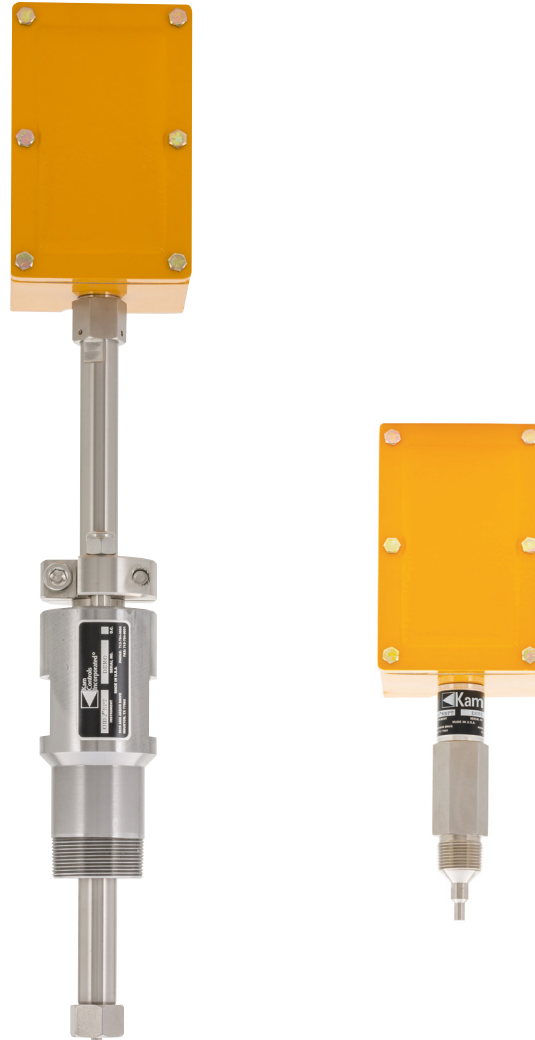




Simple Precision™



Kam® OFD™

Optical Fluorescence Detector



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An ISO 9001 certified company

User Manual

OFDMANUAL-0816
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CAUTION:

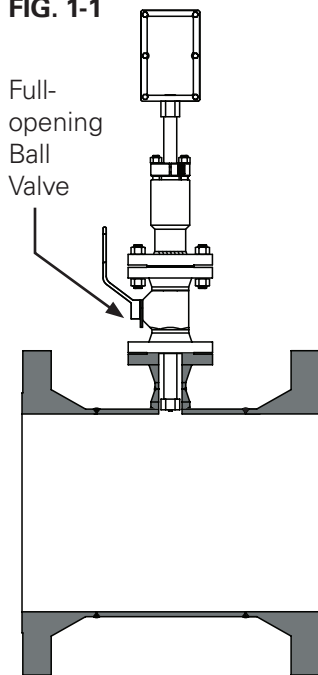
When installing the OFD™ sensor in a pipeline containing petroleum products, petrochemicals, waste waters with the presence of pressure & temperature, and high-pressure steam refer to the Pipeline Operators' "Health, Safety and Environmental Policy Procedures" to ensure safe installation.

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

INTRODUCTION

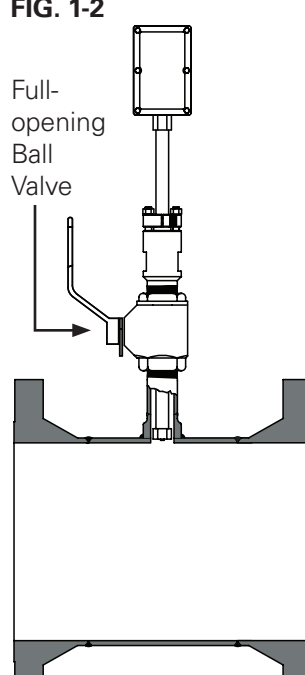
AVAILABLE MODELS and MOUNTING OPTIONS

FIG. 1-1



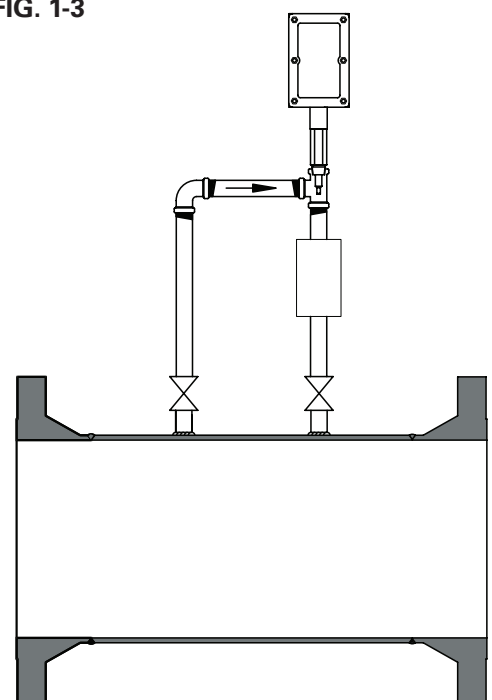
Retractable OFD™
on a main pipe, with
2", 3", or 4" flanged
seal housing

FIG. 1-2



Retractable OFD™
on a main pipe, with
2" MNPT seal housing

FIG. 1-3



OFD™ FT Flow Through
on a densitometer loop
with 3/4" or 1" MNPT

SPECIFICATIONS

Media:	Refined products
Material:	Wetted parts—316 stainless steel
Power:	12–24 VDC 15 Watts max (Max current is 1275 mA @ 12V and 637 mA @ 24V)
Output:	4-20 mA
Communication Port:	RS485 (MODBUS RTU) RS232 (Diagnostics)
Fluid temperature:	-40° to 160° F (-40° to 70° C)
Electronics temp.:	-40° to 160° F (-40° to 70° C)
Pressure ratings:	ANSI 150, 300, 600, 900 (flow-through models only)
Mounting:	3/4" and 1" MNPT Flow Through 2" MNPT Seal Housing Insertable/Retractable 2", 3", or 4" Flanged Seal Housing Insertable/Retractable
EX enclosure:	3" x 6" x 3" (76 mm x 152 mm x 76 mm)
Shaft length:	12" to 60" – Off-the-shelf lengths are 24", 30", 36", 48", and 60" (610 mm to 1524 mm) (Off-the-shelf 610 mm, 762 mm, 914.4 mm, 1219 mm, 1524 mm)
Pipe size:	3/4" to 48" (20 mm to 1200 mm)
Weight:	from 10 lbs. (4.5 kg)

SPECIFICATIONS CONTINUED

DIMENSIONAL DRAWINGS

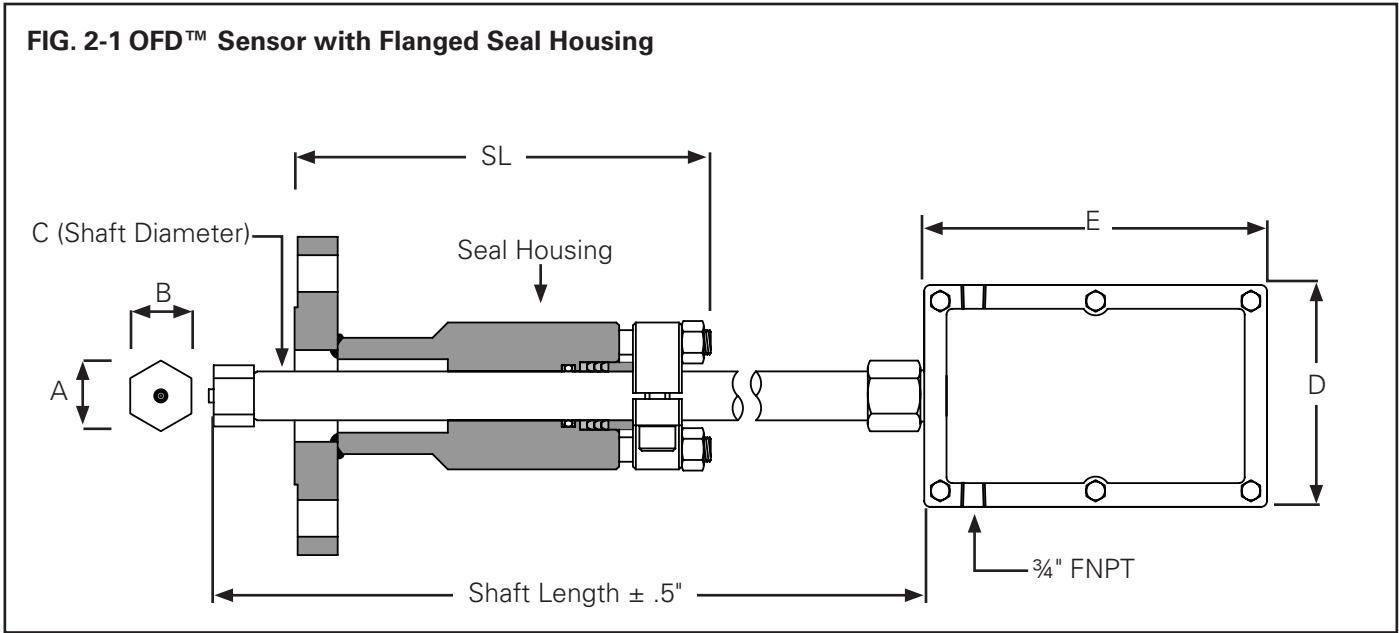


TABLE 2-2 Flange Size and Class (SL)

	150		300		600		900	
"	INCHES	MM	INCHES	MM	INCHES	MM	INCHES	MM
2	8.40	213	8.50	216	8.90	226	9.40	240
3	8.60	218	8.75	222	9.15	232	9.40	240
4	8.60	218	8.90	226	9.40	240	9.65	245

TABLE 2-3 DIMENSIONS

	INCHES	MM	Shaft Lengths are available in .5" (12.7 mm) increments. Standard sizes are 24", 30", 36", 48", and 60". (610 mm, 762 mm, 914.4 mm, 1219 mm, 1524 mm)
A	1.443	37	
B	1.25	32	
C	1	25	
D	4.53	115	
E	7	178	

SPECIFICATIONS CONTINUED

FIG. 2-4 FLOW THROUGH OFD™ for ANALYZER LOOP

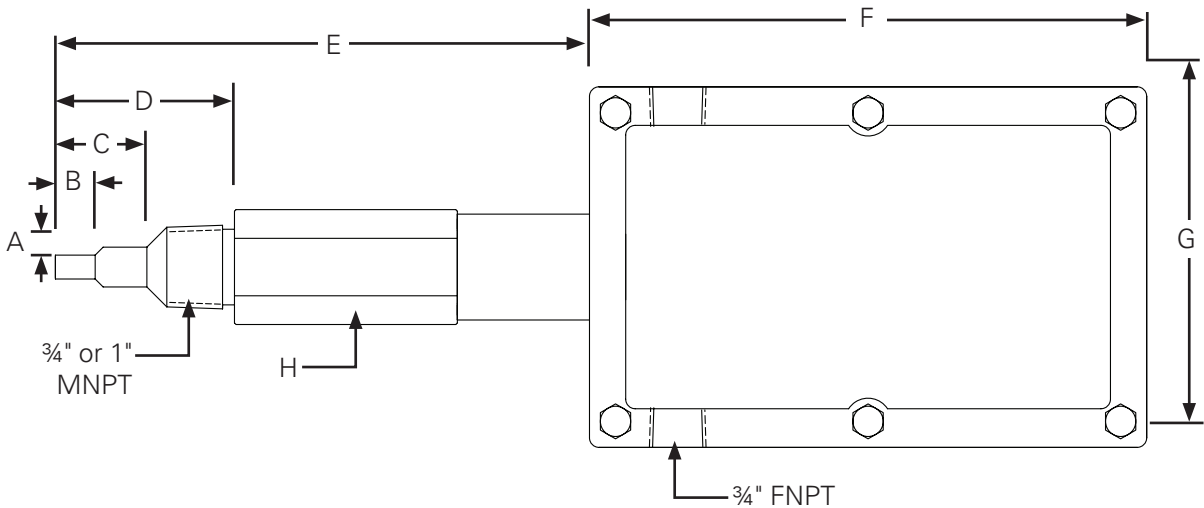


TABLE 2-5 3/4" MNPT DIMENSIONS

	INCHES	MM
A	.3	8
B	.5	13
C	1.4	36
D	2.25	57
E	6.75	171
F	7	178
G	4.53	115
H	1.2	30

TABLE 2-6 1" MNPT DIMENSIONS

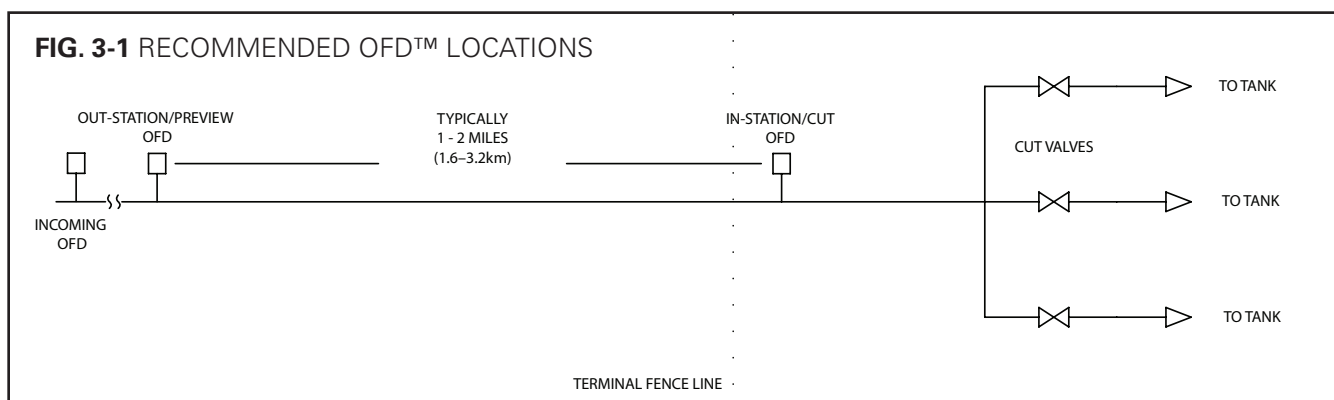
	INCHES	MM
A	.3	8
B	.5	13
C	1.45	37
D	2.4	61
E	6.75	171
F	7	178
G	4.53	115
H	1.3	33

INSTALLATION

LOCATION

For optimal batch detection, KAM CONTROLS recommends that you install the in-station OFD™ sensor at the first accessible pipeline location inside the terminal fence-line — upstream of the interface cut valve(s). This allows the operator ample time to open/close the cut valves prior to the arrival of the product interface.

KAM CONTROLS also strongly recommends that you utilize a preview (or out-station) OFD™ sensor. This lets the operator decide how to optimize each batch cut prior to actually making the batch cut at the in-station and gives the operator more confidence in their decisions as well as the time to identify and resolve any issues that may arise during a critical interface.



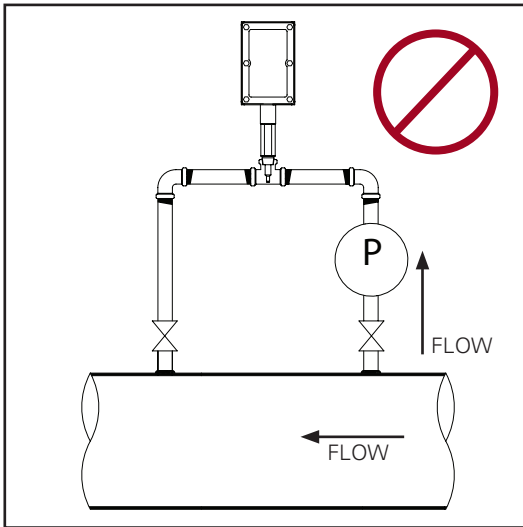
PRIOR TO INSTALLATION

Remove all the protective packaging materials including the red cap placed at the tip of the sensor probe. Ensure that the OFD™ sensor was not damaged during transit.

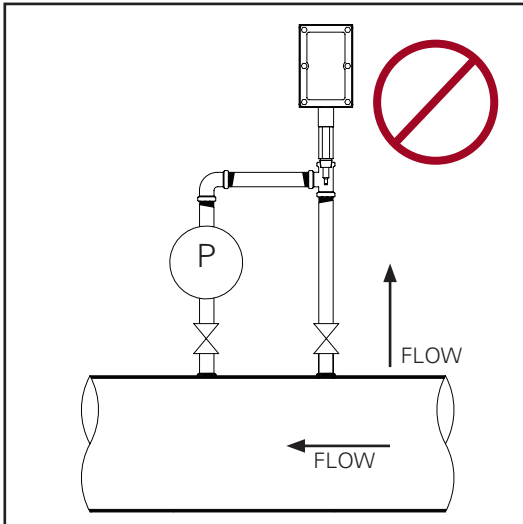
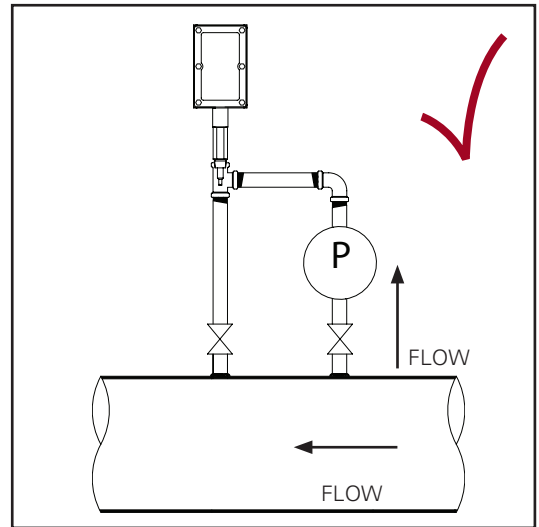
CAUTION: Do not stand the OFD™ sensor on the probe end or allow the probe to hit the ground or any hard surface under any circumstances. This will damage the lens, and the OFD™ sensor will not work properly.

INSTALLATION CONTINUED

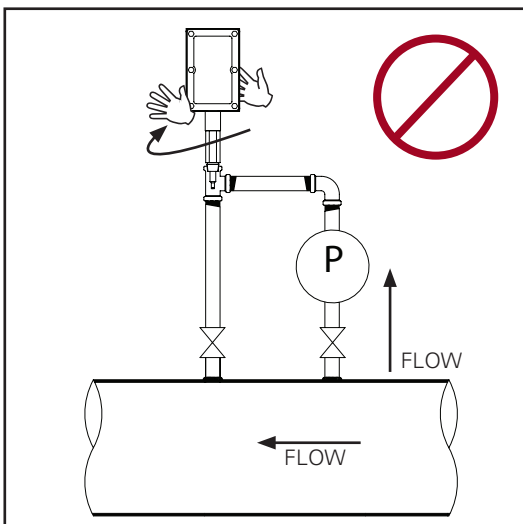
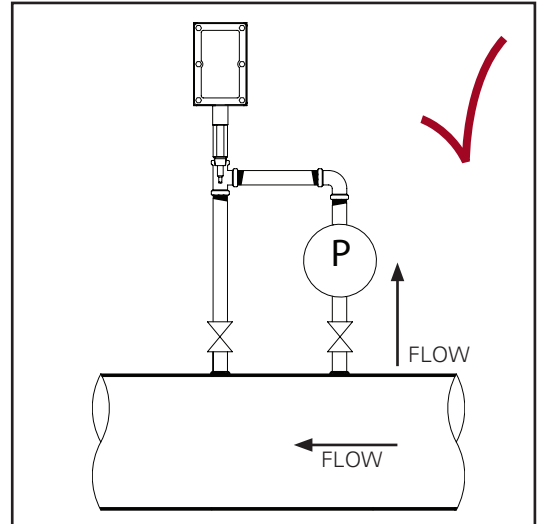
INSTALLATION DO'S AND DON'TS



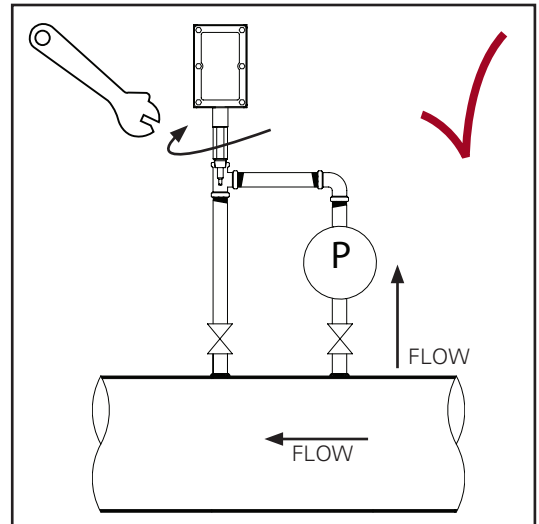
DO NOT install the fast loop OFD™ sensor in a straight portion of pipe. It needs to be mounted off the bend opposite the pump.



DO NOT install the OFD™ 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.

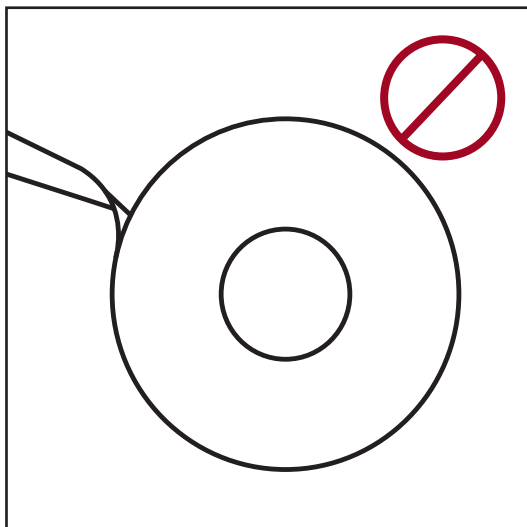


DO NOT attempt to screw the OFD™ sensor either in or out by hand. Always use a 1 1/4" or 1 3/8" wrench on the wrench flat below the electronics enclosure.

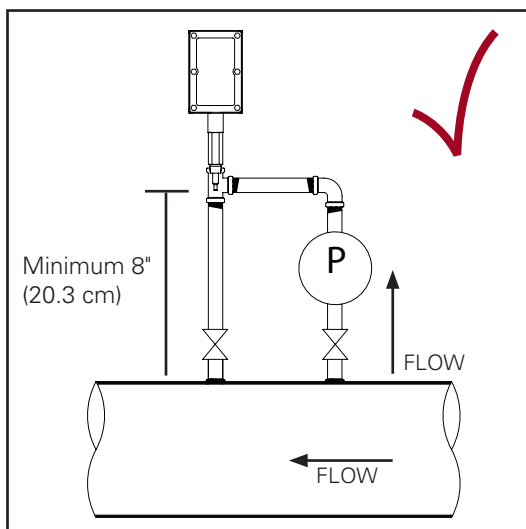
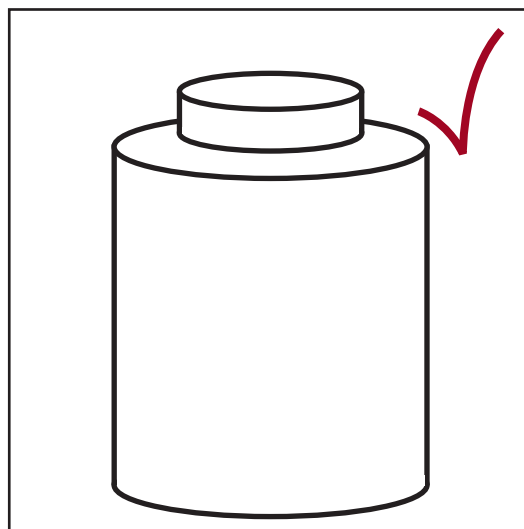


INSTALLATION CONTINUED

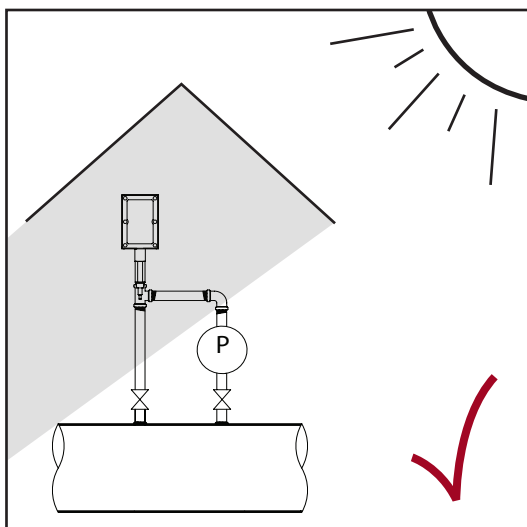
INSTALLATION DO'S AND DON'TS



DO NOT use teflon tape on the OFD™ sensor threads. DO use liquid thread sealant.



DO install the OFD™ sensor with a minimum of 8" or 200mm between the lens and the nearest flat surface.



DO install the OFD™ sensor with a sun shade if the electronics are directly exposed to sunlight.

INSTALLATION CONTINUED

PRIOR TO INSTALLATION

Remove all the protective packaging materials, and ensure that the OFD™ sensor was not damaged during transit.

MAIN LINE INSTALLATION

The KAM® OFD™ sensor should be installed according to FIG. 3-2. KAM CONTROLS recommends installing the OFD™ sensor at a 2 or 10 o'clock position to ensure the tip of the probe remains in the fluid. A full opening ball valve is used to isolate the OFD™ sensor from the pipeline during installation or removal. The seal housing of the OFD™ 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 OFD™ sensor is placed at the most representative point within the flow profile. The OFD™ sensor should be inserted so that the tip of the probe is located 1/4" above the inner wall of the pipeline. This ensures that the probe is not damaged when pigging the pipeline.

NOTE: If line pressure exceeds 100 psi, use a KAM® IT Insertion Tool when installing/removing the KAM® OFD™ sensor.

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

1. Lay the OFD™ sensor on the ground or a table.
2. Loosen Socket Cap Screws on the locking collar. This will allow the OFD™ shaft to slide through the seal housing.
3. Push the OFD™ shaft through the seal housing until the OFD™ probe sits flush with the end of the seal housing or seal housing flange. FIG. 3-3 and 3-4. (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. 3-2

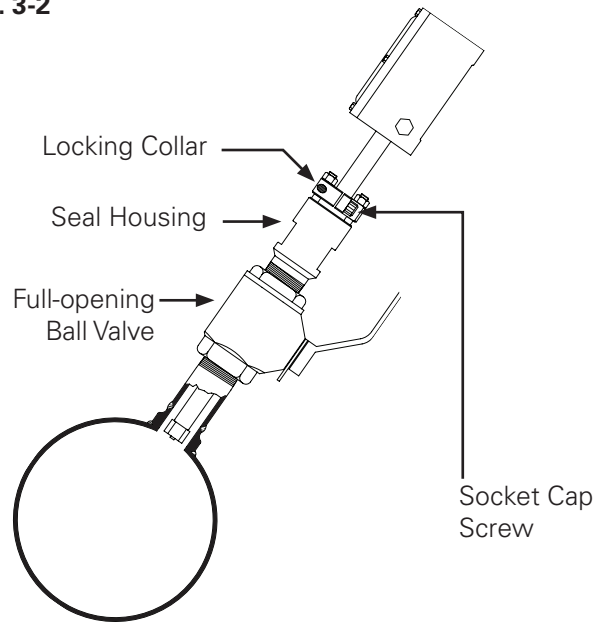


FIG. 3-3

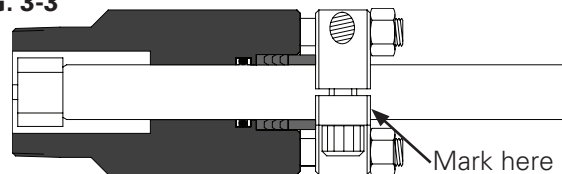
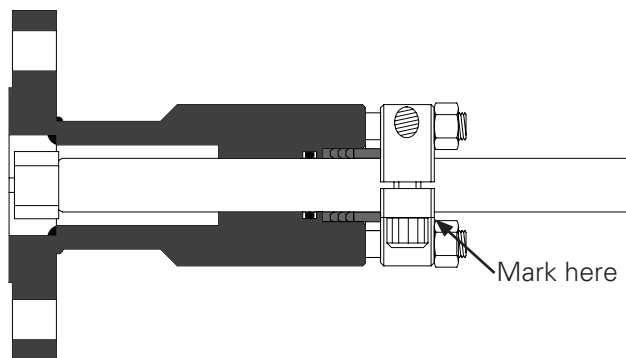
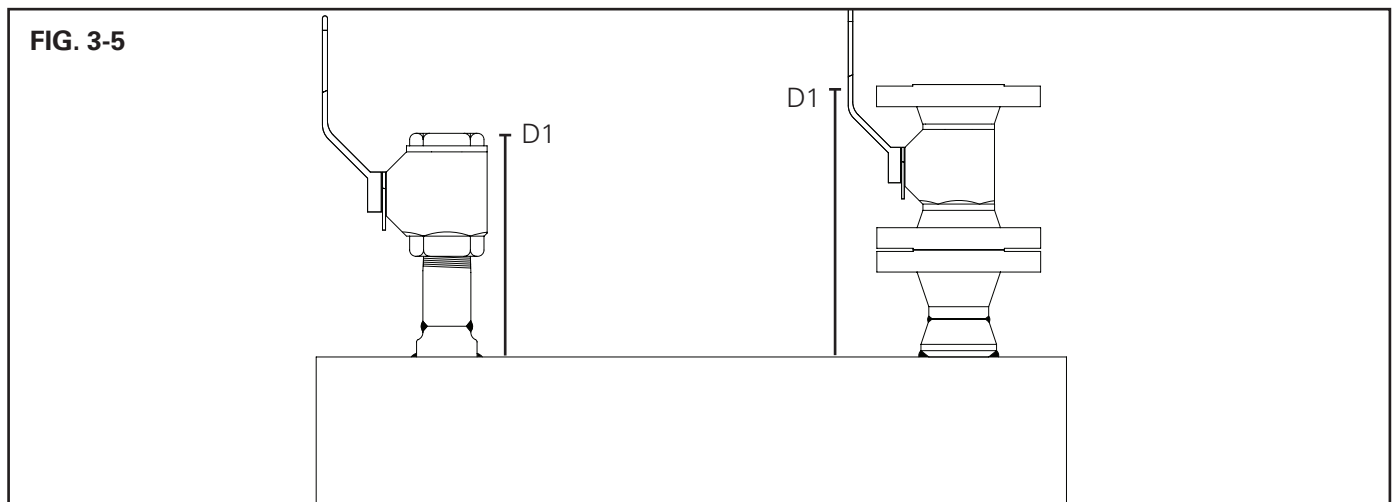


FIG. 3-4



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 OFD™ shaft from sliding and the probe from getting damaged during mounting.
6. Measure the distance (D1) from the outside diameter of main pipe to the end of the connection where the OFD™ sensor is going to be installed. FIG. 3-5.



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

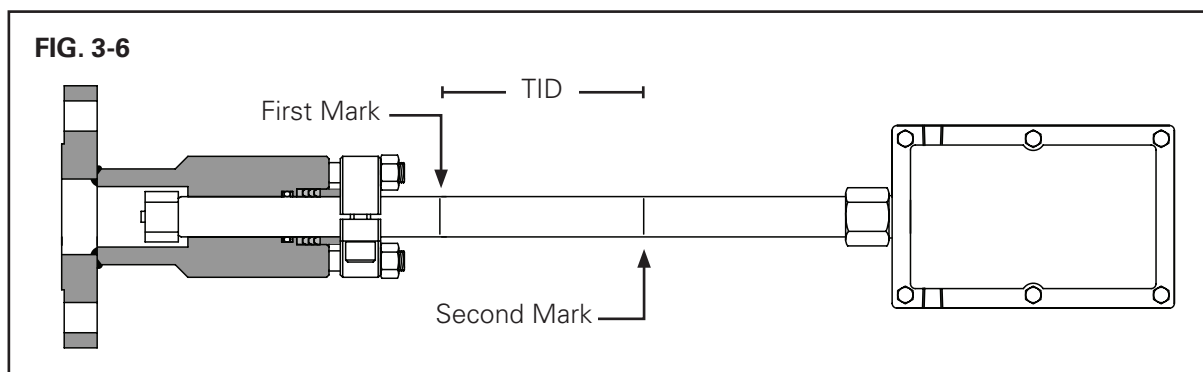
Total Insertion Distance (TID) = D1 + Pipe Wall Thickness + Seal Thickness - 1/4"

Example for D1= 19", Pipe WT=3/8", and Seal Thickness is 1/8"

TID=19 + 3/8 + 1/8 - 1/4 or TID=19 + .375 + .125 - .25

TID= 19 1/4" or 19.25"

8. Use the calculated TID and mark a second line on the shaft, measuring from first mark. FIG. 3-6.



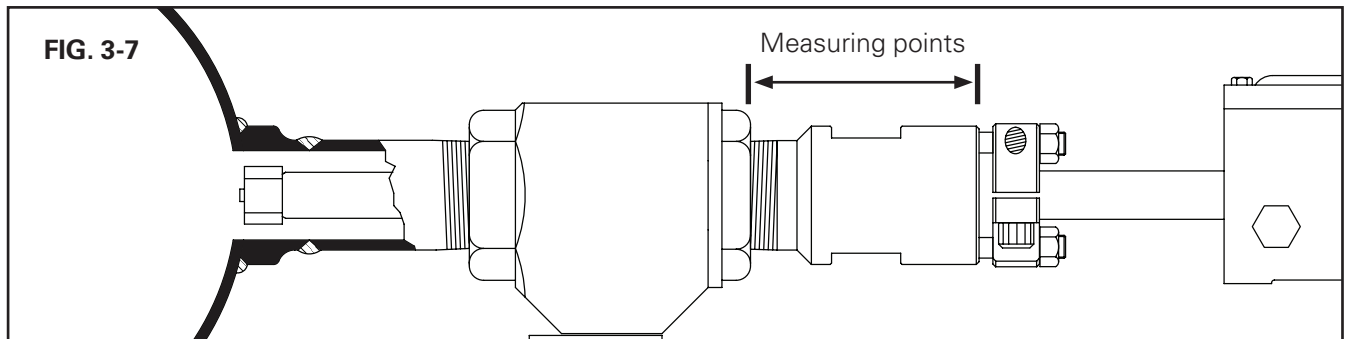
9. Bolt or screw the OFD™ sensor to the valve or designated installation location. (KAM CONTROLS recommends using thread sealant and not Teflon tape for the threaded OFD™). Skip to Step 12 (OFD with Flanged Seal Housing only).

INSTALLATION CONTINUED

10. Calculate the Insertion distance for 2" MNPT Seal Housing:

TID cannot be calculated until the Seal Housing is screwed into place. If you have not already done so, please screw your OFD™ 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 5.25". FIG. 3-7.



For example:

If the measured distance from the top of the valve to the top of the seal housing body is 4.75", you would calculate the threaded depth (TD) by subtracting 4.65" from 5.25". (5.25 – 4.65=0.6) In this case the threaded depth TD would be .6".

You are now ready to calculate TID.

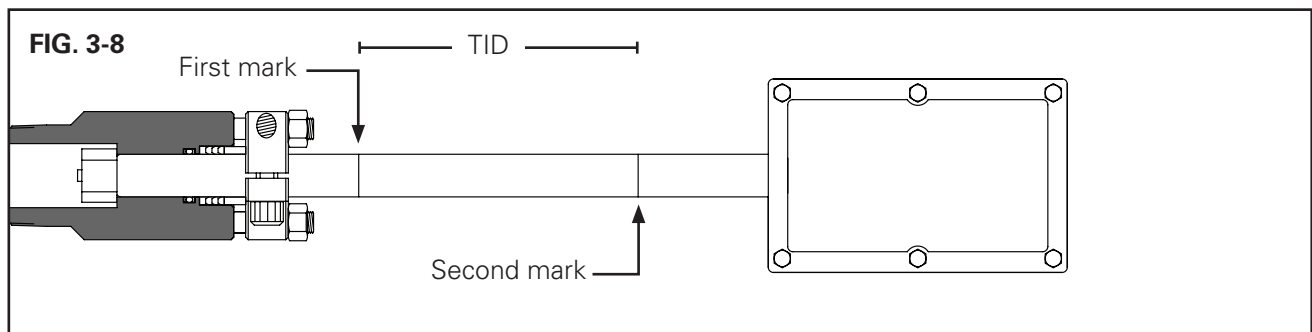
$$\text{TID} = (D1) + (\text{Pipe Wall Thickness}) - (\text{TD}) - (.25")$$

Example for D1=19", Pipe WT=3/8", and TD=.6"

$$\text{TID} = (19) + (.375) - (.6) - (.25)$$

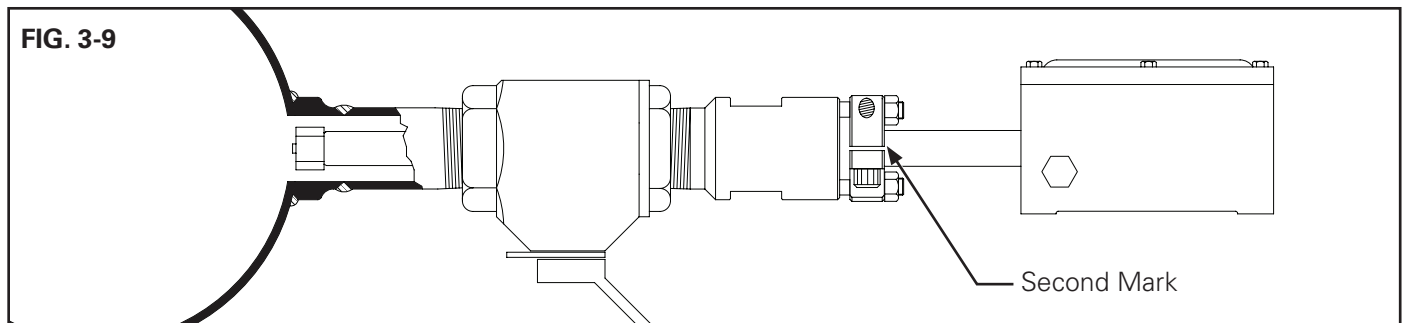
$$\text{TID} = 18.525"$$

11. Use the calculated TID and mark a second line on the shaft, measuring from first mark. FIG. 3-8.



INSTALLATION CONTINUED

12. If you have an OFD™ with a Flanged Seal Housing, you may now attach it to the valve on the pipeline.
13. Slowly open Full-opening Ball Valve and check for leaks.
14. Loosen Socket Head Screw on the Locking Collar.
15. Push the OFD™ in until the Second Mark is at the top edge of the Locking Collar. FIG. 3-9.



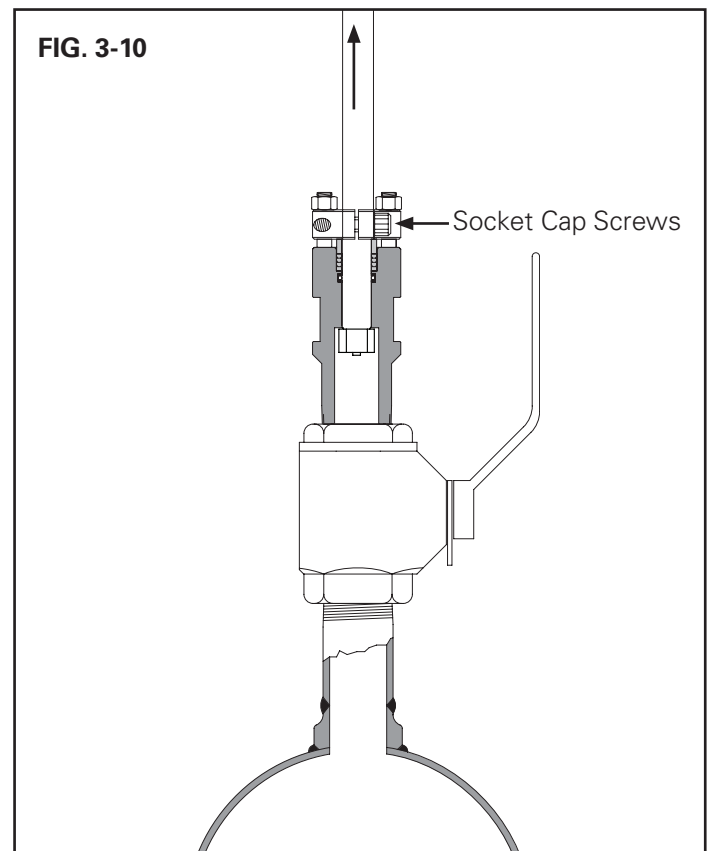
10. Re-tighten the Socket Cap Screws.
11. Tighten the Hex Nuts on the top of the Locking Collar one half turn. These nuts should never be over tightened. Their major function is to apply light pressure on the chevron packing to ensure a seal between the seal housing body and the insertion shaft.

REMOVING THE OFD™ SENSOR

1. To remove the OFD™ sensor, first disconnect all electrical connections to the OFD™ enclosure.
2. Make sure that the line pressure is below 100 psi. Then, slowly and with caution loosen the Socket Cap Screws on the Lock Down Collar.

NOTE: Once the Socket Cap Screws have been loosened, the OFD™ 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.

3. Slide the OFD™ sensor upward until it stops and the probe rests inside the seal housing. FIG. 3-10.
4. Next, close the Full-opening Ball Valve tightly. The OFD™ sensor may now be unbolted from the system.



INSTALLATION CONTINUED

ANALYZER LOOP INSTALLATION

KAM CONTROLS recommends this installation for 3/4" & 1" MNPT OFD™ sensors.

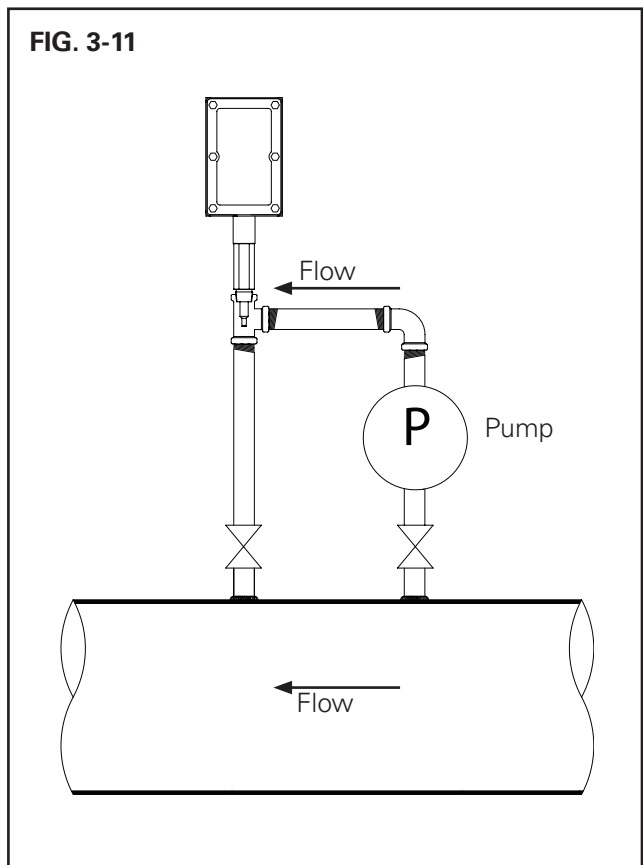
We recommend using thread sealant and not teflon tape for the OFD™ sensor threads.

CAUTION: DO NOT USE THE ENCLOSURE TO TIGHTEN OR LOOSEN THE OFD. THIS CAN CAUSE THE PROBE TO COME UNDONE AND THE FIBER CABLE TO BREAK. Please refer to "Do's and Don'ts" on pages 8-9.

KAM 3/4" and 1" MNPT OFD™ sensors should be installed according to FIG. 3-10. The OFD™ 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. The reason for this is to:

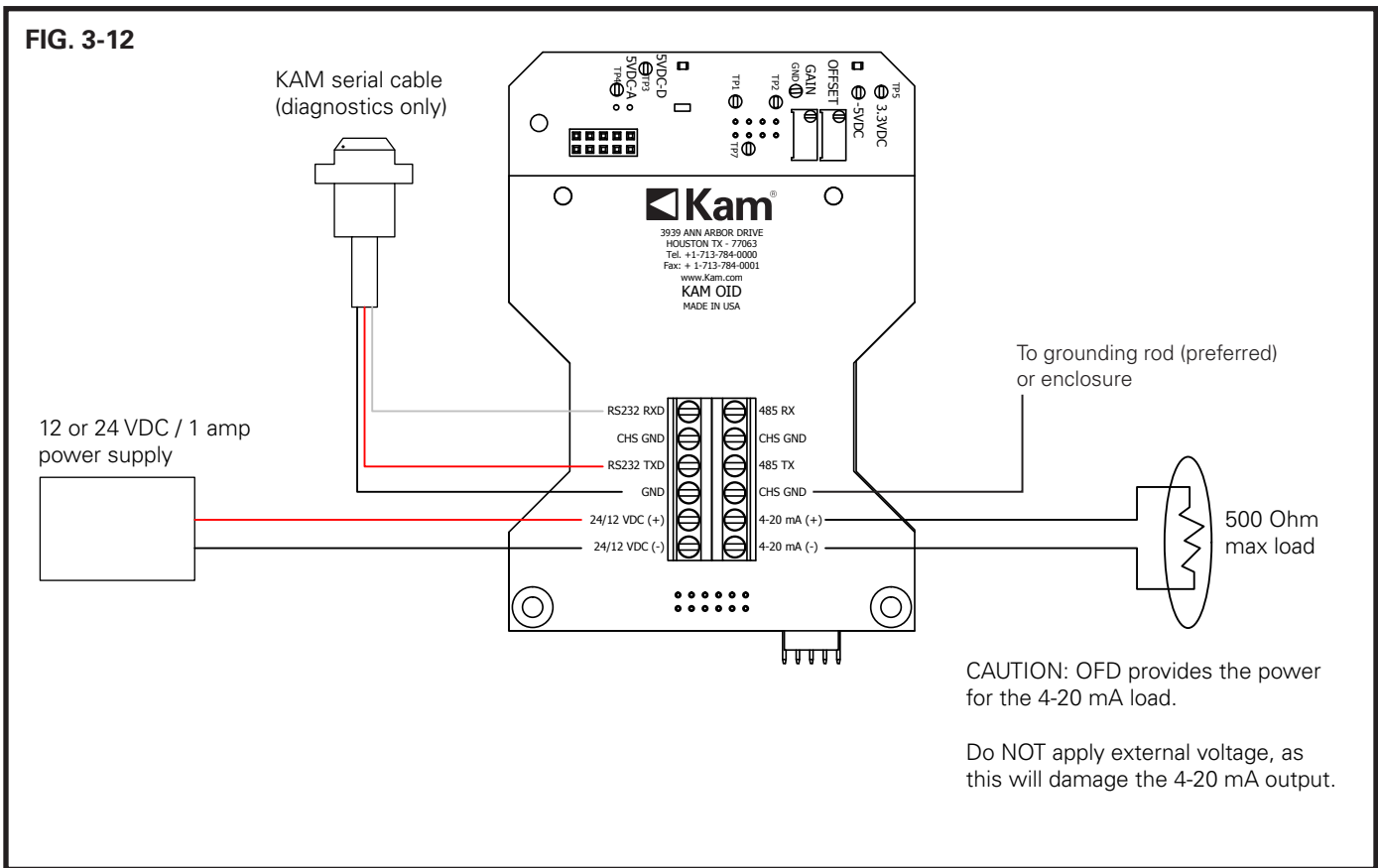
- 1) obtain a credible reading of the product pipeline interface
- 2) keep the lens of the probe clean and abrasion free. If the OFD™ is installed with the product rushing directly at the probe, particles in the pipeline can scratch the lens causing abrasions and resulting in a non-credible reading.

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



INSTALLATION CONTINUED

WIRING



POWER

V (+)
GND

COMMUNICATION INTERFACE

RS232 (diagnostics)
RS485 (Modbus RTU)

OUTPUTS

4-20 mA (-) Current output, source powered
4-20 mA (+)

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 OFD malfunctioning.

INSTALLATION CONTINUED

CONNECTING THE OFD

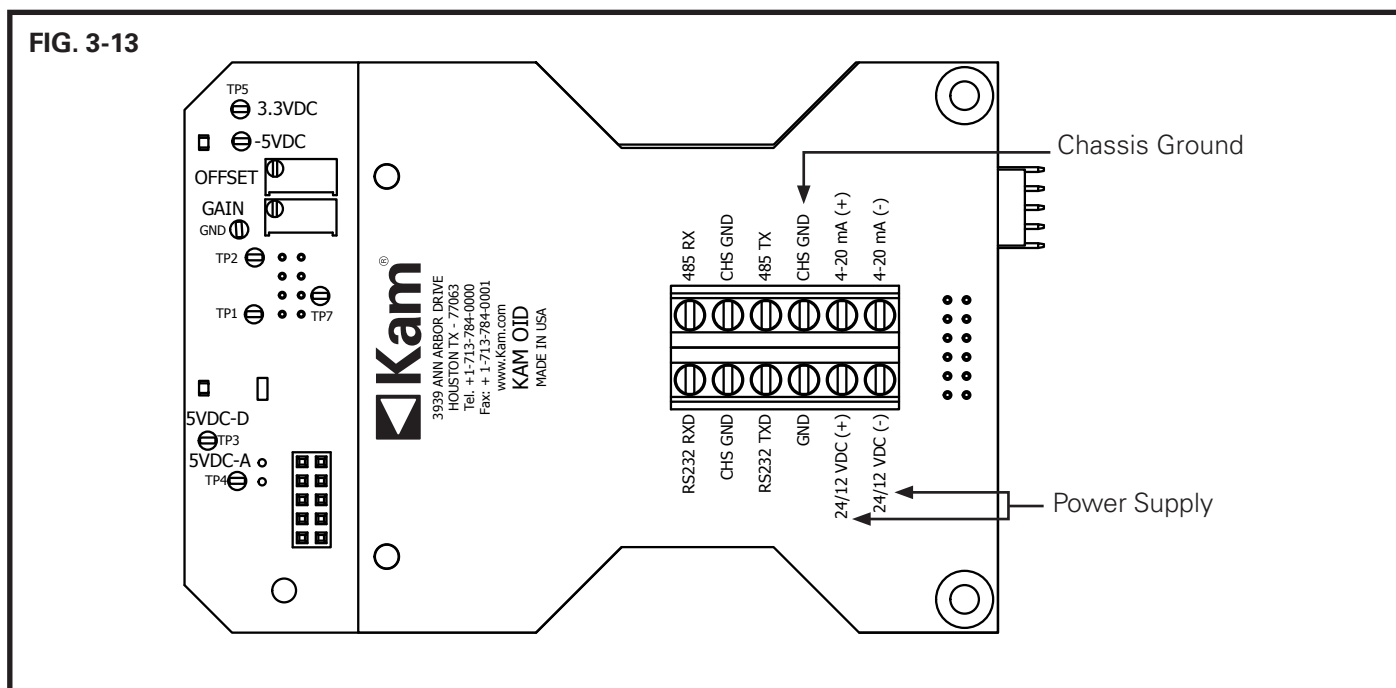
1. Proper Grounding of the OFD™ sensor.

Grounding the OFD™ sensor through the 4-20 mA signal out and power lines is not adequate to protect the OFD™ sensor against power surges.

To ground the OFD™ sensor, connect the chassis ground on the OFD™ board (labeled CHS on the OFD™ Terminal Block. FIG. 3-13) to the green grounding screw on the OFD™ explosion-proof box using 16 AWG braided wire. Ensure that the box is connected to Earth ground either through the pipeline or appropriate low-impedance buried grounding structure.

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

2. To connect the power for the OFD™ sensor, first check both wires from the source for polarity and voltage, then label appropriately.*
3. Connect positive wire to 24/12 VDC (+). FIG. 3-13.
4. Connect negative wire to 24/12 VDC (-).** FIG. 3-13.
5. Check voltage and polarity at terminal block.



EXTERNAL FUSES:

Power Amp slow fuse, Current loop 750 mA

MAXIMUM CURRENT LOOP RESISTANCE: 500 Ohm

*Recommended Wire: Shielded twisted pair wire is recommended for both power and signal.

**WARNING: Connecting a power source to the 4-20 mA ports on the TB will damage the 4-20 mA output and result in failure of the unit.

FIELD CALIBRATION

The OFD is factory calibrated such that 4 ppm of fluorescent dye is equal to 20 mA and should not require calibration. However, if operators change dye levels, some fine-tuning may be necessary.

INCREASE SENSITIVITY WHEN dye levels are below 4 ppm or when readings from dyed product are typically falling in the lower or middle portion of the KAM® OFD™ output range.

DECREASE SENSITIVITY WHEN dyed products levels are above 4 ppm or when readings exceed the maximum reading of the pre-calibrated settings. Products that exceed the pre-set calibration readings will produce an off-scale reading exceeding 20 mA. Decreasing sensitivity lowers the output range of the KAM® OFD™ sensor to allow all readings to fall within the 4-20 mA output ranges.

Caution: When multiple KAM® OFD™ sensors are being used on the same system, each sensor should be calibrated equally wherein fluids with 4 ppm of fluorescent dye are calibrated to 20 mA on the OFD.

The calibration procedure consists of increasing the gain or reducing the gain as needed to increase or reduce sensitivity.

LED light output settings are pre-set at the factory and should not be adjusted.

REQUIRED TOOLS: VOLT METER, SMALL FLAT-HEAD SCREWDRIVER

CHANGING THE HIGH END OF OUTPUT RANGE IN LINE

1. Determine when fluorescent dyed product will be at sensor,.
2. Connect a volt meter across 4-20 mA terminals. With fluorescent dyed product flowing, increase the gain by turning GAIN (FIG. 4-1) counterclockwise or decrease by turning clockwise. As you are turning, look at your volt meter and stop when it reads 20 mA or 100% of scale.

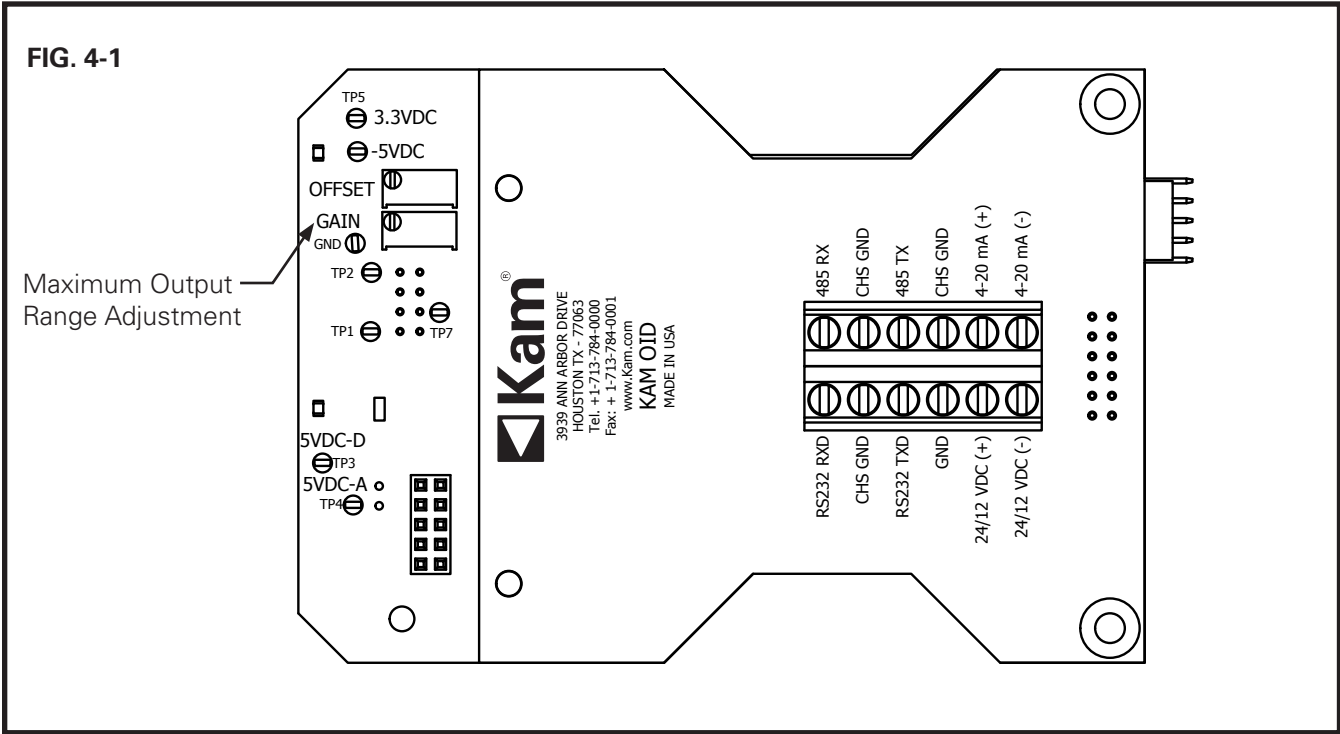
CHANGING THE HIGH END OF OUTPUT RANGE OFF LINE

1. Place the sensor tip of the OFD in a sample container with a dyed fuel sample containing the maximum amount of dye in which the OFD will operate (usually 4 ppm). The sample should be in a container that is at least 8" deep, and the tip of the sensor should be positioned at least 6" away from the bottom. The container should be sealed from any external light.
2. Turn the OFD power on and wait for 5 minutes.
3. Connect a volt meter across 4-20 mA terminals. Increase the gain by turning GAIN (FIG. 4-1) counterclockwise or decrease by turning clockwise. As you are turning, look at your volt meter and stop when it reads 20 mA or 100% of scale.

The low end of the range is set for non-dyed products or 0 ppm. Readings may vary somewhat but should not exceed 5 mA.

FOR ALL OTHER TYPES OF ADJUSTMENTS CALL KAM CONTROLS, INC. +1 713 784 0000.

FIELD CALIBRATION CONTINUED



MAINTENANCE

CLEANING AND INSPECTION

Under normal operation, the KAM OFD should not require cleaning, unless pipeline usage is limited to a small number of products. Gasoline products or jet fuel in the pipeline will clean the OFD without removal.

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, isopropyl alcohol, gasoline, or diesel. Do not use other chemicals.

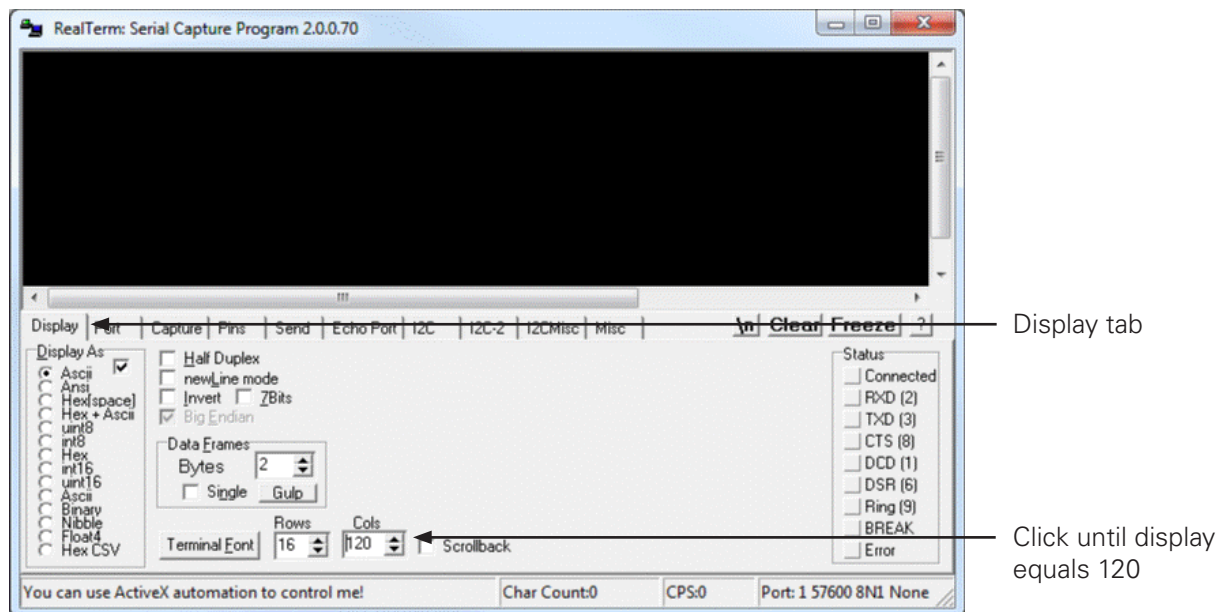
If you have a question regarding cleaning solvents, please contact KAM CONTROLS directly at +1 713 784-0000, or email: AskAnEngineer@Kam.com

DIAGNOSTICS VIA RS232

Connecting to the RS232 Serial Port using RealTerm

1. Install RealTerm if not installed on your PC.
 - RealTerm Software can be Downloaded at <http://sourceforge.net/projects/realterm/files/Realterm/2.0.0.70/>
 - Click on Realterm_2.0.0.70._setup.exe to install.
2. Connect the RS232 cable to the OFD as shown in the wiring diagram. FIG. 3-12 on page 15.
3. Connect the other end of the RS232 Cable to your computer serial port or to USB with the provided serial converter.
4. Open RealTerm. A window will open up as shown in Fig. 5-1.
5. The program will open on the "Display" tab. Click on the up arrow of the "Cols" window until it reaches 120. Do not try to type the number in the window as it will result in an error. If you do this, you must close the program and start again.

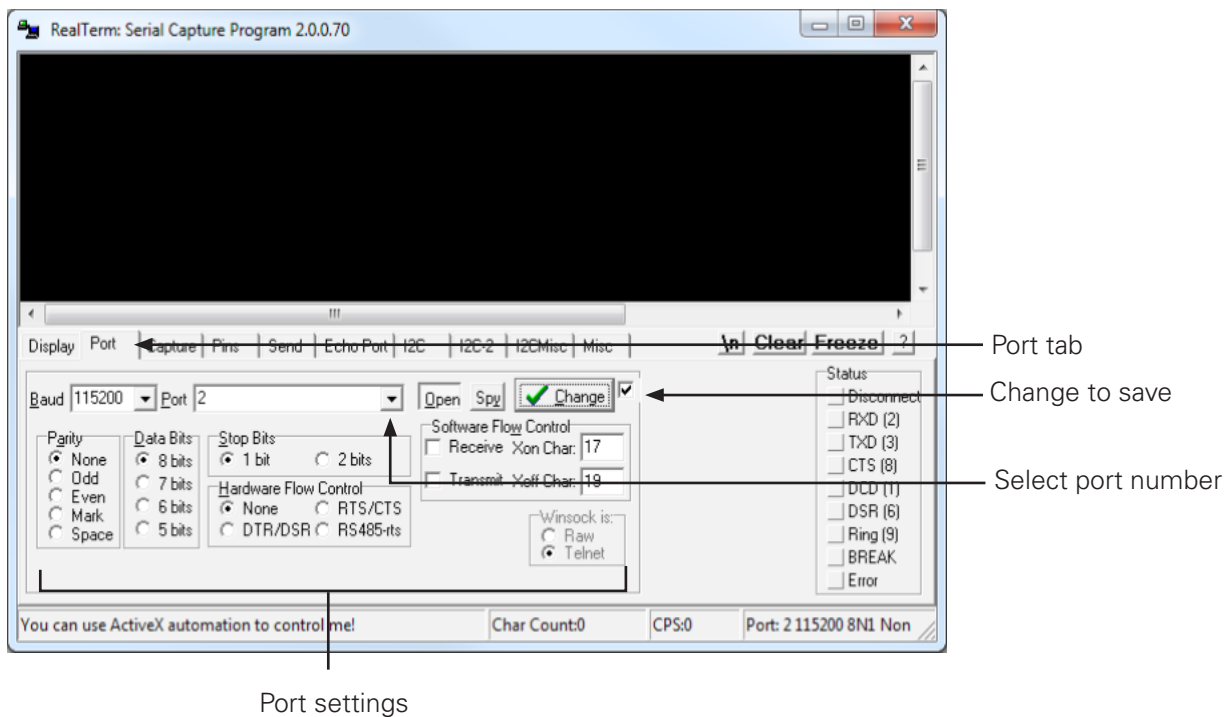
FIG. 5-1



MAINTENANCE CONTINUED

6. Click on the "Port" Tab (See FIG. 5-2), and change the settings as follows:
 - a. Baud = 115200
 - b. Parity = None
 - c. Data Bits = 8
 - d. Stop Bits = 1
 - e. Hardware Flow Control = None
 - f. Port = Select Port number assigned to your serial port or USB to serial converter
 - g. Click on the Change button to save these settings.

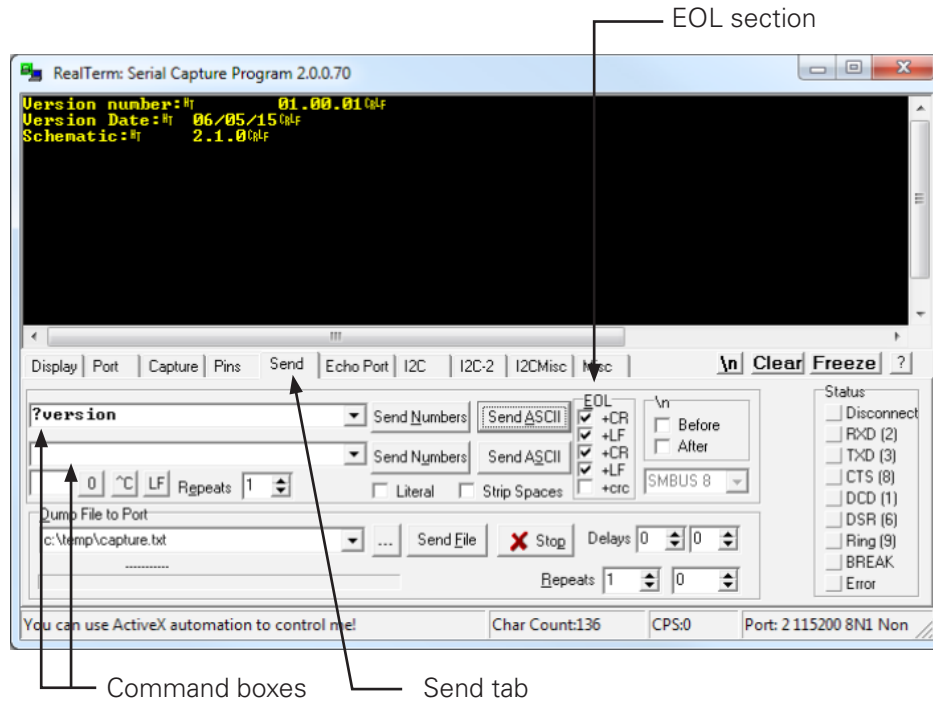
FIG. 5-2



MAINTENANCE CONTINUED

- Click on the "Send" tab.
- Check the first 4 boxes in the "EOL" section.
- Type "?version" in either of the command boxes and click the "Send ASCII" button. You will see a message on the window displaying the software version number, the version date and the schematic version of the board.

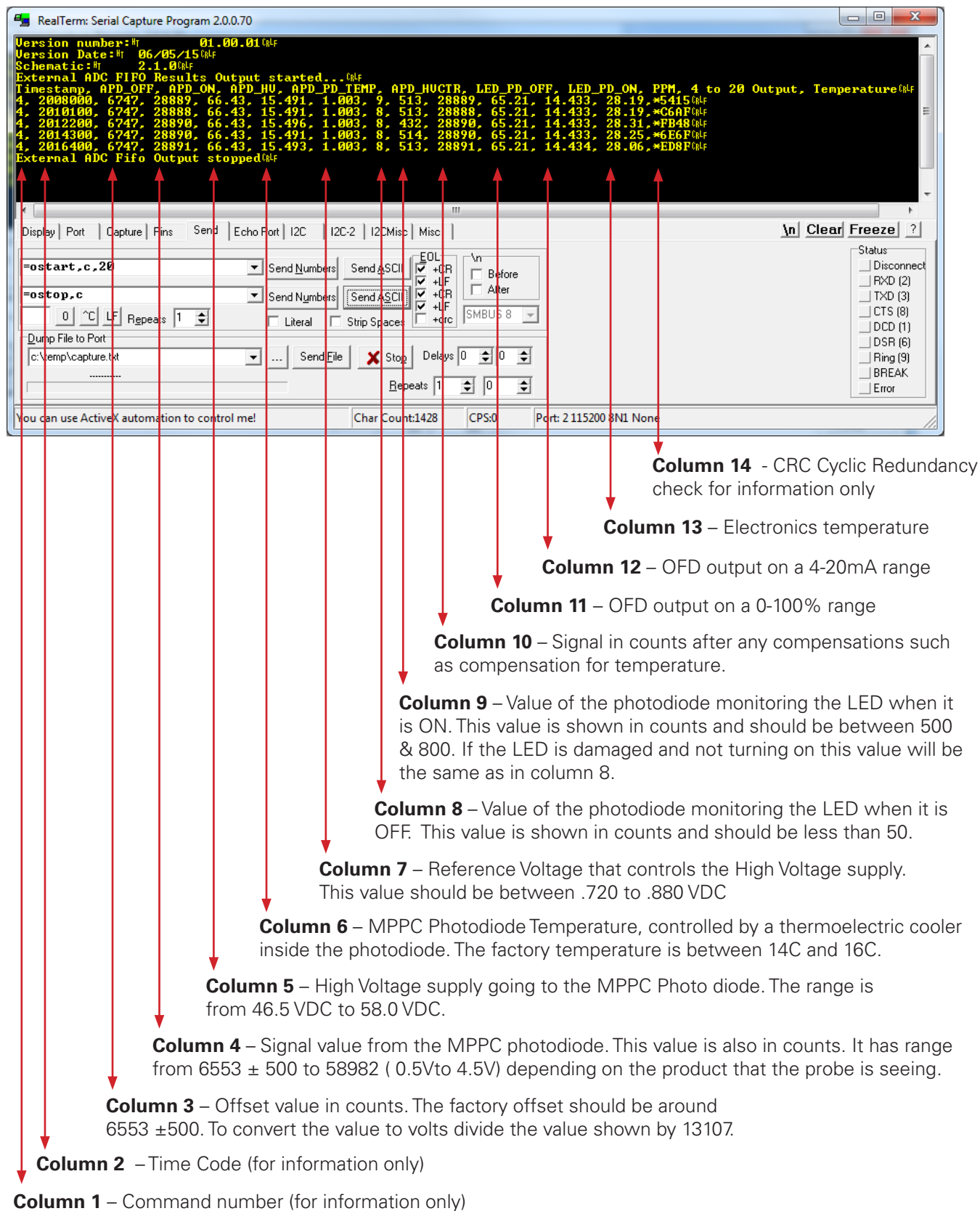
FIG. 5-3



- To view output data, type the command "=ostart,c,20" and click on Send ASCII. See FIG. 5-4 on page 22.
- Type the command "=ostop,c" to stop the data. Always do this before disconnecting.

MAINTENANCE CONTINUED

FIG. 5-4



APPENDIX A

MODBUS REGISTER

SETTINGS	
MODE	RTU
BAUD RATE	9600
DATA BITS	8
STOP BITS	1
PARITY	NONE
SLAVE ID	1
OFFSET	0

OFD Holding Modbus Registers		
Register No	Type	Description
42000	32bit Float	Signal Offset
42001	32bit Float	Sinal In from Photodiode
42002	32bit Float	LED OFF status
42003	32bit Float	LED ON Status
42004	32bit Float	Electronics Temperature in Celsius
42005	32bit Float	0-100 Output
42006	32bit Float	4-20mA Output