ECHART
OPERATORS MANUAL

Flow Computer
Gas Version

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Date: 11/22/2021

WARRANTY

Dynamic Flow Computers warrants to the owner of the ECHART 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:
DYNAMIC FLOW COMPUTERS SHALL HAVE NO LIABILITY FOR ANY INDIRECT OR SPECULATIVE DAMAGES (INCLUDING, WITHOUT LIMITING THE FOREGOING, CONSEQUENTIAL, INCIDENTAL AND SPECIAL DAMAGES) ARISING FROM THE USE OF, OR INABILITY TO USE THIS PRODUCT. WHETHER ARISING OUT OF CONTRACT, OR UNDER ANY WARRANTY, IRRESPECTIVE OF WHETHER DFM HAS ADVANCED NOTICE OF THE POSSIBILITY OF ANY SUCH DAMAGE INCLUDING, BUT NOT LIMITED TO LOSS OF USE, BUSINESS INTERRUPTION, AND LOSS OF PROFITS. NOTWITHSTANDING THE FOREGOING, DFM'S TOTAL LIABILITY FOR ALL CLAIMS UNDER THIS AGREEMENT SHALL NOT EXCEED THE PRICE PAID FOR THE PRODUCT. THESE LIMITATIONS ON POTENTIAL LIABILITY WERE AN ESSENTIAL ELEMENT IN SETTING THE PRODUCT PRICE. DFM NEITHER ASSUMES NOR AUTHORIZES ANYONE TO ASSUME FOR IT ANY OTHER LIABILITIES

Date: 11/22/2021

CHAPTER 1: QUICK START

Introduction:

The ECHART Flow Computer was designed after careful listening 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 ECHART Flow Computer has delivered and met the design intentions. The ECHART 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 ECHART Flow Computer will be a simple pleasant experience, not intimidating in any way.

The ECHART Flow computer handles one meter run and optional additional auxiliary meter. It includes the following flow equations: New API14.3, ISO 5167, turbine (AGA7/AGA9), Cone/Smart Cone, Slotted DP Meter, Annubar and Verabar Meter. Additionally, it can perform density calculations per these standard procedures: AGA8, other tables are added constantly, call our main office for current software

One Rosemount multi-variable digital transducers is connected to each ECHART flow computer for temperature, pressure (up to 3626 PSIG), and DP (up to 830 inches H_2O).

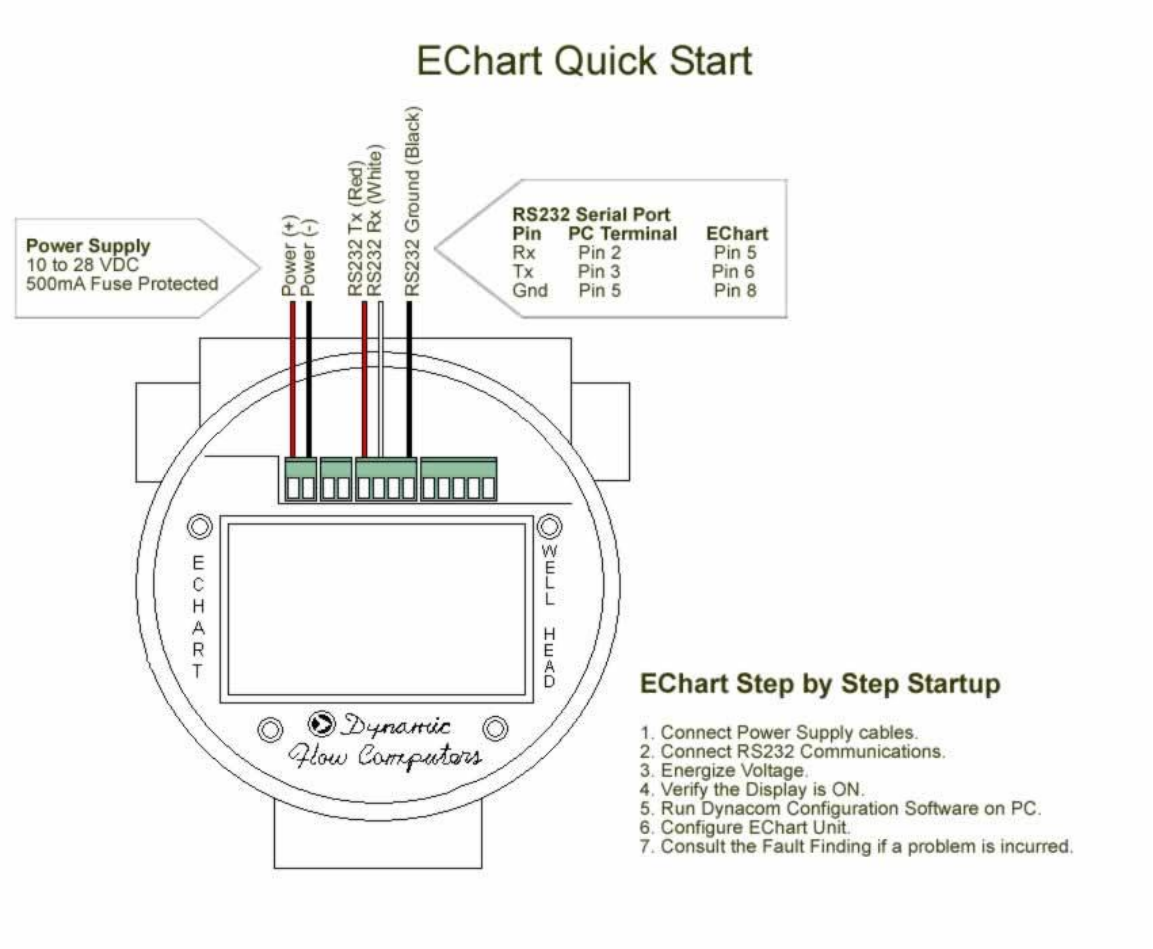
The ECHART flow Computer has a host of inputs and outputs beyond the built in Rosemount Multi Variable transmitter.

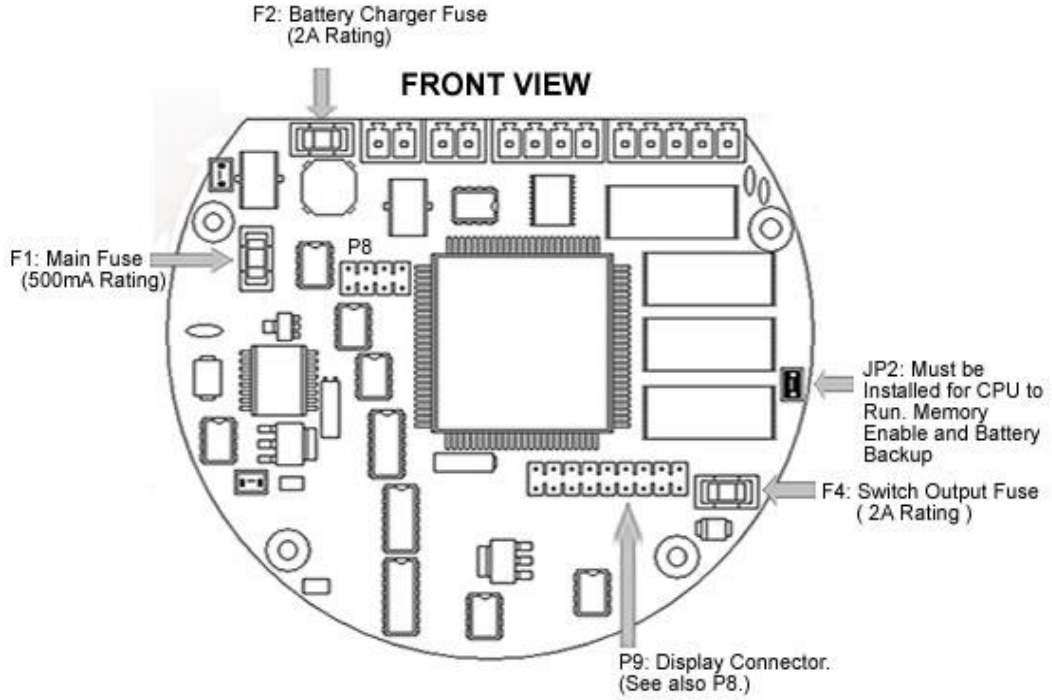
One turbine input (Square wave), 6 volts, or lighter.
One analog output 16 bits.
One RS232/RS485
Optional additional RS232

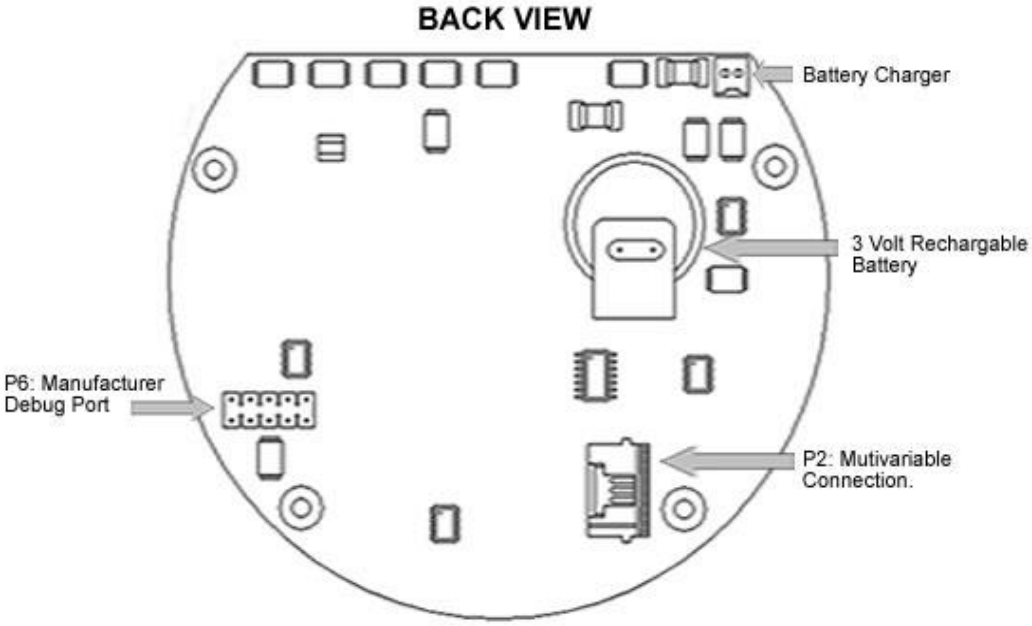
One status input and two digital outputs (user configurable).
Graphic screen: 128 x 64.
Additionally, each ECHART Flow Computer can store up to 64 days of hourly and daily data. Optional expandable memory (Virtual Hard Drive) up to 132 Megs, combined with our customized data storage allows almost any type data logging task to become possible.

Note: Flow equations used are continuously upgraded and new equations are added.
Call factory for current software library.

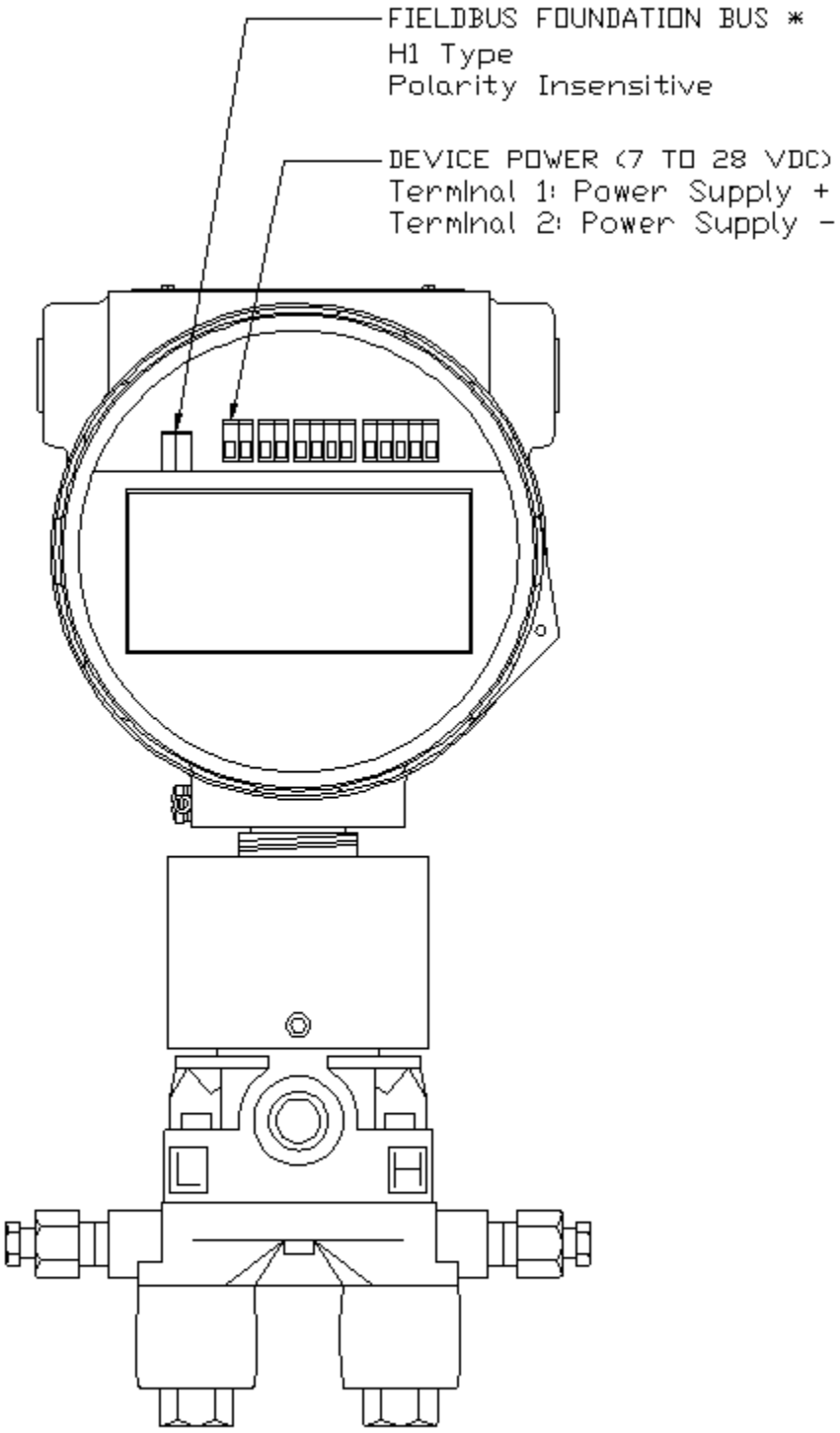
Quick Start Up




F2: Battery Charger Fuse
(2A Rating)
FRONT VIEW
F1: Main Fuse
(500mA Rating)
P8
JP2: Must be Installed for CPU to Run. Memory Enable and Battery Backup
F4: Switch Output Fuse
(2A Rating)
P9: Display Connector.
(See also P8.)

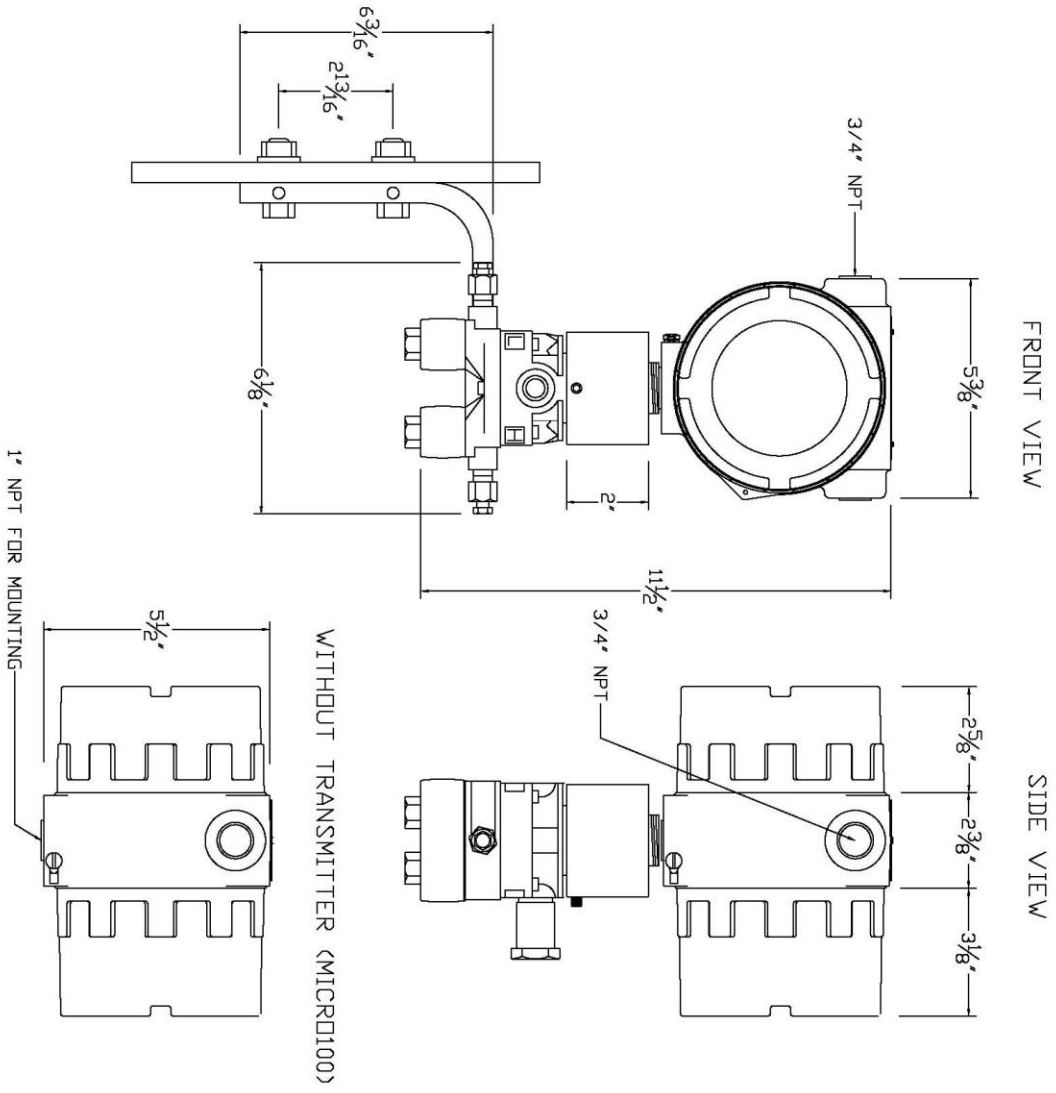

BACK VIEW
Battery Charger
3 Volt Rechargable Battery
P6: Manufacturer Debug Port
P2: Mutivariable Connection.

Fieldbus Quick Start



* Flow Computer must be ordered with FOUNDATION FIELDBUS interface.

ECHART Flow Computer: Dimensions



Technical Data

POWER	
VOLTAGE RANGE	7-24 VDC
WATTAGE	0.3 WATT
OPERATING CONDITIONS	
TEMPERATURE	- 40 TO 185 °F
HUMIDITY	100%
HOUSING	NEMA 4X CLASS 1 DIV. 1
DISPLAY	-20 TO 70 °C WIDE ANGLE
FEATURES	
DISPLAY	PLASMA 8 LINES 16 CHARACTER AND GRAPHICS 64x128 PIXELS
PROCESSOR	32-BIT MOTOROLA 68332 @ 16.7 MHz
FLASH ROM	4 MB @ 70 NANO SECONDS
RAM	2 MB @ 70 NANO SECONDS
FREQUENCY INPUT	1 CHANNEL SQUARE WAVE > 3 VOLTS WAVE
MULTIVARIABLE	BUILT-IN ROSEMOUNT MULTIVARIABLE TRANSMITTER WITH DIRECT SPI DIGITAL CONNECTION. MAXIMUM UPDATE SPEED ONCE EVERY 109 MILLISECONDS. TEMPERATURE RANGE: - 200 thru 1200 F PRESSURE RANGE: 0 thru 3626 PSIG DP RANGE: 0 thru 250 inches OR 0 thru 1000 inches
ANALOG OUTPUT	1 16-BITS OPTICALLY ISOLATED OUTPUT
DIGITAL I/O	1 DIGITAL INPUTS 2 DIGITAL OUTPUTS. DIGITAL OUTPUTS HAVE 0.25 AMPS RATING
SERIAL COMMUNICATION	1 SERIAL PORT CONFIGURABLE AS RS485 OR RS232 EXPANDABLE TO 2 PORTS
COMMUNICATION PROTOCOL	MODBUS
PID CONTROL	FLOW LOOP AND PRESSURE LOOP

Parts List

Spare Parts - E-Chart / E-Plus / E-Lite	
Part #	**Description**
ECC	E-Chart CPU Board
EPC	E-Plus CPU Board
ELC	E-Lite CPU Board - No Expansion or RS485 capability
ELX	E-Lite EXP CPU Board
EXP	Expansion Board (For use with ELX)
WDP	Wellhead Display Board Plain (No Communication Option)
WDS	Wellhead Display Board with RS-232 Communication Option
WDW	Wellhead Display Board with Wireless Radio Communication Option
WDB	Wellhead Display Board with Bluetooth Communication Option
S6920	Explosion Proof Housing Unit for E-Chart Flow Computer
Adapter A	Adapter for 0205 Rosemount Transmitter (Accommodates E-Chart, E-Plus, E-Lite Flow Computer)
Bracket-WD	Bracket for Wellhead Display Board
O-Ring A	O-Ring Gasket for E-Chart Housing
Fuse A	250 mA Fuse
Fuse B	500 mA Fuse
Fuse C	2 Amp Fuse
Battery A	Replacement Battery for E-Chart Flow Computer (Board Mounted)
WD-LCD	LCD Screen for Wellhead Display Board

Starting and installing Dynacom Software:

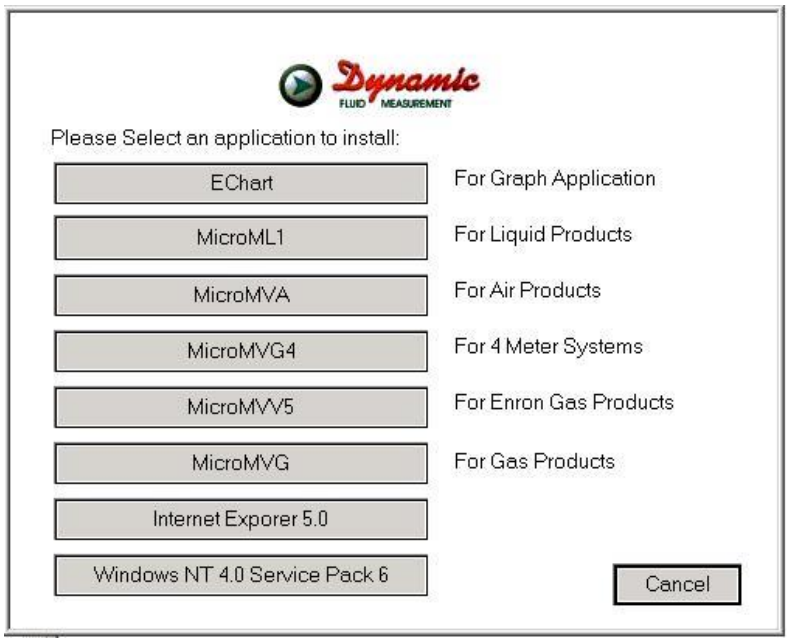
First make sure your computer has the minimum requirements to install Dynamic's Dynacom software.

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, Windows 7, Windows 8, Windows 10)
- For a Windows NT machine: Service Pack 3 or later
- For an NT or Win2000 Machine: 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, just insert the installation CD in the CD unit and the following menu will pop up automatically



Click on the button for the application you are trying to install and the setup process will start and guide you through the different steps needed to install the application. If your computer doesn't pop up the installation menu automatically you can go the windows' **Start** button, select **Run…**, and type "**D:\start.exe**", where D is the letter for your CD unit.

What is a configuration file?

The configuration file is an archive that contains the information 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.

- 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 a 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

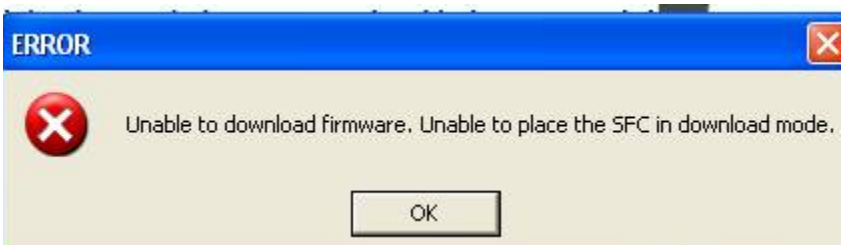
- Download an image file through **Main RS-232 port** on CPU board only.
- To Download an Image File to the Flow Computer select the **Tools | Download Program** option form the main menu or press the  button in the toolbar.
- A small dialog will appear asking for the file name of the image file (Image 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**.

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).

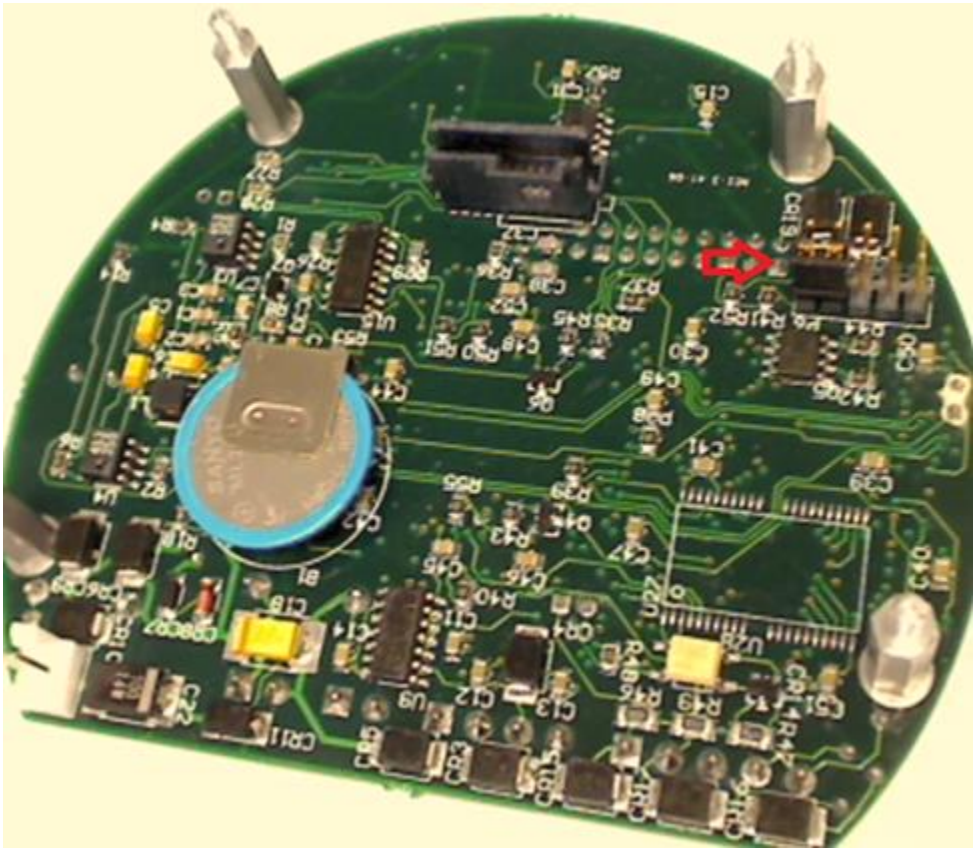
How to force a board into download mode

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 **Main RS-232 port** on CPU board. EChart Suite version 2.20 or higher is required.
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. 

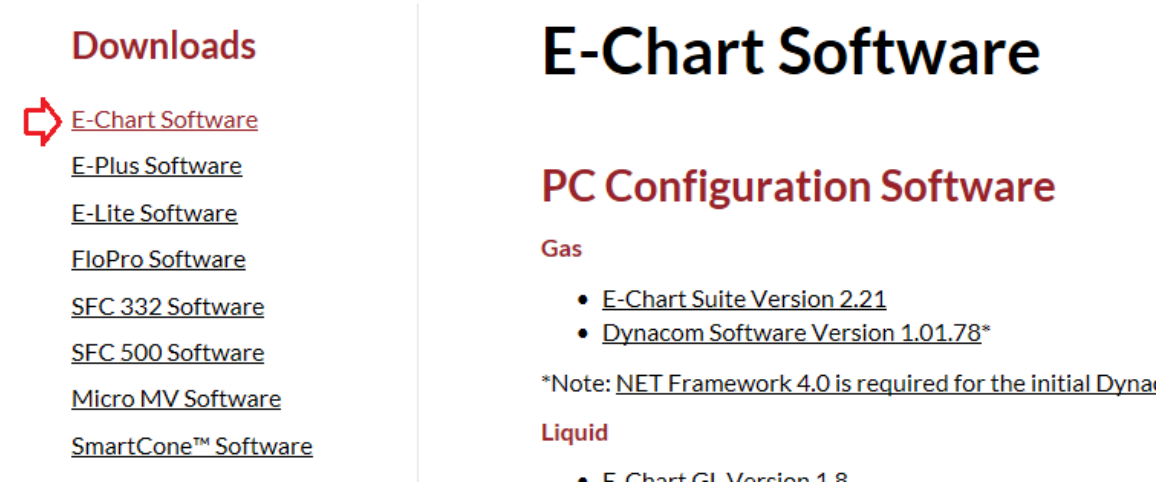


(3) Power up the board
(4) Board is in download mode
(5) Download image
(6) Remove power and jumper on P6 after a new image is loaded
(7) Board is ready

DFC Configuration Software

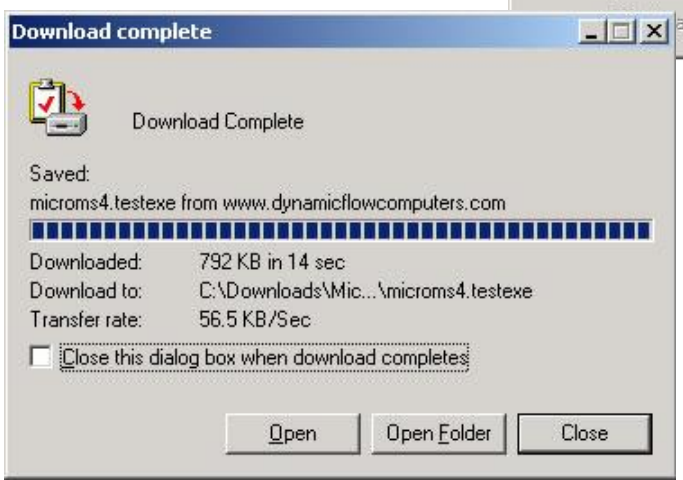
Step 1. Go to our website WWW.DYNAMICFLOWCOMPUTERS.COM

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



Step 3. Select the application 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.

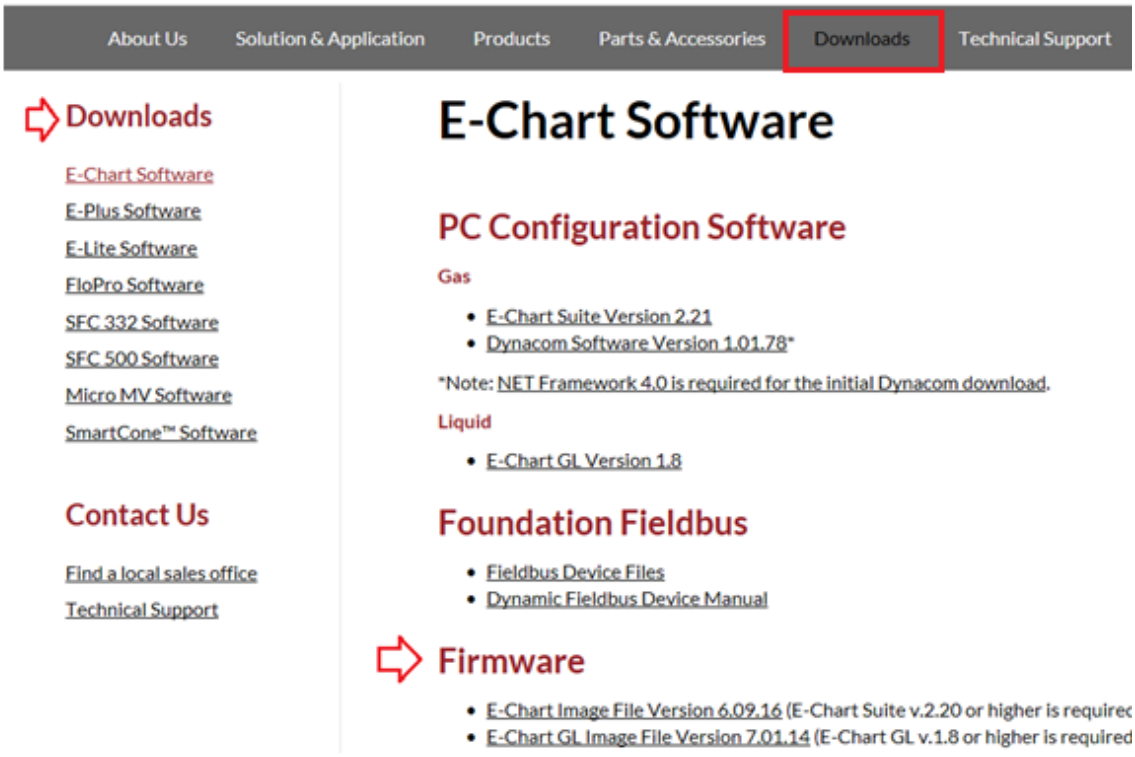
Website – Image File (Firmware)

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 that you are trying to download. Once you hit the link it will ask you the location and file name to be saved.

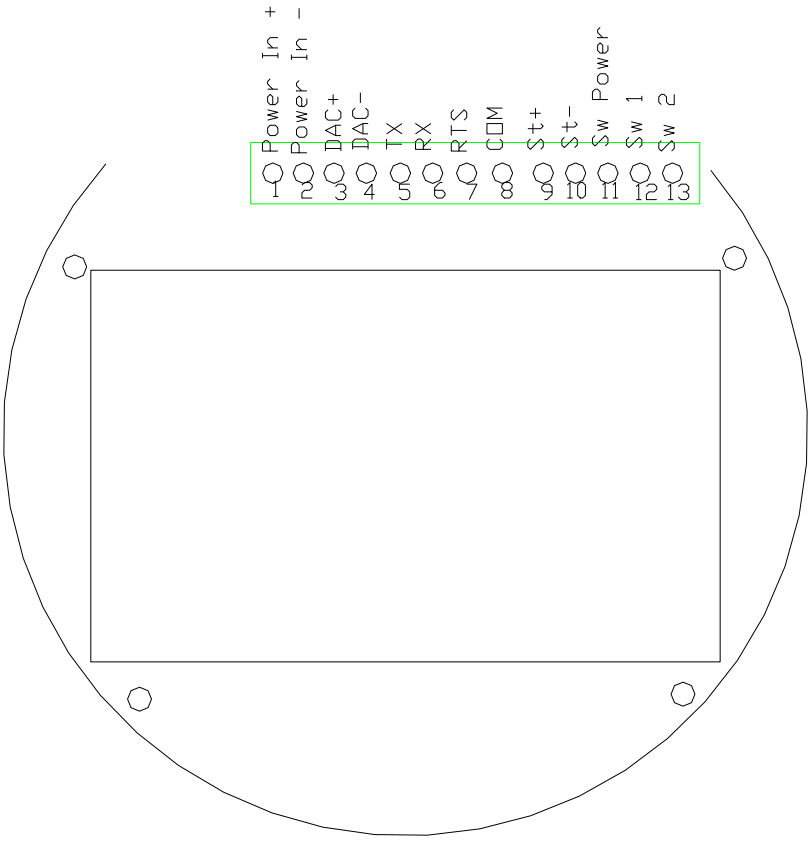


Step 4. The file will start to transfer to your computer. The download time depends on your Internet connection speed and the type of application that being downloaded.

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

Getting acquainted with the flow computer wiring:

Terminal wiring:



DAC (Digital to Analog Converter) or Analog Output (16Bits)

INPUT/OUTPUT: Assigning and Ranging Inputs

We will now configure your ECHART Flow Computer's inputs and outputs. The flow computer allows the user to configure the inputs and outputs.

The Multi Variable pressure and temperature can be used and the DP becomes a spare input that could be assigned for strainer differential.

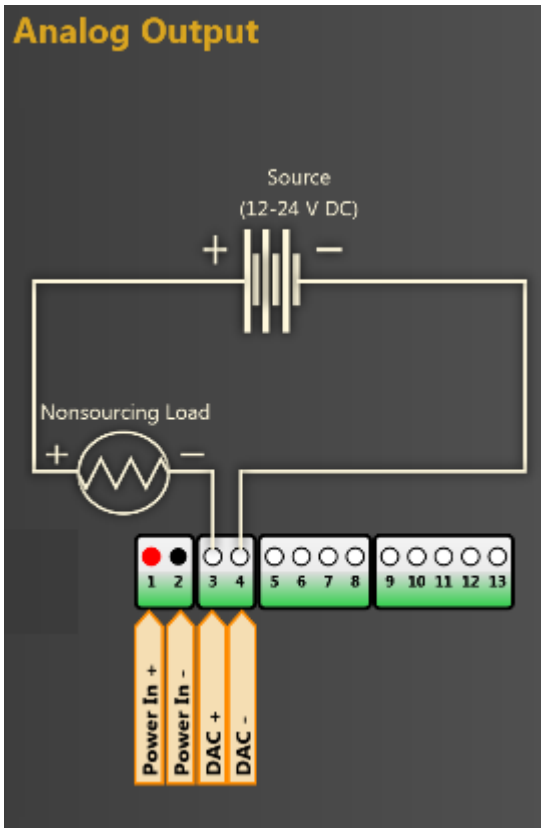
1. **Enter the high and low limits**: high limits and low limits are simply the alarm points in which you would like the flow computer to flag as an alarm condition. Enter these values with respect to the upper and lower range conditions. Try to avoid creating alarm log when conditions are normal. For 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.
2. **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).

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 Output:

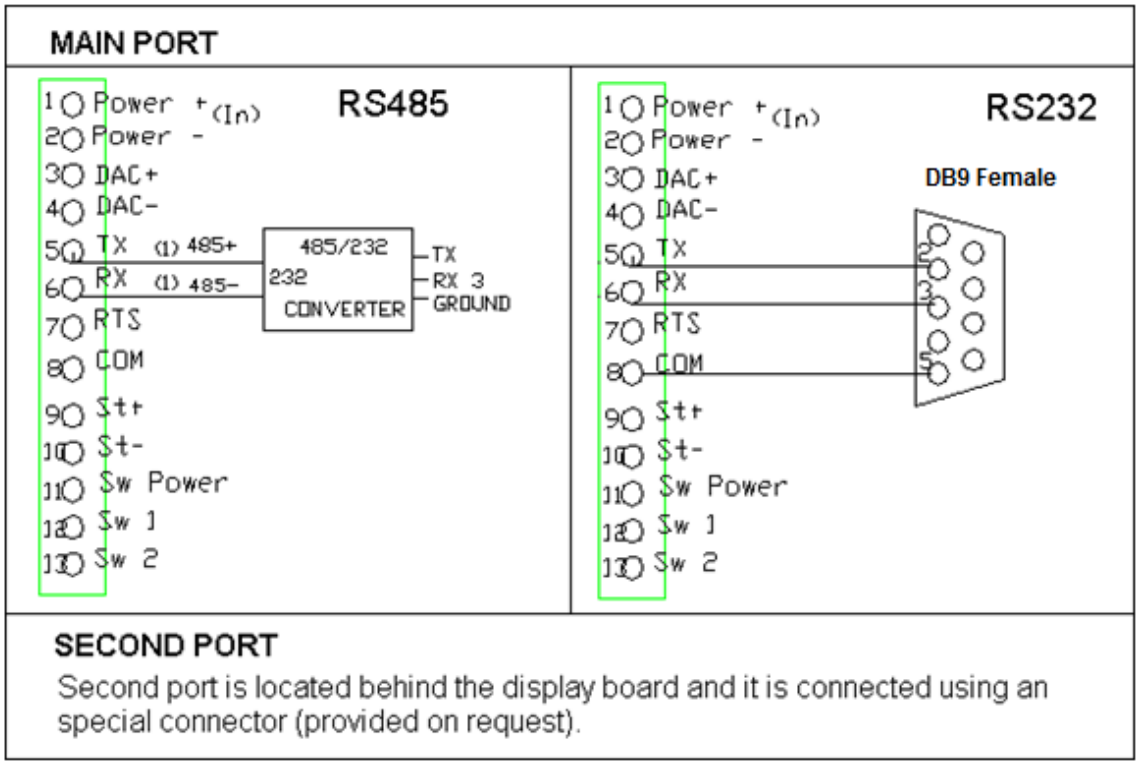
Wiring diagram shows typical Analog output wiring. The analog output will regulate 4-20 mA current loop but DOES NOT source the power for it. **External power is required.**



Assigning/Ranging the 4-20mA Analog Outputs:

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

RS-485/RS-232 connection:



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

Note: RS-485 Twisted shielded cable is required. The maximum distance when 18-gauge wire is used is 4000 feet.

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

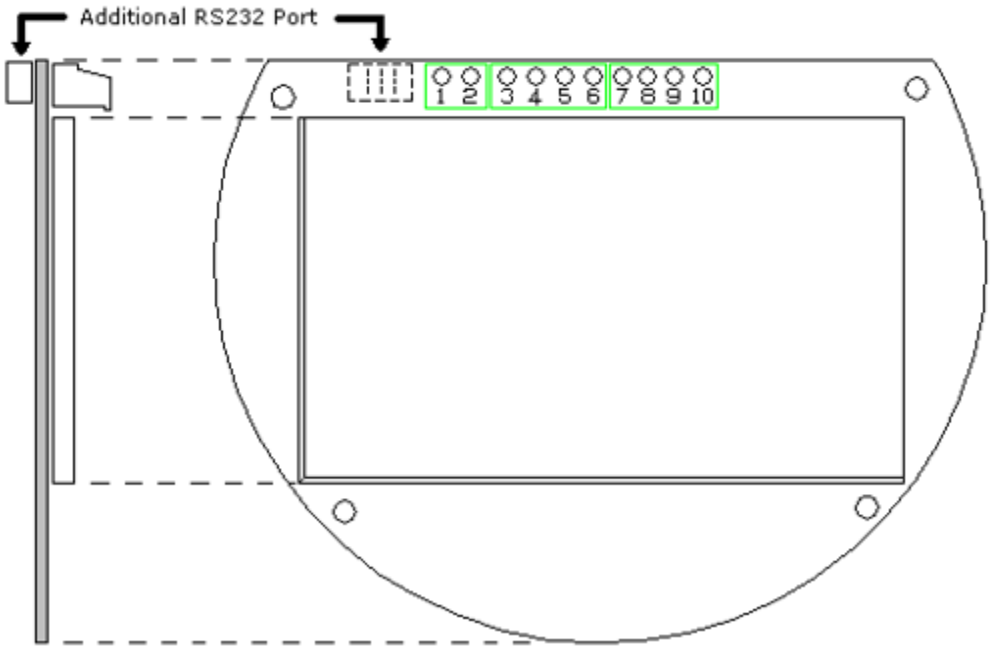
RS485/232 Adapter

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.

Additional RS-232 Connection:

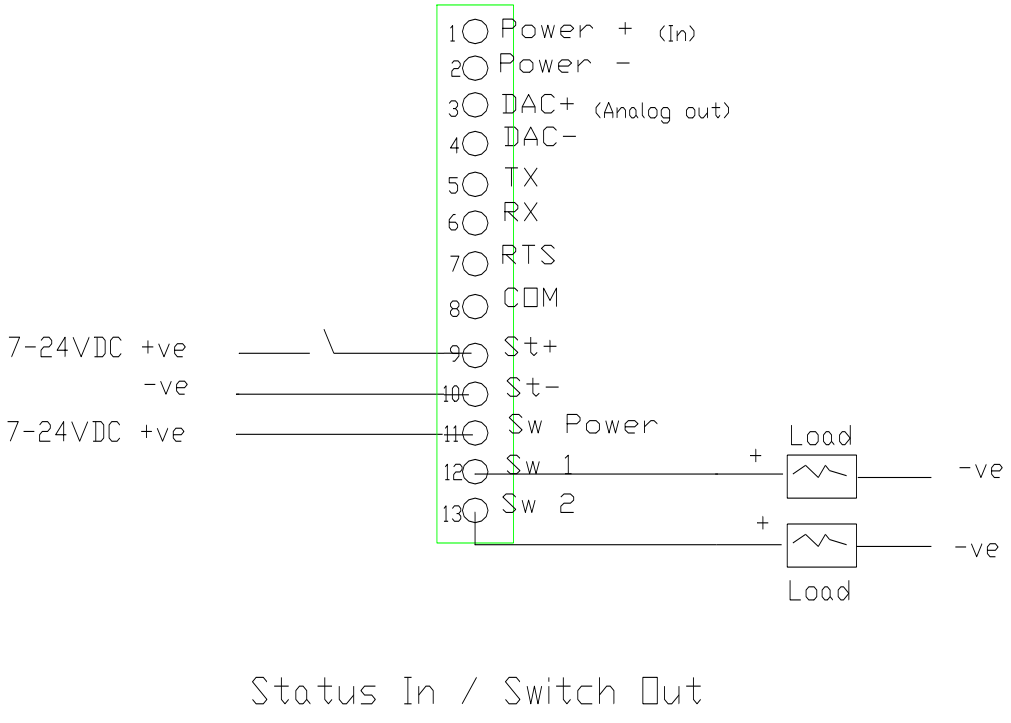
Part Number: WDS

Additional RS232 Port is located behind the display board and is prewired with a special connector.
It has a DB9 connector provided upon request.



Wiring of Status Input/Switch Outputs:

There are one digital input and two outputs.



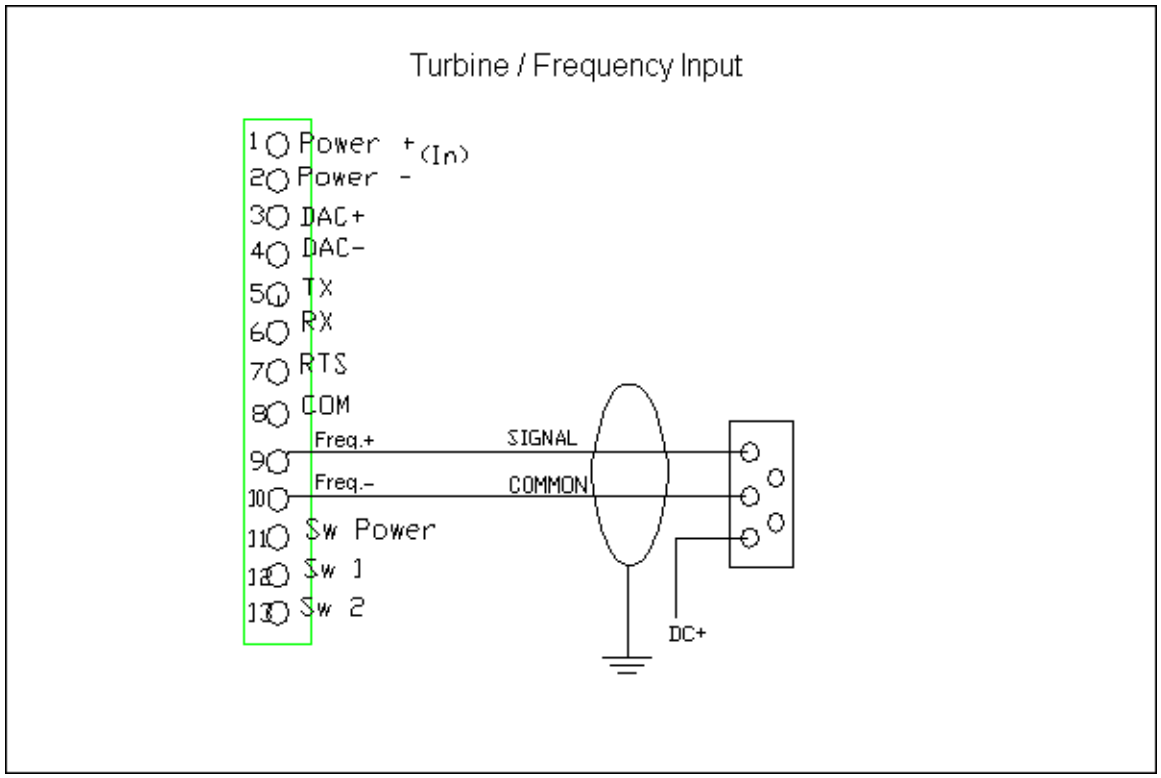
Status In / Switch Out

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	switch output 1	Switch – Maximum rating: 350mA @24 volts Switch Output Range: 5-28 VDC
2	switch output 2	

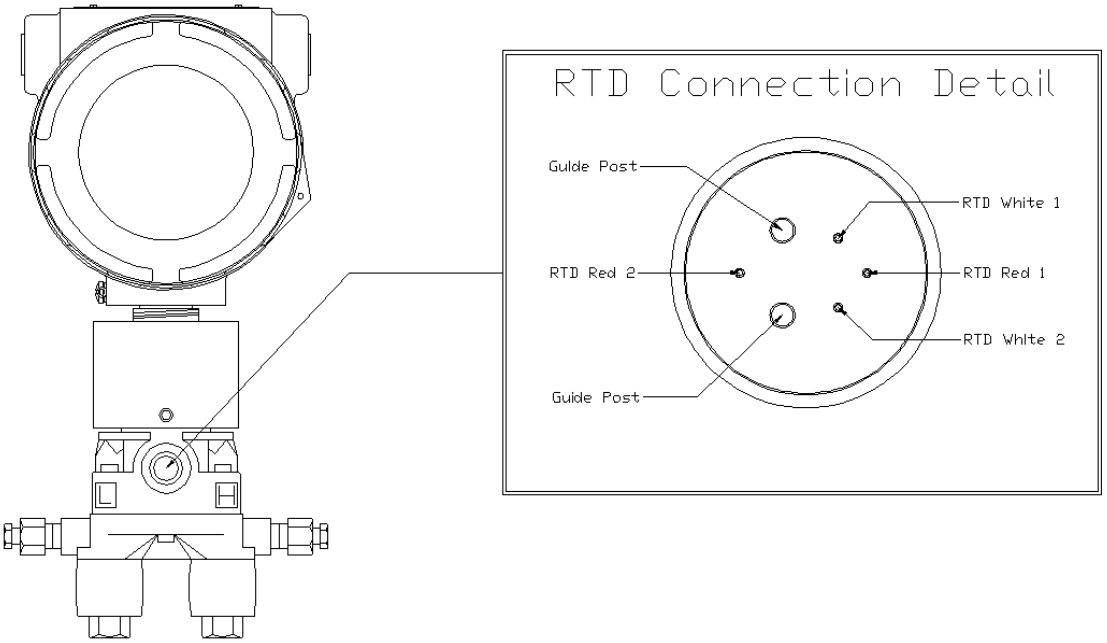
Jumper JP6 changes the sensitivity of the Status Input. The low range sensitivity, achieved when the jumper is on, is about 4.5V. For signals in the 5 to 12 Volt range the jumper is installed. **The jumper must be removed to limit input current when the signals are in the range of 12-24 volt.**
This feature is mainly for added noise immunity in handling the taller signals. Still, the input also needs some protection if large static signals are to be handled. Short pulses, (less than 10[sec], with 50% max duty cycle) will be handled by the hardware without overheating with the jumper on. So if the goal is to handle any signal from 5 to 24 Volt, (only short pulses as described), and added noise immunity is to be sacrificed in favor of wider input range, leave the jumper on. If, however, the connected device fails 'ON', the input may be damaged. If the jumper is removed, 24Volt may be connected to the input for an indeterminate period.

Wiring of Turbine Input:

One turbine input (Square wave), 3 volts, or higher and up to 24 volts.



Rosemount RTD Connection:



CALIBRATION

Calibration of Analog Output

Follow the following steps to calibrate the analog output against the end device:

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 4mA. 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***.

To use default calibration

1. Select analog output
2. Select Reset method
3. ***Now verify the live reading against the flow computer reading***

Calibration of 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 DP or 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 ECHART close reading to the induced value.
The DP reading must be re-calibrated for the zero offset after applying line pressure.

Calibration of 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**.

Verifying Digital Input and Outputs

Use the diagnostic menu. A live input and output is displayed. On the top of the screen pulse input is 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 **`View | Wiring Drawing| Turbine`** for proper turbine input wiring. 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. The switch outputs are open collector and require external voltage.

CHAPTER 2: Data Entry and Configuration Menus

Introduction to the ECHART Computer Software

The ECHART software is constructed around a menu-driven organization

Configuration File

We will begin with the DYNACOM PC software menu. Create a new configuration file, and save it.

1. The software opens ready for you with a default configuration file. To choose an existing file go to the **Configuration File** | **Open...** and provide the configuration file name. If you want to create a new file, select **Configuration File** | **New.**
2. Now go back to **Configuration File**. Use the down arrow key to move the cursor to **Save** and press ENTER. You have just saved the file you just created. Notice that now the file name will appears in the left top corner of the screen. This indicates the name of the currently active file; if you change parameters and **Save** again, the changes will be saved to your file.

Configuration File Menu

Open a File

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 (files with extension .SFC). Use the cursor arrow keys to move the cursor to your selection. This function also can be reached pressing  on the toolbar.

Open a New File

Create a new file to store all the programmed information for one ECHART Liquid Flow Computer. You are prompted for the new file's name. If you enter the name of a pre-existing file, the software informs you of this and prompts you if you want to overwrite the old file. After a file is opened it becomes the currently active file; its contents can be viewed and its parameters can be edited. This option can be activated pressing  on the toolbar.

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. You are prompted for the new file's name. If you enter the name of a pre-existing file, the software asks you if you want to overwrite the old file. The original file will remain in memory.

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. The system will ask you for the name you want for this file. You can also save pressing  on the toolbar.

Exit

Exit the application, if changes were made to the configuration and haven't been saved you will be asked if you want to save them.

Before the Exit option there is a list of the most recently used configuration files so you can select one of them without looking for it in the disk.

VIEW

View Drawings

To view the wiring drawings for the Flow Computer go to the **View** menu and then select **Wiring.** The drawings available for this device will be listed.

- Terminals
- Analog Output
- RS-232/RS-485
- Status Input
- Switch Output
- Turbine Input

TOOLS

Communication Port Settings

You can access this window either through the **Tools | Comm Settings** menu option or the Comm button  on the toolbar.

This window let you set the port settings in order to communicate with the Flow Computer. You have the following options available:

SERIAL PARAMETERS

Port Number

Enter the PC port used to communicate with the ECHART Flow Computer.

Baud Rate

> *Note: this parameter must be set the same for both the PC and the ECHART 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 ECHART 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 ECHART 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 ECHART 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 ECHART Flow Computer (Modbus type, parity, baud rate, etc.) or lack of power to the ECHART Flow Computer. To use this feature, the user must insure that only one ECHART Flow Computer is connected to the PC. More than one ECHART 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.

CST 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

Protocol to be used through the Ethernet connection. 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. The 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 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 (Configure Device)

METER DATA

METER PARAMETERS

Meter ID

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

Meter Application Type

0 =	Gas Application	
1 =	Liquid Application	Gross, Net in BBL (US Unit), in M3 (Metric Unit)

Flow Equation Type (0-7)

0 = API 14.3 (NEW AGA3)
1 = ISO5167
2 = AGA7/AGA9 (TURBINE or Frequency Type Input)
3 = Cone/Smart Cone Meter
4 = Slotted DP Meter
5 = Annubar
6 = Verabar
7 = ISO5167 – 1595
8 = Accelabar

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.

On the right hand side of the selection box is a property button  that when pressed pops up a window with the flow equation settings.

Density of Dry Air

Typical value would be 28.9625

Relative Density

The real gas relative density is used in the calculations of the compressibility factor, flowing and reference densities (required only when AGA8 is not used).

Flow Rate High/Low 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.

Density Equation: Specifies the equation used to calculate density.

Select	Calculation Type	Comments and Limitations
1	AGA8 Gross Method 1	Relative Density: 0.554–0.87 US Unit- Heating Value: 477–1150 BTU/SCF Metric Unit- Heating Value: 18.7 – 45.1 MJ/M3
2	AGA8 Gross Method 2	Relative Density: 0.554–0.87 US Unit – Heating Value: 477–1150 BTU/SCF Metric Unit - Heating Value: 18.7 – 45.1 MJ/M3
3	AGA8 Detail Method	Relative Density: 0.07–1.52 Heating Value 0–1800 BTU/SCF (US Unist)
4	Steam Equations	$260 \le T \le 2500$ Deg.K,, $0 \le P \le 3000$ Mpa Heating Value BTU/LB (US Units),MJ/KG (Metric Units)

AGA 8 Detail method can be used for gases other than natural gas, such as methane, carbon dioxide, ethane, and hydrogen sulfide.

On the right hand side of the selection box is a property button  that when pressed pops up a window with the density equation settings.

Heating Value

Energy flow calculation requires the heating value.
For AGA8 Detail Method, using zero is a command to use ISO6976 to calculate a heating value.

Auxiliary Turbine Meter

Enter '1' to select auxiliary turbine meter and **status input assignment must be set to 5** to be used as frequency input.

Auxiliary Turbine Gross Flow Rate = Frequency / K Factor.

Auxiliary Turbine Meter 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.

US Unit	Barrels
Metric Unit	M3

Units Set Up

Select Unit

Selection	Description	Temperature	Pressure	DP
0	US Unit	DEG.F	PSIG	Inches of Water
1	Metric Unit	DEG.C	BAR, KG/CM	KPA, m.Bar

Flow Unit

Selection	Description
0	MCF
1	KM3
2	CF
3	M3

Metric Pressure Unit

Selection	Description	Pressure
0	Metric Unit	BAR
1	Metric Unit	KG/CM2
2	Metric Unit	KPA

Metric DP Unit

Selection	Description
0	m.BAR
1	KPA

API 14.3 Data (new AGA3)

Flow Equation Type = 0

Pipe I.D.

Orifice ID

Pipe ID in inches (us unit), or in millimeter (metric unit) is the measured inside pipe diameter at reference conditions. Orifice ID is the measured diameter of the orifice at reference conditions.

DP Cutoff

The ECHART 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 (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. When multi-variable is used, the pressure sensor is always upstream and set Y to 1.

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.

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 at typical flowing conditions. Natural gas has a typical viscosity of 0.01.

Reference Temperature of Orifice

Reference Temperature of Pipe

These parameters give temperature at which the bore internal diameter was measured on the orifice and pipe respectively. Commonly 68 °F (us unit) or 20 °C (metric unit) is used.

Orifice Thermal Expansion Coefficient E-6

Pipe Thermal Expansion Coefficient E-6

These parameters give the linear expansion coefficients of the orifice and pipe materials respectively.

	Us Unit	Metric Unit
Type 304 and 316 Stainless	9.25 E-6	16.7 E-6
Monel	7.95 E-6	14.3 E-6
Carbon Steel	6.20 E-6	11.2 E-6

ISO5167

Flow Equation Type = 1

Pipe I.D.

Orifice ID

Pipe ID in inches (us unit), or in millimeter (metric unit) is the measured inside pipe diameter to 5 decimals at reference conditions. Orifice ID is the measured diameter of the orifice at reference conditions.

DP Cutoff

The ECHART Flow Computer suspends flow 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.

Select Position of Temperature and Pressure Sensors

Selection	Description
1	Temperature and Pressure Upstream
4	Temperature and Pressure Downstream
5	Temperature Upstream and Pressure Downstream
6	Temperature Downstream and Pressure Upstream

Note: *When the multi-variable is used, the pressure sensor is always upstream.*

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

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.

Reference Temperature of Orifice

Reference Temperature of Pipe

These parameters give temperature at which the bore internal diameter was measured on the orifice and pipe respectively. Commonly 68 °F (us unit) or 20 °C (metric unit) is used.

Orifice Thermal Expansion Coefficient E-6

Pipe Thermal Expansion Coefficient. E-6

These parameters give the linear expansion coefficients of the orifice and pipe materials respectively.

	Us Unit	Metric Unit
Type 304 and 316 Stainless	9.25 E-6	16.7 E-6
Monel	7.95 E-6	14.3 E-6
Carbon Steel	6.20 E-6	11.2 E-6

Distance of Upstream Tapping

Distance of upstream tapping from the upstream face of the plate

Distance of Downstream Tapping

Distance of upstream tapping from the face of the orifice plate

AGA 7/AGA 9 Data (Frequency)

Flow Equation Type = 2

K Factor

K Factor is the number of pulses per unit volume, i.e. 1000 pulses/CF (us unit), M3 (metric 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

The ECHART Flow Computer will quit totalizing when the turbine frequency (or other frequency input) is below this set limit. This feature is to reduce extraneous noise appearing as volume data when the meter is down for period of time.

Slow Pulse Application

Check the box to select slow pulse application.

Flow Rate Cut Off Time

Flow Rates go to zero when no pulse occur within cut off time. (Slow pulse application only).

De-Bounce Time

When slow pulse is used, hysteresis time is required to insure proper de-bounce time.

Flow Cutoff Frequency

The ECHART Flow Computer will quit totalizing when the turbine frequency (or other frequency input) is below this set limit. This feature is to reduce extraneous noise appearing as volume data when the meter is down for period of time.
This value is entered as pulses per second.

Flow Rate Threshold/Linear Factor

Enter the different correction factors for the meter at different flow rates. The ECHART Flow Computer will perform linear interpolation each second. Notice that even though using this feature enhances the measurement accuracy and range, performing audit trail on a linearized meter factor is very difficult.

Cone/Smart Cone

`Flow Equation Type = 3`

Meter I.D.

Cone ID

Meter ID in inches (us unit), or in millimeter (metric unit) is the measured inside pipe diameter at reference conditions. Cone ID is the measured diameter of the cone at reference conditions.

DP Cutoff

The ECHART 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(US Unit)*

	Us Unit	Metric Unit
Type 304 and 316 Stainless	9.25 E-6	16.7 E-6

Viscosity in Centipoise

This value is used to calculate Reynolds number. Enter viscosity in centipoise.

Reynolds Number Threshold/Flow Coefficient Linear Factor

Enter the different correction factors for the meter at different Reynolds numbers. The ECHART will perform linear interpolation each second. Notice that even though using this feature enhances the measurement accuracy and range, performing audit trail on a linear flow coefficient factor is very difficult.

Slotted DP Meter

`Flow Equation Type = 4`

Pipe I.D.

Pipe ID in inches (us unit) is the measured inside pipe diameter at reference conditions.

Beta

Enter ratio of beta for the slotted DP meter.

Flow Coefficient A, B, E, F

Enter flow coefficients of the meter.

Mass of FT3 Air

Typical value is .07647. Base Density = S.G. x .07647

Viscosity in LBM/FT s E-6

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. Slotted DP Meter has a typical viscosity of 1.4 E-6.

FPV

Enter super-compressibility factor.

DP/P Ratio Limit

Enter ratio limit of DP / Pressure.

DP Cutoff

The ECHART Flow Computer suspends flow rate calculations whenever the DP, in inches of water column (us 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.

Annubar Data

To set Annubar flow parameters, set **`Meter Data`**|**`Flow Equation Type = 5`**. 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.

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

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.

Verabar Data

To set Verabar flow parameters, set **`Meter Data`**|**`Flow Equation Type = 6`**. 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.

The Sensor's Probe Width –

$$Beta = TheSensorBlockage = \frac{4 \times PW}{\pi \times D}$$

where D = *Pipe I.D. in Inches*

PW = *The Sensor's Probe Width in Inches*

$PW = .336"$ *for a -05 sensor*

$PW = .614"$ *for a -10 Sensor*

$PW = 1.043"$ *for a -15 Sensor*

π=3.141592654

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.

Flow Coefficient K

Enter flow coefficient for pipe dimension and wall thickness.

Isentropic Exponent (Specific Heat)

Fluid isentropic exponent at flowing conditions.

Reference Temperature

Reference temperature is the temperature at which the bore internal diameter was measured. Commonly 68 °F is used (US Unit).

Thermal Expansion Coefficient E-6

Enter linear coefficient of thermal expansion. (Typically 6.2E-6 is for carbon steel).

ISO5167-1595 Flow Conditioner

To set ISO5167 flow parameters, set **`Meter Data`**|**`Flow Equation Type = 7`**. You will then access a submenu in which you can set the parameters below.

Pipe I.D. Inches

Orifice ID

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

DP Cutoff

The ECHART 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.

Isentropic Exponent (Specific Heat)

Fluid isentropic exponent at flowing 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.

Reference Temperature of Orifice

Reference Temperature of Pipe

These parameters give temperature at which the bore internal diameter was measured on the orifice and pipe respectively. Commonly 68 °F (us unit) or 20 °C (metric unit) is used.

Orifice Thermal Expansion Coefficient E-6

Pipe Thermal Expansion Coefficient. E-6

These parameters give the linear expansion coefficients of the orifice and pipe materials respectively.

	Us Unit	Metric Unit
Type 304 and 316 Stainless	9.25 E-6	16.7 E-6
Monel	7.95 E-6	14.3 E-6
Carbon Steel	6.20 E-6	11.2 E-6

Calibration Factor

Enter calibration factor of the meter.

Accelabar Data –

To set Accelabar flow parameters, set **`Meter Data`**|**`Flow Equation Type = 8`**. You will then access a submenu in which you can set the parameters below.

Accelabar Size

Selection	Size	Throat Diameter	Flow Constant
0	2"	.9"	0.4650
1	3"	1.289"	0.6566
2	4"	1.700"	0.7106
3	6"	2.560"	0.6779
4	8"	3.389"	0.7123
5	10"	4.251"	0.7329
6	12"	5.056	0.7455

Pipe Material

Selection	Pipe Material
0	CS
1	SS
2	Chrome-Molly
3	P91
4	Monel
5	Others

DP Cutoff

The Flow Computer suspends all calculations whenever the DP 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.

Isentropic Exponent (Specific Heat)

Isentropic exponent for a real gas (approximately 1.3 for natural gas).

METER SETTINGS

Day Start Hour (0-23)

Day start hour is used for daily operation. The day will end at day start hour; all daily totalizers and flow-weighted values are reset.

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.

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 1-10 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.

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.

Base Temperature

Enter the basis reference temperature for all corrections. Used, for example, when seller contracts to sell to buyer at an agreed base temperature. Typically value is 60.0 °F in US units, 15 °C in Metric units.

Base Pressure

Enter the basis reference pressure for all corrections. Used, for example, when seller contracts to sell to buyer at an agreed base pressure. Typical values are 14.73 PSIA for US units, 1.01325 bar in Metric units.

Atmospheric Pressure

This pressure is the local pressure or contracted atmospheric pressure to be used. Typical value is 14.696 PSIA for US units. *Enter zero if absolute pressure transmitter is used*

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.

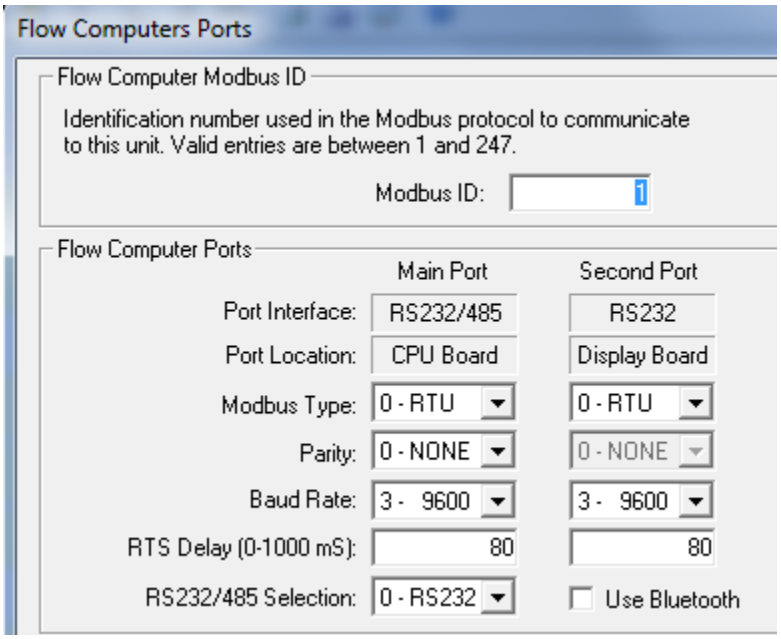
ECHART COMMUNICATION PORTS

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

- Serial Port RS485/RS232 Selectable (on CPU Board)
- 1 Optional RS232 Serial Port (on Display Board)

Port #1/#2 Modbus Type

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

The Modbus Communication Specification is either Binary RTU or ASCII.

Port #1/#2 Parity

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

RTU - NONE
ASCII - EVEN or ODD

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

Port #1/#2 Baud Rate

Note: this parameter must be set the same for both the PC and the ECHART 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/#2 RTS Delay

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

Main Port RS232/RS485 Selection

Selection	Description
0	RS-232 (Default)
1	RS-485

Use Bluetooth

The display board must be equipped with Bluetooth. In order to communicate via Bluetooth™ with a flow computer your PC must be Bluetooth capable or must have a USB-to-Bluetooth adapter. Meter ID is used as the device name and any special characters will not work (ex. '.', ' ', …)

Floating Point Mode

Number of Bytes

Selection	Description
4 Bytes	One Register - 4 Bytes
2 Bytes	Two Registers – 4 Bytes

Bytes Order

Selection	Description
HI, LO	Data - 4 Bytes HI HI LO LO
LO, HI	Data - 4 Bytes LO LO HI HI

INPUT/OUTPUT CONFIGURATION

MULTI.VARIABLE SETTINGS

TAG ID

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

Low/High Limit

Enter the low and high limits. When live value exceeds high limit or less than low limit, an alarm log will be generated.

Maintenance Value

Enter the value to be used when the multivariable fails, or while calibrating. Set fail code to 1 while calibrating.

Fail Code

Fail Code 0: always use the live value even if the multivariable failed.
Fail Code 1: always use the maintenance value
Fail Code 2: use maintenance value if multivariable failed

STATUS INPUT /SWITCH OUTPUT ASSIGNMENT

Status Input Assignment

	Assignment	Comments
1	Spare	
2	Calibration Mode	
3	Orifice Plate Selector	Up to 6 orifice plates can be preconfigured. Use selector and stay for 20 seconds to set new orifice plate.
4	Alarm Acknowledge	Reset the previous occurred alarms output bit
5	Frequency Input	
6	Slow Pulse Input	
7	Event Status	

Switch Output Assignment

User can assign an output to each of the ECHART Flow Computer's output switches from this list. The ECHART Flow Computer switch outputs are open collector type, requiring external D.C power applied to the SW power.
Outputs in the top list, "Pulse Outputs", require a definition of pulse output per unit volume and "Pulse Output Width".
Outputs in the bottom list, "Contact Type Outputs", are ON/OFF type outputs

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 ECHART 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 ECHART Flow Computer can produce up to 50 pulses per second.
The ECHART Flow Computer's maximum pulse output is 125 pulses/sec. The Pulse Output in combination with the Pulse Output Width should be set appropriately.

Assignments - Pulse Outputs

Gross	1
Net	2
Mass	3
Energy	4
Auxiliary	21

Assignments - Contact Type Outputs

	Meter
Meter Down	7
AGA8 Out of Range	8
Flow Rate High	9
Flow Rate Low	10

Day Ended	5
Month Ended	6
Multi-Variable DP High	11
Multi-Variable DP Low	12
Multi-Variable PF High	13
Multi-Variable PF Low	14
Multi-Variable TF High	15
Multi-Variable TF Low	16
Active Alarms	17
Occurred Alarms	18
Watchdog	19
Remote Control	20

ANALOG OUTPUT ASSIGNMENT

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

Analog Output 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:

	Meter
Gross Flow Rate	11
Net Flow Rate	12
Mass Flow Rate	13
Energy Flow Rate	14
DP	21
Temperature	22
Pressure	23
Density	24
Dens.Temp.	25
Density.b	26
SG	27
Auxiliary Gross Flow Rate	28

	Assignment
PID Control	1
Remote Control	2

Analog Output 4mA/20mA

4-20mA selection must be proportional and within the range of the selected parameter. The 4-20mA output signal is 12 bits.

ECHART COMPUTER DISPLAY ASSIGNMENT

Text Assignment

Display text selections are up to three screens. Each screen has four selections. The ECHART Flow Computer will scroll through them at the assigned delay time.

Gross Flow Rate	1
Net Flow Rate	2
Mass Flow Rate	3
Energy Flow Rate	4
Gross Daily Total	5
Net Daily Total	6
Mass Daily Total	7
Energy Daily Total	8
Gross Cumulative Total	9
Net Cumulative Total	10
Mass Cumulative Total	11
Energy Cumulative Total	12
Gross Monthly Total	13
Net Monthly Total	14
Mass Monthly Total	15
Energy Monthly Total	16
DP	17
Temperature	18
Pressure	19
Density	20
SG	21
CO2 %	22
N2 %	23
Heating Value	24
Meter ID	25
Orifice ID/ K Factor	26
Pipe ID/ Meter Factor	27
PID Flow	28
PID Pressure	29
PID Output	30

Date	31
Time	32
Alarms	33
BLM Screen	34
Previous Daily Gross Total	41
Previous Daily Net Total	42
Previous Daily Mass Total	43
Previous Daily Energy Total	44
Previous Cumulative Gross	45
Previous Cumulative Net	46
Previous Cumulative Mass	47
Previous Cumulative Energy	48
Previous Daily FWA DP	49
Previous Daily FWA Temperature	50
Previous Daily FWA Pressure	51
Previous Daily FWA SG	52
Auxiliary Gross Flow Rate	53
Auxiliary Gross Daily Total	54
Auxiliary Gross Cumulative Total	55
Auxiliary Gross Month Total	56
Previous Day – Aux. Gross Total	57
Previous Day – Aux. Gross Cum.	58
Auxiliary K Factor	59
Setting of Main Port and Bluetooth	443

Example for text screen#1 selection

1st Line	**2nd Line**	**3rd Line**	**4th Line**
2	10	14	26

The first screen will show net flow rate (2), cumulative net (10), monthly net (14), and orifice ID (26).

Graphic Screen Assignment

Display graphic selections are up to three screens. Each screen has two selections. The first trend will be shown as a thick line and the second trend as a thin line. The ECHART Flow Computer will scroll through them at the assigned delay time.

(2 Digit Selection)

First Digit	
1	Average
2	Minimum
3	Maximum

Second Digit	
1	Hour DP
2	Hour Pressure
3	Hour Temperature
4	Hour Flow
5	Day DP
6	Day Pressure
7	Day Temperature
8	Day Flow

Example for graphic screen selection

1st Trend	**2nd Trend**
11	21

The first screen will show the hourly average DP (a thick line) and the hourly minimum DP (a thin line).

Graphic Maximum Values

Graphic is established the maximum-highest point on the screen. They are approximately 60 vertical pixels that represent the highest point. The value for each pixel would be scaled to the set maximum.

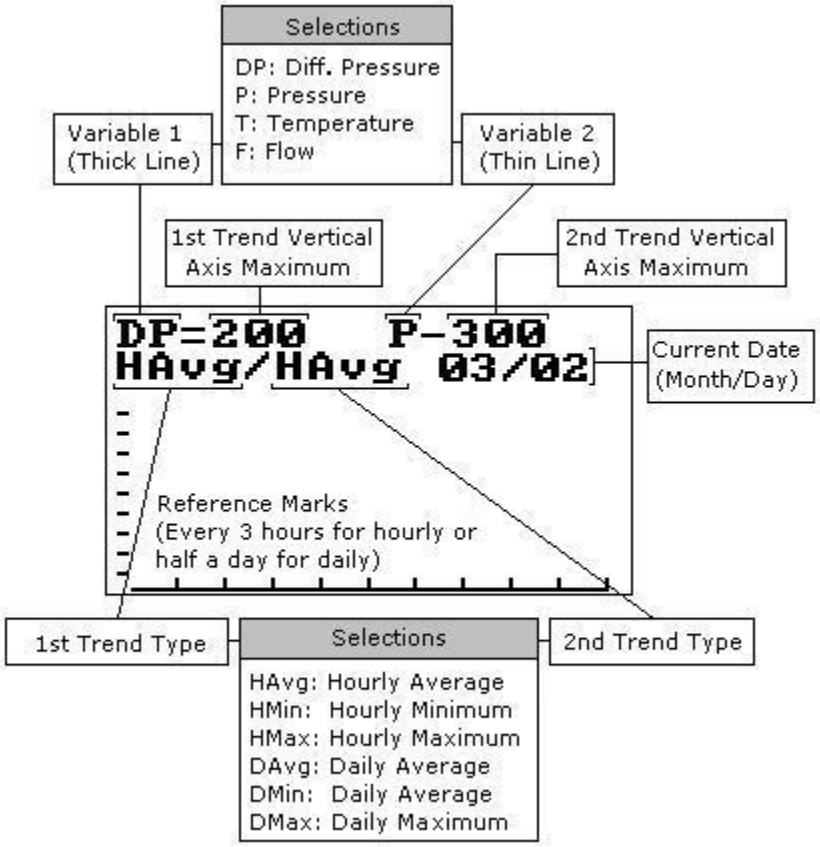
Graphical Screen

The screen displays up to 2 trends. The first trend is represented by a thick line while the second trend is shown as a thin line.

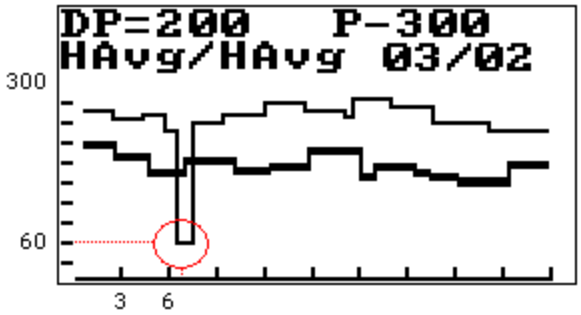
The graphical screen has a resolution of 120 by 50 dots. The trend shows either hourly values or daily values. For hourly values, every 4 points in the X axis is equivalent to 1 hour, thus the screens shows the last 30 hours and there is a reference mark every 3 hours on the horizontal axis. For daily values, every 24 points in the X axis is equivalent to 1 day, thus the screen shows the last 5 days; each reference mark on the horizontal axis equals half a day.

For the Y axis scaling the flow computer uses the maximum values enter by the user in the display configuration and scales them to 60 dots resolution. Each reference mark on the vertical axis equal 1/10 of the full scale.

The top of the screen shows the variables being plot, the maximum scale value for each variable, the type of value (daily or hourly, average, maximum, or minimum), and the current date. See image below.



Example:



Let's identify the red marked area:

1. It is the second variable because it is drawn with a thin line, therefore it represents meter pressure.
2. The maximum vertical value for pressure is 300, there are 10 spaces on the vertical axis so each vertical mark equates to 30 PSI (300 divided by 10).
3. The trend shows the Hourly Pressure average so every horizontal line equates to 3 hours. (If it was daily, each line represents half a day)
4. We can conclude that there was a pressure drop about 7 hours ago and it dropped to 60 PSI.

ADDITIONAL OPTIONS

MODBUS SHIFT- 2 OR 4 BYTES

Reassigns Modbus address registers on the ECHART Flow Computer to predefined Modbus registers for easy polling and convenience. Use Modbus Shift to collect values in scattered Modbus registers into a consecutive order. The ECHART Flow Computer will repeat the assigned variables into the selected locations.

Example: you want to read the current status of switches #1 and #2 (addresses 2751 and 2752) and the Daily Gross Total for Meter #1 (address 3131). Make assignments such as:

3082=2751 (2 bytes)
3083=2752 (2 bytes)
3819=3131 (4 bytes)

MODBUS SHIFT – FLOATING POINT

Use Modbus Shift to collect values in scattered Modbus floating point registers into a consecutive order. The ECHART Flow Computer will repeat the assigned variables. (Refer to the Modbus Address Table Registers in Chapter 4) into the selected locations. (7501-7600)

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

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.

PID Flow Base

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

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

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.

PROGRAM VARIABLE STATEMENTS

From the ECHART Configuration Software, Point cursor 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:
7803 is equal to total of variable#1(Modbus addr.7801) and variable#2 (Modbus addr.7802)
7803=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

7971-7975 – 5 Variables will be reset at the end of hour.
7976-7980 – 5 Variables will be reset at the end of day.
7981-7985 – 5 Variables will be reset at the end of Month.

Last Hour Program Variables – 7718- 7722.
Last Day Program Variables - 7723-7727.
Last Month Program Variables – 7728- 7732

Scratch Pad Variables – Floating Point - 7801-7830 (Read or Write)
- Long Integer – 5031 – 5069 (Read or Write)

Historical Program Variables
7051-7055 – Historical Hour Program Variables (Read Only)
7056-7060 – Historical Month/Day Program Variables (Read Only)

VARIABLE STATEMENT TAGS

These tags are provided to add a meaningful description for the program variables.

BOOLEAN STATEMENTS AND FUNCTIONS

Enter the Boolean statements (**no space allowed**, up to 30 statements). Each statement contains up to two Boolean variables (optionally preceded by '/') and one of the Boolean function (&, +, *). ***4 digits are required*** for referencing programmable variables or Boolean points. (Example: 0001)

Example:

The statement is true if either temperature or pressure override is in use.

0070=0112+0113

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
0002	Spare
0003	Spare
0004	Spare
0005	Spare
0006	Digital Output #1
0007	Digital Output #2
0008-0050	Spare

0070 through 0099 **Programmable Boolean Points**

0100 through 400 Meter Boolean Points

1st digit–always 0, 2nd digit–always 1, 3rd and 4th digit-Selection

0101	Meter Active
0102	AGA 8 Out of Range
0103	Flow Rate High Alarm
0104	Flow Rate Low Alarm
0105-0400	Spare

0401 through 0800 Other Boolean Points

1st digit–always 0, 2nd, 3rd and 4th digit-Selection

0401	Calibration Mode
0402	Any Active Alarms
0403	DP Override in use
0404	Pressure Override in use
0405	Temperature Override in use
0406	Spare
0407	Spare
0408	DP High Alarm
0409	DP Low Alarm
0410	Pressure High Alarm
0411	Pressure Low Alarm
0412	Temperature High Alarm
0413	Temperature Low Alarm
0414	Analog Output Out of Range
0415-0700	Spare
0701	Day Ended Flag (Last 5 Seconds)
0702	Month Ended Flag (Last 5 Seconds)
0703-0800	Spare

0801 through 0899 Command Boolean Points

0801	Alarm Acknowledge

Download Firmware/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 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.

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**.

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 ECHART Flow Computer will resume its normal operation.

View Diagnostic Data

Diagnostic data will show live data changing real time. To control the switch outputs manually, check "Enable Switch Output Diagnostic Mode".

Data Verification

Data verification will not affect the calibration, but will be documented into calibration and verification report.

Parameter Overrides:

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 ECHART Flow Computer.

Multi-variables Input Override

The value can be used when the multivariable fails.

Orifice ID Override

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

Composition Override

Entering a value to change composition factors of AGA8 method.

Heating Value Override

BTU override is used in the AGA8 calculation Gross Method 1. In addition the heating value totalizer requires the heating value. . If AGA8 Detail Method is configured, using zero is a command to use ISO6976 to calculate a heating value.

Base Density Override

In the event the user would like to override the calculated base density. This number would affect the net calculations only. Using zero is a command to use the live value. Base density is used to convert mass volume into corrected standard volume

Flowing Density Override

In the event the user would like to override the flowing density. Using zero is a command to use the live value.

FPV Override

Entering a value to override NX19 super-compressibility factor. Using zero is a command to use the live value.

Water Factor Override

The value is used in the AGA7/AGA9 equation.

Gross Flow Rate = Frequency / K Factor x Linear Meter Factor.

Net Flow Rate = Gross Flow Rate x Flowing Density / Base Density x ***Water Factor Override***.

SYSTEM

DATE AND TIME

Change the date and time for the flow computer.

RESET CUMULATIVE TOTALIZER

Enter reset code to reset accumulated volume totalizer.
Non-resettable accumulated volume will roll over at 999999999.

CLEAR SYSTEM

Enter reset system code to reset all data.

HISTORICAL DATA

To retrieve historical data, go to **Historical Data** menu. It retrieves the information, shows it on the screen and stores in one report. Use the different names to save new reports. The data will be overwritten by the same file name. Select reports, enter the file name, click 

button to save all data in one report.

Templates are created for each report. The user can edit, modify the report template, and save as a new formatted report. Go to **"Tools | Settings…",** then click 

button to specify the location or directory for the new report, and the location of the reports to be saved. Check "DFM File" box to generate the additional binary format of reports.

The available types of reports are:

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 have 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.

Previous Hourly Data

Up to 1536 previous hourly data are stored in the Flow Computer. Enter meter number and the computer will go backward from that selected time. Current hour cannot be selected.

Calibration Data

Up to 20 previous calibration data are stored in the Flow Computer.

Previous Daily Data

Up to 64 previous daily reports can be retrieved.

Previous Day Hourly Data

Up to 64 previous daily of hour by hour reports can be retrieved.

Previous Month Data

Last six months data are stored in the Flow Computer. Select number of previous month data to capture. Current month data cannot be retrieved.

Last Month Daily Data

Two Months of daily data are stored in the Flow Computer. Select number of previous month data to capture. Current month data cannot be retrieved.

Get Data that has not been collected

By checking this option the application will collect all the information available in the ECHART PLUS flow computer that has not been previously retrieved. For example, the information in the meter was collected 2 weeks ago, now we want to collect all the data for the last two weeks, it is only necessary to specify which information we want (audit, alarm, hourly, etc.), and then check the data not collected option, there is no need to specify the number of days or records that we want.

Once the information is retrieved it will remain in the flow computer but it will now be flagged as already collected.

Report Name

The reports generated by "Dynacom Software" are extension DFM. The name can have any combination of letters and numbers.

Use Meter ID as Report Name

By checking this option, the "Dynacom Software" will use meter ID to name the report.

Generate Additional files

The report generated by "Dynacom Software" can be only viewed using "Dynacom Software".

Additional report formats are provided to be viewed by other software applications.

HTML Reports:
This format can be viewed with endless number of software applications, among them are Internet Explorer, Microsoft Excel, Microsoft Word, etc.

CFX Format:
Using this proprietary format, the user can import data into Flow-CAL's custody transfer system. The extension of this report is CFX.

PGAS Format:
This option allows users to import historical information into a PGAS system. When this option is selected, four files will be generated(*.vol, *.arm, *.ana, *.evt) and needed to import all the information into PGAS. The PGAS report is created monthly and can have 3 different formats.

Viewing Saved Reports

Once a report is saved with DFM extension, the report can be viewed from this option.
The browse button can be used to locate the report.

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.

Custom Storage

The ECHART flow computer is Factory configured to store 64 days of hourly history with 16 variables stored per hour. To require more hours of history, remove variables and use the freed space as additional hourly storage.
Up to 10 hourly storage variables can be configured by the user. Enter '0' to use standard format, or '1' to use a customized format.

CUSTOM STORAGE VARIABLES AND HOURS

Number of Variables	Hours
2	6528
3	5208
4	4344
5	3720
6	3264
7	2880
8	2592
9	2374
10	2176

CUSTOM STORAGE SELECTION

Selection	Description
1	Flow Time
2	Gross
3	Net
4	Mass
5	Energy
6	Temperature
7	Pressure
8	DP
9	DP Extension
10	SG
11	Program Variable#1
12	Program Variable#2
13	Program Variable#3
14	Program Variable#4
15	Program Variable#5

Historical Report Examples

HOURLY REPORT

Company Name:		Specific Gravity:	0.600000
Meter Location:		Heating Value:	2.744
Meter ID:		Base Temperature:	15.00
Contract Hour:	0	Base Pressure:	1.0133
Pipe ID (mm):	200.00000	Atmospheric Pressure:	1.0130
Orifice ID (mm):	100.00000	Mole % N2:	0.0000
DP Cut Off:	0.5000	Mole % CO2:	0.0000

Default Bits: Variable was Fixed or in Override (Bit 0 - DP, Bit 1 - Temperature, Bit 2 - Pressure).

Date	Hour	Flow Time (Mins.)	Net Total (M3)	Mass Total (TONNE)	Energy (GJ)	Temp. (°C)	Pressure (BAR)	DP (mBAR)	DP Extension	SG	Default Bits
12/09/16	5	60.0	25309.0	18.6	51.0	315.0	100.0	100.0000	100.5052	0.600000	00000110
12/09/16	4	60.0	25309.0	18.6	51.1	315.0	100.0	100.0000	100.5052	0.600000	00000110
12/09/16	3	60.0	25309.0	18.6	51.0	315.0	100.0	100.0000	100.5052	0.600000	00000110
12/09/16	2	60.0	25309.0	18.6	51.0	315.0	100.0	100.0000	100.5052	0.600000	00000110
12/09/16	1	60.0	25309.0	18.6	51.1	315.0	100.0	100.0000	100.5052	0.600000	00000110
12/09/16	0	60.0	25309.0	18.6	51.0	315.0	100.0	100.0000	100.5052	0.600000	00000110

Historical Report Examples – Continued

DAY HOURLY REPORT

Company Name:		Specific Gravity:	0.600000
Meter Location:		Heating Value:	2.744
Meter ID:		Base Temperature:	15.00
Contract Hour:	0	Base Pressure:	1.0133
Pipe ID (mm):	200.00000	Atmospheric Pressure:	1.0130
Orifice ID (mm):	100.00000	Mole % N2:	0.0000
DP Cut Off:	0.5000	Mole % CO2:	0.0000

Date	Hour	Flow Time (Hours)	Net Total (M3)	DP (mBAR)	Temp (°C)	Pressure (BAR)	DP Ext.
12/08/16	23	0.79	6553.5	100	23.5	23	38.15
12/08/16	22	0	0	0	0	0	0
12/08/16	21	0	0	0	0	0	0
12/08/16	20	0	0	0	0	0	0
12/08/16	19	0	0	0	0	0	0
12/08/16	18	0	0	0	0	0	0
12/08/16	17	0	0	0	0	0	0
12/08/16	16	0	0	0	0	0	0
12/08/16	15	0	0	0	0	0	0
12/08/16	14	1	6553.5	100	20	22	47.97
12/08/16	13	1	6553.5	100	20	22	47.97
12/08/16	12	1	6553.5	100	20	22	47.97
12/08/16	11	1	6553.5	100	20	22	47.97
12/08/16	10	1	6553.5	100	20	22	47.97
12/08/16	9	1	6553.5	100	20	22	47.97
12/08/16	8	1	6553.5	100	20	22	47.97
12/08/16	7	1	6553.5	100	20	22	47.97
12/08/16	6	1	6553.5	100	20	22	47.97
12/08/16	5	1	6553.5	100	20	22	47.97
12/08/16	4	1	6553.5	100	20	22	47.97
12/08/16	3	1	6553.5	100	20	22	47.97
12/08/16	2	1	6553.5	100	20	22	47.97
12/08/16	1	1	6553.5	100	20	22	47.97
12/08/16	0	1	6553.5	100	20	22	47.97

Historical Report Examples - Continued

DAILY REPORT

Meter ID:		Date:	12/08/16
Company:		Location:	
Flowing Time (Min):	947.1	Contract Hour:	0

Flow	Daily Total	Cumulative Total
Gross (M3)	9873.5	10566
Net (M3)	229655.6	264380
Mass (TONNE)	156.2	181
Energy (GJ)	8668.9	8966

Average Values	
DP (mBAR)	100.0000
Temperature (°C)	20.20
Pressure (BAR)	22.00
DP Ext	31.5722
Specific Gravity (SG)	0.600000

Gas Composition					
Heat Value	37.751	H2	0.0000	N-Heptane	0.0000
N2	0.0000	CO	0.0000	N-Octane	0.0000
CO2	0.0000	Oxygen	0.0000	N-Nonane	0.0000
Methane	0.0000	I-Butane	0.0000	N-Decane	0.0000
Ethane	0.0000	N-Butane	0.0000	Helium	0.0000
Propane	0.0000	I-Pentane	0.0000	Argon	0.0000
Water	0.0000	N-Pentane	0.0000		
H2S	0.0000	N_Hexane	0.0000		

Auxiliary Turbine 1	
Gross Total (M3)	0.0
Cumulative Total (M3)	0

Historical Report Examples - Continued

MONTH DAILY REPORT

Company Name:		Specific Gravity:	0.600000
Meter Location:		Heating Value:	2.744
Meter ID:		Base Temperature:	15.00
Contract Hour:	0	Base Pressure:	1.0133
Pipe ID (mm):	200.00000	Atmospheric Pressure:	1.0130
Orifice ID (mm):	100.00000	Mole % N2:	0.0000
DP Cut Off:	0.5000	Mole % CO2:	0.0000

Month	Day	Net (M3)	Energy (GJ)	DP Ext.	Avg. DP (mBAR)	Avg . Temp (°C)	Avg. Pressure (BAR)	Flowing Time (Mins)
12/2016	8	229655.6	8668.9	31.5722	100	20.2	22	947.1
12/2016	7	394.6	14.9	0.0544	100	20.3	21.5	1.7
12/2016	6	193.5	7.3	0.0286	100	13.2	12.2	1.1
12/2016	5	394.6	14.9	0.0544	100	20.3	21.5	1.7
12/2016	4	193.5	7.3	0.0286	100	13.2	12.2	1.1
12/2016	3	4000.5	151.1	0.5542	100	20.1	21.9	16.6

CURRENT DATA

Date: 01/01/17 Time: 00:03:48
Meter ID: Location:
Company:

Pipe ID (mm)	200.00000	K Factor	0.000
Orifice ID (mm)	100.00000	Alpha/CD/LMF	0.603173
Specific Gravity	0.600000	FPV	1.018108
Density (KG/M3)	14.26727	Density Base (KG/M3)	0.679872
DP (mBAR) or Freq.	100.0000	Y Factor	0.998419
Temperature (°C)	22.00	* Means Fixed Value	
Pressure (BAR)	20.00		

Flow	Flow Rate / Hour	Daily Total	Cumulative Total
Gross (M3)	658.47	26.0	12826
Net (M3)	13818.13	1452.9	432275
Mass (TONNE)	9.39	1.1	305
Energy (GJ)	522.06	13.7	9316

Gas Composition					
Heat Value	37.781	H2	0.0000	N-Heptane	0.0000
N2	0.0000	CO	0.0000	N-Octane	0.0000
CO2	0.0000	Oxygen	0.0000	N-Nonane	0.0000
Methane	100.0000	I-Butane	0.0000	N-Decane	0.0000
Ethane	0.0000	N-Butane	0.0000	Helium	0.0000
Propane	0.0000	I-Pentane	0.0000	Argon	0.0000
Water	0.0000	N-Pentane	0.0000		
H2S	0.0000	N-Hexane	0.0000		

Auxiliary Turbine	
Gross Flow (M3/Hour)	0.00
Daily Total (M3)	0.0
Cumulative Total (M3)	0

Program Variables	
Variable 1	0.000000
Variable 2	0.000000
Variable 3	0.000000
Variable 4	0.000000
Variable 5	0.000000

CHAPTER 3: FLOW EQUATIONS

Common Terms

The following terms are used throughout this chapter.
The following terms are used throughout this chapter.

Term	Definition	US Units	Metric Unit	Examples
q	Flow rate: volume or mass displaced per unit time	See equations	See equations	q_{mass} , q_{energy}
T	Temperature	°F unless noted	°C unless noted	
DP	Differential Pressure across measuring device	Inches H_2O	m.Bar	
d	Orifice Diameter	Inches	Millimeter	d , d_r , d_m
D	Pipe Diameter	Inches	Millimeter	D , D_r , D_m
β	$= \frac{d}{D} = \frac{Orifice\ diameter}{Pipe\ diameter}$			β , β_r
ρ	Density (usually of the fluid)	Lb/ft^3	Kg/M^3	$\rho_{flowing}$, ρ_m
μ	Viscosity	centipoise	Centipoise	
HN	Heating Value	BTU/ ft^3	MJ/ M^3	
Y	Expansion factor			

Subscripts: Conventions Used

This Subscript	Means	Examples
r	At reference conditions	$T_{r,p}$ = reference temperature of the pipe
O (letter o)	Refers to the orifice	$T_{r,O}$ = reference temperature of the orifice
1. P	Refers to the pipe	
flowing	At flow conditions	$\rho_{flowing}$ = density at flow conditions
cal	Calibration conditions	T_{cal} , P_{cal}
m	At measured conditions	D_m = pipe diameter at measured temp.

API 14.3

For more information, please see *Orifice Metering of Natural Gas*, 3rd edition.

Mass Flow Rate $= \frac{\pi}{4} \times N_c \times C_d \times E_v \times d^2 \times Y \times \sqrt{2DP \times Density} \times .001$

Net Flow Rate $= \frac{Mass\ Flow}{Base\ Density} \times Conversion\ Factor$

Gross Flow Rate $= \frac{Mass\ Flow}{Flowing\ Density} \times Conversion\ Factor$

Energy Flow Rate $= Net\ Flow \times Heating\ Value \times Conversion\ Factor$

Where:

N_c = *Units Conversion Constant*

C_d = *Orifice Plate Coefficient of Discharge*

$E_v = \frac{1}{\sqrt{1-\beta^4}}$ = *Velocity of Approach Factor*

d = *Orifice plate bore diameter*

Y = *Expansion Factor*

DP = *Orifice Differential Pressure*

	US unit	Metric Unit
N_c	323.279	.036
Density	lb/ft^3	kg/m^3
Gross Flow Rate/HR	Selectable by Data Entry	Selectable by Data Entry
Net Flow Rate/HR	Selectable by Data Entry	Selectable by Data Entry
Mass Flow Rate/HR	MLB	TONNE
Energy Flow Rate/HR	MMBTU	GJ

ISO5167

$$\text{Mass Flowrate} = \frac{\pi}{4} \times N_c \times FA \times E_v \times d^2 Y \sqrt{2000 \times DP \times \rho}$$

$$= \boldsymbol{q_{mass}} \text{ (TON/Hr)}$$

$$\text{Net Flowrate} = \frac{q_{mass}}{\rho_{reference}} = \text{KM3/Hr}$$

$$\text{Gross Flowrate} = \frac{q_{mass}}{\rho_{flowing}} = \text{KM3/Hr}$$

$$\text{Energy Flowrate} = \text{Net Flowrate} \times HeatingValue / 1000.0 = GJ / HR$$

Where :

$N_c = ALPHA$

$Y = 10^{-6}$

$E_v = Exp. \times 3600$

AGA 7 / AGA9

Gross Flow Rate = $\frac{Pulses \times Meter\ Factor \times Linear\ Factor \times Conversion\ Factor}{K\ Factor}$

Net Flow Rate = $\frac{Gross\ Flow \times Flowing\ Density \times Water\ Factor \times (1-BSW\%) \times Conversion\ Factor}{Base\ Density}$

Mass Flow Rate = $Gross\ Flow \times Flowing\ Density \times Conversion\ Factor$

Energy Flow Rate = $\frac{Gross\ Flow \times Flowing\ Density \times Heating\ Value}{Base\ Density} \times Conversion\ Factor$

Where:

GAS Application	US unit	Metric Unit
K Factor	Pulses/CF	Pulses/M3
Density	LB/CF	KG/M3
Gross Flow Rate/HR	Selectable by Data Entry	Selectable by Data Entry
Net Flow Rate/HR	Selectable by Data Entry	Selectable by Data Entry
Mass Flow Rate/HR	MLB	TONNE
Energy Flow Rate/HR	MMBTU	GJ

Liquid Application	US unit	Metric Unit
K Factor	Pulses/BBL	Pulses/M3
Density	LB/CF	KG/M3
Gross Flow Rate/HR	BBL	M3
Net Flow Rate/HR	BBL	SM3
Mass Flow Rate/HR	MLB	TONNE

Cone/Smart Cone

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

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

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

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

$$\text{Energy Flowrate} = \text{Net Flowrate} \times HeatingValue / 1000$$

Where:

g_c = Dimensional Conversion Constant,32,174 $lb_m ft \, / lb_f \, sec^2$

C_f = Flow Coefficient of the Meter

ρ = Density (LB/FT3-US, KG/M3-Metric)

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

$\Delta Psf = \Delta P_{wc} \times 5.197$

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)

Fa = Thermal Expansion Factor

Slotted DP Meter – US unit only

Mass Flow Rate in MLB

Net Flow Rate in MCF =

$$\frac{MassFlowRate}{BaseDensity}$$

Gross Flow Rate in MCF =

$$\frac{MassFlowRate}{FlowingDensity}$$

Annubar – US Unit Only

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

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

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

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}

Typical values for some Annubar Factors

Term	Value	Conditions
F_{RA}	1.0	For Diamond II Annubar
F_m	1.0	For electronic transmitters
F_{AA}	1.0	31°F ≤ T ≤ 106°F

Accelabar

$$Mass\ Flow\ LB/Hour = N \times K \times Y \times Fa \times D^2 \times \sqrt{\rho \times Dp} \times 3600$$

$$= \boldsymbol{q_{mass}}\ (\text{Hour})$$

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

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

$$\text{Energy Flowrate} = \text{Net Flowrate} \times HeatingValue/1000$$

Where :

$K = Flow\ Constant$

$N = .0997429$

$Density = FlowingFluidDensity(LB/FT3)$

$D = ThroatDiameter$

$Fa = ThermalExpansionCoefficient$

$Y = Accelabar\ Gas\ Expansion\ Factor\ (Y = 1\ for\ Liquid\ Application)$

$Dp = Different\ Pressure\ IN\ H2O(68F)$

Refer to VERIS Accelabar Meter

The unit of Mass Flow

Mass Unit	Description
MLB	US unit
TONNE	Metric Ton

DENSITY EQUATIONS

Sarasota Density(GM/CC-US Unit, KG/M3-Metric Unit)

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

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

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 (USUnit) or °C (MetricUnit)*

P = *Flowing pressure in PSIG (USUnit), BAR, or KG / CM (MetricUnit)*

P_{coef} = *Pressure coefficient in microseconds/PSIG (US Unit), BAR, or KG/CM(Metric Unit)*

P_{cal} = *Calibration pressure in PSIG (USUnit), BAR, or KG / CM (MetricUnit)*

UGC Density(GM/CC-US Unit, KG/M3-Metric Unit)

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

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

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(USUnit), or °C(MetricUnit)*

Solartron Density (GM/CC-US Unit, KG/M3-Metric Unit)

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

Density at 20 Deg.C and 0 BAR

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

Where :

t = *Densitometer Oscillation Period in microseconds*

K_0, K_1, K_2 = *Calibration Constants Supplied by Solartron*

Temperature Corrected Density

$$DT = D[1 + K_{18}(T - 20) + K_{19}(T - 20)]$$

Additional Equation for Gas offset data

The following equation can provide more accurate measurement for Argon/Methane Gas Mixture over density range 60 to 200 kg/m^3. ***Contact Solarton to get information about KR and KJ constants.***

$$DA = DT + (1 + K3/(DT + K4)x0.00236 - G/(T + 273))$$

G = Gas Specific Gravity / Ratio of Specific Heats.

Density (GM/CC)= Density(KG/M3) / 1000.0

AGA8 Gross Method 1

Refer to Transmission Measurement Committee Report No. 8

AGA8 Gross Method 2

Refer to Transmission Measurement Committee Report No. 8

AGA8 Detail Method

Refer to Transmission Measurement Committee Report No. 8

Steam NBS Equation

Refer to NBS/NRC Steam Tables.

CHAPTER 4: 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
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

ASCII MODE

Read Address 3076

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 9549

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 **93131**
Delta-V Modbus system - read address **43131**
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. It can be configured to be one register or two registers with 4 data bytes(high/low or low/high word)
Modbus Address: From 7001 to 7999

IEEE Floating Point Format

Sign	Exponent	Mantissa
1 bit	8 bits	23 bits

Sample Floating Point Value - Read Register 7047 (**one register with 4 data bytes**)

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 (high word first, low word)**

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

Response - Four Data Bytes - **47 6C 4A 00 (HEX) = 60490.0 (low word first, high word)**

ADDR	FUNC CODE	BYTE COUNTS	DATA				CRC CHECK	
			LO Word		**HI Word**			
01	03	04	**4A**	**00**	**47**	**6C**	DF	F6

Sample Floating Point Value - Read Register 7047 (**two registers with 4 data bytes**)

ADDR	FUNC CODE	STARTING Address		# OF Registers		CRC CHECK	
		HI	LO	HI	LO		
01	03	1B	87	00	**02**	72	C6

Response - Four Data Bytes - **47 6C 4A 00 (HEX) = 60490.0 (high word first, low word)**

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

Response - Four Data Bytes - **47 6C 4A 00 (HEX) = 60490.0 (low word first, high word)**

ADDR	FUNC CODE	BYTE COUNTS	DATA				CRC CHECK	
			LO Word		**HI Word**			
01	03	04	**4A**	**00**	**47**	**6C**	DF	F6

Modbus Address Table – 16 Bits

ADDRESS	DESCRIPTION	DECIMAL	READ/WRITE

Modbus Address Table – 16 Bits

2018	Re-Initialize Bluetooth	0 Inferred	Read/Write
2019	Use Bluetooth (1=Yes)	0 Inferred	Read/Write
2020-2108	Reserved		
2109	Frequency Input	0 Inferred	Read
2110-2113	Reserved		
2114	Extended Modbus Addressing 0:One Byte Unit ID (The Unit ID can be 1-247) 1:One Byte Unit ID if ID < 247, Two Bytes if ID >= 247 (Unit ID 1 to 9999) 2:Two Bytes Unit ID (The Unit ID can be 1 to 9999)	0 Inferred	Read
2115-2532	Reserved		
2533	Display Unit in Million	0 Inferred	Read/Write
]2534	Flow Copmputer Display Delay	0 Inferred	Read/Write
2535-2540	Reserved		
2541	Flow Computer Graphic Screen #1 Assignment #1	0 Inferred	Read/Write
2542	Flow Computer Graphic Screen #1 Assignment #2	0 Inferred	Read/Write
2543	Flow Computer Graphic Screen #2 Assignment #1	0 Inferred	Read/Write
2544	Flow Computer Graphic Screen #2 Assignment #2	0 Inferred	Read/Write
2545	Flow Computer Graphic Screen #3 Assignment #1	0 Inferred	Read/Write
2546	Flow Computer Graphic Screen #3 Assignment #2	0 Inferred	Read/Write
2547-2550	Spare		
2551	Flow Copmputer ID or Unit 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 Select 0=RTS,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	Reserved		
2565	Port 2 RTS Delay in Milliseconds	0 Inferred	Read/Write
2566	Printer- Number of Nulls	0 Inferred	Read/Write
2567	Reserved		
2568	Port 0=RS232, 1=RS485	0 Inferred	Read/Write
2569	Select 0=US, 1=Metric Unit	0 Inferred	Read/Write
2570	Metric Pressure Units? 0=Bar,1=KG/CM2,2=KPA	0 Inferred	Read/Write
2571	Flow Units? 0=MCF,1=KM3,2=CF,4=M3	0 Inferred	Read/Write
2572	Spare		
2573	Metric DP Units ? 0=m.BAR,1=KPA	0 Inferred	Read/Write
2574	Meter Application Type ? 0=Gas,1=Liquid	0 Inferred	Read/Write
2575-2578	Spare		
2579	Slow Pulse Application (1=Yes)	0 Inferred	Read/Write
2580	Slow Pulse - Flow Rate Cut Off Time in Seconds	0 Inferred	Read/Write

Modbus Address Table – 16 Bits

ADDRESS	DESCRIPTION	DECIMAL	READ/WRITE
2581	Flow Rate Display 0=Hour,1=Day,2=Minute	0 Inferred	Read/Write
2582	Flowrate Averaged Seconds (1-10)	0 Inferred	Read/Write
2583	Day Start Hour (0-23)	0 Inferred	Read/Write
2584	Disable Alarms ? (0=No, 1=Yes)	0 Inferred	Read/Write
2585	Pulse Width	0 Inferred	Read/Write
2587	Accelabar Size	0 Inferred	Read/Write
2588	Accelabar - Pipe Material	0 Inferred	Read/Write
2585-2596	Spare		
2597	Status Input Assign	0 Inferred	Read/Write
2598	Switch Output #1 Assign	0 Inferred	Read/Write
2599	Switch Output #2 Assign	0 Inferred	Read/Write
2600	Analog Output Assign	0 Inferred	Read/Write
2601-2603	Spare		
2604	Slow Pulse – Number of Debounce	0 Inferred	Read/Write
2605-2610	Spare		
2611-2620	Company Name	20 Chars	Read/Write
2621-2630	Meter Location	20 Chars.	Read/Write
2631-2634	Meter ID	8 Chars	Read/Write
2635	Flow Computer Text Screen #1 Assignment#1	0 Inferred	Read/Write
2636	Flow Computer Text Screen #1 Assignment#2	0 Inferred	Read/Write
2637	Flow Computer Text Screen #1 Assignment#3	0 Inferred	Read/Write
2638	Flow Computer Text Screen #1 Assignment#4	0 Inferred	Read/Write
2639	Flow Computer Text Screen #2 Assignment#1	0 Inferred	Read/Write
2640	Flow Computer Text Screen #2 Assignment#2	0 Inferred	Read/Write
2641	Flow Computer Text Screen #2 Assignment#3	0 Inferred	Read/Write
2642	Flow Computer Text Screen #2 Assignment#4	0 Inferred	Read/Write
2643	Flow Computer Text Screen #3 Assignment#1	0 Inferred	Read/Write
2644	Flow Computer Text Screen #3 Assignment#2	0 Inferred	Read/Write
2645	Flow Computer Text Screen #3 Assignment#3	0 Inferred	Read/Write
2646	Flow Computer Text Screen #3 Assignment#4	0 Inferred	Read/Write
2647-2658	Reserved		
2659	Meter Flow Cut Off	0 Inferred	Read/Write
2660	Meter Flow Equation	0 Inferred	Read/Write
2661	Meter Y Factor Select	0 Inferred	Read/Write
2662	Meter Density Calculation Type	0 Inferred	Read/Write

Modbus Address Table – 16 Bits

ADDRESS	DESCRIPTION	DECIMAL	READ/WRITE
2663	Custom Storage Mode - 1st Selection	0 Inferred	Read/Write
2664	Custom Storage Mode - 2nd Selection	0 Inferred	Read/Write
2665	Custom Storage Mode - 3rd Selection	0 Inferred	Read/Write
2666	Custom Storage Mode - 4th Selection	0 Inferred	Read/Write
2667	Custom Storage Mode - 5th Selection	0 Inferred	Read/Write
2668	Custom Storage Mode - 6th Selection	0 Inferred	Read/Write
2669	Custom Storage Mode - 7th Selection	0 Inferred	Read/Write
2670	Custom Storage Mode - 8th Selection	0 Inferred	Read/Write
2671	Custom Storage Mode - 9th Selection	0 Inferred	Read/Write
2672	Custom Storage Mode - 10th Selection	0 Inferred	Read/Write
2673	Custom Storage Mode - No.of Variables	0 Inferred	Read/Write
2674	Hour Data Storage 0=Standard,1=CustomDatabase	0 Inferred	Read/Write

Selection	**Description**
1	Flow Time
2	Gross Volume
3	Net Volume
4	Mass Volume
5	Energy Volume
6	Temperature
7	Pressure
8	DP
9	DP Extension
10	SG
11	Program Variable#1
12	Program Variable#2
13	Program Variable#3
14	Program Variable#4
15	Program Variable#5

2675-2734	Spare		
2735	Spring Forward Month	0 Inferred	Read/Write
2736	Spring Forward Day	0 Inferred	Read/Write
2737	Fall Back Month	0 Inferred	Read/Write
2738	Fall Back Day	0 Inferred	Read/Write
2739	Enable Daylight Time Saving	0 Inferred	Read/Write
2740	Spare		
2741	Muti.Var.DP Fail Code	0 Inferred	Read/Write
2742	Muti.Var.Pressure Fail Code	0 Inferred	Read/Write
2743	Muti.Var.Temperature Fail Code	0 Inferred	Read/Write
2744-2750	Spare		
2751	Status Input Status (0=OFF,1=ON)	0 Inferred	Read/Write
2752	Switch Output #1 Status (0=OFF,1=ON)	0 Inferred	Read/Write
2753	Switch Output #2 Status (0=OFF,1=ON)	0 Inferred	Read/Write
2754-2880	Spare		
2881-2883	Reserved		
2884-2890	Spare		
2891	Boolean Scratch Pad#1	0 Inferred	Read/Write
2892	Boolean Scratch Pad#2	0 Inferred	Read/Write
2893	Boolean Scratch Pad#3	0 Inferred	Read/Write
2894	Boolean Scratch Pad#4	0 Inferred	Read/Write
2895	Boolean Scratch Pad#5	0 Inferred	Read/Write

Modbus Address Table – 16 Bits

ADDRESS	DESCRIPTION	DECIMAL	READ/WRITE
2896-2926	Spare		
2927-2930	Analog Output Tag Name	8 Chars	Read/Write
2931-2934	Multi.Var. DP Tag	8 Chars.	Read/Write
2935-2938	Multi.Var. Pressure Tag	8 Chars.	Read/Write
2939-2942	Multi.Var. Temperature Tag	8 Chars.	Read/Write
2943	Meter PID Auto/Manual	0 Inferred	Read/Write
2944	Meter PID Flow Loop Used (1=Yes)	0 Inferred	Read/Write
2945	Meter PID Flow Direct/Reverse Act	0 Inferred	Read/Write
2946	Meter PID Pressure Loop Used (1=Yes)	0 Inferred	Read/Write
2947	Meter PID Pressure Direct/Reverse Act	0 Inferred	Read/Write
2948	Meter PID Flow Loop in Service	0 Inferred	Read/Write
2949	Meter PID Pressure Loop in Service	0 Inferred	Read/Write
2950	Meter PID 0=Low,1=High Signal	0 Inferred	Read/Write
2951	Meter PID Flow Base 0=Gross,1=Net,2=Mass	0 Inferred	Read/Write
2952-2979	Spare		
2980	Slow Pulse Flow Rate Time Cut Off	0 Inferred	Read/Write
2981-2984	Spare		
2985	Analog Output Percentage	0 Inferred	Read
2989-2990	Spare		
2991	Reset PID		

Modbus Address Table – 16 Bits

ADDRESS	DESCRIPTION	DECIMAL	READ/WRITE
3001	Version Number	2 Inferred	Read
3002	Reversed		
3003	Reversed		
3004	Prev. Day of Current or Last Month Data Request (+) Day for the Current Month (-) Day for the Previous Month Error Checking – Invalid Data -> 999 Valid Data -> 900 + Day	0 Inferred	Read/Write
3005	Last Two Hours Minutes Data Request (1-12)	0 Inferred	Write
3006	Reserved		
3007	Product Used	0 Inferred	Read
3008-3011	Meter ID	8 Chars	Read
3012-3017	Spare		
3018	Flow Computer Unit Number	0 Inferred	Read
3019	Disable Alarms (1=Yes)	0 Inferred	Read
3020	Data Verification Report Request (1-100)	0 Inferred	Read
3021	Last Month Summary Report Request	0 Inferred	Write
3022	Last Month Summary Report Pointer	0 Inferred	Read
3023	Applicaton Tag	0 Inferred	Read
3024	Enable Calibration Mode (1=Yes)	0 Inferred	Read
3025	Calibration – Set Time (1-9 Hours)	0 Inferred	Read
3026	Last Daily Report Request (1=Latest,64=Oldest) Daily Data Area in Location 3431-3511	0 Inferred	Write
3027	Last Monthly Report Request(1=Latest,6=Oldest) Set Last Monthly Report Request to 1 Monthly Data Area in Location 3431-3511	0 Inferred	Write
3028	Reserved		
3029	Last Hourly Report Request(1=Latest,1536=Oldest)	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
3032	Time Clock – Month		Read
3033	Time Clock – Day		Read
3034	Time Clock – Year (2 Digits)		Read
3035	Time Clock – Hour		Read
3036	Time Clock – Minute		Read
3037	Time Clock – Second		Read
3038-3081	Spare		
3082-3121	Modbus Address Shift Data Area		Read

Modbus 16-bit Address Table Ends

Modbus Address Table – 2x16 Bits Integer

ADDRESS DESCRIPTION DECIMAL READ/WRITE

Modbus Address Table – 2x16 Bits Integer

***Non-resettable accumulated volume will roll over at 999999999.**

3131	Meter Daily Gross Total	1 inferred	Read
3133	Meter Daily Net Total	1 inferred	Read
3135	Meter Daily Mass Total	1 inferred	Read
3137	Meter Daily Energy Total	1 inferred	Read
3139	Meter Hourly Gross Total	1 Inferred	Read
3141	Meter Hourly Net Total	1 Inferred	Read
3143	Meter Hourly Mass Total	1 Inferred	Read
3145	Meter Hourly Energy Total	1 Inferred	Read
3147	Meter Monthly Gross Total	1 Inferred	Read
3149	Meter Monthly Net Total	1 Inferred	Read
3151	Meter Monthly Mass Total	1 Inferred	Read
3153	Meter Monthly Energy Total	1 Inferred	Read
3155	Meter Cumulative Gross Total*	0 Inferred	Read
3157	Meter Cumulative Net Total*	0 Inferred	Read
3159	Meter Cumulative Mass Total*	0 Inferred	Read
3161	Meter Cumulative Energy Total*	0 Inferred	Read
3163	Meter Meter Factor	6 Inferred	Read
3165	Meter Linear Factor	6 Inferred	Read
3167-3349	Spare		
3351	Analog Output MA Value	3 Inferred	Read
3353	Display Contrast	0 Inferred	Read
3355-3381	Spare		
3383	Analog Output Output %	2 Inferred	Read
3385-3429	Spare		

Modbus Address Table – 2x16 Bits Integer

Last Daily or Monthly Data Area

Set Last Daily Report Request (3026) to 1=Latest,64=Oldtest
(3026,16 bits Integer,Write only)
Daily Data Area in Location 3431-3511
Set Last Monthly Report Request (3027) to 1=Latest,6=Oldtest
(3027,16 bits Integer,Write only)
Monthly Data Area in Location 3431-3511

ADDRESS	DESCRIPTION	DECIMAL	READ/WRITE
3431	Batch Type/Disp/Bank/Station Flag	0 Inferred	Read
3433	Day/Month Start Date	0 Inferred	Read
3435	Day/Month Start Time	0 Inferred	Read
3437-3439	Meter ID	8 Chars.	Read
3441	Meter Flowing Time	1 Inferred	Read
3443	Meter Daily/Monthly Gross Total	1 Inferred	Read
3445	Meter Daily/Monthly Net Total	1 Inferred	Read
3447	Meter Daily/Monthly Mass Total	1 Inferred	Read
3449	Meter Daily/Monthly Energy Total	1 Inferred	Read
3451	Meter Average DP	4 Inferred	Read
3453	Meter Average Temperature	2 Inferred	Read
3455	Meter Average Pressure	2 Inferred	Read
3457	Meter Average DP_EXT	4 Inferred	Read
3459	Meter Average Heating Value	3 Inferred	Read
3461	Meter Average SG	6 Inferred	Read
3463	Meter Average N2	4 Inferred	Read
3465	Meter Average CO2	4 Inferred	Read
3467	Meter Average Methane	4 Inferred	Read
3469	Meter Average Ethane	4 Inferred	Read
3471	Meter Average Propane	4 Inferred	Read
3473	Meter Average Water	4 Inferred	Read
3475	Meter Average H2S	4 Inferred	Read
3477	Meter Average H2	4 Inferred	Read
3479	Meter Average CO	4 Inferred	Read
3481	Meter Average Oxygen	4 Inferred	Read
3483	Meter Average i-Butane	4 Inferred	Read
3485	Meter Average n-Butane	4 Inferred	Read
3487	Meter Average i-Pentane	4 Inferred	Read
3489	Meter Average n-Pentane	4 Inferred	Read
3491	Meter Average n-Hexane	4 Inferred	Read
3493	Meter Average n-Heptane	4 Inferred	Read
3495	Meter Average n-Octane	4 Inferred	Read
3497	Meter Average n-Nonane	4 Inferred	Read
3499	Meter Average n-Decane	4 Inferred	Read
3501	Meter Average Helium	4 Inferred	Read
3503	Meter Average Argon	4 Inferred	Read
3505	Meter Cumulative Gross Total	0 Inderred	Read
3507	Meter Cumulative Net Total	0 Inderred	Read
3509	Meter Cumulative Mass Total	0 Inderred	Read
3511	Meter Cumulative Energy Total	0 Inderred	Read
3513	Auxiliary Meter Gross Total	1 Inferred	Read
3515	Auxiliary Meter Cumulative Gross Total	0 Inferred	Read
3517	Roll Over Number – Gross Month Total	0 Inferred	Read
3519	Roll Over Number – Net Month Total	0 Inferred	Read
3521	Roll Over Number – Mass Month Total	0 Inferred	Read
3523	Roll Over Number – Energy Month Total	0 Inferred	Read
3525	Roll Over Number – Auxiliary Gross Month Total	0 Inferred	Read

(Month total roll over at 999999999. Use the following method to get correct value with 1 decimal inferred.
Total (Double) = (Roll Over Number x 99999999+ Total) / 10.

Last Daily or Monthly Data Area Ends

Modbus Address Table – 2x16 Bits Integer

ADDRESS	DESCRIPTION	DECIMAL	READ/WRITE
3527-3697	Spare		

Last Two Hours Minutes Data Area

Set Last Two Hours Minutes Data Report Request (3005).

1 = Previous 1st Hour 1-10 Minutes (Latest)
2 = Previous 1st Hour 11-20 Minutes
3 = Previous 1st Hour 21-30 Minutes
4 = Previous 1st Hour 31-40 Minutes
5 = Previous 1st Hour 41-50 Minutes
6 = Previous 1st Hour 51-60 Minutes

7 = Previous 2nd Hour 1-10 Minutes
8 = Previous 2nd Hour 11-20 Minutes
9 = Previous 2nd Hour 21-30 Minutes
10 = Previous 2nd Hour 31-40 Minutes
11 = Previous 2nd Hour 41-50 Minutes
12 = Previous 2nd Hour 51-60 Minutes

3699	1st Time Stamp (hhmm)	0 Inferred	Read
3701	1st Pressure	2 Inferred	Read
3703	1st DP	4 Inferred	Read
3705	1st Temperature	2 Inferred	Read
3707	1st Net Flow Rate	1 Inferred	Read
3709	1st Orifice ID	5 Inferred	Read
3711	2nd Time Stamp (hhmm)	0 Inferred	Read
3713	2nd Pressure	2 Inferred	Read
3715	2nd DP	4 Inferred	Read
3717	2nd Temperature	2 Inferred	Read
3719	2nd Net Flow Rate	1 Inferred	Read
3721	2nd Orifice ID	5 Inferred	Read
3723	3rd Time Stamp (hhmm)	0 Inferred	Read
3725	3rd Pressure	2 Inferred	Read
3727	3rd DP	4 Inferred	Read
3729	3rd Temperature	2 Inferred	Read
3731	3rd Net Flow Rate	1 Inferred	Read
3733	3rd Orifice ID	5 Inferred	Read
3735	4th Time Stamp (hhmm)	0 Inferred	Read
3737	4th Pressure	2 Inferred	Read
3739	4th DP	4 Inferred	Read
3741	4th Temperature	2 Inferred	Read
3743	4th Net Flow Rate	1 Inferred	Read
3745	4th Orifice ID	5 Inferred	Read
3747	5th Time Stamp (hhmm)	0 Inferred	Read
3749	5th Pressure	2 Inferred	Read
3751	5th DP	4 Inferred	Read
3753	5th Temperature	2 Inferred	Read
3755	5th Net Flow Rate	1 Inferred	Read
3757	5th Orifice ID	5 Inferred	Read

Modbus Address Table – 2x16 Bits Integer

ADDRESS	DESCRIPTION	DECIMAL	READ/WRITE
3759	6th Time Stamp (hhmm)	0 Inferred	Read
3761	6th Pressure	2 Inferred	Read
3763	6th DP	4 Inferred	Read
3765	6th Temperature	2 Inferred	Read
3767	6th Net Flow Rate	1 Inferred	Read
3769	6th Orifice ID	5 Inferred	Read
3771	7th Time Stamp (hhmm)	0 Inferred	Read
3773	7th Pressure	2 Inferred	Read
3775	7th DP	4 Inferred	Read
3777	7th Temperature	2 Inferred	Read
3779	7th Net Flow Rate	1 Inferred	Read
3781	7th Orifice ID	5 Inferred	Read
3783	8th Time Stamp (hhmm)	0 Inferred	Read
3785	8th Pressure	2 Inferred	Read
3787	8th DP	4 Inferred	Read
3789	8th Temperature	2 Inferred	Read
3791	8th Net Flow Rate	1 Inferred	Read
3793	8th Orifice ID	5 Inferred	Read
3795	9th Time Stamp (hhmm)	0 Inferred	Read
3797	9th Pressure	2 Inferred	Read
3799	9th DP	4 Inferred	Read
3801	9th Temperature	2 Inferred	Read
3803	9th Net Flow Rate	1 Inferred	Read
3805	9th Orifice ID	5 Inferred	Read
3807	10th Time Stamp (hhmm)	0 Inferred	Read
3809	10th Pressure	2 Inferred	Read
3811	10th DP	4 Inferred	Read
3813	10th Temperature	2 Inferred	Read
3815	10th Net Flow Rate	1 Inferred	Read
3817	10th Orifice ID	5 Inferred	Read

Last Two Hours Data Area Ends

Modbus Address Table – 2x16 Bits Integer

ADDRESS	DESCRIPTION	DECIMAL	READ/WRITE
3817	Spare		
3819-3997	Modbus Address Shift Data Area		Read
4001-4089	Reserved		
4091-4109	Spare		
4111	Meter PID – Pressure	2 Inferred	Read
4113	Meter PID – Flow	2 Inferred	Read
4115	Meter PID – Output %	2 Inferred	Read
4117	Meter PID – Flow Output %	2 Inferred	Read
4119	Meter PID – Pressure Output %	2 Inferred	Read
4121	Meter #2 PID – Pressure	2 Inferred	Read
4123-4199	Spare		
4201	Date (MMDDYY)	0 Inferred	Read/Write
4203	Time (HHMMSS)	0 Inferred	Read/Write
AGA 8 GROSS METHOD 1			
4205	Meter Mol % of Carbon Dioxide	4 Inferred	Read/Write
4207	Meter Mol % of Hydrogen	4 Inferred	Read/Write
4209	Meter Mol % of Carbon Monoxide	4 Inferred	Read/Write
4211-4373	Spare		
AGA 8 GROSS METHOD 2			
4205	Meter#1 Mol % of Nitrogen	4 Inferred	Read/Write
4207	Meter#1 Mol % of Carbon Dioxide	4 Inferred	Read/Write
4209	Meter#1 Mol % of Hydrogen	4 Inferred	Read/Write
4211	Meter#1 Mol % of Carbon Monoxide	4 Inferred	Read/Write
4213-4373	Spare		
AGA 8 Detail Method			
4205	Meter#1 Mol % of Methane	4 Inferred	Read/Write
4207	Meter#1 Mol % of Nitrogen	4 Inferred	Read/Write
4209	Meter#1 Mol % of Carbon Dioxide	4 Inferred	Read/Write
4211	Meter#1 Mol % of Ethane	4 Inferred	Read/Write
4213	Meter#1 Mol % of Propane	4 Inferred	Read/Write
4215	Meter#1 Mol % of Water	4 Inferred	Read/Write
4217	Meter#1 Mol % of Hydrogen Sulfide	4 Inferred	Read/Write
4219	Meter#1 Mol % of Hydrogen	4 Inferred	Read/Write
4221	Meter#1 Mol % of Carbon Monoxide	4 Inferred	Read/Write
4223	Meter#1 Mol % of Oxygen	4 Inferred	Read/Write
4225	Meter#1 Mol % of i-Butane	4 Inferred	Read/Write
4227	Meter#1 Mol % of n-Butane	4 Inferred	Read/Write
4229	Meter#1 Mol % of i-Pentane	4 Inferred	Read/Write
4231	Meter#1 Mol % of n-Pentane	4 Inferred	Read/Write
4233	Meter#1 Mol % of i-Hexane	4 Inferred	Read/Write
4235	Meter#1 Mol % of n-Heptane	4 Inferred	Read/Write
4237	Meter#1 Mol % of i-Octane	4 Inferred	Read/Write
4239	Meter#1 Mol % of i-Nonane	4 Inferred	Read/Write
4241	Meter#1 Mol % of i-Decane	4 Inferred	Read/Write
4243	Meter#1 Mol % of Helium	4 Inferred	Read/Write
4245	Meter#1 Mol % of Argon	4 Inferred	Read/Write

AGA 8 Detail Method Ends

Modbus Address Table – 2x16 Bits Integer

ADDRESS	DESCRIPTION	DECIMAL	READ/WRITE
4247	DP Verfication Point	4 Inferred	Read/Write
4249	Pressure Verification Point	2 Inferred	Read/Write
4251	Temperature Verification Point	2 Inferred	Read/Write
4253-4373	Spare		
4351	Cone Meter-Reynolds Number Threshold #1	0 Inferred	Read/Write
4353	Cone Meter-Reynolds Number Threshold #2	0 Inferred	Read/Write
4355	Cone Meter-Reynolds Number Threshold #3	0 Inferred	Read/Write
4357	Cone Meter-Reynolds Number Threshold #4	0 Inferred	Read/Write
4359	Cone Meter-Reynolds Number Threshold #5	0 Inferred	Read/Write
4361	Cone Meter-Reynolds Number Threshold #6	0 Inferred	Read/Write
4363	Cone Meter-Flow Coeff. Linear Factor #1	6 Inferred	Read/Write
4365	Cone Meter-Flow Coeff. Linear Factor #2	6 Inferred	Read/Write
4367	Cone Meter-Flow Coeff. Linear Factor #3	6 Inferred	Read/Write
4369	Cone Meter-Flow Coeff. Linear Factor #4	6 Inferred	Read/Write
4371	Cone Meter-Flow Coeff. Linear Factor #5	6 Inferred	Read/Write
4373	Cone Meter–Flow Coeff. Linear Factor #6	6 Inferred	Read/Write
4375	Meter Density of Dry Air	5 Inferred	Read/Write
4377	Meter Relative Density	6 Inferred	Read/Write
4379	Meter Ratio of Heat	4 Inferred	Read/Wirte
4381	Meter Viscosity	6 Inferred	Read/Write
4383	Meter Pipe Thermal E-6	2 Inferred	Read/Write
4385	Meter Orifice Thermal E-6	2 Inferred	Read/Write
4387	Meter Reference Temperature of Pipe	2 Inferred	Read/Write
4389	Meter Reference Temperature of Orifice	2 Inferred	Read/Write
4391	Meter ISO5167 up-stream Tapping	2 Inferred	Read/Write
4393	Meter ISO5167 down-stream Tapping	2 Inferred	Read/Write
4395	Meter DP Cut Off	4 Inferred	Read/Write
4397	Spare		
4399	Meter Meter Factor	6 Inferred	Read/Write
4401	Meter Flow Threshold #1	2 Inferred	Read/Write
4403	Meter Flow Threshold #2	2 Inferred	Read/Write
4405	Meter Flow Threshold #3	2 Inferred	Read/Write
4407	Meter Flow Threshold #4	2 Inferred	Read/Write
4409	Meter Linear Factor #1	6 Inferred	Read/Write
4411	Meter Linear Factor #2	6 Inferred	Read/Write
4413	Meter Linear Factor #3	6 Inferred	Read/Write
4415	Meter Linear Factor #4	6 Inferred	Read/Write
4417	Graphic Setup – DP Maximum	0 Inferred	Read/Write
4419	Graphic Setup – Pressure Maximum	0 Inferred	Read/Write
4421	Graphic Setup – Temperature Maximum	0 Inferred	Read/Write
4423	Graphic Setup – Flow Maximum	0 Inferred	Read/Write
4425-4433	Spare		
4435	Annubar Manometer Factor	6 Inferred	Read/Write
4437	Annuber Location Factor	6 Inferred	Read/Write
4439	Annubar Reynolds Number Factor	6 Inferred	Read/Write
4441	Annubar/Verabar Flow Coefficient K	6 Inferred	Read/Write
4443	Annubar/Verabar Thermal Expansion Factor	6 Inferred	Read/Write
4445-4547	Spare		
4549	Multi.Var. DP Low Limit	4 Inferred	Read/Write
4551	Multi.Var. DP High Limit	4 Inferred	Read/Write
4553	Multi.Var. DP Maintenance	4 Inferred	Read/Write
4555	Multi.Var. Pressure Low Limit	2 Inferred	Read/Write

Modbus Address Table – 2x16 Bits Integer

ADDRESS	DESCRIPTION	DECIMAL	READ/WRITE
4557	Multi.Var. Pressure High Limit	2 Inferred	Read/Write
4559	Multi.Var. Pressure Maintenance	2 Inferred	Read/Write
4561	Multi.Var. Temperature Low Limit	2 Inferred	Read/Write
4563	Multi.Var. Temperature High Limit	2 Inferred	Read/Write
4565	Multi.Var. Temperature Maintenance	2 Inferred	Read/Write
4567	Multi.Var DP Override	4 Inferred	Read/Write
4569	Multi.Var Pressure Override	2 Inferred	Read/Write
4571	Multi.Var Temperature Override	2 Inferred	Read/Write
4573-4615	Spare		
4617	DP Calibration Value	4 Inferred	Read/Write
4619	Pressure Calibration Value	2 Inferred	Read/Write
4621	Temperature Calibration Value	2 Inferred	Read/Write
4623-4651	Spare		
4653	Analog Output % – Remote Control (0.00-100.00)	2 Inferred	Read/Write
4655	Water Factor Override	6 Inferred	Read/Write
4657	Meter Heating Value Override	3 Inferred	Read/Write
4659	Meter FPV Override	6 Inferred	Read/Write
4661	Meter Temperature Override	2 Inferred	Read/Write
4663	Meter Pressure Override	2 Inferred	Read/Write
4665-4825	Spare		
4827	Pulse Output Volume #1 Pulses/Unit	3 Inferred	Read/Write
4829	Pulse Output Volume #2 Pulses/Unit	3 Inferred	Read/Write
4831	Meter PID Output %	2 nferred	Read/Write
4833	Meter PID Flow	2 Inferred	Read/Write
4835	Meter PID Flow Set Point	2 Inferred	Read/Write
4837	Meter PID Flow Controller Gain	2 Inferred	Read/Write
4839	Meter PID Flow Controller Reset	2 Inferred	Read/Write
4841	Meter PID Pressure Maximum	2 Inferred	Read/Write
4843	Meter PID Pressure Set Point	2 Inferred	Read/Write
4845	Meter PID Flow Controller Gain	2 Inferred	Read/Write
4847	Meter PID Flow Controller Reset	2 Inferred	Read/Write
4849	Meter PID Mininum Output %	2 Inferred	Read/Write
4851	Meter PID Maxinum Output %	2 Inferred	Read/Write
4853-4975	Spare		
4975-5019	Reserved		

Modbus Address Table – 2x16 Bits Integer

ADDRESS	DESCRIPTION	DECIMAL	READ/WRITE
Scratch Pad for Program Variables – (Long Integer) 5031,5033-5069			
5031	Sratch Pad – Program Variable Integer		
5033			
5035			
5037			
5039			
5041			
5043			
5045			
5047			
5049			
5051			
5053			
5055			
5057			
5059			
5061			

Modbus Address Table – 2x16 Bits Integer

ADDRESS	DESCRIPTION	DECIMAL	READ/WRITE

3029 = Last Hourly Report Request (16 bits) (1=Lastest, 1536=Oldest)
(3029, 16bits Integer, Write only)

Last Hourly Data Area

8001	Date (mm/dd/yy)	0 Inferred	Read
8003	Time (hh/mm/ss)	0 Inferred	Read
8005	Meter Hourly Duration of Flow	1 Inferred	Read
8007	Meter GrossTotal	1 Inferred	Read
8009	Meter Net Total	1 Inferred	Read
8011	Meter Mass Total	1 Inferred	Read
8013	Meter Energy Total	1 Inferred	Read
8015	Meter Average Temperature	1 Inferred	Read
8017	Meter Average Pressure	1 Inferred	Read
8019	Meter Average DP	4 Inferred	Read
8021	Meter Average DP EXT	4 Inferred	Read
8023	Meter Average SG	6 Inferred	Read

Last Hourly Data Area Ends

Modbus Address Table – 2x16 Bits Integer

ADDRESS	DESCRIPTION	DECIMAL	READ/WRITE

3021 = Last Month Data Request (16 bits) (1=Lastest, 2=Oldest)
3022 = Day of the month (1-31)
(3021-3022, 16bits Integer, Write only)

Last Month Data Area

8025	SG	6 Inferred	Read
8027	N2 Percentage	4 Inferred	Read
8029	CO2 Percentage	4 Inferred	Read
8031	Heating Value	3 Inferred	Read
8033	Pipe ID	5 Inferred	Read
8035	Orifice ID	5 Inferred	Read
8037	Base Temperature	2 Inferred	Read
8039	Base Pressure	4 Inferred	Read
8041	Atmospheric Pressure	4 Inferred	Read
8043	DP Cut Off	4 Inferred	Read
8045	Date	0 Inferred	Read
8047	Month	0 Inferred	Read
8049	Year	0 Inferred	Read
8051	Index	0 Inferred	Read
8053	Daily Flowing Time	1 Inferred	Read
8055	Daily Total Net	1 Inferred	Read
8057	Daily Total – Energy	1 Inferred	Read
8059	Daily Average Temperature	2 Inferred	Read
8061	Daily Average Pressure	2 Inferred	Read
8063	Daily Average DP	4 Inferred	Read
8065	Daily Average DP/EXT	4 Inferred	Read
8067	Month Flowing Time	1 Inferred	Read
8069	Month Total – Net	1 Inferred	Read
8071	Month Total – Energy	1 Inferred	Read
8073	Month Average Temperature	2 Inferred	Read
8075	Month Average Pressure	2 Inferred	Read
8077	Month Average DP	4 Inferred	Read
8079	Month Average DP/EXT	4 Inferred	Read
8081	Density Calc Type/Y Factor Configuration	0 Inferred	Read
8083	Spare		
8085	Reserved		
8087	Roll Over Number –Net Month Total	0 Inferred	Read
8089	Roll Over Number – Energy Month Total	0 Inferred	Read

(Month total roll over at 999999999. Use the following method to get correct value with 1 decimal inferred.

Total (Double) = (Roll Over Number x 99999999+ Total) / 10.

Last Month Data Area Ends

Modbus Address Table – 2x16 Bits Integer

ADDRESS	DESCRIPTION	DECIMAL	READ/WRITE

***Non-resettable accumulated volume will roll over at 999999999.**

Current Data Area

9001	Meter Calculation Type	0 Inferred	Read
9003	Meter Flow Flag	0 Inferred	Read
9005	Meter Alarm Status Flag	0 Inferred	Read
9007	Meter Daily Gross Total	1 inferred	Read
9009	Meter Daily Net Total	1 inferred	Read
9011	Meter Daily Mass Total	1 inferred	Read
9013	Meter Daily Energy Total	1 inferred	Read
9015	Meter Cum. Gross Total*	0 Inferred	Read
9017	Meter Cum. Net Total*	0 Inferred	Read
9019	Meter Cum. Mass Total*	0 Inferred	Read
9021	Meter Cum. Energy Total*	0 Inferred	Read
9023	Meter N2 Percent	4 Inferred	Read
9025	Meter Co2 Percent	4 Inferred	Read
9027	Meter Methane Percent	4 Inferred	Read
9029	Meter Ethane Percent	4 Inferred	Read
9031	Meter Propane Percent	4 Inferred	Read
9033	Meter Water Percent	4 Inferred	Read
9035	Meter H2S Percent	4 Inferred	Read
9037	Meter H2 Percent	4 Inferred	Read
9039	Meter CO Percent	4 Inferred	Read
9041	Meter Oxygen Percent	4 Inferred	Read
9043	Meter I-Butane Percent	4 Inferred	Read
9045	Meter n-Butane Percent	4 Inferred.	Read
9047	Meter I-Pentane Percent	4 Inferred	Read
9049	Meter n-Pentane Percent	4 Inferred	Read
9051	Meter n-Hexane Percent	4 Inferred	Read
9053	Meter n-Heptane Percent	4 Inferred	Read
9055	Meter n-Octane Percent	4 Inferred	Read
9057	Meter n-Nonane Percent	4 Inferred	Read
9059	Meter n-Decane Percent	4 Inferred	Read
9061	Meter Helium Percent	4 Inferred	Read
9063	Meter Argon Percent	4 Inferred	Read
9065	MeterHeating Value	3 Inferred	Read
9067	Meter Gross Flowrate	2 Inferred	Read
9069	Meter Net Flowrate	2 Inferred	Read
9071	Meter Mass Flowrate	2 Inferred	Read
9073	Meter Energy Flowrate	2 Inferred	Read
9075	Meter Product	0 Inferred	Read
9077-9079	Meter Meter ID	8 Chars.	Read
9081	Meter Pipe ID	5 Inferred	Read
9083	Meter Orifice ID	5 Inferred	Read
9085	Meter Frequency	0 Inferred	Read
9087	Density of Dry Air	5 Inferred	Read
9089	K Factor	3 Inferred	Read
9091	Date(mmddyy)	0 Inferred	Read
9093	Time (hhmmss)	0 Inferred	Read
9095	MeterDP	4 Inferred	Read
9097	Meter Temperature	2 Inferred	Read
9099	Meter Pressure	2 Inferred	Read

Modbus Address Table – 2x16 Bits Integer

ADDRESS	DESCRIPTION	DECIMAL	READ/WRITE
9101	Meter Density	5 Inferred	Read
9103	Meter Dens.b	6 Inferred	Read
9105	Meter SG	6 Inferred	Read
9107	Meter Y Factor	6 Inferred	Read
9109	Meter K /CD/LMF	6 Inferred	Read
9111	Meter DP EXT	4 Inferred	Read
9113	Meter FPV	6 Inferred	Read
9115	Auxiliary Meter Gross Flow Rate	2 Inferred	Read
9117	Auxiliary Meter Gross Daily Total	1 Inferred	Read
9119	Auxiliary Meter Gross Cumulative Total	0 Inferred	Read
9121	Last Month Gross Total	0 Inferred	Read
9123	Last Month Net Total	0 Inferred	Read
9125	Last Month Mass Total	0 Inferred	Read
9127	Last Month Energy Total	0 Inferred	Read
9129	Yesterday's Gross Total	1 Inferred	Read
9131	Yesterday's Net Total	1 Inferred	Read
9133	Yesterday's Mass Total	1 Inferred	Read
9135	Yesterday's Energy Total	1 Inferred	Read
9137	Last Hour Gross Total	1 Inferred	Read
9139	Last Hour Net Total	1 Inferred	Read
9141	Last Hour Mass Total	1 Inferred	Read
9143	Last Hour Energy Total	1 Inferred	Read
9145	Yesterday's Auxiliary Meter Gross Total	1 Inferred	Read
9147	Last Month Auxiliary Meter Gross Total	0 Inferred	Read
9149-9167	Spare		
9169	Meter FA Factor	6 Inferred	Read
9171-9519	Spare		
9521	Multi.Var DP	4 Inferred	Read
9523	Multi.Var.Pressure	2 Inferred	Read
9525	Multi.Var.Temperature	2 Inferred	Read
9527	Multi.Var. Communcation Status	0 Inferred	Rea

Floating Point

Modbus Address Table – Floating Point

7001-7002 Reserved

AGA 8 GROSS METHOD 1

7003	Meter Mol % of Carbon Dioxide	Read/Write
7004	Meter Mol % of Hydrogen	Read/Write
7005	Meter Mol % of Carbon Monoxide	Read/Write
7006-7019	Spare	

AGA 8 GROSS METHOD 2

7003	Meter#1 Mol % of Nitrogen	Read/Write
7004	Meter#1 Mol % of Carbon Dioxide	Read/Write
7005	Meter#1 Mol % of Hydrogen	Read/Write
7006	Meter#1 Mol % of Carbon Monoxide	Read/Write
7007-7019	Spare	

AGA 8 Detail Method

7003	Meter#1 Mol % of Methane (CH4)	Read/Write
7004	Meter#1 Mol % of Nitrogen (N2)	Read/Write
7005	Meter#1 Mol % of Carbon Dioxide (CO2)	Read/Write
7006	Meter#1 Mol % of Ethane (C2H6)	Read/Write
7007	Meter#1 Mol % of Propane(C3H8)	Read/Write
7008	Meter#1 Mol % of Water(H2O)	Read/Write
7009	Meter#1 Mol % of Hydrogen Sulfide (H2S)	Read/Write
7010	Meter#1 Mol % of Hydrogen (H2)	Read/Write
7011	Meter#1 Mol % of Carbon Monoxide (CO)	Read/Write
7012	Meter#1 Mol % of Oxygen (O2)	Read/Write
7013	Meter#1 Mol % of i-Butane (i-C4H10)	Read/Write
7014	Meter#1 Mol % of n-Butane (n-C4 H10)	Read/Write
7015	Meter#1 Mol % of i-Pentane (i-C5H12)	Read/Write
7016	Meter#1 Mol % of n-Pentane(n-C5H12)	Read/Write
7017	Meter#1 Mol % of i-Hexane(C6H14)	Read/Write
7018	Meter#1 Mol % of n-Heptane (C7H16)	Read/Write
7019	Meter#1 Mol % of i-Octane (C8H18)	Read/Write
7020	Meter#1 Mol % of i-Nonane (C9H20)	Read/Write
7021	Meter#1 Mol % of i-Decane (C10H22)	Read/Write
7022	Meter#1 Mol % of Helium (He)	Read/Write
7023	Meter#1 Mol % of Argon (Ar)	Read/Write
7024-7025	Spare	
7026	Meter Orifice ID/Blockage Number	Read/Write
7027	Meter Pipe ID	Read/Write
7028	Meter K Factor	Read/Write
7029	Meter Low Limit	Read/Write
7030	Meter High Limit	Read/Write
7031	Base Temperature	Read/Write
7032	Base Pressure	Read/Write
7033	Atmospheric Pressure	Read/Write
7034	Auxiliary Meter K Factor	Read/Write

Floating Point

7035	Slotted DP Meter – DP/P Limit	Read/Write
7036	Slotted DP Meter – Mass of Air	Read/Write
7037	Slotted DP Meter – Coefficient A	Read/Write
7038	Slotted DP Meter – Coefficient B	Read/Write
7039	Slotted DP Meter – Coefficient E	Read/Write
7040	Slotted DP Meter – Coefficient F	Read/Write
7041	FPV Override	Read/Write
7042	Spare	
7043	Orifice ID #1	Read/Write
7044	Orifice ID #2	Read/Write
7045	Orifice ID #3	Read/Write
7046	Orifice ID #4	Read/Write
7047	Orifice ID #5	Read/Write
7048	Orifice ID #6	Read/Write
7049	Analog Output Percentage- Remote Control (0-100)	Read/Write
7050	Spare	

Last Hour Program Variables Data Area -
Set Last Hour Report Request (3029) to 1=Latest,1536=Oldtest
(3029-16 bits Integer, Write only)
Last Hour Data Area in Location 7051-7055

7051	Last Hour Program Variable #1	Read
7052	Last Hour Program Variable #2	Read
7053	Last Hour Program Variable #3	Read
7054	Last Hour Program Variable #4	Read
7055	Last Hour Program Variable #5	Read

Last Daily or Monthly Program Variables Data Area -
Set Last Daily Report Request (3026) to 1=Latest,64=Oldtest
(3026-16 bits Integer, Write only)
Daily Data Area in Location 7056-7060

Set Last Monthly Report Request (3027) to 1=Latest,6=Oldtest
(3027-16 bits Integer, Write only)
Monthly Data Area in Location 7056-7060

7056	Last Day/Month Program Variable #1	Read
7057	Last Day/Month Program Variable #2	Read
7058	Last Day/Month Program Variable #3	Read
7059	Last Day/Month Program Variable #4	Read
7060	Last Day/Month Program Variable #5	Read

Floating Point

7901	Analog Output @4mA	Read/Write
7902	Analog Output @20mA	Read/Write
7903	Base Density Override	Read/Write
7904	Flowing Density Override	Read/Write
7905-7914	Reserved	
7915	Analog Output Value	Read
7916-7974	Spare	

Programmable Floating Point Variables

7791-7798 – Program Display Variables	Read/Write
7801-7830 – Scratch Pad Variables – Floating Point	Read/Write

7971	Hour Program Variable #1	Read/Write
7972	Hour Program Variable #2	Read/Write
7973	Hour Program Variable #3	Read/Write
7974	Hour Program Variable #4	Read/Write
7975	Hour Program Variable #5	Read/Write
	7971-7975 – 5 Variables will be reset at the end of hour.	
7976	Day Program Variable #1	Read/Write
7977	Day Program Variable #2	Read/Write
7978	Day Program Variable #3	Read/Write
7979	Day Program Variable #4	Read/Write
7980	Day Program Variable #5	Read/Write
	7976-7980 – 5 Variables will be reset at the end of day.	
7981	Month Program Variable #1	Read/Write
7982	Month Program Variable #2	Read/Write
7983	Month Program Variable #3	Read/Write
7984	Month Program Variable #4	Read/Write
7985	Month Program Variable #5	Read/Write
	7981-7985 – 5 Variables will be reset at the end of Month.	

Floating Point

7098 Current Daily Archive Record Number
7099 Current Hourly Archive Record Number

Current Data Area

7100	Spare	
7101	Meter Gross Flowrate	Read
7102	Meter Net Flowrate	Read
7103	Meter Mass Flowrate	Read
7104	Meter Energy Flowrate	Read
7105	Meter Daily Gross Total	Read
7106	Meter Daily Net Total	Read
7107	Meter Daily Mass Total	Read
7108	Meter Daily Energy Total	Read
7109	Meter Cum. Gross Total	Read
7110	Meter Cum. Net Total	Read
7111	Meter Cum. Msss Total	Read
7112	Meter Cum. Energy Total	Read
7113	Meter Dp	Read
7114	Meter Temperature	Read
7115	Meter Pressure	Read
7116	Meter Density	Read
7117	Meter Heating Value	Read
7118	Meter Dens.b	Read
7119	Meter SG	Read
7120	Meter Y Factor	Read
7121	Meter K/CD/LMF	Read
7122	Spare	
7123	Meter FPV	Read
7124	Meter N2 Percent	Read
7125	Meter CO2 Percent	Read
7126	Meter Methane Percent	Read
7127	Meter Etnane Percent	Read
7128	Meter Propane Percent	Read
7129	Meter Water Percent	Read
7130	Meter H2S Percent	Read
7131	Meter H2 Percent	Read
7132	Meter CO Percent	Read
7133	Meter Oxygen Percent	Read
7134	Meter I-Butane Percent	Read
7135	Meter n-Butane Percent	Read
7136	Meter I-Pentane Percent	Read
7137	Meter n-Pentane Percent	Read
7138	Meter n-Hexane Percent	Read
7139	Meter n-Heptane Percent	Read
7140	Meter n-Octane Percent	Read
7141	Meter n-Nonane Percent	Read
7142	Meter n-Decane Percent	Read
7143	Meter Helium Percent	Read
7144	Meter Argon Percent	Read
7145	Auxiliary Meter Gross Flow Rate	Read
7146	Auxiliary Meter Gross Daily Total	Read
7147	Auxiliary Meter Cumulative Gross Total	Read
7148	Daily Flow Time in Minutes	Read
7149	Daily Flow Time in Seconds	Read

Floating Point

7150	Roll Over Number – Cumulative Gross Total	Read
7151	Current Date	Read
7152	Current Time	Read
7153	Roll Over Number – Cumulative Net Total	Read
7154	Roll Over Number – Cumulative Mass Total	Read
7155	Roll Over Number – Cumulative Energy Total	Read
7156	Roll Over Number – Cumulative Auxiliary Gross Total	Read
7157	Spare	
7158	Last Month Flow Time in Seconds	Read
7159	Last Month Flow Time in Minutes	Read
7160	Current Month Flow Time in Seconds	Read
7161	Current Month Flow Time in Minutes	Read
7162	Current Month Total – Gross	Read
7163	Current Month Total – Net	Read
7164	Current Month Total – Mass	Read
7165	Current Month Total – Energy	Read
7166	Current Month Total – Auxiliary Gross	Read
7167	Roll Over Number – Current Month Gross	Read
7168	Roll Over Number – Current Month Net	Read
7169	Roll Over Number – Current Month Mass	Read
7170	Roll Over Number – Current Month Energy	Read
7171	Roll Over Number – Current Month Auxiliary Gross	Read

(Month total and cumulative total roll over at 9999999. Use the following method to get correct value.

Total (Double) = Roll Over Number x 9999999+ Total

Floating Point

Last Month Data Area

7268	Gross Total	Read
7269	Net Total	Read
7270	Mass Total	Read
7271	Energy Total	Read
7281	Auxiliary Meter Gross Total	Read
7287	Roll Over Number – Gross Total	Read
7288	Roll Over Number – Net Total	Read
7289	Roll Over Number – Mass Total	Read
7291	Roll Over Number – Energy Total	Read
7292	Roll Over Number – Auxiliary Gross Total	Read
7728	Program Variable #1	Read
7729	Program Variable #2	Read
7730	Program Variable #3	Read
7731	Program Variable #4	Read
7732	Program Variable #5	Read

(Month total roll over at 999999999. Use the following method to get correct value in floating point,

Total (Double) = Roll Over Number x 9999999 + Total

Last Hour Data Area

7272	Gross Total	Read
7273	Net Total	Read
7274	Mass Total	Read
7275	Energy Total	Read
7718	Program Variable #1	Read
7719	Program Variable #2	Read
7720	Program Variable #3	Read
7721	Program Variable #4	Read
7722	Program Variable #5	Read

Floating Point

Yesterday's Data Area

7257	Flowing Time in Minutes (One Decimal Resolution)	Read
7258	Average SG	Read
7259	Average DP	Read
7260	Average Temperature	Read
7261	Average Pressure	Read
7276	Gross Total	Read
7277	Net Total	Read
7278	Mass Total	Read
7279	Energy Total	Read
7280	Auxiliary Meter Gross Daily Total	Read
7295	Flowing Time in Minutes (Floating)	Read
7296	Flowing Time in Seconds	Read
7723	Program Variable #1	Read
7724	Program Variable #2	Read
7725	Program Variable #3	Read
7726	Program Variable #4	Read
7727	Program Variable #5	Read

Floating Point

Previous Daily Data Area – Meter

3026 Last Daily Report Request (1=Latest,64=Oldest)
(3026-16 bits Integer, Write only)

7201	Date	Read
7202	Time	Read
7203	Flow Time (Hour)	Read
7204	Meter Average DP	Read
7205	Meter Average Pressure	Read
7206	Meter Average Temperature	Read
7207	Meter Average DP/EXT	Read
7208	Meter Gross Total	Read
7209	Meter Net Total	Read
7210	Meter Mass Total	Read
7211	Meter Energy Total	Read
7212	Meter Average Heating Value	Read
7213	Meter Average SG	Read
7214	Meter Average N2 Percent	Read
7215	Meter Average CO2 Percent	Read
7216	Meter Average Methane Percent	Read
7217	Meter Average Ethane Percent	Read
7218	Meter Average Propane Percent	Read
7219	Meter Average Water Percent	Read
7220	Meter Average H2S Percent	Read
7221	Meter Average H2 Percent	Read
7222	Meter Average CO Percent	Read
7223	Meter Average Oxygen Percent	Read
7224	Meter Average I-Butane Percent	Read
7225	Meter Average n-Butane Percent	Read
7226	Meter Average I-Pentane Percent	Read
7227	Meter Average n-Pentane Percent	Read
7228	Meter Average n-Hexane Percent	Read
7229	Meter Average n-Heptane Percent	Read
7230	Meter Average n-Octane Percent	Read
7231	Meter Average n-Nonane Percent	Read
7232	Meter Average n-Decane Percent	Read
7233	Meter Average Helium Percent	Read
7234	Meter Average Argon Percent	Read
7235	Auxiliary Meter Gross	Read

Floating Point

Previous Hourly Data Area

3029 Last Hourly Report Request(1=Latest,1536=Oldest)
(3029,16bits Integer, Write only)

7241	Date	Read
7242	Time	Read
7243	Flow Time	Read
7244	Average DP	Read
7245	Average Temperature	Read
7246	Average Pressure	Read
7247	Average DP/EXT	Read
7248	Hourly Gross	Read
7249	Hourly Net	Read
7250	Hourly Mass	Read
7251	Hourly Energy	Read
7252	Program Variable #1	Read
7253	Program Variable #2	Read
7254	Program Variable #3	Read
7255	Program Variable #4	Read
7256	Program Variable #5	Read

Floating Point

Last Two Hours Minutes Data Area

Set Last Two Hours Minutes Data Report Request (3005,16bits Integer, Write only**).**

1 = Previous 1st Hour 1-10 Minutes
2 = Previous 1st Hour 11-20 Minutes
3 = Previous 1st Hour 21-30 Minutes
4 = Previous 1st Hour 31-40 Minutes
5 = Previous 1st Hour 41-50 Minutes
6 = Previous 1st Hour 51-60 Minutes

7 = Previous 2nd Hour 1-10 Minutes
8 = Previous 2nd Hour 11-20 Minutes
9 = Previous 2nd Hour 21-30 Minutes
10 = Previous 2nd Hour 31-40 Minutes
11 = Previous 2nd Hour 41-50 Minutes
12 = Previous 2nd Hour 51-60 Minutes

7401	1st Time Stamp (hhmm)	Read
7402	1st Pressure	Read
7403	1st DP	Read
7404	1st Temperature	Read
7405	1st Net Flow Rate	Read
7406	1st Orifice ID	Read
7407	2nd Time Stamp (hhmm)	Read
7408	2nd Pressure	Read
7409	2nd DP	Read
7410	2nd Temperature	Read
7411	2nd Net Flow Rate	Read
7412	2nd Orifice ID	Read
7413	3rd Time Stamp (hhmm)	Read
7414	3rd Pressure	Read
7415	3rd DP	Read
7416	3rd Temperature	Read
7417	3rd Net Flow Rate	Read
7418	3rd Orifice ID	Read
7419	4th Time Stamp (hhmm)	Read
7420	4th Pressure	Read
7421	4th DP	Read
7422	4th Temperature	Read
7423	4th Net Flow Rate	Read
7424	4th Orifice ID	Read
7425	5th Time Stamp (hhmm)	Read
7426	5th Pressure	Read
7427	5th DP	Read
7428	5th Temperature	Read
7429	5th Net Flow Rate	Read
7430	5th Orifice ID	Read

Floating Point

7431	6th Time Stamp (hhmm)	Read
7432	6th Pressure	Read
7433	6th DP	Read
7434	6th Temperature	Read
7435	6th Net Flow Rate	Read
7436	6th Orifice ID	Read
7437	7th Time Stamp (hhmm)	Read
7438	7th Pressure	Read
7439	7th DP	Read
7440	7th Temperature	Read
7441	7th Net Flow Rate	Read
7442	7th Orifice ID	Read
7443	8th Time Stamp (hhmm)	Read
7444	8th Pressure	Read
7445	8th DP	Read
7446	8th Temperature	Read
7447	8th Net Flow Rate	Read
7448	8th Orifice ID	Read
7449	9th Time Stamp (hhmm)	Read
7450	9th Pressure	Read
7451	9th DP	Read
7452	9th Temperature	Read
7453	9th Net Flow Rate	Read
7454	9th Orifice ID	Read
7455	10th Time Stamp (hhmm)	Read
7456	10th Pressure	Read
7457	10th DP	Read
7458	10th Temperature	Read
7459	10th Net Flow Rate	Read
7460	10th Orifice ID	Read

Last Two Hours Minutes Floating Point Data Area Ends

Floating Point

7301	Spare	Read
7302	Spare	Read
7303	Date (mm/dd/yy)	Read
7304	Time (hh/mm/ss)	Read
7305	Net Flow Rate	Read
7306	Pressure	Read
7307	DP	Read
7308	Temperature	Read
7309	Accumulated Net Volume Today	Read
7310	Accumulated Time on Production Today	Read
7311	Accumulated Net Volume Yesterday	Read
7312	Accumulated Time on Production Yesterday	Read
7313	FPV	Read
7314	K/CD/LMF Factor	Read
7315	Y Factor	Read
7316	Ev Factor	Read
7317	Zb Factor	Read
7318	Zf Factor	Read
7319	Q Factor	Read
7320-7348		
7349	Heating Value	Read
7350	Density	Read
7351	Density Base	Read
7352	Ratio of Heat	Read
7353	Viscosity	Read
7354	Contract Hour	Read
7355	Atmospheric Pressure	Read
7356	Base Pressure	Read
7357	Base Temperature	Read
7358	Meter Tube Reference Inside Diameter	Read
7359	Orifice Plate Reference Bore Size	Read
7360	Static Pressure Tap Location 0=None, 1=Upstream, 2 = Downstream	Read
7361	Orifice Plate Material	Read
7362	Meter Tube Material	Read
7363	Calibrated Static Pressure Low Range	Read
7364	Calibrated Static Pressure High Range	Read
7365	Calibrated DP Low Range	Read
7366	Calibrated DP High Range	Read
7367	Calibrated Temperature Low Range	Read
7368	Calibrated Temperature High Range	Read
7369	High DP Cut Off	Read
7370	Low DP Cut Off	Read
7371	Meter Factor	Read
7372	K Factor	Read
7373-7374	Reserved	

Floating Point

7375	SG	Read
7376	Mol % of Methane	Read
7377	Mol % of Nitrogen	Read
7378	Mol % of Carbon Dioxide	Read
7379	Mol % of Ethane	Read
7380	Mol % of Propane	Read
7381	Mol % of Water	Read
7382	Mol % of Hydrogen Sulfide	Read
7383	Mol % of Hydrogen	Read
7384	Mol % of Carbon Monoxide	Read
7385	Mol % of Oxygen	Read
7386	Mol % of i-Butane	Read
7387	Mol % of n-Butane	Read
7388	Mol % of i-Pentane	Read
7389	Mol % of n-Pentane	Read
7390	Mol % of i-Hexane	Read
7391	Mol % of n-Heptane	Read
7392	Mol % of i-Octane	Read
7393	Mol % of i-Nonane	Read
7394	Mol % of i-Decane	Read
7395	Mol % of Helium	Read
7396	Mol % of Argon	Read

Floating Point

Hourly and Daily archive flow data 701, 703, 704 are fixed length arrays. The data field is used to address an individual record

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 ECHART can store up to 64 day's data. The daily pointer will be 1 through 64. The pointer will roll over at 64 to 1.

Read Archive Record Quary Message – Read archive registers 701 record number 10

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..		

Daily Archive 701 - Previous Daily Data

701

Date
Time
Average Heating Value
Average SG
Average Carbon Dioxide Percent
Average Nitrogen Percent
Average Methane Percent
Average Ethane Percent
Average Propane Percent
Average Iso-Butane Percent
Average n-Butane Percent
Average I-Pentane Percent
Average n-Pentane Percent
Average Hexane Percent
Average Heptane Percent
Average Nonane Percent
Average Octane Percent
Average H2S Percent
Average Hydrogen Percent
Average Helium Percent
Average Oxygen Percent
Average Carbon Monoxide Percent

Floating Point

Daily Archive 703 - Previous Daily Data

703
Date
Time
Flow Time (Min.)
Average Pressure
Average Temperature
Gross Total
Net Total
Mass Total
Energy
Average DP
Average DP/EXT

One Modbus register (7099 -floating point) is used to indicate the current *hourly record pointer numbers*. This pointer identifies the current record which data was last logged. The ECHART can store up to 1536 hour's data. The hourly pointer will be 1 through 1536. (The pointer will roll over at 1536 to 1).

Hourly Archive 704 - Previous Hourly Data

704
Date
Time
Flow Time (Min.)
Average Pressure
Average Temperature
Gross Total
Net Total
Mass Total
Energy Total
Average DP
Average DP/EXT

Alarms, Audit Trail, and Calibration

Previous Alarms and Status Codes

Set last alarm status request (3030, 16bits Integer, Write only) to 1.
4001-4003 (2x16bits Integer, Read only)
4001 last alarm date mmddyy
4003 last alarm time hhmmss
4005 last alarm flag - IDx1000000 + CODE x10000 +ACODEx100 +STATUS

Last Alarm Flag

ID	CODE	ACODE	STATUS

ID

0	Analog Output
1	
2	
3	
4	
5	
6	

18	Calibration Mode
20	Multi.Var. DP
21	Multi.Var. Pressurer
22	Multi.Var. Temperature
11	Meter

CODE (Only For ID=Meter)

1	Net Flowrate (Gross –AGA7/AGA9)
3	Density Out of Range (AGA8/Steam)

7	Down
8	Start

ACODE
N/A

STATUS

0	ID = 0	OVERRANGE OK
	ID=18,19	OFF
	ID=Others	OK
Others	Not Used	

1	ID=18	Calib.Mode
	ID=19	Event Status ON
	ID=Others	HI
2	LO	
5	OVERRANGE	

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

Previous Audit Data

Set last audit data request (3031, 16 bits Integer, Write only) to 1.
8101-8109 (2x16bits Integer, Read only)

8101	Last Audit Date mmddyy
8103	Last Audit Time hhmmss
8105	Old Value (Decimal Inferred in the 4th byte of 8109)
8107	New Vaule(Decimal Inferred in the 4th byte of 8109)
8109	Code Flag-Given in four hexadecimal bytes (no,audit code,dec)

Code Flag

	No.	Audit Code	Old/New Value Decimal Inferred

NO.
The following table is only for audit code is less than 200
Value 0 : this field is not used.

1	Meter

211	Multi.Var.DP	***Tag***
212	Multi.Var.Pressure	
213	Multi.Var.Temperature	

Audit Codes

1	DP Cut Off
2	
3	Heating Value
4	Flowing Density Override
5	Base Density Override
6	Pipe ID
7	Orifice ID
8	Temperature Override
9	Pressure Override
10	Density Dry Air
11	Base SG
12	Ratio of Heat
13	Viscosity
14	Pipe Thermal Expansion E-6
15	Orifice Thermal Expansion E-6
16	Reference Temperature of Pipe
17	Reference Temperature of Orifice
18	MOL% of Methane (aga8d) CO2 (AGA8 Gross Method 1) Nitrogen(AGA8 Gross Method 2)
19	Hydrogen(AGA8 GrossMethod1) CO2 (AGA8 Gross Method 2) Nitrogen(AGA8 Detail Method)
20	CO (AGA8 Gross Method 1) Hydrogen(AGA8 Gross Method 2) CO2 (AGA8 Detail Method)
21	CO (AGA8 Gross Method 2) Ethane (AGA8 Detail Method)

142	Flow Rate Threshold #1
143	Flow Rate Threshold #2
144	Flow Rate Threshold #3
145	Flow Rate Threshold #4
146	Linearization Factor #1
147	Linearization Factor #2
148	Linearization Factor #3
149	Linearization Factor #4
150	
151	
152	
153	Flow Rate Display
154	Calculation Type
155	Y Factor Select
156	
157	
158	
159	
161	Day Start Hour

22	Propane (AGA8 Detail Method)
23	Water (AGA8 Detail Method)
24	H2S (AGA8 Detail Method)
25	Hydrogen (AGA8 Detail Method)
26	CO (AGA8 Detail Method)
27	Oxygen (AGA8 Detail Method)
28	i-Butane (AGA8 Detail Method)
29	n-Butane (AGA8 Detail Method)
58	Density Correction Factor
60	Base Temperature
61	Base Pressure
62	Atmospheric Pressure
63	Pulse Output #1 Volume
64	Pulse Output #2 Volume
65	Mol % of I-Pentane
66	Mol % of n-Pentane
67	Mol % of n-Hexane
68	Mol % of n-Heptane
69	Mol % of n-Octane
70	Mol % of n-Nonane
71	Mol % of n-Decane
72	Mol % of Helium
73	Mol % of Argon
131	Fail Code
132	@4mA
133	@20mA
134	Maintenance
135	Override
137	Maintenance
138	Override
139	Low Limit
140	High Limit

162	Disable Alarms
163	
164	Density Calculation Type
165	
166	
167	
168	
170	
171	Pressure Unit
173	Flow Unit
180	*****SEE NOTE (next page)**
181	Flow Cut Off Hertz
182	K Factor
183	Meter Factor
184	Graphic Setup-DP Maximum
185	Graphic Setup-Pressure Max.
186	Graphic Setup-Temperature Max.
187	Graphic Setup-Flow Maximum

254	Date
255	Time

***Example*:** Density Correction Factor change from 1.00000 to 1.10000

8101 **Last Audit Date mmddyy**
00 00 C8 C8 (Hex), 051400 (Decimal) – May 14, 2000

8103 **Last Audit Time hhmmss**
00 03 0d 40 (Hex), 200000(Decimal) – 8 PM

8105 **Old Value (Decimal Inferred in the 4th byte of 8109)**
00 01 86 a0 (Hex) 100000 (Decimal)
4th byte of 8513 = 5 (Decimal Places)
result = 1.00000

8107 **New Vaule(Decimal Inferred in the 4th byte of 8109)**
00 01 ad b0 (Hex) 110000 (Decimal)
4th byte of 8513 = 5 (Decimal Places)
Rsult = 1.10000

8109 **Code Flag**
00 26 3a 05 in Hex
2nd Byte – 26 (Hex) 38 (Decimal) Meter Density,
3rd Byte – Audit Code – 3A(Hex) 58 (Decimal) – 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.

8101 System Start Date

8103 System Start Time

8105 System Failed Date

8107 System Failed Time

8109 Not Used

Previous Audit Data Area Ends

Previous Calibration/Verification Data

3020 Last Calib./Verification Rpt Req.(1=Latest,100=Oldest)
(3020-16 bits Integer, Write only)

8251 Last Calibration/Verification Date mmddyy
8253 Last Calibration/Verification Time hhmmss
8255 As Found / Verification Point (Decimal Inferred in the 4th byte of 8259)
8257 As Left (Decimal Inferred in the 4th byte of 8259)
8259 Code Flag-Given in four hexadecimal bytes (no,code,dec)

Code Flag

	ID	Code	Value Decimal Inferred

ID

1	DP
2	Pressure
3	Temperature

Code

0	Calibration
1	Verification

Decimal Inferred

4	4 Decimal Inferred
2	2 Decimal Inferred

Current Alarm Status

4 Bytes in Hex - FF FF FF FF

Meter Modbus Address 9533

The Current Alarm Status is a 4-byte string that resides at **Modbus address 9533.**

1st byte	2nd byte	3rd byte	4th byte	
01	00	00	00	Meter Down
02	00	00	00	Meter Density Out of Range
04	00	00	00	Net Flowrate High(Gross Flowrate High if AGA7/AGA9 is selected)
08	00	00	00	Net Flowrate Low (Gross Flowrate Low if AGA7/AGA9 is selected)

Other Alarms (Modbus Address 9531)

4 Bytes in Hex - FF FF FF FF

00	80	00	00	Calibration Mode ON
00	40	00	00	Event Status ON
00	00	01	00	Multi.Var.DP High
00	00	02	00	Multi.Var.DP Low
00	00	04	00	Multi.Var.Pressure High
00	00	08	00	Multi.Var.Pressure Low
00	00	10	00	Multi.Var.Temperature High
00	00	20	00	Multi.Var.Temperature Low
00	00	40	00	Analog Output Overrange

Data Packet

Previous Hourly Data Packet (101-407)

Hourly archive flow data 101, 102, .. 406, 407 are fixed length arrays. The data field is used to address an 5 hours individual group record.(101=Latest, 407=Oldest) (available only for version 6.03 or above)

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	F0	00	01..		

Response Data Message

DESCRIPTION	**DECIMAL**	**HOUR**
Date	0 Inferred	First Hour
Alarm Status/Hour(16 Bits)	0 Inferred	First Hour
Flowing Time	1 Inferred	First Hour
Gross Total	1 Inferred	First Hour
Net Total	1 Inferred	First Hour
Mass Total	1 Inferred	First Hour
Energy Total	1 Inferred	First Hour
Temperature	1 Inferred	First Hour
Pressure	1 Inferred	First Hour
DP	4 Inferred	First Hour
DP/EXT	4 Inferred	First Hour
SG	6 Inferred	First Hour
Date	0 Inferred	Second Hour
Alarm Status/ Hour (16 Bits)	0 Inferred	Second Hour
Flowing Time	1 Inferred	Second Hour
Gross Total	1 Inferred	Second Hour
Net Total	1 Inferred	Second Hour
Mass Total	1 Inferred	Second Hour
Energy Total	1 Inferred	Second Hour
Temperature	1 Inferred	Second Hour
Pressure	1 Inferred	Second Hour
DP	4 Inferred	Second Hour
DP/EXT	4 Inferred	Second Hour
SG	6 Inferred	Second Hour

DATA PACKET

Response Data Message

DESCRIPTION	DECIMAL	HOUR
Date	0 Inferred	Third Hour
Alarm Status/ Hour (16 Bits)	0 Inferred	Third Hour
Flowing Time	1 Inferred	Third Hour
Gross Total	1 Inferred	Third Hour
Net Total	1 Inferred	Third Hour
Mass Total	1 Inferred	Third Hour
Energy Total	1 Inferred	Third Hour
Temperature	1 Inferred	Third Hour
Pressure	1 Inferred	Third Hour
DP	4 Inferred	Third Hour
DP/EXT	4 Inferred	Third Hour
SG	6 Inferred	Third Hour
Date	0 Inferred	Fourth Hour
Alarm Status/ Hour (16 Bits)	0 Inferred	Fourth Hour
Flowing Time	1 Inferred	Fourth Hour
Gross Total	1 Inferred	Fourth Hour
Net Total	1 Inferred	Fourth Hour
Mass Total	1 Inferred	Fourth Hour
Energy Total	1 Inferred	Fourth Hour
Temperature	1 Inferred	Fourth Hour
Pressure	1 Inferred	Fourth Hour
DP	4 Inferred	Fourth Hour
DP/EXT	4 Inferred	Fourth Hour
SG	6 Inferred	Fourth Hour
Date	0 Inferred	Fifth Hour
Alarm Status/ Hour (16 Bits)	0 Inferred	Fifth Hour
Flowing Time	1 Inferred	Fifth Hour
Gross Total	1 Inferred	Fifth Hour
Net Total	1 Inferred	Fifth Hour
Mass Total	1 Inferred	Fifth Hour
Energy Total	1 Inferred	Fifth Hour
Temperature	1 Inferred	Fifth Hour
Pressure	1 Inferred	Fifth Hour
DP	4 Inferred	Fifth Hour
DP/EXT	4 Inferred	Fifth Hour
SG	6 Inferred	Fifth Hour

***Note: Alarm Status**

Bit 0	0 – Live DP 1 – DP maintenance value.
Bit 1	0 – Live Pressure 1 – Pressure maintenance or override value
Bit 2	0 – Live Temperature 1 – Temperature maintenance or override value

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

Previous Hourly 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

Previous Hourly 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

Previous Hourly 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	

Number	Hour
386	1426-1430
387	1431-1435
388	1436-1440
389	1441-1445
390	1446-1450
391	1451-1455
392	1456-1460
393	1461-1465
394	1466-1470
395	1471-1475
396	1476-1480
397	1481-1485
398	1486-1490
399	1491-1495
400	1496-1500

Number	Hour
401	1501-1505
402	1506-1510
403	1511-1515
404	1516-1520
405	1521-1525
406	1526-1530
407	1531-1535

DATA PACKET

Previous Daily Data Packet (601)

Daily archive flow data 601 is a fixed length array. The data field is used to address an 1day (24 hours) individual group record.(1=Latest, 64=Oldest) (available only for version 6.0.7 or above)

RTU MODE -

ADDR	FUNC CODE	STARTING POINT		# OF POINTS		CRC CHECK	
		HI	LO	HI	LO		
01	03	02	59	00	01		

Response

ADDR	FUNC CODE	BYTE COUNTS	DATA …(Repeat n Times)		CRC CHECK	
			HI	LO		
01	03	F7	00	01..		

Response Data Message

DESCRIPTION	**DECIMAL**
Date and Day Start Hour (4 Bytes)	0 Inferred
1st Hour Variable #1 (4 Bytes)	0 Inferred
1st Hour Variable #2 (4 Bytes)	0 Inferred
1st Hour Variable #3 (2 Bytes)	0 Inferred
2nd Hour Variable #1 (4 Bytes)	0 Inferred
2nd Hour Variable #2 (4 Bytes)	0 Inferred
2nd Hour Variable #3 (2 Bytes)	0 Inferred
3rd Hour Variable #1 (4 Bytes)	0 Inferred
3rd Hour Variable #2 (4 Bytes)	0 Inferred
3rd Hour Variable #3 (2 Bytes)	0 Inferred
4th Hour Variable #1 (4 Bytes)	0 Inferred
4th Hour Variable #2 (4 Bytes)	0 Inferred
4th Hour Variable #3 (2 Bytes)	0 Inferred
5th Hour Variable #1 (4 Bytes)	0 Inferred
5th Hour Variable #2 (4 Bytes)	0 Inferred
5th Hour Variable #3 (2 Bytes)	0 Inferred
…	
…	
…	
24th Hour Variable #1 (4 Bytes)	0 Inferred
24th Hour Variable #2 (4 Bytes)	0 Inferred
24th Hour Variable #3 (2 Bytes)	0 Inferred

DATA PACKET

Description of Daily Data Packet

Date and Day Start Hour (32 Bits)

24 Bits	8 Bits
Date (MM/DD/YY)	Day Start Hour

Variable#1 (32 Bits)

8 Bits	16 Bits	8 Bits
Flow Time in Hour (2 Decimal Inferred)	Net Total (1 Decimal Inferred)	DP (1st Part)

Variable#2 (32 Bits)

4 Bits (2nd Part DP)	12 Bits	12 Bits	4 Bits
DP (1 Decimal Inferred)	Temperature (1 Decimal)	Pressure (0 Decimal)	DP/Ext (1st Part)

Variable#3 (16 Bits)

16 Bits (2nd Part DP)
DP/EXT (2 Decimal Inferred)

Description of Daily Data Packet - AGA7/AGA9 Data Format

Date and Day Start Hour (32 Bits)

24 Bits	8 Bits
Date (MM/DD/YY)	Day Start Hour

Variable#1 (32 Bits)

8 Bits	16 Bits	8 Bits
Flow Time in Hour (2 Decimal Inferred)	Net Total (1 Decimal Inferred)	DP (1st Part)

Variable#2 (32 Bits)

4 Bits (2nd Part DP)	12 Bits	12 Bits	4 Bits
DP (1 Decimal Inferred)	Temperature (1 Decimal)	Pressure (0 Decimal)	Gross Total

Variable#3 (16 Bits)

16 Bits (2nd Part Gross)
Gross Total (1 Decimal Inferred)

DATA PACKET

Previous Month Data Packet (411,421)

Monthly archive flow data 411-and 421 are fixed length arrays. The data field is used to address month configuration and month totals record.(411=Lastest, 421=Oldest) (available only for version 6.03 or above)

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	E4	00	01..		

DESCRIPTION	**DECIMAL**
Base SG	6 Inferred
N2	4 Inferred
CO2	4 Inferred
Heating Value	3 Inferred
Pipe ID	4 Inferred
Orifice ID	4 Inferred
Base Temperature	2 Inferred
Base Pressure…	4 Inferred
Atmospheric Pressure…	4 Inferred
DP Cut Off…	4 Inferred
Flowing Time	1 Inferred
Month Total – Net	1 Inferred
Month Total – Energy	1 Inferred
Month Averaged Temperature	2 Inferred
Month Average Pressure	2 Inferred
Month Average DP	4 Inferred
Month Average DP/EXT	4 Inferred
Configuration Flag	0 Inferred
Date	0 Inferred
Month	0 Inferred
Year	0 Inferred
Reserved	0 Inferred

DATA PACKET

Previous Month Data Packet (412-414,422-424)

Monthly archive flow data 412-414, .422-424 are fixed length arrays. The data field is used to address an 8 days individual group record. (available only for version 6.03 or above)

Number	Day
412	**1-8**
413	**9-16**
414	**17-24**

Number	Day
422	**1-8**
423	**9-16**
424	**17-24**

DESCRIPTION	DECIMAL	Days
Index	0 Inferred	
Flowing Time	1 Inferred	First Day
Net	1 Inferred	First Day
Energy	1 Inferred	First Day
Temperature	2 Inferred	First Day
Pressure	2 Inferred	First Day
DP	4 Inferred	First Day
DP/EXT	4 Inferred	First Day
…	…	…
…	…	…
…	…	…
Flowing Time	1 Inferred	Eighth Day
Net	1 Inferred	Eighth Day
Energy	1 Inferred	Eighth Day
Temperature	2 Inferred	Eighth Day
Pressure	2 Inferred	Eighth Day
DP	4 Inferred	Eighth Day
DP/EXT	4 Inferred	Eighth Day

DATA PACKET

Previous Month Data Packet (415, 425)

Monthly archive flow data 415, .425 are fixed length arrays. The data field is used to address an 7 days individual group record. (available only for version 6.03 or above)

Number	Day
415	25-31

Number	Day
425	25-31

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	C8	00	01..		

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.

DFM ENRON MODBUS

Hourly and Daily archive flow data 701, 703, 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 Average Gas Quality
703	Archive	Daily Flow Data Log
704	Archive	Hourly Flow Data Log

DFM 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 ECHART can store up to 64 day's data. The daily pointer will be 1 through 64. The pointer will roll over at 64 to 1.

701	**Date**
	Time
	Average Heating Value
	Average Real Specific Gravity
	Average Carbon Dioxide Percent
	Average Nitrogen Percent
	Average Methane Percent
	Average Ethane Percent
	Average Propane Percent
	Average Iso-Butane Percent
	Average n-Butane Percent
	Average Iso-Pentane Percent
	Average n-Pentane Percent
	Average Hexane Percent
	Average Heptane Percent
	Average Nonane Percent
	Average Octane Percent
	Average H2S Percent
	Average Hydrogen Percent
	Average Helium Percent
	Average Oxygen Percent
	Average Carbon Monoxide Percent

DFM ENRON MODBUS

Example Modbus* Daily Average Gas Quality Data *Collection

Query - 7098 Daily Pointer

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

ECHART 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		

ECHART Response–Record 1: yesterday data.

Address	Func	Bytes	Data	CRC	
01	03	58	46ff7e00 0000000 447a0000 3f19999a 00000000 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
		Average Heating Value	1000.0
		Average Real Specific Gravity	0.6
		Average Carbon Dioxide Percent	0.0
		Average Nitrogen Percent	10.0
		Average Methane Percent	90.0
		Average Ethane Percent	0.0
		Average Propane Percent	0.0
		Average Iso-Butane Percent	0.0
		Average n-Butane Percent	0.0
		Average Iso-Pentane Percent	0.0
		Average n-Pentane Percent	0.0
		Average Hexane Percent	0.0
		Average Heptane Percent	0.0
		Average Nonane Percent	0.0
		Average Octane Percent	0.0
		Average H2S Percent	0.0
		Average Hydrogen Percent	0.0
		Average Helium Percent	0.0
		Average Oxygen Percent	0.0
		Average Carbon Monoxide Percent	0.0

DFM ENRON MODBUS

ARCHIVE 703 - PREVIOUS DAILY FLOW DATA LOG

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 ECHART can store up to 64 day's data. The daily pointer will be 1 through 64. (The pointer will roll over at 64 to 1).

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

DFM ENRON MODBUS

Example Modbus Previous Daily Flow Data Collection

Query - 7098 Daily Pointer

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

ECHART 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		

ECHART Response–Record 3:yesterday data

Address	Func	Bytes	Data	CRC	
01	03	2c	46ff7e00 0000000 44aaf000 43fa0000 428c0000 44772d8b 470c29ca 44cc2d26 470c29ca 42c80000 43577268	C8	52

Archive	**Record**	**Description**	**Value**
703	1	Date	3/27/03
		Time	00:00:00
		Flow Time (Minutes)	1367.5
		Average Pressure	500.0
		Average Temperature	70.0
		Gross Total	988.71
		Net Total	35881.78
		Mass Total	1633.411
		Energy	35881.78
		Average DP	100.0
		Average DP/EXT	215.45

DFM ENRON MODBUS

ARCHIVE 704 – PREVIOUS HOURLY FLOW DATA LOG

One Modbus register (7099 -floating point) is used to indicate the current *hourly record pointer numbers*. This pointer identifies the current record which data was last logged. The ECHART can store up to 1536 hour's data. The hourly pointer will be 1 through 1536. (The pointer will roll over at 1536 to 1).

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

DFM ENRON MODBUS

Example Modbus Previous Hour Flow Data Collection

Query - 7099 Hourly Pointer

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

ECHART 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		

ECHART Response–Record 1:the last hour data

Address	Func	Bytes	Data	CRC	
01	03	2c	46ff7e00 48609c00 423e1111 42840000 43fa0000 42096b52 449bd99a 42630674 449bd99a 42c80000 4333aaee	fd	7a

Archive	**Record**	**Description**	**Value**
704	1	Date	3/27/03
		Time	23:00:00
		Flow Time (Minutes)	47.51
		Average Pressure	500.0
		Average Temperature	70.0
		Gross Total	34.555
		Net Total	1246.8
		Mass Total	56.75
		Energy	1246.8
		Average DP	100.0
		Average DP/EXT	179.668

DFM 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	

DFM 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)

DFM 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 ECHART 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 ECHARTs event buffer is empty of all events that occurred since last collection.

7100= Event/Alarm Pointer

DFM 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 ECHART 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 ECHART device returns the same message it received.

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

DFM ENRON MODBUS

Example Modbus Alarm/Event Log Data Collection

To request the ECHART 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 ECHART. The ECHART 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 ECHART 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 ECHART 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 ECHART response message would contain zero data bytes. This would also indicate to the master that the event Modbus event 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 5: 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.

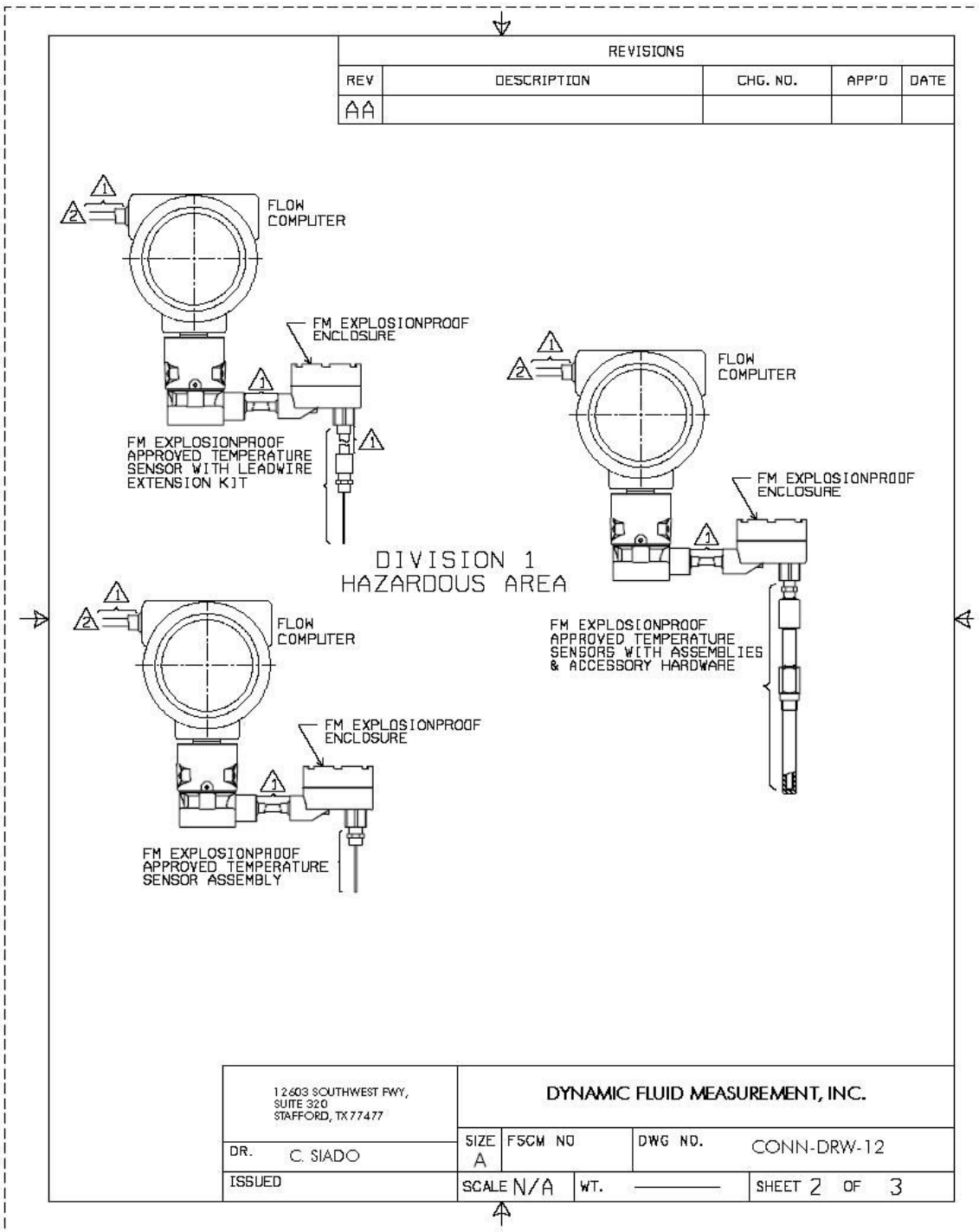
4. COMPONENTS REQUIRED TO BE APPROVED MUST BE FOR GAS GROUP APPROPIATE TO AREA CLASSIFICATION.

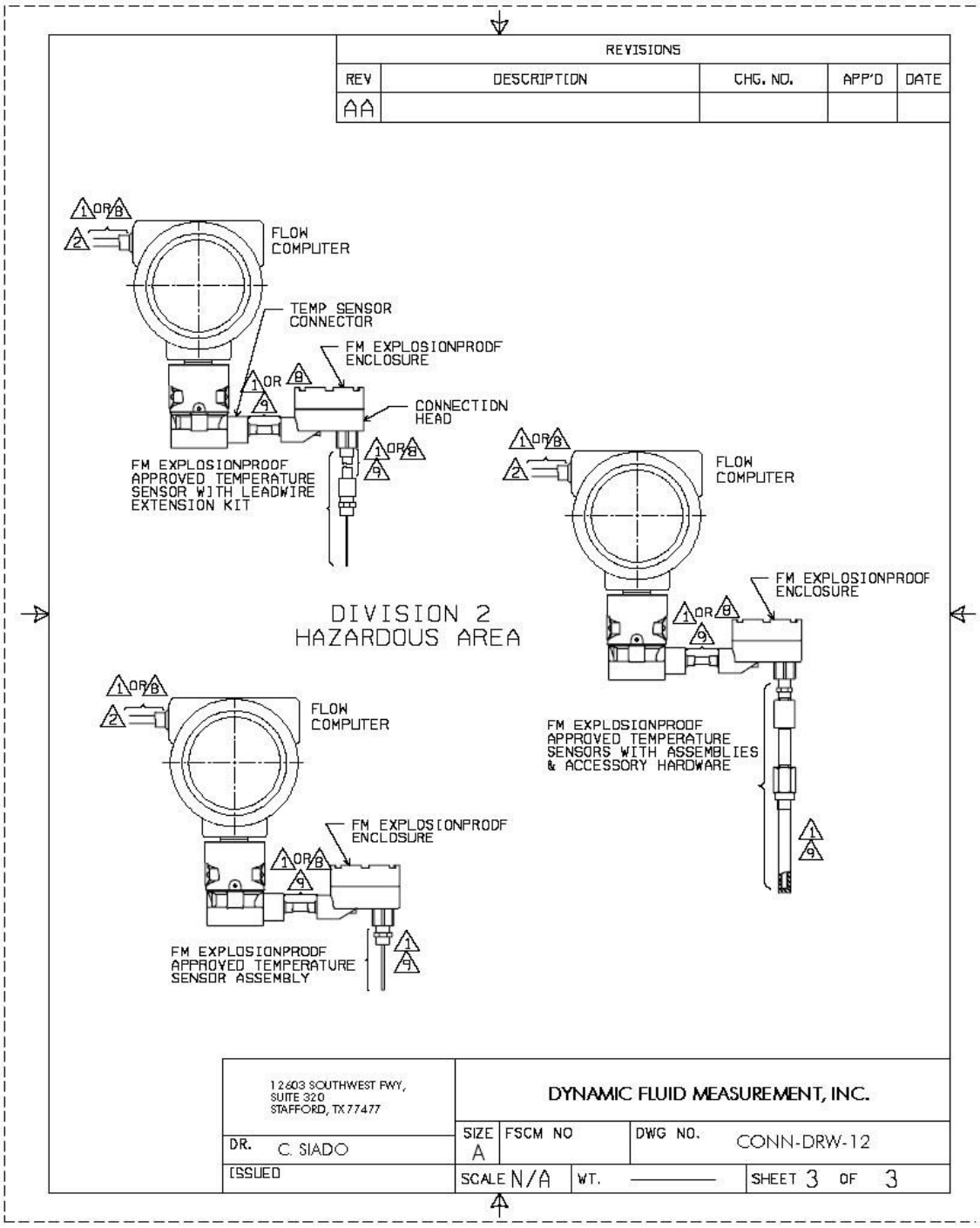
3. ALL CONDUITS THREADS TO BE ASSEMBLED WITH FIVE FULL THREADS MINIMUM.

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

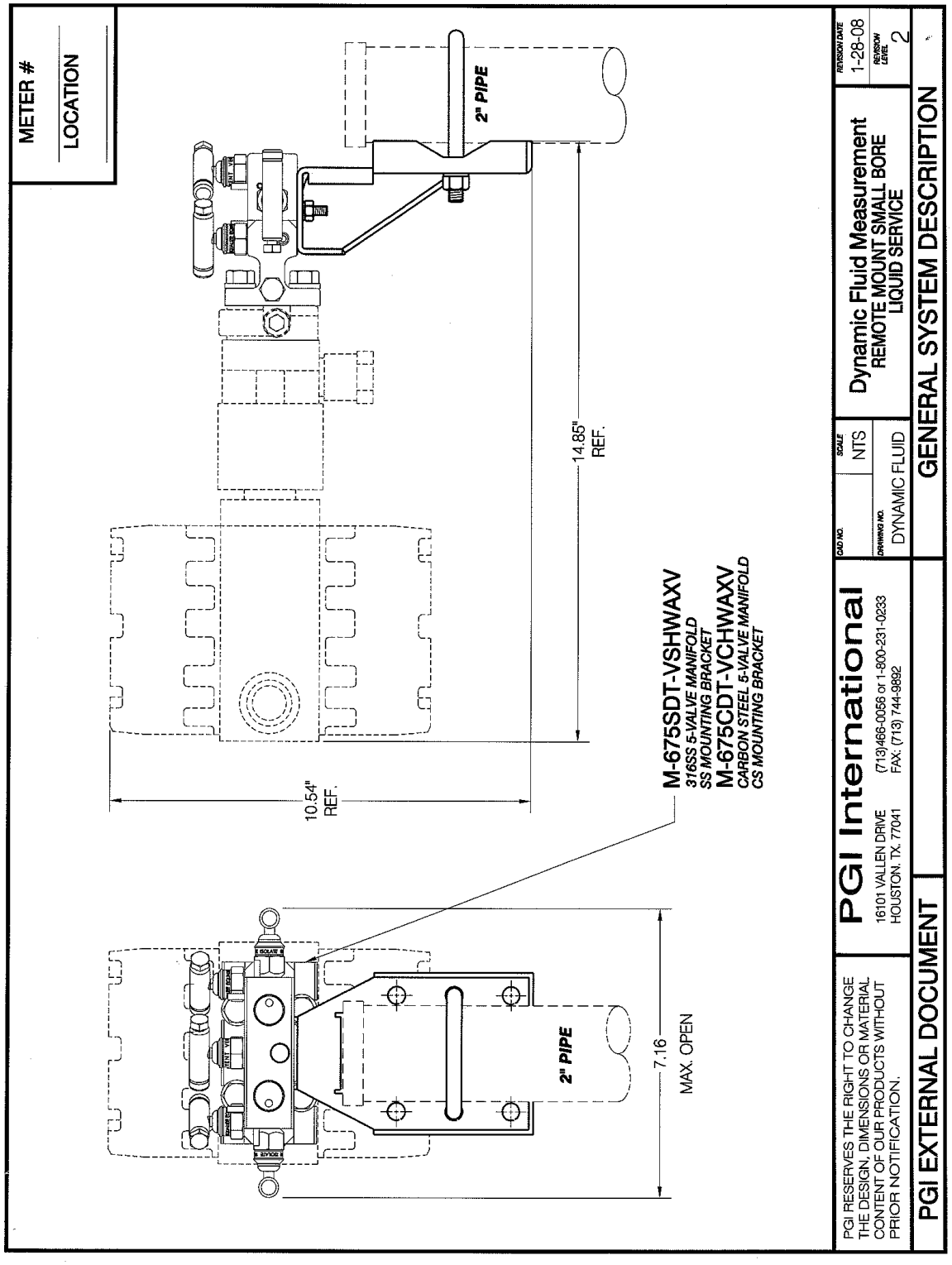
1. WIRING METHOD SUITABLE FOR CLASS I, DIV 1, ANY LENGTH.

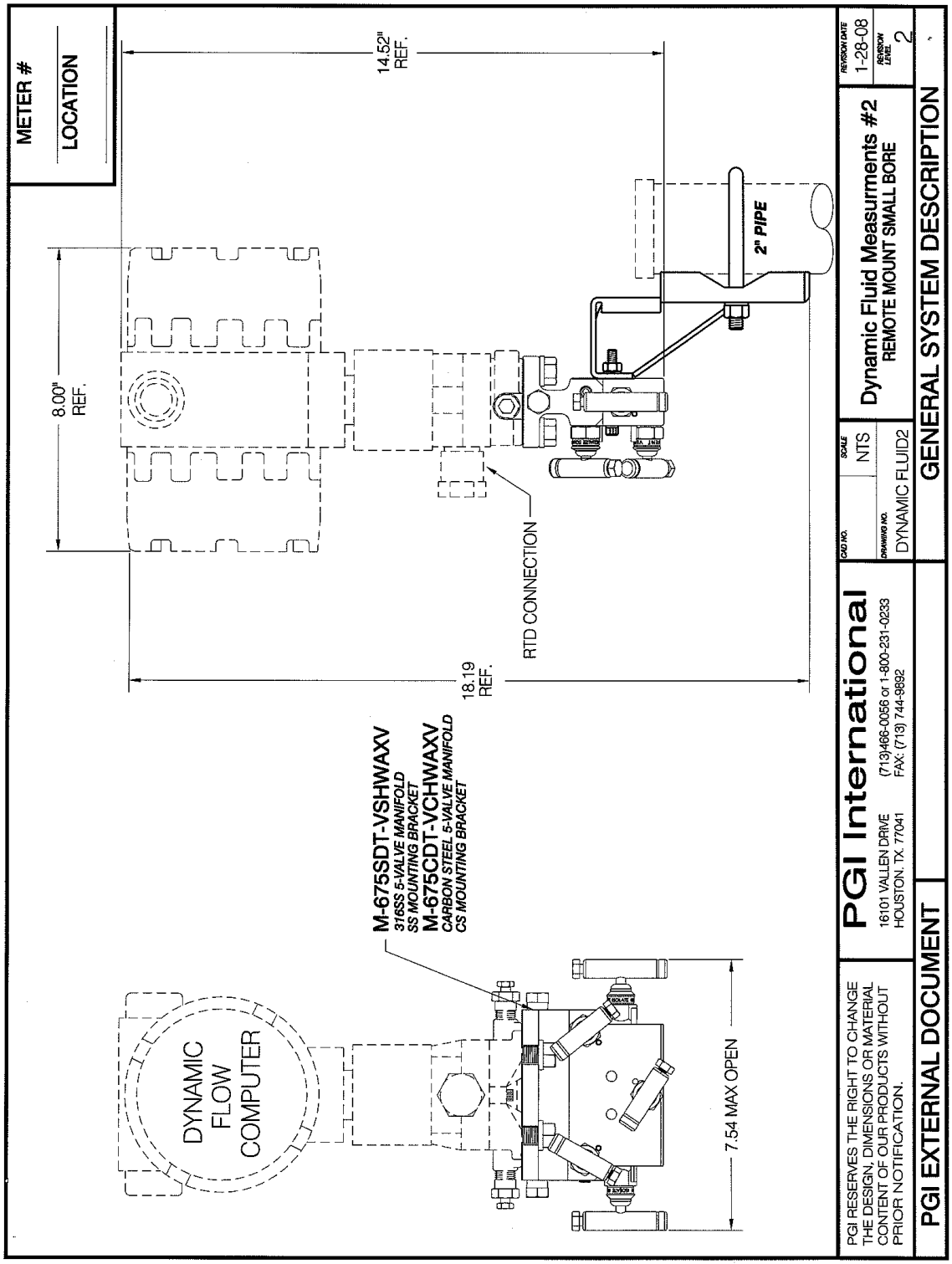
UNLESS OTHERWISE SPECIFIED DIMENSIONS IN INCHES [mm]. REMOVE ALL BURRS AND SHARP EDGES. MACHINE SURFACE FINISH 125	CONTRACT NO.	DYNAMIC FLUID MEASUREMENT, INC.	12603 SOUTHWEST FWY, SUITE 320 STAFFORD, TX 77477
	DR. C. SIADO	TITLE	MODEL MICROMV AND ECHART EXPLOSIONPROOF INSTALLATION DRAWING, FACTORY MUTUAL
-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

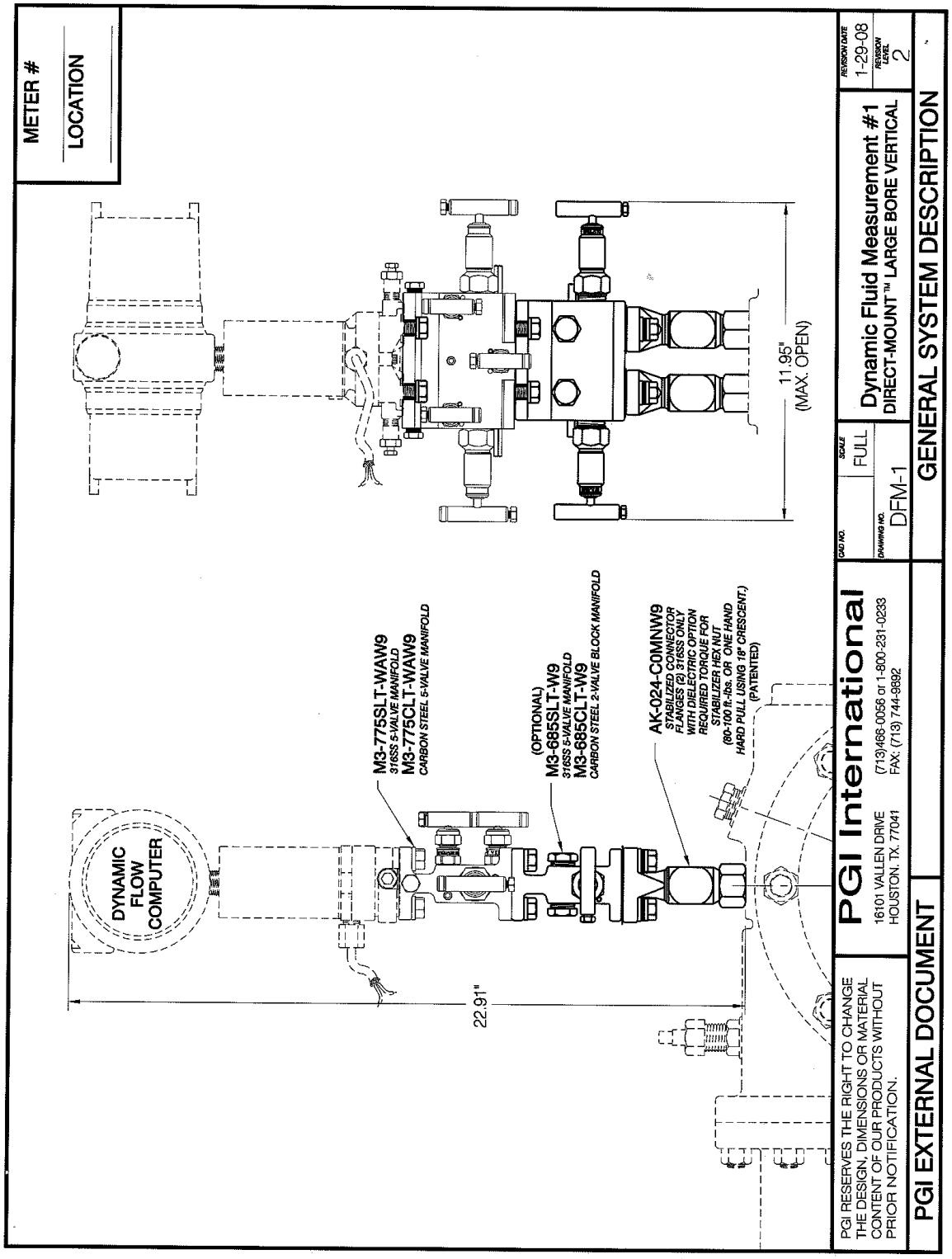

REVISIONS
REV
DESCRIPTION
CHG. NO.
APP'D
DATE
AA
FLOW COMPUTER
FM EXPLOSIONPROOF ENCLOSURE
FM EXPLOSIONPROOF APPROVED TEMPERATURE SENSOR WITH LEADWIRE EXTENSION KIT
DIVISION 1 HAZARDOUS AREA
FLOW COMPUTER
FM EXPLOSIONPROOF ENCLOSURE
FM EXPLOSIONPROOF APPROVED TEMPERATURE SENSORS WITH ASSEMBLIES & ACCESSORY 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

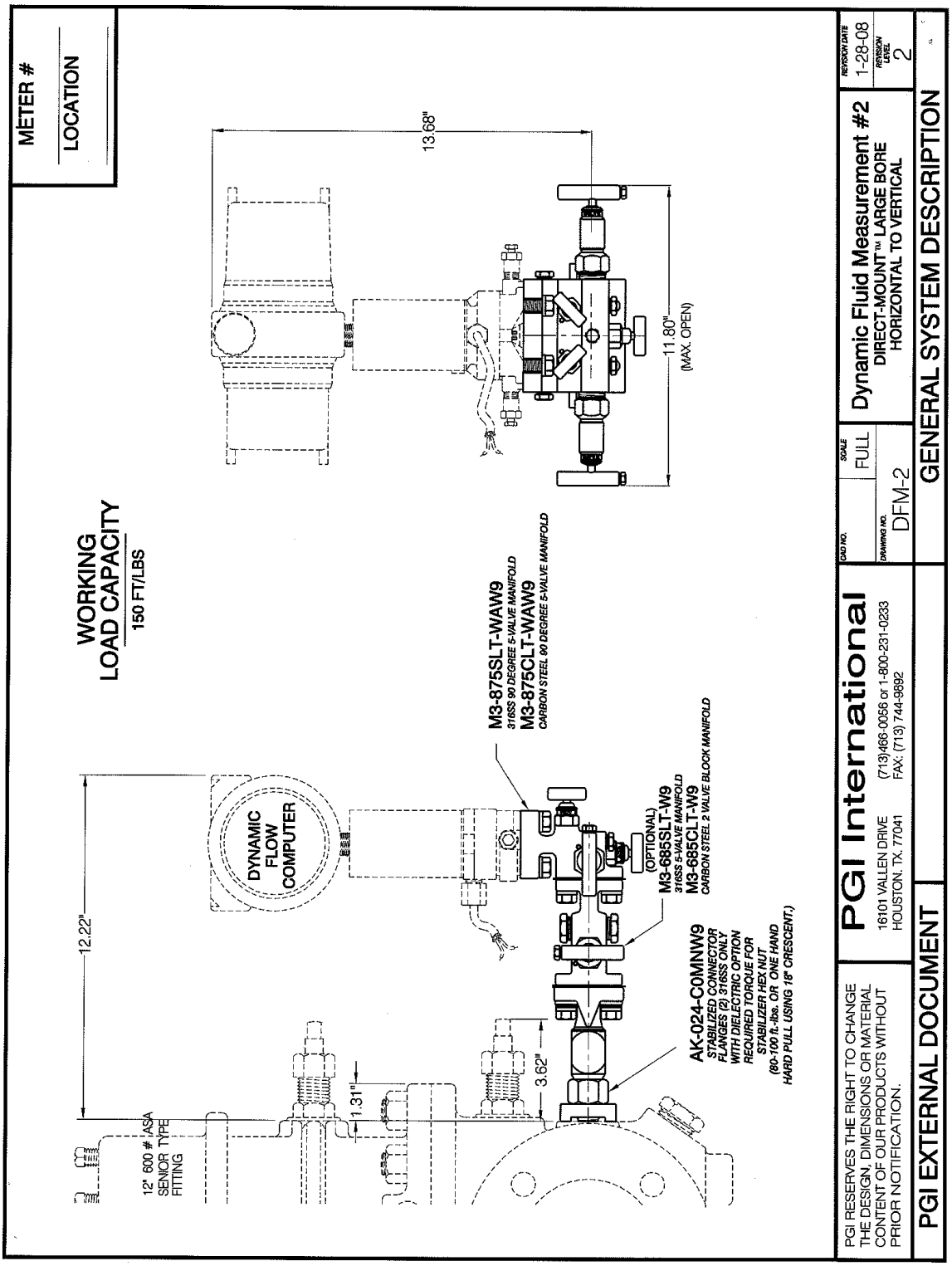

REVISIONS
REV
DESCRIPTION
CHG. NO.
APP'D
DATE
AA
FLOW COMPUTER
TEMP SENSOR CONNECTOR
FM EXPLOSIONPRODF ENCLOSURE
CONNECTION HEAD
FM EXPLOSIONPRODF APPROVED TEMPERATURE SENSOR WITH LEADWIRE EXTENSION KIT
DIVISION 2 HAZARDOUS AREA
FLOW COMPUTER
FM EXPLOSIONPRODF ENCLOSURE
FM EXPLOSIONPRODF APPROVED TEMPERATURE SENSORS WITH ASSEMBLIES & ACCESSORY HARDWARE
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"
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.)
3.62"
1.31"
12" 600 # ASA
SENIOR TYPE
FITTING
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

Appendix A: Radio Board Manual

Introduction

Our Radio Interface board with battery charger was designed after careful listening to our customers in all sectors of the oil and gas industry. It was built to address the different wireless connection 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 this interface board, with all its multiple wireless modules has delivered and met the design intentions.

The product combines the following features:

- **Simple and Reliable**
- **Flexible and able to use either 900Mhz, 2.4Ghz, GSM, CDMA and WiFi Modules**
- **Easy to understand and configure**
- **Rugged and designed to industrial specifications**
- **Economical to install and maintain**

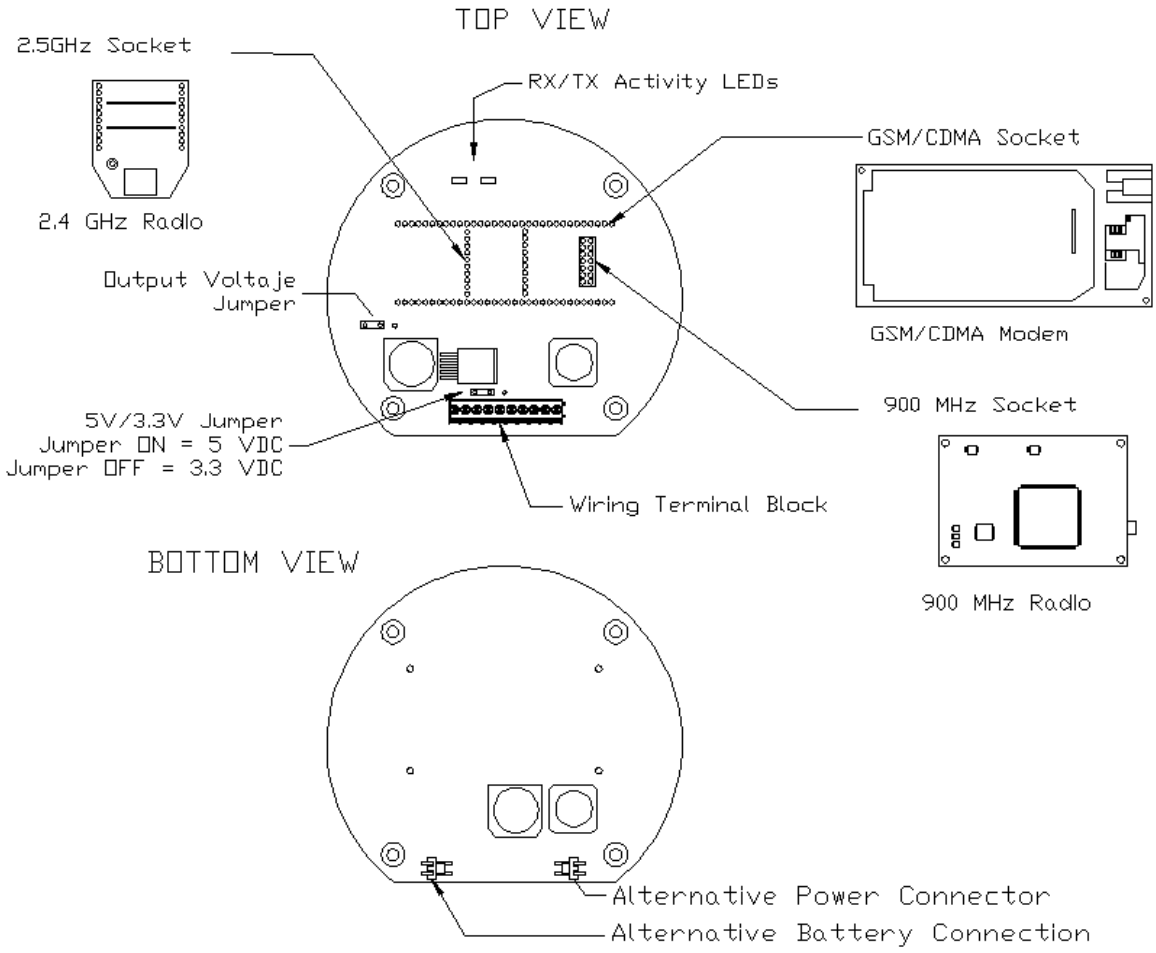
We hope that your experience with our products will be a simple pleasant experience, not intimidating in any way.

The Radio interface board can handle three different socket modules.

- A 900 MHz radio module for long distance radio links.
- A 2.4 GHz radio module ideal for short range radio links.
- A socket modem that can be either GSM or CDMA. Ideal to access remote locations using existing cellular network infrastructure. The modem can be also Wi-Fi which can take advantage of existing wireless networks.

In addition the board provides power to external devices which allow the user to connect other radios. It also has a shutdown input to turn the radio On/Off to improve power management on top of the smart battery charger included on the board to extend the life of the battery pack and take advantage of the power coming from external supplies.

Overview

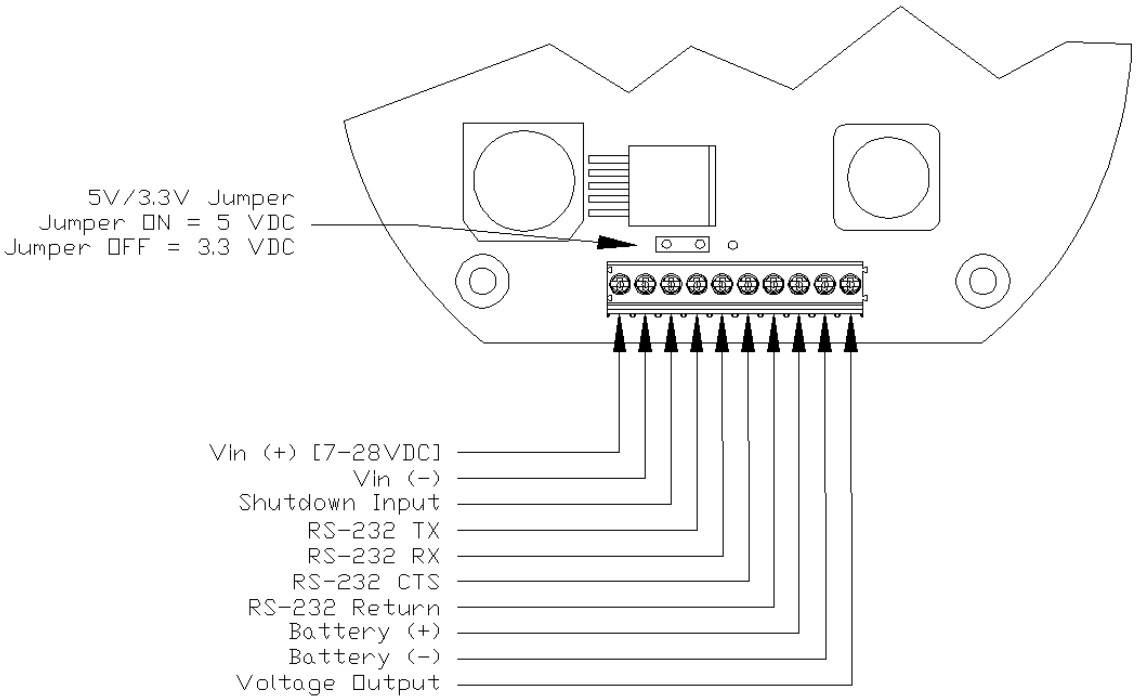

TOP VIEW
2.5GHz Socket
2.4 GHz Radio
RX/TX Activity LEDs
GSM/CDMA Socket
GSM/CDMA Modem
Output Voltaje Jumper
5V/3.3V Jumper
Jumper ON = 5 VDC
Jumper OFF = 3.3 VDC
900 MHz Socket
900 MHz Radio
Wiring Terminal Block
BOTTOM VIEW
Alternative Power Connector
Alternative Battery Connection

Technical Data

CHARGER	
VOLTAGE INPUT	7-28 VDC
DROPOUT VOLTAGE	0.5 VOLTS
PROTECTION	Automatic Disconnect below -20°C
OUTPUT	Up to 4A
TARGET CHARGE	12.6V
GSM/CDMA MODULE	
POWER SUPPLY MAX. CURRENT CONSUMPTION SERIAL INTERFACE	5 VDC 770 mA TTL
900 MHZ RADIO MODULE	
POWER SUPPLY	3 VDC to 5.25 VDC
MAX. CURRENT COMSUMPTION	900 mA
SERIAL INTERFACE	TTL
2.4GHZ RADIO MODULE	
POWER SUPPLY	3.3 VDC
MAX. CURRENT COMSUMPTION	215 mA
SERIAL INTERFACE	TTL
OTHER I/O	
SERIAL INTEFACE	RS-232 INTERFACE
POWER OUTPUT	3.3V, 5V or POWER SUPPLY
SHUT DOWN (POWER SAVE)	OPEN COLLECTOR RADIO SHUT DOWN INPUT AND RTS/CTS SHUT DOWN INPUT.

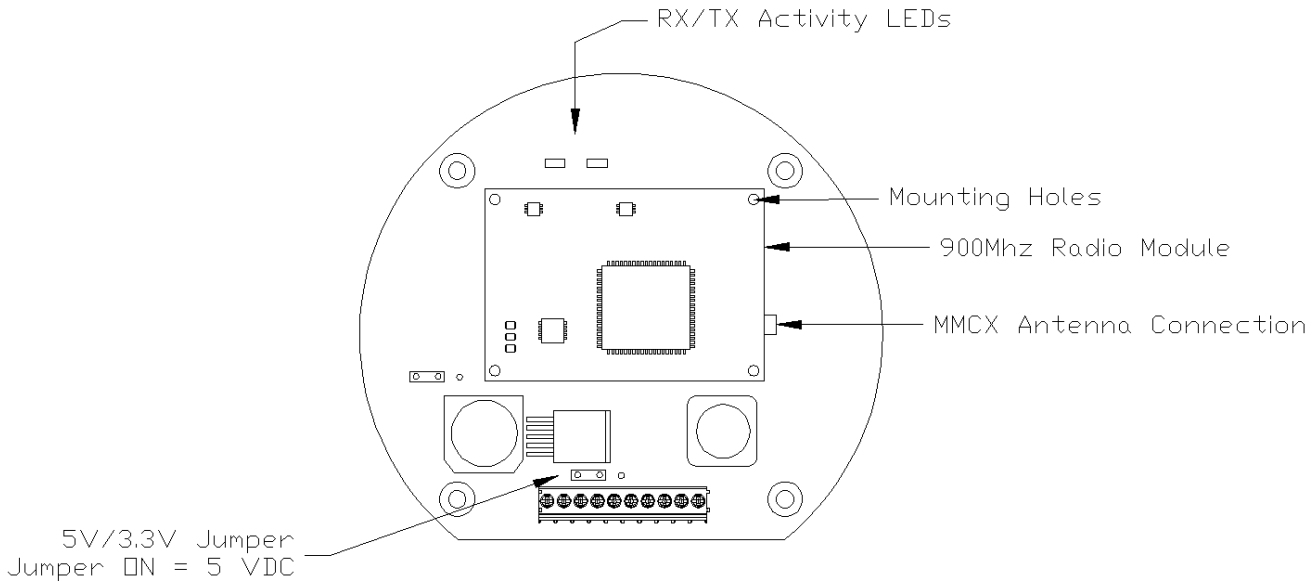
Getting acquainted with the wiring:

Wiring Terminal Block



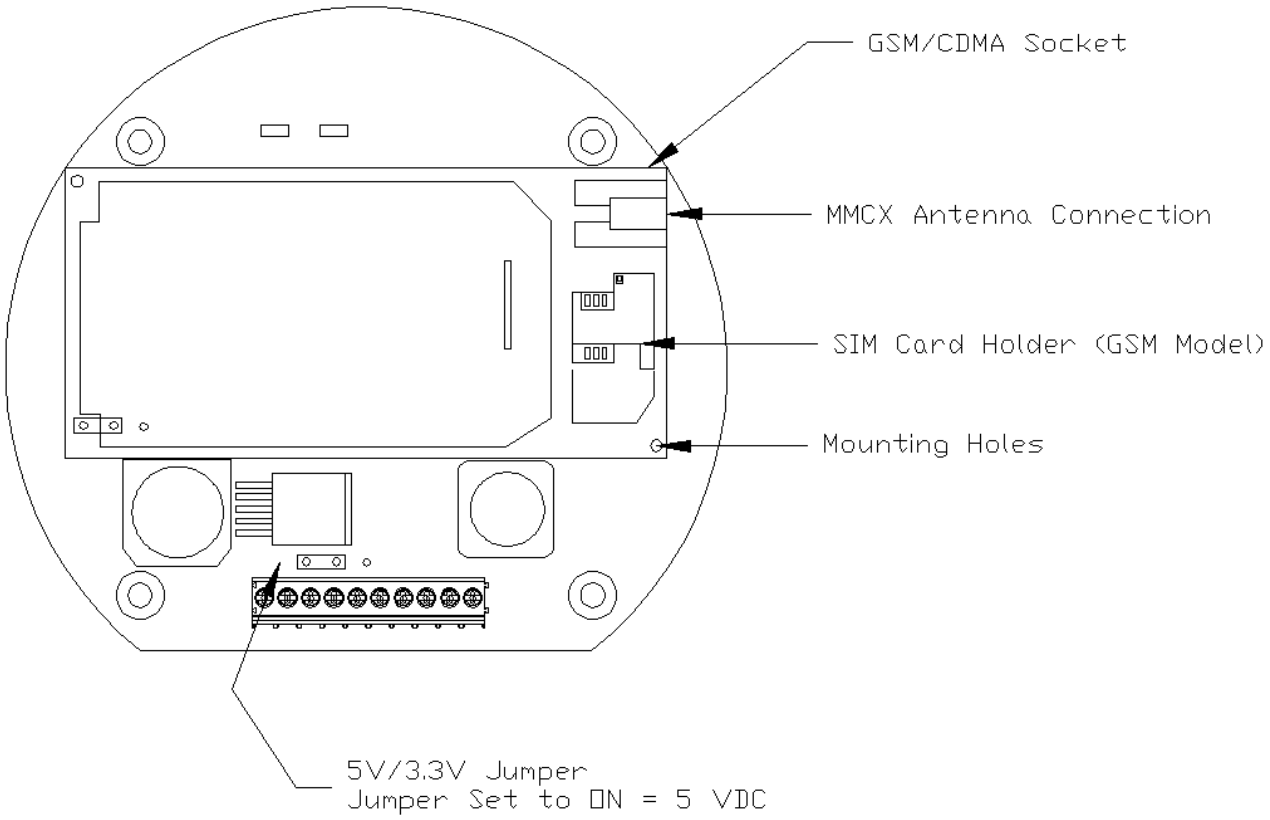
Installation of 900 Mhz Module

- Remove power from the interface board
- Mount stand-offs for radio module
- Mount 900 MHz Radio on the top side of the board on socket U8B
- Fasten module to stand-offs using 440 nuts.
- Place Link on jumper JP1 to provide 5V to the module.
- Connect MMCX coaxial cable for antenna.



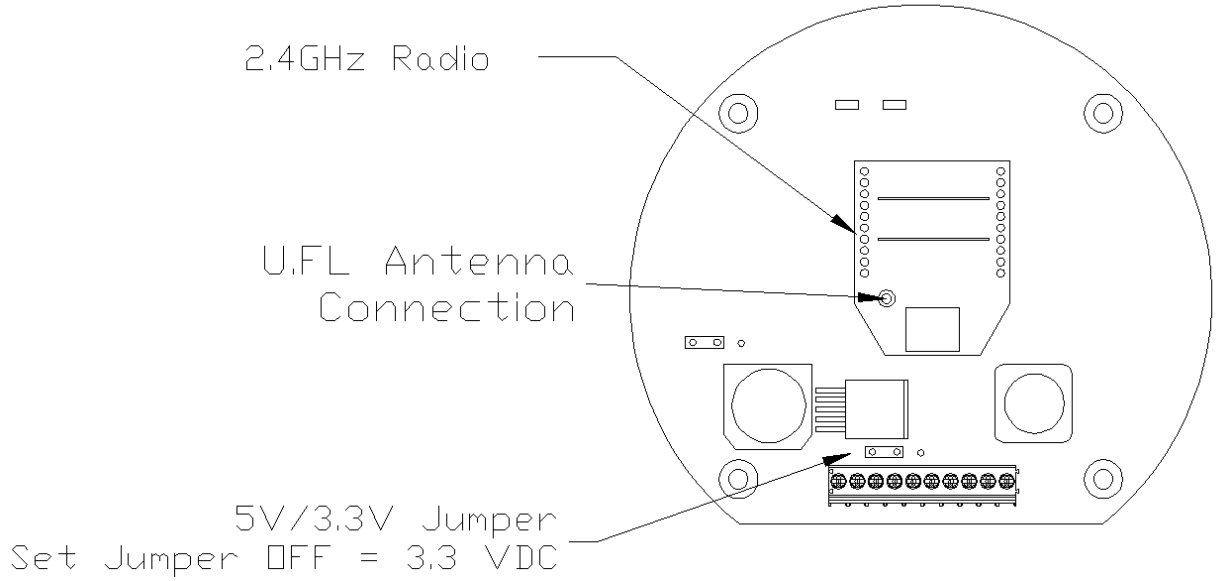
Installation of Socket Modem Module

- Remove power from the interface board
- Mount stand-offs for radio module
- Mount GSM/CDMA Modem on the top side of the board on socket U8A
- Fasten module to stand-offs using 440 nuts.
- Place Link on jumper JP1 to provide 5V to the module.
- Connect MMCX coaxial cable for antenna.



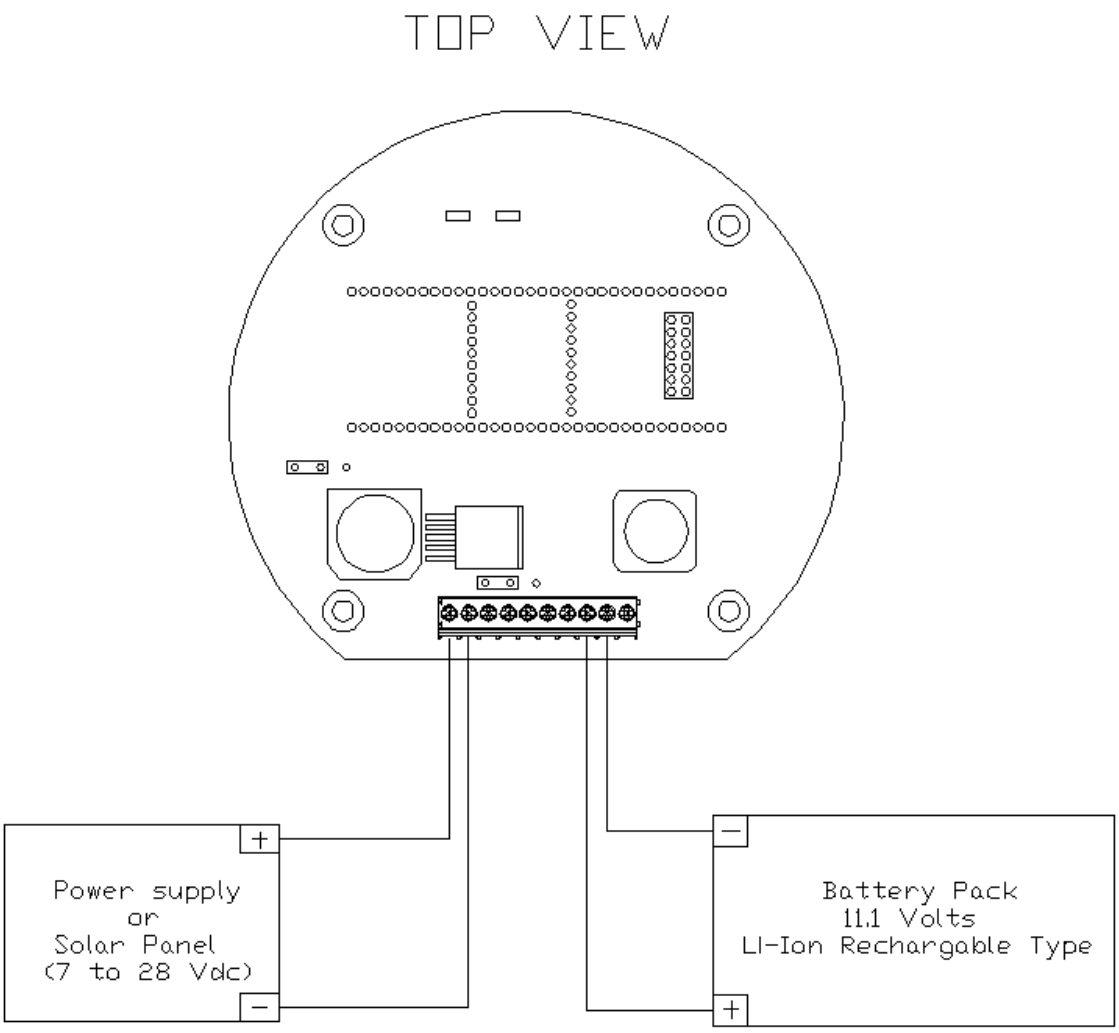
Installation of 2.4 Ghz Module

- Remove power from the interface board
- Mount 2.4GHz Radio on the top side of the board on socket U8C
- Remove Link on jumper JP1 to provide 3.3V to the module.
- Connect U.FL coaxial cable for antenna.



Wiring of Power System

- Power to the unit can be wired either through the 10-pin terminal block or the power and battery plugs located on the back of the board.

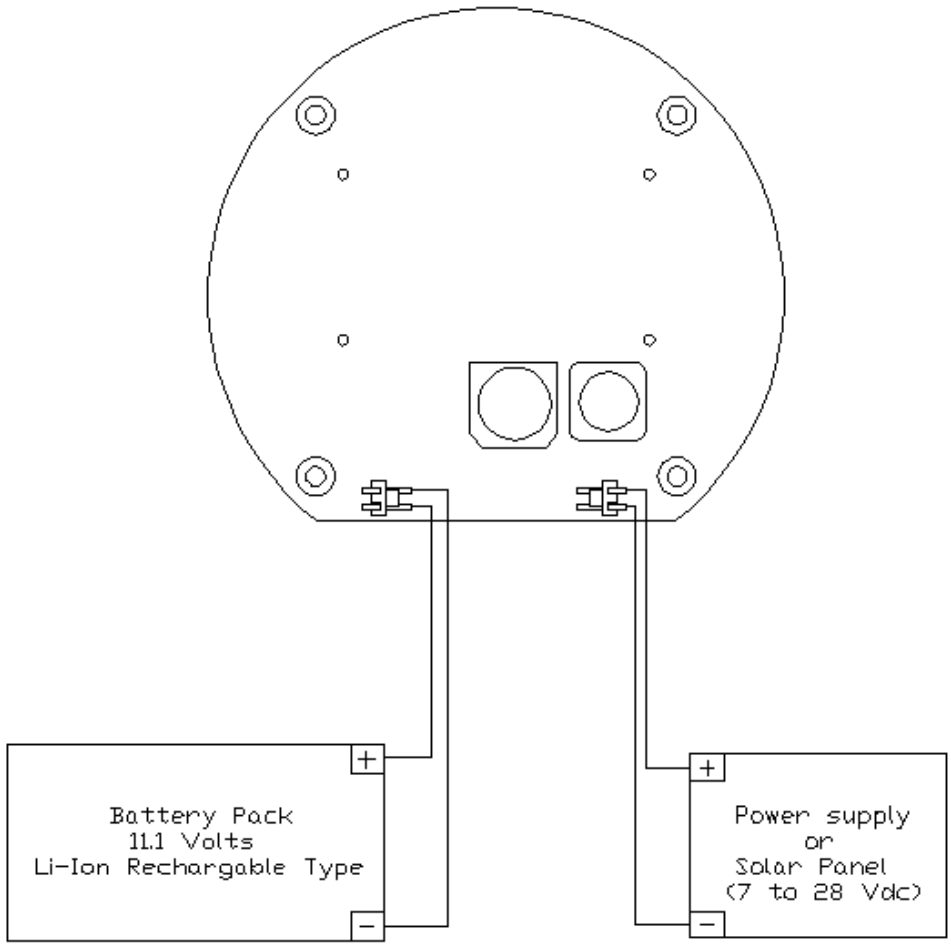


Warning

- Verify Voltage and current ratings before powering the unit.
- Follow all Hazardous Environment guidelines before connecting a live power supply.

BOTTOM VIEW

ALTERNATIVE WIRING USING BOTTOM PLUGS

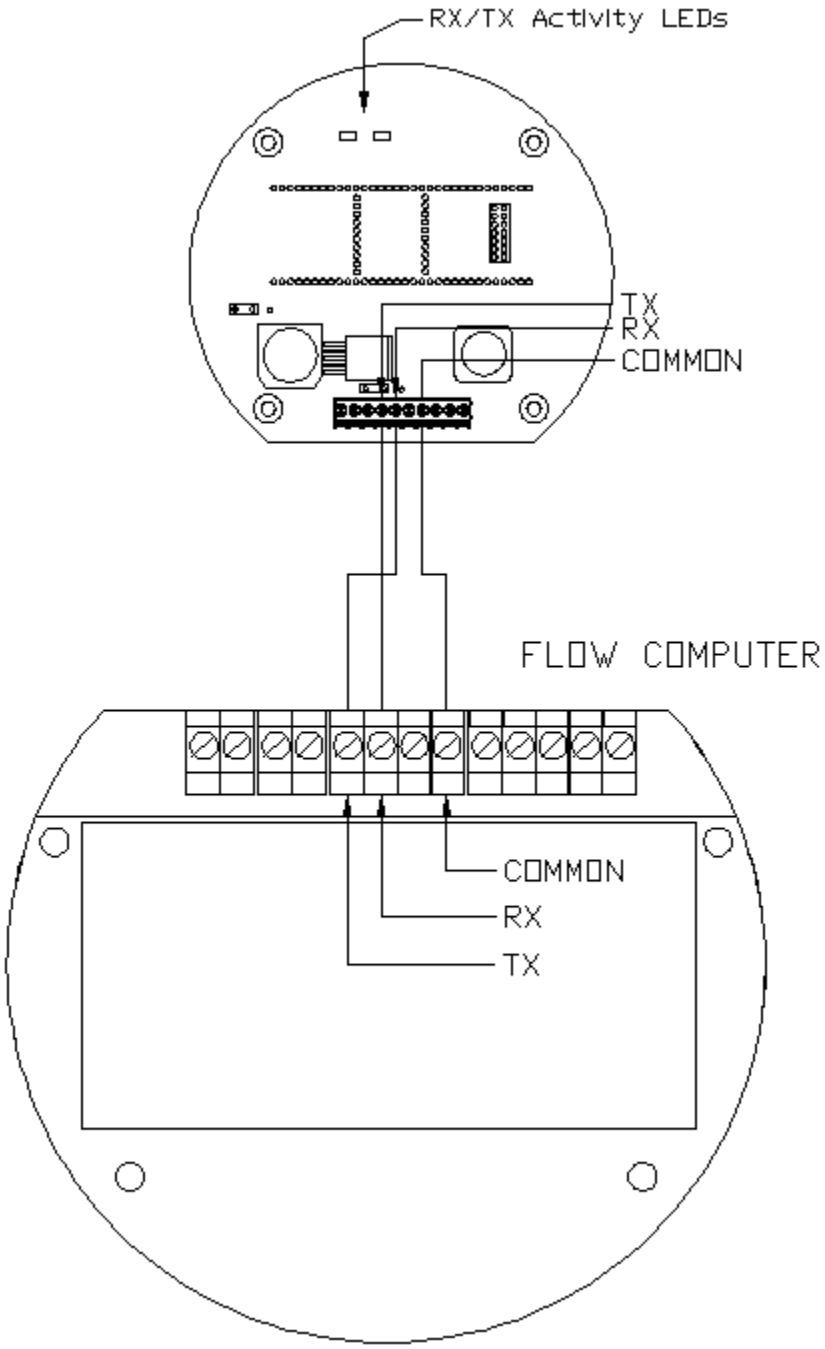


Warning

- Verify Voltage and current ratings before powering the unit.
- Follow all Hazardous Environment guidelines before connecting a live power supply.

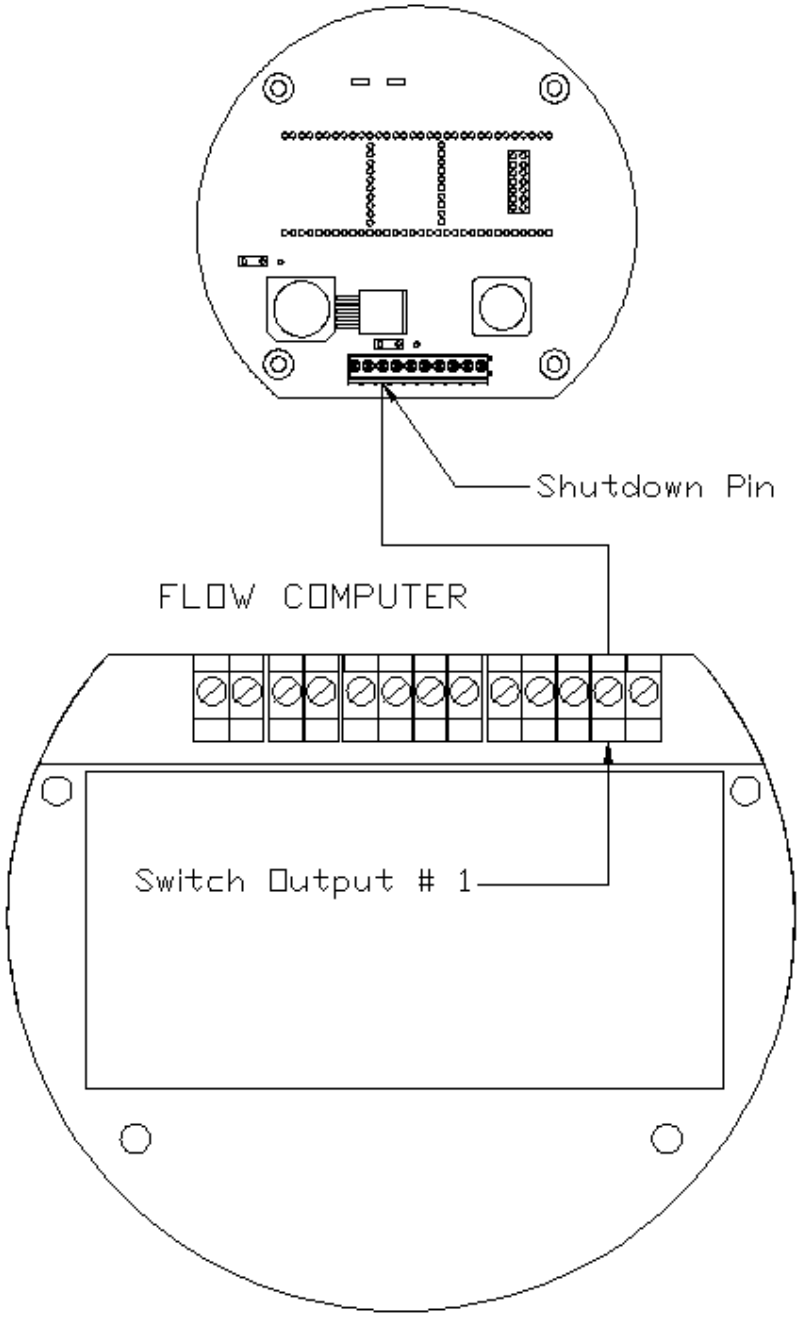
Wiring of RS-232 Interface

- Wire TX Terminal in the flow computer to RX terminal on Radio board (Pin 5).
- Wire RX terminal in the flow computer to TX terminal on Radio board (Pin 4).
- Wire RS-232 Common or Return from flow computer to radio board (Pin 7).
- You can user the RX/TD LEDs to monitor port activity.
- The picture below shows an EChart flow computer pin location as example.



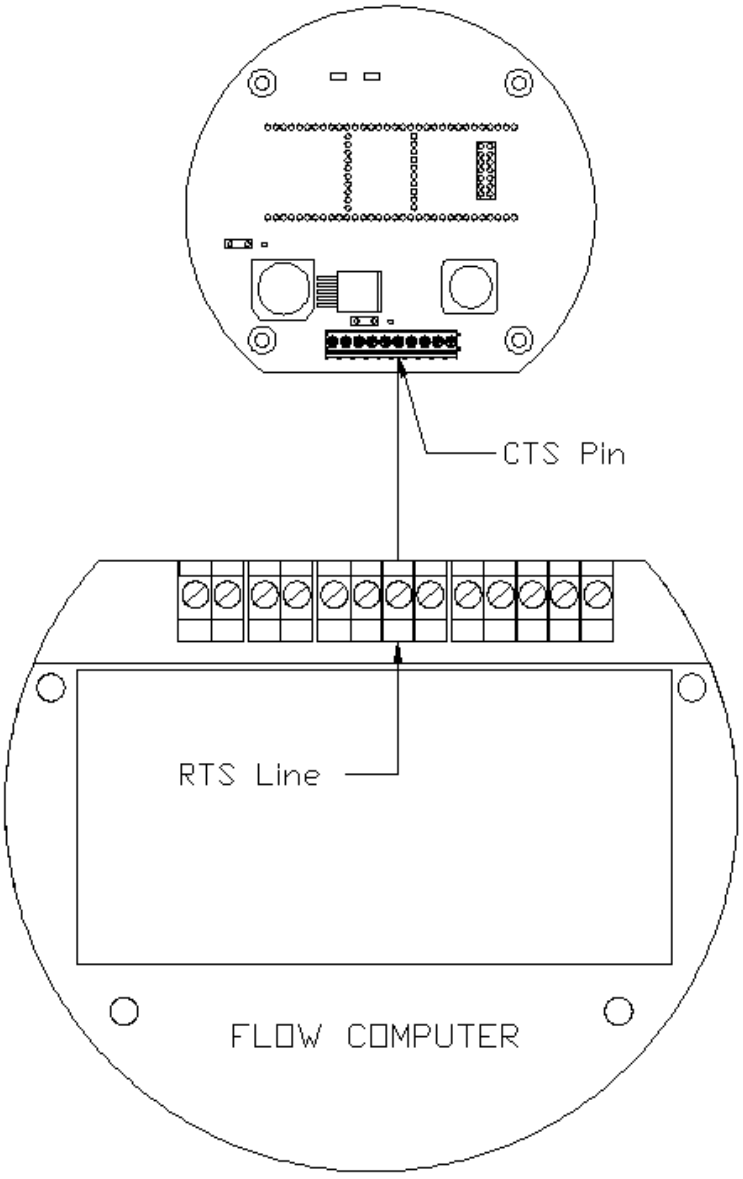
Wiring of Shutdown Input

- If the shutdown pin is not wired the radio is always ON.
- Because the Radio board and the flow computer share the same electrical ground only one wire is needed. In the event each device uses different power supplies then the ground of both devices must be tied together.
- The picture below shows an EChart flow computer using Switch Output 1 for shutdown but any switch output can be used.
- Remember to configure the switch output to manage the power on the radio board.



Wiring of RTS/CTS Input

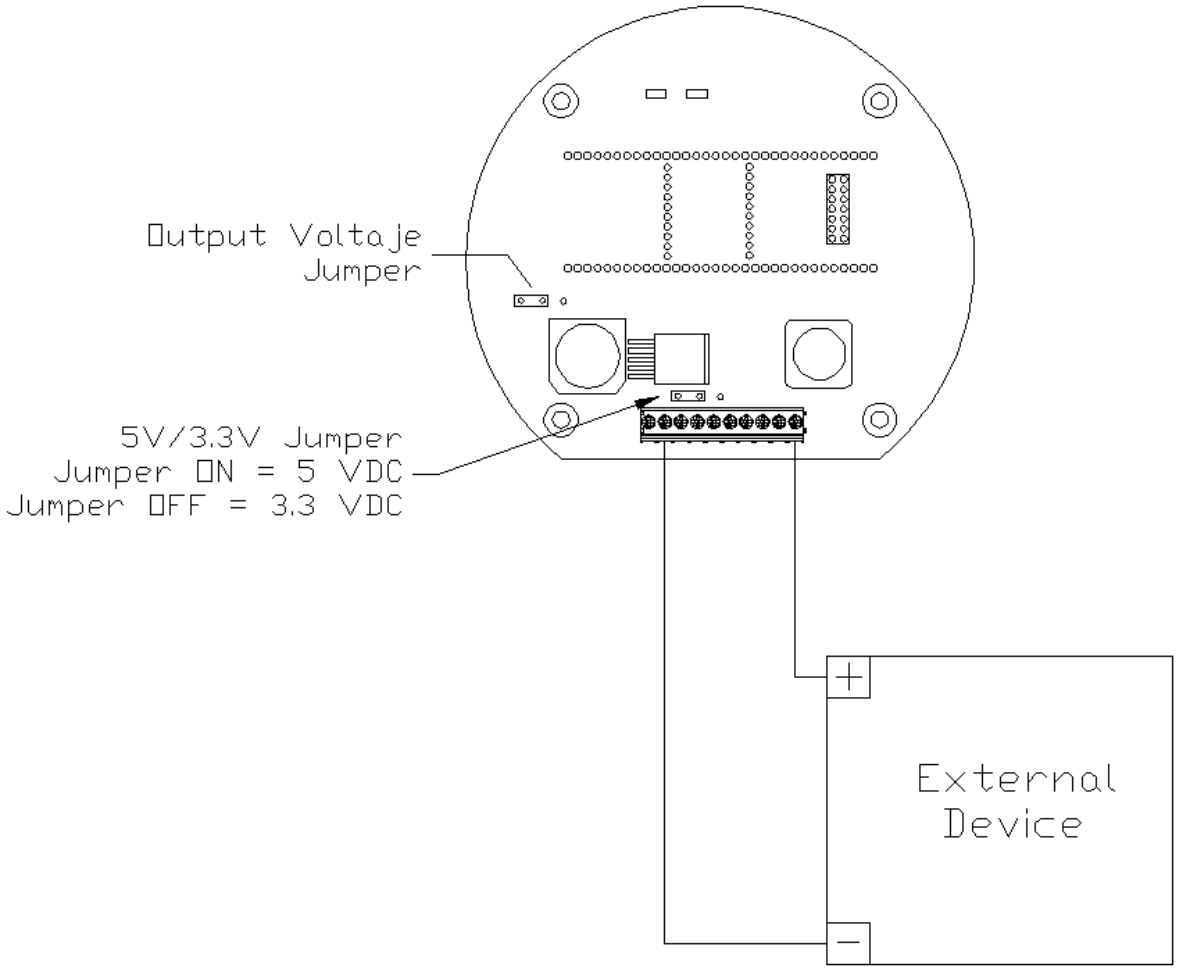
- The CTS pin allows us to optimize power consumption of the radio module using the RS-232 RTS Hardware handshake line.
- For optimal power saving use the Shutdown pin shown above, for power radio power saving only use the CTS option.
- If the CTS pin (Pin 6) is not wired the radio is always ON.
- Because the Radio board and the flow computer share the same electrical ground only one wire is needed. In the event each device uses different power supplies then the ground of both devices must be tied together.
- The picture below shows an EChart flow computer as an example but any model can be used.
- Remember to configure the RTS line output to manage the power on the radio board.



Wiring of Voltage Output

- Remove power from the interface board
- In the event none of the three radio modules fits the application, the interface board can still be used to power an external radio and turn it ON/OFF via the shutdown pin.
- Wire terminal 10 to the positive terminal on the external device.
- Wire terminal 2 to the negative terminal on the external device.
- Configure the jumper for the desired voltage output:

Jumper	Output	
JP2 with Link on pins 1 & 2	Supply voltage (whatever is applied to terminals 1 & 2)	
JP2 with Link on pins 2 & 3	With Jumper JP1 OFF	3.3 VDC
	With Jumper JP1 ON	5 VDC



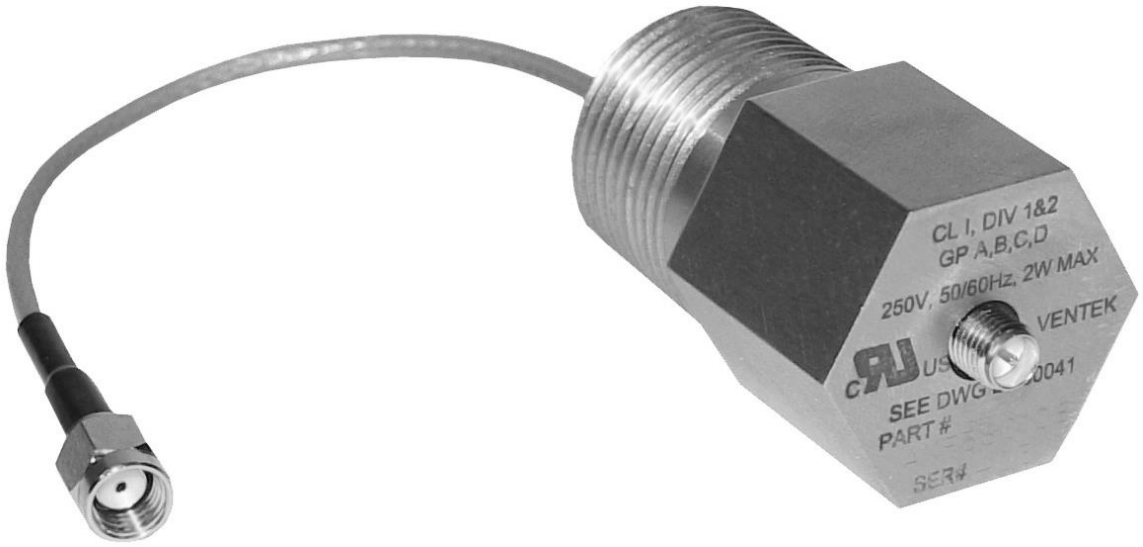
Explosion Proof External Antenna Conection

Since the radio in enclosed by an explosion proof metal housing using an internal antenna would yield a very short range thus an external antenna is required. In order to fit an external antenna to an internal radio an approved explosion proof connection must be made and that is the purpose of the explosion proof coaxial coupler.

Explosion Proof Antenna Coupler Specifications

General	
Approximate weight	0.5 lb (0.23 kg)
Housing material	300 Series Stainless Steel
Ambient Temperature Range	-40°C to +85°C (subject to end product evaluation)
Certification	
CUR; USR (UL) Recognized Component	Rating: Class I, Div. 1, Group A, B, C, D File #: E219089
Maximum Fault Voltage	250 VDC, 250 VAC 50-60 Hz
Maximum Antenna Power Output	2 Watts or 33 dB (subject to end product evaluation)
Electrical	
Maximum Capacitance	5.64 nF
Frequency Range	260 to 2483 MHz
Impedance	50 Ohms
Approximate Signal Attenuation	
@ 425 MHz	0.6 dB
@ 915 MHz	2.2 dB
@ 2.4 GHz	2.6 dB

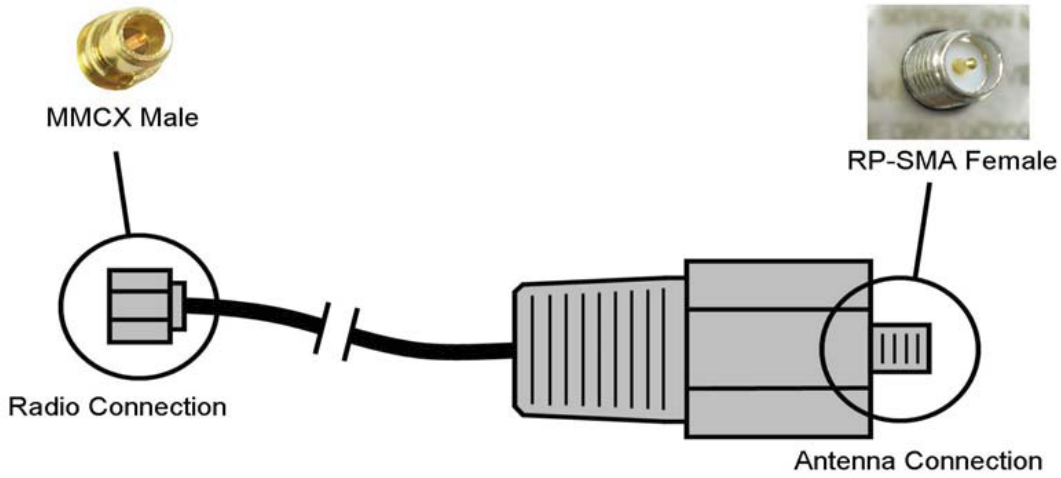
Coupler Drawing



Part Numbers

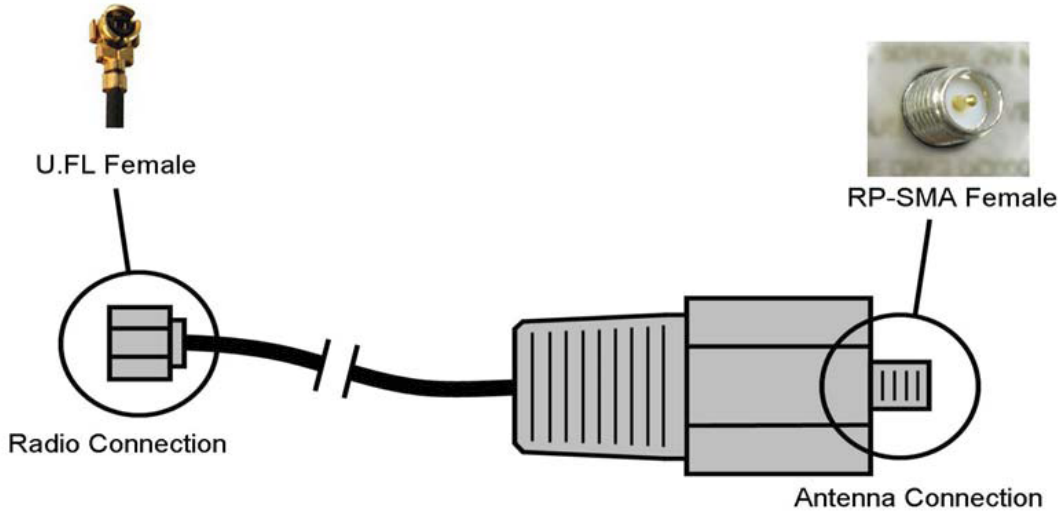
There are two models to fir our radio options:

Model AXF3S1510: Has a MMCX male radio connection to be used with our Socket Modem and our 900 MHz radio option.



Model AXF3S1510

Model AXF3S2410: Has a U.FL female radio connection to be used with our 2.4GHz radio option.



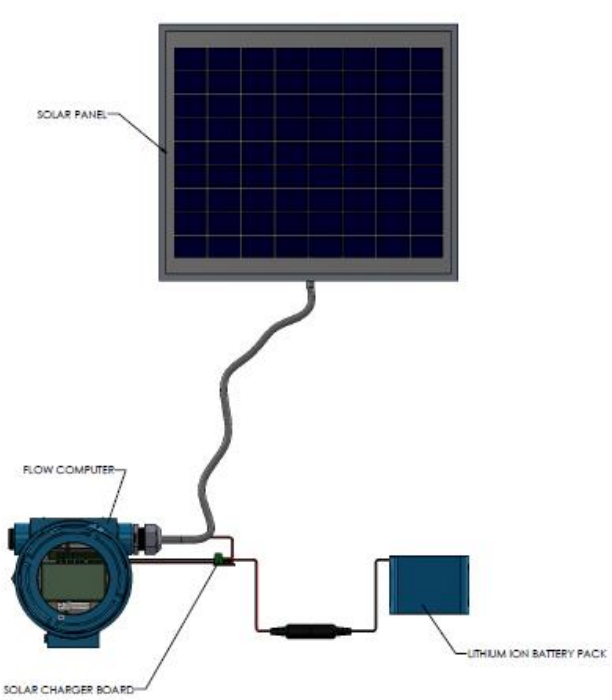
Model AXF3S2410

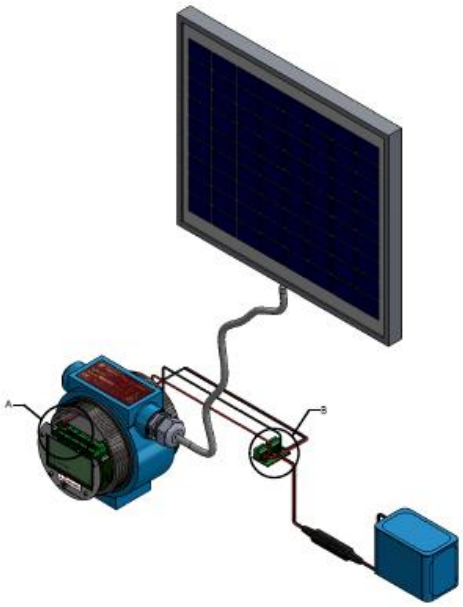
NOTE: Both models have a female RP-SMA connector for an external antenna.

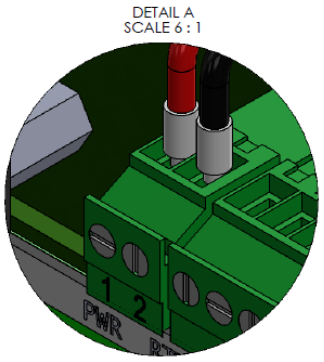
Appendix B: Battery and Solar Panel Wiring

Battery Wiring and Connection

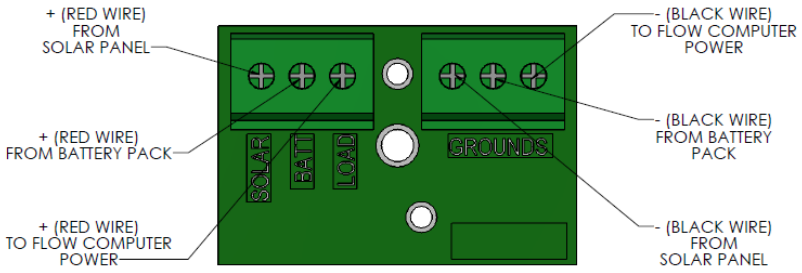
There is no need for an external diode. The Solar Panel connects directly to the terminal 1 & 2 on the terminal block like a regular power supply.



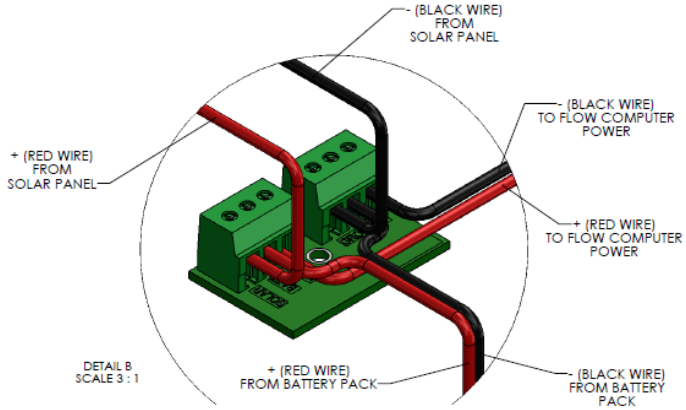




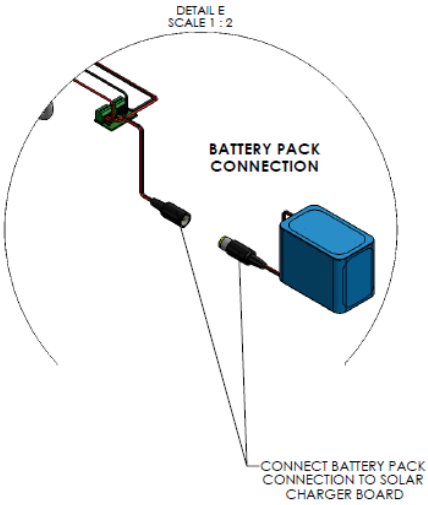
FLOW COMPUTER POWER CONNECTION

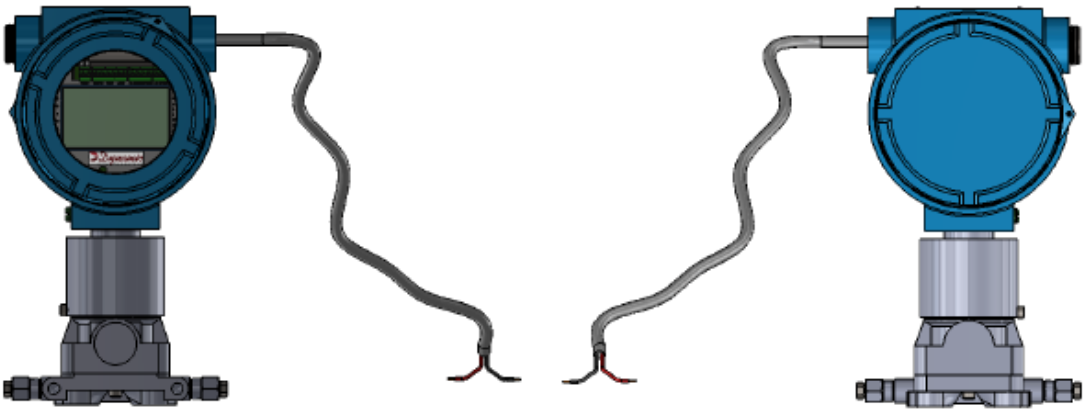


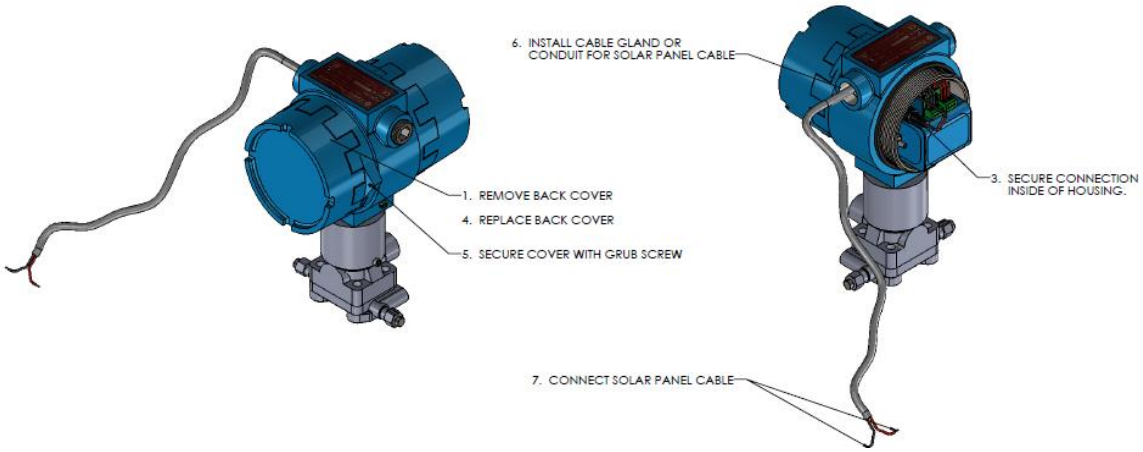
SOLAR CHARGER BOARD

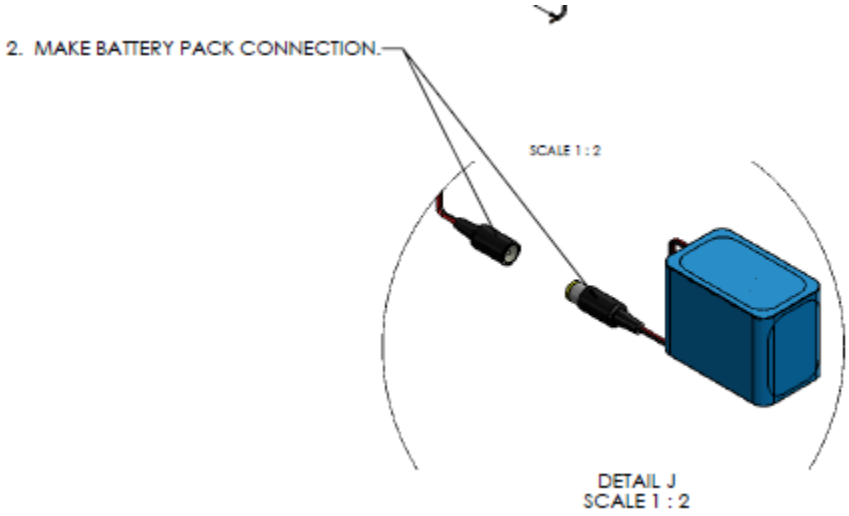


SOLAR CHARGER BOARD (CONNECTIONS MADE)






6. INSTALL CABLE GLAND OR CONDUIT FOR SOLAR PANEL CABLE
3. SECURE CONNECTION INSIDE OF HOUSING.
1. REMOVE BACK COVER
4. REPLACE BACK COVER
5. SECURE COVER WITH GRUB SCREW
7. CONNECT SOLAR PANEL CABLE


2. MAKE BATTERY PACK CONNECTION.
SCALE 1 : 2
DETAIL J
SCALE 1 : 2