Simple Precision™

KAM® ATD™
AUTOMATIC TANK DEWATERING

PTB 08 ATEX 1026
II 2 G Ex db IIB T6 Gb
IECEx PTB 19.0048
Ex db IIB T6 Gb

User Manual
ATDMANUAL 0221

TEL +1 713 784 0000
FAX +1 713 784 0001
Email Sales@Kam.com
KAM CONTROLS, INC.
3939 Ann Arbor Drive
Houston, Texas 77063 USA
www.KAM.com

An ISO 9001 certified company

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CAUTION:

When installing the ATD™ sensor in tanks containing petroleum products, petro-chemicals, waste waters with the presence of pressure & temperature, and high-pressure steam refer to the Pipeline Operators' "Health, Safety and Environmental Policy Procedures" to ensure safe installation.

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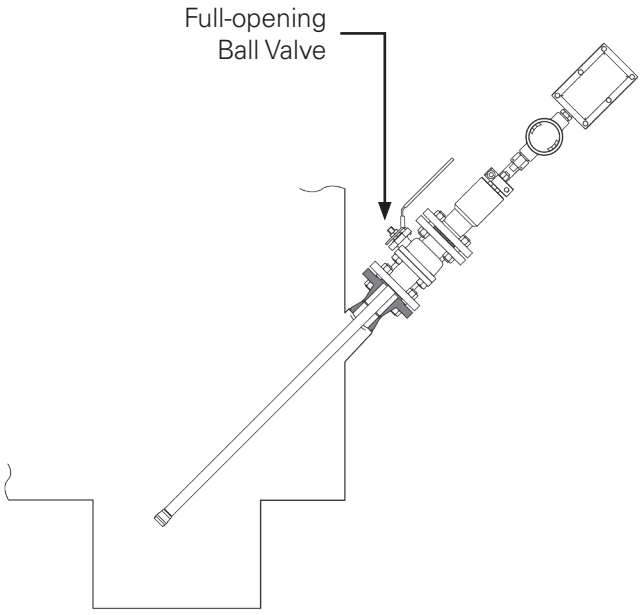
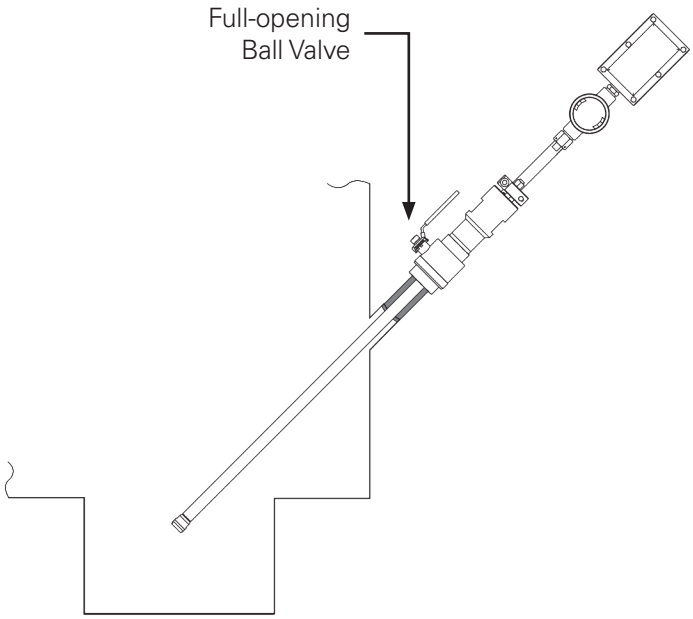
INTRODUCTION

AVAILABLE MODELS and MOUNTING OPTIONS

FIG. 1-1 INSERTABLE/RETRACTABLE MODELS

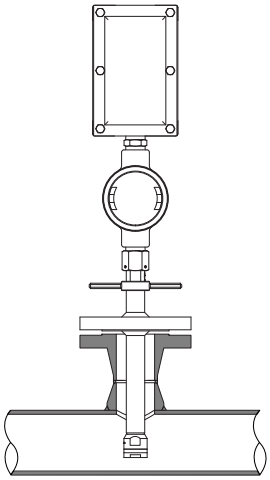


Option 1: Insertable/retractable ATD™
with 2", 3", or 4" flanged seal housing



Option 2: Insertable/retractable ATD™
with 2" MNPT seal housing

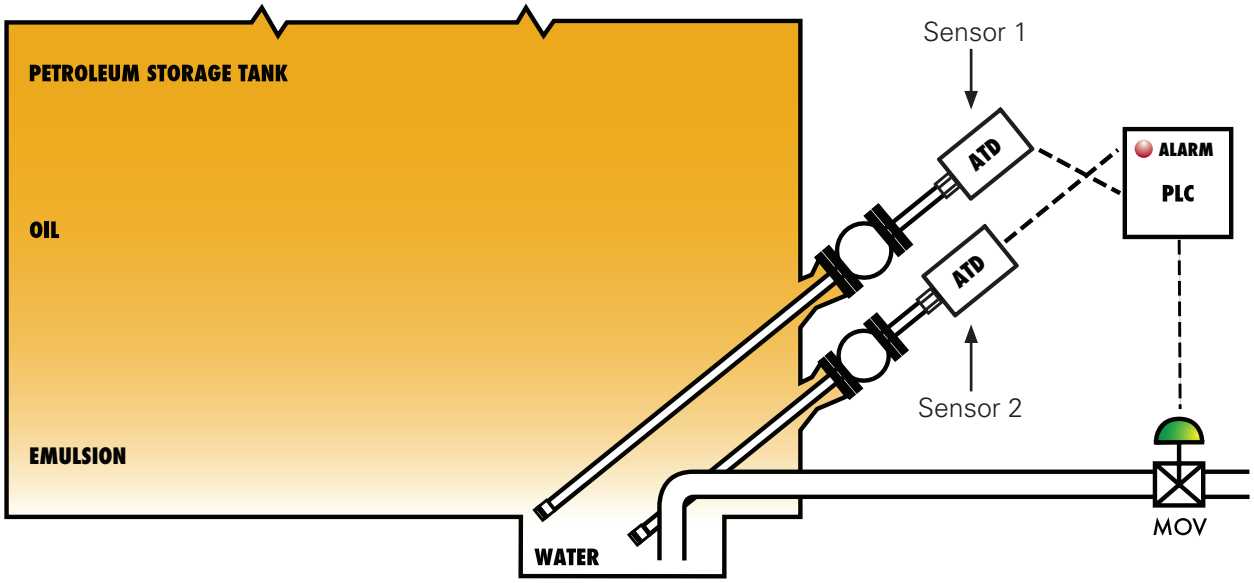
FIG. 1-2 FIXED INSERTION MODEL



Option 3: Fixed-insertion ATD™
for direct mount on dewatering line

THEORY OF OPERATION

FIG. 1-3 AUTOMATED TANK DEWATERING



KAM ATD™ Automated Tank Dewatering incorporates 2 microwave sensors. The first sensor monitors the descending emulsion layer and triggers the closing of the MOV on the draw-off line when the percentage of water falls to a predetermined level. With the MOV closed, water concentrations increase in the bottom of the tank eventually triggering the reopening of the MOV.

The second ATD™ sensor is an alarm sensor. Should Sensor 1 fail for any reason, Sensor 2 detects decreasing water concentrations and triggers both auditory and visual alarms as well as the closing of the MOV.

Because Sensor 2 detects the descending emulsion layer well before it reaches the draw-off line outlet, no oil ever enters the draw-off line. FIG. 1-4.

KAM ATD™ probes are designed with a solid tubular surface to prevent parafins or any other substance from accumulating on the probe and affecting measurement.

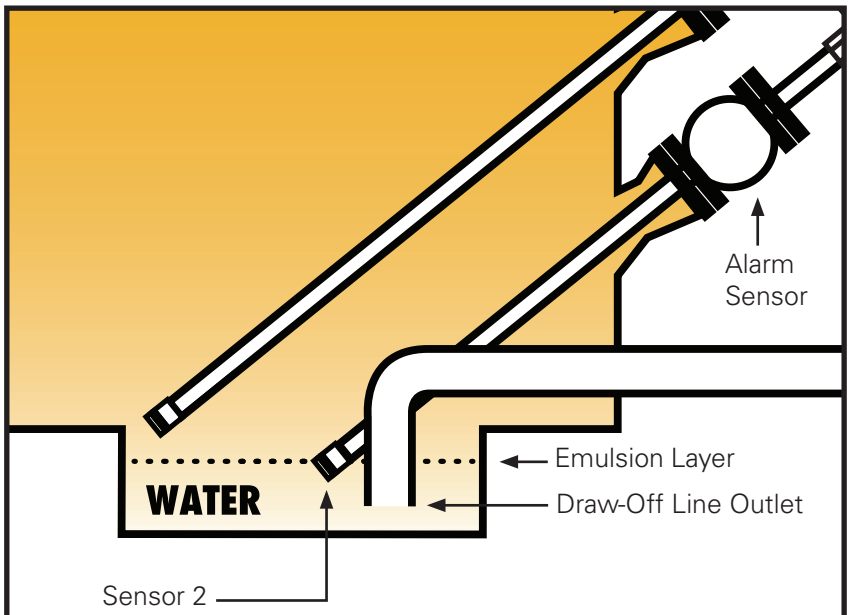


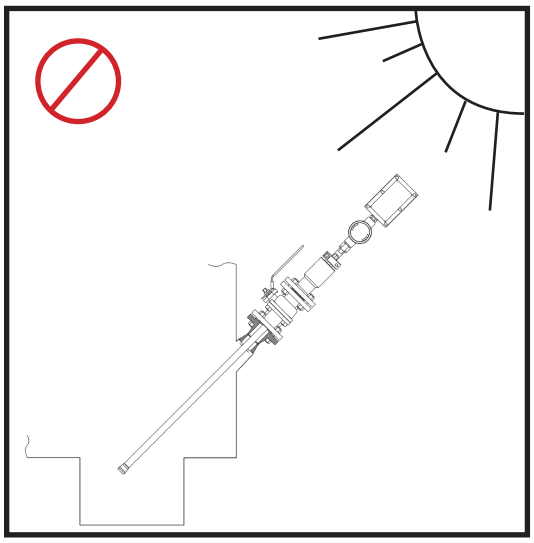
FIG. 1-4 AUTOMATED TANK DEWATERING ALARM SEQUENCE

SPECIFICATIONS

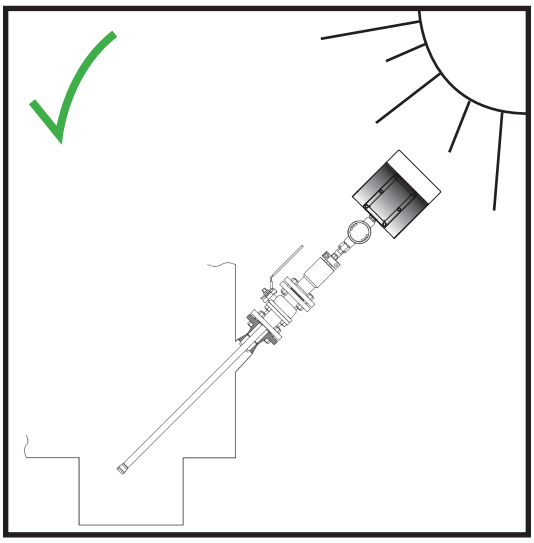
Media:	Crude oil, refined products and water
Material:	Wetted parts- 316 stainless steel, PEEK
Fluid temperature:	-32ºF to 176ºF (0ºC to 80ºC)
Ambient temperature:	-4ºF to 131ºF (-20ºC to +55ºC) Temps below 32ºF (0ºC) require heat tracing
Power requirements:	24 VDC/1 amp at 24 watts
Accuracy:	±5%
Repeatability:	±0.01%
Resolution:	±0.01%
Hazardous area:	PTB 08 ATEX 1026 IECEx PTB 19.0048 Ex db IIB T6 Gb
Outputs:	4–20 mA Alarm relay RS232 RS485 Modbus on non-HART models HART (optional)
Mounting:	2" MNPT seal housing for tank mounted models 2", 3", or 4" flanged seal housing for tank mounted models Flanged fixed insertion for draw-off line installations
Pressure ratings:	ANSI 150, 300
Sensor dimensions:	Ø1.3" x 1.25" (33.1 mm x 31.75 mm)
EX enclosures:	Sensor electronics – 4.4" x 7.1" x 4.6" (101.5 mm x 180.3 mm x 117 mm)
Shaft length:	Per user specification up to 16 feet
Weight:	from 20 lbs. (9kg)

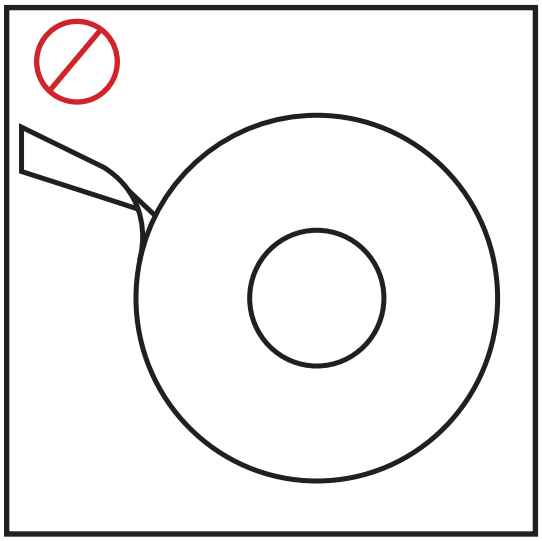
INSTALLATION

GENERAL INSTALLATION DO'S AND DON'TS

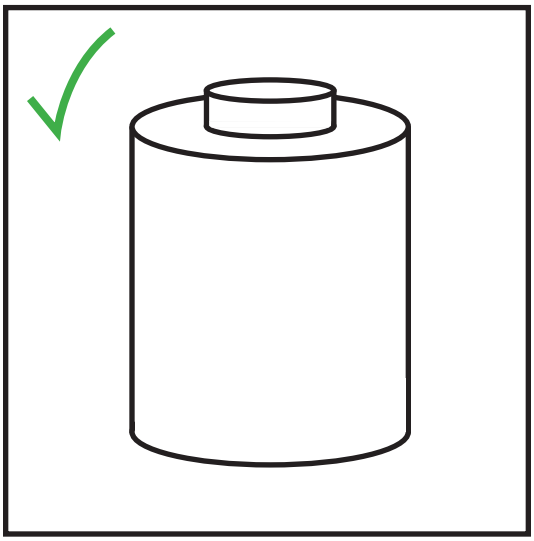


Always install ATD™ sensors with the electronics enclosure shaded from direct sunlight.





DO NOT use teflon tape when installing ATD™ threaded models. DO use liquid thread sealant.



PRIOR TO INSTALLATION

Remove all the protective packaging materials, and ensure that the ATD™ sensors were not damaged during transit.

The following items are provided with the KAM® ATD™ sensor:

One (1) RS232 communication cable for connecting your PC to the ATD™
One (1) USB-to-serial converter, in case your computer does not have an RS232 serial port

Please ensure you have received these items and store them properly. They will be used for initial startup and operation of the ATD™ sensor.

A full-opening ball valve is used to isolate the ATD™ sensor from the tank during installation or removal. The seal housing of the ATD™ sensor allows the probe to be inserted and removed from the tank under pressure and operating conditions.

NOTE: If line pressure exceeds 100 psi, use a KAM® IT Insertion Tool when installing/removing the KAM® ATD™ sensor. Failure to do so could result in damage to the instrument and/or serious bodily injury.

Although the ATD™ has been calibrated in the factory, it should be calibrated offline prior to installation. Follow instructions on pages 31–32 of this manual for off-line calibration.

CALCULATING THE REQUIRED INSERTION LENGTH

Prior to mounting the ATD™ sensor on the Full-opening Ball Valve of a tank, you must determine the insertion length and where you will need to stop the insertion on the ATD™. The ATD™ shaft length should have been calculated during the purchasing process.

1. Calculate the insertion length (See FIG. 3-1):

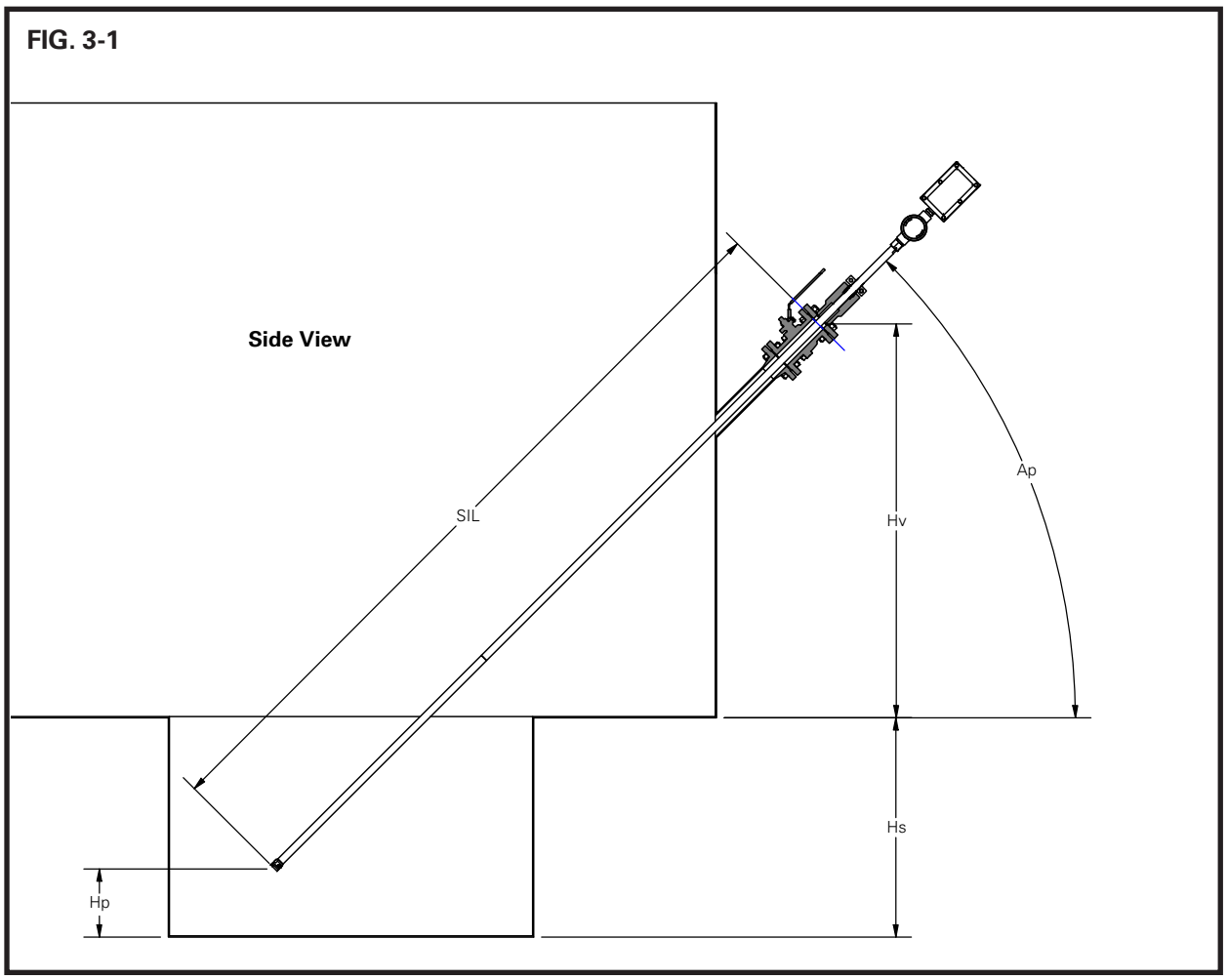
SIL	–	Insertion length
Hv	–	Valve Port height
Hs	–	Sump height
Hp	–	Probe height (desired distance from the ATD™ probe to the bottom of the sump)
Ap	–	Port Angle

SIL=(Hv+ Hs-Hp)/sin(Ap)

Example: Hv=47.4"
Hs=22.55"
Hp=10"
Ap= 3

SIL=(47.4 + 22.55 - 10) / sin(A1)
SIL=59.95/(0.5)
SIL=119.9

FIG. 3-1



2. Next, take note of the shaft length of the ATD™. This information can be found in the documentation or in the serial tag placed on the enclosure of the ATD™. The shaft length is part of the Model Number, shown in the tag. For instance, on Model Number "ATD-2-150-134," the last set of digits correspond to the shaft length in inches (134"). If you would like to verify that the shaft length is correct, preassemble the shaft and measure it.

3. Proceed to calculate the marking length (where to stop insertion):

ML – Marking Length

ATDSL – ATD™ Shaft Length

ML=ATDSL - SIL - 6.55

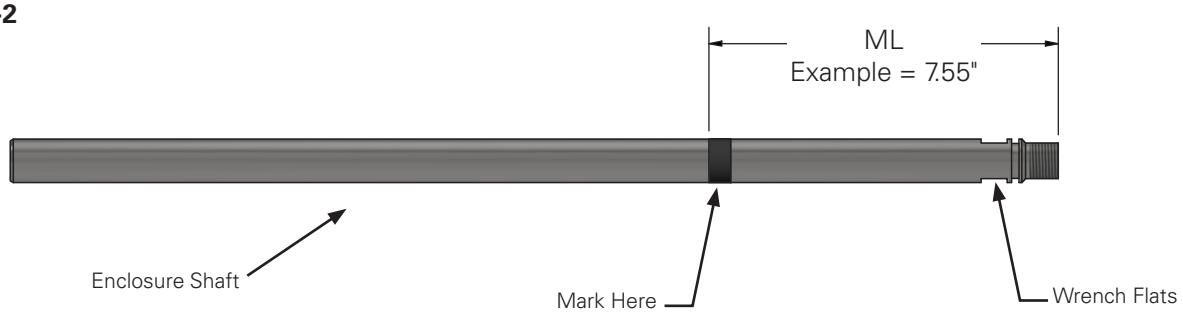
Example: ATDSL=134"
SIL=119.9"

ML=134 - 119.9 - 6.55
ML=7.55

4. Measure the calculated Marking Length (ML) from the bottom of the Enclosure Shaft Section and place a mark with a permanent marker or electrical tape (Do not use anything sharp to mark the shaft as this will create grooves that will damage the O-rings in the seal housing.) FIG. 3-2.

NOTE: The Enclosure Shaft Section can be identified by the wrench flats. It is the only shaft section with wrench flats.

FIG. 3-2



SHAFT SECTION ASSEMBLY PROCEDURE

The ATD™ shaft may be separated in two or more sections. The first section of the ATD™ shaft will come pre-installed with the probe and the seal housing. Follow the steps bellow to assemble the entire ATD™ shaft.

The following tools and parts are required for the shaft section assembly procedure:

(1) Locking Tool (provided)
(1) 13/16-20 Hex Jam Nut (provided)
(1) 3/4" NPS Nut (provided)
(1) 3/8" Allen wrench
(1) 3/4" Wrench
(1) 7/16" Wrench

1. Lay the ATD™ sensor on the ground or a table.

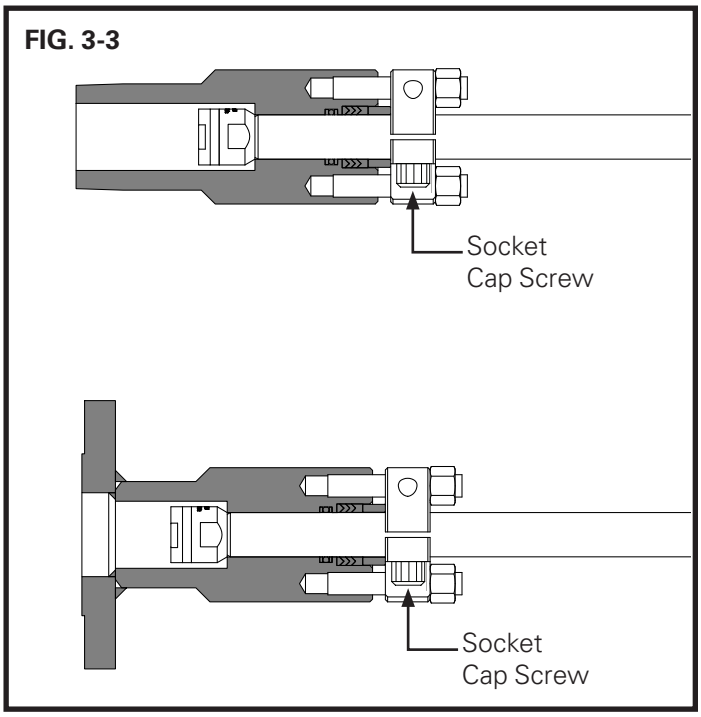
2. Use a 3/8" Allen Wrench to loosen the Socket Cap Screws on the Locking Collar. This will allow the ATD™ shaft to slide through the seal housing.

3. Push the ATD™ back through the seal housing until the ATD™ probe is retracted inside the seal housing. FIG. 3-3.

4. Retighten the Socket Cap Screws on the Locking Collar. This will prevent the ATD™ shaft from sliding and the probe from getting damaged during mounting.

5. You can now attach the ATD™ to the valve on the tank. For threaded models, KAM recommends liquid thread sealant and not Teflon tape for the threaded ATD™ sensor.

FIG. 3-3



7. Open the Full-opening Valve.

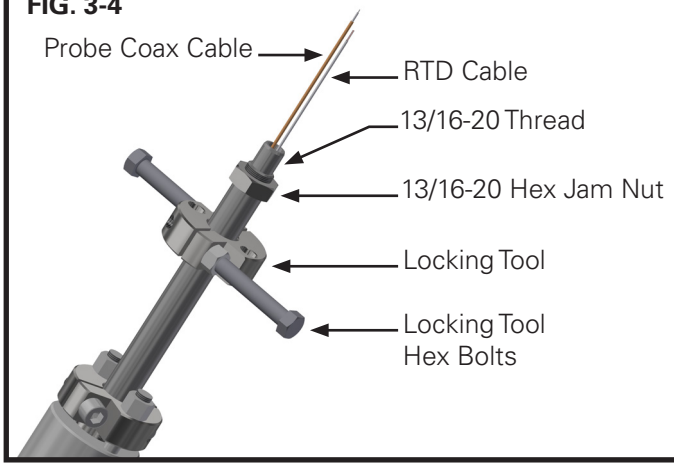
8. Use a 3/4" Wrench to open the Locking Tool and loosen its Hex Bolts.

9. Place the Locking Tool about 3" from the 13/16-20 thread of the first shaft and thread the 13/16-20 Hex Jam Nut to the shaft thread. FIG 3-4.

NOTE: This will prevent the shaft from sliding during the installation.

NOTE: The first shaft is pre-installed with the probe and the seal housing. You will see the RTD cable and the Probe Coax Cable coming out from the threaded end of the shaft.

FIG. 3-4

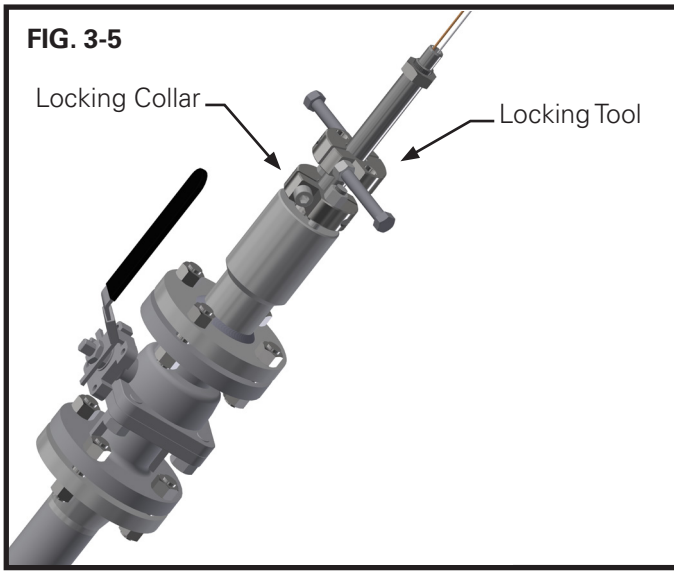


9. Loosen Socket Cap Screws on the Seal Housing Locking Collar.

WARNING: Loosen the Socket Cap Screws completely to avoid scratching the shafts.

10. Push ATD™ sensor in until the Locking Tool reaches the Locking Collar. FIG. 3-5.

FIG. 3-5



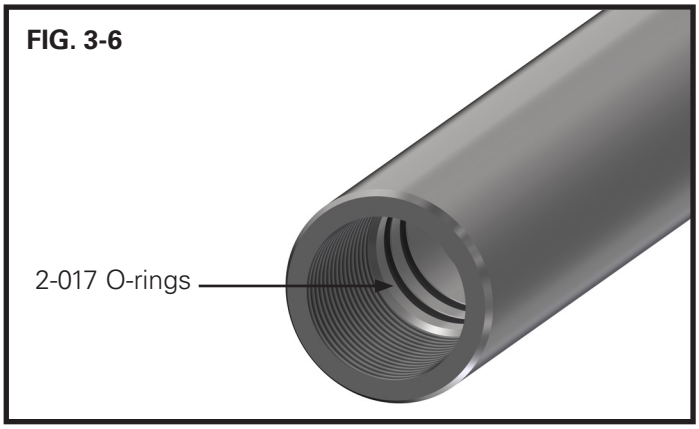
11. Re-tighten the Socket Cap Screws on the Seal Housing Locking Collar.

12. Remove the 13/16-20 Hex Jam Nut and the Locking Tool.

13. Wrap thread lock tape three times around the 13/16-20 thread of the first shaft section.

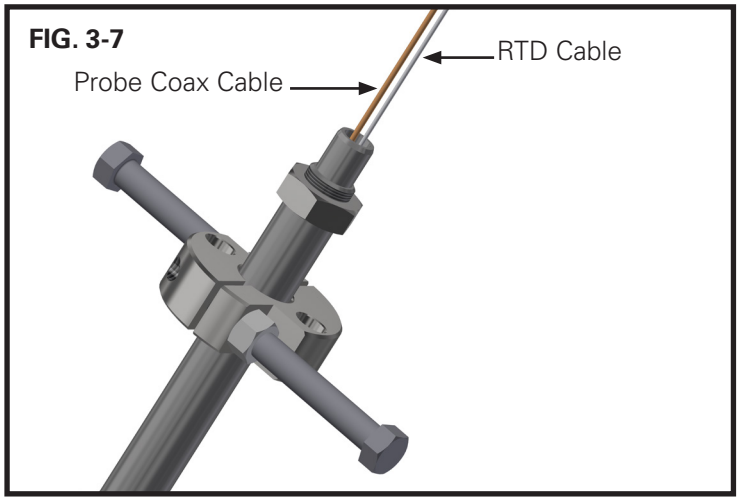
14. Inspect the internal thread of the second section of the shaft and ensure that the two 2-017 O-rings are installed. FIG. 3-6.

FIG. 3-6



15. Push the Probe Coax and RTD cables through the next Shaft Section and and attach the Second Shaft Section to the first shaft by turning it clockwise by hand. FIG. 3-7.

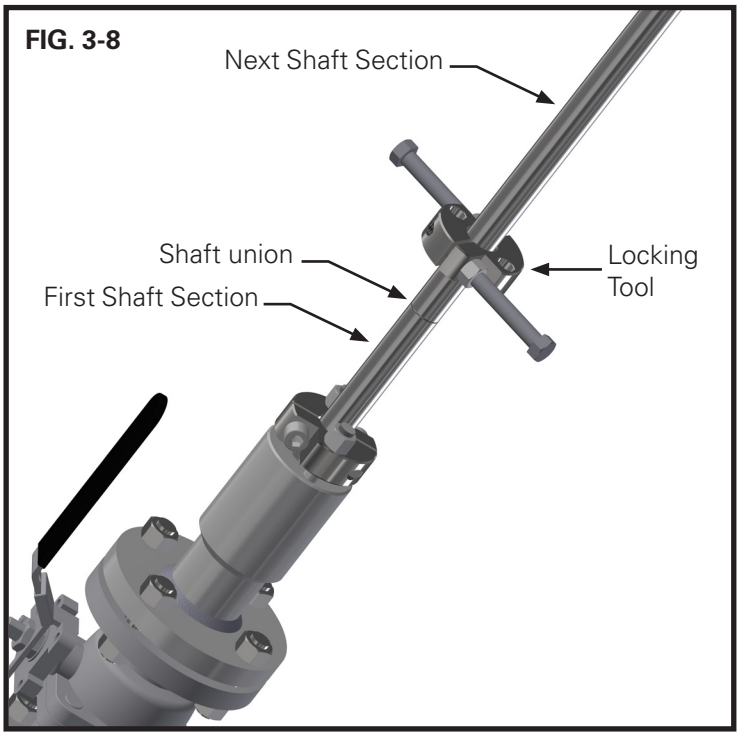
FIG. 3-7



16. Place the Locking Tool on the next Shaft Section close to the union of the shafts and tighten its Hex Bolts. Use the Locking Tool to tighten the shafts together. FIG. 3-8.

17. Loosen the Locking Tool Hex Bolts and move the Locking Tool 3" from the thread of the top end of the shaft.

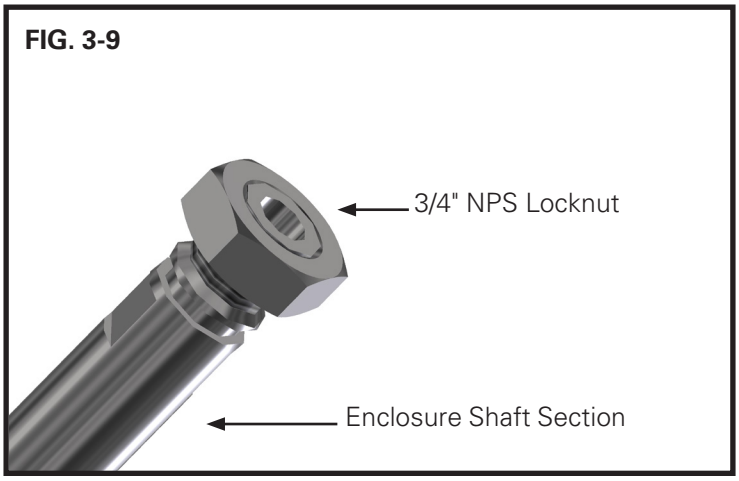
FIG. 3-8



18. For models with only two Shaft Sections: Screw in the 3/4" NPS Locknut to the top of the shaft (Enclosure Shaft Section) by hand. FIG. 3-9. Once done, proceed to step 19.

For models with more than two Shaft Sections: Repeat steps 9 through 18 until you have reached the last shaft (Enclosure Shaft Section). Once done, screw in the 3/4" NPS Locknut to the top of the last shaft (Enclosure Shaft Section) by hand. FIG. 3-9. Proceed to step 19.

FIG. 3-9



19. Loosen the Socket Cap Screws on the Seal Housing Locking Collar.

WARNING: Loosen the Socket Cap Screws completely to avoid scratching the shafts.

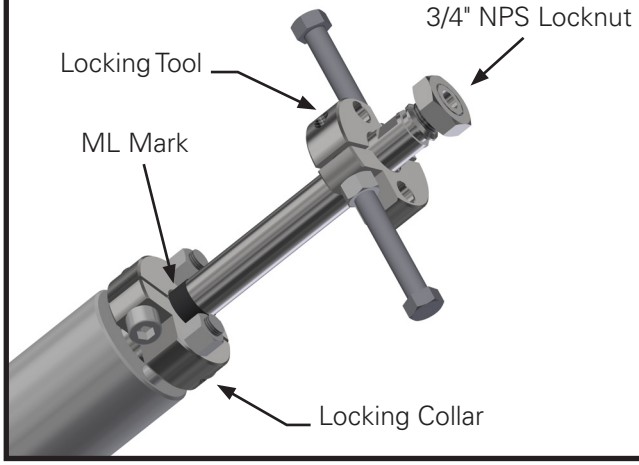
20. Push the ATD™ shaft until the Marking Length (ML) mark on the shaft reaches the Locking Collar. FIG. 3-10.

21. Re-tighten the Socket Cap Screws.

22. Remove the 3/4" NPS Locknut.

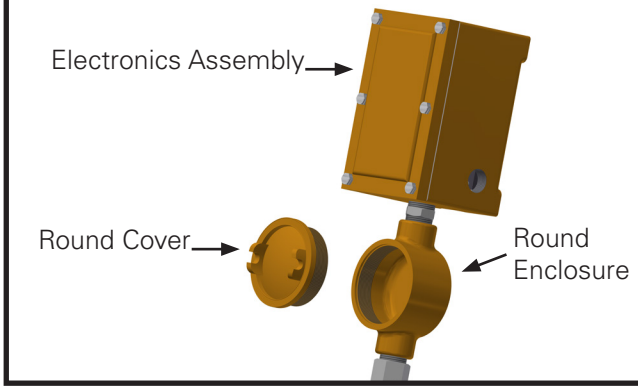
23. Remove the Locking Tool by loosening its Hex Bolts and sliding it out of the shaft.

FIG. 3-10



24. Once the Enclosure Shaft Section has been installed and placed at its proper insertion length, you are now ready to prepare the Electronics Assembly for installation. Open the Round Enclosure cover by hand. FIG. 3-11. Set the cover aside.

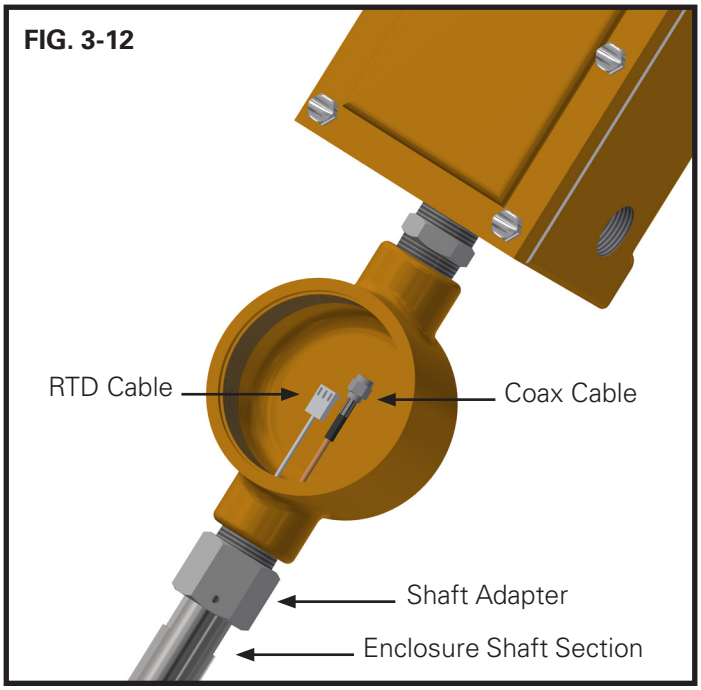
FIG. 3-11



25. Pass the probe Coax and the RTD cables through the Shaft Adapter until it is inside the Round Enclosure and screw the Electronics Assembly onto the Enclosure Shaft Section. FIG. 3-12.

NOTE: Hand tighten only the Electronics Assembly to the Enclosure Shaft Section. Also, be careful to not twist the excess Coax and RTD cables while rotating the Electronics Assembly.

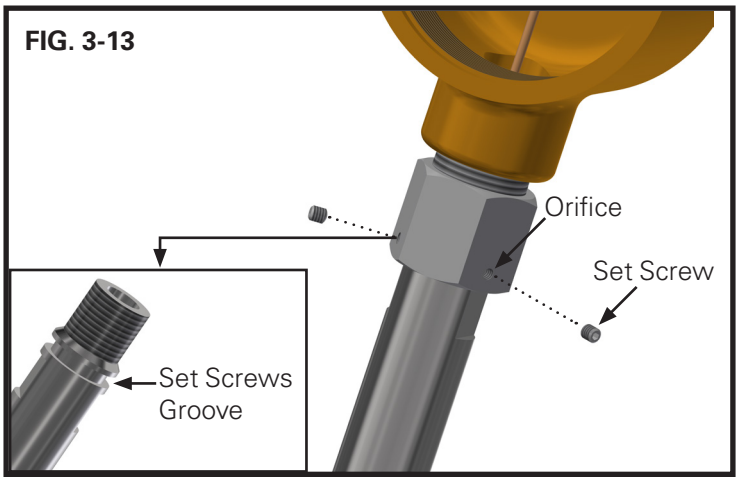
FIG. 3-12



26. Secure the Electronics Assembly by using the (3) 8-32 x 3/16 Set Screws on the Shaft Adapter. FIG. 3-13.

WARNING: Make sure the Set Screws Groove is visible through the 8-32 Set Screw orifices. The Set Screws should at least be able to sit flush with the adapter.

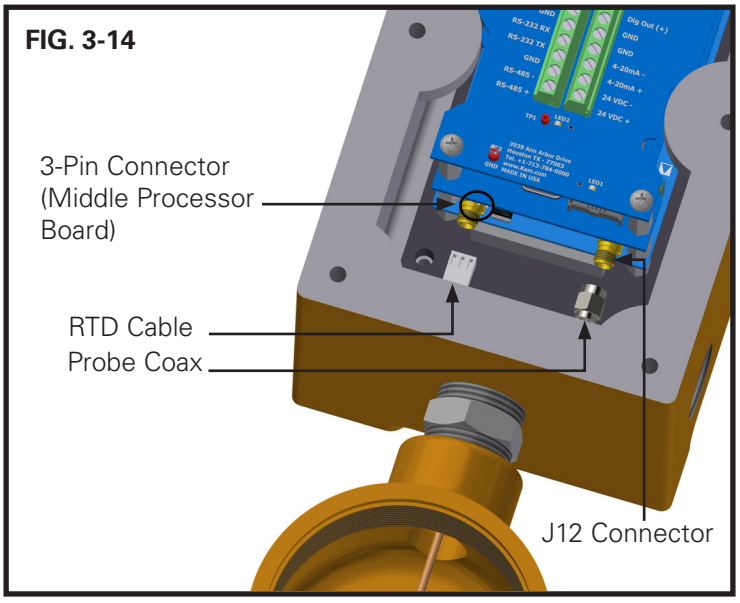
FIG. 3-13



27. Use a 7/16" wrench to remove the (6) hex screws on the Explosion Proof electronics enclosure and remove the cover. Once done, pass the Coax and RTD cables up through it.

28. Connect the probe cable to the J12 connector (right connector) and the RTD Cable to the 3-Pin Connector on the Processor Board. FIG. 3-14.

FIG. 3-14



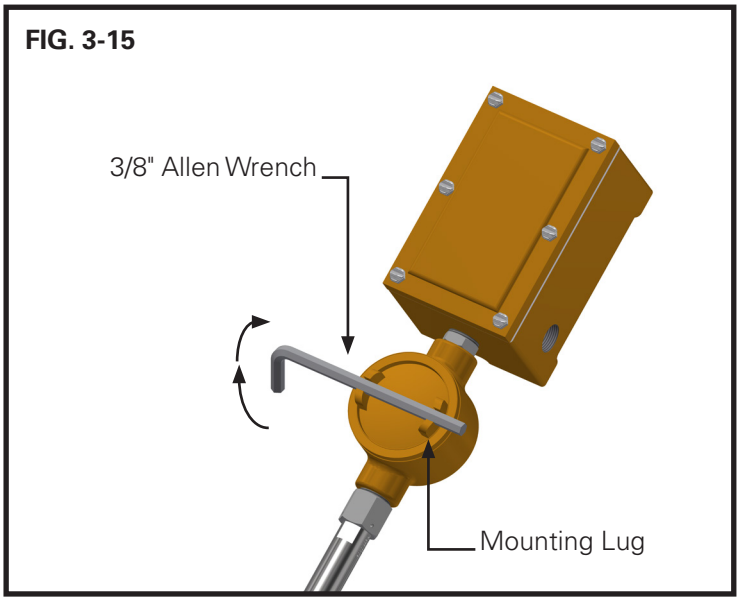
28. Wrap any excess Probe Coax and RTD cables in the Round Enclosure.

29. Screw the Round Enclosure's cover by hand. Tighten the Round Cover by placing a 3/8" Allen Wrench horizontally between the Mounting Lugs, grabbing it from both sides and turning clockwise. FIG. 3-15.

NOTE: Make sure the Round Enclosure is fully closed to prevent water ingress.

NOTE: KAM recommends using some oxide inhibitor or similar product to create an airtight seal between the threads of the Round Enclosure.

FIG. 3-15



REMOVING THE INSERTABLE/RETRACTABLE ATD™ SENSOR

The following tools and parts are required for the removal procedure:

(1) Locking Tool (provided)
(1) 13/16-20 Hex Jam Nut (provided)
(1) 3/4" NPS Nut (provided)
(1) 3/8" Allen wrench
(1) 3/4" Wrench
(1) 7/16" Wrench

NOTE: Prior to remove, turn off all power to the ATD™ probe.

1. Use a 7/16" wrench to remove the (6) hex screws on the Explosion Proof electronics enclosure and remove the cover.

2. Disconnect the probe cable to the J12 connector (right connector) and the RTD Cable to the 3-Pin Connector on the Processor Board. FIG. 3-16.

3. Unscrew the Round Enclosure's cover by placing a 3/8" Allen Wrench horizontally between the Mounting Lugs, grabbing it from both sides and turning counterclockwise. FIG. 3-17. Set the cover aside.

4. Unwrap any excess Probe Coax and RTD cables in the Round Enclosure.

5. Start detaching the Electronics Assembly by removing the (3) 8-32 x 3/16 Set Screws on the Shaft Adapter. FIG. 3-18.

6. Pull the Probe Coax and RTD cables until they are inside the Round Enclosure.

FIG. 3-16

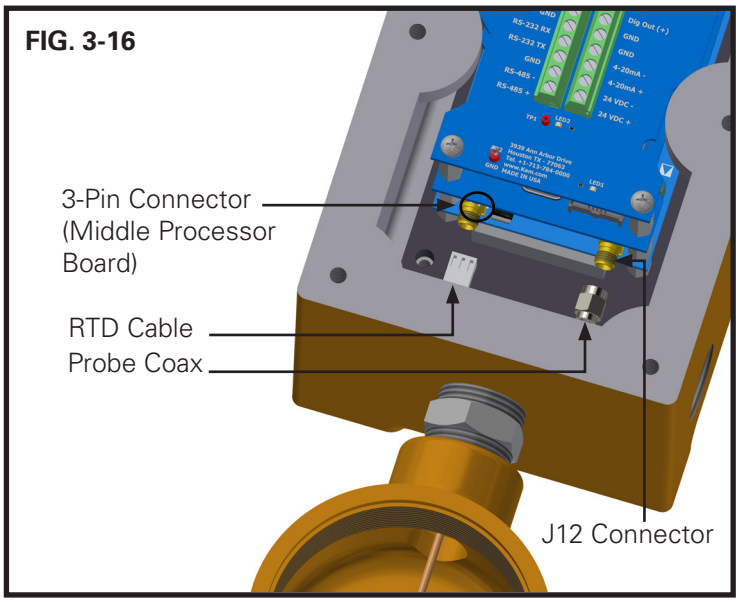


FIG. 3-17

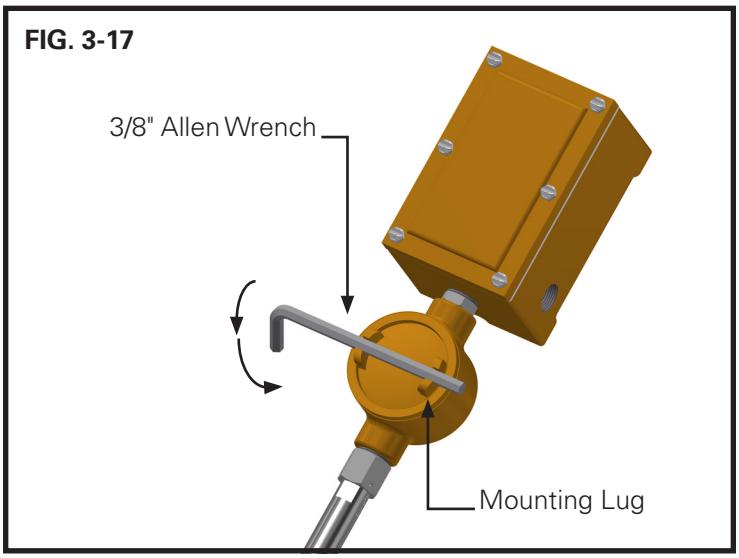
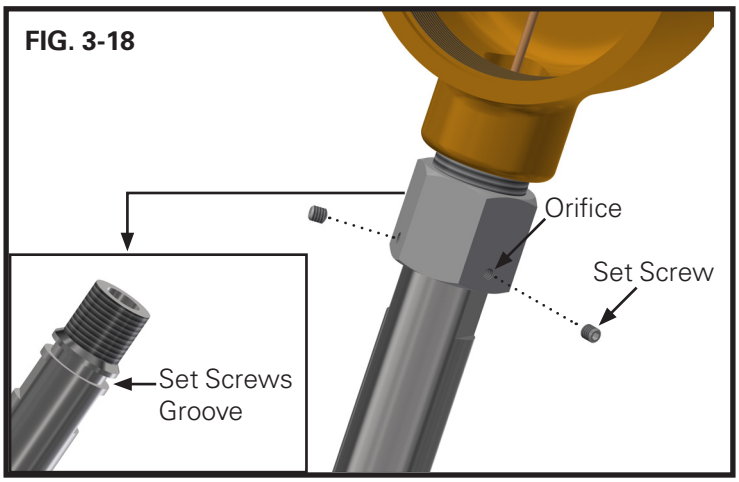


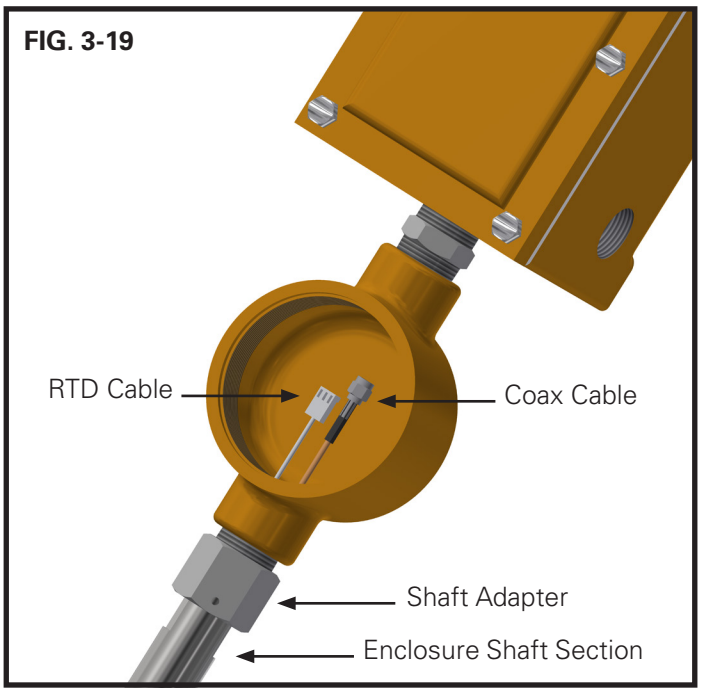
FIG. 3-18



7. Unscrew the Electronics Assembly at the junction of the Shaft Adapter and Enclosure Shaft Section. Shaft Adapter should remain screwed onto the Electronics Assembly. FIG. 3-19.

NOTE: Be careful to not twist the excess Coax and RTD cables while rotating the Electronics Assembly.

FIG. 3-19



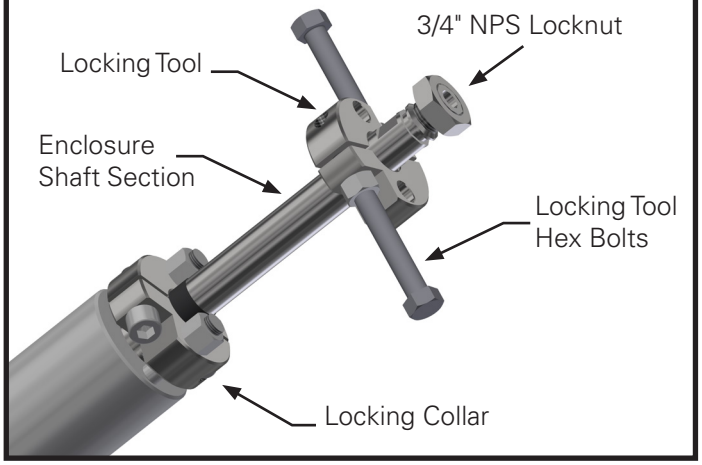
8. Place the Locking Tool about 3" from the thread of the top end of the Enclosure Shaft Section and use a 3/4" Wrench to tighten its Hex Bolts. FIG. 3-20.

9. Screw in the 3/4" NPS Locknut to the top of the shaft (Enclosure Shaft Section) by hand. FIG. 3-20.

10. Use a 3/8" Allen wrench to loosen the Socket Cap Screws on the Seal Housing Locking Collar.

WARNING: Loosen the Socket Cap Screws completely to avoid scratching the shafts.

FIG. 3-20



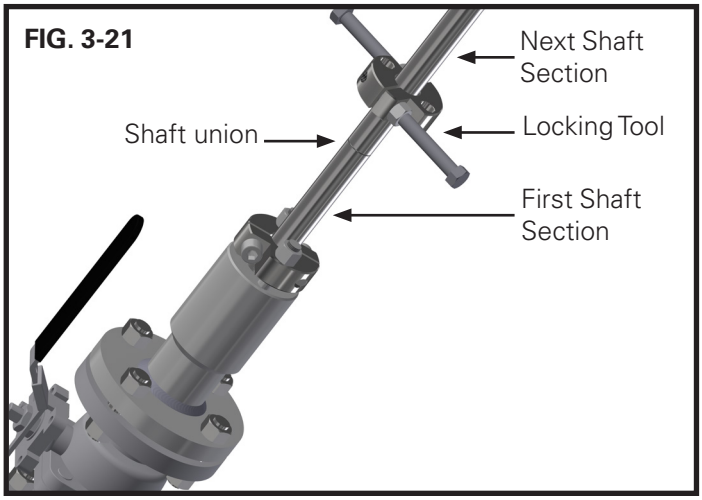
11. Add grease to the shaft. Push shaft in approximately 4" (if possible).

12. Carefully pull the ATD™ shaft until the next section of the shaft is about 6" from the Seal Housing Locking Collar.

13. Tighten the Socket Cap Screws on the Seal Housing Locking Collar.

14. Loosen the Locking Tool Hex Bolts and slide it toward the end of the shaft section, close to the union of the shafts. FIG. 3-21.

FIG. 3-21



15. Loosen the shaft section with the help of the Looking Tool, remove the tool and unscrew the shaft by hand.

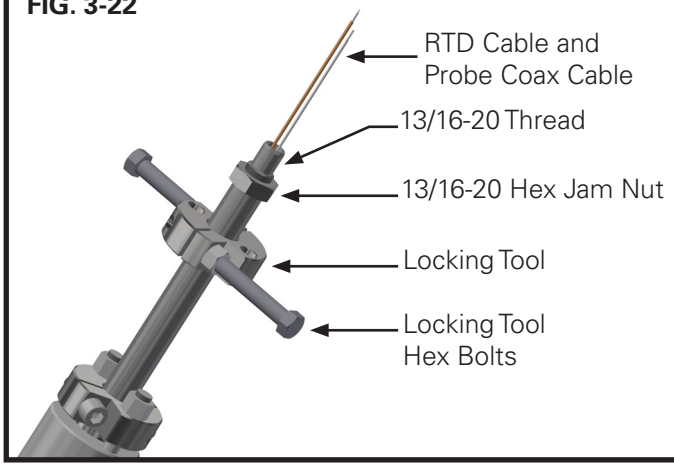
16. Pull the RTD and Probe Coax Cables from the removed shaft section.

17. Place the Locking Tool about 3" from the 13/16-20 thread from the next shaft section and thread the 13/16-20 Hex Jam Nut to the shaft thread. FIG 3-22.

18. Loosen the Socket Cap Screws on the Seal Housing Locking Collar.

WARNING: Loosen the Socket Cap Screws completely to avoid scratching the shafts.

FIG. 3-22



19. For models with only two Shaft Sections: Pull the Probe Shaft section until ATD™ probe is retracted inside the Seal Housing.

For models with more than two Shaft Sections: Carefully pull the ATD™ shaft until the next section of the shaft is about 6" from the Seal Housing Locking Collar. Repeat steps 13 through 18 until you have reached the Probe Shaft Section.

20. Tighten the Socket Cap Screws on the Seal Housing Locking Collar.

21. Close the full opening Valve.

22. The ATD™ can now be removed from the tank valve.

Removal should be conducted in accordance with all regional and Class requirements.

REMOVING FIXED INSERTION ATD™ SENSOR

1. To remove the ATD™ sensor, first shut off power to the instrument.

2. Discontinue flow in line and drain.

Removal should be conducted in accordance with all regional and Class requirements.

WIRING

Any components attached or installed (e.g. terminal compartments, bushings, explosion-proof cable entries, connectors) shall be of a technical standard that complies with the specifications on the cover sheet as a minimum and for which a separate examination certificate has been issued. The operating conditions set forth in the relevant component certificates must by all means be complied with.

The temperature of the process fluid must not exceed +80 °C.

All wiring and maintenance on the KAM ATD™ must be done in accordance with regional and classification requirements. It is the user's responsibility to understand these requirements.

It is also recommended that the ATD™ be wired with flexible wiring/conduit with additional slack/length in the wire to accommodate insertion, removal, and testing.

Operator's should take all possible precautions to avoid any moisture from entering the electronics enclosure. The enclosure should not be left open in inclement weather or for long periods of time, especially during operation as condensation will accumulate. Lid should be tightly screwed shut, all conduits should be sealed and secured in accordance with regional and classification requirements, and unused 3/4" NPT openings should be sealed in accordance with regional and classification requirements. Do not power wash the unit.

- The installed 3/4" NPT plug is not part of the instrument installation and should be replaced by the appropriate Ex certified 3/4" NPT plug for the final installation.
- The Oil Water Detector KAM OWD/ATD/LRW shall be connected by means of suitable cable entries or conduit systems, which meet the requirements of IEC 60079-1, sections 13.1 and 13.2, and for which a separate examination certificate has been issued.
- Cable entries (conduit threads) and sealing plugs of simple designs must not be used. Should the Oil Water Detector KAM OWD/ATD/LRW be connected by means of a conduit entry which has been approved for this purpose, the appertaining sealing device shall be provided immediately at the terminal box.
- Openings not used shall be sealed in compliance with IEC 60079-1, section 11.8.
- The connecting wire of the Oil Water Detector KAM OWD/ATD/LRW shall be installed to provide for permanent wiring and adequate protection against mechanical damage.
- If the temperature at entry fittings should exceed 70 °C, the connecting cables used have to be of the temperature resistant type.
- The Oil Water Detector KAM OWD/ATD/LRW has to be included into the local equipotential bonding.
- The connecting wire of the Oil Water Detector KAM OWD/ATD/LRW has to be installed in an enclosure which complies with the requirements of an accepted type of protection acc. to IEC 60079-0, section 1, if the connection

INPUTS

24 VDC –	GND
24 VDC +	24-30 VDC

OUTPUTS

4-20 mA –	Current output, source powered.
4-20 mA +	Set to requisite percent water at factory.
Dig Out (+)	Alarm or relay (digital contact closure)
RS-485 –	Modbus interface
RS-485 +	

INPUT/OUTPUT

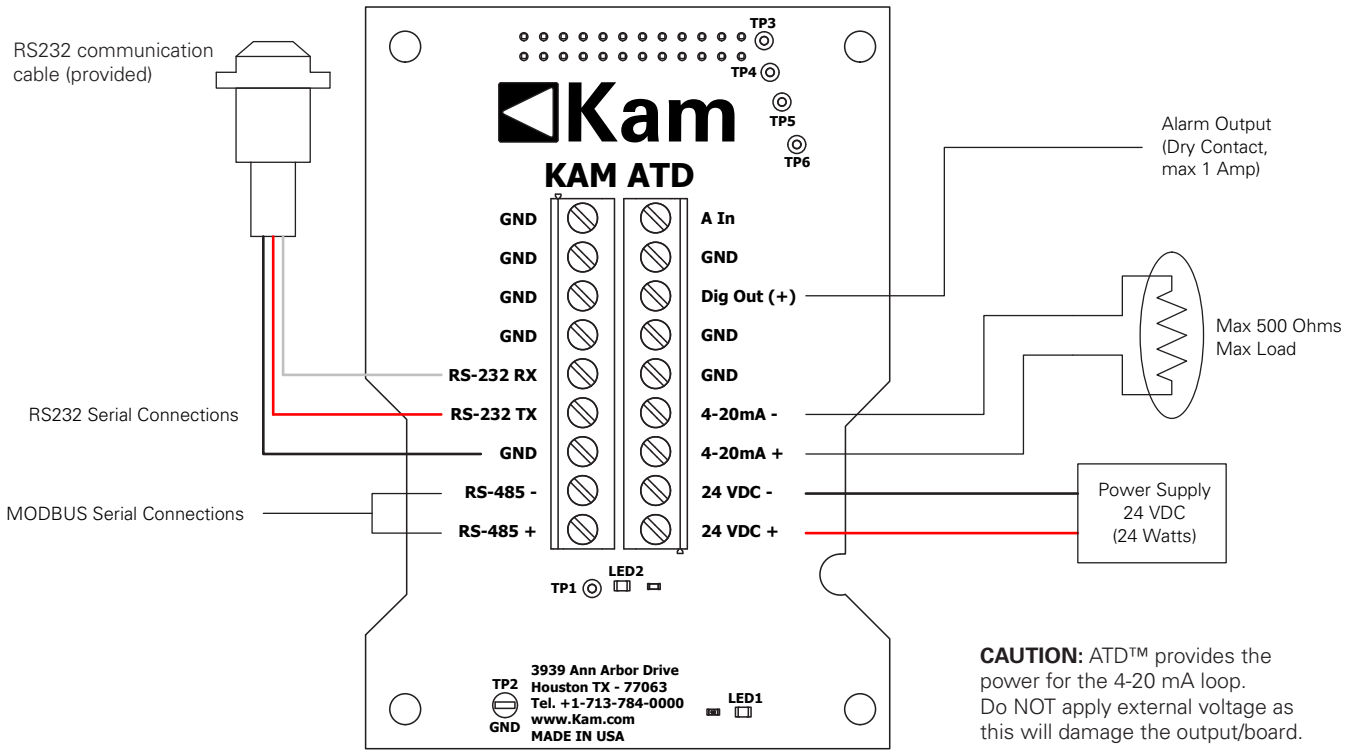
RS-232 RX	Console port – communication interface
RS-232 TX	for calibration

LED INDICATORS

LED1	24 VDC Power
LED2	5 VDC Internal supply

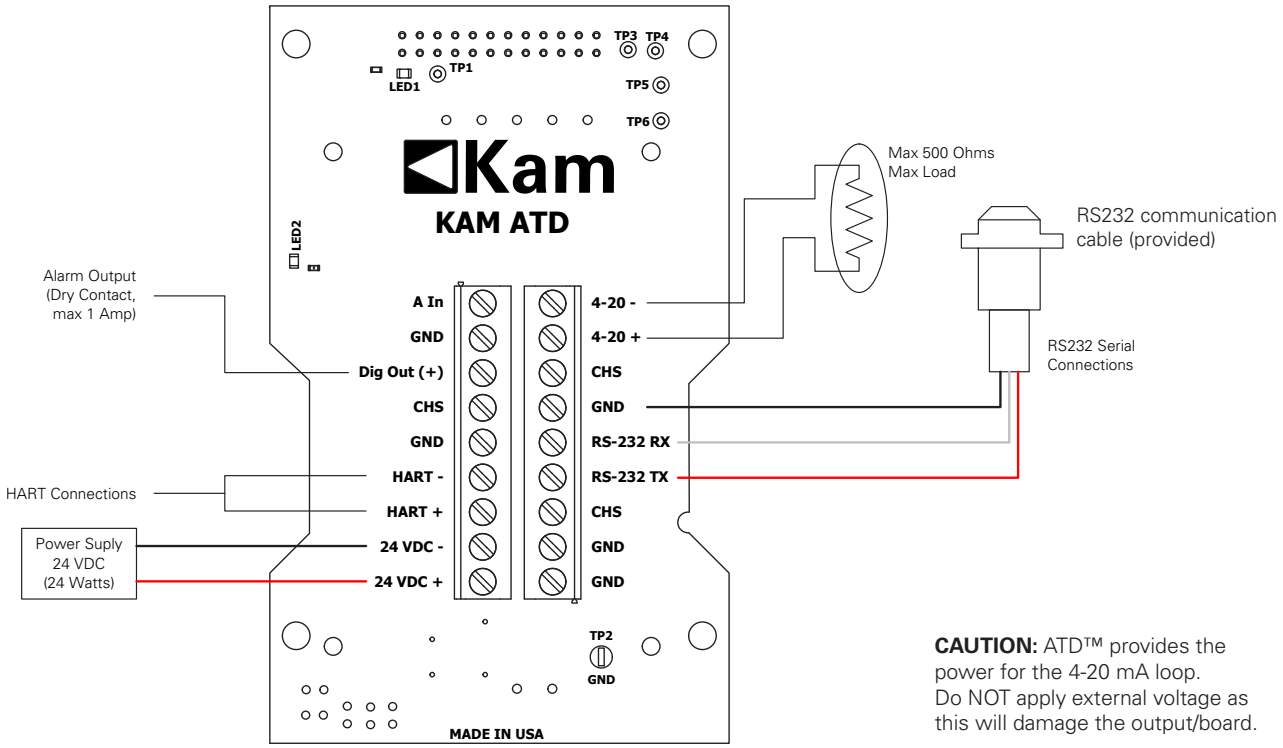
WIRING CONTINUED

FIG. 3-23 WIRING DIAGRAM- UNITS WITHOUT HART



CAUTION: ATD™ provides the power for the 4-20 mA loop. Do NOT apply external voltage as this will damage the output/board.

FIG. 3-24 WIRING DIAGRAM – UNITS WITH HART

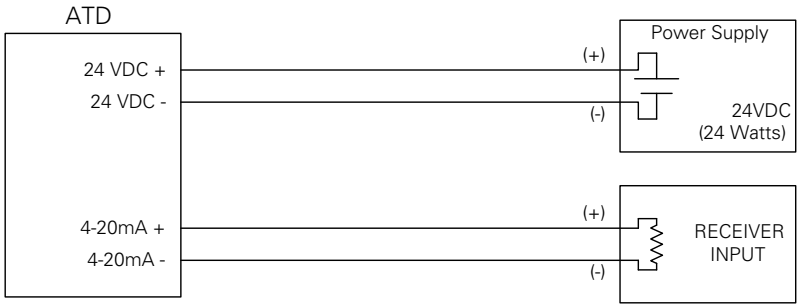


CAUTION: ATD™ provides the power for the 4-20 mA loop. Do NOT apply external voltage as this will damage the output/board.

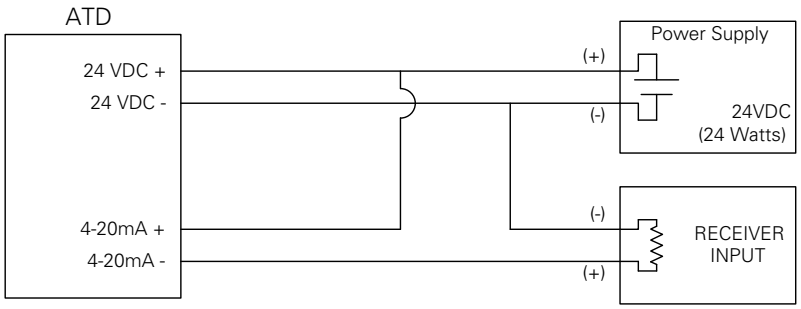
WIRING CONTINUED

TYPICAL POWER AND LOOP WIRING CONFIGURATION

FIG. 3-25



TYPICAL WIRING



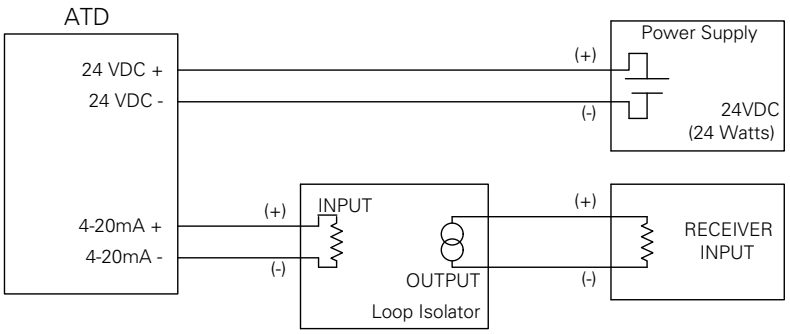
WRONG WIRING

The ATD™ provides power for the 4-20 mA loop. Adding external power can damage the output and/or board.

WIRING CONTINUED

POWER SUPPLY AND OUTPUT WIRING WITH LOOP POWERED ISOLATOR (RECOMMENDED)

FIG. 3-26



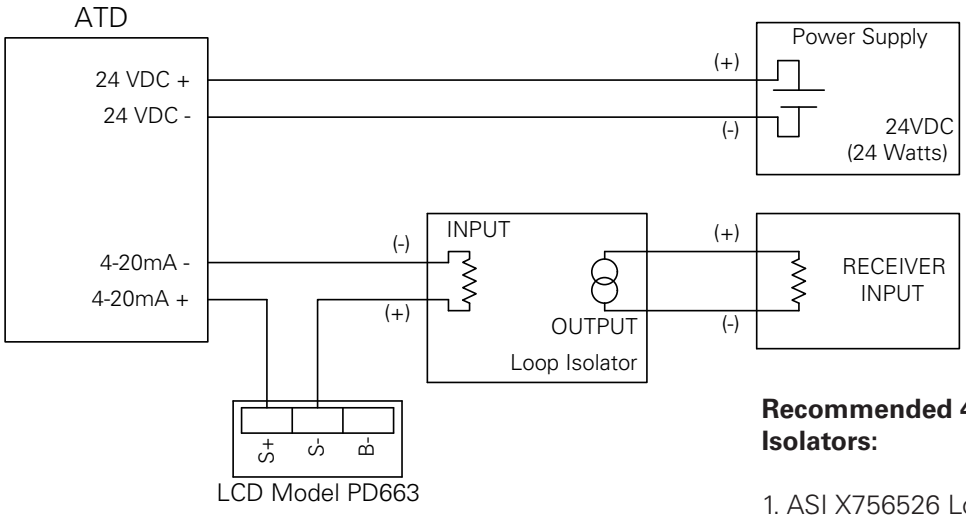
Recommended 4-20 mA Loop Isolators:

1. ASI X756526 Loop Powered Analog Signal Isolator, DIN Rail, Slim Line Single Channel

2. ASI 451129 4-20 mA Loop Powered Analog Signal Isolator, Single Channel, DIN Rail

POWER SUPPLY AND OUTPUT WIRING WITH LCD AND LOOP POWERED ISOLATOR (RECOMMENDED)

FIG. 3-27



Recommended 4-20 mA Loop Isolators:

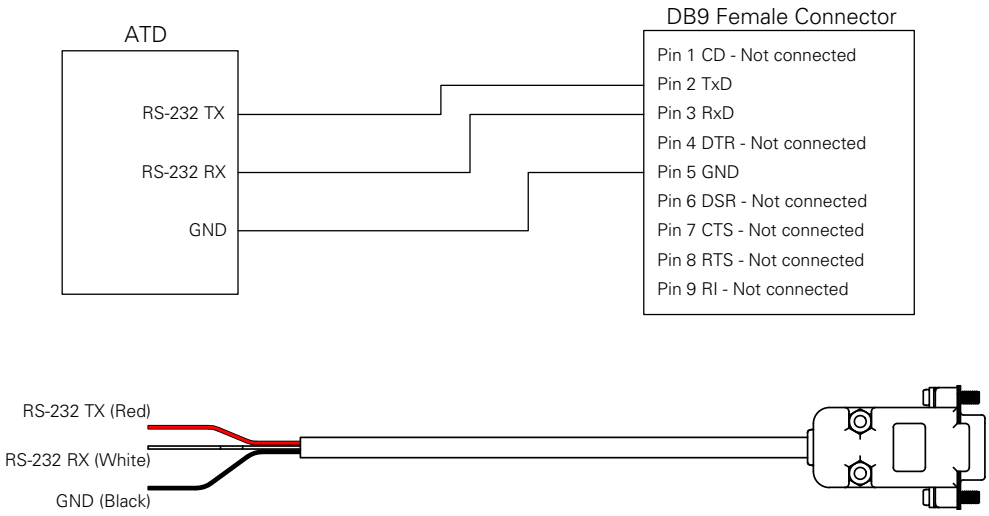
1. ASI X756526 Loop Powered Analog Signal Isolator, DIN Rail, Slim Line Single Channel

2. ASI 451129 4-20 mA Loop Powered Analog Signal Isolator, Single Channel, DIN Rail

WIRING CONTINUED

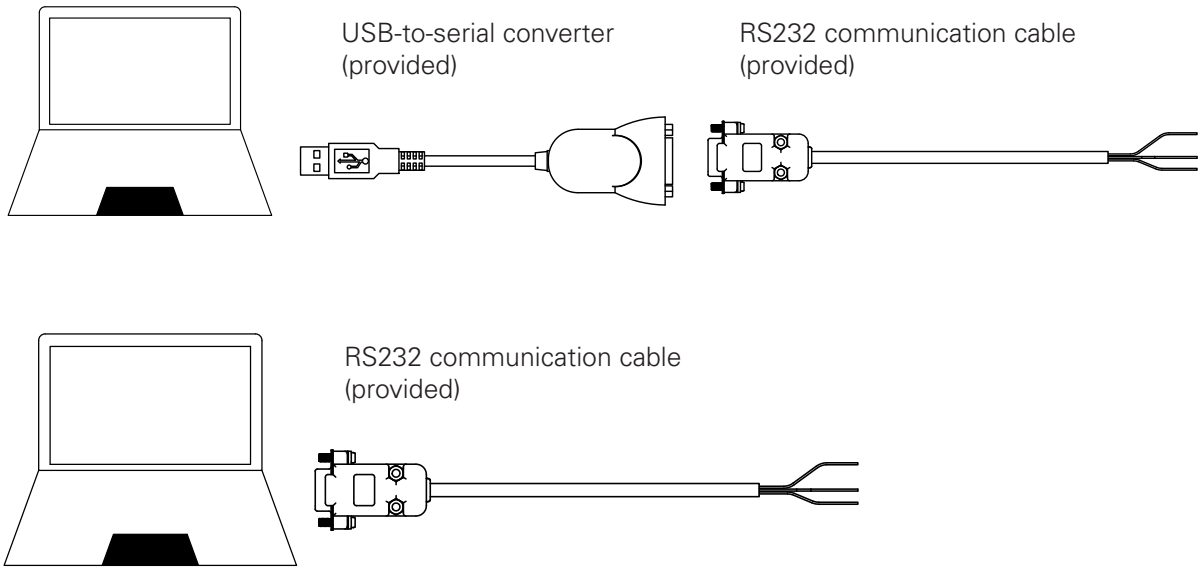
RS232 WIRING DIAGRAM

FIG. 3-28



NOTE: To avoid repeatedly opening electronics enclosure during diagnostics, it is recommended operators permanently wire an RS232 connection to the instrument with corresponding 9-pin connection at junction box for PC connection.

FIG. 3-29



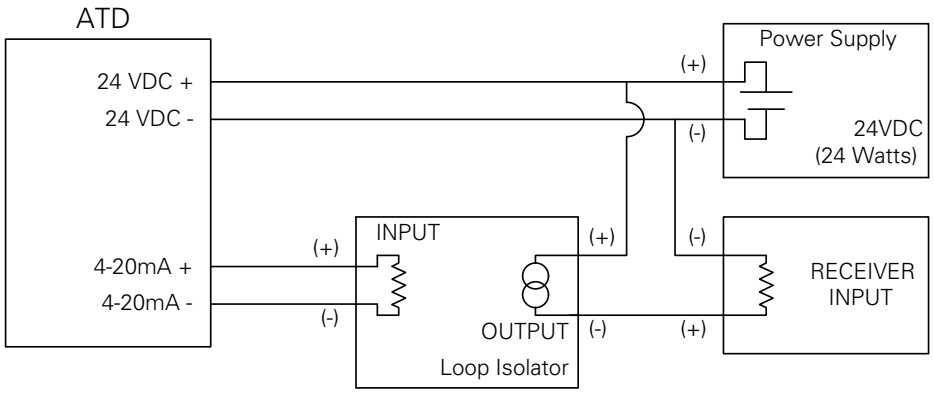
WIRING CONTINUED

RS485 WIRING DIAGRAM

FIG. 3-30

POWER SUPPLY AND OUTPUT WIRING WITH EXTERNAL POWER ISOLATOR

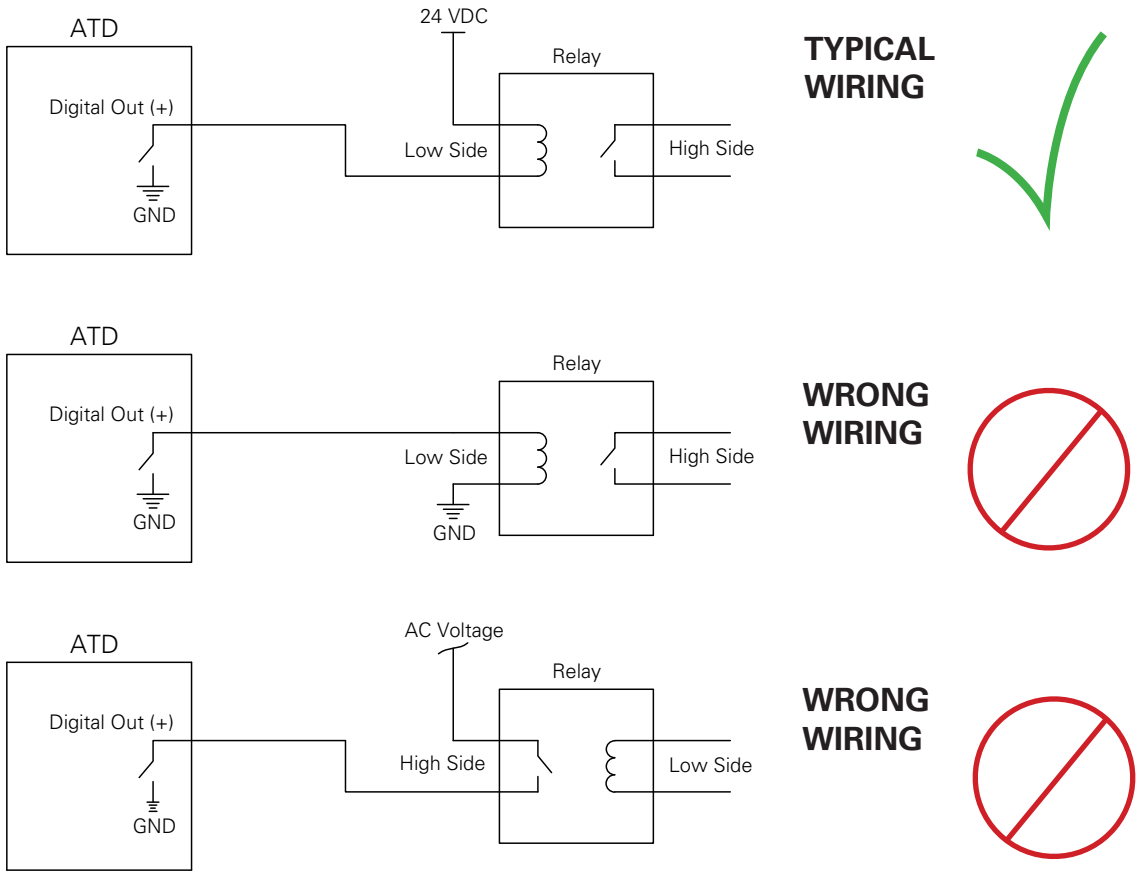
FIG. 3-31



WIRING CONTINUED

DIGITAL RELAY CONFIGURATION

FIG. 3-32



OPERATION REALTERM

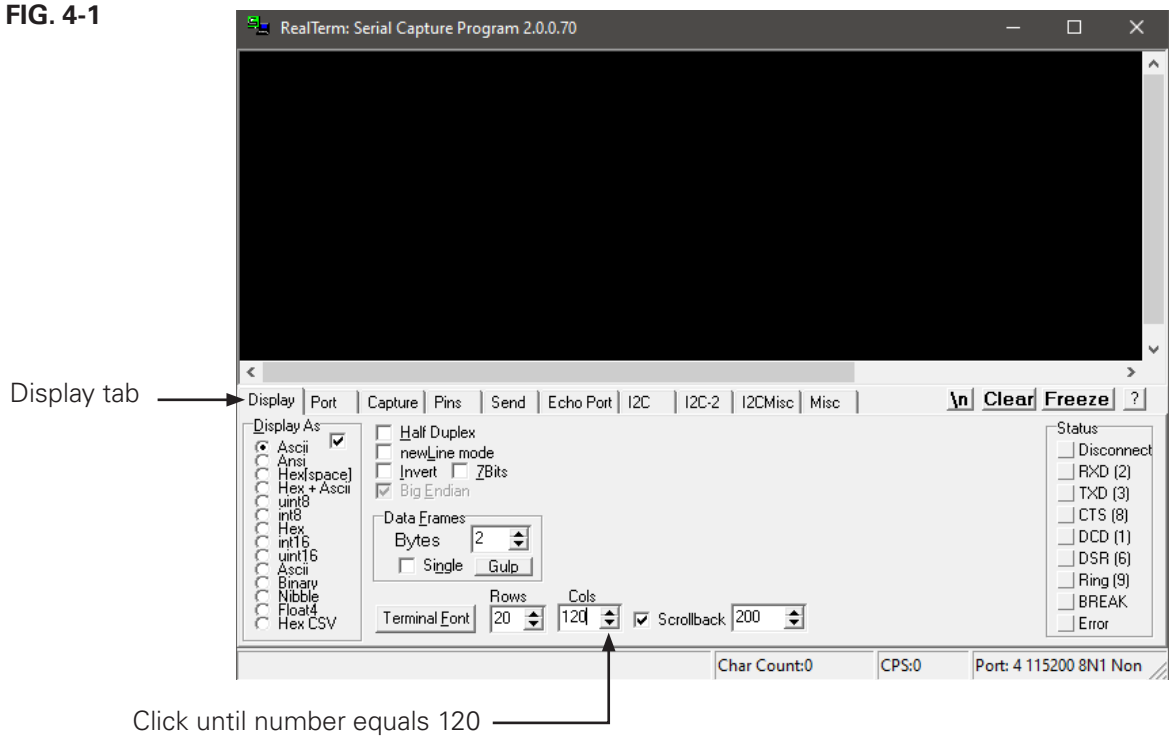
REALTERM SOFTWARE CONFIGURATION

RealTerm software is used for calibration, debugging and configuration of the ATD™. To download RealTerm, go to https://www.kam.com/documentation/ and download the file "Realterm Software" from the "Software" section. Once downloaded, unzip the file, double-click on the executable file (.exe) and follow on-screen instructions to install.

1. Open RealTerm software. A window will open as shown in FIG. 4-1.

2. The window will automatically default to the "Display" tab. Click on the up arrow underneath of the "Cols" window until the number reaches 120. Do not attempt to type the number in as this will result in an error message. If you receive the error message, you must close RealTerm and reopen.

FIG. 4-1



3. Click on the "Port" tab (FIG. 4-2) and change the Port settings as follows:

Baud: 9600
Parity: None
Data Bits: 8
Stop Bits: 1
Hardware Flow Control: 1
Port: Select port number assigned to your serial port or USB port connected to the converter. You can find this information in the Device Manager of your PC under "Ports." FIG. 4-3.

4. Click on the "Change" button to save these settings.

FIG. 4-2

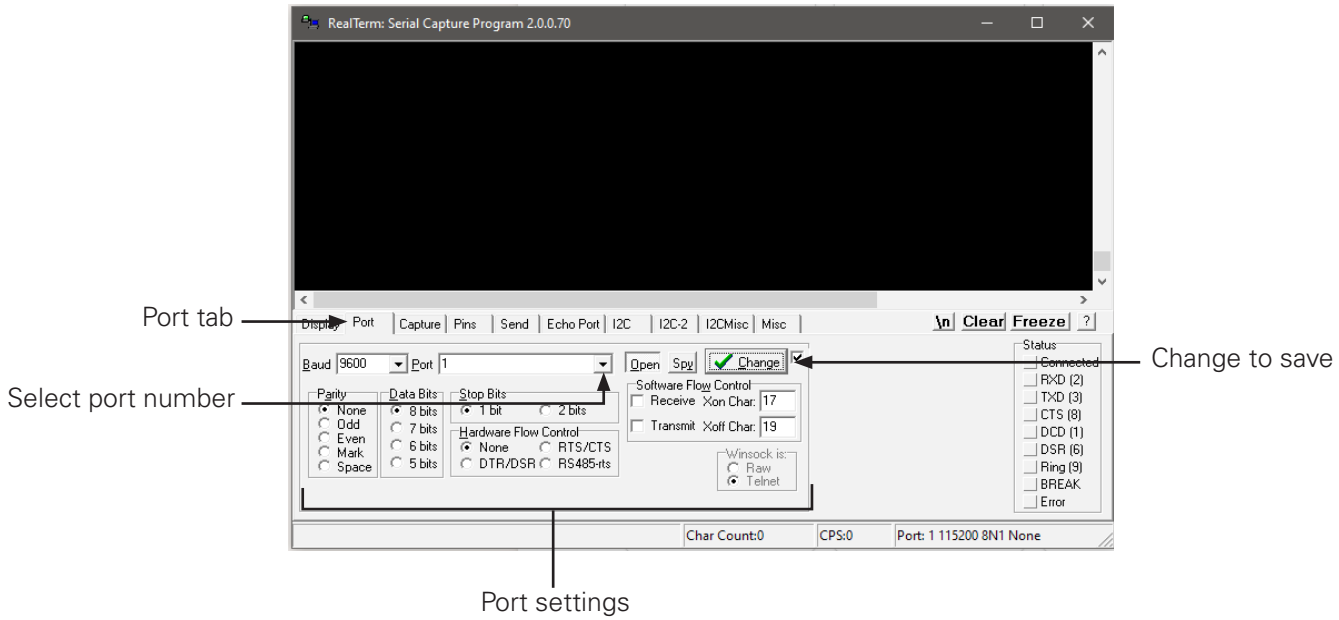
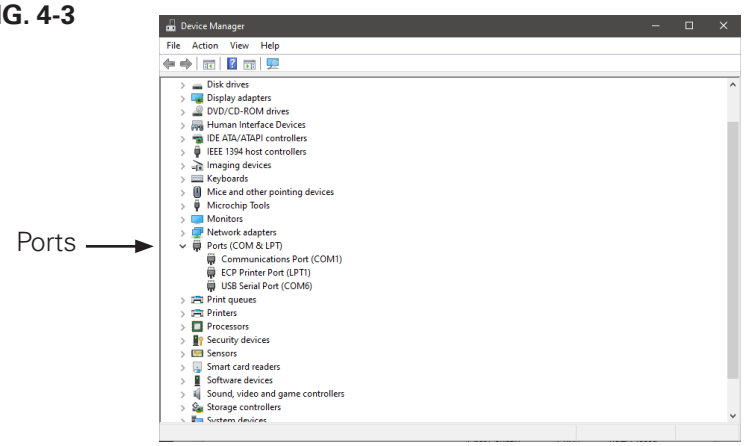


FIG. 4-3

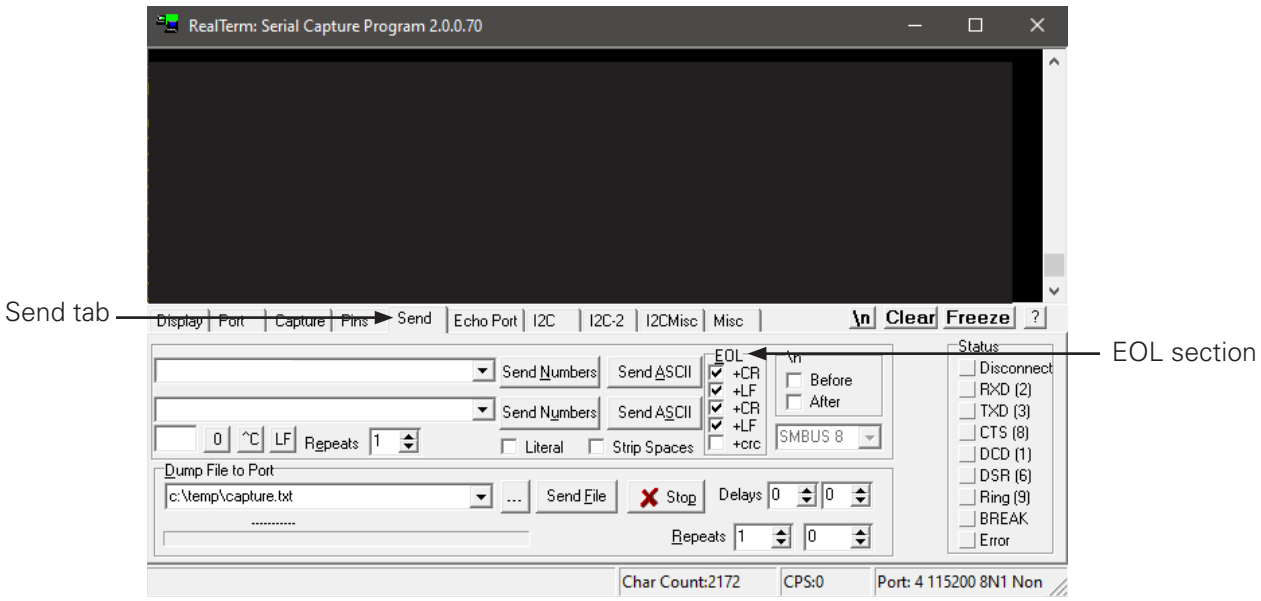


5. Click on the "Send" tab. FIG. 4-4.

6. Check the first 4 boxes in the "EOL" section. FIG. 4-4.

7. The RealTerm software configuration is complete.

FIG. 4-4



OPERATION REALTERM CONTINUED

OUTPUT DATA

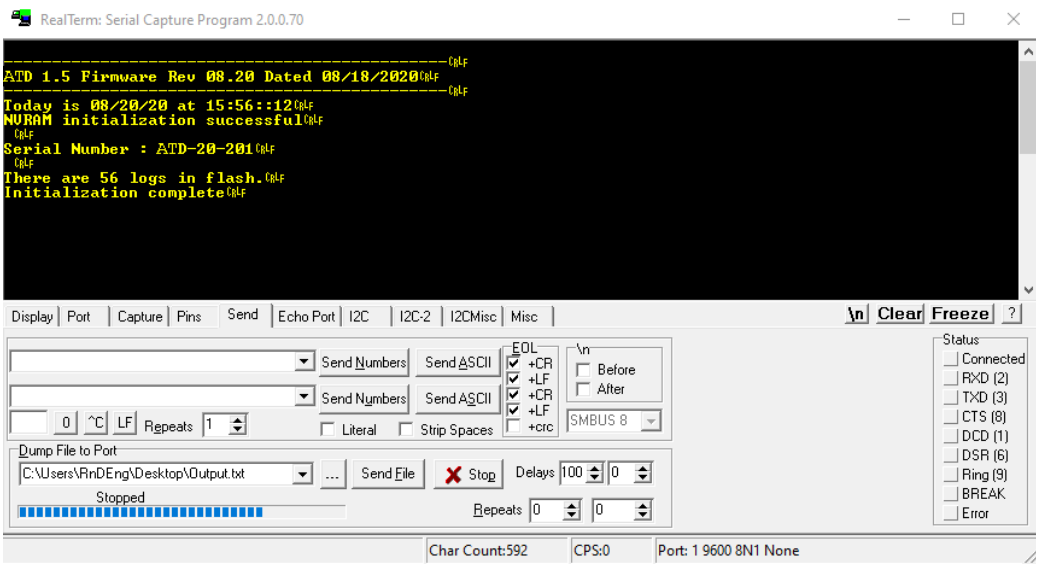
An RS232 cable for connecting your PC to the ATD™ has been supplied with the ATD™ along with a USB-to-serial converter in case your computer does not have an RS232 serial port. Go to https://www.kam.com/documentation/ and download the file "RS232 Driver" from the "Software" section. Once downloaded, unzip the file, double-click on the executable file (.exe) and follow on-screen instructions to install.

Before proceeding, install and configure RealTerm as per instructions on pages 24-26 of this manual. Ensure your PC is connected to the ATD™ sensor via the supplied RS232 serial cable and USB-to-serial converter as per wiring diagram on page 18. To access the boards, use a 7/16" wrench to remove the (6) hex screws on the Explosion Proof electronics enclosure and remove the cover.

Follow the steps below to view output data.

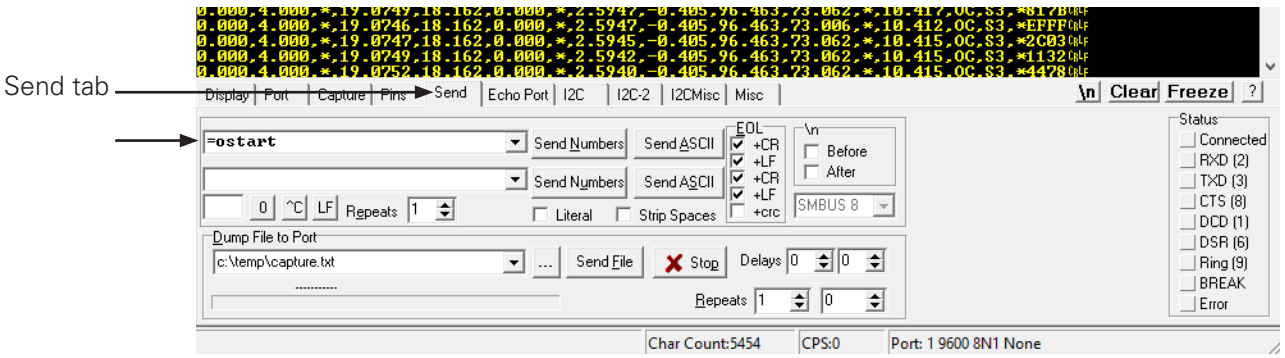
1. Launch RealTerm and turn on power to the ATD™. The initial message will only appear once the unit is powered up and after all the connections and configurations are made. If the ATD™ was turned on prior to launching RealTerm, the message won't display. FIG. 4-5.

FIG. 4-5



2. Go to the "Send" tab, type "=ostart" on either command box for continuous data output every second, and click on the "Send ASCII" button on the same line as the text box where the command is entered to send the command. FIG. 4-6.

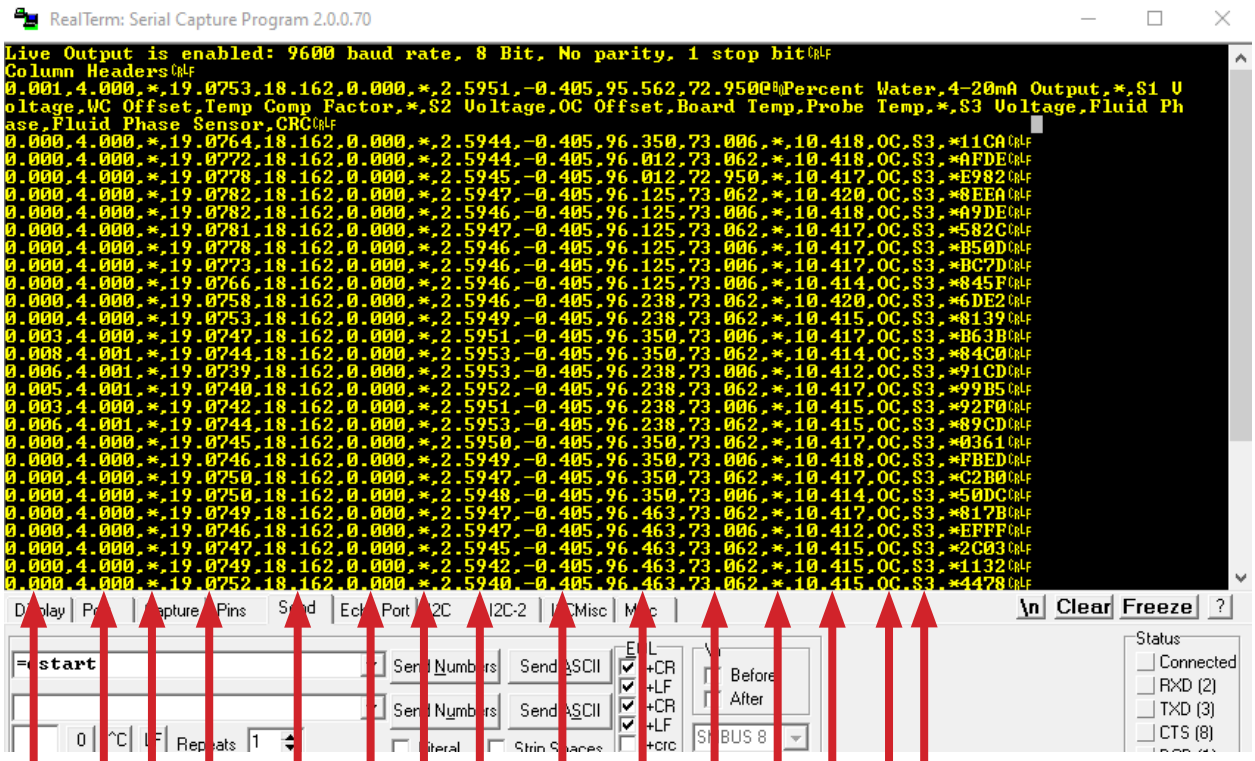
FIG. 4-6



3. The output will start automatically in CSV (comma separated values) format. See FIG. 4-7 on page 27 for output data definitions.

If the output readings do not display in the RealTerm menu, proceed to the "RS232 Communication" troubleshooting section on page 43 of this manual.

FIG. 4-7 OUTPUT DATA



Column 15: Fluid phase sensor (S2 or S3)

Column 14: Fluid phase state (OC or WC)

Column 13: Sensor 3 voltage

Column 12: Separation indicator

Column 11: Probe temperature. Range: 0 to 149 °C

Column 10: Board temperature. Range: 0 to 70 °C

Column 9: Oil continuous mode offset

Column 8: Sensor 2 voltage. Range: 0-20 volts

Column 7: Separation indicator

Column 6: Temperature compensation factor

Column 5: Water continuous mode offset

Column 4: For factory use only

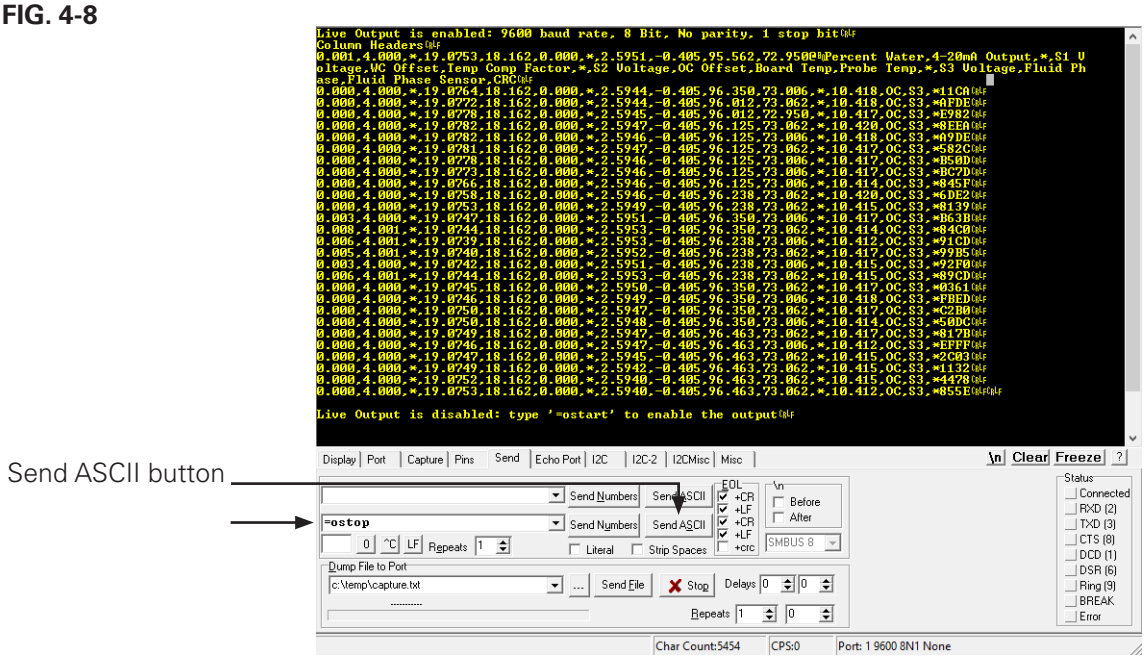
Column 3: Separation indicator

Column 2: 4-20 mA output

Column 1: Percent water output

4. Type "=ostop" and click on "Send ASCII" to stop the continuous output. **Always do this before disconnecting**. FIG. 4-8.

FIG. 4-8



OFF–LINE CALIBRATION

NOTE: This procedure should be used in all tank installations and in applications where manual samples are not easily collected from the main line at the point of ATD™ installation.

Although the ATD™ has been calibrated in the factory, it should be calibrated in process conditions prior to use. This can be done using 100% brine (produced water) and 100% dry oil in buckets as outlined below.

For the brine/dry oil method, in addition to fluid samples, operators will need appropriate tools for the extraction of the ATD™, an RS232 cable (supplied) or an USB-to-serial converter (supplied), and a PC equipped with RealTerm software. Follow instructions on the "RealTerm Software Configuration" section on pages 24-26 to install and configure RealTerm.

1. If the ATD™ has been already installed, remove from the line according to the instructions on page 14 of this manual. Clean the ATD™ sensor according the guidelines on page 40 of this manual. You do not need to completely assemble the ATD™ unit to do an off-line calibration. The RTD and Coax cables can be inserted into the Electronics Enclosure and connected per the instructions on page 13 without connecting all the shaft sections. This will make actual bucket insertion easier. Be careful not to bend the cables.

2. Restore power to the ATD™. Connect your PC to the ATD™ sensor via supplied RS232 serial port or USB-to-serial converter as per the wiring diagram on page 18 of this manual. To access the boards, use a 7/16" wrench to remove the (6) hex screws on the Explosion Proof electronics enclosure and remove the cover.

3. Launch RealTerm. Let the ATD™ warm up for 20 minutes. This will stabilize the electronics temperature.

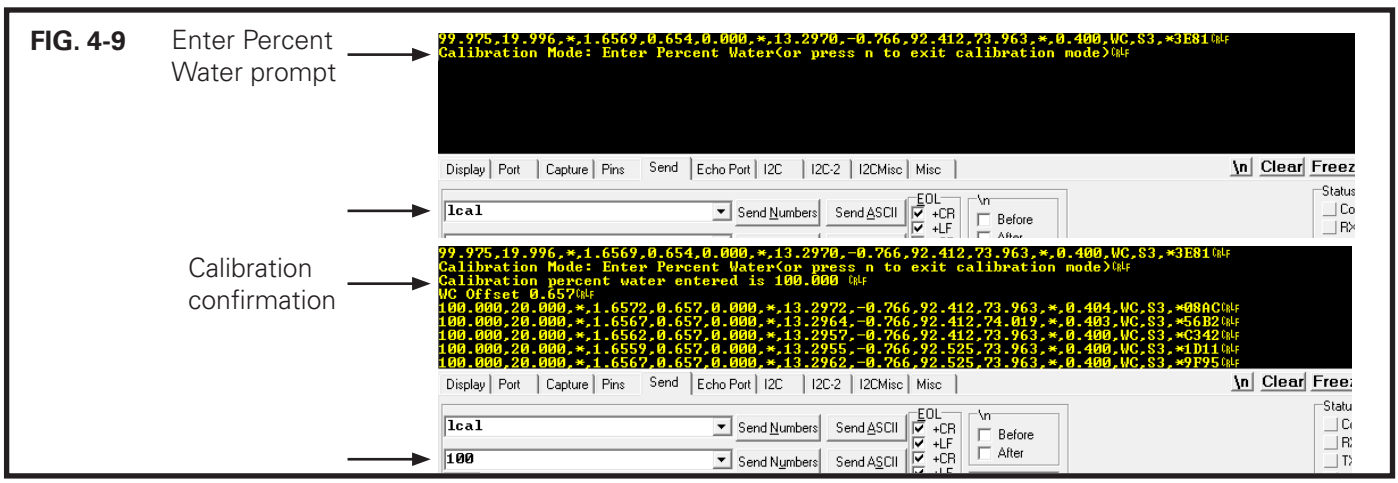
4. Insert the sensor in a bucket with brine (produced water). Probe should remain in brine until a stabilized temperature is observed. Readings should show 100% water or something close to 100% (Column 1) and the water-continuous state (Column 14) in the RealTerm menu.

   NOTE: As all water in crude oil has salt, the ATD™ sensor has already been calibrated to salinity content stated on approved drawings. You will not get an accurate reading if you use fresh water for testing. Salt water content should match stated content on approved drawings/data sheet. It should also show 20 mA if the mA range is calibrated for 0-100%, which you can measure at the output terminal. Regardless of readings, the sensor must be recalibrated.

   WARNING: If the sensor is submerged in brine and Column 14 does not display WC (Water Continuous), do not perform the calibration and contact KAM Technical Support for further assistance.

5. On RealTerm, type "lcal" (lower case L) on the first command box under the "Send" tab and click on "Send ASCII." An "Enter Percent Water" prompt will appear. You have 20 seconds to enter the water percentage. Type "100" on the second command box and click on "Send ASCII." The calibration confirmation message will display. FIG. 4-9. If the 20-second window expires, repeat the process.

FIG. 4-9



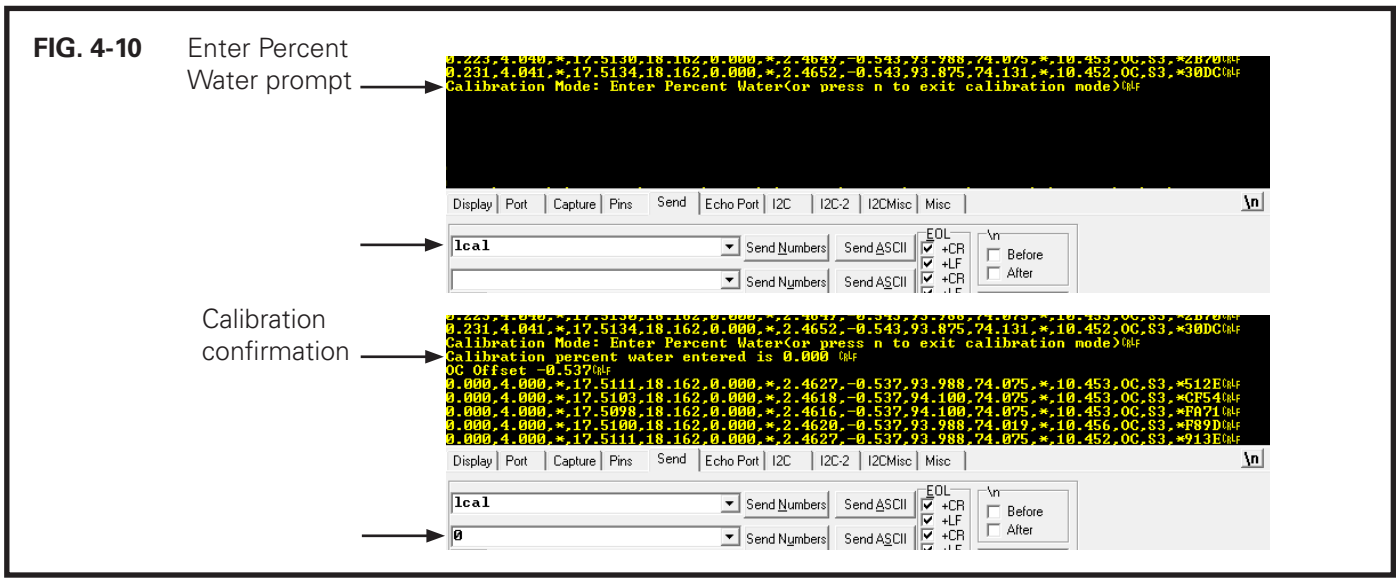
6. Remove the instrument from brine, and thoroughly clean and dry the probe.

7. Insert the ATD™ sensor into a bucket or a jar filled with a sample of dry oil. To accurately test the ATD™, you must use oil that does not have any water in it or which has a known, low percentage of water (preferably <1%). Sample water percentage can be determined by Karl Fischer, centrifuge or distillation per API Chapter 10. The water percentage reading should show 0% or reflect the known water percentage (Column 1) and the oil-continuous state (Column 14) on RealTerm.

   WARNING: If the sensor is submerged in dry oil and Column 14 does not display OC (Oil Continuous) do not perform the calibration and contact KAM Technical Support for further assistance.

8. Type "lcal" (lower case L) on the first command box under the "Send" tab and click on "Send ASCII." An "Enter Percent Water" prompt will appear, you have 20 seconds to enter the water percentage. Type "0" or the known percentage of water on the second command box and click on "Send ASCII." The calibration confirmation message will display. FIG. 4-10. If the 20-second window expires, repeat the process.

FIG. 4-10



9. The ATD™ has now been calibrated to process conditions and can be installed.

PROCESS PARAMETER VALUES

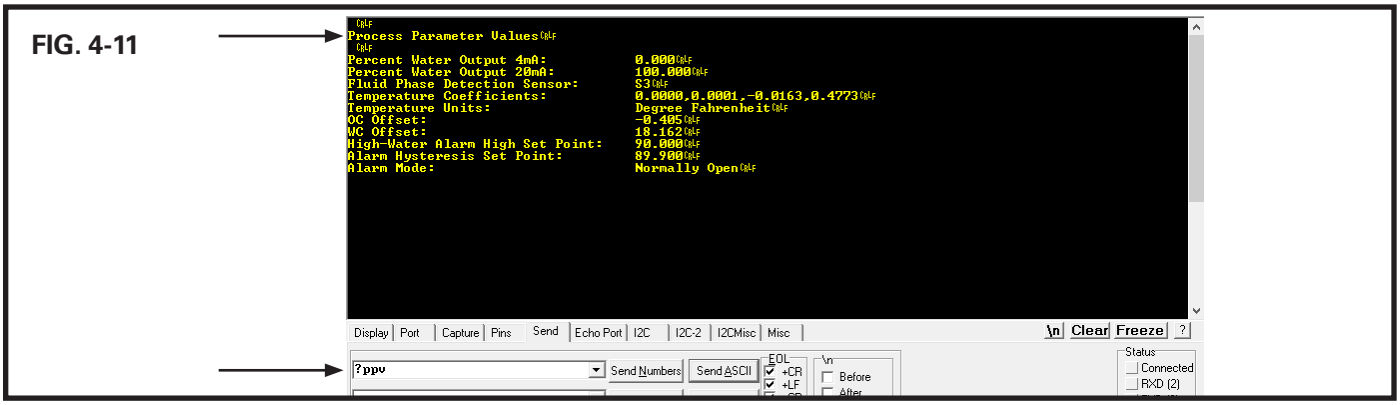
The overall configuration of the instrument is shown within the process parameter values, which include the 4-20 mA loop (water percent range), phase sensor, temperature coefficients, temperature units, OC-WC offsets, and alarm settings.

Before proceeding, install and configure RealTerm as per instructions on pages 24-26 of this manual. Ensure your PC is connected to the ATD™ sensor via the supplied RS232 serial cable and USB-to-serial converter as per wiring diagram on page 18. To access the boards, use a 7/16" wrench to remove the (6) hex screws on the Explosion Proof electronics enclosure and remove the cover.

To view the parameters:

1. Launch RealTerm. Type "?ppv" in the command box under the "Send" tab and click on "Send ASCII." The configured values for process parameters will be displayed. FIG. 4-11.

FIG. 4-11



SETTING THE PERCENT WATER FOR THE 20 mA OUTPUT

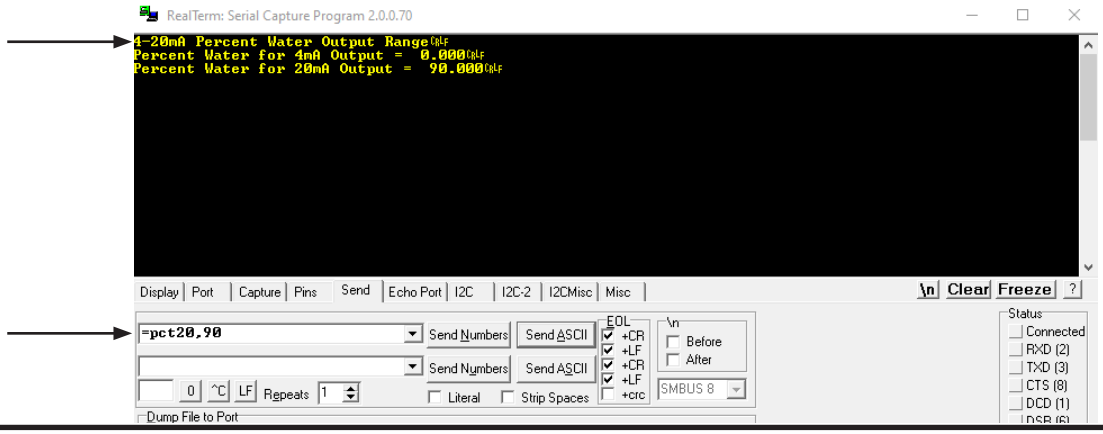
Before proceeding, install and configure RealTerm as per instructions on pages 24-26 of this manual. Ensure your PC is connected to the ATD™ sensor via the supplied RS232 serial cable and USB-to-serial converter as per wiring diagram on page 18. To access the boards, use a 7/16" wrench to remove the (6) hex screws on the Explosion Proof electronics enclosure and remove the cover.

The default percent water for the 20 mA output is 100%. To set a lower percent water for the 20 mA loop output:

1. Launch RealTerm. Go to the "Send" tab, type "pct20,<percent value>" on either command box and click on "Send ASCII." For example, if the water percent equivalent to the 20 mA of the output loop is 90, you would enter "=pct20,90". The change will be confirmed in the main window. FIG. 4-12.

   NOTE: Setting this value does not change the accuracy of the instrument +/- 1.0%

FIG. 4-12



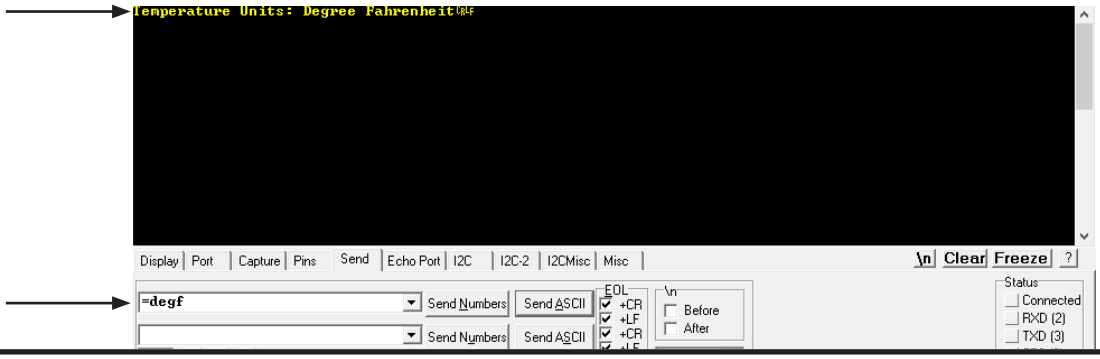
CHANGING THE TEMPERATURE UNITS

Before proceeding, install and configure RealTerm as per instructions on pages 24-26 of this manual. Ensure your PC is connected to the ATD™ sensor via the supplied RS232 serial cable and USB-to-serial converter as per wiring diagram on page 18. To access the boards, use a 7/16" wrench to remove the (6) hex screws on the Explosion Proof electronics enclosure and remove the cover.

To change the temperature unit (The default unit for temperature is degrees Celsius):

1. Launch RealTerm. Type "=degf" for Fahrenheit or "=degc" for Celsius on either command box under the "Send" tab and click on "Send ASCII." The change will be confirmed in the main window. FIG. 4-13.

FIG. 4-13



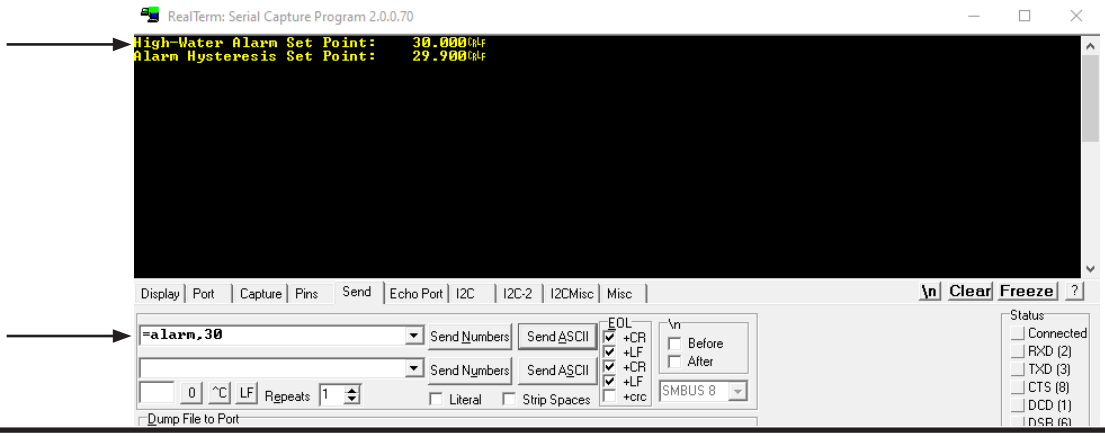
SETTING THE ALARM SETPOINTS

Ensure RealTerm is installed and configured as per instructions on pages 24-26 of this manual. Connect your PC to the ATD™ sensor via supplied RS232 serial cable or USB-to-serial converter as per wiring diagram on page 13. To access the boards, use a 7/16" wrench to remove the (6) hex screws on the Explosion Proof electronics enclosure and remove the cover.

To set the alarm [Digital Out (+)]:

1. Launch RealTerm, go to the "Send" tab, type "=alarm,<percent value>" on either comand box and click on "Send ASCII." For example, if the percent water where the alarm will activate is 30, you would enter "=alarm,30". The configured values will be displayed. FIG. 4-14.

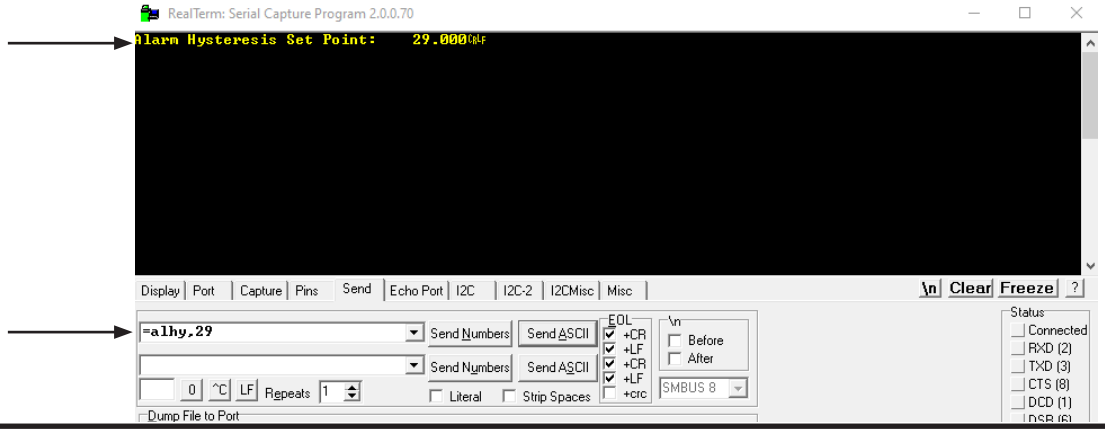
FIG. 4-14



2. The hysteresis point is adjusted automatically to 0.1% lower than the high set point.

3. To adjust the hysteresis point manually, type the command "=alhy,<hysteresis percent>" and click on "Send ASCII." The hysteresis percent must have a difference higher than 0.1% from the high set point. For example, if the water percent lower limit where the alarm will clear the high-water status and be able to reactivate is 29, you would type "=alhy,29". The new hysteresis alarm value will be displayed. FIG. 4-15.

FIG. 4-15



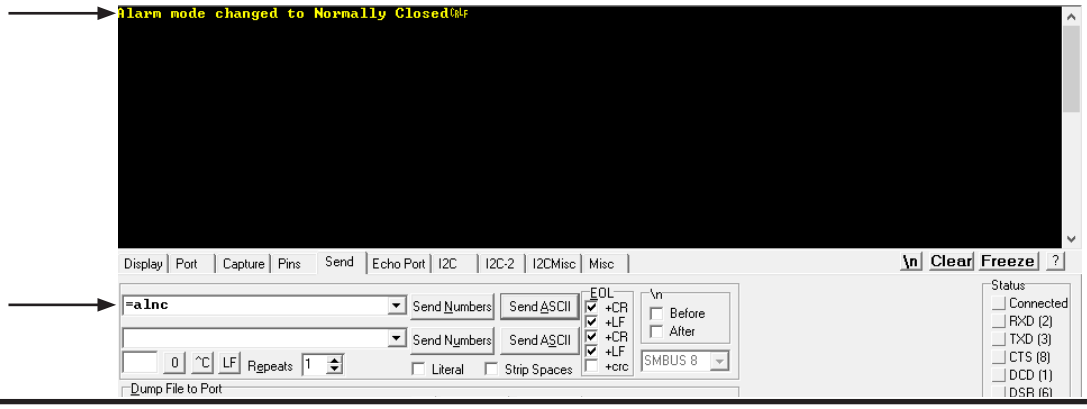
SETTING THE ALARM MODE

Before proceeding, install and configure RealTerm as per instructions on pages 24-26 of this manual. Ensure your PC is connected to the ATD™ sensor via the supplied RS232 serial cable and USB-to-serial converter as per wiring diagram on page 18. To access the boards, use a 7/16" wrench to remove the (6) hex screws on the Explosion Proof electronics enclosure and remove the cover.

The alarm mode is set to "Normally Open" by default, follow the steps below to change the mode to "Normally Closed."

1. To set the alarm mode, launch RealTerm and type "=alnc" on either command box under the "Send" tab. Click on "Send ASCII." The change will be confirmed in the main window. FIG. 4-16.

FIG. 4-16



2. To change the alarm mode back to "Normally Open", type the command "=alno" and click on "Send ASCII."

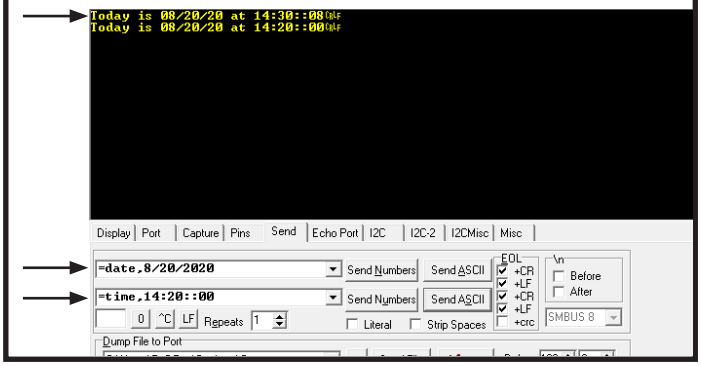
SETTING THE DATE AND TIME

Before proceeding, install and configure RealTerm as per instructions on pages 24-26 of this manual. Ensure your PC is connected to the ATD™ sensor via the supplied RS232 serial cable and USB-to-serial converter as per wiring diagram on page 18. To access the boards, use a 7/16" wrench to remove the (6) hex screws on the Explosion Proof electronics enclosure and remove the cover.

1. To set the date, launch RealTerm and type the command "=date,<MM>/<DD>/<YYYY>" on either command box under the "Send" tab. Click on "Send ASCII." For example, if the desired date is August 20th, 2020, you would enter "=date,08/20/2020". The change will be confirmed in the main window FIG. 4-17.

2. To set the time, type the command "=time,<HR>:<MM>::<SS>". For example, if the desired time is 14:20::00 hrs, you would enter "=time,14:20::00". The change will be confirmed in the main window. FIG. 4-22.

FIG. 4-17

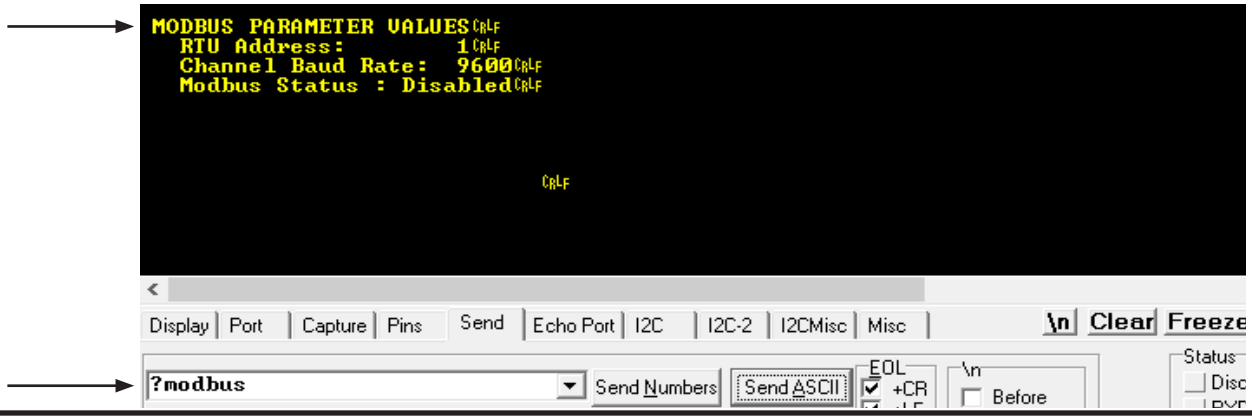


ENABLE/DISABLE MODBUS

Unless requested, Modbus is usually disabled prior to shipment from KAM. Before proceeding, install and configure RealTerm as per instructions on pages 24-26 of this manual. Ensure your PC is connected to the ATD™ sensor via the supplied RS232 serial cable and USB-to-serial converter as per wiring diagram on page 18. To access the boards, use a 7/16" wrench to remove the (6) hex screws on the Explosion Proof electronics enclosure and remove the cover.

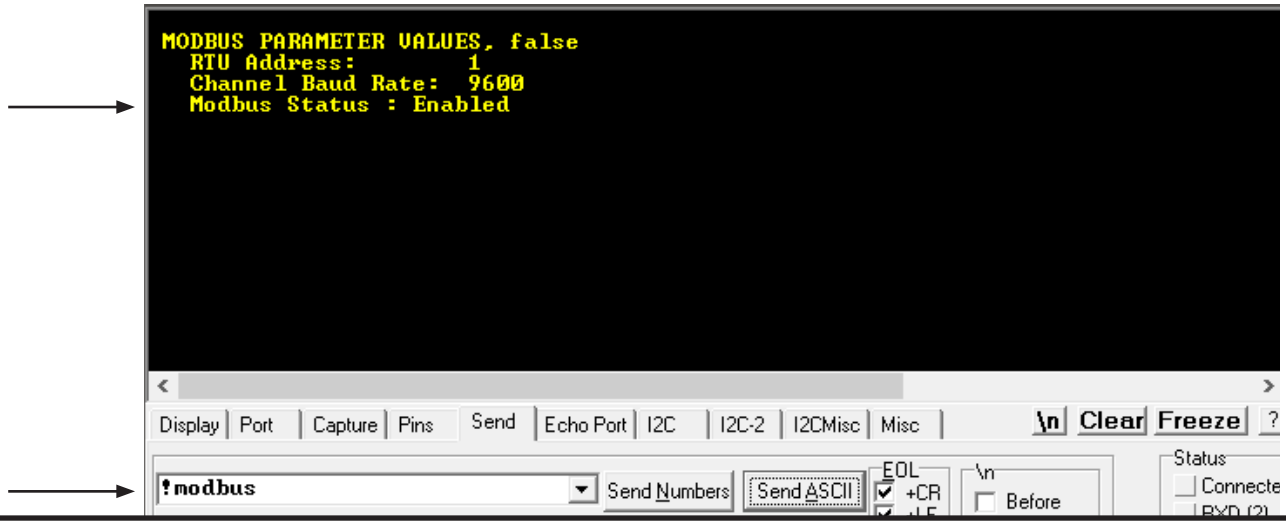
1. Launch RealTerm. Go to the "Send" tab, type "?modbus" on either command box and click on "Send ASCII" to check Modbus status. The Modbus parameters will display on the RealTerm window. FIG. 4-18.

FIG. 4-18



2. Type the command "!modbus" and click on "Send ASCII" to enable Modbus. Modbus status will change to "Enabled" confirming the change. FIG. 4-19.

FIG. 4-19



3. Power cycle (turn off and on) the ATD™ to start the Modbus communication.

4. To disable Modbus, use the same command "!modbus" and click on "Send ASCII." Modbus status will change to "Disabled" confirming the change.

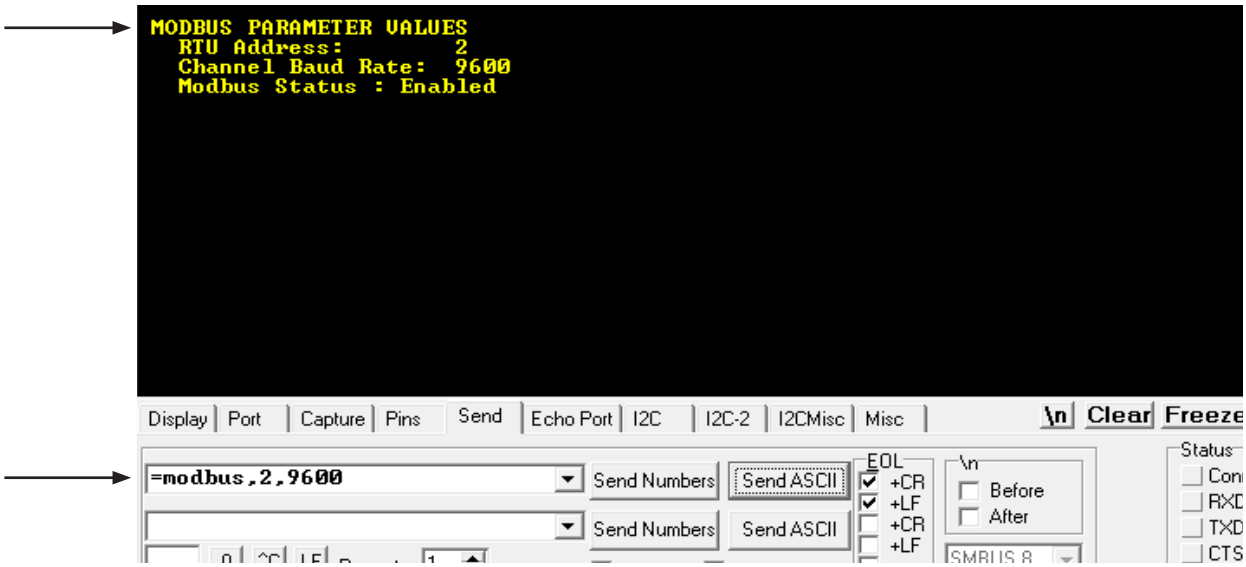
CHANGE THE MODBUS ADDRESS

The default Modbus address is 1. This address can be change to any number from 1 to 247. Follow the steps below to change the Modbus address.

Before proceeding, install and configure RealTerm as per instructions on pages 24-26 of this manual. Ensure your PC is connected to the ATD™ sensor via the supplied RS232 serial cable and USB-to-serial converter as per wiring diagram on page 18. To access the boards, use a 7/16" wrench to remove the (6) hex screws on the Explosion Proof electronics enclosure and remove the cover.

1. On RealTerm, go to the "Send" tab and type the command "=modbus,2,9600" on either command box. Click on "Send ASCII." FIG. 4-20. The #2 represents the new address.

FIG. 4-20



2. To save the change, turn the ATD™ power off, wait two to three seconds, and turn it back on.

COMMAND LIST

Once RealTerm has been installed and configured as per the instructions on the "RealTerm Software Configuration" section, any of the commands listed in the table below can be used to view or change the various instrument's parameters.

TABLE 4-1

COMMAND	PURPOSE
^ostart	Start continuous output
output	Single line output
^ostop	Stop continuous output
lcal (lower case L)	Live calibration
^pcaloc,<value>,<value2>	Oil Continuous calibration for laboratory sample analysis
^pcalwc,<value>,<value2>	Water Continuous calibration for laboratory sample analysis
?ppv	View the process parameters values
=degc	Set the temperature units displayed to Celsius (°C)
=degf	Set the temperature units displayed to Fahrenheit (°F)
^pct20, <value>	Set the percent water for the 20 mA output
^alarm, <value>	Set high water percent alarm value
^alhy,<value>	Set alarm hysteresis (lower limit for the alarm activation band)
=alnc	Set alarm mode to normally closed
=alno	Set alarm mode to normally open
=date,<MM>/<DD>/<YYYY>	Set the current date
=time,<HR>:<MM>::<SS>	Set the current time
^modbus	View/Change MODBUS parameters
?sn	View the serial number of the instrument
?version	Display the software version of the instrument
help	Display a list of commands

The command the symbol "^" can be replaced with the following options:

"*" to see the command usage details
"?" to see the current value of the parameter
"=" to change the value of the parameter

Type the command with the replaced symbol in the command box and click on "Send ASCII" to send the command.

Detailed instructions on how to use commands and examples are available in the previous sections.

OPERATION USING MODBUS

1. If you have not already done so, follow instructions on the "Enabling/Disabling Modbus" on page 36 of this manual to enable Modbus.

2. Ensure power to the ATD™ is turned off.

3. Set any jumpers on the RS485 converter to use two wire mode.

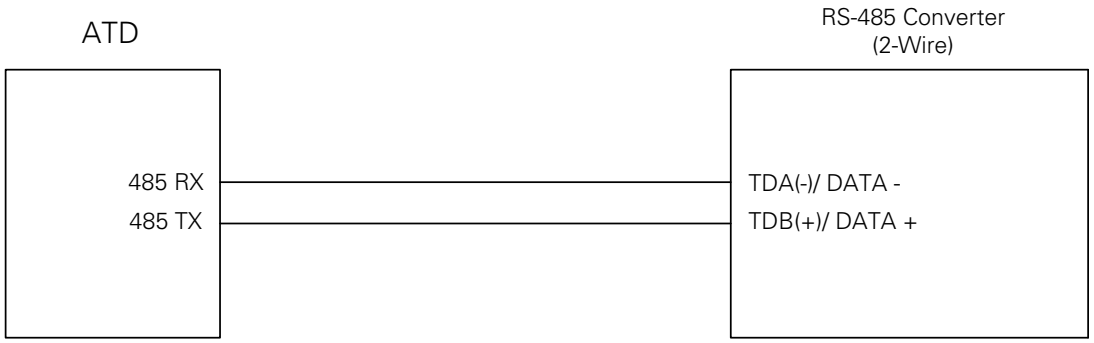
4. Set your RS485 converter for two-wire mode as per the instructions on the RS485 converter manufacturer's manual.

5. To access the boards, use a 7/16" wrench to remove the (6) hex screws on the electronics enclosure and remove the cover.

6. Connect the "RS-485 +" terminal on the ATD™'s Terminal Board to the Data(+) line on the RS485 converter. FIG. 5-1.

7. Connect the "RS-485 -" terminal on the ATD™'s Terminal Board to the Data(-) line on the RS485 converter. FIG. 5-1.

FIG. 5-1 RS485 WIRING DIAGRAM



8. Turn on power to the ATD™.

9. Make sure the activity indicator (when available) on the converter blinks as data is transferred or read by the Modbus master reader software.

10. Set the appropriate COM port in the Modbus software. This setting varies with the system and whether the connection to the converter is connected to the serial communications port or to the USB port. Follow converter manufacturer's recommendations for settings.

11. Use the following configuration settings in the Modbus software:

Mode: RTU
Baud Rate: 9600
Data Bits: 8
Stop Bits: 1
Parity: None
Function Code: 3
Slave ID: 1 (By default, the Slave ID or Modbus Address is set to 1. To change Modbus address see "Changing Modbus Address" section on page 37 if necessary).
Offset: 0

12. Make sure that the correct registers are being read as 32 bit float. See Table 5-1.

TABLE 5-1

ATD Modbus Registers			
Register	**Type**	**Read/Write**	**Value**
42000	Float	Read	Percent Water
42001	Float	Read	Current Output (mA)
42002	Float	Read	S1 Voltage
42003	Float	Read	S2 Voltage
42004	Float	Read	S3 (OC/WC) Voltage
42005	Float	Read	OC Offset
42006	Float	Read	WC Offset
42007	Float	Read	Board Temperature
42008	Float	Read	RTD Temperature
42009	Float	Read	OC-WC Enabled/Disabled State
42010	Float	Read	Temperature Compensation
42011	Float	Read	Phase State(OC/WC)

13. The output data of the ATD™ can be accessed via the Modbus registers.

MAINTENANCE

CLEANING AND INSPECTION

If probe is removed from the line for inspection, NEVER use sharp or metallic objects such as a knife or screw driver to clean the antenna. Do NOT power wash the unit.

Instead, to remove any oil residues for visual inspection, use a clean cloth with oil solvent or part washer. Preferred solvents include, any petroleum solvent such as mineral spirits, xylene, toluene, gasoline, or diesel. Do not use WD40 or other chemicals.

If you have a question regarding cleaning solvents, please contact KAM CONTROLS directly at +1 713 784 0000, or email: sales@kam.com

During inspection, ensure that there are no foreign objects stuck in the probe or attached to the antennas.

TROUBLESHOOTING

If experiencing any of the issues listed below, please proceed to follow instructions on each of the following sections in their specific order, starting with the "Power Verification" section.

- Instrument is not powering on
- No 4-20 mA output
- PLC is not reading the 4-20 mA output
- No RS232 communication
- No RS485 communication
- Output is not changing
- Instrument does not calibrate

To perform any of the troubleshooting procedures, you will need to access the boards. To do so, use a 7/16" wrench to remove the (6) hex screws on the electronics enclosure and remove the cover.

A device to measure both voltage and amperage is needed during the troubleshooting process. Please have a multimeter available before proceeding.

NOTE: Regardless of the problem being experienced, the troubleshooting steps need to be followed in order, starting from the "Power Verification" section.

POWER VERIFICATION

There are 2 LEDs on the ATD™'s Terminal Board. These LEDs indicate the presence of power. When any of the LEDs are lit, it indicates that there is voltage going to the boards, but not necessarily the proper voltage. When any of the LEDs are not lit, it may indicate they are damaged. In any case, the first step is to check all power supplies. Please follow the procedure below.

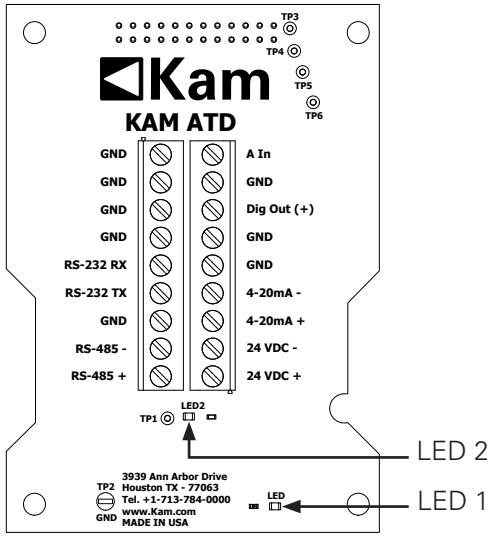
1. Use a multimeter in voltmeter mode to measure the voltage across the power loop terminals 24 VDC + and 24 VDC -. The voltage should be within the instrument's requirements (24 V) and close to the power supply ratings (+/- 0.5 V). For example, a 24 V power supply could measure 23.5 V on the ATD™ terminals. If the voltage is not within those requirements, verify that the power supply has a wattage capability of 24 watts, and check for any blown fuses, faulty wiring, or a faulty power supply.

   If LED1 does not light up, but you have the adequate voltage at the power terminals, it indicates a bad LED. The faulty LED will not affect the operation of the instrument, it is only an indicator that a voltage is present.

2. Once the voltage across power loop terminals has been verified, make sure the ATD™ is wired with the correct polarity as per the wiring diagram on page 13 of this manual. If the polarity is wrong, turn off the power and rewire the ATD™ with the correct polarity. Turn the power back on when done.

   NOTE: The ATD™ has built-in protection to avoid incorrectly polarized voltages from damaging the instrument.

FIG. 7-1



NOTE: LED location may vary depending on the version of board

3. Using a multimeter in voltmeter mode, verify the voltage of the primary power supply by measuring across TP1 and TP2 (GND). The voltage should be between +4.8 VDC and 5.1 VDC.

If the voltage is lower than 4.8 VDC, it indicates that the primary power supply of the Terminal Board is not working properly or there is a short circuit on the board. In this case, the Terminal Board needs to be fixed or replaced. Please contact KAM Technical Support for further assistance.

NOTE: LED 2 on the Terminal Board remains lit when there is voltage between TP1 and TP2. If not, it indicates a faulty LED. The faulty LED will not affect the operation of the instrument, but a Terminal Board repair is recommended.

4-20 mA OUTPUT LOOP

Once the power supplies have been verified as per instructions in the previous section ("Power Verification"), proceed to verify the output loop by following the procedure below.

1. Use a small screwdriver to disconnect the wires connected to the 4-20 mA terminals from the Terminal Board.

2. Using a multimeter in voltmeter mode, measure the voltage across the two wires that were connected to the "4-20 mA+" and "4-20 mA-" terminals by placing one of the voltmeter's test lead in one wire and the other test lead on the other wire. Polarity is not important. The voltage should be 0 V. If there is any voltage, the loop is powered up externally. Proceed to disable the power source from the connected device.

3. Use a small screwdriver and fully close the terminals on the "4-20 mA+" and "4-20 mA-" terminals by turning the screwdriver clockwise. Using a multimeter in voltmeter mode, measure the voltage across the "4-20 mA+" and "4-20 mA-" terminals. The voltage should be between 10.0 to 12.0 volts. If the voltage is within the specified range, continue to step 4. If not, contact KAM Technical Support for further assistance.

4. Using a multimeter in ammeter mode, measure the amperage across the "4-20 mA+" and "4-20 mA-" terminals. The electric current should be between 3.9 to 20.1 mA. If the voltage from step 3 is within the set limits but the electric current is not, check the multimeter fuse and repeat this step. If there is no change, contact KAM Technical Support for further assistance.

If the measurements are within the corresponding ranges, reconnect the 4-20 mA output loop wires to the ATD™ as per the wiring diagram on page 18. If the PLC cannot read the output, there could be a wiring issue with the loop. Please inspect the wires from the ATD™ to the PLC If the issue persists, continue to the next section, and contact KAM Technical Support for further assistance.

NOTE: The 4-20 mA terminals are isolated from the chassis/earth ground.

RS232 COMMUNICATION

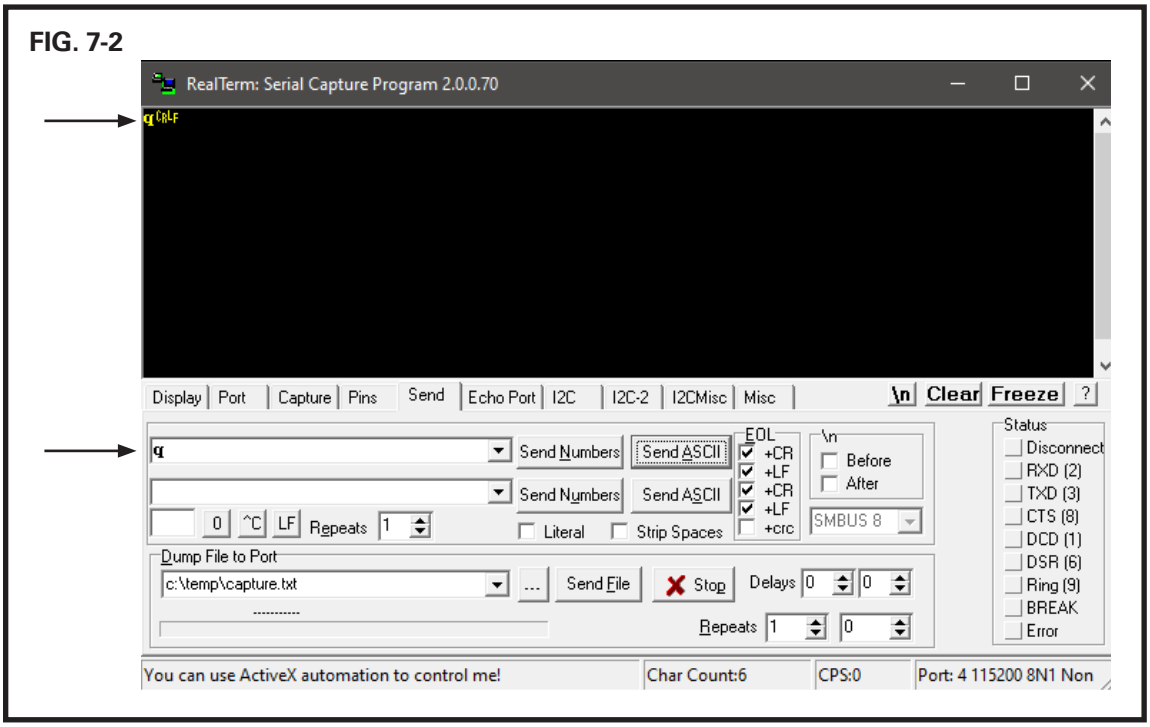
If you have not already done so, follow the previous procedures of the Troubleshooting section to verify power supplies.

Before proceeding, install and configure RealTerm as per instructions on pages 24-26 of this manual. Also, please ensure the driver for the supplied USB-to-serial converter is installed on your PC.

1. If the RS232 cable is connected to the ATD™, ensure all 3 wires from the OWD terminal are disconnected. Proceed to connect the supplied RS232 serial cable and USB-to-serial converter to your computer and launch RealTerm.

2. The RS232 serial cable has three wires (red, white, and black). Connect the tips of the white wire (RS232 RX) and the red wire (RS232 TX) together. While the tips of these wires are connected, type any letter (i.e. "q") in either command box of the "Send" tab on RealTerm and click on "Send ASCII." If the configuration is done properly, the letter should appear in the window display. FIG. 7-2.

FIG. 7-2



If there is no change, use another RS232 serial cable and/or USB-to-serial converter and try sending the command once more. If the same letter you typed does not appear, try reinstalling the USB-to-serial converter drivers or try a different converter and repeat step 2.

If there is still no change, there might be a communication issue with the RS232 serial cable, the USB-to-serial converter, or the computer. Please contact KAM Technical Support for further assistance.

3. Once the letter appears on the window display, connect the RS232 serial cable to the ATD™ as per the wiring diagram on page 18 of this manual.

4. Turn the ATD™ off and back on.

5. Type the command "help" in either command box and click on "Send ASCII." A list of commands should appear in the window. If the list does not appear, proceed to the next step. If the list appears, you are now ready to perform the desired procedures, such as calibration or configuration changes by following the instructions on the corresponding sections of this manual.

6. Using a multimeter in voltmeter mode, measure the voltage between the terminals "RS232 RXD" and "GND." Ensure the terminal screws on the board are fully closed. The voltage should be between -5 and -10 volts. If the voltage is not between the stated range, the RS232 port from the ATD™ may be damaged. Contact KAM Technical Support for further assistance.

If the voltage is within the specified range, but you are still not able to establish communication with the ATD™, please contact KAM Technical Support for further assistance.

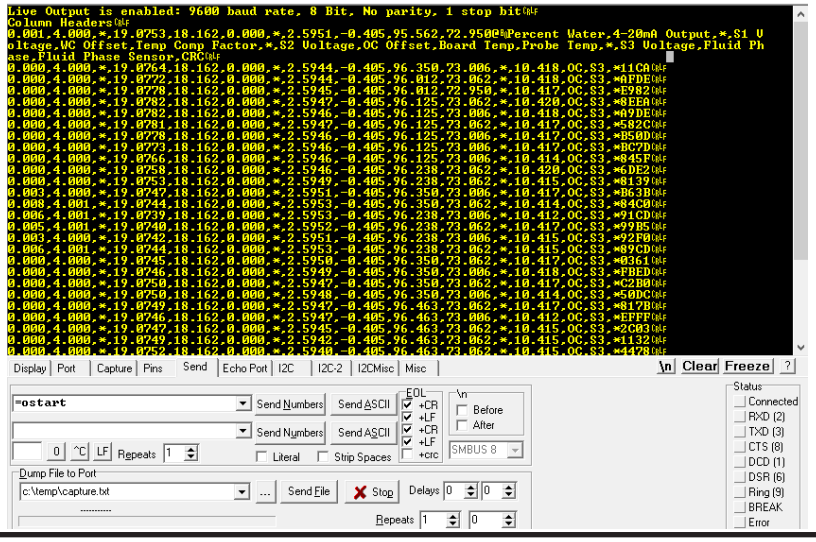
ELECTRONICS DEBUGGING

The following procedure is to be conducted in cases where the Power Connections, 4-20 mA Output Loop and RS232 Communication sections' steps have been performed, but the output is not changing, the instrument cannot be calibrated, or is still having issues.

Before proceeding, install and configure RealTerm as per instructions on pages 24-26 of this manual. Ensure your PC is connected to the ATD™ sensor via the supplied RS232 serial cable and USB-to-serial converter as per wiring diagram on page 18. To access the boards, use a 7/16" wrench to remove the (6) hex screws on the Explosion Proof electronics enclosure and remove the cover. Also, please ensure the driver for the supplied USB-to-serial converter is installed on your PC.

1. Launch RealTerm and follow the steps to view output data as per instructions on pages 25-27. The instrument's data will start being displayed. FIG. 7-3. If not, contact KAM Technical Support for further assistance.

FIG. 7-3



2. Using a multimeter in voltmeter mode, measure the voltage between the test point TP4 and TP2 (GND). Compare this voltage to the value on Column 8 (Sensor 2 voltage) of the RealTerm display. With a steady state fluid condition (i.e. constant water content and flow conditions), the values should have less than 0.2 V difference. If not, contact KAM Technical Support for further assistance.

3. Using a multimeter in voltmeter mode, measure the voltage between the test point TP5 and TP2 (GND). This test point can have two values 9.75 +/- 2 V or 0.7 +/- 1 V. This voltage and the value on Column 13 (Sensor 3 voltage) of the RealTerm display should have a difference of less than 2 V. If not, contact KAM Technical Support for further assistance.

4. Verify that the value of the 4-20 mA current output (Column 2) matches the reading of the connected device to the 4-20 mA terminals (PLC, flow computer, etc.) If the values do not match, please contact KAM Technical Support for further assistance.

If initially experiencing RS485 communication issues, continue to the next section. If any of the other issues persist after performing all the troubleshooting procedures above, contact KAM Technical Support for further assistance.

RS485 COMMUNICATION

The following procedure is to be conducted in cases where the Power Connections, RS232 Communication and Electronics Debugging sections' steps have been performed, but there is no RS485 communication with the PLC/computer.

1. Ensure the Modbus settings are configured according to the instructions on page 39 of this manual and verify that the RS485 converter (not provided) is installed on your PC as per the device's user manual.

2. Connect the RS485 converter to the ATD™ per the wiring diagram on page 17 of this manual.

3. Use a multimeter in voltmeter mode to measure the voltage between the "485 TX" and "485 RX" on the Terminal Board. The differential voltage is usually around 2 volts. Continue to the next step.

   NOTE: The RS485+ and RS485- lines in two-wire mode are differential, so their voltage needs to be measured with respect to each other to conform to the RS485 standards. The bias is provided by the master device.

4. Ensure the ATD™ and PLC/Computer are connected properly as per the RS485 converter's user manual.

5. Check the activity LEDs on the RS485 converter connected to the RS485 terminals of the ATD™. The LEDs should be blinking while data is being sent/received.

6. If the differential voltage is not present and/or there is no activity on the LED of the RS485 converter, contact KAM Technical Support for further assistance.