NON-INVASIVE DENSITY METER

Version 4.1

FOR PROCESS PIPES

INSTALLATION AND OPERATOR'S MANUAL

IMPORTANT: Before Installing the ULTIMO DENSITY METER or making any changes visit http://www.ultimompd.com/information for the latest edition of this Manual.

NOTIFICATIONS

CONTACTING TECH SUPPORT

Tech Support may be reached via email at:

Techsupport@Ultimompd.com. Please include a description of the issue and expect a response within two (2) business hours.

Business Hours - 8 am to 7 pm – Monday through Saturday – UTC -5

UPDATES

The most recent version of this Manual is always available on our website **www.ultimompd.com** at the Information Page. Please visit periodically this site to be sure that you are using the most recent edition of this Manual and for other new information.

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CHAPTER 1. INTRODUCTION TO THE ULTIMO DENSITY METER

This chapter introduces you to the ULTIMO DENSITY METER, explains its features and benefits and outlines the minimum software and hardware requirements for you to be able to effectively use this product. This chapter describes the following topics:

- Product Overview
- Features
- Benefits
- Technical Specifications
- Functional Block Diagram

PRODUCT OVERVIEW

Ultimo's proprietary vibration-based (non-acoustic) Percussion technology generates, acquires and analyzes oscillations at a pipe wall to determine the density of the material inside.

The ULTIMO DENSITY METER'S self-learning software discriminates between valuable and ambient vibrations and automatically adjusts the energy of percussion to obtain the unique 'signature' created by the vessel and the content material. Advanced algorithms instantaneously and, in high resolution, analyze the vibration spectrum and produce high accuracy and exceptional precision of measurement.

FEATURES OF THE ULTIMO DENSITY METER

- Non-Invasive and non-contact exterior installation
- Suitable for process pipes
- Analog, digital, and relay outputs
- Two-point calibration
- Alternative single point simulated calibration
- Self-diagnosing
- Fail-safe functionality

BENEFITS OF NON-INVASIVE MEASUREMENT

- Non-invasive — the ULTIMO DENSITY METER mounts on the exterior of the pipe with no penetration of the wall and no contact with the material or vapors inside the pipe.
- Easy to install and use — No holes or apertures are required. Simply attach the striker/receiver module to the pipe using the mounting brackets provided with standard cable straps. The ULTIMO DENSITY METER is easily relocated. Install any time - full or empty.
- No nuclear radiation — No licensing, permitting or special insurance endorsements are required to use the ULTIMO DENSITY METER.
- Cost effective — the ULTIMO DENSITY METER is designed for a long service life. No periodic maintenance or cleaning is required.
- Flexible — can be used with any pipe wall construction and all free flowing non-gaseous materials.

COMPUTER REQUIRED FOR INSTALLATION

The software provided runs on Windows XP and later OS and requires the PC to have ≥4 GB RAM. The installation computer must be successfully pre-tested with the RS232 (Serial) -to-USB cable and the RS485 (Serial) -to-USB converter. In the event the installation computer does not recognize these serial cable interfaces, you must search for the appropriate drivers and install them on the C-drive of the PC.

FUNCTIONAL BLOCK DIAGRAM

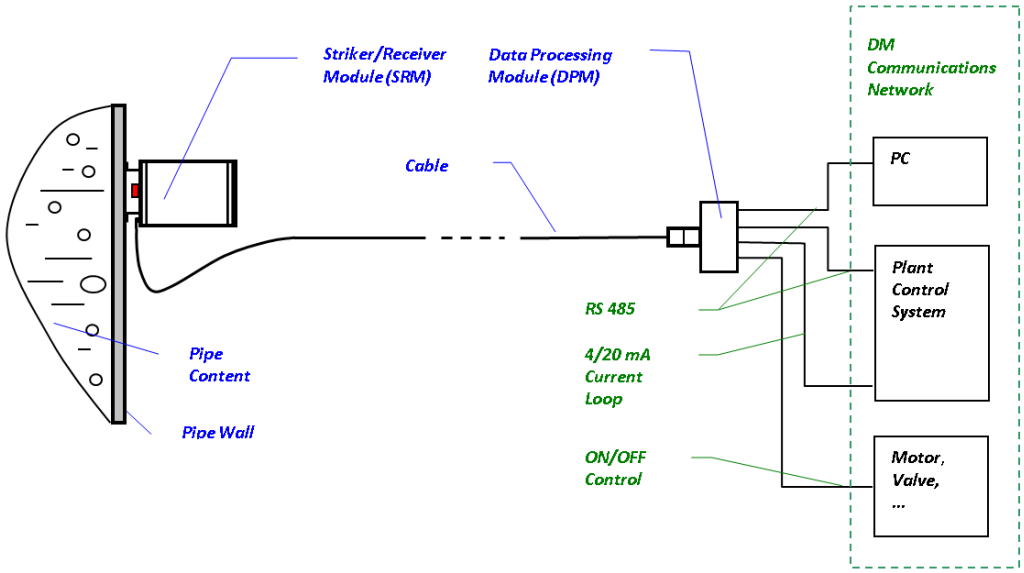

Figure 1. Functional Block Diagram

SYSTEM SPECIFICATIONS

TABLE 1. ULTIMO DENSITY METER 4.1 SPECIFICATIONS

Item	Description
Pipe Wall Material	Any metal, plastic, fiberglass
Pipe Size (DN)	≥3" (70.62 mm)
Electrical Power	110 / 220 VAC
Outputs	Analog:4-20 mA current loop Digital: Modbus RTU (RS 485) Relay: 20A Relay contact @ 120 / 220 VAC
Communication	Digital: RS 485
Process Pressure	N/A
Process Temperature	Up to 250° C
Ambient Temperature	From -40° C to +60° C
Enclosure	IP 66 or NEMA 4x

SUITABILITY AND PURPOSE

The ULTIMO DENSITY METER is suitable for loose solid, slurry and liquid materials where the process temperature does not exceed 250° C and where the ambient temperature is in the range of -40° C to +60° C.

The ULTIMO DENSITY METER is a process control measurement instrument used in applications of non-gaseous materials flowing through various production stages. See **Appendix 1** for limitations of pipe dimensions.

ACCOMPANYING EQUIPMENT

The ULTIMO DENSITY METER includes the following equipment:

1. Striker/Receiver Module (SRM) – Figure 2
2. Data Processing Module (DPM) – Figure 3
3. Mounting Brackets – provided for your specific pipe size – Figure 4
4. SRM to DPM and output cable interfaces (RS 232, RS 485 – serial and 4 – 20 mA – analog) – not shown

ULTIMO DENSITY METER COMPONENTS

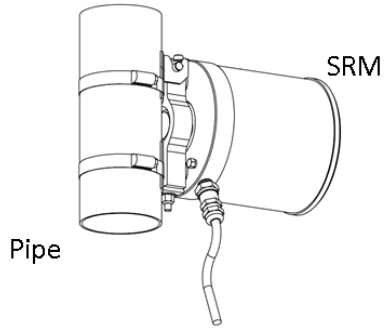

Figure 2. SRM

The SRM is attached to the process pipe (with the mounting brackets provided) and generates, acquires and sends the vibrations signal to the Data Processing Module.

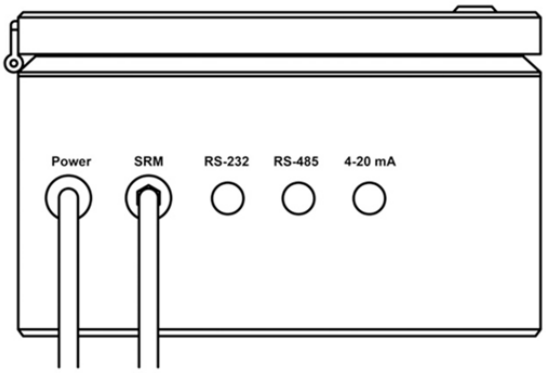

Figure 3. DPM

The DPM controls activities of the SRM and processes the vibrations signal received from the SRM into the amplitude-frequency spectrum data, analyses the data, generates and outputs measurements.

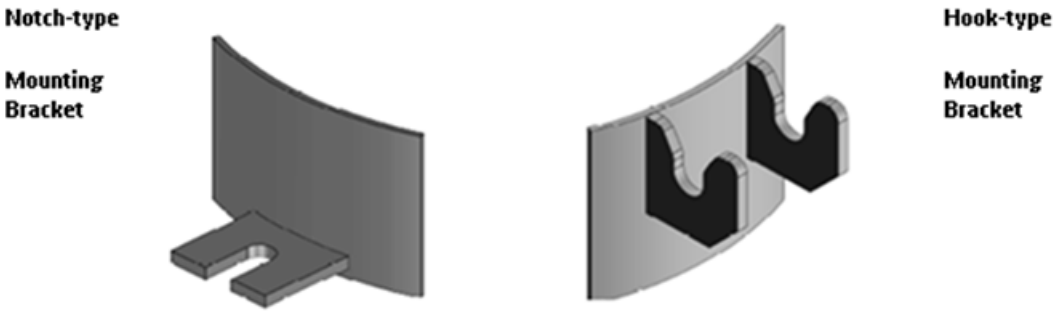

Figure 4. Mounting Brackets
Provide for a firm attachment of the SRM to the Process Pipe
DO NOT Use any Substitutes

Ultimo Density Meter Communication Cables

5. One (1) RS232 to USB Cable equipped with the round male connector matching the round female connector of the DPM marked RS 232 on the front panel
6. One (1) RS485 to USB Cable equipped with the round male connector matching the round female connector of the DPM marked RS 485 on the front panel
7. One (1) analog interface cable (4 -20 mA current loop 4-conductors cable)

CHAPTER 2. INSTALLING THE SRM

PROVIDING A SUITABLE PIPE SUPPORT

The pipe and its supports form an integral part of the 'system' required for optimal performance of the Ultimo Density Meter. This system requires the following:

1. Pipe supports which are firmly attached to the infrastructure of the facility and properly spaced in accordance with the table shown in Chapter 8, Appendix 1. This table is for typical process flow applications and should be considered a guide for installation requirements. The suggested values of spacing between supports and distance to the major source of ambient vibrations may require changes based on the specifics of certain measurement applications. Please contact Tech Support to ensure a successful installation under those circumstances.
2. A secure attachment of the pipe to the supports using a U-shaped bolt.

The following illustrations depict Correct and Incorrect pipe support systems. The absence of proper infrastructure anchored rigid supports and U-bolt clamping of the pipe to those supports will prevent proper functioning of the density meter.

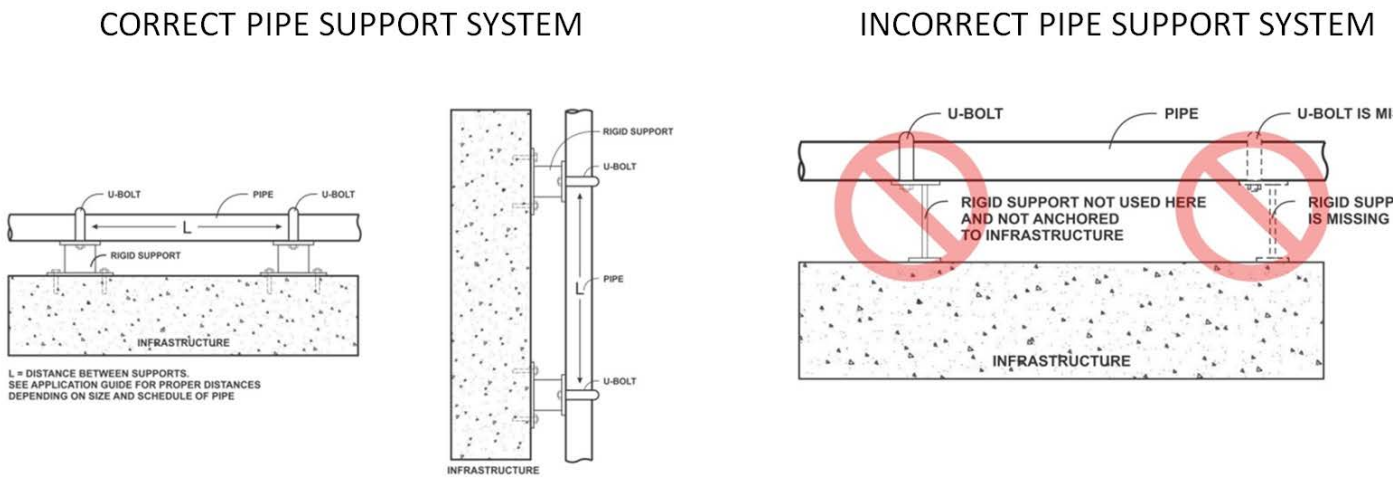

Figure 5. Correct Pipe Support Systems

3. Pipe's surface must be clean with no irregularities like dents, seams or paint chips.

SRM INSTALLATION

The length of the pipe section between supports onto which the SRM is mounted must meet the requirements shown in Appendix 1.

Mounting the SRM on a Pipe

The SRM can be positioned on the pipe at any angle between its vertical (1) and horizontal (2) position.

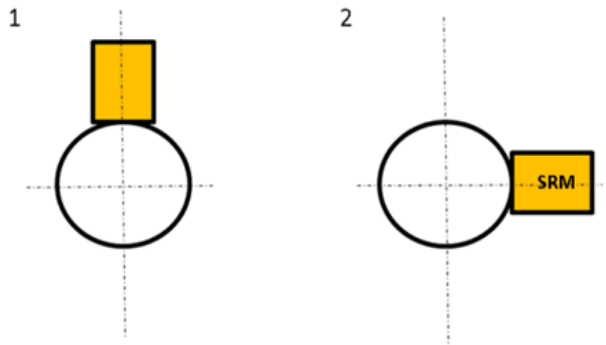

Figure 6. Mounting the SRM on Pipe

The best position should be determined by evaluating the SRM's response spectral diagram as described in Chapter 12 below.

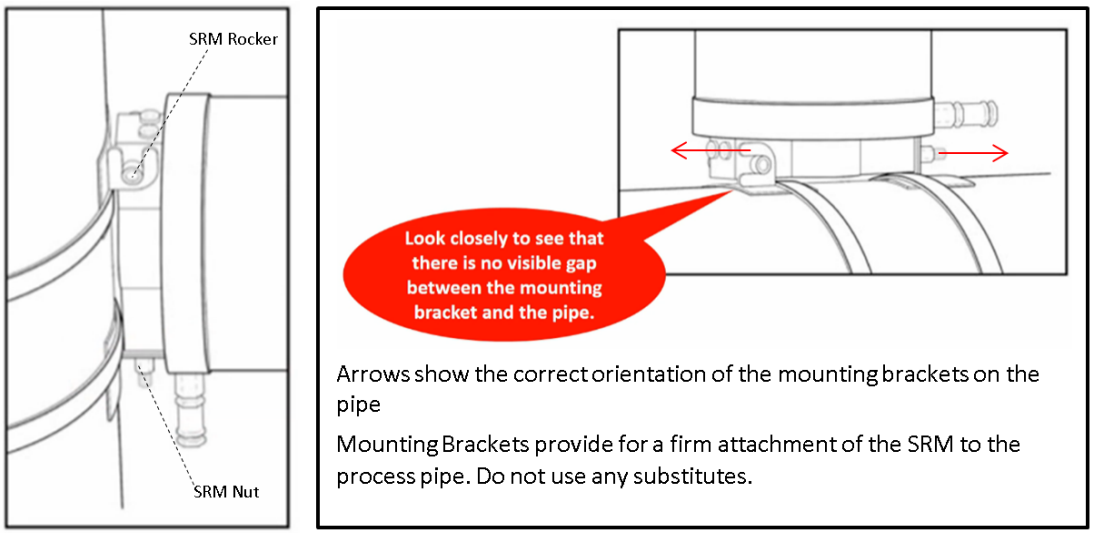

Figure 7. Using Mounting Brackets provided

When installing in the vertical position, mount the SRM rocker on the hook-type mounting bracket and let the SRM to hang freely against the pipe. Then, slide the notch-type mounting bracket up along the pipe and tighten the unit against the bottom of the mounting bracket.

Installing the SRM on a Pipe with an Elbow

Avoid mounting SRM on pipe next to an elbow. If you have to do it, position SRM as shown below (in normal = perpendicular direction to the plane that the pipe lies in).

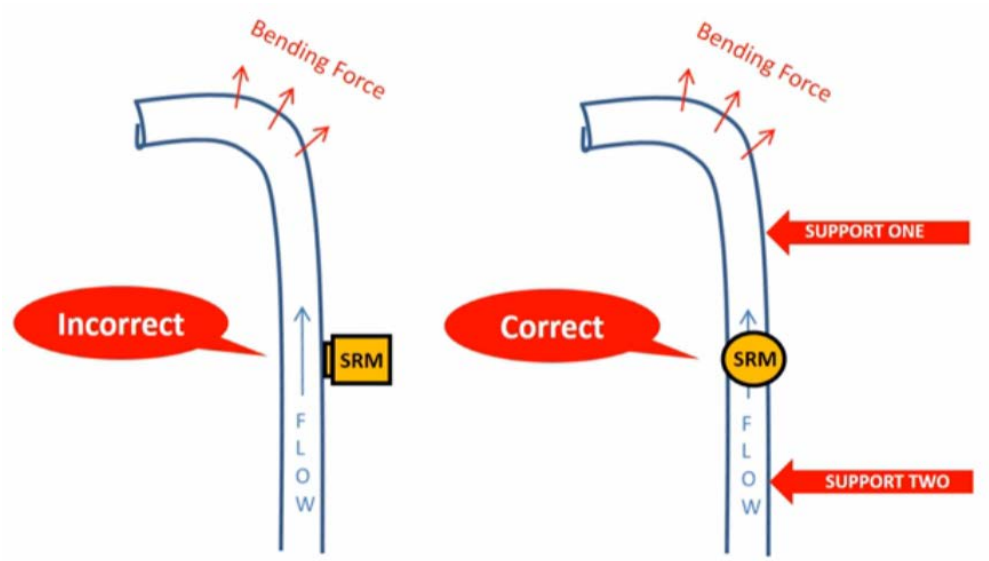

Figure 8. Installing on a pipe with elbow

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CHAPTER 3. GETTING STARTED

This chapter explains how to start working with the ULTIMO DENSITY METER once you have completed attachment of the SRM to the pipe. The SRM is equipped with a 15 ft. cable with a male connector. The female connector is on the front of the DPM labeled "To SRM".

POWERING THE DENSITY METER

We supply the DPM equipped with a power cord ending with the US-standard three-prong power plug. In order to be used at a worksite, the power cord must be connected to the AC power source using a surge protector.

To use your own power cord, follow the steps below.

1. Open the top panel of the DPM.
2. Insert the 120 V AC power cord through the conduit-type power connector on the front of the DPM and connect the wires of the power cord to terminal blocks in accordance with the diagram shown in Figure 9.

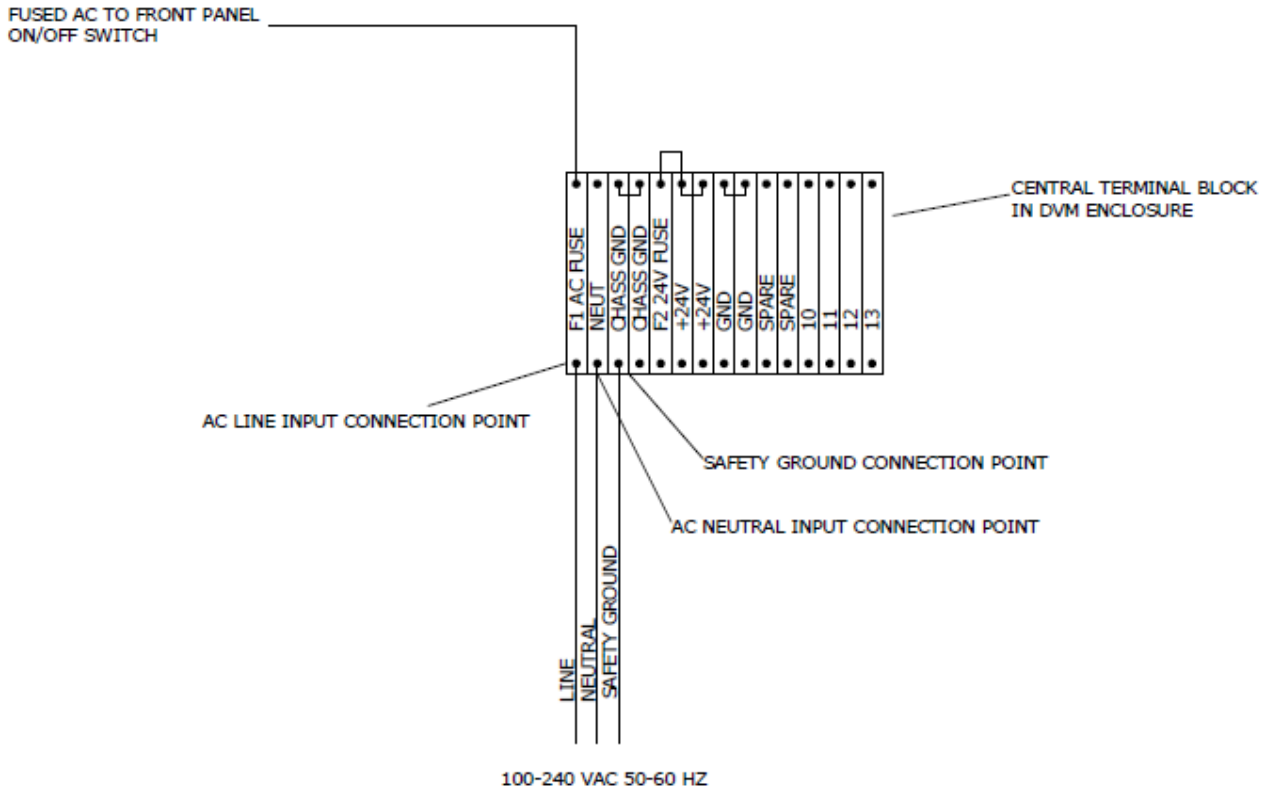
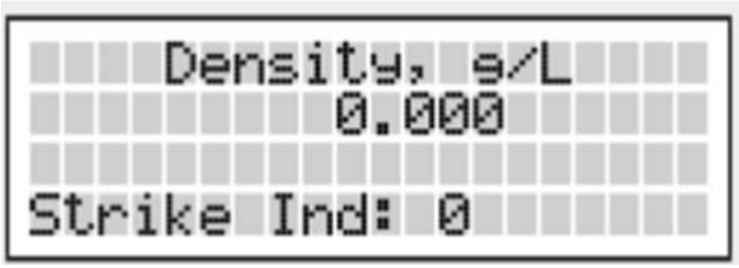


Figure 9. Powering the Ultimo Density Meter

Figure 10. Wiring with your own Power Cord

3. After connecting the power cord, turn on the power switch.
4. With the power switch on, you should see the following or similar text on the display of the DPM after about 30 seconds of initialization period



5. It is important that the display shows at least three readable lines of text.
6. If it does not, refer to the troubleshooting guide in the manual.
7. Confirm that the LED1 flashes constantly during the striking cycle, LED2 blinking and LED3 blinking. If this sequence is violated, refer to the troubleshooting guide in the manual.

CONNECTING SRM to DPM and CHECKING UNIT'S VITAL SIGNS

1. Turn the DPM power OFF
2. Connect the SRM to the DPM as shown here in Figure 11.

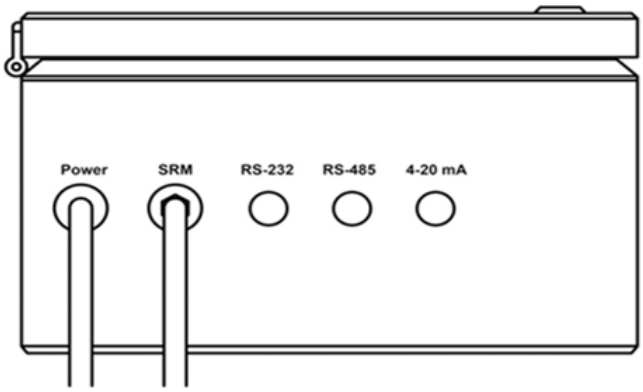


Figure 11. Connecting SRM to the DPM

3. If the density meter is equipped with a detachable SRM-to-DPM cable, find the corresponding connector of the cable and connect it to the connector on the front panel of the DPM labeled "SRM".
4. Connect the other connector of the detachable SRM-to-DPM cable to the connector on the SRM.
5. Turn on the power switch located on the DPM top panel.
6. Verify that the SRM begin striking at the pipe and the polyurethane tip of the striker touches the pipe's outer surface and then returns to its initial position inside the SRM mounting plank every striking cycle. If the striker does not reach the pipe as previously described or if the movement of the striker is not uniform and regular, immediately turn off the DPM power and refer the troubleshooting section of the manual.

CONNECTING DIAGNOSTIC RELAY FOR TROUBLESHOOTING & HELP

The following two paragraphs describe to you how to enable the self-diagnostic feature of the ULTIMO DENSITY METER.

The ULTIMO DENSITY METER is equipped with a "System Good" diagnostic relay, which switches from the "Device Healthy" status (the contacts of the diagnostic relay are closed) to "Device Unhealthy" (the contacts of the diagnostic relay are open) if the ULTIMO DENSITY METER self-diagnostic function indicates failure to produce strikes or there is an interruption in communication between the ULTIMO DENSITY METER and the plant DCS.

To know the status of the Ultimo Density Meter the user needs to access the relay contacts. You can access the relay contacts by referring to the DPM Wiring Diagram shown on Figure 12 below. On the Wiring Diagram the

contacts are located on the MPU DIN rail box lower terminal strip P11 and P14. You need to connect your wires to the identified contacts in the DPM enclosure box.

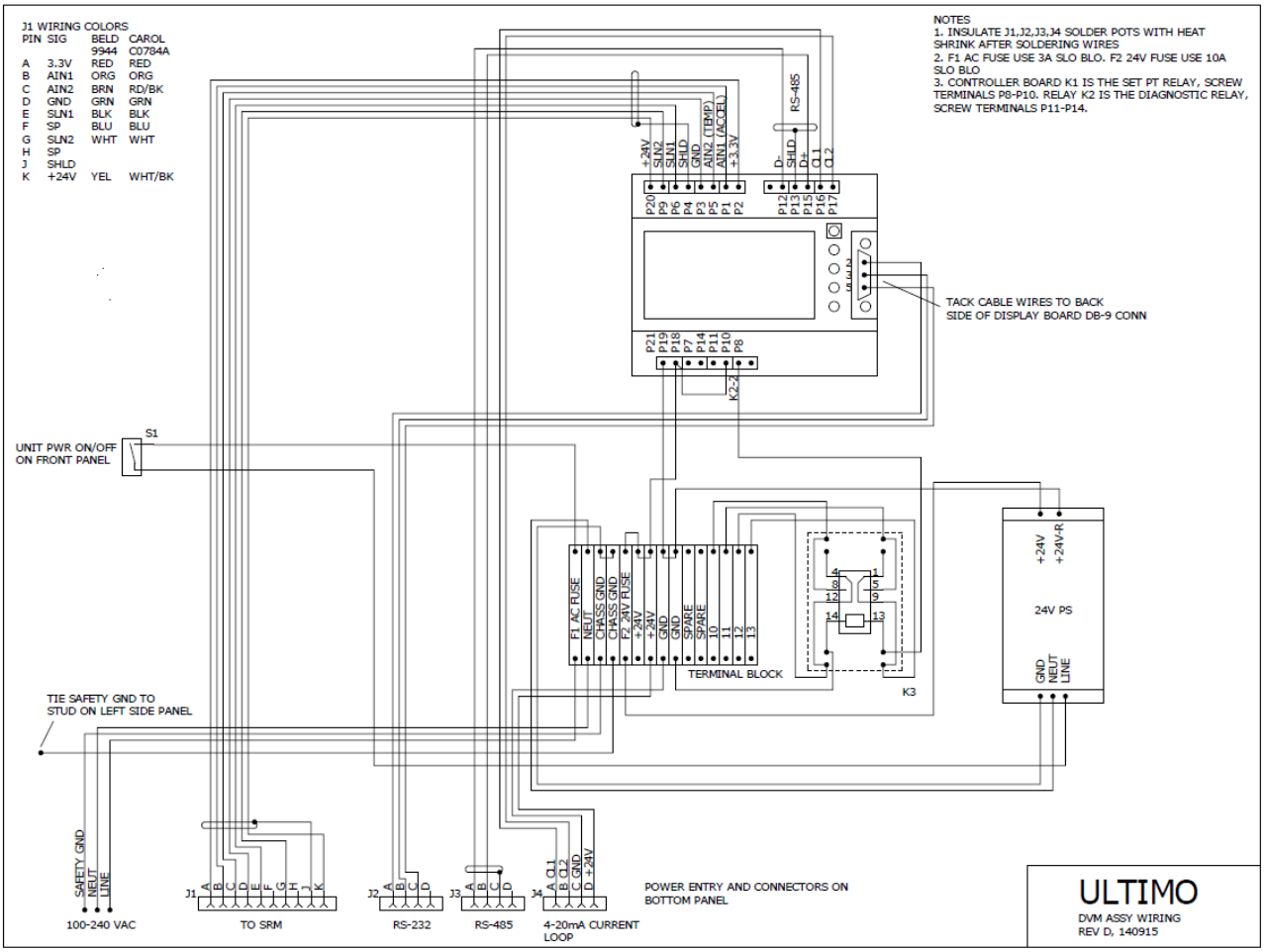


Figure 12. DPM Wiring Diagram

RUNNING SETUP & MONITORING PROGRAM

1. Download the programs provided to you, if not already done, to the PC and save them in a designated folder. If you are planning to perform several installations using the same PC, create one folder per each density meter by copying the supplied installation software into each folder. This will prevent errors in the configuration files that have the same name ***DVM_Pipe.ini*** but contain different data depending on the measurement application.
2. Run the ***DVM Setup.msi*** program residing in the above folder. This program will register necessary graphics utilities and should be run <u>one time only</u> unless you change the installation PC.
3. Open the PC Monitoring program ***DVM Monitor v. XX.X***.

ULTIMO DENSITY METER COMMUNICATIONS NETWORK

The Ultimo Density Meter communications network consists of the following hardware and software components:

a. Ultimo Density Meter having the DPM that displays density readings and sends them out via its serial digital (Modbus RTU based on RS 485) and analog (4-20 mA current loop) interfaces
b. A computer for the Ultimo Density Meter setup that communicates with the density meter using its serial RS 485 or RS 232 interfaces
c. A plant control station (may include the computer used for the Ultimo Density Meter setup and monitoring)
d. Setup and monitoring software that runs on PC
e. Ultimo supplies the downloadable software application for the Ultimo Density Meter setup and monitoring, configuration file and firmware if its upgrade is required

CONNECTING THE DPM TO PLANT MONITORING/CONTROL SYSTEM (CS)

To send the DPM digital output to the CS, combine the RS 485 cable of the CS with the RS 485 cable of the Density Meter in a single cable interface. The total length of the extension serial cable must not exceed 450 ft.

The DM 4.1 is supplied with a 5 ft. RS 232 cable interface suitable for connecting to the USB port of the setup computer located next to the DPM when uploading of the DM 4.1 firmware is required. To prevent communication errors, only one DPM attached serial cable should be connected to the setup and monitoring PC at any time.

CONNECTING THE DPM ANALOG OUTPUT (4-20 mA Current Loop) TO THE CS

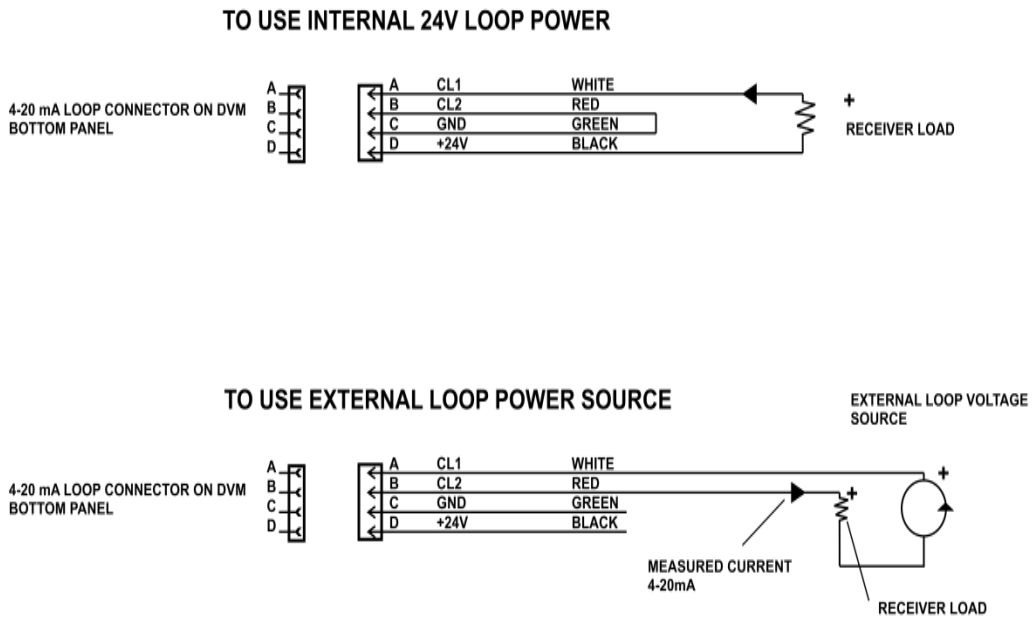


Figure 13. Connecting the DPM 4-20 mA Current Loop Circuit to the CS

Ultimo supplies the 4 – 20 mA cable wired in accordance with the above internal power supply wiring diagram.

ULTIMO DENSITY METER DISPLAY FEATURES

The Ultimo Density Meter display works in either of the following modes:

- Measurement Mode for reading measured values
- Boot Loader Mode for upgrading the Ultimo Density Meter firmware. A guide on how to use the Boot Loader Mode for future upgrades to the Ultimo Density Meter software is in Appendix 4.

After the power switch is turned ON, the Ultimo Density Meter switches into Measurement Mode automatically.

ULTIMO DENSITY METER USER INTERFACE OVERVIEW: FEATURES & OPERATION

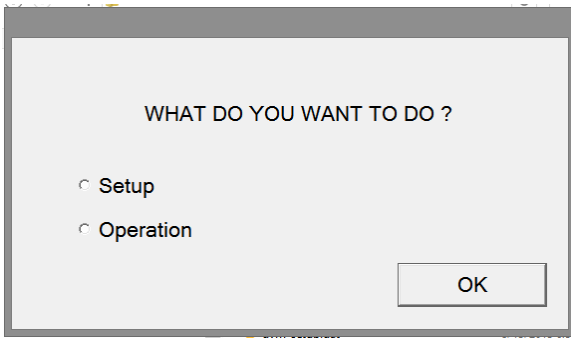
In order to use the DM 4.1 PC Monitoring Software and its graphical user interface (GUI), the user must open the PC monitoring software application from its designated folder. The filename format of this application is ***DVM Monitor vXX.XX.exe***

The monitoring software GUI supports the density meter's setup and operation functions which are accessible through the Main Menu and the Toolbar.

The first screen of the GUI is the welcome screen offering you a selection of the language that will be used for operating the meter. This screen has the following look:

Clicking the radio button next to the flag of country will produce the entire GUI in the local language.

Clicking the OK button on the Welcome Screen will bring you to the screen where you will chose either the setup of the meter or one of the multiple functions available in the Operation mode.



If the Setup was selected, then the GUI interactive wizard will guide you through the setup process.

If Operation was selected, then the GUI allows you to use one of several operation control functions of the Density Meter by taking you to the Main Window of the GUI which shows the toolbar, reading and chart windows.

OPERATIONS CONTROL

There are two ways of operating the Density Meter:

- Using icons from the toolbar, figure 14
- Using Main Window Menu, after the Setup line is selected, figure 15

The Setup line opens the Setup Wizard which gives you the following options:

- Device Setup
- Offset
- Strike Adaptation
- 2-point Calibration
- Sample-Free Calibration
- 4-20 mA Setup
- Samples Correction
- Calibration Curve Correction
- Calibration Curve Correction2

Figure 14. ULTIMO Density Meter GUI Main Window

Figure 15. ULTIMO Density Meter PC Application GUI: Main Window Toolbar

Table 2. ULTIMO DENSITY METER TOOLBAR ELEMENTS

This table summarizes the graphical user interface features.

Setup and Operation		
 Repeated in the Menu	Change COM Port	Sets the communication port on the computer connected to the ULTIMO DENSITY METER. Sets communication protocol; RS 232 / RS 485.
 Repeated in the Menu	Do Setup/View Setup Parameters	Sets the ULTIMO DENSITY METER operating parameters.
 Repeated in the Menu	Start Log File	Creates a time-stamped log file of the ULTIMO DENSITY METER'S continuous readings.
 Repeated in the Menu	Exit	Exits ULTIMO DENSITY METER setup and monitoring software application.

The message area at the bottom of the Main Window (see Figure 15) displays the current measurement status. Table 3 below shows the log messages:

TABLE 3. LOG MESSAGES & STATUS

Item	Description
Communication failure	Suggests troubleshooting if the message appears continuously
Working	Normal operation
Collecting data	System is collecting measurement data.
	When this flashes green, it indicates that communication between the DPM and the PC is established and the ULTIMO DENSITY METER is working normally.

TABLE 4. MAIN WINDOW MENU OPTIONS

Menu Line	Description
Chart Refresh	To refresh the Chart, click on the Chart Refresh line in the menu.
Initialization	By clicking on the Initialization line on the menu the ULTIMO Density Meter acquires the latest default data from the configuration file.
Applications Type	To select the measurement Application, e.g., Density Measurement
Regimens	To select the candidate calibration curve after the Single Point Calibration (Sample-Free Calibration) is performed

SPECIAL GUI SCREENS

The GUI is equipped with two very important screens that are designed to allow the user to be able to modify core factory-set parameters of the Ultimo Density Meter using the Advanced Setup Window (ASW) and to observe the captured pipe's vibration signal in time (real time SRM output monitoring) and frequency (pipe vibration spectrum) domains using the Real Time Window (RTW).

ADVANCED SETUP WINDOW (ASW)

Clicking **ctrl+f1** will open the ASW that looks as shown in the photo below.

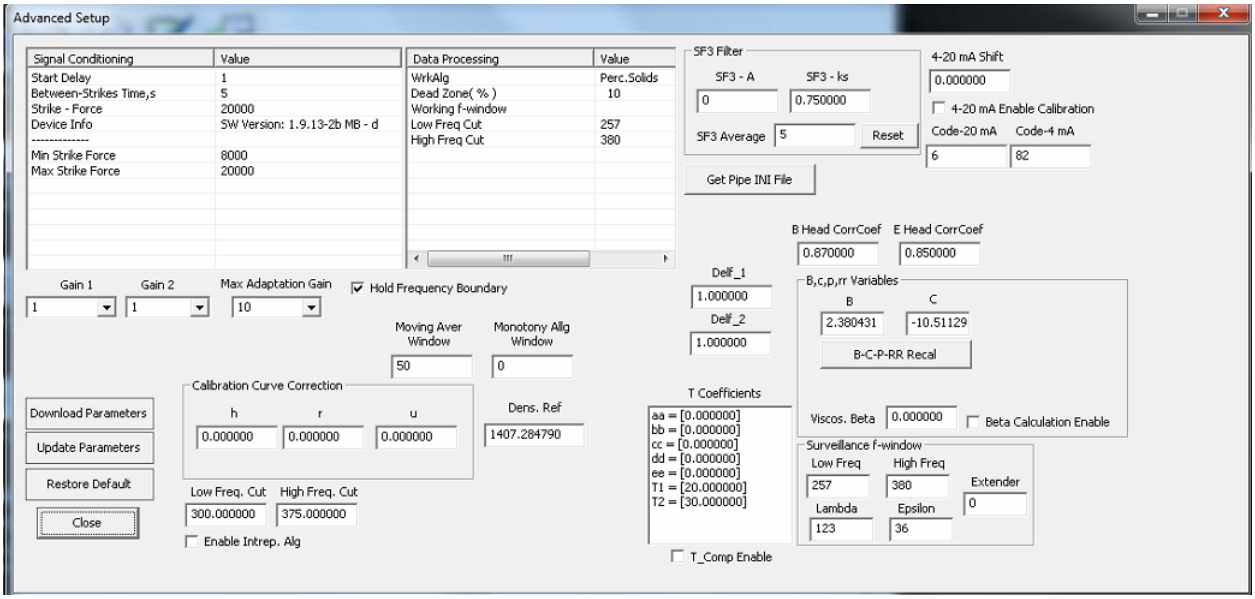


Figure 16. Advanced Setup Window (ASW)

TABLE 5. ASW MAIN ELEMENTS

FUNCTION: SIGNAL CONDITIONING

Parameter	Description	Nominal Value/Meaning
Start Delay, ms.	**Defines time interval between strike initiation and beginning of vibration signal monitoring**	1.0
Between Strikes Time, s		5.0
Strike Force, µs	**Time interval when driving voltage is being applied to solenoids**	≤20,000
Device Info	**Firmware Name**	

FUNCTION: DATA PROCESSING (Working Frequency Window)

Parameter	Description	Nominal Value/Range
WrkAlg	Type of Measurement Application	Density/Percent Solids
Dead Zone, %	**Used to set the ON/OFF control function of the instrument**	10.0
Low Freq. Cut, Hz	**Left boundary of the monitored frequencies range**	≤650
High Freq. Cut, Hz	**Right boundary of the monitored frequencies range**	≤650*

* High Freq. Cut> Low Freq. Cut

FUNCTION: FREQUENCY MONITORING (Surveillance Frequency Window)

Parameter	Description	Nominal Value/Range
Low Freq. Cut, Hz	**Left boundary of the monitored frequencies range**	≤650
High Freq. Cut, Hz	**Right boundary of the monitored frequencies range**	≤650*
Lambda	**Monitored frequencies span**	High Freq. Cut- Low Freq. Cut
Epsilon	**Surveillance Window within the monitored frequencies range**	0.3·Lambda

* High Freq. Cut > Low Freq. Cut

FUNCTION: SIGNALING

Parameter	Description	Nominal Value/Range
Gain 1	**Gain of the accelerometer's amplifier**	1; [1,32]
Gain 2	**Gain of the thermal sensor amplifier**	1
Max Adaptation Gain	**Max accelerometer gain value used in Adaptation**	10; ≤32

FUNCTION: OUTPUT SMOOTHING

Parameter	Description	Nominal Value/Range
Moving Average Window **(MAW)**	**Controls smoothing of the density readings**	20; [1,255]
Monotony Alg. Window	**Controls smoothing of the density readings. Should be used when the MAW is not sufficient**	0; [0,255]

FUNCTION: ANALOG INTERFACE PARAMETERS SETUP

Parameter/Button/Checkbox	Description	Nominal Value/Control Type
Code-20 mA	**Sets high end of the 4-20 mA microchip calibration curve**	9
Code-4 mA	**Sets low end of the 4-20 mA microchip calibration curve**	83
4-20 mA Shift	**4-20 mA output current offset**	0
4-20 mA Enable Calibration	**Switches to the 4-20 mA microchip calibration mode**	Checkbox

FUNCTION: SPIKE FILTERING (SF3)*

Parameter	Description	Nominal Value
SF3-A	**Spike Filter parameter.**	0
SF3-ks	**Spike Filter Parameter**	0.75
Sf3-average	**Spike Filter Parameter**	5

*SF3-A = 0 disables the function – recommended

FUNCTION: CALIBRATION CURVE CORRECTION

Parameter	Description	Nominal Value
H	**Corrector's Parameter**	0
R	**Corrector's Parameter**	0
U	**Corrector's Parameter**	0
Low Freq. Cut, Hz	**Left boundary of the blocked from monitoring frequencies range**	0
High Freq. Cut, Hz	**Right boundary of the blocked from monitoring frequencies range**	0

ASW CONTROLS

Control Function	Description	Control Type
Hold Frequency Boundaries	**Allows manually control the monitored frequencies range**	Checkbox
Get Pipe INI File	**Reads setup parameters of the instrument's calibration curve from its configuration file**	Button
B-C-P-RR Recal	**Calculates instrument's calibration curve using its setup parameters from the configuration file**	Button
Enable Intrepid Alg.	**Enables inversed Calibration Curve Measurement Algorithm**	Checkbox
Download Parameters	**Reads setup values from the DPM into the installation PC and shows them on the ASW**	Button
Update Parameters	**Writes setup values from the ASW into the instrument**	Button
Restore Default	**Restore all default setup values set at the factory**	Button
Close	**Closes the ASW**	Button

REAL TIME WINDOW (RTW)

Figure 17. Real Time Window (RTW)

TABLE 6. RTW MAIN ELEMENTS

Display or Control Function	Description	GUI Element Type
Start Strike Force	**Beginning value of the strike force used by the Adaptation procedure**	Text box
Stop Strike Force	**Ending value of the strike force used by the Adaptation procedure**	Text box
Step Force	**Strike force incremental value used by the Adaptation procedure**	Text box
Current Force	**Instantaneous strike force value during the Adaptation procedure**	Text box
Current Gain	**Instantaneous Gain1 value during the Adaptation procedure**	Text box
Time/Spectral Diagram Chart	**Displays on the window chart the real time SRM sensor's output or the SRM-initiated spectral diagram of the pipe**	Chart Window
Regular Frequencies	**Value of the tracked frequency obtained via standard FFT**	Text box
Accurate Frequencies	**Value of the tracked frequency obtained via Ultimo FFT**	Text box
Exit	**Exits the RTW to the Main Window of the GUI**	Button
Reset Filter	**Resets data accumulated in the smoothing function's buffer**	Button
Start/Stop Recording	**Start or stops recording: a) real time SRM output signal into an excel file; b) spectrum of vibrations produced by the SRM**	Button
Real Time Signal	**Selects displaying real time SRM output signal on the window chart**	Checkbox
FFT	**Selects displaying vibration spectrum on the window chart**	Checkbox
Result	**Displays Density/%Solids measured value calculated by the installation PC**	Text box
Left Boundary	**Left boundary of the monitored frequencies range**	Text box
Right Boundary	**Right boundary of the monitored frequencies range**	Text box
Temperature	**Temperature inside the SRM, °C**	Text box

The ASW and RTW are used in accordance with the following principle:

a. Change a parameter on the ASW
b. Observe the result of the made change on the RTW

The diagram on the RTW's chart window is a spectrum representing the scaled amount of energy of each vibration harmonic at its vibration frequency. The diagram is built using the standard FFT procedure. Note, that the vibration frequency tracking is performed using the high resolution Ultimo proprietary FFT-like procedure. The red segment on the diagram indicates the frequency range corresponding with the boundaries of the instrument's calibration curve.

The **Setup** includes four major steps:

1. **Inserting Measurement Application Data**

   For example, Pipe OD and ID or Pipe Size and Schedule, distance between the supports.

   After the measurement application data values are inserted, the Setup Wizard guides you to performing the Adaptation Procedure by clicking on the Adaptation button if you are performing the setup for the first time. If it is not the first time setup, the Setup Wizard will give you a menu of selectable options in the pop-up window.

2. **Adaptation**

   The Ultimo Density Meter automatically senses vibrations of the pipe and adjusts the striking force and amplification to create optimal conditions for the instrument's signal/data processing.

   After the Adaptation Procedure is completed, the Setup Wizard guides you through the Calibration process when you select Calibration from the pop up window options if you are performing setup for the first time.

3. **Calibration**

   This stage allows you to follow either the 2-Point Calibration procedure or the Single Sample Simulated Calibration method. Both methods are explained in the following Chapter 6. The 2-Point Calibration Procedure is the prime calibration method. The Single Sample Simulate method is a simulated calibration that typically requires multiple tuning sessions and therefore is time consuming. We recommend using this procedure when there is no possibility to create material samples required by the 2-Point Calibration procedure.

4. **Post-Calibration Tuning**

   Upon completion of the Calibration, you will have to observe performance of the instrument and make a decision on the need for post calibration tuning. The Post-Calibration Tuning technique is described in Chapter 7.

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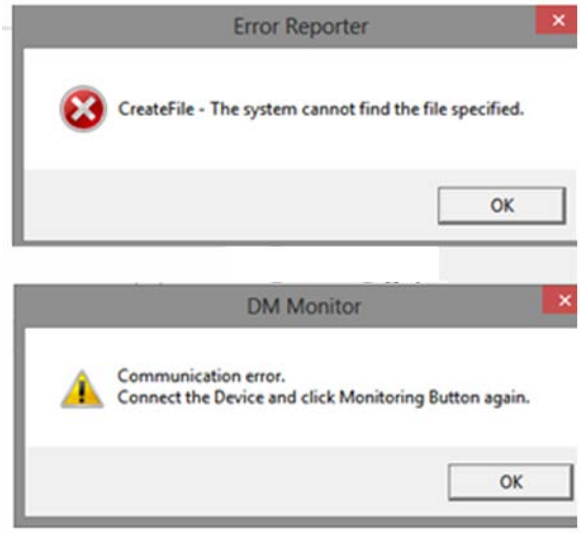
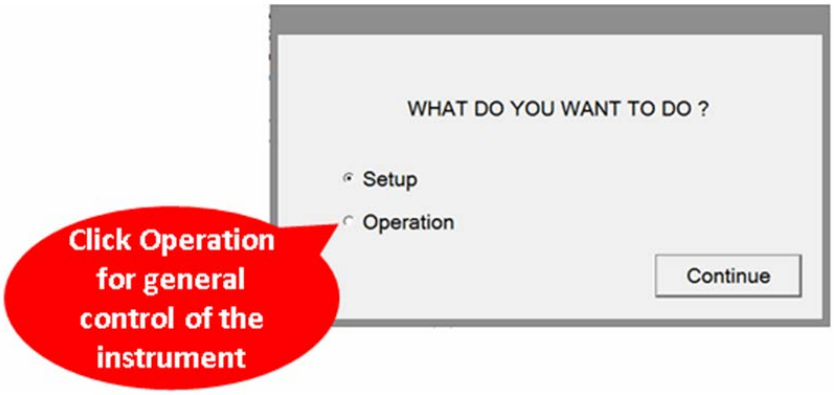
CHAPTER 4. SETUP & INPUTS

Go to the working folder where the ultimo software resides. Open the ultimo monitoring program.

Normally the Language selection screen will appear, but you may see that there is no communication because the port number that your computer is using and the port number written in the memory of the instrument do not match.



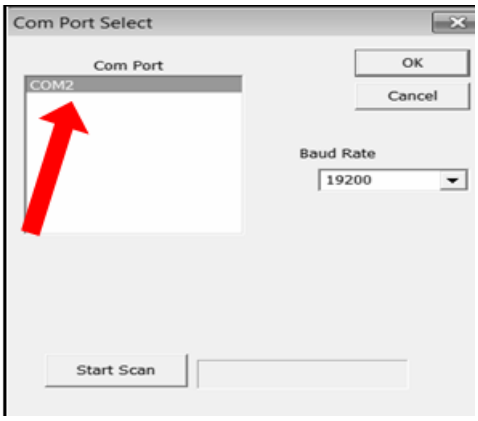
Simply click OK to any errors that appear and the system will bring you to the language selection screen again. Click OK to get to the operation control screen.



Then, you will be brought to the main window where you should click on the port setup button  .

Select the Com Port that will be used for communicating with the Ultimo Density Meter.

You may see more than one choice. If so, select the one that corresponds with the actual port number as seen on your laptop device manager and click OK.



Now you will return to the main screen of the GUI. The unit will then begin communicating with the laptop as seen on the blue bar at the bottom of the Main Window screen which will say either "collecting data" or "working".

If, however, you see "Communication error", refer to the trouble shooting guide, Chapter 11.

The setup process is guided by the GUI and can be initiated by either clicking on the Setup icon on the toolbar  or by opening the Main Menu and selecting the Setup line. The process of setup is guided by the GUI and includes inserting values characterizing the pipe's material and dimensions if the density the reported variable. If the reported variable is the % Solids, you will additionally insert values of the solid component density and liquid carrier density.

In the setup, the density values should be inserted in g/L and all dimensional values should be inserted in inches

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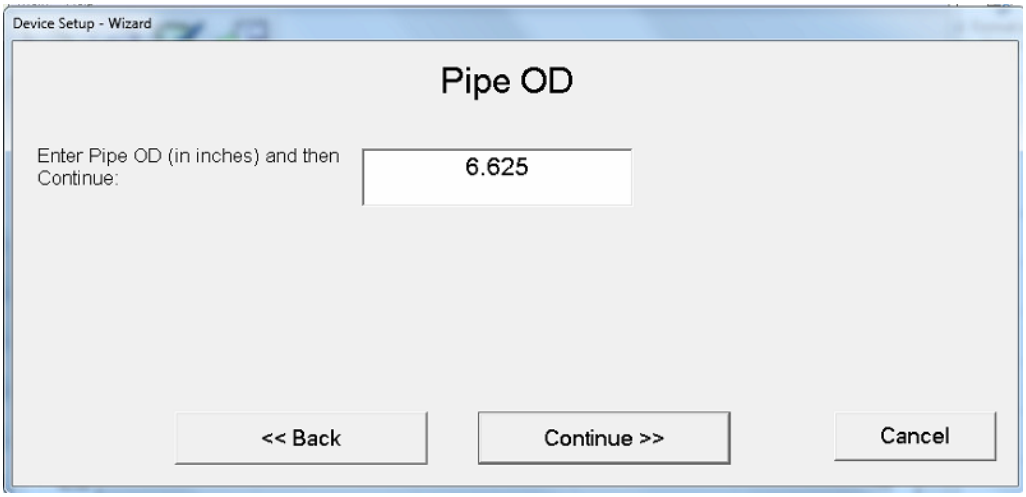
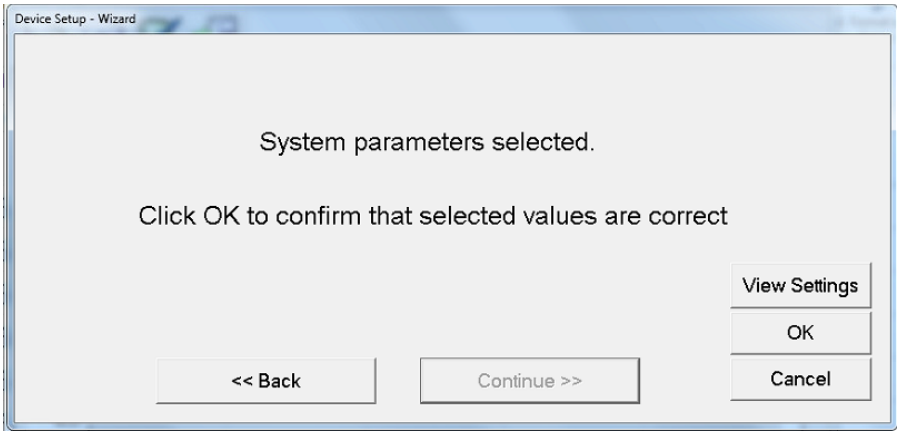
A typical setup wizard screen has the following view



After inserting values in the screen's checkboxes, you either move to the next screen by clicking the Continue button or you move to the previous screen by clicking the Back button. Clicking Cancel will stop the setup and

bring you to the Main Window of the GUI.

The setup process ends with the screen where you can confirm (click OK) that the setup parameters are inserted correctly or view them all on a single screen by clicking View Settings button.



The following Setup Parameters screen will pop up.

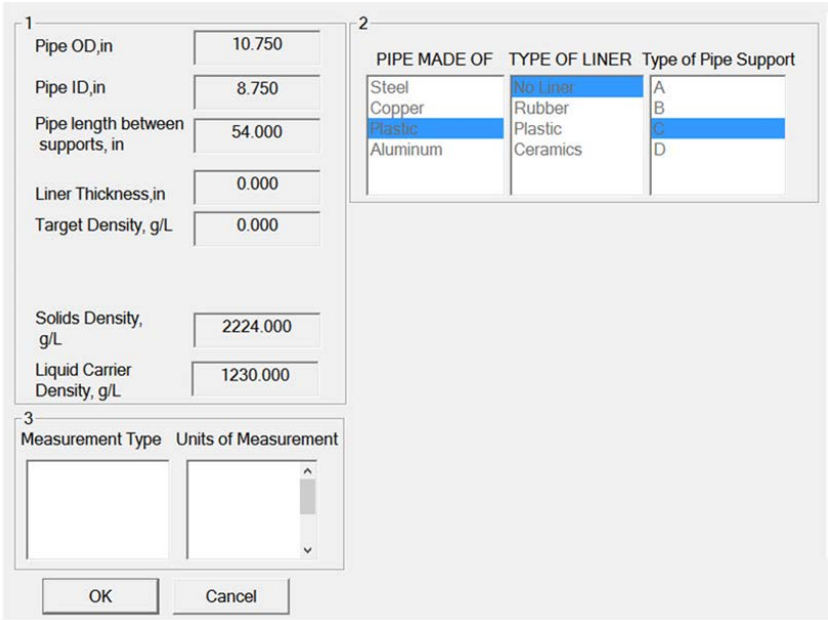


Figure 18. Setup Parameters Screen used in the % Solids Measurement Application

If the Density Measurement Application is used, the Section 3 of the above Screen has the following view.

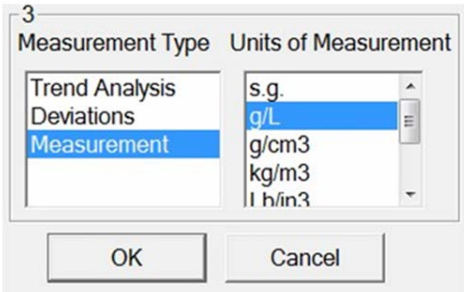


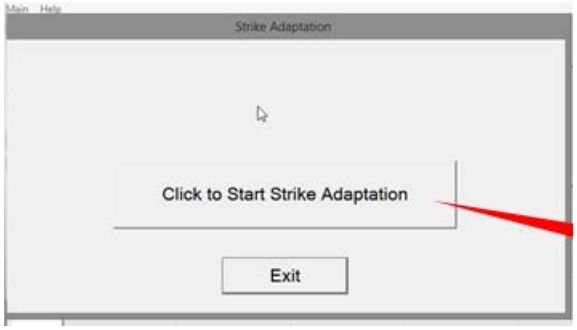
Figure 19. Setting units of the density measurement for the Density Meter's output

If you find that some settings' values are incorrectly inserted, click OK on the Setup Parameters screen (figure 18) and you will be brought back to the final screen of the setup wizard from which you can repeatedly click on the Back button to find the screen with incorrectly inserted value. After fixing each incorrect setup parameter's value, you navigate to the final screen by repeatedly clicking on the Continue button. Then click OK to complete the setup parameters process.

After the setup process is completed, you will be asked whether you are a first time user. By confirming it, you command the wizard to continue guiding you through the next steps of Adaptation and Calibration. In the opposite case, you will be offered a command menu to choose from to further operate the instrument.

CHAPTER 5. ADAPTATION

The Adaptation is a process of automatically setting the minimum values of the strike force and the amplification gain at which the criteria of the captured signal quality are satisfied. After entering into the Adaptation phase as the first time user or by selecting the Adaptation line from the menu, you will have to initiate the process by clicking Start Adaptation on the following screen.



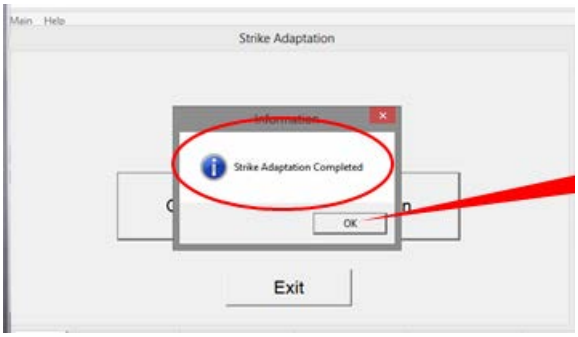
The adaptation process will begin. The Start Adaptation button will automatically switch to the Stop Adaptation state. The process of adaptation takes about three minutes.

You can stop the adaptation process at any time. If you choose to click "Stop Strike Adaptation" you will be brought to the beginning of the adaptation process for when you want to continue but you will be still treated as a first time user if you were the one.

If you halt the adaptation process by clicking on "Exit", you will be brought to the Main Window and you will no longer be a first time user.

Adaptation completion will be confirmed. Click OK to be brought to the next step.

If something went wrong, the system will say "Cannot complete adaptation". Click Ok and you will be brought to the beginning of the Adaptation process. At this point you need to consult the Troubleshooting section of this Manual to find out what caused the failure.



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CHAPTER 6. HOW TO CALIBRATE

OVERVIEW

There are two ways to calibrate using the ULTIMO Density Meter:

1. 2-Point Calibration and
2. Single Point Simulated Calibration (Sample-Free Calibration in older versions of the GUI)

Always try to perform calibration at a nominal value of the flow rate

Either 2-Point Calibration or Single Sample Simulated Calibration (SC)/Sample-Free Calibration (SFC) starts by opening the Main Window Menu and choosing the appropriate option. You will be guided through the process, and at the completion of all steps you will be notified that the 2-Point Calibration or the SC has been completed.

2-POINT CALIBRATION

2-Point Calibration should be used when you are able to take samples that are representative of the endpoints of the normal range of density values typical for the measured material. If taking samples is too difficult or not possible at all, then the Single Sample Simulated Calibration method must be used.

SINGLE SAMPLE SIMULATED CALIBRATION (SC)

SC is used to perform a calibration when taking samples is not possible or is inconvenient. It involves using an estimate of the density of the material flowing through the pipe and using this estimate and your judgment to create and select from several possible calibration curves.

After performing either calibration process, a post-calibration adjustment is required. This adjustment is based on monitoring the density meter's readings and comparing them with readings of the same material density obtained from another calibrated instrument or physically measured samples. The GUI is equipped with two Calibration Curve Correction utilities that can be accessed from the Main Window Menu.

Here's how to use either method

2-Point Calibration

The GUI calibration wizard will ask you to take a sample. Once you do, follow these steps:

1. Immediately confirm that you have done so by clicking on the OK button. The system will notify that it is acquiring the signal coming from the SRM.

2. The wizard will ask you to insert the value of the density of the sample. The system will pause while it waits for you to enter the density value of the sample. The system will then associate the sampled material density value with the SRM output signal that was memorized when the sample was taken.

3. After you enter this first sample density, the system will pause again while it waits for you to obtain the second sample.

4. Since there might be a long time lapse before you are able to take the second sample, the system will wait for you. You can disconnect the installation PC from the DPM if there will be a long waiting period before the second sample is available.

5. When you are ready to take the second sample, connect the PC to the DPM and open the PC Monitoring software application and return to where you left off. There you will be asked to continue the calibration. Click "Yes" and then take the second sample.

6. When you enter the second sample density value the system will complete its calculations and after a short pause you will be notified that the calibration has been completed. Once you click OK the calibration will be accepted and you are now measuring.

   If you have access to a better set of density values at a later time, you can improve the calibration by opening the GUI Main Window Menu and choosing the Samples Correction option.

   <u>The SC method will require you to:</u>

1. Insert an estimated value of the material density that is flowing through the pipe at the time you are performing the SC.

2. Insert the smallest and largest expected values of the density. This defines the desired density measurement range. Calculations will begin when you click the OK button on the wizard dialog box.

3. The wizard will then guide you to the menu option Regimens. You will see a set of prospective calibration curves. You then can select the calibration curve you would like to evaluate. Do this one at a time and decide which calibration curve is optimal. You may also click on the Search Curve button on the Regimens window and the system will automatically select the correct calibration curve out of the set of available curves after the density value of the material sample becomes available. Once the Search Curve function is going to be used, make sure that the reference density value differs from your guess density value by at least 5%.

CHAPTER 7. HOW TO TUNE THE ULTIMO DENSITY METER

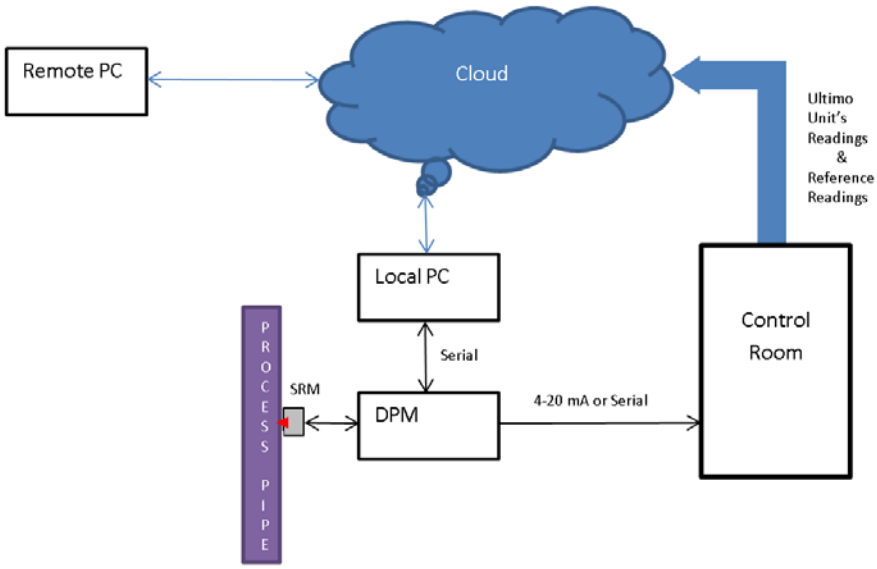
Tuning includes:

- Monitoring of readings (data)
- Data Collection
- Data Comparison
- Data Analysis
- Adjustment of instrument's setup

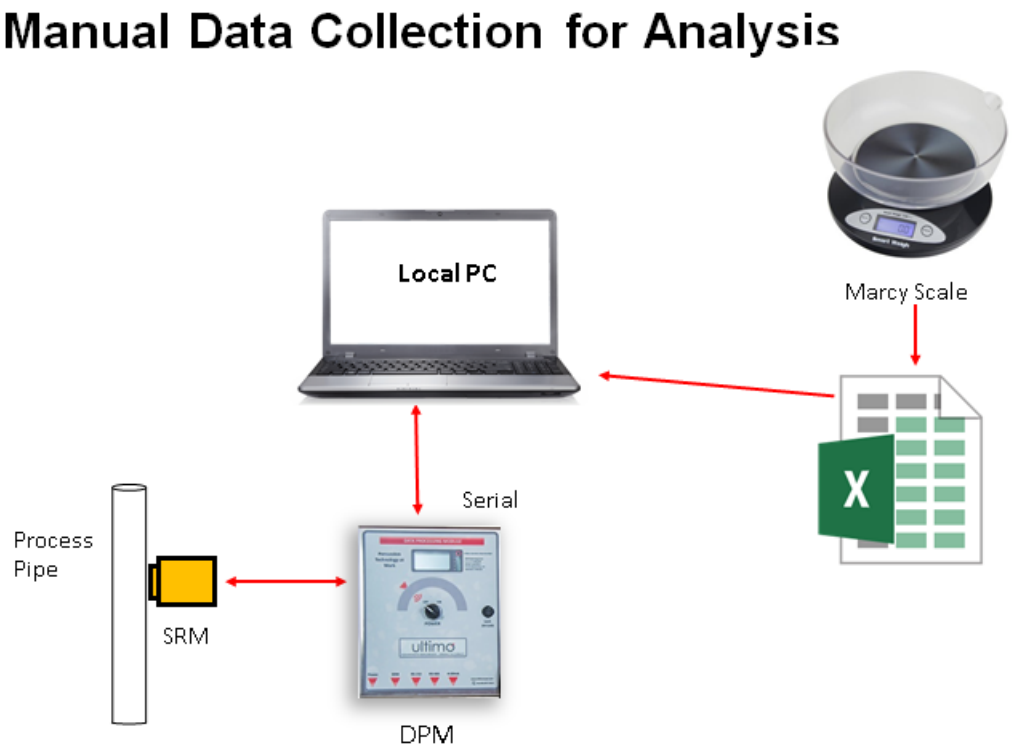
MONITORING & DATA COLLECTION

Tuning is not possible without monitoring the Ultimo Density Meter readings and comparing them with readings from a Reference Source of data ("standard" inline instrument or laboratory measurements of material samples). To make a successful comparison, the Ultimo Density Meter readings and the Reference Source measurements must have the same time stamps.

If Tuning will be done remotely the best method of monitoring and data collection is shown below.



If you don't have a DCS – based data collection system, the following information system structure is recommended



Once the instrument is connected to the installation PC, the PC will collect measurement data from the DPM. It is collected in an Excel file named DVM_MEAS.

If you don't have a DCS-based collection system, you will need to collect manual samples using a Marcy cup scale. These readings will be manually entered into a separate Excel file which will be used to create the graph for analysis.

DATA COMPARISON

Recorded data from the Ultimo Density Meter and from the Reference Source must be in the same time scale, e.g., as shown in the following Excel table.

	A	B	C
1	Date +Time	Ultimo Readings	Reference Data
2	7/21/2015 6:45	1.707876	1.7138116
3	7/21/2015 6:46	1.70787	1.7132427
4	7/21/2015 6:47	1.707864	1.7126738
5	7/21/2015 6:48	1.707858	1.7121048
6	7/21/2015 6:49	1.707852	1.7115358
7	7/21/2015 6:50	1.707847	1.7109669
8	7/21/2015 6:51	1.707841	1.710398
9	7/21/2015 6:52	1.707835	1.7098291
10	7/21/2015 6:53	1.707829	1.7092601
11	7/21/2015 6:54	1.707824	1.7086911
12	7/21/2015 6:55	1.707818	1.7081223
13	7/21/2015 6:56	1.707812	1.7075533
14	7/21/2015 6:57	1.707806	1.7069844
15	7/21/2015 6:58	1.7078	1.7064154
16	7/21/2015 6:59	1.707795	1.7058464
17	7/21/2015 7:00	1.707789	1.7052776
18	7/21/2015 7:01	1.707783	1.7048881
19	7/21/2015 7:02	1.707777	1.7052464

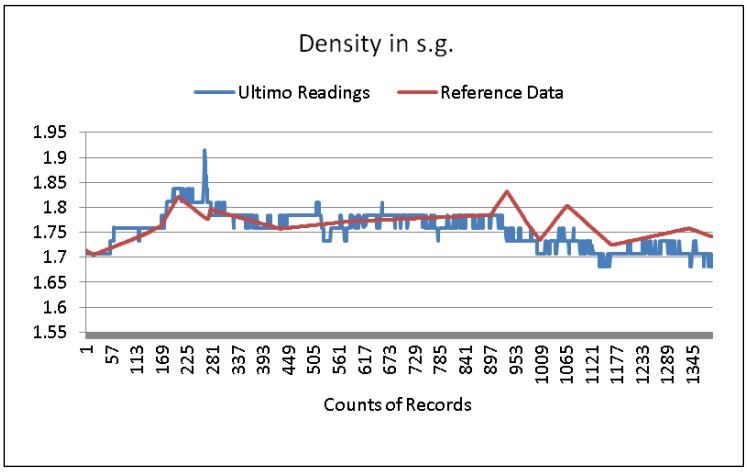
This table shows the time stamped compiled data from the Ultimo Density Meter readings and reference data.

We suggest that you average the data every minute.

DATA ANALYSIS

An easy way to perform data analysis (for the post-calibration tuning) is based on viewing patterns of trends of data by visually investigating the plot of the above records as shown in the example below.

Since you'll be creating a graph of this data for trend analysis, be sure to collect enough points to generate a meaningful graph. In order to analyze the statistical sample with at least 95% confidence, it should be at least 100 records in the above table.



It is important to know or estimate the rate of change of density in the current installation.

If, for example, the density changes 1% per hour, there is no need to obtain readings every five minutes because the change is too small.

If density changes say around 30% every hour, you need to obtain readings more frequently to capture the trend.

Post calibration tuning can be performed in one of two ways.

First, if the difference between the instrument readings and reference data (measurement error) is very small.

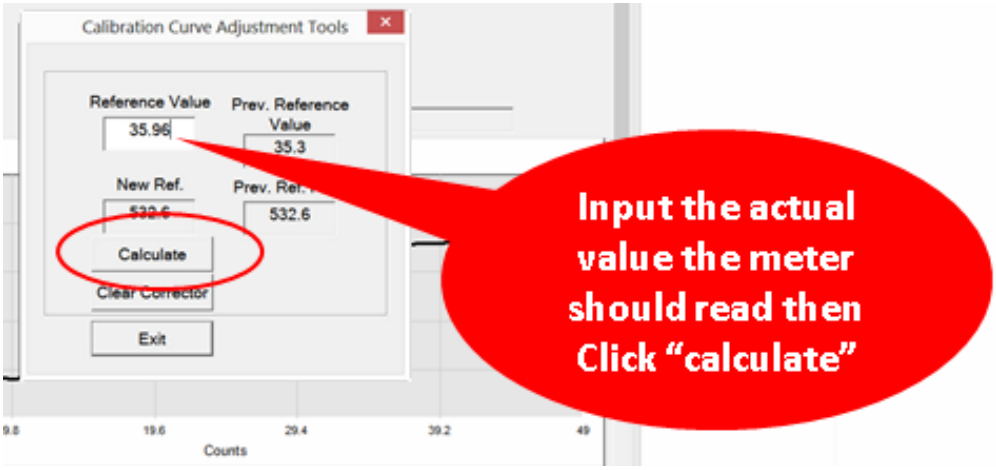
Second, if the discrepancy is not small, there is a full post calibration tuning procedure.

Tuning when the Measurement Error is small

Go to **Main Menu → Setup → Calibration Curve Correction**.

This correction makes an automatic adjustment of the calibration curve based on the difference between the value that the instrument is measuring and the reference value.

You simply insert the reference value. Notice on the photo of the correction screen below. The value 35.96 is the reference value. If, for instance the instrument is measuring 35.42, this very small difference of -0.54 will be analyzed by the instrument and it will act on its own and adjust.



Typical Post Calibration Tuning Problems

To make a correct adjustment of the Ultimo Density Meter's setup parameters, the user must understand what the calibration curve is and build a mapping between the observed trending patterns and the layout of the calibration curve generated as a result of running the 2-pt or the SC Calibration Procedure.

Calibration Curve of the Ultimo Density Meter is a mathematical function which output is the measured density and input is the monitored frequency. The input range is defined by the interval $[f_{\min}, f_{\max}]$ where $f_{\min}$ corresponds with the highest density ($\rho_{\max}$) of the measurement range and $f_{\max}$ corresponds with the lowest density ($\rho_{\min}$) of the measurement range. The calibration curve has the following basic view.

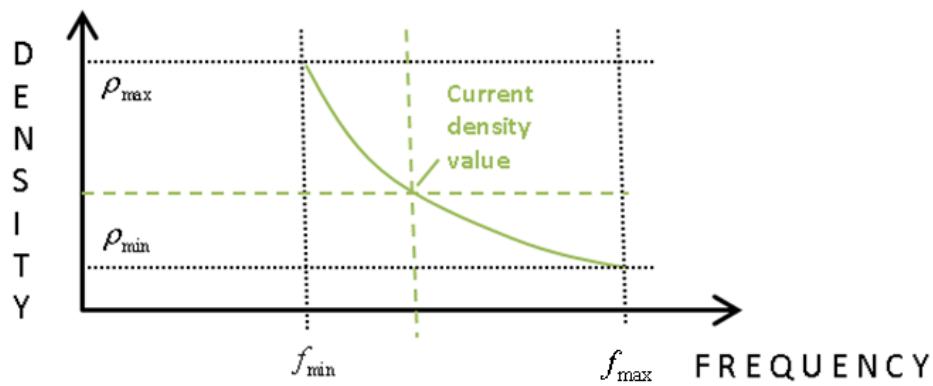


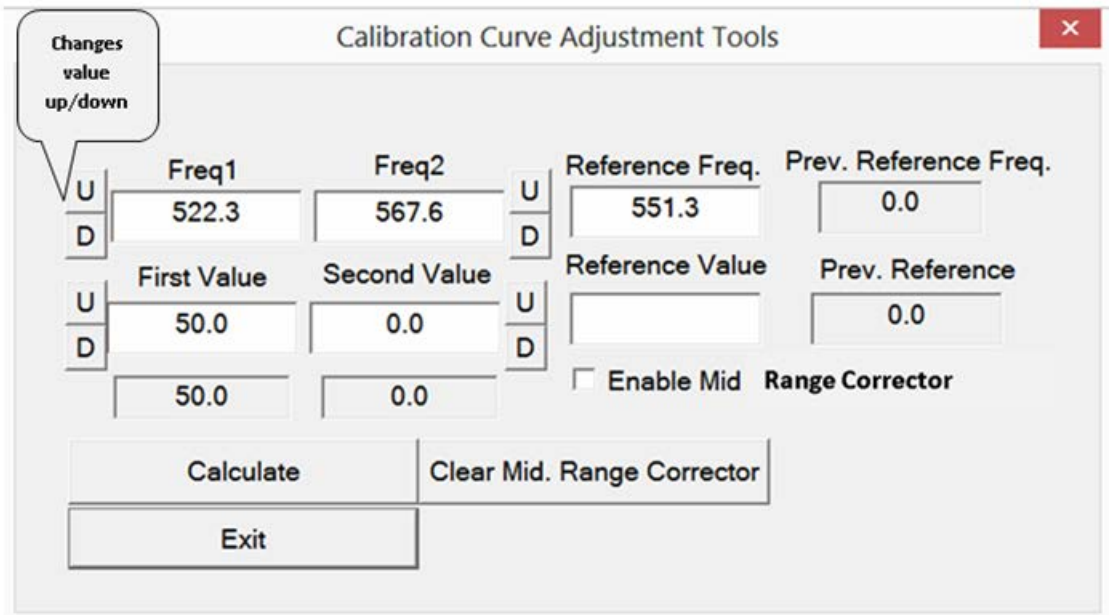
Figure 19. Typical Calibration Curve of the Ultimo Density Meter

Issues solved by post-calibration tuning

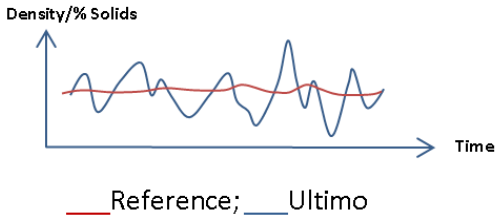
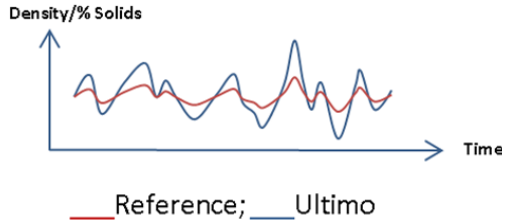
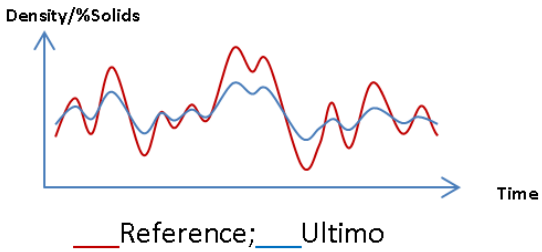
- Low Precision
- Narrow or wide input range
- Lack of sensitivity to low or high density values
- Density reading are too low or high
- Discrepancy between local display readings and converted 4-20 mA readings at the output of the DPM
- Discrepancy between converted 4-20 mA readings at the DPM and the converted 4-20 mA readings in the control room

How to Solve Typical Measurement Issues with Tuning

The calibration curve adjustment tool is located at **Main→Setup→ Calibration Curve CorrectIon2**. This tool's screen is shown below.

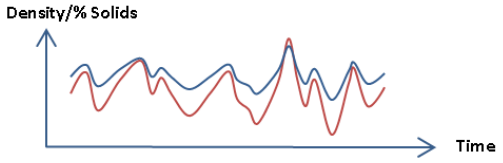


Some typical post-calibration tuning problems and their tuning solutions based on using the Calibration Curve Correction 2 and Advanced Setup Window are presented in the table below. On the Correction 2 screen, FREQ1 corresponds with $f_{\min}$, FREQ2 corresponds with $f_{\max}$ and Value1 corresponds with $\rho_{\max}$, Value2 corresponds with $\rho_{\min}$ of the calibration curve shown in the figure 19.

#	Problem Description	Solution
1	Low Precision  	SOLUTION Increase the size of the Moving Average window. Typical size: [20, 50] Location on the GUI : Advanced Setup Window: Ctrl+f1 (figure 16)
2	Narrow Input Range [f_{min}, f_{max}]  	SOLUTION 1 1. Reduce FREQ1 2. Increase FREQ2 3. NO CHANGES TO FIRST VALE & SECOND VALUE SOLUTION2 1. Increase SECOND VALUE 2. Reduce FIRST VALUE) 3. NO CHANGES TO FREQ1 & FREQ2
3	Wide Input Range [f_{min}, f_{max}]  	SOLUTION1 1. Increase FREQ1 2. Reduce FREQ2 3. NO CHANGES TO FIRST VALE & SECOND VALUE SOLUTION2 1. Reduce SECOND VALUE 2. Increase FIRST VALUE 3. NO CHANGES TO FREQ1 & FREQ2

4

Lack of Sensitivity to Low Density Values



___Reference; ___Ultimo

SOLUTION1

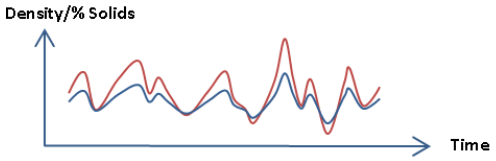
1. Reduce FREQ2
2. NO CHANGES TO FIRST VALE & SECOND VALUE

SOLUTION2

1. Reduce SECOND VALUE
2. NO CHANGES TO FREQ1 & FREQ2

5

Lack of Sensitivity to High Density Values



___Reference; ___Ultimo

SOLUTION1

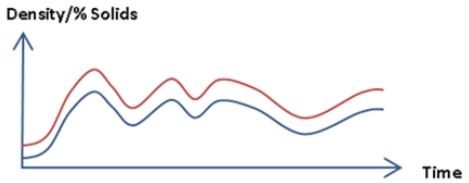
1. Increase FREQ1
2. NO CHANGES TO FIRST VALE & SECOND VALUE

SOLUTION2

1. Increase FIRST VALUE
2. NO CHANGES TO FREQ1 & FREQ2

6

Density Readings too low



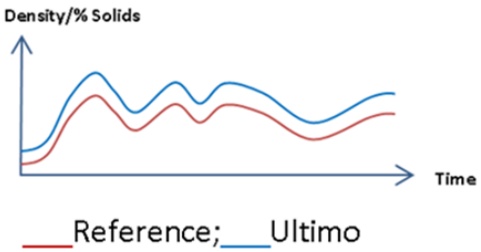
___Reference; ___Ultimo

SOLUTION

1. Increase FERQ1
2. Increase FREQ2
3. NO CHANGES TO FIRST VALE & SECOND VALUE

7

Density readings too high



SOLUTION

1. Reduce FERQ1
2. Reduce FREQ2

NO CHANGES TO FIRST VALE & SECOND VALUE

8

Discrepancy between the local display readings and the converted 4-20 mA readings at the output of the DPM

Adjust the code numbers for 4 mA and 20 mA values toward lower numbers to increase the values and toward higher numbers to decrease the values

Location on the GUI : Advanced Setup Window: Ctrl+f1

See Training Module #6, p. 9, right upper corner

9

Discrepancy between converted 4-20 mA readings at the output of the DPM =local display readings, and the

converted 4-20 mA readings in the econtrol room

Verify the conversion formula used by the DCS PLC

10

2pt Calibration Failure. Analysis of frequencies captured during the calibration points at the "Inverse Calibration Curve" case

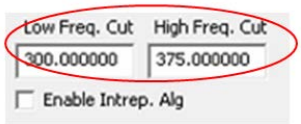
Open the ASW by clicking Ctrl+f1. Enable the "Intrep. Alg" to achieve the inversion of the calibration curve. Readings on the Main Window and on the instrument display will be generated in accordance with the invers calibration curve. Readings in the RESULT window of the RTW screen will be generated in accordance with the standard direct calibration curve

11

Disturbing spikes of frequencies of ambient vibrations appear within the Surveilance Range of the Density Meter

Observe the dynamics of the spectral diagram on the RTW (Ctrl+f2) against the reference density/%Solids values and confirm that the disturbing spikes are present.

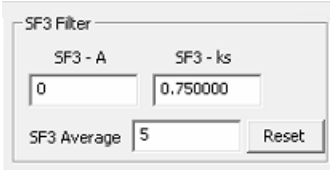
Open the ASW (Ctrl+f1) and insert the frequency range's beginning (Low Freq. Cut) and ending (High Freq. Cut) values that you want to block to prevent the frequency disturbance. The frequencies blocking text boxes are located at the bottom of the ASW GUI screen.



12

Readings are not stable and monitored frequency values on the RTW sporadically shift from its trend an dthen quickly returned to the trend

1. Open the ASW and find the Spike Filter (SF3) at the top of the screen



2. Activate the SF by inserting a non-zero value (between 1 to 10; typically 2) in the SF3-A textbox
3. Insert a non-zero value (between 0.25 to 1.5; typically 0.75) in the SF3-k textbox
4. Click Update Parameters to write the settings in the DPM

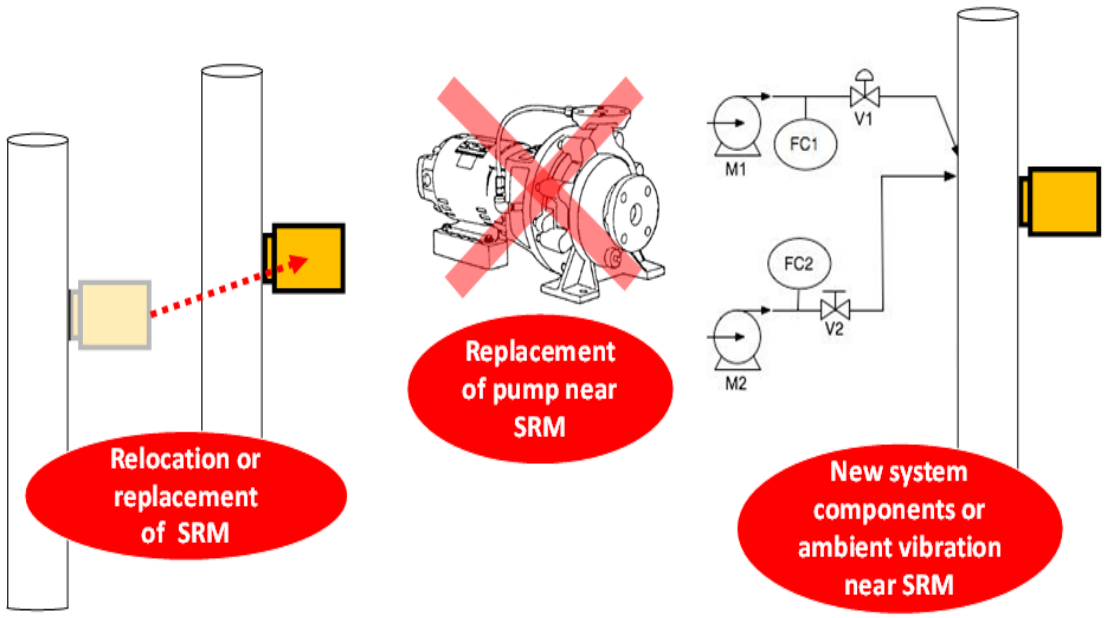
To disable the SF, insert 0 into the SF3-A textbox

Use this tool only when you are absolutely confident that the random variations of the monitored frequency occur within the Surveillance Window

In those cases when the readings are accurate at the ends of the measurement range but not so accurate in the midrange, use the Mid. Range Corrector from the Calibration Curve Correction 2 as follows.

1. Check the **Enable Mid. Range Corrector** checkbox
2. Insert the desired value of the density or % Solids into the Reference Value field on the Corrector screen
3. Click on the **Calculate** button to implement the correction

Conditions Requiring System Re-calibration or Re-tuning



CHAPTER 8. MEASURING DENSITY

The ULTIMO DENSITY METER enables you to monitor the density in three different ways: The displayed values are shown in the units selected in Section 3 (figure 19) of the Setup Screen and are viewable on the Main Window (figure 14), the display window of the DPM and the plant DCS.

MEASUREMENT

Measurement expressed in the preferred units of measurement.

TREND

Trend shown by a graph scaled in counts along the x-axis and the % deviation from Target Density on the y-axis. One count is approximately equal to 12 s. The purpose of the Trend diagram is to demonstrate the current direction of change in the density of the pipe contents.

DEVIATION

Deviation shown by a graph scaled in counts along the x-axis and the units of density deviation from Target along the y-axis, all expressed in the chosen unit of measure

If you chose to monitor the Density, the readings on the Main Window will be shown in the density-chosen units of measurement.

If you chose to monitor the Density Trend, the readings on the Main Window will be shown as the % of relative change of density against the target density value.

If you chose to monitor the Density Deviation, the readings on the Main Window will be shown as the difference between the current density value and the target value expressed in the units of measurement chosen.

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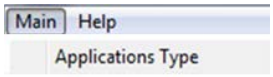
CHAPTER 9. MEASURING % SOLIDS

If for first time use, the GUI opens in the Density Measurement Mode, go back to the Main Menu



and select the %Solids Measurement option by clicking the Applications Type line.

The monitoring window below illustrates the % Solids display window and the % Solids time chart Window of the GUI.

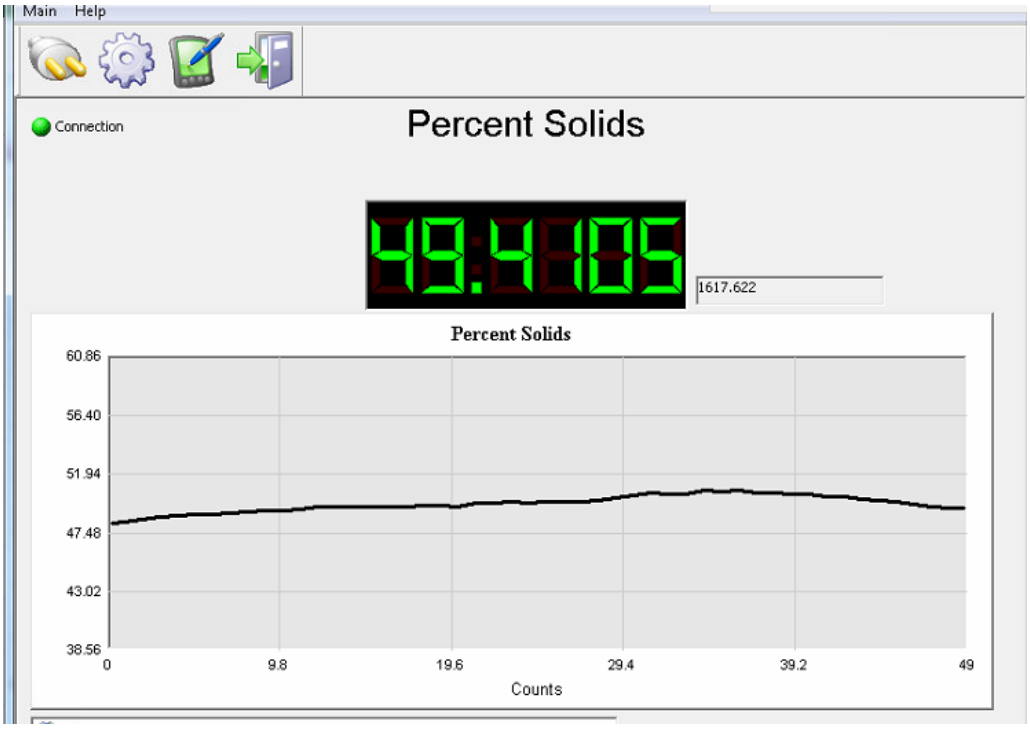


Figure 20. Monitoring %Solids on the Main Window GUI

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CHAPTER 10. OTHER INFORMATION

FINDING OPTIMAL ANGULAR POSITION OF THE SRM ON THE PIPE

Prior to performing the strike force adaptation, the installer should rotate the SRM around the pipe, for example, from its 90° (vertical) position to 45° position, and finally to its 0° (horizontal) position. In each set angular position of the SRM, the installer should evaluate the spectral diagram on the Real Time Window to find the best angular position for the SRM. The best position is characterized by the following specifics of the spectral diagram:

- Smallest number of harmonics which power spectral density (intensity) is greater than the average spectral density (significant harmonics)
- Largest frequency interval between the significant harmonics

USING THE 4-20 mA CURRENT LOOP

The Ultimo Density Meter automatically sets the parameters of the 4 – 20 mA current loop interface (analog interface) after the completion of the 2pt Calibration. The 4 mA electrical current corresponds with the lowest value of the calibrated measurement range. The 20 mA electrical current corresponds with the highest value of the calibrated measurement range. The connection of the wires from the user's end of the current loop is described in Chapter 3.

You can associate different values of density with the values that were set as a result of Calibration with 4 mA and/ or 20 mA values of the electrical current. In order to do so, you will have to go to the Main Window Menu ⇒ Setup ⇒ 4 – 20 mA Setup and follow the instructions from the 4 – 20 mA current loop setup wizard.

If the SC procedure was used, you should manually set the parameters of the 4-20 mA current loop interface as described in the above paragraph.

CREATING A LOG FILE

The Log File function, which stores measurement readings in the memory of the connected installation PC for further analysis is activated by the user.

To start a log file click Start/Stop Log  on the toolbar and set the destination for the Log File. The Log File is in EXCEL format as shown on the example below.

Date	Time	Density
10/17/2013	13:50:49	1099.486
10/17/2013	13:50:58	1099.547
10/17/2013	13:51:08	1099.631

Click Start/Stop Log again before opening the log file.

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CHAPTER 11. Troubleshooting and Diagnostic Procedures

READINGS

1. Instrument's readings in the Control Room are far beyond the measurement range. What do I have to do?

    a. After the DPM is turned ON, no LEDs flashing and the SRM is not striking
        - Check for the AC power availability
        - Check the DPM fuses located inside the DPM cabinet. Open the DPM top panel to access the fuses
        - Check the DPM DC power availability. The DC Power supply is located inside the DPM cabinet

    b. DPM display's LEDs sequence is out of order and/or displayed characters are corrupted or blank
        - Test DPM electronics and firmware: **DIAGNOSTIC PROCEDURE 3**

    c. DPM Display's LEDs sequence is in order and displayed readings are incorrect
        - Test SRM and solenoid drivers in the DPM : **DIAGNOSTIC PROCEDURES 2 and 3**

    d. DPM Display's LEDs sequence is in order and displayed readings are correct
        - Test Control Room Equipment and data cable: **DIAGNOSTIC PROCEDURE 4**
        - Verify settings of 4-20 mA analog interface if it is used for data delivery: **DIAGNOSTIC PROCEDURE 5**

    e. Striker does not move. LEDs sequence is OK
        - Verify mounting brackets' positioning on the pipe and SRM positioning on mounting brackets: Operator's Manual Ch. 2 "Installing the SRM"
        - Test SRM: **DIAGNOSTIC PROCEDURE 2**
        - Test SRM cable and solenoid drivers in the **DIAGNOSTIC PROCEDURES 2 and 3**

    f. Striker moves with interruptions and/or delays
        - Test SRM mechanics: **DIAGNOSTIC PROCEDURE 2**

    g. Striker cannot reach the pipe
        - Verify mounting brackets' positioning on the pipe and SRM positioning on mounting brackets: Operator's Manual Ch. 2 "Installing the SRM"
        - Test SRM: **DIAGNOSTIC PROCEDURE 3**

2. Instrument's readings in the Control Room are within the measurement range. Discrepancy between the instrument's readings and the reference values are at least 3 times greater than specified. What do I have to do?

a. Local display readings are the same as the control room readings
   - Check the setup parameters of the instrument
   - Verify that the configuration file ***DVM_Pipe.ini*** is not corrupted: The configuration file's template is located on your PC at ***C\Program Files (x86)\Ultimo\Setup***
   - Make sure that no new mechanical equipment was attached to the pipe. If there are new mechanical attachments, retune the instrument by following the Post-Calibration Tuning Procedure as described in the Training Module #6 published on http://www.ultimompd.com/#!installation-training/c1r3q
   - Check the correctness of the site preparation by executing the following steps:
     1. Open the Real Time Window by inserting Ctrl+f1 with FFT checkbox checked
     2. If multiple unstable harmonics are present on the spectral diagram, then check the rigidity of the pipe supports and clamps
     3. If multiple unstable harmonics are present on the spectral diagram and pipe supports and clamps are rigid, then check the distance between the pipe support and the nearest source of ambient vibrations
     4. If the distance between the pipe support and the nearest source of ambient vibrations is correct, then call Tech Support

b. Local display readings are correct. Control room readings are not correct.
   - Test the data cable between the DPM and the Control Room: **DIAGNOSTIC PROCEDURE 4**
   - Reload Firmware: Operator's Manual, Chapter 12, Appendix 4
   - Check the settings of the 4-20 mA analog interface if it is being used for the data delivery: **DIAGNOSTIC PROCEDURE 5**

3. Instrument's readings in the Control Room are within the measurement range. Discrepancy between the instrument's readings and the reference values less than 3 times of specified. What do I have to do?

Adjust the calibration curve by following the Post-Calibration Tuning Procedure as described in the video Training Module #6 published on http://www.ultimompd.com/#!installation-training/c1r3q

ADAPTATION

I ran ADAPTATION Procedure and it FAILED. What do I have to do?

Follow the steps below.

1) Verify that the installation site was prepared in accordance with the Ultimo requirements
2) Open the Configuration File ***DVM_Pipe.ini*** and verify that the ***snr***- value is not equal to the number 2
3) If snr = 2 then go to Step 6
4) Insert the new value for the snr equal to the old value minus 1. Then, save and close the configuration file
5) Keep repeating ADAPTATION and each time reduce the snr value by 1 until you get to the number 2
6) If the failure persists at the ***snr***=2, test the SRM: **DIAGNOSTIC PROCEDURE 2**

CALIBRATION

I ran the 2pt CALIBRATION Procedure and it says "Failure". What do I have to do?

Follow the steps below.

1) Verify that the calibration material samples values were inserted correctly
2) Verify that the site was prepared in accordance with the Ultimo requirements
3) Verify that the Configuration File is not corrupted by comparing its structure with the template configuration file located on your PC at ***C\Program Files (x86)\Ultimo\Setup***
4) If items 1) and 2) are OK , do the following
   a. Open the configuration file ***DVM_Pipe.ini***
   b. At the end of the file change the value of the ***freq_test_mode***- variable to 1 and save and close the configuration file
   c. Close the Monitoring Program and open it again
   d. Follow the GUI wizard to obtain the ***Freq_Range.xls*** file located in the same folder as the Monitoring Program
   e. Open the configuration file ***DVM_Pipe.ini***
   f. Change the value of the ***freq_test_mode*** - variable to 0 and save and close the configuration file
   g. Send the ***Freq_Range.xls*** file to Ultimo tech support for further analysis

FIRMWARE & SOFTWARE

1. When I try to open the Bootloader software, I receive error messages. What do I have to do?

- Verify that the USB port number of the installation laptop matches the port number shown on the DPM
- Verify that the RS 232 serial cable is used for uploading the firmware to the DPM microprocessor
- Verify that the installation laptop has the RS 232 serial driver correctly installed

2. Bootloader program cannot open the Com Port

- Verify that the USB port number of the installation laptop matches the port number shown on the DPM and is not greater than Port #8

3. An attempt to open the Bootloader program produces "Create File" and "Communications" errors

Verify that the DPM is set to work in the Bootloader Mode. The DPM Display Bootloader Mode feature is described in Operator's Manual, Ch. 11, Appendix 3

4. After the firmware upgrade was completed, the instrument stopped working properly

- You uploaded corrupted firmware. Upload the firmware again using the firmware stored on your ***Program Files (x86) folder***. If no improvement, call Tech Support
- If setup commands form the Advanced Setup Window is not accepted by the firmware, then the new firmware does not correspond with the configuration file. Call Tech Support
- Monitoring software does not match the uploaded version of the firmware: use **DIAGNOSTIC PROCEDURE 7** to verify. If true, then call Tech Support

5. After installing new software, the instrument stopped working properly

- You installed corrupted software. Reinstall the software using the software stored on your ***Program Files (x86) folder***. If no improvement, call Tech Support
- New software does not correspond with the configuration file and/or the firmware. Use **DIAGNOSTIC PROCEDURE 6** to verify. If true, then call Tech Support

6. PC Monitoring Program does not start or gets frozen during the instrument setup operation

- Reopen the Monitoring Program. If it does not help, reboot the laptop
- If problem persists,
    1) Reboot your laptop
    2) If reboot does not help, then your firmware is corrupted- reload

COMMUNICATIONS & DATA

7. I noticed non-stop repetitions of the "Communication Failure" message on the Main Window. What does it mean and what do I do?

1) Check the serial cable: **DIAGNOSTIC PROCEDURE 4**
    - To prove that the USB port to which the serial cable is connected is recognized, you should open the Device Manager on the installation laptop and verify that the port number is shown under the LPT Port section and the port number is not highlighted yellow:
    - Reinstall the serial cable driver
    - Replace the serial cable
    - Replace the laptop
    - If the problem persists, call Tech Support

2) Verify that the DPM recognizes the serial cable: **DIAGNOSTIC PROCEDURE 4**
    - To prove that the DPM does not recognize the serial cable when the laptop recognizes it, you should click on the  button and confirm that the port number is shown on the DPM Port Setup screen
    - Verify that the USB port number of the installation laptop matches the port number on the DPM
    - Reboot the installation laptop
    - Turn OFF and then Turn ON the DPM
    - Replace the laptop
    - If problem persists, call your service provider

8. Corrupted or slow changing GUI graphics

Amount of RAM in the installation laptop is less than 4 GB. Use another laptop.

9. Upon opening, the Monitoring Program is trying to establish communication between the PC and the DPM. After a minute of doing so, the "Communication error" message appears on the laptop monitor

Incorrectly set serial communication mode (RS 232 or RS 485) on the DPM

10. Failure to deliver data via the Modbus RTU protocol

Incorrectly set Modbus mode of communication. To reset, follow instructions in Chapter 15, Appendix 5.

11. Instrument's readings in the Control Room are far beyond the measurement range when 4-20 mA cable is used for data delivery

Implement the following steps:

1) Go to Main Menu → Setup → 4-20 mA Setup
2) Verify that the lowest value in the measurement range is associated with the 4 mA output electrical current value (analog output value). If there is no association, correctly set up the DPM analog output: **DIAGNOSTIC PROCEDURE 5**
3) Verify that the highest value in the measurement range is associated with the 20 mA output electrical current value. If there is no association, correctly set up the DPM analog output: **DIAGNOSTIC PROCEDURE 5**
4) Confirm that the DPM analog output value corresponds with the DPM display readings
5) Confirm that the problem disappears
6) If the problem persists, disconnect the analog line between the DPM and the Control Room and measure the DPM analog output value. Verify that the same value of the electrical current is measured at the terminals of the Control Room PLC
7) If there is no match between the DPM analog output value and the Control Room's value, then a) test the analog cable integrity; b) test the Control Room PLC

DIAGNOSTC PROCEDURES

UNIT OVERALL HEALTH

Test LEDs Sequence

LEDs Sequence; Operation: Measurement:

LED1 fleshes constantly during the cycle → LED2 blinking → LED3 blinking

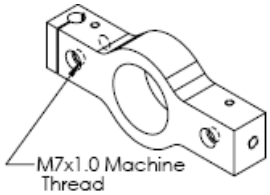
LEDs Sequence; Operation: Firmware Upgrade – Bootloader Mode:

LED1 fleshes constantly during the cycle → LED2 blinking → LED3 blinking → LED4 blinking

a. LED Sequence OK & Display is readable ⇒ **Diagnostic Procedure 2. SRM**
b. LED Sequence OK and/or Display is not readable ⇒ **Diagnostic Procedure 3. DPM**

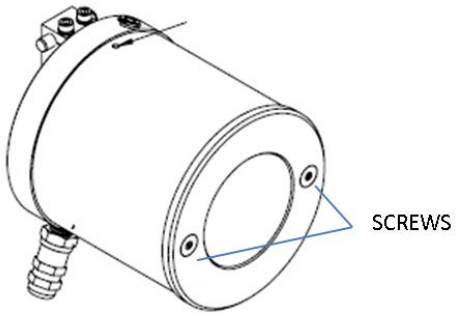
SRM

1. Having the SRM mounted on the pipe, turn ON the DPM
2. Make a visual of the SRM and confirm that the SRM is mounted on the pipe in accordance with the Installation & Operator's Manual requirements
3. Step 2 = TRUE ⇒ Step 4, otherwise ⇒ Step 16
4. Make a visual of the SRM and confirm that the striker executes the striking cycle without interruptions or delays
5. Step 4 = TRUE ⇒ Step 6, otherwise ⇒ Step 16
6. Connect a laptop to the DPM and open the monitoring program
7. Insert Ctrl+F1 to open the Advanced Setup Window (ASW)
8. Set the Striking Force to 1500
9. Insert Ctrl+F2 to open the Real Time Window (RTW) and check the FFT checkbox
10. Evaluate the overall intensity of the signal
11. Set the Striking Force to 10,000 and evaluate the overall intensity of the signal
12. Set the Striking Force to 15,000 and evaluate the overall intensity of the signal
13. Set the Striking Force to 20,000 and evaluate the overall intensity of the signal
14. Confirm that the overall intensity of the signal increased in accordance with the increase of the Striking Force
15. Step 14 = TRUE ⇒ Test DPM & Cables
16. Turn OFF the DPM
17. Take the SRM off the pipe
18. Hold the SRM with one hand by the shown below Mounting Bracket

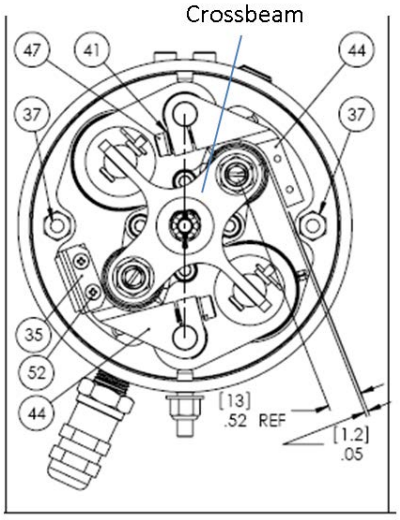


and pull the SRM housing back and forth along the direction of striking.

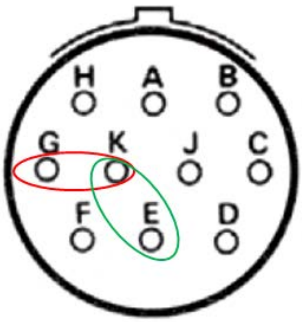
19. Make sure that the housing moves freely, and once released, returns back to its initial position without hesitations or delays
20. Step 19 = TRUE ⇒ Step 21, otherwise ⇒ Fix SRM
21. Unscrew 2 screws on the top plate of the SRM housing as shown in the sketch below



22. Locate the Striker Assembly as shown in the sketch below. Push on the Striker Assembly's crossbeam in the direction of the strikes. Then, allow the crossbeam to return back to its initial position without releasing the crossbeam; your fingers on the crossbeam should allow feeling the striker mechanism movements



23. Confirm that the striking mechanism was moving freely without hesitations and delays
24. Step 23 = TRUE ⇒ Step 25, otherwise ⇒ Fix SRM
25. With the DPM unpowered, disconnect the cable that connects the SRM to the DPM
26. Measure the resistance between pins K and G and pins K and E of the SRM cable connector as shown in the sketch below. The resistance should be between 5 to 10 Ohms.



27. Step 26 = TRUE ⇒ Test DPM & Cables, otherwise ⇒ Fix SRM

DPM

Test DPM & Cables

LED Sequence OK & Display is not readable

1. Turn OFF the DPM
2. Turn ON the DPM
3. No Difference? ⇒ Reload FW
4. No Difference? ⇒ Replace "Display" PCB of the DPM

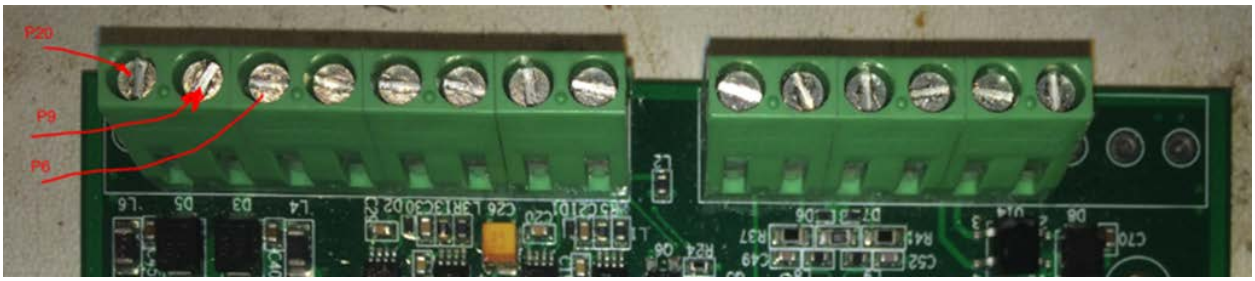
LED Sequence is not OK

1. Turn OFF the DPM
2. Turn ON the DPM
3. No Difference? ⇒ Reload FW
4. No Difference? ⇒ Replace "Processor" PCB of the DPM

LED Sequence is OK & SRM Mechanics is OK

1. With the power OFF, unscrew terminals p6 and p9 as indicated in the photo below and free the corresponding wires
2. Turn the power ON and connect the SRM to the DPM using the SRM cable
3. Briefly touch the p6-connected wire to the electrical ground point and register any movement of the striking mechanism.
4. Striker mechanism moves = TRUE ⇒ the first solenoid and the related wiring of the SRM cable are intact ⇒ otherwise ⇒ Step 7
5. Briefly touch the p9-connected wire to the electrical ground point and register any movement of the striking mechanism.
6. Striker mechanism moves = TRUE ⇒ the second solenoid and the related wiring of the SRM cable are intact ⇒ otherwise ⇒ Step 7

7. Return the wires to their original locations at p6 and p9.
8. Measure the voltage between the P6 and the electrical ground point and between the P9 and the electrical ground point. The expected voltage should be close to 28V. Continue the voltage monitoring for at least 60 seconds, and observe if voltage is staying at a steady level or has short regular variations.



9. Voltage is close to 28 V and the variations are observed = TRUE ⇒ Call Tech Support, otherwise ⇒ "Fix DPM/Replace Cable"

SERIAL COMMUNCATION/DATA INTERFACE

1. Verify that the DPM is set to transfer data in the desired communication mode (RS 232 or RS 485). To do so refer Chapter 14, Appendix 4
2. Open the Device Manager on the installation laptop
3. Connect the serial cable to the DPM and to the laptop
4. Verify that the Device Manager recognizes the cable
5. The cable is not recognized or the device manager indicates the serial cable driver issue ⇒ re-install the driver software
6. The driver software is OK but the communication is still cannot be established ⇒ reboot the laptop
7. Still no communication ⇒ replace the cable with another one of the same kind
8. Still no communication ⇒ try using another laptop
9. Still no communication ⇒ call Tech Support

ANALOG INTERFACE

1. Test the electrical integrity of the cable by verifying that each conductor of the cable is intact. Use an electrical multimeter for this purpose
2. The cable is intact but the readings of the electrical current at between appropriate wires of the cable are not correct ⇒ test the DPM 4-20 mA settings and the circuit by following the steps:
    a. Go to Main → Setup → 4-20 mA Setup
    b. On the 4-20 mA Setup pop-up screen, verify that the smallest value of the measurement range corresponds with the 4 mA setting for the analog output and the largest value of the measurement range corresponds with the 20 mA setting for the analog output

SITE PREPARATION

Strictly follow the requirements of the site preparation described in the training video Module #3 published on http://www.ultimompd.com/#!copy-of-site-preparation/c1v6h

SOFTWARE & FIRMWARE

Software

1. Verify that the Monitoring Program was registered by confirming the folder ***DVM Setup*** was created at ***C:\Program Files (x86)\Ultimo***
2. Not registered ⇒ ***Run Setup.msi*** from any location on the drive C or a removable storage
3. Verify that the currently used version of the Monitoring Program matches the version of the DPM Firmware
4. If you still have difficulty running the Monitoring Software which includes inability to open the program, viewing the GUI, set values on the Advanced Setup Window and opening the Real Time window, obtain a new copy of the Monitoring Program and try it again
5. Problem Persists ⇒ Call Tech Support

Firmware and Configuration File

1. Use the table below to verify that the DPM Firmware version matches the Monitoring Program version

DPM Firmware	Monitoring Program
MPD4_vX.Y.Z -2b.bin	*DVM_Monitor vX.Y.exe*
1.9.9	22.1
1.9.11	22.8
1.9.14	22.92
1.9.15	22.92
1.9.16	22.92

2. Verify that the structure of the configuration file ***DVM_Pipe.ini*** in your working folder matches the structure of the configuration file from the Ultimo-supplied installation package of your currently used software and firmware
3. Earlier identified firmware problem persists ⇒ reload the firmware by following instructions from the Installation & Operator's Manual , Chapter 13, Appendix 3

Chapter 12 - APPENDIX 1. APPLICATION GUIDE

Material measured

- Slurries, Liquids, Loose Solids
- Types of Measurements: Density, %Solids
- Process Temperature: Up to 250° C
- Particle Size – no practical limits

Process Conditions

- Process Pressure – no practical limits
- Flow Rate – no practical limits
- Ambient Temperature: -40° C to +60° C

Process Pipe Limitations

For minimum or maximum spacing between supports for mounting the SRM, see table below

- Pipe Wall Material: metal, plastic, fiberglass
- Liners – any

Minimum & Maximum Spacing between Supports*

	Standard Steel Pipe			Standard Plastic Pipe		
Size, in	Lmin, in.	**Lopt, in.**	Lmax, in.	Lmin, in.	**Lopt, in.**	Lmax, in.
3	27	**36**	46	14	**19**	24
4	30	**41**	52	15	**21**	27
5	33	**45**	57	17	**23**	29
6	36	**49**	62	18	**25**	31
8	41	**56**	70	20	**28**	35
10	45	**62**	78	22	**31**	39
12	49	**67**	85	24	**33**	42
14	51	**70**	89	25	**35**	44
16	55	**75**	95	27	**37**	47
18	58	**79**	101	29	**39**	49
20	61	**84**	106	30	**41**	52
22	64	**88**	111	31	**43**	54
24	67	**91**	116	33	**45**	57
26	61	**83**	105	27	**37**	47
28	64	**88**	112	29	**40**	51
30	66	**90**	114	30	**41**	52
32	69	**94**	119	31	**43**	54
34	70	**95**	121	32	**43**	55
36	72	**99**	125	33	**45**	57

Ideal mounting location is centered between the supports. The above table is for typical process flow applications and should be considered a guide for installation requirements. The suggested values of spacing between supports and distance to the major source of ambient vibrations **may require changes** based on the specifics of certain measurement applications. Please contact Tech Support to ensure a successful installation under those circumstances. If the normal operating range is >1,750 g/L mount the SRM at the Maximum distance between the supports.

For pipe sizes smaller than 10 inches the pipe support (clamp) closest to the SRM should be 100 inches away from the nearest source of ambient vibrations such as a pump, motor, valve or sharp changes in the pipe layout such as an elbow. For pipe sizes equal to or greater than 10 inches the distance between this pipe support and the source of ambient vibration must be at least 10 times the pipe OD.

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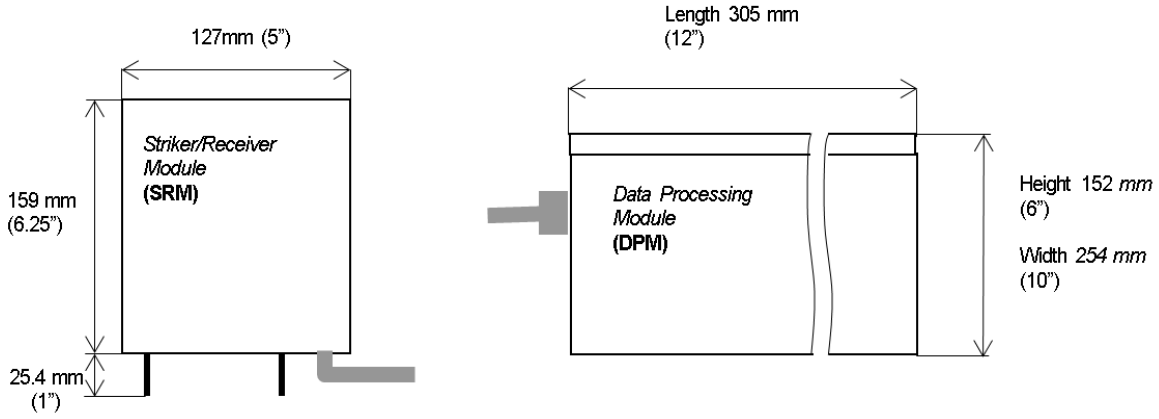
CHAPTER 13 - APPENDIX 2. DIMENSIONS



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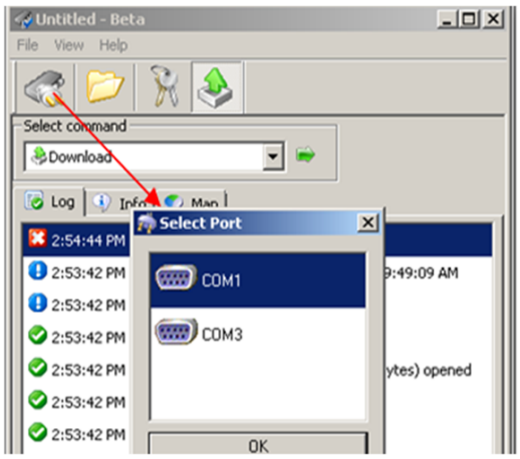
CHAPTER 14 - APPENDIX 3. BOOT LOADER MODE

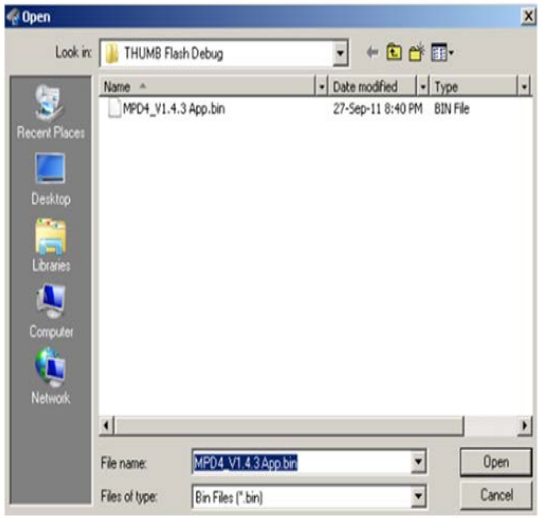
To access the Boot Loader Mode of operation use the Ultimo Density Meter Display Menu Interface, requires executing the following steps?

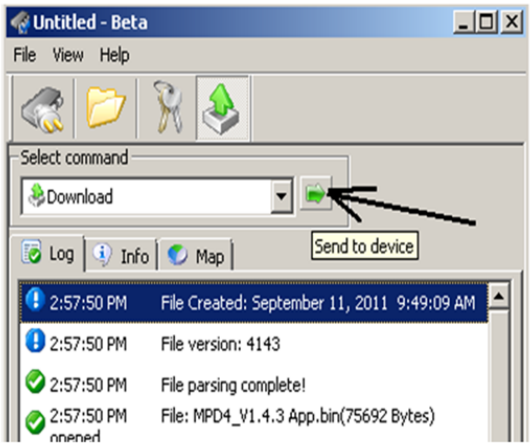
1. Connect RS232 to USB cable between the RS232-labled connector on the DPM front panel and PC. The RS232 cable interface should be used for any operation where the Boot Loader is involved.
2. Switch the DPM power to "OFF".
3. Press and hold the backlight button.
4. With the backlight button still depressed, turn the DPM power "ON".
5. Release the backlight button 3 seconds after turning the power "ON".
6. "Boot Loader Mode" is displayed on the LCD screen of the Ultimo Density Meter display.
7. Run the **Boot Loader** application located in the Ultimo Density Meter Setup Folder of the Setup & Monitoring PC. A corresponding sequence of the Boot Loader utility screens are shown in below



Make sure that the "COM port Opened" message is received confirming the correct port selection.

If a highlighted COM port number appears on the screen or the message "COM port Opened" is not shown, then open the Device Manager on the PC and make sure that the COM port number there matches the COM port number on the screen of the Boot Loader application.





To download, click Send to Device button

If after clicking "Send to device" button, the progress bar movement does not appear at the bottom of the Boot Loader window; then refer to the Maintenance and Troubleshooting Section of this Manual.

CHAPTER 15 - APPENDIX 4. DISPLAY MENU INTERFACE

The Ultimo Density Meter interface menu allows you to switch the communication interface between RS 232 and RS 485 and restore the default settings of the device. In order to enter into the Ultimo Density Meter Display Menu take the following steps:

1. Switch the DPM power to "OFF".

2. Press the backlight button and hold until the message "Release Button" appears on the display.

    a. Release the backlight button.
    b. The following menu appears on the display with a currently active item blinking.

2. Current RS 232 or RS 485 Baud Rate 19200 (or another selected data exchange rate)

    a. RS 232 Interface
    b. RS 485 interface
    c. Reset All

3. Quickly press and release the backlight button to reach the menu item that should be selected. After the selection is completed, the Ultimo Density Meter Display Menu disappears, leaving the Ultimo Density Meter in the Normal Work Mode.

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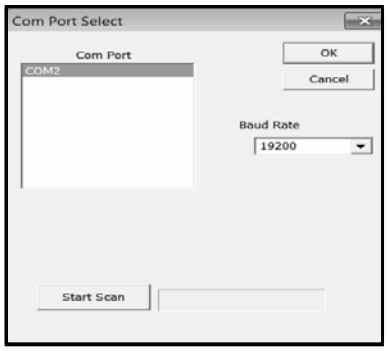
CHAPTER 16 - APPENDIX 5. PC APPLICATION COM PORT SETUP

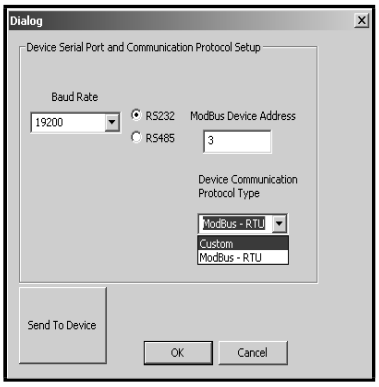
1. Click on the icon circled.

2. Select the Com Port that will be used for communicating with the Ultimo Density Meter and the working Baud Rate (19200 is the default) as shown below.
3. If the Com Port number is not known then use "Start Scan" button to automatically search for the appropriate Baud Rate.



ULTIMO DENSITY METER COM PORT PROTOCOL SETUP

1. Go to the Main Menu (figure 15) and select the "Device port Setup" option.
2. The ULTIMO DENSITY METER has two communication interfaces: RS232 and RS485



a. To activate the RS232 interface click the RS232 radio button. This interface is used for a regular data exchange, tuning the ULTIMO DENSITY METER, and when the device is working in the Boot Loader Mode.
b. To activate the RS485 interface click the RS485 radio button. This interface is used for the regular data exchange and the tuning process only.

3. The Ultimo Density Meter is equipped with two communication protocols: Ultimo proprietary protocol and Modbus RTU.

   a. The Modbus protocol is used for regular data exchange only.
   b. In order to select the communication protocol, click the Device Communication Protocol Type pull down menu on figure 22 above and select the appropriate communication protocol.
   c. Click "Send to Device" button to apply the device serial port settings.
   d. Turn ON and then turn OFF the Ultimo Density Meter and close and then open the PC monitoring application.