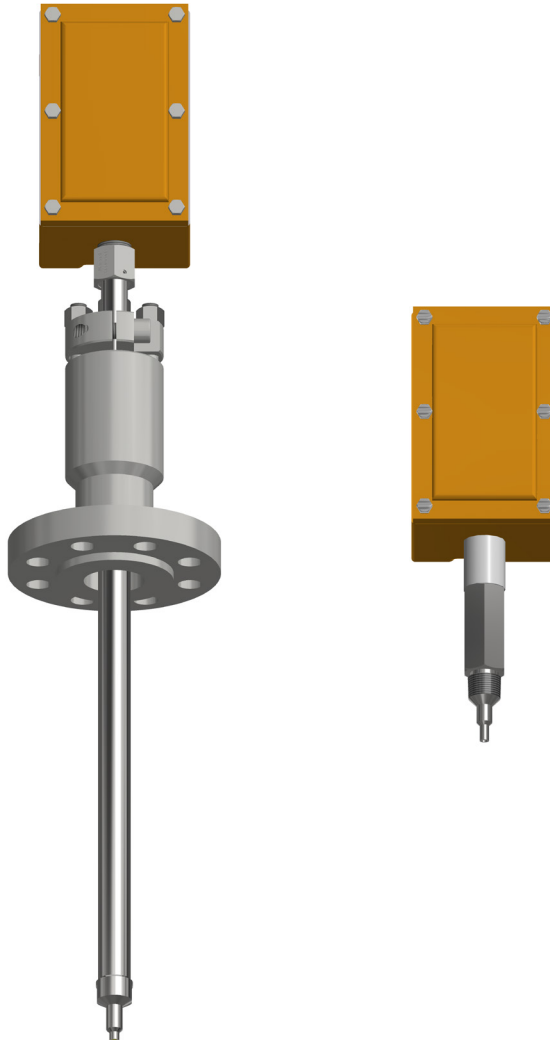# Kam®

Simple Precision™

KAM® OOD™
OPTICAL OIL DETECTOR

User Manual
OODMANUAL 0723

PTB 04 ATEX 1027
II 2 G Ex db IIB T6 Gb
IECEx PTB 21.0012
Ex db IIB T6 Gb

TABLE OF CONTENTS

KAM CONTROLS, INC. reserves the right to make changes to this document without notice.

1 INTRODUCTION

AVAILABLE MODELS and MOUNTING OPTIONS

FIG. 1-1

Full-opening Ball Valve

Insertable/Retractable OOD™
on a main pipe, with
2" MNPT seal housing

FIG. 1-2

OOD™ FT Flow Through
on a fast loop
with ¾" or 1" MNPT

FIG. 1-3

OOD™ FT Flow Through
Flanged Fixed Insertion
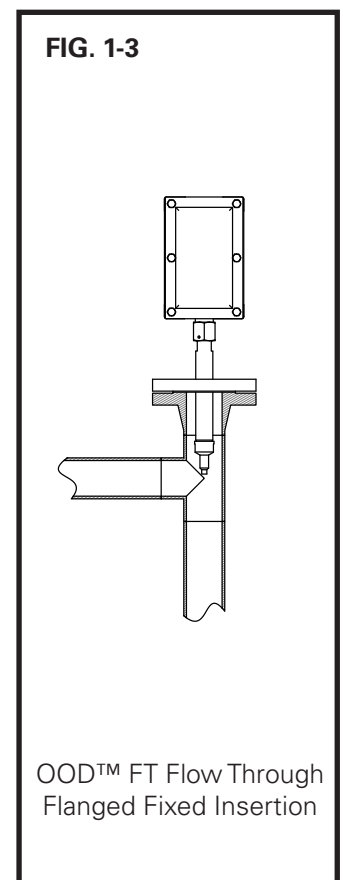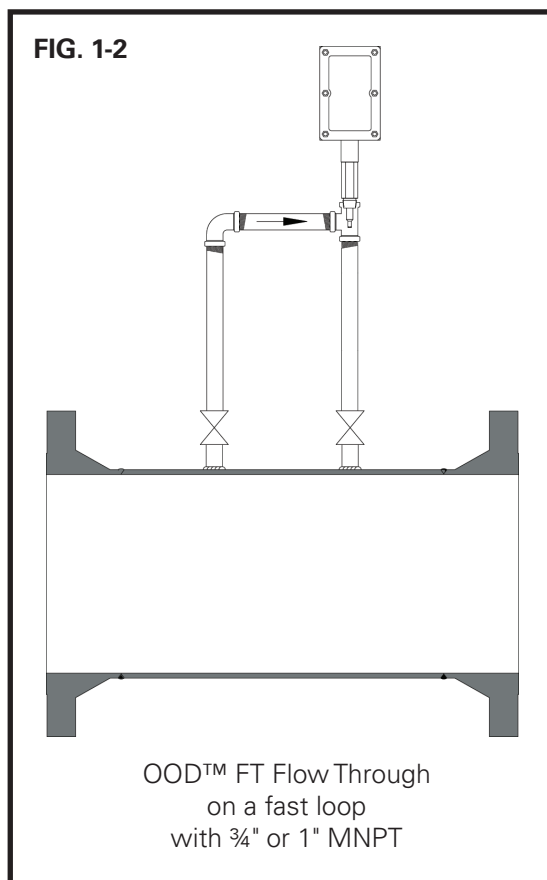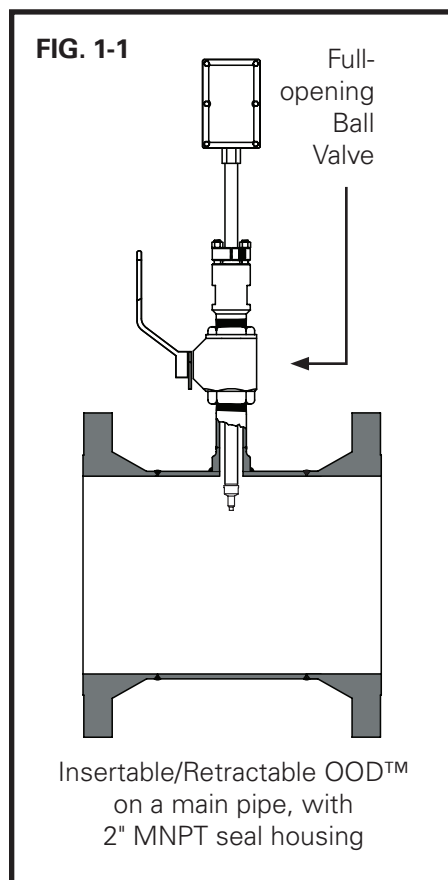
THEORY OF OPERATION

The ideal solution for oil-in-water detection, the KAM® OOD™ Optical Oil Detector offers unmatched simplicity and pin-point accuracy in an in-line meter. The OOD allows operators to **monitor produced water, leak detection and wastewater streams** for the presence of hydrocarbons in a variety of applications, providing continuous, real-time data with a variable range up to 0-5000 ppm. Fiber optics within the optical probe respond to the fluorescence and absorption in the fluid to detect the presence and quantity of hydrocarbons in water.

The **simplicity of design** and quality of engineering employed in the KAM® OOD™ mean there are no moving parts. Using a long-lasting LED light source ensures long-term, stable performance with limited maintenance and power requirements. In addition, locating the electronics within an explosion-proof enclosure directly on the atmospheric end of the optical probe creates a complete and compact unit with **maximum installation flexibility.**

Measurement is completely automatic without the need for operator intervention or supervision, and the output signal can be sent to the SCADA, PLC's, or to a central control room for logging or display on chart recorders or monitors.

CAUTION:

When installing the OOD™ sensor in a pipeline containing petroleum products, petrochemicals, 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.

2 SPECIFICATIONS

Minimum Range: 0-100*

Maximum Range: 0-5000 ppm*

Accuracy: 0-500 ppm and higher ± 1% of full range
                        Below 0-500 ppm, minimum resolution of 5 ppm

Material: Wetted parts–316 stainless steel**, other materials available
                        Electronics enclosure–Copper-free aluminum

Power: 12–24 VDC 5 Watts max, 110/220 AC available with adapter

Output: 4-20 mA
                        RS485 Modbus
                        HART (optional)
                        (1) High-current output (alarm/digital out)

Fluid temperature: -40° to 176°F (-40° to 80°C)

Electronics temp.:   -4° to 140°F (-20° to 60°C)

Pressure ratings: ANSI 150, 300, 600, 900
                        Threaded models (3/4", 1" MNPT) designed maximum working pressure of 2100 psig

Mounting: 2" MNPT seal housing**
                        2", 3", or 4" flanged seal housing
                        3/4", 1" MNPT for analyzer loops

EX enclosure: 3" x 6" x 3" (76 mm x 152 mm x 76 mm)

Protection: NEMA 4X

Shaft length: Off-the-shelf lengths are 20", 24", 30", 36" (508 mm, 609.6 mm, 762 mm, 914.4 mm)
                        Additional sizes available

Pipe size: 3/4" to 48"

Weight: from 10 lbs. (4.5 kg)

* Range and accuracy are hydrocarbon dependent. Some applications/hydrocarbons may require lab samples for testing in order to determine allowable range and accuracy.

** Seal Housing for 2" MNPT Models are Carbon Steel.

3 INSTALLATION

INSTALLATION FLOW AND LOCATION REQUIREMENTS

The KAM OOD can be installed directly in main lines with a pipe diameter of 4" and greater. FIG. 3-1.

On applications where the pipe diameter is less than 4″ the instrument must be installed on a "T" or analyzer loop with a minimum distance of 6″ before any bends, reducers, elbows, valves, etc. FIG. 3-2.

PLEASE NOTE: In all KAM OOD installations, the user should ensure that the KAM OOD is installed in a turbulent flow per KAM recommendations.
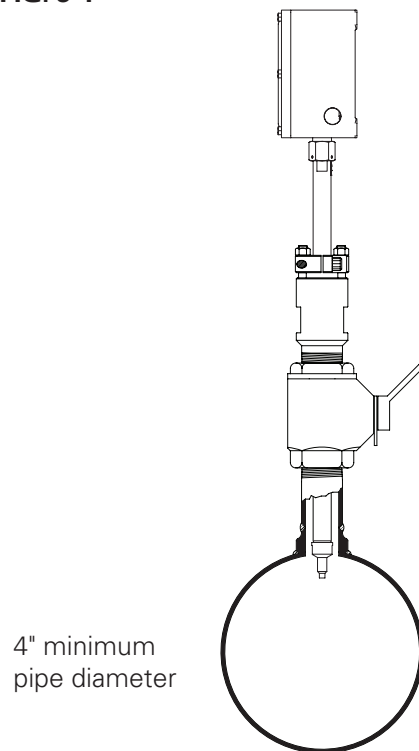
FIG. 3-1

4" minimum pipe diameter

FIG. 3-2

6" minimum

P

FLOW

FLOW

INSTALLATION CONTINUED

INSTALLATION DO'S AND DON'TS

DO NOT install the fast loop OOD™ sensor in a straight portion of pipe. It needs to be mounted off the bend opposite the pump.
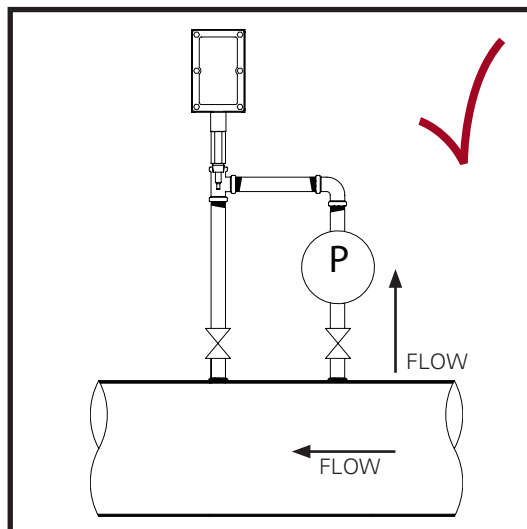
DO NOT install the OOD™ sensor with the lens facing directly into the flow. If the product has particulate matter in the fluid, like sand, this will sandblast the lens and could cause premature failure.
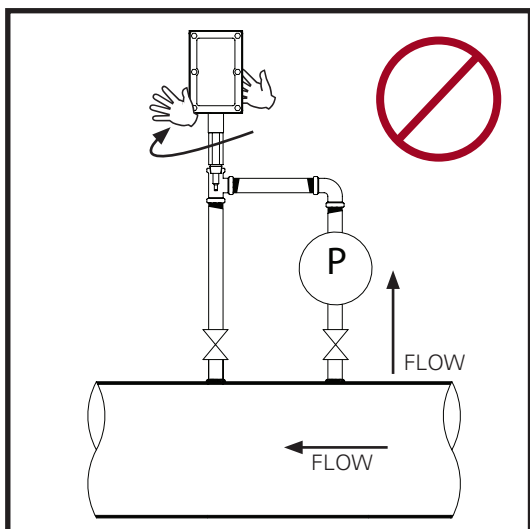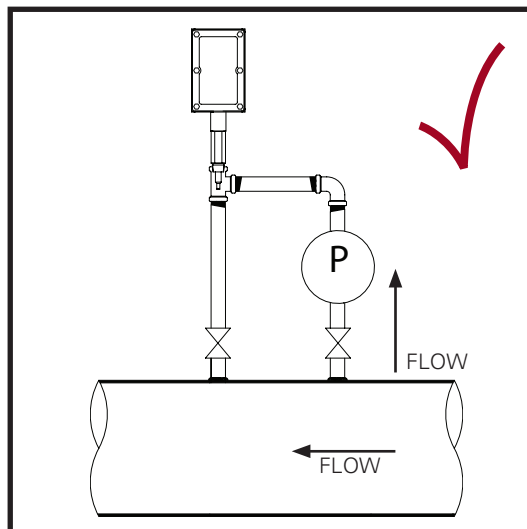
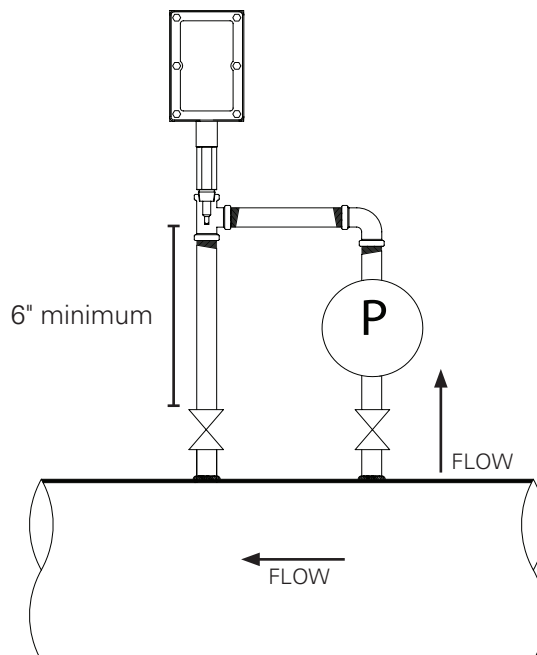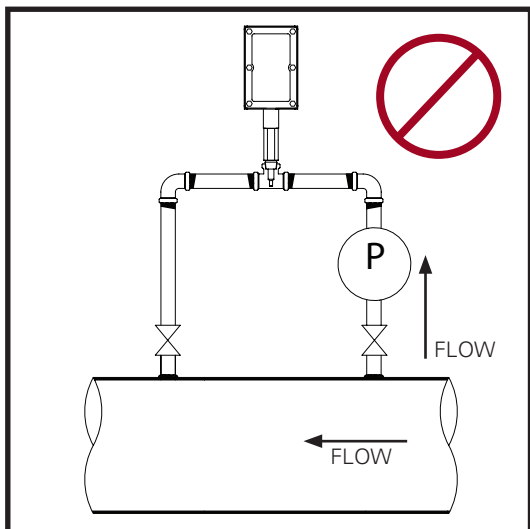DO NOT attempt to screw the OOD™ sensor either in or out by hand. Always use a 1 1/4" or 1 3/8" wrench on the wrench flat below the electronics enclosure.
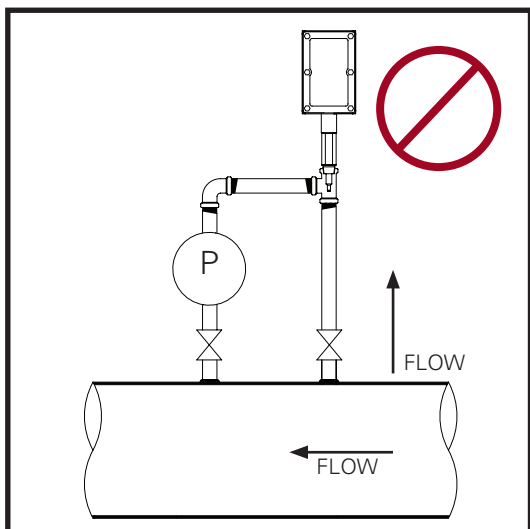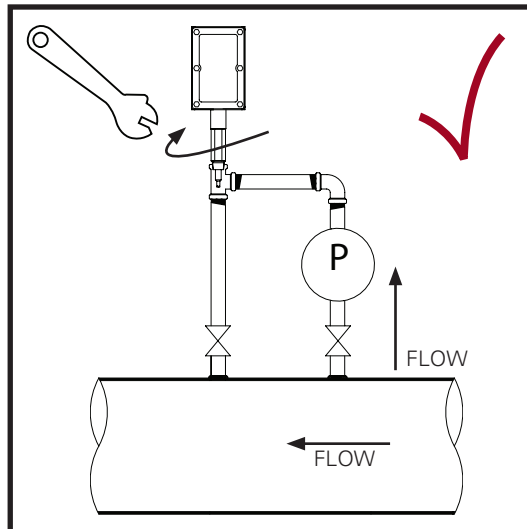
INSTALLATION CONTINUED

INSTALLATION DO'S AND DON'TS
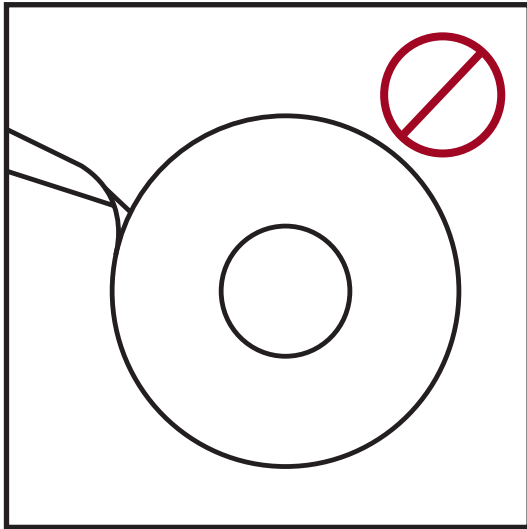
DO NOT use teflon tape on the OOD™ sensor threads.

DO use liquid thread sealant.
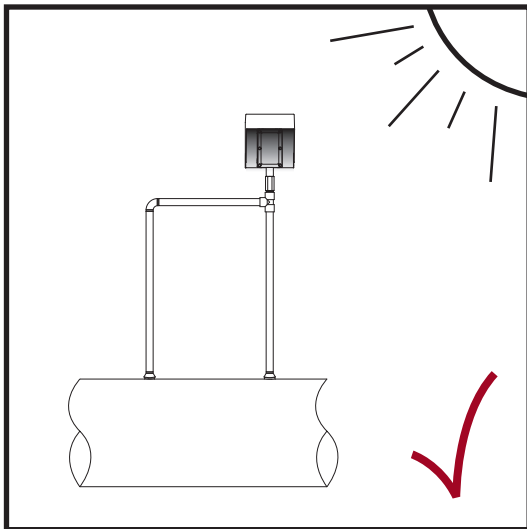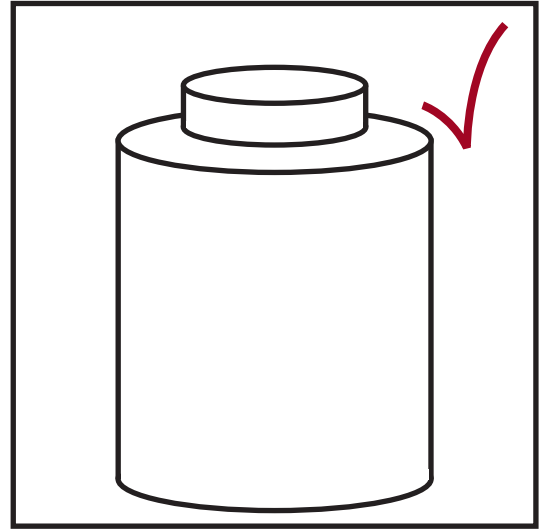
DO install the OOD™ sensor with a sunshade if the electronics are directly exposed to sunlight.

PRIOR TO INSTALLATION

Remove all the protective packaging materials including the protective cap on the tip of the sensor and ensure that the OOD™ sensor was not damaged during transit.

INSERTABLE/RETRACTABLE MODELS INSTALLATION

KAM CONTROLS recommends vertical installations wherever possible. For horizontal pipelines, we recommend installing the OOD™ sensor at a 3 or 9 o'clock position to ensure the tip of the probe remains in the fluid, and to minimize deposits of oil and dirt in the lens. FIG. 3-3.

A Full-opening Ball Valve is used to isolate the OOD™ sensor from the pipeline during installation or removal. The seal housing of the OOD™ sensor allows the optical probe to be inserted and removed from the pipe under pressure and flow conditions. It is the user's responsibility to ensure that the OOD™ sensor is installed per the recommendations of this manual.

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

FIG. 3-3 KAM® OOD™ INSTALLED ON A MAIN PIPE

Locking Collar
Seal Housing
Full-opening Ball Valve
Socket Cap Screw
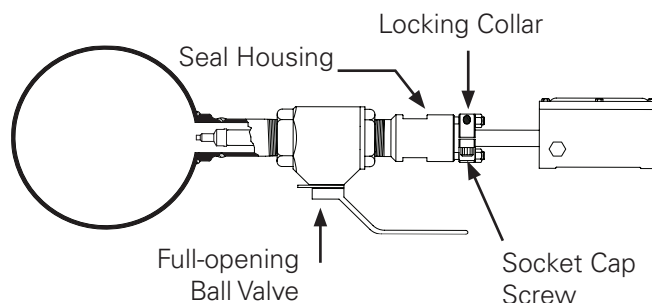
CALCULATING THE REQUIRED INSERTION LENGTH

Prior to mounting the OOD™ sensor on the Full-opening Ball Valve, you must determine the insertion length required.

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

2. Loosen the Socket Cap Screws, using a 3/8" Allen wrench on the locking collar. This will allow the OOD™ shaft to slide through the seal housing.

3. Push the OOD™ back through the seal housing until the OOD™ probe sits flush with the end of the seal housing or seal housing flange. FIG. 3-4 and 3-5. (Remove red protection cap on the tip of the probe if it has not been removed.)

4. Place a mark with a sharpie or a permanent marker on the shaft at the edge of the locking collar. (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. 3-4 and 3-5.

FIG. 3-4

Mark here

FIG. 3-5

Mark here
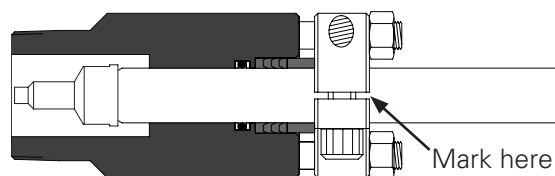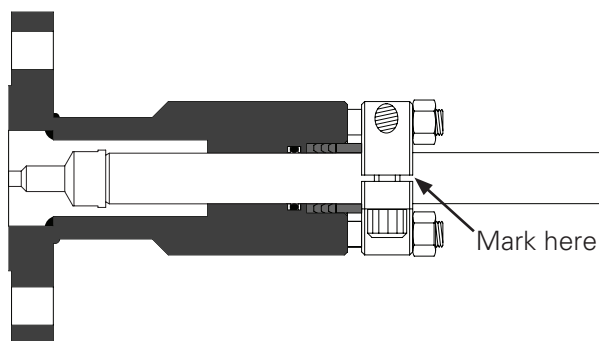
INSTALLATION CONTINUED

5. Pull shaft back until the probe is all the way in the seal housing and tighten the Socket Cap Screws on the locking collar. This will prevent the OOD™ shaft from sliding and the probe from getting damaged during mounting. FIG. 3-6.

6. Measure the distance (D1) from the outside diameter of main pipe to the tip of the valve. FIG. 3-7.

FIG. 3-6

FIG. 3-7
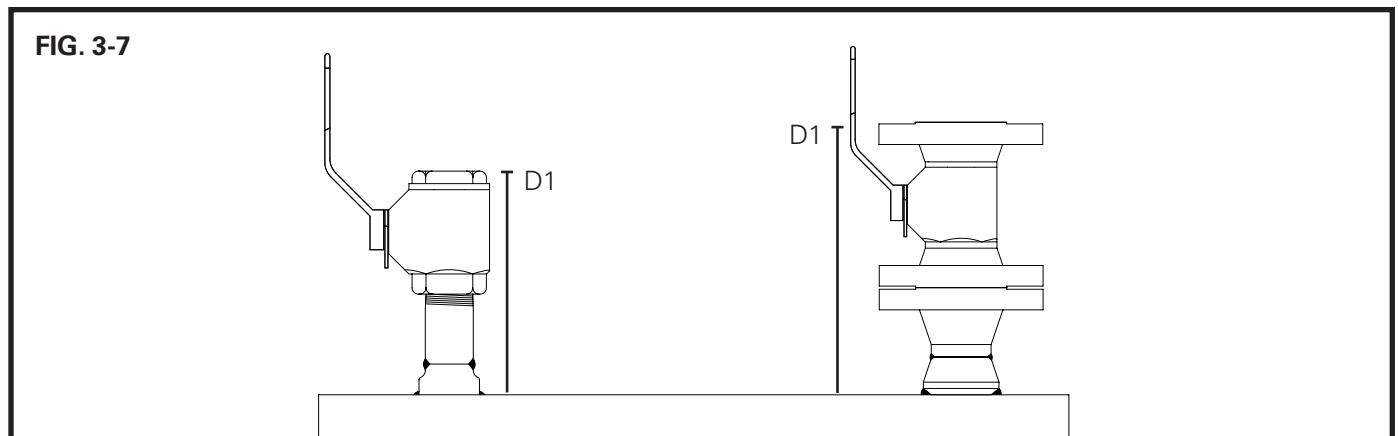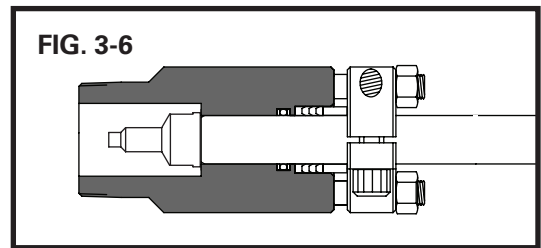
7. Calculate the insertion distance for **Flanged Seal Housing** (If you have a MNPT Seal Housing, proceed to step 9):

Total Insertion Distance (TID) = D1 + Pipe Wall Thickness + Seal Thickness + X
Use Table 3-1 to determine "X" value.

Example for D1=19", Pipe WT=3/8", Seal Thickness=1/8", and Pipe Diameter=6" (X=1")
TID=19 + .375 + .125 + 1
TID= 20.5"

TABLE 3-1. "X" VALUE

Pipe Diameter	X
4"	1/4"
6" and above	1"

8. Use the calculated TID and mark a second line on the shaft, measuring from first mark. FIG. 3-8. (Do not use anything sharp to mark the shaft as this will create grooves that will damage the O-rings in the seal housing.) Proceed to step 11.

**FIG. 3-8**

First Mark

TID

Second Mark
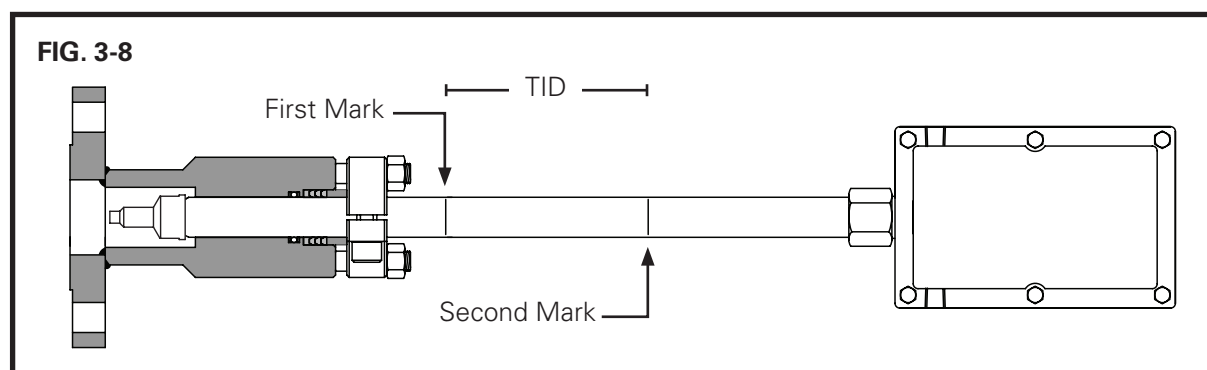
INSTALLATION CONTINUED

9. Calculate the insertion distance for **2" MNPT Seal Housing**:

Total Insertion Distance (TID) cannot be calculated until the Seal Housing is screwed into place. If you have not already done so, please screw your OOD™ sensor into place now.

You must then measure the Threaded Depth (TD) into the Valve or connection in order to calculate TID.
You can do this by measuring the distance from the edge of the Valve or female connection to the top of the Seal Housing body and subtracting that distance from 6.75". FIG. 3-9.

FIG. 3-9   Measuring points
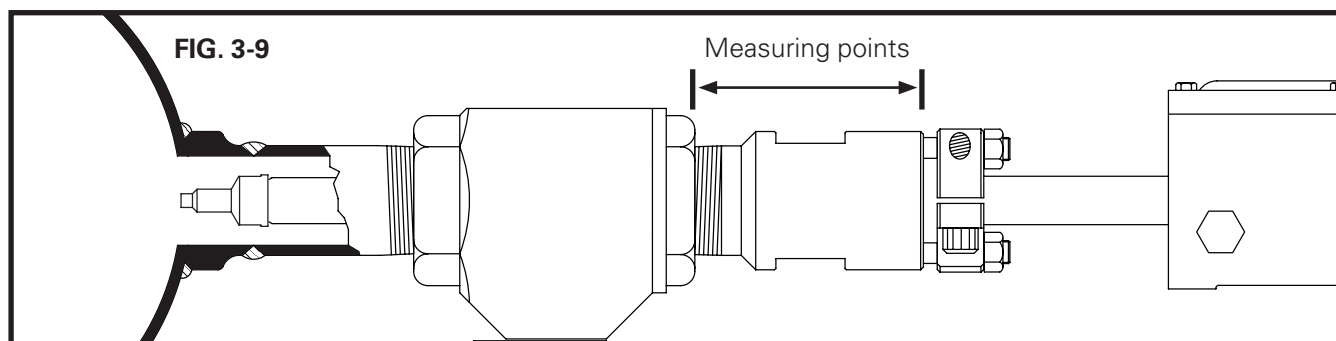
For example:

If the measured distance from the top of the valve to the top of the seal housing body is 6.1",
you would calculate the Threaded Depth (TD) by subtracting 6.1" from 6.75".
(6.75 – 6.1=0.65) In this case the threaded depth TD would be .65".

You are now ready to calculate TID.

TID = D1 + Pipe Wall Thickness + X – TD
Use Table 3-2 to determine "X" value.

> Example for D1=19", Pipe WT=3/8", TD=.65", and Pipe diameter=6" (X=1")
> TID=19 + .375 + 1 – .65
> TID=19.77"

TABLE 3-2. "X" VALUE

Pipe Diameter	X
4"	1/4"
6" and above	1"

10. Use the calculated TID and mark a second line on the shaft, measuring from first mark. FIG. 3-10.

FIG. 3-10

First mark   TID

Second mark
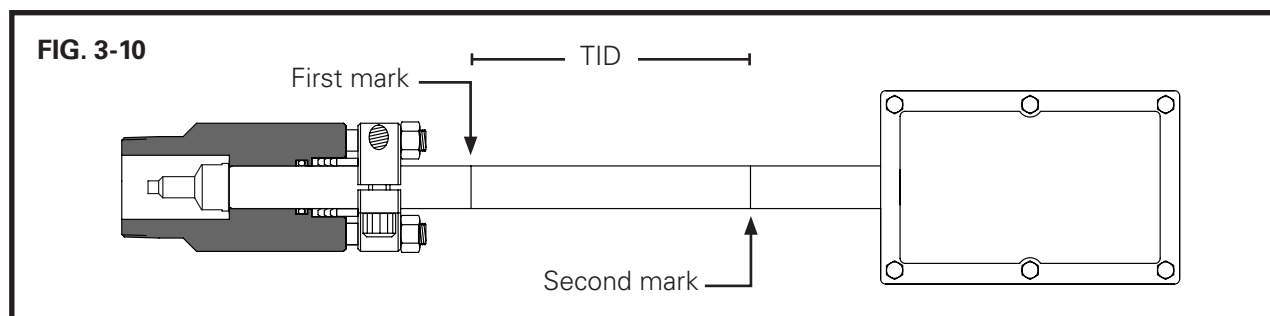
INSTALLATION CONTINUED

11. Bolt or screw the OOD™ sensor to the valve.
(KAM CONTROLS recommends using thread sealant and not Teflon tape for the threaded OOD™).

12. Slowly open Full-opening Ball Valve and check for leaks.

13. Using a 3/8" Allen wrench, loosen Socket Cap Screws on the Locking Collar.

14. Push the OOD™ in until the Second Mark is at the top edge of the Locking Collar. FIG. 3-11.

FIG. 3-11

Second Mark
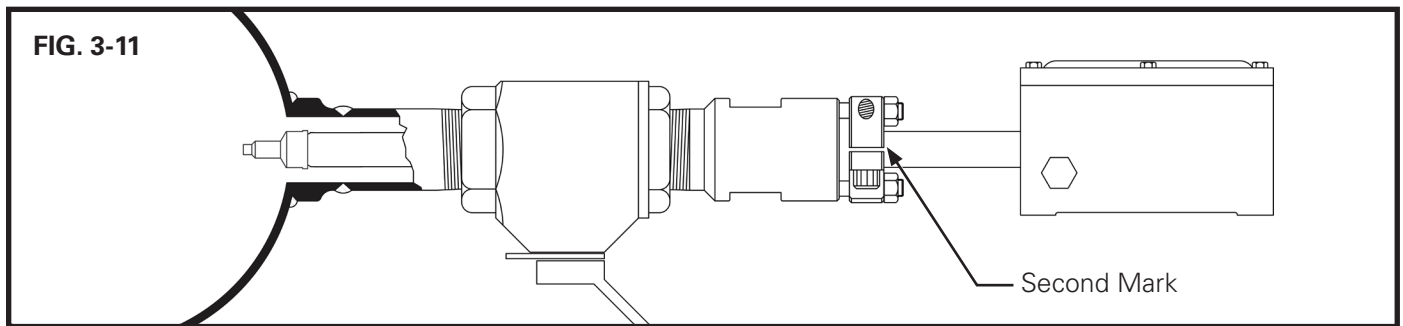
15. Re-tighten the Socket Cap Screws so that the gaps between the two halves of the locking collar are the same distance. FIG. 3-12.

FIG. 3-12 TOP VIEW LOCKING COLLAR

Gap

Socket Cap Screw

Hex Nut

Socket Cap Screw
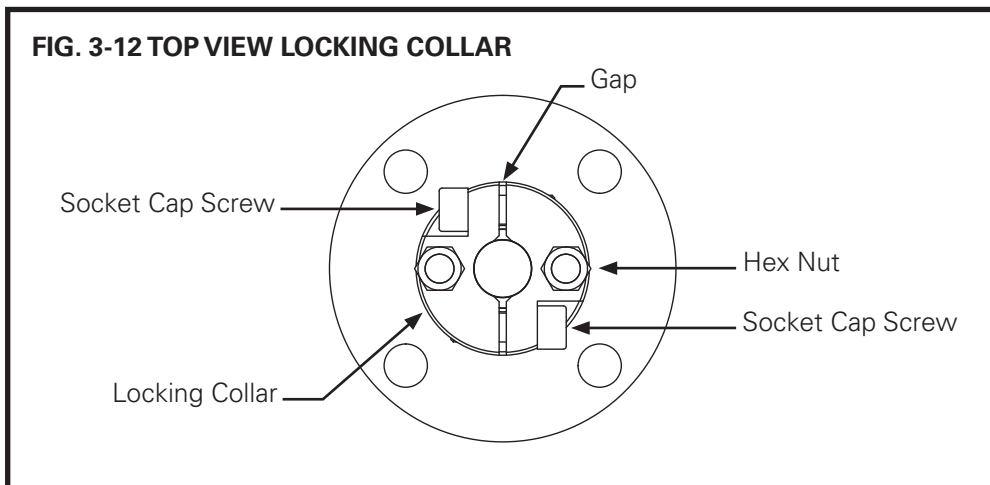
Locking Collar

16. Tighten the Hex Nuts, using a 3/4" wrench, on the top of the Locking Collar one quarter to one half turn. These nuts should never be over tightened. Their major function is to apply light pressure on the chevron packing to ensure a seal between the seal housing body and the insertion shaft. FIG. 3-12.

WARNING: If pigging the pipeline, retract the OOD sensor enough that the tip of the probe is located at least 1/4" within the inner wall of the pipeline. Preferably, the probe should be fully retracted into the seal housing. This ensures that the probe is not damaged during the pigging process. Follow instructions on the "Removing the OOD Sensor" section to uninstall the OOD from the pipeline if needed.

INSTALLATION CONTINUED

REMOVING THE OOD™ SENSOR

1. To remove the OOD™ sensor, first turn off power and disconnect all electrical connections to the OOD™ enclosure.

2. Make sure that the line pressure is below 100 psi. Loosen the Hex Nuts, using a 3/4" wrench, on the top of the Locking Collar one quarter to one half turn.

3. Slowly and with caution, use a 3/8" Allen wrench tp loosen the Socket Cap Screws on the Locking Collar. In cases where line pressure cannot be reduced below 100 psi, a KAM IT Insertion Tool must be used to safely remove the unit.

    CAUTION: Once the Socket Cap Screws have been loosened, the OOD™ shaft may push out from the line. If pressure in the line is above 100 psi, it may do so with enough force to cause bodily injury or damage to the instrument.

4. Slide the OOD™ sensor upward until it stops and the probe rests inside the seal housing. FIG. 3-13.

5. Next, close the Full-opening Ball Valve tightly. The OOD™ sensor may now be unbolted or unscrewed from the system.

FIG. 3-13

Hex Nuts

Socket Cap Screws
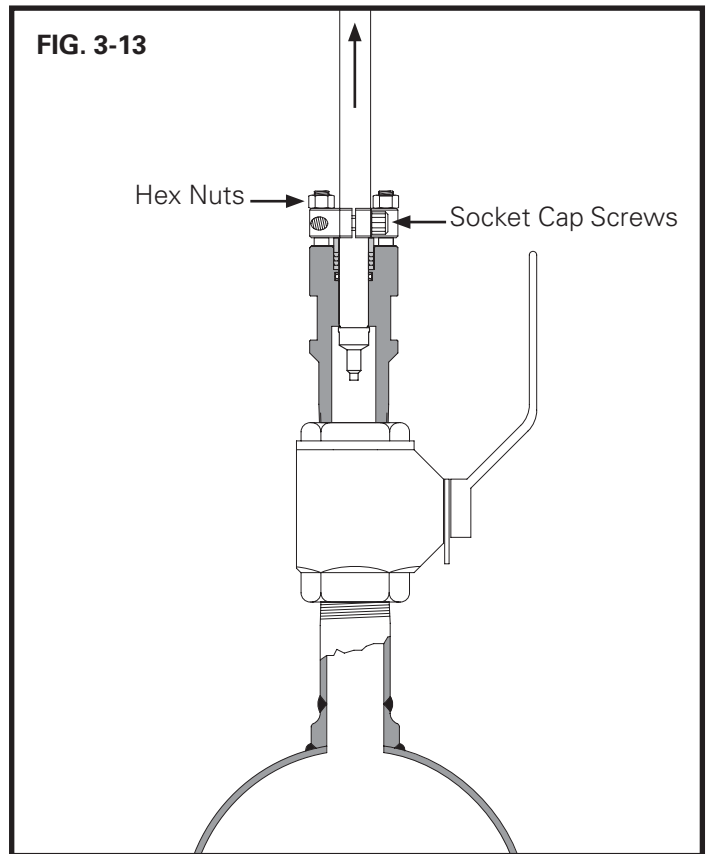
INSTALLATION CONTINUED

ANALYZER LOOP INSTALLATION

KAM CONTROLS recommends this installation for 3/4" and 1" MNPT OOD™ sensors.

We recommend using thread sealant and not Teflon tape for the OOD™ sensor threads.

CAUTION: DO NOT USE THE ENCLOSURE TO TIGHTEN OR LOOSEN THE OOD. THIS CAN CAUSE THE PROBE TO COME UNDONE AND THE FIBER CABLE TO BREAK. Please refer to "Installation Do's and Don'ts" on pages 5-6.

KAM 3/4" and 1" MNPT OOD™ sensors should be installed according to FIG. 3-14. The OOD™ sensor should be installed in an analyzer loop in such a fashion that the flow sweeps across the probe lens rather than rushing directly at the probe.

If the OOD™ is installed with the product rushing directly at the probe, particles in the pipeline can scratch the lens causing abrasions and resulting in a non-credible reading.

You do not need to measure for insertion distance on fast loop models.

FLANGED FIXED INSERTION MODELS INSTALLATION

On flanged fixed insertion models, the insertion distance has been calculated at the factory based on supplied end user measurements. These measurements should be double checked against the actual site measurements at the time of installation. These can be installed either on a "T" or on a main line with a diameter of greater than 4". FIG. 3-15 and FIG. 3-16.

FIG. 3-14

Flow

P Pump

Flow

FIG. 3-15

FIG. 3-16
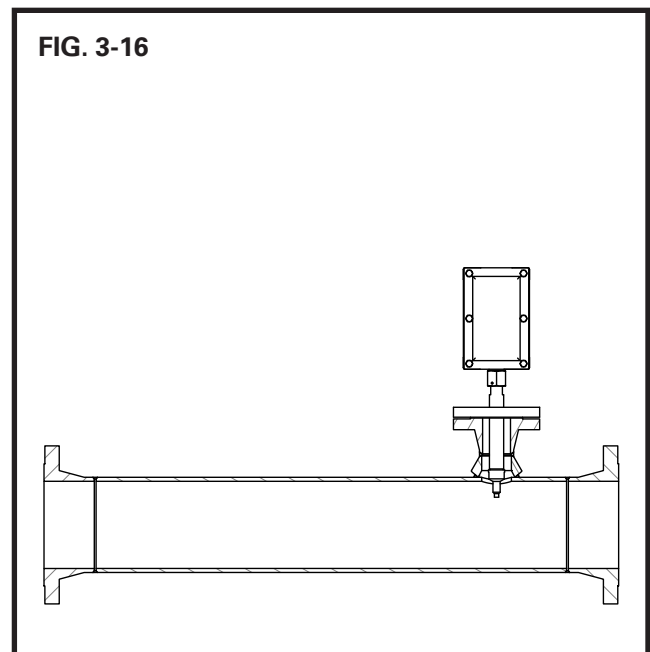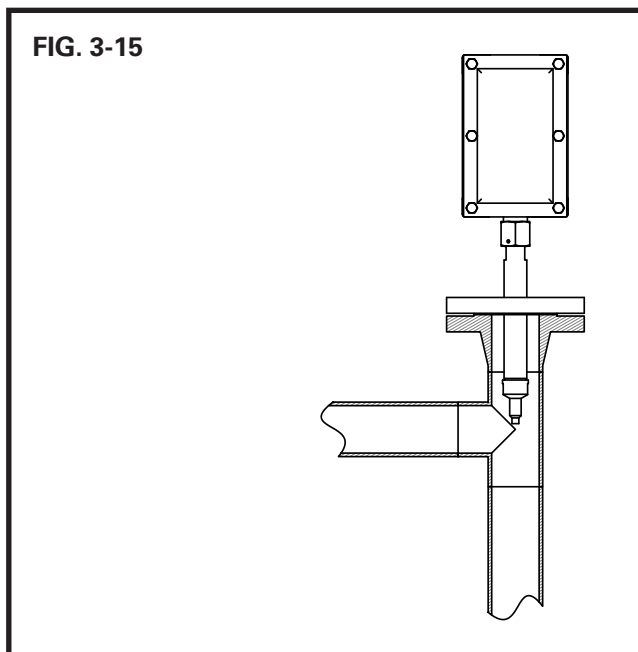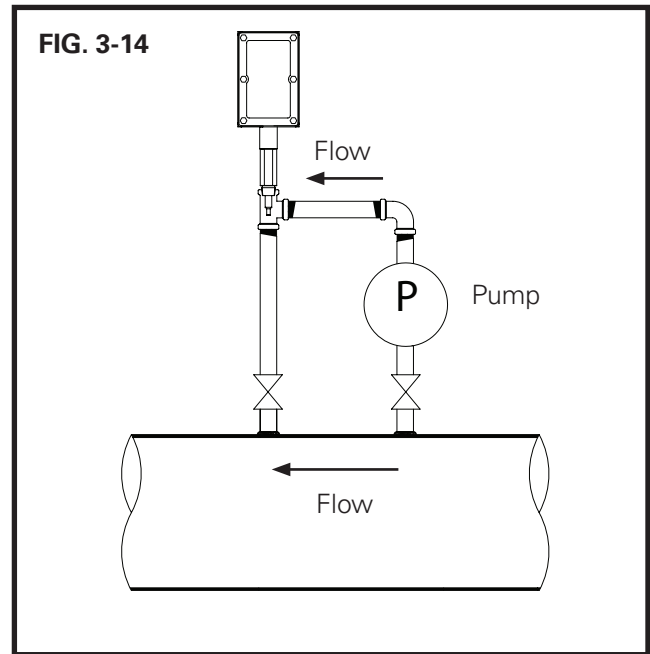
INSTALLATION CONTINUED

WIRING

CAUTION: When electronics enclosure is open, be extremely careful to avoid any contact with interior fiber optic connections. Failure to do so could result in the OOD malfunctioning.

• 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 KAM OOD EX shall be connected by means of suitable cable entries, resp. conduit systems which correspond technically to the requirements at least of the standard conditions, indicated on the cover sheet of the referenced ATEX certification, and for which a separate test certificate is available. Thereby the operating conditions specified in the appropriate certificates of the components are to be considered absolutely.
• Cable entries (heavy-gauge screwed cable glands) and sealing plugs of simple construction shall not be used. For connection of the OOD by means of an approved conduit entry, the associated sealing device must be arranged directly at the enclosure.
• Non-used openings shall be sealed according to EN 60079-1, section 13.8.
• The connecting lead of the OOD shall be installed as permanent installation and as such that it is sufficiently protected against damage.

INSTALLATION CONTINUED

WIRING CONTINUED

NOTE: Grounding the OOD™ sensor through the 4-20 mA output signal and power lines will not protect the OOD™ sensor against power surges or lightning strikes.

FIG. 3-17

KAM serial cable (diagnostics only)

KAM OOD
MADE IN USA

3939 ANN ARBOR DRIVE
HOUSTON TX - 77063
Tel. +1-713-784-0000
Fax: + 1-713-784-0001
www.Kam.com

12 or 24 VDC (5 Watts) power supply

Modbus/RS485 serial connections

To grounding rod (preferred) or enclosure

RS232 RXD — 485 RX
CHS GND — 485 TX
RS232 TXD — DIGITAL OUT
GND — CHS GND
POWER (+) — 4-20 mA (+)
POWER (-) — 4-20 mA (-)

500 Ohm max load

CAUTION: OOD provides the power for the 4-20 mA load.

Do NOT apply external voltage, as this will damage the 4-20 mA output.

1. To access the boards, use a 7/16" wrench to remove the (6) screws on the electronics enclosure and remove the cover. Ensure that power to the OOD is turned off before proceeding.

2. To ground the OOD™ sensor, connect the chassis ground on the OOD™ board labeled "CHS GND" on the OOD™ Terminal Block (FIG. 3-17) to earth ground either through the pipeline or appropriate low impedance buried grounding structure, using 16 AWG braided wire.

   NOTE: CHS is isolated from GND. Grounding CHS to pipeline through the grounding screw will not short OOD™ GND to the pipeline.

3. Prior to connecting power for the OOD™ sensor, first check both wires from the source for polarity and voltage, then label appropriately. KAM recommends using shielded twisted pair wire for both power and signal.

4. Connect positive wire to POWER (+). See FIG. 3-17.

5. Connect negative wire to POWER (-). See FIG. 3-17.

6. Turn on power to the OOD and check voltage and polarity at the terminal block. Measurement should be close to supply voltage.

INSTALLATION CONTINUED

WIRING CONTINUED

TYPICAL POWER AND LOOP WIRING CONFIGURATION

FIG. 3-18

OOD

POWER (+)
POWER (-)

POWER SUPPLY
(+)
(-)
24VDC
(5 Watts)

4-20mA (+)
4-20mA (-)

(+)
(-)
RECEIVER
INPUT

TYPICAL WIRING

Recommended configuration see FIG. 3-19/3-20

OOD

POWER (+)
POWER (-)

POWER SUPPLY
(+)
(-)
24VDC
(5 Watts)

4-20mA (+)
4-20mA (-)

(-)
(+)
RECEIVER
INPUT

WRONG WIRING

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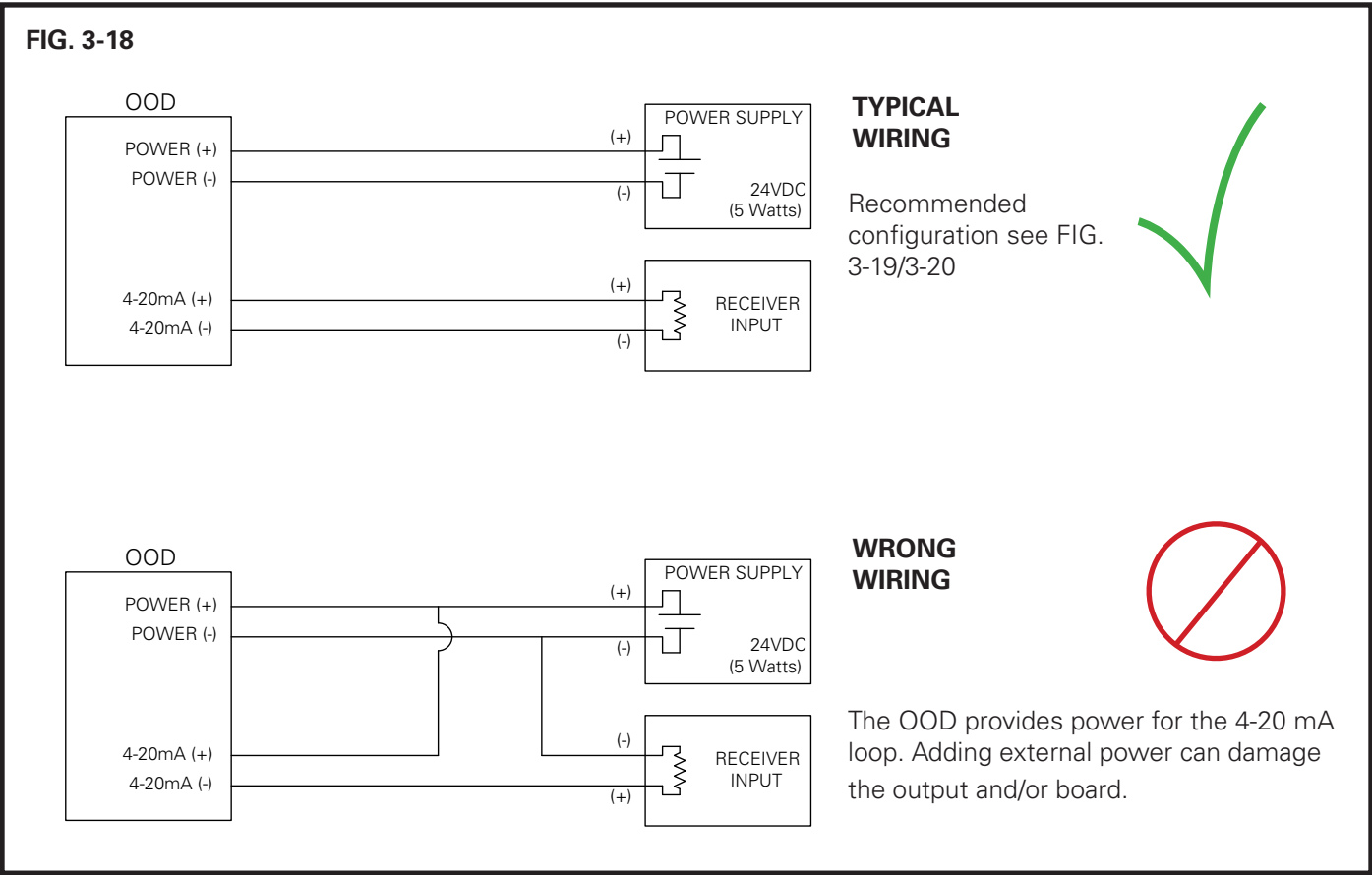
INSTALLATION CONTINUED

WIRING CONTINUED

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

FIG. 3-19

OOD
POWER (+)
POWER (-)
POWER SUPPLY
(+)
(-)
24VDC
(5 Watts)

INPUT
4-20mA (+)
4-20mA (-)
(+)
RECEIVER
INPUT
(-)
OUTPUT
Loop Isolator
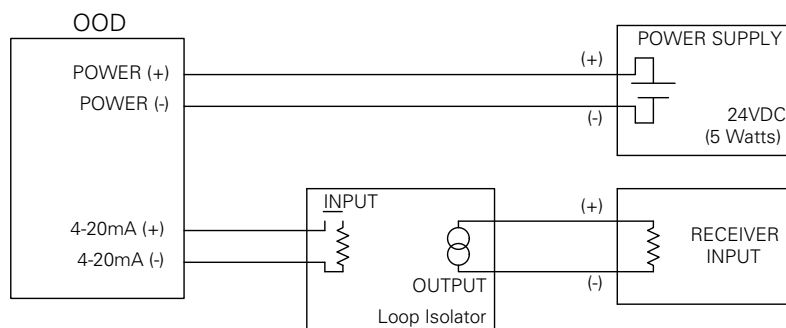
Recommended 4-20 mA Loop Isolators:

XCONPC528P DIN Rail Mount Loop Powered Isolator, 4-20mA, Galvanic, UL Listed or similar (V min 10 Volts)

Loop Isolator Minimum Requirments:
Voltage: 6- 30 VDC
Input Range: 0-20 mA

POWER SUPPLY AND OUTPUT WIRING WITH EXTERNAL POWER ISOLATOR

FIG. 3-20

OOD
POWER (+)
POWER (-)
POWER SUPPLY
(+)
(-)
24VDC
(5 Watts)

INPUT
4-20mA (+)
4-20mA (-)
(+)
(-)
RECEIVER
INPUT
OUTPUT
(-)
(+)
Loop Isolator
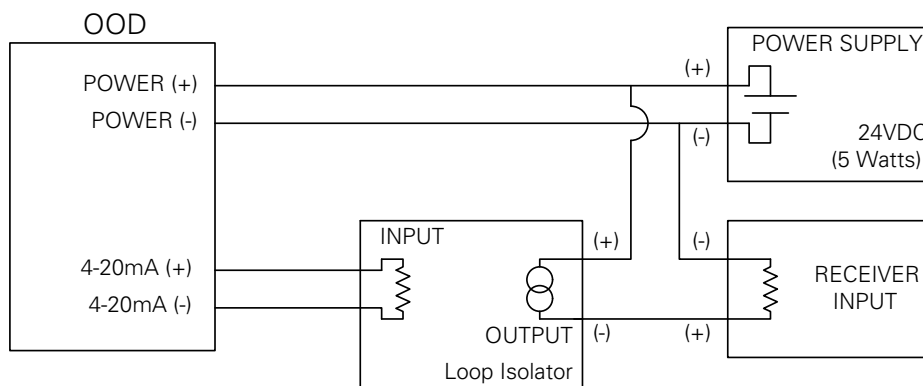
INSTALLATION CONTINUED

WIRING CONTINUED

DIGITAL RELAY CONFIGURATION

FIG. 3-21

OOD
24 VDC
Relay
Digital Out
Low Side
High Side
GND
TYPICAL WIRING ✓

OOD
Relay
Digital Out
Low Side
High Side
GND
WRONG WIRING ⊘
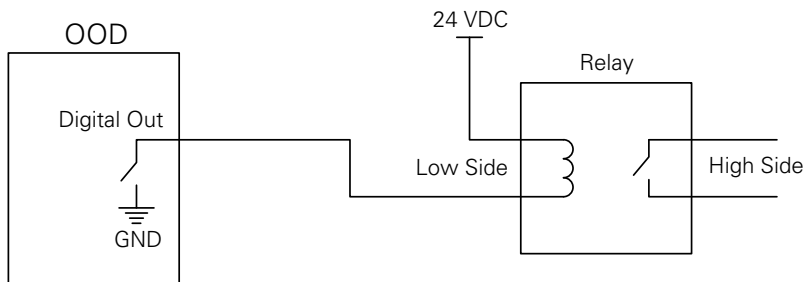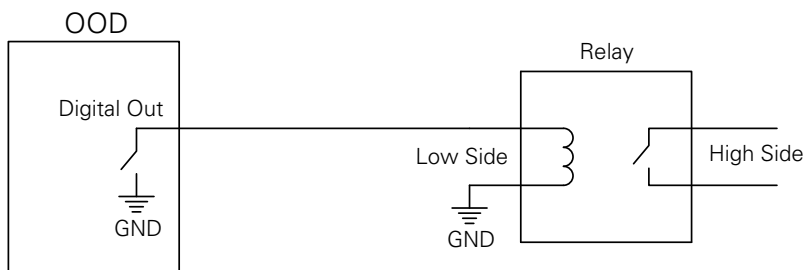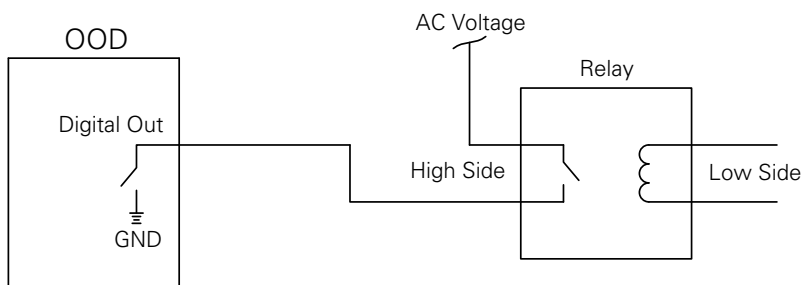
OOD
AC Voltage
Relay
Digital Out
High Side
Low Side
GND
WRONG WIRING ⊘

INSTALLATION CONTINUED

WIRING CONTINUED

RS232 WIRING DIAGRAM

FIG. 3-22

OOD

DB9 Female
Connector

RS232 TXD

RS232 RXD

GND

Pin 1 CD Not connected
Pin 2 TxD
Pin 3 RxD
Pin 4 DTR - Not connected
Pin 5 GND
Pin 6 DSR- Not connected
Pin 7 CTS Not connected
Pin 8 RTS Not Connected
Pin 9 RI Not Connected

RS232 TXD
RS232 RXD

RS232 GND

FIG. 3-23

USB to serial converter
(provided)

RS232 communication cable
(provided)

RS232 communication cable
(provided)
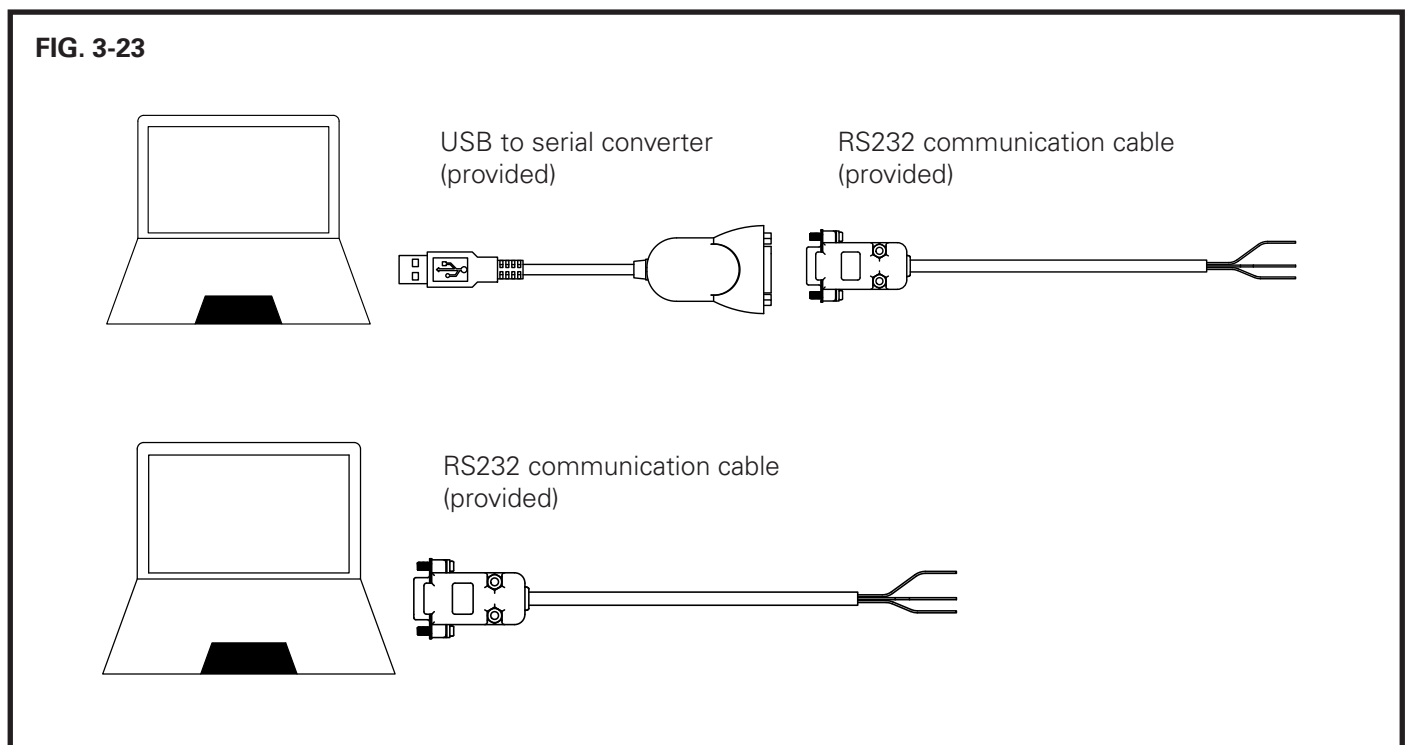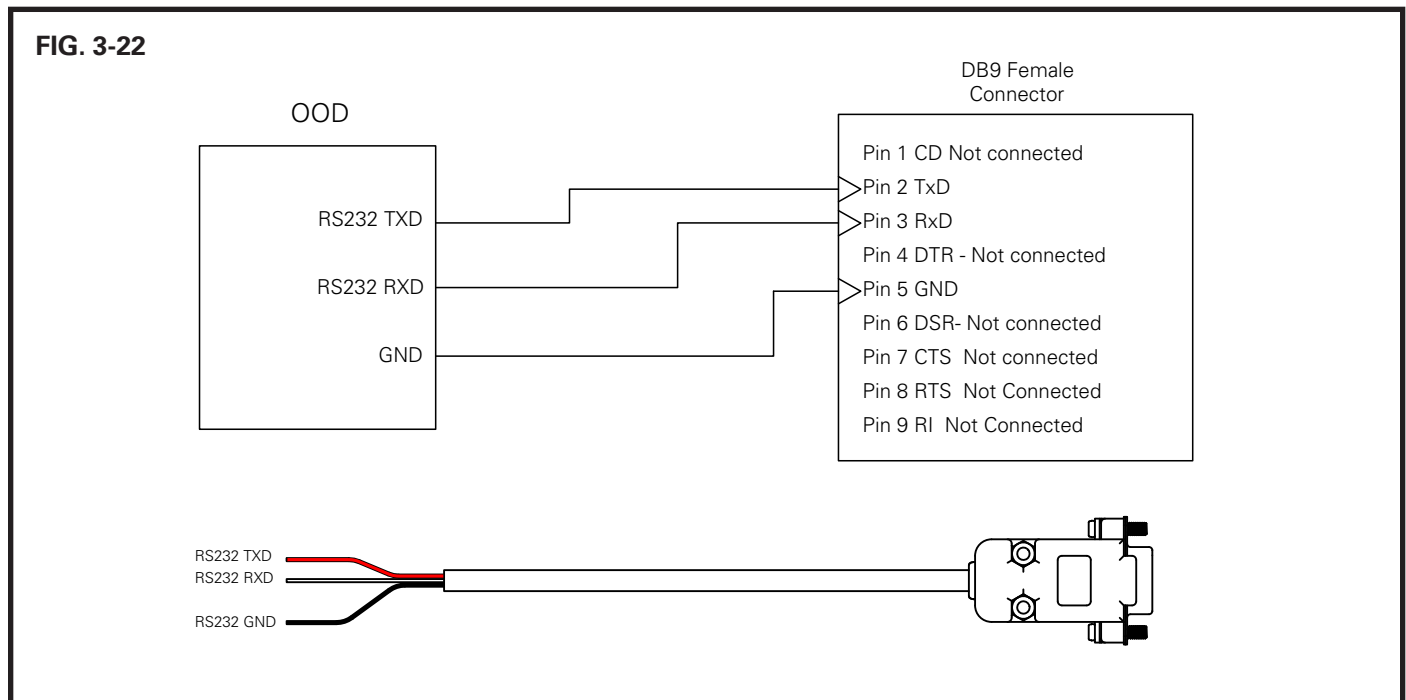
INSTALLATION CONTINUED

WIRING CONTINUED

RS485 WIRING DIAGRAM

FIG. 3-24

OOD

RS-485 Converter
(2-Wire)

485 RX   TDA(-)/ DATA -

485 TX   TDB(+)/ DATA +
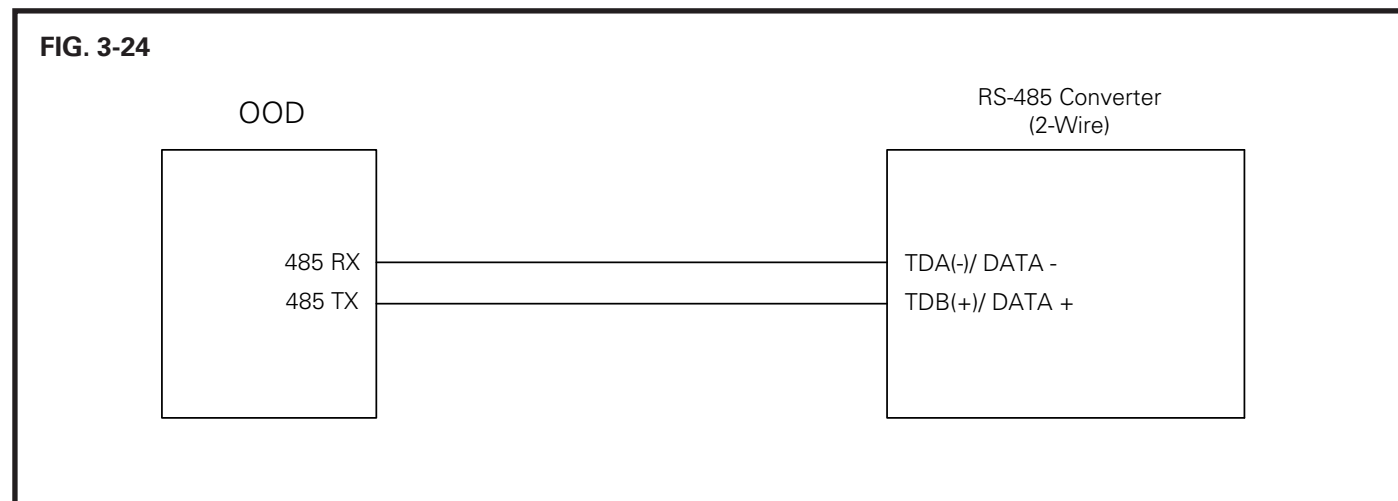
POWER SUPPLY AND OUTPUT WIRING WITH LCD & LOOP POWERED ISOLATOR (RECOMMENDED)

FIG. 3-25

OOD

POWER (+)

POWER (-)

POWER SUPPLY

(+)

(-)

24VDC
(5 Watts)

4-20mA (-)

4-20mA (+)

(-)   INPUT   (+)   (+)

RECEIVER
INPUT

(+)   OUTPUT   (-)   (-)

Loop Isolator

S+   S-   B-

LCD Model
PD663

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
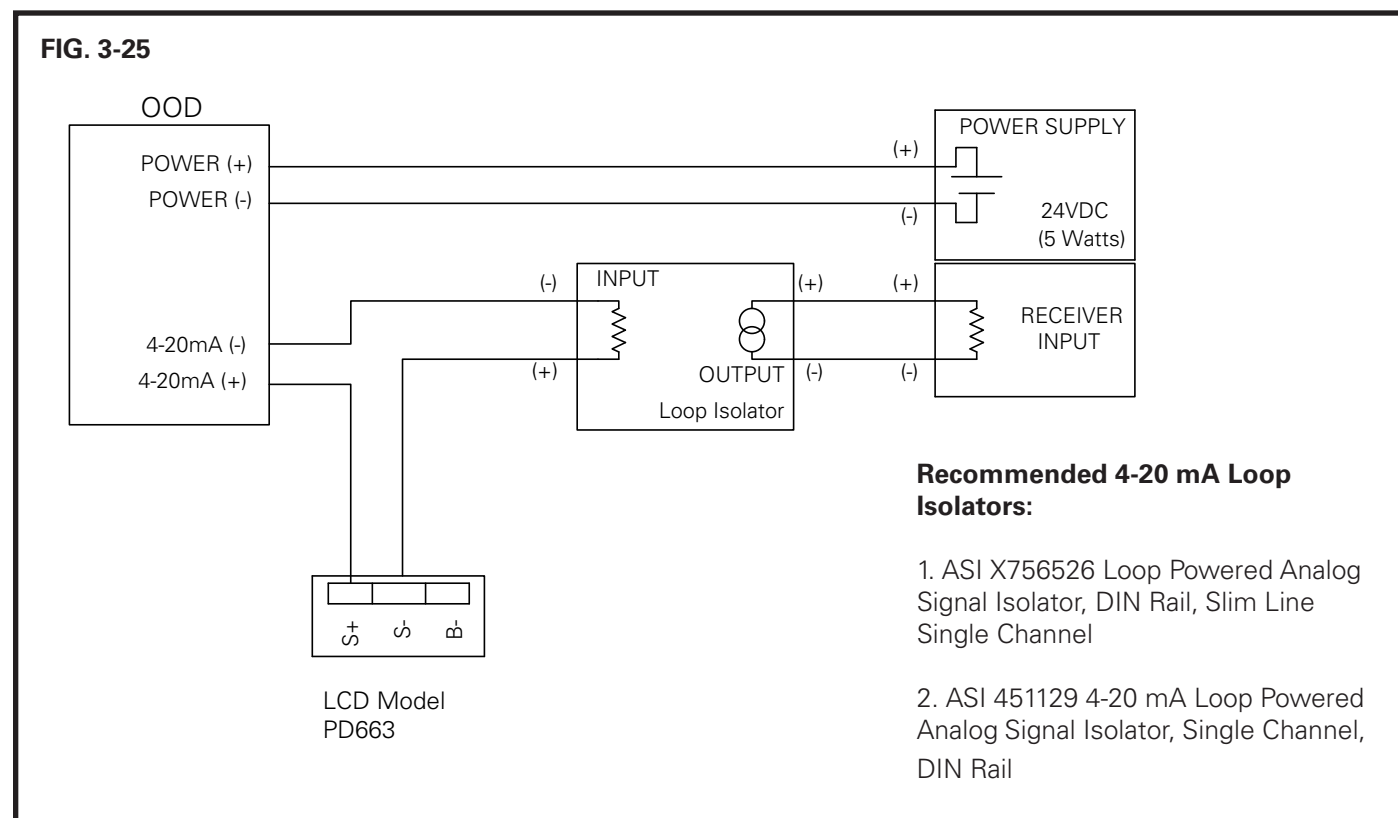
4 OPERATION

COMMUNICATION SOFTWARE CONFIGURATION

RealTerm software is used for calibration and troubleshooting of the KAM OOD. RealTerm is available as a free download.

To download RealTerm, go to http://sourceforge.net/projects/RealTerm/ and click on the download button.

Follow on-screen instructions to install RealTerm. Once done, follow instructions below to configure the software.

NOTE: Please remember to turn off power to the OOD before accessing the boards and connecting or disconnecting any cables or wires. Turn on power to the unit once done.

NOTE: 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. An RS232 cable for connecting your PC to the OOD has been supplied with the OOD as well as a USB to serial converter in case your computer does not have an RS232 serial port. If you haven't already done so, connect the RS232 cable to the OOD Terminals as shown on page 18, FIG. 3-22.

2. Connect the other end of the RS232 cable to the serial port of your computer as shown on page 18, FIG. 3-23.

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

4. The window will automatically default to the "Display" tab. Click on the up arrow beneath 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

Display tab

Click until number equals 120
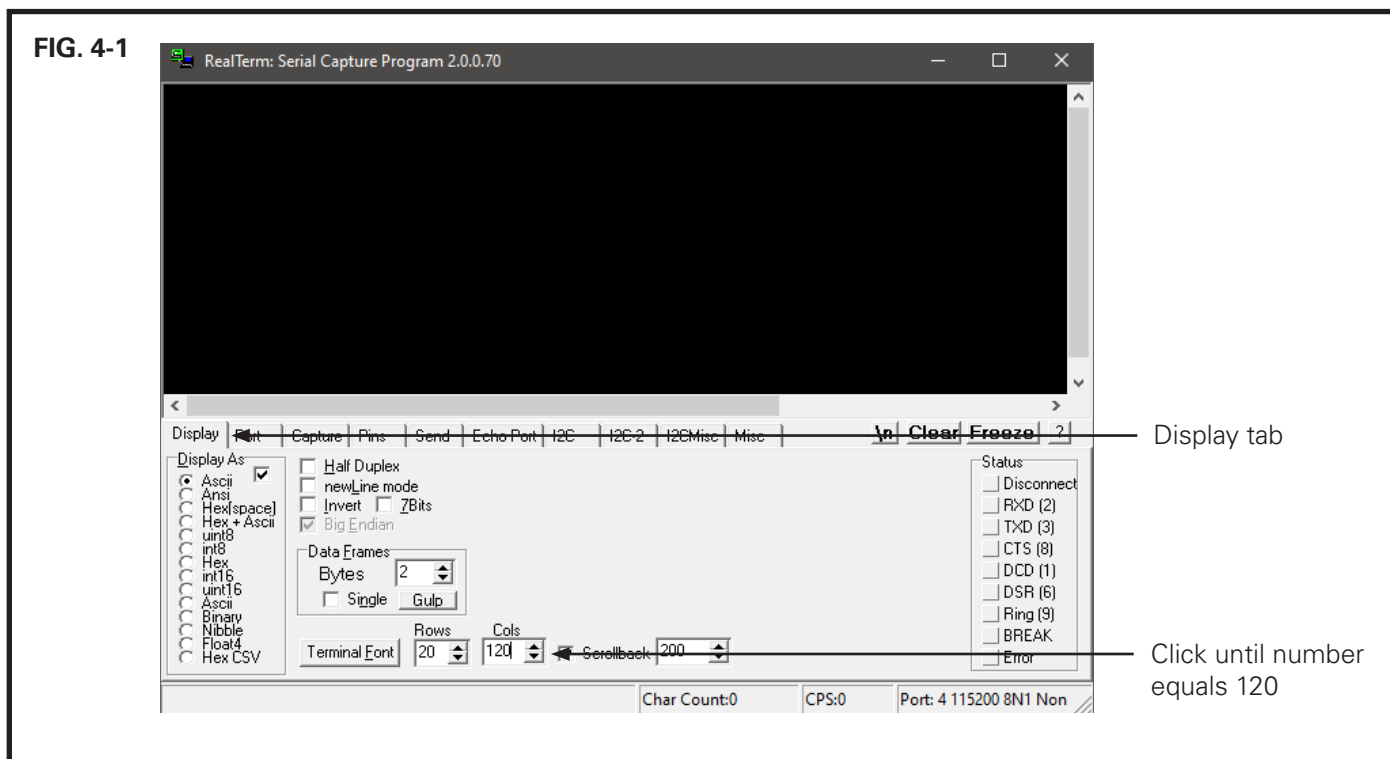
OPERATION CONTINUED

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

Baud: 115200
Parity: None
Data Bits: 8
Stop Bits: 1
Hardware Flow Control: None
Port: Select port number assigned to your serial port or USB port connected to converter

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

FIG. 4-2
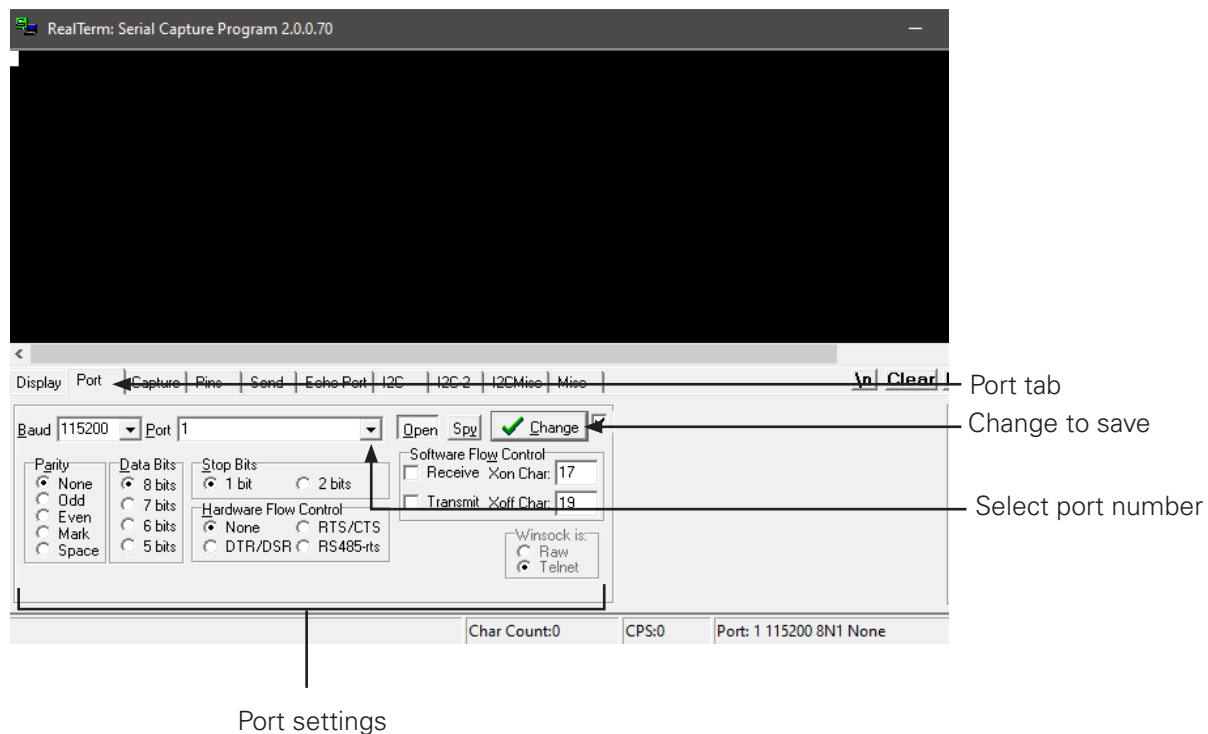
OPERATION CONTINUED

7. Click on the "Send" tab.

8. Check the first 4 boxes in the "EOL" section. FIG. 4-3.

9. Communication software configuration is complete. Continue to next section to view output data if desired.

FIG. 4-3
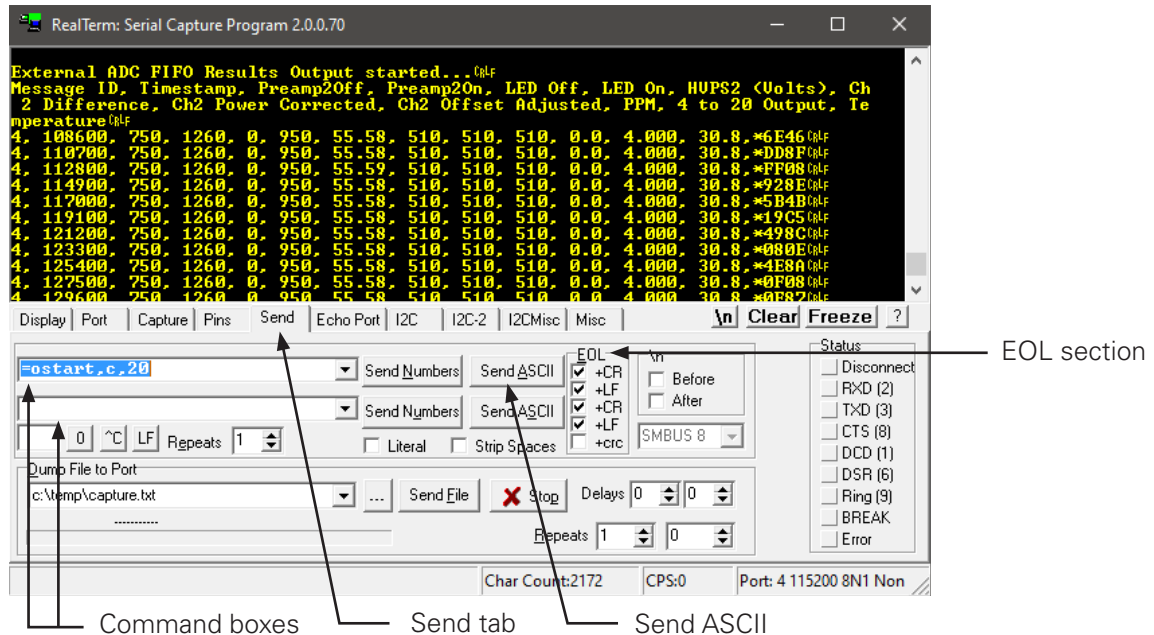
OUTPUT DATA

Once RealTerm has been installed and configured as per instructions on the "Communication Software Configuration" section, please follow the steps below to view output data.

1. Go to the "Send" tab, type "=ostart,c,20" on the first command box and click on "Send ASCII." FIG. 4-3. Readings will be displayed in the RealTerm menu. See FIG. 4-4 and FIG. 4-5 on pages 23-24 for output data definitions according to your OOD's serial number.

   If the output readings do not display in the RealTerm menu, proceed to the "RS232 Communication" troubleshooting section on page 35 of this manual.

2. Type "=ostop,c" in either command box and click on "Send ASCII" to stop the data. Always do this before disconnecting.

FIG. 4-4 Output data OOD models serial numbers OOD-19-140 or lower
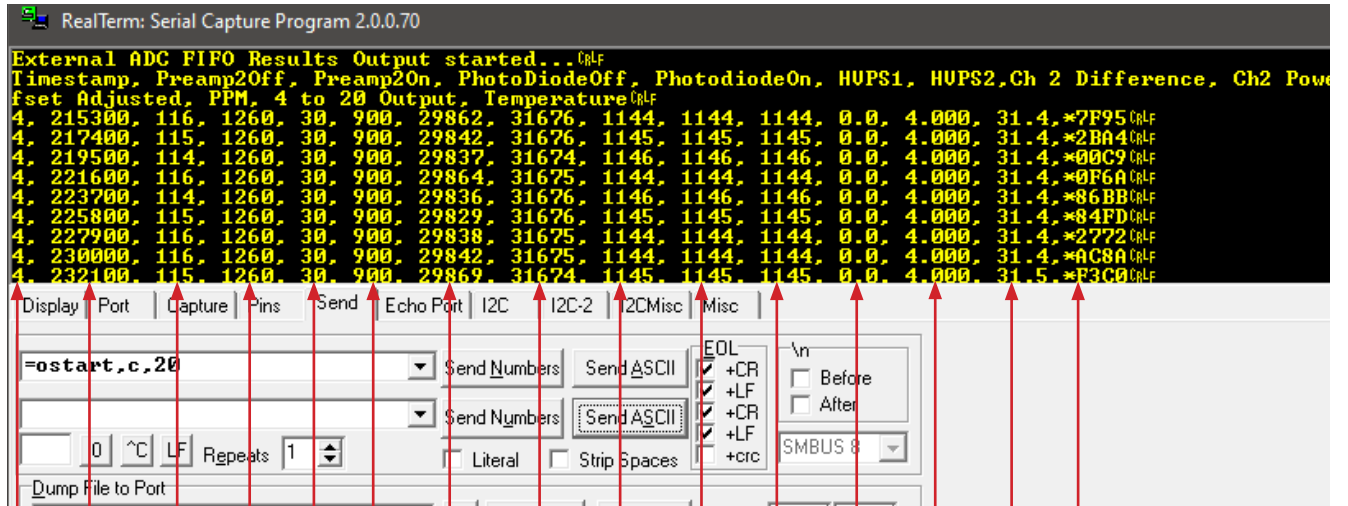
Column 15 – CRC Cyclic Redundancy Check (for information only)

Column 14 – Electronics temperature: Range 0.0 to 70.0 °C

Column 13 – 4-20 mA Output Loop

Column 12 – Oil output: Range 0 to 5,000 ppm (Max)

Column 11 – Offset level compensated PD Sensor Signal

Column 10 – Light source compensated PD sensor signal

Column 9 – Differential value between the PD sensor signal and the background signal

Column 8 – PD sensor voltage: Range 28,000 to 45,000

Column 7 – For factory use only

Column 6 – LED On signal: Shows the value of the LED light source when it is on. Range 500 to 1,023

Column 5 – LED Off signal: Shows the value of the LED light source when it is off. Range 0 to 150

Column 4 – PD sensor signal: Shows the output value from the PD sensor when the light source is on. Range background sensor signal value to 65,535

Column 3 – Background signal: Shows the output value from the PD sensor when the light source is off. Range 0 to 2,500

Column 2 – Time code (for information only)

Column 1 – Message ID (for information only)

OPERATION CONTINUED

FIG. 4-5 Output data OOD models serial numbers OOD-19-141 or higher

Column 14 - CRC Cyclic Redundancy Check (for information only)

Column 13 – Electronics temperature. Range: 0.0 to 70.0 °C

Column 12 – 4-20 mA Output Loop

Column 11 – Oil Output: Range 0 to 5,000 ppm (Max)

Column 10 – Offset level compensated PD sensor signal

Column 9 – Light source compensated PD sensor signal

Column 8 – Differential value between the PD sensor signal and the background signal

Column 7 – PD sensor voltage: Range 47.0 to 55.0

Column 6 – LED On signal: Shows the value of the LED light source when it is on. Range: 500 to 1,023

Column 5 – LED Off signal: Shows the value of the LED light source when it is off. Range: 0 to 150

Column 4 – PD sensor signal: Shows the output value from the PD sensor when the light source is on. Range background sensor signal value to 65,535

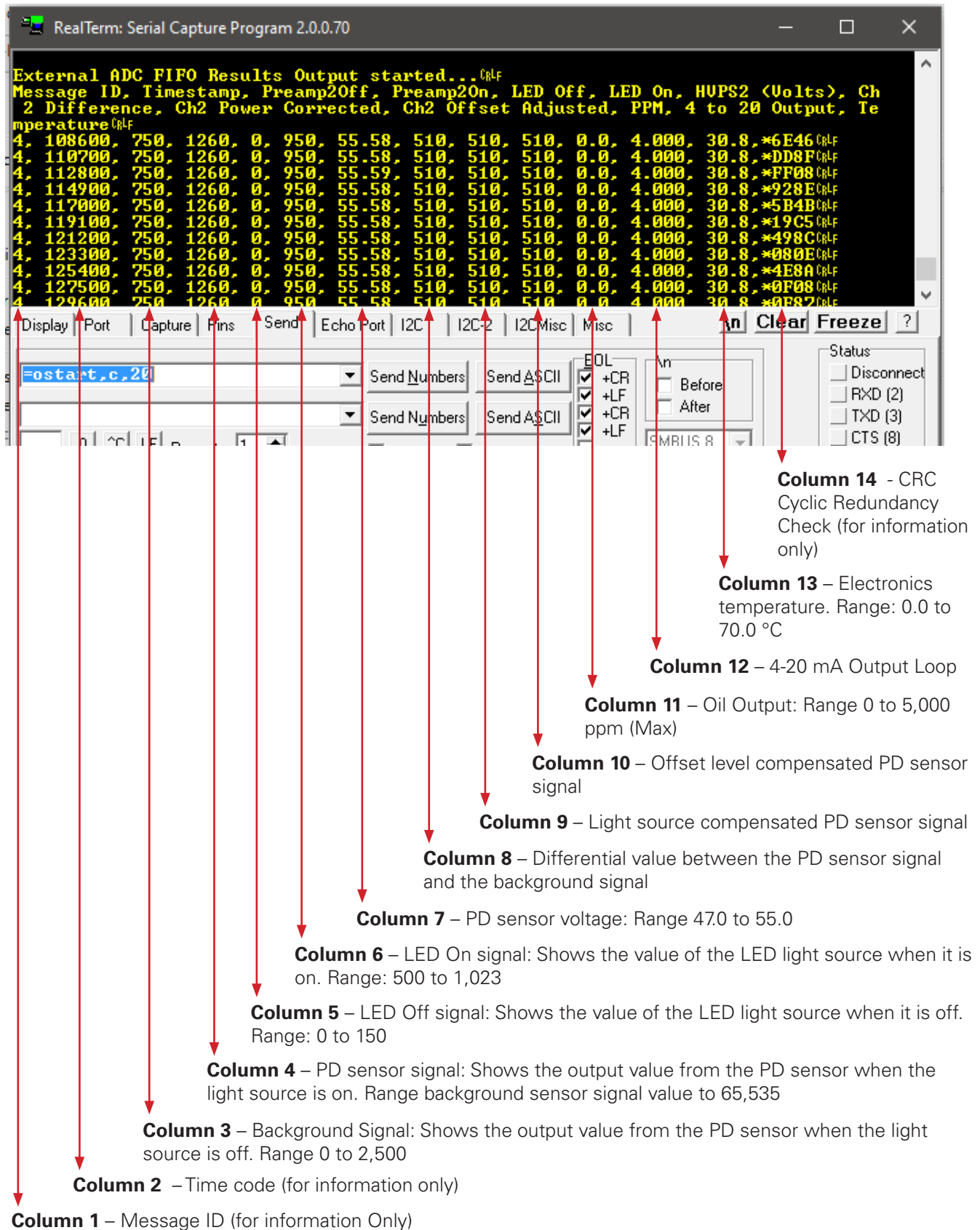**Column 3** – Background Signal: Shows the output value from the PD sensor when the light source is off. Range 0 to 2,500

Column 2 – Time code (for information only)

Column 1 – Message ID (for information Only)
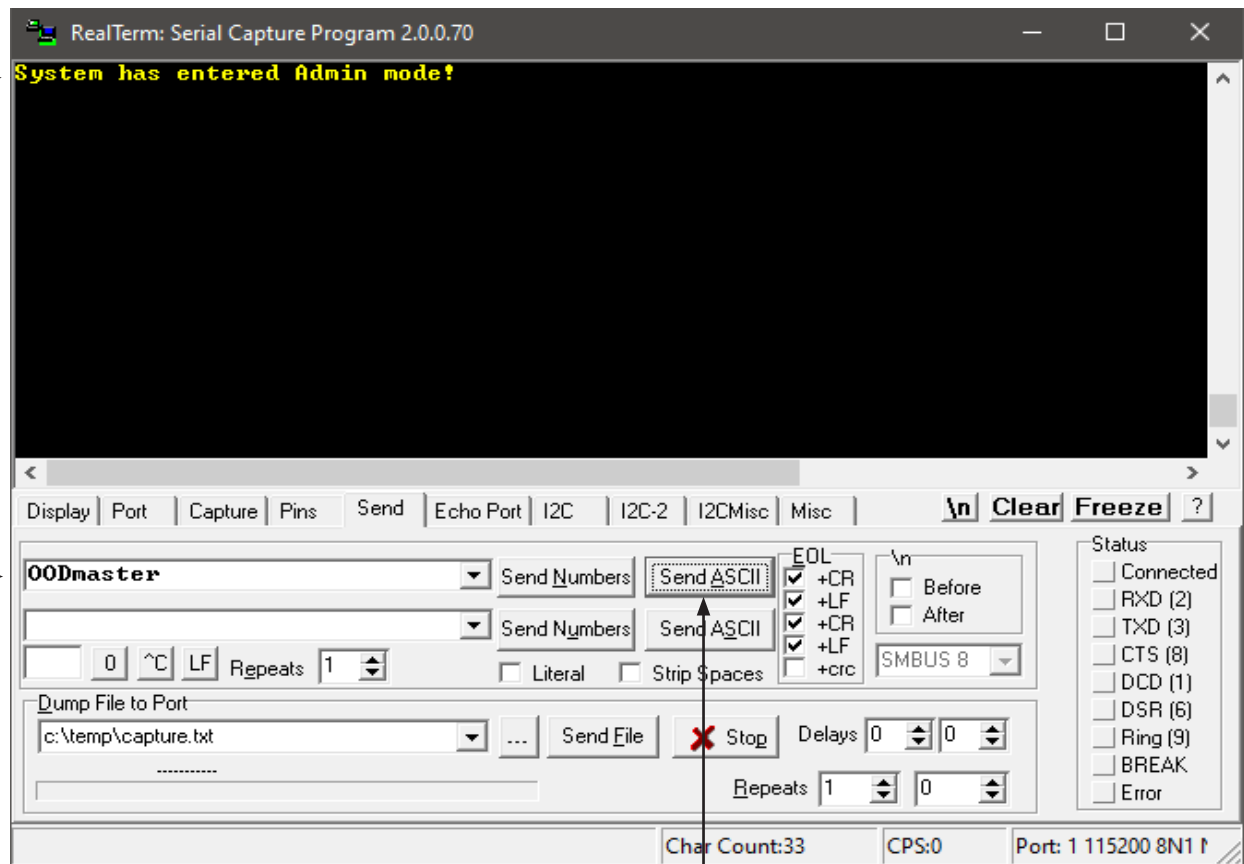
OPERATION CONTINUED

FIELD CALIBRATION

Though the KAM® OOD™ sensor is factory calibrated, it should be calibrated in the field to suit specific application requirements.

PLEASE NOTE: The following calibration steps are to be conducted during initial installation with existing process conditions, during routine verification procedures, or when OOD readings indicate a slight drift off acceptable accuracies in continuous operation. The procedure should be performed while the OOD is installed in the pipeline. You will need an RS232 cable (supplied), a USB to serial converter (supplied), a PC equipped with RealTerm software, and a means for manually collecting and measuring samples.

1. Ensure power to the OOD is turned off. To access the boards, use a 7/16" wrench to remove the (6) hex screws on the electronics enclosure and remove the cover. Connect your PC to the OOD sensor via the supplied RS232 serial cable and USB to serial converter as per wiring diagram shown on page 14, FIG. 3-17.

2. Turn on power to the OOD.

3. If not already done so, launch RealTerm and follow steps indicated on pages 20-22 to configure RealTerm.

4. Type "OODmaster" (case sensitive) in either command box under the "Send" tab and click on "Send ASCII." The following message will appear: "System has entered Admin mode!." FIG. 4-6.
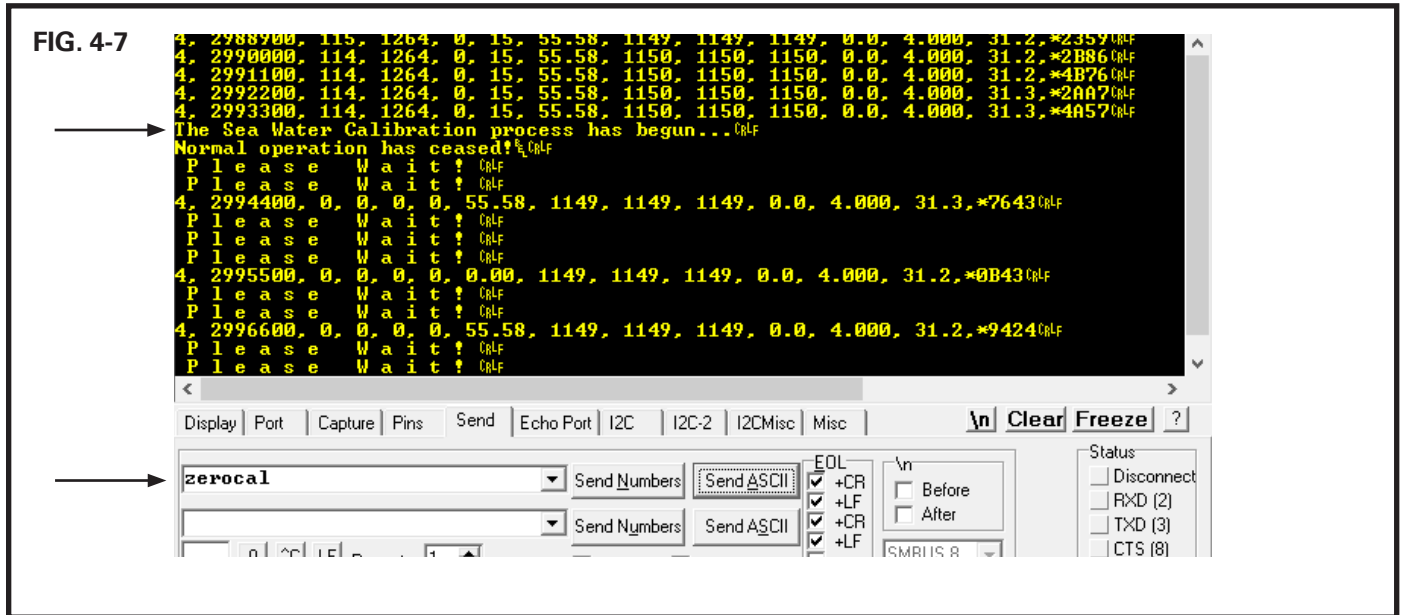
FIG. 4-6

Send ASCII

OPERATION CONTINUED

5. Type "zerocal" on either command box and click on "Send ASCII." The OOD will average a few readings and calibration results will be displayed along with the confirmation message. FIG. 4-7.

6. The OOD is now calibrated and will read current pipeline conditions as 0 ppm oil.

FIG. 4-7

SETTING THE ALARM SETPOINT

Please follow the steps below once RealTerm has been installed and configured as per instructions on the "Communication Software Configuration" section on pages 20-22.

1. Ensure power to the OOD is turned off. 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. Connect your PC to the OOD sensor via the supplied RS232 serial cable and USB to serial converter as per wiring diagram on page 14 of this manual.

2. Turn on power to the OOD and launch RealTerm.

3. Go to the "Send" tab and type "OODmaster" (case sensitive) in either command box. Click on "Send ASCII." There will be a return message: "System has entered Admin mode!" FIG. 4-8.

FIG. 4-8
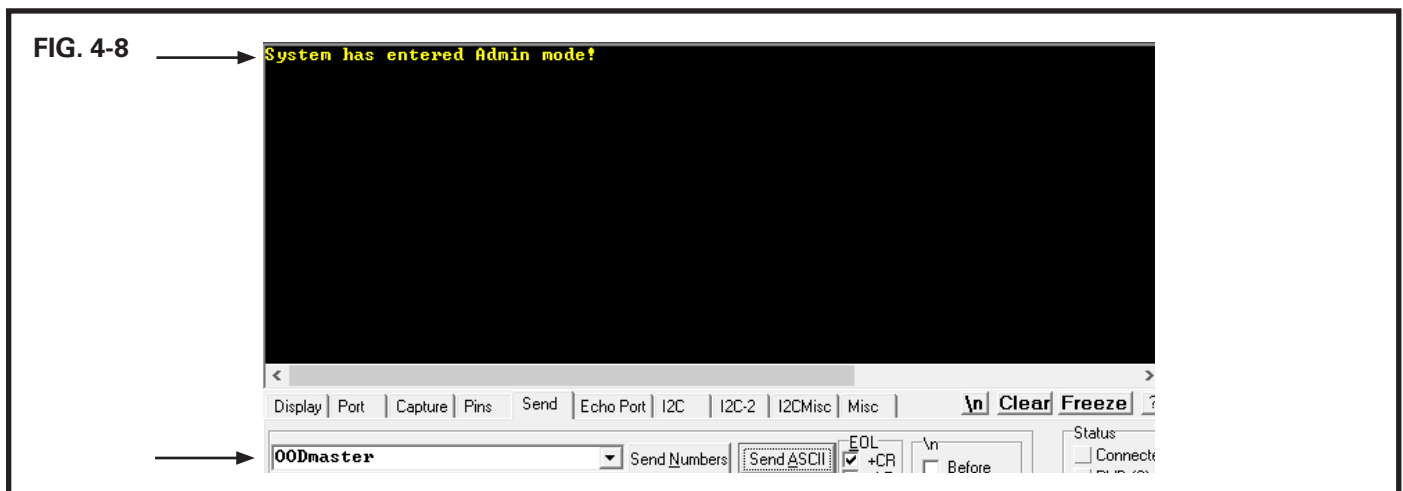
4. To set the alarm (DIGITAL OUT) type the command "=proc,ALMHi,<value>"
   For example: "=proc,ALMHi,5000" (5000 is the ppm level where the alarm will activate).

5. Click on "Send ASCII." The configured values for process parameters will be displayed. The new alarm value will be displayed next to "Alarm Value" FIG. 4-9.

FIG. 4-9

New alarm value →
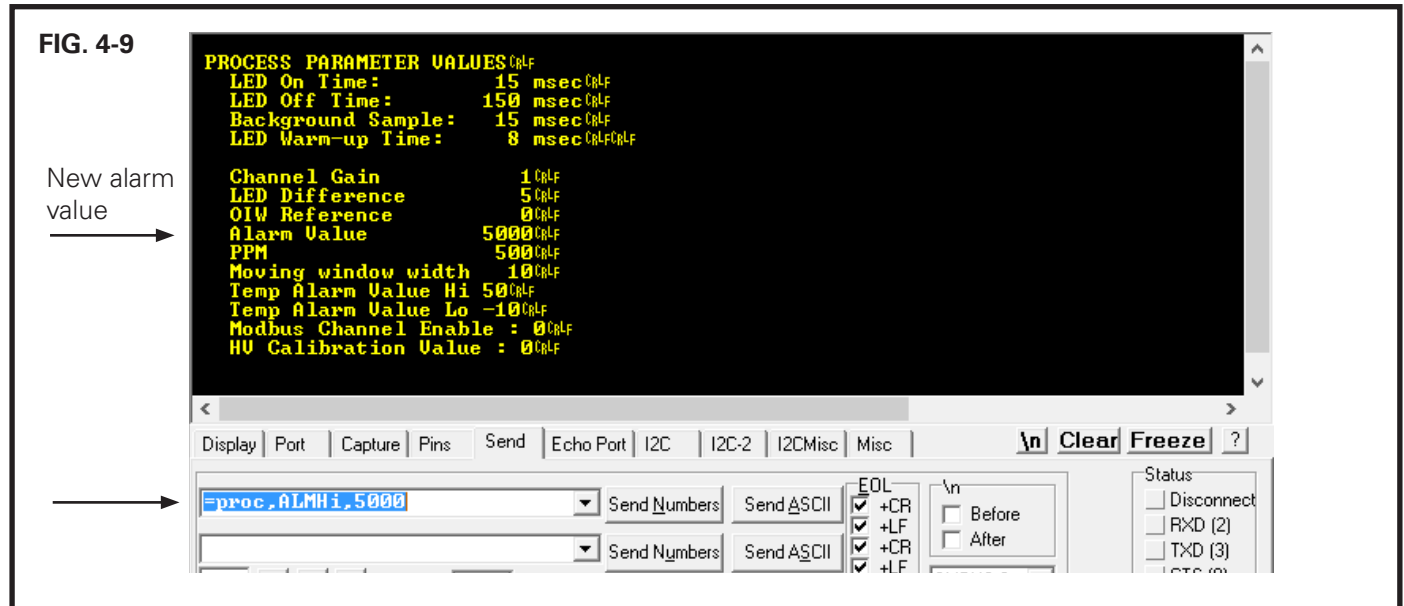
ENABLING / DISABLING MODBUS

Unless requested, Modbus is usually disabled prior to shipment from KAM. If not done so already, please install and configure RealTerm as per instructions on pages 20-22 of this manual.

1. Connect your PC to the OOD sensor via the supplied RS232 serial cable and USB to serial converter as per the wiring diagram on page 14 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.

2. Launch RealTerm on your computer. Go to the "Send" tab, type "?modbus" on either command box and click on "Send ASCII" to check Modbus status. The Modbus parameters will appear on the RealTerm window. FIG. 4-10.
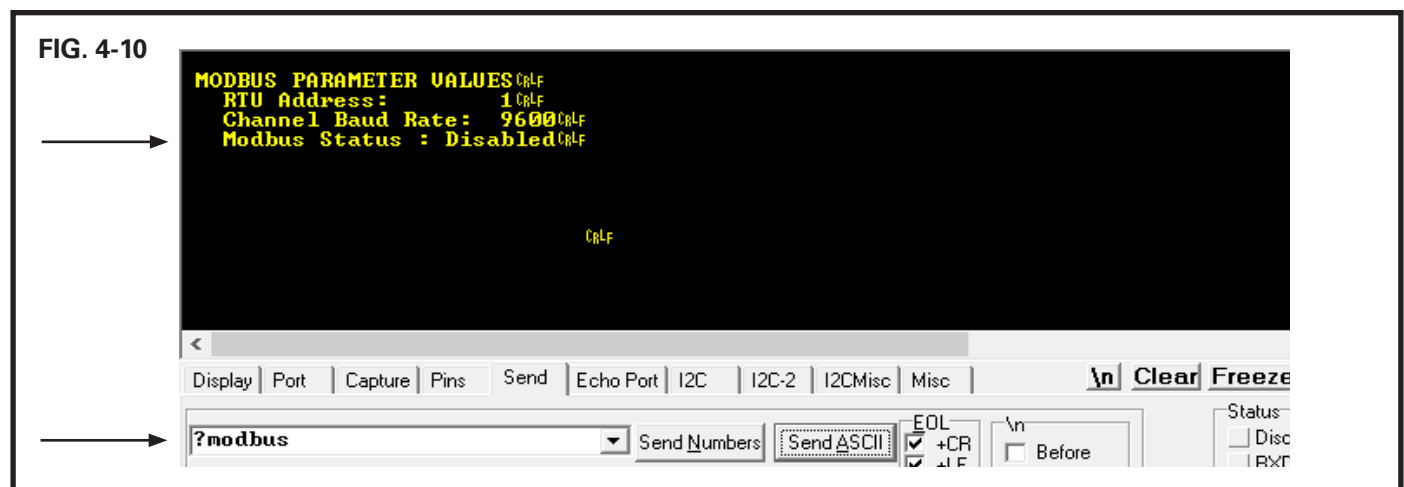
FIG. 4-10

OPERATION CONTINUED

3. Type the command "!modbus" and click on "Send ASCII" to enable Modbus. Modbus status will change to "Enabled" confirming the change. FIG. 4-11.

FIG. 4-11

```
MODBUS PARAMETER VALUES, false
    RTU Address:         1
    Channel Baud Rate:  9600
    Modbus Status : Enabled
```

Display | Port | Capture | Pins | Send | Echo Port | I2C | I2C-2 | I2CMisc | Misc | \n Clear Freeze ?

!modbus ▼ Send Numbers | Send ASCII |

EOL ☑ +CR ☑ +LF \n ☐ Before ☐ After Status ☐ Connecte ☐ RXD (2)

▼ Send Numbers | Send ASCII | ☑ +CR ☑ +LF ☐ TXD (3)
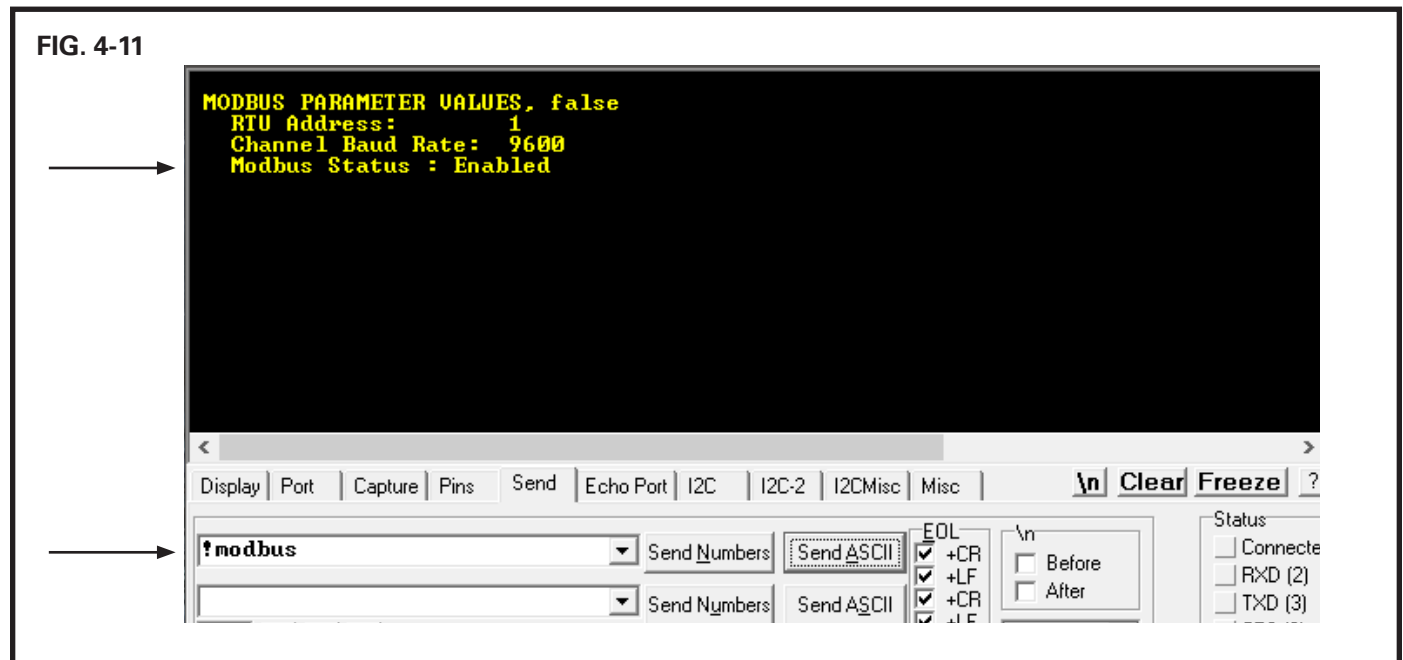
4. Power cycle (turn off and on) the OOD to start the Modbus communication.

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

OPERATION CONTINUED

CHANGING THE MODBUS ADDRESS

1. To access the boards, use a 7/16" wrench to remove the (6) screws on the electronics enclosure and remove the cover. Connect the RS232 Serial cable (provided) to the OOD per the wiring diagram on page 14 of this manual.

2. Follow instructions to install and configure RealTerm on pages 20-22 of this manual.

3. Type "OODmaster"(case sensitive) in either command box and click on "Send ASCII." FIG. 4-12.
There will be a return message: "System has entered Admin mode!"

FIG. 4-12
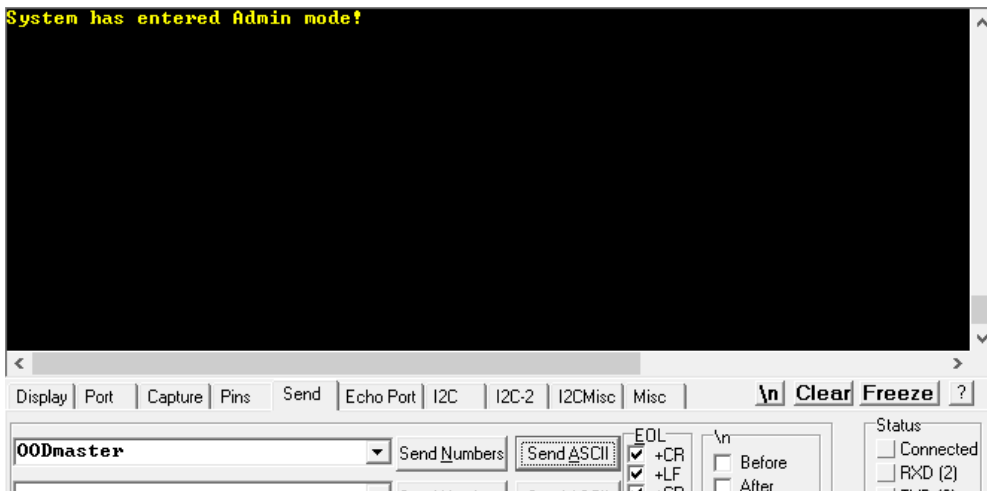
4. Type the command "=modbus,2,9600" and click on "Send ASCII." FIG. 4-13.
The #2 represents the new address. That number can be any number from 1 to 247.

FIG. 4-13

5. To complete the change, turn the OOD power off, wait two seconds and turn it back on.

OPERATION CONTINUED

RECOMMENDED RS485 CONNECTIONS

1. If you haven't already done so, follow instructions on the "Enabling/Disabling Modbus" on pages 27-28 of this manual to enable Modbus.

2. Ensure power to the OOD is turned off.
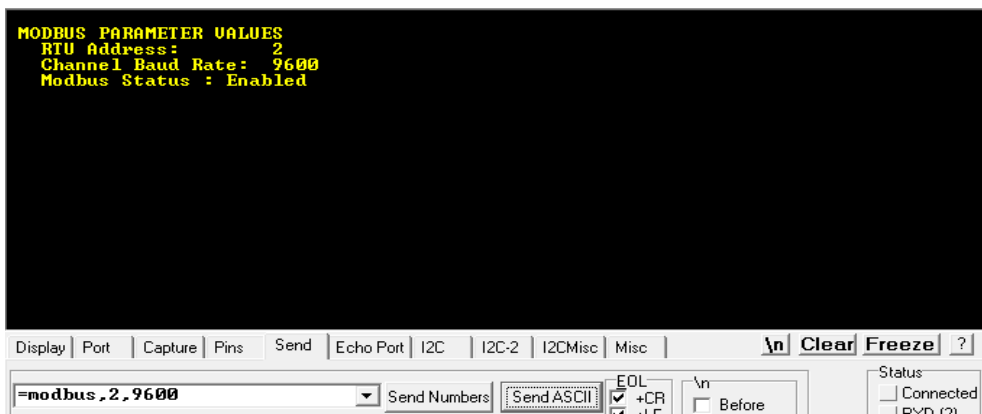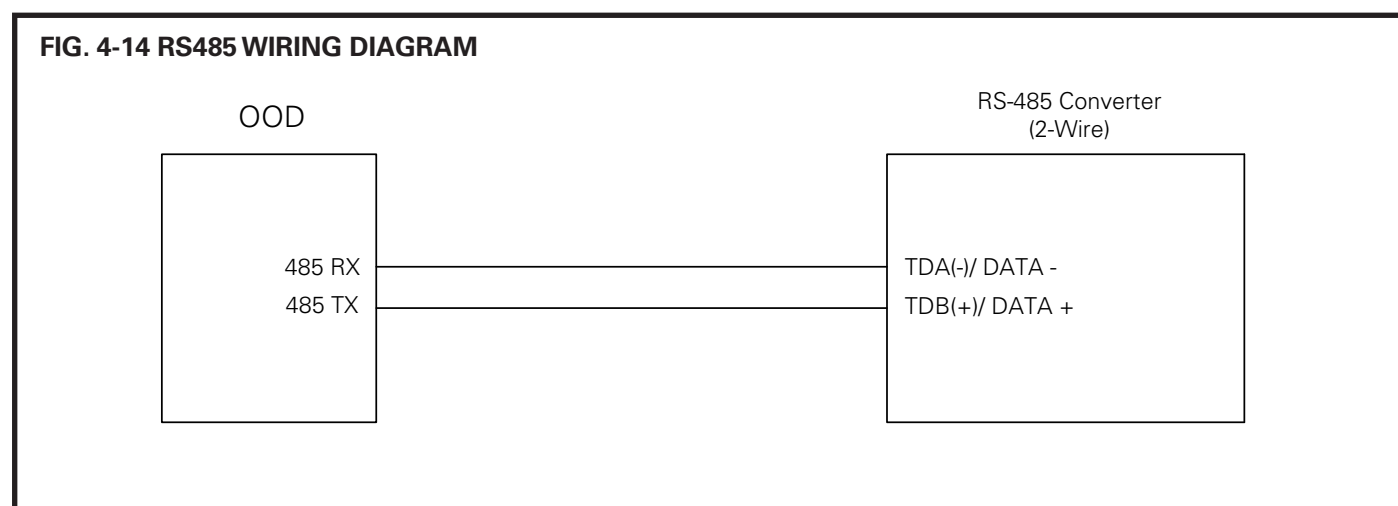
3. Set any jumpers on the RS485 converter to use two-wire mode.

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

5. Hook up the 485 TX terminal on the OOD's top board to Data(+) line on the RS485 converter. FIG. 4-14.

6. Hook up the 485 RX terminal on the OOD's top board to the Data(-) line on the RS485 converter. FIG. 4-14.

FIG. 4-14 RS485 WIRING DIAGRAM

OOD

RS-485 Converter
(2-Wire)

485 RX — TDA(-)/ DATA -
485 TX — TDB(+)/ DATA +

---

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

8. 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.

9. 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 29 if necessary).
Offset: 0

OPERATION CONTINUED

10. Make sure that the correct registers are being read as 32 bit float. See Table 4-1.

TABLE 4-1

OOD Modbus Registers		
Register No	Type	Description
42001	32bit Float	Background offset
42003	32bit Float	Signal in from Photodiode
42004	32bit Float	LED OFF status
42005	32bit Float	LED ON status
42006	32bit Float	Electronics temperature in Celsius
42008	32bit Float	4-20mA output
42009	32bit Float	Oil content in ppm

11. Connect the converter to the computer and power on the OOD.

5 MAINTENANCE

CLEANING

Properly installed and under normal operation, the KAM® OOD™ should not require cleaning, as the perpendicular flow should keep the lens free of any build up.

However, in some cases it may be necessary to clean the lens of any residue. To do so, first follow the instructions to uninstall or remove the OOD from the pipeline (page 11) and place the OOD on a flat surface. Use a clean cloth with oil solvent or part washer to carefully clean the lens at the tip of the probe. Preferred solvents include, any petroleum solvent such as mineral spirits, 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: AskAnEngineer@Kam.com

6 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.
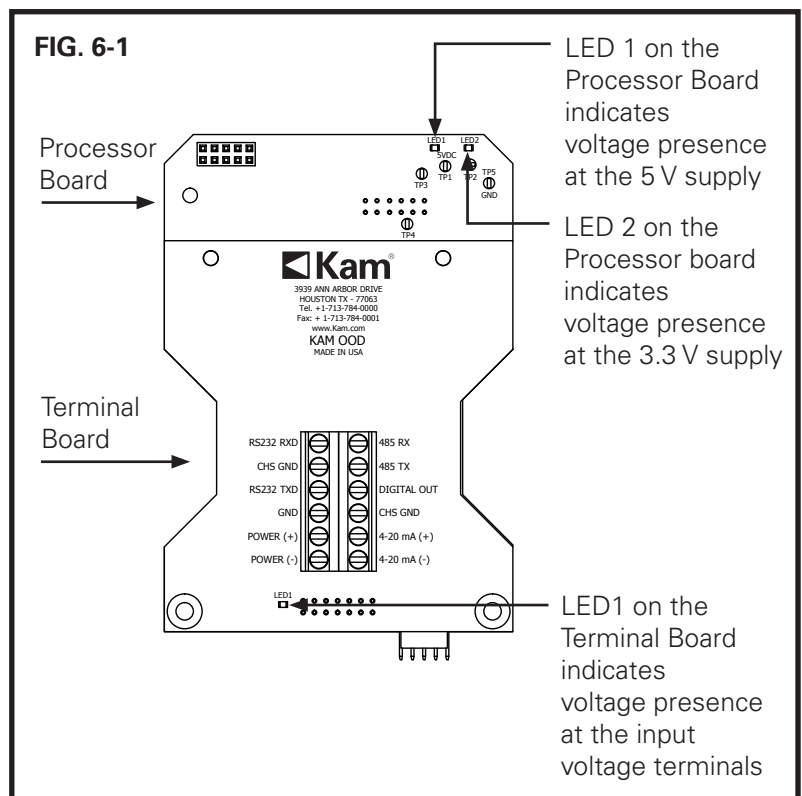
A device to measure both voltage and amperage is needed during the troubleshooting process. Please have a multimeter available before proceeding.

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 3 LEDs on the OOD electronics (two on the Processor Board and one on the 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 POWER (+) and POWER (-). The voltage should be within the instrument's requirements (12 V to 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 OOD terminals. If the voltage is not within those requirements, verify that the power supply has a wattage capability of 5 Watts, and check for any blown fuses, faulty wiring, or a faulty power supply. If LED1 on the Terminal Board does not light up, but the voltage at the power terminals is within the appropriate range, it indicates a bad LED. The faulty LED will not affect the operation of the instrument, since it is only an indicator that a voltage is present.

2. Once voltage across power loop terminals has been verified, make sure the OOD is wired with the correct polarity as per the wiring diagram on page 14 of this manual. If the polarity is wrong, turn off the power and rewire the OOD with the correct polarity. Turn the power back on when done.

FIG. 6-1

Processor Board

LED 1 on the Processor Board indicates voltage presence at the 5 V supply

LED 2 on the Processor board indicates voltage presence at the 3.3 V supply

Terminal Board

RS232 RXD
CHS GND
RS232 TXD
GND
POWER (+)
POWER (-)

485 RX
485 TX
DIGITAL OUT
CHS GND
4-20 mA (+)
4-20 mA (-)

LED1 on the Terminal Board indicates voltage presence at the input voltage terminals

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

3. Use a mutimeter in voltmeter mode to verify the voltage of the Processor Board's primary power supply by measuring across TP1 and TP5 (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 processor board is not working properly or there is a short circuit on the board. The Processor Board needs to be fixed or replaced. Contact KAM Technical Support for further assistance.

   NOTE: LED 1 on the Processor Board remains lit when there is voltage between TP1 and TP5. If not, it indicates a faulty LED. The faulty LED will not affect the operation of the instrument, but a Processor Board repair is recommended.

4. Use a multimeter in voltmeter mode to verify the voltage of the Processor Board's secondary power supply by measuring across TP2 and TP5 (GND). It should be between +3.1 VDC and 3.4 VDC.

   If you have a voltage lower than 3.1 VDC, it indicates that the secondary power supply is not working properly or there is a short circuit on the board. The Processor Board needs to be fixed or replaced. Contact KAM Technical Support for further assistance.

   NOTE: LED 2 on the Processor Board remains lit when there is voltage between TP2 and TP5 (GND). If not, it indicates a faulty LED. The faulty LED will not affect the operation of the instrument, but a Processor Board repair is recommended.

4-20 mA OUTPUT LOOP

Once the power supplies have been verified, 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 VDC. 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 to fully close the 4-20 mA+ and 4-20 mA- terminals. 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 VDC to 12.0 VDC. 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 OOD as per the wiring diagram on FIG. 3-18, page 15. If the PLC cannot read the output, there could be a wiring issue with the loop. Please inspect the wires from the OOD 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.

TROUBLESHOOTING CONTINUED

RS232 COMMUNICATION

If you have not already done so, follow the previous procedures of the Troubleshooting section to verify power supplies and check the 4-20 mA output.

Before proceeding, please ensure that RealTerm has been installed and properly configured as per instructions on pages 20-22 of this manual. Also, please verify the driver for the supplied USB to serial converter is installed on your PC.

1. Using a multimeter in voltmeter mode, measure the voltage between the terminals RS232 TXD and GND. Ensure the terminal screws on the board are fully closed. The voltage should be between -5 and -10 VDC. If the voltage is not between the stated range, then the RS232 communication circuit might be damaged. Please contact KAM Technical Support for further assistance.

2. If the voltage is within the stated range, proceed to connect the supplied RS232 serial cable and USB to serial converter to your computer and launch RealTerm.

3. 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 these wires are connected, type any letter (e.g. "q") in any of the command boxes of the "Send" tab on RealTerm and click on "Send ASCII." If the configuration is done properly, the letter will appear in the window display. FIG. 6-2.

FIG. 6-2
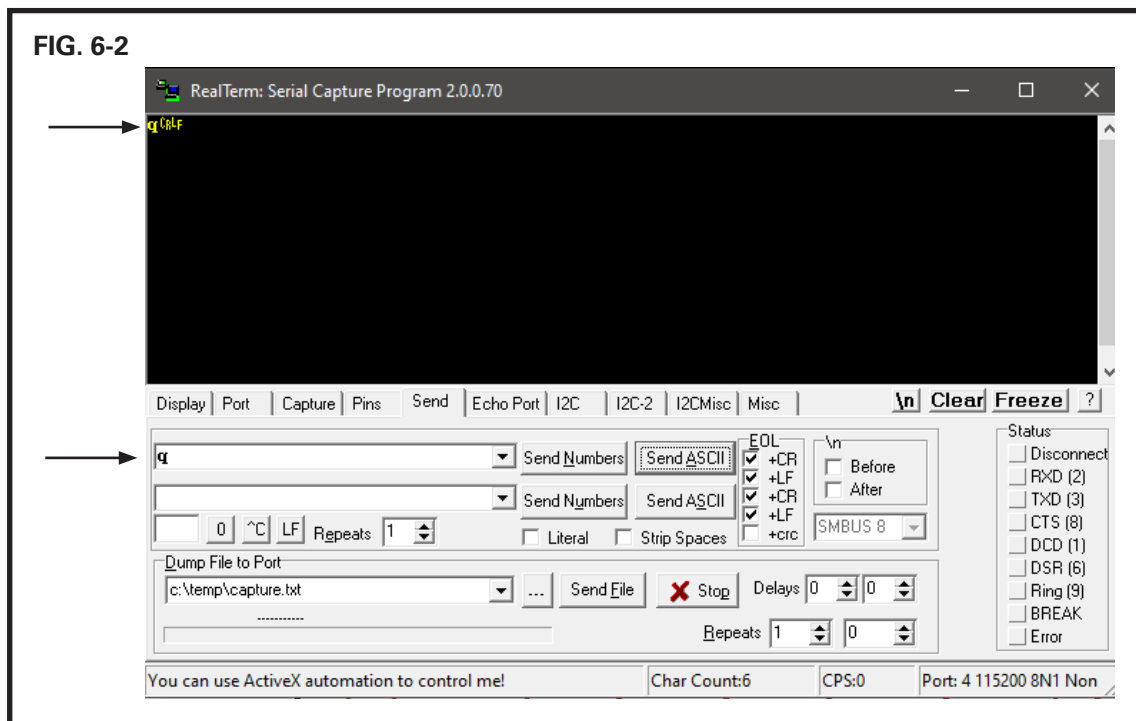
If there is no response, verify the RealTerm settings as per the instructions on pages 20-22 of this manual and try sending the command again.

If there is no change, use another RS232 serial cable and/or USB to serial converter and try sending the command once more.

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.

4. Once the letter appears on the window display, connect the RS232 serial cable to the OOD as per the wiring diagram on page 14 of this manual.

5. 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 VDC. If the voltage is not between the stated range, then the RS232 serial cable and/or the USB to serial converter might be damaged. They need to be replaced. Contact KAM Technical Support for further assistance.

   If the voltage is within the specified range, please continue to the next section and follow instructions for debugging the electronics.

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 it is still having issues.

Before proceeding, please ensure that RealTerm has been installed and properly configured as per instructions on pages 20-22 of this manual. Also, please verify the driver for the supplied USB to serial converter is installed on your PC.

1. Launch RealTerm and type "=ostart,c,20" in either command box on the "Send" tab and click on "Send ASCII." The instrument's data will start being displayed. If not, contact KAM Technical Support for further assistance. FIG. 6-3 & FIG. 6-4.

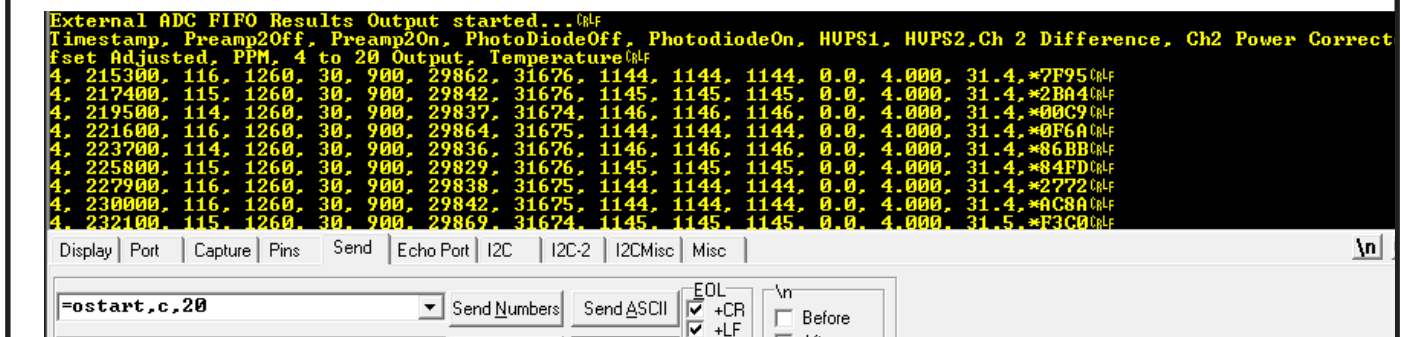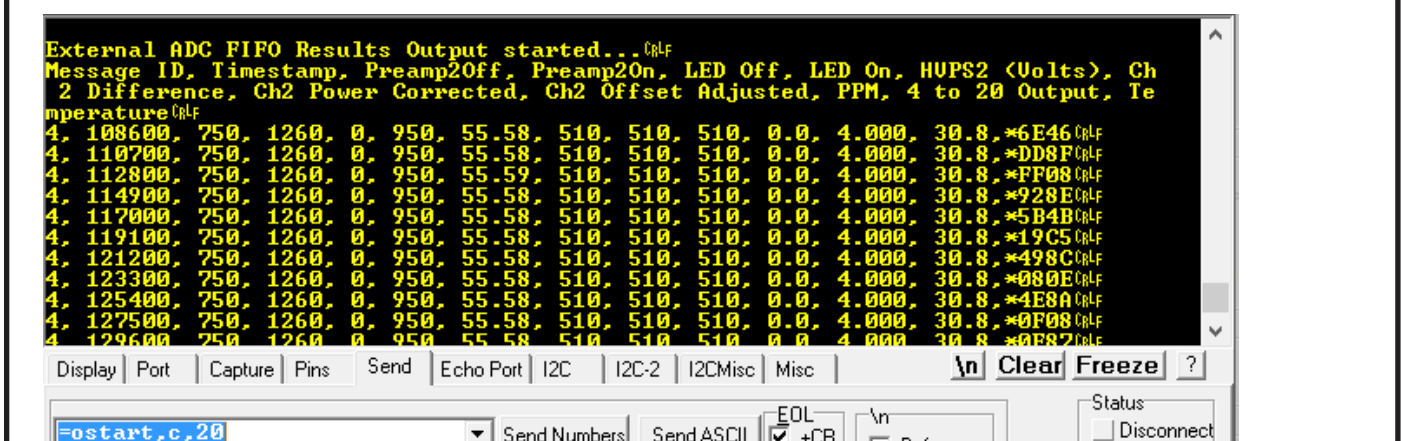**FIG. 6-3** Output data OOD models serial numbers OOD-19-140 or lower

FIG. 6-4 Output data OOD models serial numbers OOD-19-141 or higher

2. Compare the value of the background signal (column 3) against the value of the PD sensor signal (Column 4). The PD sensor signal should have a value of at least 500 counts higher than the background signal. If these two values have the specified difference, continue to the next step. If not, contact KAM Technical Support for further assistance.

3. Verify that the value of the LED Off signal (column 5) is between 0 and 150 and the value of the LED On signal (Column 6) is between 500 and 1,024. If the values of these signals are within the stated limits, continue to the next step. If not, contact KAM Technical Support for further assistance.

4. Verify the value of the PD sensor voltage as follows:

   For Serial Numbers OOD-19-140 or lower: Column 8 should have a value in between 28,000 and 45,000.
   For Serial Numbers OOD-19-141 or higher: Column 7 should be in between 47.0 and 57.0 volts.

   If the voltage is within the stated limits, continue to the next step. If not, contact KAM Technical Support for further assistance.

5. Use a multimeter in ammeter mode to measure the output current loop across the 4-20 mA+ and 4-20 mA- terminals on the top board. This voltage should match the value of the 4-20 mA current output (column 12) displayed on RealTerm. If the values do not match, please 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 30 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 OOD per the wiring diagram on page 14 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 me measured with respect to each other to conform to the RS485 standards. The bias is provided by the master device.

4. Ensure the OOD 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 OOD. The LEDs should be blinking while data is being sent/received.

6. If there is no differential voltage or there is no activity on the LED (if available) of the RS485 converter, contact KAM Technical Support for further assistance.