Kam®

Simple Precision™

KAM® LRW™
LOW RANGE WATERCUT

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

LRWMANUAL 0824
User Manual

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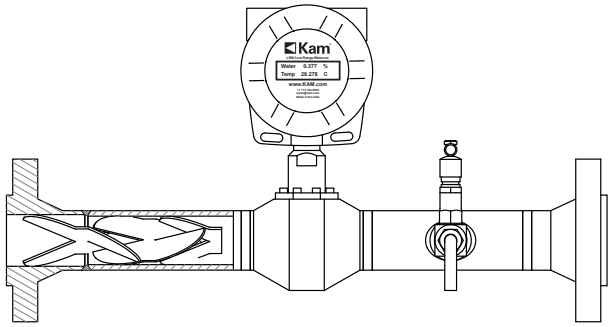
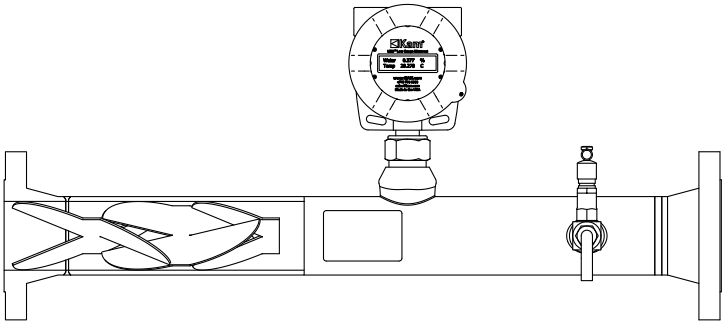
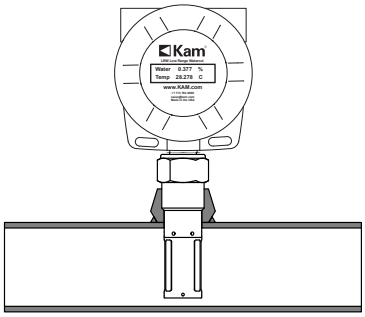


2" Flow Through LRW with included static mixer and manual draw-off valve

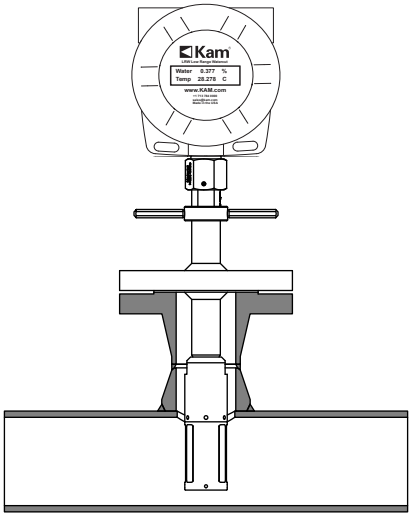


3" and 4" Flow Through LRW with included static mixer and manual draw-off valve

FIG. 1-2 FIXED INSERTION MODELS

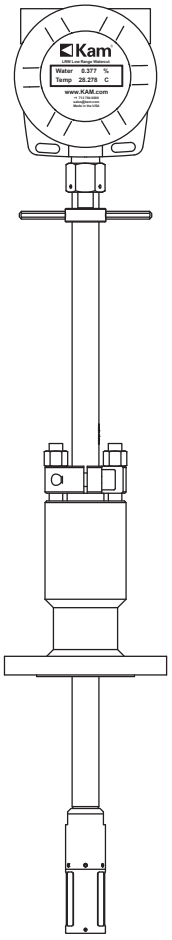


1.25" NPT Fixed Insertion LRW for pipelines 3" – 8"



Flanged Fixed Insertion LRW for pipelines 3" and up with 2", 3" or 4" flanged process connection

FIG. 1-3 INSERTABLE/RETRACTABLE MODEL



Insertable/retractable LRW for pipelines 3" and up with 2", 3" or 4" flanged seal housing or 2" MNPT process connection

THEORY OF OPERATION

The KAM LRW™ Low Range Watercut / BS&W meter uses a patented microwave resonance technology, responding to the differing electrical properties of water and oil to determine water content for ranges 0-3%, 0-5%, and 0-10%. The technology is highly repeatable and offers industry-leading accuracy (±0.03% up to 3% water). Additionally, proprietary AnyDensity™ technology allows the instrument to compensate for any change in density across the entire API gravity range. Compensation is based on a density input from a mass flow meter or densitometer, and all compensation is automatic. This is paramount in situations where a single truck or rail unloading site could see swings in API gravity from the 20s to the 70s.

The unit can be calibrated and verified in line.

The LRW's high-quality components are made and assembled entirely in the USA, providing reliable and consistent performance for long-term use.

TABLE 1-1 MEASUREMENT CAPABILITIES: CALIBRATED RANGE AND ACCURACIES

Range (water in oil)	0-3%	3-5%	5-10%
Accuracy	±0.03%	±0.05%	±0.1%

2 SPECIFICATIONS

Media:	Crude oil, water and refined products
Material:	Wetted parts–316 SS*, Hastelloy, & PEEK (Other materials available)
	Electronics enclosure–Copper-free aluminum
Fluid temperature:	32ºF to 176ºF (0ºC to +80ºC)
Ambient temperature:	-4º F to 131º F (-20º C to +55º C)
Power requirements:	24 VDC
Power consumption:	12 watts
Available ranges:	0-3%, 0-5%, 0-10% water in oil
Accuracy:	+/- 0.03% up to 3% water; +/- 0.05% from 3-5% water; +/- 0.1% from 5-10% water
Repeatability:	+/- 0.01%
Resolution:	+/- 0.01%
Minimum water detection:	100 ppm
Outputs:	4–20 mA
	Alarm relay
	RS232/RS485
Input:	4-20 mA for density
Density Correction:	AnyDensity™ compensates for changes in fluid density across entire API gravity range
	(requires density input in Observed Specific Gravity or API Gravity)
Ingress protection:	NEMA IV; IP66
Pressure ratings:	ANSI 150, 300, 600, 900**
Flow conditions:	Well mixed in accordance with KAM recommendations
Hazardous area:	PTB 08 ATEX 1026
	II 2 G Ex db IIB T6 Gb
	IECEx PTB 19.0048
	Ex db IIB T6 Gb

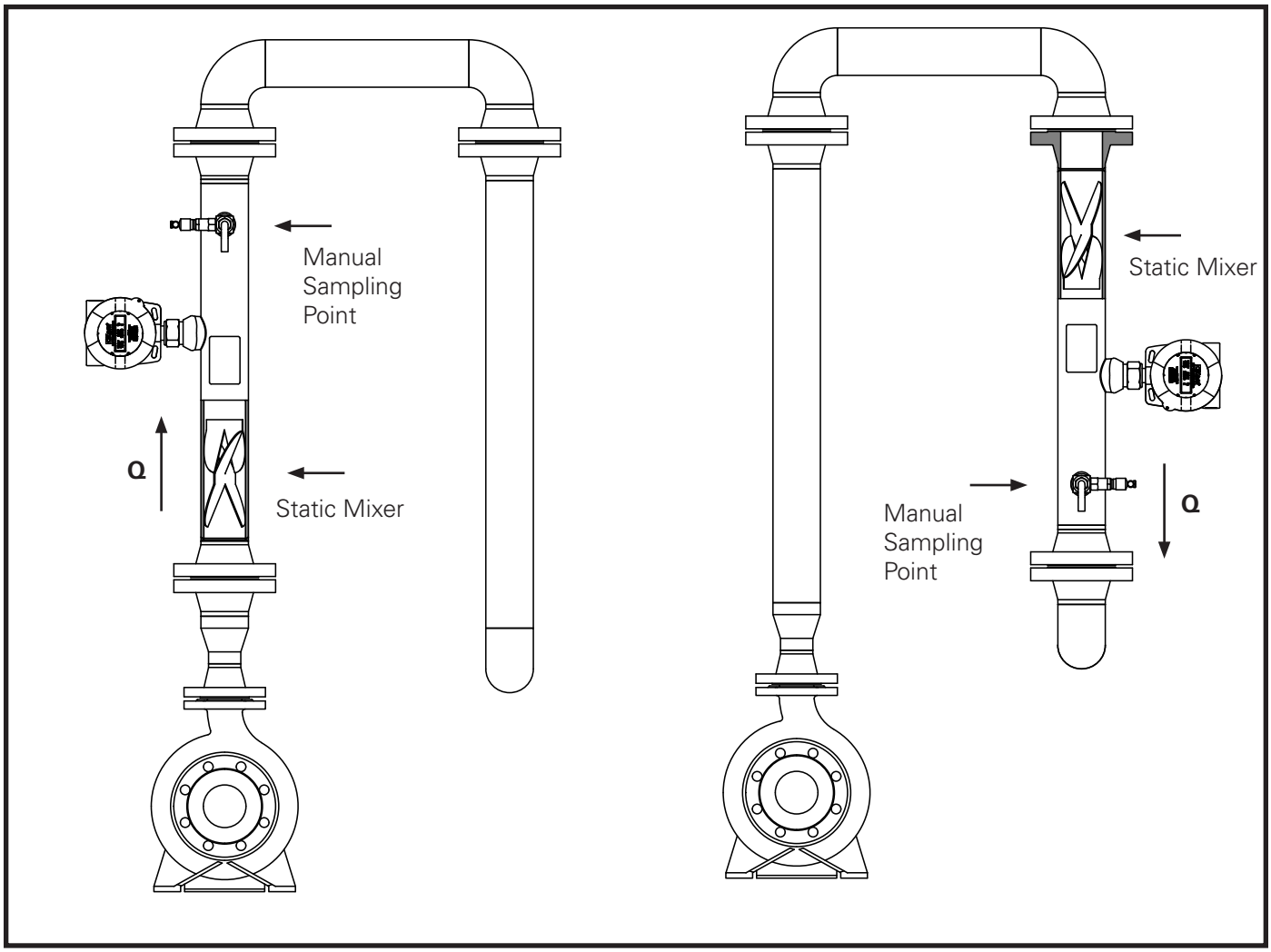
* Seal Housing for 2" MNPT Models are Carbon Steel.

** Insertable models not available for ANSI 900 applications without additional high-pressure security brace.

3 INSTALLATION

INSTALLATION FLOW AND LOCATION REQUIREMENTS

KAM HIGHLY RECOMMENDS VERTICAL INSTALLATIONS WHEREVER POSSIBLE FOR OPTIMAL MIXING. For LACT units, truck unloading risers, etc., KAM recommends installation of the LRW in the vertical flow up, immediately after the pump (**OPTION 1**) or in the vertical flow down after a static mixer (**OPTION 2**). For other options, please consult with the KAM factory.



PLEASE NOTE: The LRW should always be installed per KAM recommendations, including the mixing requirement calculated per customer provided flow conditions. LRW should be installed as close as possible to a manual sample point (1-2 pipe diameters)

CAUTION: When installing the LRW® 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.

INSTALLATION

INSTALLATION MIXING AND FLOW REQUIREMENTS

The LRW should always be installed per KAM recommendations, including the mixing requirement calculated per customer provided flow conditions. Vertical installations are ALWAYS preferred.

FIG. 3-1

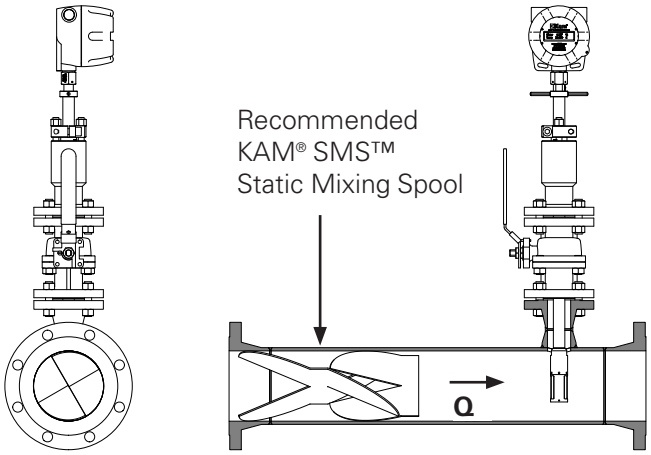


FIG. 3-2

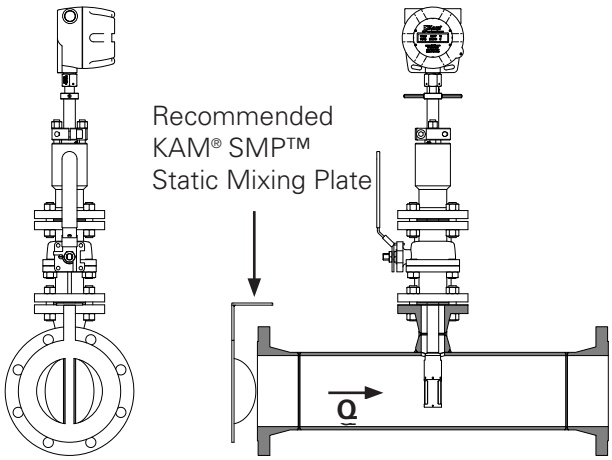
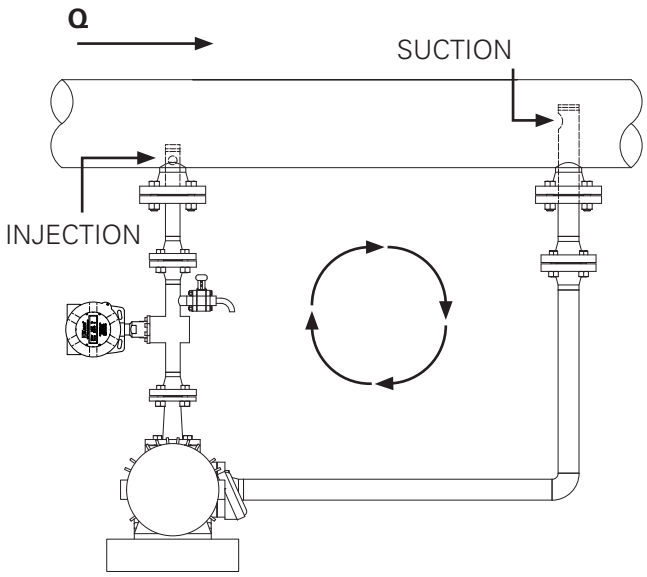
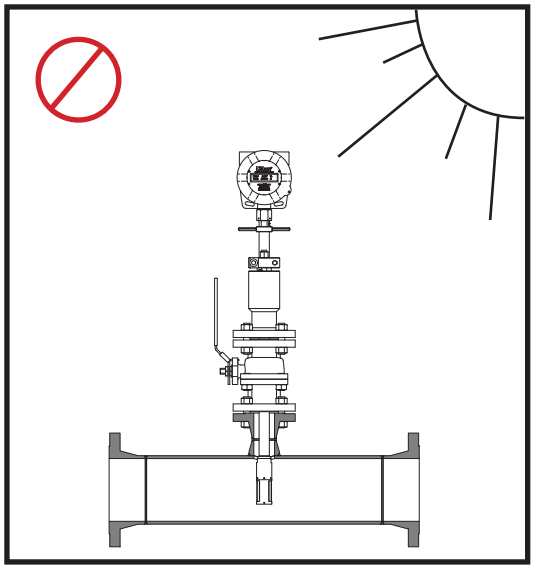


FIG. 3-3 LRW INSTALLED ON A KAM ML MEASUREMENT LOOP

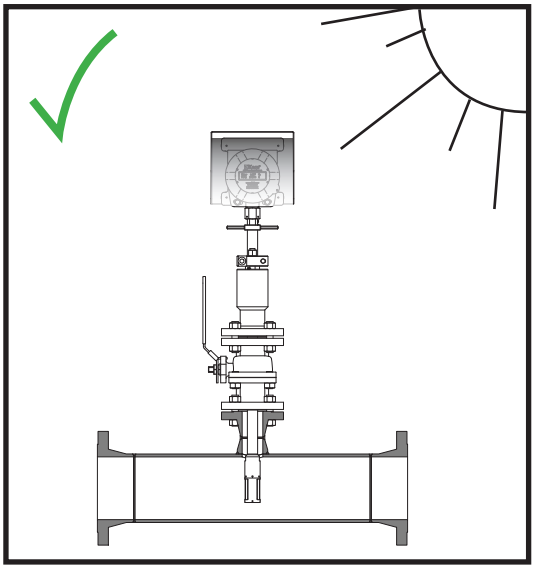


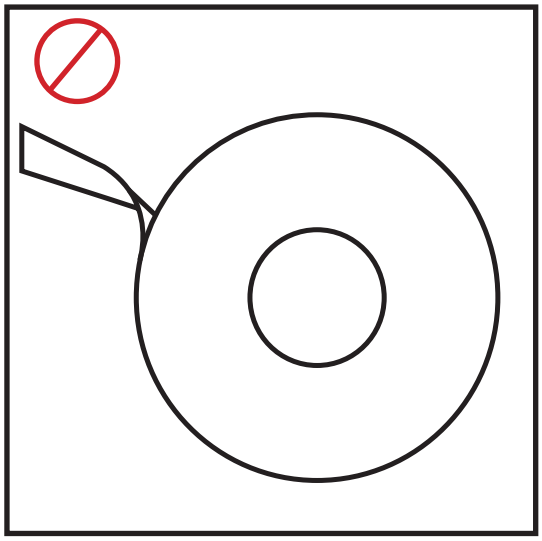
The KAM ML Measurement Loop utilizes a pump to draw a representative flow from the main line into a circulation loop, incorporating a KAM LRW. The loop flow is injected back into the main pipeline upstream of the suction site, creating mixing and homogeneity prior to suction. A homogenous flow of 10–13 fps is maintained at the sensor head for the most accurate measurement at all times.

GENERAL INSTALLATION DO'S AND DON'TS

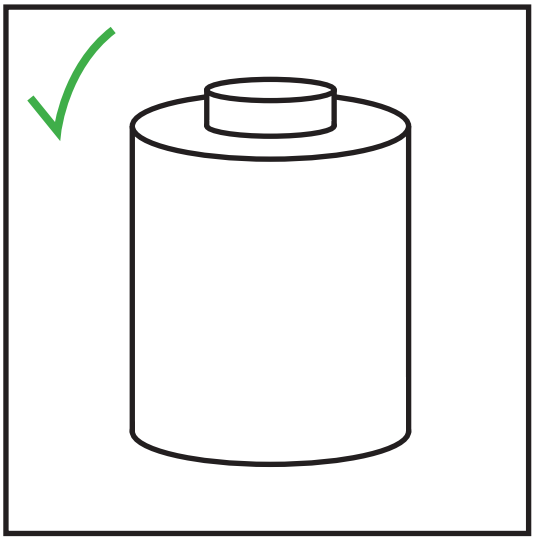


Always install LRW® sensors with the electronics enclosure shaded from direct sunlight.





DO NOT use Teflon tape on threads connecting to the LRW® flow through sensor. DO use liquid thread sealant.



PRIOR TO INSTALLATION

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

The following items are provided with the KAM® LRW® sensor:

One (1) RS232 communication cable, for connecting your PC to the LRW
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 LRW sensor.

REMINDER: Please refer to the Installation Flow Requirements on page 5 of this manual to ensure proper sensor placement where at all possible.

In installations below -4°C where the LRW is exposed to an open environment, KAM CONTROLS recommends operators insulate the LRW, and if the pipeline is heated, that the heating trace be extended to include the LRW.

If pipeline flow is going to be stopped for an extended amount of time and the pipeline is not heated, then the LRW should be removed from the line to avoid damage to the sensor from freezing water.

LRW FLOW THROUGH ASSEMBLY

Flow through (spool) units will be shipped partially assembled. 1" and 2" LRW unit can be wired prior to insertion into the spool for convenience, but this is not required.

For 1" and 2" units (FIG. 3-4):

1. Grease around the O-ring below the small flange.

2. Insert LRW body into the spool and ensure unit is fully seated.

   NOTE: LCD screen face should be aligned with direction of pipe flow.

3. Using a 5/8" Allen wrench, install (8) hex screws around the circumference of the flange until tight. Screw manual sample probe into valve until tight.

For 3" and 4" flow through units (FIG. 3-5):

1. Screw LRW body into spool using 1 3/4" wrench flat. KAM Controls recommends using liquid pipe sealant rather than Teflon tape.

2. Screw manual sample probe into valve until tight.

FIG. 3-4 LRW FLOW THROUGH 2" MODELS

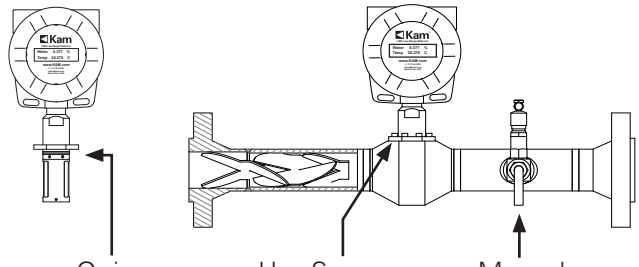
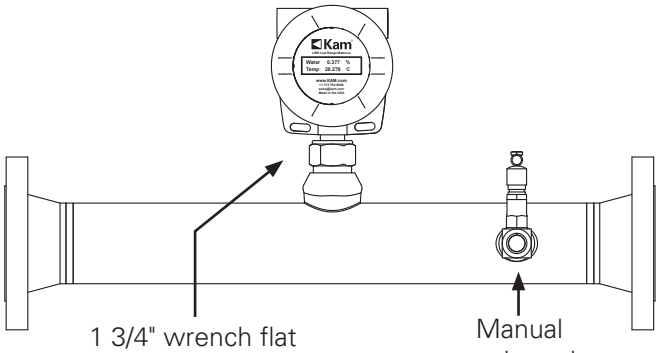


FIG. 3-5 LRW FLOW THROUGH 3" and 4" MODELS

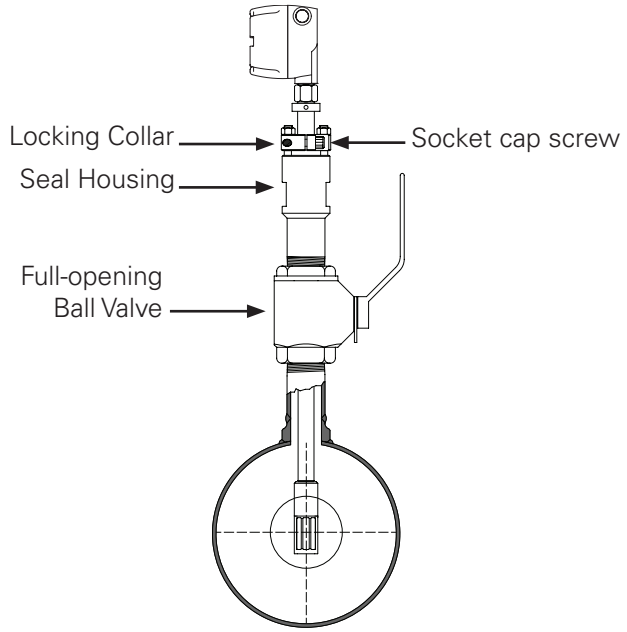


MAIN LINE INSTALLATION INSERTABLE MODELS

The KAM® LRW sensor should be installed according to FIG. 3-6. A full-opening ball valve is used to isolate the LRW® sensor from the pipeline during installation or removal. The seal housing of the LRW® sensor allows the probe to be inserted and removed from the pipe under pressure and flow conditions. It is the user's responsibility to ensure that the LRW® sensor be placed at the most representative point within the flow profile (see flow recommendations on page 5 of this manual). The LRW® sensor should be inserted so that the window of the probe is located in the center half of the diameter of the pipeline.

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

FIG. 3-6 KAM® LRW INSTALLED ON A MAIN PIPE



CALCULATING THE REQUIRED INSERTION LENGTH

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

1. Lay the LRW™ 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 LRW™ shaft to slide through the seal housing.
3. Pull the LRW™ back through the seal housing until the LRW probe is retracted inside the seal housing. FIG. 3-7 and FIG.3-8.

   NOTE: The antennas on the LRW sensor probe won't necessarily end up all the way inside the seal housing.
4. Retighten the Socket Cap Screws on the locking collar. This will prevent the LRW™ shaft from sliding and the probe from getting damaged during mounting.

FIG. 3-7

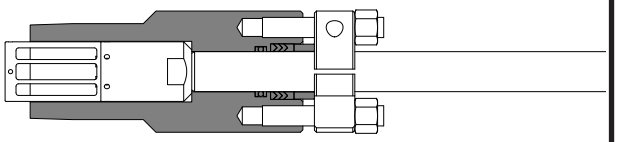
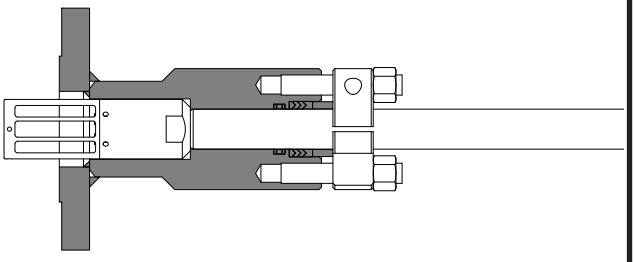


FIG. 3-8



5. Measure the distance (D1) from the outside diameter of main pipe to the end of the connection where the LRW® sensor is going to be installed. FIG. 3-9a and FIG. 3-9b.

FIG. 3-9a Flanged Seal Housing

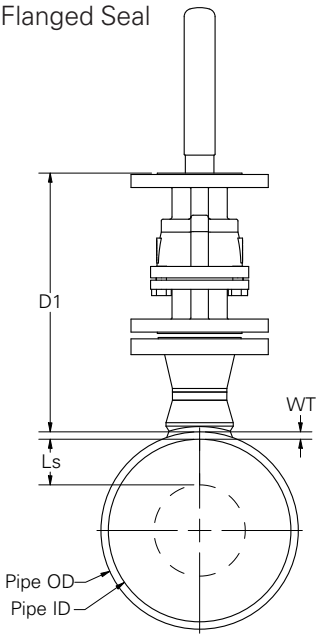
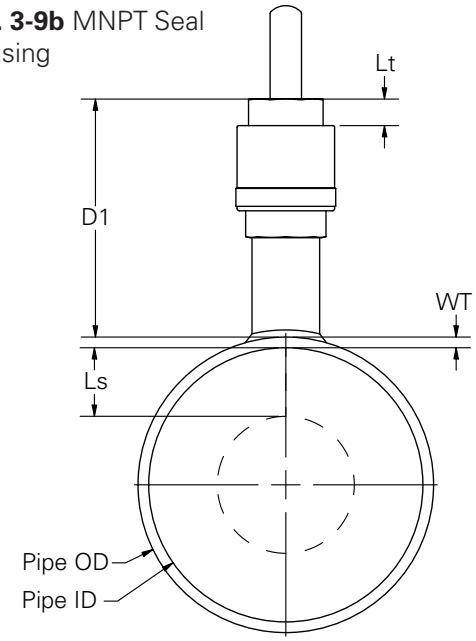


FIG. 3-9b MNPT Seal Housing



6. Calculate the insertion distance:

For flanged Seal Housing models

MID	–	Minimum Insertion Distance
D1	–	Distance from the top of the valve to the pipe
Lg	–	Gasket Width (Typical 0.134")
WT	–	Pipe Wall Thickness
Ls	–	Pipe ID x 0.25 (Measurement Area Length)
Ds	–	Pipe ID x 0.5 (Measurement Diameter Area)

Minimum Insertion Distance (MID)=D1 + Lg + WT + Ls + LRW Factor

Example: D1=14"
Lg=0.134"
WT=0.25"
ID=8.125"
LRW Factor 2" 150#=1"

MID=14 + 0.134 + 0.25 + (8.125 x 0.25) + 1
MID=17.41"

Take note of the calculated MID and proceed to step 7.

NOTE: The recommended sampling area per API guidelines is approximately the center half of the pipe. Use the "Ds" parameter described above to determine this area if needed.

TABLE 3-1 LRW FACTOR

Class Rating	2" Size	3" Size
150#	1.00"	1.20"
300#	1.12"	1.37"
600#	1.50"	1.75"
900#	2.00"	2.00"

For 2" MNPT Seal Housing models

D1	–	Distance from the top of the valve to the pipe
WT	–	Pipe Wall Thickness
Ls	–	Pipe ID x 0.25 (Measurement Area Length)
LRW Factor	–	1.65"
Lt	–	Thread Engagement (0.75")

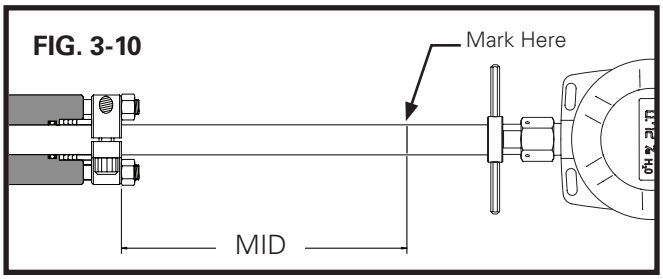
Minimum Insertion Distance (MID)= D1 + WT + Ls + LRW Factor - Lt

Example: D1=14"
WT=0.25"
ID=8.125"
LRW Factor=1.65
Lt=0.75"

MID=14 + 0.25 + (8.125 x 0.25) + 1.65 - 0.75
MID=17.18"

7. Measure the calculated MID from the top of the Locking Collar and place a mark with a permanent marker or tape on the Shaft (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. 3-10.

FIG. 3-10



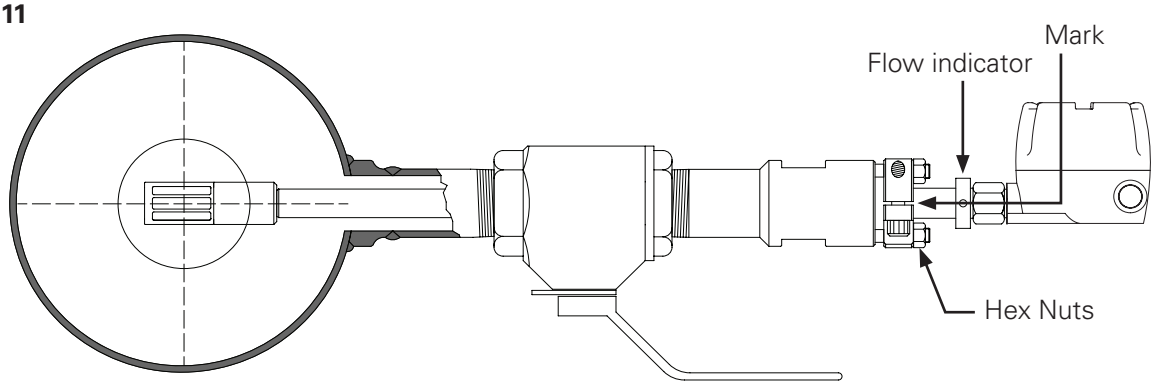
8. You can now attach the LRW to the valve on the pipeline. For threaded models, KAM CONTROLS recommends liquid thread sealant and not Teflon tape for the threaded LRW™ sensor.)

9. Open Full-opening Valve.

10. Loosen Socket Cap Screws on the Locking Collar.

11. Push LRW® sensor in until the mark is at the top edge of the Locking Collar. Ensure that LRW® flow indicator is aligned with pipeline flow direction. FIG. 3-11.

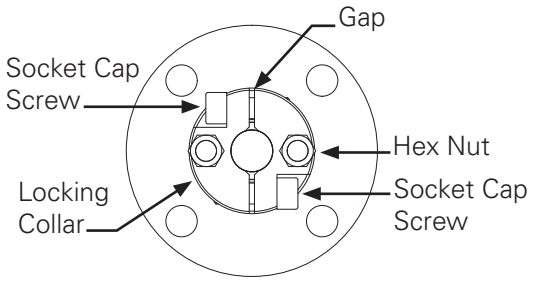
FIG. 3-11



12. 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.

13. Tighten the hex nuts holding down the Locking Collar one half turn (FIG. 3-12). These 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 TOP VIEW LOCKING COLLAR



REMOVING AN INSERTABLE LRW SENSOR

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

2. Loosen the Socket Cap Screws on the Lock Down Collar, using a 3/8" Allen wrench.

3. Loosen Hex Nuts 1/2 turn.

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

5. Slide the LRW sensor upward until the probe rests inside the seal housing. There is a mechanical stop when the unit is fully retracted.

6. Retighten the Socket Cap Screws.

7. Close the Full-opening Ball Valve tightly. Drain oil from valve if possible.

8. The LRW sensor may now be unbolted from the system.

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

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

REMOVING THE LRW® SENSOR FROM FLOW THROUGH SPOOL

1. To remove the LRW® sensor, first shut off power to the instrument.

2. Discontinue flow in loop from the main line and drain fluid from loop.

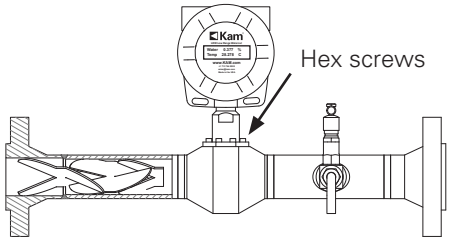
3. Using a 5/32" Allen wrench, remove the (10) 32 x 5/8" Hex screws with on collar (2" models) or unscrewed from spool body (3" and 4" models) using the 1 3/4" wrench flat. FIG. 3-13.

4. The probe can then be lifted from the cell for testing/inspection/calibration purposes.

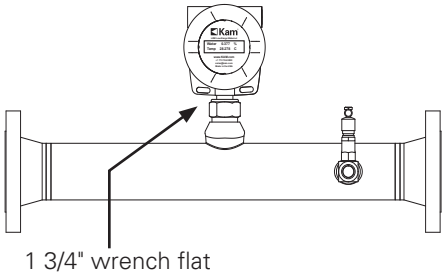
Removal should be conducted in accordance with all regional and class requirements.

FIG. 3-13

2" LRW Flow Through model



3" and 4" LRW Flow Through models



INSTALLATION CONTINUED

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 LRW 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 LRW 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 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 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 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 LRW has to be included into the local equipotential bonding.
- The connecting wire of the Oil Water Detector KAM 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 takes place in an area with potentially explosive atmosphere.

INPUTS

POWER–	GND
POWER+	24-30 VDC
DENSITY IN	Current loop output from densitometer, coriolis meter or flow computer.
GND	

INPUT/OUTPUT

232-RXD	Console port – communication interface
232-TXD	for calibration, connection to PLC

OUTPUTS

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

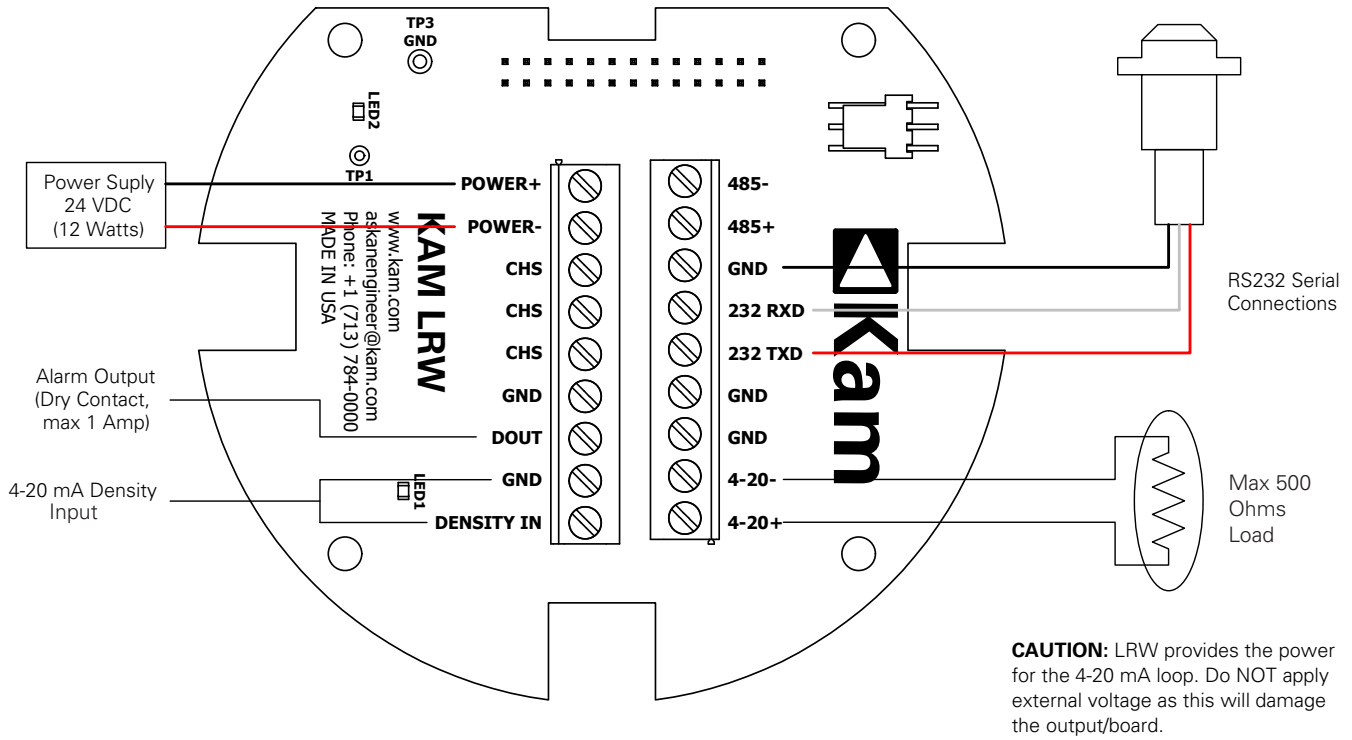
LED INDICATORS

LED1	24 VDC Power
LED2	5 VDC Internal supply

WIRING DIAGRAMS

CAUTION: Do not connect power to 4-20 mA output. This will damage the board and void product warranty.

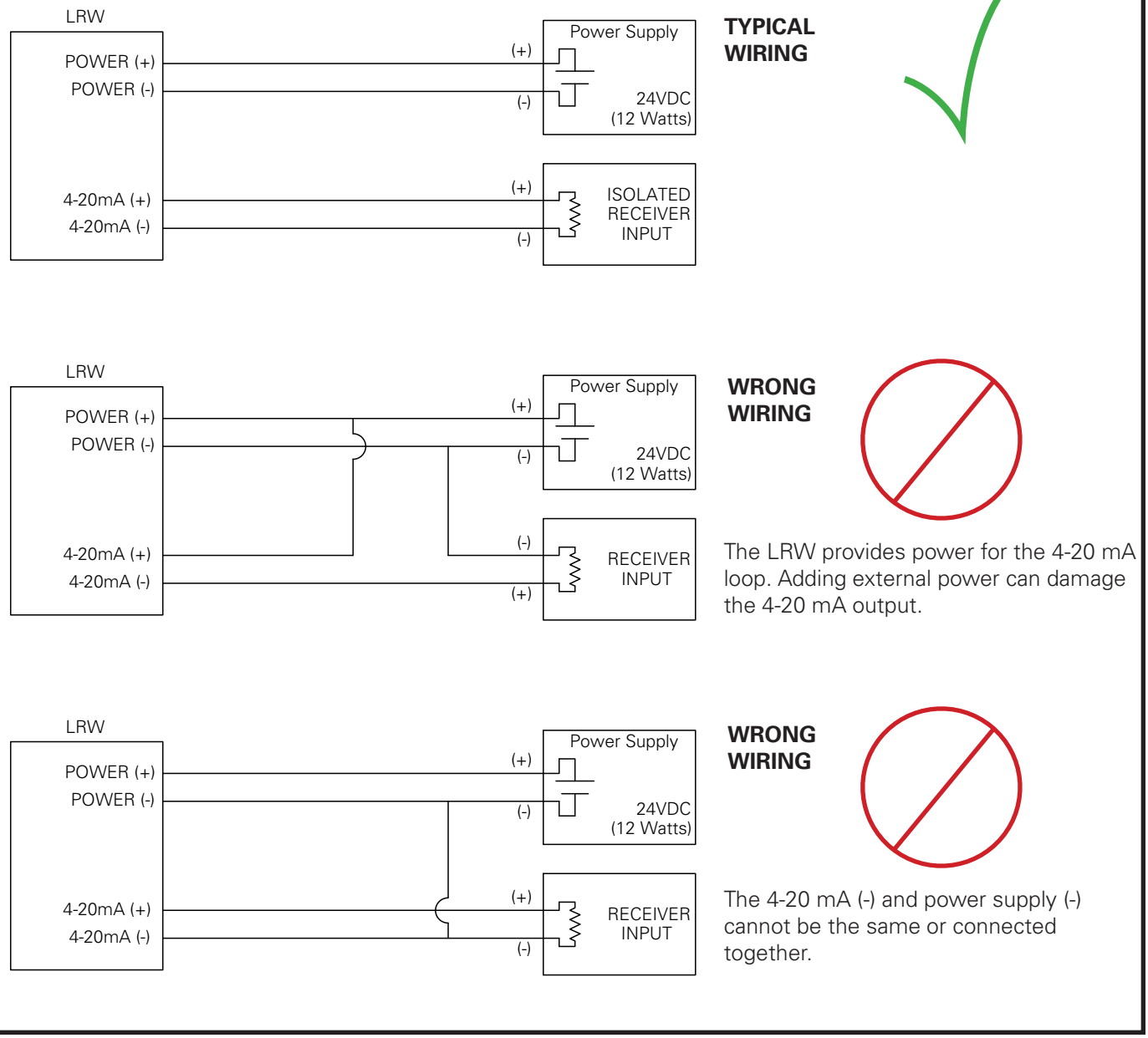
FIG. 3-14 WIRING DIAGRAM



WIRING CONTINUED

TYPICAL POWER AND LOOP WIRING CONFIGURATION

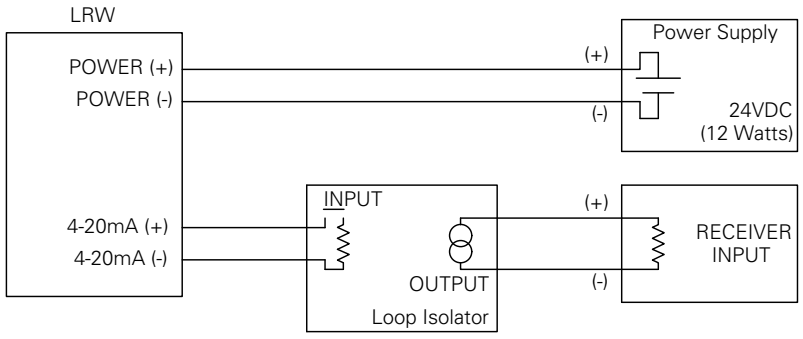
FIG. 3-15



WIRING CONTINUED

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

FIG. 3-16



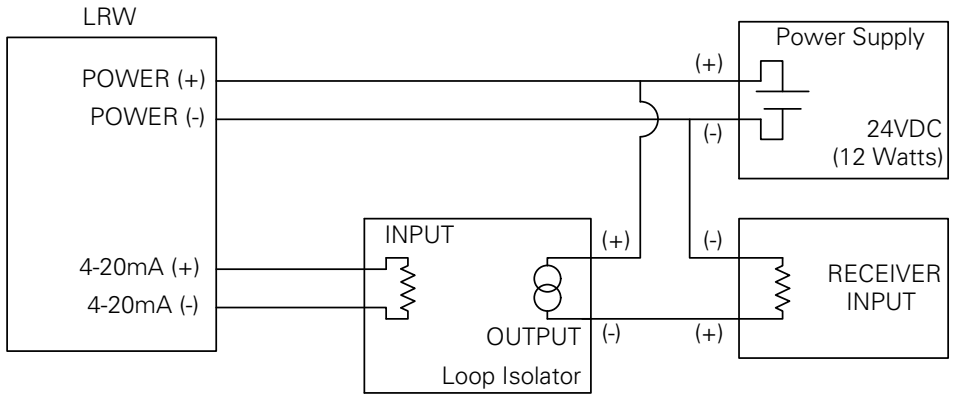
Recommended 4-20 mA Loop Isolators:

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

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

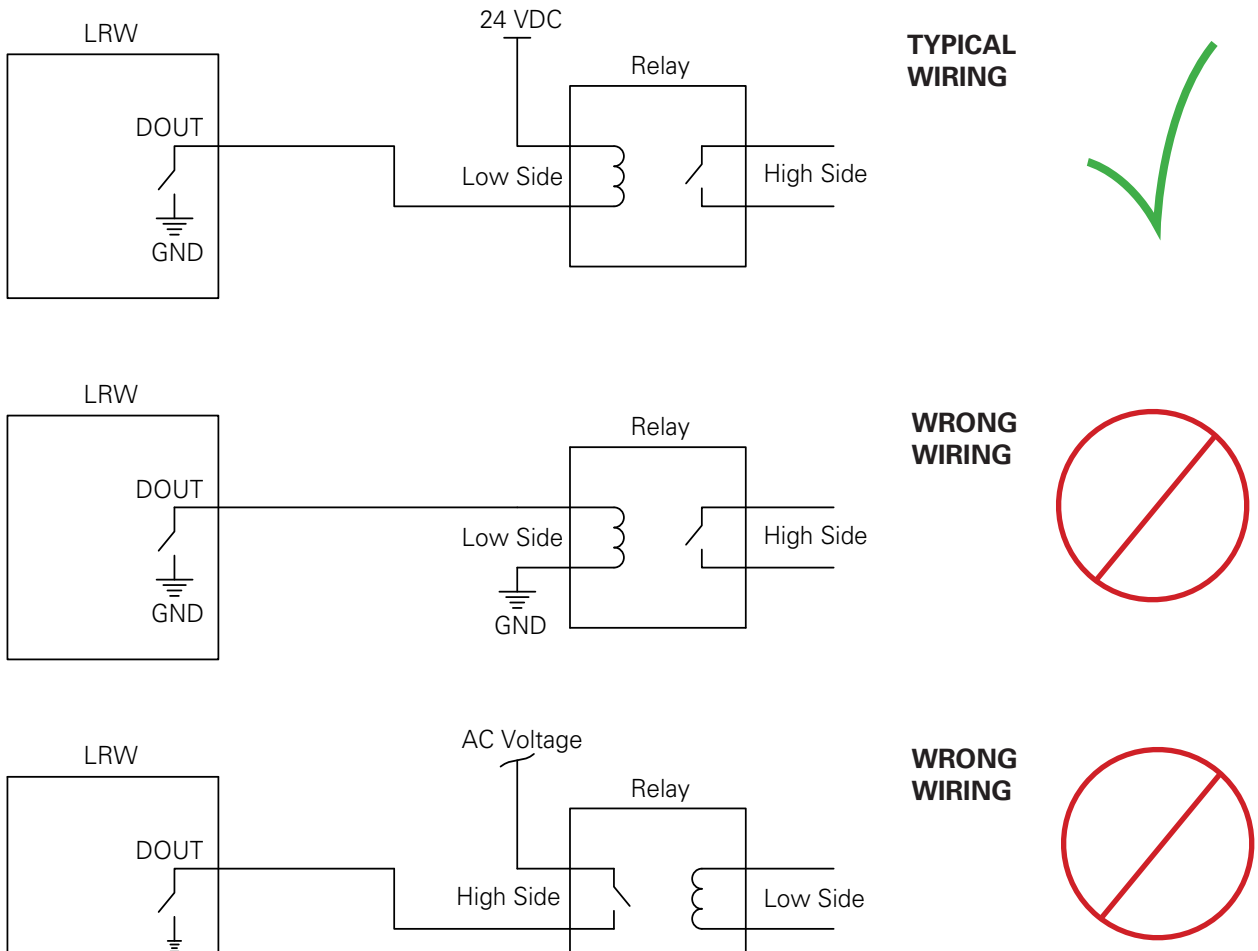
POWER SUPPLY AND OUTPUT WIRING WITH EXTERNAL POWERED ISOLATOR

FIG. 3-17



DIGITAL RELAY WIRING

FIG. 3-18 DIGITAL RELAY CONFIGURATION



DENSITY INPUT WIRING

FIG. 3-19 DENSITY METER PROVIDES POWER FOR 4-20 mA DENSITY LOOP

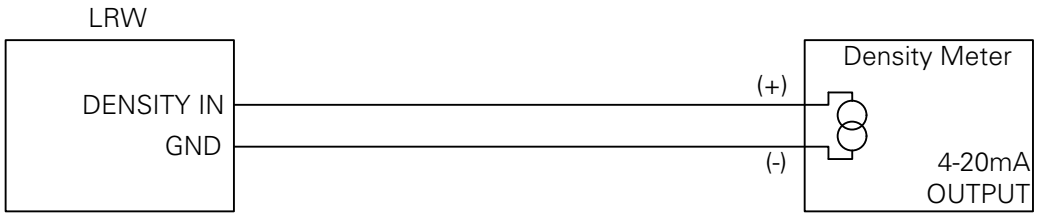
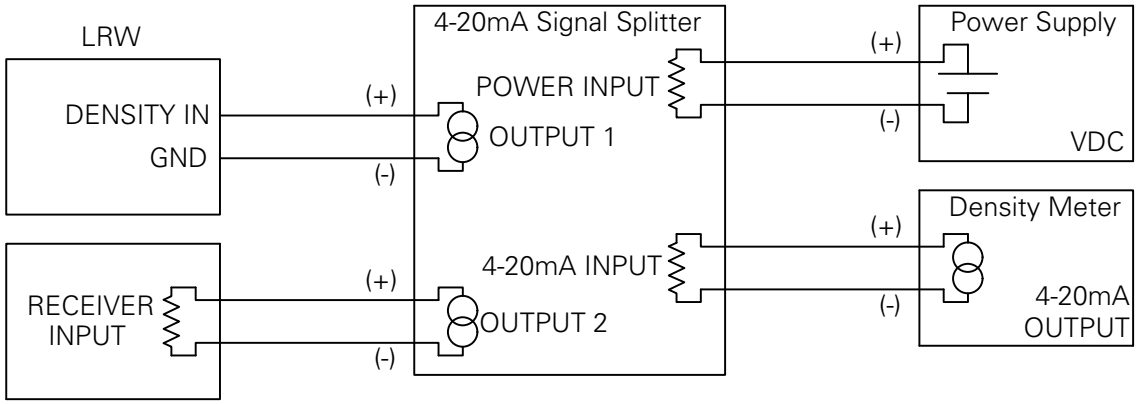


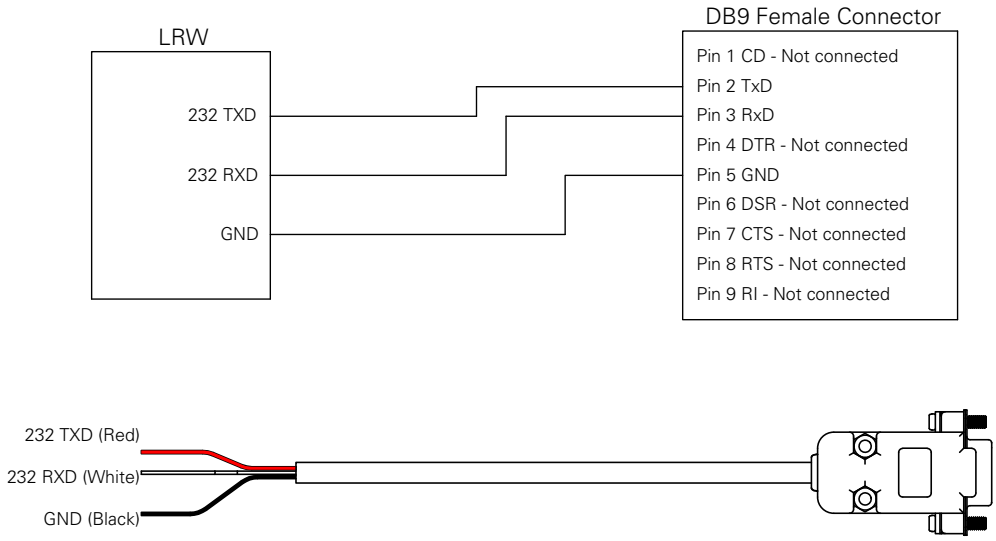
FIG. 3-20 DENSITY METER WITH A 4-20 mA SIGNAL SPLITTER
(WHEN A SECONDARY RECEIVER SHARES ONE DENSITY OUTPUT)



WIRING CONTINUED

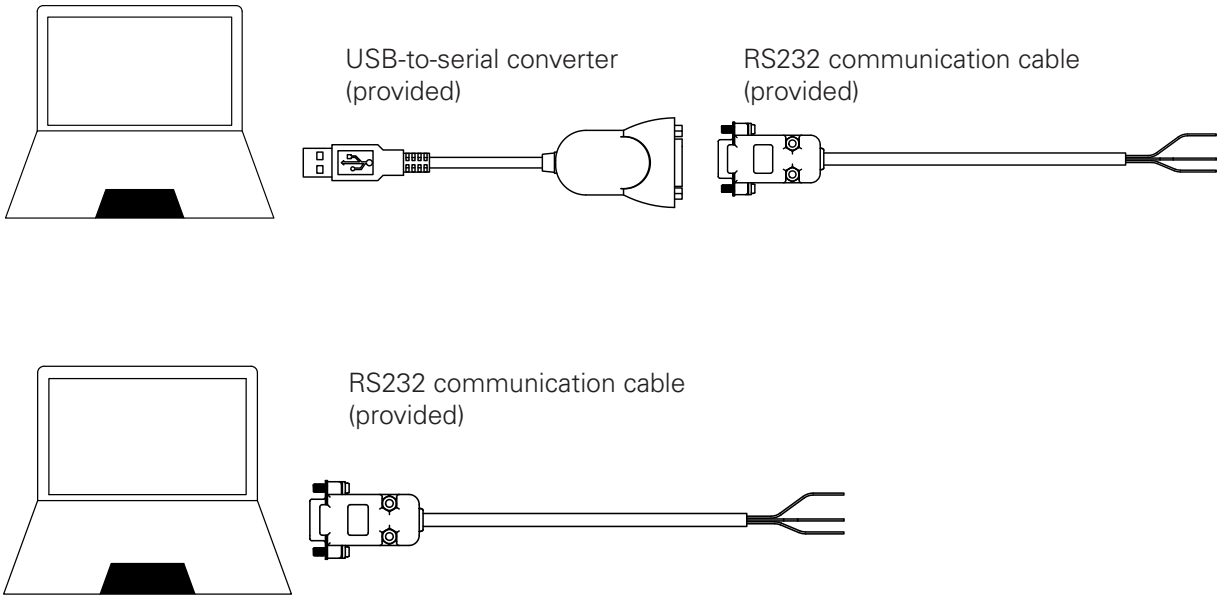
RS232 WIRING DIAGRAM

FIG. 3-21



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. 3-22



4 KAM LRW OPERATION REALTERM

REALTERM SOFTWARE CONFIGURATION

If you do not have or cannot install the LRW Connect software, you can use RealTerm. RealTerm software is used for calibration, debugging and configuration of the LRW. 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.

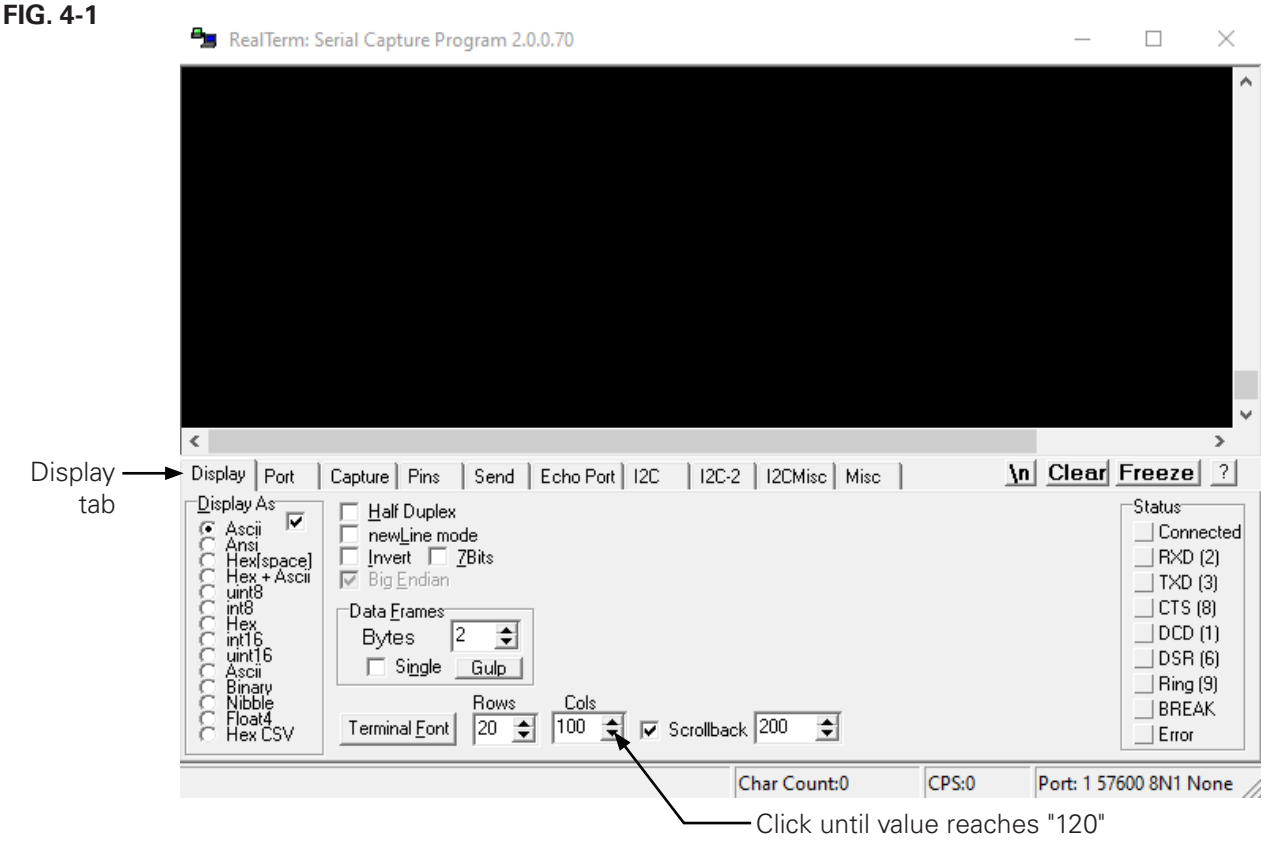
1. If you haven't already done so, connect the RS232 cable to the LRW board as shown on page 14 of this manual. To access the boards, unscrew the cover from the Explosion Proof electronics enclosure, unscrew the LCD Display plate and carefully unplug the LCD connector.

2. Connect the other end of RS232 cable to the serial port of your computer. An RS232 cable for connecting your PC to the LRW has been supplied with the LRW as well as a USB adaptor in case your computer does not have an RS232 serial port.

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



5. Click on the "Port" tab (FIG. 4-2) and then configure settings to match below.

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. You can find this information in the Device Manager of your PC under "Ports." FIG. 4-3.

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

FIG. 4-2

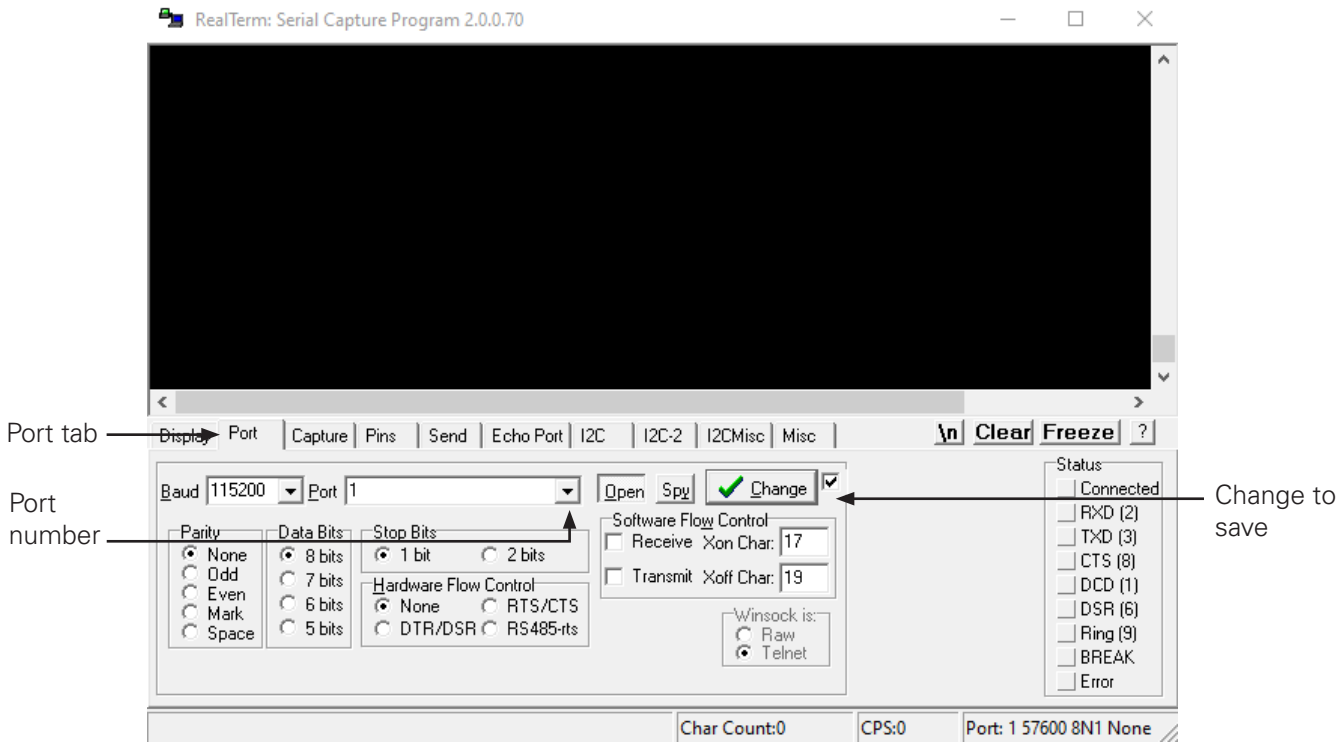
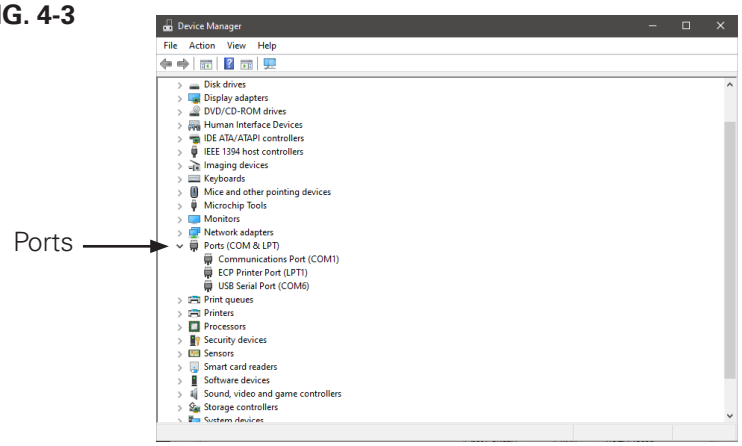


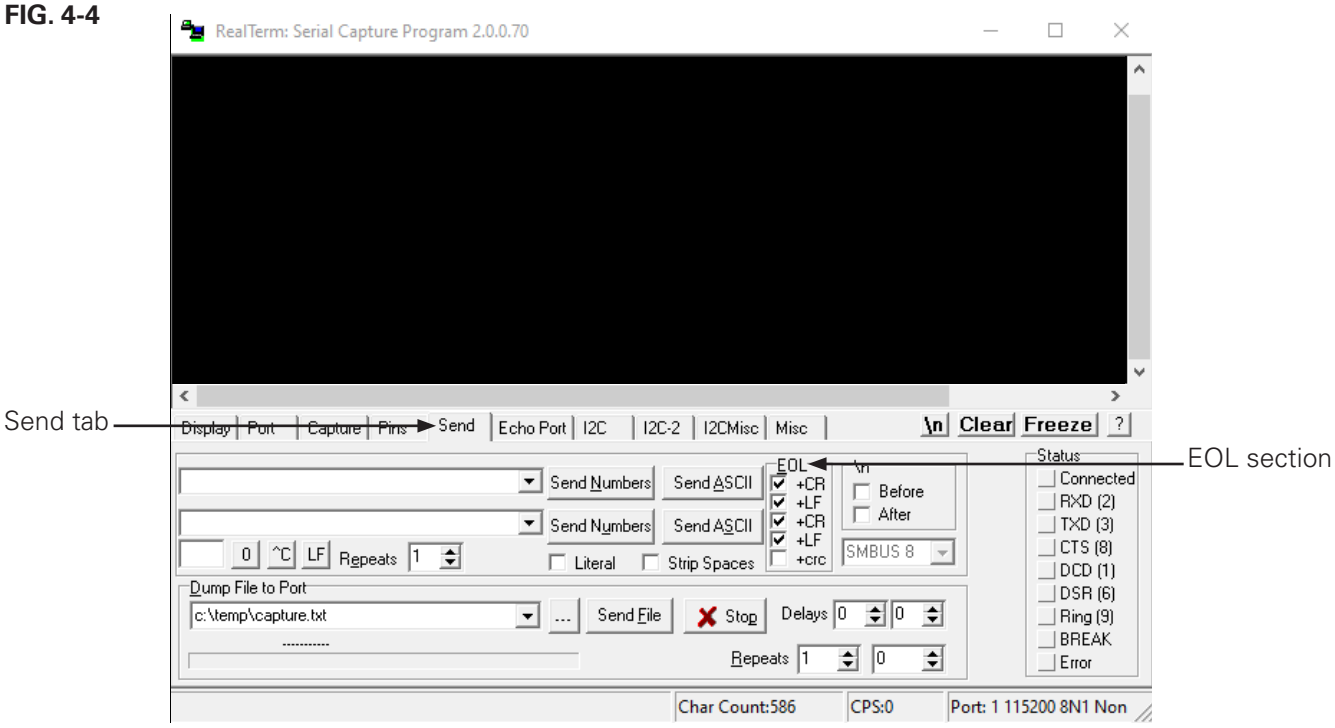
FIG. 4-3



7. Click on the "Send" tab and select first four boxes under the "EOL" section. FIG. 4-4.

8. The RealTerm software configuration is complete.

FIG. 4-4



OUTPUT DATA

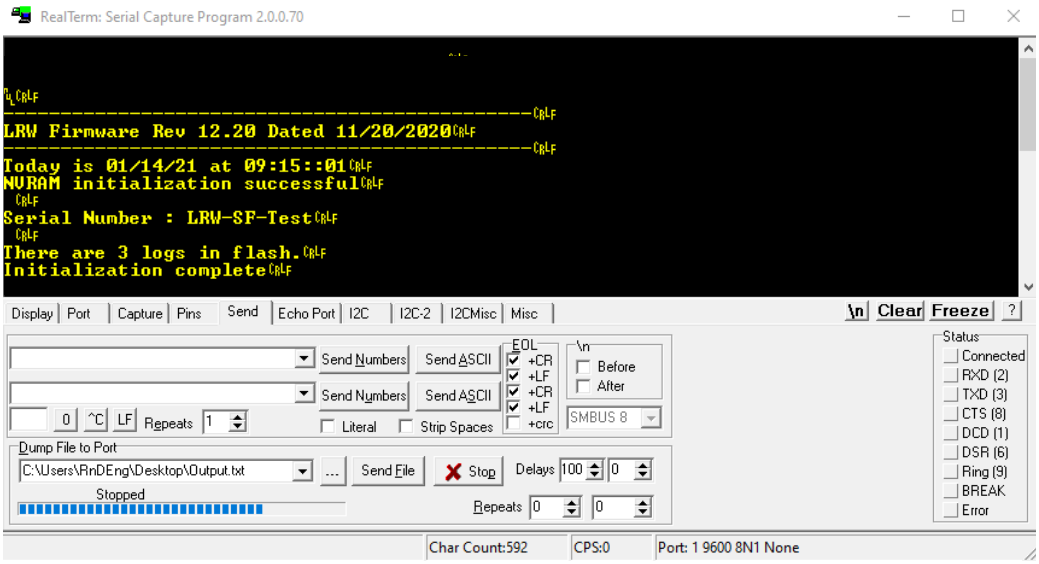
An RS232 cable for connecting your PC to the LRW has been supplied with the LRW along with a USB-to-serial converter in case your computer does not have an RS232 serial port. Go to https://www.kam.com/documentation/ and download the file "RS232 Driver" from the "Software" section. Once downloaded, unzip 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 20-22 of this manual. Ensure your PC is connected to the LRW sensor via the supplied RS232 serial cable and USB-to-serial converter as per wiring diagram on page 16. To access the boards, unscrew the cover from the Explosion Proof electronics enclosure, unscrew the LCD Display plate and carefully unplug the LCD connector.

Follow the steps below to view output data.

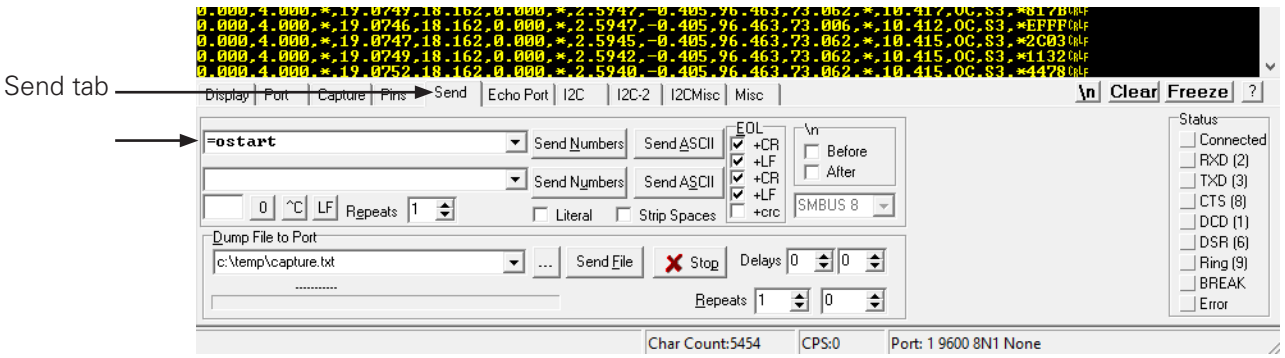
1. Launch RealTerm and turn on power to the LRW. The initial message will only appear once the unit is powered up and after all the connections and configurations are made. If the LRW was already on, the message won't display. FIG. 4-5.

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.

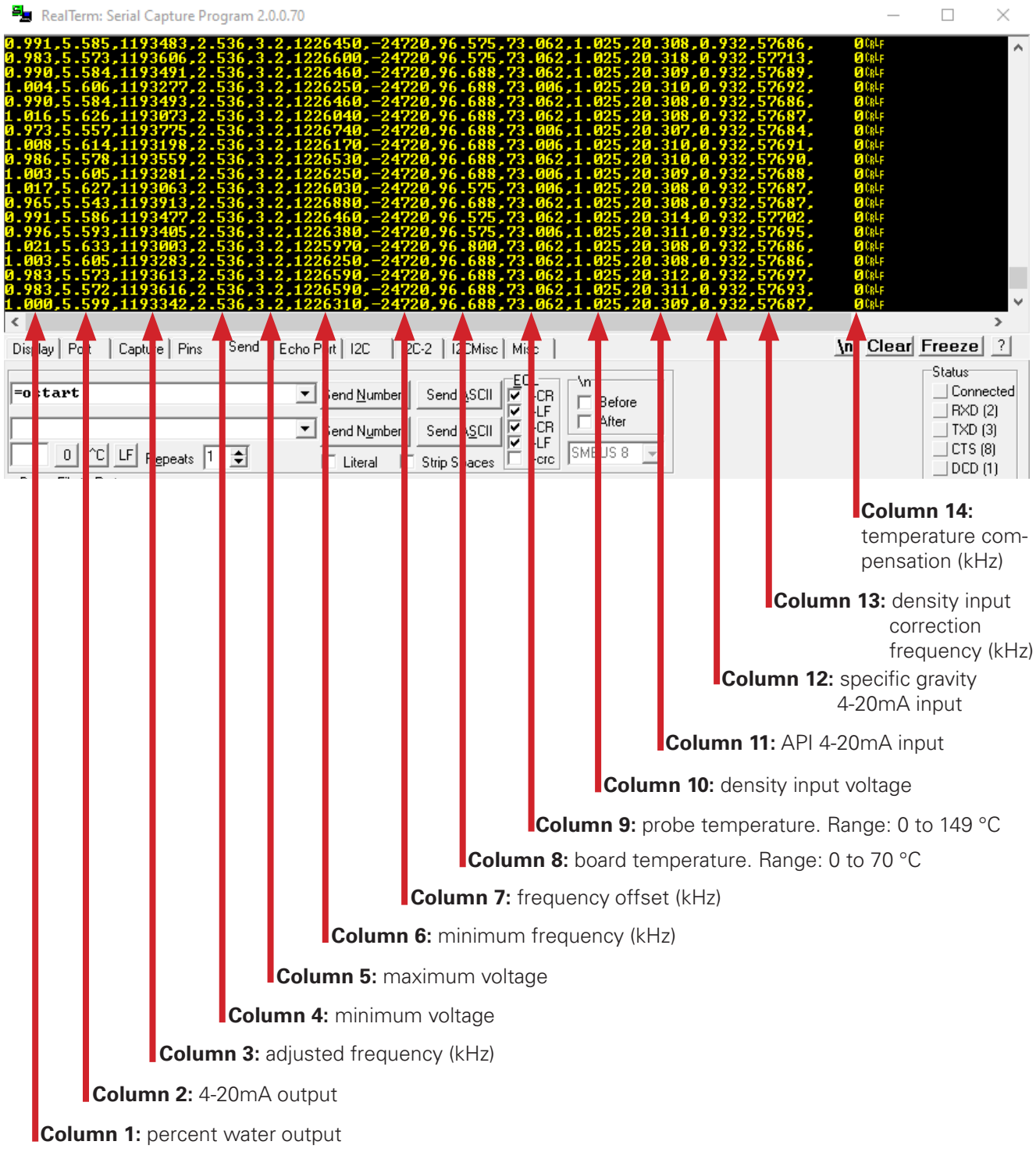
FIG. 4-6



3. The output will start automatically in CSV (comma separated values) format. See FIG. 4-7 on page 25 for output data definitions.

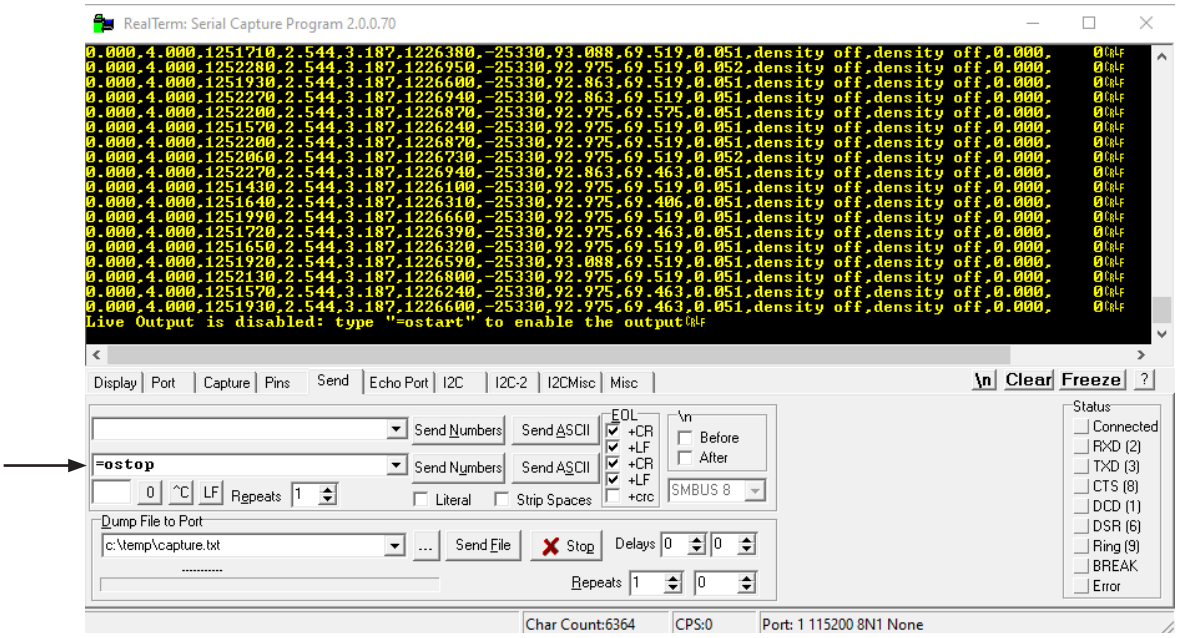
If the output readings do not display in the RealTerm menu, proceed to the "RS232 Troubleshooting" section on page 45 of this manual.

FIG. 4-7 OUTPUT DATA



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

FIG. 4-8



IN-LINE CALIBRATION AND VERIFICATION

PLEASE NOTE: The following calibration steps are to be conducted during initial installation with existing process conditions; during routine verification procedures; or when LRW readings indicate a slight drift off acceptable accuracies in continuous operation. You will need an RS232 cable (supplied) or an RS232/USB adapter (supplied), a PC equipped with RealTerm software, and a means for manually collecting and measuring samples.

Before proceeding, install and configure RealTerm as per instructions on pages 20-22 of this manual. Ensure your PC is connected to the LRW sensor via the supplied RS232 serial cable and USB-to-serial converter as per wiring diagram on page 19. To access the boards,unscrew the cover from the Explosion Proof electronics enclosure, unscrew the LCD Display plate and carefully unplug the LCD connector.

1. Launch RealTerm. Manually draw (3) samples of fluid according to API MPMS Chapter 8.1, waiting at least 15 minutes between samples.

2. Each time a sample is drawn, note value or take a screenshot of the current % water LRW reading in the Real-Term window.

3. Determine water percentage in each sample using a KAM Karl Fischer Moisture Analyzer (recommended), or other available method.

4. Average the water content from the three manual samples.

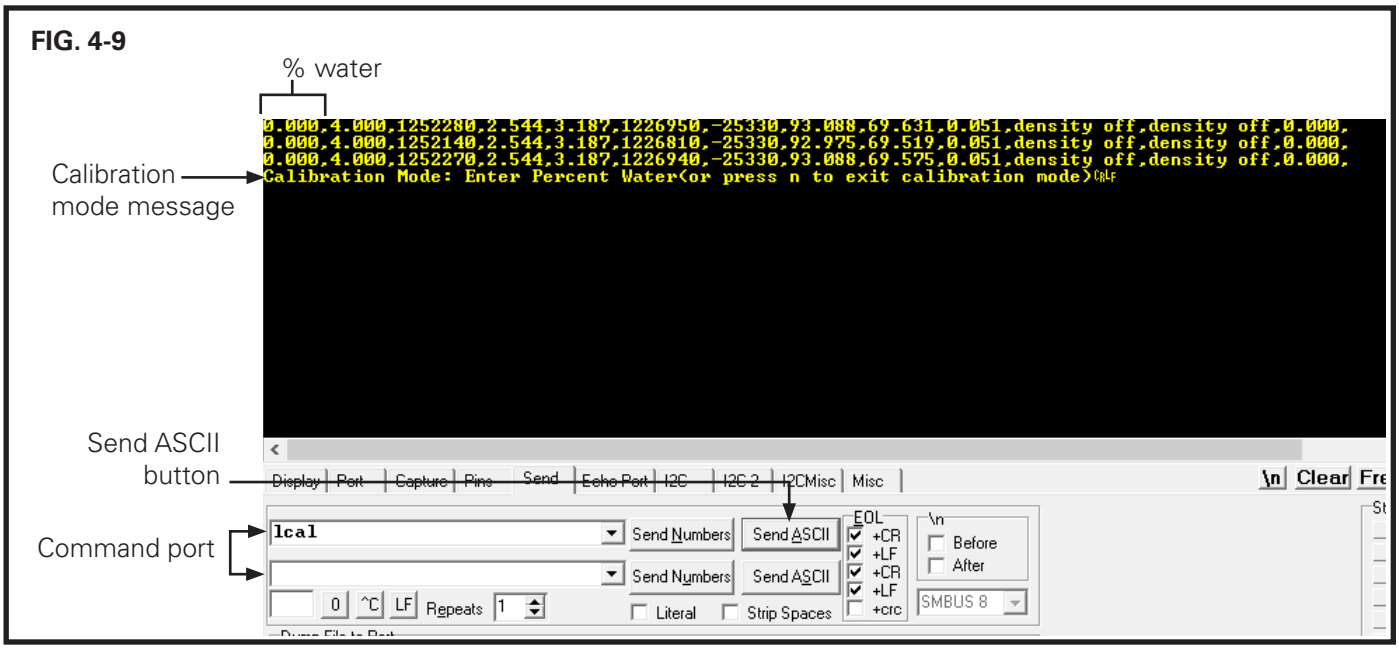
5. Average the water content from the three LRW readings or screenshots (first data column in RealTerm). FIG. 4-9.

6. Take note of the current reading of the LRW in RealTerm.

7. Calculate the difference between manual sample averages and LRW averages and add or subtract that value to the current reading of the LRW in Realterm. This value is the calculated percent of water to be entered on Realterm to calibrate the LRW. See Calibration Example on page 28.

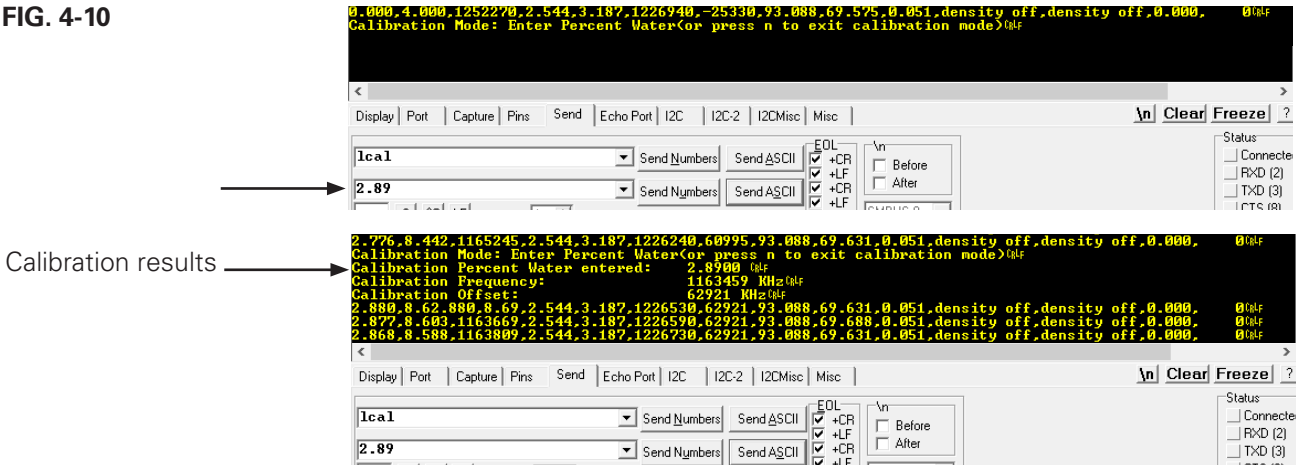
8. Type "lcal" (lower case L) in either command port under the "Send" tab and click on "Send ASCII." The "Calibration Mode" message will appear. FIG. 4-9.

FIG. 4-9



10. Type the calculated percent of water (i.e. 2.89 for 2.89%) and click on "Send ASCII." Calibration results will be displayed. FIG. 4-10.

FIG. 4-10



CALIBRATION EXAMPLE

Manual samples water content:	LRW screenshots water content:
1. 2.51%	1. 2.60%
2. 2.75%	2. 2.91%
3. 2.62%	3. 2.70%
Average = 2.63%	Average = 2.74%

Difference of averages:

2.74% – 2.63% = 0.11%

According to the averages, the LRW is reading 0.11% high.

Current reading: 3.0%

To adjust the LRW, the reading needs to be lowered by 0.11%.

3.0% – 0.11% = 2.89%.

This is the new value to be entered into the LRW.

CALIBRATION WITH LABORATORY RESULTS

In cases where on-site reference measurement (Karl Fischer or centrifuge) is not available, the LRW™ can be verified after obtaining results of manual sample analysis at a laboratory.

Before proceeding, install and configure RealTerm as per instructions on pages 20-22 of this manual. Ensure your PC is connected to the LRW sensor via the supplied RS232 serial cable and USB-to-serial converter as per wiring diagram on page 19. To access the boards,unscrew the cover from the Explosion Proof electronics enclosure, unscrew the LCD Display plate and carefully unplug the LCD connector.

1. Launch RealTerm. Manually draw (3) samples of fluid according to API MPMS Chapter 8.1, waiting at least 15 minutes between sample draws.

2. Each time a sample is drawn, note or take a screenshot of the current LRW reading in the RealTerm window.

3. Send the samples to the lab for water content determination.

4. Once results have been received from the lab, average the water content from the three samples. This value is the "Lab observed % water."

5. Average the water content from the three LRW screenshots. This value is the "LRW observed % water." NOTE: The "LRW observed % water" should be more than 0 and less than the maximum water % on the calibration table.

6. Type "=pcal,<LRW observed % water>, <Lab observed % water>" in the command port under the "Send" tab and click on "Send ASCII." In other words, if the LRW observed water was 1.5% and the Lab observed % water was 1.75%, you would input "=pcal,1.5,1.75". FIG. 4-11.

7. Calibration results will be displayed. FIG. 4-12. If not, run the numbers again or contact KAM for further assistance.

FIG. 4-11

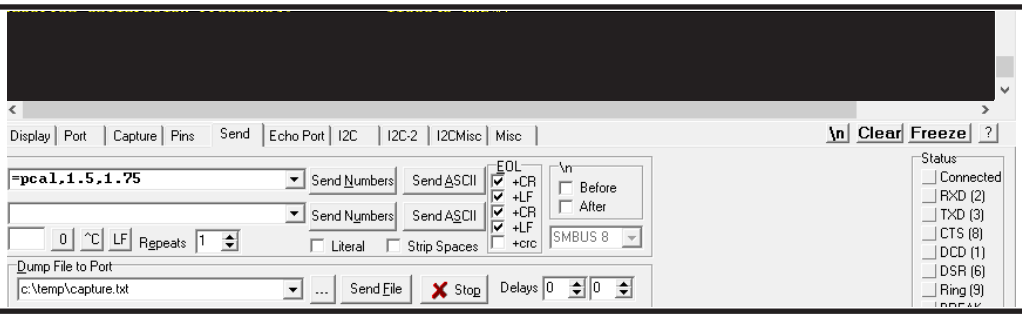
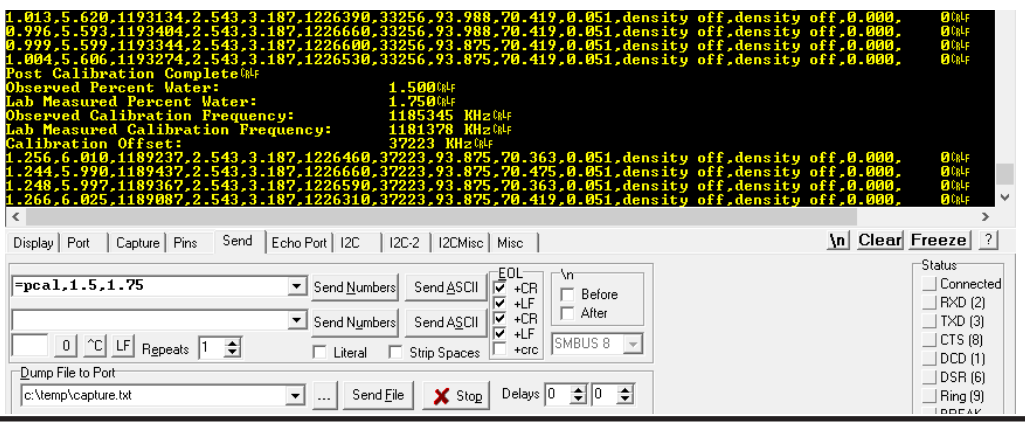


FIG. 4-12



PROCESS PARAMETER VALUES

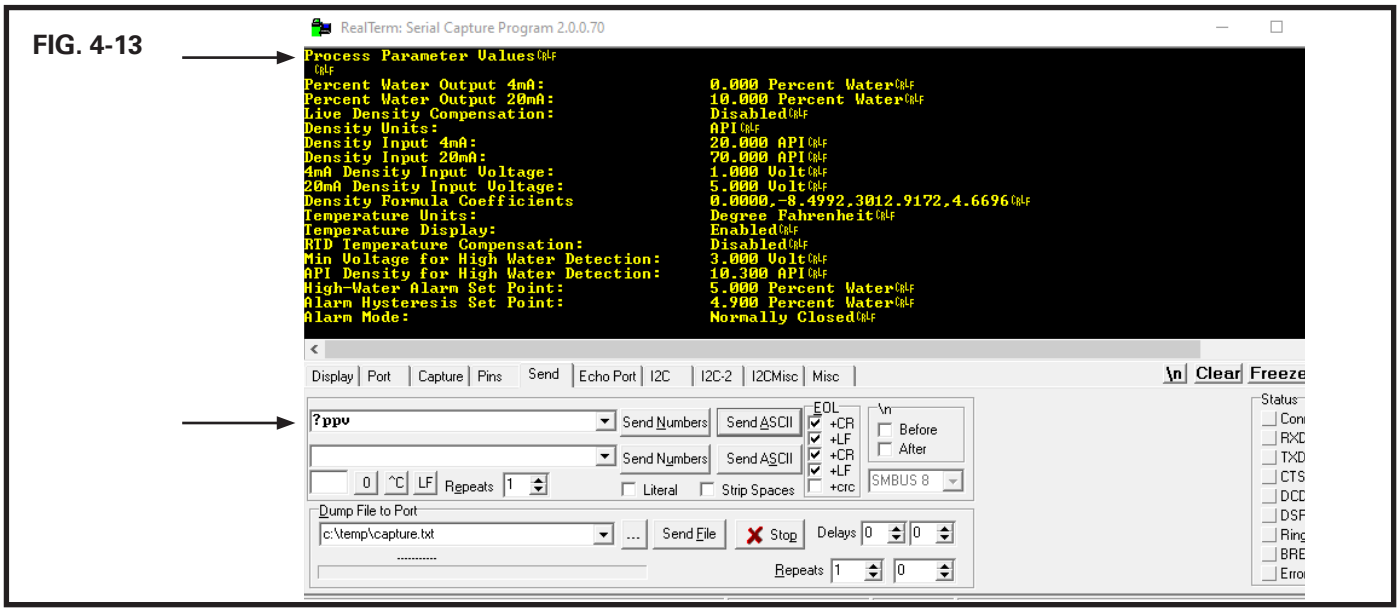
The overall configuration of the instrument is shown within the process parameter values, which include the 4-20 mA loop (water percent range), phase sensor, temperature coefficients, temperature units, OC-WC offsets, and alarm settings.

Before proceeding, install and configure RealTerm as per instructions on pages 20–22 of this manual. Ensure your PC is connected to the LRW sensor via the supplied RS232 serial cable and USB-to-serial converter as per wiring diagram on page 19. To access the boards, unscrew the cover from the Explosion Proof electronics enclosure, unscrew the LCD Display plate and carefully unplug the LCD connector.

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. 4-13.

FIG. 4-13



DENSITY INPUT VERIFICATION AND RE-CONFIGURATION

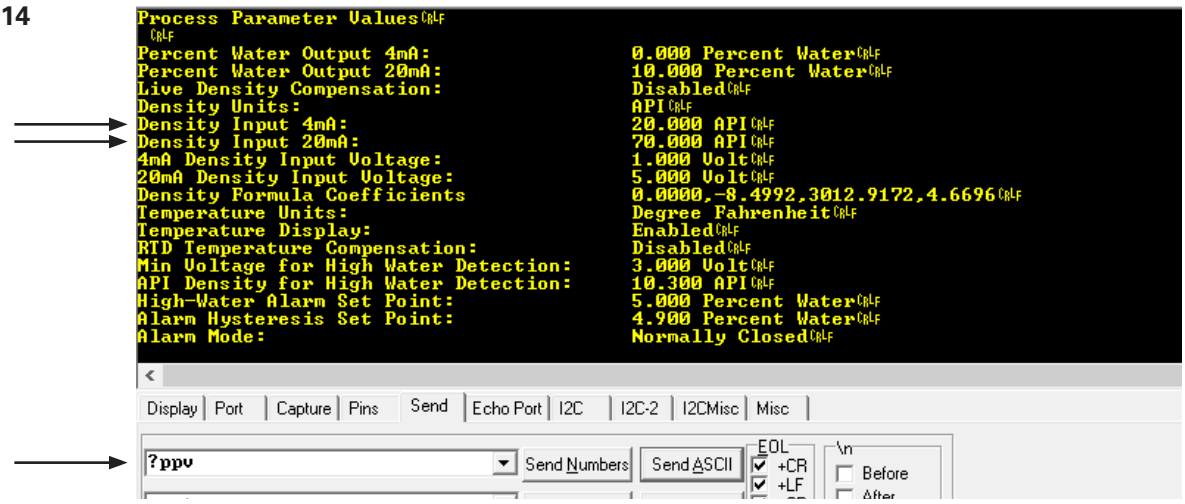
Density input values are configured at the factory according to information provided by the customer. These values must match output values from the mass flow meter/densitometer for accurate operation of the LRW.

KAM Controls recommends contacting the factory before changing these settings.

Before proceeding, install and configure RealTerm as per instructions on pages 20-22 of this manual. Ensure your PC is connected to the LRW sensor via the supplied RS232 serial cable and USB-to-serial converter as per wiring diagram on page 19. To access the boards, unscrew the cover from the Explosion Proof electronics enclosure, unscrew the LCD Display plate and carefully unplug the LCD connector.

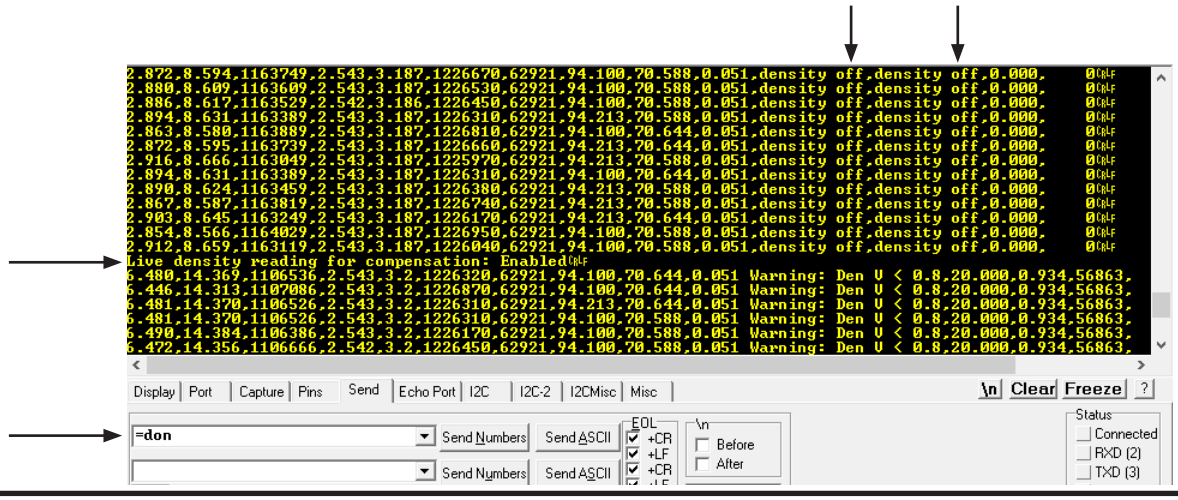
1. Launch RealTerm. Verify the low and high end of the density loop by typing "?ppv" in the command port and clicking on "Send ASCII." The parameters will show the current values for 4mA and 20mA with their respective units (API or g/cm3). FIG. 4-14.

FIG. 4-14



2. If the density is disabled, enable it by typing the command "=don" and clicking on "Send ASCII." FIG. 4-15. The density input should only be disabled in situations where process density remains constant. Density can be disabled by typing "=doff" and clicking on "Send ASCII."

FIG. 4-15



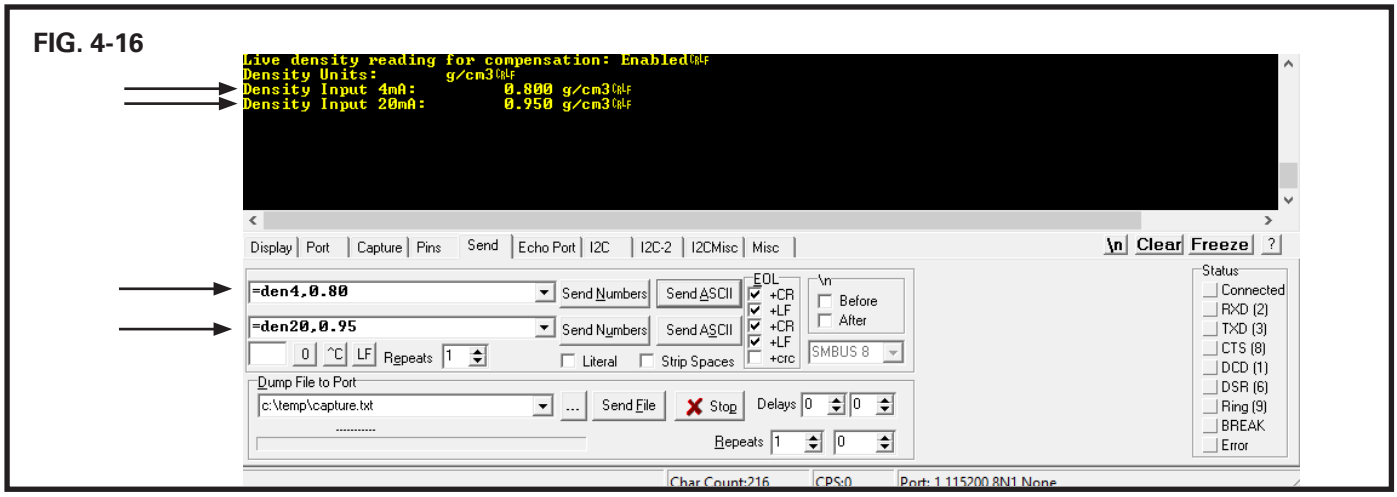
DENSITY INPUT VERIFICATION AND RE-CONFIGURATION CONTINUED

Units for the density input range can either be API gravity or g/cm3. Factory default unit is API gravity and default range is 20-70. Current input units are indicated under Process Parameter Values (FIG. 4-14). If the input units on the LRW do not match the output units of the densitometer or PLC, both units and values must be changed to match the output from the densitometer/PLC.
To change the density input range to **specific gravity units**:

1. Enter "=den" in the command port and click on "Send ASCII." Current input units will be displayed.

2. To change the values, enter "=den4,<4mA Density value>" and "=den20,<20mA Density value>" in the command ports and then click "send ASCII." For instance, if the desired low end of the range was 0.80 g/cm3 and the desired high end of the range was 0.95 g/cm3, you would enter "=den4,0.80" and "=den20,0.95". FIG. 4-16. Values can be entered in either command port, but you must click the "Send ASCII" button associated with each port.

FIG. 4-16



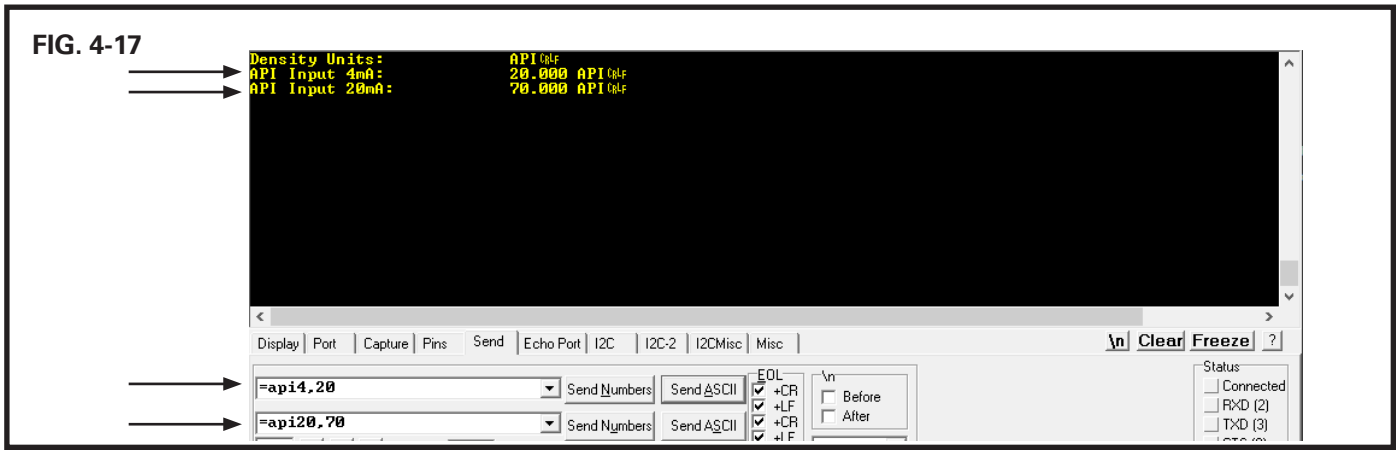
To change the density input range to **API Gravity units**,

1. Enter "=api" into the comman port and click on "Send ASCII." Current input units will be displayed.

2. To change the values, enter "=api4,<4mA Density value (API)>" and "=api20,<20mA Density value (API)>" into the command ports and click on "Send ASCII". For instance, if the desired low end of the range was API 20 and the desired high end of the range was API 70, you would enter "=api4,20" and "=api20, 70". FIG. 4-17.

   NOTE: For manual calibration instructions please contact KAM Controls.

FIG. 4-17



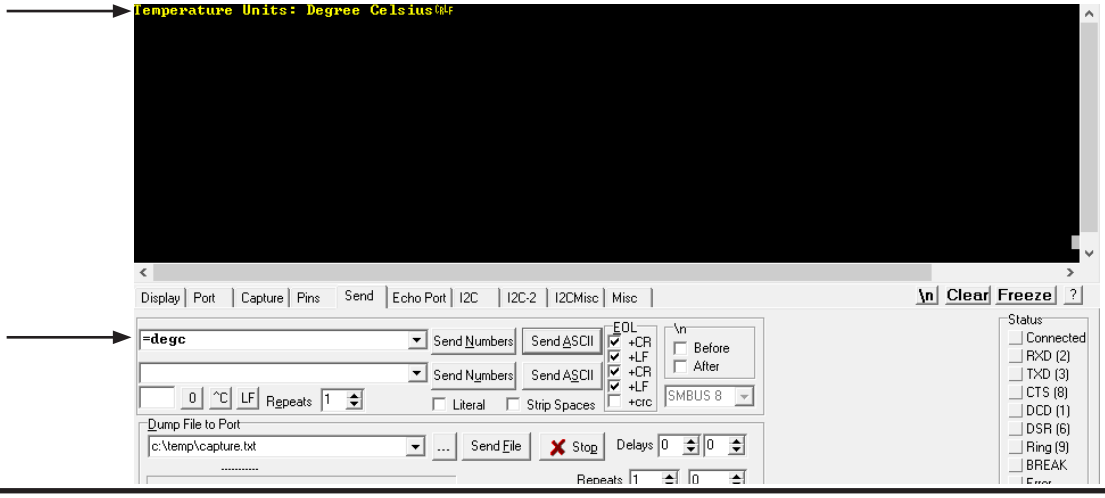
CHANGING THE TEMPERATURE UNITS

Before proceeding, install and configure RealTerm as per instructions on pages 20-22 of this manual. Ensure your PC is connected to the LRW sensor via the supplied RS232 serial cable and USB-to-serial converter as per wiring diagram on page 19. To access the boards, unscrew the cover from the Explosion Proof electronics enclosure, unscrew the LCD Display plate and carefully unplug the LCD connector.

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

1. Launch RealTerm. Type "=degc" for Celsius or "=degf" for Fahrenheit on either command box under the "Send" tab and click on "Send ASCII." The change will be confirmed in the main window. FIG. 4-18.

FIG. 4-18



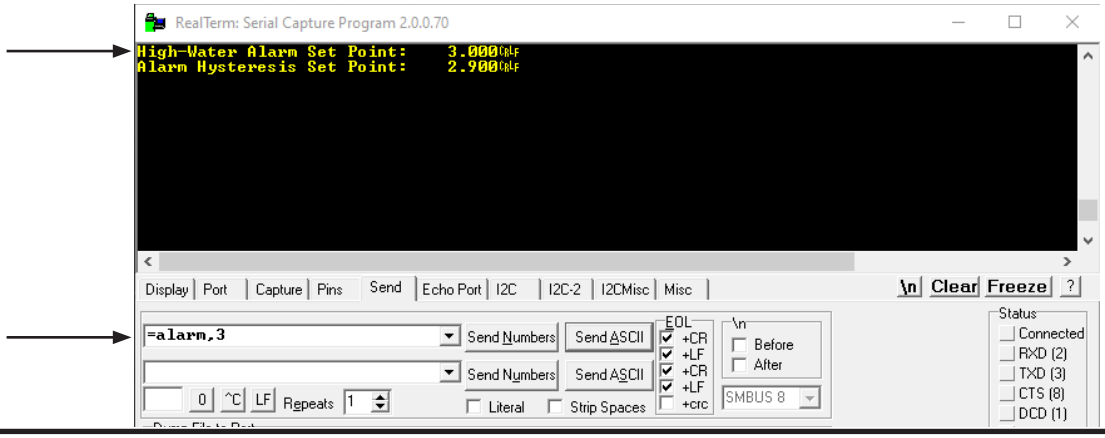
SETTING THE ALARM SETPOINTS

Ensure RealTerm is installed and configured as per instructions on pages 20-22 of this manual. Ensure your PC is connected to the LRW sensor via the supplied RS232 serial cable and USB-to-serial converter as per wiring diagram on page 19. To access the boards, unscrew the cover from the Explosion Proof electronics enclosure, unscrew the LCD Display plate and carefully unplug the LCD connector.

To set the alarm [DOUT]:

1. Launch RealTerm, go to the "Send" tab, type "=alarm,<percent value>" on either command box and click on "Send ASCII." For example, if the percent water where the alarm will activate is 3, you would enter "=alarm,3". The configured values will be displayed. FIG. 4-19.

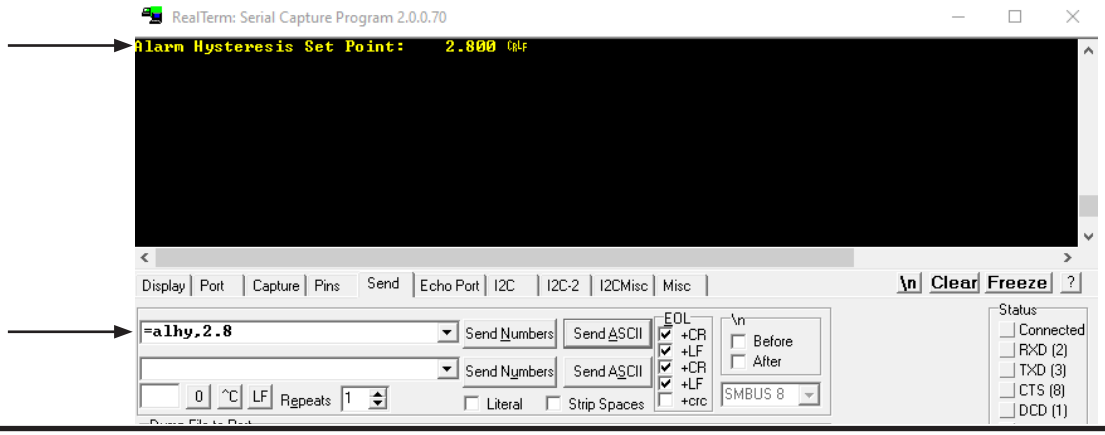
FIG. 4-19



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 2.8, you would type "=alhy,2.8". The new hysteresis alarm value will be displayed. FIG. 4-20.

FIG. 4-20



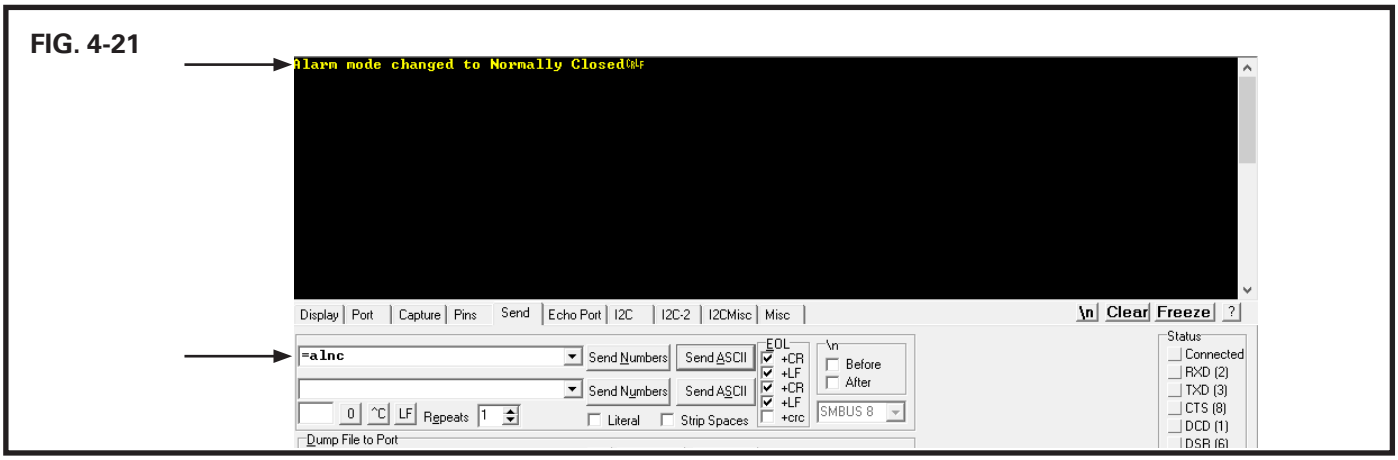
SETTING THE ALARM MODE

Before proceeding, install and configure RealTerm as per instructions on pages 20-22 of this manual. Ensure your PC is connected to the LRW sensor via the supplied RS232 serial cable and USB-to-serial converter as per wiring diagram on page 19. To access the boards, unscrew the cover from the Explosion Proof electronics enclosure, unscrew the LCD Display plate and carefully unplug the LCD connector.

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. 4-21.

FIG. 4-21



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

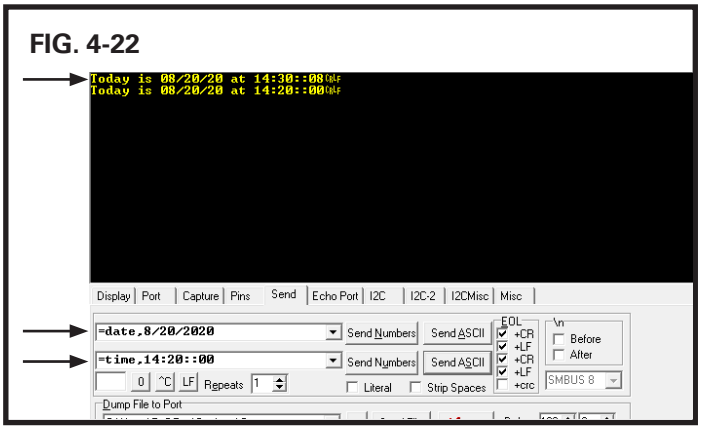
SETTING THE DATE AND TIME

Before proceeding, install and configure RealTerm as per instructions on pages 20-22 of this manual. Ensure your PC is connected to the LRW sensor via the supplied RS232 serial cable and USB-to-serial converter as per wiring diagram on page 16. To access the boards, unscrew the cover from the Explosion Proof electronics enclosure, unscrew the LCD Display plate and carefully unplug the LCD connector.

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. 4-23.

2. To set the time, type the command "=time,<HR>:<MM>::<SS>" on either command box under the "Send" tab. Click on "Send ASCII." 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. 4-22

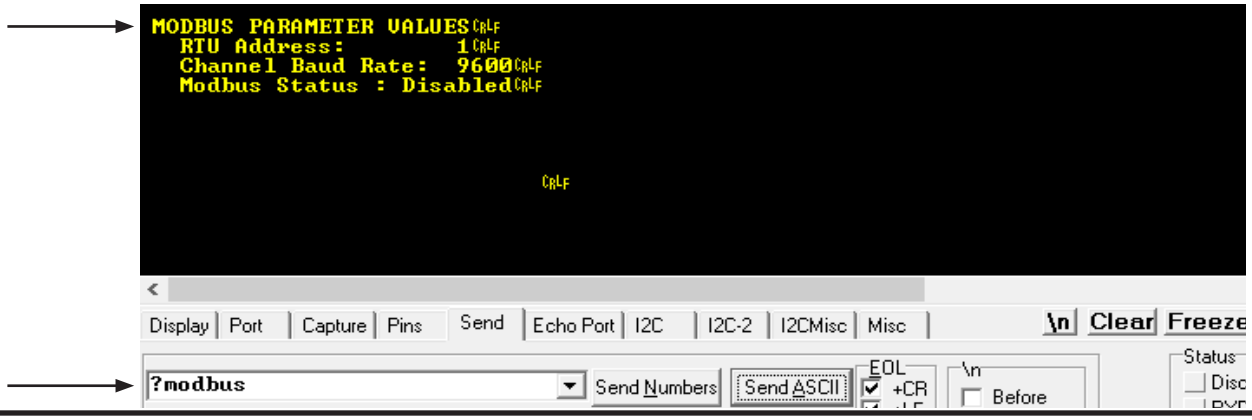


ENABLE/DISABLE MODBUS

Unless requested, Modbus is usually disabled prior to shipment from KAM. Before proceeding, install and configure RealTerm as per instructions on pages 20-22 of this manual. Ensure your PC is connected to the LRW sensor via the supplied RS232 serial cable and USB-to-serial converter as per wiring diagram on page 19. To access the boards, unscrew the cover from the Explosion Proof electronics enclosure, unscrew the LCD Display plate and carefully unplug the LCD connector.

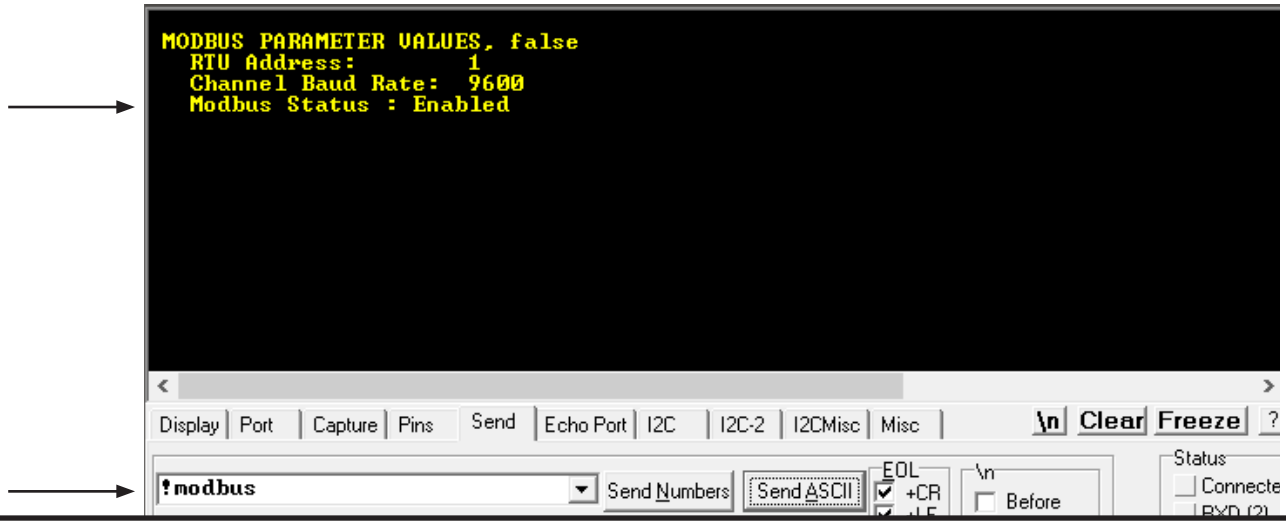
1. Launch RealTerm. Go to the "Send" tab, type "?modbus" on either command box and click on "Send ASCII" to check Modbus status. The Modbus parameters will display on the RealTerm window. FIG. 4-23.

FIG. 4-23



2. Type the command "!modbus" and click on "Send ASCII" to enable Modbus. Modbus status will change to "Enabled" confirming the change. FIG. 4-24.

FIG. 4-24



3. Power cycle (turn off and on) the LRW 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.

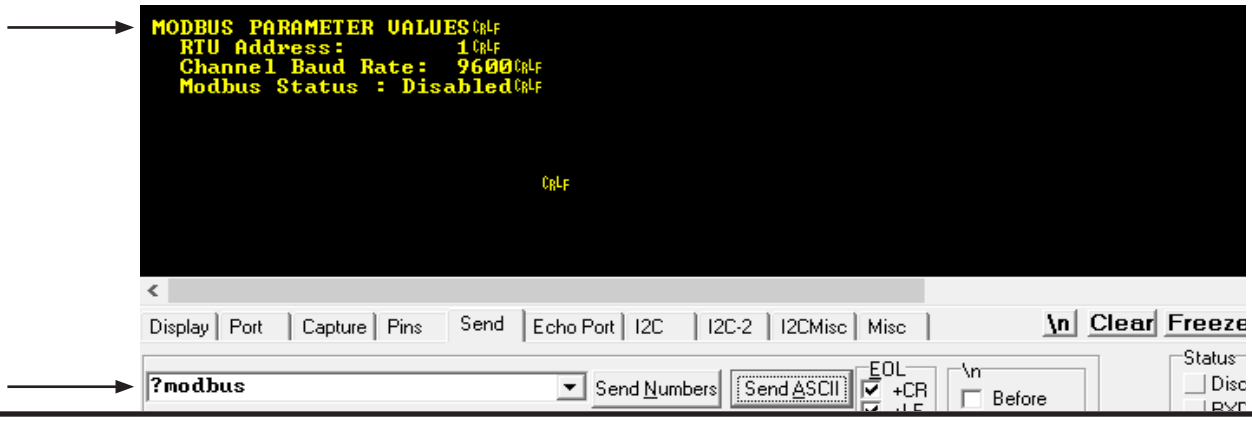
CHANGE MODBUS ADDRESS

The default Modbus address is 1. This address can be changed 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 20-22 of this manual. Ensure your PC is connected to the LRW sensor via the supplied RS232 serial cable and USB-to-serial converter as per wiring diagram on page 19. To access the boards, unscrew the cover from the Explosion Proof electronics enclosure, unscrew the LCD Display plate and carefully unplug the LCD connector.

1. On RealTerm, go to the "Send" tab and type the command "=modbus,2,9600" on either command box. Click on "Send ASCII." FIG. 4-25. The #2 represents the new address.

FIG. 4-25



2. To complete the change, turn the LRW 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
^pcal,<value>,<value2>	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
^mformat	Change the modbus address format (High byte or Low Byte)
?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.

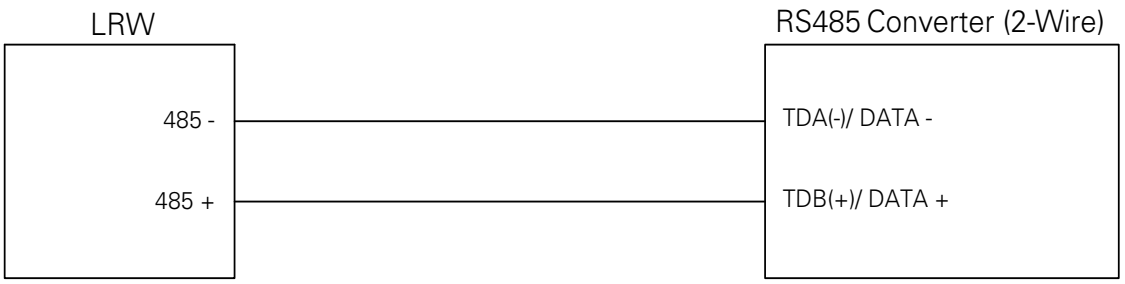
Detailed instructions on how to use commands and examples are available in the previous sections.

5 KAM LRW OPERATION MODBUS

OPERATIONS 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 LRW is turned off.
3. Set your RS485 converter for two wire mode as per the manufacturer's instructions of the converter.
4. To access the boards, use a 5/64" Allen Key to remove set screw on the electronics enclosure cover and un screw the cover to remove it.
5. Hook up the "485 +" terminal on the LRW's Terminal board to Data (+) line on the RS485 converter. Fig 5-1
6. Hook up the "485-" terminal on the LRW's Terminal board to the Data (-) line on the RS485 converter. Fig 5-1

FIG. 5-1 RS485 WIRING DIAGRAM



7. Turn the power on to the LRW.
8. Make sure the activity lines on the converter blink as data is transferred or read by the Modbus master reader software.
9. 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 on the USB ports. You may need to connect external power to the converter.
10. 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 can be change the Modbus Address see "Changing Modbus Address" section on page 35 if necessary)
    Offset: 40001

KAM LRW OPERATION MODBUS CONTINUED

The output data of the LRW can be accessed via the following Modbus registers.

TABLE 5-1

Register	Data	Type of Register	Type of Data	Expected Value Range
40200	Percent Water	Read	32 Float Bit	0.000- 20.000
40202	4-20mA Output	Read	32 Float Bit	0.000- 20.000
40204	Adjusted Frequency (kHz)	Read	32 Float Bit	0- 1,500,000
40206	Minimum Frequency (kHz)	Read	32 Float Bit	0- 1,500,000
40208	Frequency Offset (kHz)	Read	32 Float Bit	0- 1,500,000
40210	Density Correction Frequency (kHz)	Read	32 Float Bit	0- 1,500,000
40212	Temp Compensation Frequency (kHz)	Read	32 Float Bit	0- 1,500,000
40214	Minimum Voltage	Read	32 Float Bit	0.000- 10.000
40216	Maximum Voltage	Read	32 Float Bit	0.000- 10.000
40218	Board Temperature	Read	32 Float Bit	(-) 40 to (+) 120
40220	Probe Temperature	Read	32 Float Bit	(-) 40 to (+) 120
40222	Density 4-20 Loop Voltage	Read	32 Float Bit	0.000- 6.000
40224	Density in API Gravity	Read	32 Float Bit	0.000- 200.000
40226	Density in g/cm3	Read	32 Float Bit	0.0000- 2.0000
40228	Calibrate Percent Water	Write	32 Float Bit	

6 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 antennas. Do NOT power wash the unit.

Instead, to remove any oil residue 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. Follow your company's policies and procedures for chemical use and handling

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

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

7 TROUBLESHOOTING

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

-LCD Display is not working

-Instrument 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 in any of the sections you will need to access the boards, use a 5/64" Allen Key to remove set screw on the electronics enclosure cover and unscrew the cover to remove it.

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

NOTE: Regardless of the problem being experienced, the troubleshooting sections need to be followed in the order shown in this manual, starting from the "LCD Display Verification" section.

LCD DISPLAY VERIFICATION

The LCD shows in a cycle some values measured by the LRW (Water Percent, Min Frequency, Density Input, & Temperature). If these values are not cycling in the LCD perform the step below.

1. If the LCD is only showing one value, power cycle the LRW by turning it off and on. This will reset the LRW, and the LCD Display should be cycling the values. If this issue persists, please contact KAM Technical Support for further assistance.

If the LCD display is off despite the LRW being powered on, please follow these instructions:

1. Remove the four (4) screws on the LCD display plate with a Phillips screwdriver (FIG 6-1).

2. Unplug the LCD connector from the terminal board (FIG 6-2) and set LCD display plate aside.

3. Remove the four (4) screws on the Terminal Board with a Phillips screwdriver. FIG 6-2.

4. Carefully pull the Terminal Board away from the Processor board by firmly holding it on the edges and pulling straight up. Pulling the unit sideways or at an angle may damage the 26-pin connection.

7 TROUBLESHOOTING

LCD DISPLAY VERIFICATION CONTINUED

5. Check for any fuses or surge protection devices visibly damaged on the bottom side of the Terminal Board.
6. If the board passes a visual check, reinstall the Terminal PCB on the LRW by carefully aligning the 26-pin header with its corresponding mating connector on the Processor Board. Push directly down and then install four (4) screws.
7. Connect the field power supply between 12-30V DC (+24V DC power is preferred) to the POWER+ and POWER- terminals on the Terminal Board.
8. Turn on power to LRW.

If the LCD issue persists, contact Kam Technical Support for further assistance.

FIG 7-1 LCD DISPLAY PLATE

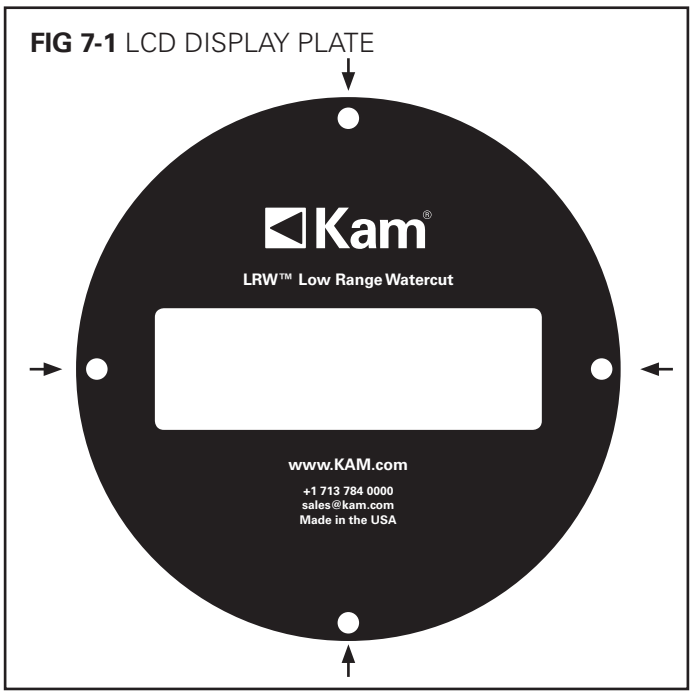
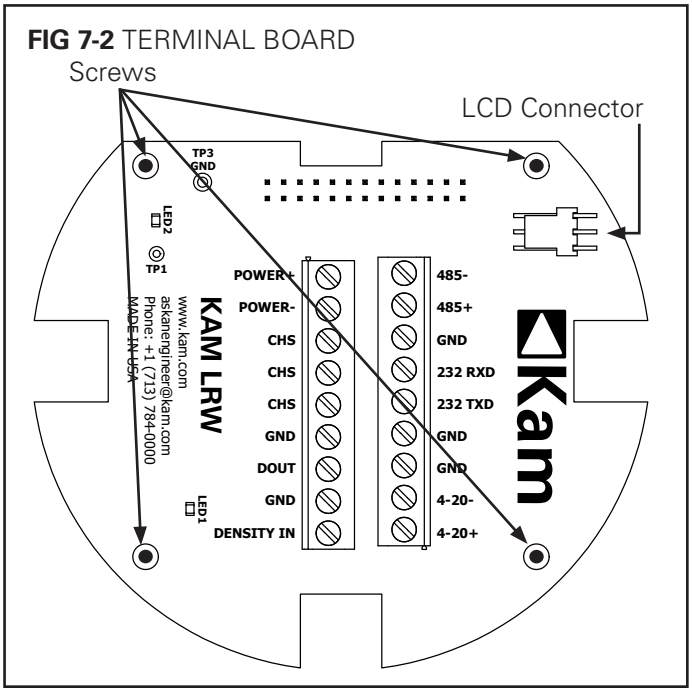


FIG 7-2 TERMINAL BOARD



POWER VERIFICATION

There are 2 LEDs on the LRW's electronics 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 (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 LRW terminals. If the voltage is not within those requirements, verify that the power supply has a wattage capability of 12 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 LRW is wired with the correct polarity as per the wiring diagram on page 37 of this manual. If the polarity is wrong, turn off the power and rewire the LRW with the correct polarity. Turn the power back on when done.

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

3. Use a multimeter in voltmeter mode to verify the voltage of the primary power supply by measuring across TP1 and TP3 (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 TP3. 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+" and "4-20-" terminals by placing one of the voltmeter's test leads on 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+" and "4-20-" terminals by turning the screw clockwise. Using a multimeter in voltmeter mode, measure the voltage across the "4-20+" and "4-20-" terminals. The voltage should be between 10.0 to 12.5 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+" and "4-20-" terminals. The electric current should be between 3.9 to 20.1mA. 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 4-20mA output loop wires to the LRW as per the wiring diagram on Fig 5-1, page 37. If the PLC cannot read the output, there could be a wiring issue with the loop. Please inspect the wires from the LRW to the PLC. If the issue persists, continue to the next section, and contact KAM Technical Support for further assistance.

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

RS 232 COMMUNICATION

If you have not already done so, follow the Power Verification procedure to verify power supplies. The procedure can only be checked with Real Term.

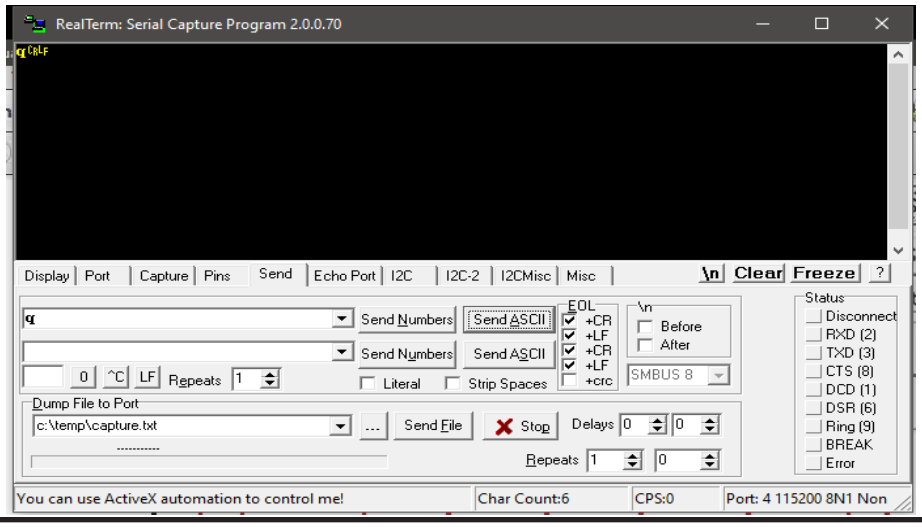
Before proceeding, install and configure RealTerm as per instructions on pages 20-22 of this manual. Also, please ensure the driver for the supplied USB-to-serial converter is installed on your PC.

TROUBLESHOOTING CONTINUED

1. If the RS232 cable is connected to the LRW, ensure all 3 wires from the LRW 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 ends of the white wire (232 RXD) and the red wire (232 TXD) together. While the ends of these wires are connected, type any letter in any of the Command Boxes of the "Send" tab in RealTerm and click on "Send ASCII". If the configuration is done properly, the letter will appear in the window display (See Fig 6-3).

FIG 7-3



If there is still no change, use another RS232 serial cable and/or USB-to-Serial converter and try sending the command once more. If there the same letter you typed does not appeared, try reinstalling the USB-to-Serial converter driver, and repeat from 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.

If experiencing either blank or a non-alphanumeric output on the LRW PC software or on the RS232 terminal (e.g. RealTerm), please follow these instructions:

3. Once the letter appears on the window display, connect the RS232 serial cable to the LRW as per the wiring diagram Fig 3-16 on page 16 of this manual.

4. Turn the LRW off and back on.

5. Type the command "help" in any of the Command Boxes 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 232 TXD 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 within the stated range, then the RS232 port from the LRW might be damaged. Contact KAM Technical Support for further assistance.

If the voltage is within the specified range and you are still not able to establish communication with the LRW 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 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 37 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 LRW per the wiring diagram FIG. 3-16 on page 16 of this manual.

3. Use a multimeter in voltmeter mode to measure the voltage between the "485-" and "485+" on the terminal board. The differential voltage is usually around 2 Volts. Continue to the next step.

NOTE: The 485+ and 485- 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 LRW 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 LRW. The LEDs should be blinking while data is being sent/received.

6. If there 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.

8 SPARE PARTS

SPARE PARTS

FIG. 8-1 Spare Parts for Flow Through Models

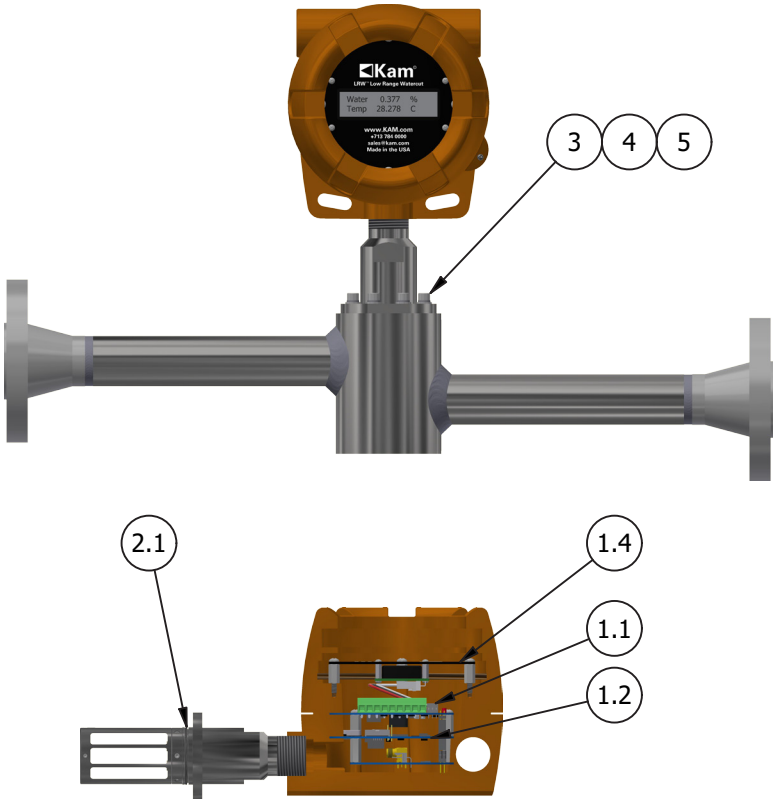


TABLE 8-1 Spare Parts for Flow Through Models

ITEM	QTY	PART #	DESCRIPTION
1.1	1	113100	LRW Terminal Board Assembly
1.2	1	113200	LRW Processor Board Assembly
1.4	1	381180	LRW LCD Assembly
2.1	5	150028	2-028 O-Ring
3	8	260532	#10 Flat Washer
4	8	260531	#10 Lock Washer
5	8	260550	10-32 x 5/8 Hex Socket Screw

SPARE PARTS

FIG. 8-2 Spare parts for Insertable/Retractable and Fixed Insertion Models

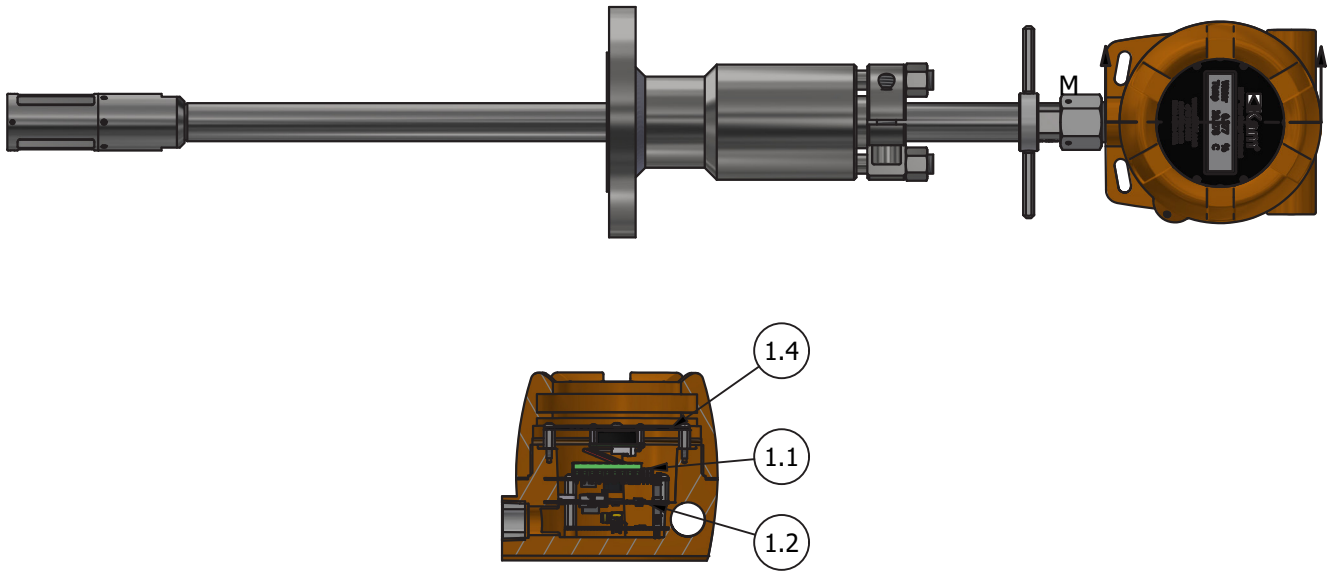


TABLE 8-2 Spare Parts for Insertable/ Retractable Models

ITEM	QTY	PART #	DESCRIPTION
1.1	1	113100	LRW Terminal Board Assembly
1.2	1	113200	LRW Processor Board Assembly
1.4	1	381180	LRW LCD Assembly