MicroML1/Micro100 LIQUID OPERATORS MANUAL

Flow Computer
Liquid Version

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Date: 9/28/2022

WARRANTY

Dynamic Flow Computers warrants to the owner of the Smart Flow Computer that the product delivered will be free from defects in material and workmanship for one (1) year following the date of purchase.
This warranty does not cover the product if it is damaged in the process of being installed or damaged by abuse, accident, misuse, neglect, alteration, repair, disaster, or improper testing.
If the product is found otherwise defective, Dynamic Flow Computers will replace or repair the product at no charge, provided that you deliver the product along with a return material authorization (RMA) number from Dynamic Flow Computers.
Dynamic Flow Computers will not assume any shipping charge or be responsible for product damage due to improper shipping.

THE ABOVE WARRANTY IS IN LIEU OF ANY OTHER WARRANTY EXPRESS IMPLIED OR STATUTORY. BUT NOT LIMITED TO ANY WARRANTY OF MERCHANTABILITY, FITNESS FOR PARTICULAR PURPOSE, OR ANY WARRANTY ARISING OUT OF ANY PROPOSAL, SPECIFICATION, OR SAMPLE.
LIMITATION OF LIABILITY:
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Date: 9/28/2022

CHAPTER 1: QUICK START

Introduction:

The micro MV Liquid Flow Computer was designed after careful consideration to our customers in all sectors of the oil and gas industry. It was built to address the different needs for refineries, chemical plants, gas processing plants, offshore platforms, pipeline and transmission, remote gas wells, and storage caverns. The focus has been to bring the different needs and requirements of these specialized industries into one hardware platform and therefore reducing the spare parts requirements, the training process, calibration, and overall cost of ownership. We believe the Micro MV Liquid Flow Computer has delivered and met the design intentions.

The Micro MV Liquid Flow Computer combines the following features:

- User Friendly
- Flexible
- Easy to understand and configure
- Rugged
- Economical to install and maintain
- Accurate

We hope that your experience with the Micro MV Liquid Flow Computer will be a simple pleasant experience, not intimidating in any way.

General Description: The Micro MV Liquid Flow Computer is one meter run bi-directional flow computer for the measurement of liquid products. Using orifice plate, Venturi, turbine/PD/ultrasonic mass meter, or wedge devices, it can meter a wide variety of products, such as crude, refined product, LPG/NGL products, products that use table 24C, ethylene, propylene, and water. Sixty days of previous daily data, two previous batch data, and 1440 previous hourly data are stored. The previous 100 audit trail reports and 100 alarm reports are stored.

One Rosemount multi-variable digital transducers can be connected to each Micro MV flow computer for temperature, pressure (up to 3626 PSIG), and DP (up to 830 inches H_2O). Other Rosemount multi variable transmitters can be connected to the Micro MV Liquid Flow Computer via RS485 serial interface. The 2nd RS485 is used as a slave or a master Modbus port for data acquisition and other serial functions.

The Micro MV Liquid Flow Computer has a host of inputs and outputs beyond the built in Rosemount Multi Variable transmitter.

Three high speed frequency inputs (Sine or Square wave), 70 mV peak to peak or sine wave 6 volts, or lighter on square wave

Four additional analog inputs, or two analog inputs and one three wire RTD inputs

One analog output expandable to four

One RS232 and two RS485 with Modbus protocol, and one additional serial printer output.

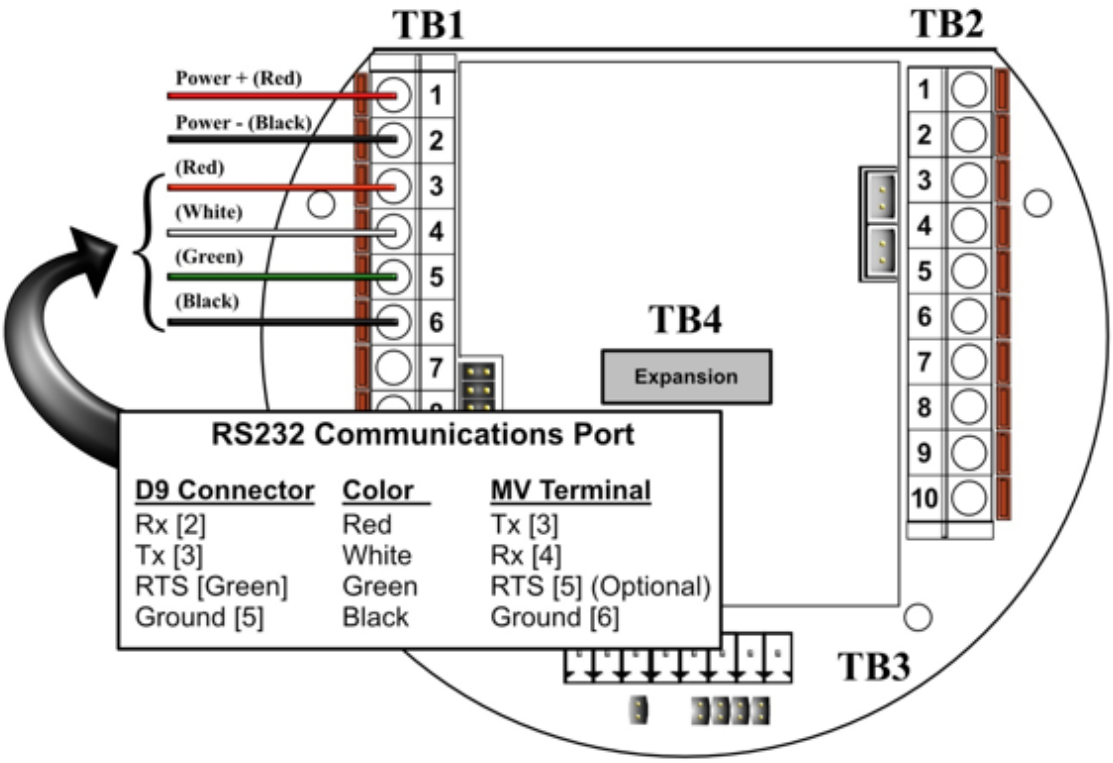
4 status inputs or digital outputs (user configurable). The fourth digital I/O is optional.

Additionally, each Micro MV Liquid Flow Computer can store up to 60 day's hours of hourly and 60 days of daily data. Optional expandable memory (Virtual Hard Drive) up to 128 Megs; combined with our customized data storage allows almost any type data logging task to become possible.

Quick Start Up

Version 2 - MicroMV Main/Memory Boards (Micro2009 and Later Model)

Main Board

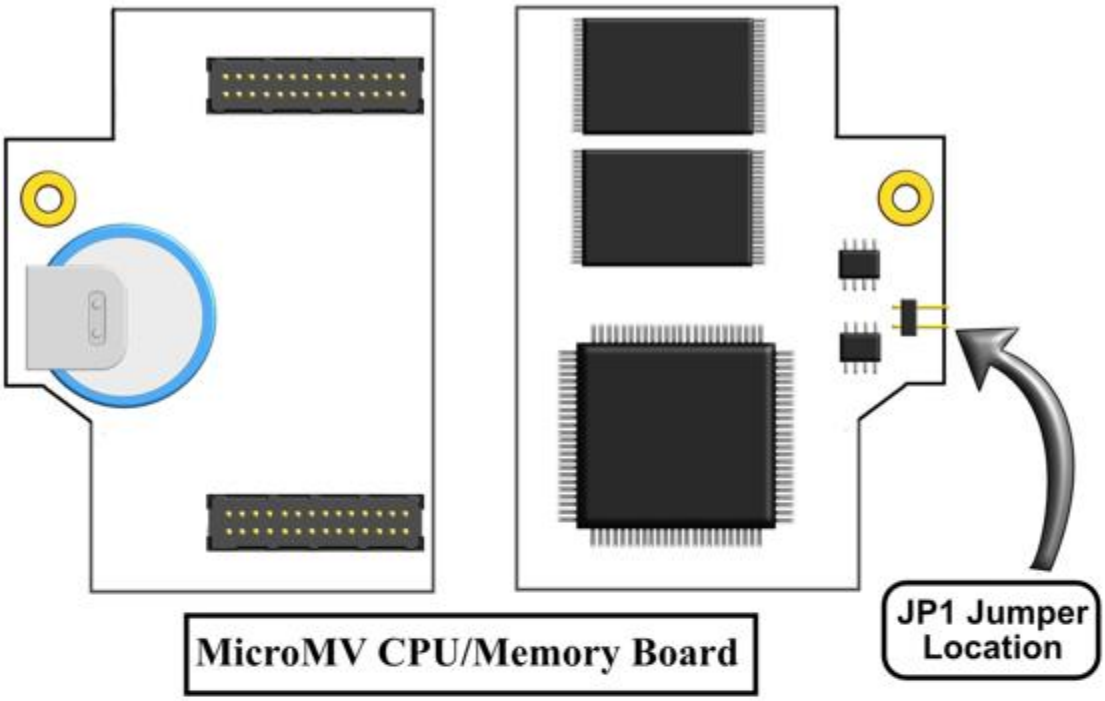


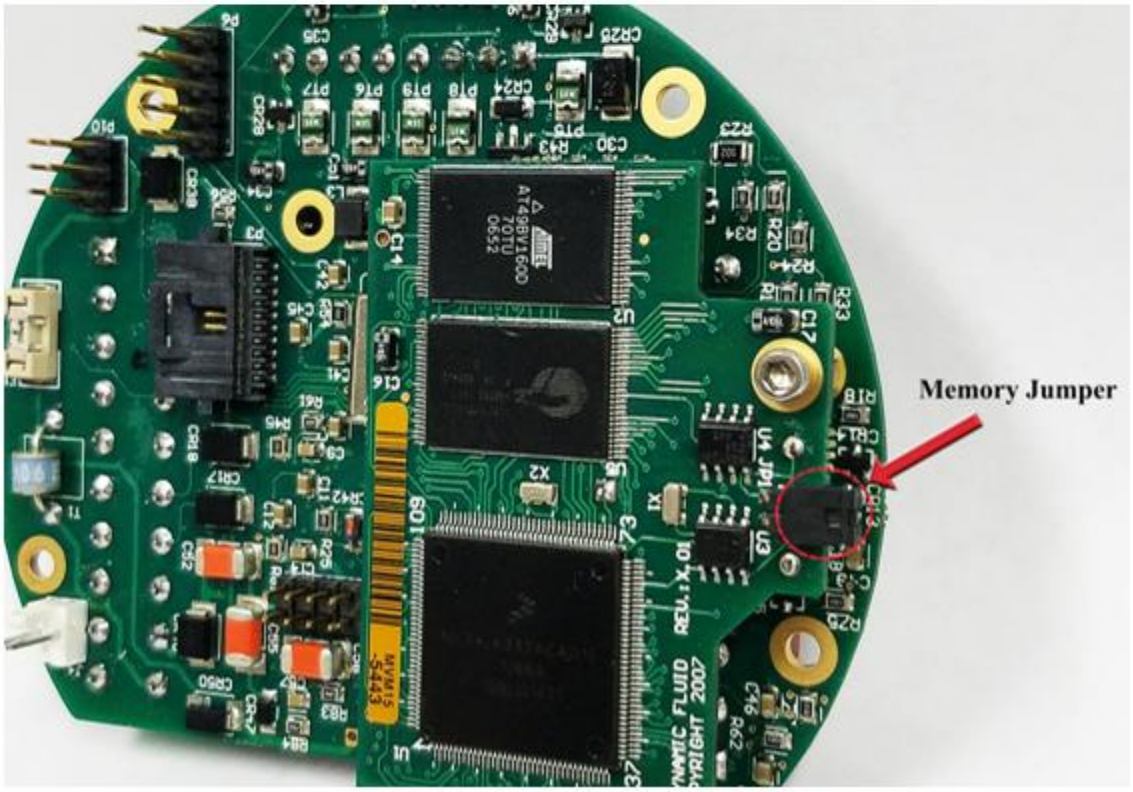
MV Step by Step Startup:

1. Connect power supply cable
2. Connect RS-232 Communications
3. Ensure jumper JP1 is installed on memory board
4. Energize power supply (24 Volts Recommended)
5. Verify display comes on
6. Run DFC Software
7. Configure the Micro MV device

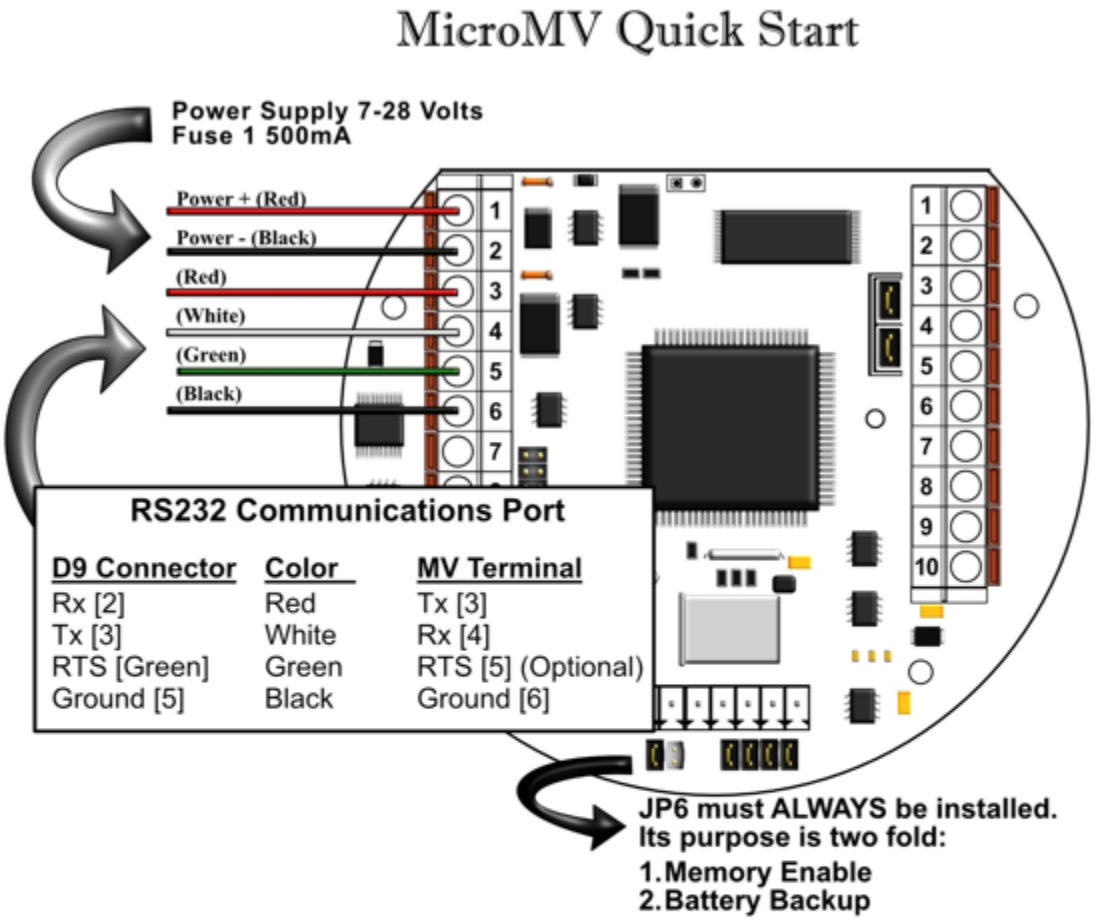
Version 2 - MicroMV Main/Memory Boards (Micro2009 and Later Model)

Memory/CPU Board





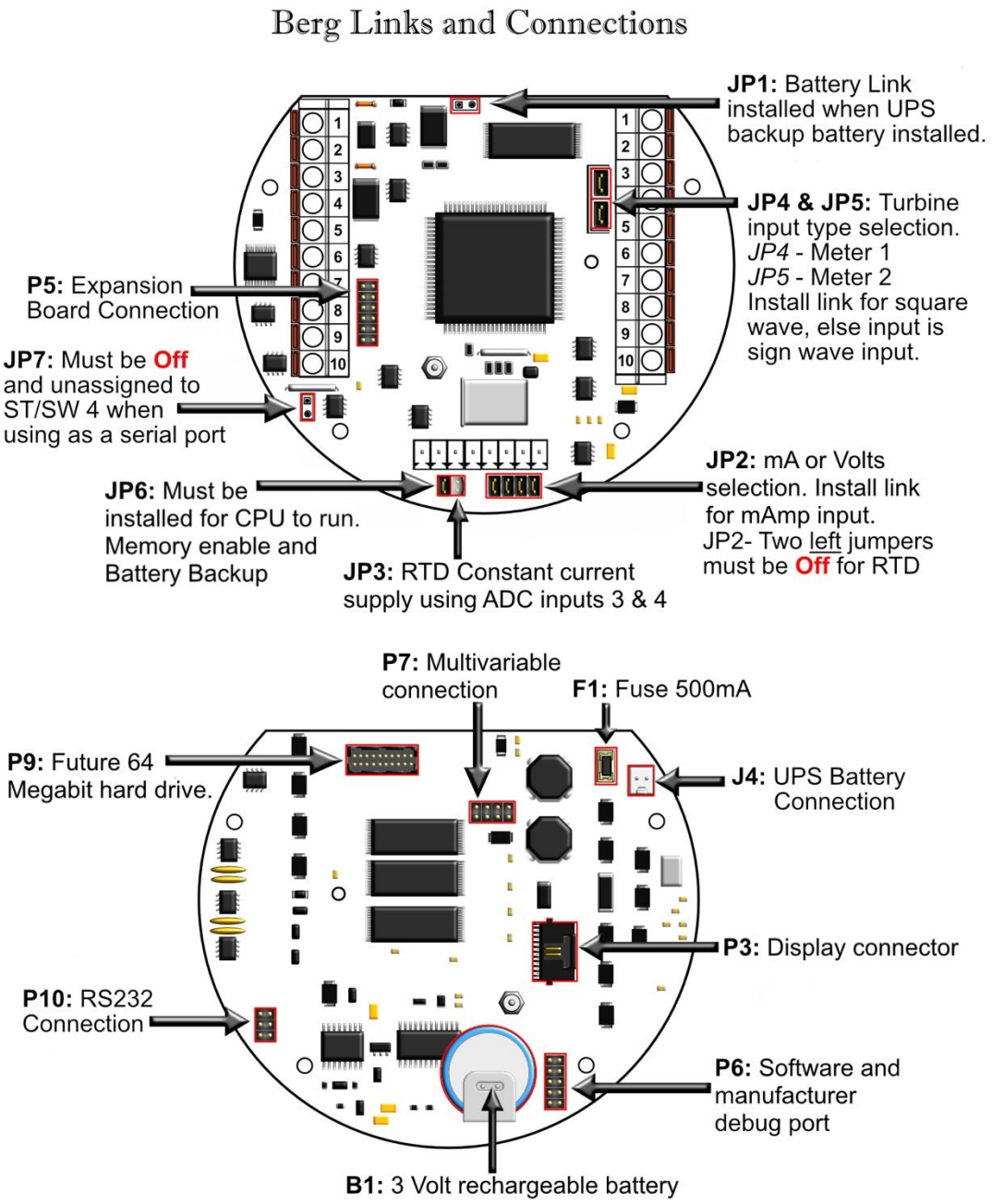
Version 1 - MicroMV Board (Older MicroMV Models)



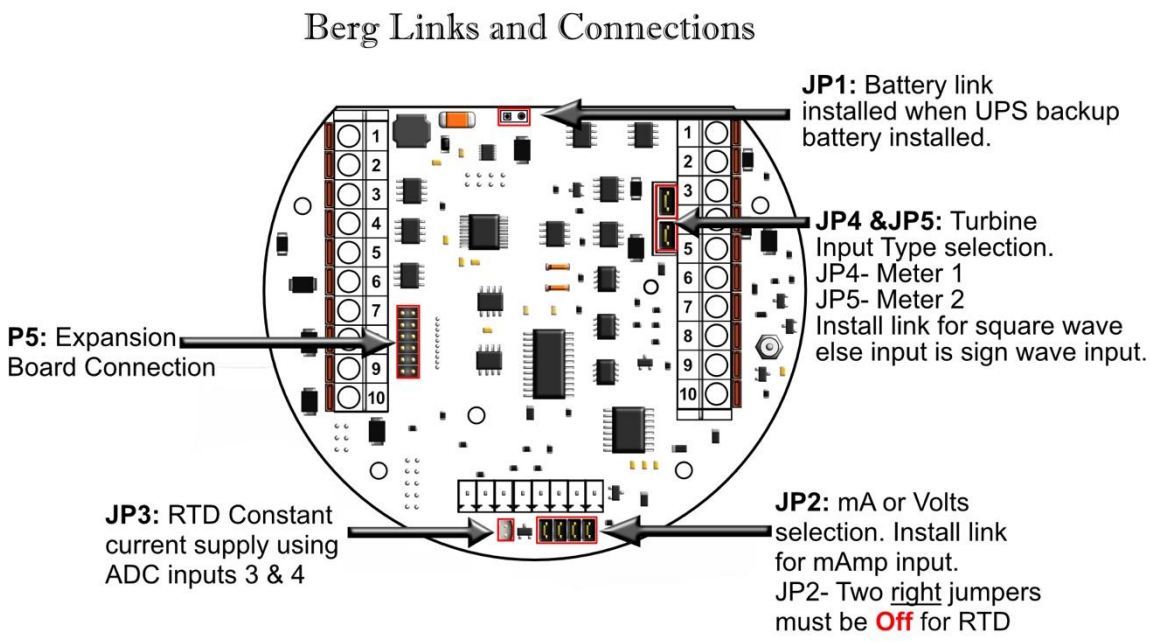
MV Step by Step Startup:

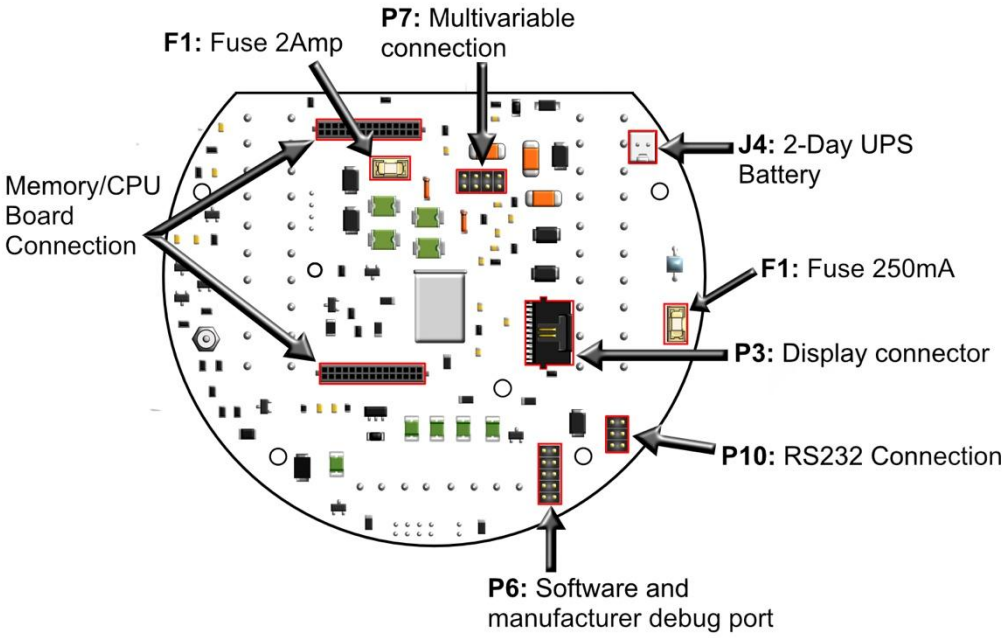
1. Connect power supply cable
2. Connect RS-232 Communications
3. Ensure jumper JP6 is installed
4. Energize voltage (24 Volts Recommended)
5. Verify DynacomTM Software
6. Run DynacomTM Software
7. Configure the Micro MV unit
8. Consult the Faultfinding if a problem is incurred

Version 1 - MicroMV Board (Older MicroMV Models)

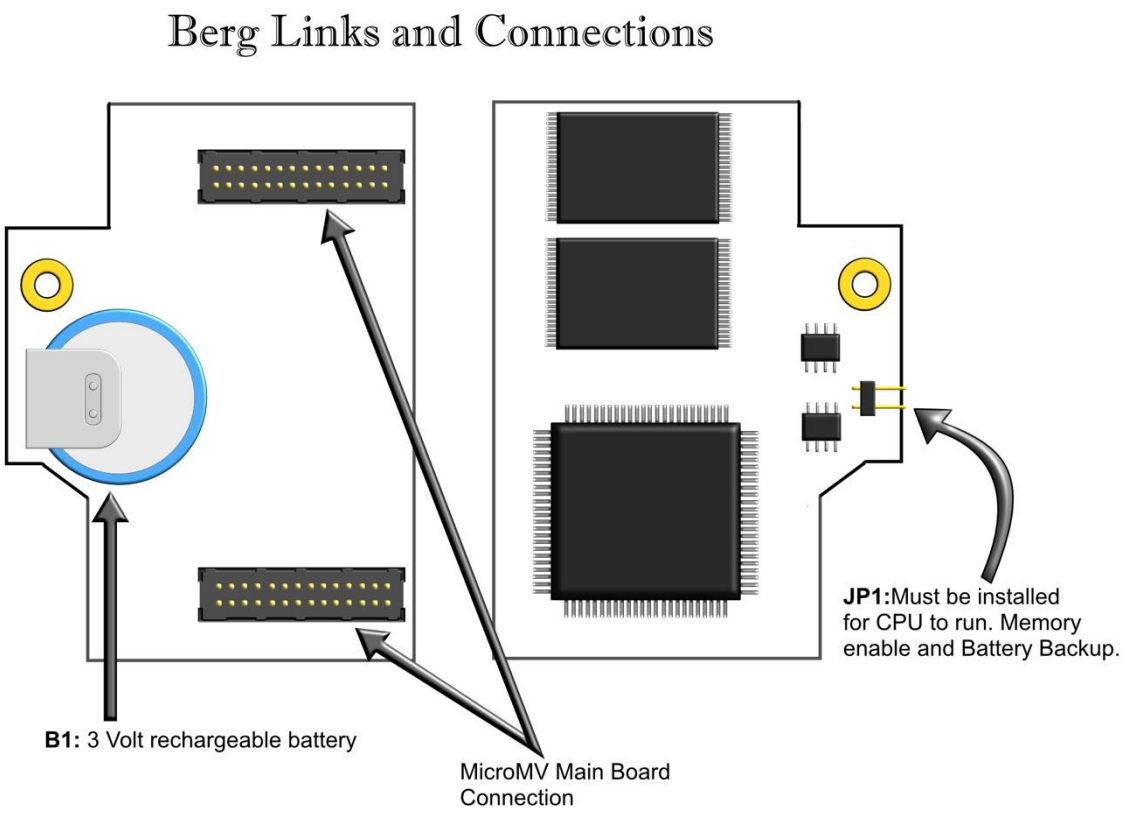


Version 2 - MicroMV Main Board (Micro2009 and Later Model)





Version 2 - MicroMV Memory/CPU Board



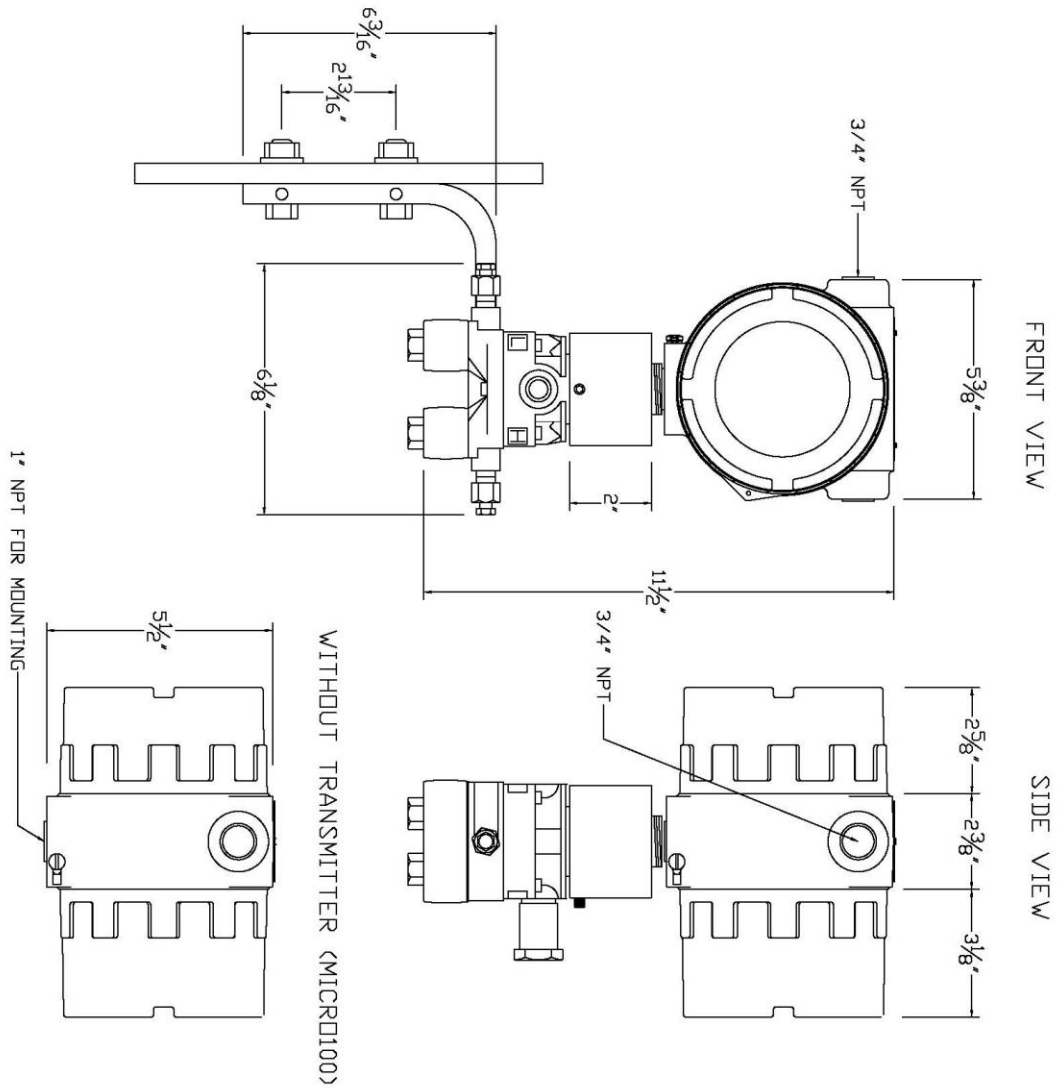
Technical Data

POWER	
VOLTAGE RANGE	7-28 VDC
POWER CONSUMPTION	0.5 WATT
OPERATING CONDITIONS	
TEMPERATURE	- 40 TO 185 °F
HUMIDITY	100%
HOUSING	NEMA 4X CLASS 1 DIV. 1
FEATURES	
DISPLAY	PLASMA 4 LINES 20 CHARACTERS BACKLIT DISPLAY WITH 4 INFRARED REFLECTIVE SENSORS
PROCESSOR	32-BIT MOTOROLA 68332 @ 16.7 MHZ
FLASH ROM	4 MBITS @ 70 NANO SECONDS
RAM	2 MBITS
FREQUENCY INPUT	3 CHANNELS CHANNELS 1 & 2 ARE SINE/SQUARE WAVE CAPABLE CHANNEL 3 IS SQUARE WAVE ONLY SQUARE WAVE RANGE 0 - 6000 HZ SINE WAVE RANGE 0 – 1200 HZ SIGNAL > 40 mV FOR SINE WAVE SIGNAL > 3 VOLTS and < 12 VOLTS FOR SQUARE WAVE (CHANNELS 1 & 2)
ANALOG INPUT	4 INPUTS STANDARD EXPANDABLE UP TO 9 ANALOG INPUTS OR 7 WITH ADDITIONAL 3 WIRE RTD.
MULTIVARIABLE	BUILT-IN ROSEMOUNT MULTIVARIABLE TRANSMITTER WITH DIRECT SPI DIGITAL CONNECTION. MAXIMUM UPDATE SPEED ONCE EVERY 109 MILLISECONDS.
ANALOG OUTPUT	1 16-BITS SINGLE ENDED EXPANDABLE TO 4
DIGITAL I/O	4 DIGITAL INPUTS OR OUTPUTS. DIGITAL OUTPUTS HAVE 0.25 AMPS RATING.
ALL INPUTS AND OUTPUTS ARE OPTICALLY ISOLATED	
SERIAL	2 RS485 @ 9600 BAUDS VARIABLE 1 RS232 @ 9600 BAUDS VARIABLE 1 PRINTER OUTPUT
COMMUNICATION PROTOCOL	MODBUS

Parts List

Spare Parts - Micro MV	
Part #	**Description**
MVC	Micro MV CPU Main Board Only
MVM	Micro MV CPU Mempry Board Only
MVD	Micro MV Display Board
MVI	Micro MV Analog In Board
MVO	Micro MV Analog Out Board
MVP	Micro MV Prover Board
MVR	Micro MV Rosemount Board
S6920	Explosion Proof Housing Unit for Micro MV Flow Computer
Adapter A	Adapter for 0205 Rosemount Transmitter (Accommodates Micro MV Flow Computer)
Bracket-MVD	Bracket for Micro MV Display
Bracket-MVC A	Bracket for Micro MV CPU (Without Analog)
Bracket-MVC B	Bracket for Micro MV CPU (With Analog)
MVD Cable	Micro MV Display Ribbon Cable
O-Ring A	O-Ring Gasket for Micro MV Housing
Fuse A	250 mA Fuse
Fuse B	500 mA Fuse
Fuse C	2 Amp Fuse
Battery A	Replacement Battery for Micro MV Flow Computer (Board Mounted)

Micro MV Flow Computer: Dimensions



Starting and Installing theSoftware:

First make sure your computer has the minimum requirements to install Dynamic's Dynacom software.

System Minimum Requirements

In order to install this software product the following requirements must be met:

- Windows Operating System (Win95, Win98, Win98SE, win2000, WinNT, WinXP, Vista, Windows 7, Windows 8, Windows 10)
- For Windows NT, 2000, XP or Vista: Administrator level access to create an ODBC system DNS.
- Minimum disk space available: 16 MB.
- 1 Serial Communication Port

If your computer meets these requirements, you can run the setup file downloaded from our website.

What is a configuration file?

The configuration file is an archive that contains the data used by the flow computer to determine calculation settings (Pipe ID, Flow Equation, Meter ID, etc.) and input/output assignments.

Downloading a configuration file to the flow computer.

- Open the configuration file using the **Configuration File | Open…** option on the main menu or pressing the open button  in the toolbar. Once the file is open the file name will appear on the upper left corner of the window, so you can verify that the desired file was open.

- Connect to the Flow Computer either by using the **Tools | Connect to Device** option on the main menu, the 

button on the vertical toolbar, or by pressing the **[F5]** key on the keyboard. Once you are connected the application it will show an ONLINE status on the lower right corner of the main window. Failure to communicate can occur because of a communication wiring problem, wrong PC port selection, communication parameter mismatch between PC and MicroMV (Modbus type, parity, baud rate, etc.) or lack of power to the MicroMV Flow Computer. To use **"Tools | Com Settings | Auto Detect Settings"** option, the user must insure that **only one MicroMV** computer is connected to the PC. More than one MicroMV Flow Computer in the loop will cause data collisions and unintelligible responses.

- Go to the configure device option either by using the **Tools | Meter Configuration** option, the 

button on the vertical toolbar, or by pressing the **[F10]** key on the keyboard.

- Because you are connected to a device, a window will appear asking you if you want to read the configuration from the connected meter, Press **NO** since what we want is to write the PC file to the flow computer.

- A configuration window will now appear showing you the information in the configuration file, you can check these values to make sure this is the file you want to send to the flow computer. Once you have checked that the configuration is correct, press the **[Download]** button. A blue bar indicating the progress of the download will appear at the bottom of the application window, after that the information in the configuration file will be in the flow computer.

Note: In case the flow computer is a liquid application, remember to End Batch after the configuration in downloaded for the changes to take effect.

What is an Image File?

An image file is an EPROM code for a certain purpose (liquid, gas, prover, etc.) **The image file is only done when an application upgrade is needed**.

When an image file is downloaded to the flow computer, all the information in the computer is lost (configuration and historical data), so make sure to retrieve all the important information before changing the image file.

How to download an Image File

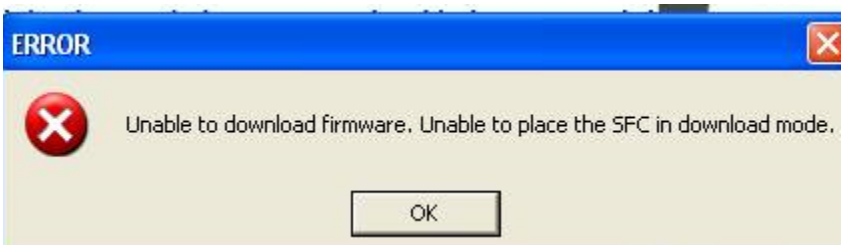
- Download an image file through **RS232 port** only.
- To Download an Image File to the Flow Computer select the **Tools | Download Program** option form the main menu or press the  button in the toolbar.
- A small dialog will appear asking for the file name of the image file (Image file have the extension .img). Type it in or use the **Browse** button to locate it.
- Once the file name is in place press **Download**.
- If a retry message of small dialog appears, try to use **"Tools | Com Settings | Auto Detect Settings"** option, the user must insure that **only one MicroMV** computer is connected to the PC. More than one MicroMV Flow Computer in the loop will cause data collisions and unintelligible responses. Failure to communicate can occur because of a communication wiring problem, wrong PC port selection, communication parameter mismatch between PC and MicroMV (Modbus type, parity, baud rate, etc.) or lack of power to the MicroMV Flow Computer. After the device is detected, then you can follow steps described above.

Warning messages will remind you that this action will erase **ALL** the information in the flow computer.

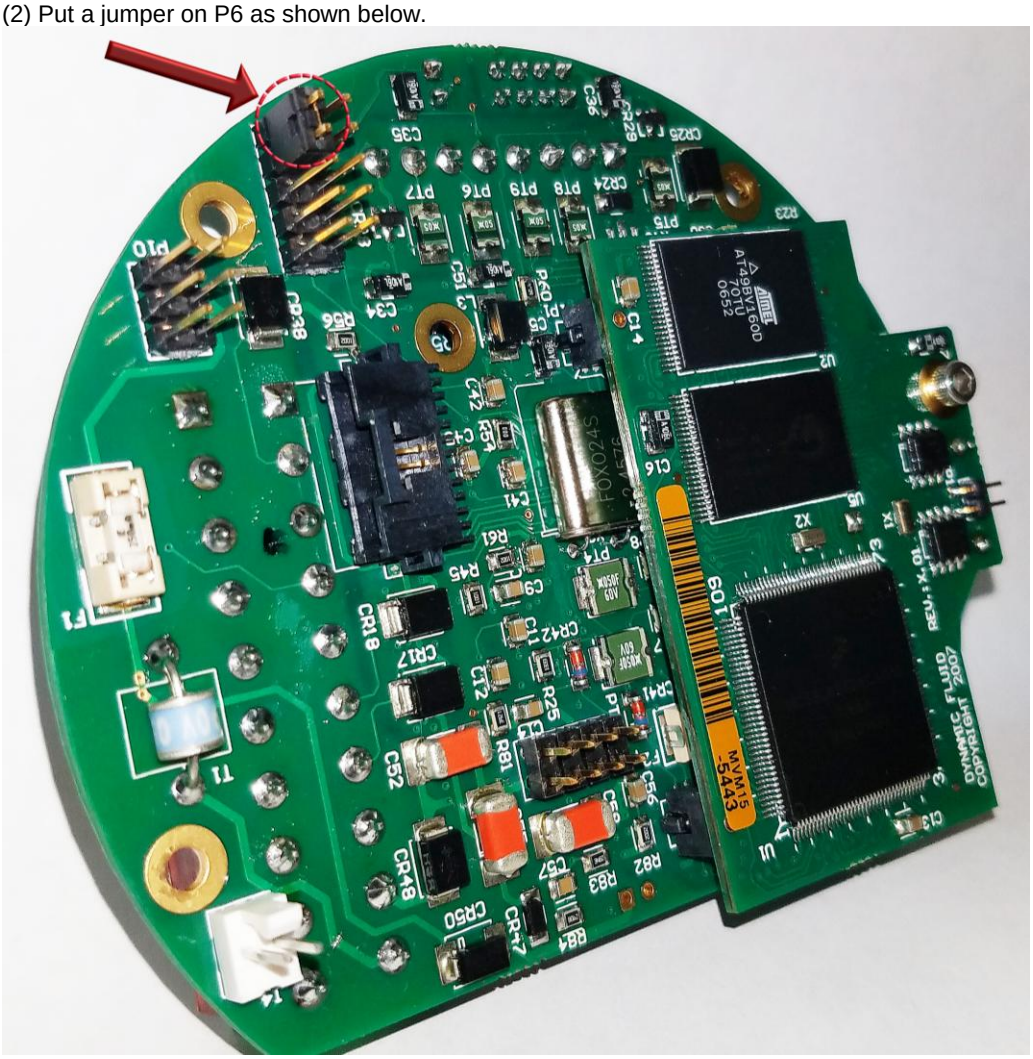
The download task will take about 7 minutes to be completed. Once the image file is in place, the flow computer is ready to be configured (enter calculation parameters and I/O assignments).

How to force the board into download mode

First, try to recycle the power and reload the image if the error message is displayed while downloading a new image file. Download an image file only through **RS-232 port**. MicroML1 Windows Software version 2.11 or higher is required. Contact technical support for old boards loaded with downloader v1.
Forcing download mode could be required if a wrong type of application image was loaded or other issues. Call our main office for more information



Steps to force the board into download mode.
(1) Remove Power
(2) Put a jumper on P6 as shown below.



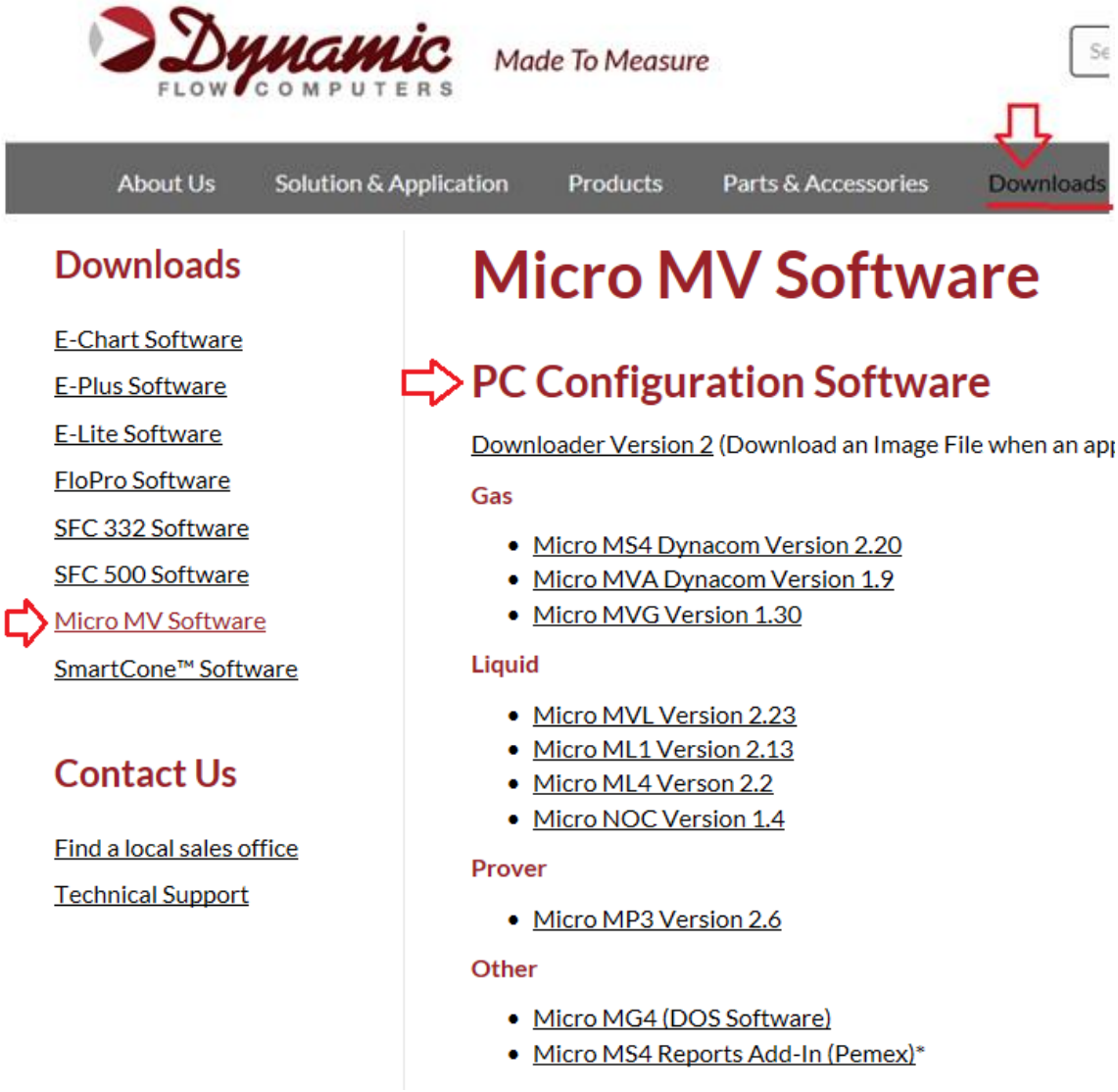
(3) Power up the board
(4) Board is in download mode
(5) Download image
(6) Remove power and jumper on P6 after a new image is loaded

(7) Board is ready

Website - DFC Configuration Software

Step 1. Go to our website WWW.DYNAMICFLOWCOMPUTERS.COM

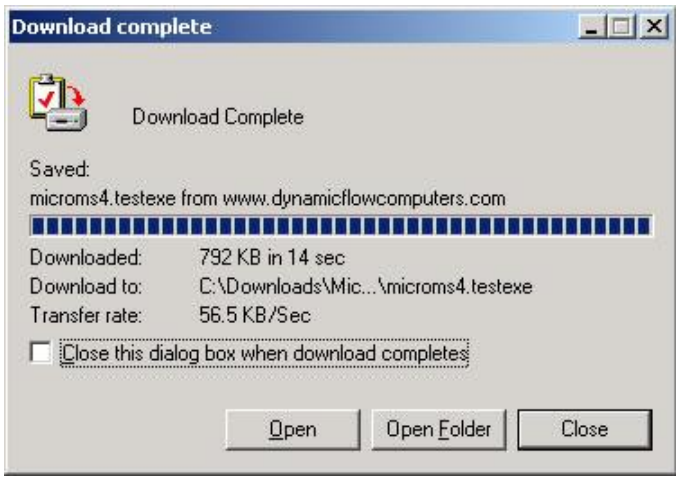
Step 2. Click on the "**Downloads**"



Step 3. Select application software based on Step 2.

Step 4. On the new screen presented to you click on the application that you are trying to download. Once you hit the link it

will ask you if you want to run or save the file in your computer. Select **SAVE.** (See illustration 1)



Step 5. The file will start to transfer to your computer. The download time depends on your Internet connection speed and the type of application that being downloaded.

Step 6. When the download if finish. Press the **OPEN** button to start the setup process. (See Illustration)

Step 7. Follow the steps in the application setup.

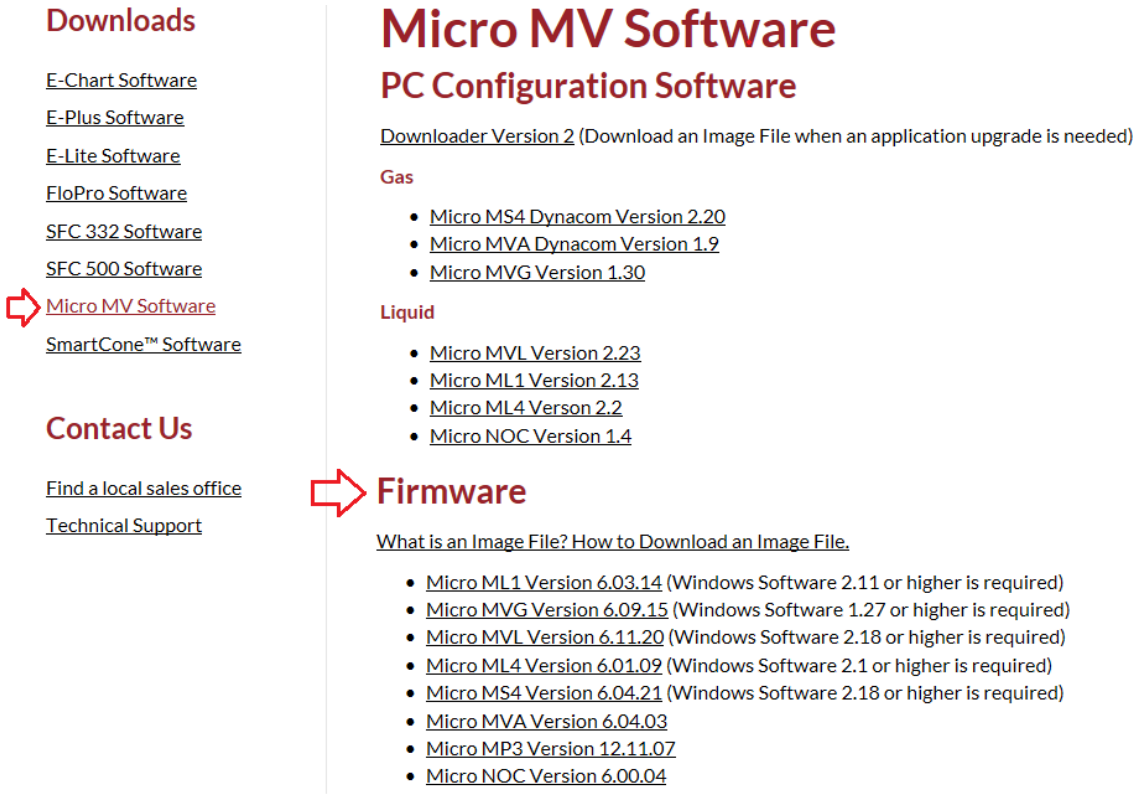
Website – Image File (Firmware)

Check the version number of image file. **The image file is only done when an application upgrade is needed**.

Step 1. Go to our website WWW.DYNAMICFLOWCOMPUTERS.COM

Step 2. Click on the "**Downloads**"

Step 3. On the new screen presented to you click on the application firmware that you are trying to download. Once you hit the link it will ask you the location and file name to be saved.



Step 4. The file will start to transfer to your computer. The download time depends on your Internet connection speed and the type of application that being downloaded.

Step 5. After the download is finished, follow the steps in the image downloading setup.

Getting acquainted with the flow computer wiring:

Back Terminal Wiring:

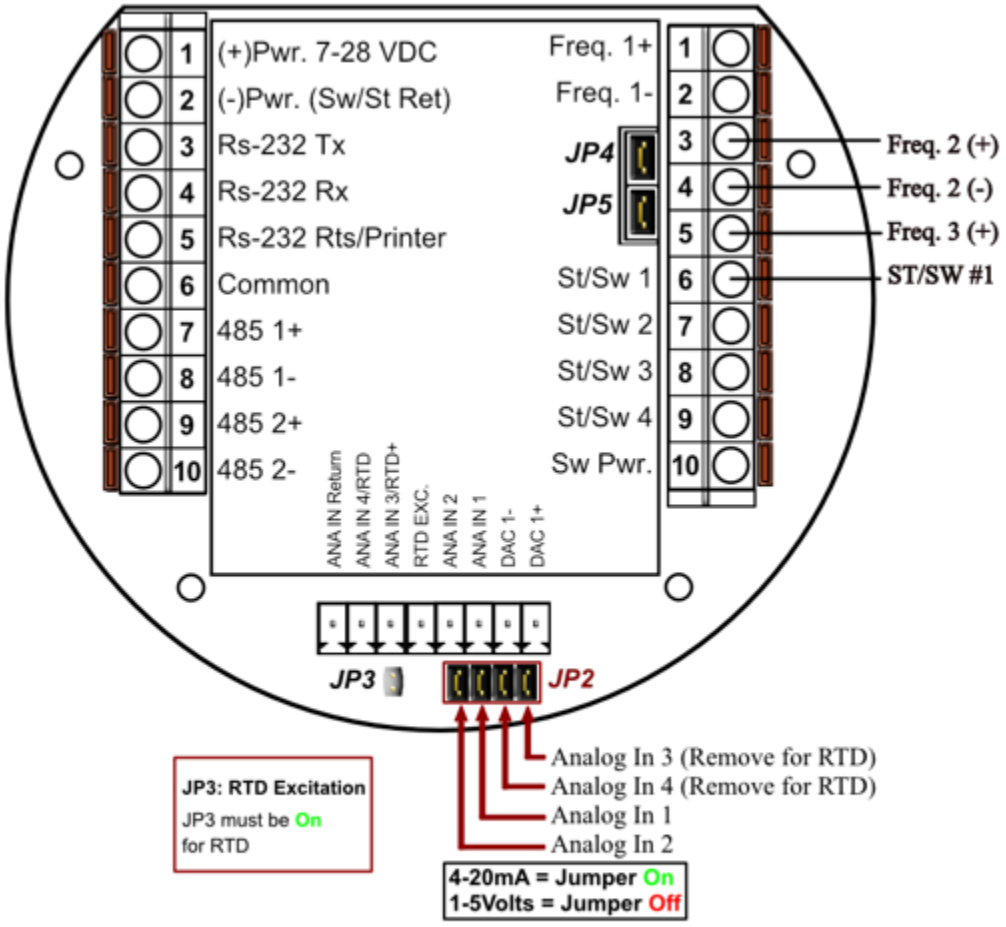
The back terminal wiring indicates the overall positions of the terminal plugs and their functions. Though the back panel's jumpers are also shown, refer to the next drawing, "Back Panel Jumpers", for information on their settings and functions.

The MicroMV receives its power via the .top two pins on Terminal P1, on the left of the board. Also on Terminal P1 from top to bottom are inputs to the four serial connections

To the right (P4), from top to bottom, are two turbine inputs, density frequency input, and switch/status inputs and output.

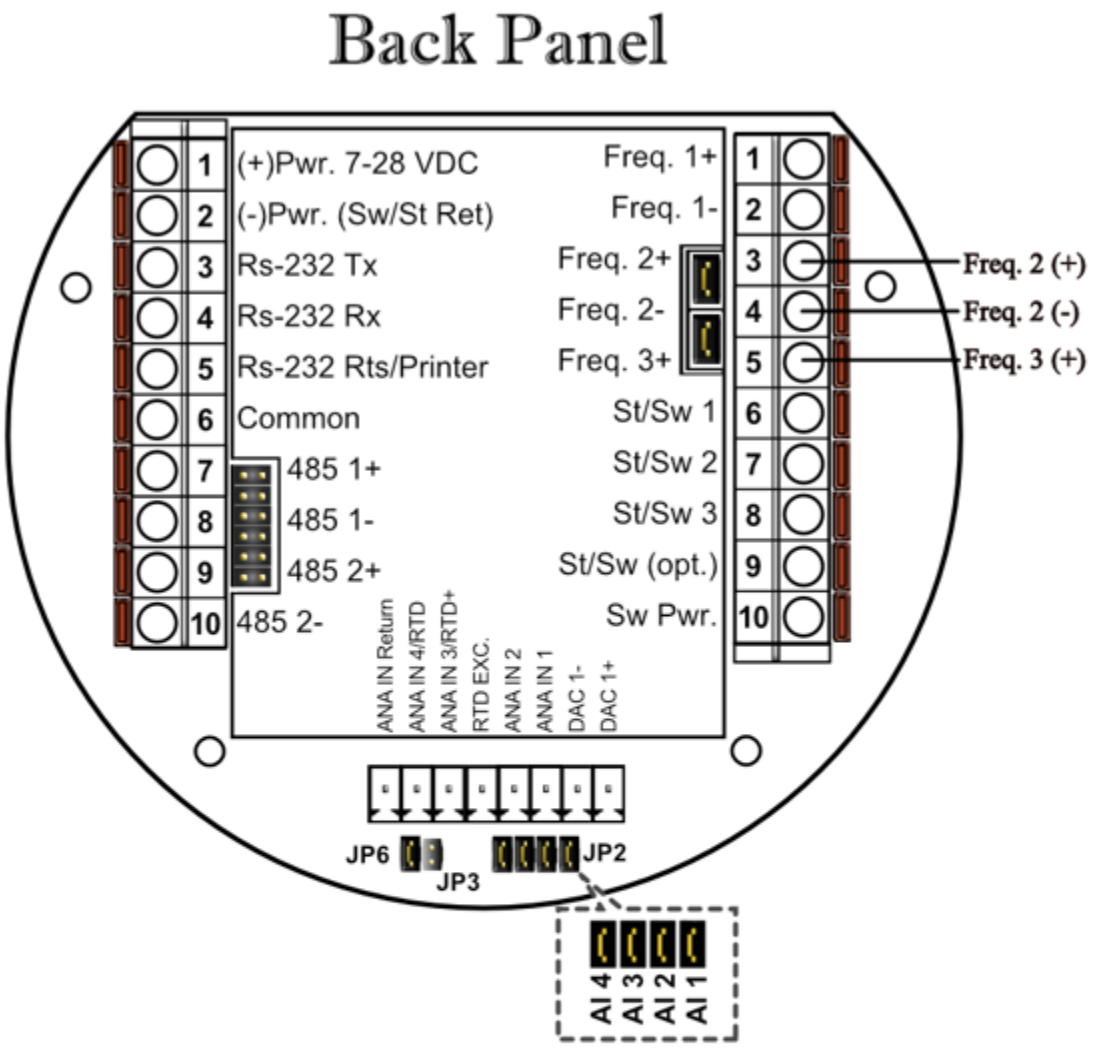
Terminal P3, at the lower bottom, handles analog inputs/RTD and analog output.

VERSION 2 - MICROMV MAIN/MEMORY BOARDS (MICRO2009 AND LATER MODEL)



JP4: When ON Meter 1 Uses Square Wave. When OFF Meter 1 Uses Sine Wave
JP5: When ON Meter 2 Uses Square Wave. When OFF Meter 2 Uses Sine Wave

VERSION 1 - MICROMV BOARD (OLDER MICROMV MODELS)



JP2: Must be installed for 4-20mA inputs. When removed, the analog input is used as 1 to 2.5 Volts Input. JP2 consists of 4 links, each link corresponds to one analog input.

JP3: Is RTD Excitation and should never be installed when Analog 3 & 4 are used as Analog inputs (See RTD Connection for details).

JP4: When ON, Meter 1 Uses Square wave.When OFF, Meter 1 Uses Sine wave

JP5: When ON, Meter 2 Uses Square Wave. When OFF, Meter 2 Uses Sine Wave

JP6: Always installed. It can be removed after power is removed to clear RAM memory.

INPUT/OUTPUT: Assigning and Ranging Inputs

Input/Output Assignment

We will now configure your Micro MV Liquid Flow Computer's inputs and outputs. The flow computer allows the user to configure the inputs and outputs. . The flow computer does not use unassigned inputs.

How to assign a transmitter to an I/O point:

1 Click "Configure Device", configuration menu is prompted

2 On configuration menu, click "Input Assignment"

3 Enter assignments for DP, temperature, pressure, density and spare inputs.

4 **Assignment (1-*n*)**. Assignments 1-4 are analog inputs attached to terminal of the back panel. These inputs accept 4-20mA or 1-5 volts are suitable for temperature, pressure, density, or spare inputs. An assignment 5 is strictly RTD (temperature) input only for the meter, densitometer or spare. Assignment 7 indicates a density frequency input; it is assigned automatically once you choose live density frequency input in the setup menu at density type Assignment 10 (module 1) is for Rosemount multi-variable module only. DP, pressure, and temperature for the meter can be assigned. When a frequency type primary element is hooked to the flow computer, the Multi Variable pressure and temperature can be used and the DP becomes a spare input that could be assigned for strainer differential.

Ranging the Transmitter Inputs:

1. **Enter the range values for analog inputs**: after assigning the analog inputs, click square box next to the assignment to scale the 4-20mA. Enter the value at **`@4mA`** and **`@20mA`**. Enter both values similar to the way the transmitter is ranged. 1-5 volts are equivalent to 4-20mA. Enter the 1 Volt value at the 4mA, 5 volt value at 20mA. When the Multi Variable is used the 4-20 ma scale has no effect on anything and does not need to be configured for that input. The reason is simply that the flow computer gets the data via digital communication from the transmitter in engineering units, and therefore a scale is not needed. Normal pressure range is 0-3626, temperature –40 to 1200, DP –250 to 250, or -830 to 830 inches of water.
2. **Enter the high and low limits**: high limits and low limits are simply the alarm points in which you would like the flow computer to flag as an alarm condition. Enter these values with respect to the upper and lower range conditions. Try to avoid creating alarm log when conditions are normal. For example: If the line condition for the pressure is between 0 to 500 PSIG. Then you should program less than zero for low pressure alarm, and 500 or more for high pressure alarm. High limits are also used in the SCALE for the Modbus variables. The high limit is equivalent to 32767 or 4095. The low limit is not used for calculating the scale. The scale starts at zero to wherever the high limit value.
3. **Set up the fail code:** **`Maintenance`** and **`Failure Code`** values tell the flow computer to use a default value in the event the transmitter fails. The default value is stored in **`Maintenance`**. There are three outcomes: the transmitter value is always used, no matter what (**`Failure Code`** = 0); the **`Maintenance`** value is always used, no matter what (**`Failure Code`** = 1); and the **`Maintenance`** value is used only when the transmitter's value indicates that the transmitter has temporarily failed (**`Failure Code`** = 2).

RTD inputs will skip 4-20 mA assignment because RTD is a raw signal of 50Ω (ohms) to 156Ω. Readings beyond that range require a 4-20 mA signal to the flow computer or using the built in Rosemount Multi Variable transmitter. The Rosemount Multivariable has a range of –40-1200 degrees Fahrenheit.
Density coefficients for raw frequency inputs are programmed in this menu. The menu will only show parameters relevant to the live density selected (i.e., Solartron or UGC, etc.).

WIRING:

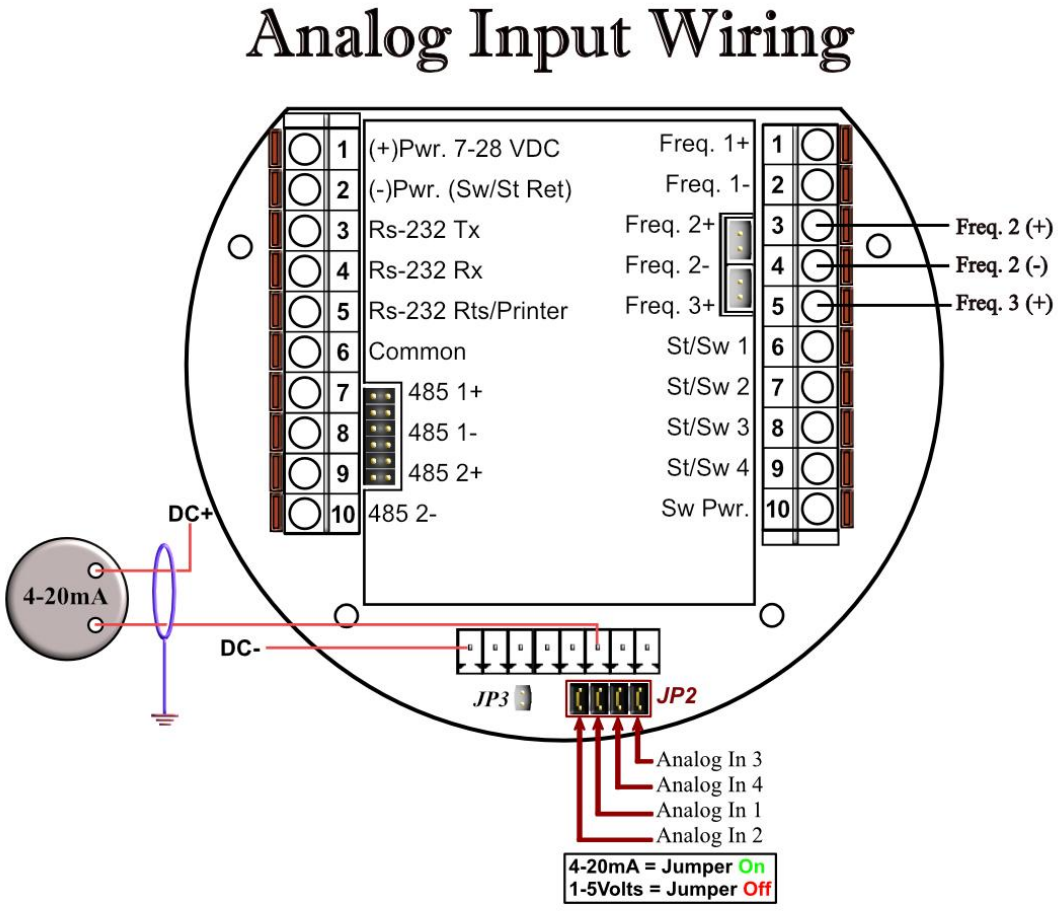
Wiring to the flow computer is very straightforward and simple. But still it is very important to get familiar with the wiring diagram.

Wiring of Analog Inputs: Version 2 Board

MicroMV Main/Memory Boards (Micro2009 and Later Model)

Typical wiring for analog inputs 2 and 1 are shown in the drawing. Analog inputs 4 and 3 are to the left of analog 2 and 1 separated by the RTD excitation. Note that the analog input has only one common return that is the -Ve signal of power supply powering the transmitters.

When wiring **1-5 volts**, **make sure to calibrate** the flow computer for the 1-5 volt signal because the flow computer calibration defaults for the 4-20 ma, which is different from the 1-5 volts. JP2 must be removed for 1-5 volt inputs. Signal line impedance provided by our flow computer is 250Ω.

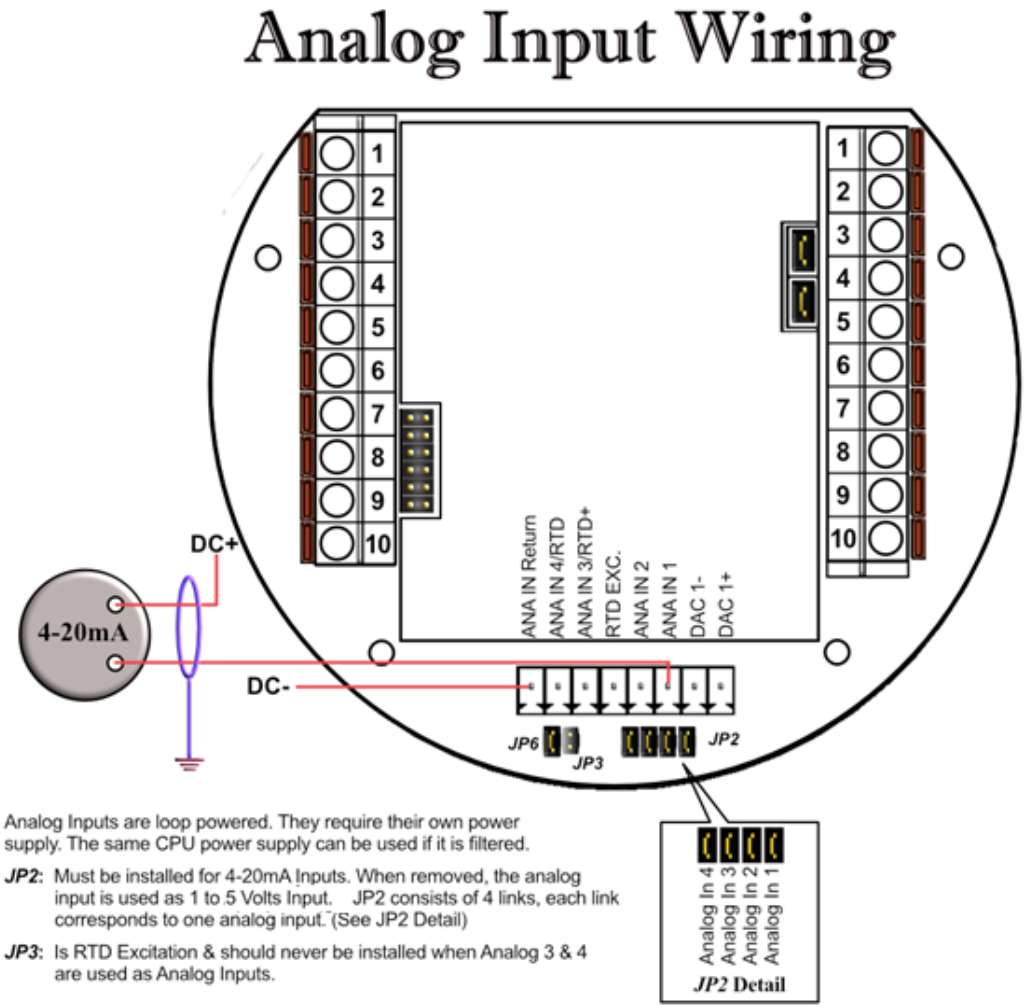


Wiring of Analog Inputs: Version 1 Board

MicroMV Board (Older MicroMV Models)

Typical wiring for analog inputs 1 and 2 are shown in the drawing. Analog inputs 3 and 4 are to the left of analog 1 and 2 separated by the RTD excitation. Note that the analog input has only one common return that is the -Ve signal of power supply powering the transmitters.

When wiring **1-5 volts**, **make sure to calibrate** the flow computer for the 1-5 volt signal because the flow computer calibration defaults for the 4-20 ma, which is different from the 1-5 volts. JP2 must be removed for 1-5 volt inputs. Signal line impedance provided by our flow computer is 250Ω.



Analog Inputs are loop powered. They require their own power supply. The same CPU power supply can be used if it is filtered.

JP2: Must be installed for 4-20mA Inputs. When removed, the analog input is used as 1 to 5 Volts Input. JP2 consists of 4 links, each link corresponds to one analog input. (See JP2 Detail)

JP3: Is RTD Excitation & should never be installed when Analog 3 & 4 are used as Analog Inputs.

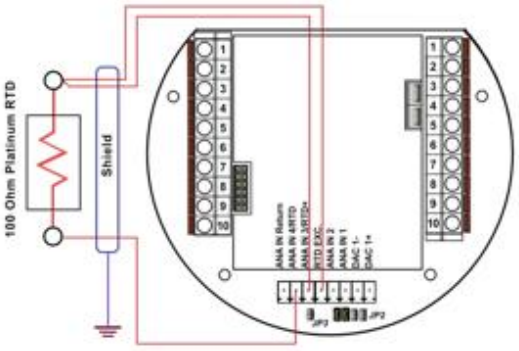
NOTE: The 4-20mA or 1-5 volt DOES NOT source power to the transmitters. You can use the DC power feeding the flow computer to power the 4-20mA loops IF that power supply is FILTERED.

Wiring of RTD

100Ω platinum **must** be used; a temperature range of -43°F to +300°F can be measured. RTD is to the left of analog in 1&2. The RTD excitation jumper (JP3) has to be installed for the RTD to function. In the figure below, notice that the RTD requires a three wire connections. Internal excitation current source generated is in the micro AMP range.

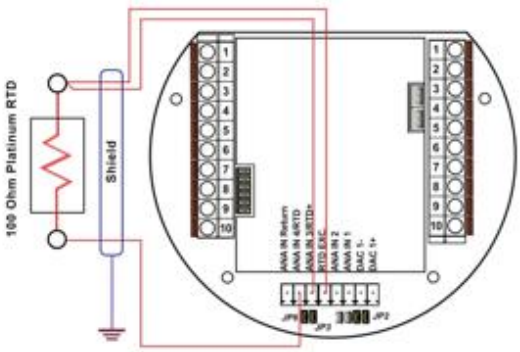
Wiring RTD Directly Into CPU Board

MicroMV 2009 & Later Model



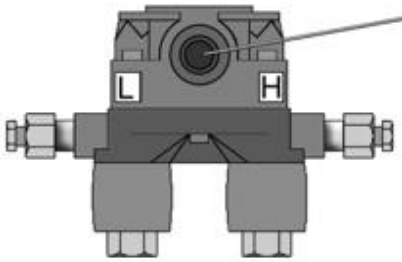
Jumper Settings:
JP3- Must be On
JP2- Two right jumpers must be Off
For 4-wire RTD, tie the two return wires together and wire as 3-wire RTD

Older MicroMV Models



Jumper Settings:
JP3- Must be On
JP2- Two left jumpers must be Off
For 4-wire RTD, tie the two return wires together and wire as 3-wire RTD

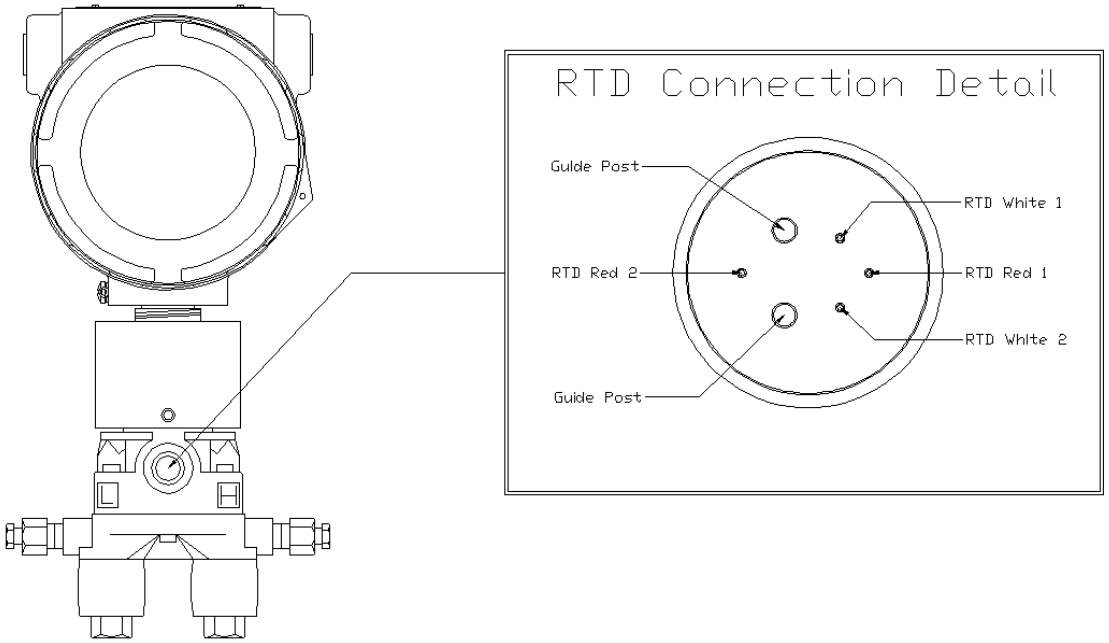
Wiring RTD Into Rosemount Multivariable



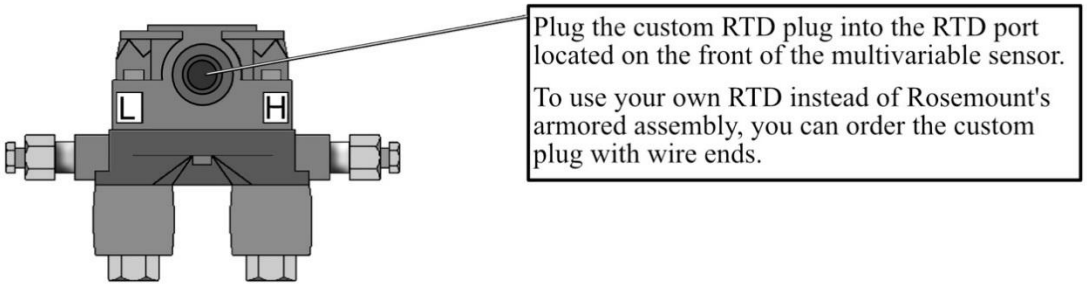
Plug the custom RTD plug into the RTD port located on the front of the multivariable sensor.

To use your own RTD instead of Rosemount's armored assembly, you can order the custom plug with wire ends.

Rosemount RTD Connection

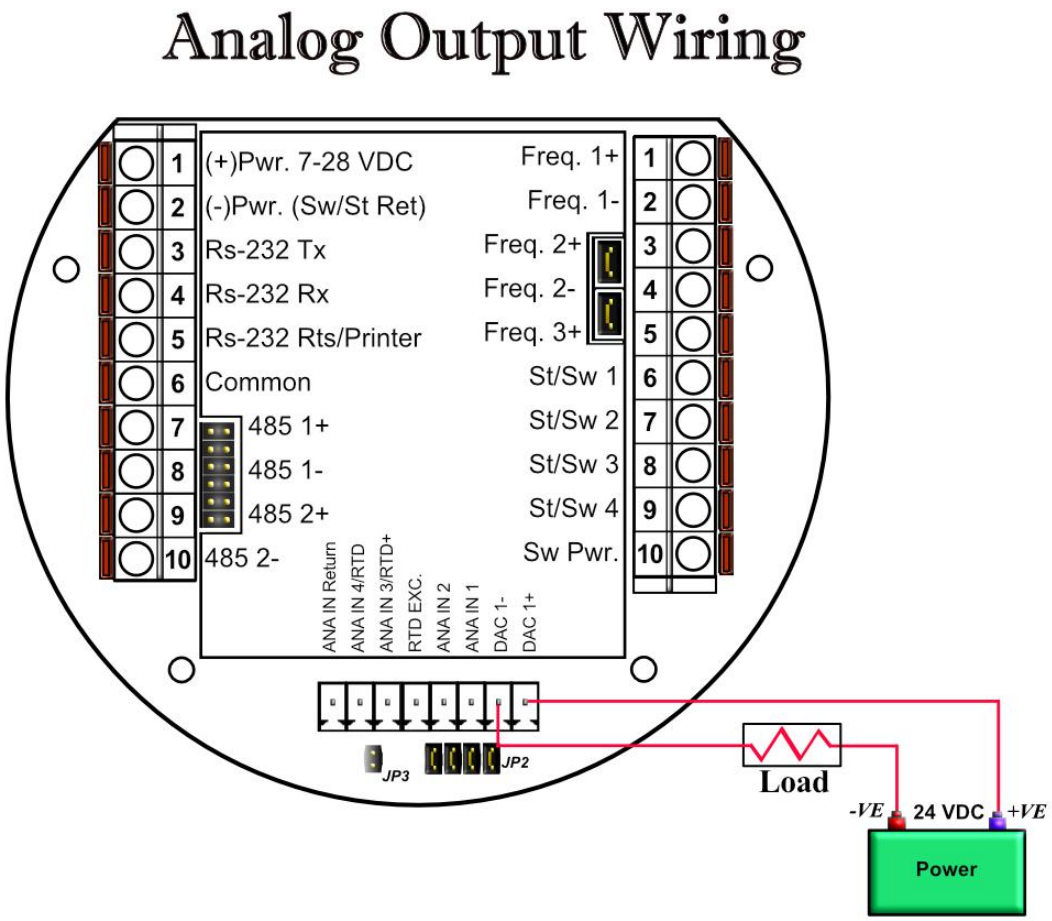


Wiring RTD Into Rosemount Multivariable



Wiring of Analog Output:

Wiring diagram shows typical Analog output wiring. Notice that analog outputs will regulate 4-20 mA current loops but DOES NOT source the power for it. External power is required.

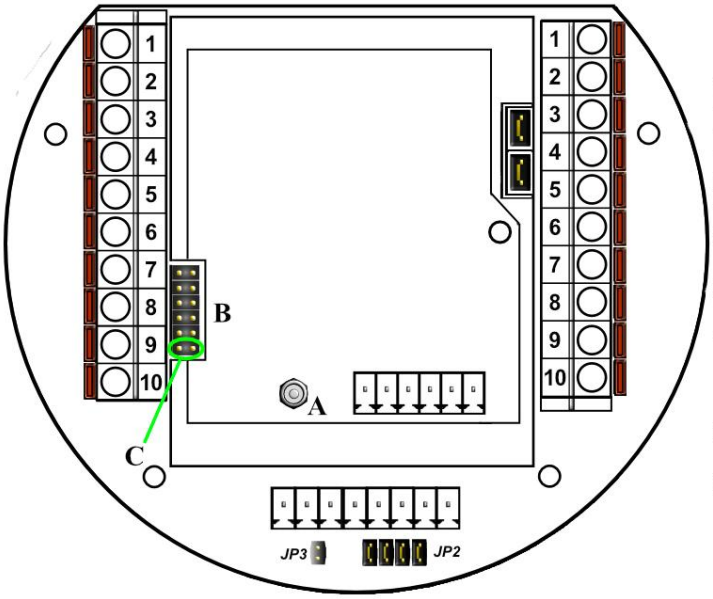


Assigning/Ranging the 4-20mA Analog Outputs:

Go to the **`I/O`** assignment main menu and click **`Analog Output Assignment`**. A selection menu is prompted. Select the analog output number, and then enter what the 4 mA output will indicate and the 20 mA. Make sure that the 20 mA assignment value exceeds the upper range limit of what you assigned the Analog output for, otherwise the analog output will not update beyond 20 mA.

Additional Analog Inputs or Analog Outputs – Board Installation

Connecting Additional Analog Board



Components Needed:
- Extra Analog Board
- 1/4" Stand-off (**Figure D**)
- 1/4 Nut Screwdriver

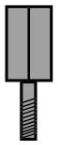
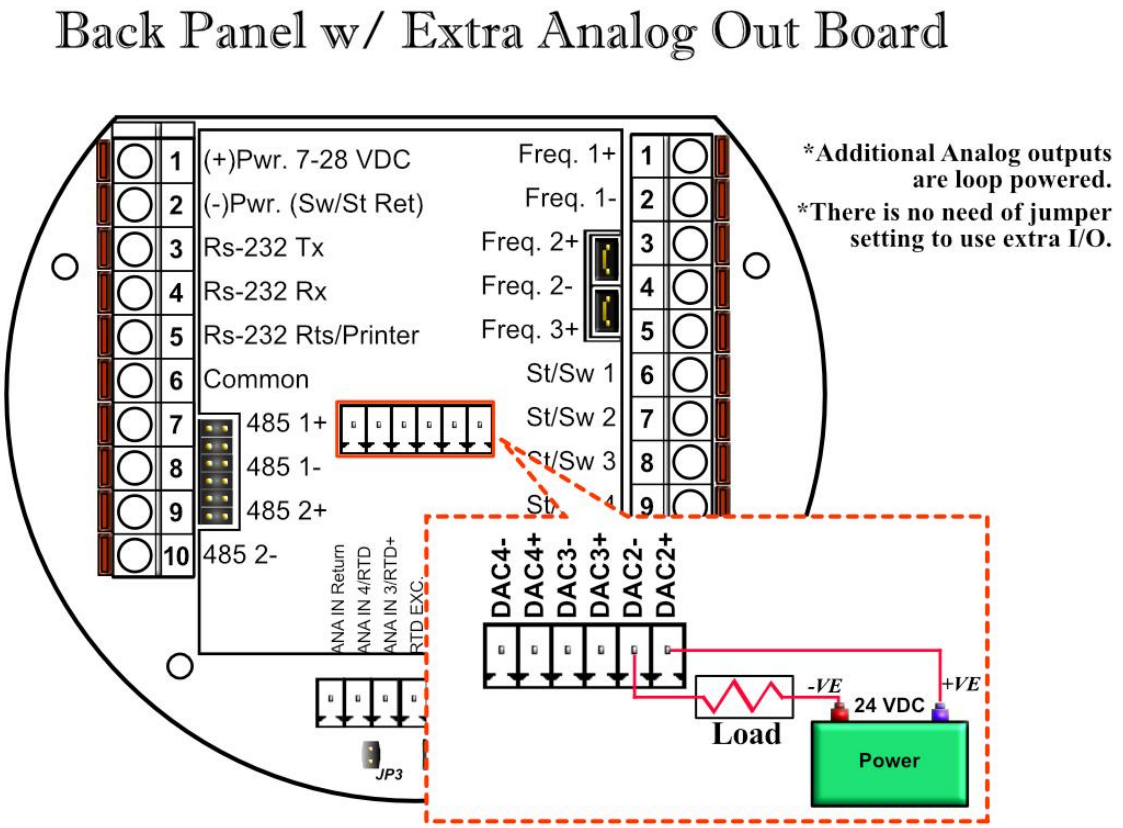


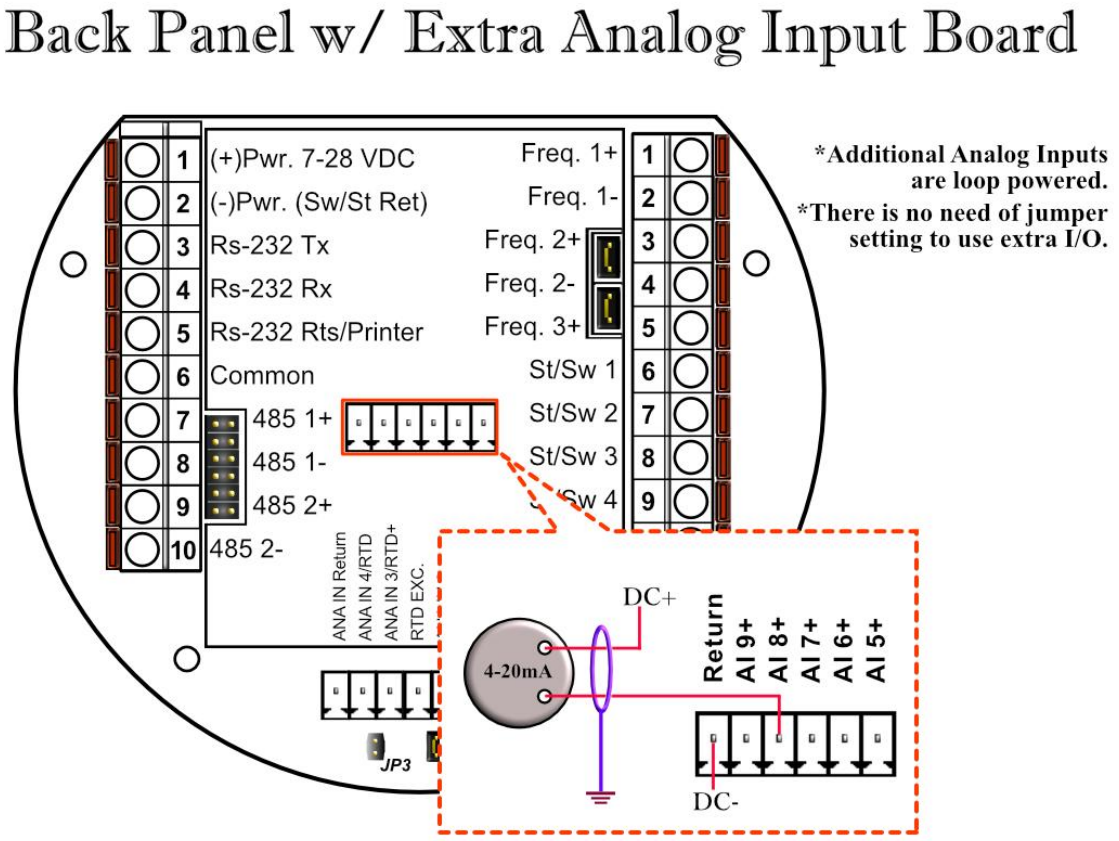
Figure D

Procedure:
1. Remove power from the Main board.
2. Remove nut from the Main Board (See **A**) and Install 1/4" Stand Off in its place.
3. Plug Analog board to the Main Board (Using Connector **B**)
4. Note that the Analog board connector has 10 pins while the Main board connector has 12 pins. The bottom two are NOT connected [See **C**].
5. Place the nut removed on step 2 on the stand-off (**A**) to secure analog board.
6. For wiring of extra Analogs, refer to specific drawing.(Analog Input/Analog Output).

Back Panel - Additional Analog Outputs

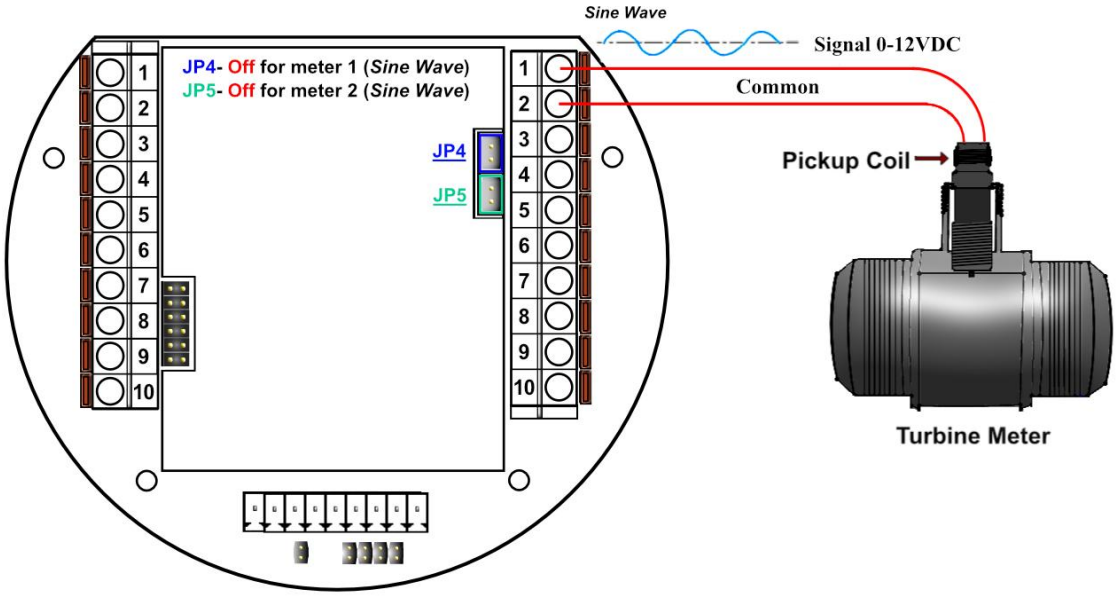


Back Panel - Additional Analog Intputs



Turbine Input Wiring

Go to view main menu, click turbine under **`Wiring Drawings`**. Two drawings above each other will show typical wiring for turbine meter 1 and turbine meter 2. When dual pickups from the same turbine are connected, use the inputs for turbine 1 for pickup 1 and turbine 2 for the second pickup coil. When connecting sine wave directly from the pickup coil make sure the distance from the pickup coil to the flow computer is very short–less than 50 feet with shielded cable. In the event there is presence of noise, the distance must be shortened. When connecting sine wave signal, the JP4 jumper for meter 1 must not be installed and JP5 jumper for meter 2 must not be installed. (*JP4 and JP5 must be off when using sine wave*). On the other hand, when using square wave, the square wave signal can be sinusoidal but has to be above 5 volts peak to peak with less than 0.4 volts offset in order for the flow computer to read it. The JP4 jumper for meter 1 must be installed and JP5 jumper for meter 2 must be installed.



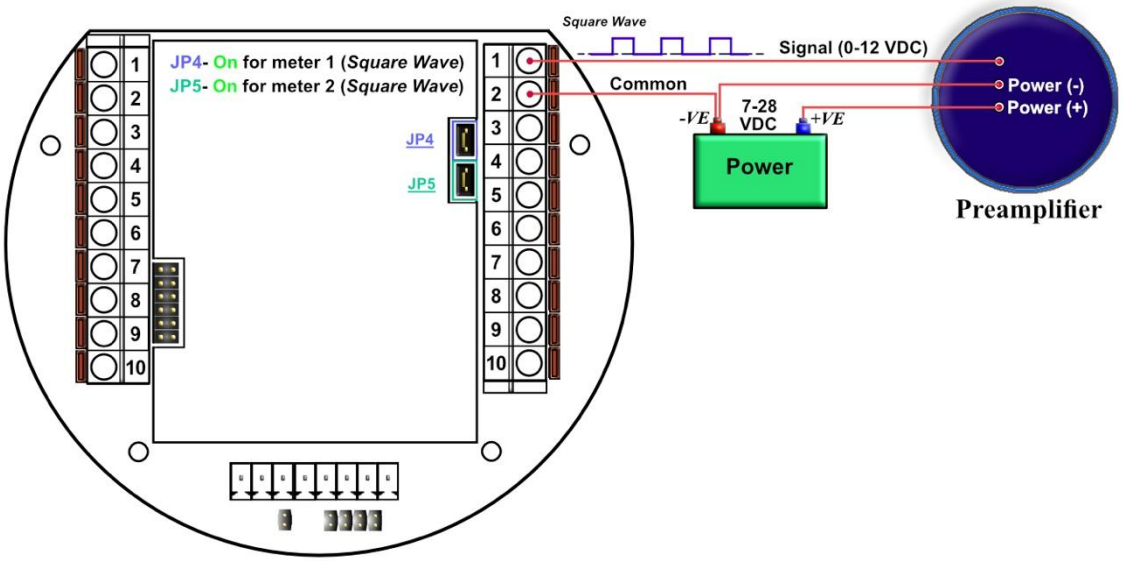
Note:	*When connecting square wave input, the JP4 and JP5 connect the turbine return to the flow computer power return. Therefore, signal polarity is very important. Reverse polarity could result in some **damage or power loss**. When sine wave is used the signal polarity is usually of no significance.*

The turbine input is on the top of terminal P3 The third pin down from the top is Turbine/PD input 2 plus and below it is Turbine 2 minus. The third frequency input (fifth pin down) has the positive input and the negative is the power input ground. If a different power supply is used to power the densitometer then the power return for that input needs to be connected to the Micro MV power ground.

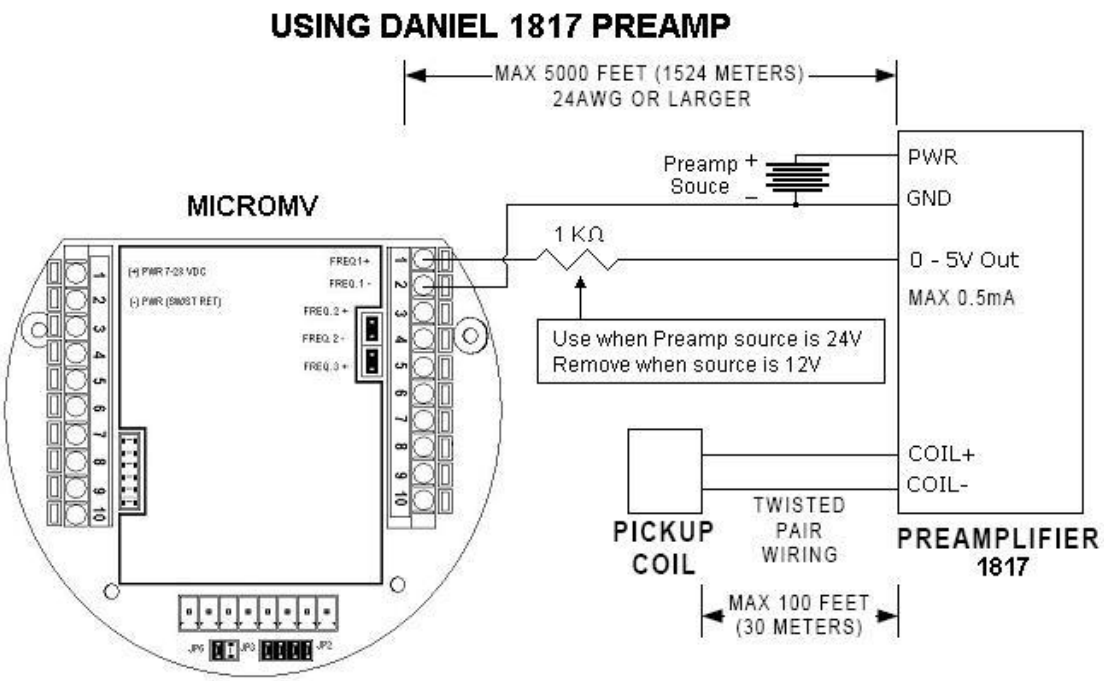
Turbine Input Wiring

For square wave, the voltage is 5 to 12 VDC. Do not exceed 12 VDC
(Terminal 1-Frequency#1 input+ and Terminal 3-Frequency#2 input+).

Using Daniel 1818 Preamp



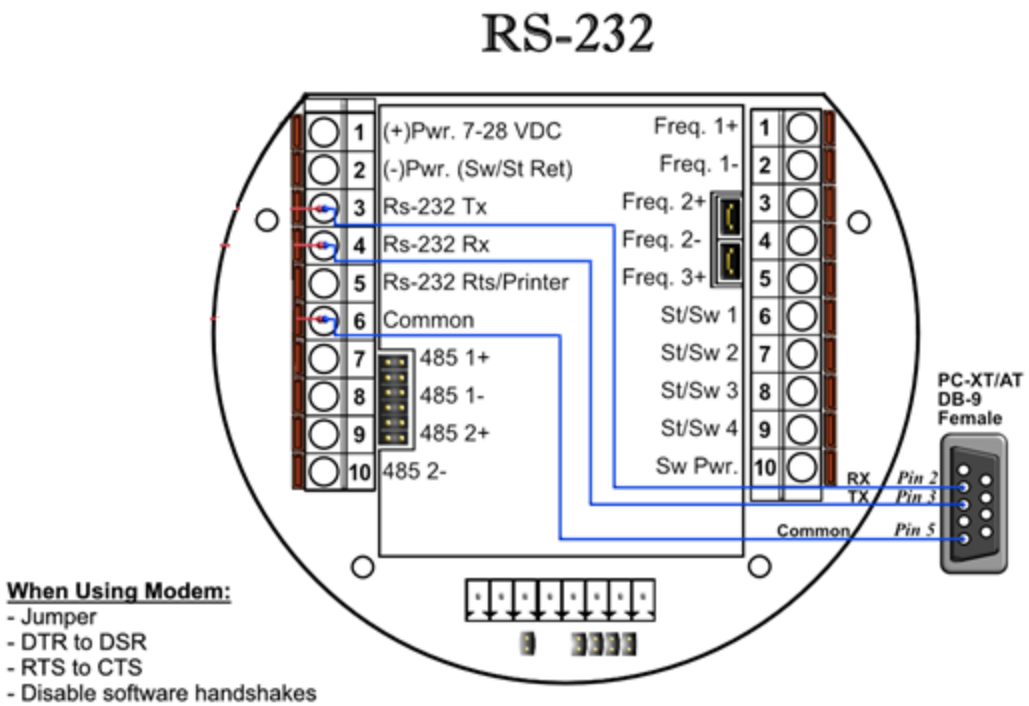
Turbine Input Wiring – Using Daniel 1817 Preamp



RS-232 Connection:

The RS-232 is located on the left terminal block. The third, fourth, fifth, and sixth pins of the RS232 below the power input.

Note: Twisted shielded cable is required.



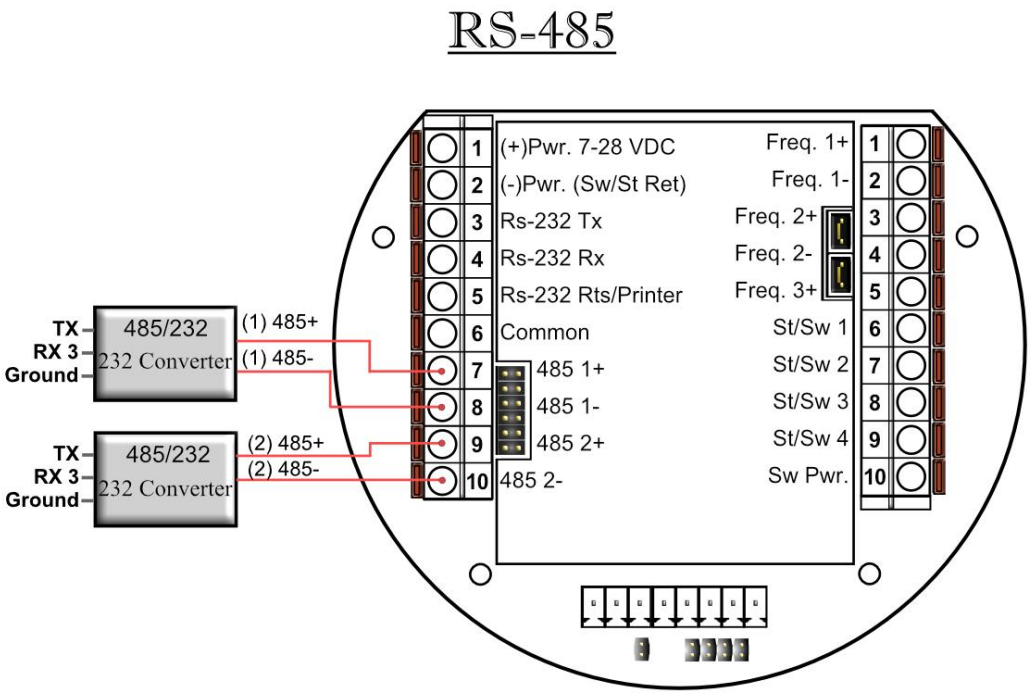
When Using Modem:
- Jumper
- DTR to DSR
- RTS to CTS
- Disable software handshakes

WARNING: *When the RS-232 terminal is used with a modem, external protection on the phone line is required. Jumper DTR to DSR, RTS to CTS, and disable software handshake on the modem RS232 connection*

RS-485 Connection

RS-485 wiring is shown in the wiring diagram under **RS-485**. Two Rs485 channels are available for Modbus communication or as a master to other slave devices. i.e. gas G.C., external Modbus slave devices and token passing ring. The maximum distance when 18-gauge wire is used is 4000 feet.

Note: Twisted shielded cable is required.



WARNING: When the RS-485 terminal is used, external transient protection and optical isolation is required, especially for long distance wiring.

RS485/232 Adapter

Dynamic recommends B&B Electronics. We generally use Model 485D9TB, which is a port power converter requiring only a 2-Wire connection. The 485D9TB has a terminal block which makes the wiring more convenient and provides the option of external 12V power for low power serial ports. Model 485SD9R can also be used, but it has a DB9 terminal which requires additional cables. With Model 485SD9R the pins that connect to the flow computer are pin 3 on the DB9 to TX on the flow computer and pin 8 on the DB9 goes to RX on the flow computer. For a USB to RS485 converter, we recommend Model USTL4 which is also port powered and supports half and full duplex networks.

***Note**

Version 1: MicroMV Board (Older MicroMV Models)

The second RS485 gets disabled if ST/SW#4 is used. They cannot be used at same time.

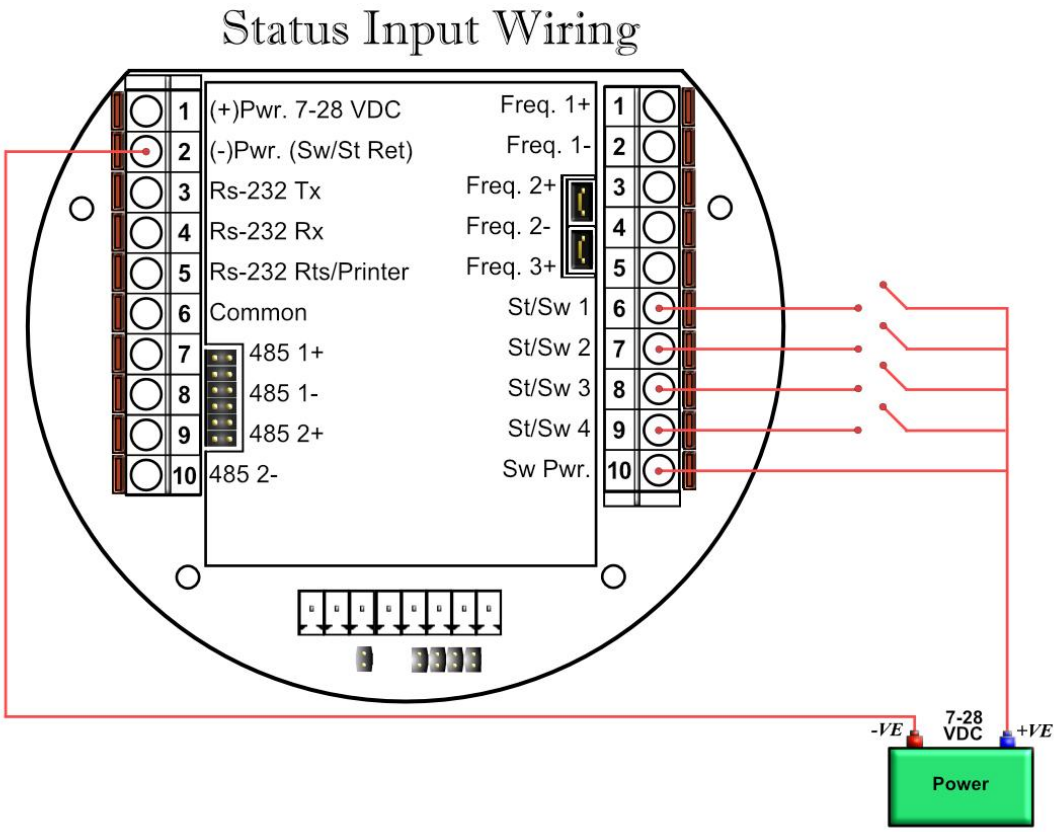
To use ST/SW#4 as a serial port, JP7 must be OFF and no assignment for ST/SW#4, otherwise serial port#3 (Second 485 Port) gets burned if voltage is applied.

Version 2: Main/Mem MicroMV Boards (Micro2009 and Later Model)

ST/SW#4 and the second RS485 can be used be used at same time.

Wiring of Status Inputs:

There are 4 digital inputs or outputs that are user configurable. The configuration software will configure the input to be a status input or a switch output.. The standard status input has 4 volts of noise hysteresis, with on trigger point of 5 volts and an off point of 1 Volt.



***Note**

Version 1: MicroMV Board (Older MicroMV Models)

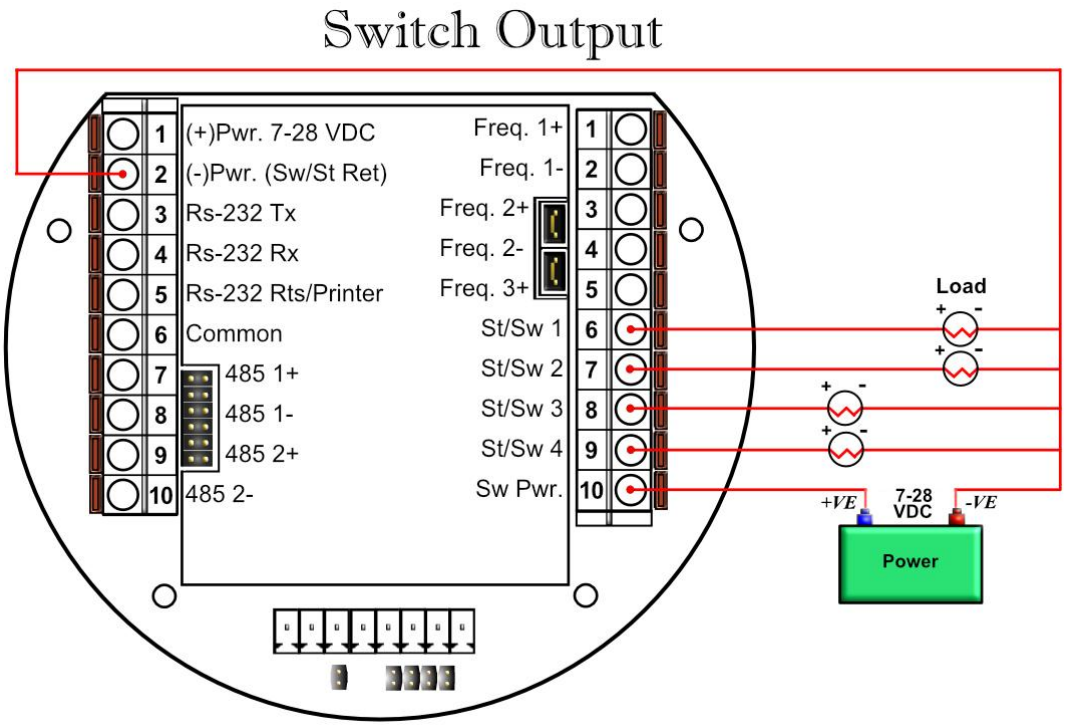
The fourth digital I/O is optional and can only be use if the 2nd RS485 is not used.
The second RS485 gets disabled if ST/SW#4 is used. They cannot be used at same time.
To use Status 4 JP7 Must be ON otherwise OFF

Version 2: Main/Mem MicroMV Boards (Micro2009 and Later Model)

ST/SW#4 and the second RS485 can be used be used at same time.

Wiring of Switch/Pulse Outputs:

Switch one and two can be on /off or pulse type output up to 125 pulse per second. Notice that the switch outputs are transistor type outputs (open collector type with maximum DC rating of 350 mA continuous at 24 VDC) connections		
1	Status Input /switch output 1	Switch - Maximum rating: 350mA @24 volts Switch Output Range: 5-28 VDC Status Input Rating: 6-28 VDC
2	Status Input/switch output 2	
3	Status Input /switch output 3	
4	Status input/ switch output 4	



***Note**

Version 1: MicroMV Board (Older MicroMV Models)

The fourth digital I/O is optional and can only be use if the 2nd RS485 is not used.

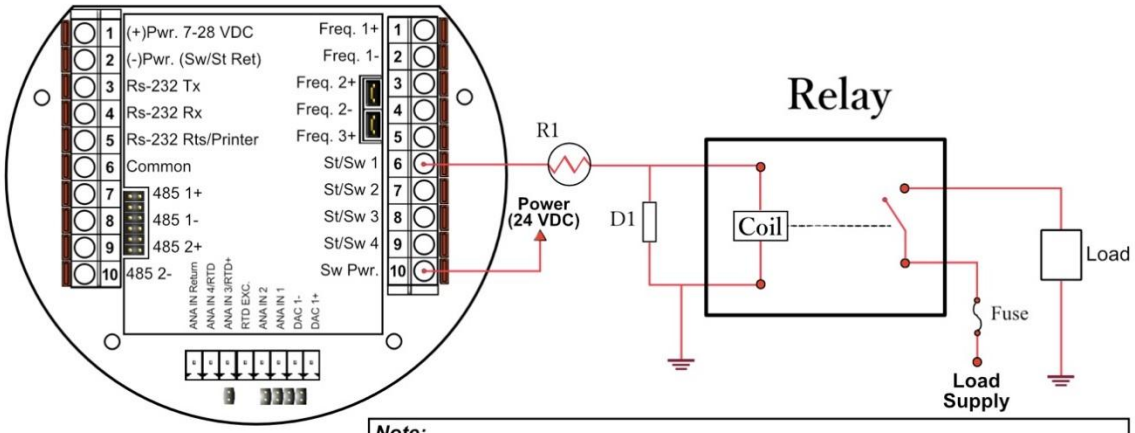
When using ST/SW#4, the second RS485 gets disabled. They cannot be used at same time.

Version 2: Main/Mem MicroMV Boards

ST/SW#4 and the second RS485 can be used be used at same time.

Switch Output to Relay Wiring Diagram

When wiring the Switch Outputs to an inductive load such as a relay, it is better to add transient protection to the flow computer's electronics due to the surge in voltage that inductive loads may create. This protection can be added as shown in the drawing below.



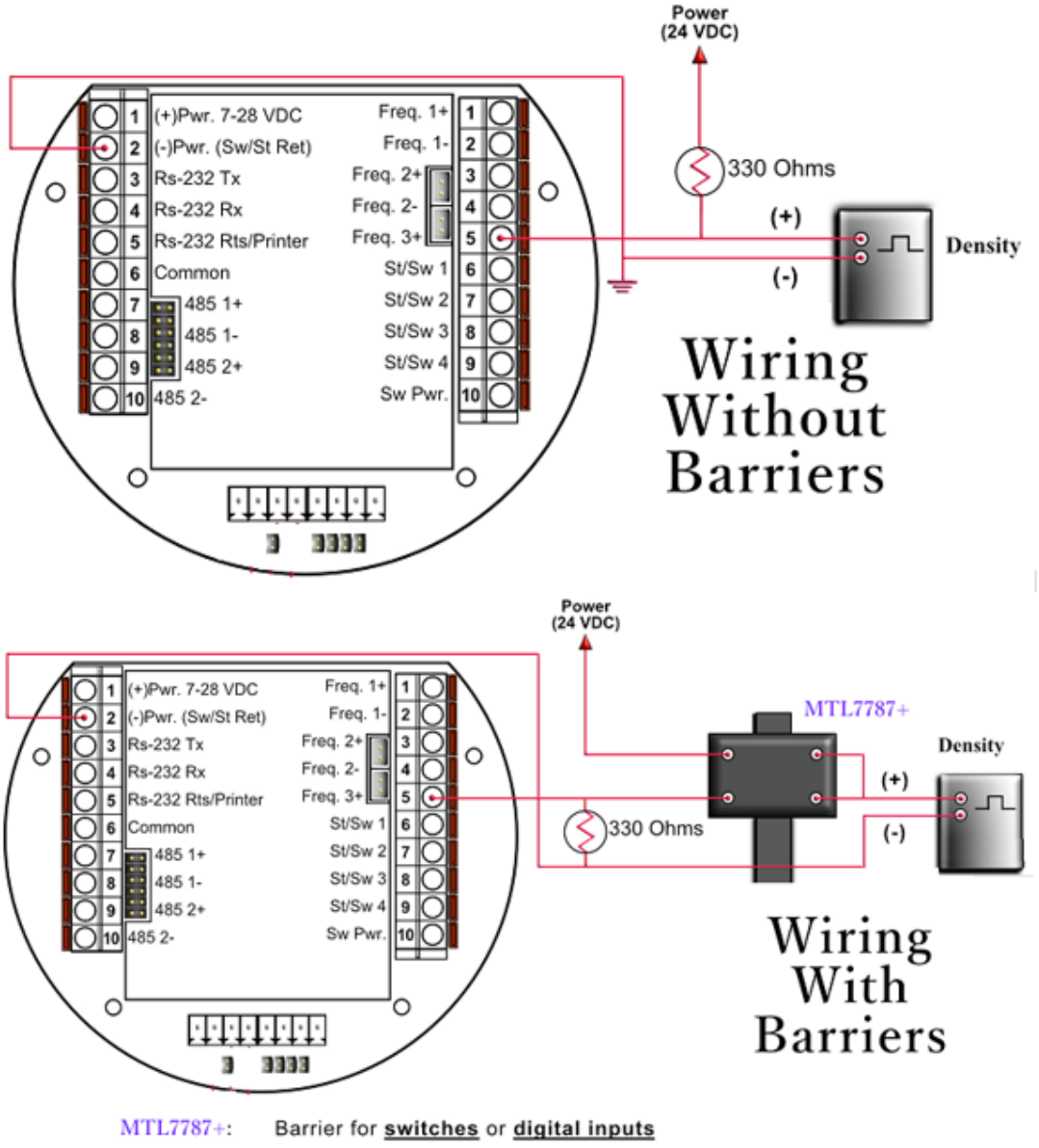
Note:

R1- Current limiting resistor. Current must not exceed 250mA.

D1- Use on relay or any inductive load
Transient voltage suppressor. Part No. 1.5KE30CA
It is a bidirectional part, so wiring polarity is indifferent.
Unidirection part No. 1.5KE30A may also be used. In such case, the stripped side is to be connected to the Switch Output side and the other side to ground.

Density Input Wiring:

When using a live densitometer input with frequency signal, the signal can be brought into the MicroMV in its raw form. The MicroMV accepts a sine wave or square with or without DC offset.



MTL7787+: Barrier for **switches** or **digital inputs**

Note:	*When wiring the density input polarity is of significance and reverse polarity could result in some damage or power loss. When Density input is 4-20mA it should be connected as a regular 4-20mA signal to the analog input and not the density frequency input.*

CALIBRATION

Analog Input 4-20mA or 1-5 Volt Signal

Calibrations are performed under **Calibration**. Select inputs to be calibrated, and then select full, single, offset calibration method.

OFFSET CALIBRATION:

For simple offset type calibration simply induce the signal into the analog input and make sure the MicroMV is reading it. After you verify that the MicroMV recognized the analog input, enter the correct mA reading, and then click OK. The offset type calibration is mainly used when a small offset adjustment needs to be changed in the full-scale reading. The offset will apply to the zero and span. Offset is the recommended method for calibrating the temperature input.

FULL CALIBRATION METHOD:

To perform full calibration be prepared to induce zero and span type signal.

1. Induce the low end signal i.e. 4mA in the analog input.
2. Click inputs to be calibrated under calibration menu, click full calibration, enter the first point - the analog input value i.e. 4mA, and then click OK button.
3. Now be ready to enter the full-scale value. Simply induce the analog signal and then enter the second value i.e. 20mA, and then click OK button
4. ***Induce live values to verify the calibration***.

TO USE DEFAULT CALIBRATION

1. Select Analog Input
2. Select Reset calibration method
3. ***Now verify the live reading against the flow computer reading***

RTD calibration:

RTD Calibration is a 2-step process. The first step is a onetime procedure to verify transducer linearity and is done at the time the meter is being setup. The second step is the routine calibration sequence.

Step 1 – Linearity Verification

1- Use a Decade box with 0-150 °F settings.
2- Connect RTD cable to this resistive element for verification of linearity. Verify low and high points. It must be within ½ degree.
3- Connect the actual RTD element and compare with a certified thermometer.
4- If not within ½ degree do a Full Calibration (See Full Calibration below). If problem persists verify other elements such as RTD Probe, connections, shield, conductivity of connectors, etc.

The purpose of the above procedure is to verify zero and span and make sure that the two points fall within the expected tolerance.

Step 2 – Routine Calibration

Once Linearity has been verified through Step 1, the routine calibration procedure is reduced to simply connecting the actual RTD and doing an offset point calibration (see offset calibration below).

Calibration after that will be simple verification for the stability of the transmitter. If it drifts abnormally then you need to verify the other parts involved.

Calibration Procedures through Windows™ Software

At the top menu, go to Calibration and Select RTD Input.

RESET TO DEFAULT CALIBRATION
1. Select Reset calibration method
2. **Now verify the live reading against the flow computer reading**

OFFSET CALIBRATION:
1. Select offset calibration method.
2. Induce a live value and wait for 10 seconds for the reading to stabilize. Then enter the live value. The value entered must be in Ohm only.
3. **Now verify the live reading against the flow computer reading**

FULL SCALE CALIBRATION:
1. Prepare low range resistive input (i.e., 80 Ohm.) and High range resistive input (i.e., 120. Ohm).
2. Go to the calibration menu and select RTD full calibration method. Induce the low end (80 Ohm.) resistive signal and then wait 10 seconds, enter live value in Ohm, and click OK button.
3. Induce the High range signal (120 Ohm.) and wait 10 seconds, then enter 120 Ohm and click OK button.
4. **Now verify the live reading against the flow computer reading**.

Calibration of Analog Output:

To calibrate the analog output against the end device follow the following steps:

1. Go to the calibration menu, select analog output, and then select method. Full calibration will cause the flow computer to output the minimum possible signal 4 mA. Enter the live output value reading in the end device i.e. 4 mA and click OK button. Now the flow computer will output full scale 20 mA. Enter the live output i.e. 20 then click OK button.
2. ***Now verify the output against the calibration device***.

Multi-Variable Transmitters (Model 205)- DP and Pressure

Calibrations are performed under **Calibration**. . Select inputs to be calibrated, and then select full, single, offset calibration method.

OFFSET CALIBRATION

1. Induce live value for pressure or DP.
2. Select Multivariable DP or pressure.
3. Select offset calibration method, enter offset, and click OK button.
4. ***Now read induce live values to verify the calibration.***

FULL SCALE CALIBRATION

1. Induce live value for pressure or DP.
2. Select Multivariable DP or pressure
3. Select full calibration method
4. Induce the low range signal, enter the first point, and then click OK button.
5. Induce the high range signal, enter the second point, and then click OK button.
6. ***Now verify the live reading against the flow computer reading***.

TO USE DEFAULT CALIBRATION

1. Select Multivariable DPor pressure
2. Select Reset calibration method
3. Now verify the live reading against the flow computer reading

While doing calibration before downloading any of the calibrated values, it is a good practice to verify that the Micro MV close reading to the induced value.
The DP reading must be re-calibrated for the zero offset after applying line pressure.

Multi-Variable Transmitters (Model 205) –RTD

RTD Calibration is a 2-step process. The first step is a onetime procedure to verify transducer linearity and is done at the time the meter is being setup. The second step is the routine calibration sequence.

Step 1 – Linearity Verification

1. Use a Decade box with 0-150 °F settings.
2. Connect RTD cable to this resistive element for verification of linearity. Verify low and high points. It must be within ½ degree.
3. Connect the actual RTD element and compare with a certified thermometer.
4. If not within ½ degree do a Full Calibration (See Full Calibration below). If problem persists verify other elements such as RTD Probe, connections, shield, conductivity of connectors, etc.

The purpose of the above procedure is to verify zero and span and make sure that the two points fall within the expected tolerance.

Step 2 – Routine Calibration

Once Linearity has been verified through Step 1, the routine calibration procedure is reduced to simply connecting the actual RTD and doing an offset point calibration (see offset calibration below).

Calibration after that will be simple verification for the stability of the transmitter. If it drifts abnormally then you need to verify the other parts involved.

Calibration Procedures through Windows™ Software

At the top menu, go to Calibration and Select RTD Input.

RESET TO DEFAULT CALIBRATION

1. Select Reset calibration method
2. **Now verify the live reading against the flow computer reading**

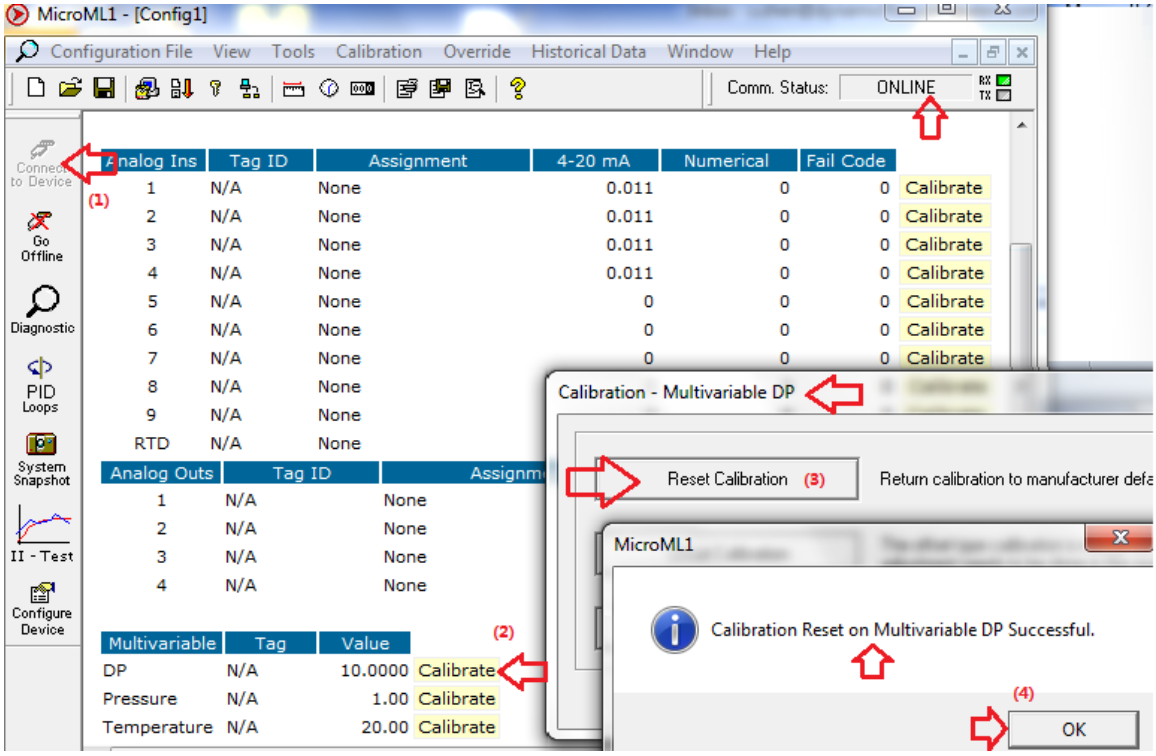
OFFSET CALIBRATION:

1. Select offset calibration method.
2. Induce a live value and wait for 10 seconds for the reading to stabilize. Then enter the live value. The value entered must be in Degrees only.
3. **Now verify the live reading against the flow computer reading**

FULL SCALE CALIBRATION:

1. Prepare low range resistive input (i.e., 80 Ohm.) and High range resistive input (i.e., 120. Ohm).
2. Go to the calibration menu and select RTD full calibration method. Induce the low end (80 Ohm.) resistive signal and then wait 10 seconds, enter the equivalent temperature in degrees, and click OK button.
3. Induce the High range signal (120 Ohm.) and wait 10 seconds, then enter the temperature degrees equivalent to 120 Ohm and click OK button.
4. **Now verify the live reading against the flow computer reading**.

Example: Reset Multivariable DP Calibration



Verifying Digital Inputs and Outputs

Use the diagnostic menu. to verify all inputs and outputs. A live input and output is displayed. On the top of the screen pulse inputs and density frequency input are shown. Compare the live value against the displayed value on the screen. Failure to read turbine input could be a result of a bad preamplifier or the jumper selection for sine and square wave input are not in the correct position. Refer to wiring diagram **`Wiring | Turbine`** for proper turbine input wiring. Density input can be sine or square wave with or without DC offset. Minimum accepted signal has to be greater than 1.2 volt peak to peak. Status input is shown below the frequency input to the left of the screen. When the status input is on, the live diagnostic data will show **`ON`**. Minimum voltage to activate the status is 6 volts with negative threshold of 2 volts. To activate the switch outputs to the on and off position, click on "Enable/Disable Diagnostic" button in the diagnostic menu. After the screen freeze, click on "Toggle ON/OFF" button to toggle the switch on/off . To exit, click on "Enable/Disable Diagnostic" button again. The switch outputs are open collector and require external voltage.

Well Testing

Up to ten stages can be configured to do injection testing. Each stage has its own duration and logging interval. **When the test is prompted all previous historical data has to be retrieved before the test is requested**. All historical data will be deleted as soon as the test starts.
Once the test is complete the flow computer will idle until the unit is taken out of test mode. And then it will start storing the data from scratch on hourly basis per our standard.
The test will end automatically even if the operator did not end the test once the time period for testing expires.

Edit Settings
The test consists of up to ten stages. Each stage has its own duration and logging interval. Stage duration is given in hours and logging interval is given in seconds. There is no limit in the length of the stage or logging interval, the only limitation is memory capacity, which is shown by the memory bar at the bottom of the Settings window.

If data damping is necessary use the Average period entry. This option allows for data averaging. The computer samples data every second and the period entered (in Seconds) indicates the amount of samples used for the average. For example, entering 3 seconds, stores the average value of the last 3 seconds.

Use the Settings window to enter the different stages and their intervals, for non-used stages type 0 (zero) as the duration.

IMPORTANT: The settings must be downloaded to the flow computer for them to have effect. The settings can be changed while a test is in progress but the changes will only affect stages that have not started yet.

Start Test
By pressing the Start Test button the flow computer will enter in Test Mode, deleting all previous historical data and test data. If there is relevant historical information in the flow computer it must be retrieved before starting the test. Once the Test has started the II Test window will indicate the test progress, remaining time, current stage and time remaining for the next log.

Stop Test
The II Test can be stopped at any time. If the test run for enough time to log data a Data Ready will appear in the Test Status. This data can be retrieved by pressing the Retrieve button.

Reset Test Data
This button clears all test and historical information and exits the flow computer from the test mode and it will start storing alarms, audit trail and data from scratch on hourly basis per our standard.

The Reset Test Data button does not delete the Test data stored in the PC's database so it can be viewed in a later time.

Retrieve Test Data
This button retrieves all the formation of the last test done from the flow computer. Once this information is retrieved it is stored in Dynacom's database for later viewing. The Database always keeps the last test retrieved.

Show Last Data
This buttons allow the user to view, print and export the test data stored in the PC's database which is the last test uploaded from the from computer.

CHAPTER 2: Data Entry and Configuration Menus

Introduction to the Micro M.V. Computer Software

The Micro MV Liquid software is constructed around a menu-driven organization

Configuration File

New

Create a new file to store all the programmed information for one Micro MV Liquid Flow Computer. After a file is opened it becomes the currently active file, its contents can be viewed and its parameters can be edited.

Open

Use this function to open an existing configuration file. After a file is opened it becomes the currently active file, its contents can be viewed and its parameters can be edited. When this function is chosen a list of existing configuration files is displayed. Select the file to be opened.

Close

Close or exit configuration file.

Save

When permanent modifications are performed on a file, user must save the new changes before exiting the program, or proceeding to open a different file.

Save As

Use Save As to save the parameters in the currently active file (that is, the parameter values currently being edited) to a new file. The original file will remain in memory.

VIEW

View Drawings

Select the wiring diagram to be displayed. (See details in chapter 1)

- Back Panel
- Analog Input
- RTD
- Analog Output
- Status Input
- Switch Output
- Turbine
- Densitometer
- RS 232
- RS 485

TOOLS

Communication Port Settings

SERIAL COMMUNICATIONS

Communication Port Number

Enter the PC port used to communicate with the Micro MV Liquid Flow Computer.

Baud Rate

> *Note: this parameter must be set the same for both the PC and the Micro MV Liquid Flow Computer for communication to occur.*

Baud rate is defined as number of bits per second. The available selections are 1200, 2400, 4800, 9600, or 19200.

Parity

> *Note: this parameter must be set the same for both the PC and the Micro MV Liquid Flow Computer for communication to occur.*

RTU - NONE
ASCII - EVEN or ODD

Set the parity to match the **`Modbus Type`**.

Data Bits

Options available: 5, 6, 7, or 8. Generally used: 8 for RTU mod, 7 for ASCII mode.

Stop Bits

Options available: 1, 1.5,or28. Generally used: 1.

Modbus Type

> *Note: this parameter must be set the same for both the PC and the Micro MV Liquid Flow Computer for communication to occur.*

The Modbus Communication Specification is either Binary RTU or ASCII.

Auto Detect Settings

Click this button and the configuration program will attempt to communicate with a single Micro MV Liquid Flow Computer at different baud rates and formats.
Failure to communicate can occur because of a wiring problem, wrong PC port selection, communication parameter mismatch between PC and Micro MV Liquid Flow Computer. (Modbus type, parity, baud rate, etc.) or lack of power to the Micro MV Liquid Flow Computer. To use this feature, the user must insure that only one Micro MV Liquid Flow Computer is connected to the PC. More than one Micro MV Liquid Flow Computer in the loop will cause data collisions and unintelligible responses

FLOW CONTROL

RTS Flow Control

Turns the RTS flow control on and off. The Enable option turns ON the RTS line during the connection. The Handshake option turns on RTS handshaking. Disable turns OFF the RTS line. Toggle specifies that the RTS line is high if bytes are available for transmission. After all buffered bytes have been sent the RTS line will be low.

DTR Flow Control

Specifies the DTR flow control. Enable turns ON the DTR line during the connection. Handshake turns on DTR handshaking. Disable turns off the DTR line.

CTS Flow Control

Turns the CTS flow control on and off. To use RTS/CTS flow control, specify Enable for this option and Handshake control for the RTS option.

USE INTERNET PROTOCOL

Check the box if you are planning to communicate using an Ethernet connection instead of a serial connection.

IP Address

IP Address of the target Flow Computer. This address must follow the addressing standard xxx.xxx.xxx.xxx. You must provide both IP Address and Port in order to communicate with a flow computer.

Port

In conjunction with the IP Address, a port number must be specified. The default port number for Modbus/Ethernet bridges is 502 but it can be any number.

Protocol

Select a Modbus TCP or TCP/IP Encapsulation protocol to be used through Ethernet connection.

Unit I Modbus TCP –

Also known as Modbus Ethernet consists of a Modbus message without CRC wrapped by a TCP/IP message. This protocol is generally used by industrial Modbus to Ethernet converters.

TCP/IP Encapsulation –

Also known as TCP/IP Pass Through Mode consists of a regular Modbus message embedded in a TCP/IP message. This protocol is generally used by a general purpose Ethernet to Serial converters.

UNIT ID NUMBER

The Unit ID Number is used strictly for communication purposes; it can take any value from 1 to 247. Only one master can exist in each loop.

> *Note: Do not duplicate the Unit ID number in a single communication loop! This situation will lead to response collisions and inhibit communications to units with duplicate ID numbers.*

TIME OUT

The amount of time in seconds the program will wait for an answer from the flow computer.

RETRY TIMES

Retry times for the program to communicate with the flow computer in case of timeout.

Meter Configuration

METER DATA

Meter ID

Up to 8 characters. This function will serve as meter tag.

Flow Equation Type

0 = Cone/Smart Cone
1 = API 14.3 (NEW AGA3)
2 = Wedge
3 = Venturi
4 = Frequency Device or Turbine
5 = Annubar

Select the desired calculation mode. API 14.3 is the latest orifice calculations introduced in 1994 All new installations are recommended to use API 14.3 for orifice calculations.

Flow Rate Low/High Limit

The high/low flow rate alarm is activated, when net flow rate exceeds or is below the set limit. The alarm will be documented with time, date, and totalizer.

Unit of Measurement

Select desired units 0=BBL, 1=GAL, 2=CF.. The Micro MV Liquid Flow Computer will perform the proper conversion routine from barrels to gallons to cubic feet.

CONE/SMART CONE DATA

To set Cone flow parameters, set **`Flow Equation Type = 0`**, and click "eq. settings" button. You will then access a submenu in which you can set the parameters below.

Pipe I.D.

Orifice ID

Pipe ID in inches is the measured inside pipe diameter at reference conditions. Orifice ID is the measured diameter of the orifice at reference conditions.

DP Cutoff

The EPLUS Flow Computer suspends flow rate calculations whenever the DP, in inches of water column (us unit) or in mbar or in KPA (metric unit), is less than this value. This function is vital for suppressing extraneous data when the DP transmitter drifts around the zero mark under no-flow conditions.

Y Factor

Selection	Description
0	Non-Compressible
1	Compressible Fluids – Precision
2	Compressible Fluids – Wafer & Cone

Isentropic Exponent (Specific Heat)

Ratio of specific heat is a constant associated with each product. Even though it varies slightly with temperature and pressure, in all cases it is assumed as a constant.

Flow Coefficient

Enter flow coefficient of the meter. Using zero is a command to use the flow coefficient linear factor.

Pipe and Cone Thermal Expansion Coefficient E-6

Enter the Pipe and cone material coefficient of thermal expansion.
Note: *the value is typically between 5.0e-6 and 10.0e-6.*

API 14.3 DATA (NEW AGA3)

To set API 14.3 flow parameters, set **`Flow Equation Type = 1`**, and click "eq. settings" button. You will then access a submenu in which you can set the parameters below.

Pipe I.D. Inches

Orifice ID Inches

Pipe ID in inches is the measured inside pipe diameter to 5 decimals at reference conditions. Orifice ID in inches is the measured diameter of the orifice at reference conditions.

DP Cut off

The Micro MV Liquid Flow Computer suspends all calculations whenever the DP, in inches of water column, is less than this value. This function is vital for suppressing extraneous data when the DP transmitter drifts around the zero mark under no-flow conditions.

Y Factor (0=None,1=Upstream,2=Downstream)

Y factor is the expansion factor through the orifice. The user must enter the position of the pressure and temperature sensors. Select y=1 if the sensors are installed upstream of the orifice plate. Select y=2 if the sensors are downstream of the orifice plate.

Isentropic Exponent (Specific Heat)

Ratio of specific heat is a constant associated with each product. Even though it varies slightly with temperature and pressure, in most cases it is assumed as a constant.

Viscosity in Centipoise

Viscosity is entered in centipoise even though viscosity will shift with temperature and pressure; the effect on the calculations is negligent. Therefore using a single value is appropriate in most cases.

Reference Temperature of Orifice

Reference temperature of orifice is the temperature at which the orifice bore internal diameter was measured. Commonly 68 °F is used.

Orifice Thermal Expansion Coeff. E-6

Orifice thermal expansion is the linear expansion coefficient of orifice material.

Type 304 and 316 Stainless	9.25 E-6
Monel	7.95 E-6
Carbon Steel	6.20 E-6

Reference Temperature of Pipe

Reference temperature of pipe is the temperature at which the pipe bore internal diameter was measured. Commonly 68 °F is used.

Pipe Thermal Expansion Coeff. E-6

Pipe thermal expansion is the linear expansion coefficient of pipe material.

Type 304 and 316 Stainless	9.25 E-6
Monel	7.95 E-6
Carbon Steel	6.20 E-6

WEDGE METER DATA

To set Wedge meter flow parameters, | **`Flow Equation Type = 2,`** and click "eq. settings" button. You will then access a submenu in which you can set the parameters below.

DP Cutoff

The Micro MV Liquid Flow Computer suspends all calculations whenever the DP, in inches of water column, is less than this value. This function is vital for suppressing extraneous data when the DP transmitter drifts around the zero mark under no-flow conditions.

Flow Coeff Kd2 and Expansion Factor Fa

$$\textbf{Flow Rate (GPM)} = (5.668 \, x \, F_a \, x \, K_{d2}) \times \sqrt{\frac{DP}{SG}}$$

$\textbf{DP} = differential\ pressure, inches\ of\ water$

$\textbf{SG} = liquid\ specific\ gravity\ at\ flow\ conditions$

$\textbf{F}_\textbf{a} = Expansion\ coefficient\ of\ wedge$

$\textbf{K}_\textbf{d2} = Discharge\ coefficient\ of\ wedge$

VENTURI DATA

To set Venturi flow parameters, set **`Meter Data|Flow Equation Type = 3,`** and click "eq. settings" button. You will then access a submenu in which you can set the parameters below.

Pipe I.D. Inches

Pipe ID in inches is the measured inside pipe diameter to 5 decimals at reference conditions.

Orifice ID Inches

Orifice ID in inches is the measured diameter of the Venturi throat.

DP Cutoff

The Micro MV Liquid Flow Computer suspends all calculations whenever the DP, in inches of water column, is less than this value. This function is vital for suppressing extraneous data when the DP transmitter drifts around the zero mark under no-flow conditions.

Y Factor (0=None,1=Upstream,2=Downstream)

Y factor is the expansion factor through the Venturi. The user must enter the position of the pressure and temperature sensors. Select y=1 if the sensors are installed upstream of the Venturi. Select y=2 if the sensors are downstream of the Venturi.

Isentropic Exponent (Specific Heat)

Ratio of specific heat is a constant associated with each product. Even though it varies slightly with temperature and pressure, in most cases it is assumed as a constant.

Reference Temperature of Orifice

Reference temperature of orifice is the temperature at which the orifice bore internal diameter was measured. Commonly 68 °F is used.

Orifice Thermal Expansion Coeff. E-6

Orifice thermal expansion is the linear expansion coefficient of Venturi throat material.

Type 304 and 316 Stainless	9.25 E-6
Monel	7.95 E-6
Carbon Steel	6.20 E-6

Pipe Thermal Expansion Coeff. E-6

Pipe thermal expansion is the linear expansion coefficient of pipe material.

Type 304 and 316 Stainless	9.25 E-6
Monel	7.95 E-6
Carbon Steel	6.20 E-6

Discharge Coefficient C

This value is the discharge coefficient for Venturi flow equations. The default value is 0.9950.

FREQUENCY DEVICE DATA

To set Frequency Device flow parameters, set **Meter Data | Flow Equation Type = 4** and click "eq. settings" button You will then access a submenu in which you can set the parameters below.

Mass Pulse

Enter '1' to select mass pulse input in LB.

K Factor

K Factor is the number of pulses per unit volume, i.e. 1000 pulses/Unit. The meter's tag would normally indicate the K Factor.

Meter Factor

Meter Factor is a correction to the K Factor for this individual meter, applied multiplicatively to the K factor.

Flow Cutoff Frequency (0-99)

The Micro MV Liquid Flow Computer will quit totalizing, when frequency is below the set limit. This feature is to reduce extraneous noise appearing as data when the meter is down for period of time. The totalizer will stop totalizing when the turbine frequency is below the limit.

Retroactive Meter Factor

If zero is selected, the meter factor will not apply to the entire batch. It will only apply from the time the new meter factor is entered. Retroactive meter factor, on the other hand, will apply to the entire batch and the entire batch is re-calculated, using the new meter factor.

Gross Include Meter Factor

Enter '1' to include meter factor in gross flow.

Linear Factor

Enter the different correction factors for the meter at different flow rates. The flow computer will perform linear interpolation. Notice that even though using this feature enhance the measurement accuracy, performing audit trail on a linearized meter factor is very difficult.

ANNUBAR DATA

To set Annubar flow parameters, set **Meter Data|Flow Equation Type = 5,** and click "eq. settings" button. You will then access a submenu in which you can set the parameters below.

Pipe I.D. Inches

Pipe ID in inches is the measured inside pipe diameter to 5 decimals at reference conditions.

Annubar Blockage Number

$$Blockage = \frac{4 \times d}{\pi \times D}$$

where D = *Pipe I.D.*

d = *Annubar Blockage Number*

π=3.141592654

DP Cutoff

The Smart Flow Computer suspends all calculations whenever the DP, in inches of water column, is less than this value. This function is vital for suppressing extraneous data when the DP transmitter drifts around the zero mark under no-flow conditions.

Flow Coefficient K

Flow coefficient for pipe dimension and wall thickness.

Isentropic Exponent (Specific Heat)

Ratio of specific heat is a constant associated with each product. Even though it varies slightly with temperature and pressure, in most cases it is assumed as a constant.

Reynolds Number Factor (FRA)

Reynolds number factor set at 1.0 for Diamond II Annubar.

Manometer Factor (FM)

Manometer factor set at 1.0 for electronic transmitters.

Gage Location Factor (FL)

Gravity correction factor (for liquid manometers only)

Thermal Expansion Factor (FAA)

Thermal expansion factor of the pipe. **FAA** = 1.0 is fine for the range 31°F ≤ T ≤ 106°F.

Reference Temperature

Reference temperature is the temperature at which the orifice bore internal diameter was measured. Commonly 68 °F is used.

Thermal Expansion Coeff.E-6

Linear coefficient of thermal expansion (6.2E-6 for carbon steel)

Type 304 and 316 Stainless	9.25 E-6
Monel	7.95 E-6
Carbon Steel	6.20 E-6

PRODUCT DATA

End the current batch is required to use the new product data settings.

Product Name

Up to 16 characters.

Table Selection

0=	5A/6A	8=	N/A	15=	Saturated Steam(IAPWS-IF97)*
1=	6A	9=	N/A	16=	Water
2=	5B/6B	10=	24C	17=	N/A
3=	6B	11=	6C	18=	New 23/24
4=	23A/24A	12=	N/A	19=	ASTM1550A/B
5=	24A	13=	N/A	20=	ASTM1550B
6=	23B/24B			21=	NIST14*****
7=	24B	14=	N/A	22=	PPMIX

Table A is for Crude, the Table B is for refined products, the Table C is for special products - butadiene, toluene. OLD Tables are used for LPG and NGLs.

For this Product	Use this Table	Under these Conditions
Crude oil, natural gasoline, drip gasoline	***6A,24A***	Density is known
Crude oil, natural gasoline, drip gasoline	5A/6A,23A/24A	Live densitometer used
Gasoline, naphthalene, jet fuel, aviation fuel, kerosene, diesel, heating oil, furnace oil	5B/6B,23B/24B	Live density is used
Gasoline, naphthalene, jet fuel, aviation fuel, kerosene, diesel, heating oil, furnace oil	6B, 24B	No live density is used
Benzene, toluene, styrene, *ortho*-xylene, *meta*-xylene, acetone	6C/24C	All conditions
LPG	OLD 23/24	Live density is used
LPG	OLD 24	Density is known
LPG	New 23/24	All conditions
	ASTM1550A/B	Live density is used
	ASTM1550B	Density is known
Mixture Property	NIST14	All conditions
PPMix	PPMIX	Live density is used

When Ethylene-API2565-NBS1045 is selected and API2565 is out of range, NBS 1045 is used for calculations.
Light products: GPA15 is used to calculate vapor pressure. Pressure correction is performed per Ch. 11.2.1, Ch. 11.22.

This Parameter is Required	For These Tables
API Gravity at 60 Deg.F	1, 3, 11
Specific Gravity at 60 Deg.F	5, 7, 9, 10, 14
Density at 60 Deg.F	12, 13, 15, 16,
Alpha T E-6	10, 11

Alpha T E-6

The Alpha T will be prompted only if table 6C or 24C is selected. Enter Alpha T value, the number entered will be divided by 10^{-6}.

Example: Entered Value 335 (Actual value 0.000335)

***IAPWS-IF97:** Calculate density for wet steam based on its pressure and quality (vapor content)
Enter 0% quality for water and 100% quality for steam

OTHER PARAMETERS

Company Name

Up to 20 characters. The company name appears in the reports.

Meter Location

Up to 20 characters. This entry appears only in the report and serves no other function.

Day Start Hour (0-23)

Day start hour is used for batch operation. If daily batch is selected, the batch will end at day start hour, all batch totalizers and flow-weighted values are reset.

Disable Alarms

Use Disable Alarms to ignore alarms. When the alarm function is disabled alarms are not logged. Alarms are also not logged if the DP is below the cut-off limit.

Use Customized Reports

Enable this feature to use customized hourly reports instead of standard reports.

Atmospheric Pressure

Local pressure or contracted atmospheric pressure. (i.e. 14.73 PSI).

Scale Value

Scale value **uses high limit parameters**. Full-scale value can be selected using 32767 or 4095.

Example:
Current temperature reading is 80 Degree F

Select Scale Value Data Entry	32767	4095
Temperature High Limit Data Entry	32767	4095
Value of Modbus Register <3059>	80	80

Bi-Directional

This feature allows a status input or multi-variable DP indication to give direction for the meter. Bi-directional totalizers will totalize accordingly.

Flow Rate Selection

The flow rate will be based on daily basis, hourly, or minute.

Flow Rate Average Second

The flow rate is averaged for 1-5 seconds to minimize fluctuating flow rate conditions. This number averages the current flow rate by adding it to the previous seconds' flow rate, and then displays an averaged smoothed number. Only a low-resolution pulse meter requires this function.

Base Temperature

The Contracted reference temperature in which all the corrections are based on. Typically 60.0 Degrees F is in US units and 15 Degrees C in Metric units.

Daylight Saving Time (DST)

Enabling Daylight Saving Time (also called "Summer Time") sets the Flow Computer to automatically forward its time by one hour at 2:00 AM on a preset day ("Spring Forward") of the year and roll back on a second date("Fall Back").

If left in auto mode, the computer calculates the DST dates based on USA standards, which are, Spring Forward the first Sunday of April and Fall Back the last Sunday of October.

For countries with other DST dates, the user can enter dates manually. For example, European Summer Time starts the last Sunday in March and ends the last Sunday in October.

Effects of DST on Historical Data

Given the sudden time change that DST creates, the historical reports will show an hour with zero flow at 2:00 AM of Spring Forward Day and an hour with double flow at 1:00 AM of Fall Back Day, to achieve consistent 24-Hour a day flow records.

PID PARAMETERS

PID CONFIGURATION

(PID) Proportional Integral Derivative control– We call this function PID, however the flow computer performs Proportional Integral control. And does not apply the Derivative. The Derivative is not normally used in flow and pressure control operations and complicates the tuning operation

Use Flow Loop

(Valid entries are 0 or 1)
Enter 1 if the computer performs flow control.
Enter 0 if the flow computer does not perform flow control.

Flow Loop Maximum Flow rate

Enter the maximum flow rate for this meter. This rate will be basis for maximum flow rate to control at.

Flow Set Point

Enter the set point. The set point is the flow rate that the flow computer will try to control at.

Flow Acting – forward or reverse

Enter 0 if the control is direct acting, Enter 1 if the control is reverse acting.
Direct acting is when the output of the controller causes the flow rate to follow in the same direction. The output goes up and the flow rate increases. A fail Close valve located in line with the meter will typically be direct acting. If the Controller output signal increases, the control valve will open more causing the flow rate to increase.
Reverse acting is when the output of the controller causes the opposite action in the flow rate. A fail open valve in line with the meter will typically be reverse acting. If the Controller output increases the control valve will close some causing the flow rate to decrease.
Care must be taken to study where the valves are located in relation to the meter and whether the valves are fail open or fail close to understand if the controller should be direct or reverse acting. Some control valves can be fail in position (especially Electrically actuated control valves). This valve should be studied to understand if the actuators themselves are direct or reverse acting.

Use Pressure Loop

(Valid entries are 0 or 1)
Enter 1 if the computer performs pressure control.
Enter 0 if the flow computer does not perform pressure control.

Pressure Maximum

Enter the Maximum pressure for this meter. This pressure will be basis for Maximum pressure to control at.

Pressure Set Point

Enter the set point. The set point is the pressure that the flow computer will try to control at.

Pressure Acting – forward or reverse

Enter 0 if the control is direct acting, Enter 1 if the control is reverse acting.
Direct acting is when the output of the controller causes the pressure to follow in the same direction. The output goes up and the pressure increases. A fail open valve located in the line downstream of the meter will typically be direct acting to maintain the pressure at the meter. An Increase in the output from the controller will cause the control valve to close thus causing the pressure to increase.
Reverse acting is when the output of the controller causes the opposite action in the flow rate. A fail close valve in the line downstream of the meter will typically be reverse acting to maintain the pressure at the meter. An increase in the output signal will cause the valve to open, which will cause the pressure to be released thus causing the pressure to decrease.
Care must be taken to study where the valves are located in relation to the meter and whether the valves are fail open or fail close to understand if the controller should be direct or reverse acting. Some control valves can be fail in position (especially Electrically actuated control valves). These valves should be studied to understand if the actuators themselves are direct or reverse acting.

System Data Minimum Output

Enter the minimum output percent (default to 0)

System Data Maximum Output

Enter the maximum output percent (default to 100.0)

Signal Selection

If flow loop and pressure loop are both configured in the PID control loop, select high or low signal to be the output.

PID flow Base

PID flow rate base can be gross, net, or mass flow rate.

PID TUNING

Flow Controller Gain

(Allowable Entries 0.0 – 9.99)
The gain is effectively 1/Proportional Band.
The basis of theory for proportional band is the relationship of the percentage of the output of the controller to the percentage of the change of the process. In this case, if the control output changes 5% the flow rate should change 5%, the proportional band would be 1.0 and the gain would be 1.0.
If the percentage of the output is 5% and the flow rate would change by 10%, the proportional band would be 2 and the Gain would be 0.5
However since you do not know until you are flowing the effect of the output on the flow rate, you have to start somewhere. A good starting point is to use a proportional band of 0.5 if the valve is properly sized.

Flow Controller Reset

(Allowable Range 0.0 – 9.99)
Reset is the number of minutes per repeat is the time interval controller adjusts the output to the final control element. If the reset is set at 2, the flow computer will adjust the signal to the flow control valve every 2 minutes. If the Reset is set at 0.3, the output signal will be adjusted approximately every 20 seconds, until the process and set point are the same.
The rule of thumb is the reset per minute should be set slightly slower that the amount of time it takes for the control valve and the flow rate to react to the flow computer output signal changing.
This can only be determined when there is actual flow under normal conditions. It is best to start the reset at 0.3 or reset the signal every 3 minutes, if the control valve is properly sized.

Pressure Controller Gain

(Allowable Entries 0.0 – 9.99)
The gain is effectively 1/Proportional Band.
The basis of theory for proportional band is the relationship of the percentage of the output of the controller to the percentage of the change of the process. In this case, if the control output changes 5% the pressure should change 5%, the proportional band would be 1.0 and the gain would be 1.0.
If the percentage change of the output is 5% and the pressure would change by 10%, the proportional band would be 2 and the Gain would be 0.5.
However since you do not know until you are flowing the effect of the output on the pressure, you have to start somewhere. A good starting point is to use a proportional band of 0.5 if the control element is properly sized.

Pressure Controller Reset

(Allowable Range 0.0 – 9.99)
Reset is the number of times per minute the controller adjusts the output to the control valve. If the reset is set at 2, the flow computer will adjust the signal to the final control element every 2 minutes. If the Reset is set at 0.3, the output signal will be adjusted approximately every 20 seconds, until the process and the set point are the same.
The rule of thumb is the reset per minute should be set slightly slower that the amount of time it takes for the control valve and the pressure to react to the flow computer changing the output.
This can only be determined when there is actually flow under normal conditions. It is best to start the reset at 0.3 or reset the signal every 3 minutes, if the control element is properly sized.

INPUT/OUTPUT

TRANSDUCER INPUT TAGS

Up to 8 alphanumeric ID number. The transmitters are referred to according to the TAG ID. All alarms are labeled according to TAG ID. The multi-variables are referred to according to the TAG ID

STATUS INPUT/SWITCH OUTPUT ASSIGNMENT

Status Input Assignment

User can select any one of status input and assign it to input point.

	Assignment	Comments
1	End Batch	End the batch and reset batch totalizer
2	Print Request	
3	Calibration Mode	
4	Alarm Acknowledge	Reset the previous occurred alarms output bit
5	Flow Direction	"Off"= forward and "ON"= reverse. For bi-directional meters
6	Event Status	

.

Switch Output Assignment

User can assign an output to each of the Micro MV Liquid Flow Computer's output switches from this list. The Micro MV Liquid Flow Computer switch outputs are open collector type, requiring external D.C power.
Outputs in the top list, "Pulse Outputs", require a definition of pulse output per unit volume. Therefore a Pulse Output Width must be defined when one of these switch types are chosen. These outputs are available through switches 1 or 2 only.
Outputs in the bottom list, "Contact Type Outputs", are ON/OFF type outputs. They can be assigned to any of the four switch outputs.

Switches 1 and 2 can be pulse or contact type output; switches 3, 4 are contact-type output only.

Assignments – Pulse Outputs

Gross	101
Net	102
Mass	103

Assignments – Contact Type Outputs

Batch Ended (5 sec)	113
Day Ended (5 seconds)	114
Meter Down	115
Flow Low	116
Flow High	117
Temperature Low	118
Temperature High	119
Pressure Low	120
Pressure Low	121
Density Low	122
Density High	123
Dens. Temp. Low	124
Dens. Temp. High	125
Dens. Pressure Low	126
Dens. Pressure High	127
DP Low	128
DP High	129
Dens. Period Low	130

Dens. Period High	131
Temperature Out of Range	132
Gravity Out of Range	133
Pressure Out of Range	134
Active Alarms	135
Occurred Alarms	136
Direction - Forward	137
Direction - Reverse	138
Watch Dog	139
Remote Control	140
Boolean Points*	170-199

Examples:

134 = Pressure out of range

Note - Boolean Points Assignment 170 – Boolean Point 70
Boolean Points Assignment 171 – Boolean Point 71 etc.

Pulse Output and **Pulse Output Width**

Pulse Output is used to activate a sampler or external totalizer. The number selected will be pulses per unit volume or per unit mass. If 0.1 pulse is selected, the one pulse will be given every 10-unit volumes has passed through the meter.

Pulse Output Width is the duration, in milliseconds, of one complete pulse cycle (where each cycle is the pulse plus a wait period, in a 50/50 ratio). For example: if POW = 500 mSec, the Micro MV Liquid Flow Computer at most can produce one pulse each second regardless of the pulse per unit volume selected (500 mSec pulse + 500 mSec wait). If POW = 10 mSec the Micro MV Liquid Flow Computer can produce up to 50 pulses per second.

The Micro MV Liquid Flow Computer's maximum pulse output is 125 pulses/sec. The Pulse Output in combination with the Pulse Output Width should be set so that this number is not exceeded.

ANALOG OUTPUT ASSIGNMENT

TAG ID

Up to 8 alphanumeric ID number. The transmitters are referred to according to the TAG ID. All alarms are labeled according to TAG ID

Assignments:

	Forward	Reverse	Forward/ Reverse
Gross Flow Rate	1	5	9
Net Flow Rate	2	6	10
Mass Flow Rate	3	7	11

DP	13
Temperature	14
Pressure	15
Density LB/FT3	16
Density Temperature	17
Density Pressure	18
DP LOW	19
DP HIGH	20
Density @60 – LB/FT3	21
API	22
API@60	23
Specific Gravity	24
SG@60	25
GM/CC	26

Spare #1	27
Spare #2	28
PID	29
Remote Control*	30

4-20mA

4-20mA selection must be proportional and within the range of the selected parameter. 4-20mA signals are 12 bits.

FLOW COMPUTER DISPLAY ASSIGNMENT

Display assignment selects up to 16 assignments. The Micro MV Liquid Flow Computer will scroll through them at the assigned delay time.

Assignment

3 Digit Selection, where

1st Digit: 0: Forward 1: Reverse

2nd and 3rd Digit: Selection (see table below)

Selection	Description
01	Flow Rate
02	Batch Total
03	Daily Total
04	Cum. Total
05	Previous Daily Total
06	Previous Batch Total
07	DP/DP Low, High
08	Temperature, Pressure
09	Density, Density at Base
10	Density Frequency, Densitometer period, Density GM/CC
11	SG, SG@60, API, API@60
12	Product
13	Calibration Mass Flow Rate
14	Date/Time
15	Alarm
16	Spare #1, Spare #2
17	Density Temperature, Density Pressure
18	Last Batch Average Temperature, Pressure, Density
19	Last Batch Average API, SG, GM/CC
20	Program Variable #1-#4
21	Program Variable #5-#8
22	Company, Meter ID, Location, and Plant
23	Custom Display Screen #1
24	Custom Display Screen #2

MODBUS SHIFT

Reassigns Modbus address registers on one Micro MV Liquid Flow Computer to variables for easy polling and convenience. Use Modbus Shift to collect values in scattered Modbus registers into a consecutive order. The Micro MV Liquid Flow Computer will repeat the assigned variables into the selected locations.
Note: Modbus shift registers are for READ ONLY. Some Modbus registers are 2 byte/16 bit, and some are 4 byte/32 bit. Register size incompatibility could cause rejection to certain address assignments. Refer to the manual for more details and a listing of the Modbus Address Table Registers.
Example: you want to read the current status of switches #1 and #2 (addresses 2617 and 2618) and the Forward and Reverse Daily Gross Total for Meter #1 (Addresses 3173 and 3189). Make assignments such as:

```
3082=2617
3083=2618

3819=3173
3821=3189
```

***Note: Modbus shift registers are READ ONLY registers.**

BOOLEAN STATEMENTS AND FUNCTIONS

Each programmable Boolean statement consists of two Boolean variables optionally preceded a Boolean 'NOT' function (/) and separated by one of the Boolean functions (**&, +, *)**. Each statement is evaluated every 100 milliseconds. Boolean variables have only two states 0 (False, OFF) or 1 (True, ON). Any variable (integer or floating point) can be used in the Boolean statements. The value of Integer or floating point can be either positive (TRUE) or negative (FALSE).

Boolean Functions	**Symbol**
NOT	**/**
AND	**&**
OR	+
EXCLUSIVE OR	*****

Boolean points are numbered as follows:

0001 through 0050	Digital I/O Points 1 through 50
0001 –	Status Input/Digital Output #1
0002 –	Status Input/Digital Output #2
0003 –	Status Input/Digital Output #3
0004 –	Status Input/Digital Output #4
0005 – 0050	Spare
0070 through 0099	Programmable Boolean Points (Read/Write) See Boolean Statements.

Boolean Points

0100 through 0199	Boolean Points
1st digit–always 0, 2nd digit– always 0, 3rd and 4th digit-Selection	
0n01	Gross Flow Pulses
0n02	Net Flow Pulses
0n03	Mass Flow Pulses
0n04	Spare
0n05	Meter Active
0n06	Batch Ended Flag (last 5 Seconds)
0n07	Any Active Alarms
0n08-0n10	Spare
0n11	DP Override in use
0n12	Temperature Override in use
0n13	Pressure Override in use
0n14	Density Override in use
0n15	Densitometer Temperature Override in use
0n16	Densitometer Pressure Override in use
0n16-0n19	Spare
0n20	Flow Rate High Alarm
0n21	Flow Rate Low Alarm
0n22	Temperature High Alarm
0n23	Temperature Low Alarm
0n24	Pressure High Alarm
0n25	Pressure Low Alarm
0n26	Density High Alarm
0n27	Density Low Alarm
0n28	Densitometer High Alarm
0n29	Densitometer Low Alarm
0n30	DP Inches High Alarm
0n31	DP Inches Low Alarm
0n32	Densitometer Period High Alarm
0n33	Densitometer Period Low Alarm
0n34	Densitometer Pressure High Alarm
0n35	Densitometer Pressure Low Alarm

PROGRAM VARIABLE STATEMENTS

From the MicroMV Flow Computer Configuration Software, Point cursor to **'I/O',** scroll down to **'Program Variable Statements'** and a window will pop up allowing you to enter the statements.

Enter the user programmable statements (**no space allowed**, up to 69 statements). Each statement contains up to three variables and separated by one of the mathematical functions. ***4 digits are required*** for referencing programmable variables or Boolean points. (Example: 0001+7801)

Example:
7832 is equal to total of variable#1(Modbus addr.7801) and variable#2 (Modbus addr.7802)
32=7801+7802

VARIABLE STATEMENTS AND MATHEMATICAL FUNCTIONS

Each statement can contain up to 3 variables or constants.

Function	Symbol	
ADD	**+**	Add the two variables or constant
SUBTRACT	**-**	Subtract the variable or constant
MULTIPLY	*****	Multiply the two variables or constant
DIVIDE	**/**	Divide the two variables or constants
CONSTANT	**#**	The number following is interpreted as a constant
POWER	**&**	1st variable to the power of 2nd variable
ABSOLUTE	**$**	unsigned value of variable
EQUAL	**=**	Move result to another variable Variable within the range of 7801-7899 (floating points) Variable within the range of 5031-5069 (long integer)
IF STATEMENT	**)**	Compares the variable to another

Example: 7801)T7835 (if variable is greater to or is equal to 1 then go to 7835)
7801)7802=#0 (if variable is greater to or is equal to 1 then set variable 7802 to 0)

GOTO STATEMENT	**T**	Go to a different statement (**forward only**)

Example: 7801%#60**T**7836 (if variable is equal to 60 then go to statement 7836)

COMPARE	**%**	Compare a value (**EQUAL TO**)
GREATER/EQUAL	**>**	Compare a value (**GREATER OR EQUAL TO)**

Example: 7801>7802**T**7836
(If variable 1 is greater to or equal to variable 2 then go to 7836)

Natural Log	**L**	Natural Log of variable

Order of precedence – absolute, power, multiply, divide, add and subtract.
Same precedence – left to right

INPUT ASSIGNMENT

DP/Pressure/Temperature Assignment

The Micro MV Liquid Flow Computer provides 4 analog inputs, 4 status input/switch outputs, one density frequency input, two turbine inputs, one 4 wire RTD inputs, and multi variable inputs. In order for the Micro MV Liquid Flow Computer to read the live input, the input must be properly assigned and properly wired.

0=	Not Used
1=	Analog 1
2=	Analog 2
21=	Analog 5
22=	Analog 6

3=	Analog 3
4=	Analog 4
5=	RTD
23=	Analog 7
24=	Analog 8

7 =	Dens.Freq (Not Selectable)
10 =	Multi. Variable Module
25=	Analog 9

4mA and 20mA

Enter the 4mA value and the 20mA value for the transducer.
Note that these values cannot be edited if **`Assignment`** = 0 or 10. Therefore to set the parameter **`Temperature @4mA`** the **`Temperature Assignment`** parameter cannot equal zero, or 10.

Lo/Hi Limit

Enter the low and high limits. When live values exceeds high limit or less than low limit, an alarm log will be generated.
Note that this value cannot be edited if **`Assignment`** = 0. Therefore to set the parameter **`Meter Temperature Low Limit`** the **`Temperature Assignment`** parameter cannot equal zero.

Maintenance Value

It is the value to be used when the transmitter fails or while is being calibrated. Set fail code to 1 while calibrating.
Note that this value cannot be edited if **`Assignment`** = 0. Therefore to set the parameter **`Meter Temperature Maintenance`** the **`Temperature Assignment`** parameter cannot equal zero.

Fail Code

Fail Code 0: always use the live value even if the transmitter failed.
Fail Code 1: always use the maintenance value
Fail Code 2: use maintenance value if transmitter failed. I.e. 4-20mA is >21.75 or <3.25)

Use Stack DP

The Micro MV Liquid Flow Computer allows the user to select dual DP transmitters on each meter for better accuracy and a higher range flow. Use in conjunction with the DP Switch High % parameter setting.

DP Switch High %

The Micro MV Liquid Flow Computer will begin using the high DP when the low DP reaches the percent limit assigned in this entry. Example: DP low was ranged from 0-25 inches and switch % was set at 95%. When low DP reaches 23.75 in (= 0.95 * 25) the Micro MV Liquid Flow Computer will begin using the high DP provided the high DP did not fail. When the high DP cell drops below 23.75, the Flow Computer will start using the Low DP for measurement.

Density Type

If live density is connected to the meter, user must enter the density type. Raw density frequency or a 4-20mA input can be selected. This density will be used to calculate mass flow and net flow.

Density Type	Densitometer
Type 0	None
Type 1	4–20 mA
Type 2	UGC
Type 3	Sarasota
Type 4	Solartron
Type 5	UGC2

Density 4–20 mA Type	
Type 0	Specific Gravity 4-20mA
Type 1	API Gravity 4-20mA
Type 2	Density Signal 4-20mA in GM/CC

Density 4-20mA Type

Note that this type of input requires the user to choose a subtype, as indicated in the table above.

Use Meter Temperature as Density Temperature

Allows the meter temperature to calculate the effect of temperature on the densitometer. Make sure the meter and density temperature are similar to avoid measurement errors.

Use Meter Pressure as Density Pressure

To allow the meter pressure to calculate the effect of pressure on the densitometer. Make sure the meter and density pressure are similar to avoid measurement errors.

Spare Assignment

Spare input is used for display and alarm purpose only. It is not used in the calculation process. To read spare input value, use the diagnostic screen

FC PORTS

Unit ID Number

The Unit ID Number is used strictly for communication purposes; it can take any value from 1 to 247.

> *Note: Do not duplicate the Unit ID number in a single communication loop! This situation will lead to response collisions and inhibit communications to units with duplicate ID numbers.*

Only one master can exist in each loop.

Flow Computer Ports

Port #1/#3 Modbus Type

> *Note: this parameter must be set the same for both the PC and the Micro MV Liquid Flow Computer for communication to occur.*

The Modbus Communication Specification is either Binary RTU or ASCII.

Port #1/#3 Parity

> *Note: this parameter must be set the same for both the PC and the Micro MV Liquid Flow Computer for communication to occur.*

RTU – NONE
ASCII – EVEN or ODD

Set the parity to match the **`Modbus Type`**.

Port #1/#3 Baud Rate

> *Note: this parameter must be set the same for both the PC and the Micro MV Liquid Flow Computer for communication to occur.*

Baud rate is defined as number of bits per second. The available selections are 1200, 2400, 4800, 9600, or 19200.

Port #1/#3 RTS Delay

This function allows modem delay time before transmission. The Micro MV Liquid Flow Computer will turn the RTS line high before transmission for the entered time delay period.

Port #2 Baud Rate

Baud rate is defined as number of bits per second. The available selections are 1200, 2400, 4800, 9600, or 19200.

Port #2 Modbus Type

> *Note: this parameter must be set the same for both the PC and the Micro MV Liquid Flow Computer for communication to occur.*

The Modbus Communication Specification is either Binary RTU or ASCII.

Port #2 Parity

RTU – NONE
ASCII – EVEN or ODD

Set the parity to match the **`Modbus Type`**.

Select 0=RTS, 1=Printer (N/A)

RTS line has dual function selection: either RTS for driving request to send or transmit to serial printer. To use serial printer interface for printing reports, i.e. batch, daily, and interval Connect the serial printer to RTS and common return, and select 1 for printer. Serial printer function is not available.

Port 2 RTS Delay

This function allows modem delay time before transmission. The Micro MV Liquid Flow Computer will turn the RTS line high before transmission for the entered time delay period.

Printer Baud Rate (N/A)

Baud rate is defined as number of bits per second. The available selections are 1200, 2400, 4800, or 9600.

Printer Number of Nulls (N/A)

This function is used because no hand shaking with the printer is available and data can become garbled as the printer's buffer is filled. The Micro MV Liquid Flow Computer will send nulls at the end of each line to allow time for the carriage to return. Printers with large buffers do not require additional nulls. If data is still being garbled, try reducing the baud rate to 1200.

Slave Units

The Micro MV can poll up to four slaves

Slave Unit

The Slave Unit ID Number is used strictly for communication purposes; it can take any value from 1 to 247.

VT – Variable Type

Variable type describes the position of high, low words of slave device. When a 32 bits (two words) register is polled, it is essential to define where the highest significant word is.

Code	Description	Sequence in words
0	2 registers of 16 bits integers	High, Low
1	1 register of 32 bits floating	Low, High
2	2 registers of 16 bits floating	Low, High
3	1 register of 32 bits integer	High, Low
4	2 registers of 16 bits integers	Low, High
5	1 register of 32 bits floating	High, Low
6	2 registers of 16 bits floating	High, Low
7	1 register of 32 bits integer	Low, High

DEST – Destination Address

Destination defines where the polled variables are used in the flow computer. Variable statements and other pre-defined locations are accepted. Pre-defined locations are temperature, pressure, and density. Variables can be accessed through the display and reports.

0	Floating Var#1 (7086)
1	Floating Var#1 (7087)
2	Floating Var#1 (7088)
3	Floating Var#1 (7089)
4	Floating Var#1 (7090)
5	Floating Var#1 (7091)
6	Floating Var#1 (7092)
7	Floating Var#1 (7093)
8	Floating Var#1 (7094)
9	Floating Var#1 (7095)

10	Integer Var#1(5081)
11	Integer Var#2(5083)
12	Integer Var#3(5085)
13	Integer Var#4(5087)
14	Integer Var#5(5089)
15	Integer Var#6(5091)
16	Integer Var#7(5093)
17	Integer Var#8(5095)
18	Integer Var#9(5097)
19	Integer Var#10(5099)

20	Temperature. Deg.F
21	Pressure. PSIG
22	Density LB/FT3

ADDR – Source Address

Source defines the actual registers being polled from the slave device. Source address is considered to be continuous without zero address in between.

Example: Meter #1 density uses micro motion density.

Slave ID = Micro Motion ID ***VT*** = 2, ***DEST***=22, ***ADDR***=248

Download Firmare/Image File

To Download an Image File to the Flow Computer select the Tools option form the menu, and then Download Program.
A small dialog will appear asking for the file name of the image file. Type it in or use the Browse option to locate it. Once the file name is in place press Download. This task will take about 5 minutes to be completed.

Security

SECURITY CODES

The desktop application provides 4 security areas to prevent users from entering data into certain areas. The four areas are:

Configuration: Allow user to modify device configuration settings.

Override: Allow user to change values directly on the device.

Calibration: Let the user to calibrate the device inputs.

Image File Download: Let user download an image file to the device. This procedure will erase all the information and configuration stored in the device.

Master Access: Once the master access is granted, the user can access to all four areas.

Use the **Tools|Security Codes** option to modify the access code; a form will appear showing the five different security areas and the actual access status (at bottom of the form). To put a new access code log in to the desired security area and press Change security Code, type in the code and retype it on the confirm space to avoid mistyped codes. Then click [OK].

The system will update the security access every time the application connects to the device and every time data is written to the device it will check for security access before writing.

NOTE: In case the access code is forgotten contact our offices for a reset code.

Connect to Device

Click 

to establish the communication. If the communication is failed, check information in the “Communication Port Settings”.

Go Offline

Click 

to disconnect the communication.

Modbus Driver

DFM provides this tool to read and write Modbus registers from and to the MicroMV flow computers.
It will display transmitting and receiving message in HEX format. It should be used for testing purpose only.

PID OPERATING

Click PID Loops icon to display PID output percentage, flow, and pressure data. To change setup, select entries under PID menu.

CALIBRATION

Calibrations are performed under **Calibration**. . Select inputs to be calibrated, and then select full, single, offset calibration method. (See details in chapter 1)

Calibrate Mode

To calibrate Flow Computer, totalizers will continue at same rate where live parameters will show actual value, i.e. flow rate, DP, pressure etc. Enter '1' to enable this feature.

SET TIME (1-9 HOUR)

This entry is the duration for the calibrate mode. After time expires, the Micro MV Flow Computer will resume its normal operation.

MASS FLOW RATE OVERRIDE

Override the mass flow rate during the calibration.

Parameter Overrides:

Orifice ID Override

Orifice ID in inches is the measured diameter of the orifice at reference conditions.

Temperature Override

This value is entered when no live temperature is available, or when a different value from the live value should be used.

Pressure Override

Pressure override can be used when no live pressure transmitter is connected to the Micro MV Liquid Flow Computer.

DP Override

DP override can be used when no live DP transmitter is connected to the Micro MV Liquid Flow Computer.

Venturi C Override

The value is the discharge coefficient for Venturi flow equations. The default value is .9950

Alpha T E-6 Override

Enter Alpha T Override to the batch. It will not affect the Alpha T value in the product file. Alpha T is the thermal expansion coefficient for the selected product. The flow computer divides by 1000000.

Example: 0.000355 = 355 / 1000000 (value entered is *335* for an Alpha T of 0.000355)

API/SG/Density Override

Enter Gravity Override to replace current gravity. The gravity override is a non-retroactive gravity and will not override the product file gravity. It only applies to the current running batch.

Wedge Fa Override and Wedge Kd2 Override

$$\textbf{Flow Rate (GPM)} = (5.668 \, x \, F_a \, x \, K_{d2}) \times \sqrt{\frac{DP}{SG}}$$

$DP = differential\ pressure, inches\ of\ water$

$SG = liquid\ specific\ gravity\ at\ flow\ conditions$

$F_a = Expansion\ coefficient\ of\ wedge$

$K_{d2} = Discharge\ coefficient\ of\ wedge$

End Batch

The batch will end if requested through this menu. The current batch totalizer and flow-weighted data will reset to zero. Non-resettable totalizers are not affected by the batch resetting.
Non-resettable accumulated volume will roll over at 9999999.

SYSTEM

DATE AND TIME

Change the date and time for the flow computer.

HISTORICAL DATA

VIEW, CAPTURE AND STORE

To retrieve historical data, go to **Historical Data** menu. The **View** option retrieves the data from the flow computer but does not store the information into the database. The second option, **Capture and Store**, retrieves the information, shows it on the screen and stores it on the database.

On any of these options, a small dialog like the following appears to select the amount of reports to get and from which one to start.

The valid data entries are shown at the bottom of the dialog. The available types of reports are:

PREVIOUS HOURLY DATA

Up to 1440 previous hourly data are stored in the Flow Computer. Enter number of reports and the Flow Computer will go backward from that selected report. Current hour cannot be selected.

PREVIOUS DAILY DATA

Up to 60 previous daily reports can be retrieved.

LAST MONTH DATA

One last month data is stored in the Flow Computer. Current month data cannot be retrieved.

LAST BATCH DATA

Up to 2 previous batch data are stored in the Flow Computer. Select the batch data to display, print, or capture. Current batch data cannot be retrieved.

ALARM REPORT

Up to 100 previous alarm data can be retrieved. The data are starting from the most recent to the oldest.

AUDIT REPORT

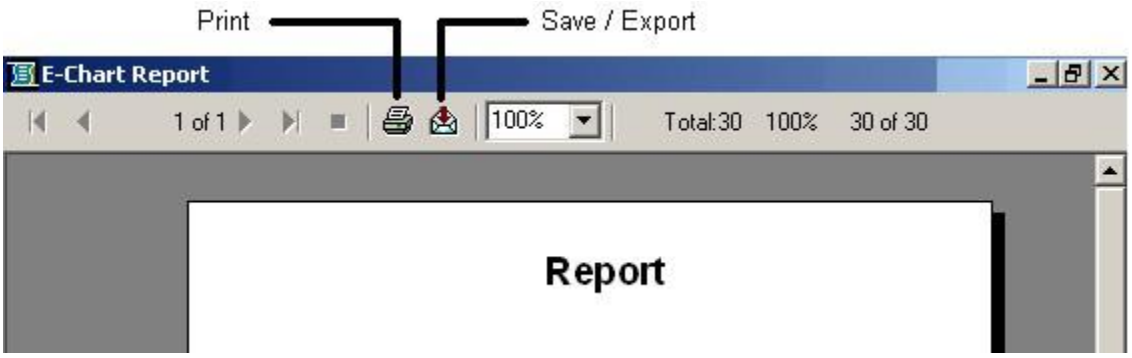
The audit trail report shows configuration parameters that has changed which could influence the calculated numbers. The Flow Computer provides up to 100 event logs. One purpose for audit trail is to back track calculation errors that result from mistakes by the operator of the flow computer operator.

Viewing previously captured reports

Once a report is stored in the database using the **Historical Data|Capture and Store** option it can be seen using the **Previously Captured Reports** option under the Historical Data Menu.

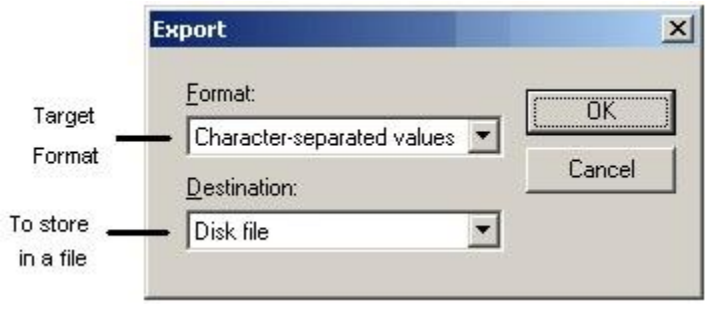
When the option is selected, a dialog will appear asking for the name of the report you want to see. There is a "View last captured report" option than will show the data acquired the last time from a device. If you want to see another report different than the last one just type the name of the report in the space provided. The browse button can be used to see the list of reports stored in the database.

Exporting or Printing Reports



Once the data is retrieved from the Flow Computer it is shown in a report format, like the picture above. On this window there are several buttons.

- **Arrow** buttons let you go through all the reports captured.
- The **Print** Button (shown o the picture) lets you print the report to any printer installed in your computer. The printed version will look just like it is shown on the screen.
- The **Export** Button allows the user to save the report in different formats. Once the button is pressed a small dialog appears showing the different formats available (see following picture).



In the first box select the format you want the file to have. **Excel**, **Word** or **HTML** formats are recommended because they preserve the report format. The plain text formats (text-format, CSV comma separated values, tab-separated values) include all the information but will require user modification to improve readability. The other text formats are **text** or **paginated text**. **IMPORTANT:** when a report is exported to text format it can only be 80 character wide, thus, some numbers might appear together making

it hard to determine their original values. (i.e. values 1.2543 and 34.2342 on following columns might appear as 1.254334.2342).

Once the export format is selected, press OK and a dialog will appear asking for the file name that you want for the report. Type in the name and press SAVE.

SCHEDULED AUTO POLLING

Automatic Data Polling

Use the **Historical Data|Scheduled Auto Polling** to retrieve report information from devices in a periodic basis automatically.

These are the following settings:

Enable Automatic Data Retrieval: Check this option to enable the automatic polling. If the automatic polling function is enabled an "AUTOPOLL" message will appear on the application's status bar (bottom-right corner of the application window).

Reports to Retrieve: check the reports you want to get from the devices, you can select as many as you want, just make sure the polling interval is long enough to allow the PC to retrieve the archive. For example, if the computer is programmed to poll 100 reports every 10 seconds, there will not be enough time to get the report before the next poll starts and data will be overlapped.

Report Name: provide a name to the reports captured so they will be available for viewing, printing and exporting.

Starting Day: Type the date where the poll is going to start. Select "Every Day" is the date doesn't matter.

Polling Time: select the time you want the automatic polling to start, then select "Poll One Time" if you want to execute these poll only once or select "Poll Every…" and type the polling interval for periodic polls. For example, to poll every hour and a half select "Poll Every…" and type 90 in the Minutes field. **IMPORTANT:** Do not use straight hours as starting time (i.e. 7:00, 8:00). The flow computer calculates and updates its information at the beginning of the hour so if data is retrieved at this time it might be erroneous. Allow about 5 minutes for the flow computer to update the data.

Polling List: Add all the units you want to get data from on every poll. You can add up to 100 units. To add a unit just click "Add" and then type the unit's **Modbus** ID number.

NOTE: The file C:\AutoPoll.log will contain all the logs for the automatic poll, it will tell if there was a problem or if the data was retrieved successfully.

CHAPTER 3: Data Entry

Through Front Panel Display

The Data entry is a menu driven type construction.

Four Keys – **ESC/Mode, Enter/Select, ↓ ,→**
These keys can be operated with a reflective object. The reflective object must be placed in front of the key to get a response.

Function

ESC/Mode Key
This key serves dual functions. In order to access the data entry, the mode key has to be activated. The mode key is on/off type key. This key will get the security code prompt, and then using select, enter key with the arrow keys to access the program. Place the reflective object on and then off for each step. Once the data menu function access is completed, exit by using the escape key.

Select/Enter Key

It is used to stop screen from scrolling, to select data entry, and accept the data configurations. It is on/off type key. Place the reflective object in front of key, and then move away before the next step.

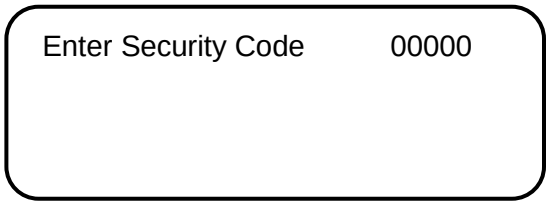
↓ Key, → Key

Scrolling keys, the **→ Key** function is to scroll → way for selecting the number to be changed, and then changing the number by using **↓ Key**

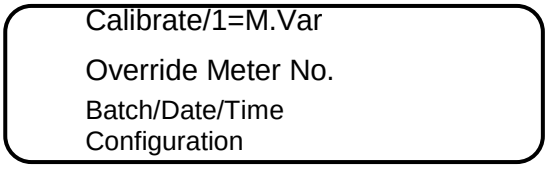
MAIN MENU

It consists primarily of series of topics. Your valid choices are the two Arrow Keys (↓, →) and select/enter key. Use the Down (↓) or Right (→) Arrow keys to make your selection and then use the select/enter key. Use Esc/Mode key to go back to previous mode.

Security Code

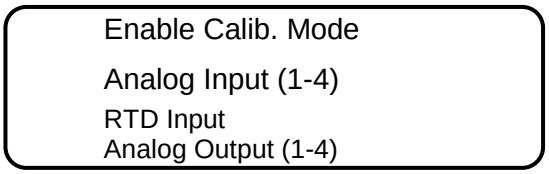


Enter the right security code to be able to change data.



Calibrate /1=M.Var

Enter 0 to calibrate analog input 1-4, RTD, analog output 1-4, or enter '1' to calibrate multivariable.



Enable Calibrate Mode

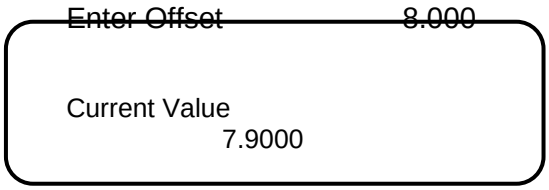
Enter '1' to enable calibrate mode. Calibration mode will set the flow computer to continue totalizing at same rate while all values are still showing live readings.

Calibrate Analog Input, RTD

0=**Offset** is a single point calibration that will offset zero and span.
1=**Full** – zero and span must be calibrated.
2=**Reset** to factory calibration.

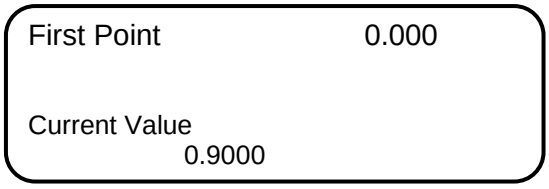
OFFSET (SINGLE POINT)

Induce the signal into the analog input, wait for 10 seconds for the reading to stabilize, then enter the offset.

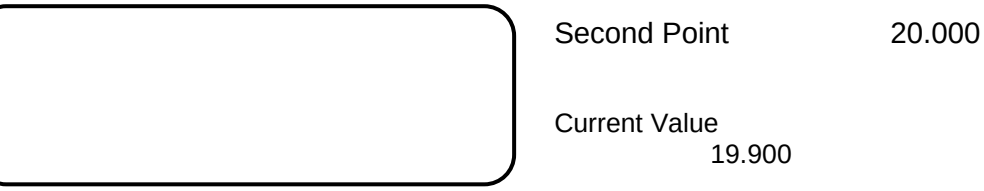


FULL (ZERO AND SPAN CALIBRATION)

Calibrate Low Point (4mA or 75 Ω,), induce the known live value for the low set point, and wait for 10 seconds for the reading to stabilize. Now enter in that value.



Calibrate High Point (20mA or 120 Ω), induce the known live value for the high set point, and then wait for 10 seconds for the reading to stabilize. Now enter in that value.

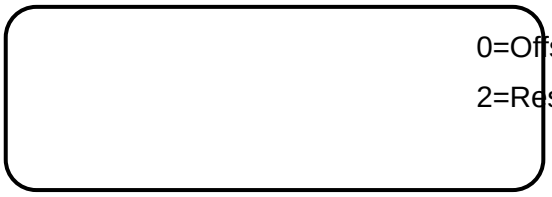


RESET (USE DEFAULT)

Enter '2' to use manufacture default.

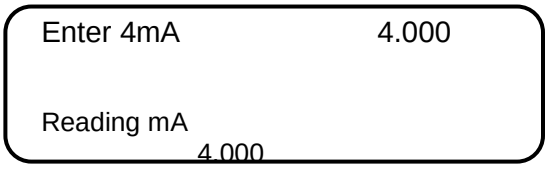
Calibrate Analog Output

0=Offset is a single point calibration that will offset zero and span.
1=Full – zero and span must be calibrated.
2=Reset to factory calibration.

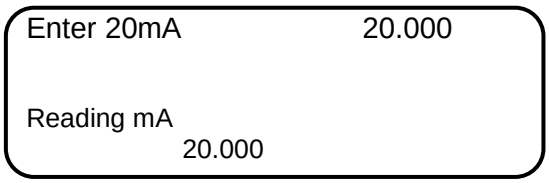


FULL (ZERO AND SPAN CALIBRATION)

1.The screen will show the minimum possible signal 4mA. Enter the live output value reading in the end device i.e. 4mA.



2. Now the flow computer will output full-scale 20mA. Enter the live output i.e. 20mA

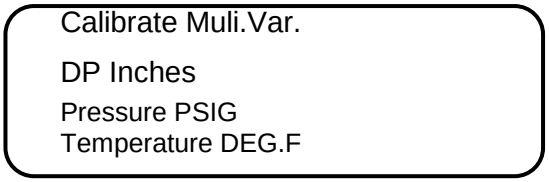


RESET (USE DEFAULT)

Enter '2' to use manufacture default.

Calibrate Multivariable

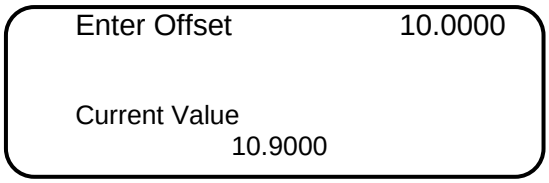
Select DP, Pressure, or Temperature to be calibrated.



Enter the calibrate method (0=Offset, 1=Full, 2=Reset).

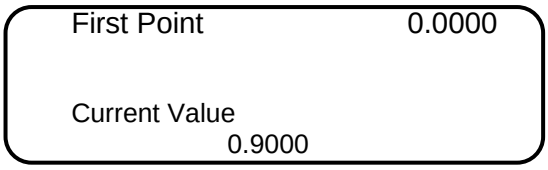
OFFSET (SINGLE POINT)

Induce the live value, and then enter the offset.

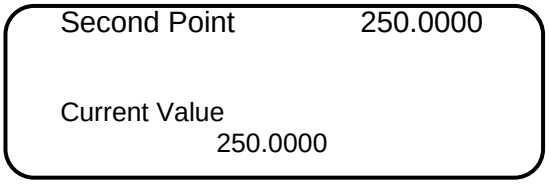


FULL (ZERO AND SPAN CALIBRATION)

1.Calibrate Low Point – induce the low range signal, and enter in that value.



2. Calibrate High Point – induce the high range signal, and enter in that value.



RESET (USE DEFAULT)

Enter ‘2’ to use manufacture default.

Override Meter

DEGF/PSIG/M.F.
VenturC/Wedge FA/KD2
Grav/DCF/EquP/AlpphaT
Orifice/Pipe/DP

DEGF/PSIG/M.F.

DEGF – Temperature Deg.F

This value is entered when no live temperature is available, or when a different value from the live value should be used.

PSIG – Pressure PSIG

This value is entered when no live temperature is available, or when a different value from the live value should be used.

M.F. – Meter Factor

Enter the value to change current meter factor (Frequency Device Method)

VENTURIC/WEDGE FA/KD2

Venturi C Override is the discharge coefficient for Venturi flow equations. The value is default to .9950.

Wedge Fa Override and Wedge Kd2 Override

$$\textbf{Flow Rate (GPM)} = (5.668\, x\, F_a\, x\, K_{d2}) \times \sqrt{\frac{DP}{SG}}$$

$DP = differential\ pressure, inches\ of\ water$

$SG = liquid\ specific\ gravity\ at\ flow\ conditions$

$F_a = Expansion\ coefficient\ of\ wedge$

$K_{d2} = Discharge\ coefficient\ of\ wedge$

GRAV/DCF/EQUP/ALPHAT

Gravity Override is to replace current gravity. The gravity override is a non-retroactive gravity. It will not override the product file gravity. It only applies to the current running batch.

DCF- Density Correction Factor

Equp Override is to replace current equilibrium pressure

Alpha T Override is to replace current Alpha Tit will not affect the value in the product file. Enter number assuming that is divided by 100000. Example: .000355 = 355/1000000.

ORIFICE/PIPE/DP

Orifice ID in inches is the measured inside pipe diameter to 5 decimals at reference conditions

Pipe ID in inches is the measured diameter of the orifice at reference conditions.

DP Override in inches of water.

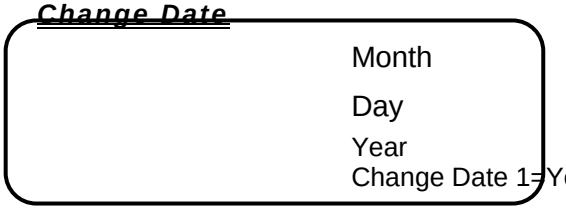
Batch/Date/Time

End Batch
Change Date
Change Time

END BATCH

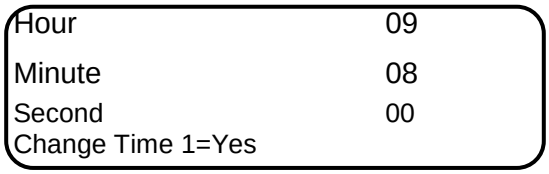
End Batch – Enter ‘1’ to end batches.

Change Date



Enter Month (1-12), Day (1-31), Year (0-99) and then enter ‘1’ to change date.

Change Time



Enter Hour (0-23), Minute (0-59), Second (0-59) and then enter ‘1’ to change time.

Configuration

Configure Meter

Configure I/O

Pulse Output
Others

Configue Meter

Flow Equation 1-5 1

1=New AGA3,

2=Wedge, 3=Venturi
4=Freq. ,5=Annubar

Flow Equation Type

0 = Cone/Smart Cone Equation
1 = API 14.3 (NEW AGA3, 1992 Orifice Equations)
2 = Wedge Meter Flow Calculation
3 = Venturi
4 = Frequency Device
5 = Annubar

Cone/New AGA3/Venturi/Wedge Meter

Orifice ID	10.00000
Pipe ID,	5.00000
DP Cut Off	1.0000
Viscosity	.024500

PIPE I.D. INCHES

ORIFICE ID INCHES

Pipe ID in inches is the measured inside pipe diameter to 5 decimals at reference conditions. Orifice ID in inches is the measured diameter of the orifice at reference conditions.

DP CUTOFF

The Micro MV Gas Flow Computer suspends all calculations whenever the DP, in inches of water column, is less than this value. This function is vital for suppressing extraneous data when the DP transmitter drifts around the zero mark under no-flow conditions.

VISCOSITY IN CENTIPOISE

Even though viscosity will shift with temperature and pressure changes, the effect on the calculations is negligent. Therefore using a single value is appropriate in most cases. Enter viscosity in centipoise.

WEDGE KD2

$$\textbf{Flow Rate (GPM)} = (5.668 \, x \, F_a \, x \, K_{d2}) \times \sqrt{\frac{DP}{SG}}$$

$DP = differential\ pressure, inches\ of\ water$

$SG = liquid\ specific\ gravity\ at\ flow\ conditions$

$F_a = Expansion\ coefficient\ of\ wedge$

$K_{d2} = Discharge\ coefficient\ of\ wedge$

VENTURI C

Venturi C is the discharge coefficient for Venturi flow equations. The value is default to .9950.

Frequency Device

K Factor	1000.000
F.M.Factor	1.000000
R.M.Factor	1.000000
Flow Cut Off	.024500

K FACTOR

K Factor is the number of pulses per unit volume, i.e. 1000 pulses/Unit. The meter's tag would normally indicate the K Factor.

METER FACTOR

Meter Factor is a correction to the K Factor for this individual meter, applied multiplicatively to the K factor.

FLOW CUTOFF

The Micro MV Liquid Flow Computer will quit totalizing, when frequency is below the set limit. This feature is to reduce extraneous noise appearing as data when the meter is down for period of time. The totalizer will stop totalizing when the turbine frequency is below the limit.

Configure I/O

Analog Output

Meter I/O

Status/Switch

F.C.Display

Analog Output

Ana.Out#1 Assign	1
Ana.Out#2 Assign	0
Ana.Out#3 Assign	0
Ana.Out#4 Assign	0

Assignments:

	Forward	Reverse	Forward/Rev
Gross Flow Rate	1	5	9
Net Flow Rate	2	6	10
Mass Flow Rate	3	7	11

DP	13
Temperature	14
Pressure	15
Density LB/FT3	16
Density Temperature	17
Density Pressure	18
DP LOW	19
DP HIGH	20
Density @60 – LB/FT3	21
API	22
API@60	23
Specific Gravity	24
SG@60	25
GM/CC	26

Meter-Independent Parameters	
Spare #1	27
Spare #2	28
PID	29
Remote Control*	30

Meter I/O

Temperature Deg.F

Pressure PSIG

DP Inches
Densitometer

ASSIGNMENTS

0=	Not Used
1=	Analog#1
2=	Analog#2
3=	Analog#3

4=	Analog#4
5=	RTD

7 =	Dens.Freq (Not Selectable)
10 =	Multi. Variable Module

4MA

Enter the 4mA value for the transducer.

20MA

Enter the 20mA value for the transducer.

Status Input /Switch Output Assignment

Status/Switch#1	000
Status/Switch#2	001
Status/Switch#3	000
Status/Switch#4	000

	Assignment	Comments
1	End Batch	End the batch and reset batch totalizer
2	Print Request	
3	Calibration Mode	
4	Alarm Acknowledge	Reset the previous occurred alarms output bit
5	Flow Direction	“Off”= forward and “ON”= reverse. For bi-directional meters
6	Event Status	

Switch Output Assignment

User can assign an output to each of the Micro MV Gas Flow Computer's output switches from this list. The Micro MV Gas Flow Computer switch outputs are sourcing through switch power input power. Outputs in the top list, "Pulse Outputs", require a definition of pulse output per unit volume. Therefore a Pulse Output Width must be defined when one of these switch types are chosen. These outputs are available through switches 1 or 2 only.

Outputs in the bottom list, "Contact Type Outputs", are ON/OFF type outputs. They can be assigned to any of the four switch outputs.

Switches 1 and 2 can be pulse or contact type output; switches 3, 4 are contact-type output only.

ASSIGNMENTS – PULSE OUTPUTS

Gross	101
Net	102
Mass	103

ASSIGNMENTS – CONTACT TYPE OUTPUTS

Batch Ended (5 sec)	113
Day Ended (5 seconds)	114
Meter Down	115
Flow Low	116
Flow High	117
Temperature Low	118
Temperature High	119
Pressure Low	120
Pressure Low	121
Density Low	122
Density High	123
Dens. Temp. Low	124
Dens. Temp. High	125
Dens. Pressure Low	126
Dens. Pressure High	127
DP Low	128
DP High	129
Dens. Period Low	130

Dens. Period High	131
Temperature Out of Range	132
Gravity Out of Range	133
Pressure Out of Range	134
Active Alarms	135
Occurred Alarms	136
Direction – Forward	137
Direction – Reverse	138
Watch Dog	139
Remote Control	140
Boolean Points*	170-199

Examples:

134 = Pressure out of range

Flow Computer Display Assignment

FC.Display#1	000
FC.Display#2	001
FC.Display#3	000
FC.Display#4	000

Display assignment select up to 16 assignments. The Micro MV Liquid Flow Computer will scroll through them at the assigned delay time

Assignment

3 Digit Selection, where

1st Digit: 0: Forward 1: Reverse

2nd and 3rd Digit: Selection (see table below)

01	Flow Rate
02	Batch Total
03	Daily Total
04	Cum. Total
05	Previous Daily Total
06	Previous Batch Total
07	DP/DP Low, High
08	Temperature, Pressure
09	Density, Density at Base
10	Density Frequency, Densitometer Period, Density GM/CC
11	SG, SG@60, API, API@60
12	Product
13	Calibration Mass Flow Rate
14	Date/Time
15	Alarm
16	Spare #1, Spare #2
17	Density Temperature, Density Pressure
18	Last Batch Average Temperature, Pressure, Density
19	Last Batch Average API, SG, GM/CC
20	Program Variable #1-#4
21	Program Variable #5-#8
22	Company, Meter ID, Plant, and Location
23	Custom Display Screen #1
24	Custom Display Screen #2

Pulse Output

Pulse Output	
#1 P/Unit#1	1.000
#2 P/Unit#2	1.000
Pulse Width	50

PULSE OUTPUT AND PULSE OUTPUT WIDTH

Pulse Output is used to activate a sampler or external totalizer. The number selected will be pulses per unit volume or per unit mass. If 0.1 pulses is selected, the one pulse will be given every 10-unit volumes has passed through the meter.

Pulse Output Width is the duration, in milliseconds, of one complete pulse cycle (where each cycle is the pulse plus a wait period, in a 50/50 ratio). For example: if POW = 500 mSec, the Micro MV Liquid Flow Computer at most can produce one pulse each second regardless of the pulse per unit volume selected (500 mSec pulse + 500 mSec wait). If POW = 10 mSec the Micro MV Liquid Flow Computer can produce up to 50 pulses per second.

The Micro MV Liquid Flow Computer's maximum pulse output is 125 pulses/sec. The Pulse Output in combination with the Pulse Output Width should be set appropriately.

Others

Day Start Hour	7
0=Hour,1=Day,2=Min	0
Disable Alarms	0

DAY START HOUR (0-23)

Day start hour is used for daily totalizer reset operation.

FLOW RATE SELECTION

The flow rate will be based on hourly basis, daily, or minute.

DISABLE ALARMS

Use Disable Alarms to ignore alarms. When the alarm function is disabled alarms are not logged. Alarms are also not logged if the DP is below the cut-off limit.

CHAPTER 4: FLOW EQUATIONS

Cone/Smart Cone

$$\text{Mass Flowrate} = \frac{\pi}{4} \times \sqrt{2g_c \times \rho} \times \frac{D^2 \times \beta^2}{\sqrt{1-\beta^4}} \times Cf \times Y \times \sqrt{Psf} \times Fa$$

$$= \boldsymbol{q_{mass/second}}\ (LB-US, KG-Metric)$$

$$\text{Net Flowrate} = \frac{q_{mass}}{\rho_{reference}}$$

$$\text{Gross Flowrate} = \frac{q_{mass}}{\rho_{flowing}}$$

Where:

g_c = Dimensional Conversion Constant

C_f = Flow Coefficient of the Meter

ρ = Density (LB/FT3-US, KG/M3-Metric)

D = Meter Inside Diameter (Feet-US, Meters-Metric)

Psf = D.Pressure(Pounds force per square foot-US, Pascal-Metric)

Y = Adiabatic Expansion Factor for Contoured Elements

$\beta = \sqrt{1-\frac{d^2}{D^2}}$

d = Cone Diameter, D=Meter Inside Diameter (Inches-US, Millimeters-Metric)

API 14.3

$$\text{Mass Flowrate} = \frac{\pi}{4} \times N_c \times C_d \times E_v \times Y \times d^2 \times (\sqrt{2DP \times \rho}) \times 10^{-3}$$
$$= (\text{MLb/Hr})$$

$$\text{Net Flowrate} = \frac{\textit{Mass Flowrate (Lb/Hr)}}{\textit{Density@60°F}}$$
$$= \text{MCF/Hr}$$

$$\text{Gross Flowrate} = \frac{\textit{Mass Flowrate (LB/HR)}}{\textit{Flowing Density}}$$
$$= \text{MCF/Hr}$$

(Refer to ***Orifice Metering of Natural Gas***, 3rd edition.)
Where:

$N_c = \textit{unit conversion constant} = 323.279$
$C_d = \textit{orifice plate coefficient of discharge}$
$E_v = \textit{velocity of approach factor} = \frac{1}{\sqrt{1-\beta^4}}$
$Y = \textit{expansion factor}$
$\beta = \frac{d}{D} = \frac{\textit{orifice plate bore diameter from reference diameter}}{\textit{meter tube internal diameter from reference diameter}}$
$\rho = \textit{density of the fluid at flowing conditions}$
$DP = \textit{orifice differential pressure}$

Wedge

$$\text{Gross Flowrate} = 5.668 \times 60.0 \times F_a \times K_{d2} \times \sqrt{\frac{DP}{SG}}$$
$$= \text{Gal/Hr}$$

$$\text{Net Flowrate} = \frac{Gross\ Flowrate \times Flowing\ Density}{Density@60°F}$$
$$= \text{Gal/Hr}$$

$$\text{Mass Flowrate} = Gross\ Flowrate \times Flowing\ Density \times Conversion\ Factor$$
$$= \text{MLb/Hr}$$

Where $DP = Differential\ Pressure, inches\ of\ water$
$SG = Liquid\ Specific\ Gravity\ at\ flowing\ conditions$
$F_a = Flow\ Expansion\ Factor\ (Data\ Entry)$
$K_{d2} = Flow\ Coefficient\ (Data\ Entry)$

Venturi

$$\text{Mass Flowrate} = 0.0997424 \times 3.6 \times \sqrt{\rho \times DP} \times \frac{C \times Y \times F_a \times d^2}{\sqrt{1-\beta^4}}$$

$$= (\text{MLb/Hr})$$

$$\text{Net Flowrate} = \frac{\textit{Mass Flowrate (MLb/Hr)}}{\textit{Reference Density}}$$

$$= (\text{MCF/Hr})$$

$$\text{Gross Flowrate} = \frac{\textit{Mass Flowrate (MLb/Hr)}}{\textit{Flowing Density}}$$

$$= (\text{MCF/Hr})$$

Where $C = \textit{discharge coefficien t C (manual entry)}$

$Y = \textit{expansion factor}$

$\beta = \frac{d}{D} = \frac{\textit{venturi bore diameter at reference}}{\textit{meter tube internal diameter at reference}}$

$\rho = \textit{density of the fluid at flowing conditions}$

$DP = \textit{differenti al pressure}$

(Refer to **Miller Measurement Engineering Handbook**)

Frequency Device

$$\textbf{Gross Flowrate} = \frac{Total\ (Pulses/Second)}{Nominal\ K\ Factor\ (Pulses/UM)} \times 3600$$
$$= \textbf{(UM/Hr)}$$

$$\textbf{Net Flowrate} = \frac{Gross\ Flowrate\ (UM/Hr) \times Meter\ Factor \times Flowing\ Density}{Reference\ Density}$$
$$= \textbf{(UM/Hr)}$$

$$\textbf{Mass Flowrate} = Gross\ Flowrate\ (UM/Hr) \times Flowing\ Density \times \frac{Meter\ factor}{1000} \times Factor$$
$$= \textbf{(MLB/Hr)}$$

Note :

$UM = Unit\ of\ Measurement\ (Selectable\ by\ Data\ Entry)$

$0 = BBL$

$1 = Gal$

$2 = CF$

$Factor = Conversion\ Factor$

Annubar

Please see ***Common Terms*** at the beginning of this chapter.

$$\textbf{Mass Flowrate} = 359.07264K(D_{flowing})^2 \times F_{RA}F_M F_{AA}F_L \times Y\sqrt{\rho_{pps}DP}$$
$$= q_{mass}\ \textbf{(MLb/Hr)}$$

$$\textbf{Net Flowrate} = \frac{q_{mass}}{\rho_{reference}} = \textbf{MCF/Hr}$$

$$\textbf{Gross Flowrate} = \frac{q_{mass}}{\rho_{flowing}} = \textbf{MCF/Hr}$$

Where :

K = *Flow Coefficient for pipe dimension and wall thickness*

$D_{flowing}$ = *Internal Diameter of Pipe at Flowing Conditions*

$= D_{0P}[1+\alpha(T_{flowing} - T_{0P})]$

α = *Linear Coefficient of Thermal Expansion*

F_{RA} = *Reynolds Number Factor*

F_M = *Manometer Factor*

F_{AA} = *Thermal Expansion Factor*

F_L = *Location Factor*

ρ_{pps} = *Density, expressed in Lb/ft*^{3}

DENSITY EQUATIONS

Sarasota Density GM/CC

Sarasota density is calculated using the frequency signal produced by a Sarasota densitometer, and applying temperature and pressure corrections as shown below.

$$\textbf{Corrected Density} = DCF \times \frac{2D_0(t\text{-}T_{0p})}{T_{0p} \times \frac{1 + K(t\text{-}T_{0p})}{2T_{0p}}}$$

Where:

$T_{0p} = T_{coef} \times (T - T_{cal}) + P_{coef} \times (P - P_{cal}) + T_0$

DCF = *Density Correction Factor*

D_0 = *Calibration constant, mass/volume, gm/cm*^{3}

t = *Densitometer oscillation period in microseconds.*

t_0 = *A calibration constant in microseconds*

T_{coef} = *Temperature coefficient in microseconds/°F*

P = *Flowing pressure in PSIG*

P_{coef} = *Pressure coefficient in microseconds/PSIG*

P_{cal} = *Calibration pressure in PSIG*

UGC Density GM/CC

UGC density is calculated using the frequency signal produced by a UGC densitometer, and applying temperature and pressure corrections as shown below

$$\textbf{Corrected Density} = DCF \times P_{flowing}\{[K(P_{off}+d)\times 10^{-6}]+[K_T(T_{flowing}-T_{cal})] + d\}$$

Where:

$$d = K_0 + K_1 t + K_2 t^2$$

K_0, K_1, K_2 = *Calibration Constants*

t = *Densitometer oscillation period in microseconds*

DCF = *Density Correction Factor*

K = *Pressure Constant*

P_{off} = *Pressure Offset*

K_T = *Temperature Coefficient*

T_{cal} = *Temperature coefficient in microseconds/°F*

Solartron Density GM/CC

Solartron density is calculated using the frequency signal produced by a Solartron densitometer, and applying temperature and pressure corrections as shown below.

Density at 68^{O}F and 0 PSIG

$$D = K_0 + K_1 t + K_2 t^2$$

$$Where \quad t = Densitometer\ Oscillation\ Period\ in\ microseconds$$

$$K_0, K_1, K_2 = Calibration\ Constants\ Supplied\ by\ Solartron$$

Temperature Corrected Density

$$DT = D[1 + K_{18}(T\text{-}68)] + K_{19}(T\text{-}68)$$

$$Where\ T = Temperature\ in\ °F$$

Temperature and Pressure Corrected Density

$$DP = DL(1 + K_{20}P) + K_{21}P$$

$$Where:$$

$$P = Pressure\ in\ PSIG$$

$$K_{20} = K_{20A} + K_{20B}P$$

$$K_{21} = K_{21A} + K_{21B}P$$

$$K_{20A}, K_{20B}, K_{21A}, K_{21B} = Calibration\ Constants\ Supplied\ by\ Solarton$$

Additional Equation for Velocity of Sound Effects

The following equation can provide more accurate measurement for LPG products in the density range of $0.300 \le D \le 0.550$ (D is in gm/cc).

$$D_{vos} = DP + K_r (DP - K_j)^3$$

$$Let\ K_r = 0.0\ outside\ this\ range.$$

NIST14

Temperature Range 24–200°F
Pressure Range 250-2920 PSIA

DENSITY EQUATIONS (Without Live Densitometer)

If API Table is selected:

$$\text{Flowing Density} = Density@60°F \times CTL \times CPL$$

$$= {}^{gm}/_{cm^3}$$

$$\text{Where } CTL = e^{-\alpha_T \Delta_T (1 + (0.8 \alpha_T \Delta_T))}$$

$$= Correction\ for\ temperature\ effect\ on\ liquid\ (\text{ASTM D1250})$$

$$\Delta_T = T_{Actual} - T_{Reference}$$

$$\alpha_T = \frac{K_0 + K_1 \rho_T}{\rho_T^{\,2}} = Correction\ of\ expansion\ at\ reference\ temp.$$

$$\rho_T = \frac{141.5 \times Density\ of\ Water}{API + 131.5}$$

$$= Product\ density\ at\ reference\ temperature\ in\ {}^{gm}/_{cm^3}$$

where:

$$API = API\ Gravity\ at\ reference\ temperature$$

$$CPL = \frac{1}{1 - F(P - P_e)} = Correction\ for\ compressibility\ on\ liquid$$

$$\text{Flowing Density} = \textit{Density@}60°F \times CTL \times CPL$$

$$= {}^{gm}/_{cm^3}$$

$$\textit{Where} \quad CTL = e^{-\alpha_T \Delta_T (1 + (0.8 \alpha_T \Delta_T))}$$

$$= \textit{Correction for temperature effect on liquid (}\text{ASTM D1250}\textit{)}$$

$$\Delta_T = T_{Actual} - T_{Reference}$$

$$\alpha_T = \frac{K_0 + K_1 \rho_T}{\rho_T{}^2} = \textit{Correction of expansion at reference temp.}$$

$$\rho_T = \frac{141.5 \times \textit{Density of Water}}{API + 131.5}$$

$$= \textit{Product density at reference temperature in } {}^{gm}/_{cm^3}$$

where:

API = *API Gravity at reference temperature*

$$CPL = \frac{1}{1 - F(P - P_e)} = \textit{Correction for compressibility on liquid}$$

P = *Flowing pressure in PSIG*

P_e = *Equilibrium pressure,* calculated from the equations developed by Dr.R.W. Hankinson and published as *GPA Technical Publication No.15,* or override value

Temperature Range: -50 °F to 140 °F.

Relative Density Range: 0.49 to 0.676

F = *Compressibility factor*

Using API Chapter 11.2.1 for liquids 0-90 API

Using API Chapter 11.2.2 for Hydrocarbons

Temperature Range: -50 °F to 140 °F

Relative Density: 0.350-0.637

Density is converted from gm/cm^3 to lb/ft^3 via the conversion factor ${}^{lb}/_{ft^3} = {}^{gm}/_{cm^3} \times 36.07$.

K_0 and **K_1** in the above equations are physical constants from the API Manual and are given in the table below for various product types. However, for products between the jet group and gasoline use constants **A** and **B** in the following equation:

$$\alpha_T = A + \frac{B}{\rho_T{}^2}$$

Table	Product Type	API Gravity	Relative Density	K_0	K_1
6A, 23A	**Crude Oil**	0-100	.6110 to 1.0760	341.0957	0.0
6B, 23B	**Fuel Oil**	0-137	.5270 to 1.0760	103.8720	0.2701
6B, 23B	**Jet Group**	37.1-47.9	.7890 to .8395	330.3010	0.0
6B, 23B	**Gasoline**	52.1-85	.6535 to .7705	192.4571	0.2438
6B, 23B	**Between Jet and Gasoline**	48-52	.7710 to .7885	A = -0.00186840	B = 1489.0670

CHAPTER 5: MODBUS DATA

MODBUS PROTOCOL

TRANSMISSION MODE

	ASCII	RTU
DATA BITS	7	8
START BITS	1	1
PARITY	EVEN, ODD	NONE
STOP BITS	1	1
ERROR CHECKING	LRC	CRC
BAUD RATE	1200-9600	1200-9600

ASCII FRAMING

Framing is accomplished by using colon (:) character indicating the beginning of frame and carriage (CR), line feed (LF) for the end of frame

ASCII MESSAGE FORMAT

	ADDRESS	FUNCTION	DATA	ERR\CHECK		
:	2 CHAR	2 CHAR	Nx2 CHAR	2 CHAR	CR	LF
8 BITS	16 BITS	16 BITS	Nx16 BITS	16 BITS	8 BITS	8 BITS

RTU FRAMING

Frame synchronization is done by time basis only. The Smart Flow Computer allows 3.5 characters time without new characters coming in before proceeding to process the message and resetting the buffer.

RTU MESSAGE FORMAT

ADDRESS	FUNCTION	DATA	CRC
8 BITS	8 BITS	Nx8 BITS	16 BITS

FUNCTION CODE

To inform the slave device of what function to perform

FUNCTION CODE	ACTION
01	
03	Read Strings or Multiple 16 Bits
16	Write Strings or Multiple 16 Bits

ERROR CHECK

LRC MODE

The LRC check is transmitted as two ASCII hexadecimal characters. First, the message has to be stripped of the: LF, CR, and then converted the HEX ASCII to Binary. Add the Binary bits and then two's complement the result.

CRC MODE

The entire message is considered in the CRC mode. Most significant bit is transmitted first. The message is pre-multiplied by 16. The integer quotient digits are ignored and the 16-bit remainder is appended to the message as the two CRC check bytes. The resulting message including the CRC, when divided by the same polynomial (X16+X15+X2+1) at the receiver, which will give zero remainder if no error, has occurred.

EXCEPTION RESPONSE

Exception response comes from the slave if it finds errors in communication. The slave responds to the master echoing the slave address, function code (with high bit set), exception code and error check. To indicate that the response is notification of an error, the high order bit of the function code is set to 1.

EXCEPTION CODE	DESCRIPTION
01	Illegal Function
02	Illegal Data Address
03	Illegal Data Value

BROADCAST COMMAND

All units listen to Unit ID Zero, and no one will respond when the write function is broadcasted.

MODBUS EXAMPLES

FUNCTION CODE 03 (Read Single or Multiple Register Points)

Each Modbus System has a different Modbus address range. For example, 40000 or 90000 is the high level message generated through the host Modbus system. The set up and offset are different for each host Modbus system.

READ A SHORT (SINGLE) WORD NUMERIC VARIABLE

The short word numeric variable is a 16-bit integer
Data: 16 bits (short word: two 8-bit bytes - high byte, low byte),
Short Integer Variable Modbus Address: from 2018 to 3030

RTU MODE

Read Address 3001

ADDR	FUNC CODE	STARTING POINT		# OF POINTS		CRC CHECK	
		HI	LO	HI	LO		
01	03	0B	B9	00	01	57	CB

Response - Data - 02 63 (Hex), 611 (Decimal)

ADDR	FUNC CODE	BYTE COUNTS	DATA		CRC CHECK	
			HI	**LO**		
01	03	02	**02**	**63**	F9	0D

ADDR		FUNC CODE		STARTING POINT				# OF POINTS				LRC CHECK			
				HI		LO		HI		LO					
:	30	31	30	33	30	43	30	43	30	30	30	31	45	42	CR	LF

Response

ADDR		FUNC CODE		BYTE COUNT		DATA				LRC CHECK			
						HI		LO					
:	30	31	30	33	30	32	30	30	30	31	46	39	CR	LF

READ A LONG WORD NUMERIC VARIABLE

The long word numeric variable is a *two 16-bit integers* with decimal places inferred
Data: two 16-bit (32 bits, two words: high word, low word).
Sign bit - first bit of high word (0:positive, 1:negative)
Long Integer Variable Modbus Address: from 3131 to 9625

Read Address 3131

ADDR	FUNC CODE	STARTING Address		# OF Registers		CRC CHECK	
		HI	LO	HI	LO		
01	03	0C	3B	00	**02**	B6	96

Response - Data - **4 Bytes - 00 05 6A 29 (Hex), 611 (Decimal)**

ADDR	FUNC CODE	BYTE COUNTS	**DATA**				CRC CHECK	
			HI Word		**LO Word**			
01	03	04	**00**	**05**	**6A**	**29**	05	4C

Data Bytes - 00 05 6A 29 (Hex) = 354857 (decimal)
Data with 2 decimal places inferred = 3548.57

For Example:
Honeywell Modbus System - read address **9**3131
Delta-V Modbus system - read address **4**3131
Data Calculation
Value = High Word x 65536 + Low Word
High Word = 00 05 (Hex), 5 (Decimal)
Low Word = 6A 29 (Hex), 27177 (Decimal)
= 5 x 65536 + 27177
= 354857
Two decimal places inferred
= 3548.57

READ A FLOATING POINT VARIABLE

The floating point variable is a single precision floating point value
One register with 4 data bytes- high word and low word

IEEE Floating Point Format

Sign	Exponent	Mantissa
1 bit	8 bits	23 bits

Byte 3	Byte 2	Byte 1	Byte 0
SEEEEEEE	EMMMMMMM	MMMMMMMM	MMMMMMMM

Modbus Address: From 7001 to 7999

Sample Floating Point Value

Read Register 7047

ADDR	FUNC CODE	STARTING Address		# OF Registers		CRC CHECK	
		HI	LO	HI	LO		
01	03	1B	87	00	**01**	32	C7

Response - Four Data Bytes - **47 6C 4A 00 (HEX) = 60490.0**

ADDR	FUNC CODE	BYTE COUNTS	**DATA**				CRC CHECK	
			HI Word		**LO Word**			
01	03	04	**47**	**6C**	**4A**	**00**	19	FA

Modbus Address Table – 16 Bits Integer

ADDRESS	DESCRIPTION	DECIMAL	READ/WRITE
2351	Port 3 Modbus Type (0=RTU,1=ASCII)	0 Inferred	Read/Write
2352	Port 3 Parity(0=None,1=Odd,2=Even)	0 Inferred	Read/Write
2353	Port 3 Baud Rate(0=1200,1=2400,3=4800,4=9600)		
2354	reserved		
2355	Port 3 RTS Delay in Milliseconds	0 Inferred	Read/Write
2534	Flow Computer Display Delay	0 Inferred	Read/Write
2535	Flow Computer Assignment #1	0 Inferred	Read/Write
2536	Flow Computer Assignment #2	0 Inferred	Read/Write
2537	Flow Computer Assignment #3	0 Inferred	Read/Write
2538	Flow Computer Assignment #4	0 Inferred	Read/Write
2539	Flow Computer Assignment #5	0 Inferred	Read/Write
2540	Flow Computer Assignment #6	0 Inferred	Read/Write
2541	Flow Computer Assignment #7	0 Inferred	Read/Write
2542	Flow Computer Assignment #8	0 Inferred	Read/Write
2543	Flow Computer Assignment #9	0 Inferred	Read/Write
2544	Flow Computer Assignment #10	0 Inferred	Read/Write
2545	Flow Computer Assignment #11	0 Inferred	Read/Write
2546	Flow Computer Assignment #12	0 Inferred	Read/Write
2547	Flow Computer Assignment #13	0 Inferred	Read/Write
2548	Flow Computer Assignment #14	0 Inferred	Read/Write
2549	Flow Computer Assignment #15	0 Inferred	Read/Write
2550	Flow Computer Assignment #16	0 Inferred	Read/Write
2551	Flow Computer ID	0 Inferred	Read/Write
2552	reserved		
2553	Port 1 Modbus Type (0=RTU,1=ASCII)	0 Inferred	Read/Write
2554	Port 1 Parity(0=None,1=Odd,2=Even)	0 Inferred	Read/Write
2555	Port 1 Baud Rate(0=1200,1=2400,3=4800,4=9600)		
2556	reserved		
2557	Port 1 RTS Delay in Milliseconds	0 Inferred	Read/Write
2558-2559	reserved		
2560	Port 2 Type (0=Modbus, 1=Printer)	0 Inferred	Read/Write
2561	Port 2 Modbus Type (0=RTU,1=ASCII)	0 Inferred	Read/Write
2562	Port 2 Parity(0=None,1=Odd,2=Even)	0 Inferred	Read/Write
2563	Port 2 Baud Rate(0=1200,1=2400,3=4800,4=9600)		
2564	Printer Baudrate(0=1200,1=2400,3=4800,4=9600)		
2565	Port 2 RTS Delay in Milliseconds	0 Inferred	Read/Write
2566	Printer-Number of Nulls	0 Inferred	Read/Write
2567	Spare		
2568-2581	Spare		
2582	Ext. Analog Input #5-#9	0 Inferred	Read/Write
2583	Enable Battery Alarm	0 Inferred	Read/Write
2584	Report Configuration	0 Inferred	Read/Write
2585	SLAVE #1 ID	0 Inferred	Read/Write
2586	SLAVE #2 ID	0 Inferred	Read/Write
2587	SLAVE #3 ID	0 Inferred	Read/Write
2588	SLAVE #4 ID	0 Inferred	Read/Write
2589	Scale Selection (0=32767,1=4095)	0 Inferred	Read/Write

Modbus Address Table – 16 bits Integer

ADDRESS	DESCRIPTION	DECIMAL	READ/WRITE
2590	Flow Direction Selection	0 Inferred	Read/Write
2591	Use Stack DP	0 Inferred	Read/Write
2592	Meter Volume Units 0=BBL, 1=GAL	0 Inferred	Read/Write
2593	Flow Rate Display	0 Inferred	Read/Write
2594	Flowrate Averaged Second	0 Inferred	Read/Write
2595	Day Start Hour (0-23)	0 Inferred	Read/Write
2596-2605	Company Name	40 Chars	Read/Write
2606	Disable Alarms ? (0=No, 1=Yes)	0 Inferred	Read/Write
2607	Print Interval in Minutes (0-1440)	0 Inferred	Read/Write
2608	Pulse Width	0 Inferred	Read/Write
2609	Density Type 0=None,1=4-20mA,2=S,3=U,3=S	0 Inferred	Read/Write
2610	Density Unit 0=SG,1=API,2=Density	0 Inferred	Read/Write
2611	Use Meter Temp as Dens.Temp 0=N,1=Y	0 Inferred	Read/Write
2612	Use Meter Pressure as Dens.Press 1=Yes	0 Inferred	Read/Write
2613	Mass Pulse	0 Inferred	Read/Write
2614	Retroactive Meter Factor	0 Inferred	Read/Write
2615	Meter Flow Cut Off	0 Inferred	Read/Write
2616	Gross Flow Inclue Meter Factor	0 Inferred	Read/Write
2617	Status Input/Switch Output #1 (0=OFF,1=ON)	0 Inferred	Read/Write
2618	Status Input/Switch Output #2 (0=OFF,1=ON)	0 Inferred	Read/Write
2619	Status Input/Switch Output #3 (0=OFF,1=ON)	0 Inferred	Read/Write
2620	Status Input/Switch Output #4 (0=OFF,1=ON)	0 Inferred	Read/Write
2621-2623	Spare		
2624-2633	Meter Location	20 Chars.	Read/Write
2634-2637	Meter ID	8 Chars.	Read/Write
2638	Spare	0 Inferred	Read/Write
2639-2648	Spare		
2649-2651	Reserved		
2947	Spring Forward Month	0 Inferred	Read/Write
2948	Spring Forward Day	0 Inferred	Read/Write
2949	Fall Back Month	0 Inferred	Read/Write
2950	Fall Back Day	0 Inferred	Read/Write
2951	Enable Daylight Time Saving	0 Inferred	Read/Write
2652-2659	Product Name	16 Chars.	Read/Write
2660	Product Table Select	0 Inferred	Read/Write
2661	Spare		
2662	spare		
2663	DP Low Assignment	0 Inferred	Read/Write
2664	Temperature Assignment	0 Inferred	Read/Write
2665	Pressure Assignment	0 Inferred	Read/Write
2666	Density Assignment	0 Inferred	Read/Write
2667	Density Temp. Assignment	0 Inferred	Read/Write
2668	Density Pressure Assignment	0 Inferred	Read/Write
2669	DP High Assignment	0 Inferred	Read/Write
2670	Spare #1 Assignment	0 Inferred	Read/Write
2671	Spare #2 Assignment	0 Inferred	Read/Write
2672	DP Fail Code	0 Inferred	Read/Write
2673	Temperature Fail Code	0 Inferred	Read/Write

Modbus Address Table – 16 bits Integer

ADDRESS	DESCRIPTION	DECIMAL	READ/WRITE
2674	Pressure Fail Code	0 Inferred	Read/Write
2675	Density Fail Code	0 Inferred	Read/Write
2676	Density Temperature Fail Code	0 Inferred	Read/Write
2677	Density Pressure Fail Code	0 Inferred	Read/Write
2678	Spare		
2679	Spare #1 Failure Code	0 Inferred	Read/Write
2680	Spare #2 Failure Code	0 Inferred	Read/Write
2681	Calculation Type	0 Inferred	Read/Write
2682	Y Factor Selection	0 Inferred	Read/Write
2683	Orifice Material	0 Inferred	Read/Write
2684	Analog Output #1 Assign	0 Inferred	Read/Write
2685	Analog Output #2 Assign	0 Inferred	Read/Write
2686	Analog Output #3 Assign	0 Inferred	Read/Write
2687	Analog Output #4 Assign	0 Inferred	Read/Write
2688	Status Input/Switch Output #1 Assign	0 Inferred	Read/Write
2689	Status Input/Switch Output #2 Assign	0 Inferred	Read/Write
2690	Status Input/Switch Output #3 Assign	0 Inferred	Read/Write
2691	Status Input/Switch Output #4 Assign	0 Inferred	Read/Write
2692	Well Test Schedule #1 Duration in Minutes	0 Inferred	Read/Write
2693	Well Test Schedule #1 Interval in Seconds	0 Inferred	Read/Write
2694	Well Test Schedule #2 Duration in Minutes	0 Inferred	Read/Write
2695	Well Test Schedule #2 Interval in Seconds	0 Inferred	Read/Write
2696	Well Test Schedule #3 Duration in Minutes	0 Inferred	Read/Write
2697	Well Test Schedule #3 Interval in Seconds	0 Inferred	Read/Write
2698	Well Test Schedule #4 Duration in Minutes	0 Inferred	Read/Write
2699	Well Test Schedule #4 Interval in Seconds	0 Inferred	Read/Write
2700	Well Test Schedule #5 Duration in Minutes	0 Inferred	Read/Write
2701	Well Test Schedule #5 Interval in Seconds	0 Inferred	Read/Write
2702	Well Test Schedule #6 Duration in Minutes	0 Inferred	Read/Write
2703	Well Test Schedule #6 Interval in Seconds	0 Inferred	Read/Write
2704	Well Test Schedule #7 Duration in Minutes	0 Inferred	Read/Write
2705	Well Test Schedule #7 Interval in Seconds	0 Inferred	Read/Write
2706	Well Test Schedule #8 Duration in Minutes	0 Inferred	Read/Write
2707	Well Test Schedule #8 Interval in Seconds	0 Inferred	Read/Write
2708	Well Test Schedule #9 Duration in Minutes	0 Inferred	Read/Write
2709	Well Test Schedule #9 Interval in Seconds	0 Inferred	Read/Write
2710	Well Test Schedule #10 Duration in Minutes	0 Inferred	Read/Write
2711	Well Test Schedule #10 Interval in Seconds	0 Inferred	Read/Write
2712	DP or Net Flow Rate Log Selection	0 Inferred	Read/Write
2713	Pressure Log Selection	0 Inferred	Read/Write
2714	Test Average Sample Period in Seconds	0 Inferred	Read/Write
2716	Select 0=Analog Input#1,1=Digital Input#5	0 Inferred	Read/Write
2717	Select 0=Analog Input#2,1=Digital Input#6	0 Inferred	Read/Write
2718	Select 0=Analog Input#3,1=Digital Input#7	0 Inferred	Read/Write
2719	Select 0=Analog Input#4,1=Digital Input#8	0 Inferred	Read/Write
2720	Digital Input#5 Assignment	0 Inferred	Read/Write
2721	Digital Input#6 Assignment	0 Inferred	Read/Write
2722	Digital Input#7 Assignment	0 Inferred	Read/Write
2723	Digital Input#8 Assignment	0 Inferred	Read/Write
2724-2820	Spare		

Modbus Address Table – 16 bits Integer

ADDRESS	DESCRIPTION	DECIMAL	READ/WRITE
2821-2824	Analog Input#5 Tag	8 Chars.	Read/Write
2825-2828	Analog Input#6 Tag	8 Chars.	Read/Write
2829-2832	Analog Input#7 Tag	8 Chars.	Read/Write
2833-2836	Analog Input#8 Tag	8 Chars.	Read/Write
2837-2840	Analog Input#9 Tag	8 Chars.	Read/Write
2841-2844	Analog Input #1 Tag	8 Chars.	Read/Write
2845-2848	Analog Input #2 Tag	8 Chars.	Read/Write
2849-2852	Analog Input #3 Tag	8 Chars.	Read/Write
2853-2856	Analog Input #4 Tag	8 Chars.	Read/Write
2857-2860	RTD Input Tag	8 Chars.	Read/Write
2861-2864	Densitometer Tag	8 Chars.	Read/Write
2865-2868	Analog Output #1 Tag	8 Chars.	Read/Write
2869-2872	Analog Output #2 Tag	8 Chars.	Read/Write
2873-2876	Analog Output #3 Tag	8 Chars.	Read/Write
2877-2880	Analog Output #4 Tag	8 Chars.	Read/Write
2881-2888	Reserved		
2889-2955	Spare		

Modbus Address Table – 16 bits Integer

ADDRESS	DESCRIPTION	DECIMAL	READ/WRITE
2961-2964	Multi.Var#1 DP Tag	8 Chars.	Read/Write
2965-2968	Multi.Var#1 Pressure Tag	8 Chars.	Read/Write
2969-2972	Multi.Var#1 Temperature Tag	8 Chars.	Read/Write
2973-2976	Multi.Var#2 DP Tag	8 Chars.	Read/Write
2977-2980	Multi.Var#2 Pressure Tag	8 Chars.	Read/Write
2981-2984	Multi.Var#2 Temperature Tag	8 Chars.	Read/Write
2985	Analog Output #1 Remote Control (0-100)	0 Inferred	Read/Write
2986	Analog Output #2 Remote Control (0-100)	0 Inferred	Read/Write
2987	Analog Output #3 Remote Control (0-100)	0 Inferred	Read/Write
2988	Analog Output #4 Remote Control (0-100)	0 Inferred	Read/Write
2989-2990	Spare		
2991	Reset PID	0 Inferred	Read/Write
3001	Version Number	2 Inferred	Read
3002-3003	Spare		
3004	Frequency #1	0 Inferred	Read
3005	Frequency #2	0 Inferred	Read
3006	Table Used	0 Inferred	Read
3007-3010	Meter ID	8 Chars	Read
3011	II-Test Status	0 Inferred	Read
3012	II-Test Stage Number	0 Inferred	Read
3013	Spare		
3014	II-Test Interval	0 Inferred	Read
3015	Reserved		
3016	Stop Well Test	0 Inferred	Read/Write
3017	Start Well Test	0 Inferred	Read/Write
3018	Unit ID	0 Inferred	Read
3019	Disable Alarms	0 Inferred	Read
3020-3022	Spare		
3023	Application TAG Number	0 Inferred	Read
3024	Calibration – Set Time (1-9 Hours)	0 Inferred	Read/Write
3025	Enable Calibration Mode	0 Inferred	Read/Write
3026	Last Daily Report Request (1=Latest,32=Oldest) Daily Data Area in Location 3431-3711	0 Inferred	Write
3027-3028	Spare		
3029	Last Hourly Report Request (1=Latest,1040=Oldest) Last Hour Data Area in Location 8001-8037	0 Inferred	Write
3030	Last Alarm Report Request (1=Latest,100=Oldest)	0 Inferred	Write
3031	Last Audit Report Request (1=Latest,100=Oldest)	0 Inferred	Write
Scaled Data Area			
3032	Gross Flowrate	0 Inferred	Read
3033	Net Flowrate	0 Inferred	Read
3034	Mass Flowrate	0 Inferred	Read
3035	Spare		
3036	Forwar Daily Gross	0 Inferred	Read
3037	Forward Daily Net	0 Inferred	Read
3038	Forward Daily Mass	0 Inferred	Read
3039	Spare		

Modbus Address Table – 16 bits Integer

ADDRESS	DESCRIPTION	DECIMAL	READ/WRITE
3040	Reverse Daily Gross	0 Inferred	Read
3041	Reverse Daily Net	0 Inferred	Read
3042	Reverse Daily Mass	0 Inferred	Read
3043	Spare		
3044	Spare		
3045	Spare		
3046	Spare		
3047	Spare		
3048	Spare		
3049	Spare		
3050	Spare		
3051	Spare		
3052	Spare		
3053	Spare		
3054	Spare		
3055	Spare		
3056	Spare #1 Data	0 Inferred	Read
3057	Spare #2 Data	0 Inferred	Read
3058	DP	0 Inferred	Read
3059	Temperature	0 Inferred	Read
3060	Pressure	0 Inferred	Read
3061	Density	0 Inferred	Read
3062	Density Temperature	0 Inferred	Read
3063	Density Pressure	0 Inferred	Read

Scaled Data Area Ends

Modbus 16-bit Address Table Ends

Modbus Address Table – 2x16 Bits Integer

Non-resettable accumulated volume will roll over at 9999999.

ADDRESS	DESCRIPTION	DECIMAL	READ/WRITE
3131	Gross Flowrate	2 Inferred	Read
3133	Net Flowrate	2 Inferred	Read
3135	Mass Flowrate	2 Inferred	Read
3137	Spare		
3139	DP Low	4 Inferred	Read
3141	DP High	4 Inferred	Read
3143	DP	4 Inferred	Read
3145	Temperature	2 Inferred	Read
3147	Pressure	2 Inferred	Read
3149	Density	4 Inferred	Read
3151	Density Temperature	2 Inferred	Read
3153	Density@60	4 Inferred	Read
3155	Y Factor	6 Inferred	Read
3157	Fa Factor	6 Inferred	Read
3159	K/CD/MF Factor	6 Inferred	Read
3161	Density Pressure	2 Inferred	Read
3163	CTL	4 Inferred	Read
3165	CPL	4 Inferred	Read
3167	EQUIL	3 Inferred	Read
3169	API	1 Inferred	Read
3171	SG	4 Inferred	Read
3173	Forward Daily GROSS Total	1 Inferred	Read
3175	Forward Daily NET Total	1 Inferred	Read
3177	Forward Daily MASS Total	2 Inferred	Read
3179	Spare		
3181	Forward Cum. GROSS Total	0 Inferred	Read
3183	Forward Cum. NET Total	0 Inferred	Read
3185	Forward Cum. MASS Total	0 Inferred	Read
3187	Spare		
3189	Reverse Daily GROSS Total	1 Inferred	Read
3191	Reverse Daily NET Total	1 Inferred	Read
3193	Reverse Daily MASS Total	2 Inferred	Read
3195	Spare		
3197	Reverse Cum GROSS Total*	0 Inferred	Read
3199	Reverse Cum NET Total*	0 Inferred	Read
3201	Reverse Cum MASS Total*	0 Inferred	Read
3203	Spare		
3205	Calc.Density LB/FT3	4 inferred	Read
3207	Day Start Date	0 Inferred	Read
3209	Day Start Time	0 Inferred	Read
3211	Forward Hourly Gross Total	1 Inferred	Read
3213	Forward Hourly Mass Total	2 Inferred	Read
3215	Forward Hourly Net Total	1 Inferred	Read
3217	Spare		
3219	Reverse Hourly Gross Total	1 Inferred	Read
3221	Reverse Hourly Mass Total	2 Inferred	Read
3223	Reverse Hourly Net Total	1 Inferred	Read
3225	Spare		

Modbus Address Table – 2x16 Bits Integer

ADDRESS	DESCRIPTION	DECIMAL	READ/WRITE
3227	Uncorrected Density	3 Inferred	Read
3229	Spare #1	4 Inferred	Read
3231	Spare #2	4 Inferred	Read
3233	Analog Output #1 Output %	2 Inferred	Read
3235	Analog Output #2 Output %	2 Inferred	Read
3237	Analog Output #3 Output %	2 Inferred	Read
3239	Analog Output #4 Output %	2 Inferred	Read
3241	Yesterday Forward Cum.Gross Total	0 inferred	Read
3243	Yesterday Forward Cum.Net Total	0 Inferred	Read
3245	Yesterday Forward Cum Mass Total	0 Inferred	Read
3247	Spare	0 Inferred	Read
3249	Yesterday Reverse Cum Gross Total	0 Inferred	Read
3251	Yesterday Reverse Cum Net Total	0 Inferred	Read
3253	Yesterday Reverse Cum Mass Total	0 Inferred	Read
3255	Spare		
3257	Yesterday Forward Gross Total	1 inferred	Read
3259	Yesterday Forward Net Total	1 Inferred	Read
3261	Yesterday Forward Mass Total	2 Inferred	Read
3263	Spare	1 Inferred	Read
3265	Yesterday Reverse Gross Total	1 Inferred	Read
3267	Yesterday Reverse Net Total	1 Inferred	Read
3269	Yesterday Reverse Mass Total	2 Inferred	Read
3271	Test Stage #1 Date	0 Inferred	Read
3273	Test Stage #1 Time	0 Inferred	Read
3275	Test Stage #1 Interval	0 Inferred	Read
3277	Test Stage #1 Start Number	0 Inferred	Read
3279	Test Stage #1 Max Number	0 Inferred	Read
3281	Test Stage #2 Date	0 Inferred	Read
3283	Test Stage #2 Time	0 Inferred	Read
3285	Test Stage #2 Interval	0 Inferred	Read
3287	Test Stage #2 Start Number	0 Inferred	Read
3289	Test Stage #2 Max Number	0 Inferred	Read
3291	Test Stage #3 Date	0 Inferred	Read
3293	Test Stage #3 Time	0 Inferred	Read
3295	Test Stage #3 Interval	0 Inferred	Read
3297	Test Stage #3 Start Number	0 Inferred	Read
3299	Test Stage #3 Max Number	0 Inferred	Read
3301	Test Stage #4 Date	0 Inferred	Read
3303	Test Stage #4 Time	0 Inferred	Read
3305	Test Stage #4 Interval	0 Inferred	Read
3307	Test Stage #4 Start Number	0 Inferred	Read
3309	Test Stage #4 Max Number	0 Inferred	Read
3311	Test Stage #5 Date	0 Inferred	Read
3313	Test Stage #5 Time	0 Inferred	Read
3315	Test Stage #5 Interval	0 Inferred	Read
3317	Test Stage #5 Start Number	0 Inferred	Read
3319	Test Stage #5 Max Number	0 Inferred	Read

Modbus Address Table – 2x16 Bits Integer

ADDRESS	DESCRIPTION	DECIMAL	READ/WRITE
3321	Test Stage #6 Date	0 Inferred	Read
3323	Test Stage #6 Time	0 Inferred	Read
3325	Test Stage #6 Interval	0 Inferred	Read
3327	Test Stage #6 Start Number	0 Inferred	Read
3329	Test Stage #6 Max Number	0 Inferred	Read
3331	Test Stage #7 Date	0 Inferred	Read
3333	Test Stage #7 Time	0 Inferred	Read
3335	Test Stage #7 Interval	0 Inferred	Read
3337	Test Stage #7 Start Number	0 Inferred	Read
3339	Test Stage #7 Max Number	0 Inferred	Read
3341	Test Stage #8 Date	0 Inferred	Read
3343	Test Stage #8 Time	0 Inferred	Read
3345	Test Stage #8 Interval	0 Inferred	Read
3347	Test Stage #8 Start Number	0 Inferred	Read
3349	Test Stage #8 Max Number	0 Inferred	Read
3351	Test Stage #9 Date	0 Inferred	Read
3353	Test Stage #9 Time	0 Inferred	Read
3355	Test Stage #9 Interval	0 Inferred	Read
3357	Test Stage #9 Start Number	0 Inferred	Read
3359	Test Stage #9 Max Number	0 Inferred	Read
3361	Test Stage #10 Date	0 Inferred	Read
3363	Test Stage #10 Time	0 Inferred	Read
3365	Test Stage #10 Interval	0 Inferred	Read
3367	Test Stage #10 Start Number	0 Inferred	Read
3369	Test Stage #10 Max Number	0 Inferred	Read
3371	Month Total – Forward Gross Total	0 Inferred	Read
3373	Month Total – Forward Net Total	0 Inferred	Read
3375	Month Total – Forward Mass Total	0 Inferred	Read
3377	Month Total – Reverse Gross Total	0 Inferred	Read
3379	Month Total – Reverse Net Total	0 Inferred	Read
3381	Month Total – Reverse Mass Total	0 Inferred	Read
3383	Month Roll Over Number – Forward Gross Total	0 Inferred	Read
3385	Month Roll Over Number – Forward Net Total	0 Inferred	Read
3387	Month Roll Over Number – Forward Mass Total	0 Inferred	Read
3389	Month Roll Over Number – Reverse Gross Total	0 Inferred	Read
3391	Month Roll Over Number – Reverse Net Total	0 Inferred	Read
3393	Month Roll Over Number – Reverse Mass Total	0 Inferred	Read
3395	Last Month Total – Forward Gross Total	0 Inferred	Read
3397	Last Month Total – Forward Net Total	0 Inferred	Read
3399	Last Month Total – Forward Mass Total	0 Inferred	Read
3401	Last Month Total – Reverse Gross Total	0 Inferred	Read
3403	Last Month Total – Reverse Net Total	0 Inferred	Read
3405	Last Month Total – Reverse Mass Total	0 Inferred	Read
3407	Last Month Roll Over No – Forward Gross Total	0 Inferred	Read
3409	Last Month Roll Over No – Forward Net Total	0 Inferred	Read
3411	Last Month Roll Over No – Forward Mass Total	0 Inferred	Read
3413	Last Month Roll Over No – Reverse Gross Total	0 Inferred	Read
3415	Last Month Roll Over No – Reverse Net Total	0 Inferred	Read
3419	Last Month Roll Over No – Reverse Mass Total	0 Inferred	Read
3421-3429	Spare		

(Month total roll over at 999999999. Use the following method to get correct value.
Total (Double) = Roll Over Number x 99999999+ Total

Modbus Address Table – 2x16 Bits Integer

ADDRESS	DESCRIPTION	DECIMAL	READ/WRITE

Last Batch Data Area

Last Batch Report

3026 =	Last Batch Report Request (16 bits Integer, Write only)		
Set last daily report request to 1=Latest, 2=Oldest.			
3431	Batch Type/Disp/Bank/Station Flag	0 Inferred	Read
3433	Table Used	0 Inferred	Read
3435-3439	Spare		
3441	Opening Forward GROSS Total	0 Inferred	Read
3443	Opening Forward NET Total	0 Inferred	Read
3445	Opening Forward MASS Total	0 Inferred	Read
3447	Spare		
3449	Daily GROSS Total	1 Inferred	Read
3451	Daily NET Total	1 Inferred	Read
3453	Daily MASS Total	2 Inferred	Read
3455	Spare		
3457	Forward Average DP	4 Inferred	Read
3459	Forward Average Temperature	2 Inferred	Read
3461	Forward Average Pressure	2 Inferred	Read
3463	Forward Average SG	4 Inferred	Read
3465	Spare	4 Inferred	Read
3467	Opening Reverse GROSS Total	0 Inferred	Read
3469	Opening Reverse NET Total	0 Inferred	Read
3471	Opening Reverse MASS Total	0 Inferred	Read
3473	Spare		
3475	Reverse Daily GROSS Total	1 Inferred	Read
3477	Reverse Daily NET Total	1 Inferred	Read
3479	Reverse Daily MASS Total	2 Inferred	Read
3481	Spare		
3483	Reverse Average DP	4 Inferred	Read
3485	Reverse Average Temperature	2 Inferred	Read
3487	Reverse Average Pressure	2 Inferred	Read
3489	Reverse Average SG	4 Inferred	Read
3491	Spare	4 Inferred	Read
3493	Start Date	0 Inferred	Read
3495	Start Time	0 Inferred	Read
3497	End Date	0 Inferred	Read
3499	End Time	0 Inferred	Read
3501-3507	Product Name	16 Char	Read
3509-3511	Meter ID	8 Char	Read

Modbus Address Table – 2x16 Bits Integer

ADDRESS	DESCRIPTION	DECIMAL	READ/WRITE
3513	Pipe ID	5 Inferred	Read
3515	Orifice ID	5 Inferred	Read
3517	Dens.Corr.Factor	5 Inferred	Read
3519	Meter Volume Unit	0 Inferred	Read
3521	Calculation Type	0 Inferred	Read
3523	K Factor	3 Inferred	Read
3525	Spare		
3527	Spare #1 Data	4 Inferred	Read
3529	Spare #2 Data	4 Inferred	Read
3531	Forward Gross Total Roll Over Number	0 Inferred	Read
3533	Forward Net Total Roll Over Number	0 Inferred	Read
3535	Forward Mass Total Roll Over Number	0 Inferred	Read
3537	Reverse Gross Total Roll Over Number	0 Inferred	Read
3539	Reverse Net Total Roll Over Number	0 Inferred	Read
3541	Reverse Mass Total Roll Over Number	0 Inferred	Read

(Total roll over at 9999999. Use the following method to get correct value.
Total (Double) = Roll Over Number x 99999999+ Total

Last Batch Area Ends

Modbus Address Table – 2x16 Bits Integer

ADDRESS	DESCRIPTION	DECIMAL	READ/WRITE
3543-3739	Spare		
3741	Calibration Mass Flowrate	2 Inferred	Read
3743-3789	Spare		
3791	Temperature Override	2 Inferred	Read/Write
3793	Pressure Override	2 Inferred	Read/Write
3795	DP Override	4 Inferred	Read/Write
3797	Equilibrium Pressure Override	3 Inferred	Read/Write
3799	Gravity Override	1 or 4 Inferred	Read/Write
3801	Alpha T E-6 Override	1 Inferred	Read/Write
3803	FA Override	6 Inferred	Read/Write
3805	Kd2 Override	6 Inferred	Read/Write
3807	Venturi C Override	6 Inferred	Read/Write
3809-3817	Spare		
3819-4149	Reserved		
4151	Densitometer Period	3 Inferred	Read
4153-4199	Spare		
4201	Date (MMDDYY)	0 Inferred	Read/Write
4203	Time (HHMMSS)	0 Inferred	Read/Write
4205	DP Cut Off	4 Inferred	Read/Write
4207	Flow Low Limit	2 Inferred	Read/Write
4209	Flow High Limit	2 Inferred	Read/Write
4211	Product API Gravity Override	1 Inferred	Read/Write
4213	Product Specific Gravity Override	4 Inferred	Read/Write
4215	Product Density Override	4 Inferred	Read/Write
4217	Product Alpha T E-6	1 Inferred	Read/Write
4219	Steam Quality (0-100 %)	0 Inferred	Read/Write
4221	Pipe ID Inches	5 Inferred	Read/Write
4223	Orifice ID Inches	5 Inferred	Read/Write
4225	Specific Heats (Isentropic Exponent)	4 Inferred	Read/Write
4227	Viscosity in Centipoise	6 Inferred	Read/Write
4229	Pipe Coeff. Thermal Expansion E-6	2 Inferred	Read/Write
4231	Orifice Coeff. Thermal Expansion E-6	2 Inferred	Read/Write
4233	Reference Temperature of Pipe	2 Inferred	Read/Write
4235	Reference Temperature of Orifice	2 Inferred	Read/Write
4237	DP Switch High Percentage	2 Inferred	Read/Write
4239	K Factor	3 Inferred	Read/Write
4241	Forward Meter Factor	6 Inferred	Read/Write
4243	Reverse Meter Factor	6 Inferred	Read/Write
4245	Forward Flowrate Threshold#1	2 Inferred	Read/Write
4247	Forward Flowrate Threshold#2	2 Inferred	Read/Write
4249	Forward Flowrate Threshold#3	2 Inferred	Read/Write
4251	Forward Flowrate Threshold#4	2 Inferred	Read/Write
4253	Forward Linear Factor #1	6 Inferred	Read/Write
4255	Forward Linear Factor #2	6 Inferred	Read/Write
4257	Forward Linear Factor #3	6 Inferred	Read/Write
4259	Forward Linear Factor #4	6 Inferred	Read/Write

Modbus Address Table – 2x16 Bits Integer

ADDRESS	DESCRIPTION	DECIMAL	READ/WRITE
4261	Reverse Flowrate Threshold#1	2 Inferred	Read/Write
4263	Reverse Flowrate Threshold#2	2 Inferred	Read/Write
4265	Reverse Flowrate Threshold#3	2 Inferred	Read/Write
4267	Reverse Flowrate Threshold#4	2 Inferred	Read/Write
4269	Reverse Linear Factor #1	6 Inferred	Read/Write
4271	Reverse Linear Factor #2	6 Inferred	Read/Write
4273	Reverse Linear Factor #3	6 Inferred	Read/Write
4275	Reverse Linear Factor #4	6 Inferred	Read/Write
4277	PID Output %	2 Inferred	Read/Write
4279	PID Flow	2 Inferred	Read/Write
4281	PID Flow Set Point	2 Inferred	Read/Write
4283	PID Flow Controller Gain	2 Inferred	Read/Write
4285	PID Flow Controller Reset(M	2 Inferred	Read/Write
4287	PID Pressure Maximum	2 Inferred	Read/Write
4289	PID Pres.Set Point	2 Inferred	Read/Write
4291	PID Pres.Controller Gain	2 Inferred	Read/Write
4293	PID Pres.Controller Reset(M.)	2 Inferred	Read/Write
4295	PID Minimum Output %	2 Inferred	Read/Write
4297	PID Maximum Output %	2 Inferred	Read/Write
4299	PID Auto/Manual	0 Inferred	Read/Write
4301	PID Flow Loop Used (1=Yes)	0 Inferred	Read/Write
4303	PID Flow Direct/Reverse Act	0 Inferred	Read/Write
4305	PID Pressure Loop Used (1=Yes)	0 Inferred	Read/Write
4307	PID Pressure Direct/Reverse Act	0 Inferred	Read/Write
4309	PID Flow Loop in Service	0 Inferred	Read/Write
4311	PID Pressure Loop in Service	0 Inferred	Read/Write
4313	PID 0=Low,1=High Signal	0 Inferred	Read/Write
4315	PID Flow Base 0=Gross,1=Net,2=Mass	0 Inferred	Read/Write
4317	UGC Constant K0	6 Inferred	Read/Write
4319	DP Low @4mA	4 Inferred	Read/Write
4321	DP Low @20mA	4 Inferred	Read/Write
4323	DP Lo-Limit	4 Inferred	Read/Write
4325	DP Hi-Limit	4 Inferred	Read/Write
4327	DP Maintenance	4 Inferred	Read/Write
4329	Temperature @4mA	2 Inferred	Read/Write
4331	Temperature @20mA	2 Inferred	Read/Write
4333	Temperature Lo-Limit	2 Inferred	Read/Write
4335	Temperature Hi-Limit	2 Inferred	Read/Write
4337	Temperature Maintenance	2 Inferred	Read/Write
4339	Pressure @4mA	2 Inferred	Read/Write
4341	Pressure @20mA	2 Inferred	Read/Write
4343	Pressure Lo-Limit	2 Inferred	Read/Write
4345	Pressure Hi-Limit	2 Inferred	Read/Write
4347	Pressure Maintenance	2 Inferred	Read/Write

Modbus Address Table – 2x16 Bits Integer

ADDRESS	DESCRIPTION	DECIMAL	READ/WRITE
4349	Density/Gravity @4mA	4 or 1 Inferred	Read/Write
4351	Density/Gravity @20mA	4 or 1 Inferred	Read/Write
4353	Density/Gravity Lo-Limit	4 or 1 Inferred	Read/Write
4355	Density/Gravity Hi-Limit	4 or 1 Inferred	Read/Write
4357	Density/Gravity Maintenance	4 or 1 Inferred	Read/Write
4359	Density Temp. @4mA	2 Inferred	Read/Write
4361	Density Temp. @20mA	2 Inferred	Read/Write
4363	Density Temp. Lo-Limit	2 Inferred	Read/Write
4365	Density Temp. Hi-Limit	2 Inferred	Read/Write
4367	Density Temp. Maintenance	2 Inferred	Read/Write
4369	Density Press. @4mA	1 Inferred	Read/Write
4371	Density Press. @20mA	1 Inferred	Read/Write
4373	Density Press. Lo-Limit	1 Inferred	Read/Write
4375	Density Press. Hi-Limit	1 Inferred	Read/Write
4377	Density Press. Maintenance	1 Inferred	Read/Write
4379	DP High @4mA	4 Inferred	Read/Write
4381	DP High. @20mA	4 Inferred.	Read/Write
4383-4387	Spare		
4389	Dens.Correction Factor	5 Inferred	Read/Write
4391	Dens.Period Low Limit	3 Inferred	Read/Write
4393	Dens.Period High Limit	3 Inferred	Read/Write
4395	UGC2 Calibration Temperature	3 Inferred	Read/Write
4397-4399	Spare		
4401	Spare#1 @4mA	4 Inferred	Read/Write
4403	Spare#1 @20mA	4 Inferred	Read/Write
4405	Spare#1 Lo-Limit	4 Inferred	Read/Write
4407	Spare#1 Hi-Limit	4 Inferred	Read/Write
4409	Spare#1 Maintenance	4 Inferred	Read/Write
4411	Spare#2 @4mA	4 Inferred	Read/Write
4413	Spare#2 @20mA	4 Inferred	Read/Write
4415	Spare#2 Lo-Limit	4 Inferred	Read/Write
4417	Spare#2 Hi-Limit	4 Inferred	Read/Write
4419	Spare#2 Maintenance	4 Inferred	Read/Write
4421	GM/CC Conversion Factor	6 Inferred	Read/Write
4423	Spare		
4425	Spare		
4427	Spare		
4429	Base Temperature	2 Inferred	Read/Write
4431	Atmospheric Pressure PSIA	3 Inferred	Read/Write
4433	Pulse Output Volume #1 Pulses/Unit	3 Inferred	Read/Write
4435	Pulse Output Volume #2 Pulses/Unit	3 Inferred	Read/Write

Modbus Address Table – 2x16 Bits Integer

ADDRESS	DESCRIPTION	DECIMAL	READ/WRITE
4437	Analog Output#1 @4mA	*Inferred	Read/Write
4439	Analog Output#1 @20mA	*Inferred	Read/Write
4441	Analog Output#2 @4mA	*Inferred	Read/Write
4443	Analog Output#2 @20mA	*Inferred	Read/Write
4445	Analog Output#3 @4mA	*Inferred	Read/Write
4447	Analog Output#3 @20mA	*Inferred	Read/Write
4449	Analog Output#4 @4mA	*Inferred	Read/Write
4451	Analog Output#4 @20mA	*Inferred	Read/Write

***Note Assignment Modbus Address**

Analog Input Assignment	Read only	Read/Write
#1	2096	2684
#2	2097	2685
#3	2098	2686
#4	2099	2687

Decimal Inferred

Assignment No.	Decimal Inferred
0-12	2
13,19,20,24, 25,26,27,28	4
14,15,17,18	2
16,21	3
22,23	1
Others	0

4453	Mass Flowrate Override	1 Inferred	Read/Write
4455	Spare		
4457	Spare		
4459	Nist14 – Mol % of Methane	4 Inferred	Read/Write
4461	Nist14 – Mol % of Ethane	4 Inferred	Read/Write
4463	Nist14 – Mol % of Propane	4 Inferred	Read/Write
4465	Nist14 – Mol % of i-Butane	4 Inferred	Read/Write
4467	Nist14 – Mol % of n-Butane	4 Inferred	Read/Write
4469	Nist14 – Mol % of Carbon Dioxide	4 Inferred	Read/Write
4471	Nist14 – Mol % of Argon	4 Inferred	Read/Write
4473	Nist14 – Mol % of Ethylene	4 Inferred	Read/Write
4475	Nist14 – Mol % of Nitrogen	4 Inferred	Read/Write
4477	Nist14 – Mol % of Oxygen	4 Inferred	Read/Write
4479	Nist14 – Mol % of Carbon Monoxide	4 Inferred	Read/Write
4481	Nist14 – Mol % of Hydrogen Sulfide	4 Inferred	Read/Write
4483	Nist14 – Mol % of n-Pentane	4 Inferred	Read/Write
4485	Nist14 – Mol % of i-Pentane	4 Inferred	Read/Write
4487	Nist14 – Mol % of n-Hexane	4 Inferred	Read/Write
4489	Nist14 – Mol % of i-Hexane	4 Inferred	Read/Write
4491	Nist14 – Mol % of n-Heptane	4 Inferred	Read/Write
4493	Nist14 – Density.b Override	6 Inferred	Read/Write
4495	Annubar - Manometer Factor	6 Inferred	Read/Write
4497	Annubar - Location Factor	6 Inferred	Read/Write
4499	Annubar - Fra Factor	6 Inferred	Read/Write
4501	Annubar - Flow Coefficient K	6 Inferred	Read/Write
4503	Annubar - Thermal Factor	6 Inferred	Read/Write

Modbus Address Table – 2x16 Bits Integer

ADDRESS	DESCRIPTION	DECIMAL	READ/WRITE
4505	Water Flowing Density Override	4 Inferred	Read/Write
4507-4657	Spare		
4659-4689	Reserved		
4691-4699	Custom Display Screen#1 Line #1	20 Chars	Read/Write
4701-4709	Custom Display Screen#1 Line #2	20 Chars	Read/Write
4711-4719	Custom Display Screen#1 Line #3	20 Chars	Read/Write
4721-4729	Custom Display Screen#1 Line #4	20 Chars	Read/Write
4731-4739	Custom Display Screen#2 Line #1	20 Chars	Read/Write
4741-4749	Custom Display Screen#2 Line #2	20 Chars	Read/Write
4751-4759	Custom Display Screen#2 Line #3	20 Chars	Read/Write
4761-4769	Custom Display Screen#2 Line #4	20 Chars	Read/Write
4771-4993	Spare		
4995	Digital Inputs Bits	0 Inferred	Read
4997	Digital Outputs Bits	0 Inferred	Read
4999	Ticks Left	0 Inferred	Read
5001-5039	Reserved		

Modbus Address Table – 2x16 Bits Integer

ADDRESS	DESCRIPTION	DECIMAL	READ/WRITE

Scratch Pad for Program Variables – (Long Integer) 5041,5043-5079

Sratch Pad – Program Variable Integer

5041
5043
5045
5047
5049
5051
5053
5055
5057
5059
5061
5063-5079

Slave Unit Variables

5081	Variable #1	0 Inferred	Read/Write
5083	Variable #2	0 Inferred	Read/Write
5085	Variable #3	0 Inferred	Read/Write
5087	Variable #4	0 Inferred	Read/Write
5089	Variable #5	0 Inferred	Read/Write
5091	Variable #6	0 Inferred	Read/Write
5093	Variable #7	0 Inferred	Read/Write
5095	Variable #8	0 Inferred	Read/Write
5097	Variable #9	0 Inferred	Read/Write
5099	Variable #10	0 Inferred	Read/Write

Modbus Address Table – 2x16 Bits Integer

ADDRESS	DESCRIPTION	DECIMAL	READ/WRITE

Current Data Area

(Cumulative Total roll over at 9999999. Use the following method to get correct value.
Total (Double) = Roll Over Number x 99999999+ Total

9001	Calculation Type Flag	0 Inferred	Read
9003	Flow Flag/Flow Dir Flow Direction B0-B3 : 1:Reverse, 0:Forward	0 Inferred	Read
9005	Alarm Status Flag	0 Inferred	Read
9007	Forward Daily GROSS	1 Inferred	Read
9009	Forward Daily NET	1 Inferred	Read
9011	Forward Daily MASS	2 Inferred	Read
9013	Spare		
9015	Forward Average DP	4 Inferred	Read
9017	Forward Average Temperature	2 Inferred	Read
9019	Forward Average Pressure	2 Inferred	Read
9021	Forward Average SG	4 Inferred	Read
9023	Forward Average DP EXT	4 Inferred	Read
9025	II-Test Time Left in Second	0 Inferred	Read
9027	Forward Cum. Gross Roll Over Number	0 Inferred	Read
9029	Forward Cum. Net Roll Over Number	0 Inferred	Read
9031	Forward Cum. Mass Roll Over Number	0 Inferred	Read
9033	Reverse Cum. Gross Roll Over Number	0 Inferred	Read
9035	Reverse Cum. Net Roll Over Number	0 Inferred	Read
9037	Reverse Cum. Mass Roll Over Number	0 Inferred	Read
9039	Spare		
9041	Gross Flow Rate	2 Inferred	Read
9043	Net Flow Rate	2 Inferred	Read
9045	Mass Flow Rate	2 Inferred	Read
9047	Spare		
9049	DP	4 Inferred	Read
9051	Temperature	2 Inferred	Read
9053	Pressure	2 Inferred	Read
9055	Density LB/FT3	4 Inferred	Read
9057	Densitometer Temperature	2 Inferred	Read
9059	Densitometer Pressure	2 Inferred	Read
9061	LB/FT3.b	4 Inferred	Read
9063	Y Factor	6 Inferred	Read
9065	Fa Factor	6 Inferred	Read
9067	K/CD/MF Factor	6 Inferred	Read
9069	GM/CC	6 Inferred	Read
9071	GM/CC@60	6 Inferred	Read
9073	CTL Factor	4 Inferred	Read
9075	CPL Factor	4 Inferred	Read
9077	Equilibrium Pressure	3 Inferred	Read
9079	API	1 Inferred	Read
9081	API@60	1 Inferred	Read
9083	SG	4 Inferred	Read
9085	SG@60	4 Inferred	Read

Modbus Address Table – 2x16 Bits Integer

ADDRESS	DESCRIPTION	DECIMAL	READ/WRITE
9087	Meter Factor	6 Inferred	Read
9089	Linear Factor	6 Inferred	Read
9091	Forward Cum GROSS	0 Inferred	Read
9093	Forward Cum NET	0 Inferred	Read
9095	Forward Cum MASS	0 Inferred	Read
9097	Spare		
9099	Reverse Cum GROSS*	0 Inferred	Read
9101	Reverse Cum NET*	0 Inferred	Read
9103	Reverse Cum MASS*	0 Inferred	Read
9105	Spare		
9107	Reverse Daily GROSS	0 Inferred	Read
9109	Reverse Daily NET	1 Inferred	Read
9111	Reverse Daily MASS	2 Inferred	Read
9113	Spare		
9115	Reverse Average DP	4 Inferred	Read
9117	Reverse Average Temperature	2 Inferred	Read
9119	Reverse Average Pressure	2 Inferred	Read
9121	Reverse Average SG	4 Inferred	Read
9123	Reverse Average DP/EXT	4 Inferred	Read
9125	Reverse Average Density in LB/FT3	4 Inferred	Read
9127	Forward Average Density in LB/FT3	4 Inferred	Read
9129	Table Used	0 Inferred	Read
9131	Unit of Measurement	0 Inferred	Read
9133	Start Date	0 Inferred	Read
9135	Start Time	0 Inferred	Read
9137	Current Date	0 Inferred	Read
9139	Current Time	0 Inferred	Read
9141-9147	Product ID	16 Chars.	Read
9149-9151	Meter ID	8 Chars.	Read
9153	Pipe ID Inches	5 Inferred	Read
9155	Orifice ID Inches	5 Inferred	Read
9157	Density Correction Factor	5 Inferred	Read
9159	K Factor	3 Inferred	Read
9161	Spare#1 Data	4 Inferred	Read
9163	Spare#2 Data	4 Inferred	Read
9165	Forward Flow - Linear Factor	6 Inferred	Read
9167	Reverse Flow – Linear Factor	6 Inferred	Read
9169	Average Sample Variables – DP or Net Flow Rate	0 Inferred	Read
9171	Average Sample Variables – Pressure,Spare Data	0 Inferred	Read
9173-9487	Reserved		
9489	Battery Voltage	1 Inferred	Read

Modbus Address Table – 2x16 Bits Integer

ADDRESS	DESCRIPTION	DECIMAL	READ/WRITE

Previous Hourly Report

3029 = Last Hour Report Request (16 bits Integer, Write only)
Set last hourly report request to 1=Latest, 1040=Oldest.

8001	Date (mm/dd/yy)	0 Inferred	Read
8003	Hour	0 Inferred	Read
8005	Forward Flowing Time in Hour	2 Inferred	Read
8007	Forward Gross Total	1 Inferred	Read
8009	Forward Net Total	1 Inferred	Read
8011	Forward Mass Total	2 Inferred	Read
8013	Forward Averaged Temperature	1 Inferred	Read
8015	Forward Averaged Pressure	1 Inferred	Read
8017	Forward Averaged DP	4 Inferred	Read
8019	Forward Averaged SG/Density-Nist14 LB/FT3)	4 Inferred	Read
8021	Forward Averaged DP/Extension	4 Inferred	Read
8023	Alarm Status		
8025	Reverse Flowing Time in Hour	2 Inferred	Read
8027	Reverse Gross Total	1 Inferred	Read
8029	Reverse Net Total	1 Inferred	Read
8031	Reverse Mass Total	2 Inferred	Read
8033	Reverse Averaged Temperature	1 Inferred	Read
8035	Reverse Averaged Pressure	1 Inferred	Read
8037	Reverse Averaged DP	4 Inferred	Read
8039	Reverse Averaged SG/Density-Nist14 LB/FT3)	4 Inferred	Read
8041	Reverse Averaged DP/Extension	4 Inferred	Read
8043-8049	Spare		

Last Hour data area

8051	Date (mm/dd/yy)	0 Inferred	Read
8053	Hour	0 Inferred	Read
8055	Forward Flowing Time in Seconds	0 Inferred	Read
8057	Forward Gross Total	1 Inferred	Read
8059	Forward Net Total	1 Inferred	Read
8061	Forward Mass Total	2 Inferred	Read
8063	Forward Averaged Temperature	1 Inferred	Read
8065	Forward Averaged Pressure	1 Inferred	Read
8067	Forward Averaged DP	4 Inferred	Read
8069	Forward Averaged SG/Density-Nist14 LB/FT3)	4 Inferred	Read
8071	Forward Averaged DP/Extension	4 Inferred	Read
8073	Alarm Status		
8075	Reverse Flowing Time in Seconds	0 Inferred	Read
8077	Reverse Gross Total	1 Inferred	Read
8079	Reverse Net Total	1 Inferred	Read
8081	Reverse Mass Total	2 Inferred	Read
8083	Reverse Averaged Temperature	1 Inferred	Read
8085	Reverse Averaged Pressure	1 Inferred	Read
8087	Reverse Averaged DP	4 Inferred	Read
8089	Reverse Averaged SG/Density-Nist14 LB/FT3)	4 Inferred	Read
8091	Reverse Averaged DP/Extension	4 Inferred	Read
8093-8099	Spare		

Alarms and Audit Trail Data

Previous Data Alarm Area

Set last alarm status request (3030,16 bits Integer, Write only) to 1.

4001-4009 ((2x16 bits Integers, Read only)
4001 last alarm date mmddyy
4003 last alarm time hhmmss
4005 last alarm flag - IDx1000000 + CODE x10000 +ACODEx100 +STATUS
4007 last alarm forward cumulative gross total
4009 last alarm reverse cumulative gross total

Last Alarm Flag

ID	CODE	ACODE	STATUS

ID

1	Analog Input #1	17	Event Status	31	Slave#1 Comm.
2	Analog Input #2	18	Calibration Mode	32	Slave#2 Comm.
3	Analog Input #3	20	Multi.Var DP	33	Slave#3 Comm.
4	Analog Input #4	21	Multi.Var Pressure	34	Slave#4 Comm.
5	RTD Input	22	Multi.Var Temperature		
9	Densitometer	23	Analog Input #5		
6	Analog Output#1	24	Analog Input #6		
7	Analog Output#2	25	Analog Input #7		
8	Analog Output#3	26	Analog Input #8		
9	Analog Output#4	27	Analog Input #9		
10	Densitometer				
11	Meter				

CODE (Only For ID=Meter)

1	Flow	6	N/A
2	Specific Gravity Out of Range	7	Down
3	Temperature Out of Range	8	Start
4	ALPHA T Out of Range	9	Ethylene/Proplene Out of Range
5	N/A	10	D.Calc(Nist14/PPMIX) Out Range

ACODE

Given in one hexadecimal byte (HEX 00):

0	No Bi-Direction
1	Bi-Direction Configuration

STATUS

0	ID = 10	FAILED OK
	ID = 6,7,8,9	OVERRANGE OK
	ID=Others	OK
6	ID=1-5,20-27	FAILED OK

1	HIGH	ON if ID=17,18
2	LO	
4	FAILED	
5	OVERRANGE	
3	Alarm Indication	

Example: Last Alarm Flag – (Hex: A8EA33, Decimal: 11070003)
ID= 11, CODE=7,ACODE=0,STATUS=3 -> METER DOWN

Previous Alarm Data Area Ends

Previous Audit Data Area

Set last audit data request (3031, 16 bits Integer, Write only) to 1.

8501-8513 (2x16 bits Integers, Read only)

8501	Last Audit Date mmddyy
8503	Last Audit Time hhmmss
8505	Old Value (Decimal Inferred in the 4th byte of 8513)
8507	New Vaule(Decimal Inferred in the 4th byte of 8513)
8509	Forward Cum. Gross Total
8511	Reverse Cum Gross Total
8513	Code Flag

Code Flag

Config Code	No.	Audit Code	Old/New Value Decimal Inferred

Config Code

0	One Direction Configuration
1	Bi-Directional Configuration

NO.

This field is not used.

Audit Codes

1	DP Cut Off
2	DP High Switch Percentage
3	Equilibrium Pressure Override
4	N/A
5	Alpha T Override
6	Pipe ID
7	Orifice ID
8	Product API Override
9	Product SG Override
10	Product Density Override
11	Product Alpha T E-6 Override
12	Ratio of Heat
13	Viscosity
14	Pipe Thermal
15	Orifice Thermal
16	Reference Temperature of Pipe
17	Reference Temperature of Orifice
18	K Factor
19	Forward Meter Factor
20	Reverse Meter Factor
30	DP Low @4mA
31	DP Low @20mA
32	DP Maintenance
33	DP High @4mA
34	DP High @20mA
35	Temperature @4mA
36	Temperature @20mA
37	Temperature Maintenance
38	Pressure @4mA
39	Pressure @20mA
40	Pressure Maintenance
41	Density/Gravity @4mA

121	Analog Output#2 @4mA
122	Analog Output#2 @20mA
123	Analog Output#3 @4mA
124	Analog Output#3 @20mA
125	Analog Output#4 @4mA
126	Analog Output#4 @20mA
131	Forward Flow Threshold #1
132	Forward Flow Threshold #2
133	Forward Flow Threshold #3
134	Forward Flow Threshold #4
135	Forward Linear Factor #1
136	Forward Linear Factor #2
137	Forward Linear Factor #3
138	Forward Linear Factor #4
139	Reverse Flow Threshold #1
140	Reverse Flow Threshold #2
141	Reverse Flow Threshold #3
142	Reverse Flow Threshold #4
143	Reverse Linear Factor #1
144	Reverse Linear Factor #2
145	Reverse Linear Factor #3
146	Reverse Linear Factor #4
150	Meter Factor in Gross
151	Mass Pulse (1=Yes)
152	Retroactive Meter Factor
153	Flow Rate Display
154	Calculation Type

42	Density/Gravity @20mA
43	Density/Gravity Maintenance
44	Dens. Temperature @4mA
45	Dens. Temperature @20mA
46	Dens. Temperature Maintenance
47	Densitometer Pressure 4mA
48	Densitometer Pressure 20mA
49	Densitometer Press. Maintenance
50	Spare #1 @4mA
51	Spare #1 @20mA
52	Spare #1 Maintenance
53	Spare #2 @4mA
54	Spare #2 @20mA
55	Spare #2 Maintenance
56	Analog Output #1@4mA
57	Analog Output #1@20mA
58	Density Correction Factor
59	N/A
60	Base Temperature
61	Atmospheric Pressure PSIA
62	Pulse Output #1 Volume
63	Pulse Output #2 Volume
71	API Override
72	SG Override
73	Density Override
74	Temperature Override
75	Pressure Override
76	DP Override
77	FA Override
78	KD2 Override
79	Venturi C Override
80	Mol% - Methane
81	Mol% - Ethane
82	Mol% - Propane
83	Mol% - i-Butane
84	Mol% - n-Butane
85	Mol% - CO2
86	Mol% - Argon
87	Mol% - Ethylene
88	Mol% - N2
89	Mol% - Oxygen
90	Mol% - Carbon Monoxide
91	Mol% - Hydrogen Sulfide
92	Mol% - n-Pentane
93	Mol% - i-Pentane
94	Mol% - n-Hexane
95	Mol% - i-Hexane
96	Mol% - n-Heptane
97	Nist14 Base Density

155	Y Factor Select
156	Orifice Material
157	Use Stack DP 0=No, 1=Yes
158	Densitometer Type
159	Density Unit
160	Use Meter Temp as Dens. Temp
161	Day Start Hour
162	Disable Alarms
163	Product Table Selection
164	Densitometer Pressure Assignment
165	DP Low Assignment
166	Temperature Assignment
167	Pressure Assignment
168	Densitometer Assignment
169	Densitometer Temperature Assignment
170	DP High Assignment
171	Spare#1 Assignment
172	Spare#2 Assignment
173	DP Low Fail Code
174	Temperature Fail Code
175	Pressure Fail Code
176	Densitometer Fail Code
177	Dens. Temp Fail Code
178	Spare#1 Fail Code
179	Spare#2 Fail Code
180	*****SEE NOTE (next page)**
181	Flow Cut Off Hertz
182	Densitometer Pressure Fail Code
184	Use Meter Press as Density Press
201	Analog Input #1 Calibration Data
202	Analog Input #2 Calibration Data
203	Analog Input #3 Calibration Data
204	Analog Input #4 Calibration Data
205	RTD Input Calibration Data
221	Analog Input #5 Calibration Data
222	Analog Input #6 Calibration Data
223	Analog Input #7 Calibration Data
224	Analog Input #8 Calibration Data
225	Analog Input #9 Calibration Data
211	Multivar DP Calibration Data
212	Multivar PF Calibration Data
213	Multivar TF Calibration Data

8501 **Last Audit Date mmddyy**
00 00 C8 C8 (Hex), 051400 (Digit) – May 14, 2000

8503 **Last Audit Time hhmmss**
00 03 0d 40 (Hex), 200000(Digit) – 8 PM

8505 **Old Value (Decimal Inferred in the 4th byte of 8113)**
00 01 86 a0 (Hex) 100000 (Digit)
4th byte of 8113 = 5 (Decimal Places)
result = 1.00000

8507 **New Vaule(Decimal Inferred in the 4th byte of 8113)**
00 01 ad b0 (Hex) 110000 (Digit)
4th byte of 8113 = 5 (Decimal Places)
Rsult = 1.10000

8509 **Forward Cumulative Gross Total**
00 00 01 F4 (Hex), 500 (Digit)
Result = 500

8511 **Reverse Cumulative Gross Total**
00 00 01 F4 (Hex), 500 (Digit)
Result = 500

8513 **Code Flag**

00 26 3a 05 in Hex
1st Byte –Bi-directional flag
2nd Byte – NO 26 (Hex) 38 (Digit) Density,
3rd Byte – Audit Code – 3A(Hex) 58 (Digit) – Density Correction Factor
4th Byte – Decimal Places – 05(Hex) – 5 Decimal Places

NOTE:

When Audit Code = 180, then the following Modbus Addresses store the parameters indicated.

8501 System Start Date

8503 System Start Time

8505 System Failed Date

8507 System Failed Time

8509 Not Used

8511 Not Used

Previous Audit Data Area Ends

Current Alarm Status

Bytes in Hex – FF FF FF FF

METER#1: MODBUS ADDRESS 9497

The Current Alarm Status is a 4-byte string that resides at **Modbus address 9497 for the Meter**

01	00	00	00	Mass Flowrate High (Freq. Gross Flow)
02	00	00	00	Mass Flowrate Low (Freq. Gross Flow)
04	00	00	00	Temperature Assignment High
08	00	00	00	Temperature Assignment Low
10	00	00	00	Pressure Assignment High
20	00	00	00	Pressure Assignment Low
40	00	00	00	Gravity/Density Assignment High
80	00	00	00	Gravity/Density Assignment Low
00	01	00	00	Dens.Temperature Assignment High
00	02	00	00	Dens.Temperature Assignment Low
00	04	00	00	DP Used Assignment High
00	08	00	00	DP Used Assignment Low
00	10	00	00	Densitometer Failed
00	20	00	00	Densitometer Failed
00	40	00	00	Dens.Pressure Assign High
00	80	00	00	Dens.Pressure Assign Low
00	00	00	01	Down
00	00	00	02	SG Out of Range
00	00	00	04	Temperature Out of Range
00	00	00	08	Alpha T Out of Range
00	00	00	40	API Out of Range
00	00	00	80	D.Calc (Nist14 or PPMIX) Out of Range

OTHER ALARMS (MODBUS ADDRESS 9495)

Bytes in Hex – FF FF FF FF

01	00	00	00	Analog Output #1 Overrange
02	00	00	00	Analog Output #2 Overrange
04	00	00	00	Analog Output #3 Overrange
08	00	00	00	Analog Output #4 Overrange
10	00	00	00	Spare#1/Voltage Assignment High
20	00	00	00	Spare#1/Voltage Assignment Low
40	00	00	00	Spare #2 Assignment High
80	00	00	00	Spare #2 Assignment Low
00	02	00	00	Event Status ON
00	04	00	00	Calibration Mode ON
00	08	00	00	Battery Alarm
00	10	00	00	Analog Input#5 Failed
00	20	00	00	Analog Input#6 Failed
00	40	00	00	Analog Input#7 Failed
00	80	00	00	Analog Input#8 Failed
00	00	01	00	Slave Unit #1 Comm. Failed
00	00	02	00	Slave Unit #2 Comm. Failed
00	00	04	00	Slave Unit #3 Comm. Failed
00	00	08	00	Slave Unit #4 Comm. Failed
00	00	10	00	Analog Input#9 Failed
00	00	00	01	Multi.Var.DP Failed
00	00	00	02	Multi.Var.Pressure Failed
00	00	00	04	Multi.Var.Temperature Failed
00	00	00	08	RTD Failed
00	00	00	10	Analog Input #1 Failed
00	00	00	20	Analog Input #2 Failed
00	00	00	40	Analog Input #3 Failed
00	00	00	80	Analog Input #4 Failed

Current Alarms Status Section Ends

INPUT ASSIGNMENTS

1 – Analog Input #1
2 – Analog Input #2
3 – Analog Input #3
4 – Analog Input #4
5 – RTD
10 – Multi.Variable #1
11 – Multi.Variable #2
22 – Analog Input #5
23 – Analog Input #6
24 – Analog Input #7
25 – Analog Input #8
26 – Analog Input #9

ADDRESS	DESCRIPTION	
2663	DP Low Assignment	
2664	Temperature Assignment	
2665	Pressure Assignment	
2666	Density Assignment	
2667	Dens.Temperature Assignment	
2668	Dens.Pressure Assignment	
2669	DP High Assigmemnt	
2670	Spare #1 Assignment	
2671	Spare #2 Assignment	
2821-2824	Analog Input #5 TAG ID	8 Chars.
2825-2828	Analog Input #6 TAG ID	8 Chars.
2829-2832	Analog Input #7 TAG ID	8 Chars.
2833-2836	Analog Input #8 TAG ID	8 Chars.
2837-2840	Analog Input #9 TAG ID	8 Chars.
2841-2844	Analog Input #1 TAG ID	8 Chars.
2845-2848	Analog Input #2 TAG ID	8 Chars.
2849-2852	Analog Input #3 TAG ID	8 Chars.
2853-2856	Analog Input #4 TAG ID	8 Chars.
2857-2860	RTD TAG ID	8 Chars.
2861-2864	Densitometer TAG ID	8 Chars
2865-2868	Analog Output #1 TAG ID	8 Chars
2869-2872	Analog Output #2 TAG ID	8 Chars
2873-2876	Analog Output #3 TAG ID	8 Chars
2877-2880	Analog Output #4 TAG ID	8 Chars

Modbus Address Table - Float Point

ADDRESS	DESCRIPTION	READ/WRITE
7001	Sarasota Constant D0	Read/Write
7002	Sarasota Constant T0	Read/Write
7003	Sarasota Constant K	Read/Write
7004	Sarasota Constant Temperature Coeff.	Read/Write
7005	Sarasota Constant Temperature Cal.	Read/Write
7006	Sarasota Constant Pressure Coeff.	Read/Write
7007	Sarasota Constant Pressure Cal.	Read/Write
7008	UGC Constant K0	Read/Write
7009	UGC Constant K1	Read/Write
7010	UGC Constant K2	Read/Write
7011	UGC Constant KT	Read/Write
7012	UGC Constant Temperature Cal	Read/Write
7013	UGC Constant K	Read/Write
7014	UGC Constant P0	Read/Write
7015	Solartron Constant K0	Read/Write
7016	Solartron Constant K1	Read/Write
7017	Solartron Constant K2	Read/Write
7018	Solartron Constant K18	Read/Write
7019	Solartron Constant K19	Read/Write
7020	Solartron Constant K20A	Read/Write
7021	Solartron Constant K20B	Read/Write
7022	Solartron Constant K21A	Read/Write
7023	Solartron Constant K21B	Read/Write
7024	Solartron Constant KR	Read/Write
7025	Solartron Constant KJ	Read/Write

Modbus Address Table – Float Point

ADDRESS	DESCRIPTION	READ/WRITE
7051	Meter#1 Calc. Viscosity	Read
7052	Meter#2 Calc. Viscosity	Read
7053-7060		
7061	Prog.Var 7791	Read
7062	Prog.Var 7792	Read
7063	Prog.Var 7793	Read
7064	Prog.Var 7794	Read
7065	Prog.Var 7795	Read
7066	Prog.Var 7796	Read
7067	Prog.Var 7797	Read
7068	Prog.Var 7798	Read
7069	Prog.Var 7799	Read
7070	Prog.Var.7800	Read
7071	Previous Hour - Prog.Var.7776	Read
7072	Previous Hour - Prog.Var.7777	Read
7073	Previous Hour - Prog.Var.7778	Read
7074	Previous Hour - Prog.Var.7779	Read
7075	Previous Hour - Prog.Var.7780	Read
7076	Previous Day - Prog.Var.7781	Read
7077	Previous Day - Prog.Var.7782	Read
7078	Previous Day - Prog.Var.7783	Read
7079	Previous Day - Prog.Var.7784	Read
7080	Previous Day - Prog.Var.7785	Read
7081	Previous Batch - Prog.Var.7786	Read
7082	Previous Batch - Prog.Var.7787	Read
7083	Previous Batch - Prog.Var.7788	Read
7084	Previous Batch - Prog.Var.7789	Read
7085	Previous Batch - Prog.Var.7790	Read

Slave Unit Registers (7086-7095)

7086	Variable#1	Read/Write
7087	Variable#2	Read/Write
7088	Variable#3	Read/Write
7089	Variable#4	Read/Write
7090	Variable#5	Read/Write
7091	Variable#6	Read/Write
7092	Variable#7	Read/Write
7093	Variable#8	Read/Write
7094	Variable#9	Read/Write
7095	Variable#10	Read/Write

Modbus Address Table – Float Point

ADDRESS	DESCRIPTION	READ/WRITE
Current Data Area– Meter		
7101	Forward Batch GROSS	Read
7102	Forward Batch NET	Read
7103	Forward Batch MASS	Read
7104	Spare	
7105	Forward Average DP	Read
7106	Forward Average Temperature	Read
7107	Forward Average Pressure	Read
7108	Forward Average SG	Read
7109	Forward Average DP/EXT	Read
7110	GROSS Flowrate	Read
7111	NET Flowrate	Read
7112	MASS Flowrate	Read
7113	Spare	
7114	DP	Read
7115	Temperature	Read
7116	Pressure	Read
7117	Density LB/FT3	Read
7118	Densitometer Temperature	Read
7119	Densitometer Pressure	Read
7120	LB/FT3.b	Read
7121	Y Factor	Read
7122	Fa Factor	Read
7123	K/CD/MF Factor	Read
7124	GM/CC	Read
7125	GM/CC@60	Read
7126	CTL Factor	Read
7127	CPL Factor	Read
7128	Equilibrium Pressure	Read
7129	API	Read
7130	API@60	Read
7131	SG	Read
7132	SG@60	Read
7133	Meter Factor	Read
7134	Linear Factor	Read
7135	Forward Cum GROSS	Read
7136	Forward Cum NET	Read
7137	Forward Cum MASS	Read
7138	Spare	
7139	Reverse Cum GROSS	Read
7140	Reverse Cum NET	Read
7141	Reverse Cum MASS	Read
7142	Spare	
7143	Reverse Batch Gross	Read
7144	Reverse Batch Net	Read
7145	Reverse Batch Mass	Read
7146	Spare	
7147	Forward Average DP	Read
7148	Forward Average Temperature	Read
7149	Forward Average Pressure	Read
7150	Forward Average SG	Read
7151	Forward Average DP/EXT	Read

Modbus Address Table – Float Point

ADDRESS	DESCRIPTION	READ/WRITE
7152	Pipe ID Inches	Read
7153	Orifice ID Inches	Read
7154	Density Correction Factor	Read
7155	K Factor	Read
7156	Spare#1 Data	Read
7157	Spare#2 Data	Read
7158	Calculated Density	Read
7159	Calculated Density@60	Read
7160	Average Sample Period DP or Net Flow Rate	Read
7161	Average Sample Period Pressure or Spare Data	Read
7162	Forward Cumulative Gross Roll Over Number	Read
7163	Forward Cumulative Net Roll Over Number	Read
7164	Forward Cumulative Mass Roll Over Number	Read
7165	Reverse Cumulative Gross Roll Over Number	Read
7166	Reverse Cumulative Net Roll Over Number	Read
7167	Reverse Cumulative Mass Roll Over Number	Read
7168	Average Sample Period Spare Data	Read
7169-7176	Spare	
7177	Live Multi.DP Reading	Read
7178	Live Multi.Pressure Reading	Read
7179	Live Multi.Temperature Reading	Read
7180-7187	Reserved	
7188	Enron Modbus – Alarms and Event	Read
7189	Enron Modbus – Hourly Pointer	Read
7190	Enron Modbus – Daily Pointer	Read

Modbus Address Table – Float Point

ADDRESS	DESCRIPTION	READ/WRITE
7201	Last Hour – Forward Gross Total	Read
7202	Last Hour – Forward Net Total	Read
7203	Last Hour – Forward Mass Total	Read
7204	Yesterday – Forward Gross Total	Read
7205	Yesterday – Forward Net Total	Read
7206	Yesterday – Forward Mass Total	Read
7207	Last Month – Forward Gross Total	Read
7208	Last Month – Forward Net Total	Read
7209	Last Month – Forward Mass Total	Read
7210	Yesterday – Forward Average Temperature	Read
7211	Yesterday – Forward Average Pressure	Read
7212	Yesterday – Forward Average DP/EXT	Read
7213	Yesterday – Forward Average SG	Read
7214	Yesterday – Forward Average API	Read
7215	Yesterday – Forward Average GM/CC	Read
7216	Last Hour – Reverse Gross Total	Read
7217	Last Hour – Reverse Net Total	Read
7218	Last Hour – Reverse Mass Total	Read
7219	Yesterday – Reverse Gross Total	Read
7220	Yesterday – Reverse Net Total	Read
7221	Yesterday – Reverse Mass Total	Read
7222	Last Month – Reverse Gross Total	Read
7223	Last Month – Reverse Net Total	Read
7224	Last Month – Reverse Mass Total	Read
7225	Yesterday – Reverse Average Temperature	Read
7226	Yesterday – Reverse Average Pressure	Read
7227	Yesterday – Reverse Average DP/EXT	Read
7228	Yesterday – Reverse Average SG	Read
7229	Yesterday – Reverse Average API	Read
7230	Yesterday – Reverse Average GM/CC	Read
7231	Last Month – Forward Gross Roll Over Number	Read
7232	Last Month – Forward Net Roll Over Number	Read
7233	Last Month – Forward Mass Roll Over Number	Read
7234	Last Month – Reverse Gross Roll Over Number	Read
7235	Last Month – Reverse Net Roll Over Number	Read
7236	Last Month – Reverse Mass Roll Over Number	Read

Modbus Address Table – Float Point

ADDRESS	DESCRIPTION	READ/WRITE
7301	Date	Read
7302	Time	Read
7303	Nist14 – Mol % of Methane	Read
7304	Nist14 – Mol % of Ethane	Read
7305	Nist14 – Mol % of Propane	Read
7306	Nist14 – Mol % of i-Butane	Read
7307	Nist14 – Mol % of n-Butane	Read
7308	Nist14 – Mol % of Carbon Dioxide	Read
7309	Nist14 – Mol % of Argon	Read
7310	Nist14 – Mol % of Ethylene	Read
7311	Nist14 – Mol % of Nitrogen	Read
7312	Nist14 – Mol % of Oxygen	Read
7313	Nist14 – Mol % of Carbon Monoxide	Read
7314	Nist14 – Mol % of Hydrogen Sulfide	Read
7315	Nist14 – Mol % of n-Pentane	Read
7316	Nist14 – Mol % of i-Pentane	Read
7317	Nist14 – Mol % of n-Hexane	Read
7318	Nist14 – Mol % of i-Hexane	Read
7319	Nist14 – Mol % of n-Heptane	Read
7320	Nist14 – Density.b Override	Read
7321-7340	Spare	

Data Packet

Previous Hourly Data Packet (101-388)

Hourly archive flow data 101, 102, .. 387, 388 are fixed length arrays. The data field is used to address an 5 hours individual group record.(101=Latest, 388=Oldest)

RTU MODE –

ADDR	FUNC CODE	STARTING POINT		# OF POINTS		CRC CHECK	
		HI	LO	HI	LO		
01	03	00	65	00	01	94	15

Response

ADDR	FUNC CODE	BYTE COUNTS	DATA …(Repeat n Times)		CRC CHECK	
			HI	LO		
01	03	DC	00	01..		

Data Packet

Response Data Message

DESCRIPTION STANDARD ***note** Set "Use Aramco's Customized Report" to 0	**DESCRIPTION CUSTOMERMIZED** ***note** Set "Use Aramco's Customized Report" to 1	**DECIMAL**	**HOUR**
Date	Date	0 Inferred	First Hour
Alarm Status/Time	Alarm Status/Time	0 Inferred	First Hour
Flowing Time	Today's Flow Time	2 Inferred	First Hour
Gross Total	Net Cumulative Volume	1 Inferred	First Hour
Net Total	Today's Flow Rate	1 Inferred	First Hour
Mass Total	Log Interval Avg. Rate	2 Inferred	First Hour
Temperature	Instantaneous Pressure	1 Inferred	First Hour
Pressure	Today's Pressure	1 Inferred	First Hour
DP	Average DP Low	4 Inferred	First Hour
SG	Not Used	4 Inferred	First Hour
DP/EXT	Average DP High	4 Inferred	First Hour
Date	Date	0 Inferred	Second Hour
Alarm Status/Time	Alarm Status/Time	0 Inferred	Second Hour
Flowing Time	Today's Flow Time	2 Inferred	Second Hour
Gross Total	Net Cumulative Volume	1 Inferred	Second Hour
Net Total	Today's Flow Rate	1 Inferred	Second Hour
Mass Total	Log Interval Avg. Rate	2 Inferred	Second Hour
Temperature	Instantaneous Pressure	1 Inferred	Second Hour
Pressure	Today's Pressure	1 Inferred	Second Hour
DP	Average DP Low	4 Inferred	Second Hour
SG	Not Used	4 Inferred	Second Hour
DP/EXT	Average DP High	4 Inferred	Second Hour

Alarm Status:

Bit 0	DP Override
Bit 1	Temperature Override
Bit 2	Pressure Override
Bit 3	Voltage Override
Bit 4	DP High
Bit 5	DP Low
Bit 6	Temperature High
Bit 7	Temperature Low

Bit 8	Pressure High
Bit 9	Pressure Low
Bit 10	Voltage High
Bit 11	Voltage Low

Data Packet

DESCRIPTION STANDARD ***note** Set "Use Aramco's Customized Report" to 0	**DESCRIPTION CUSTOMERMIZED** ***note** Set "Use Aramco's Customized Report" to 1	**DECIMAL**	**HOUR**
Date	Date	0 Inferred	Third Hour
Alarm Status/Time	Alarm Status/Time	0 Inferred	Third Hour
Flowing Time	Today's Flow Time	2 Inferred	Third Hour
Gross Total	Cumulative Volume	1 Inferred	Third Hour
Net Total	Today's Flow Rate	1 Inferred	Third Hour
Mass Total	Log Interval Avg. Rate	2 Inferred	Third Hour
Temperature	Instantaneous Pressure	1 Inferred	Third Hour
Pressure	Today's Pressure	1 Inferred	Third Hour
DP	Average DP Low	4 Inferred	Third Hour
SG	Not Used	4 Inferred	Third Hour
DP/EXT	Average DP High	4 Inferred	Third Hour
Date	Date	0 Inferred	Fourth Hour
Alarm Status/Time	Alarm Status/Time	0 Inferred	Fourth Hour
Flowing Time	Today's Flow Time	2 Inferred	Fourth Hour
Gross Total	Net Cumulative Volume	1 Inferred	Fourth Hour
Net Total	Today's Flow Rate	1 Inferred	Fourth Hour
Mass Total	Log Interval Avg. Rate	2 Inferred	Fourth Hour
Temperature	Instantaneous Pressure	1 Inferred	Fourth Hour
Pressure	Today's Pressure	1 Inferred	Fourth Hour
DP	Average DP Low	4 Inferred	Fourth Hour
SG	Not Used	4 Inferred	Fourth Hour
DP/EXT	Average DP High	4 Inferred	Fourth Hour
Date	Date	0 Inferred	Fifth Hour
Alarm Status/Time	Alarm Status/Time	0 Inferred	Fifth Hour
Flowing Time	Today's Flow Time	2 Inferred	Fifth Hour
Gross Total	Net Cumulative Volume	1 Inferred	Fifth Hour
Net Total	Today's Flow Rate	1 Inferred	Fifth Hour
Mass Total	Log Interval Avg. Rate	1 Inferred	Fifth Hour
Temperature	Instantaneous Pressure	1 Inferred	Fifth Hour
Pressure	Today's Pressure	1 Inferred	Fifth Hour
DP	Average DP Low	4 Inferred	Fifth Hour
SG	Not Used	4 Inferred	Fifth Hour
DP/EXT	Average DP High	4 Inferred	Fifth Hour

Data Packet

Previous Hourly Data Packet

Number	Hour
101	1-5
102	6-10
103	11-15
104	16-20
105	21-25
106	26-30
107	31-35
108	36-40
109	41-45
110	46-50
111	51-55
112	56-60
113	61-65
114	66-70
115	71-75
116	76-80
117	81-85
118	86-90
119	91-95
120	96-100
121	101-105
122	106-110
123	111-115
124	116-120
125	121-125
126	126-130
127	131-135
128	136-140
129	141-145
130	146-150

Number	Hour
131	151-155
132	156-160
133	161-165
134	166-170
135	171-175
136	176-180
137	181-185
138	186-190
139	191-195
140	196-200
141	201-205
142	206-210
143	211-215
144	216-220
145	221-225
146	226-230
147	231-235
148	236-240
149	241-245
150	246-250
151	251-255
152	256-260
153	261-265
154	266-270
155	271-275
156	276-280
157	281-285
158	286-290
159	291-295
160	296-300

Number	Hour
161	301-305
162	306-310
163	311-315
164	316-320
165	321-325
166	326-330
167	331-335
168	336-340
169	341-345
170	346-350
171	351-355
172	356-360
173	361-365
174	366-370
175	371-375
176	376-380
177	381-385
178	386-390
179	391-395
180	396-400
181	401-405
182	406-410
183	411-415
184	416-420
185	421-425
186	426-430
187	431-435
188	436-440
189	441-445
190	446-450

Data Packet

Number	Hour
191	451-455
192	456-460
193	461-465
194	466-470
195	471-475
196	476-480
197	481-485
198	486-490
199	491-495
200	496-500
201	501-505
202	506-510
203	511-515
204	516-520
205	521-525
206	526-530
207	531-535
208	536-540
209	541-545
210	546-550
211	551-555
212	556-560
213	561-565
214	566-570
215	571-575
216	576-580
217	581-585
218	586-590
219	591-595
220	596-600

Number	Hour
221	601-605
222	606-610
223	611-615
224	616-620
225	621-625
226	626-630
227	631-635
228	636-640
229	641-645
230	646-650
231	651-655
232	656-660
233	661-665
234	666-670
235	671-675
236	676-680
237	681-685
238	686-690
239	691-695
240	696-700
241	701-705
242	706-710
243	711-715
244	716-720
245	721-725
246	726-730
247	731-735
248	736-740
249	741-745
250	746-750

Number	Hour
251	751-755
252	756-760
253	761-765
254	766-770
255	771-775
256	776-780
257	781-785
258	786-790
259	791-795
260	796-800
261	801-805
262	806-810
263	811-815
264	816-820
265	821-825
266	826-830
267	831-835
268	836-840
269	841-845
270	846-850
271	851-855
272	856-860
273	861-865
274	866-870
275	871-875
276	876-880
277	881-885
278	886-890
279	891-895
280	896-900

Data Packet

Number	Hour
281	901-905
282	906-910
283	911-915
284	916-920
285	921-925
286	926-930
287	931-935
288	936-940
289	941-945
290	946-950
291	951-955
292	956-960
293	961-965
294	966-970
295	971-975
296	976-980
297	981-985
298	986-990
299	991-995
300	996-1000
301	1001-1005
302	1006-1010
303	1011-1015
304	1016-1020
305	1021-1025
306	1026-1030
307	1031-1035
308	1036-1040
309	1041-1045
310	1046-1050

Number	Hour
311	1051-1055
312	1056-1060
313	1061-1065
314	1066-1070
315	1071-1075
316	1076-1080
317	1081-1085
318	1086-1090
319	1091-1095
320	1096-1100
321	1101-1105
322	1106-1110
323	1111-1115
324	1116-1120
325	1121-1125
326	1126-1130
327	1131-1135
328	1136-1140
329	1141-1145
330	1146-1150
331	1151-1155
332	1156-1160
333	1161-1165
334	1166-1170
335	1171-1175
336	1176-1180
337	1181-1185
338	1186-1190
339	1191-1195
340	1196-1200

Number	Hour
341	1201-1205
342	1206-1210
343	1211-1215
344	1216-1220
345	1221-1225
346	1226-1230
347	1231-1235
348	1236-1240
349	1241-1245
350	1246-1250
351	1251-1255
352	1256-1260
353	1261-1265
354	1266-1270
355	1271-1275
356	1276-1280
357	1281-1285
358	1286-1290
359	1291-1295
360	1296-1300
361	1301-1305
362	1306-1310
363	1311-1315
364	1316-1320
365	1321-1325
366	1326-1330
367	1331-1335
368	1336-1340
369	1341-1345
370	1346-1350

Data Packet

Number	Hour
371	1351-1355
372	1356-1360
373	1361-1365
374	1366-1370
375	1371-1375
376	1376-1380
377	1381-1385
378	1386-1390
379	1391-1395
380	1396-1400
381	1401-1405
382	1406-1410
383	1411-1415
384	1416-1420
385	1421-1425
386	1426-1430
387	1431-1435
388	1436-1440

Data Packet

Previous Daily Data Packet (431-442)

Hourly archive flow data 431,432, .. 433,437 are fixed length arrays. The data field is used to address an 5 days individual group record.431=Latest, 442=Oldest)

RTU MODE –

ADDR	FUNC CODE	STARTING POINT		# OF POINTS		CRC CHECK	
		HI	LO	HI	LO		
01	03	01	AF	00	01		

Response

ADDR	FUNC CODE	BYTE COUNTS	DATA …(Repeat n Times)		CRC CHECK	
			HI	LO		
01	03	DC	00	01..		

Data Packet

Response Data Message

DESCRIPTION	DECIMAL	DAY
Date	0 Inferred	First Day
Alarm Status/Time	0 Inferred	First Day
Flowing Time	2 Inferred	First Day
Gross Total	1 Inferred	First Day
Net Total	1 Inferred	First Day
Mass Total	2 Inferred	First Day
Temperature	1 Inferred	First Day
Pressure	1 Inferred	First Day
DP	4 Inferred	First Day
SG	4 Inferred	First Day
DP/EXT	4 Inferred	First Day
Date	0 Inferred	Second Day
Alarm Status/Time	0 Inferred	Second Day
Flowing Time	2 Inferred	Second Day
Gross Total	1 Inferred	Second Day
Net Total	1 Inferred	Second Day
Mass Total	2 Inferred	Second Day
Temperature	1 Inferred	Second Day
Pressure	1 Inferred	Second Day
DP	4 Inferred	Second Day
SG	4 Inferred	Second Day
DP/EXT	4 Inferred	Second Day

Data Packet

DESCRIPTION	DECIMAL	DAY
Date	0 Inferred	Third Day
Alarm Status/Time	0 Inferred	Third Day
Flowing Time	2 Inferred	Third Day
Gross Total	1 Inferred	Third Day
Net Total	1 Inferred	Third Day
Mass Total	2 Inferred	Third Day
Temperature	1 Inferred	Third Day
Pressure	1 Inferred	Third Day
DP	4 Inferred	Third Day
SG	4 Inferred	Third Day
DP/EXT	4 Inferred	Third Day
Date	0 Inferred	Fourth Day
Alarm Status/Time	0 Inferred	Fourth Day
Flowing Time	2 Inferred	Fourth Day
Gross Total	1 Inferred	Fourth Day
Net Total	1 Inferred	Fourth Day
Mass Total	2 Inferred	Fourth Day
Temperature	1 Inferred	Fourth Day
Pressure	1 Inferred	Fourth Day
DP	4 Inferred	Fourth Day
SG	4 Inferred	Fourth Day
DP/EXT	4 Inferred	Fourth Day
Date	0 Inferred	Fifth Day
Alarm Status/Time	0 Inferred	Fifth Day
Flowing Time	2 Inferred	Fifth Day
Gross Total	1 Inferred	Fifth Day
Net Total	1 Inferred	Fifth Day
Mass Total	1 Inferred	Fifth Day
Temperature	1 Inferred	Fifth Day
Pressure	1 Inferred	Fifth Day
DP	4 Inferred	Fifth Day
SG	4 Inferred	Fifth Day
DP/EXT	4 Inferred	Fifth Day

Data Packet

Previous Daily Data Packet

Number	Day
431	1-5
432	6-10
433	11-15
434	16-20
435	21-25
436	26-30
437	31-35
438	36-40
439	41-45
440	46-50
441	51-55
442	56-60

DATA PACKET

Previous Month Data Packet (411)

Monthly archive flow data 411-is a fixed length array. The data field is used to address month configuration and month totals record.

RTU MODE -

ADDR	FUNC CODE	STARTING POINT		# OF POINTS		CRC CHECK	
		HI	LO	HI	LO		
01	03	01	9b	00	01		

Response

ADDR	FUNC CODE	BYTE COUNTS	DATA …(Repeat n Times)		CRC CHECK	
			HI	LO		
01	03	4C	00	01..		

DESCRIPTION	**DECIMAL**
Base Temperature	2 Inferred
Pipe ID	5 Inferred
Orifice ID	5 Inferred
Atmospheric Pressure	3 Inferred
DP Cut Off	4 Inferred
Flowing Time	1 Inferred
Month Total – Gross	0 Inferred
Month Total – Net	0 Inferred
Month Total – Mass	0 Inferred
Month Averaged Temperature	1 Inferred
Month Average Pressure	1 Inferred
Month Average DP	4 Inferred
Month Average SG	4 Inferred
Month Average DP/EXT	4 Inferred
Configuration Flag	0 Inferred
Date	0 Inferred
Month	0 Inferred
Year	0 Inferred
Index	0 Inferred

DATA PACKET

Previous Month Data Packet (412-417)

Monthly archive flow data 412-417 are fixed length arrays. The data field is used to address an 6 days individual group record

RTU MODE -

ADDR	FUNC CODE	STARTING POINT		# OF POINTS		CRC CHECK	
		HI	LO	HI	LO		
01	03	01	9f	00	01		

Response

ADDR	FUNC CODE	BYTE COUNTS	DATA …(Repeat n Times)		CRC CHECK	
			HI	LO		
01	03	220	00	01..		

Number	**Day**
412	**1-6**
413	**7-12**
414	**13-18**
415	**19-24**
416	**25-30**

DESCRIPTION	**DECIMAL**	**Days**
Index	0 Inferred	
Flowing Time	2 Inferred	First Day
Gross	1 Inferred	First Day
Net	1 Inferred	First Day
Mass	2 Inferred	First Day
Temperature	1 Inferred	First Day
Pressure	1 Inferred	First Day
DP	4 Inferred	First Day
SG	4 Inferred	First Day
DP/EXT	4 Inferred	First Day
…	…	…
…	…	…
Flowing Time	2 Inferred	6th Day
Gross	1 Inferred	6th Day
Net	1 Inferred	6th Day
Mass	1 Inferred	6th Day
Temperature	1 Inferred	6th Day
Pressure	1 Inferred	6th Day
DP	4 Inferred	6th Day
SG	4 Inferred	6th Day
DP/EXT	4 Inferred	6th Day

DATA PACKET

Previous Month Data Packet (418)

Monthly archive flow data 418 is a fixed length array. The data field is used to address a 1 day individual group record.

Number	**Day**
417	**31**

RTU MODE -

ADDR	FUNC CODE	STARTING POINT		# OF POINTS		CRC CHECK	
		HI	LO	HI	LO		
01	03	01	9f	00	01		

Response

ADDR	FUNC CODE	BYTE COUNTS	DATA …(Repeat n Times)		CRC CHECK	
			HI	LO		
01	03	2c	00	01..		

Well Testing Data

10 data entries to cover the different test stages

Stage	Date Entry 1	Data Entry 2
1	Duration/ Minutes	Capture Interval/Seconds
2	Duration/ Minutes	Capture Interval/Seconds
3	Duration/ Minutes	Capture Interval/Seconds
4	Duration/ Minutes	Capture Interval/Seconds
5	Duration/ Minutes	Capture Interval/Seconds
6	Duration/ Minutes	Capture Interval/Seconds
7	Duration/ Minutes	Capture Interval/Seconds
8	Duration/ Minutes	Capture Interval/Seconds
9	Duration/ Minutes	Capture Interval/Seconds
10	Duration/ Minutes	Capture Interval/Seconds
	Maximum Records: 33000	

16 Bits Integers

2692	Well Test Stage #1 Duration/Minutes	0 Inferred	Read/Write
2693	Well Test Stage #1 Capture Interval/Seconds	0 Inferred	Read/Write
2694	Well Test Stage #2 Duration/ Minutes	0 Inferred	Read/Write
2695	Well Test Stage #2 Capture Interval/Seconds	0 Inferred	Read/Write
2696	Well Test Stage #3 Duration/ Minutes	0 Inferred	Read/Write
2697	Well Test Stage #3 Capture Interval/Seconds	0 Inferred	Read/Write
2698	Well Test Stage #4 Duration/ Minutes	0 Inferred	Read/Write
2699	Well Test Stage #4 Capture Interval/Seconds	0 Inferred	Read/Write
2700	Well Test Stage #5 Duration/ Minutes	0 Inferred	Read/Write
2701	Well Test Stage #5 Capture Interval/Seconds	0 Inferred	Read/Write
2702	Well Test Stage #6 Duration/ Minutes	0 Inferred	Read/Write
2703	Well Test Stage #6 Capture Interval/Seconds	0 Inferred	Read/Write
2704	Well Test Stage #7 Duration/ Minutes	0 Inferred	Read/Write
2705	Well Test Stage #7 Capture Interval/Seconds	0 Inferred	Read/Write
2706	Well Test Stage #8 Duration/ Minutes	0 Inferred	Read/Write
2707	Well Test Stage #8 Capture Interval/Seconds	0 Inferred	Read/Write
2708	Well Test Stage #9 Duration/ Minutes	0 Inferred	Read/Write
2709	Well Test Stage #9 Capture Interval/Seconds	0 Inferred	Read/Write
2710	Well Test Stage #10 Duration/ Minutes	0 Inferred	Read/Write
2711	Well Test Stage #10 Capture Interval/Seconds	0 Inferred	Read/Write
2712	Well Test Historical Var#1 DP or Net Flow Selection	0 Inferred	Read/Write
2713	Well Test Historical Var#2 Pressure Selection	0 Inferred	Read/Write
2714	Well Test Average Sample Period	0 Inferred	Read/Write
2715	Well Test Historical Var#3 Pressure Selection	0 Inferred	Read/Write
3011	Well Test Status 1=Busy,2=Data Ready	0 Inferred	Read
3012	Current Well Test Stage Number	0 Inferred	Read
3013	Current Well Test Stage Timer Left	0 Inferred	Read
3014	Current Well Test Stage Interval Timer Left	0 Inferred	Read
3015	Reset Well Test Data	0 Inferred	Write
3016	Stop Well Test	0 Inferred	Write
3017	Start Well Test Request	0 Inferred	Write

Well Testing Data

32 Bits Integers

3271	Well Test Stage #1 Starting Date (DD/MM/YY)	0 Inferred	Read
3273	Well Test Stage #1 Starting Time (HH/MM/SS)	0 Inferred	Read
3275	Well Test Stage #1 Interval in Seconds	0 Inferred	Read
3277	Well Test Stage #1 Record Starting Number	0 Inferred	Read
3279	Well Test Stage #1 Number of Record	0 Inferred	Read
3281	Well Test Stage #2 Starting Date (DD/MM/YY)	0 Inferred	Read
3283	Well Test Stage #2 Starting Time (HH/MM/SS)	0 Inferred	Read
3285	Well Test Stage #2 Interval in Seconds	0 Inferred	Read
3287	Well Test Stage #2 Record Starting Number	0 Inferred	Read
3289	Well Test Stage #2 Number of Record	0 Inferred	Read
3291	Well Test Stage #3 Starting Date (DD/MM/YY)	0 Inferred	Read
3293	Well Test Stage #3 Starting Time (HH/MM/SS)	0 Inferred	Read
3295	Well Test Stage #3 Interval in Seconds	0 Inferred	Read
3297	Well Test Stage #3 Record Starting Number	0 Inferred	Read
3299	Well Test Stage #3 Number of Record	0 Inferred	Read
3301	Well Test Stage #4 Starting Date (DD/MM/YY)	0 Inferred	Read
3303	Well Test Stage #4 Starting Time (HH/MM/SS)	0 Inferred	Read
3305	Well Test Stage #4 Interval in Seconds	0 Inferred	Read
3307	Well Test Stage #4 Record Starting Number	0 Inferred	Read
3309	Well Test Stage #4 Number of Record	0 Inferred	Read
3311	Well Test Stage #5 Starting Date (DD/MM/YY)	0 Inferred	Read
3313	Well Test Stage #5 Starting Time (HH/MM/SS)	0 Inferred	Read
3315	Well Test Stage #5 Interval in Seconds	0 Inferred	Read
3317	Well Test Stage #5 Record Starting Number	0 Inferred	Read
3319	Well Test Stage #5 Number of Record	0 Inferred	Read
3321	Well Test Stage #6 Starting Date (DD/MM/YY)	0 Inferred	Read
3323	Well Test Stage #6 Starting Time (HH/MM/SS)	0 Inferred	Read
3325	Well Test Stage #6 Interval in Seconds	0 Inferred	Read
3327	Well Test Stage #6 Record Starting Number	0 Inferred	Read
3329	Well Test Stage #6 Number of Record	0 Inferred	Read
3331	Well Test Stage #7 Starting Date (DD/MM/YY)	0 Inferred	Read
3333	Well Test Stage #7 Starting Time (HH/MM/SS)	0 Inferred	Read
3335	Well Test Stage #7 Interval in Seconds	0 Inferred	Read
3337	Well Test Stage #7 Record Starting Number	0 Inferred	Read
3339	Well Test Stage #7 Number of Record	0 Inferred	Read
3341	Well Test Stage #8 Starting Date (DD/MM/YY)	0 Inferred	Read
3343	Well Test Stage #8 Starting Time (HH/MM/SS)	0 Inferred	Read
3345	Well Test Stage #8 Interval in Seconds	0 Inferred	Read
3347	Well Test Stage #8 Record Starting Number	0 Inferred	Read
3349	Well Test Stage #8 Number of Record	0 Inferred	Read
3351	Well Test Stage #9 Starting Date (DD/MM/YY)	0 Inferred	Read
3353	Well Test Stage #9 Starting Time (HH/MM/SS)	0 Inferred	Read
3355	Well Test Stage #9 Interval in Seconds	0 Inferred	Read
3357	Well Test Stage #9 Record Starting Number	0 Inferred	Read
3359	Well Test Stage #9 Number of Record	0 Inferred	Read
3361	Well Test Stage 10 Starting Date (DD/MM/YY)	0 Inferred	Read
3363	Well Test Stage 10 Starting Time (HH/MM/SS)	0 Inferred	Read
3365	Well Test Stage 10 Interval in Seconds	0 Inferred	Read
3367	Well Test Stage 10 Record Starting Number	0 Inferred	Read
3369	Well Test Stage 10 Number of Record	0 Inferred	Read

Well Testing Data

Well Test Data Packet (801)

Well test archive data 801 is a fixed length array. The data field is used to address 63 records – Two Variables, or 42 records – Three Variables (252 bytes).
The data can be retrieved only if the status is ready (modbus 3011: 2 –Ready, 1-Busy)

RTU MODE -

ADDR	FUNC CODE	Data Packet		Record Number		CRC CHECK	
		HI	LO	HI	LO		
01	03	03	21	00	01		

Response

ADDR	FUNC CODE	BYTE COUNTS	DATA …(Repeat n Times)		CRC CHECK	
			HI	LO		
01	03	fc	00	01..		

Record Definition – 2x16 bits Integer

18 bits	14 bits
Net Flow Rate or DP	Pressure

Record Definition – 16 bits Integer

16 bits
Pressure

Well Testing Data

	Modbus Register				
Test Stage	**Date**	**Time**	**Starting Record No.**	**No. of Record**	**Interval in Second**
1	3271	3273	3277	3279	3275
2	3281	3283	3287	3289	3285
3	3291	3293	3297	3299	3295
4	3301	3303	3307	3309	3305
5	3311	3313	3317	3319	3315
6	3321	3323	3327	3329	3325
7	3331	3333	3337	3339	3335
8	3341	3343	3347	3349	3345
9	3351	3353	3357	3359	3355
10	3361	3363	3367	3369	3365

ENRON MODBUS SPECIFICATIONS

16 BITS INTEGER

The short word numeric variable is a 16-bit integer. A short word is transmitted as two 8-bit bytes, 4 characters.

Example:
BBA (HEX) = 3002 (Decimal)

32 BITS INTEGER

The long word numeric variable is a two 16-bit integers. A long word is transmitted as four 8-bit bytes, 8 characters.

Example:
38270 (HEX) = 230000 (Decimal)

Floating Point

32-bit single precision floating-point numbers are read as groups of four bytes (8 characters) with the following specific bit order

Sign	Exponent	Mantissa	
(1 bit)	(8 bits)	(23 bits)	
SEEEEEEE	EMMMMMMM	MMMMMMMM	MMMMMMMM
Byte 3	Byte 2	Byte 1	Byte 0

S: is the sign bit.
E: is the two's exponent.
M: is 23 bit normalized mantissa.

DFC ENRON MODBUS

Hourly and Daily archive flow data 701, 704 are fixed length arrays. The data field is used to address an individual record

RTU MODE

ADDR	FUNC CODE	STARTING POINT		# OF POINTS		CRC CHECK	
		HI	LO	HI	LO		
01	03	02	BD	00	0A	54	51

Response

ADDR	FUNC CODE	BYTE COUNTS	DATA …(Repeat n Times)		CRC CHECK	
			HI	LO		
01	03	58	00	01..		

Archive Register Assignments

Register	Class	Description
701	Archive	Daily Snapshot Gas Quality
703	Archive	Daily Flow Data Log
704	Archive	Hourly Flow Data Log

DFC Enron Modbus

ARCHIVE 701 PREVIOUS DAILY DATA AREA -DAILY AVERAGE GAS QUALITY DATA

One Modbus register (7098 -floating point) is used to indicate the current *daily record pointer numbers*. This pointer identifies the current record which data was last logged. The MicroML1 can store up to 60 day's data. The daily pointer will be 1 through 60. The pointer will roll over at 60 to 1.

701	**Date**
	Time
	Mol % - Methane
	Mol % - Ethane
	Mol % - Propane
	Mol % - i-Butane
	Mol % - n-Butane
	Mol % - Carbon Dioxide
	Mol % - Argon
	Mol % - Ethylene
	Mol % - Nitrogen
	Mol % - Oxygen
	Mol % - Carbon Monoxide
	Mol % - Hydrogen Sulfide
	Mol % - n-Pentane
	Mol % - i-Pentane
	Mol % - n-Hexane
	Mol % - i-Hexane
	Mol % - n-heptane
	Base Density

DFC Enron Modbus

Example Modbus* Daily Snapshot Gas Quality Data *Collection

Query - 7098 Daily Pointer

Address	Func	Start HI	Start LO	No of Register		CRC	
01	03	1b	Ba	00	01		

MicroML1 Response–daily pointer

Address	Func	Bytes	Data Hi		Data Lo		CRC	
01	03	04						

Query - 703 - Previous Daily Flow Data Record 1 – Yesterday's Data

Address	Func	Start HI	Start LO	Record Number		CRC	
01	03	02	bf	00	01		

MicroML1 Response–Record 1: yesterday data.

Address	Func	Bytes	Data	CRC	
01	03	80	46ff7e00 0000000 41200000 42b40000 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000		

Archive	**Record**	**Description**	**Value**
701	1	Date	3/27/03
		Time	00:00:00
		Mol % - Methane	90.00
		Mol% - Ethane	10.00
		Mol% - Propane	0.0
		Mol% - i-Butane	0.0
		Mol% - n-Butane	0.0
		Mol% - Carbon Dioxide	0.0
		Mol% - Argon	0.0
		Mol% - Ethylene	0.0
		Mol% - Nitrogen	0.0
		Mol% - Oxygen	0.0
		Mol% - Carbon Monoxide	0.0
		Mol% - Hydrogen Sulfide	0.0
		Mol% - n-Pentane	0.0
		Mol% - i-Pentane	0.0
		Mol% - n-Hexane	0.0
		Mol% - i-Hexane	0.0
		Mol% - n-Heptane	0.0
		Base Density	0.0

DFC Enron Modbus

ARCHIVE 703 - PREVIOUS DAILY FLOW DATA LOG

One Modbus register (7190 -floating point) is used to indicate the current *daily record pointer numbers*. This pointer identifies the current record which data was last logged. The MicroML1 can store up to 60 day's data. The daily pointer will be 1 through 60. (The pointer will roll over at 60 to 1).

703	**Date**
	Time
	Flow Time (Minutes)
	Gross Total
	Net Total
	Mass Total
	Average Temperature
	Average Pressure
	Average DP
	Average Density
	Average DP/EXT

DFC Enron Modbus

Example Modbus Previous Daily Flow Data Collection

Query - 7190 Daily Pointer

Address	Func	Start HI	Start LO	No of Register		CRC	
01	03	1c	16	00	01		

MicroML1 Response–Daily Pointer

Address	Func	Bytes	Data Hi		Data Lo		CRC	
01	03	04						

Query - 703 - Previous Daily Flow Data Record 1 – Yesterday's Data

Address	Func	Start HI	Start LO	Record Number		CRC	
01	03	02	Bf	00	01		

MIcroML1 Response–Record 3:yesterday data

Address	Func	Bytes	Data	CRC	
01	03	2c	46ff7e00 0000000 … … …		

Archive	**Record**	**Description**	**Value**
703	1	Date	3/27/03
		Time	00:00:00
		Flow Time (Minutes)	1367.5
		Gross Total	988.71
		Net Total	35881.78
		Mass Total	1633.411
		Average Temperature	70.0
		Average Pressure	500.0
		Average DP	35881.78
		Average Base Density	5.0
		Average DP/EXT	215.45

DFC Enron Modbus

ARCHIVE 704 – PREVIOUS HOURLY FLOW DATA LOG

One Modbus register (7189 -floating point) is used to indicate the current *hourly record pointer numbers*. This pointer identifies the current record which data was last logged. The MicroML1 can store up to 1440 hour's data. The hourly pointer will be 1 through 1440. (The pointer will roll over at 1440 to 1).

704	**Date**
	Time
	Flow Time (Minutes)
	Gross Total
	Net Total
	Mass Total
	Average Temperature
	Average Pressure
	Average DP
	Average Density
	Average DP/EXT

DFC Enron Modbus

Example Modbus Previous Hour Flow Data Collection

Query - 7189 Hourly Pointer

Address	Func	Start HI	Start LO	No of Register		CRC	
01	03	1c	15	00	01		

MicroML1 Response.

Address	Func	Bytes	Data Hi		Data Lo		CRC	
01	03	04						

Query - 704 - Previous Hourly Flow Data Record 1 – Last Hour Data

Address	Func	Start HI	Start LO	Record Number		CRC	
01	03	02	bf	00	01		

MicroML1 Response–Record 1:the last hour data

Address	Func	Bytes	Data	CRC	
01	03	2c	46ff7e00 48609c00 423e1111 … … …	fd	7a

Archive	**Record**	**Description**	**Value**
704	1	Date	3/27/03
		Time	23:00:00
		Flow Time (Minutes)	47.51
		Gross Total	988.71
		Net Total	35881.78
		Mass Total	1633.411
		Average Temperature	70.0
		Average Pressure	500.0
		Average DP	35881.78
		Average Base Density	5.0
		Average DP/EXT	215.45

DFC Enron Modbus

ENRON EVENT/ALARM RECORD DESCRIPTION

The two event log record formats are both the same size and have similar contents. The first word in a record is a bit map in which bit 9 indicate if the event record is an operator change or an alarm event. The meanings of the other bits are specific to either the operator or alarm event log records.

OPERATOR EVENT RECORD

The operator event record consists of the following:

BYTE	CONTENTS
1-2	Operator change bit map (16 bit integer)
3-4	Modbus register number of variable (16 bit integer)
5-8	Time stamp (HHMMSS; 32 bit floating point)
9-12	Date stamp (MMDDYY; 32 bit floating point)
13-16	Previous value of variable (32 bit floating point)
17-20	Current (new) value of variable (32 bit floating point)

The operator change bit map is:

Bit	Value Changed
0	Fixed Value
1	Zero Scale
2	Full Scale
3	Operator Entry Work Value
4	
5	
6	Table Entry Change
7	
8	
9	Operator Change Event Identifier Bit
10	
11	Low Limit
12	High Limit
13	
14	
15	

DFC Enron Modbus

Alarm Event Record

The operator event record consists of the following:

BYTE	CONTENTS
1-2	Alarm change bit map (16 bit integer)
3-4	Modbus register number of variable (16 bit integer)
5-8	Time stamp (HHMMSS; 32 bit floating point)
9-12	Date stamp (MMDDYY; 32 bit floating point)
13-16	Current (alarmed) value of variable (32 bit floating point)
17-20	Zero Filled

The operator change bit map is:

Bit	Value Changed
0-8	Unassigned
9	Operator Change Event Identifier Bit
10	
11	Low Limit
12	High Limit
13	
14	
15	Set/Reset Alarm (1=Set, 0=Reset)

DFC Enron Modbus

Reading Event/Alarm Register

The Modbus request to read the event log uses the standard read function code 03 and the register number 32 (20 Hex).

After receipt of the acknowledge packet, the MicroML1 will reset its event pointer to the next packet of events. After an event pointer has been reset, the master can not go back and collect the previous events.

This process is repeated until the MicroML1s event buffer is empty of all events that occurred since last collection.

7188= Event/Alarm Pointer

DFC Enron Modbus

Reading Alarm/Audit Event

Query

Address	Func	Start HI	Start LO	No . HI	No. LO	CRC	
01	03	00	20	00	01		

Response
In response to this request the MicroML1 device returns the current contents of the event log – up to the maximum size of a Modbus message (255 bytes)

Acknowledge Alarm/Audit Event

Query

Address	Func	Start HI	Start LO	Data HI	Data Lo	CRC	
01	05	00	20	ff	00		

Response
In response to this request the MicroML1 device returns the same message it received.

Address	Func	Start HI	Start LO	Data HI	Data Lo	CRC	
01	05	00	20	ff	00		

DFC Enron Modbus

Example Modbus Alarm/Event Log Data Collection

To request the MicroML1 events a Modbus read is used for register 32 and the number of data points is usually set to 1. The number of data points requested is ignored by the MicroML1. The MicroML1 response will contain from zero to as many events as can be sent within a Modbus message. If no events have occurred since the last event collection, the response message will contain zero data bytes.

Eighty "80" is added to the data value to convert the MicroML1 event log dates to the current year.

Note: The registers used in the examples may not agree with the example register list included within this document

Query

Address	Function	Start HI	Start LO	No. HI	No. LO	CRC	
01	03	00	20	00	01		

Response

Address	Function	Byte	Data	CRC	
01	03	50	08001B7347D7A500478C7380426B5EEF00000000 12001B7347D7B900478C738042C0000428C0000 9000B7347D7EA00478C73804297C38B00000000 10001B7347D80800478C73804283175900000000		

Bit Map	Register	Time	Date	Old Value	New Value
0800	7027	114106.0	71911.0	58.843	0.000
1200	7027	110450.0	71911.0	110.000	70.00
9000	7027	110548.0	71911.0	75.882	0.000
1000	7027	110608.0	71911.0	65.546	0.000

1. Reset Lo alarm on an analog input
2. Changed high limit alarm from 110.0 to 70.0
3. Set high alarm on an input
4. Reset high alarm on an input

After the master has correctly received these events, a reset message is transmitted to the MicroML1 to clear these events from the Modbus event buffer. Since less than the maximum number of events (12) were received, no additional events remain within the Modbus event buffer. If the master sent an additional read message after these events were cleared from the event buffer, the MicroML1 response message would contain zero data bytes. This would also indicate to the master that the event Modbus buffer has been cleared.

Acknowledging Event/Alarms

Address	Func	Start HI	Start LO	Data HI	Data Lo	CRC	
01	05	00	20	ff	00		

Response

Address	Func	Start HI	Start LO	Data HI	Data Lo	CRC	
01	05	00	20	ff	00		

CHAPTER 6: Installation Drawings

Explosion-Proof Installation Drawings

	REVISIONS				
	REV	DESCRIPTION	CHG. NO.	APP'D	DATE
	AA				

12. INSTALLATION TO BE IN ACCORDANCE WITH NATIONAL ELECTRICAL CODE.

9. NON-INCENDIVE FIELD WIRING METHODS MAY BE USED FOR CONNECTING THE TEMPERATURE SENSING ASSEMBLY. WHEN USING NON-INCENDIVE FIELD WIRING, THE CONNECTION HEAD AND TEMPERATURE SENSOR ASSEMBLY NEED NOT BE EXPLOSION PROOF, BUT ALL COMPONENTS CONNECTED TO THE TEMP SENSOR CONNECTOR MUST BE CLASSIFIED "SIMPLE APPARATUS". SIMPLE APPARATUS ARE DEVICES WHICH ARE INCAPABLE OF GENERATING OR STORING MORE THAN 1.2V, 0.1A, 25MW, OR 20uJ (RTD'S QUALIFY AS SIMPLE APPARATUS).

8. DIVISION 2 WIRING METHOD.

6. CLASS II INSTALLATIONS MUST USE A CSA APPROVED DUST-INGITIONPROOF SENSOR.

5. IN AMBIENTS GREATER THAN 40°C, SPRING LOADED TEMPERATURE SENSORS USED WITHOUT AN EXPLOSION PROOF THERMOWELL MUST BE RATED FOR AT LEAST 85°C.

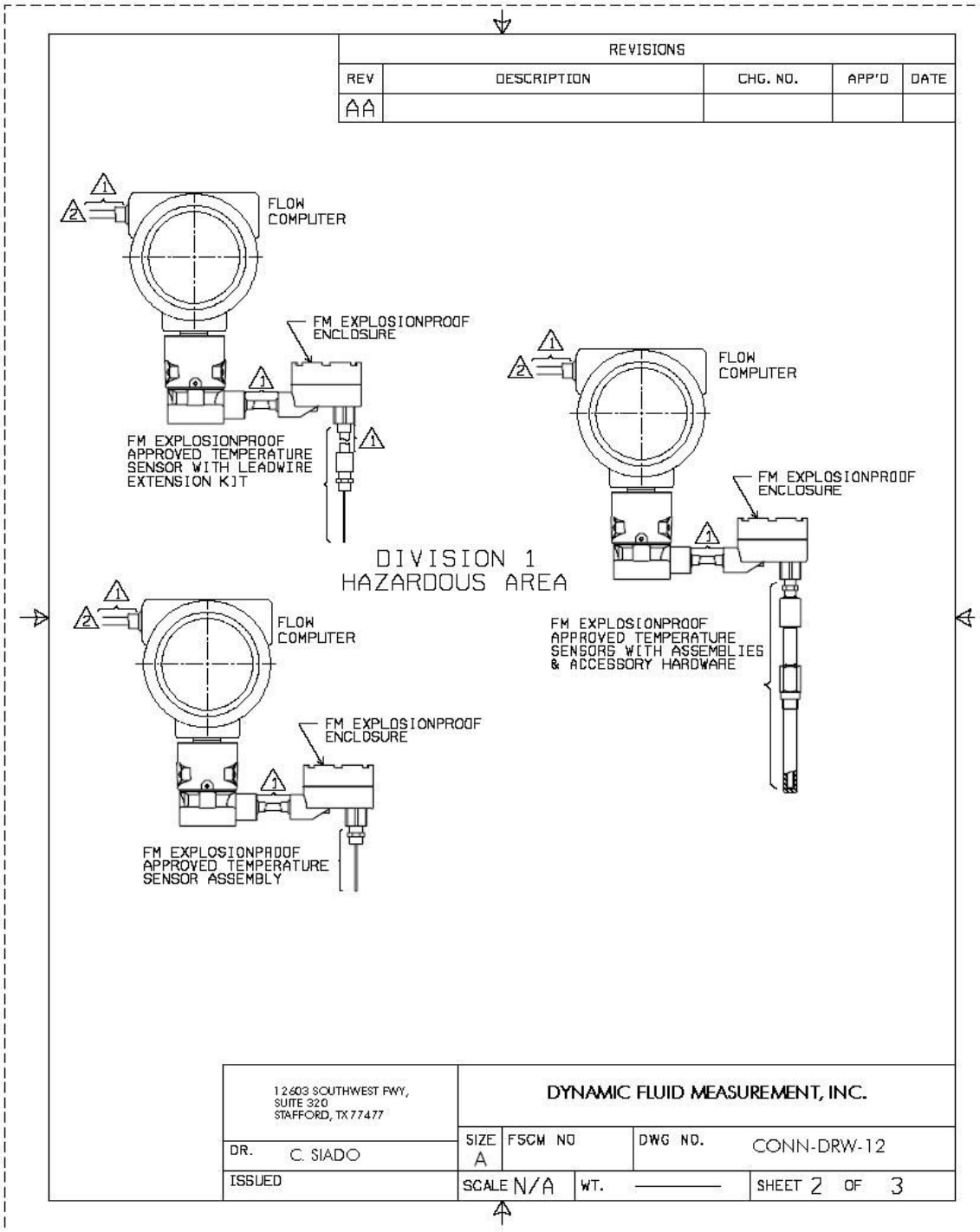
4. COMPONENTS REQUIRED TO BE APPROVED MUST BE FOR GAS GROUP APPROPIATE TO AREA CLASSIFICATION.

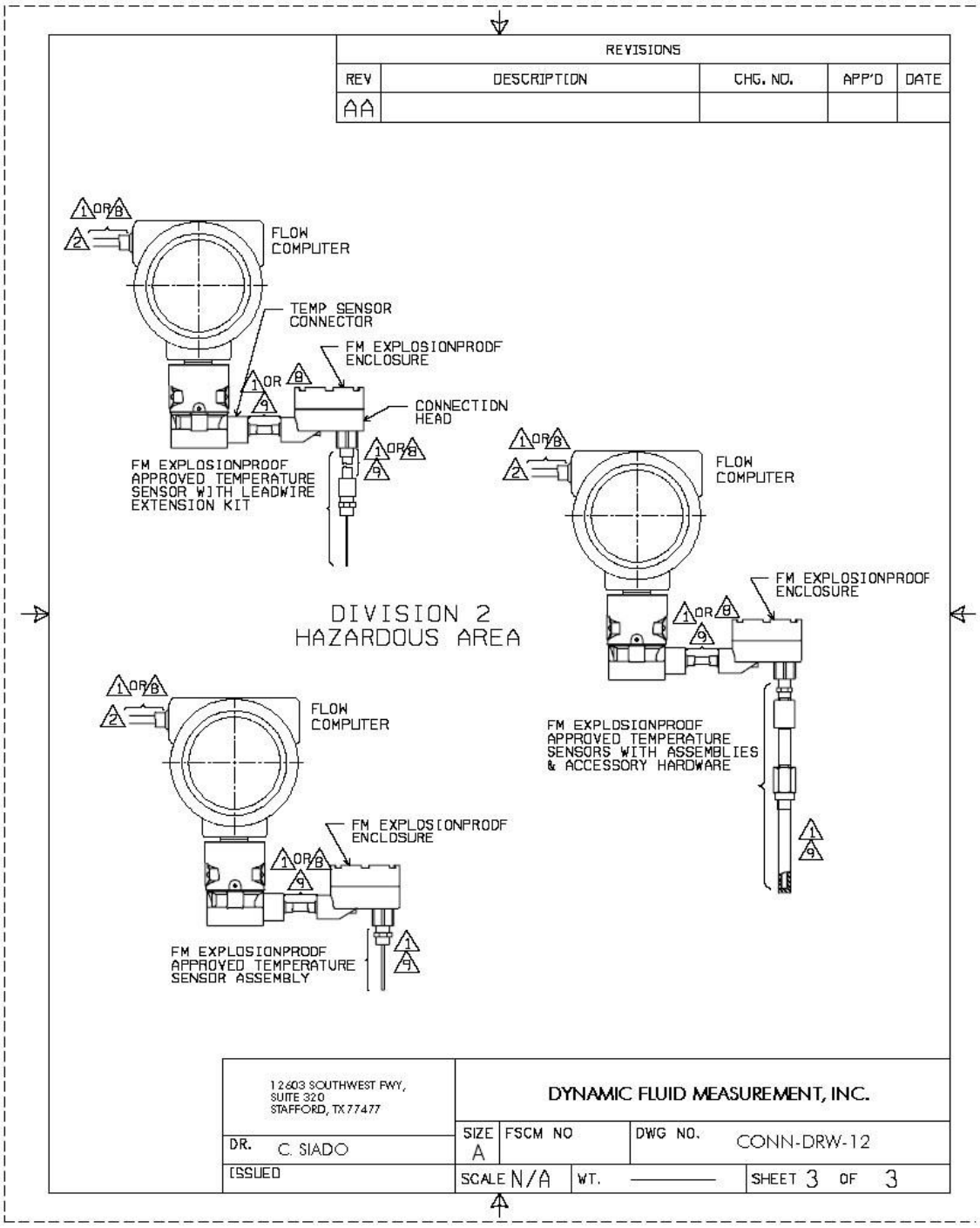
3. ALL CONDUITS THREADS TO BE ASSEMBLED WITH FIVE FULL THREADS MINIMUM.

2. TRANSMITTER MUST NOT BE CONNECTED TO EQUIPMENT GENERATING MORE THAN 250VAC.

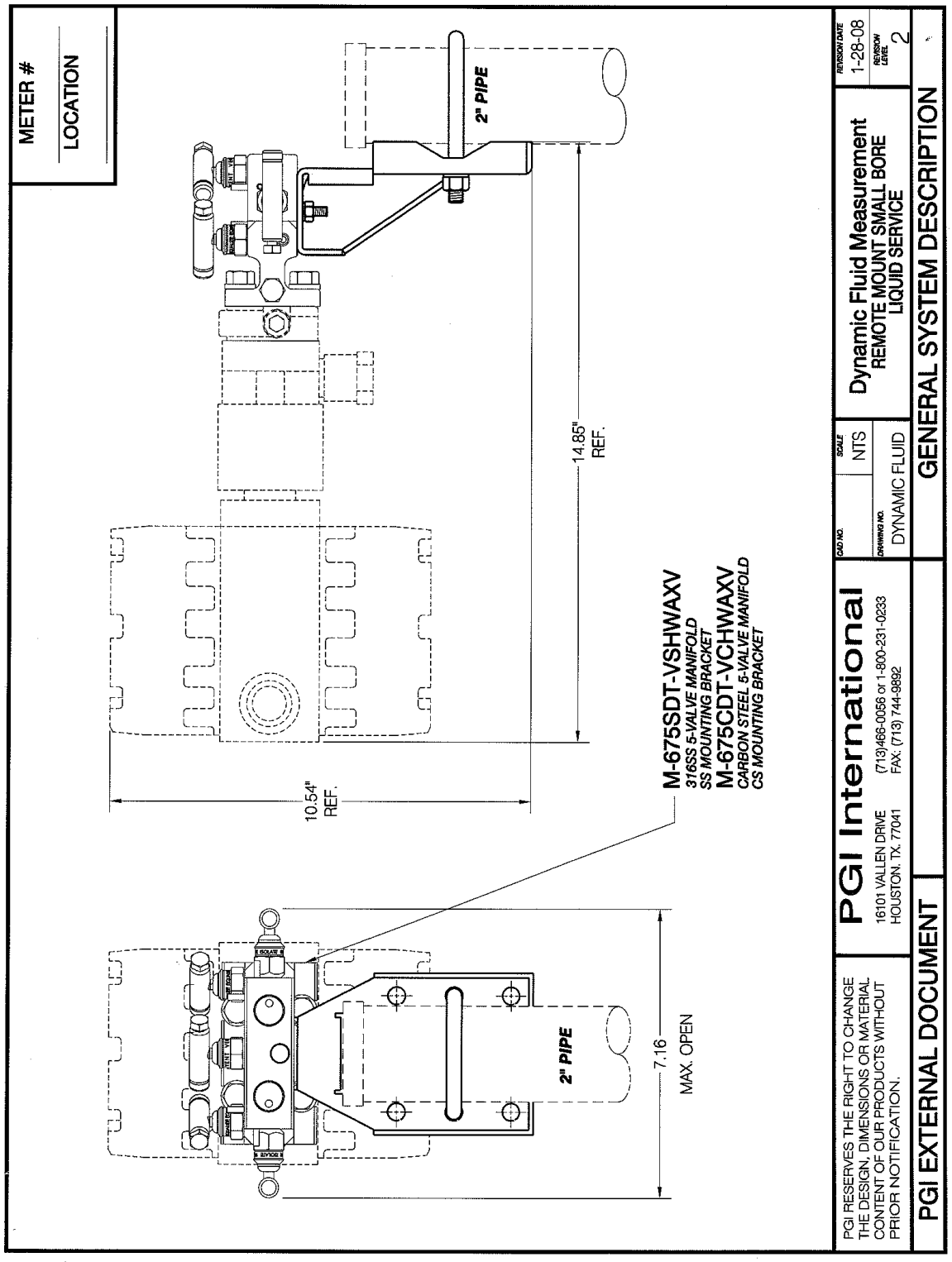
1. WIRING METHOD SUITABLE FOR CLASS I, DIV 1, ANY LENGTH.

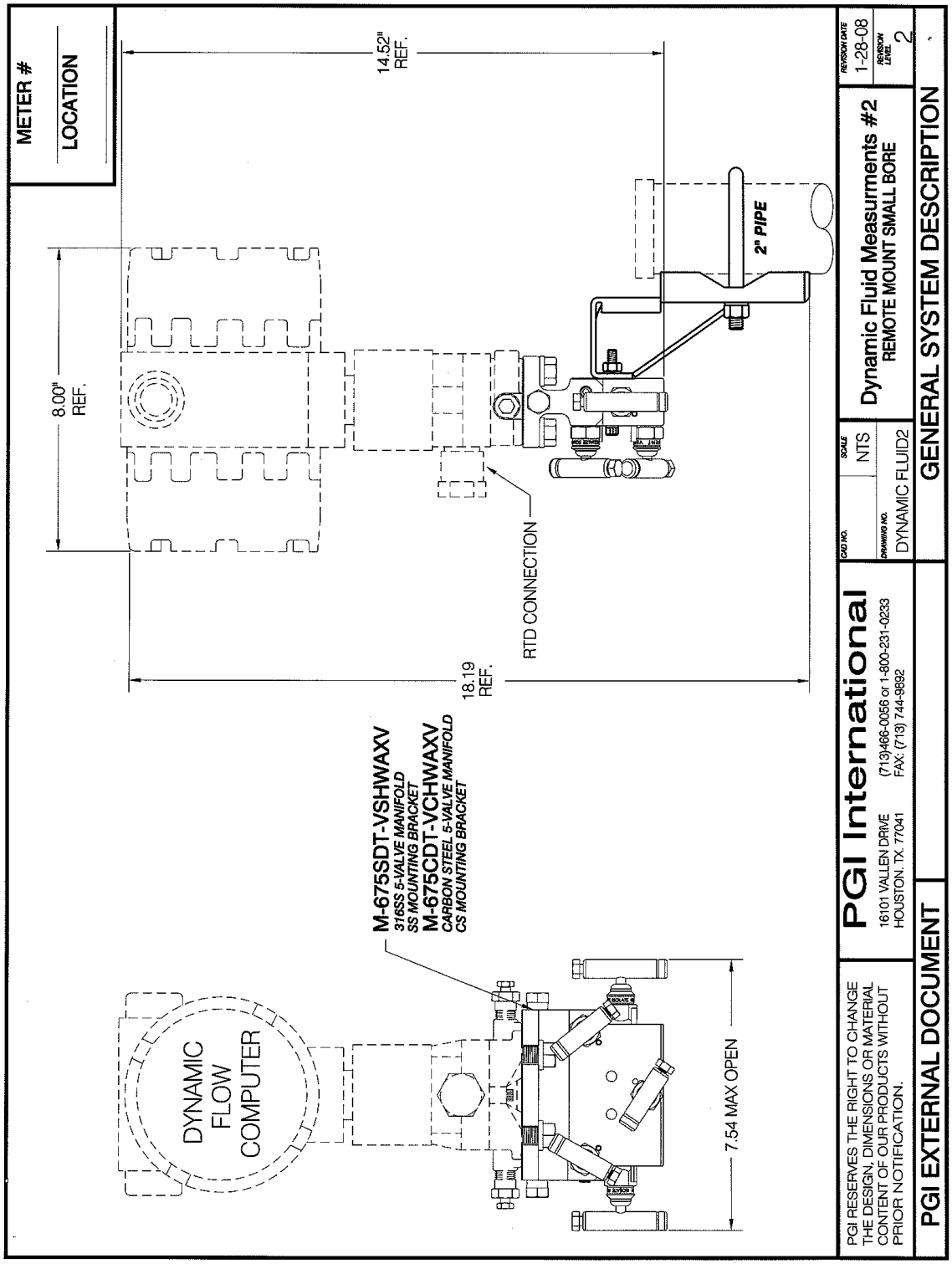
UNLESS OTHERWISE SPECIFIED DIMENSIONS IN INCHES [mm]. REMOVE ALL BURRS AND SHARP EDGES. MACHINE SURFACE FINISH 125	CONTRACT NO.	DYNAMIC FLUID MEASUREMENT, INC.	12603 SOUTHWEST FWY, SUITE 320 STAFFORD, TX 77477
	DR. C. SIADO	TITLE: MODEL MICROMV AND ECHART EXPLOSIONPROOF INSTALLATION DRAWING, FACTORY MUTUAL	
-TOLERANCE- .X = .1 [2.5] .XX = .02 [0.5] .XXX = .010[0.25] FRACTIONS = 1/32 ANGLES = 2°	CHK'D		
	APP'D. S. HALILAH		
		SIZE A / FSCM NO / DWG NO. CONN-DRW-12	
DO NOT SCALE PRINT	APP'D. GOVT.	SCALE / WT. / SHEET 1 OF 3	

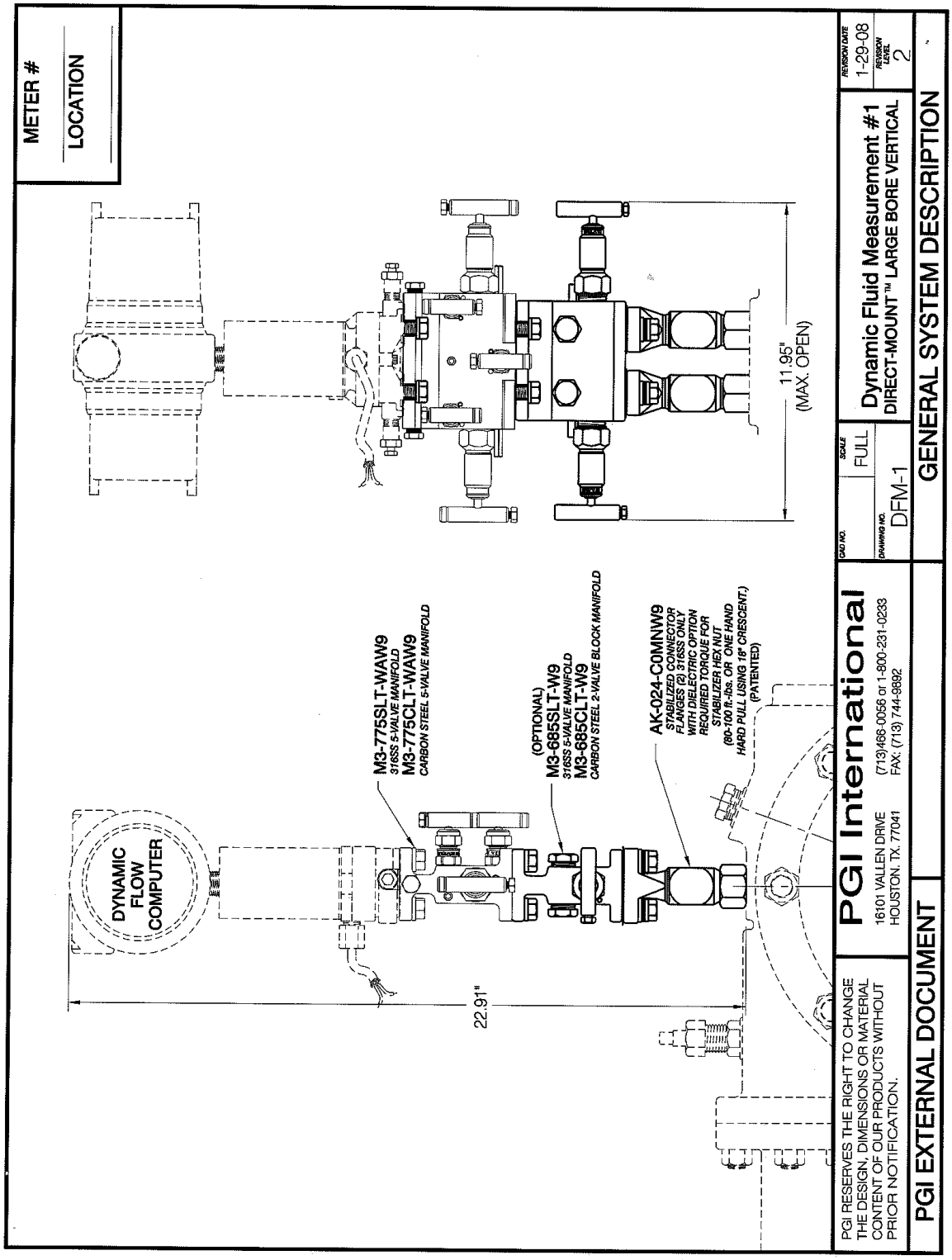

REVISIONS
REV
DESCRIPTION
CHG. NO.
APP'D
DATE
AA
FLOW COMPUTER
FM EXPLOSIONPROOF ENCLOSURE
FM EXPLOSIONPROOF APPROVED TEMPERATURE SENSOR WITH LEADWIRE EXTENSION KIT
DIVISION 1 HAZARDOUS AREA
FLOW COMPUTER
FM EXPLOSIONPROOF ENCLOSURE
FM EXPLOSIONPROOF APPROVED TEMPERATURE SENSORS WITH ASSEMBLIES & ACCESSORY HARDWARE
FLOW COMPUTER
FM EXPLOSIONPROOF ENCLOSURE
FM EXPLOSIONPROOF APPROVED TEMPERATURE SENSOR ASSEMBLY
12603 SOUTHWEST FWY, SUITE 320 STAFFORD, TX 77477
DYNAMIC FLUID MEASUREMENT, INC.
DR. C. SIADO
SIZE A
FSCM NO
DWG NO. CONN-DRW-12
ISSUED
SCALE N/A
WT.
SHEET 2 OF 3

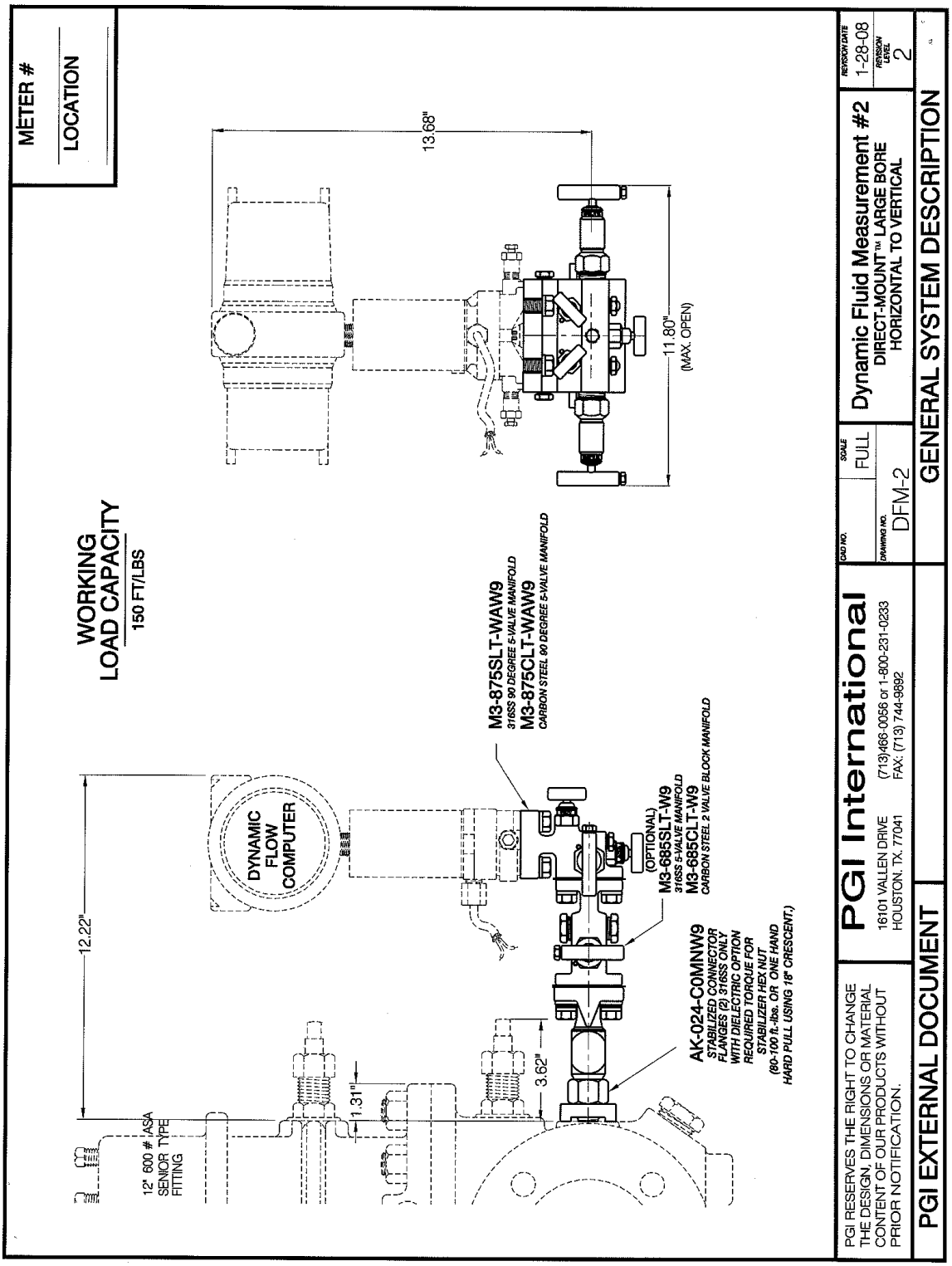

REVISIONS
REV
DESCRIPTION
CHG. NO.
APP'D
DATE
AA
FLOW COMPUTER
TEMP SENSOR CONNECTOR
FM EXPLOSIONPRODF ENCLOSURE
CONNECTION HEAD
FM EXPLOSIONPRODF APPROVED TEMPERATURE SENSOR WITH LEADWIRE EXTENSION KIT
FLOW COMPUTER
FM EXPLOSIONPRODF ENCLOSURE
FM EXPLOSIONPRODF APPROVED TEMPERATURE SENSORS WITH ASSEMBLIES & ACCESSORY HARDWARE
DIVISION 2 HAZARDOUS AREA
FLOW COMPUTER
FM EXPLOSIONPRODF ENCLOSURE
FM EXPLOSIONPRODF APPROVED TEMPERATURE SENSOR ASSEMBLY
12603 SOUTHWEST FWY, SUITE 320 STAFFORD, TX 77477
DYNAMIC FLUID MEASUREMENT, INC.
DR. C. SIADO
SIZE A
FSCM NO
DWG NO. CONN-DRW-12
ISSUED
SCALE N/A
WT.
SHEET 3 OF 3

Manifold Installation Drawings




METER #
LOCATION
14.52" REF.
8.00" REF.
2" PIPE
RTD CONNECTION
18.19 REF.
M-675SDT-VSHWAXV
316SS 5-VALVE MANIFOLD
SS MOUNTING BRACKET
M-675CDT-VCHWAXV
CARBON STEEL 5-VALVE MANIFOLD
CS MOUNTING BRACKET
DYNAMIC FLOW COMPUTER
7.54 MAX OPEN
PGI International
16101 VALLEN DRIVE
HOUSTON, TX. 77041
(713)466-0056 or 1-800-231-0233
FAX: (713) 744-9892
CAD NO.
DRAWING NO.
DYNAMIC FLUID2
SCALE
NTS
Dynamic Fluid Measurments #2
REMOTE MOUNT SMALL BORE
REVISION DATE
1-28-08
REVISION LEVEL
2
GENERAL SYSTEM DESCRIPTION
PGI RESERVES THE RIGHT TO CHANGE THE DESIGN, DIMENSIONS OR MATERIAL CONTENT OF OUR PRODUCTS WITHOUT PRIOR NOTIFICATION.
PGI EXTERNAL DOCUMENT


METER #
LOCATION
DYNAMIC FLOW COMPUTER
M3-775SLT-WAW9
316SS 5-VALVE MANIFOLD
M3-775CLT-WAW9
CARBON STEEL 5-VALVE MANIFOLD
(OPTIONAL)
M3-685SLT-W9
316SS 5-VALVE MANIFOLD
M3-685CLT-W9
CARBON STEEL 2-VALVE BLOCK MANIFOLD
AK-024-C0MNW9
STABILIZED CONNECTOR
FLANGES (2) 316SS ONLY
WITH DIELECTRIC OPTION
REQUIRED TORQUE FOR
STABILIZER HEX NUT
(80-100 ft.-lbs. OR ONE HAND
HARD PULL USING 18" CRESCENT.)
(PATENTED)
22.91"
11.95"
(MAX. OPEN)
PGI RESERVES THE RIGHT TO CHANGE THE DESIGN, DIMENSIONS OR MATERIAL CONTENT OF OUR PRODUCTS WITHOUT PRIOR NOTIFICATION.
PGI International
16101 VALLEN DRIVE
HOUSTON, TX. 77041
(713)466-0056 or 1-800-231-0233
FAX: (713) 744-9892
CAD NO.
DRAWING NO. DFM-1
SCALE FULL
Dynamic Fluid Measurement #1
DIRECT-MOUNT™ LARGE BORE VERTICAL
REVISION DATE 1-29-08
REVISION LEVEL 2
PGI EXTERNAL DOCUMENT
GENERAL SYSTEM DESCRIPTION


METER #
LOCATION
WORKING LOAD CAPACITY
150 FT/LBS
13.68"
11.80" (MAX. OPEN)
M3-875SLT-WAW9
316SS 90 DEGREE 5-VALVE MANIFOLD
M3-875CLT-WAW9
CARBON STEEL 90 DEGREE 5-VALVE MANIFOLD
DYNAMIC FLOW COMPUTER
(OPTIONAL)
M3-685SLT-W9
316SS 5-VALVE MANIFOLD
M3-685CLT-W9
CARBON STEEL 2 VALVE BLOCK MANIFOLD
12.22"
12" 600 # ASA SENIOR TYPE FITTING
1.31"
3.62"
AK-024-COMNW9
STABILIZED CONNECTOR FLANGES (2) 316SS ONLY WITH DIELECTRIC OPTION
REQUIRED TORQUE FOR STABILIZER HEX NUT (60-100 ft.-lbs. OR ONE HAND HARD PULL USING 18" CRESCENT.)
PGI RESERVES THE RIGHT TO CHANGE THE DESIGN, DIMENSIONS OR MATERIAL CONTENT OF OUR PRODUCTS WITHOUT PRIOR NOTIFICATION.
PGI International
16101 VALLEN DRIVE
HOUSTON, TX. 77041
(713)466-0056 or 1-800-231-0233
FAX: (713) 744-9892
CAD NO.
DRAWING NO. DFM-2
SCALE FULL
Dynamic Fluid Measurement #2
DIRECT-MOUNT™ LARGE BORE
HORIZONTAL TO VERTICAL
REVISION DATE 1-28-08
REVISION LEVEL 2
PGI EXTERNAL DOCUMENT
GENERAL SYSTEM DESCRIPTION