



Simple Precision™



KAM® LRW™ LOW RANGE WATERCUT

User Manual
LRWMANUAL 0918

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

An ISO 9001 certified company

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CAUTION:

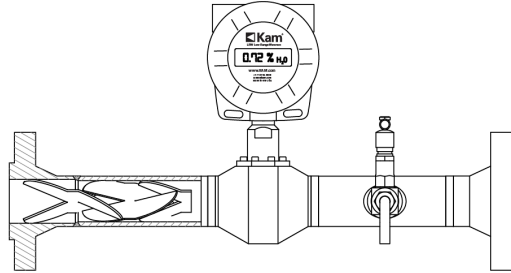
When installing the LRW® sensor in a pipeline containing petroleum products, petrochemicals, waste waters with the presence of pressure & temperature, and high-pressure steam refer to the Pipeline Operators' "Health, Safety and Environmental Policy Procedures" to ensure safe installation.

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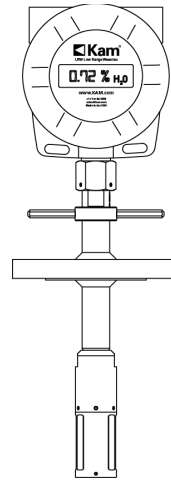
INTRODUCTION

AVAILABLE MODELS and MOUNTING OPTIONS

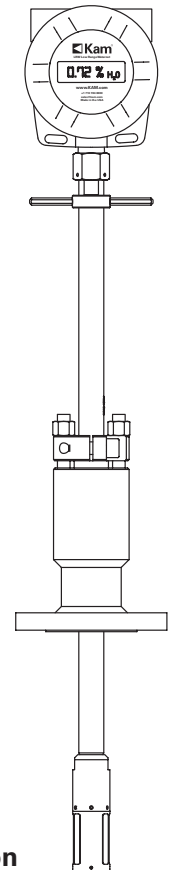
LRW™ flow-through spool for 1", 2", and 3" pipelines with included static mixer and manual draw-off valve



**LRW™ fixed insertion for pipelines 3" and up
2", 3" or 4" flanged process connection**



**LRW™ insertable/retractable for pipelines 3" and up
2", 3" or 4" flanged seal housing or 2" MNPT process connection**



INTRODUCTION continued

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 ($\pm 0.03\%$ for a 0-3% range). 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 60s.

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%	0-5%	0-10%
Accuracy (at listed range)	$\pm 0.03\%$	$\pm 0.05\%$	$\pm 0.05\%$ (from 0-5% water); $\pm 0.1\%$ from 5-10% water

SPECIFICATIONS

Media:	Crude oil and refined products
Wetted parts:	316 SS, hastelloy, & PEEK (Other materials available)
Fluid temp:	To 300° F (149° C)
Electronics temp:	-40° F to 158° F (-40° C to +70° C)
Power requirements:	24 VDC
Power consumption:	12 watts
Available ranges:	0-3%, 0-5%, 0-10% water in oil
Accuracy:	1% of range (0-10% models have an accuracy of 0,05% for water from 0-5% and an accuracy of 0,1% for water from 5-10%)
Repeatability:	+/- 0.01 %
Resolution:	+/- 0.01 %
Minimum water detection:	300 ppm (0-3% models)
Outputs/serial ports:	4–20 mA Alarm relay RS232 ASCII (calibration and diagnostics only) RS485 Modbus
Input:	4-20 mA for density
Density Correction:	AnyDensity™ compensates for changes in fluid density across entire API gravity range (requires density input)
Ingress protection:	NEMA IV; IP66
Temperature Correction:	Automatic
Pressure ratings:	ANSI 150, 300, 600, 900
Flow conditions:	Well mixed in accordance with API MPMS Chapter 8.2 mixing requirements, vertical installation strongly recommended
Enclosure hazardous approvals:	Explosion-proof for Class I, Division 1, Groups B, C and D Dust-ignition-proof for Class II/III, Division 1, Groups E, F and G, hazardous (classified) locations, indoors and outdoors (Type 4X/IP66) ATEX: II 2 G D, Ex d IIC, Ex tD A21, IP68, Ta = -40°C to +85°C IEC EX: Ex d IIC, Ex A21 tD, IP68, Ta = -40°C to +85°C

INSTALLATION

INSTALLATION FLOW REQUIREMENTS

KAM HIGHLY RECOMMENDS VERTICAL INSTALLATIONS WHEREVER POSSIBLE FOR OPTIMAL MIXING.

PLEASE NOTE: In all KAM LRW Installations, the user should ensure that the KAM LRW is installed in a turbulent flow with the Reynolds Number above 2000. Additionally, all KAM LRW's should be installed in accordance with API MPMS Chapter 8, Section 2, Table 1, and in accordance with KAM mixing recommendations.

PRIOR TO INSTALLATION

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

It is always recommended that the LRW NOT be installed in direct sunlight, and in high-ambient-temperature installations that it be installed with recommended sunshade.

In cold weather, if 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 the pipeline is not going to flow for extended amount of time and the pipe is not heated then LRW should be taken out to avoid damage to the sensor probe by freezing water.

LRW FLOWTHROUGH ASSEMBLY

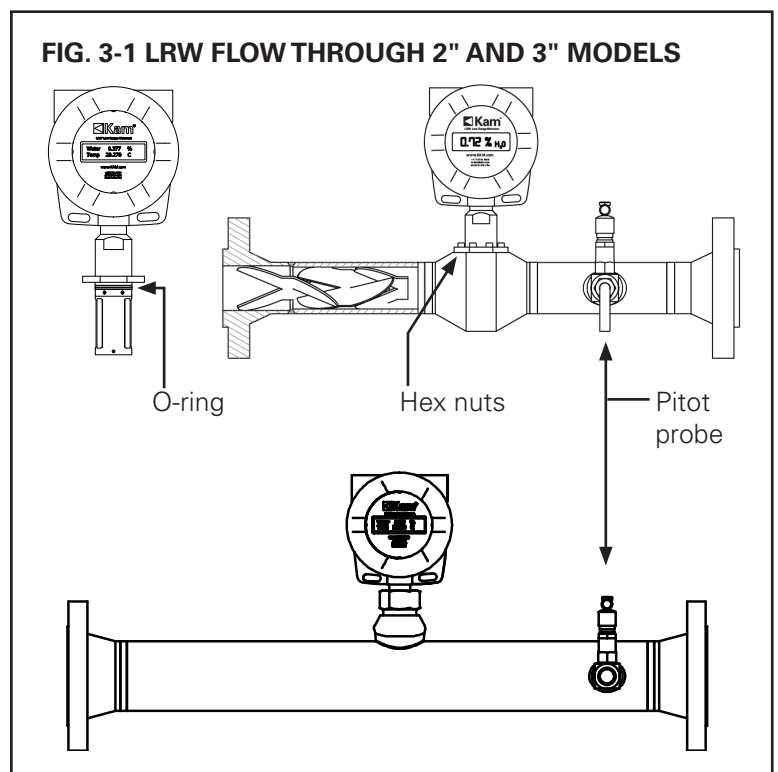
Flow through (spool) units will be shipped partially assembled. LRW unit can be wired prior to insertion into the spool for convenience, but this is not required.

For 2" units:

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.
4. Screw pitot probe into valve until tight.

For 3" and 4" flow through units:

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 pitot probe into valve until tight.



INSTALLATION continued

INSERTABLE/RETRACTABLE INSTALLATION

The KAM® LRW sensor should be installed according to FIG. 3-2. 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 location recommendations above). The LRW sensor should be inserted so that the window of the probe is located in the center 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.

1. Prior to mounting verify that the tip of the sensor is all the way inside the seal housing. FIGS. 3-3, 3-4.
2. If sensor is not fully enclosed inside the seal housing, pull the 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 LRW shaft from sliding and the probe from getting damaged during mounting.

FIG. 3-2 KAM® LRW INSTALLED ON A MAIN PIPE

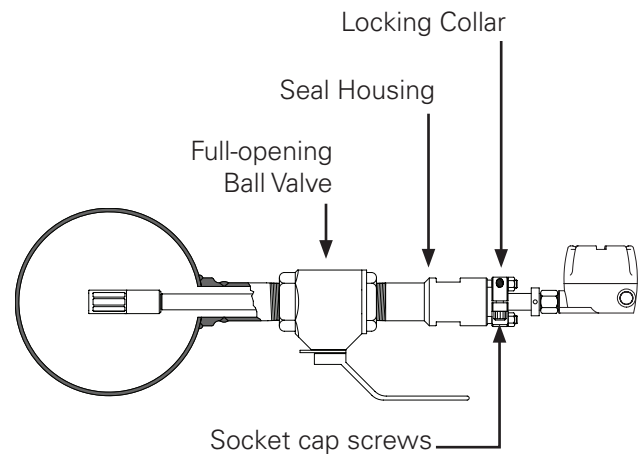


FIG. 3-3

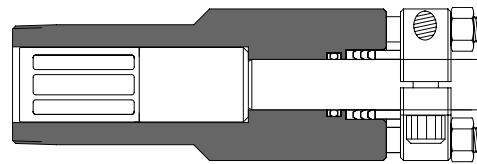
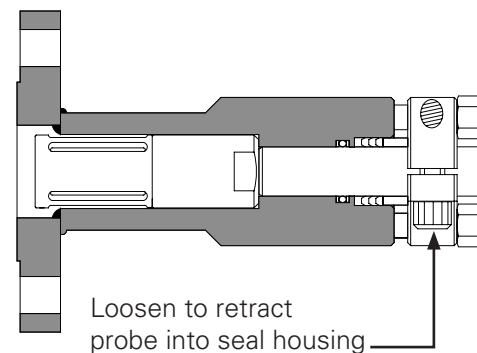
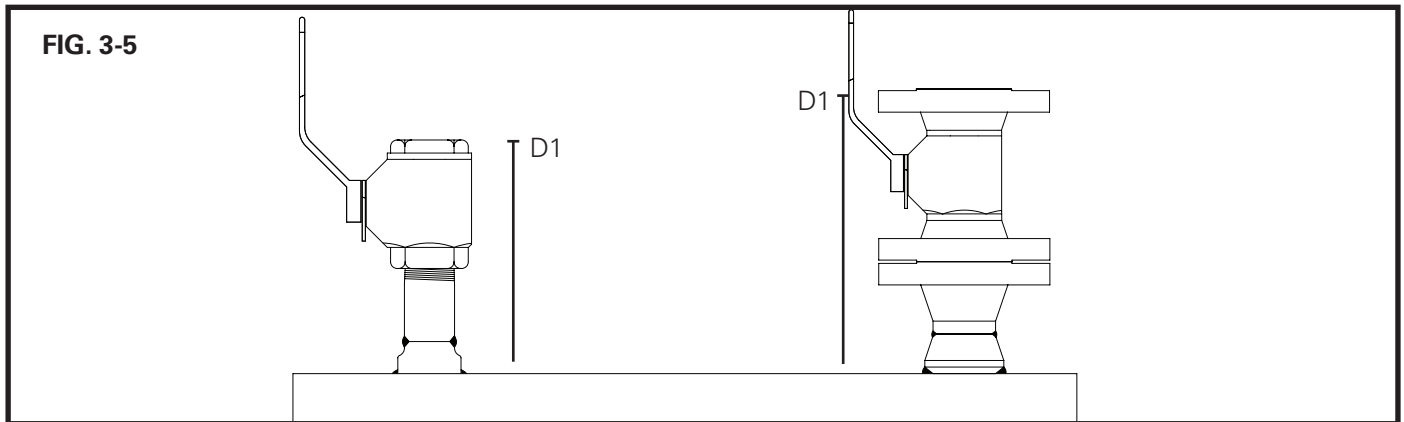


FIG. 3-4



INSTALLATION continued

3. 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. 3-5.

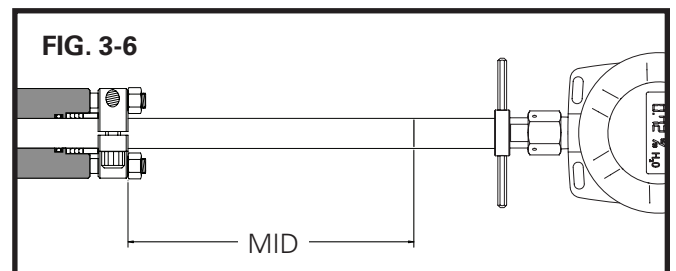


4. Calculate the minimum insertion distance for the LRW.

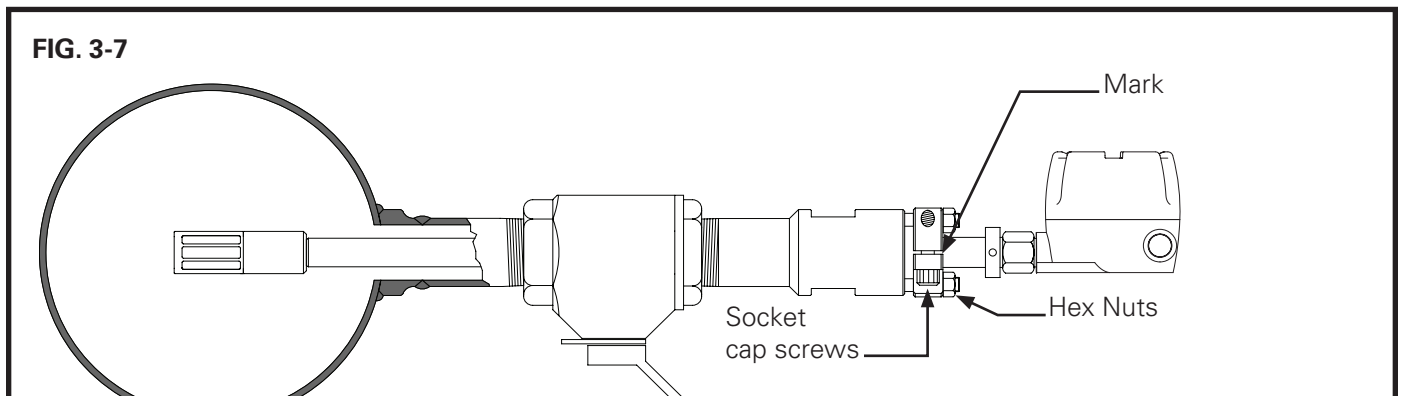
Minimum insertion distance (MID) =
D1 +
Pipe Wall Thickness (WT) +
Gasket Thickness +
3"

Example for D1=16", WT = 1/4",
Gasket Thickness=1/8"

MID = 16 + 1/4 + 1/8 + 3
MID = 19 3/8"



5. Measure the calculated MID from the top of the Locking Collar and place a mark with a permanent marker or tape on the Shaft. FIG. 3-6.
6. Bolt or screw the LRW sensor to the valve or designated installation location. (KAM CONTROLS recommends using thread sealant and not Teflon tape for the threaded LRW).
7. Open full opening valve.
8. Loosen Socket Cap Screws on the locking collar.
9. 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. 3-7.



INSTALLATION continued

10. Re-tighten the Socket Cap Screws.
11. Tighten the hex nuts holding down the Locking Collar one half turn. (FIG. 3-7) 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.

REMOVING THE LRW SENSOR

To remove the LRW sensor, first shut off power to the instrument. Loosen the Socket Cap Screws on the Lock Down Collar. Slide the LRW sensor upward until the probe rests inside the seal housing. There is a mechanical stop when the unit is fully retracted. Retighten the Socket Cap Screws. Next, close the Full-opening Ball Valve tightly. Drain oil from valve if possible. The LRW sensor may now be unbolted from the system.

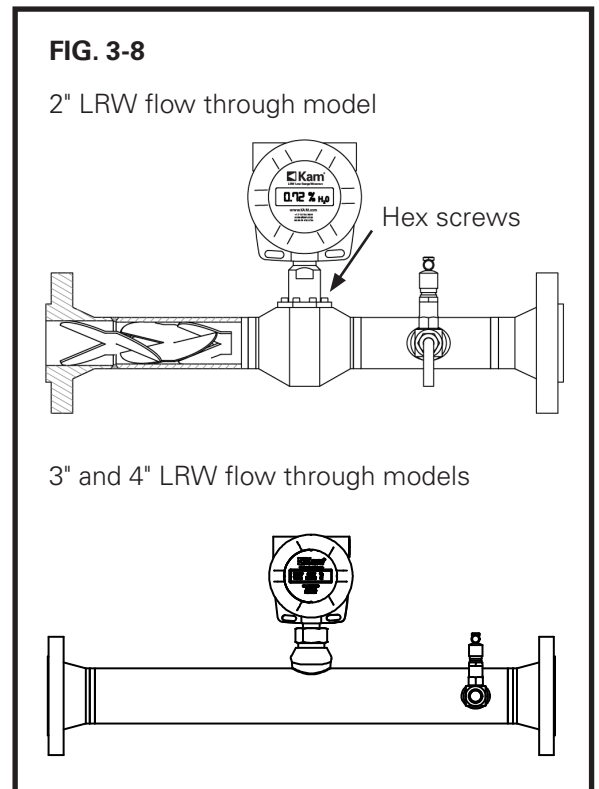
Note: If line pressure exceeds 100 psi, use a KAM® IT Insertion Tool when installing/removing the KAM® LRW sensor.

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

REMOVING THE LRW® SENSOR FROM FLOWTHROUGH SPOOLS WITH FIXED INSERTION

To remove the LRW® sensor, first shut off power to the instrument. Discontinue flow in loop from the main line and drain fluid from loop. The probe can be removed from the housing by removing the 5/8" hex screws on collar (2" models) or unscrewed from spool body (3" and 4" models). FIG. 3-8. The probe can then be lifted from the cell for testing/inspection/calibration purposes.

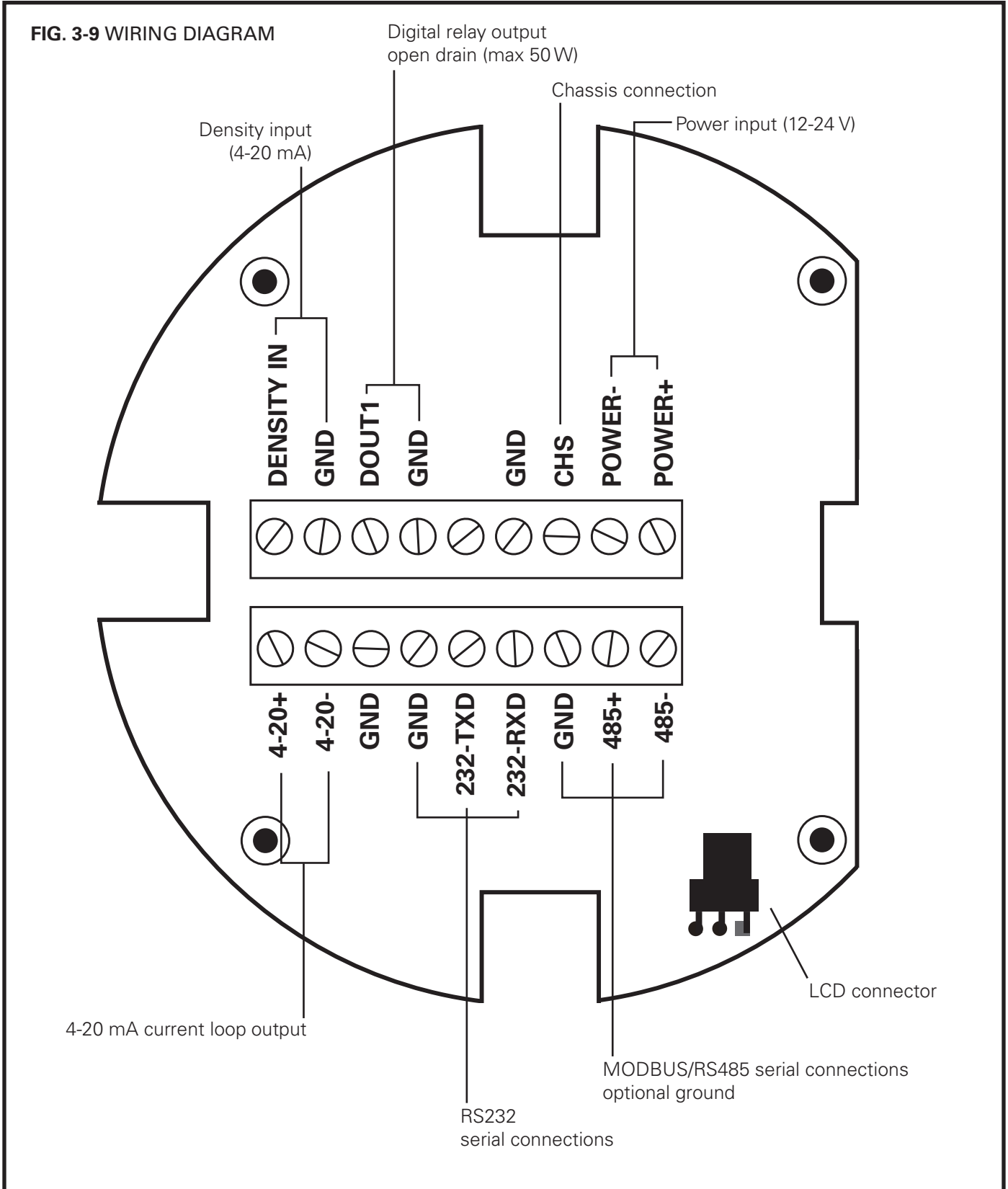
Removal should be conducted in accordance with all regional and Class requirements.



INSTALLATION continued

WIRING

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



INSTALLATION continued

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.

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.

Operators 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. All conduits should be sealed and secured in accordance with regional and classification requirements, and unused 3/4" NPT openings should be sealed with provided plug. Do not power wash the unit.

If necessary, disconnect LCD connector in order to access wiring terminals. The LRW supplies power for the loop. Make sure the device that receives data from the LRW does not have a power source of its own switched on. Also, the LOOP+ and LOOP- are isolated inputs from the chassis/earth. Do not connect either to a common ground. Use an isolator if necessary.

INPUTS/OUTPUTS/SERIAL

POWER (-) GND
POWER (+) 24-30 VDC

DENSITY IN From mass flow or densitometer.
GND

4-20 mA (-) Current output, source powered. Set to requisite percent water at factory.
4-20 mA (+)

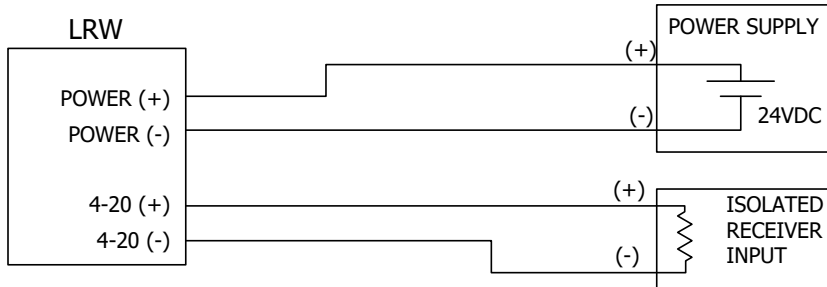
DIG OUT (-) Alarm or relay (digital contact closure / max 50W)
DIG OUT (+)

RS232 Console port – communication interface for calibration, connection to PLC
RS485 Modbus interface

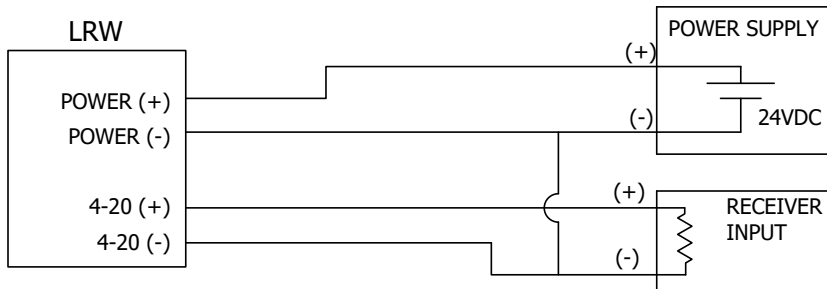
INSTALLATION continued

TYPICAL POWER AND LOOP WIRING CONFIGURATIONS

FIG. 3-10

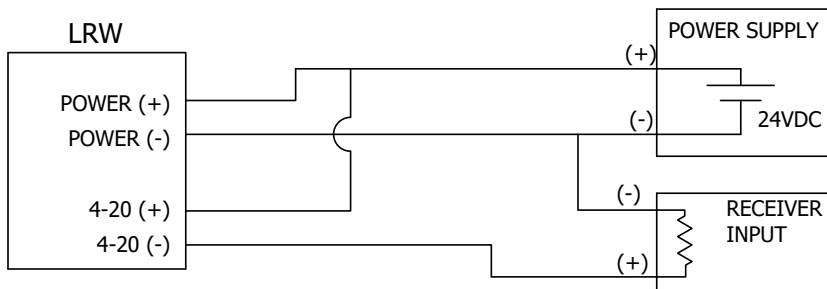


CORRECT



WRONG:

The 4-30 mA (-) and power supply (-) cannot be the same or connected together.



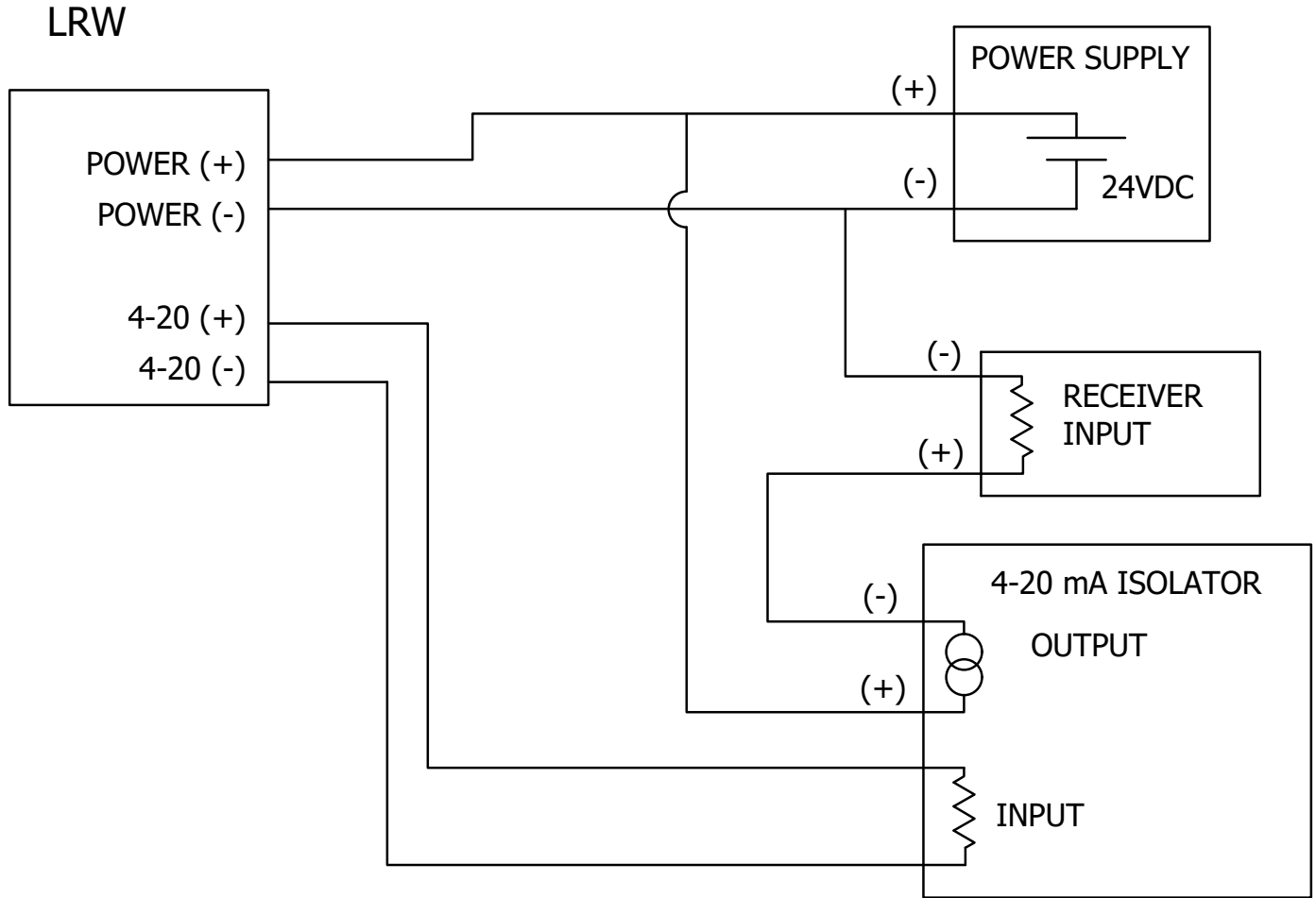
WRONG:

LRW provides power for the 4-20 mA loop. Adding external power can damage the 4-20 mA output.

INSTALLATION continued

TYPICAL POWER AND LOOP WIRING CONFIGURATIONS

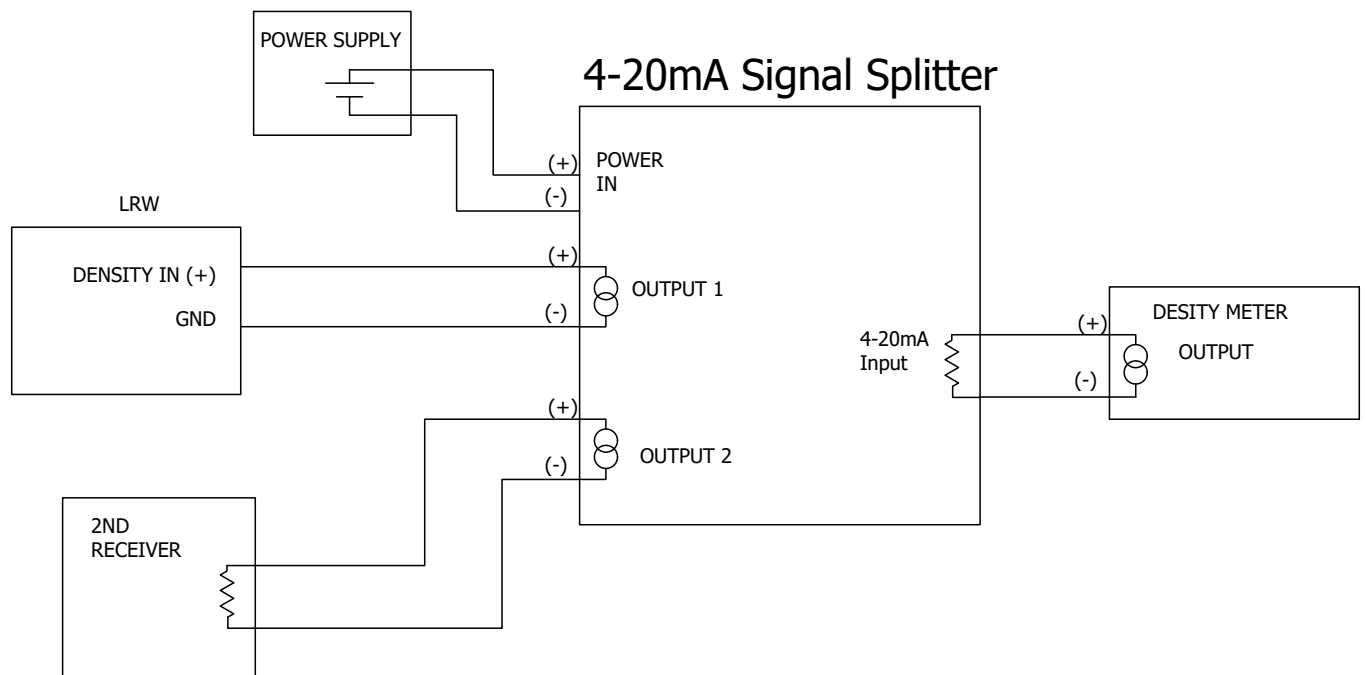
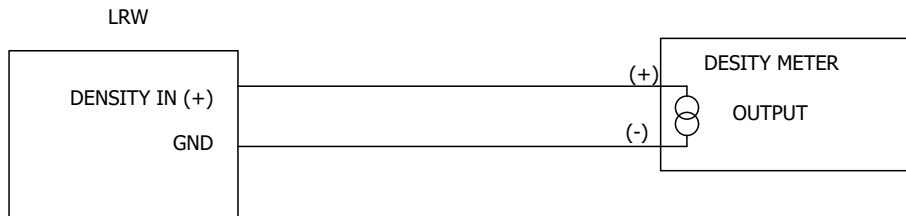
FIG. 3-11 Power and loop with isolator



INSTALLATION continued

DENSITY INPUT WIRING

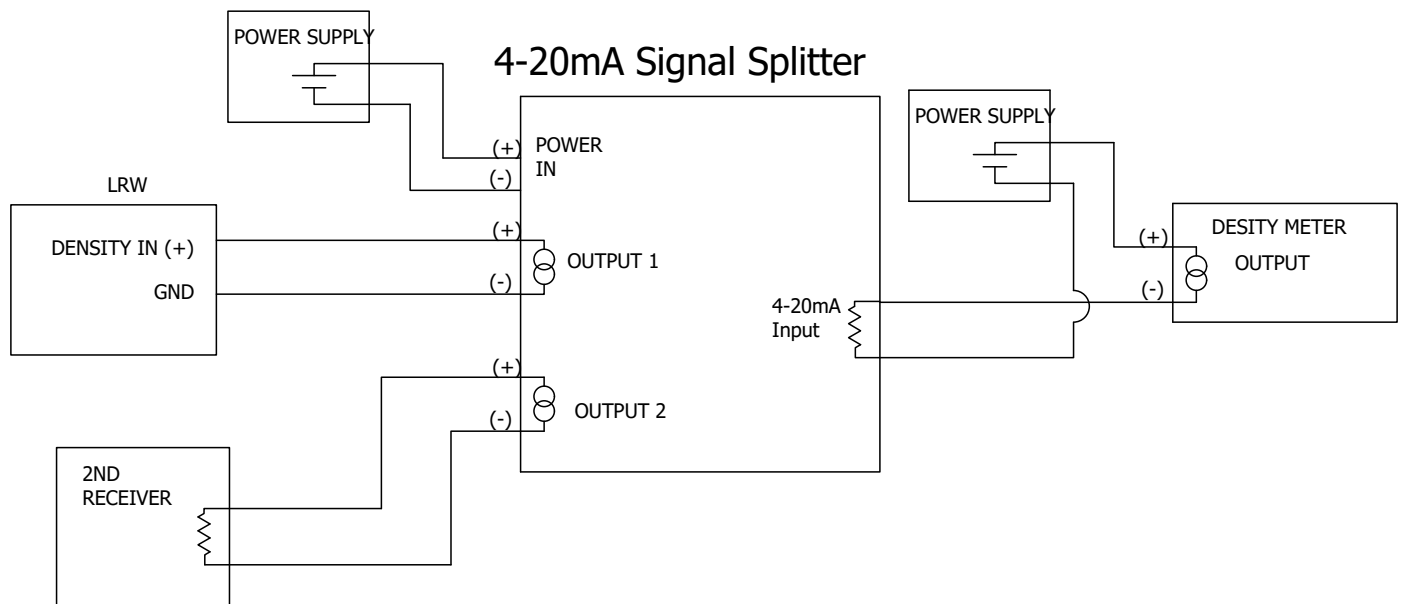
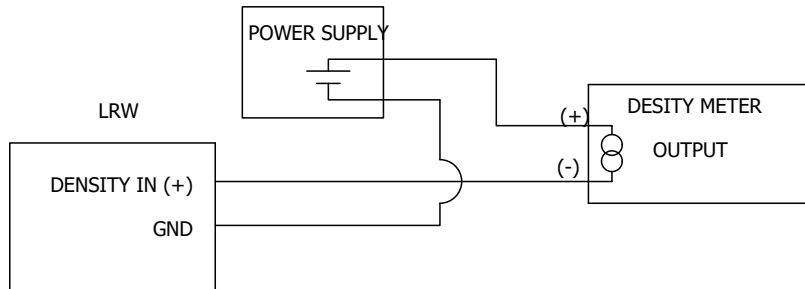
FIG. 3-12 Density meter provides power for 4-20 mA output



INSTALLATION continued

DENSITY INPUT WIRING

FIG. 3-13 Density meter 4-20 mA output requires external power



KAM LRW OPERATION

CONFIGURATION

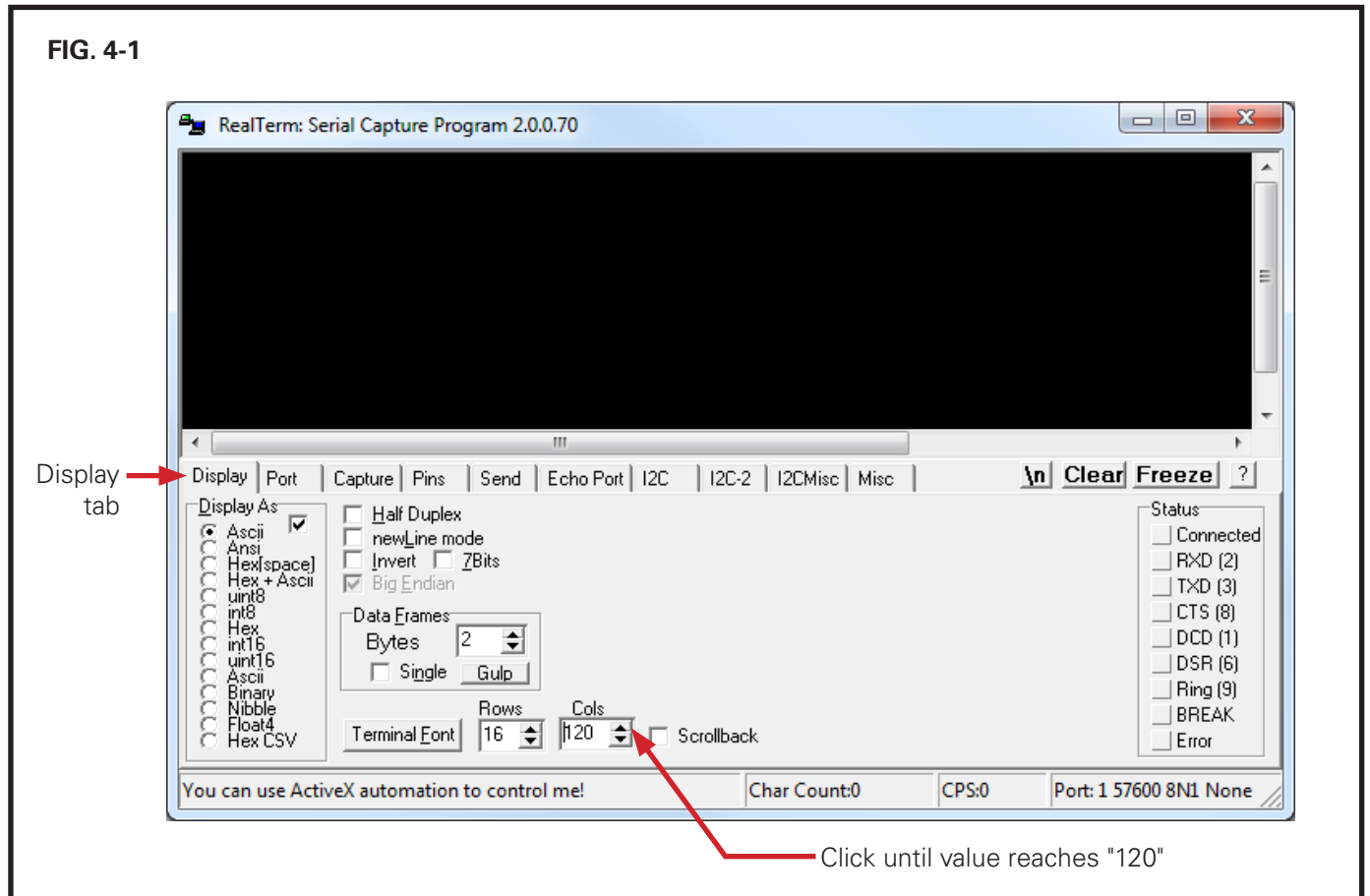
RealTerm software is used for testing and calibration of the LRW. RealTerm is available as a free download.

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

Follow on screen instructions to install RealTerm.

1. If you haven't already done so, connect the RS232 cable to the LRW board as shown on page 9, FIG. 3-9 of this manual.
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



KAM LRW OPERATION continued

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

Baud: 115200

Parity: None

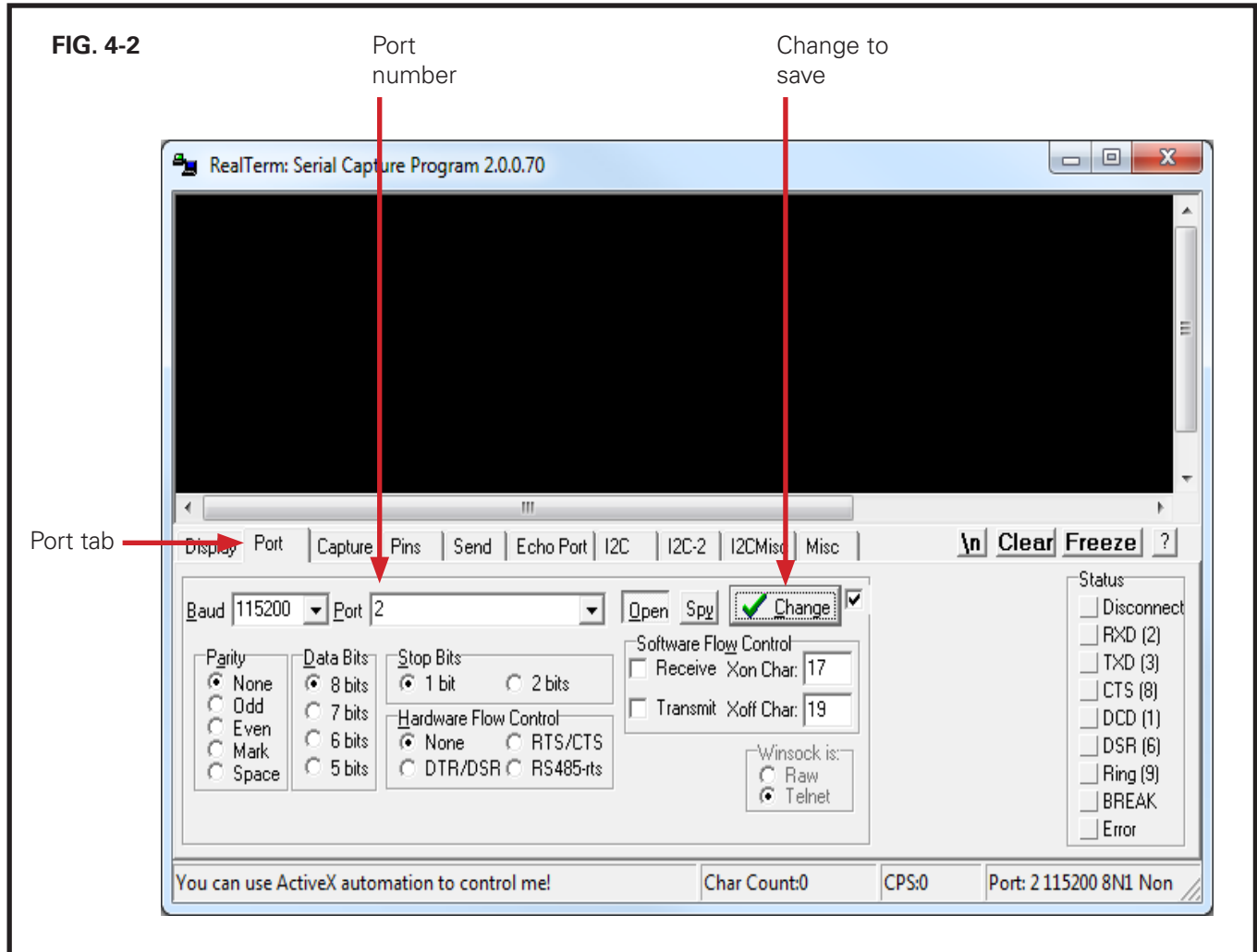
Data Bits: 8

Stop Bits: 1

Hardware Flow Control: 1

Port: Select port number assigned to your serial port or USB port connected to converter

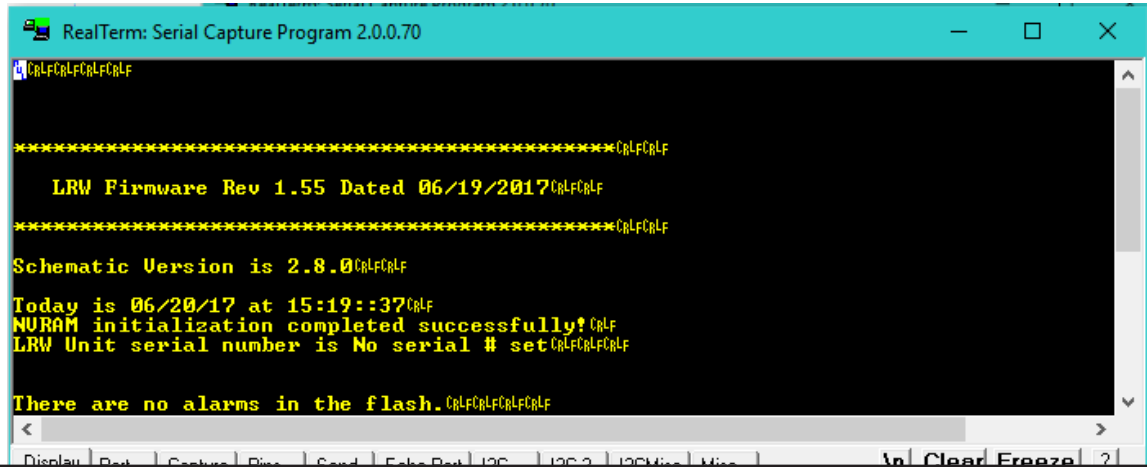
- Click on the "Change" button to save these settings.



KAM LRW OPERATION continued

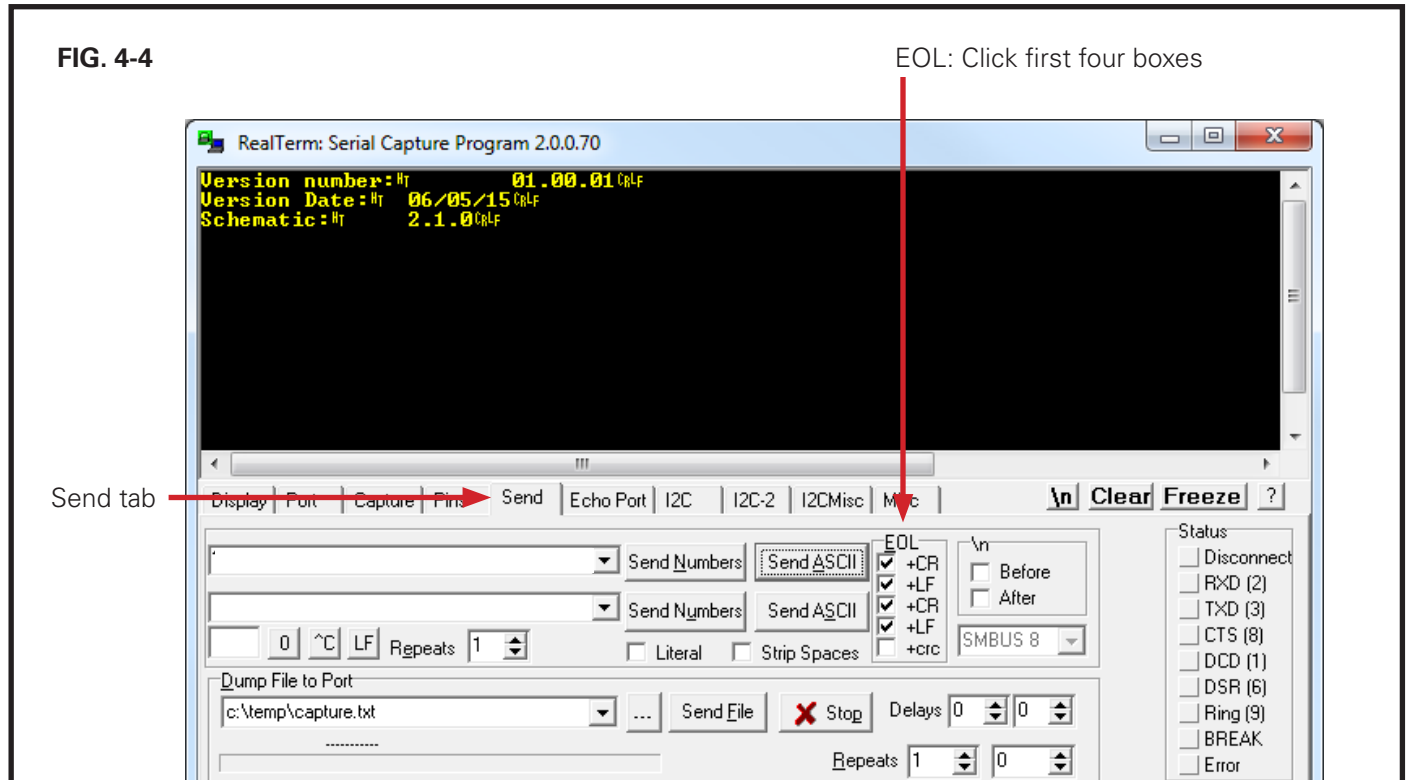
7. If not already turned on, turn on power to LRW™. The initial greeting message will appear if the unit is newly powered up. FIG. 4-3

FIG. 4-3



8. Click on the "Send" tab and select first four boxes under "EOL" (FIG. 4-4)

FIG. 4-4

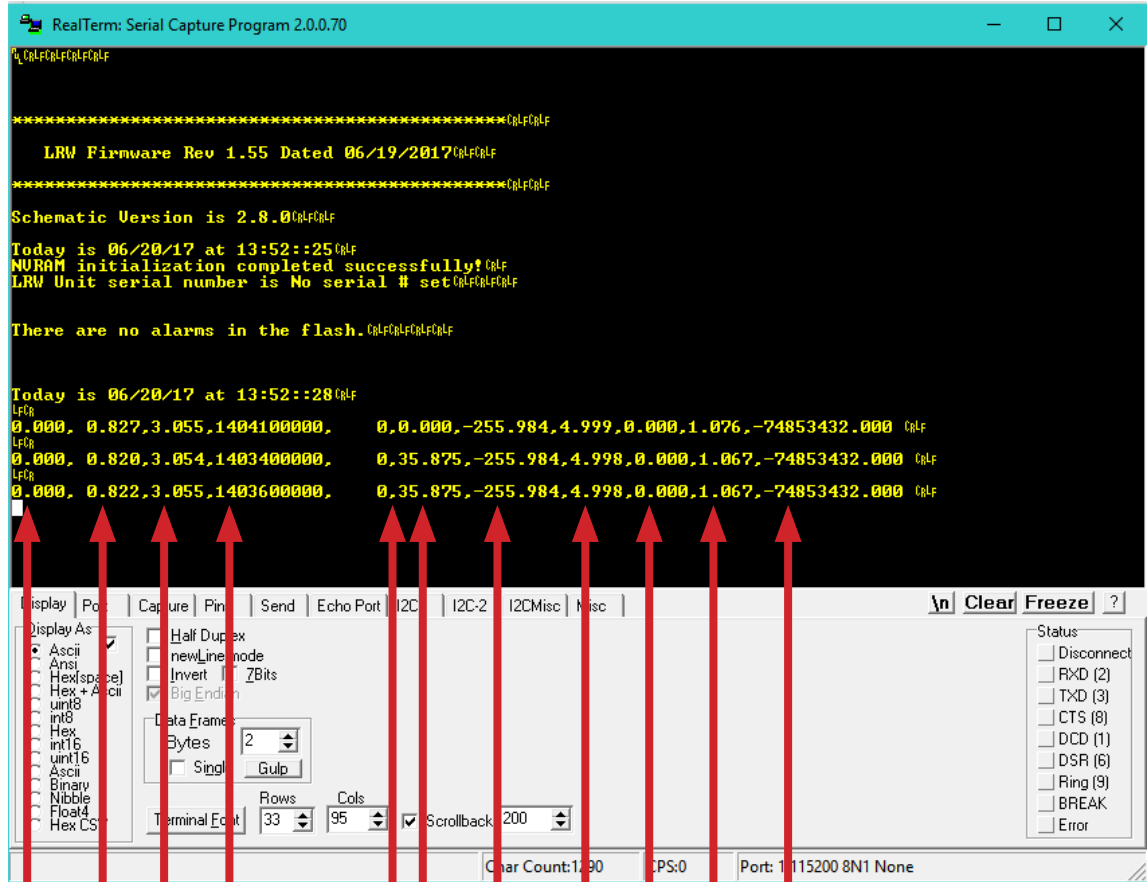


KAM LRW OPERATION continued

9. LRW output will start automatically in CSV (comma separated values) format. FIG. 4-5

Data can be exported using the capture function. See next page (19) for instructions.

FIG. 4-5



- Column 11:** density correction frequency (Hz)
- Column 10:** density in g/cm³
- Column 9:** density in API gravity
- Column 8:** density in volts
- Column 7:** fluid temperature at probe (°C)
- Column 6:** electronics temperature (°C)
- Column 5:** frequency offset (Hz)
- Column 4:** minimum frequency (Hz)
- Column 3:** maximum voltage (V)
- Column 2:** minimum voltage (V)
- Column 1:** percent water

KAM LRW OPERATION continued

DATA CAPTURE IN REALTERM

1. Click on the "Capture" tab. FIG 4-6
2. Uncheck the "Direct Capture" option
3. Click on the button marked with the ellipses: "..."
4. A new window will open. If a folder is not already selected, choose a folder and click open. Name the data file and save to selected folder. FIG 4-7. Click on "Open".
5. Press the "Start: Overwrite" button. The screen will clear and start continuously capturing all data. Fig. 4-6.

FIG. 4-6

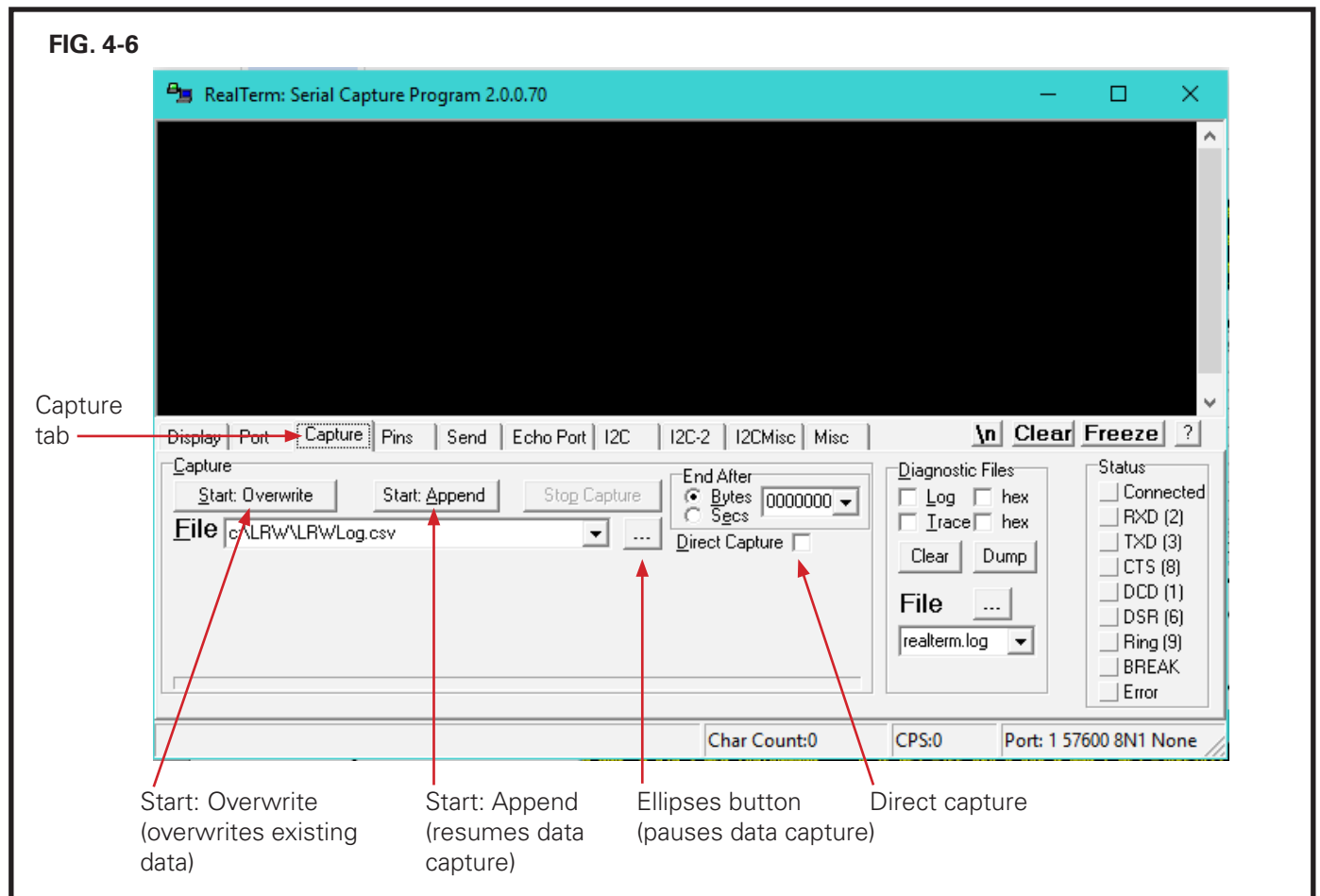
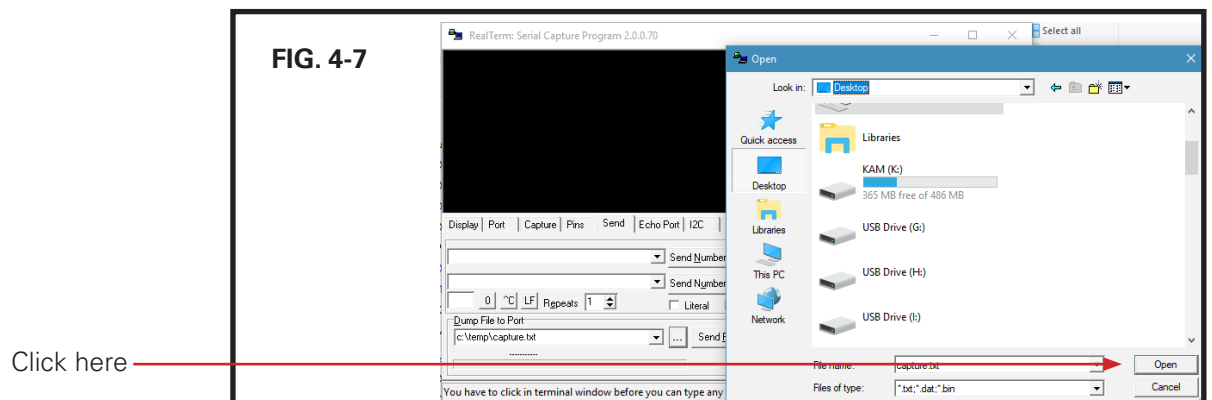


FIG. 4-7

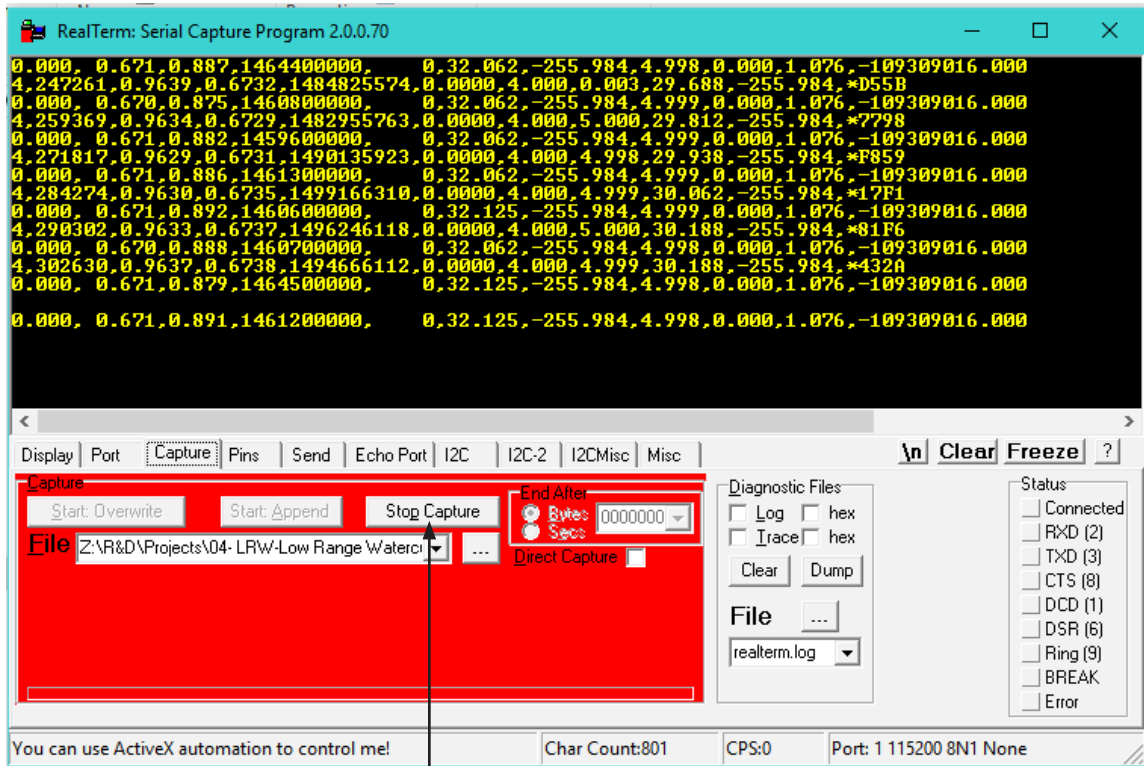


KAM LRW OPERATION continued

DATA CAPTURE IN REALTERM CONTINUED

6. While capturing data, the "Capture" window turns red. FIG 4-8
7. Press Stop Capture to stop data capturing. The saved file can be opened either in MS Excel or in Notepad.

FIG. 4-8



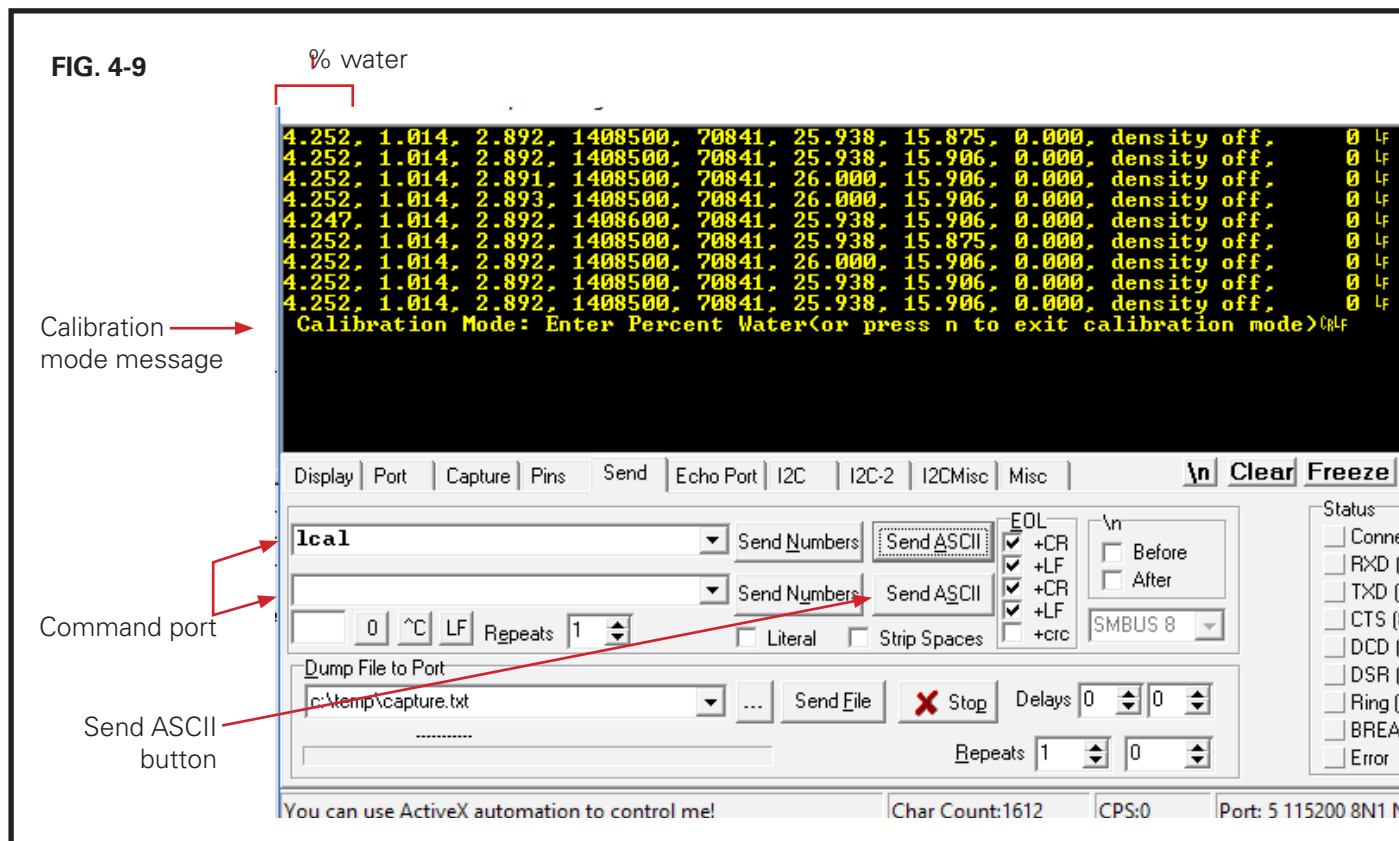
Stop Capture

KAM LRW OPERATION continued

ON-LINE CALIBRATION AND VERIFICATION OF THE KAM® LRW®

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.

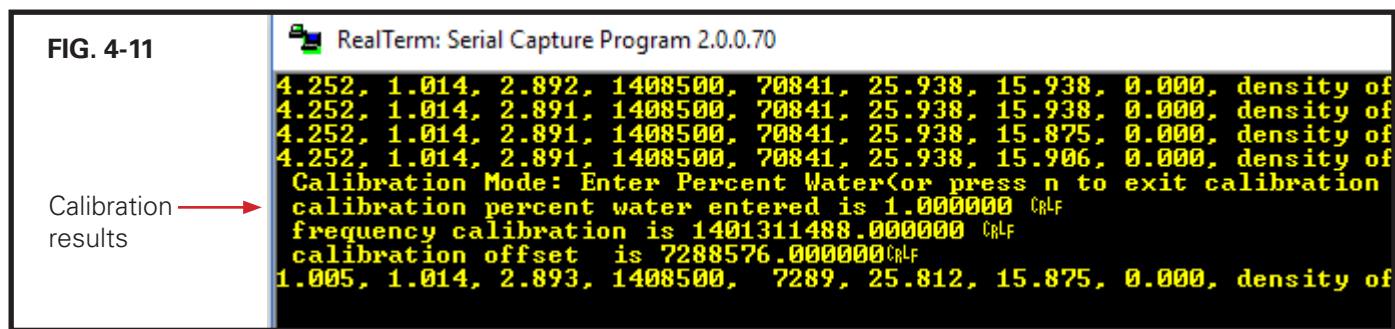
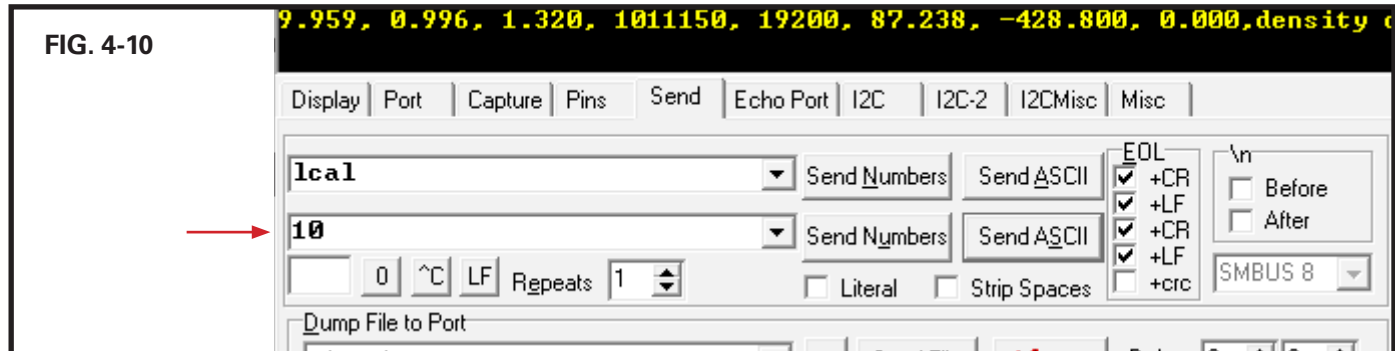
1. Connect PC to the LRW sensor via supplied RS232 serial port or RS232/USB adapter. Launch RealTerm and follow steps indicated on pages 15-18 to configure RealTerm.
2. Manually draw (3) samples of fluid according to API MPMS Chapter 8.1, waiting at least 15 minutes between samples.
3. Each time a sample is drawn, note or take a screen shot of the current % water LRW reading in the RealTerm window.
4. Determine water percentage in sample using a KAM Karl Fischer Moisture Analyzer (recommended), or available method.
5. Average the water content from the three samples.
6. Average the water content from the three LRW screen shots (first data column).
7. Check the current reading of the LRW in RealTerm.
8. Subtract or add the value of the difference between sample averages and LRW averages.
9. Type "lcal" (lower case L) in either command port under the "Send" tab and click on "Send ASCII."



KAM LRW OPERATION continued

ON-LINE CALIBRATION OF THE KAM® LRW™ continued

10. Type the calculated percent of water (i.e. 1.58 for 1.58%) and click on the Send ASCII button. FIG. 4-10.
Calibration results will be displayed in the RealTerm menu. FIG. 4-11



CALIBRATION EXAMPLE

Manual samples water content:

1. 2.51%
2. 2.75%
3. 2.62%

Average = 2.63%

LRW screen shots water content:

1. 2.60%
2. 2.91%
3. 2.70%

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.

KAM LRW OPERATION continued

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.

1. Connect PC to the LRW™ sensor via supplied RS232 serial port or RS232/USB adapter and launch RealTerm. If not already done, follow steps indicated on pages 15-18 to configure RealTerm.
2. Manually draw (3) samples of fluid according to API MPMS Chapter 8.1, waiting at least 15 minutes between sample draws.
3. Each time a sample is drawn, note or take a screen shot of the current LRW™ reading in the RealTerm window.
4. Send the samples to the lab for water content determination.
5. Once results have been received from the lab, average the water content from the three samples. This value is the "Lab observed % water."
6. Average the water content from the three LRW screen shots. 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.
7. 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. 4-12
8. Calibration results will be displayed. FIG. 4-13

FIG. 4-12

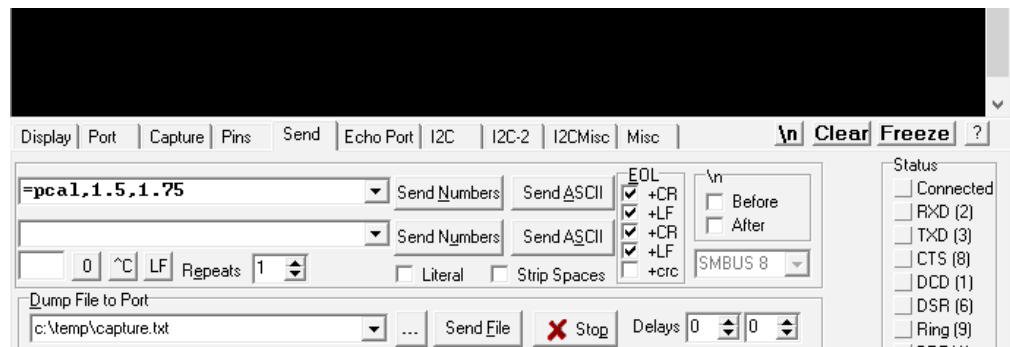
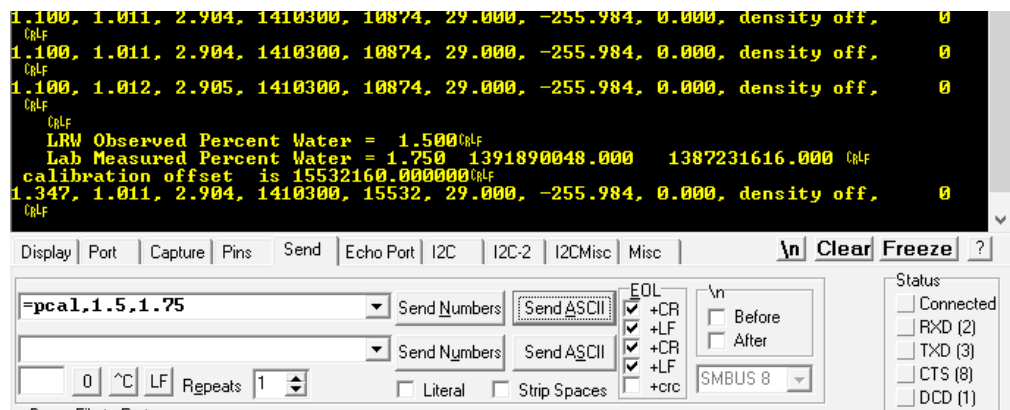


FIG. 4-13

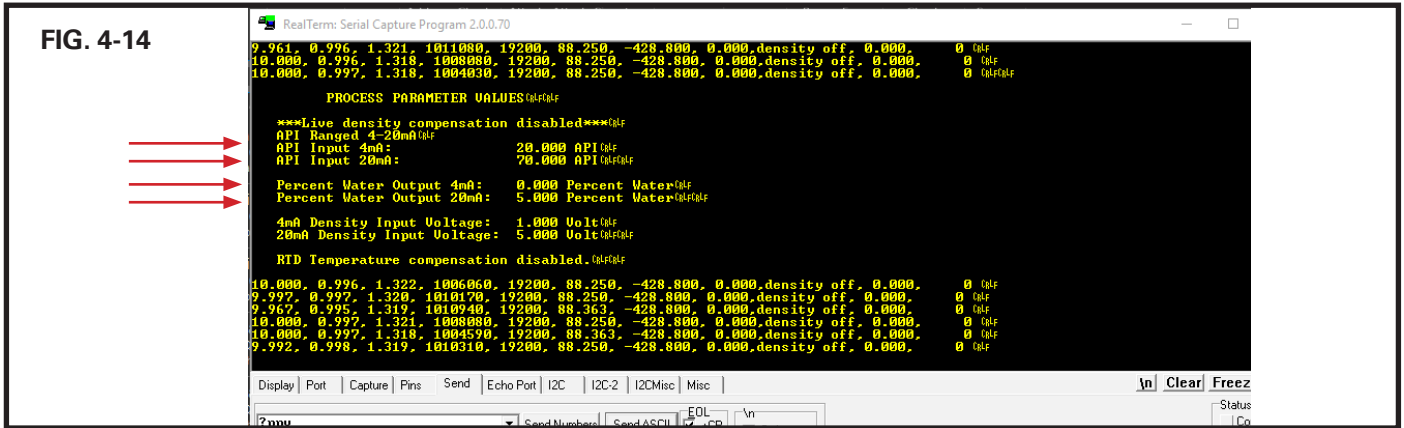


KAM LRW OPERATION continued

OUTPUT PROCESS VALUES

Values for the 4-20mA loop (water %) and density range can be viewed by following the prompts below.

1. Connect PC to the LRW sensor via supplied RS232 serial port or RS232/USB adapter.
2. Launch RealTerm. Type "?ppv" in the command port under the "Send" tab and click on "Send ASCII." The configured values for process parameters will be displayed. FIG. 4-14

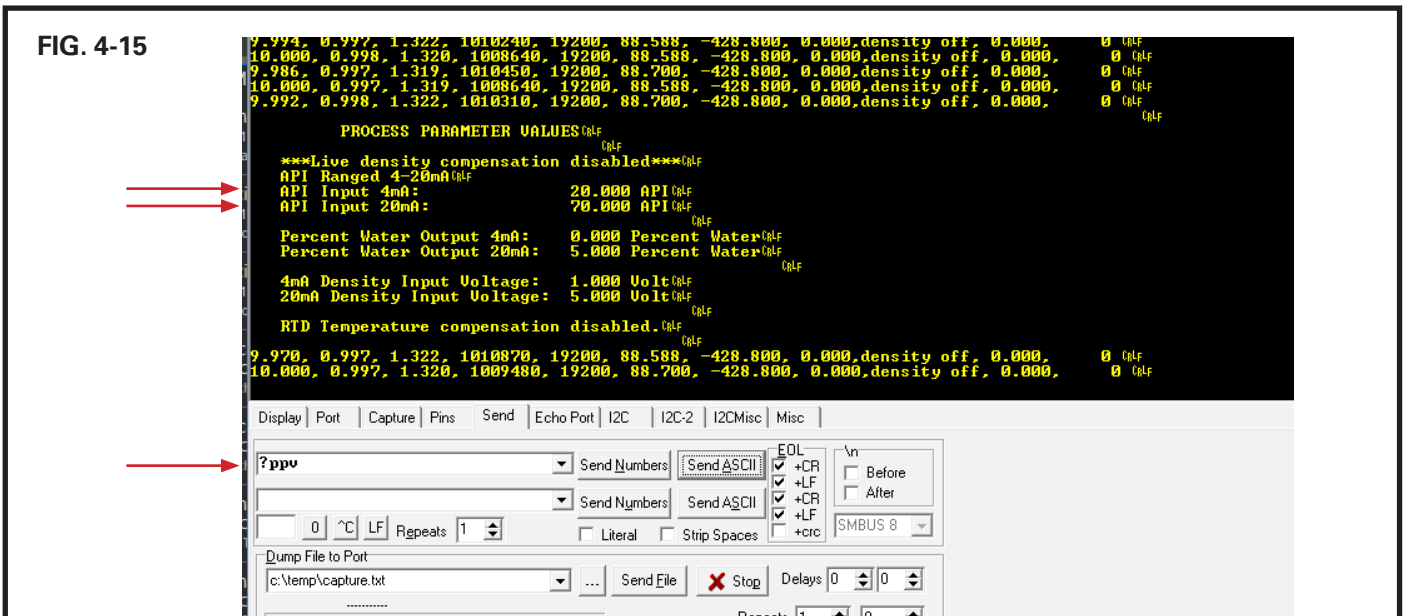


DENSITY INPUT VERIFICATION AND RE-CONFIGURATION

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.

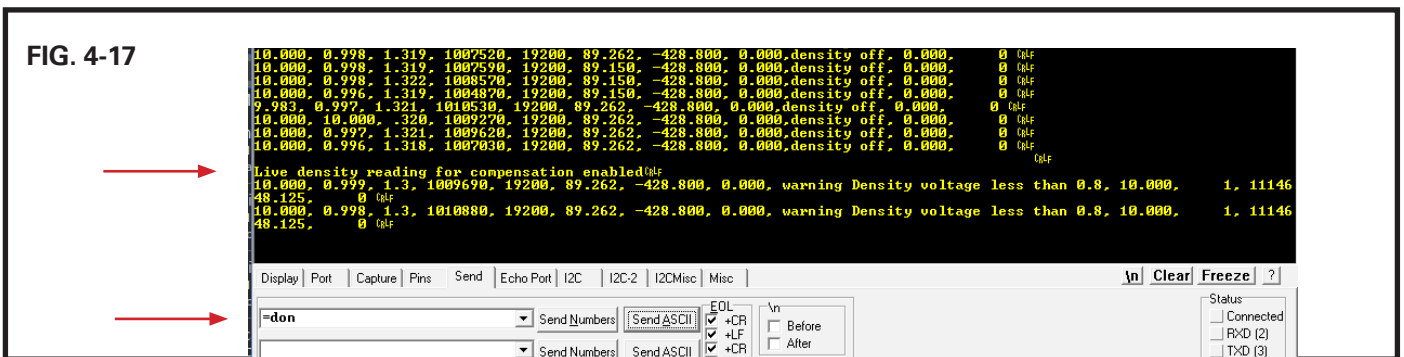
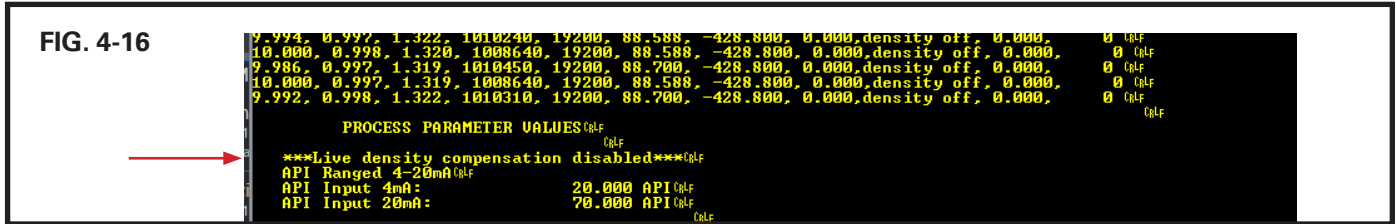
1. Verify the low and high end of the density loop by typing "?ppv" and clicking on "Send ASCII." The parameters will show the current values for 4mA and 20mA with their respective units (API or g/cm3). FIG. 4-15



KAM LRW OPERATION continued

DENSITY INPUT VERIFICATION AND RE-CONFIGURATION continued

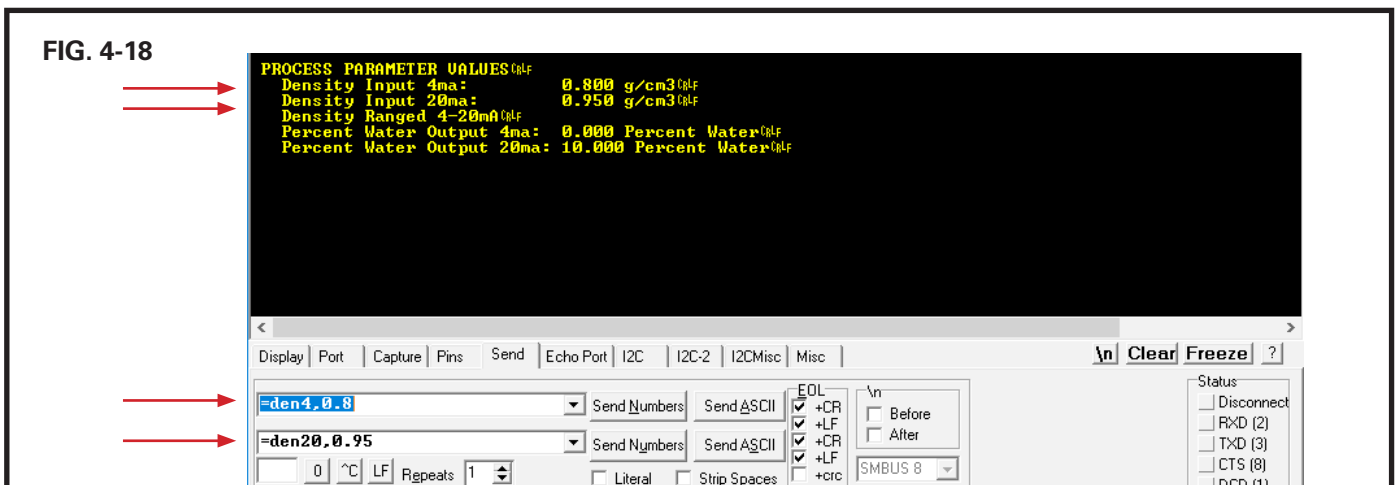
- If the density is disabled (FIG 4-16), enable it by typing the command "=don" and clicking on "Send ASCII." FIG. 4-17. The density input should only ever be disabled in situations where process density remains constant. Density can be disabled by typing "=doff" and clicking on "Send ASCII."



Units for the density input range can either be API gravity or g/cm3. Current input units are indicated under Process Parameter Values. Fig. 4-16. 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**:

- Enter "=den" and click on "Send ASCII."
- To change the values, enter "=den4,<4mA Density value>" and "=den20,<20mA Density value>" and then click "send ASCII." For instance, if the desired low end of the range was 0.8 g/cm3 and the desired high end of the range was 0.95 g/cm3, you would enter "=den4,0.85" and "=den20,0.95". FIG. 4-18. Values can be entered in either command port, but you must click the "send ASCII" button associated with each port.



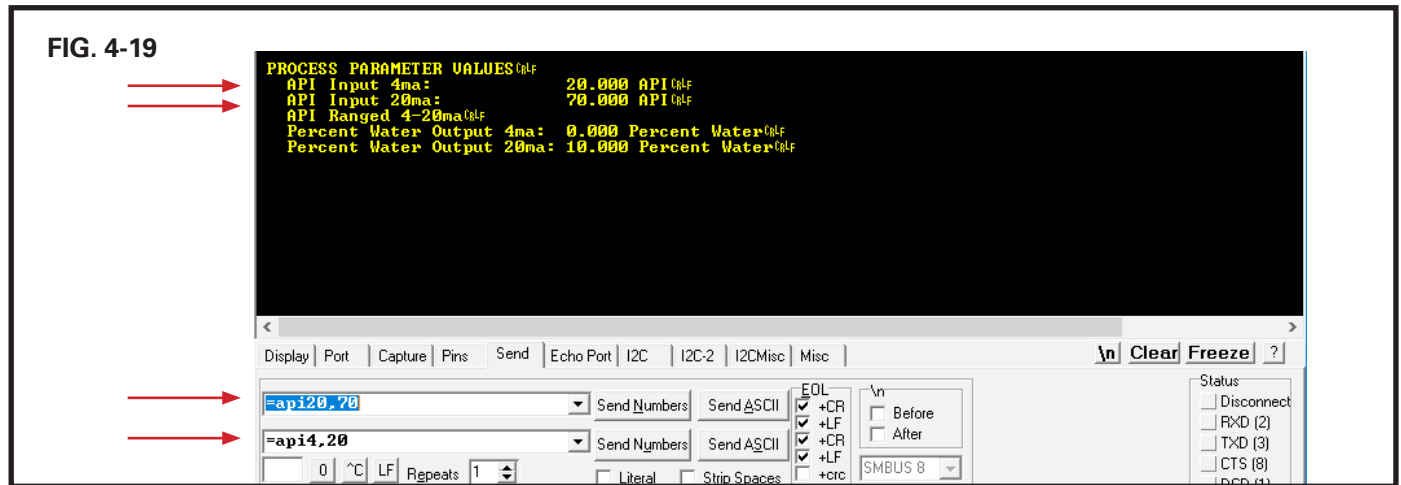
KAM LRW OPERATION continued

DENSITY INPUT VERIFICATION AND RE-CONFIGURATION continued

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

1. Enter "=api" and click on "Send ASCII."
2. To change the values, enter "=api4,<4mA Density value (API)>" and "=api20,<20mA Density value (API)>" 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 , you would enter "=api4,20" and "=api20, 70". FIG. 4-19.

NOTE: For manual calibration instructions please contact KAM Controls.



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.

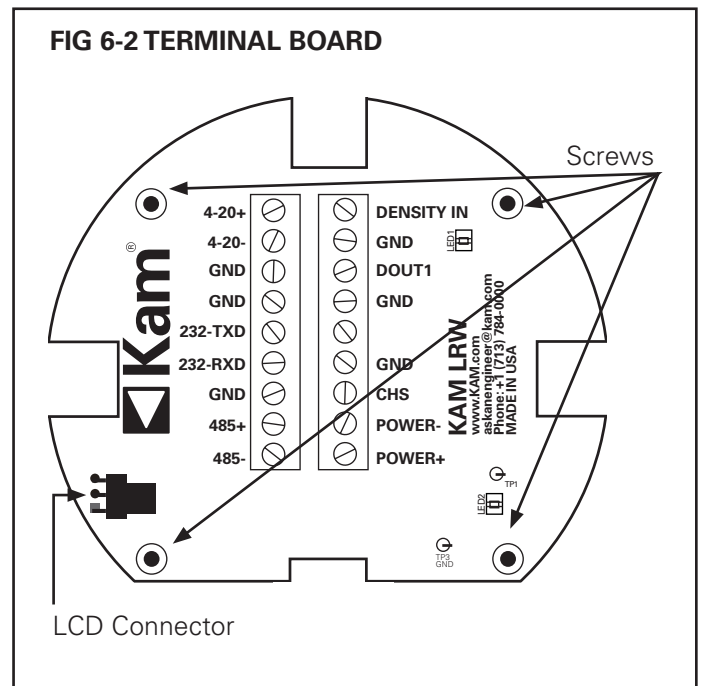
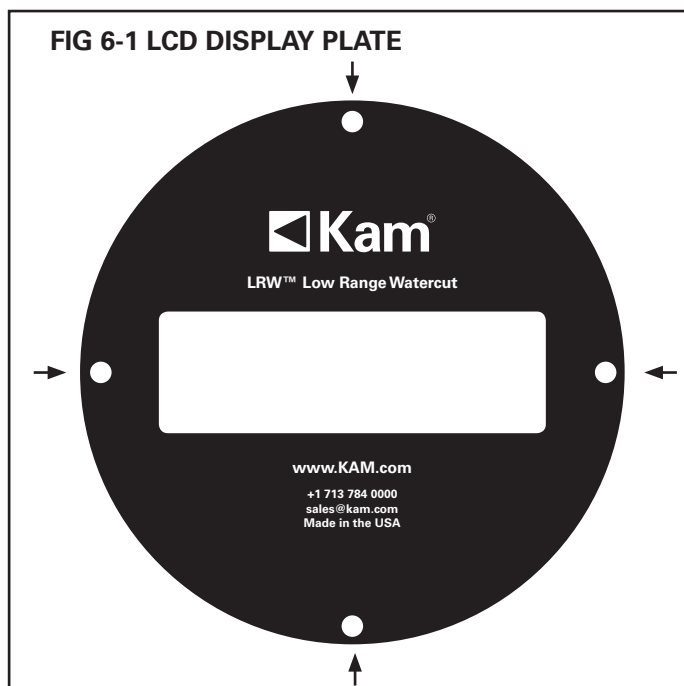
If you have a question regarding cleaning solvents, please contact KAM CONTROLS directly at +1 713 784 0000, or email: AskAnEngineer@Kam.com

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

TROUBLESHOOTING

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

1. Turn off the field power supply to the LRW.
2. Use a 5/64 Allen wrench to remove the set screw on the display cover.
3. Turning it counterclockwise by hand, remove the display cover.
4. Remove the four (4) screws on the LCD display plate with a Phillips screwdriver (FIG 6-1).
5. Unplug the LCD connector from the terminal board (FIG 6-2) and set LCD display plate aside.
6. Remove the four (4) screws on the Terminal PCB with a Phillips screwdriver. FIG 6-2
7. 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.
8. Check for any fuses or surge protection devices visibly damaged on the bottom side of the Terminal PCB.
9. 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.
10. Connect the POWER+ and POWER- pins to the field power supply between 12-30V DC (+24V DC power is preferred) if not already done
11. Turn on power to LRW.



TROUBLESHOOTING CONTINUED

POWER CONNECTIONS

If you have not already checked the Terminal board for physical defects, please do so according to the instructions on page 28 of this manual.

The LRWTERMINAL PCB has LEDs to indicate the status of the input power and on board voltages of the LRW. The sections below provide instructions to verify if the LRW is powered up with the right voltages.

Please note:

LED1 Indicates voltage presence at the input voltage terminals.

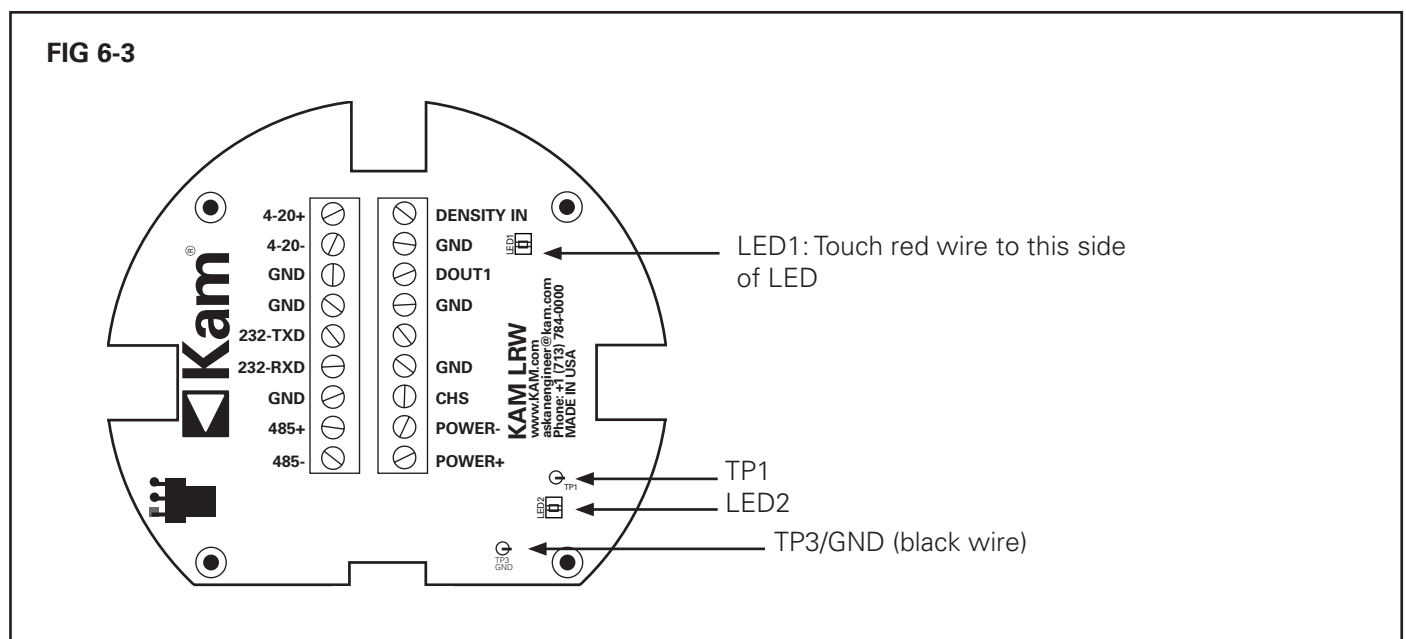
LED 2 Indicates voltage presence at the 5V supply.

Lit LEDs do not necessarily indicate proper voltage.

CHECKING THE INPUT POWER

1. Use a voltmeter to check the POWER + and POWER- terminals and ensure that the voltage across them is between 12-30 V DC (24 V DC is recommended).
2. If voltage is not within this range, check the field power supply and bring it within the limits above. Check again. If it is still not within limits, contact KAM Controls for further assistance.
3. If the voltage across the input power terminals is within the specified limits, connect the red wire of a voltmeter on the side of LED1 and the black to TP3/GND. FIG. 6-3. It should show the input voltage (12-30 V). This means the LRW input power is working properly, proceed to next section ("Checking 5V DC supply").

If it does not show this voltage, either the fuse is blown or the lightning protection has been activated. The instrument electronics need to be checked for additional damage. Please contact KAM Controls at +1 713 784 0000 or email AskAnEngineer@kam.com for further assistance.



TROUBLESHOOTING CONTINUED

CHECKING 5V DC SUPPLY

Once the LRW input power has been verified as per instructions above, proceed to check the 5V DC supply:

1. Check LED2. If lit, power is flowing to the 5V circuit.
2. Proceed to verify the level of this 5V supply by connecting the red wire of the multimeter to TP1 and black wire to TP3 (GND) Terminal. FIG. 6-3.
3. The DC voltage should read between 4.95V and 5.05V. This means the power supplies are operational, there could be a fault in the other systems of the instrument. Contact KAM Technical Support for further assistance.
4. If the voltage is not within limits, the 5V power supply is nonfunctional. Return to the factory for repair.
5. If LED2 does not light up, the 5V DC supply may be damaged. Please contact KAM Technical Support at +1 713 784 0000 or askanengineer@kam.com for further assistance.

LOOP TROUBLESHOOTING

If you have not already done so, follow the steps on page 28 of this manual to remove LCD cover and faceplate.

If the Loop water reading does not match the water % reading on the LRW local display, please follow these instructions:

1. The LRW supplies power for the loop. Make sure the device that receives data from the LRW does not have a power source of its own switched on. Also, the LOOP+ and LOOP- are isolated inputs from the chassis/earth. Do not connect either to a common ground. Use an isolator if necessary.
2. Check the voltage across the LOOP+ and LOOP- terminals on the Terminal Board. It should read between 10V and 12V. If not, contact KAM Controls for further assistance.
3. If the voltage across the Loop terminals is within the specified limits, make sure the loop is working properly by switching the multimeter to ammeter mode and checking the current running through it without a load. The current must correspond with the readings on the LCD display:

If it does, the 4-20mA wire from the LRW to the PLC may be damaged.
If it doesn't, contact KAM Technical Support for further assistance.

TROUBLESHOOTING CONTINUED

RS232 TROUBLESHOOTING

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:

1. Make sure the communication settings are set as described on page 16 of this manual. Ensure the communication port is opened in the terminal software.
2. Follow steps 1 through 4 on the previous section ("Loop Troubleshooting") to access the terminal board of the LRW.
3. Check the RS232 wires connected to the LRW terminals for damage and ensure they are installed as per the wiring diagram on page 9 of this manual. Replace wires if necessary.
4. Use a multimeter to measure voltage as described below. Please note the red wire on the multimeter should be connected to RS232 terminals and the black wire to GND.

RS232 RXD (LRW data input line) to GND terminal should be between -5V and -12V.

RS232 TXD (LRW output line) to GND terminal should be between -5V and -12V.

If the voltages are not within this range, the RS232 circuit may be damaged. Contact KAM Technical Support for further instructions.

If either the RS232 RXD or the RS232 TXD terminal voltages read 0V with respect to the GND terminal and the wire connections are good, try reversing the RS232 RXD and RS232 TXD wires and check the output on the LRW PC software (If using RealTerm, follow configuration procedure on pages 15 to 18).

If the issue continues, please contact KAM Technical Support for further assistance.

RS485 TROUBLESHOOTING

If not able to read MODBUS registers, please follow the instructions below.

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

1. RS485 is intended for MODBUS output. Check the activity LEDs on any RS485 converter connected to the RS485 terminals on the LRW.

If lit, verify the MODBUS registers and call KAM Technical Support for further assistance.

If not lit, follow steps 1 through 4 on the "Loop Troubleshooting" section on the previous page to access the terminal board on the LRW. Proceed to use a voltmeter and connect the red wire on RS485+ and the black wire on the RS485- terminal. Measure and take note of the voltages. Call KAM Technical Support for further assistance.

APPENDIX A: MODBUS INTERFACE REGISTERS

Register Data	Type of Data	Register number
LOW ALARM	BOOLEAN	1
HIGH ALARM	BOOLEAN	2
TEMPERATURE HIGH ALARM	BOOLEAN	3
TEMPERATURE LOW ALARM	BOOLEAN	4
WATER CONTENT IN %	32 BIT FLOAT	42000
RTD_TEMPERATURE	32 BIT FLOAT	42001
BOARD TEMPERATURE	32 BIT FLOAT	42002
API GRAVITY	32 BIT FLOAT	42003
DENSITY	32 BIT FLOAT	42004
MAXIMUM FREQUENCY	32 BIT FLOAT	42005
MINIMUM FREQUENCY	32 BIT FLOAT	42006
MINIMUM VOLT	32 BIT FLOAT	42007
MAXIMUM VOLT	32 BIT FLOAT	42008
CURRENT OUTPUT	32 BIT FLOAT	42009