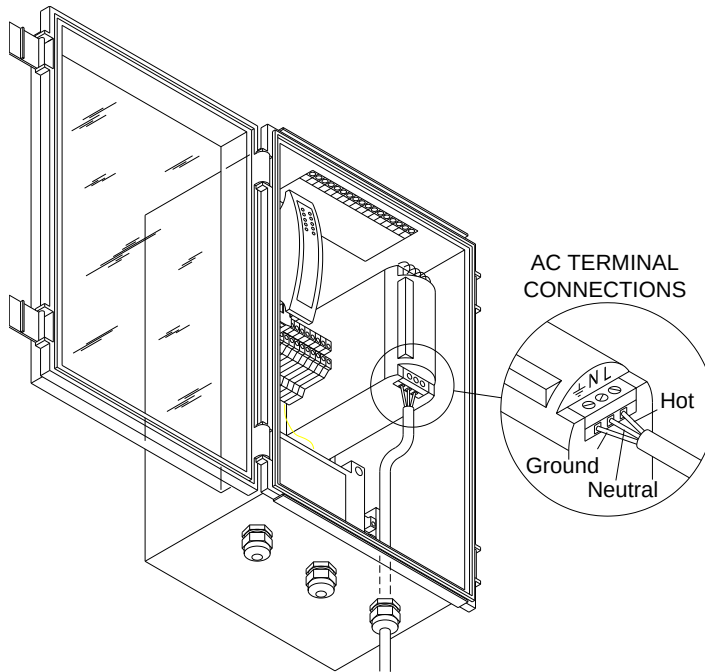
6. Loosen the screws on the AC input terminals at the bottom, front of the power supply.



Location of AC input terminal block on power supply

7. Connect the power cable wires to the terminals on the power supply by running each wire through the appropriate terminal hole in the bottom of the power supply and tightening the corresponding terminal screw:
 - ☐ Connect the *hot* (typically *black or red*) wire from the power cable to the *line (L)* terminal on the power supply.

- ❑ Connect the neutral (typically white) wire from the power cable to the neutral (N) terminal on the power supply.
- ❑ Connect the earth ground (typically green) wire from the power cable or electrical panel chassis to the earth ground (⏏) terminal on the power supply.



Input terminal connections on power supply for AC cable

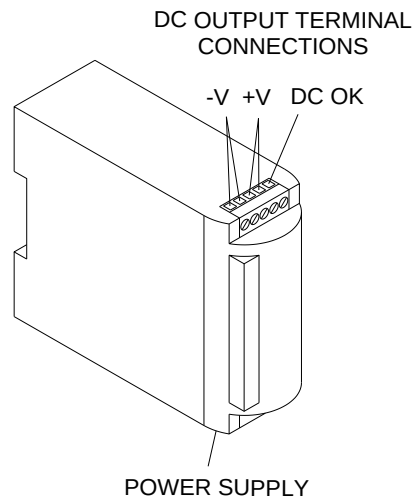
Wiring the Power Supply to the ExPAC

Note: The XIO and XBUS both come from the factory with the ExPAC and power supply pre-wired in the XIO/XBUS enclosure. Therefore, for applications involving the XIO or XBUS, proceed to the next section, *Running the Ground Wire*. Instructions for installing and wiring the power supply to the ExPAC have not been included for applications involving an XIO or XBUS.

The next step in connecting the monitor to external power involves running two wires between the power supply and the ExPAC. ADS recommends using 18- to 22-gauge stranded wire. However, for runs longer than 20 feet, use 14-gauge wire.

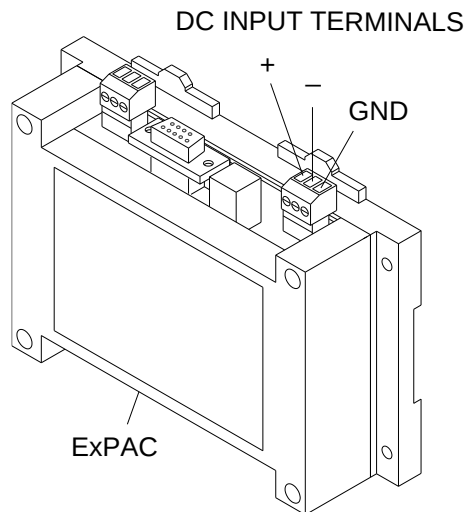
Connect the wires to the power supply and the ExPAC in the following way:

1. Strip the individual wires on both ends to prepare for connecting to the terminals on the hardware.
2. Loosen the screws on one of the -V and one of the +V DC output terminals (front, top corner) on the power supply.



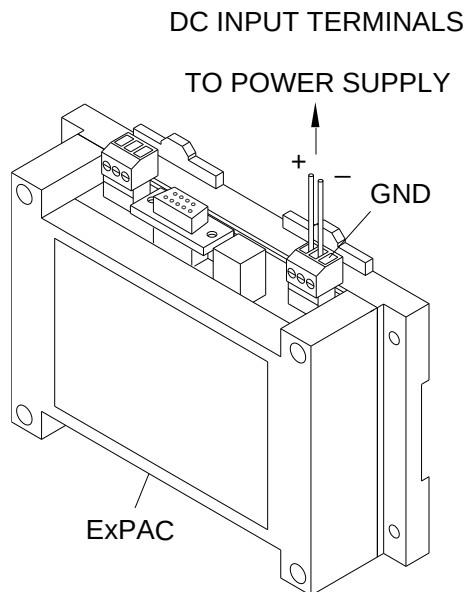
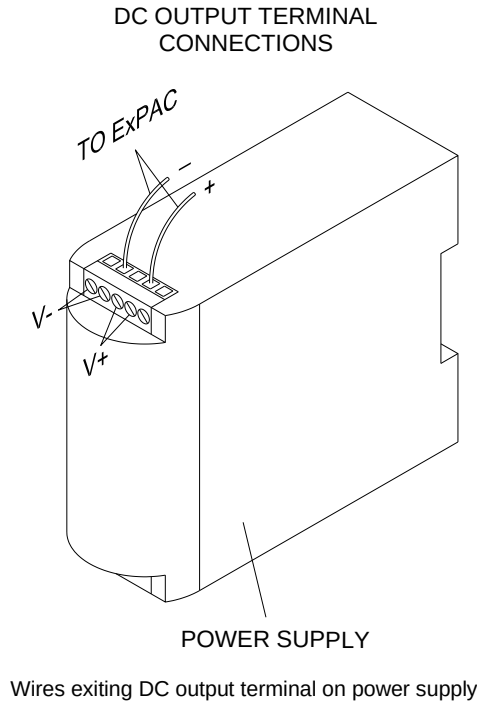
DC output terminals on power supply

3. Loosen the screws on the +, -, and GND DC INPUT terminal connector on the ExPAC (top, right). Refer also to the wiring label on top of the ExPAC.



DC input terminals on ExPAC

4. Insert the end of one wire into the hole corresponding to the -V DC output terminal on the power supply, and tighten the associated terminal screw. Then, insert the other end of the same wire into the hole corresponding to the negative (-) DC input terminal on the ExPAC, and tighten the associated terminal screw.
5. Insert the end of the other wire into the hole corresponding to the +V DC output terminal on the power supply, and tighten the associated terminal screw. Then, insert the other end of the same wire into the hole corresponding to the positive (+) DC input terminal on the ExPAC, and tighten the associated terminal screw.



Positive and negative wires entering DC input terminal connector on ExPAC

Running the Ground Wires

Ground wires are required for all external power applications: one running from the ExPAC to the earth ground *and* one running from the ExPAC to the monitor. The procedure for installing these wires varies slightly based on whether you are using the XIO, XBUS, or another enclosure to house the ExPAC.

The XIO and XBUS both come from the factory with a short ground wire running from the ExPAC to one of two ground terminal blocks that are adjacent to the ExPAC. For these applications, you must run a ground wire from one of the ground terminal blocks to the existing earth ground outside the XIO/XBUS *and* then run another ground wire from the other ground terminal block to the *ground connection facility* on

the **TRITON+** monitor. The ground connection facility represents the specific location on the monitor top at which the ground wire from the ExPAC terminates.

When using an ExPAC, you first must install two ground terminal blocks next to the ExPAC and run a short ground wire from the ExPAC to one of two ground terminal blocks adjacent to the ExPAC. Then, you must run a ground wire from one of the ground terminal blocks to the existing earth ground outside the applicable enclosure *and* run another ground wire from the other ground terminal block to the **TRITON+** monitor's ground connection facility.

The *10-gauge* ground wire that runs between a ground terminal block and the monitor is included in an *external power grounding kit* available through ADS (p/n 8000-0434-xxx). This kit is *required* for all external power applications. For the ground wire that runs between a ground terminal block and the existing earth ground, ADS recommends using at least a *12-gauge* ground wire. For applications that do not include the XIO or XBUS, you must acquire *two* ground terminal blocks that can accommodate 18- to 10-gauge wires and obtain an *18-gauge* ground wire to run from the ExPAC to a ground terminal block.

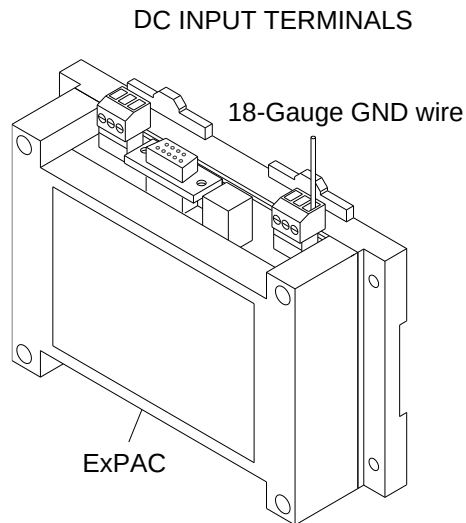
Install the ground wiring in the following way:

1. (*applies only to applications without an XIO or XBUS*) Perform the following steps to prepare the ExPAC before running the two primary ground wires:

- ☐ Mount two ground terminal blocks on the existing DIN rail or other suitable structure to the right of the ExPAC. Remember, you must use terminal blocks that can accommodate 18- to 10-gauge ground wire.

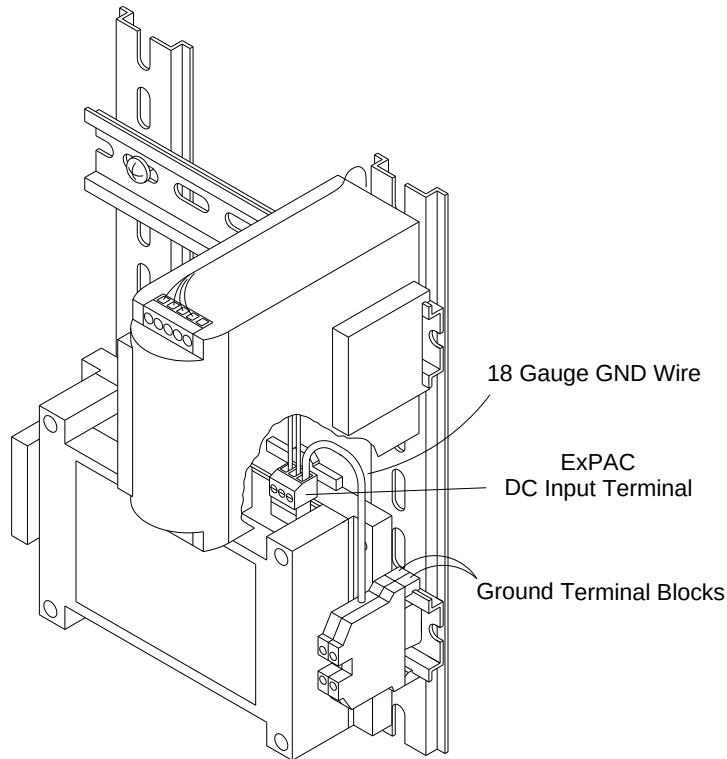
Note: If you are not mounting the ground terminal blocks to a metal DIN rail, make sure they are mounted to a structure or intersect in such a way that ensures that all the ground wires attached to both terminal blocks share a common electrical connection.

- ☐ Loosen the screw corresponding to the earth ground (⚡) terminal on the DC INPUT terminal connector on the ExPAC. Insert one end of the 18-gauge ground wire into the terminal, and tighten the screw.



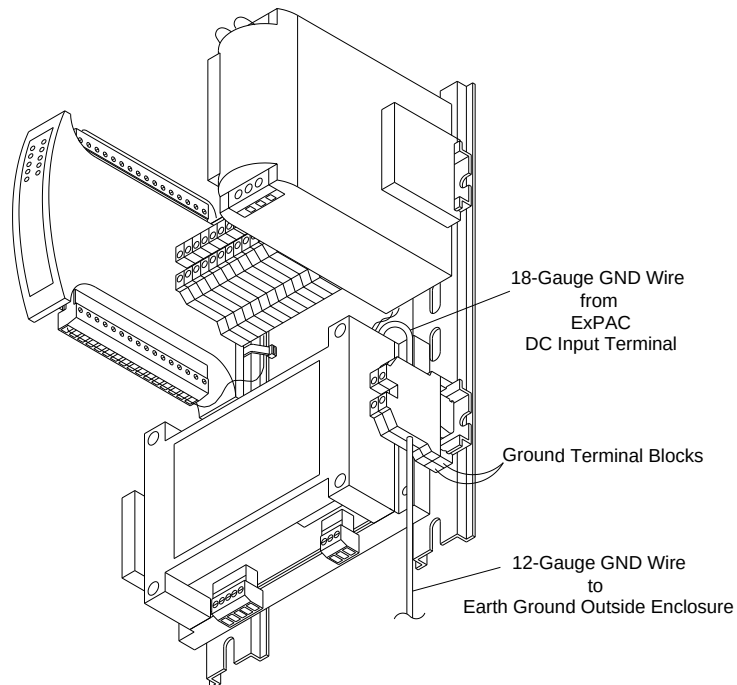
18-gauge ground wire inserted into DC input terminal on ExPAC

- ☐ Loosen the terminal screw corresponding to the top terminal of one of the new ground terminal blocks. Insert the other end of the 18-gauge ground wire into the terminal and tighten the screw.



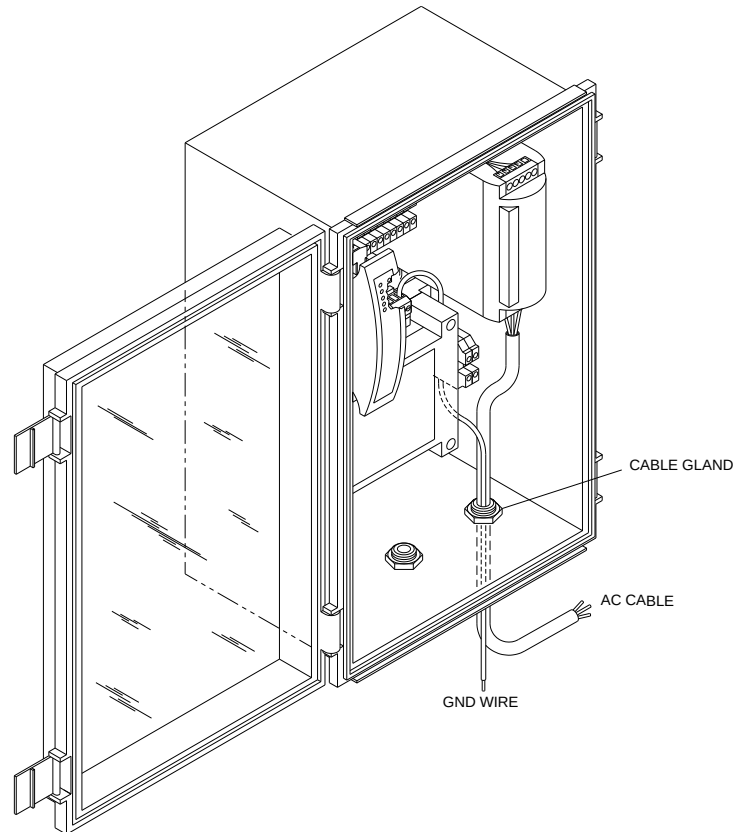
Inserting the 18-gauge ground wire into the top terminal of one of the ground terminal blocks

2. Loosen the terminal screw corresponding to the bottom terminal of one of the ground terminal blocks next to the ExPAC, and insert one end of the 12-gauge ground wire into the terminal and tighten the screw.



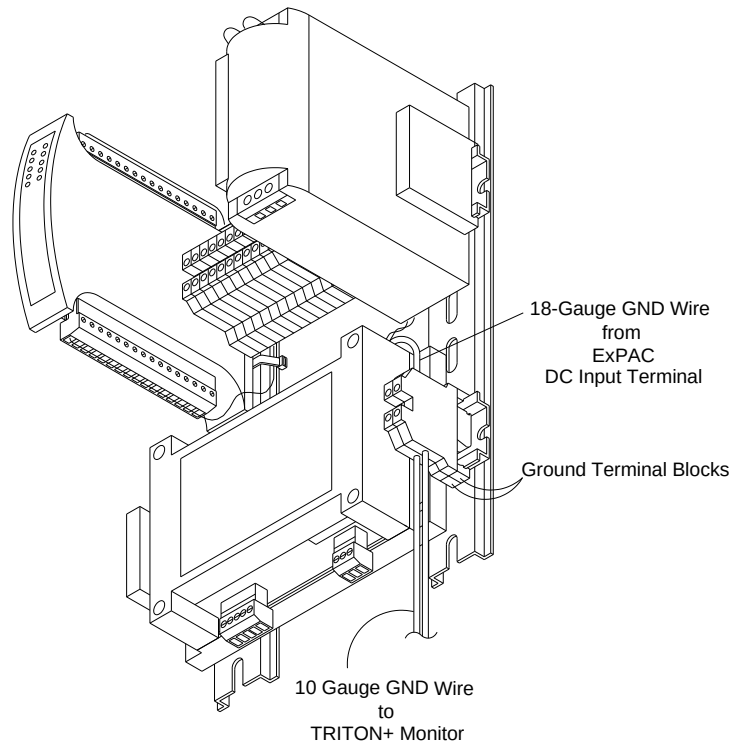
Securing the 12-gauge ground wire into one of the ground terminal blocks

3. Run the free end of the 12-gauge ground wire through the cable gland on the right (*for the XIO/XBUS*) or through an available cable exit route from the inside of the existing enclosure. The cable gland referenced for the *XIO/XBUS* is the same gland through which the *AC power cable* enters the unit.



Ground wire running from ExPAC through cable gland in enclosure

4. Connect the free end of the 12-gauge ground wire to the earth ground available at the location.
5. Run the free end (*without the ring terminal*) of the 10-gauge ground wire (from the *external power grounding kit*, ADS p/n 8000-0434-xxx) up through the cable gland on the right (*on the XIO/XBUS*) or up through an available cable route from the outside of the existing enclosure. The cable gland or entry entry route referenced is the same gland/route through which the *AC power cable* and other ground wire are exiting the unit.
6. Loosen the terminal screw corresponding to the bottom terminal of the other ground terminal block next to the ExPAC, and insert the free end of the 10-gauge ground wire into the terminal and tighten the screw.



Securing the 10-gauge ground wire into the other ground terminal block

7. Gently pull on the ground and power cables from the outside of the enclosure to remove any excess cabling inside the enclosure.
8. (*applicable only to the XIO and XBUS*) Hand-tighten the plastic nut on the cable gland to secure the cables and prevent moisture or debris from entering the inside of the enclosure through the cable entry point.



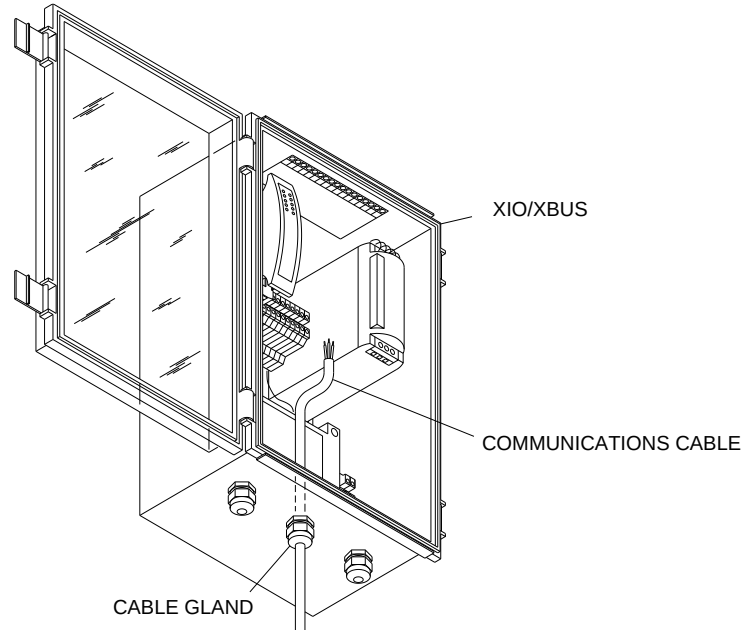
AC power cable running through cable gland with plastic nut (*ground wires are not visible from this perspective*)

Wiring the ExPAC/XBUS/XIO to the Monitor

The last step in connecting the monitor to the external power source involves running the external power/communication cable (ADS p/n 8000-0378-xx) and ground cable (from the *external power grounding kit*, ADS p/n 8000-0434-xxx) between the ExPAC, XBUS, or XIO and the monitor. One end of the external power/communication cable has a metal connector for connection directly into the monitor's communication/external power port (**COMM + EXT PWR**). The other end includes loose wires for connecting to the terminals on the ExPAC. One end of the ground cable has a metal ring terminal for attachment to one of the bolts on the monitor top referred to as the *ground connection facility*. The other end of the ground cable should have been connected to the inside of the ExPAC enclosure, XBUS, or XIO based on the instructions in the previous section.

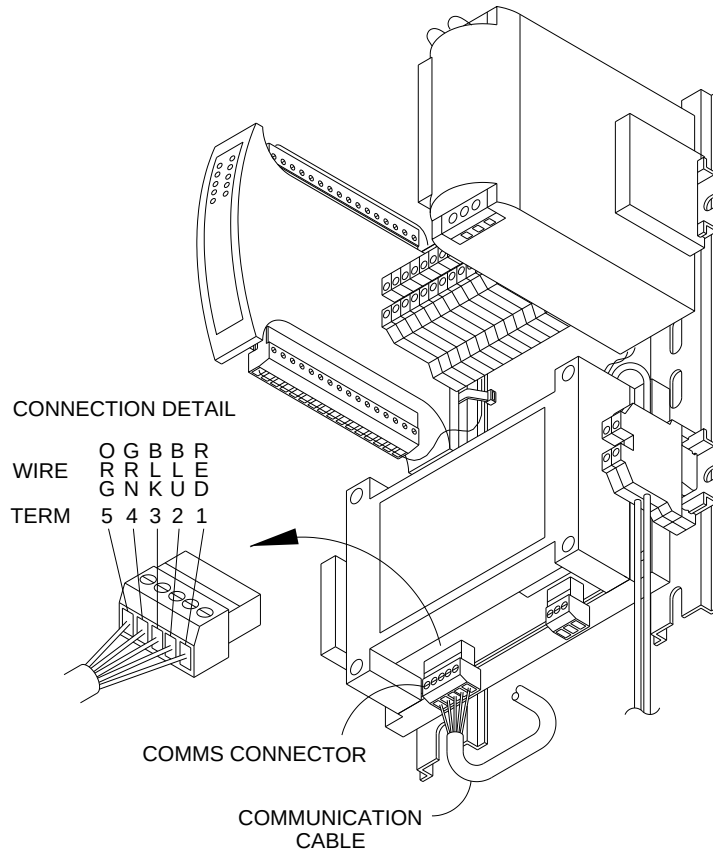
Connect the ExPAC/XBUS/XIO to the monitor in the following way:

1. (*applicable only to the XIO and XBUS*) Loosen the plastic nut corresponding to the middle cable gland on the bottom of the XIO/XBUS unit.
2. Feed the end of the communication cable with the loose wires through the middle cable gland in the XIO/XBUS or a suitable cable entry point into the other enclosure, as applicable, from the outside of the unit/enclosure.



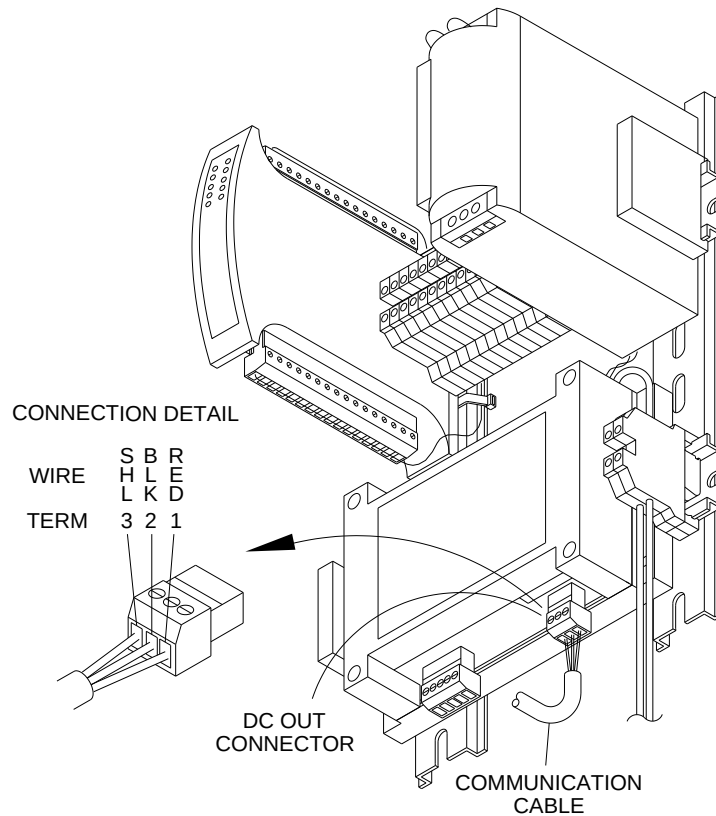
Communications cable coming through the middle cable gland at the bottom of the XIO/XBUS

3. Loosen all of the **COMMS** and **DC OUT** terminal screws on the bottom of the ExPAC. Consider removing the corresponding terminal block connectors from the ExPAC to simplify the process of loosening the terminal screws, inserting the wires in the terminals, and re-tightening the screws.
4. Insert the *lighter* gauge (i.e., smaller diameter) wires into the associated terminals on the **COMMS** terminal block connector based on the color of the wire, and tighten the corresponding terminal screws. Refer to the color guide for the wires on the label at the bottom of the ExPAC in front of the **COMMS** terminal connector.



Wiring communications cable to **COMMS** terminal connector on ExPAC

5. Insert the **COMMS** terminal block connector back into the corresponding port on the ExPAC, when applicable.
6. Insert the *heavier* gauge (i.e., larger diameter) *red* and *black* wires into the associated **RED** and **BLK** terminals on the **DC OUT** terminal block connector, and tighten the corresponding terminal screws. Refer to the color guide for the wires on the label at the bottom of the ExPAC in front of the **DC OUT** terminal connector.



Wiring communications cable to **DC OUT** terminal connector on ExPAC

7. Insert the remaining *lighter gauge clear* wire into the **SHL** terminal on the **DC OUT** terminal block connector, and tighten the corresponding terminal screw.
8. Insert the **DC OUT** terminal block connector back into the corresponding port on the ExPAC, when applicable.
9. Gently pull on the communication cable from the outside of the enclosure to remove any excess cabling inside the enclosure.
10. Hand-tighten the plastic nut on the cable gland to secure the cable and prevent moisture or debris from accessing the inside of the enclosure through the cable entry point.



Monitor communication cable running through middle cable gland with plastic nut on XIO or XBUS

11. Run the communication cable and the ground wire (*with the ring terminal*) to the monitor location.
12. Remove the bolt adjacent to the **COMM + EXT PWR** and **ANTENNA** ports from the monitor top using a 13-mm nut driver. This bolt secures the ground connection facility washers and also helps secure the monitor top to the canister. *You may encounter some resistance to removing the bolt from the retaining washer located between the monitor top and the canister.*



Retaining washer from bottom of monitor top

13. Remove and discard the used *retaining* washer.
14. Remove the internal-tooth washer and the washer with the guide tabs (i.e., two sides turned up) from the bolt, but leave the square and split (i.e., lock) washers on the bolt.



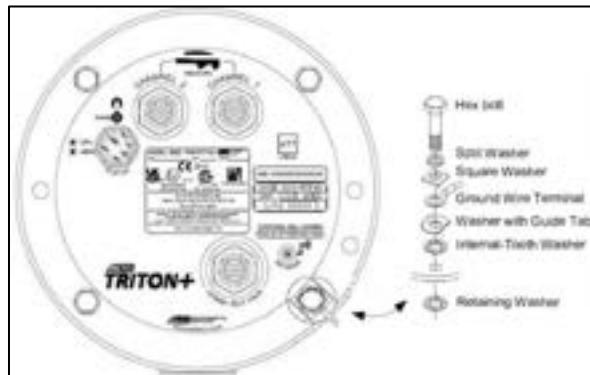
Internal-tooth washer (left) and washer with guide tabs (right)

15. Slide the ring terminal from the ground wire onto the bolt (*with the crimp barrel on the ring terminal facing the head of the bolt*), and then slide the washer with the guide tabs and the internal-tooth washer back onto the bolt. Make sure the ground wire is exiting one of the sides of the washer that is not turned up. The ring terminal should be seated *flat* against the washer with the guide tabs.



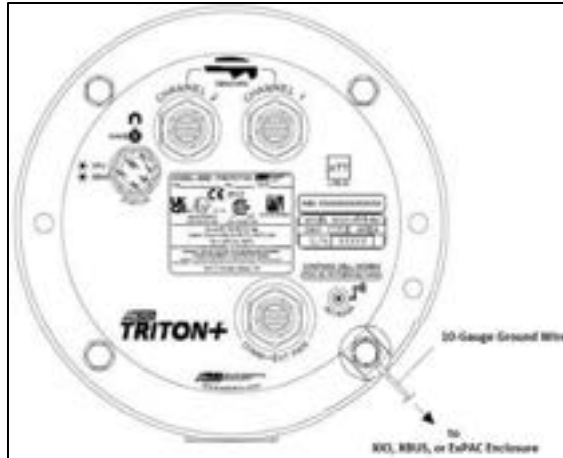
Ground wire ring terminal from ground cable

16. Slide the new retaining washer (from the external power grounding kit) in between the monitor top and the canister, positioning it so that it is properly aligned with the bolt hole.
17. Insert the bolt with the stacked washers and ring terminal back through both the hole in the monitor top and the new retaining washer back until it contacts the threads in the hole on top of the canister.



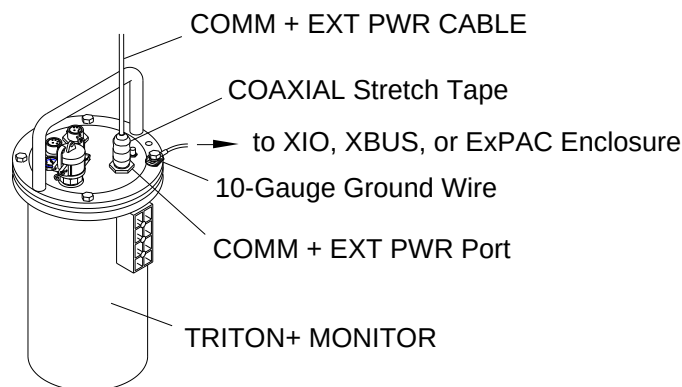
Bolt with ring terminal and washers inserted through monitor top and secured with the retaining washer

18. Tighten the bolt to approximately **30 inch-pounds** (2.50 foot-pounds/ 3.39 Nm) to fully secure the ground connection facility and the ground wire, as well as the top to the canister.



Proper orientation of ground wire in ground connection facility

19. Attach the other end of the communication cable to the **COMM + EXT PWR** port on the top of the monitor. If the monitor will be in a manhole, ADS recommends wrapping rubber stretch tape around the entire cable connection, extending 1 to 2 inches onto the cable beyond the connection.



External power/communication cable attached to **COMM + EXT PWR** port and ground wire secured to bolt on top of monitor

Final Instructions

1. Verify the following *before* connecting to the power source:
 - ☐ External power cable is connected to both the AC power source or distribution device (i.e., disconnect, fuse, or breaker box) and the power supply (when applicable)
 - ☐ Power supply (or appropriate DC power source) is connected to the ExPAC
 - ☐ Ground wire is connected to both the XIO/XBUS ground terminal block/ExPAC (as applicable) and the existing earth ground
 - ☐ Communication cable is connected to both the monitor and the ExPAC
 - ☐ Grip fittings on the cable glands are tightened securely and XIO/XBUS (or other enclosure cover) is closed and latched
2. Supply power to the system.
3. Verify that the **ON** LED is *illuminated* on the power supply (*when applicable*) and that both the ExPAC DC IN and DC OUT LEDs also are illuminated. For more information on locating and interpreting the LEDs on the ExPAC, refer to *Chapter 10, Maintenance and Troubleshooting*.

CHAPTER 7

Monitor Installation

After installing the sensors and establishing communications, install the ADS **TRITON**+[®] 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 or by a hook connected to the monitor that attaches to a rung. 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.

Note: When ordering a monitor, please also indicate the mounting option to ensure you receive the appropriate installation hardware: *wall/rim* mount (ADS p/n I40-0009) or *rung* mount (ADS p/n 8000-0021).

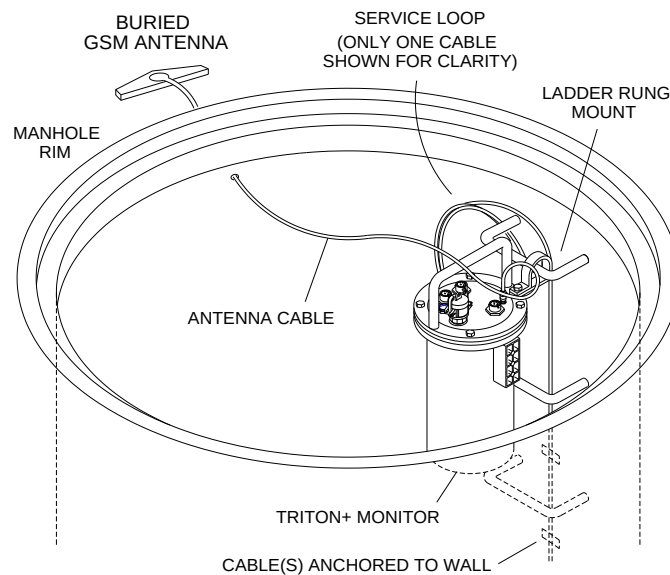
Before installing the monitor at the site, activate the monitor to verify that the monitor is configured correctly for the application and that the battery pack is operating at an adequate voltage. Make any necessary changes to the configuration *before* mounting the unit. Refer to *Chapter 11, Maintenance and Troubleshooting*, for information on replacing the battery pack, when 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 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.

Mounting the Monitor on Manhole Rung

The simplest way to mount a monitor in a manhole is to attach it to a rung. *TRITON+* monitors come with a standard hook (ADS p/n 8000-0021) for this purpose.

- Make sure the rungs are capable of holding the weight of the monitor and cables. The monitor weighs 30.3 pounds (13.7 kg) with added weight coming from the cables.
- The hook must be closed to prevent accidental dislodging from its support rung. The hook has two pieces, a curved portion that goes over the rung and a straight portion which closes the hook underneath the rung. The hook must be closed and the clamping bolt/nut tight enough to ensure that the straight closure remains in position.



TRITON+ monitor secured to a manhole rung

Mounting the Monitor to the Manhole Wall

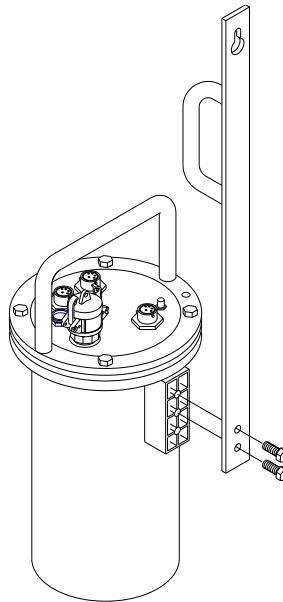
If the project will involve measuring flow over a long period of time, consider mounting the monitor permanently to the manhole wall. Using a monitor mounting bracket/flange (ADS p/n I40-0009), you can hang the monitor more securely and out of the way to allow use of the rungs.

Mount the monitor handle to the manhole wall as follows:

1. Determine the appropriate location to mount the monitor handle 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 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 approximately 3 inches (75 mm) deep at the mark, and install a 3/8-inch x 3-inch. (10-mm x 75-mm) 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 mounting flange with two M8 x 30-mm stainless steel bolts, two M8 stainless steel lock washers, and two M8 stainless steel flat washers (supplied with the **TRITON+** when shipped).

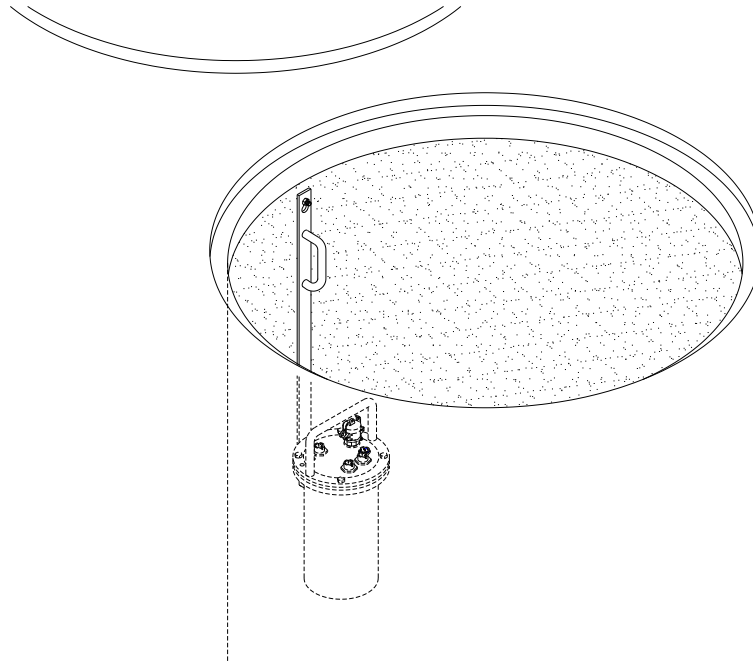


Bolting the mounting bracket to the flange welded to the monitor

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 communication cables in the manhole to simplify future monitor service activities. Secure the cables to plastic anchors or ¼-inch x 2¼-inch (M6 x 55-mm) anchor bolts using 14-inch (5-mm x 300-mm) 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

Mounting a monitor to the manhole rim has certain advantages. Removing and reinstalling are easier. The rim may be more structurally sound than deteriorated rungs. However, the manhole lid must clear the mounting hardware while it is removed or replaced.

Mount the monitor bracket/flange (ADS p/n I40-0009) to the manhole rim in the following way:

1. Determine the appropriate location to mount the monitor handle 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 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 (2.5 cm) deep using a carbide-tipped 5/16-inch drill bit or one that matches the size of the anchor bolt to be inserted.

Note: Consider starting the hole using smaller bits to make pilot holes and increasing up to the final size 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 (10-mm) tap that matches the stud thread 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-inch x 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.



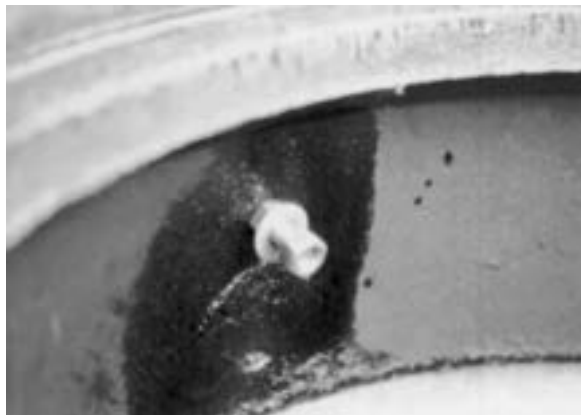
Binding the nuts together with the washer in between

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 3/4 inch (20 mm) 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 with two M8 x 35-mm stainless steel bolts, two M8 stainless steel lock washers, and two M8 stainless steel flat washers.
12. It may be necessary to drill new holes in the flange.
13. 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.

14. Slide the bracket against the inner nut and washer, and tighten and secure the outer nut against the bracket.
15. Neatly coil and secure the excess sensor and communication cables in the manhole to simplify future monitor service activities. Secure the cables to plastic anchors or ¼-inch x 2¼-inch (M6 x 55-mm) anchor bolts using 14-inch (300-mm) 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

Inclinometer

The ADS Inclinometer sensor (ADS p/n 8000-0528) utilizes an integrated accelerometer in a sealed, intrinsically safe housing to accurately determine the state (angle opening) of a flood gate in water control management systems. The sensor connects to the **COMM + EXT PWR** port on the ADS **TRITON+** monitor. Install the Inclinometer when the flood gate is in the closed position. Once installed it measures the angle differential from the closed position and reports this with the *ANGLE* entity recorded at the monitor wake-up interval. The ADS **TRITON+** monitor can be configured to send an alert when the angle exceeds a *Tilt* threshold. The default *Tilt* threshold is greater than $\pm 5^\circ$.



ADS Inclinometer sensor

Installing the Inclinometer

Follow the steps below to install the ADS Inclinometer sensor.

Note: The Inclinometer sensor should not be connected to the ADS **TRITON+** monitor until it is installed onto the flood gate.

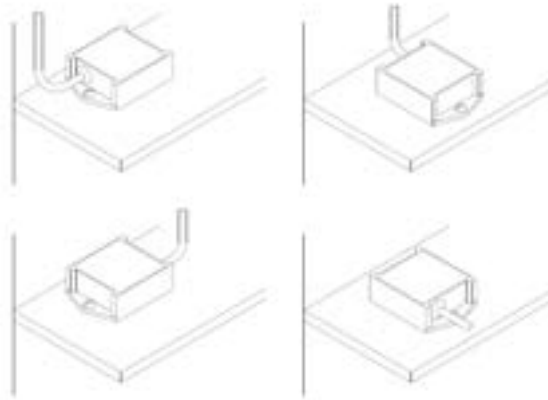
Note: If the default 25' (7.6m) length of the Inclinometer cable is not sufficient for the installation, order an extension cable (ADS P/N 8000-0044-25).

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.

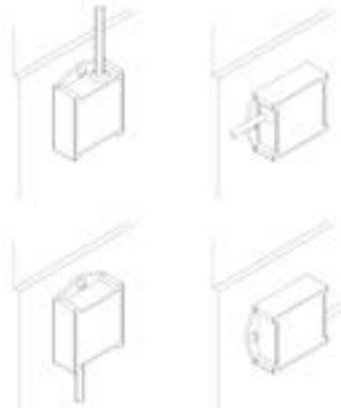
1. Ensure the flood gate is in the closed position.

2. Position the ADS Inclinometer sensor vertically or horizontally on the flood gate or to a flat, level surface attached to the flood gate. *See the following illustrations for recommended installation positions.*

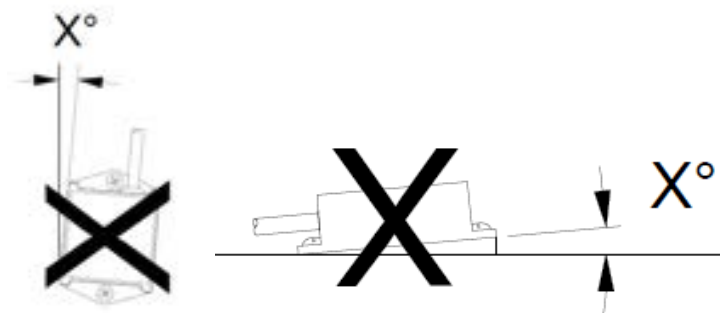
**INCLINOMETER POSITIONING
ON A FLAT SURFACE**



**INCLINOMETER POSITIONING
ON A VERTICAL SURFACE**



3. Before securing the Inclinometer to the flood gate, ensure that the sensor is at 90°, 180°, or completely flat. Inclinometers installed in the positions shown below will not record accurate angle measurement data.



Improper Inclinometer installation positions

4. Attach the inclinometer securely to the flood gate using one of the following three methods:

- ☐ Construction adhesive



Inclinometer attached using Construction Adhesive

- ☐ Two #8 stainless steel screws (hole diameter = 4.67 mm (0.184 in))



Inclinometer attached using Stainless Steel Screws

- ☐ Stainless steel clamp



Inclinometer attached using a Stainless Steel Clamp

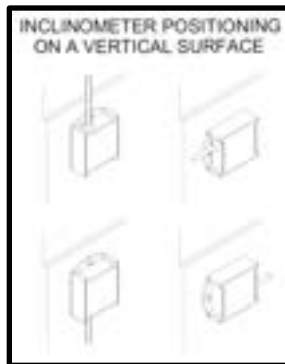
5. After the Inclinator is securely attached to the flood gate, connect the sensor cable to the **COMM + EXT PWR** port on the top of the ADS **TRITON+** monitor.
6. Configure the ADS TRITON+ monitor using **Qstart^{XML}**, selecting the Inclinator as one of the devices. See Chapter 4, [Configuration and Activation](#), for more in-depth instructions on how to configure and activate an ADS **TRITON+** monitor.

Inclinometer Data

When activated with an Inclinator, data collected from the **TRITON+** will include the *ANGLE* entity. Data for the *ANGLE* entity will either be positive points or negative points when the gate opens, dependent on the installation position of the sensor on the flood gate.

The following illustrations show the expected *ANGLE* data values based on the installation position (with the assumption that the Inclinator is installed on the wastewater side of the flood gate).

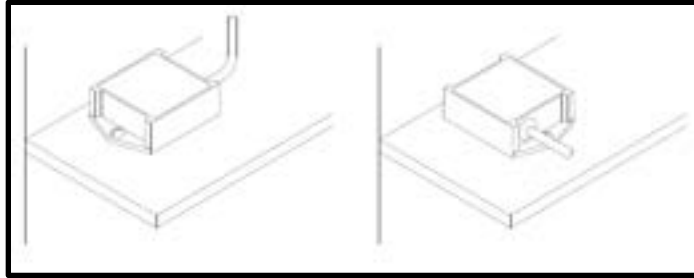
- ❑ The *ANGLE* data will be negative values when the gate opens out to the receiving body of water. *ANGLE* will be positive values when the gate opens inward toward the wastewater collection system:



- ❑ *ANGLE* data will be positive values when the gate opens out to the receiving body of water. *ANGLE* data will be negative values when the gate opens inward toward the wastewater collection system:



- ❑ *ANGLE* data will be negative values when the gate opens out to the receiving body of water. *ANGLE* data will be positive values when the gate opens inward towards the wastewater collection system:



CHAPTER 9

Analog and Digital Inputs and Outputs

The ADS **TRITON**+® (with an ADS XIO™) can monitor signals from other equipment via analog and digital inputs as well as send signals or information to other equipment via analog and digital outputs. The interface between the monitor and this equipment is the ADS XIO (external input/output unit). The XIO can accommodate up to 2 analog inputs, 2 analog outputs, 2 digital inputs, and 2 digital outputs. It also includes an ExPAC that provides an intrinsically-safe barrier for both external power and communication to the monitor. External power is essential for these input and output operations. This chapter provides general information on how to use, configure, and connect these inputs and outputs.

Note: Do not attempt to connect to a third-party system, or connect/interrupt supply of a signal to another system without an owner representative present. Under some circumstances, these activities can disable or disrupt a critical automated process (e.g., a pump control), cause a dangerous condition (e.g., overpressure), or generate a false alarm.

Note: Due to the diversity of signal sources and frequently undocumented cabling and wiring at remote monitoring locations, ADS strongly recommends acquiring a qualified electrician, instrumentation technician, or owner representative to connect ADS equipment to the signal source. Consider the examples and general procedures included in this chapter to ensure a successful installation.

Analog Inputs

The **TRITON+** (with an ADS XIO) supports the monitoring of up to two analog 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 to process the signals received from these third-party devices, you must configure the ADS **Qstart^{XML}** software with the signal scale and engineering units equivalent to the signals received.

Connecting a Third-Party Instrument to an Analog Input on the XIO

Perform the following procedure to connect each third-party instrument or device (up to two) to an analog input terminal on the ADS XIO:

Note: Make sure external power is available, *but not turned on*, to the monitor before connecting the signal wiring. If it is not available, you cannot complete testing, which may require return visits by the owner representative and/or electrician or instrument technician for wiring problems.

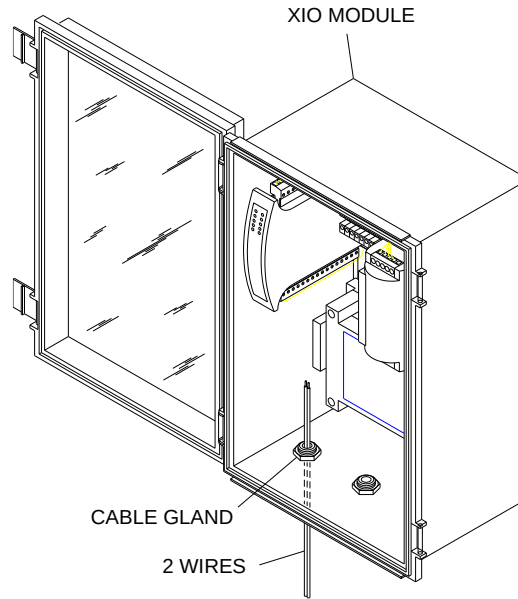
1. Determine the location at which to connect to the analog signal wiring. Make sure the distance from the signal source to the XIO unit is as short as possible and avoid any cable runs that would run parallel to switching panels or other control components. These can create electrical noise that will interfere with the signal and create false readings.

Following are some 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. Configure the Analog Input 1 (or 2) component of the XIO Device through **Qstart^{XML}** with the analog input parameters that indicate the values or measurements that correspond to the analog signals within the 4-20mA range and the specific kind of data you want the monitor to store. Refer to *Chapter 4, Configuration and Activation*, for instructions on supplying this information in **Qstart^{XML}**.
 3. Connect the analog input wires to the ADS XIO in the following way:

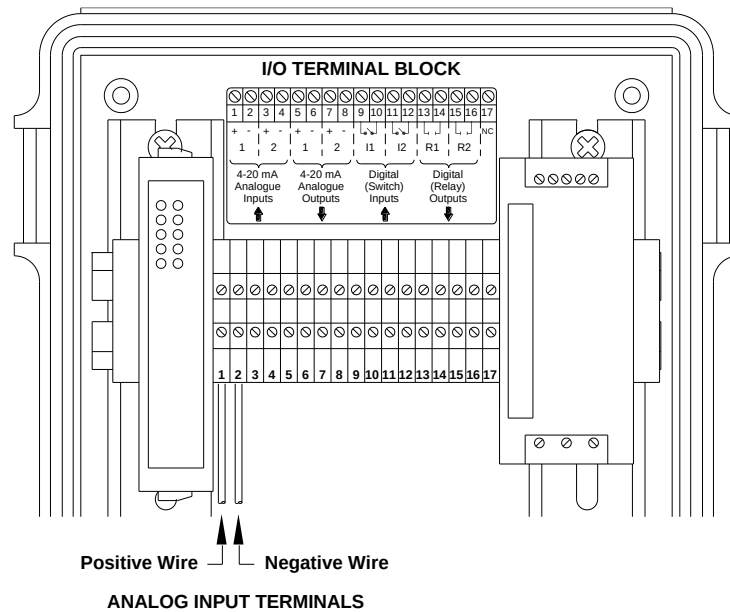
Note: Make sure the power is turned off to the third-party device and XIO.

- ☐ Release the latches and open the clear, front door on the XIO.
- ☐ Run the wires up through the left cable gland on the XIO into the enclosure. ADS recommends using 18-gauge wiring. You may need to loosen the plastic nut on the cable gland on the outside of the XIO to feed the wires through.



Feeding wires up through left cable gland in XIO

- ☐ Insert one of the stripped ends of the positive wire into the hole corresponding to terminal 1 (or 3) on the I/O terminal block in the XIO.
- ☐ Insert one of the stripped ends of the negative wire into the hole corresponding to terminal 2 (or 4) on the I/O terminal block in the XIO.



Connecting the *positive* and negative wires from the third-party device to Terminals **1** and **2** (analog input terminals) on the I/O terminal block

- ☐ Connect the other ends of the positive and negative wires to the third-party device based on the vendor's specifications.
 - ☐ Close and latch the door to the XIO.
4. Restore power to the customer's instrument or device and the ADS XIO.
 5. Verify that adding the ADS equipment will not add too much load to the analog signal loop. The XIO input adds 22 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 XIO input. If more than two devices are attached to the analog signal loop, ADS strongly recommends load testing the loop.

Determine whether too much load exists on the analog signal in the following way:

- ☐ Activate the monitor with the appropriate analog input parameters.
- ☐ Request for the owner to simulate a full-scale event that generates a signal to 20mA while connected to the XIO unit. Simulate the full-scale event through utilities in the transmitter that supply the signal or, when using a depth sensor, by placing a target under the sensor that will provide a maximum reading. Magmeters usually have a utility to drive the output to full scale. However, each device is different and, in some applications, there is no way to simulate maximum output. When this occurs, calculate the load by measuring the voltage that drives the loop and then measuring the resistance added by each device on the loop. The owner's instrumentation representative should conduct this load calculation because it requires toggling power to different devices and disconnecting/reconnecting the signal and, possibly, power wiring.
- ☐ Using **Qstart^{XML}**, collect the data and verify that the analog input values were correct during the simulated input time interval.

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.

Analog Outputs

The **TRITON+** (with an ADS XIO) can provide synchronous or real-time depth, velocity, and flow rate measurements to up to two third-party systems or devices via 4-20mA analog output signals. The most common use for analog outputs is to provide flow and depth information to SCADA systems via input to Remote Terminal Units (RTUs) or Programmable Logic Controllers (PLCs). However, other uses include other meters, totalizers, samplers, and display equipment.

To configure the monitor to properly deliver the signals to these third-party devices, you must configure the ADS **Qstart^{XML}** software with the signal scale and engineering units equivalent to the signals transferred.

Connecting a Third-Party Device to an Analog Output on the XIO

Note: Connecting the third-party device to the XIO requires a *customer-supplied* cable. ADS recommends 18- to 20 gauge, shielded, twisted-pair standard control cable. Consider using **Alpha Wire[™]** M213202 SL005 or **General Cable[™]** C7106A.41.10 cable. For more information, contact ADS Client Services.

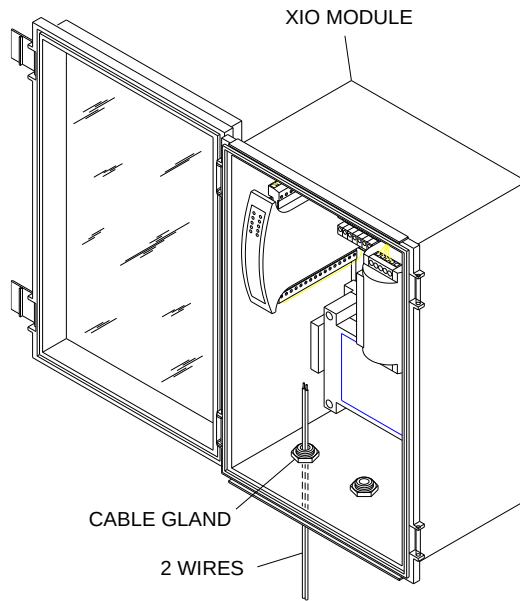
Perform the following procedure to connect each third-party device (up to two) to an analog output terminal on the ADS XIO:

Note: Make sure external power is available, *but not turned on*, to the monitor before connecting the signal wiring. If it is not available, you cannot complete testing, which may require return visits by the owner representative and/or electrician or instrument technician for wiring problems.

1. Verify that the instrument or equipment that will be receiving the analog signals has been set up to accept the signal wiring. Setup may involve penetrating existing enclosures, running conduit, or sealing glands.
2. Establish the range and engineering units representing 4 to 20mA for the analog output, and then configure the Analog Output 1 (or 2) component of the XIO Device through **Qstart^{XML}** with the analog output parameters that indicate the values or measurements that correspond to the analog signals within the 4-20mA range. Refer to *Chapter 4, Configuration and Activation*, for instructions on supplying this information in **Qstart^{XML}**.
3. Configure the device or instrument receiving the analog signals with the range and engineering units corresponding to the 4-20mA from the **TRITON+**.
4. Connect the analog output wires (from the customer-supplied cable) to the ADS XIO in the following way:

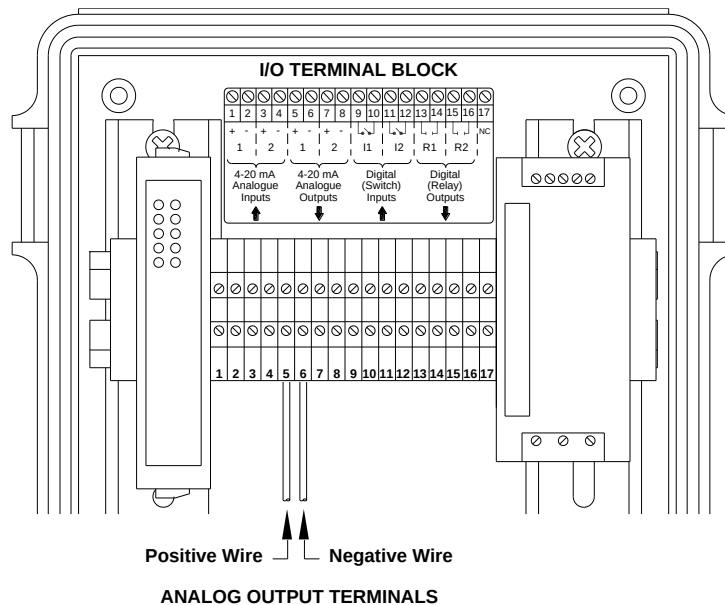
Note: Make sure the power is turned off to the third-party device and XIO.

- ☐ Release the latches and open the clear, front door on the XIO.
- ☐ Run the wires up through the left cable gland on the XIO into the enclosure. ADS recommends using 18-gauge wiring. You may need to loosen the plastic nut on the cable gland on the outside of the XIO to feed the wires through.



Feeding wires up through left cable gland in XIO

- ☐ Insert one of the stripped ends of the positive wire into the hole corresponding to terminal 5 (or 7) on the I/O terminal block in the XIO.
- ☐ Insert one of the stripped ends of the negative wire into the hole corresponding to terminal 6 (or 8) on the I/O terminal block in the XIO.



Connecting the *positive* and negative wires from the third-party device to Terminals **5** and **6** (analog output terminals) on the I/O terminal block

- ☐ Connect the other ends of the positive and negative wires to the third-party device based on the vendor's specifications.
 - ☐ Close and latch the door to the XIO.
5. Restore power to the customer's device and the ADS XIO.
 6. Run a test to verify that the third-party instrument is receiving a correct value from the monitor in the following way:

- ☐ Enter a test value in the Manual field corresponding to the appropriate Analog Output (1 or 2) section of the XIO Device dialog in **Qstart^{XML}**, and select the Enable Manual checkbox. This value must fall within the range designated in the associated Min and Max Value fields.

Note: ADS recommends testing *both* analog outputs at the same time.

- ☐ Click on the OK button on the XIO Device dialog.
- ☐ Activate the monitor. Refer to *Chapter 4, Configuration and Activation*, for instructions on activating the monitor.
- ☐ Disconnect from the monitor.
- ☐ Contact the customer representative to verify the receiving instrument is producing the same value.
- ☐ Upon confirmation, return to the XIO Device dialog in **Qstart^{XML}**, deselect the Enable Manual checkbox(es), and click on the OK button.

7. Re-activate the monitor.

Digital Inputs

The **TRITON+** (with an ADS XIO) supports the monitoring of up to two digital inputs from third-party devices, such as switches or alarms (relays). To properly configure the monitor to process the signals received from these devices, you must configure each input as active through the ADS **Qstart^{XML}** software.

Connecting a Third-Party Device to a Digital Input on the XIO

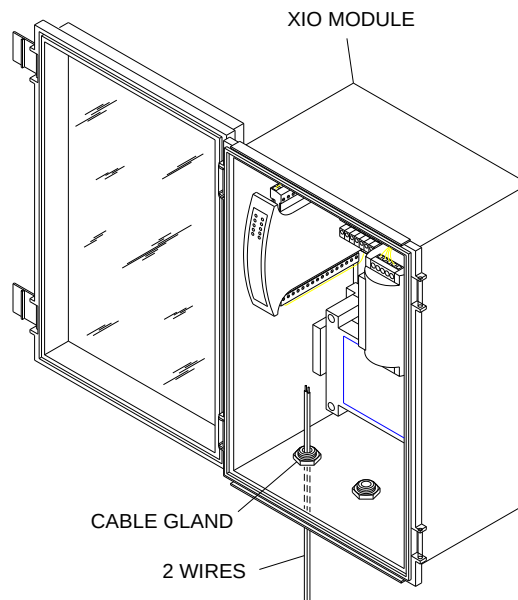
Perform the following procedure to connect each third-party device (up to two) to a digital input terminal on the ADS XIO:

Note: Make sure external power is available, *but not turned on*, to the monitor before connecting the signal wiring. If it is not available, you cannot complete testing, which may require return visits by the owner representative and/or electrician or instrument technician for wiring problems.

1. Configure the **Digital Input 1** (or **2**) component of the **XIO Device** through **Qstart^{XML}** to indicate the digital input is active and whether you want the monitor to store the data received. Refer to *Chapter 4, Configuration and Activation*, for instructions on supplying these settings in **Qstart^{XML}**.
2. Connect the digital input wires to the ADS XIO in the following way:

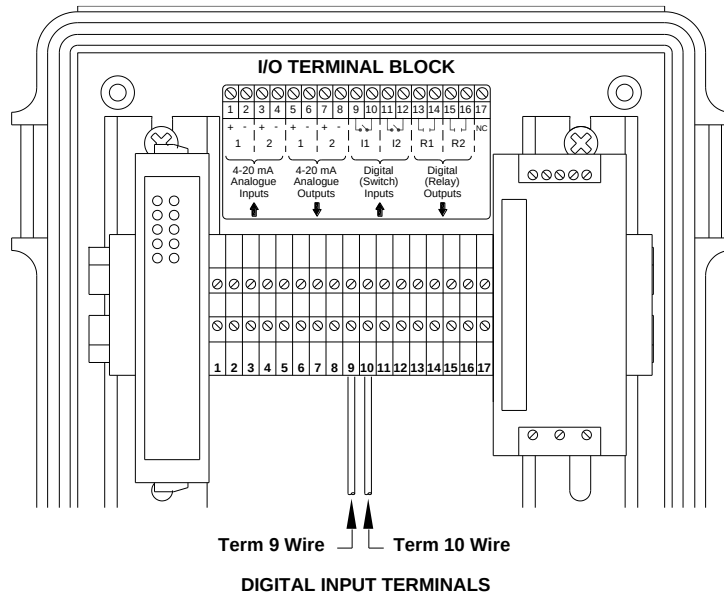
Note: Make sure the power is turned off to the third-party device and XIO.

- ☐ Release the latches and open the clear, front door on the XIO.
- ☐ Run the wires up through the left cable gland on the XIO into the enclosure. ADS recommends using 18-gauge wiring. You may need to loosen the plastic nut on the cable gland on the outside of the XIO to feed the wires through.



Feeding wires up through left cable gland in XIO

- ☐ Insert one of the stripped ends of one of the wires into the hole corresponding to terminal 9 (or 11) on the I/O terminal block in the XIO.
- ☐ Insert one of the stripped ends of the other wire into the hole corresponding to terminal 10 (or 12) on the I/O terminal block in the XIO.



Connecting the 2 wires from the third-party device to Terminals **9** and **10** (digital input terminals) on the I/O terminal block

- ☐ Connect the other ends of the wires to the third-party device based on the vendor's specifications.
 - ☐ Close and latch the door to the XIO.
3. Restore power to the customer's device and the ADS XIO.
 4. Test the digital inputs in the following way:
 - ☐ Make sure the monitor is activated with the appropriate digital input parameters.
 - ☐ Allow the monitor to record data from the digital input for at least two intervals in an inactive state and two intervals in an active state.
 - ☐ Collect the data from the monitor.
 - ☐ Verify that the data accurately represents the states of the inputs corresponding to the date/time stamps.

Digital Outputs

The **TRITON+** (with an ADS XIO) can provide the event status for up to two third-party systems or devices via digital (relay) output signals. To configure the monitor to properly deliver the signals to these third-party devices, you must configure the ADS **Qstart^{XML}** software with the specific event about which you want to relay the current status information.

Connecting a Third-Party Device to a Digital Output on the XIO

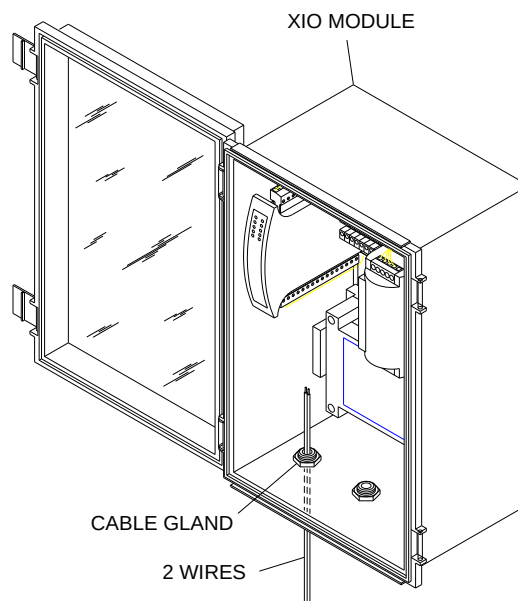
Perform the following procedure to connect each third-party device (up to two) to a digital output terminal on the ADS XIO:

Note: Make sure external power is available, *but not turned on*, to the monitor before connecting the signal wiring. If it is not available, you cannot complete testing, which may require return visits by the owner representative and/or electrician or instrument technician for wiring problems.

1. Configure the **Digital Output 1** (or 2) component of the **XIO Device** through **Qstart^{XML}** to indicate the event with which you want to associate each digital output. Refer to *Chapter 4, Configuration and Activation*, for instructions on selecting this parameter in **Qstart^{XML}**.
2. Connect the digital output wires to the ADS XIO in the following way:

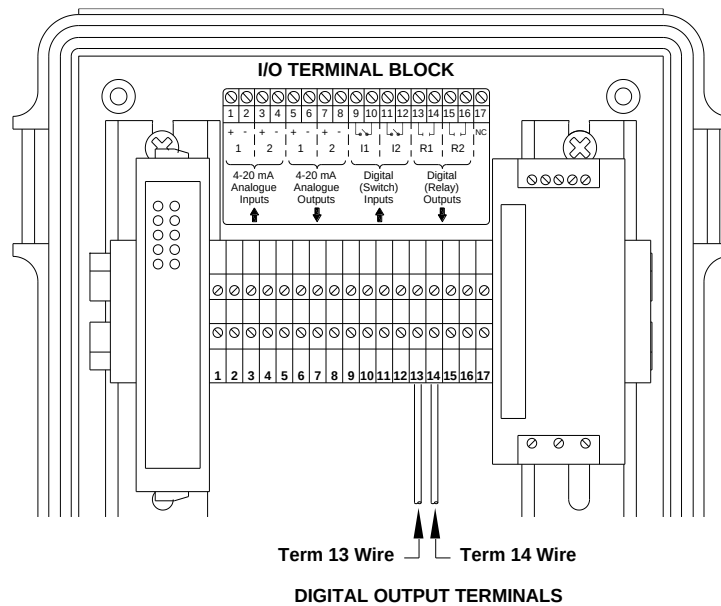
Note: Make sure the power is turned off to the third-party device and XIO.

- ☐ Release the latches and open the clear, front door on the XIO.
- ☐ Run the wires up through the left cable gland on the XIO into the enclosure. ADS recommends using 18-gauge wiring. You may need to loosen the plastic nut on the cable gland on the outside of the XIO to feed the wires through.



Feeding wires up through left cable gland in XIO

- ☐ Insert one of the stripped ends of one of the wires into the hole corresponding to terminal 13 (or 15) on the I/O terminal block in the XIO.
- ☐ Insert one of the stripped ends of the other wire into the hole corresponding to terminal 14 (or 16) on the I/O terminal block in the XIO.



Connecting the 2 wires from the third-party device to Terminals **13** and **14** (digital output terminals) on the I/O terminal block

- ☐ Connect the other ends of the wires to the third-party device based on the vendor's specifications.
 - ☐ Close and latch the door to the XIO.
3. Restore power to the customer's device and the ADS XIO.
 4. Test the digital outputs in one of the following ways, and then verify that the customer's device received the change in relay status:
 - ☐ Adjust your event triggers in **Qstart^{XML}** to force an event and subsequent return-to-normal to occur over a limited period of time. If you choose this testing option, remember to reset your event triggers and reactivate the monitor following the test.
 - ☐ Modify the environmental conditions at the monitoring location to trigger an event and return-to-normal over a limited period of time.

CHAPTER 10

Modbus

Many newer SCADA and process control systems connect either directly or wirelessly to measurement devices through a serial connection or wireless modem to quickly access process values. One of the industry standard protocols through which this occurs is *Modbus*. The ADS **TRITON**+[®] monitor serves as a Modbus slave device and provides process values based on Modbus holding registers through an ExPAC interface (*using a customer-supplied cable*) or wirelessly through the internal cellular modem.

This chapter contains essential connection and reference information regarding communication and data exchange through a serial connection involving the **TRITON**+, ExPAC/XBUS, and RTU. It also addresses Modbus wireless data exchange and Modbus data registers.

Note: An RTU (remote terminal unit) is an example of the kind of customer-supplied equipment that uses Modbus acquired data. Many other types of equipment may be connected to **TRITON**+ monitors; however, all will communicate as described. A PLC (programmable logic controller), an I/O (input/output) server, or other instruments, such as the Telog[®] Ru-33 or Ru-35, may be used in place of an RTU. ADS[®] references the RTU in this manual primarily because it is the most common type of end-point hardware used with SCADA systems.

Establishing a Modbus Connection

Note: Modbus connection is only possible when using a public, static IP address or the customer's internal, private network. **TRITON**+ Modbus communication is not supported through ADS VPN.

The SCADA or process control system connects to the **TRITON**+ either through a *customer-supplied* serial cable connection using the ADS ExPAC (which may be housed within the ADS XBUS[™] or a customer-supplied enclosure) or through a cellular wireless modem in the monitor using Modbus TCP.

Note: *The XIO does not support Modbus communications.* Only the ExPAC and XBUS support Modbus.

Setting Up a Serial Connection

Two Modbus ports are available on the ExPAC through which to communicate: RS-232 and RS-485.

Note: When both connections are available, ADS recommends using the *RS-485* connection. It has a greater immunity to noise, supports longer cable runs without signal degradation, and is easier to wire.

The required port settings are 19200 baud rate, 8 data bits, no parity, 1 stop bit, and no flow control.

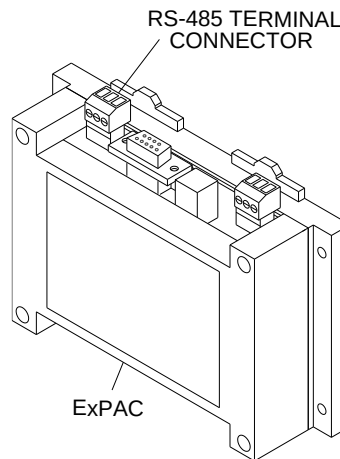
Connecting through the RS-485 Port

When using an RS-485 connection for Modbus communications, choose a cable that is no longer than 4000 feet (1219 m) in length with 24-gauge wiring. The cable must include at least one twisted pair and one

ground wire. If the cable extends beyond 1000 feet (305 m), ADS recommends using 120 ohm termination resistors at each end of the cable.

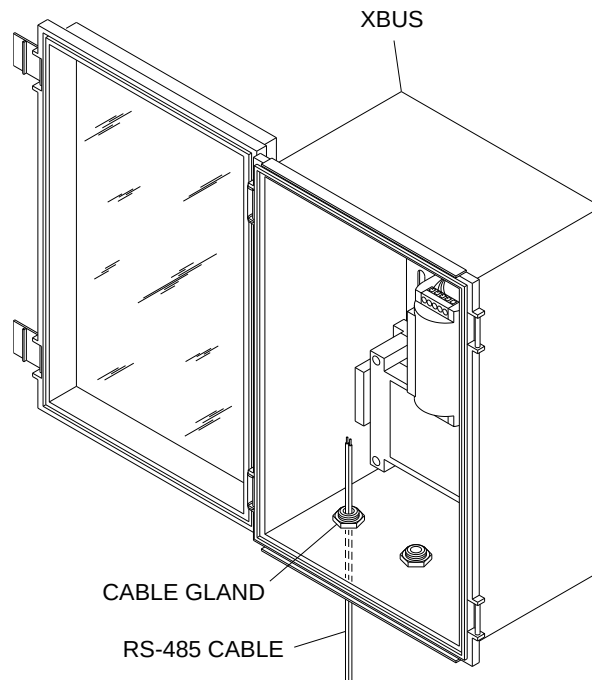
Connect the cable to the ExPAC in the following way:

1. Disconnect (i.e., unplug) the green terminal connector from the **RS-485** port on the top, left side of the ExPAC.



RS-485 terminal connector on ExPAC

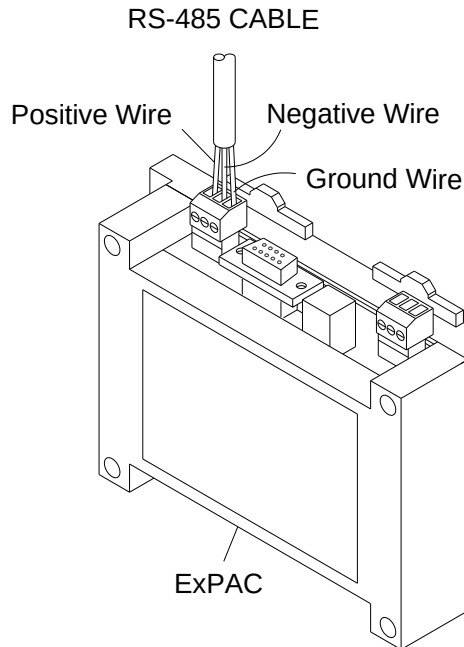
2. *(applicable only when the ExPAC is housed within an XBUS or other enclosure)* Open the door of the enclosure and run the cable through the appropriate entry point into the enclosure. For an *XBUS*, this entry point will be the *left cable gland* at the bottom of the enclosure. *You may need to loosen the plastic nut on the cable gland on the outside of the XBUS or other enclosure to feed the cable through.*



Running RS-485 cable through left cable gland in XBUS

3. Loosen the screws on the terminal connector.
4. Make sure the wires from the cable are stripped and separated.
5. Insert the negative wire (*D-*) from the cable into the *negative (-)* terminal on the connector (*refer to the label adjacent to the port*) and tighten the terminal screw.

6. Insert the positive wire (*D+*) from the cable into the *positive* (+) terminal on the connector and tighten the terminal screw.
7. Insert the ground wire (*GND/SHL*) from the cable into the *ground* (⏏) terminal on the connector and tighten the terminal screw.



Running the wires to the proper terminals on the RS-485 terminal connector

8. Insert the connector back into the **RS-485** port on the ExPAC.

Note: Refer to the manufacturer's documentation for the device to which you are connecting the ExPAC to determine the appropriate pin-out for the RS-485 connector on the device end of the cable. Identify the pins for the *D+* and *D-* signals and the *GND* or *SHL*.

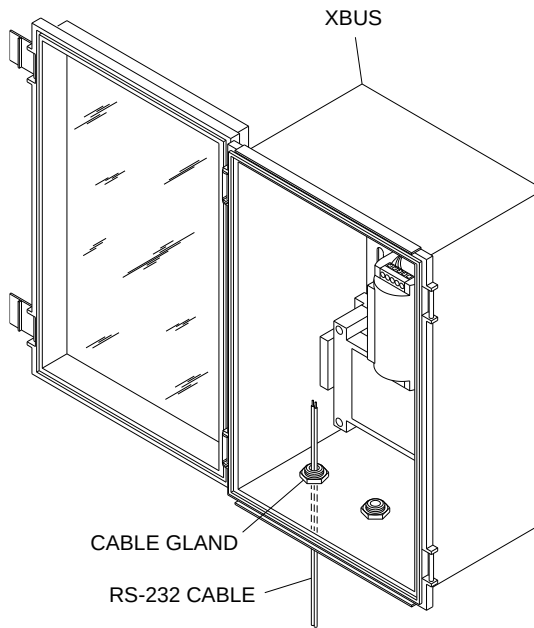
9. (*applicable only when the ExPAC is housed within an XBUS or other enclosure*) Gently pull on the cable from the outside of the enclosure to remove any excess cabling inside the enclosure. Hand-tighten the plastic nut on the cable gland (when applicable) to secure the cable and prevent moisture or debris from entering the inside of the enclosure through the cable entry point. Then, close and secure the door to the enclosure.

Connecting through the RS-232 Port

When supporting an RS-232 Modbus connection to customer equipment, such as an RTU or PLC, create a custom cable or use a customer-supplied serial cable with a DB-9 connector configured to an RS-232 *straight* connection specification. *A null-modem is not necessary.*

Connect the cable to the ExPAC in the following way:

1. (*applicable only when the ExPAC is housed within an XBUS or other enclosure*) Open the door of the enclosure and run the cable through the appropriate entry point into the enclosure. For an *XBUS*, this entry point will be the *left cable gland* at the bottom of the enclosure. *You may need to loosen the plastic nut on the cable gland on the outside of the XBUS or other enclosure to feed the cable through.* If you are using a pre-fabricated cable, you may need to remove the DB-9 connector from the cable so that you can feed the cable through the cable gland or other entry point.



Running RS-232 cable through left cable gland in XBUS

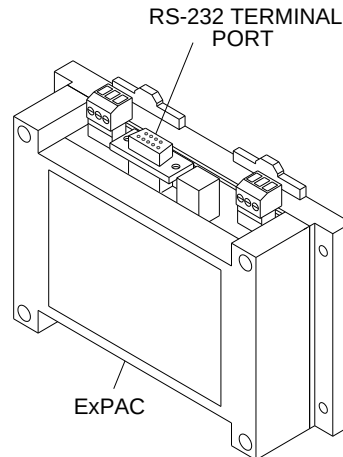
2. (applicable only when using a custom cable or after removing a DB-9 connector from a pre-fabricated cable) Strip and separate the wires from the cable and attach/re-attach the DB-9 connector to the cable based on the pin-out referenced in the following table:

Pin	Name	Direction	Notes
1	DCD	Input	
2	RX	Output	
3	TX	Input	
4	DTR	Input	
5	GND		
6	DSR		Internally connected to RTS and CTS
7	RTS		Internally connected to DSR and CTS
8	CTS		Internally connected to DSR and RTS
9	RI		Unused

Pin-out for **RS-232** Modbus port on the ExPAC

Note: A logic high is required on either DCD or DTR to enable communications.

3. Insert the DB-9 connector from the cable into the **RS-232** port on the top of the ExPAC.



RS-232 terminal connector on ExPAC

4. *(applicable only when the ExPAC is housed within an XBUS or other enclosure)* Gently pull on the cable from the outside of the enclosure to remove any excess cabling inside the enclosure. Hand-tighten the plastic nut on the cable gland (when applicable) to secure the cable and prevent moisture or debris from entering the inside of the enclosure through the cable entry point. Then, close and secure the door to the enclosure.

Note: Refer to the manufacturer's documentation for the device to which you are connecting the ExPAC to determine the appropriate pin-out for the RS-232 input connector on the device end of the cable (similar to the table above).

Note: If the DTR input is not available/supported on the device, connect the RTS output to pin 7 and pin 4 as well to ensure the ExPAC DTR input is activated, and communications are enabled. The **TRITON+** monitor connected to the ExPAC will not operate if the DTR or the DCD lines are not activated.

Setting Up a Wireless Connection

Establishing a wireless Modbus connection enables the **TRITON+** to provide the updated Modbus registers to the SCADA or process control system.

Consider the following when using a wireless connection:

- While not required, ADS strongly recommends powering the **TRITON+** for any continuous Modbus communications through an external source using an ExPAC or XBUS.
- Establishing wireless TCP/IP communication may take several minutes. Therefore, consider this initial delay in communication when setting up the host program.
- Verify that the monitor has been configured for Modbus output through **Qstart^{XML}** with a wireless connection type and the proper IP address for the monitor.
- Verify that the process control system has the proper Modbus slave ID, is configured for wireless TCP communication, and has the correct IP address for the **TRITON+**.
- Once both systems are configured and activated, verify that the process control system is receiving the appropriate Modbus register values.

Configuring the Monitor for Modbus Applications

The monitor must be configured with certain information to ensure it can communicate with and provide data to the RTU, Telog Ru-33, Ru-35, or Wavelet 4R. This includes information such as the rate at which Modbus updates the data available to the RTU, Telog or Ayyekka unit and Modbus slave ID for facilitating communication between the ExPAC and the RTU or the **TRITON+** and the Telog Ru-33, Ru-35, or Ayyekka Wavelet 4R. This configuration occurs through the **Qstart^{XML}** software. Refer to *Chapter 4, Configuration and Activation*, for instructions on entering this information.

Modbus Data Registers

This section contains tables providing Modbus registers. The first table lists the Modbus data register addresses corresponding to the entities for which the **TRITON+** provides output data. The RTU requests data from the monitor using the designated registers, and the monitor (through the ExPAC) sends the current entity data representing those registers back to the RTU. Therefore, the user must program the RTU with the appropriate registers based on the type of data desired.

The second table lists the Modbus registers associated with more general **TRITON+** information.

Note: The entities available are based on the sensors used and the data logged. In addition, all values are floating point, unless otherwise defined.

Register Addresses for Entity Data

The following table contains the entities currently available for output and the associated register addresses.

Note: The units of measure are based on the units of measure with which the monitor has been activated, except for those noted within the table.

Note: Modbus holding registers start at 40001. To address them with a Modbus Read Holding Register command, use an address of 0 (zero), which will return data for register 40001. ADS uses two Modbus registers to return one little endian floating point number. Registers that are not updated by the monitor will contain a value of -99.0. This number represents the initialization value and indicates the register is not updated. The registers used are dictated by the monitor configuration, the type and number of sensors, and the type of processing desired.

A typical message exchange, asking for the first 10 registers, would occur as follows:

```
000064-Tx:3A 30 35 30 33 30 30 30 30 30 30 41 45 45 OD
          OA
```

```
000065-Rx:3A 30 35 30 33 31 34 30 30 30 30 43 32 43 36 30
          30 30 30 43 32 43 36 30 30 30 43 32 43 36 38
          45 33 39 43 32 39 31 30 30 30 43 32 43 36 41
          41 OD OA
```


Description	Qstart ^{XML} Entity	Standard Units of Measure	Registers
Peak Velocity from Peak Combo Sensor or Velocity from AV Gated	PEAKVEL_1 for Peak Combo or VELOCITY for AV Gated	Feet per Second	40001-40002
Upward Ultrasonic Depth from Peak Combo or AV Gated Sensor	UPDEPTH_1	Inches	40003-40004
Pressure Depth from Peak Combo or AV Gated Sensor	PDEPTH_1	Inches	40005-40006
Water Temperature from Peak Combo or AV Gated Sensor	WATERTEMP_1	Fahrenheit	40007-40008
Surface Velocity from Surface Combo Sensor	SURFACEVEL_3	Feet per Second	40017-40018
Smart Depth from the Surface Combo or Ultrasonic Depth Sensor	SDEPTH_3	Inches	40019-40020
Pressure Depth from the Surface Comb Sensor	PDEPTH_3	Inches	40021-40022
Air Temperature from the Surface Combo Sensor	AIRTEMP_3	Fahrenheit	40023-40024
Flow rate based on QContinuity	FLOW1	Millions of Gallons per Day	40025-40026
Second Flow rate based on QContinuity	FLOW2	Millions of Gallons per Day	40027-40028
Peak Velocity from the monitor	RAWVEL	Feet per Second	40029-40030
Monitor Battery Voltage (daily)	BTYVOLT	Volts	40031-40032
Flow Rate Threshold from monitor	QTHRESHOLD	Millions of Gallons per Day	40033-40034
Average Flow Rate from monitor	QMLI_AVG	Millions of Gallons per Day	40035-40036
Average Depth from monitor	DMLI_AVG	Inches	40037-40038
Depth Threshold from monitor	DTHRESHOLD	Inches	40039-40040

Description	Qstart ^{XML} Entity	Standard Units of Measure	Registers
Pressure Sensor Calibration Value	PRESSK	Inches	40041-40042
Unidepth, Monitoring Point 1	MP1/UD	Inches	40045-40046
Velocity with gain applied, Monitoring Point 1	MP1/RV1	Feet per Second	40047-40048
Flow rate based on QContinuity, Monitoring Point 1	MP1/FLOW1	Millions of Gallons per Day	40049-40050
Flow volume, Monitoring Point 1	MP1/FLOW_TOTAL	Thousands of Gallons	40051-40052
Ultrasonic Depth from sensor connected to Channel 1	CH1/U1	Inches	40053-40054
Peak Velocity from Peak Combo, Velocity from AV Gated, or Surface Velocity from Surface Combo	CH1/V1 or DV1	Feet per Second	40055-40056
Pressure Depth from Peak Combo or AV Gated sensor	CH1/P1	Inches	40057-40058
Surcharge Peak Velocity from the Surface Combo Sensor	CH1/PV1	Feet per Second	40059-40060
Temperature from the sensor attached to Channel 1	CH1/CT1	Fahrenheit	40061-40062
Unidepth, Monitoring Point 2	MP2/UD2	Inches	40065-40066
Velocity with gain applied, Monitoring Point 2	MP2/RV2	Feet per Second	40067-40068
Flow rate based on QContinuity, Monitoring Point 2	MP2/FLOW2	Millions of Gallons per Day	40069-40070
Flow volume, Monitoring Point 1	MP2/FLOW_TOTAL	Thousands of Gallons	40071-40072
Ultrasonic Depth from sensor connected to Channel 2	CH2/U2	Inches	40073-40074

Description	Qstart ^{XML} Entity	Standard Units of Measure	Registers
Peak Velocity from Peak Combo, Velocity from AV Gated, or Surface Velocity from Surface Combo Sensor	CH2/V2 or DV2	Feet per Second	40075-40076
Pressure Depth from Peak Combo or AV Gated sensor	CH2/P2	Inches	40077-40078
Surcharge Peak Velocity from the Surface Combo Sensor	CH2/PV2	Feet per Second	40079-40080
Temperature from the sensor attached to Channel 2	CH2/CT2	Fahrenheit	40081-40082
Inclinometer Tilt Detected	Tilt	n/a	40083-40084
Inclinometer Angle	Angle	Degrees	40085-40086

Register Addresses for Monitor Information

The following table contains the registers corresponding to more general monitor information:

Description	Standard Units of Measure	Registers
Depth Conversion Coefficient	Inches	40137-40138
Velocity Conversion Coefficient	Feet Per Second	40139-40140
Volume Conversion	Millions of Gallons per Day	40141-40142
Temperature Conversion Type	Fahrenheit	40143-40144
Scan (Wakeup) Rate	n/a	40197-40198

Note: Temperature Conversion Type will be reported as 9800 for Fahrenheit and 9801 for Celsius.

CHAPTER 11

Maintenance and Troubleshooting

While the ADS **TRITON**+[®] 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.

Note: Remove the monitor from the manhole before replacing the battery packs or performing other service activities that may involve disconnecting cables from the monitor.

Maintaining the System Components

The **TRITON+** 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 activities ADS permits within the monitor chassis are battery pack battery PCB, regulator/modem unit, and fuse replacement. Therefore, do not handle, alter, modify, remove, or replace any other components inside the monitor. Such actions will void the monitor warranty agreement and the IS certification.

Note: All monitor maintenance should be done with the monitor in a non-hazardous area.

Gathering Replacement Parts and Supplies

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

- Dryer tube for sensors with pressure depth capability
- Battery pack for **TRITON+** monitor
- Spare combo sensors and antenna as required
- Soft bristle brush
- Paper towels
- Compressed air
- Flat head screwdriver and assorted wrenches
- Rubber stretch tape
- Blue magnet (*for troubleshooting wireless communications*)

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 can occur from a remote location where wireless communication is available.
- Review the applicable logs in **Qstart^{XML}** to verify the status of the monitor clock, communications, firmware, battery pack, and temperatures.
- Clean the monitor and sensors regularly with a soft bristle brush and paper towels. *However, do not use detergent!*

Note: Please use special care when cleaning the crystals on the Surface Combo or Ultrasonic Depth sensor. They are covered with a Teflon® coating. Therefore, do not use a wire brush or other abrasive, metallic device to clean these sensors.

- Make sure all connector ports on the monitor top are dry. Use compressed air or paper towels to dry out wet or damp connectors. Note and replace missing interfacial seals in the sensor connector ends. The connectors can be protected against moisture by wrapping with self-vulcanizing rubber stretch tape. Make sure covers are securely in place on any unused ports on the monitor top.

Confirming the Monitor

Confirm the accuracy of the sensor subsystems in the monitor on a regular basis through **Qstart^{XML}**. 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 **Qstart^{XML}** online help for detailed information on performing confirmation procedures.

Obtaining (Uploading) the Monitor Hardware Configuration

Uploading the monitor's hardware configuration parameters can assist in monitor troubleshooting. The uploaded information displays the IMEI number, firmware version, and details on the sensor hardware connected to the monitor and the channels to which they are connected.

Use **Qstart^{XML}** to upload the monitor hardware configuration by performing the following:

1. Open **Qstart^{XML}** and select the monitor from the **Location Name** drop-down list.
2. Select the **Connect** button to establish communications with the monitor.
3. Select the **Advanced** button in the **Functions** section.
4. Select the **Upload** button in the **Configuration** section to upload the hardware configuration parameters from the monitor.
5. Print the log while online or hang up and access the saved log in the **Qstart^{XML}** Logs (*Configuration* type logs).

```
Monitor Configuration: 2528782, CS7, 8/8/2018 12:13:41 PM
Firmware Version: x800 Triton Plus version 6.16 revision 229
CH1: COMBO2 (CS7) S/N: 1012 REV:1, PRESS15 zero 1630 span 14738 TEMP UpDOF VPROF 45 ACCEL
CH2: NO SENSOR DETECTED
Enable Sensor Debug: False
IP: 165.219.186.134
Mobile#: 15334351869, Network: HSPA, -64 dBm
Cell Model: ME910-D SW: 12.00.024
IMEI: 356136072394655 ICCID: 89014103279454097032
```

Sample Uploaded Configuration Log

Obtaining (Uploading) the Monitor Configuration

Uploading the monitor's current configuration parameters can assist in monitor troubleshooting. The uploaded monitor information shows the information currently stored in the monitor's memory— current device configuration and installation details. This information can be useful to review prior to performing a monitor activation to verify the monitor location information matches the computer location information.

Use **Qstart^{XML}** to upload the monitor configuration by performing the following:

1. Open **Qstart^{XML}** and select the monitor from the **Location Name** drop-down list.
2. Select the **Upload** button to establish communications with the monitor and automatically perform the location information upload process. **Qstart^{XML}** provides feedback concerning whether the information matches between the computer and the monitor and the user chooses whether to update the computer or not.
3. Choose **Hangup** to disconnect from the monitor when the upload is complete.
4. If the location parameters on the local computer have been updated, select **Save**.

Obtaining Diagnostic Codes from the Monitor

The **TRITON+** enables you to observe monitor activity, view diagnostic information, and confirm test caryouts from the monitor through a small LED status window on the monitor top. The numbers/characters

which, once initialized, display in a sequence and represent current processes, identification, status, or readings associated with the system and communications. The following sections contain general descriptions and interpretations of the diagnostic information available through the LED and instructions for accessing information or prompting a message.



LED STATUS Window on Monitor Top

Each character displayed in the LED represents a specific activity. (Refer also to [Appendix C](#) for a list of these characters and the activities to which they correspond.)

The presence of a yellow light at the upper left portion of the LED display indicates the monitor is awake or involved in active communication.

Note: Initiating the diagnostic code sequence using the magnet also wakes up and resets the modem in the monitor. When communication issues arise, the monitor often will resume wireless communications after the diagnostic codes are activated.

Initiating and Reading the LED Diagnostic Codes

Once the LED code sequence is initiated, codes display in the LED window. Performing this process requires using a small magnet (ADS p/n 8000-0460).

Note: ADS does not recommend initiating the diagnostic code sequence while codes representing monitor activity are displaying in the window. Therefore, verify that the LED window is blank and in clear view before attempting to initiate the code sequence.

Perform the following steps to initiate the LED diagnostic codes:

1. Hold the ADS magnet against the red dot located next to the **WAKE** label for several seconds.
2. Move the magnet away from the monitor once the flashing **A** displays in the LED window. (The sequence cannot begin until the magnet is removed.)



Proper Location for Magnet on Monitor Top



Codes Initiate after Removing Magnet from Contact with Monitor Top

3. Upon activation, interpret the diagnostic codes in succession in the following way:

Note: Certain diagnostic information may not be relevant or available based on the type of communication used by the monitor. When no information is available for a particular communication type, the applicable codes will display zeros.

- **4** indicates modem initialization
- **885** indicates code initiation
- **9999** is followed by the modem's model number
- **cccc** is followed by the wireless provider's number
- **bbbb** is followed by the battery voltage to two decimal places
- **cccc** is followed by the wireless communication raw signal strength (*ranging from 0 to 31*), then **bb**, followed by the signal strength in decibels (*ranging from -51 to -113 dBs; 99 indicates that no signal is available*)
- **nnnn** is followed by the monitor's network IP address
- **cccc** is followed by the network type (e.g., EGPRS, WCDMA, or HSPA)

Testing the Monitor Cryout Capability

You can test the monitor's ability to perform a cryout, representing a system event or alarm, to an ADS hosted software system (*when applicable*) by holding the magnet against the red dot (labeled **WAKE**) adjacent to the LED window on the monitor top for more than 5 seconds and then releasing the magnet from the top. The sequence **Cryout** indicates initiation of the cryout test message to the address configured in the monitor through **Qstart^{XML}**.

Checking the Monitor Battery Voltage

Check the battery voltage through the diagnostic codes (initiated on the monitor LED **STATUS** window using the blue magnet) or in **Qstart^{XML}** before installing the monitor and after collecting data. The

projected life for the internal monitor battery pack is 15 months at a 15-minute sample rate for the 12-volt battery pack. Actual battery life will vary based on the number of sensors and active functions providing data. However, replace the battery pack as soon as possible whenever the internal voltage for the 12-volt pack is 7.5 volts or less, or if **Qstart^{XML}** provides a *Low* battery status. Although the monitor may function adequately at 7.5 volts, communications with the monitor will quickly begin to degrade and become inconsistent once the battery voltage drops below 7.2 volts.

Check the current battery voltage in the monitor through **Qstart^{XML}** in the following way:

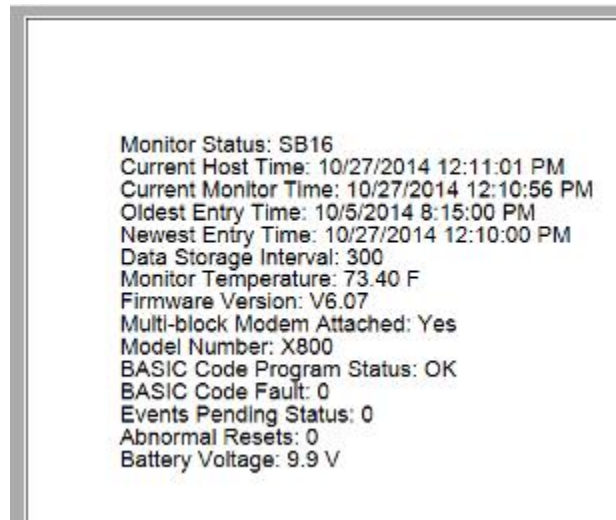
Note: Checking the battery voltage through the monitor status in **Qstart^{XML}** for monitors equipped with *dynamic* SIM cards is possible only through a serial (direct) connection.

1. Select the monitor for which you want to check the battery voltage from the **Location Name** field in the **Monitor** section on the **ADS Qstart^{XML}** dialog.
2. Click on the Status button in the **Functions** section.

*Once communication is established, the Monitor Status window displays the current status information for the monitor, including the current battery voltage. The status bar on the **ADS Qstart^{XML}** dialog also displays the current battery voltage. **Qstart^{XML}** will display the battery voltage on the status bar in red if it is low.*

3. Review the Monitor Status that displays once communication has been established. Replace the battery pack when the Monitor Status indicates that the internal voltage is *low*.

*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, if desired.*



Monitor Status report with internal battery pack voltage

4. Close the Monitor Status window and then click on the *green* **Hangup** button in the **Functions** section to discontinue communication with the monitor.

Replacing the Monitor Battery Pack

Note: The only service or maintenance activities ADS permits within the monitor chassis are battery pack, battery PCB, regulator/modem unit, SIM card replacement (as applicable) and fuse replacement. Therefore, do not handle, alter, modify, remove, or replace any other components inside the monitor. Such actions will void the monitor warranty agreement and the IS certification.

Note: Move the monitor away from the hazardous area before opening the monitor to replace the battery.

Warning: The *TRITON+* can receive internal power only from the ADS 12-volt IS battery pack (p/n 8000-0043-02/04). Do not use any other battery or power source to power the monitor internally.

ADS offers a replacement 12-volt battery pack (ADS p/n 8000-0043-02) to replace the existing battery pack when the battery voltage is low or falls below the previously specified level. Replacing the 12-volt battery pack involves a relatively simple process.

Note: Battery pack replacement involves removing the existing PCB for reuse with the replacement battery pack. Therefore, do not discard or replace the PCB unless it is necessary.



12-volt battery pack with PCB

Replace the internal battery in the *TRITON+* monitor in the following way:

1. Collect the data from the monitor (remotely or on-site). This will reduce the risk of data loss once the battery is disconnected.
 2. Remove the monitor from the manhole, and disconnect the following cables as applicable:
 - ☐ Antenna cable from the **ANTENNA** port on the monitor
 - ☐ Sensor cable(s) from the corresponding port(s) on the monitor
 3. Move the monitor from the hazardous area (i.e., at least 20 feet (6.1 m) away from the manhole), and place in a dry location.
 4. Brush off the monitor enclosure and remove the 4 bolts securing the top to the canister using a 13-mm nut driver.
- Note:** Make a note of the orientation of the monitor top to the canister before removing the bolts. Keeping proper orientation between the canister and the top is critical to maintaining the water and airtight seal on the monitor.
5. Wipe away any debris or moisture that could enter the chassis once the unit is opened.
 6. Remove the top (with the attached power regulator dome) by pulling it straight up from the canister. The battery rests at the bottom of the canister, and an 18-inch long cable extends from the battery pack to the top.



Viewing 12-volt battery pack in monitor canister from top

7. Place the top next to the canister, and then disconnect the battery cable from the dome cable and set the top/power regulator dome assembly aside. *However, do not disconnect the battery cable while the monitor is awake (e.g., taking readings or communicating)!* When the monitor is awake, characters and lights display on the LED **STATUS** window.

Note: Keep the underside of the top, the regulator dome, and the top gasket free of dirt, mud, and other debris. Debris and dirt can compromise the seal of the monitor once it is reassembled. In addition, inspect the monitor seal for damage.



Placing the top next to the monitor (left) and disconnecting the cables at the plastic white connectors (right)

8. Lift out the battery pack from the canister using the white handle (band) attached to the top of the pack.



12-volt battery pack outside canister (with retainer plug on top)

9. Lift off the retainer plug from the top of the battery pack, and disconnect the PCB from the battery pack in the following way:



12-volt battery pack without retainer plug

- ☐ Carefully move the thick red band securing the PCB to the side of the battery pack off of the PCB.
- ☐ Carefully disconnect the PCB from the battery pack at the white plastic connector.



Disconnecting the PCB from the battery pack

- ☐ Set the PCB temporarily aside in a clean, dry location. *Do not discard! This PCB will be used with the replacement battery pack.*
10. Connect the PCB to the replacement battery pack and then secure the PCB to the side of the pack with the red band.
 11. Run the loose cable from the battery pack through the hole in the underside of the retainer plug, and then seat the retainer plug on top of the battery pack. Be sure to pull the excess cable through the plug before fully seating the plug.

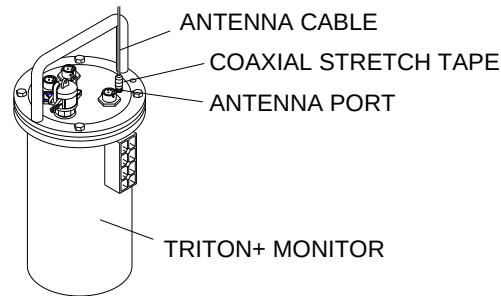
12. Lower the battery pack into the monitor canister, and then connect the cable from the battery pack to the monitor top/dome assembly.
13. Coil the excess cabling around the inner wall of the canister, and carefully lower the top/dome assembly back onto the canister. Keeping the proper orientation between the canister and the top is critical to maintaining the watertight and airtight seal on the monitor. Once the top has been torqued down after manufacture, the sealing gasket develops a *memory* profile of the canister lip. Reassembling the two pieces in the same orientation as before helps the gasket mate correctly with the canister lip.

Note: Be careful to avoid pinching the battery cable between the canister sealing lip and the gasket on the monitor top during reassembly. The cable also can get trapped between the two parts while tightening the bolts on the monitor top, preventing an effective air/watertight seal and potentially damaging the battery cable and/or gasket.



Returning the monitor top to the proper orientation with the canister – Align COMM+EXT PWR Connector with the backside of canister and molded mounting flange.

14. Finger-tighten the top bolts to make sure the top and gasket are seated properly. Then, tighten the bolts about halfway to full torque value by tightening the opposite bolts. Finally, tighten the bolts to approximately **30 inch-pounds (2.50 foot-pounds/ 3.39 Nm)** to fully secure the top to the canister. If the monitor will not seal, loosen the bolts and check for a trapped wire or debris on either the gasket or the lip. You can increase the torque value on the bolts *incrementally* to assist in sealing. However, tighten the bolts evenly to prevent distorting the gasket and *do not exceed 45-inch pounds (5.0843Nm)*.
15. Place the monitor upright on the ground surface beside the manhole, and reconnect the antenna cable to the **ANTENNA** port on the monitor *or* the landline/PSTN modem module to the COMM + EXT PWR port on the monitor.
16. Check the new battery voltage by activating the diagnostic codes in the LED **STATUS** window on the monitor using the blue magnet. The internal voltage should now be well above 7.5 volts. Refer to *Note: Initiating the diagnostic code sequence using the magnet also wakes up and resets the modem in the monitor. When communication issues arise, the monitor often will resume wireless communications after the diagnostic codes are activated.*
17. Initiating and Reading the LED Diagnostic Codes Wrap rubber stretch tape around the entire antenna cable/**ANTENNA** port connection, extending 1 to 2 inches onto the cable beyond the connection.



Antenna cable connected to **ANTENNA** port on monitor with stretch tape properly applied

18. Reconnect the sensor cable(s) to the appropriate port(s) (**Channel 1** and/or **Channel 2**) on the monitor.

Inspecting, Cleaning, and Handling the Sensors

Perform the following sensor inspections during regular site visits:

- Verify that the installation ring, bands or Mounting Bar are secure and clear of debris.
- Carefully remove any debris that has accumulated on or around the Long Range Depth Sensor.
- Clean the face of the Submersion Sensor with a clean, moist cloth as needed.
- Clean the face of the Surface Combo Sensor/Ultrasonic Depth Sensor gently with a soft brush, and wipe the sensor with a clean, moist cloth.

Note: The crystals on the Surface Combo Sensor are covered with a Teflon® coating. Therefore, do not use a wire brush or other abrasive, metallic device to clean these sensors.

- Verify that the face of the ParaDepth or ParaFlow sensor are level side to side and front to back using *Qstart^{XML}* software. Refer to *Chapter 4, Configuration and Activation* for more information.
- Verify that the face of the Surface Combo Sensor/Ultrasonic Depth Sensor is horizontally level with the flow. If necessary, reposition the sensor according to the procedures in *Chapter 5, Sensor Installation and Connection*.
- Scrub the face of the AV|Gated, AV|Max and/or Peak Combo sensor with a soft bristle brush.
- Confirm that all sensor cables are neatly arranged, securely fastened, and free of debris, cuts, kinks, and breaks that may affect performance. Replace any sensor that has a damaged cable.

When handling, storing, or packing the Surface Combo sensor or the Ultrasonic Depth sensor, avoid contacting the metal cable connector with the crystals on the sensor. This could damage the Teflon coating covering the crystals.

Replacing the Pressure Depth Sensor Dryer Tube or Desiccant

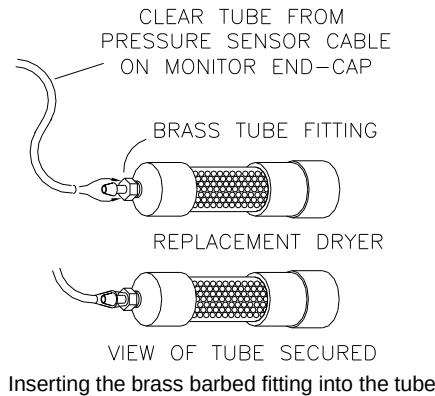
All combo sensors with a pressure depth sensor include a pressure depth sensor dryer tube. This tube contains desiccant that absorbs the moisture from the air traveling through the dryer tube into the clear plastic tubing leading to the pressure depth sensor in the pipe. Replace the dryer tube or the 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. Set aside, but do not discard, the old dryer tube with the used desiccant.
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.



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. Use the **View** or **Read All** function in the **Qstart^{XML}** software to fire the sensor and verify that the sensor is working correctly.

Replacing the Desiccant

When replacing the desiccant inside the pressure depth sensor dryer tube, use indicating beads that are approximately 0.16 inches (4.1 mm) 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 5/8-inch 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!*



Free end of dryer tube with inset nut

- 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.
9. Use the View or Read All function in the QstartXML software to fire the sensor and verify that the sensor is working correctly.

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.

Replacing the SIM Card

TRITON+ monitors supporting global Worldwide wireless network services handle wireless communications through an internal modem that is supported by a replaceable SIM card that resides in an enclosure on the monitor top and/or within the monitor Regulator/Modem bowl. The SIM card typically requires replacement only upon failure, which is rare, or when a change in wireless carrier occurs. *The monitor must be deactivated before replacing the SIM card!*

Note: The SIM cards in the 8000-FST-IM-4VZ, 8000-FST-IM-EP-4VZ, 8000-FST-IM-4WW-VZW and 8000-FST-IM-EP-4WW-VZW are specifically linked to the modem in the monitor. The original SIM card must be “un-paired” from the modem before swapping in a new SIM card.

Replacing the SIM Card in Monitors with a SIM Card Enclosure on the Monitor Top

Replace the SIM card (ADS p/n 8000-0702-GSIM, 8000-0703-CSIM (Canada), or customer-supplied) in monitors with a SIM Card enclosure on the monitor top in the following way:

Note: The only service or maintenance activities ADS permits within the monitor chassis are battery pack, battery PCB, regulator/modem unit, SIM card replacement (as applicable) and fuse replacement. Therefore, do not handle, alter, modify, remove, or replace any other components inside the monitor. Such actions will void the monitor warranty agreement and the IS certification.

Note: Move the monitor away from the hazardous area before opening the monitor to replace the battery.

1. Deactivate the monitor through **Qstart^{XML}**.
2. Remove the monitor from the manhole, and place it in a dry, clean location (i.e., an adequate distance away from the manhole).
3. Wipe away any debris or moisture that could enter the SIM card enclosure on the monitor top once the cap is removed from the enclosure.
4. Release and remove the reusable plastic tie running between the locks holding the cap on the SIM card enclosure.



SIM card enclosure with plastic tie

5. Pull out the locks securing the cap to the enclosure, and remove the cap from the enclosure.



SIM card enclosure locks released (left) and enclosure cap removed (right)

6. The SIM card holder in the enclosure functions based on spring action. Therefore, press the exposed edge of the SIM card into the holder and release. The card should pop out slightly, freed from its secured position.



SIM card slightly ejected from its secure position in holder

7. Slide the SIM card completely out of the holder.
8. Record the number of the new SIM card (IP address (*applies only to static IP addresses*) and ICCID number). You will need this information to update the monitor configuration in the **Qstart^{XML}** software and provide the ICCID number to ADS (or customer network provided) to activate the new SIM card. The IP address is printed directly on the SIM card or on a label affixed to the card.
9. Insert the SIM card into the groove in the holder on the inside of the enclosure, notched edge first with the contacts facing the pressure valve. Slide the SIM card all the way into the holder, and press down to lock it into place. The holder's spring mechanism should secure the card in the holder.



Empty SIM card holder showing pressure valve (left); inserting the SIM card properly into the holder



SIM card properly seated and secured in the holder

10. Replace the cap onto the SIM card enclosure, and snap the locks in place to secure the cap.
11. Replace and reconnect the plastic tie between the locks holding the cap on the SIM card enclosure.
12. Change the APN name using Advanced > Modem Setup device in **Qstart^{XML}** (when necessary).
13. Request a SIM deactivation for the removed SIM by emailing adssupportcenter@idexcorp.com (or the network service provider). Include the SIM number (from the SIM card holder), the last four (4) digits of the SIM ICCID number and **TRITON+** serial number. Once the SIM card is deactivated, you may discard it.
14. Request an activation of the new SIM by emailing adssupportcenter@idexcorp.com (or the network service provider). Include the last four (4) digits SIM ICCID number and modem IMEI number. Wait for return email from ADS (or the network service provider) that the SIM has been activated. The email will contain the IP address (for static IPs) and its associated phone number.

Note: Wait at least 15-minutes from the receipt of the email before proceeding with the next step. This is to ensure sufficient time for the IP address to be uploaded by the service provider.

15. Connect an ADS USB Serial Interface cable (ADS p/n 8000-0337) to the COMM + EXT PWR port on the monitor (for battery powered monitors) or a standard A-to-B USB cable to the USB port on the ExPAC (for externally-powered monitors). Attach the other end of the USB cable to your laptop computer.
16. Reactivate the monitor through **Qstart^{XML}**.

Note: You must reactivate the monitor through a direct (*serial*) connection before you can resume wireless communications following SIM card replacement.
17. Establish wireless communication with the monitor to verify communication.
18. Recoil and secure the antenna cable to the cable tie mount using a cable tie, if necessary. Refer to *Installing the Antenna* in Chapter 3, [Communication](#), for more information.

Replacing the SIM Card in Regular/Modem Bowl

Note: The only service or maintenance activities ADS permits within the monitor chassis are battery pack, battery PCB, regulator/modem unit, SIM card replacement (as applicable) and fuse replacement. Therefore, do not handle, alter, modify, remove, or replace any other components inside the monitor. Such actions will void the monitor warranty agreement and the IS certification.

Note: Move the monitor away from the hazardous area before opening the monitor to replace the battery.

Replace the SIM card in the **TRITON+** monitor with no SIM card enclosure on the monitor top in the following way:

1. Collect the data from the monitor (remotely or on-site). This will reduce the risk of data loss once the battery is disconnected.
2. Remove the monitor from the manhole, and disconnect the following cables as applicable:
 - ☐ Antenna cable from the **ANTENNA** port on the monitor
 - ☐ Sensor cable(s) from the corresponding port(s) on the monitor
3. Move the monitor from the hazardous area (i.e., at least 20 feet (6.1 m) away from the manhole), and place in a dry location.
4. Brush off the monitor enclosure and remove the 4 bolts securing the top to the canister using a 13-mm nut driver.

Note: Make a note of the orientation of the monitor top to the canister before removing the bolts. Keeping proper orientation between the canister and the top is critical to maintaining the water and airtight seal on the monitor.

5. Wipe away any debris or moisture that could enter the chassis once the unit is opened.
6. Remove the top (with the attached power regulator dome) by pulling it straight up from the canister. The battery rests at the bottom of the canister, and an 18-inch long cable extends from the battery pack to the top.

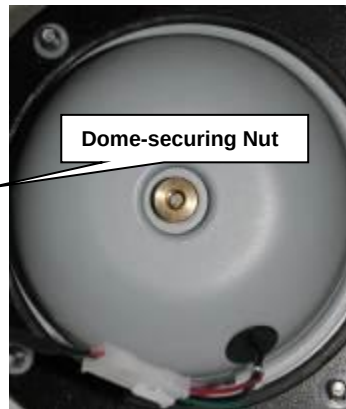


Placing the top next to the monitor (left) and disconnecting the cables at the plastic white connectors (right)

7. Place the top next to the canister, and then disconnect the battery cable from the dome cable and set the top/power regulator dome assembly aside. *However, do not disconnect the battery cable while the monitor is awake (e.g., taking readings or communicating)!* When the monitor is awake, characters and lights display on the LED **STATUS** window.

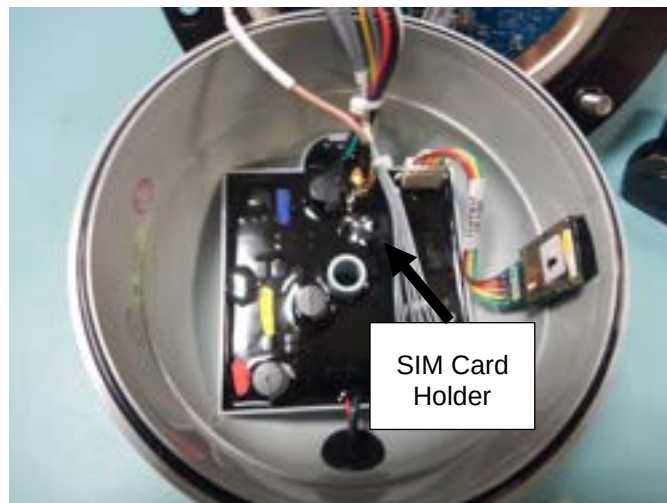
Note: Keep the underside of the top, the regulator dome, and the top gasket free of dirt, mud, and other debris. Debris and dirt can compromise the seal of the monitor once it is reassembled. In addition, inspect the monitor seal for damage.

8. Remove the brass thumb nut securing the dome to the monitor top.



Removing nut securing regulator dome to monitor top

9. Carefully lift off the dome from the top (as if opening like a book).



Open Regular/Modem Bowl Showing Internal SIM Card Holder

10. The SIM card holder in the enclosure functions based on spring action. Therefore, press the exposed edge of the SIM card into the holder and release. The card should pop out slightly, freed from its secured position.
11. Slide the SIM card completely out of the holder.
12. (*applies only when using SIM cards with static IP addresses*) Record the number of the *new* SIM card (i.e., the IP address). You will need this address to update the XML in the **Qstart^{XML}** software. The IP address is printed directly on the SIM card or on a label affixed to the card. Also the last four (4) digits of the ICCID number of the new SIM card. This information will be needed to activate the new card.
13. Insert the new SIM card into the groove in the holder on the inside of the enclosure, notched edge first with the contacts facing the pressure valve. Slide the SIM card *all the way* into the holder, and press down to lock it into place. The holder's spring mechanism should secure the card in the holder.
14. Once SIM card is firmly seated, close up Regulator Bowl tightening brass nut finger tight. Ensure no cables are caught between bowl and monitor top.
15. (*applicable only to battery-powered monitors*) Reconnect the battery cable to the cable exiting from the hole in the top/dome assembly.
16. Coil the excess cabling around the inner wall of the canister (*when applicable*), and carefully lower the top/dome assembly back onto the canister. Keeping the proper orientation between the canister and the top is critical to maintaining the watertight and airtight seal on the monitor. Once the top has been torqued down after manufacture, the sealing gasket develops a memory profile of the canister lip.

Reassembling the two pieces in the same orientation as before helps the gasket mate correctly with the canister lip.

Note: Be careful to avoid pinching the battery cable (*when applicable*) between the canister sealing lip and the gasket on the monitor top during reassembly. The cable also can get trapped between the two parts while tightening the bolts on the monitor top, preventing an effective air/watertight seal and potentially damaging the battery cable and/or the gasket.



Returning the monitor top to the proper orientation with the canister – Align COMM+EXT PWR Connector with the backside of canister and molded mounting flange.

17. Finger-tighten the top bolts to make sure the top and gasket are seated properly. Then, tighten the bolts about halfway to full torque value by tightening the opposite bolts. Finally, tighten the bolts to approximately **30 inch-pounds** (2.50 foot-pounds/ 3.39 Nm) to fully secure the top to the canister. If the monitor will not seal, loosen the bolts and check for a trapped wire or debris on either the gasket or the lip. You can increase the torque value on the bolts *incrementally* to assist in sealing. However, tighten the bolts evenly to prevent distorting the gasket and *do not exceed 45-inch pounds* (5.0843Nm).
18. Change the APN name using **Advanced > Modem Setup** device in **Qstart^{XML}** (as necessary).
19. Request a SIM deactivation for the removed SIM by emailing adssupportcenter@idexcorp.com (or the network service provider). Include the IP address, the last four (4) digits of the SIM ICCID number and **TRITON+** serial number. Once the SIM card is deactivated, you may discard it.
20. Request an activation of the new SIM by emailing adssupportcenter@idexcorp.com (or the network service provider). Include the last four (4) digits SIM ICCID number and modem IMEI number. Wait for return email from ADS (or the network service provided) that the SIM has been activated. The email will contain the IP address (for static IPs) and its associated phone number.

Note: Wait at least 15-minutes from the receipt of the email before proceeding with the next step. This is to ensure sufficient time for the IP address to be uploaded by the service provider.
21. Connect an ADS USB Serial Interface cable (ADS p/n 8000-0337) to the COMM + EXT PWR port on the monitor (for battery powered monitors) or a standard A-to-B USB cable to the USB port on the ExPAC (for externally-powered monitors). Attach the other end of the USB cable to your laptop computer.
22. Reactivate the monitor through **Qstart^{XML}**.

Note: You must reactivate the monitor through a direct (*serial*) connection before you can resume wireless communications following SIM card replacement.
23. Establish wireless communication with the monitor to verify communication.

24. Recoil and secure the antenna cable to the cable tie mount using a cable tie, if necessary. Refer to *Installing the Antenna* in Chapter 3, [Communication](#), for more information. Connect an ADS USB Serial Interface cable (ADS p/n 8000-0337) to the COMM + EXT PWR port on the monitor (for battery powered monitors) or a standard A-to-B USB cable to the USB port on the ExPAC (for externally-powered monitors). Attach the other end of the USB cable to your laptop computer.
25. Reactivate the monitor through **Qstart^{XML}**.

Note: You must reactivate the monitor through a direct (*serial*) connection before you can resume wireless communications following SIM card replacement.
26. Establish wireless communication with the monitor to verify communication.
27. Recoil and secure the antenna cable to the cable tie mount using a cable tie, if necessary. Refer to *Installing the Antenna* in Chapter 3, [Communication](#), for more information.

Replacing the Fuses in the Monitor

The **TRITON+** monitor contains a removable power regulator secured to a special dome that resides inside the monitor enclosure and is attached to the monitor top. If a regulator failure occurs, it typically involves a bad fuse on the regulator board corresponding to communications or sensors. The regulator board has *three* fuses, indicated by three color-corresponding LED lights on top of the monitor, (ADS p/n 508071, 508072, and 508073) that may be replaced independently upon failure.

The 5-volt *blue* fuse corresponds to the sensors and can be blown due to a shorted sensor. If this fuse is blown, the monitor cannot detect the sensors. The 3.3-volt *yellow* fuse is associated with the processor board. When blown, this fuse prevents the monitor from logging data and performing successful communications. The red (main input) fuse is related to the regulator board and rarely has issues.

Refer to the *Troubleshooting* section beginning on page 11-24 to identify whether a fuse may be the source of a particular problem that has occurred within the **TRITON+** system and, if so, which fuse may require replacement.

Note: If the troubleshooting procedures indicate that a sensor may have shorted *or* a sensor may have shorted and the 5-volt (blue) fuse on the power regulator in the monitor corresponding to the sensor may have blown, *do not connect the potentially shorted sensor to the same monitor with a new 5-volt fuse or another monitor* until confirming that the sensor is functional (i.e., not shorted) using a voltmeter. If the sensor is shorted, it also will blow the newly replaced 5-volt fuse or the existing 5-volt fuse in the other monitor. Please contact ADS Client Services for detailed instructions on determining whether a sensor has shorted.

Since the fuses attach to the board on the inside of the power regulator dome inside the monitor, access to and replacement of a fuse first requires opening the monitor and removing the dome.

Replace a fuse(s) in the monitor in the following way:

1. (*applicable only when blue fuse requires replacement*) Collect the data from the monitor (remotely or on-site) to limit the risk of losing data once the battery is disconnected.
2. Remove the monitor from the manhole.
3. (*applicable only to externally-powered monitors*) Turn off the power to the monitor at the external source, and then disconnect the external power/communications cable from the **COMM + EXT PWR** port on the monitor.
4. Disconnect the antenna cable from the **ANTENNA** port on the monitor from the **COMM + EXT PWR** port on the monitor.
5. Disconnect the sensor cable(s) from the corresponding port(s) on the monitor.
6. Remove the monitor from the hazardous area (i.e., at least 20 feet (6.1 m) away from the manhole), and place in a dry location.

7. Brush off the monitor enclosure and remove the 4 bolts securing the top to the canister using a 13-mm nut driver.

Note: Make a note of the orientation of the monitor top to the canister before removing the bolts. Keeping proper orientation between the canister and the top is critical to maintaining the water and airtight seal on the monitor.

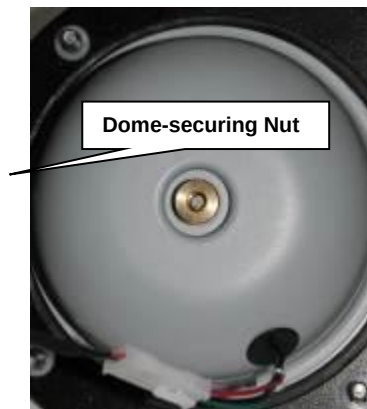
8. Wipe away any debris or moisture that could enter the chassis once the unit is opened.
9. Remove the top (with the attached power regulator dome) by pulling it straight up from the canister.
10. Place the top upside down next to the canister (with the dome facing upward), and then disconnect the battery cable (*when applicable*) from the dome cable. *However, do not disconnect the battery cable while the monitor is awake (e.g., taking readings or communicating)! When the monitor is awake, characters and lights display on the LED STATUS window.*

Note: Keep the underside of the monitor top, the regulator dome, and the top gasket free of dirt, mud, and other debris. Debris and dirt can compromise the seal of the monitor once it is reassembled. In addition, inspect the monitor seal for damage.



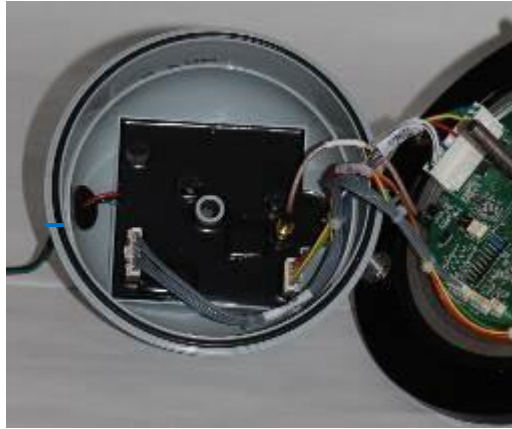
Placing the top next to the monitor (left) and disconnecting the cables at the plastic white connectors (right)

11. Remove the brass thumb nut securing the dome to the monitor top.



Removing nut securing regulator dome to monitor top

12. Carefully lift off the dome from the top (as if opening like a book). Notice the three fuses seated on the regulator board on the inside of the dome.



Inside of regulator dome (top) and underside of monitor top (bottom)

13. Remove the bad fuse(s) from the regulator board by gently, but firmly, pulling and lifting it straight up from the board. Notice that the label on each fuse displays a color bar (red, blue, or yellow) that corresponds to the color coding on the board adjacent to the fuse.



Close up of regulator board showing the three color-coded fuses



Blue fuse removed from the regulator board

14. Carefully insert the new, replacement fuse(s) into the corresponding holes in the dome without bending the fuse filaments. Verify that the color strip on the fuse matches the color on the regulator board adjacent to the holes. Make sure the fuse(s) is seated firmly and securely.
15. Realign and reseal the dome against the monitor top, and replace the thumb nut to secure the dome to the top.

16. (*applicable only to battery-powered monitors*) Reconnect the battery cable to the cable exiting from the hole in the top/dome assembly.
17. Coil the excess cabling around the inner wall of the canister (*when applicable*), and carefully lower the top/dome assembly back onto the canister. Keeping the proper orientation between the canister and the top is critical to maintaining the watertight and airtight seal on the monitor. Once the top has been torqued down after manufacture, the sealing gasket develops a memory profile of the canister lip. Reassembling the two pieces in the same orientation as before helps the gasket mate correctly with the canister lip.

Note: Be careful to avoid pinching the battery cable (*when applicable*) between the canister sealing lip and the gasket on the monitor top during reassembly. The cable also can get trapped between the two parts while tightening the bolts on the monitor top, preventing an effective air/watertight seal and potentially damaging the battery cable and/or the gasket.

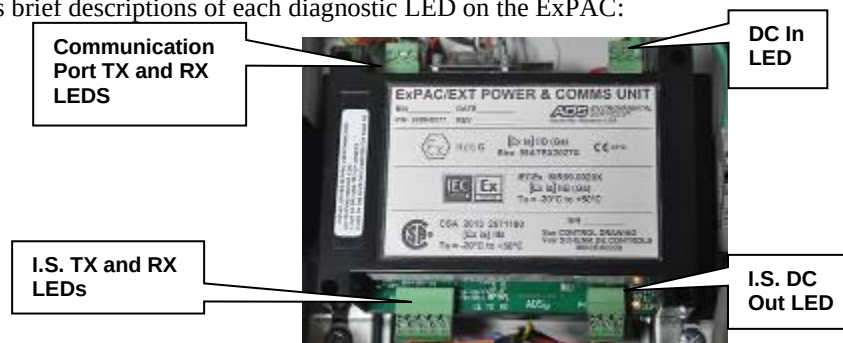


Returning the monitor top to the proper orientation with the canister – Align COMM+EXT PWR Connector with the backside of canister and molded mounting flange.

18. Finger-tighten the top bolts to make sure the top and gasket are seated properly. Then, tighten the bolts about halfway to full torque value by tightening the opposite bolts. Finally, tighten the bolts to approximately **30 inch-pounds** (2.50 foot-pounds/ 3.39 Nm) to fully secure the top to the canister. If the monitor will not seal, loosen the bolts and check for a trapped wire or debris on either the gasket or the lip. You can increase the torque value on the bolts *incrementally* to assist in sealing. However, tighten the bolts evenly to prevent distorting the gasket and *do not exceed 45-inch pounds* (5.0843Nm).
19. Place the monitor upright on the ground beside the manhole, and reconnect the antenna cable to the **ANTENNA** port on the monitor *or* the landline/PSTN modem module to the **COMM + EXT PWR** port on the monitor.
20. (*applicable only to externally-powered monitors*) Reconnect the external power/communications cable to the **COMM + EXT PWR** port on the monitor. Restore power to the monitor from the external source.
21. Establish communication with the monitor remotely to verify communication.
22. Rewrap rubber stretch tape around the entire cable connection between the antenna and **ANTENNA** port, extending 1 to 2 inches (25 to 50 mm) onto the cable beyond the connection. When applicable, rewrap the connection between the external power/communication cable and the **COMM + EXT PWR** port in the same manner.
23. Reconnect the sensor(s) to the appropriate port(s) (i.e., **Channel 1** and/or **Channel 2**) on the monitor.

Interpreting the Diagnostic LED Codes on the ExPAC

The ExPAC includes LED lights that provide diagnostic insight into the current activities involving communications and power that pertain to the ExPAC and overall system. The following image and table includes brief descriptions of each diagnostic LED on the ExPAC:



Diagnostic LEDs on ExPAC

LED	Color	State	Description
DC IN (D21 next to P3)	Yellow	On	Device powered, 9 to 36 VDC
		Off	Device not powered
I.S. DC OUT (D20 next to P4)	Yellow	On	<i>TRITON+</i> power on
		Off	<i>TRITON+</i> power off
TX (to communication port)	Blue	Flashing	Transmitting data to communication port
		Off	Not transmitting data
I.S. TX (to <i>TRITON+</i>)	Blue	Flashing	<i>TRITON+</i> transmitting data
		Off	Not transmitting data
RX (to communication port)	Red	Flashing	Receiving data from communication port
		Off	Not receiving data
I.S. RX (to <i>TRITON+</i>)	Red	Flashing	<i>TRITON+</i> receiving data
		Off	Not receiving data

Troubleshooting

The *TRITON+* flow monitor contains several different components that perform many different functions. Since a malfunctioning component increases the risk of losing data, isolating the problem component 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 monitor processor 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 communications, clock readings, time stamps, and data storage intervals usually arise from faulty processor board components, 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 board) may arise from problems with the processor board.

Note: If possible, collect all monitor data prior to swapping sensors or troubleshooting a monitor to prevent possible 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, some 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 they arrive. 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 for repair.

This section provides general guidelines for troubleshooting and correcting problems with the *TRITON+* monitor and sensor subsystems.

General Monitor Problems

The following tables contain general troubleshooting techniques for the *TRITON+* flow monitor.

Problem	Time stamp on the collected data is incorrect.
Possible Causes	PC clock may have been set to incorrect time when the monitor was activated. Monitor time zone difference for the PC clock may not have been set correctly when the monitor was activated. Monitor clock may be faulty.
Possible Solutions	Verify the time on the PC clock and correct if necessary. Reactivate the monitor to enable the clock. Verify the time <i>zone</i> setting of the monitor. Correct and reactivate if necessary. Collect the data from the monitor and replace monitor if defective.

Problem	Time on the monitor clock is incorrect.
Possible Causes	PC clock may have been set to the incorrect time when the monitor was activated. Monitor clock may be a faulty. Monitor time zone difference for the PC clock may not have been set correctly when the monitor was activated.
Possible Solutions	Verify the time on the PC clock and correct if necessary. Reactivate the monitor to enable the clock. Verify the time <i>zone</i> setting of the monitor. Correct and reactivate if necessary. Collect the data from the monitor and replace monitor if defective.

Problem	You receive a Device Time Out message in Qstart^{XML} .
Possible Cause	Communications may be marginal. Modem may be defective.
Possible Solutions	Re-attempt communication with monitor. Verify signal strength. Check a Qstart^{XML} data collect log or check the Status in Qstart^{XML}. If the signal strength indicated is less than -95 (for example: -99), consider re-orienting the antenna and/or installing the antenna in a pedestal above ground. Contact your regional ADS representative. Replace the modem if defective.

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

Problem	Data is missing at the beginning or end of the date range following data collection.
Possible Causes	Monitor activation may have failed. Monitor time may be incorrect. Monitor's firmware file may be corrupt.
Possible Solutions	Verify whether the monitor has been activated, and activate if necessary. Check monitor time, and reset clock if necessary. Contact your regional ADS representative.

Problem	Monitor independently discontinues logging data.
Possible Causes	Battery pack may be dead or below minimum voltage requirement (7.5 volts - internal). 3.3-volt (yellow) fuse on regulator may have blown. Monitor memory may have been corrupted during firmware upgrade, causing the monitor to record data only during monitor communications.
Possible Solutions	Replace battery pack. Replace the 3.3-volt (yellow) fuse on the regulator. If the monitor is logging data only during monitor communications following a firmware upgrade, contact your ADS regional representative to clear the monitor memory and reactivate the monitor. Contact your regional ADS representative.

Problem	An I/O error message displays when communicating with the monitor.
Possible Causes	Communication quality might be marginal. Antenna may be defective. Processor board may be faulty.
Possible Solutions	Re-attempt communication with the monitor. Temporarily attach new antenna, and permanently replace the existing antenna if the error message no longer occurs. Replace the monitor if defective. Contact your regional ADS representative.

Communication Problems

The following tables contain general troubleshooting techniques for wireless communications.

Note: Contact your ADS representative for further diagnosis prior to replacing a sensor or monitor.

Problem	Monitor does not answer via wireless communication.
Possible Causes	Signal strength to the modem may be insufficient. Battery pack may be dead or below minimum voltage requirement (7.5 volts - internal). Wireless network failure. SIM card is not properly provisioned. Monitor may have lost communication with network and cannot re-establish communication. Connection type may be incorrectly configured in the monitor. Antenna may be defective. Antenna may not be attached to the monitor. Antenna may not be installed correctly. Monitor may not be on the ADS VPN network. Monitor may be defective. Modem may be defective. 3.3-volt fuse on regulator may have blown. Leading zeros are included before or within the IP address.
Possible Solutions	Check the diagnostic codes on the LED Status window (using magnet) on the monitor top to verify the IP address is available. If it does not display initially, activate the LED Status window again after a minute or two. Activating the LED Status will reset the modem, which typically enables it to reconnect to the monitor. If it still does not display, disconnect the battery pack from the monitor for at least 1 minute and then reconnect the battery pack. Once the LED is no longer illuminating, reactivate the diagnostic codes to verify whether the IP address is now available. Relocate the antenna (consider a pedestal mount if installed outside the manhole) Reposition the antenna in the correct position of horizontal and with "This Side Up" facing upward. Replace the antenna. Replace the monitor battery pack (<i>when applicable</i>) if it is reading below the minimum voltage requirement. Try connecting to other wireless units in the same area (other wireless monitor sites). If all connections fail for similar IP addresses and/or none of the wireless connections are successful, there may be a wireless network outage in your area. Contact your regional ADS representative for them to investigate a possible outage. Delete any leading zeros included before or within the IP address. Replace SIM card in the GL monitor. (Does not apply to 4VZ.) <i>(applies only if the software provides a "Getting Monitor Attention" message while attempting to communicate)</i> Try to communicate with the monitor through a serial (<i>direct</i>) connection. If direct communication fails, remove the monitor from the hazardous area (at least 20 feet away from the manhole), disconnect the battery pack, wait at least 1 minute, reconnect the battery pack, and then attempt to communicate. If the monitor still will not communicate, replace the 3.3-volt yellow fuse on the regulator. Replace the monitor.

Problem	Wireless modem connects but monitor does not respond.
Possible Cause	Connection type configuration has reverted to Serial . 3.3-volt (yellow) fuse on regulator may have blown.
Possible Solutions	Verify that the communication type is set to Wireless. Connect directly with the monitor using a USB Serial Interface cable (ADS p/n 8000-0337). Verify the monitor responds. If it does, the modem might be faulty. If it does not, remove the monitor from the hazardous area (at least 20 feet away from the manhole), disconnect the battery pack, wait at least 1 minute, and then reconnect the monitor battery pack. If remote communication resumes, try to connect several times to ensure communication is reliable. Replace the 3.3-volt yellow fuse on the regulator. Contact your regional ADS representative.

Problem	Monitor cannot communicate over a serial connection.
Possible Causes	Serial connection to monitor or field computer may be loose. Communication port may not be defined correctly in Qstart^{XML}. USB Serial Interface cable may be damaged. Serial port on the computer may not be generating adequate power for the USB Serial Interface Cable to facilitate communication with the monitor. USB drivers are not loaded properly. 3.3-volt (yellow) fuse on regulator may have blown.
Possible Solutions	Verify cable connections to monitor and field computer are secure. Verify the port is correct through the Control Panel on your computer. Inspect USB serial interface cable for damage. Load USB drivers following the instructions on the USB cable. <i>(applies only if the software provides a "Getting Monitor Attention" message while attempting to communicate)</i> Remove the monitor from the hazardous area (at least 20 feet away from the manhole), disconnect the battery pack, wait at least 1 minute, reconnect the battery pack, and then attempt to communicate. If the monitor still will not communicate, replace the 3.3-volt yellow fuse on the regulator. Contact your regional ADS representative.

Long Range Depth Subsystem

The following tables contain general troubleshooting techniques for problems with the ultrasonic depth subsystem corresponding to the Long Range Depth Sensor.

Note: Contact your ADS representative for further diagnosis prior to replacing a sensor or monitor.

Problem	Depth measured not matching invert flow levels
Possible Causes	Manhole depth is greater than sensor range (20 feet). Manhole depth may be incorrect. Physical offset may be incorrect. Sensor may not be positioned correctly over the invert. Something may be obstructing the sensor. Sensor and/or mounting bar may not be level.
Possible Solutions	Install the sensor within prescribed range. Verify the manhole depth, and adjust if necessary. Verify the physical offset, and adjust if necessary. Reposition the Mounting Bar so sensor is directly over the invert. Neatly coil and cables and/or relocate TRITON+ monitor. Verify the sensor and Mounting Bar are level, and adjust if necessary.

Problem	Depth measured remains a constant value.
Possible Causes	Sensor may be positioned incorrectly over invert and/or incorrectly reading a stationary object (rung, bench, etc.) in the manhole structure. Sensor level is incorrect and not measuring invert depth.
Possible Solutions	Reposition the Mounting Bar so sensor is directly over the invert. Neatly coil all cables and/or relocate TRITON+ monitor. Verify the sensor and Mounting Bar are level, and adjust if necessary.

Problem	Depth readings are erratic.
Possible Causes	Debris is in front of sensor. Mounting Bar has become dislodged. Sensor cables are in front of sensor. Sensor is attempting to measure depths beyond specifications. Sensor may be submerged.
Possible Solutions	Clear any debris that may have accumulated on or under the sensor. Inspect the Mounting Bar to ensure installation is secure. Neatly coil sensor cables and secure them to the manhole rung or wall. Verify the sensor and Mounting Bar are level, and adjust if necessary. Wait for water level to recede and verify sensor readings return to normal.

Ultrasonic Depth Subsystem

The following tables contain general troubleshooting techniques for problems with the ultrasonic depth subsystem corresponding to the ParaDepth, ParaFlow, Surface Combo Sensor and the Ultrasonic Depth Sensor.

Note: Contact your ADS representative for further diagnosis prior to replacing a sensor or monitor.

Problem	Range from ultrasonic depth subsystem is slightly inconsistent with manually measured range.
Possible Causes	Physical offset may be incorrect. Pipe height may be incorrect. An incorrect Electronic offset has been entered.
Possible Solutions	Verify the physical offset, and adjust it if necessary. Verify the pipe height. Verify electronic offset and adjust if necessary.

Problem	Range from ultrasonic depth subsystem is significantly greater than manually measured range.
Possible Causes	Physical offset may be incorrect. Pipe height may be incorrect. Electronic offset may be incorrect. Sensor may not be level. Foam, extreme condensation, or other substance may be absorbing the pulse. Sensor may be faulty.
Possible Solutions	Verify the physical offset. Verify the pipe height. Verify electronic offset and adjust if necessary. Make sure the sensor is level and in good condition. Check the hydraulic conditions in the pipe. Fire the sensor at a shorter distance onto a hard surface to confirm accuracy. Clean/dry the sensor. Replace the sensor. Contact your regional ADS representative.

Problem	Range from the ultrasonic depth subsystem is too short (but not zero).
Possible Causes	Pipe height may be incorrect. Electronic offset may be incorrect. Sensor may be dirty. Sensor may be faulty.
Possible Solutions	Verify the pipe height. Verify electronic offset and adjust if necessary. Clean the sensor. Replace the sensor. Contact your regional ADS representative.

Problem	Raw ultrasonic depth data shows depths greater than the pipe diameter.
Possible Causes	Physical offset may be incorrect. Pipe height may be incorrect. Electronic offset may be incorrect. Pipe may be surcharged. Sensor may be dirty. Sensor may be faulty.
Possible Solutions	Verify the physical offset. Verify the pipe height. Verify electronic offset and adjust if necessary. Clean the sensor. Replace the sensor. Contact your regional ADS representative.

Problem	Depth data indicates a surcharged pipe, but the pipe is free flowing.
Possible Causes	Physical offset may be incorrect. Electronic offset may be incorrect. Pipe height may be incorrect. Sensor may be dirty. Sensor may be faulty.
Possible Solutions	Verify the physical offset and the pipe height. Verify electronic offset and adjust if necessary. Clean the sensor. Contact your regional ADS representative. Replace the sensor. Replace the monitor if defective.

Problem	Ultrasonic depth readings are erratic.
Possible Causes	Noise may exist in the sewer pipe. Sensor may be dirty. Flow may be choppy or foamy. Sensor may not be level.
Possible Solutions	Check the flow conditions. Clean the sensor. Check if the sensor is level and correct if necessary. Change the power Mode in the sensor parameter settings to determine whether the readings improve. If the readings improve, reactivate the monitor with the new setting.

Problem	Individual ultrasonic depth readings (SDEPTH_3) from ParaDepth, ParaFlow, Surface Combo Sensor/Ultrasonic Depth Sensor are consistently equivalent to the value obtained from the following equation: Pipe Height – Physical Offset + 9.99.
Possible Causes	Sensor may be faulty. 5-volt (blue) fuse on regulator may have blown.
Possible Solutions	Replace the Surface Combo Sensor/Ultrasonic Depth Sensor. Replace the 5-volt (blue) fuse on the regulator. Caution: Do not connect a potentially shorted sensor to another monitor until confirming that the sensor is functional (i.e., not shorted) using a voltmeter. A shorted sensor will blow the 5-volt (blue) replacement fuse on the regulator of the monitor.

Problem	Sensor reports abnormal temperatures.
Possible Causes	Sensor connection to monitor may be loose. Temperature sensor may be faulty. Sensor may be faulty.
Possible Solutions	Secure sensor connection to monitor if necessary. Replace the sensor.

Upward Depth Subsystem

The following tables contain general troubleshooting techniques for the upward depth subsystem corresponding to the AV|Gated, AV|Max and Peak Combo sensor.

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

Problem	UpDepth data periodically reads 0.88 inches (22 mm).
Possible Causes	Minimum flows are occurring within sensor deadband (extending 1.0 inches (25 mm) up from bottom of Peak Combo Sensor) or the sensor is receiving a strong return signal close to the sensor face. Sensor transmit/receive surfaces are dirty. Sensor or cabling might be faulty.
Possible Solutions	Verify minimum flow depths are not occurring within sensor deadband. Set the deadband on the UpDepth sensor to a setting other than <i>Auto</i>, but well below the expected minimum flow depth. Fire the sensor several times to verify whether the readings improve. Ensure the sensor is installed as closely as possible to the 6:00 position in the pipe, silt allowing. Clean the sensor transmit/receive surfaces. Inspect the sensor cables for integrity. Check for moisture in the connector. Contact your regional ADS representative. Replace the sensor. Replace the monitor if defective.

Problem	UpDepth data seems erratic over a full depth range.
Possible Causes	Sensor transmit/receive surfaces may be dirty. Sensor may be rotated greater than 15 degrees from center (greater than 5 degrees for the AV Gated sensor). Sensor may be faulty. Processor board may be faulty.
Possible Solutions	Clean the sensor transmit/receive surfaces. Check the sensor connections. Ensure the sensor is installed as closely as possible to the 6:00 position in the pipe, silt allowing. Contact your regional ADS representative. Replace the sensor. Replace the monitor if defective.

Problem	UpDepth readings are abnormally low.
Possible Causes	Sensor transmit/receive surfaces may be covered with silt. Sensor may be physically offset in the flow and the correct physical offset has not been measured and/or downloaded to the monitor.
Possible Solutions	Re-measure physical offset of the sensor. Check the site conditions, and relocate the sensor if necessary.

Problem	Individual UpDepth_1 (_2) values consistently read -9.99.
Possible Causes	Sensor may be faulty. 5-volt (blue) fuse on regulator may be blown.
Possible Solutions	Replace the Peak Combo Sensor. Replace the 5-volt blue fuse on the regulator. Caution: Do not connect a questionable sensor to another monitor before verifying the integrity of the sensor. A shorted sensor will blow the 5-volt (blue) replacement fuse on the regulator in the monitor.

Peak Velocity Subsystem

The following tables contain general troubleshooting techniques for the velocity subsystem corresponding to the AV|Max, Peak Combo Sensor and Surface Combo sensor (*Surcharge Velocity Sensor only*). Since the Surface Combo sensor is mounted at the top of the pipe, potential issues involving a sensor that is out of the flow do not apply to the Surface Combo sensor.

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

Problem	Monitor often provides a velocity reading of 0.
Possible Causes	Sensor's velocity transmit/receive surfaces may be dirty or the velocity function is broken. Minimum flows may be occurring within the sensor deadband (extending 1.0 inches (25 mm) up from the bottom of the Peak Combo Sensor). Cabling between the processor board and the velocity sensor may be bad. Velocity parameters may require adjustment.
Possible Solutions	Clean the sensor's transmit/receive surfaces. Verify that minimum flows are occurring outside the sensor deadband. Check the velocity parameters. Inspect the sensor cables for tightness. Check for moisture in the connector. Contact your regional ADS representative. Replace the sensor. Replace the monitor if defective.

Problem	Velocity data does not fluctuate much (but is not 0).
Possible Causes	Sensor may be dirty. Minimum flows may be occurring within the sensor deadband (extending 1.0 inches (25 mm) up from the bottom of the Peak Combo Sensor). Velocity function may be broken.
Possible Solutions	Clean the sensor's transmit/receive surfaces. Verify that minimum flows are occurring outside the sensor deadband. Check the sensor connections. Check the velocity parameters. Contact your regional ADS representative. Replace the velocity sensor.

Problem	Velocity data seems erratic or exhibits poor quality.
Possible Causes	Sensor's transmit/receive surfaces may be dirty. Sensor may be close to extending out of the flow. Designated value for the maximum velocity parameter may be too high, creating too broad of a range. Transmit Frequency setting may be incorrect. Sensor may be faulty. Processor board may be faulty.
Possible Solutions	Clean the sensor's transmit/receive surfaces. Verify whether the flow depth exceeds the sensor deadband at the same time and under the same conditions as the erratic data. Rotate the sensor further toward the center of the pipe if possible. Change the Transmit Frequency. It should be set to High for optimal performance. Reduce the maximum velocity in the device parameters to narrow the range. Check the sensor connections. Contact your regional ADS representative. Replace the sensor. Replace the monitor if defective.

Problem	Velocity readings are abnormally high.
Possible Causes	Sensor's velocity transmit/receive surfaces may be covered with silt or other debris. Sensitivity setting may be too high. Sensor may be extending out of the flow. Flow may be reversed or slower than (0.5 feet per second (0.15 mps))
Possible Solution	Check the site conditions, and relocate the sensor if necessary. Check the velocity parameters.

Problem	Individual PEAKVEL_1 or PEAKVEL_3 values consistently read -9.99.
Possible Causes	Sensor may be faulty. 5-volt (blue) fuse on regulator may have blown.
Possible Solutions	Replace the Peak Combo Sensor or Surface Combo Sensor. Replace the 5-volt blue fuse on the regulator. Caution: Do not connect a questionable sensor to another monitor before verifying the integrity of the sensor. A shorted sensor will blow the 5-volt (blue) replacement fuse on the regulator in the monitor.

Surface Velocity Subsystem

The following tables contain general troubleshooting techniques for the surface velocity subsystem corresponding to the ParaFlow and Surface Combo sensor.

Problem	Velocity readings are erratic or incorrect.
Possible Causes	Sensor may be dirty or covered by debris. Maximum Velocity setting may require adjustment. Transmit Frequency setting may require adjustment.
Possible Solutions	Clean the sensor transmit/receive surfaces. Fine-tune Maximum Velocity setting in device parameters. Test other Transmit Frequency settings in the velocity parameters.

Problem	Individual SURFACEVEL_3 values consistently read -9.99.
Possible Causes	Sensor may be faulty. 5-volt (blue) fuse on regulator may have blown.
Possible Solutions	Replace the Surface Combo Sensor. Replace the 5-volt blue fuse on the regulator. Caution: Do not connect a questionable sensor to another monitor before verifying the integrity of the sensor. A shorted sensor will blow the 5-volt (blue) replacement fuse on the regulator in the monitor.

Pressure Depth Subsystem

The following tables contain general troubleshooting techniques for the pressure depth subsystem corresponding to the AV|Gated, AV|Max, ParaFlow, Peak Combo sensor or Surface Combo sensor.

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

Problem	Pressure depth readings are erratic.
Possible Causes	Pressure vent tube may be pinched or blocked with water. Pressure dryer tube may not be functioning properly. Black cap may still be on the dryer tube. Desiccant has absorbed too much moisture and no longer allows the dryer tube to function properly.
Possible Solutions	Inspect color of desiccant in dryer tube and replace the dryer tube if necessary. Inspect the vent tube along its entire length to ensure the cable is not pinched and that the cable ties securing the vent tube are not too tight. Verify that the black cap has been removed from the dryer tube.

Problem	Pressure depth readings display a good pattern, but are consistently incorrect.
Possible Cause	Sensor physical offset may be incorrect.
Possible Solution	Verify the sensor offset and reactivate with the correct settings if necessary.

Problem	Individual PDEPTH_1 (_2) values consistently read 0 under wet pipe conditions.
Possible Causes	Sensor may be faulty. 5-volt (blue) fuse on regulator may have blown.
Possible Solutions	Replace the Peak Combo Sensor. Replace the 5-volt (blue) fuse on the regulator. Caution: Do not connect a questionable sensor to another monitor before verifying the integrity of the sensor. A shorted sensor will blow the 5-volt (blue) replacement fuse on the regulator in the monitor.

Temperature Subsystem

The following table contains general troubleshooting techniques for the temperature subsystem corresponding to all sensors supporting the **TRITON+**.

Note: Contact your ADS representative for further diagnosis prior to replacing a sensor or monitor.

Problem	Temperature readings are excessively low or incorrect.
Possible Causes	Temperature sensor may be faulty. Cable connecting sensor to monitor may be loose or broken. Processor board may be faulty.
Possible Solutions	Examine the sensor connection to the monitor, and verify that it is properly connected and secure. Replace the sensor. Replace the monitor if defective.

External Power, I/O, and Modbus Subsystems

The following tables contain general troubleshooting techniques for the external power, I/O, and Modbus subsystems corresponding to externally-powered **TRITON+** monitors, external input/output units (XIOs), and external Modbus interface units (XBUSs).

Problem	Monitor is not receiving power from the external source.
Possible Causes	Breaker may have tripped. Station power may be off. Wiring may not be properly connected. Power supply may be faulty. ExPAC may be faulty. Communication cable running between the ExPAC, XBUS, or XIO is disconnected or defective.
Possible Solutions	Reset breaker. Have owner/operator restore main power source to station, as applicable. Verify that the wiring is properly connected inside the XIO/XBUS or to the ExPAC and power supply. Verify that "On" LED on the front of the power supply in the XIO/XBUS is illuminated. If it is not, but AC power is live, replace the power supply/XBUS/XIO. Verify that the DC OUT LED (to the <i>right</i> of the DC OUT terminal connector) on the ExPAC is illuminated. If it is not, but the DC INPUT LED (to the <i>right</i> of the DC INPUT terminal connector) is illuminated, test the power at the DC OUT (P4 pins 1 & 2). If power is not available, replace the ExPAC/XBUS/XIO. Inspect the communication cable for proper connection at the monitor and the ExPAC/XBUS/XIO. Replace communication cable between monitor and ExPAC/XBUS/XIO. Contact your regional ADS representative.

Problem	Data or readings received at customer input device from XIO 4-20 mA output are not accurate or were unexpected.
Possible Causes	Wiring from XIO output to external 4-20 mA input device may not be properly connected. (Note: The XIO provides loop power to both 4-20 mA outputs). XIO Device may not have been properly configured through Qstart^{XML}. Analog module in XIO may not have been setup properly or may be defective.
Possible Solutions	Verify wiring between XIO output and the external input device has been properly connected. Verify that the correct entity has been selected and that the scale has been set properly in Qstart^{XML}. If necessary, adjust the configuration and reactivate the monitor. Contact your regional ADS representative.

Problem	Data or readings received at the monitor through the 4-20 mA input in the XIO from the customer output device are not accurate or were unexpected.
Possible Causes	Wiring from XIO analog input to external 4-20 mA output device may not be properly connected. XIO Device may not have been properly configured through Qstart^{XML}. Analog module in XIO may not have been setup properly or may be defective.
Possible Solutions	Verify wiring between the XIO input and the external output device has been properly connected. Verify that the correct analog input entity has been selected, the scale has been set properly, and the appropriate data checkboxes have been selected in Qstart^{XML}. If necessary, adjust the configuration and reactivate the monitor. Contact your regional ADS representative.

Problem	Data received at the monitor through the digital input in the XIO from the customer output device is not consistent with output.
Possible Causes	XIO Device may not have been properly configured in Qstart^{XML} for the digital input.
Possible Solutions	Verify that the D1 (or D2) entity and the Store Data checkbox have been selected for the appropriate digital input from the XIO Device configuration in Qstart^{XML}. If changes are required, reactivate the monitor. (Note: The D1 corresponds to digital output 1 and D2 corresponds to digital output 2.) Contact your regional ADS representative.

Problem	Event status received at customer input device from XIO digital output is not accurate.
Possible Causes	XIO Device may not have been properly configured in Qstart^{XML} for the digital output.
Possible Solutions	Verify that the HIGH_LEVEL (or HIGH_HIGH) entity has been selected for the appropriate digital output from the XIO Device in Qstart^{XML} . Verify that High Threshold and High-High Threshold have been selected for the Depth Alarms from the MLI Device in Qstart^{XML} . If changes are required, reactivate the monitor. Contact your regional ADS representative.

Problem	Modbus communication is not successful.
Possible Causes	Wiring to RS-485 or RS-232 port on ExPAC may be incorrect. Communication port settings in customer device may be incorrect. Modbus ID designated in Qstart^{XML} may be incorrect. ExPAC may be defective.
Possible Solutions	Verify wiring for RS-485 or RS-232 is correct. Verify that the proper communication port settings have been set in the customer device. Port settings should be 19200 baud, 8 data bits, no parity, 1 stop bit (8-N-1), and no flow control. Verify that the Modbus ID is correct Qstart^{XML} . If the ID requires modification, update the ID and reactivate the monitor. Contact your regional ADS representative.

APPENDIX A

Specifications

This appendix contains specifications for the ADS **TRITON+**[®] flow monitor and associated subassemblies, sensors, cables, and the external power, Modbus, I/O, and landline hardware.

TRITON+ Flow Monitor (ADS p/n 8000-FST-IM)

Enclosure	Cylindrical 0.37-inch (6.39-mm) thick, seamless, plastic canister with stainless steel threaded inserts Aluminum end-cap attached to canister with four stainless steel bolts and a gasket interface Meets NEMA6P/IP68 standard
Dimensions	17.75 inches (451 mm) long by 8.75 inches (222 mm) maximum diameter 6.63 inches (168 mm) minimum diameter
Weight	30.3 pounds (13.7 kg) (with 12-volt battery pack)
Operating / Storage Temperature	Operating: -4° to 140° F (-20° to 60° C) Storage: -4° to 167° F (-20° to 75° C)
Power	Internal: One 12-volt, 110 AH, IS alkaline battery pack External (option): External Power and Communications Unit (ExPAC) with an ADS- or customer-supplied 9- to 36-volt (minimum 15 watt) DC power supply.
Battery Life	15 months at 15-minute sample rate with one Peak Combo Sensor and daily pull communications (i.e., data collects) 6 months at 5-minute sample rate with one Peak Combo Sensor and daily pull communications Actual battery life will vary depending on operating temperature, number of active devices operated, and frequency of communications.
Connectors	U.S. MIL-C-26482 series 1, for environmental sealing, with gold-plated contacts and interfacial seals
Inputs and Outputs	• 2 configurable sensor inputs • 1 communication connector for direct interface with a computer, external power input and external communications, or water quality sampler output cable connection • 1 antenna port • 1 SIM card enclosure with an air pressure valve (<i>for testing purposes only</i>)
Memory	832 kilobytes
Data Storage	150 days for 6 stored entities (Peak Combo Sensor) at a 15-minute sample rate – Refer to <i>Calculating the Total Days of Storage Available</i> on page A-2 for details and instructions on calculating the number of days of data that can be stored in memory for a specific application.

Modem	For monitors supporting 3G global network services: Modem: Telit HE910-D UMTS/HSPA+/GSM cellular modem using TCP/IP (Transmission Control Protocol/Internet Protocol) Bands: UTMS 800/850/AWS/1900; GSM 800/ 900/1800/1900 For monitors supporting Verizon® network services: Modem: Telit ME910C1-NV, LTE-M, cellular modem using TCP/IP Bands: B13, 700 MHz NOTE: The Verizon LTE-M SIM is specifically linked to the modem in the monitor, therefore; DO NOT attempt to remove or swap the SIM card from one monitor to another. For monitors supporting WorldWide network services: Modem: Telit ME910C1-WW, LTE-M, cellular modem using TCP/IP Bands: B1 (2100), B2 (1900), B3 (1800), B4 (AWS 1700), B5 (850), B8 (900), B12 (700), B13 (700), B18 (800), B19 (800), B20 (800), B26 (850), B28 (700) and the 2G fallback bands/(Mhz) are B2 (1900), B3 (1800), B5 (850), B8 (900)
Approvals	Certified under the ATEX European Intrinsic Safety standards for Zone 0 rated hazardous areas. Sira 09ATEX2027X Certified under IECEx (International Electrotechnical Commission Explosion Proof) Intrinsic Safety Standards for use in Zone 0 (equivalent to Class I, Division 1, Groups C & D) rated hazardous areas. IECEx SIR 09.0020X CSA Certified to Class 225803 – Process Control Equipment, Intrinsically Safe and Non-Incendive Systems – For Zone 0 Hazardous Locations, Ex ia IIB T3 Ga (152°C) in Canada. CSA 13CA2671180X Certified to Class 225883 – Process Control Equipment, Intrinsically Safe and Non-Incendive Systems – For Class I Zone 0 Hazardous Locations, AEx ia IIB T3 Ga (152°C) in the USA (equivalent to Class I, Division 1, Groups C & D). CSA 13CA2671180X Certified under UKCA (United Kingdom Conformity Assessment) Intrinsic Safety standards for Zone 0 Hazardous areas. CSAE UKCA 22UKEX1159X

Calculating the Total Days of Storage Available

This section includes a special equation to use in determining the number of days of data that can be stored in the monitor memory based on a specific application. Consider the following when calculating the total days:

- The monitor memory holds 832 kilobytes (or 851,968 bytes) of data.
- The log rate determines the number of readings taken per day. At a *15-minute* sample rate, the monitor will record 96 readings a day for a single entity. At a *5-minute* sample rate, the monitor will record 288 readings a day for a single entity.
- One entity reading consumes 8 bytes of monitor memory.
- The following table lists the standard number of entities recorded for each sensor device. The date/time stamp for a reading is equal to one reading. Therefore, each total below represents the actual entities plus one date/time stamp. A date/time stamp must be included for each monitoring point associated with the monitor.

Peak Combo Sensor	AV Gated Sensor	Surface Combo Sensor	Ultrasonic Depth Sensor
7	7	6	3

- Deduct 2 to 3 days from the total days of storage to compensate for additional overhead in memory.

Following is the equation for calculating the total days of storage available in the monitor memory:

$$\begin{array}{c}
 \text{Data Storage Available in the Monitor (in Bytes)} \\
 \hline
 \begin{array}{ccccc}
 \text{Number of} & & \text{Memory} & & \text{Number of} \\
 \text{Readings} & & \text{Consumed for} & & \text{Entities Logged} \\
 \text{Taken per} & \times & \text{One Entity} & \times & \text{by the Monitor} \\
 \text{Day for} & & \text{Reading} & & \text{(based on the} \\
 \text{One entity} & & \text{(Date/Time} & & \text{selected} \\
 & & \text{Stamp)} & & \text{devices)}
 \end{array}
 \end{array}
 = \begin{array}{c}
 \text{Total Days of} \\
 \text{Storage in the} \\
 \text{Monitor} \\
 \text{Memory}
 \end{array}$$

For example, recording data at a 15-minute sample rate using a Peak Combo Sensor offers approximately 150 days of data storage.

$$\begin{array}{ccccc}
 & & 851,968 \text{ bytes} & & \\
 \hline
 96 \text{ readings} & \times & 8 \text{ bytes} & \times & 7 \text{ entities (including} \\
 & & & & 1 \text{ for the date/ time} \\
 & & & & \text{stamp)}
 \end{array}
 = 158 \text{ days (150 when}$$

accounting for overhead)

Intrinsically-Safe Sensors

AV|Gated Sensor (ADS p/n 8K-CS7-10-35)

This sensor supports upward ultrasonic depth, average velocity, pressure depth, and measurement of water temperature.

AV Gated Sensor	
Housing	Polycarbonate plastic shell, epoxy-filled
Dimensions	Enclosure: 6.76 inches (172 mm) long x 1.23 inches (31 mm) wide x 0.83 inches (21 mm) high
Cable	Standard size: 35 feet (10.7 m) x 0.28 inches (7.2 mm) nominal OD, polyurethane jacket Extension cables available up to 300 feet (91.4 m)
Operating / Storage Temperature	Operating: -4° to 140° F (-20° to 60° C) Storage: -4° to 167° F (-20° to 75° C) Note: This sensor will <i>not</i> produce accurate readings in frozen flow.
Upward Ultrasonic Depth	
Upward Depth Accuracy	0.5% of reading or +/- 0.125 inches (3.2 mm), whichever is greater
Deadband	Extending 1.0 inch (25 mm) up from the <i>bottom</i> of the sensor
Frequency	1 MHz
Range	72 inches (1828.8 mm)
Resolution	0.01 inches (0.25 mm)
Drift	0
Gated Velocity	
Range	-20 to 20 feet per second (-9.1 to 9.1 m/sec)
Deadband	Extending 5.0 inches (127 mm) up from the <i>bottom</i> of the sensor
Frequency	1 MHz
Resolution	0.01 feet per second (0.003 m/sec)
Accuracy	+/- 0.2 ft/sec (0.06 m/sec) or 4% of actual average velocity (whichever is greater) in flow velocities from -5 to 20 ft/sec (-1.52 to 6.10 m/sec)
Pressure Depth	
Pressure Range	0.0 to 10.0 PSI (0.0 - 0.68 Bar): up to 23.06 feet (7.03 m)
Pressure Accuracy	0 - 10.0 PSI (0 - 0.68 Bar): +/- 2.8 inches (70.3 mm)
Pressure Resolution	0.01 inches (0.25 mm)

AV|Max Sensor (ADS p/n 8K-CS9-10-35)

This sensor supports upward ultrasonic depth, peak velocity, pressure depth and measurement of water temperature.

AV Max Sensor	
Housing	Polycarbonate (PC)/ PEEK (Blue), epoxy-filled
Dimensions	Enclosure: 6.28 inches (159.7 mm) long x 1.49 inches (38.0 mm) wide x 0.82 inches (20.9 mm) high
Cable	Standard size: 35 feet (10.7 m) long x 0.30 inches (7.6 mm) nominal OD, polyurethane jacket Extension cables available up to 300 feet (91.4 m)
Operating / Storage Temperature	Operating: -4° to 140° F (-20° to 60° C) Storage: -4° to 167° F (-20° to 75° C) Note: This sensor will <i>not</i> produce accurate readings in frozen flow.
Upward Ultrasonic Depth	
Upward Depth Accuracy	0.5% of reading or +/- 0.125 inches (3.2 mm), whichever is greater
Deadband	Extending 1.0 inch (25 mm) up from the <i>bottom</i> of the sensor
Frequency	250 kHz – 1 MHz
Range	60 inches (1829 mm)
Resolution	0.01 inches (0.25 mm)
Drift	0
Peak Doppler Velocity	
Range	-30 to 30 feet per second (-9.1 to 9.1 m/sec)
Deadband	Extending 1.0 inch (25 mm) up from the <i>bottom</i> of the sensor
Frequency	250 kHz – 1 MHz
Resolution	0.01 feet per second (0.003 m/sec)
Accuracy	+/- 0.2 ft/sec (0.06 m/sec) or 4% of actual peak velocity (whichever is greater) in flow velocities from -5 to 20 ft/sec (-1.52 to 6.10 m/sec)
Pressure Depth	
Pressure Range	0.0 to 10.0 PSI (0.0 - 0.68 Bar): up to 23.06 feet (7.03 m)
Pressure Accuracy	0 - 10.0 PSI (0 - 0.68 Bar): +/- 2.8 inches (70.3 mm)
Pressure Resolution	0.01 inches (0.25 mm)

Long Range Depth Sensor (ADS p/n 8K-CS6-C1-10)

This sensor supports downward ultrasonic depth at long range and detects surcharge levels near the manhole lid.

Long Range Depth	
Housing	ABS plastic shell, polyurethane-filled
Dimensions	9.15 inches (232.4 mm) long x 4.40 inches (111.8 mm) wide x 4.22 inches (107.2 mm) high
Cable	Standard size: 10.0 feet (3.05 m) long x 0.285 inches (7.2 mm) nominal OD, polyurethane jacket Extension cables available up to 300 feet (91 m)
Operating / Storage Temperature	Operating: -4° to 140° F (-20° to 60° C) Storage: -4° to 167° F (-20° to 75° C) Note: The sensor will not produce accurate readings when ice is built up on the sensor.
Accuracy	0.25% of range or 0.13 inches (3.2mm) whichever is greater in a constant temperature air column
Deadband	0.00 inches/mm
Frequency	75kHz
Range	240 inches (6.1 m) from bottom of sensor housing
Resolution	0.01 inches (0.25 mm)
Drift	0.0 inches/mm
Submersion Sensor	
Housing	ABS plastic shell, epoxy-filled
Dimensions	2 inches (50.8 mm) length x 2 inches (50.8 mm) wide x 1.14 inches (29 mm) high
Cable	3 ft. (0.91 m) length, 0.35 inches nominal (8.9mm nominal) OD, polyurethane jacket.
Operating / Storage Temperature	Operating: -4° to 140° F (-20° to 60° C) Storage: -4° to 167° F (-20° to 75° C) Note: The sensor will <i>not</i> produce accurate readings when ice is built up on the sensor.

ParaDepth Sensor (ADS p/n 8K-CS8-D1-00-30-IS)

This sensor supports downward ultrasonic and air temperature measurement only.

ParaDepth Sensor	
Housing	Polycarbonate shell (PC)/ PEEK, epoxy-filled. High visibility yellow color.
Dimensions	10.9 inches (277 mm) long x 2.28 inches (57.9 mm) wide x 2.58 inches (65.5 mm) high
Cable	Standard size: 30.0 feet (9.14 m) long x 0.30 inches (7.6 mm) nominal OD, polyurethane jacket Extension cables available up to 300 feet (91 m)
Operating / Storage Temperature	Operating: -4° to 140° F (-20° to 60° C) Storage: -4° to 167° F (-20° to 75° C) Note: The sensor will not produce accurate readings when ice is built up on the sensor.
Downward Ultrasonic Depth	
Accuracy	0.125 inches (3.2 mm)
Deadband	0.0 inches (0 mm) from the face of the sensor
Frequency	125 kHz
Range	0.0 inches (0 mm) to 12.0 feet (3.66 m)
Resolution	0.01 inches (0.25 mm)
Drift	0 inches (0 mm)

ParaFlow Sensor (ADS p/n 8K-CS8-V2-10-30-IS)

This sensor supports downward ultrasonic, surface velocity, surcharge velocity, surcharge pressure depth and air temperature measurement.

ParaFlow Sensor	
Housing	Polycarbonate shell (PC)/ PEEK, epoxy-filled. High visibility yellow color.
Dimensions	13.9 inches (353 mm) long x 2.20 inches (56 mm) wide x 2.58 inches (65.5 mm) high
Cable	Standard size: 30.0 feet (9.14 m) long x 0.30 inches (7.6 mm) nominal OD, polyurethane jacket Extension cables available up to 300 feet (91 m)
Operating / Storage Temperature	Operating: -4° to 140° F (-20° to 60° C) Storage: -4° to 167° F (-20° to 75° C) Note: The sensor will not produce accurate readings when ice is built up on the sensor.
Downward Ultrasonic Depth	
Accuracy	0.125 inches (3.2 mm)
Deadband	0.0 inches (0 mm) from the face of the sensor
Frequency	125 kHz
Range	0.0 inches (0 mm) to 12.0 feet (3.66 m)

Resolution	0.01 inches (0.25 mm)
Drift	0 inches (0 mm)
Surface Velocity	
Accuracy	+/- 0.30 feet per second (0.09 m/s) or $\pm 5\%$ of the actual reading (whichever is greater) in flow velocities from 1.00 to 15.00 ft/sec (0.3 to 4.6 m/s) Note: Flow conditions may cause the designated accuracy to vary and hinder or prevent the effective use of surface velocity technology.
Deadband	0 inches (0 mm) from the face of the sensor
Minimum Velocity	1 foot per second (0.30 m/sec)
Frequency	<i>Varies based on the parameter settings</i>
Range	0 to 42 inches (7 to 1067 mm) from the face of the sensor
Resolution	0.01 feet per second (0.003 m/sec)
Surcharge Peak Velocity	
Range	-30 to 30 feet/second (-9.1 to 9.1 m/sec)
Frequency	250 kHz – 1 MHz
Resolution	0.01 feet per second (0.003 m/sec)
Accuracy	+/- 0.2 ft/sec (0.06 m/sec) or 4% of actual peak velocity (whichever is greater) in flow velocities from -5 to 20 ft/sec (-1.52 to 6.10 m/sec)
Surcharge Pressure Depth	
Pressure Range	0.0 to 10.0 PSI (0.0 - 0.68 Bar): up to 23.06 feet (7.03 m)
Pressure Accuracy	0 - 10.0 PSI (0 - 0.68 Bar): +/- 2.8 inches (70.3 mm)
Pressure Resolution	0.01 inches (0.25 mm)

Peak Combo Sensor (ADS p/n 8K-CS4-xx-35/1H)

This sensor supports upward ultrasonic depth, peak velocity, and pressure depth.

Housing	ABS plastic shell, epoxy-filled
Dimensions	Enclosure: 6.76 inches (172 mm) long x 1.23 inches (31 mm) wide x 0.83 inches (21 mm) high
Cable	Standard size: 35 feet (10.7 m) feet (30.5 m) long x 0.28 inches (7.2 mm) nominal OD, polyurethane jacket Extension cables available up to 300 feet (91.4 m)
Operating / Storage Temperature	Operating: -4° to 140° F (-20° to 60° C) Storage: -4° to 167° F (-20° to 75° C) Note: This sensor will <i>not</i> produce accurate readings in frozen flow.

Upward Ultrasonic Depth	
Upward Depth Accuracy	0.5% of reading or +/- 0.125 inches (3.2 mm), whichever is greater
Deadband	Extending 1.0 inch (25 mm) up from the <i>bottom</i> of the sensor
Frequency	250 kHz – 1 MHz
Range	60 inches (1524 mm)
Resolution	0.01 inches (0.25 mm)
Drift	0
Peak Doppler Velocity	
Range	-30 to 30 feet per second (-9.1 to 9.1 m/sec)
Deadband	Extending 1.0 inch (25 mm) up from the <i>bottom</i> of the sensor
Frequency	250 kHz – 1 MHz
Resolution	0.01 feet per second (0.003 m/sec)
Accuracy	+/- 0.2 ft/sec (0.06 m/sec) or 4% of actual peak velocity (whichever is greater) in flow velocities from -5 to 20 ft/sec (-1.52 to 6.10 m/sec)
Pressure Depth	
Pressure Range	0.0 to 5.0 PSI (0.0 - 0.34 Bar): up to 11.5 feet (3.5 m) 0.0 to 15.0 PSI (0.0 - 1.03 Bar): up to 34.5 feet (10.5 m) 0.0 to 30 PSI (0.0 – 2.07 Bar): up to 69.0 feet (21.0 m)
Pressure Accuracy	0 - 5.0 PSI (0 - 0.34 Bar): +/- 1.4 inches (36 mm) 0 - 15.0 PSI (0 - 1.03 Bar): +/- 4.1 inches (104 mm) 0.0 to 30 PSI (0.0 – 2.07 Bar): +/- 8.3 inches (211 mm)
Pressure Resolution	0.01 inches (0.25 mm)

Surface Combo Sensor (ADS p/n 8K-CS5-V2-xx-30/1H)

This sensor supports downward ultrasonic depth, surface velocity, surcharge peak velocity, and surcharge pressure depth.

Surface Combo Sensor	
Housing	ABS plastic shell, epoxy-filled
Dimensions	10.61 inches (269 mm) long x 2.03 inches (52 mm) wide x 2.45 inches (62 mm) high
Cable	Standard size: 30.0 feet (9.14 m) long x 0.35 inches (8.9 mm) nominal OD, polyurethane jacket Extension cables available up to 300 feet (91 m)
Operating / Storage Temperature	Operating: -4° to 140° F (-20° to 60° C) Storage: -4° to 167° F (-20° to 75° C) Note: The sensor will <i>not</i> produce accurate readings when ice is built up on the sensor.
Downward Ultrasonic Depth	
Accuracy	0.125 inches (3.2 mm)
Deadband	1.0 inch (25.4 mm) from the sensor face or 5% of maximum range, whichever is greater
Frequency	40 kHz
Range	1.0 inch (25.4 mm) (or 5% of maximum range, whichever is greater) to 10.0 feet (3.05 m)
Resolution	0.01 inches (0.25 mm)
Drift	0
Surface Velocity	
Accuracy	+/- 0.25 feet per second (0.08 m/s) or 5% of the actual reading (whichever is greater) in flow velocities from 1.00 to 15.00 ft/sec (0.30 to 4.57 m/s) Note: Flow conditions may cause the designated accuracy to vary and hinder or prevent the effective use of surface velocity technology.
Deadband	3 inches (76 mm) from the bottom of the rear, descended portion of the sensor
Minimum Velocity	1 foot per second (0.30 m/sec)
Frequency	<i>Varies based on the parameter settings</i>
Range	3 to 42 inches (7 to 1067 mm)
Resolution	0.01 feet per second (0.003 m/sec)
Surcharge Peak Velocity	
Range	-30 to 30 feet/second (-9.1 to 9.1 m/sec)
Frequency	250 kHz
Resolution	0.01 feet per second (0.003 m/sec)
Accuracy	+/- 0.2 ft/sec (0.06 m/sec) or 4% of actual peak velocity (whichever is greater) in flow velocities from -5 to 20 ft/sec (-1.52 to 6.10 m/sec)

Surcharge Pressure Depth	
Pressure Range	0.0 to 5.0 PSI (0.0 - 0.34 Bar): up to 11.5 feet (3.5 m) 0.0 to 15.0 PSI (0.0 - 1.03 Bar): up to 34.5 feet (10.5 m) 0.0 to 30 PSI (0.0 – 2.07 Bar): up to 69.0 feet (21.0 m)
Pressure Accuracy	0 - 5.0 PSI (0 - 0.34 Bar): +/- 1.4 inches (36 mm) 0 - 15.0 PSI (0 - 1.03 Bar): +/- 4.1 inches (104 mm) 0 - 30 PSI (0 - 2.07 Bar): +/- 8.3 inches (211 mm)
Pressure Resolution	0.01 inches (0.25 mm)

Ultrasonic Depth Sensor (ADS p/n 8K-CS5-D1-00-30)

This sensor supports downward ultrasonic depth.

Ultrasonic Depth Sensor	
Housing	ABS plastic shell, epoxy-filled
Dimensions	10.61 inches (269 mm) long x 2.03 inches (52 mm) wide x 2.45 inches (62 mm) high
Cable	Standard size: 30.0 feet (9.14 m) long x 0.35 inches nominal (8.9 mm nominal) OD, polyurethane jacket Extension cables available up to 300 feet (91 m)
Operating / Storage Temperature	Operating: -4° to 140° F (-20° to 60° C) Storage: -4° to 167° F (-20° to 75° C) Note: The sensor will <i>not</i> produce accurate readings when ice is built up on the sensor.
Accuracy	0.125 inches (3.2 mm)
Deadband	1.0 inch (25.4 mm) from the sensor face or 5% of maximum range, whichever is greater
Frequency	40 kHz
Range	1.0 inch (25.4 mm) (or 5% of maximum range, whichever is greater) to 10.0 feet (3.05 m)
Resolution	0.01 inches (0.25 mm)
Drift	0.0 inches/mm

Inclinometer Sensor (ADS p/n 8000-0528)

This sensor determines tilt via an accelerometer.

Inclinometer Sensor	
Housing	Solid, molded ABS providing high impact and abrasion resistance in a fully sealed device
Dimensions	Height 0.865 in (2.2 cm); Width: 2.03 in (5.16 cm); Length: 3.0 in (7.62 cm)
Cable	25 ft (7.62 m) X 0.28 in (7.1 mm) OD; polyurethane jacket
Weight	1.5 lbs (0.68 kg) including 25 feet (7.62 m) of communication cable and connector
Operating Range	0 to 90°

Operating / Storage Temperature	Operating: -4° to 140° F (-20° to 60° C) Storage: -4° to 167° F (-20° to 75° C) Note: The sensor will <i>not</i> produce accurate readings when ice is built up on the sensor.
Accuracy	+/- 0.25° between 0 and 40°
Resolution	0 to 60° = 0.03°; 60 to 90° = 0.3°
Mounting Method	Mount vertically (90°) or horizontally (180°) or level on flat surface on the closed flood gate
Compatibility	The Inclinator sensor is ONLY compatible with the ADS <i>TRITON+</i> flow monitor via the communications port

USB Serial Interface (ADS p/n 8000-0337)

The USB serial interface (or *direct connection*) cable supports on-site communications with the ADS *TRITON+* monitor. It consists of two cables: a primary cable with interface box and potted metal connector *and* a standard USB Type A to Type B cable.

USB Serial Interface Cable	
Cable Length	Primary Cable: 10 feet (3.1 m) long USB A-to-B Cable: 6 feet (1.8 m) long
Construction	Primary: Shielded, 10-conductor cable with polyurethane jacket; in-line opto-isolation PCB in ABS plastic housing : 3.3 inches (85 mm) x 2.5 inches (63 mm) x 1.1 inches (28 mm)
Connections	Primary: Factory-fitted potted connector (to <i>TRITON+</i> monitor COMM + EXT PWR port) USB A-to-B Cable: Type B connector (to interface box) and Type A connector (to USB port on computer)

ExPAC (ADS p/n 8000-0377)

The ExPAC (External Power and Communication unit) enables the *TRITON+* to receive power from an external DC source and supports Modbus communications.

ExPAC	
Enclosure	Rectangular, ABS Plastic, DIN rail or wall mount, IP20
Dimensions	5.7 inches (145 mm) wide x 3.6 inches (91 mm) high x 1.6 inches (41 mm) deep
Weight	0.55 pounds (0.25 kg)
Operating Temperature	-4° to 122° F (-20° to 50° C)
External Power	Requires DC power input between 9 to 36 volts and a minimum of 15 watts I.S. DC output of 8 to 11.8 volts, 500 mA
Connectors	One RS-485 (3 terminals), one RS-232 (DB9), one USB type B, one 9-to-36-volt DC input (3 terminals), monitor communications (5 terminals), and one DC out (3 terminals)

Certifications	Associated Apparatus certification for use with approved equipment in Zone 0 (equivalent to Class I, Division 1, Groups C & D, in the U.S.) and Zone 0 in the EU via SIRA/ATEX/CSA/UKCA Sira 09ATEX2027X, IECEX SIR09.0020X, CSA 13CA2671180X, UKCA CSAE 22UKEX1159X
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Power Supply (ADS p/n 508293)

This ADS-recommended power supply supports externally-powered **TRITON+** monitors.

ADS Power Supply	
Manufacturer and Model	XP Power DNR60US24
Dimensions	3.60 inches (90 mm) high x 1.59 inches (41 mm) wide x 4.53 inches (115 mm) deep
Weight	0.8 pounds (350 g)
Operating Temperature	-40° to 158° F (-40° to 70° C)
Input Voltage	85-264 VAC
Output Voltage	24 V
Ripple and Noise	50 mV pk-pk, 20 MHz bandwidth (may increase at low temperatures)

XBUS (ADS p/n 8000-0427)

The XBUS™ (External Modbus Interface unit) enables the **TRITON+** to receive power from an external AC power source and supports Modbus communications.

XBUS	
Enclosure	Indoor/outdoor NEMA 4X (IP 66), PBT and polycarbonate plastic with hinged cover
Dimensions	11.02 inches (280 mm) long x 7.49 inches (190 mm) wide x 5.03 inches (128 mm) deep
Weight	4.0 pounds (1.8 kg)
Operating/Storage Temperature	14° to 122° F (-10° to 50° C)
Power Supply	XP Power DNR60US24 (<i>Refer to page A-13 for specifications and details on the power supply</i>)
Power Input	85-264 VAC, 120-375 VDC; 47-63 Hz; 1.10 A @ 110 / 0.59 A @ 250 VAC
External Power/Communications Unit	ADS ExPAC (<i>Refer to page A-12 for specifications and details on the ExPAC</i>)
Connectors	Three cable glands for power cable, monitor communication cable, and RS-232/RS-485 cable, NEMA4X/IP66 protection

XIO (ADS p/n 8000-0400)

The XIO™ (External Input/Output unit) enables the **TRITON+** to receive power from an AC power source and serves as a digital and analog input and output interface.

XIO	
Enclosure	Indoor/outdoor NEMA 4X (IP 66), PBT and polycarbonate plastic with hinged cover
Dimensions	11.02 inches (280 mm) long x 7.49 inches (190 mm) wide x 5.03 inches (128 mm) deep
Weight	5.0 pounds (2.3 kg)
Operating/ Storage Temperature	14° to 122° F (-10° to 50° C)
Power Supply	XP Power DNR60US24 (Refer to page A-13 for specifications and details on the power supply)
Power Input	85-264 VAC, 120-375 VDC; 47-63 Hz; 1.10 A @ 110 / 0.59 A @ 250 VAC
Analog Inputs	Two 4-20mA inputs Isolation: 1500 VAC Accuracy: 0.05% F.S. Thermal Drift: 100ppm/C
Analog Outputs	Two 4-20mA outputs Provides loop power 500 ohm drive capability Isolation: 1500 VAC Accuracy: 0.1% F.S. Linearity: 0.05% F.S. Thermal Drift: 100ppm/C
Digital Inputs	Two-switch, solid state, or dry contact inputs Input impedance: 4.7 Kilo-ohms
Digital Outputs	Two SPST Relays Maximum Load: 2 A @ 250 VAC, 2A @ 30 VDC Minimum Load: 5 VDC, 20 mA
External Power/Comm Unit	ADS ExPAC (Refer to page A-12 for specifications and details on the ExPAC)
Connectors	Three cable glands for power cable, monitor communication cable, and digital and/or analog I/O cable, NEMA4X/IP66 protection 5.2-mm DIN rail terminal blocks for I/O connection (30- to 12-gauge wire size)

APPENDIX B

Part Numbers

This appendix contains a parts list of the most commonly ordered and used parts supporting the ADS **TRITON+**[®] flow monitoring system.

Monitors	
8000-FST-IM-4WW-GBL	TRITON+ MONITOR, AT&T LTE-M (INCLUDES 12-VOLT IS BATTERY PACK)
8000-FST-IM-EP-4WW-GBL	TRITON+ MONITOR, EXTERNAL POWER, AT&T LTE-M (DOES NOT INCLUDE 12-VOLT IS BATTERY PACK)
Sensors and Sensor and Sampler Cables	
8K-CS7-10-35	SENSOR, CS7, AV GATED, UPWARD DEPTH, AVERAGE VELOCITY, PRESSURE SENSOR 0 -10PSI (0.0 – 0.68 BAR), 35-FT (10.6m) CABLE
8K-CS9-10-35	SENSOR, CS9, AV MAX, UPWARD DEPTH, PEAK VELOCITY, PRESSURE SENSOR 0 – 10 PSI (0.0 – 0.68 BAR, 35-FT (10.6 m) CABLE
8K-CS8-D1-00-30	SENSOR, CS8, PARADEPTH, US DEPTH, 30-FT (9.14 m) CABLE
8K-CS8-V2-10-30	SENSOR, CS8, PARAFLOW, US DEPTH, SURFACE VEL, SURCHARGE PEAK VEL, PRESSURE SENSOR 0 – 10 PSI (0 – 0.68 BAR),
8K-CS4-05-35	SENSOR, CS4, UPWARD DEPTH, PEAK VELOCITY, PRESSURE SENSOR 0 – 5 PSI (0 – 0.34 Bar), 35-FT (10.6-m) CABLE
8K-CS4-15-35	SENSOR, CS4, UPWARD DEPTH, PEAK VELOCITY, PRESSURE SENSOR 0 – 15 PSI (0 – 1.03 Bar), 35-FT (10.6-m) CABLE
8K-CS4-30-1H	SENSOR, CS4, UPWARD DEPTH, PEAK VELOCITY, PRESSURE SENSOR 0 – 30 PSI (0 – 2.07 Bar), 100-FT (30.5-m) CABLE
8K-CS5-V2-05-30	SENSOR, CS5, US DEPTH, SURFACE VEL, PRESSURE SENSOR 0 – 5 PSI (0 – 0.34 Bar), 30-FT (9.14-m) CABLE
8K-CS5-V2-15-30	SENSOR, CS5, US DEPTH, SURFACE VEL, PRESSURE SENSOR 0 – 15 PSI (0 – 1.03 Bar), 30-FT (9.14-m) CABLE
8K-CS5-V2-30-1H	SENSOR, CS5, US DEPTH, SURFACE VEL, PRESSURE SENSOR 0 – 30 PSI (0 – 2.07 Bar), 100-FT (30.5-m) CABLE
8K-CS6-C1-10	SENSOR, CS6, LRD, CAPSNS, 10'
8000-0023-xxx (xxx represents cable length in feet)	SENSOR EXTENSION CABLE, FOR SENSORS without PRESSURE; STANDARD LENGTHS: 25 FT (7.6m), 50 FT (15.2m), 75 FT (22.8m), 100 FT (30.5m). CUSTOM LENGTHS TO 300 FT (91m)
8000-0025-xxx (xxx represents cable length in feet)	SENSOR EXTENSION CABLE, FOR SENSORS with PRESSURE; STANDARD LENGTHS: 10 FT (3.0m), 25 FT (7.6m), 50 FT (15.2m), 75 FT (22.8m), 100 FT (30.5m), 125 FT (38.1m), 150 FT (45.7m), 200 FT (61.0m). CUSTOM LENGTHS TO 300 FT (91m)
8000-0044-25	CABLE, EXT, COMM/SERIAL PORT, 25' (7.6-m)
8000-0528	ASSY, INCLINOMETER, TRITON+
8000-0348	SAMPLER CABLE, IS TRITON+ , 25-FT (7.6-m), NO CONNECTOR
8000-0348-01	SAMPLER CABLE, IS TRITON+ , 25-FT (7.6-m), FLOW PROPORTIONAL MODE

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	CONNECTOR
Communication Parts	
8000-0337	USB SERIAL INTERFACE CABLE (<i>includes 10-foot (3.1-m) primary cable and 6-foot (1.8-m) removable, standard USB A-to-B cable</i>)
8000-0044-25	USB SERIAL INTERFACE EXTENSION CABLE, 25 FT (7.6 m) – <i>also extends the Direct Serial Interface cable (p/n 8000-0054)</i>
8000-0054-01	ASSY,DIR CON,IS,TPL TO TELOG, RU33
8000-0054-02	ASSY,DIR CON,IS,TPL TO TELOG, RU35
8000-0054-03	ASSY,DIR CON,IS,TPL TO AYYEKA WAVELET 4
508227	STANDARD USB TYPE A TO TYPE B CABLE, 6 FT (1.8 m) (<i>replacement for USB cable component in 8000-0337</i>)
9000-0094	ANTENNA,EXT,4G/3G,12FT,SMA,IP68,OVERMOLDED
9000-0096	ANTENNA,EXT,4G/3G,3FT,SMA,IP68,OVERMOLDED
507165	EXTENSION, ANT, 15' SMA Female to SMA MALE
507168	EXTENSION, ANT, 50' SMA Female to SMA MALE
8000-0460	MAGNET, BLUE (for activating diagnostic codes)
Topside Retrieval System	
8000-0655-A	KIT, SYSTEM, MOUNTING BRACKETS,TOP-SIDE (includes Mounting Hardware Kit)
8000-0655-B	KIT,SYSTEM,MOUNTING BRACKETS,TOP-SIDE,W/TOOL (includes Mounting Hardware Kit)
8000-0654	TOOL, RETRIEVAL, EXTENDABLE,4-SECTION, ALUMINUM
8000-0597	BRACKET,WALL-MOUNT,SS,COMBO 8
8000-0623	ASSY,SENSOR BRACKET, COMBO 8
8000-0672	KIT,MOUNTING HARDWARE,WALL BRACKET
Monitor Replacement Parts	
8000-0043-04	BATTERY PACK, IS, 12V, UNPOTTED with PCB
8000-0043-02	BATTERY PACK, IS, 12V, UNPOTTED without PCB
8000-0447	BLACK FEET, MOUNTING BAR (CS6)
8000-0141	RETAINER, PLUG, URETHANE, 12-V IS BATTERY (for use with 8000-0043-01/02)
8000-0042-03	PCB, BATTERY, w/ CABLE
3704-0032	REPLACEMENT VENT DRYER TUBE
8000-0338-S	PCBA, PROCESSOR BOARD ASSEMBLY, TRITON+
8000-0334-4WW-S	POWER REGULATOR ASSEMBLY, REGULATOR/MODEM, 4WW Modem
508071	FUSE, MOLDED, 315mA, TH, SLOW BLOW, RED BAND
508072	FUSE, MOLDED, 140mA, 3.3-volt, TH, SLOW BLOW, YELLOW BAND
508073	FUSE, MOLDED, 100mA, 5-volt, TH, SLOW BLOW, BLUE BAND

Standard Size Installation Rings (w/ spreader mechanism & ParaDepth, ParaFlow, Surface Combo Sensor/Ultrasonic Depth Sensor bracket)	
	RING, SS [STAINLESS STEEL], [Pipe Diam. Range]
I25-0081	RING, SS, 6 IN (152mm)
I25-0082	RING, SS, 7 - 8.3 IN (178 - 211mm)
I25-0083	RING, SS, 9 - 10.3 IN (229 - 262mm)
I25-0084	RING, SS, 11 - 12.3 IN (279 - 312mm)
I25-0085	RING, SS, 12.5 - 14 IN (317 - 375mm)
I25-0086	RING, SS, 15.5 - 15.75 IN (393 - 400mm)
I25-0087	RING, SS, 14.4 - 16.75 IN (368 - 425mm)
I25-0088	RING, SS, 16.75 - 18.75 IN (425 - 476mm)
I25-0089	RING, SS, 18.5 - 20.75 IN (470 - 527mm)
I25-0090	RING, SS, 20.5 - 22.75 IN (521 - 578mm)
I25-0091	RING, SS, 22.5 - 28.75 IN (572 - 730mm)
I25-0092	RING, SS, 38.5 - 36.75 IN (724 - 933mm)
I25-0093	RING, SS, 36.5 - 48.75 IN (927 - 1238mm)
I25-0094	RING, SS, 48.75 - 60.75 IN (1238 - 1543mm)
I/O and External Power Parts	
8000-0377	ExPAC, DIN RAIL, RS485/232/USB
8000-0427	XBUS, MODBUS
8000-0378-xxx (xxx represents cable length in feet)	EXTERNAL POWER CABLE, ExPAC-to-TRITON-IM; STANDARD LENGTHS OF 10 FT (3.0m), 25 FT (7.6m), and 100 FT (30.5m); CUSTOMIZABLE UP TO 800 FT (243.8m)
508293	POWER SUPPLY, 24VDC, 2.5A, 60W, DIN RAIL
508292	MODULE, 4-20mA, 2 IN, 2 OUT, RS485, MODBUS
8000-0400	XIO, TWO 4-20mA INPUT, TWO 4-20mA OUTPUT, TWO RELAY OUTPUT, TWO DIGITAL INPUT
8000-0434-xxx (xxx represents cable length in feet)	KIT, GROUND, EXTERNAL POWER, TRITON+ ; STANDARD GROUND CABLE LENGTHS OF 10 FT (3.0m), 25 FT (7.6m), and 100 FT (30.5m); CUSTOMIZABLE UP TO 800 FT (243.8m)
Other mounting hardware	
8000-0450	ROD, MOUNTING, EXPANDING, CS6, LRD SENSOR
8000-0481	EXTENSION, ROD, MNTG, EXPNDNG, CS6, LRD SENS
8000-0484	ROD, WALL-MOUNTED, CS6, LRD SENSOR
8000-0307	BRACKET, MOUNTING, SLIDE, SURFACE COMBO or ULTRASONIC DEPTH SENSOR (CS5)
8000-0307-02	BRACKET, MOUNTING, SLIDING, CS5/CS8
8000-0271	ADAPTER, PEAK COMBO SENSOR, SILT MOUNT
I40-0007	FLANGE, PIPE SPECIAL INSTALL, PRE-DRILLED, 8 FT (2.44m), SS
700-100238-00	SPECIAL INSTALL RING MATERIAL, SS, 12 IN (304mm) LONG

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I40-0009	FLANGE HANDLE (<i>for mounting monitor in manhole</i>) 2 IN (51mm) WIDE X 18 IN (457mm) LONG X 0.25 IN (6mm) THICK
508058	BOLT, HEX, SS, M8 X 30MM ¹
517-8001254-00	WASHER, FLAT, SS ¹
517-8001274-00	WASHER, SPLIT LOCK, SS ¹
8000-0021	HOOK, SS, 2-PIECE W/ HARDWARE (FOR MOUNTING MONITOR ON MANHOLE RUNG)
I10-0003	SPREADER MECHANISM FOR RING, COMPLETE, SS
I40-0010	BRACKET, SURCHARGE, with ULTRASONIC SLIDE (Note: When ordering this bracket, you also must order the <i>Sliding Adapter Bracket</i> (8000-0299) for receiving the Ultrasonic Depth Sensor.)
I10-0012	18-IN (610-mm) CRANK HANDLE, SS
8000-0489	TOOL, SPEED HANDLE, 18", 13MM SOCKET

¹ This item is part of the mounting hardware included with the monitor for the flange handle (ADS p/n I40-0009).

Note: In all applications, only ADS IS-Certified Service Technicians are authorized to perform **TRITON+** board and/or component-level.

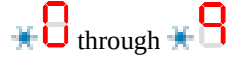
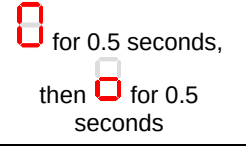
APPENDIX C

Monitor Activity Codes

This appendix contains a list of the ADS **TRITON**+[®] monitor activity codes that display automatically on the LED **STATUS** window on the monitor top while the monitor is running. This list also includes descriptions of the monitor activities corresponding to the codes.

Note: Some of the activities share a common code.

Code	Monitor Activity
8	Cycling modem power
8	Processing alarms
8	Calculating final updepth waveform (from Peak Combo Sensor)
8	Reading all the sensor pairs from the (downward) ultrasonic depth sensor (stand-alone or integrated sensor in the Surface Combo Sensor)
8	Reading the downlooking ultrasonic depth sensor
8	Running BASIC task
8	Closing the FTP connection
8	Deep sleep (monitor going to sleep)
8	Reading peak velocity (from the Peak Combo Sensor)
8	Changing FTP directories
8	Running display task
8	Running diagnostic task
8	Erasing files in modem
8	Encoding CSV data for FTP delivery
8	Processing events
8	Viewing the FTP CSV file send status
8	Hanging up
8	No active events

Code	Monitor Activity
	Writing file to modem
	Measuring peak velocity (from the Peak Combo Sensor)
	NumReadings – updepth reading number grabNums – number of vpeak grab uPairs – number of ultrasonic pairs being fired
	Connecting to FTP site
	Waiting for modem power
	Requesting the FTP CSV file send status
	Processing commands Reading pressure depth (from the Peak Combo Sensor or Surface Combo Sensor)
	Waiting to receive a message
	Processing surface spectrums
	Sleep Reading surface velocity (from the Surface Combo Sensor)
	Transmitting a message
	Reading temperature
	Reading updepth (from the Peak Combo Sensor)
	System startup
 (Blinking decimal)	Actively communicating through a serial or wireless connection (remains <i>on</i> and <i>off</i> an equivalent period of time) or actively communicating over an FTP connection (remains <i>on</i> twice as long than <i>off</i>)
	Experiencing communication errors between the processor (ADS p/n 8000-0338) and the regulator/modem (ADS p/n 8000-0334). Check fuse F9 on battery PCB (ADS p/n 8000-0042-3) and cable connections between processor and regulator/modem.

APPENDIX D

Third-Party Logger Support

The **TRITON+**® can be configured to provide data to select third-party loggers. This appendix contains information regarding the Telog® Ru-33 and Ru-35 Recording Telemetry Unit (RTU) and the Ayyeka® Wavelet™ 4R unit.

Telog Ru-33 or Ru-35

Using a wireless, battery-powered **TRITON+** monitor to support the Telog Ru-33 or Ru-35 requires some limited configuration and setup of the **TRITON+**. These procedures involve designating the appropriate identification information to enable recognition and data exchange between the ADS and Telog or Ayyeka units and using an interface cable to connect the monitor to the RTU.

Note: The Telog Ru-33 and Ru-35 must have firmware version 3.300 or later to effectively request data from the **TRITON+** monitor. Contact Telog customer support for information on setting up the Ru-33 or Ru-35.

Connecting the units together primarily involves running the ADS Triton-Telog Comm Cable from the battery-powered Ru-33 or Ru-35 to the battery-powered **TRITON+** monitor. This application requires installing both units in the manhole, a hazardous environment. However, ADS offers an optional extension cable (ADS p/n 8000-0044-25) that allows you to install the Telog unit outside the hazardous environment.

Note: The Telog Ru-33 and Ru-35 do not possess IS (intrinsically-safe) certification. Therefore, an installation involving connecting the Telog to the IS **TRITON+** with both units residing *inside the manhole* will *not* be considered intrinsically safe. The installation will be considered intrinsically safe only when the Ru-33 or Ru-35 is installed *outside* the manhole.

Configuring the Monitor to Support the Ru-33 or Ru-35

Configuring the **TRITON+** to support the Telog Ru-33 or Ru-35 requires setting two parameters in **Qstart^{XML}** when establishing a new location. Refer to *Create and Configure the Monitor Location* in *Chapter 4, Configuration and Activation*, for more information.

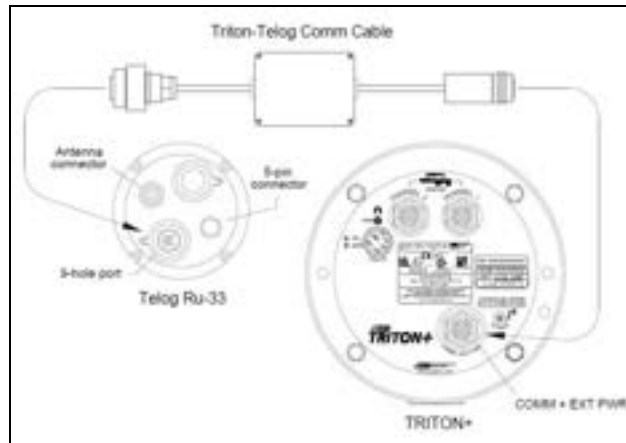
- **Modbus ID** This represents the Modbus slave ID that will be used by the Ru-33 or Ru-35 to indicate the specific monitor from which to request the data. The default ID is 1 (one). *Do not change this value!*
- **Modbus Delay Response** This represents the amount of time, in milliseconds, following the request before the monitor will return the requested Modbus output data to the Ru-33. ADS recommends maintaining the *10 ms* default setting.
- **Enable** This box must be checked to activate the Modbus configuration.

Connecting the Monitor to the Ru-33 or Ru-35

Connecting the **TRITON+** to the Ru-33 requires the ADS Triton-Telog Comm Cable (ADS p/n 8000-0054-01). Connecting the **TRITON+** to the Ru-35 requires the ADS Triton Telog Comm Cable (ADS p/n 8000-

0054-02). First, connect the black, metal connector (with gray, plastic boot) from the comm cable to the **COMM + EXT PWR** port on top of the **TRITON+**.

Then, connect the black, plastic connector from the comm cable to either *sensor port* on the Ru-33 or Ru-35. The sensor port is the 9-hole port.



Connecting the Telog Ru-33 or Ru-35 to the **TRITON+** monitor using the Triton – Telog Comm Cable

Note: Do not leave the Triton-Telog Comm Cable connected to the **TRITON+** monitor when the cable is not also connected to an operational Telog Ru-33 or Ru-35. This may cause the **TRITON+** to remain awake, unnecessarily consuming battery power and, consequently, draining the battery pack. Therefore, disconnect the Triton-Telog Comm Cable from the **TRITON+** monitor whenever the Telog unit is disconnected from the cable for an extended period of time, removed from the manhole, or out of service.

Ayyeka Wavelet 4R

Using a **TRITON+** monitor to support the Ayyeka Wavelet 4R also requires some limited configuration and setup.

Configuring the Monitor to Support the Wavelet

Configuring the **TRITON+** to support the Wavelet 4R requires setting three (3) additional parameters in **Qstart^{XML}** when establishing a new location. Refer to *Create and Configure the Monitor Location* in Chapter 4, *Configuration and Activation*, for more information.

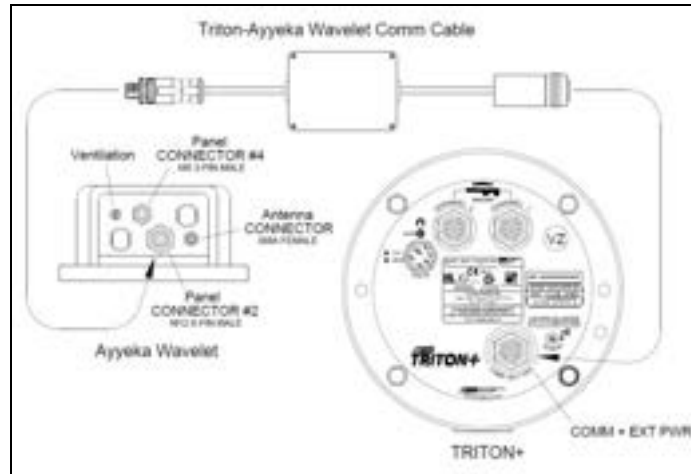
- **Modbus ID** This represents the Modbus slave ID that will be used by the Wavelet to indicate the specific monitor from which to request the data. Numbers 1, 58, and 97 are restricted Modbus IDs for the **TRITON+** using Modbus RTU protocol, but any other number between 2 and 247 may be chosen.
- **Modbus Delay Response** This represents the amount of time, in milliseconds, following the request before the monitor will return the requested Modbus output data to the Wavelet. ADS recommends maintaining the 10 ms default setting.
- **Enable** This box must be checked to activate the Modbus configuration.

Connecting the Monitor to the Wavelet 4R

Connecting the Ayyeka Wavelet to the **TRITON+** requires the ADS Ayyeka Wavelet Comm Cable (ADS p/n 8000-0054-03). First, connect the black, metal connector (with gray, plastic boot) from the comm cable to the **COMM + EXT PWR** port on top of the **TRITON+**.

Then, connect the black, plastic connector from the comm cable to the 8-pin connector port on the Wavelet 4R.

Follow Ayyekka Wavelet instructions to set up, configure and install the Wavelet 4R.



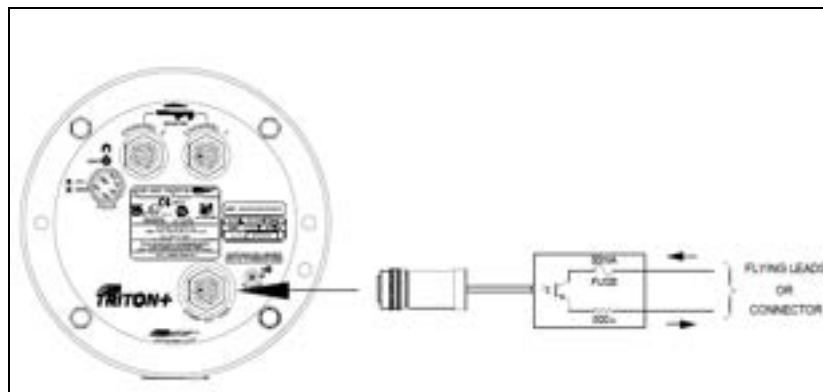
Connecting the Wavelet 4R to the **TRITON+**

APPENDIX E

Sampler Cable Connections and Specifications

This appendix contains information regarding the ADS *TRITON*+[®] sampler cable connections and specifications.

TRITON+ Sampler Cable Illustrations



Sampler Cable Illustration

Note: The Output Impedance is 500Ω.

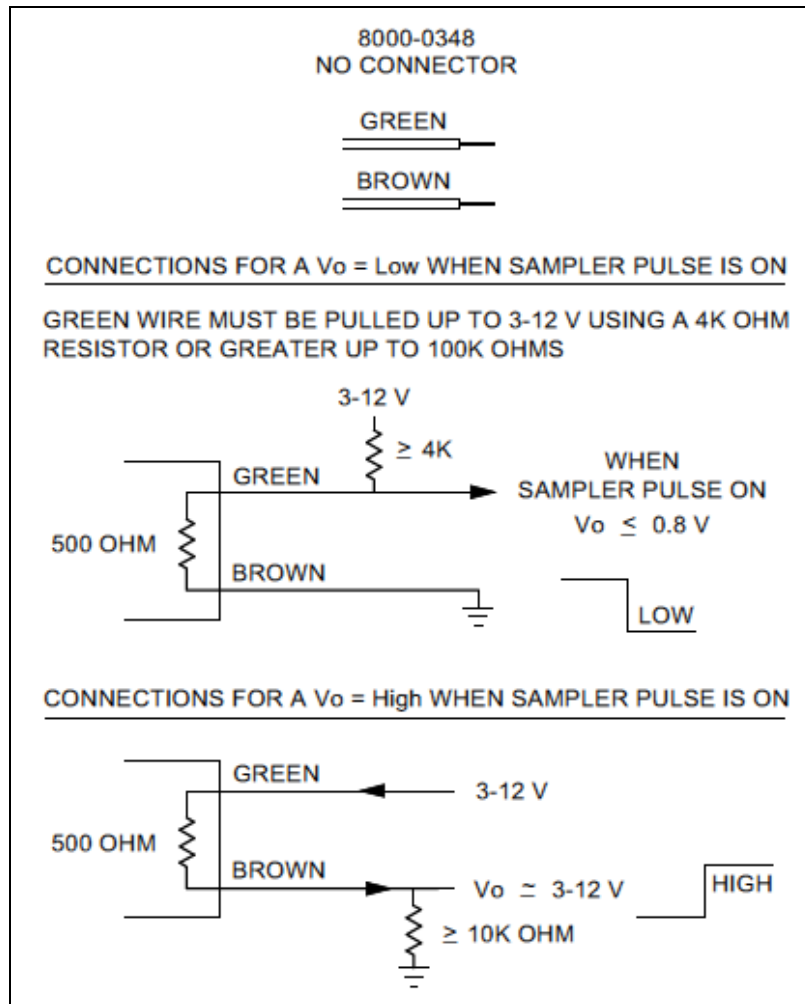
Note: The fuse within the sampler cable is Manufacturer: Shurter Inc. p/n 0034.6602.

Note: If a 6-pin to 7-pin adapter is required, select the proper adapter from the sampler provider. Be sure to note that the adapter has the correct male/female conversions.

Sampler Cable Connection Options and Specifications

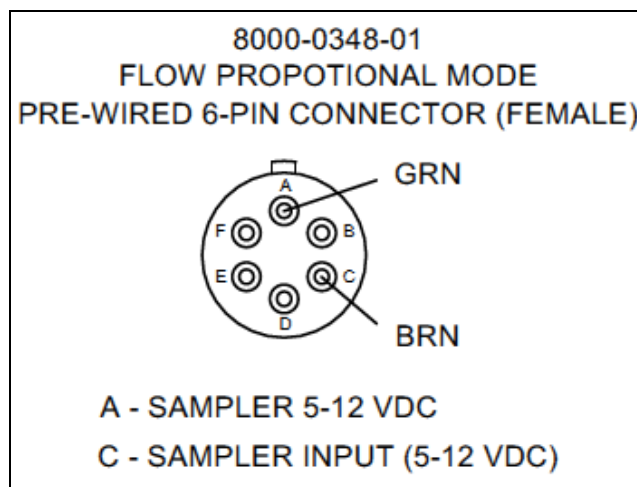
The *TRITON*+ enables the user to connect a water quality sampler to the monitor for flow proportional or level-based sampling operations. ADS offers three 25-foot (7.6-m) cable options for connecting the sampler to the monitor based on the type of sampling.

- No Pre-Wired Connector (ADS p/n 8000-0348) on application (non-monitor) end of the cable



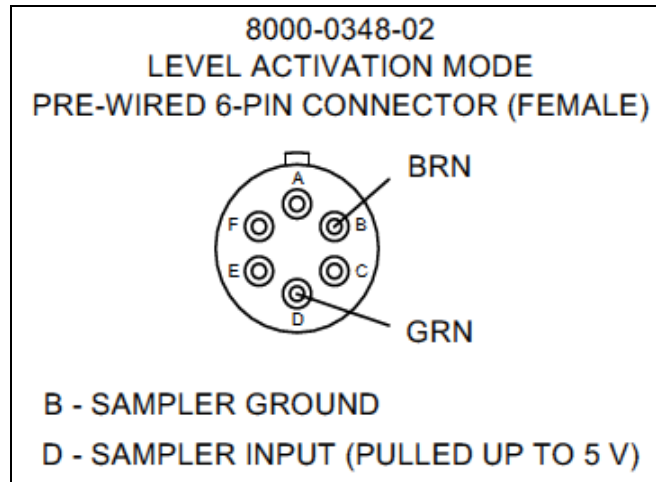
Specifications for ADS Sampler Cable 8000-0348 – Raw Wires on application end of Sampler Cable

- Flow Proportional 6-pin Pre-Wired Connector (ADS p/n 8000-0348-01)



Specifications for ADS Sampler Cable 8000-0348-01 for Flow Proportional Sampling

- Level Actuation 6-ping Pre-Wired Connector (ADS p/n 8000-0348-02)



Specifications for ADS Sampler Cable 8000-0348-02 for Level Actuation Sampling