ECHART-GL
OPERATORS MANUAL

Flow Computer

GAS/LIQUID Version

11104 W.Airport Blvd, Suite 108
Stafford, Texas 77477 USA
(281) 565-1118
Fax (281) 565-1119

Date: 11/22/2021

WARRANTY

Dynamic Flow Computers warrants to the owner of the ECHART-GL Flow Computer that the product delivered will be free from defects in material and workmanship for one (1) year following the date of purchase.

This warranty does not cover the product if it is damaged in the process of being installed or damaged by abuse, accident, misuse, neglect, alteration, repair, disaster, or improper testing.

If the product is found otherwise defective, Dynamic Flow Computers will replace or repair the product at no charge, provided that you deliver the product along with a return material authorization (RMA) number from Dynamic Flow Computers.

Dynamic Flow Computers will not assume any shipping charge or be responsible for product damage due to improper shipping.

THE ABOVE WARRANTY IS IN LIEU OF ANY OTHER WARRANTY EXPRESS IMPLIED OR STATUTORY. BUT NOT LIMITED TO ANY WARRANTY OF MERCHANTABILITY, FITNESS FOR PARTICULAR PURPOSE, OR ANY WARRANTY ARISING OUT OF ANY PROPOSAL, SPECIFICATION, OR SAMPLE.

LIMITATION OF LIABILITY:

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Date: 11/22/2021

CHAPTER 1: QUICK START

Introduction:

The ECHART-GL 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-GL Flow Computer has delivered and met the design intentions.

The ECHART-GL 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-GL Flow Computer will be a simple pleasant experience, not intimidating in any way.

The ECHART-GL Flow computer is a dual meter flow computer for the measurement of liquid and gas products. Gas product includes the following flow equations: New API14.3, ISO 5167, turbine (AGA7), and V-Cone, Slotted DP Meter. Additionally, it can perform density calculations per these standard procedures: AGA8. The liquid product uses orifice plate, turbine/PD meter, it can meter a wide variety of products, such as crude, refined product, LPG/NGL products, products that use table 24C/54C, other tables are added constantly call our main office for current software

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

The ECHART-GL 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

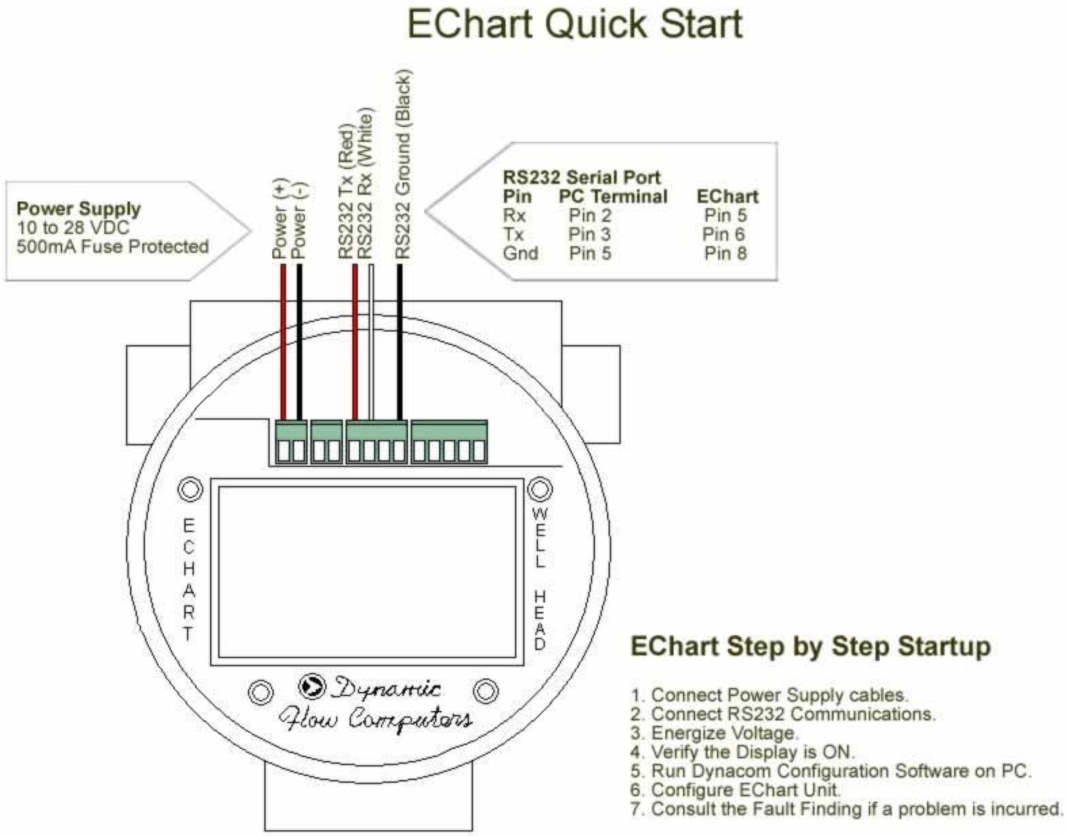
One status input and two digital outputs (user configurable).

Graphic screen: 128 x 64.

Additionally, each ECHART-GL 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.

ECHART-GL QUICK START



EChart Quick Start

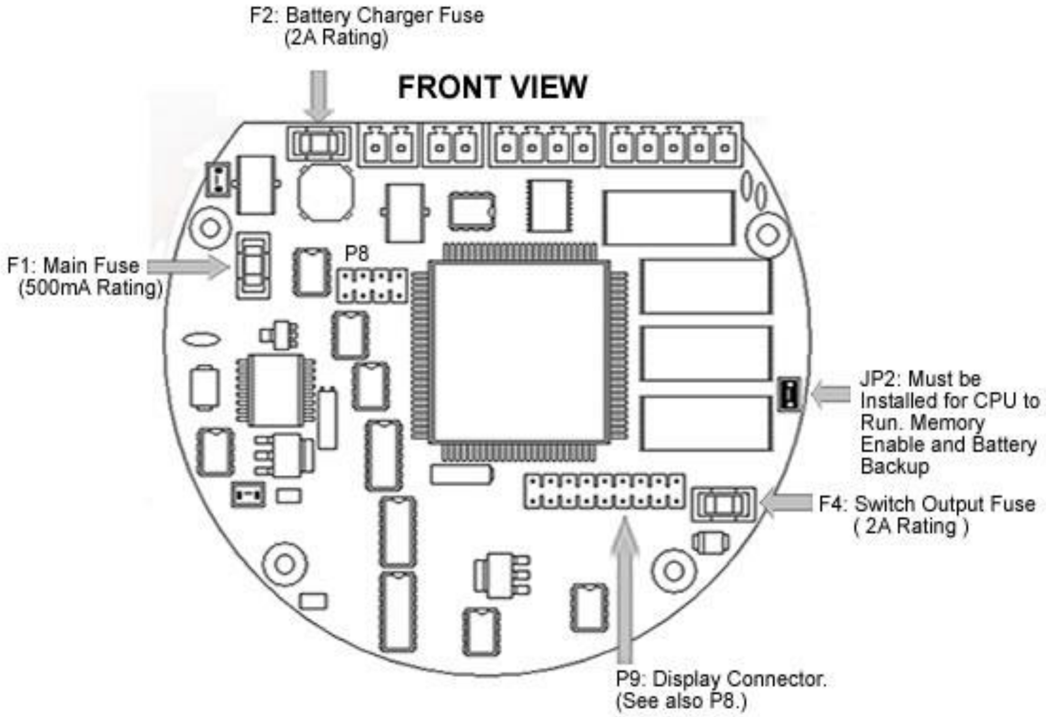
Power Supply
10 to 28 VDC
500mA Fuse Protected

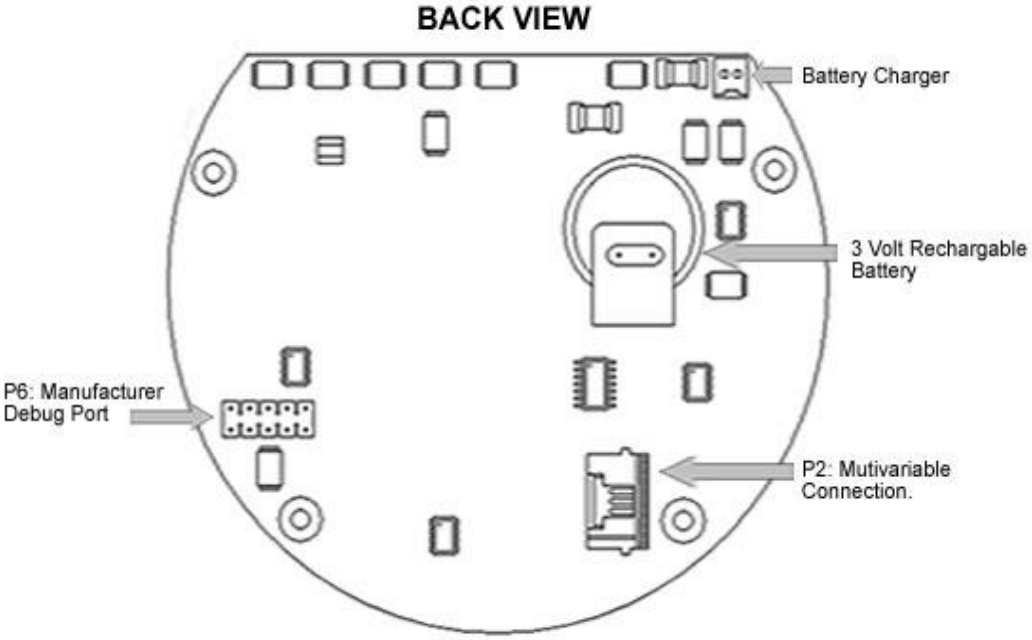
RS232 Serial Port

Pin	PC Terminal	EChart
Rx	Pin 2	Pin 5
Tx	Pin 3	Pin 6
Gnd	Pin 5	Pin 8

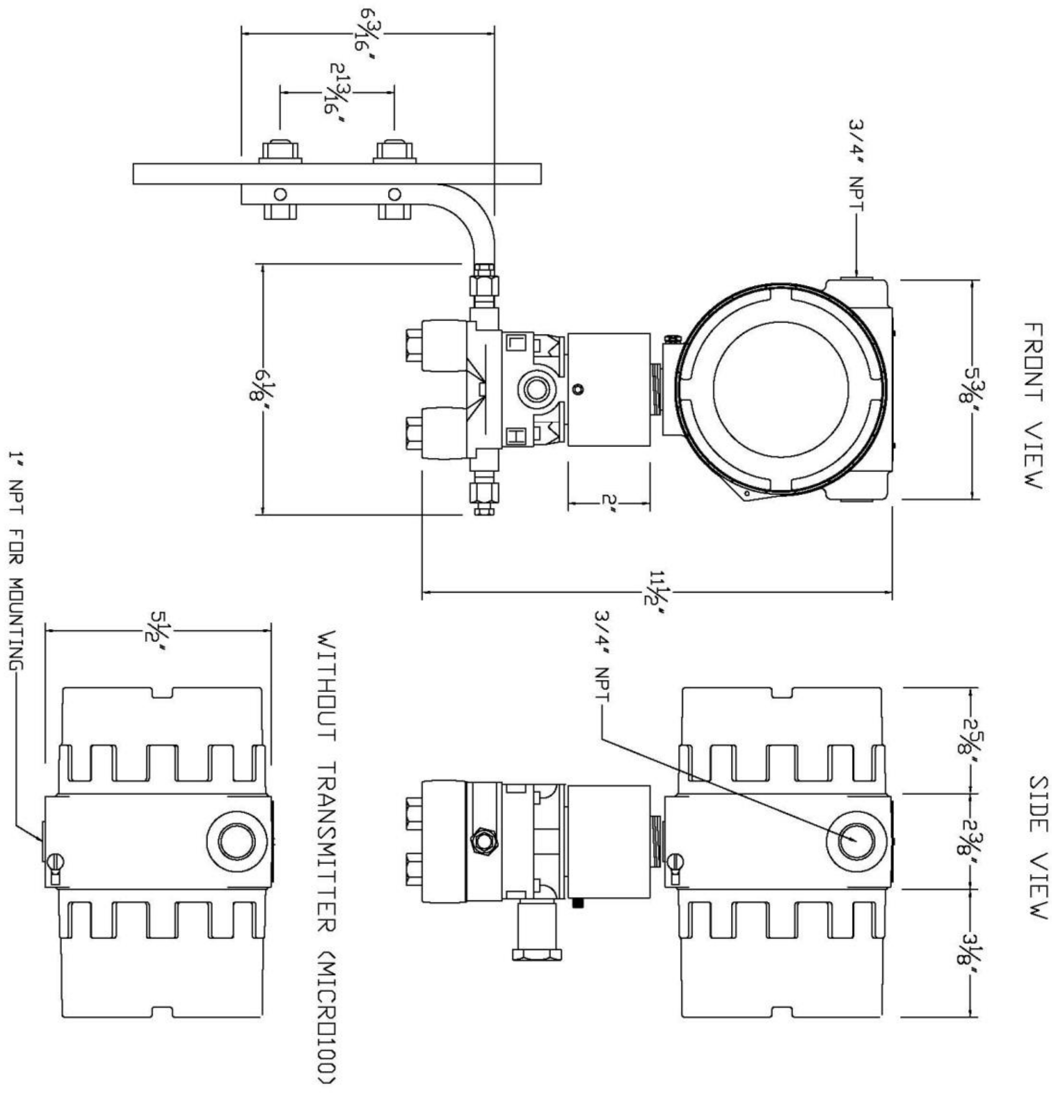
EChart Step by Step Startup

1. Connect Power Supply cables.
2. Connect RS232 Communications.
3. Energize Voltage.
4. Verify the Display is ON.
5. Run Dynacom Configuration Software on PC.
6. Configure EChart Unit.
7. Consult the Fault Finding if a problem is incurred.


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.

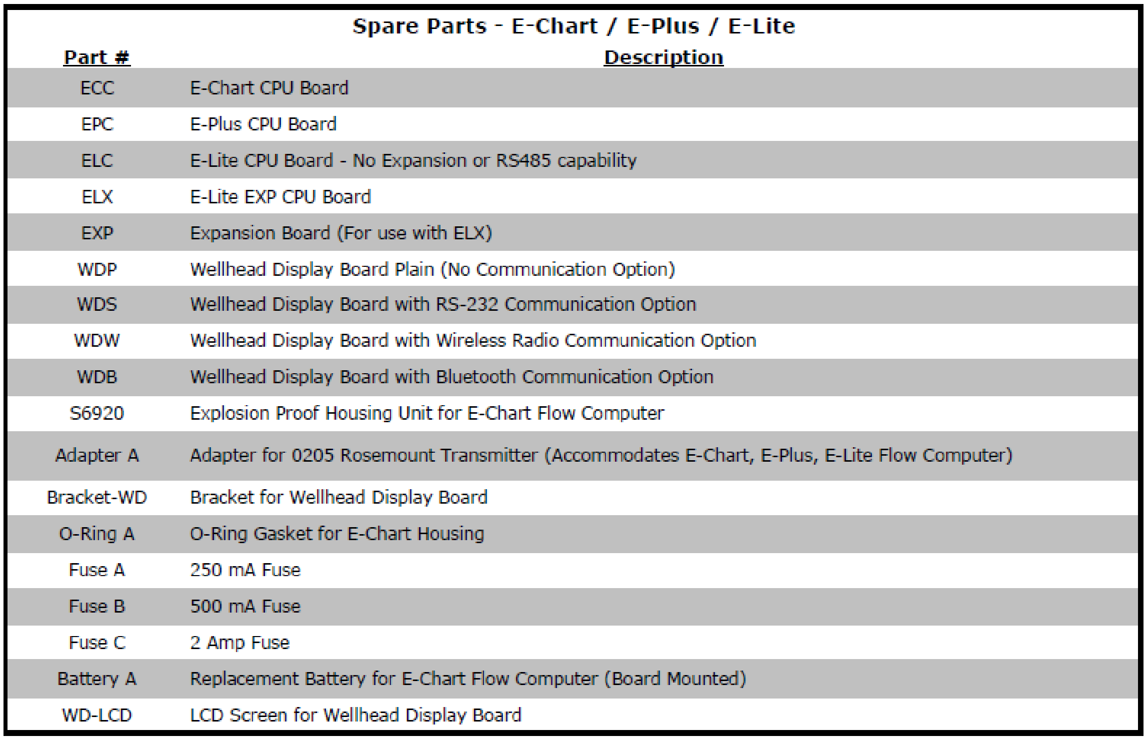
ECHART-GL Flow Computer: Dimensions



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:

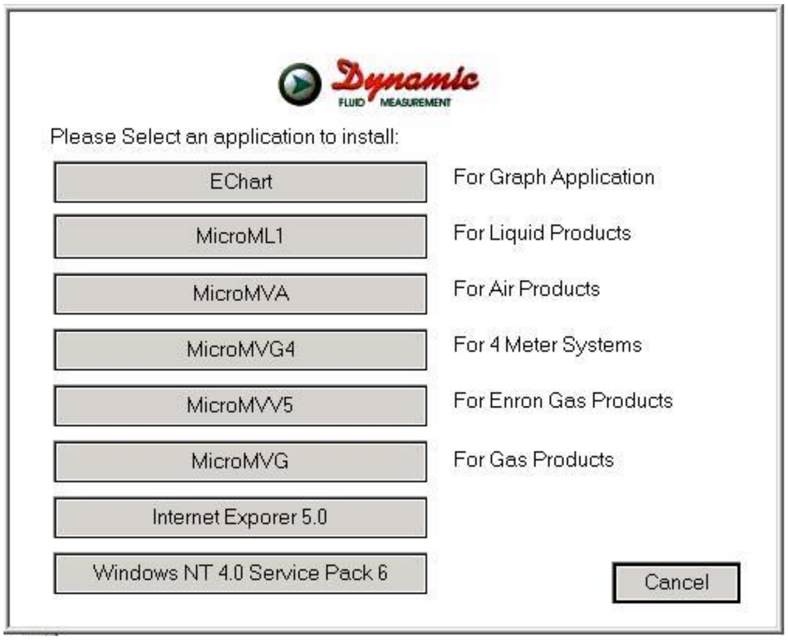
First make sure your computer has the minimum requirements to install Dynamic's Dynacom software.

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)
- For a Windows NT machine: Service Pack 3 or later. (Service Pack 5 Update is Included in the Installation Disk)
- Internet Explorer 5 or later. (Internet Update is Included in the Installation Disk)
- 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 Connect to Device 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 Configure Device 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.

What is an Image File?

An image file is EPROM codes 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

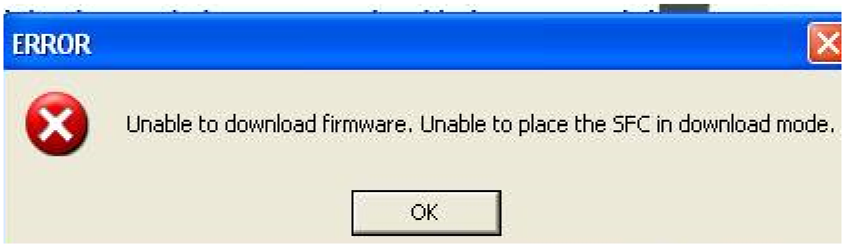
- Download an image file through **Main RS-232 port** ***only*** (Terminal 5,6 and 8).
- To Download an Image File to the Flow Computer select the **Tools | Download Program** option form the main menu or press the button in the toolbar.
- A small dialog will appear asking for the file name of the image 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.
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.

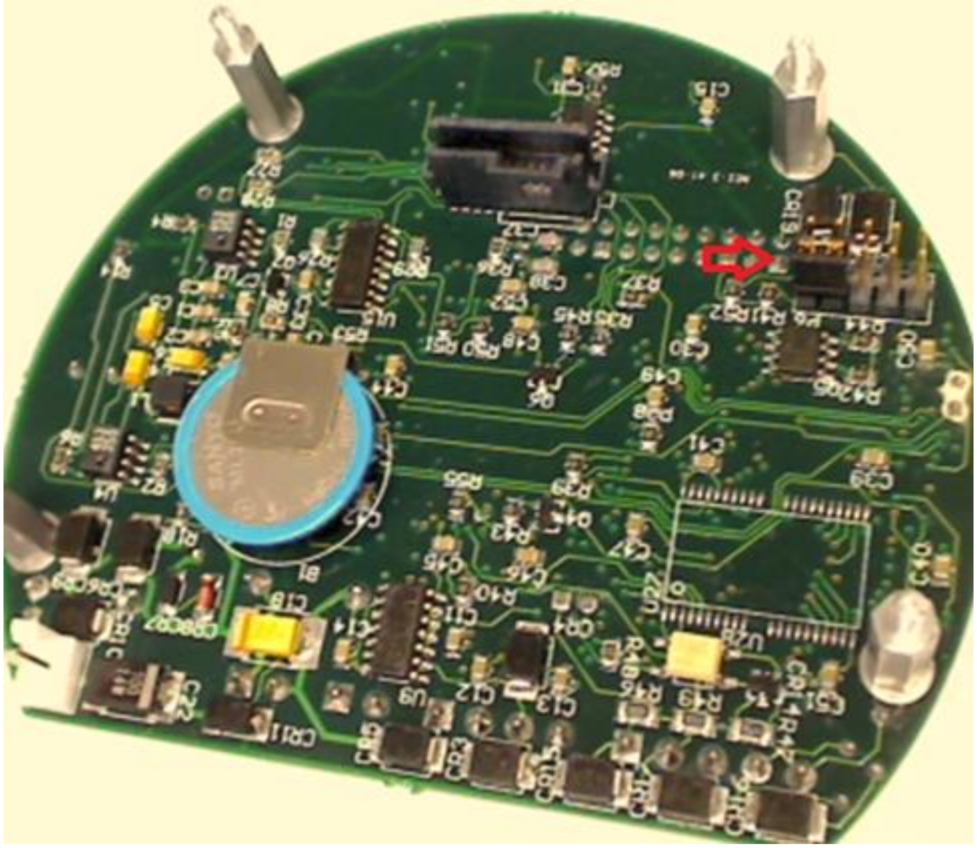


ERROR

Unable to download firmware. Unable to place the SFC in download mode.

Steps to force the board into download mode.
(1) Remove Power

(2) Put a jumper on P6 as shown below. 



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

Website - DFM Configuration Software

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

Step 2. Click on the **Software** link located on the left hand side of the web page. You will be presented with two options: **Windows®** software and **DOS** software. The following flow computer applications have Windows® software:

- EChart
- MicroMVL
- MicroMS4
- MicroMVA
- Sfc33G Air V.2
- Sfc332L
- MicroML1

If you don't see your application listed here it means it only has DOS software.

Step 3. Select either Windows® or DOS software based on Step 2.

Step 4. On the new screen presented to you click on the application that you are trying to download. Once you hit the link it will ask you if you want to run or save the file in your computer. Select **SAVE.** (See illustration 1)


File Download

Some files can harm your computer. If the file information below looks suspicious, or you do not fully trust the source, do not open or save this file.

File name: echart.exe

File type: Application

From: www.dynamicflowcomputers.com

Would you like to open the file or save it to your computer?

☑ Always ask before opening this type of file


Download complete

Download Complete

Saved:

microms4.testexe from www.dynamicflowcomputers.com

Downloaded: 792 KB in 14 sec

Download to: C:\Downloads\Mic...\microms4.testexe

Transfer rate: 56.5 KB/Sec

☐ Close this dialog box when download completes

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 **Software** link located on the left hand side of the web page, then you select **Firmware** option. The following flow computer applications have IMAGE:

- EChart
- MicroMVL
- MicroMS4
- MicroMVA
- MicroMG4
- MicroMVG
- MicroML1
- MicroMG5
- MicroML4

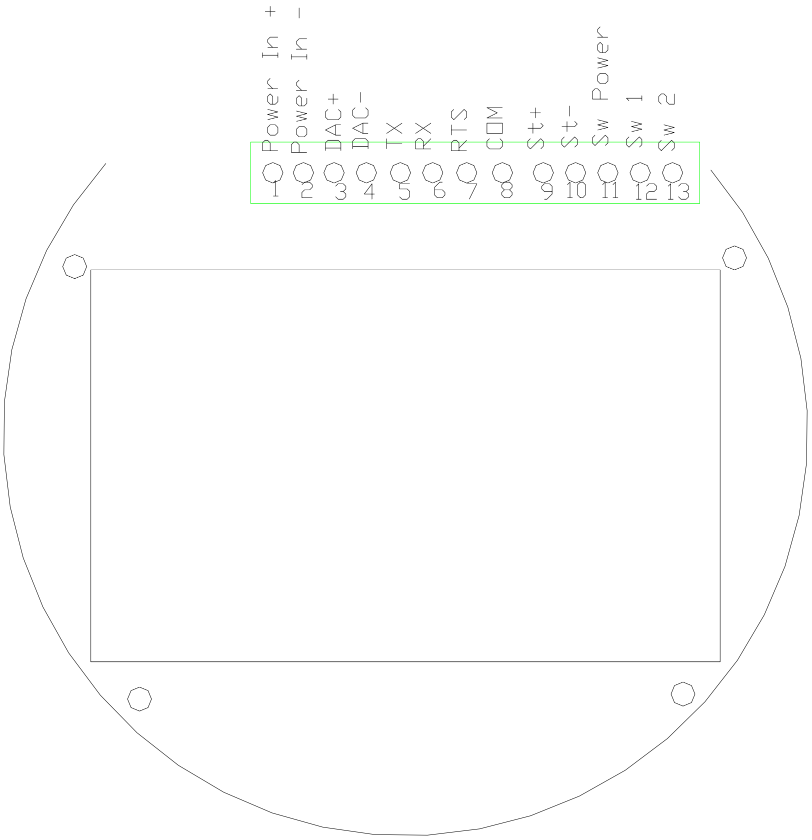
Step 3. On the new screen presented to you click on the application that you are trying to download. Once you hit the link it will ask you the location and file name to be saved.

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-GL 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.

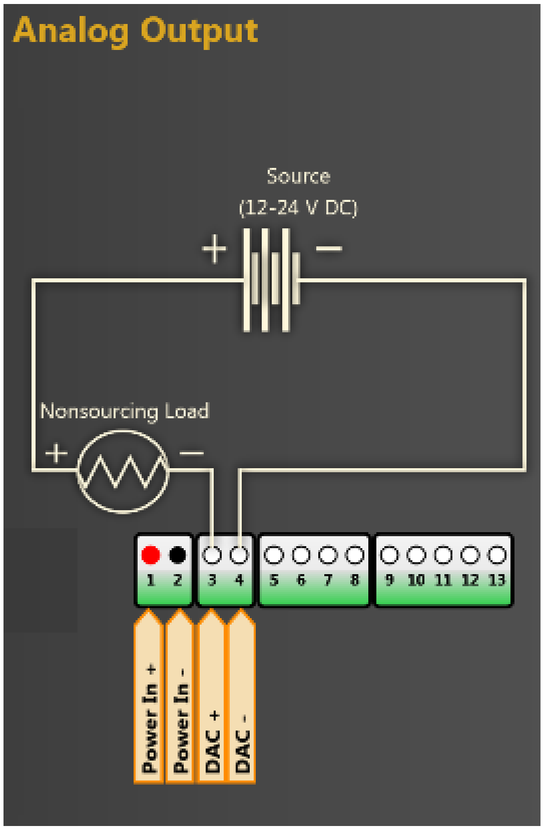
1. **Enter the high and low limits**: high limits and low limits are simply the alarm points in which you would like the flow computer to flag as an alarm condition. Enter these values with respect to the upper and lower range conditions. Try to avoid creating alarm log when conditions are normal. For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

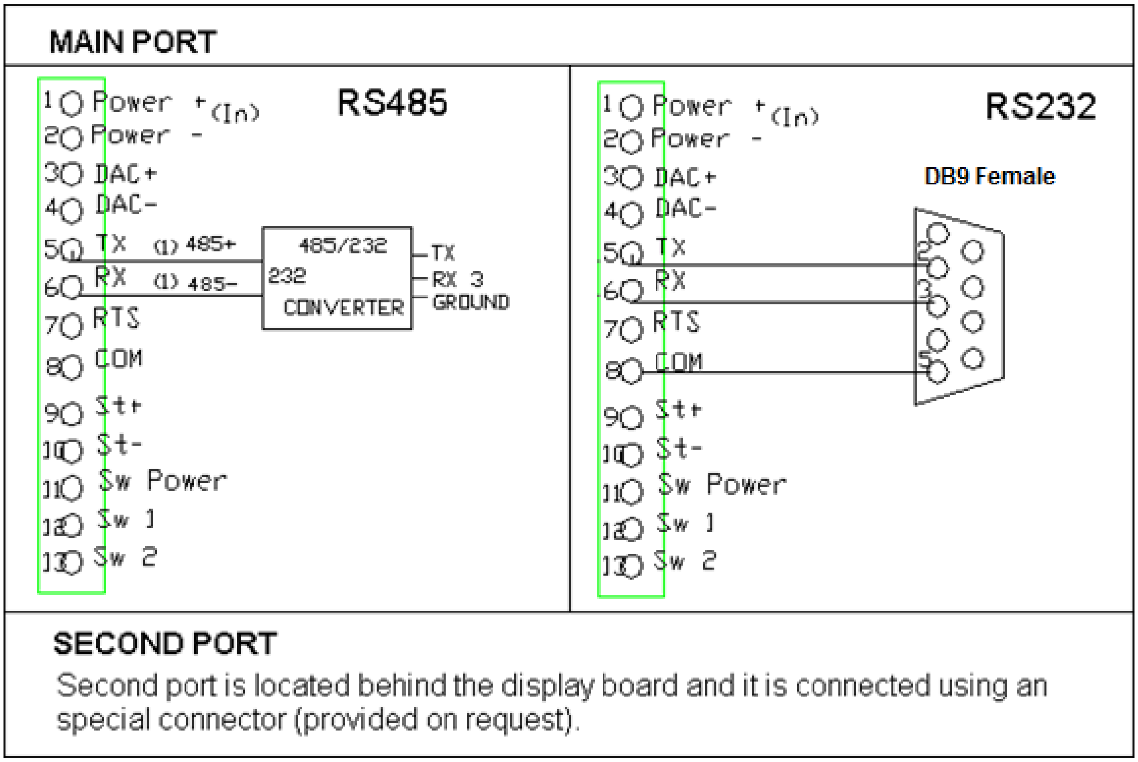
Wiring diagram shows typical Analog output wiring. The analog output will regulate 4-20 mA current loop but DOES NOT source the power for it. **External power is required.**



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:



SECOND PORT

Second port is located behind the display board and it is connected using an special connector (provided on request).

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.

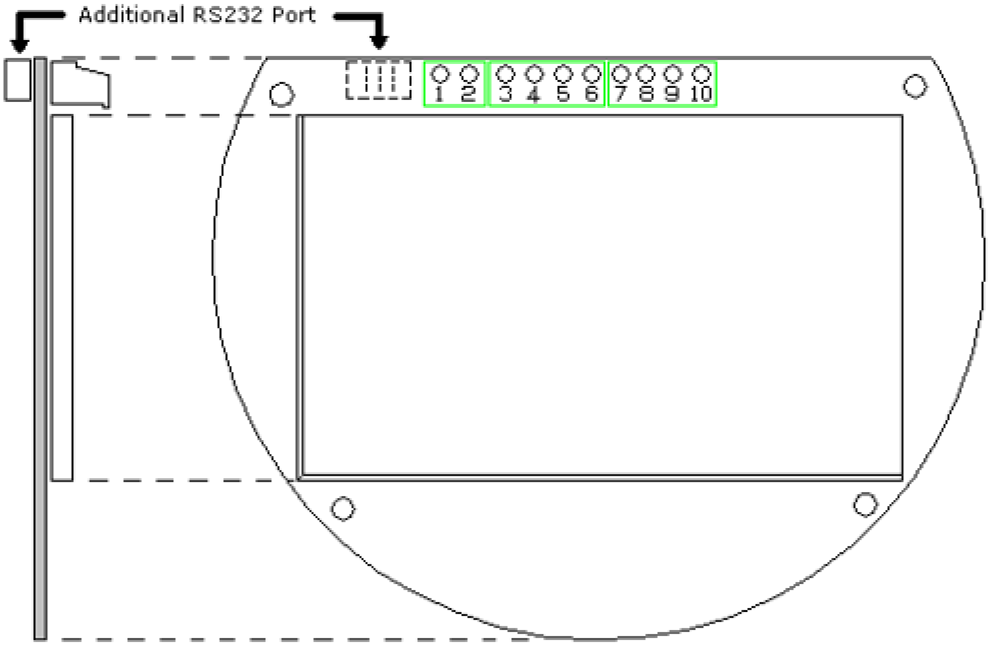
RS485/232 Adapter

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:

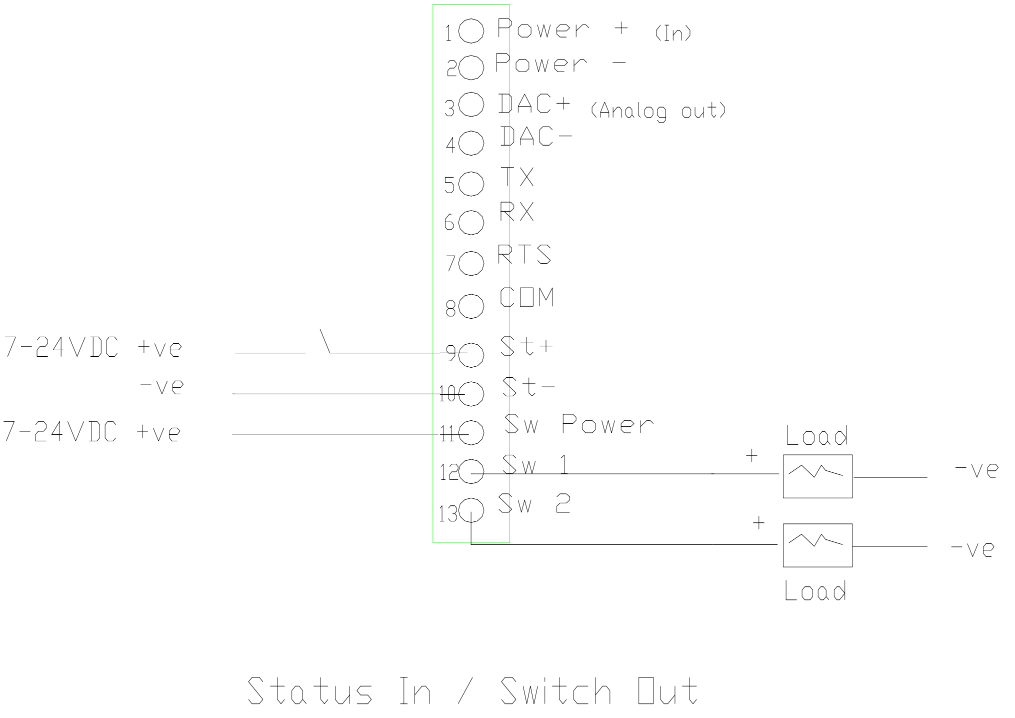
Part Number: WDS

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.



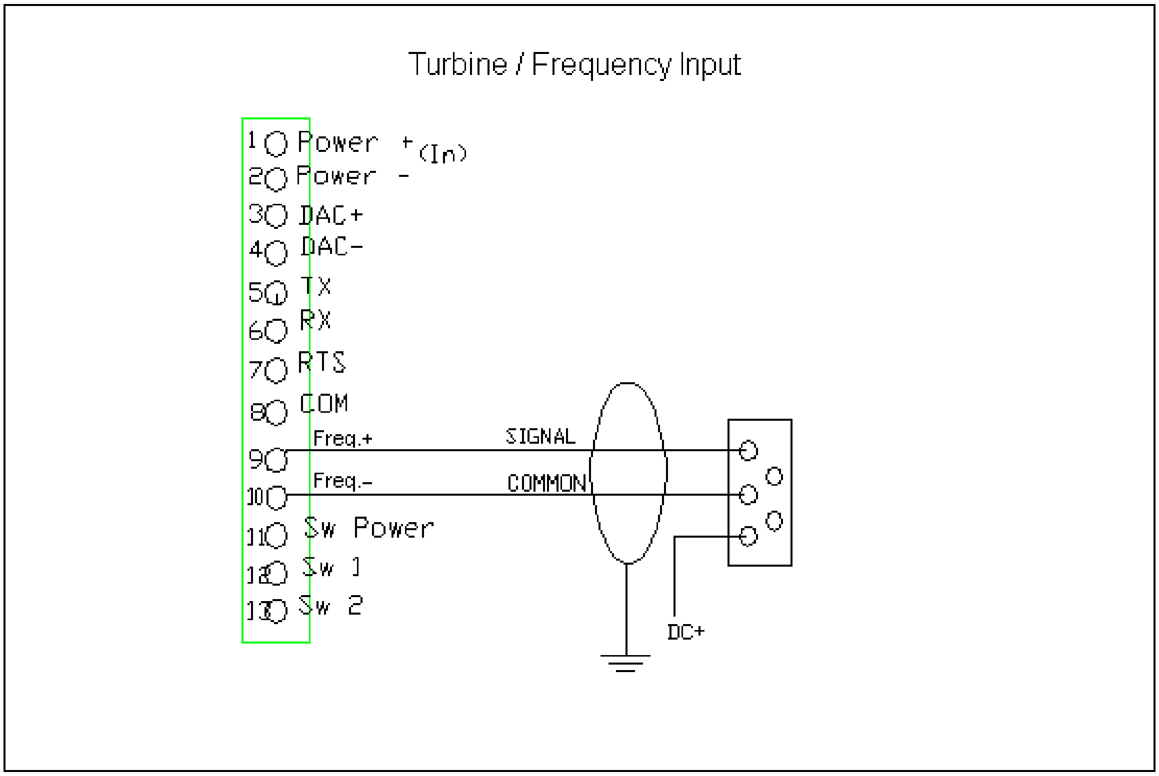
Switch one and two can be on /off or pulse type output up to 125 pulse per second. Notice that the switch outputs are transistor type outputs (open collector type with maximum DC rating of 350 mA continuous at 24 VDC) connections		
1	Switch Output 1	Switch – Maximum rating: 350mA @24 volts Switch Output 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.**

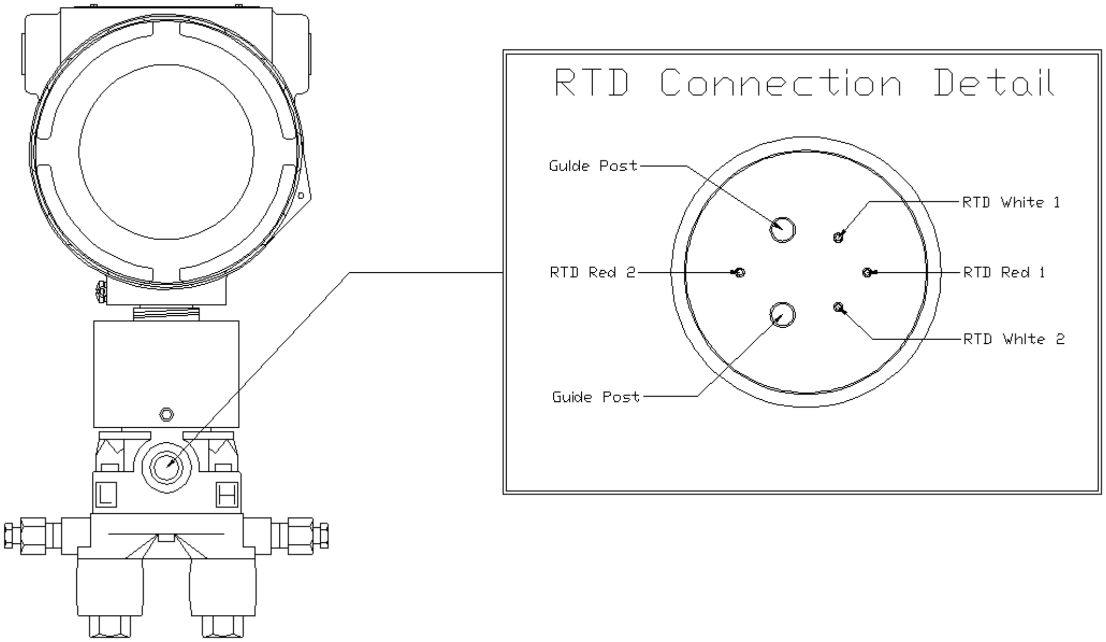
This feature is mainly for added noise immunity in handling the taller signals. Still, the input also needs some protection if large static signals are to be handled. Short pulses, (less than 10[sec], with 50% max duty cycle) will be handled by the hardware without overheating with the jumper on. So 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-GL 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 ECHART-GL Computer Software

The ECHART-GL 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-GL 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

Communication Port Number

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

Baud Rate

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

Number of Meters

Enter ‘1’, or ‘2’ meters run configuration per individual flow computer.

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.

Common Parameters

This feature allows the ECHART-GL Computer to use the transmitters on meter one to substitute and compensate for meter two.

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, KPA

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

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*

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.

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.

GAS 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).

GAS Heating Value

The energy totalizer requires the heating value entry. (US Unit - BTU/SCF, Metric Unit- MJ/M3)

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.

METER DATA

Meter ID

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

Meter Application Type

0 =	Gas Application
1 =	Liquid Application

Flow Equation Type (0-4)

0 = API 14.3 (NEW AGA3)
1 = ISO5167
2 = AGA7 (TURBINE or Frequency Type Input)
3 = Cone/Smart Cone Meter
4 = Slotted DP Meter (US Unit Only)

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.

Product Selection: Specifies the equation used to calculate density.

Gas Application

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 Unit)
4	STEAM Equation	260 <= T <= 2500 DEG.K 0 <= P <= 3000 MPA

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.

Liquid Application – US UNIT

Sel.	Table	Description	Conditions
0=	24A	Crude oil, natural gasoline, drip gasoline	Density is known, Parameter - Specific Gravity at 60 Deg.F is required
1=	24B	Gasoline, naphthalene, jet fuel, aviation fuel, kerosene, diesel, heating oil, furnace oil	Density is known, Parameter - Specific Gravity at 60 Deg.F is required
2=	New 24	LPG	Density is known, Parameter - Specific Gravity at 60 Deg.F is required
3=	24C	Benzene, toluene, styrene, *ortho*-xylene, *meta*-xylene, acetone	Density is known, Parameter - Specific Gravity at 60 Deg.F is required, Alpha T, the number entered will be divided by 10^{-6}.

Liquid Application – METRIC UNIT

4=	54A	Crude oil, natural gasoline, drip gasoline	Density is known, Parameter - Density at 15 Deg.C is required
5=	54B	Gasoline, naphthalene, jet fuel, aviation fuel, kerosene, diesel, heating oil, furnace oil	Density is known, Parameter - Density at 15 Deg.C is required
6=	OLD 54	LPG	Density is known, Parameter - Density at 15 Deg.C is required
7=	54C	Benzene, toluene, styrene, *ortho*-xylene, *meta*-xylene, acetone	All conditions
8=	60A	Crude oil, natural gasoline, drip gasoline	Density is known, Parameter - Density at 20 Deg.C is required
9=	60B	Gasoline, naphthalene, jet fuel, aviation fuel, kerosene, diesel, heating oil, furnace oil	Density is known, Parameter - Density at 20 Deg.C is required
10=	60D		Density is known,

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

Flow Rate Alarm 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.

Flow Unit

Selection	Description
0	MCF
1	KM3
2	CF
3	M3
4	GALLON
5	LITER
6	BARREL

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-GL 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-GL 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
2	Temperature and Pressure Downstream
3	Temperature Upstream and Pressure Downstream
4	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 Data (Frequency)

`Flow Equation Type = 2`

K Factor

K Factor is the number of pulses per flow unit volume, i.e. 1000 pulses/CF (us unit), M3 (metric unit). The meter's tag would normally indicate the K Factor.

K Factor Unit

Selection	Description
0	M3
1	BARREL
2	GALLON
3	M3
4	LITER

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-GL 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.

Gross Include Meter Factor

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

Slow Pulse Application

Enter '1' to select slow pulse resolution.

Flow Rate Cut Off Time

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

Flow Rate Threshold/Linear Factor

Enter the different correction factors for the meter at different flow rates. The ECHART-GL 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 Data

`Flow Equation Type = 3`

Meter I.D.

Cone ID

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

DP Cutoff

The ECHART-GL 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 Tube
2	Compressible Fluids – Wafer and 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 GL 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 (US Unit Only)

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-GL 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.

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

Port #1/#2 Modbus Type

> *Note: this parameter must be set the same for both the PC and the ECHART-GL 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-GL 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-GL 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-GL 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
1	RS-485

The main port can be configured to RS-232 or RS-485. RS-232 is the default value.

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

I/O 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	Description
0	Always use the live value even if the multivariable failed.
1	Always use the maintenance value
2	Use maintenance value if multivariable failed

STATUS INPUT /SWITCH OUTPUT ASSIGNMENT

Status Input Assignment

	Assignment	Comments
0	None	
1	Spare	
2	Calibration Mode	
3	Orifice Place 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	

Switch Output Assignment

User can assign an output to each of the ECHART-GL Flow Computer's output switches from this list.
The ECHART-GL 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-GL 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-GL Flow Computer can produce up to 50 pulses per second.
The ECHART-GL 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

	Meter #1	Meter #2
Gross	1	31
Net	2	32
Mass	3	33
Energy	4	34

Assignments - Contact Type Outputs

	Meter #1	Meter #2
Meter Down	7	21
Density Out of Range	8	22
Flow Rate High	9	23
Flow Rate Low	10	24

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
Meter #1 Gross Flow Rate	11
Meter #1 Net Flow Rate	12
Meter #1 Mass Flow Rate	13
Meter #1 Energy Flow Rate	14
Meter #2 Net Flow Rate	15
Meter #2 Mass Flow Rate	16
Meter #2 Energy Flow Rate	17
Meter #1 DP	21
Meter #1 Temperature	22
Meter #1 Pressure	23
Meter #1 Density	24
N/A	25
Meter #1 Density.b	26
Meter #1 SG	27
Meter # 2 Gross Flow Rate	28
Meter #2 DP	29
Meter #2 Temperature	30
Meter #2 Pressure	31
Meter #2 Density	32
Meter #2 Density.b	33
Meter #2 SG	34

	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-GLCOMPUTER DISPLAY ASSIGNMENT

Text Assignment

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

Meter #1 Gross Flow Rate	1
Meter #1 Net Flow Rate	2
Meter #1 Mass Flow Rate	3
Meter #1 Energy Flow Rate	4
Meter #1 Gross Daily Total	5
Meter #1 Net Daily Total	6
Meter #1 Mass Daily Total	7
Meter #1 Energy Daily Total	8
Meter #1 Gross Cumulative Total	9
Meter #1 Net Cumulative Total	10
Meter #1 Mass Cumulative Total	11
Meter #1 Energy Cumulative Total	12
Meter #1 Gross Monthly Total	13
Meter #1 Net Monthly Total	14
Meter #1 Mass Monthly Total	15
Meter #1 Energy Monthly Total	16
Meter #1 DP	17
Meter #1 Temperature	18
Meter #1 Pressure	19
Meter #1 Density	20
Meter #1 SG	21
CO2 %	22
N2 %	23
Meter #1 Heating Value	24
Meter #1 Meter ID	25
Meter #1 Orifice ID/ K Factor	26
Meter #1 Pipe ID/ Meter Factor	27
PID Flow	28
PID Pressure	29
PID Output	30
Date	31
Time	32
Alarms	33
Meter #2 Net Flow Rate	34
Meter #2 Mass Flow Rate	35
Meter #2 Energy Flow Rate	36
Meter #2 Net Daily Total	37
Meter #2 Mass Daily Total	38
Meter #2 Energy Daily Total	39
Meter #2 Net Cumulative Total	40
Meter #1 Previous Daily Gross Total	41
Meter #1 Previous Daily Net Total	42
Meter #1 Previous Daily Mass Total	43
Meter #1 Previous Daily Energy Total	44
Meter #1 Previous Day Cum. Gross	45
Meter #1 Previous Day Cumulative Net	46
Meter #1 Previous Day Cum. Mass	47
Meter #1 Previous Day Cum. Energy	48
Meter #1 Previous Daily FWA DP	49
Meter #1 Previous Daily FWA Temp	50

Meter #1 Previous Daily FWA Pressure	51
Meter #1 Previous Daily FWA SG	52
Meter #2 Gross Flow Rate	53
Meter #2 Gross Daily Total	54
Meter #2 Gross Cumulative Total	55
Meter #2 Gross Month Total	56
Meter #2 Previous Day – Gross Total	57
Meter #2 Previous Day – Gross Cum.	58
Meter #2 Orifice ID/ K Factor	59
Meter #2 Pipe ID/ Meter Factor	60
Program Variable #1	61
Program Variable #2	62
Program Variable #3	63
Program Variable #4	64
Program Variable #5	65
Program Variable #6	66
Program Variable #7	67
Program Variable #8	68
	69
Meter #2 Mass Cumulative Total	70
Meter #2 Energy Cumulative Total	71
Meter #2 Net Monthly Total	72
Meter #2 Mass Monthly Total	73
Meter #2 Energy Monthly Total	74
Meter #2 DP	75
Meter #2 Temperature	76
Meter #2 Pressure	77
Meter #2 Density	78
Meter #2 SG	79
Meter #2 Heating Value	80
Meter #2 Meter ID	81
Meter #2 Previous Daily Net Total	82
Meter #2 Previous Daily Mass Total	83
Meter #2 Previous Daily Energy Total	84
Meter #2 Previous Day Cum. Net	85
Meter #2 Previous Day Cum. Mass	86
Meter #2 Previous Day Cum. Energy	87
Meter #2 Previous Daily FWA DP	88
Meter #2 Previous Daily FWA Temp	89
Meter #2 Previous Daily FWA Pressure	90
Meter #2 Previous Daily FWA SG	91

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-GL Flow Computer will scroll through them at the assigned delay time.

(2 Digit Selection)

First Digit	
1	Meter #1 Average
2	Meter #1 Minimum
3	Meter #1 Maximum
4	Meter #2 Average
5	Meter #2 Minimum
6	Meter #2 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 meter#1 hourly average DP (a thick line) and meter#1 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.

MODBUS - 2 OR 4 BYTES

Reassigns Modbus address registers on the ECHART-GL 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-GL Flow Computer will repeat the assigned variables into the selected locations.

Note: some Modbus registers are 2 byte/16 bit, and some are 4 byte/32 bit. Register size incompatibility could cause rejection to certain address assignments. Refer to the Modbus Address Table Registers in Chapter 5.

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-GL 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-GL 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:

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

VARIABLE STATEMENTS AND MATHEMATICAL FUNCTIONS

Each statement can contain up to 3 variables or constants.

Function	**Symbol**	
ADD	**+**	Add the two variables or constant
SUBTRACT	**-**	Subtract the variable or constant
MULTIPLY	*****	Multiply the two variables or constant
DIVIDE	**/**	Divide the two variables or constants
CONSTANT	**#**	The number following is interpreted as a constant
POWER	**&**	1st variable to the power of 2nd variable
ABSOLUTE	**$**	unsigned value of variable
EQUAL	**=**	Move result to another variable Variable within the range of 7801-7899 (floating points) Variable within the range of 5031-5069 (long integer)
IF STATEMENT	**)**	Compares the variable to another Example: 7801)T7835 (if variable is greater to or is equal to 1 then go to 7835) 7801)7802=#0 (if variable is greater to or is equal to 1 then set variable 7802 to 0)
GOTO STATEMENT	**T**	Go to a different statement (**forward only**) Example: 7801%#60**T**7836 (if variable is equal to 60 then go to statement 7836)
COMPARE	**%**	Compare a value (**EQUAL TO**)
GREATER/EQUAL	**>**	Compare a value (**GREATER OR EQUAL TO)** Example: 7801>7802**T**7836 (If variable 1 is greater to or equal to variable 2 then go to 7836)
Natural Log	**L**	Natural Log of variable

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

Variables stored on the hourly report – 7971- 7975 will be **reset** at the end of hour.
Variables stored on the daily report – 7976 - 7980 will be **reset** at the end of day.
Variables stored on the month report – 7981- 7985 will be **reset** at the end of month.

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

7756-7760 – Last Hour Program Variables (Read Only)
7761-7765 – Yesterday Program Variables (Read Only)
7766-7770 – Last Month Program Variables (Read Only)

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	DP Override in use
0106	Pressure Override in use
0107	Temperature Override in use
0106-0400	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	Spare
0404	Spare
0405	Spare
0406	Spare
0407	Spare
0408	Multivariable DP High Alarm
0409	Multivariable DP Low Alarm
0410	Multivariable Pressure High Alarm
0411	Multivariable Pressure Low Alarm
0412	Multivariable Temperature High Alarm
0413	Multivariable 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

HISTORICAL DATA STORAGE

The historical data stored by the flow computer can be customized to better suit the meter application.

There are two reports that provide customized data storage. These reports are the Daily (hour by hour) report and monthly (day by day) report.

Daily Report Options:

Selection	User Variable #1
0	Gross Total
1	Net Total
2	Mass Total
3	Energy Total

Selection	User Variable #2
0	Gross Total
1	Net Total
2	Mass Total
3	Energy Total
4	DP/EXT

Monthly Report Options:

Selection	User Variable #1
0	Gross Total
1	Net Total
2	Mass Total
3	Energy Total

Selection	User Variable #2
0	Gross Total
1	Net Total
2	Mass Total
3	Energy Total

WARNING:
Any change made to the historical data configuration is* NOT *retroactive. Changes will apply from the moment there are made and will not affect data already stored.

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-GL 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-GL Flow Computer.

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 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***.

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.

Flowing Density Override

In the event the user would like to override the calculated flow density. This number would affect the net calculations only. Using zero is a command to use the live value.

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.

SYSTEM

DATE AND TIME

Change the date and time for the flow computer.

RESET CUMULATIVE TOTALIZER

Enter reset code to reset accumulated volume.
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 Get Report 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 60 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 60 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 840 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 35 previous daily reports can be retrieved.

Previous Day Hourly Data

Up to 35 previous daily of hour by hour reports can be retrieved.

Previous Month Data

Last two 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

Last Month of daily data are stored in the Flow Computer. 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-GL 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.

CHAPTER 3: FLOW EQUATIONS

Common Terms

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

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 $= = Net\ Flow \times Heating\ Value \times .001 \times Conversion\ Factor$

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	TON
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

Gross Flow Rate =

$$\frac{Pulses\ per\ second \times Linear\ Factor \times Meter\ Factor \times 3.6 \times Conversion\ Factor}{K\ Factor}$$

Net Flow Rate =

$$\frac{Gross\ Flow \times Flowing\ Density}{Base\ Density} \times Water\ Factor\ Override \times Conversion\ Factor$$

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

Energy Flow Rate = $Net\ Flow \times Heating\ Value \times 0.001 \times Conversion\ Factor$

Where:

Gas Application	US unit	Metric Unit
Density	lb/ft^3	kg/m^3
K Factor	Pulses/CF	Pulses/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	TON
Energy Flow Rate/HR	MMBTU	GJ

Liquid Application	US unit	Metric Unit
Density	lb/ft^3	kg/m^3
K Factor	Pulses/BBL	Pulses/M3
Gross Flow Rate/HR	BBL	M3
Net Flow Rate/HR	BBL	SM3
Mass Flow Rate/HR	MLB	TON

Cone/Smart Cone

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

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

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

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

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

Where:

g_c = Dimensional Conversion Constant

C_f = Flow Coefficient of the Meter

ρ = Density (LB/FT3-US, KG/M3-Metric)

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

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

Y = Adiabatic Expansion Factor for Contoured Elements

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

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

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 =

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

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.

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

$$Where:$$

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

$$DCF = Density\ Correction\ Factor$$

$$D_0 = Calibration\ constant,\ mass/volume,\ gm/cm^3$$

$$t = Densitometer\ oscillation\ period\ in\ microseconds.$$

$$t_0 = A\ calibration\ constant\ in\ microseconds$$

$$T_{coef} = Temperature\ coefficient\ in\ microseconds/°F(USUnit) or °C(MetricUnit)$$

$$P = Flowing\ pressure\ in\ PSIG(USUnit),\ BAR,\ orKG/CM(MetricUnit)$$

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

$$P_{cal} = Calibration\ pressure\ in\ PSIG(USUnit),\ BAR,\ orKG/CM(MetricUnit)$$

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

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

$$Where:$$

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

$$K_0, K_1, K_2 = Calibration\ Constants$$

$$t = Densitometer\ oscillation\ period\ in\ microseconds$$

$$DCF = Density\ Correction\ Factor$$

$$K = Pressure\ Constant$$

$$P_{off} = Pressure\ Offset$$

$$K_T = Temperature\ Coefficient$$

$$T_{cal} = Temperature\ coefficient\ in\ microseconds/{}^\circ F(USUnit), or {}^\circ C(MetricUnit)$$

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
2109	Frequency Input	0 Inferred	Read
2110-2533	Reserved		
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	Spare		
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	Meter #1 Flow Units? 0=MCF,1=KM3,	0 Inferred	Read/Write
2572	AGA 7 Unit ?	0 Inferred	Read/Write
2573	Metric DP Units ? 0=m.BAR,1=KPA	0 Inferred	Read/Write
2574	Meter#1 Application Type – 0=Gas,1=Liquid	0 Inferred	Read/Write
2575	Meter#2 Application Type – 0=Gas,1=Liquid	0 Inferred	Read/Write
2576	Number of Meters (0=1 Meter,1=2 Meters)	0 Inferred	Read/Write
2577	Gross Include Meter Factor	0 Inferred	Read/Write
2578	Meter #2 Flow Units	0 Inferred	Read/Write
2579	Slow Pulse Application	0 Inferred	Read/Write
2580	Flow Rate Cut Off Time (Slow Pulse)	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
2586	Common Temperature	0 Inferred	Read/Write
2587	Common Pressure	0 Inferred	Read/Write
2588-2592	Spare		
2593-2594	Meter #2 ID	8 Chars	Read/Write
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
2601-2602	Spare		
2603-2610	Product Name	16 Chars	Read/Write
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	Flow Cut Off	0 Inferred	Read/Write
2660	Meter #1 Flow Equation	0 Inferred	Read/Write
2661	Y Factor Select	0 Inferred	Read/Write

Modbus Address Table – 16 Bits

ADDRESS	DESCRIPTION	DECIMAL	READ/WRITE
2662	Meter #1 Product Selection	0 Inferred	Read/Write

Gas Application	
Selection	Product
1	AGA8 Gross#1
2	AGA8 Gross#2
3	AGA8 Detail Method

Liquid Application	
Selection	Product
0	Table 24A (US Unit only)
1	Table 24B (US Unit only)
2	New Table 24 (US Unit only)
3	Table 24C (US Unit only)
4	Table 54A (Metric Unit only)
5	Table 54B (Metric Unit only)
6	OLD Table 54 (Metric Unit)
7	Table 54C (Metric Unit Only)
8	Table 60A (Metric Unit Only)
9	Table 60B (Metric Unit Only)
10	Table 60D (Metric Unit Only)

2663	Meter #2 Flow Equation	0 Inferred	Read/Write
2664	Meter #2 Product Selection	0 Inferred	Read/Write

Gas Application	
Selection	Product
1	AGA8 Gross#1
2	AGA8 Gross#2
3	AGA8 Detail Method

Liquid Application	
Selection	Product
0	Table 24A (US Unit only)
1	Table 24B (US Unit only)
2	New Table 24 (US Unit only)
3	Table 24C (US Unit only)
4	Table 54A (Metric Unit only)
5	Table 54B (Metric Unit only)
6	OLD Table 54 (Metric Unit)
7	Table 54C (Metric Unit Only)
8	Table 60A (Metric Unit Only)
9	Table 60B (Metric Unit Only)
10	Table 60D (Metric Unit Only)

2665	Meter#1 Detailed Month Report Var#1 Format	0 Inferred	Read/Write
2666	Meter#1 Detailed Month Report Var#2 Format	0 Inferred	Read/Write
2667	Meter#2 Detailed Month Report Var#1 Format	0 Inferred	Read/Write
2668	Meter#2 Detailed Month Report Var#2 Format	0 Inferred	Read/Write
2669	Meter #1 Daily Report – Variable #1 Selection	0 Inferred	Read/Write
2670	Meter #1 Daily Report – Variable #2 Selection	0 Inferred	Read/Write

Modbus Address Table – 16 Bits

ADDRESS	DESCRIPTION	DECIMAL	READ/WRITE
2671	Meter #2 Daily Report – Variable #1 Selection	0 Inferred	Read/Write
2672	Meter #2 Daily Report – Variable #2 Selection	0 Inferred	Read/Write
2673-2734	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

Modbus Address Table – 16 Bits

ADDRESS	DESCRIPTION	DECIMAL	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
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	Select PID Meter Number (0=None)	0 Inferred	Read/Write
2953-2979	Spare		
2980	Spare		
2981-2984	Spare		
2985	Analog Output –Remote Control (0-100)	0 Inferred	Read/Write
2989-2990	Spare		
2991	Reset PID		

Modbus Address Table – 16 Bits

ADDRESS	DESCRIPTION	DECIMAL	READ/WRITE
3001	Version Number	2 Inferred	Read
3002-3005	Spare		
3006	Meter #2 Product Used	0 Inferred	Read
3007	Meter #1 Product Used	0 Inferred	Read
3008-3011	Meter #1 ID	8 Chars	Read
3012	Spare		
3013-3017	Reserved	0 Inferred	Read
3018	Flow Computer Unit Number	0 Inferred	Read
3019	Disable Alarms (1=Yes)	0 Inferred	Read
3020	Spare		
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,35=Oldest) Daily Data Area in Location 3431-3643	0 Inferred	Write
3027	Last Month Report Request(1=Latest,2=Oldest) Set Last Month Report Request to 1 Monthly Data Area in Location 3431-3643	0 Inferred	Write
3028	Reserved		
3029	Last Hourly Report Request(1=Latest,840=Oldest)	0 Inferred	Write
3030	Last Alarm Report Request (1=Latest,60=Oldest)	0 Inferred	Write
3031	Last Audit Report Request (1=Latest,60=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
3038-3122	Spare		

Modbus 16-bit Address Table En

Modbus Address Table – 2x16 Bits Integer

ADDRESS	DESCRIPTION	DECIMAL	READ/WRITE
3131	Meter#1 Daily Gross Total	1 inferred	Read
3133	Meter#1 Daily Net Total	1 inferred	Read
3135	Meter#1 Daily Mass Total	1 inferred	Read
3137	Meter#1 Daily Energy Total	1 inferred	Read
3139	Meter#1 Hourly Gross Total	1 Inferred	Read
3141	Meter#1 Hourly Net Total	1 Inferred	Read
3143	Meter#1 Hourly Mass Total	1 Inferred	Read
3145	Meter#1 Hourly Energy Total	1 Inferred	Read
3147	Meter#1 Monthly Gross Total	1 Inferred	Read
3149	Meter#1 Monthly Net Total	1 Inferred	Read
3151	Meter#1 Monthly Mass Total	1 Inferred	Read
3153	Meter#1 Monthly Energy Total	1 Inferred	Read
3155	Meter#1 Cumulative Gross Total	0 Inferred	Read
3157	Meter#1 Cumulative Net Total	0 Inferred	Read
3159	Meter#1 Cumulative Mass Total	0 Inferred	Read
3161	Meter#1 Cumulative Energy Total	0 Inferred	Read
3163	Meter Meter Factor	6 Inferred	Read
3165	Meter Linear Factor	6 Inferred	Read
3167-3179	Spare		
3181	Meter#2 Hourly Gross Total	1 Inferred	Read
3183	Meter#2 Hourly Net Total	1 Inferred	Read
3185	Meter#2 Hourly Mass Total	1 Inferred	Read
3187	Meter#2 Hourly Energy Total	1 Inferred	Read
3189	Meter#2 Monthly Gross Total	1 Inferred	Read
3191	Meter#2 Monthly Net Total	1 Inferred	Read
3193	Meter#2 Monthly Mass Total	1 Inferred	Read
3195	Meter#2 Monthly Energy Total	1 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

ADDRESS	DESCRIPTION	DECIMAL	READ/WRITE
Last Daily or Monthly Data Area			
	Set Last Daily Report Request (3026) to 1=Latest,35=Oldtest **Daily Data Area in Location 3431-3643** (3026,16 bits Integer, Write only)		
	Set Last Monthly Report Request (3027) to 1=Latest,2=Oldtest **Monthly Data Area in Location 3431-3643** (3027,16 bits Integer, Write only)		
3431	Meter #1 Product	0 Inferred	Read
3433	Day/Month Start Date	0 Inferred	Read
3435	Day/Month Start Time	0 Inferred	Read
3437-3439	Meter#1 ID	8 Chars.	Read
3441	Meter#1 Flowing Time	1 Inferred	Read
3443	Meter#1 Daily/Monthly Gross Total	1 Inferred	Read
3445	Meter#1 Daily/Monthly Net Total	1 Inferred	Read
3447	Meter#1 Daily/Monthly Mass Total	1 Inferred	Read
3449	Meter#1 Daily/Monthly Energy Total	1 Inferred	Read
3451	Meter#1 Average DP	4 Inferred	Read
3453	Meter#1 Average Temperature	2 Inferred	Read
3455	Meter#1 Average Pressure	2 Inferred	Read
3457	Meter#1 Average DP_EXT	4 Inferred	Read
3459	Meter#1 Average Heating Value	3 Inferred	Read
3461	Meter#1 Average SG	6 Inferred	Read
3463	Meter#1 Average N2	4 Inferred	Read
3465	Meter#1 Average CO2	4 Inferred	Read
3467	Meter#1 Average Methane	4 Inferred	Read
3469	Meter#1 Average Ethane	4 Inferred	Read
3471	Meter#1 Average Propane	4 Inferred	Read
3473	Meter#1 Average Water	4 Inferred	Read
3475	Meter#1 Average H2S	4 Inferred	Read
3477	Meter#1 Average H2	4 Inferred	Read
3479	Meter#1 Average CO	4 Inferred	Read
3481	Meter#1 Average Oxygen	4 Inferred	Read
3483	Meter#1 Average i-Butane	4 Inferred	Read
3485	Meter#1 Average n-Butane	4 Inferred	Read
3487	Meter#1 Average i-Pentane	4 Inferred	Read
3489	Meter#1 Average n-Pentane	4 Inferred	Read
3491	Meter#1 Average n-Hexane	4 Inferred	Read
3493	Meter#1 Average n-Heptane	4 Inferred	Read
3495	Meter#1 Average n-Octane	4 Inferred	Read
3497	Meter#1 Average n-Nonane	4 Inferred	Read
3499	Meter#1 Average n-Decane	4 Inferred	Read
3501	Meter#1 Average Helium	4 Inferred	Read
3503	Meter#1 Average Argon	4 Inferred	Read
3505	Meter#1 Cumulative Gross Total	0 Inderred	Read
3507	Meter#1 Cumulative Net Total	0 Inderred	Read
3509	Meter#1 Cumulative Mass Total	0 Inderred	Read
3511	Meter#1 Cumulative Energy Total	0 Inderred	Read
3513	Spare		
3515	Spare		
3517	Roll Over Number – Meter#1 Gross Month Total	0 Inferred	Read
3519	Roll Over Number – Meter#1 Net Month Total	0 Inferred	Read

Modbus Address Table – 2x16 Bits Integer

ADDRESS	DESCRIPTION	DECIMAL	READ/WRITE
3521	Roll Over Number – Meter#1 Mass Month Total	0 Inferred	Read
3523	Roll Over Number – Meter#1 Energy Month Total	0 Inferred	Read
3525	Roll Over Number – Meter#2 Gross Month Total	0 Inferred	Read
3527	Roll Over Number – Meter#2 Net Month Total	0 Inferred	Read
3529	Roll Over Number – Meter#2 Mass Month Total	0 Inferred	Read
3531	Roll Over Number – Meter#2 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.

ADDRESS	DESCRIPTION	DECIMAL	READ/WRITE
3533	Meter#1 Average- Density US Unit – Gas Application 5 decimal inferred, Liquid Application 3 decimal Inferred Metric Unit – Gas Application 5 decimal inferred, Liquid Application 1 decimal inferred	1, 3, or 5 Inferred	Read
3535	Meter#1 Average- Density@60,@15,@20 US unit – Gas Application 6 decimal inferred, Liquid Application 3 decimal Inferred Metric Unit – Gas Application 6 decimal inferred , Liquid Application 1 decimal inferred	1, 3 or 6 Inferred	Read
3537	Meter#1 Average K/CD/LMF	6 Inferred	Read
3539	Meter#1 Average CTL	5 Inferred	Read
3541	Meter#1 Average CPL	5 Inferred	Read
3543	Spare		
3545	Spare		
3547	Spare		
3549	Spare		
3551	Spare		
3553	Spare		
3555	Meter#2 Product	0 Inferred	Read
3557-3559	Meter#2 ID	8 Chars.	Read
3561	Meter#2 Flowing Time	1 Inferred	Read
3563	Meter#2 Daily/Monthly Gross Total	1 Inferred	Read
3565	Meter#2 Daily/Monthly Net Total	1 Inferred	Read
3567	Meter#2 Daily/Monthly Mass Total	1 Inferred	Read
3569	Meter#2 Daily/Monthly Energy Total	1 Inferred	Read
3571	Meter#2 Average DP	4 Inferred	Read
3573	Meter#2 Average Temperature	2 Inferred	Read
3575	Meter#2 Average Pressure	2 Inferred	Read
3577	Meter#2 Average DP_EXT	4 Inferred	Read
3579	Meter#2 Average Heating Value	3 Inferred	Read
3581	Meter#2 Average SG	6 Inferred	Read
3583	Meter#2 Average N2	4 Inferred	Read
3585	Meter#2 Average CO2	4 Inferred	Read
3587	Meter#2 Average Methane	4 Inferred	Read
3589	Meter#2 Average Ethane	4 Inferred	Read
3591	Meter#2 Average Propane	4 Inferred	Read
3593	Meter#2 Average Water	4 Inferred	Read
3595	Meter#2 Average H2S	4 Inferred	Read
3597	Meter#2 Average H2	4 Inferred	Read
3599	Meter#2 Average CO	4 Inferred	Read
3601	Meter#2 Average Oxygen	4 Inferred	Read
3603	Meter#2 Average i-Butane	4 Inferred	Read
3605	Meter#2 Average n-Butane	4 Inferred	Read
3607	Meter#2 Average i-Pentane	4 Inferred	Read
3609	Meter#2 Average n-Pentane	4 Inferred	Read
3611	Meter#2 Average n-Hexane	4 Inferred	Read
3613	Meter#2 Average n-Heptane	4 Inferred	Read
3615	Meter#2 Average n-Octane	4 Inferred	Read
3617	Meter#2 Average n-Nonane	4 Inferred	Read
3619	Meter#2 Average n-Decane	4 Inferred	Read
3621	Meter#2 Average Helium	4 Inferred	Read
3623	Meter#2 Average Argon	4 Inferred	Read

Modbus Address Table – 2x16 Bits Integer

ADDRESS	DESCRIPTION	DECIMAL	READ/WRITE
3625	Meter#2 Cumulative Gross Total	0 Inderred	Read
3627	Meter#2 Cumulative Net Total	0 Inderred	Read
3629	Meter#2 Cumulative Mass Total	0 Inderred	Read
3631	Meter#2 Cumulative Energy Total	0 Inderred	Read
3633	Meter#2 Average- Density US Unit – Gas Application 5 decimal inferred, Liquid Application 3 decimal Inferred Metric Unit – Gas Application 5 decimal inferred, Liquid Application 1 decimal inferred	5,3,or 1 Inferred	Read
3635	Meter#2 Average- Density@60,@15,@20 US Unit – Gas Application 6 decimal inferred, Liquid Application 3 decimal Inferred Metric Unit – Gas Application 6 decimal inferred , Liquid Application1 decimal inferred	6,3,or 1 Inferred	Read
3637	Meter#2 Average K/CD/LMF	6 Inferred	Read
3639	Meter#2 Average CTL	5 Inferred	Read
3641	Meter#2 Average CPL	5 Inferred	Read
3643	Spare		
3645	Spare		
3647	Spare		
3649	Spare		
3651	Spare		

Last Daily or Monthly Data Area Ends

Modbus Address Table – 2x16 Bits Integer

ADDRESS	DESCRIPTION	DECIMAL	READ/WRITE
3817	Spare		
3819-3999	Reserved		
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	Spare		
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
4253-4349	Spare		
4351	SmartCone/Cone–Reynolds Number Threshold#1	0 Inferred	Read/Write
4353	SmartCone/Cone–Reynolds Number Threshold#2	0 Inferred	Read/Write
4355	SmartCone/Cone–Reynolds Number Threshold#3	0 Inferred	Read/Write
4357	SmartCone/Cone–Reynolds Number Threshold#4	0 Inferred	Read/Write
4359	SmartCone/Cone–Reynolds Number Threshold#5	0 Inferred	Read/Write
4361	SmartCone/Cone–Reynolds Number Threshold#6	0 Inferred	Read/Write
4363	SmartCone/Cone–Flow Coeff. Linear Factor #1	6 Inferred	Read/Write
4365	SmartCone/Cone–Flow Coeff. Linear Factor #2	6 Inferred	Read/Write
4367	SmartCone/Cone–Flow Coeff. Linear Factor #3	6 Inferred	Read/Write
4369	SmartCone/Cone–Flow Coeff. Linear Factor #4	6 Inferred	Read/Write
4371	SmartCone/Cone–Flow Coeff. Linear Factor #5	6 Inferred	Read/Write
4373	SmartCone/Cone–Flow Coeff. Linear Factor #6	6 Inferred	Read/Write
4375	Spare		
4377	Relative Density	6 Inferred	Read/Write
4379	Ratio of Heat	4 Inferred	Read/Wirte
4381	Viscosity	6 Inferred	Read/Write
	Flow Coefficient for Smart Cone/Cone Meter		
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 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	Meter #1 Graphic Setup – DP Maximum	0 Inferred	Read/Write
4419	Meter #1 Graphic Setup – Pressure Maximum	0 Inferred	Read/Write
4421	Meter #1 Graphic Setup – Temperature Maximum	0 Inferred	Read/Write
4423	Meter #1 Graphic Setup – Flow Maximum	0 Inferred	Read/Write
4425	Meter #2 Graphic Setup – DP Maximum	0 Inferred	Read/Write
4427	Meter #2 Graphic Setup – Pressure Maximum	0 Inferred	Read/Write
4429	Meter #2 Graphic Setup – Temperature Maximum	0 Inferred	Read/Write
4431	Meter #2 Graphic Setup – Flow Maximum	0 Inferred	Read/Write
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 Flow Coefficient K	6 Inferred	Read/Write

Modbus Address Table – 2x16 Bits Integer

ADDRESS	DESCRIPTION	DECIMAL	READ/WRITE
4443	Annubar 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
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
4623-4653	Spare		
4655	Meter#1 Water Factor Override	6 Inferred	Read/Write
4657	Meter#1 Heating Value Override	3 Inferred	Read/Write
4659	Meter#1 FPV Override	6 Inferred	Read/Write
4661	Meter#1 Temperature Override	2 Inferred	Read/Write
4663	Meter#1 Pressure Override	2 Inferred	Read/Write
4665	Meter#2 Water Factor Override	6 Inferred	Read/Write
4667	Meter#2 Heating Value Override	3 Inferred	Read/Write
4669	Meter#2 FPV Override	6 Inferred	Read/Write
4671	Meter#2 Temperature Override	2 Inferred	Read/Write
4673	Meter#2 Pressure Override	2 Inferred	Read/Write
4675-4825	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, 840=Oldest)**		

(3029,16 bits 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#1 Hourly Duration of Flow	1 Inferred	Read
8007	Meter#1 GrossTotal	1 Inferred	Read
8009	Meter#1 Net Total	1 Inferred	Read
8011	Meter#1 Mass Total	1 Inferred	Read
8013	Meter#1 Energy Total	1 Inferred	Read
8015	Meter#1 Average Temperature	1 Inferred	Read
8017	Meter#1 Average Pressure	1 Inferred	Read
8019	Meter#1 Average DP	4 Inferred	Read
8021	Meter#1 Average DP/EXT	4 Inferred	Read
8023	Meter#1 SG (US)/Density (Metric)	6 or 1 Inferred	Read
8023-8403	Reserved		
8405	Meter#2 Hourly Duration of Flow	1 Inferred	Read
8407	Meter#2 GrossTotal	1 Inferred	Read
8409	Meter#2 Net Total	1 Inferred	Read
8411	Meter#2 Mass Total	1 Inferred	Read
8413	Meter#2 Energy Total	1 Inferred	Read
8415	Meter#2 Average Temperature	1 Inferred	Read
8417	Meter#2 Average Pressure	1 Inferred	Read
8419	Meter#2 Average DP	4 Inferred	Read
8421	Meter#2 Average DP/EXT	4 Inferred	Read
8423	Meter#1 SG (US)/Density (Metric)	6 or 1 Inferred	Read

Last Hourly Data Area Ends

Modbus Address Table – 2x16 Bits Integer

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

Last Month Data Area

ADDRESS	DESCRIPTION	DECIMAL	READ/WRITE
8025	Gas Data - SG	6 Inferred	Read
8027	Gas Data - N2 Percentage	4 Inferred	Read
8029	Gas Data - CO2 Percentage	4 Inferred	Read
8031	Meter #1 Heating Value	3 Inferred	Read
8033	Meter #1 Pipe ID	5 Inferred	Read
8035	Meter #1 Orifice ID	5 Inferred	Read
8037	Base Temperature	2 Inferred	Read
8039	Base Pressure	4 Inferred	Read
8041	Atmospheric Pressure	4 Inferred	Read
8043	Gas Data - 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	Meter#1 Daily Flowing Time	1 Inferred	Read
8055	Meter#1 Daily Total – User Defined Variable #1	1 Inferred	Read
8057	Meter#1 Daily Total – User Defined Variable #2	1 Inferred	Read
8059	Meter#1 Daily Average Temperature	2 Inferred	Read
8061	Meter#1 Daily Average Pressure	2 Inferred	Read
8063	Meter#1 Daily Average DP	4 Inferred	Read
8065	Meter#1 Daily Average DP/EXT	4 Inferred	Read
8067	Meter#1 Month Flowing Time	1 Inferred	Read
8069	Meter#1 Month Total – User Defined Variable #1	1 Inferred	Read
8071	Meter#1 Month Total – User Defined Variable #2	1 Inferred	Read
8073	Meter#1 Month Average Temperature	2 Inferred	Read
8075	Meter#1 Month Average Pressure	2 Inferred	Read
8077	Meter#1 Month Average DP	4 Inferred	Read
8079	Meter#1 Month Average DP/EXT	4 Inferred	Read
8081-8085	Reserved		
8087	Meter#1 Roll Over Number of Regiser 8069	0 Inferred	Read
8089	Meter#1 Roll Over Number of Regiser 8071	0 Inferred	Read

Modbus Address Table – 2x16 Bits Integer

ADDRESS	DESCRIPTION	DECIMAL	READ/WRITE
8447	Meter #2 Heating Value	3 Inferred	Read
8449	Meter #2 Pipe ID	5 Inferred	Read
8451	Meter #2 Orifice ID	5 Inferred	Read
8453	Meter#2 Daily Flowing Time	1 Inferred	Read
8455	Meter#2 Daily Total – User Defined Variable#1	1 Inferred	Read
8457	Meter#2 Daily Total – User Defined Variable#2	1 Inferred	Read
8459	Meter#2 Daily Average Temperature	2 Inferred	Read
8461	Meter#2 Daily Average Pressure	2 Inferred	Read
8463	Meter#2 Daily Average DP	4 Inferred	Read
8465	Meter#2 Daily Average DP/EXT	4 Inferred	Read
8467	Meter#2 Month Flowing Time	1 Inferred	Read
8469	Meter#2 Month Total – User Defined Variable#1	1 Inferred	Read
8471	Meter#2 Month Total – User Defined Variable#2	1 Inferred	Read
8473	Meter#2 Month Average Temperature	2 Inferred	Read
8475	Meter#2 Month Average Pressure	2 Inferred	Read
8477	Meter#2 Month Average DP	4 Inferred	Read
8479	Meter#2 Month Average DP/EXT	4 Inferred	Read
8481	Meter#2 Roll Over Number of Regiser 8455	0 Inferred	Read
8483	Meter#2 Roll Over Number of Regiser 8457	0 Inferred	Read
8485-8499	Spare		

(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.

(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

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

Current Data Area

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

Modbus Address Table – 2x16 Bits Integer

ADDRESS	DESCRIPTION	DECIMAL	READ/WRITE
9101	Meter#1Density US Unit – Gas Application 5 decimal inferred, Liquid Application 3 decimal Inferred Metric Unit – Gas Application 5 decimal inferred, Liquid Application 1 decimal inferred	1,3, or 5 Inferred	Read
9103	Meter#1 Dens.b US Unit – Gas Application 6 decimal inferred, Liquid Application 3 decimal Inferred Metric Unit – Gas Application 6 decimal inferred, Liquid Application 1 decimal inferred	1,3, or 6 Inferred	Read
9105	Meter#1 SG	6 Inferred	Read
9107	Meter#1 Y Factor	6 Inferred	Read
9109	Meter#1 K /CD/LMF	6 Inferred	Read
9111	Meter#1 DP EXT	4 Inferred	Read
9113	Meter#1 FPV	6 Inferred	Read
9115-9119	Spare		
9121	Meter#1 Last Month Gross Total	0 Inferred	Read
9123	Meter#1 Last Month Net Total	0 Inferred	Read
9125	Meter#1 Last Month Mass Total	0 Inferred	Read
9127	Meter#1 Last Month Energy Total	0 Inferred	Read
9129	Meter#1 Yesterday’s Gross Total	1 Inferred	Read
9131	Meter#1 Yesterday’s Net Total	1 Inferred	Read
9133	Meter#1 Yesterday’s Mass Total	1 Inferred	Read
9135	Meter#1 Yesterday’s Energy Total	1 Inferred	Read
9137	Meter#1 Last Hour Gross Total	1 Inferred	Read
9139	Meter#1 Last Hour Net Total	1 Inferred	Read
9141	Meter#1 Last Hour Mass Total	1 Inferred	Read
9143	Meter#1 Last Hour Energy Total	1 Inferred	Read
9145	Meter#2 Yesterday’s Gross Total	1 Inferred	Read
9147	Meter#2 Last Month Gross Total	0 Inferred	Read
9149	Meter#1 Yesterday Flowing Time	1 Inferred	Read
9151	Meter#1 Yesterday’s Avg SG (US)/Density (Metric)	4 Inferred	Read
9153	Meter#1 Yesterday Flow Averaged DP	4 Inferred	Read
9155	Meter#1 Yesterday Flow Averaged Temperature	2 Inferred	Read
9157	Meter#1 Yesterday Flow Averaged Pressure	2 Inferred	Read
9159	Meter#1 Last Hour Flowing Time	1 Inferred	Read
9161	Meter#1 Last Hour Flow Averaged SG/Density	4 Inferred	Read
9163	Meter#1 Last Hour Flow Averaged DP	4 Inferred	Read
9165	Meter#1 Last Hour Flow Averaged Temperature	2 Inferred	Read
9167	Meter#1 Last Hour Flow Averaged Pressure	2 Inferred	Read
9169	Meter#2 Last Hour Flowing Time	1 Inferred	Read
9171	Meter#2 Last Hour Flow Averaged SG/Density	4 Inferred	Read
9173	Meter#2 Last Hour Flow Averaged DP	4 Inferred	Read
9175	Meter#2 Last Hour Flow Averaged Temperature	2 Inferred	Read
9177	Meter#2 Last Hour Flow Averaged Pressure	2 Inferred	Read
9179	Meter#2 Last Hour Gross Total	1 Inferred	Read
9181	Meter#2 Last Hour Net Total	1 Inferred	Read
9183	Meter#2 Last Hour Mass Total	1 Inferred	Read
9185	Meter#2 Last Hour Energy Total	1 Inferred	Read
9187	Meter#2 Yesterday Flowing Time	1 Inferred	Read
9189	Meter#2 Yesterday Flow Averaged SG/Density	4 Inferred	Read
9191	Meter#2 Yesterday Flow Averaged DP	4 Inferred	Read
9193	Meter#2 Yesterday Flow Averaged Temperature	2 Inferred	Read
9195	Meter#2 Yesterday Flow Averaged Pressure	2 Inferred	Read

Modbus Address Table – 2x16 Bits Integer

ADDRESS	DESCRIPTION	DECIMAL	READ/WRITE
9197	Spare		
9199	Spare		

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

ADDRESS	DESCRIPTION	DECIMAL	READ/WRITE
9201	Meter#2 Calculation Type	0 Inferred	Read
9203	Meter#2 Flow Flag	0 Inferred	Read
9205	Meter#2 Alarm Status Flag	0 Inferred	Read
9207	Meter#2 Daily Gross Total	1 inferred	Read
9209	Meter#2 Daily Net Total	1 inferred	Read
9211	Meter#2 Daily Mass Total	1 inferred	Read
9213	Meter#2 Daily Energy Total	1 inferred	Read
9215	Meter#2 Cum. Gross Total*	0 Inferred	Read
9217	Meter#2 Cum. Net Total*	0 Inferred	Read
9219	Meter#2 Cum. Mass Total*	0 Inferred	Read
9221	Meter#2 Cum. Energy Total*	0 Inferred	Read
9223	Meter#2 Heating Value	3 Inferred	Read
9225	Meter#2 Gross Flowrate	2 Inferred	Read
9227	Meter#2 Net Flowrate	2 Inferred	Read
9229	Meter#2 Mass Flowrate	2 Inferred	Read
9231	Meter#2 Energy Flowrate	2 Inferred	Read
9233	Meter#2 Product	0 Inferred	Read
9235-9237	Meter#2 Meter ID	8 Chars.	Read
9239	Meter#2 Pipe ID	5 Inferred	Read
9241	Meter#2 Orifice ID	5 Inferred	Read
9243	Meter#2 K Factor	3 Inferred	Read
9245	Meter#2 DP	4 Inferred	Read
9247	Meter#2Temperature	2 Inferred	Read
9249	Meter#2 Pressure	2 Inferred	Read
9251	Meter#2Density	5 Inferred	Read
	US Unit – Gas Application 5 decimal inferred, Liquid Application 3 decimal Inferred		
	Metric Unit – Gas Application 5 decimal inferred, Liquid Application 1 decimal inferred		
9253	Meter#2 Dens.b	6 Inferred	Read
	US Unit – Gas Application 6 decimal inferred, Liquid Application 3 decimal Inferred		
	Metric Unit – Gas Application 6 decimal inferred, Liquid Application 1 decimal inferred		
9255	Meter#2 SG	6 Inferred	Read
9257	Meter#2 Y Factor	6 Inferred	Read
9259	Meter#2 K /CD/LMF	6 Inferred	Read
9261	Meter#2 DP EXT	4 Inferred	Read
9263	Meter#2 FPV	6 Inferred	Read
9265	Meter#2 CTL	5 Inferred	Read
9267	Meter#2 CPL	5 Inferred	Read
9269	Meter#2 C t,anp	5 Inferred	Read
9271	Meter#2 SG at 60 Deg.F	4 Inferred	Read
9273	Meter #1 CTL	5 Inferred	Read
9275	Meter #1 CPL	5 Inferred	Read
9277	Meter #1 C t,anp	5 Inferred	Read
9279	Meter #1 SG at 60, 15 Deg.F	4 Inferred	Read

Modbus Address Table – 2x16 Bits Integer

ADDRESS	DESCRIPTION	DECIMAL	READ/WRITE
9281	Meter#2 Last Month Net Total	0 Inferred	Read
9283	Meter#2 Last Month Mass Total	0 Inferred	Read
9285	Meter#2 Last Month Energy Total	0 Inferred	Read
9287	Meter#2 Yesterday's Net Total	1 Inferred	Read
9289	Meter#2 Yesterday's Mass Total	1 Inferred	Read
9291	Meter#2 Yesterday's Energy Total	1 Inferred	Read
9293-9519	Spare		
9521	Multi.Var DP	4 Inferred	Read
9523	Multi.Var.Pressure	2 Inferred	Read
9525	Multi. Variable Temperature	2 Inferred	Read

Modbus Table - Floating Point

7001-7002	Reserved	Read/Write

AGA 8 GROSS METHOD 1

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

AGA 8 GROSS METHOD 2

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

AGA 8 Detail Method

7003	Mol % of Methane	Read/Write
7004	Mol % of Nitrogen	Read/Write
7005	Mol % of Carbon Dioxide	Read/Write
7006	Mol % of Ethane	Read/Write
7007	Mol % of Propane	Read/Write
7008	Mol % of Water	Read/Write
7009	Mol % of Hydrogen Sulfide	Read/Write
7010	Mol % of Hydrogen	Read/Write
7011	Mol % of Carbon Monoxide	Read/Write
7012	Mol % of Oxygen	Read/Write
7013	Mol % of i-Butane	Read/Write
7014	Mol % of n-Butane	Read/Write
7015	Mol % of i-Pentane	Read/Write
7016	Mol % of n-Pentane	Read/Write
7017	Mol % of i-Hexane	Read/Write
7018	Mol % of n-Heptane	Read/Write
7019	Mol % of i-Octane	Read/Write
7020	Mol % of i-Nonane	Read/Write
7021	Mol % of i-Decane	Read/Write
7022	Mol % of Helium	Read/Write
7023	Mol % of Argon	Read/Write

7024	Meter#2 Flow Rate Low Limit	Read/Write
7025	Meter#2 Flow Rate High Limit	Read/Write
7026	Orifice ID	Read/Write
7027	Pipe ID	Read/Write
7028	Meter K Factor	Read/Write
7029	Meter#1 Flow Rate Low Limit	Read/Write
7030	Meter#1 Flow Rate High Limit	Read/Write
7031	Base Temperature	Read/Write
7032	Base Pressure	Read/Write
7033	Atmospheric Pressure	Read/Write
7034	Spare	
7035	Slotted DP Meter – DP/P Limit	Read/Write
7036	Viscosity for Smart Cone/Cone Meter	Read/Write

FLOATING POINTS

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	Product SG @60, @15, @20	Read/Write
7043	Product Density @60, @15, @20	Read/Write
7044	Product Alpha T	Read/Write
7901	Analog Output @4mA	Read/Write
7902	Analog Output @20mA	Read/Write
7903	Meter #1 Base Density Override	Read/Write
7904	Meter #1 Flowing Density Override	Read/Write
7905	Meter #2 Base Density Override	Read/Write
7906	Meter #2 Flowing Density Override	Read/Write
7907	Orifice ID #1	Read/Write
7908	Orifice ID #2	Read/Write
7909	Orifice ID #3	Read/Write
7910	Orifice ID #4	Read/Write
7911	Orifice ID #5	Read/Write
7912	Orifice ID #6	Read/Write
7913-7914	Spare	
7915	Analog Output Value	Read

FLOATING POINTS

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

CURRENT DATA AREA

7100	Spare	
7101	Meter #1 Gross Flowrate	Read
7102	Meter #1 Net Flowrate	Read
7103	Meter #1 Mass Flowrate	Read
7104	Meter #1 Energy Flowrate	Read
7105	Meter #1 Daily Gross Total	Read
7106	Meter #1 Daily Net Total	Read
7107	Meter #1 Daily Mass Total	Read
7108	Meter #1 Daily Energy Total	Read
7109	Meter #1 Cum. Gross Total	Read
7110	Meter #1 Cum. Net Total	Read
7111	Meter #1 Cum. Msss Total	Read
7112	Meter #1 Cum. Energy Total	Read
7113	Meter #1 DP	Read
7114	Meter #1 Temperature	Read
7115	Meter #1 Pressure	Read
7116	Meter #1 Density	Read
7117	Meter #1 Heating Value	Read
7118	Meter #1 Dens.b	Read
7119	Meter #1 SG	Read
7120	Meter #1 Y Factor	Read
7121	Meter #1 K/CD/LMF	Read
7122	Meter #1 FA	Read
7123	Meter #1 FPV	Read
7124	Gas Data - N2 Percent	Read
7125	Gas Data - CO2 Percent	Read
7126	Gas Data - Methane Percent	Read
7127	Gas Data - Etnane Percent	Read
7128	Gas Data - Propane Percent	Read
7129	Gas Data - Water Percent	Read
7130	Gas Data - H2S Percent	Read
7131	Gas Data - H2 Percent	Read
7132	Gas Data - CO Percent	Read
7133	Gas Data - Oxygen Percent	Read
7134	Gas Data - I-Butane Percent	Read
7135	Gas Data - n-Butane Percent	Read
7136	Gas Data - I-Pentane Percent	Read
7137	Gas Data - n-Pentane Percent	Read
7138	Gas Data - n-Hexane Percent	Read
7139	Gas Data - n-Heptane Percent	Read
7140	Gas Data - n-Octane Percent	Read
7141	Gas Data - n-Nonane Percent	Read
7142	Gas Data - n-Decane Percent	Read
7143	Gas Data - Helium Percent	Read
7144	Gas Data - Argon Percent	Read

FLOATING POINTS

7145	Meter#1 Pipe ID	Read
7146	Meter#1 Orifice ID	Read
7147	Spare	Read
7148	Meter#1 Daily Flow Time in Minutes	Read
7149	Meter#1 Daily Flow Time in Seconds	Read
7150	Meter#1 Cum. Gross Roll Over Times	Read
7151	Date	Read
7152	Time	Read
7153	Meter#1 Cum. Net Roll Over Times	Read
7154	Meter#1 Cum. Mass Roll Over Times	Read
7155	Meter#1 Cum. Energy Roll Over Times	Read
7156	Meter #1 CTL	Read
7157	Meter #1 CPL	Read
7158	Meter #1 CTL a_int	Read
7159	Meter #1 SG.b	Read
7160	Spare	
7161	Meter #2 Gross Flow Rate	Read
7162	Meter #2 Net Flow Rate	Read
7163	Meter #2 Mass Flow Rate	Read
7164	Meter #2 Energy Flow Rate	Read
7165	Meter #2 Gross Daily Total	Read
7166	Meter #2 Net Daily Total	Read
7167	Meter #2 Mass Daily Total	Read
7168	Meter #2 Energy Daily Total	Read
7169	Meter #2 Gross Cum. Total	Read
7170	Meter #2 Net Cum. Total	Read
7171	Meter #2 Mass Cum. Total	Read
7172	Meter #2 Energy Cum. Total	Read
7173	Meter #2 DP	Read
7174	Meter #2 Temperature	Read
7175	Meter #2 Pressure	Read
7176	Meter #2 Density	Read
7177	Meter #2 Heating Value	Read
7178	Meter #2 Density.b	Read
7179	Meter #2 SG	Read
7180	Meter #2 Y	Read
7181	Meter #2 K/CD/LMF	Read
7182	Meter #2 FPV	Read
7183	Meter #2 FA	Read
7184	Meter #2 Daily Flow Time in Minutes	Read
7185	Meter #2 Daily Flow Time in Seconds	Read
7186	Meter #2 Cum. Gross Roll Over Times	Read
7187	Meter #2 Cum. Net Roll Over Times	Read
7188	Meter #2 Cum. Mass Roll Over Times	Read
7189	Meter #2 Cum. Energy Roll Over Times	Read
7190	Meter #2 CTL	Read
7191	Meter #2 CPL	Read
7192	Meter #2 CTL a_int	Read
7193	Meter #2 SG.b	Read
7194	Meter #2 Pipe ID	Read
7195	Meter #2 Orifice ID	Read

FLOATING POINTS

Last Month Data

7268	Meter #1 Gross Total	Read
7269	Meter #1 Net Total	Read
7270	Meter #1 Mass Total	Read
7271	Meter #1 Energy Total	Read
7287	Roll Over Number – Meter #1 Gross Total	Read
7288	Roll Over Number – Meter #1 Net Total	Read
7289	Roll Over Number – Meter #1 Mass Total	Read
7290	Roll Over Number – Meter #1 Energy Total	Read
7468	Meter #2 Gross Total	Read
7469	Meter #2 Net Total	Read
7470	Meter #2 Mass Total	Read
7471	Meter #2 Energy Total	Read
7291	Roll Over Number – Meter #2 Gross Total	Read
7292	Roll Over Number – Meter #2 Net Total	Read
7293	Roll Over Number – Meter #2 Mass Total	Read
7294	Roll Over Number – Meter #2 Energy Total	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

FLOATING POINTS

Last Hour Data

7272	Meter #1 Gross Total	Read
7273	Meter #1 Net Total	Read
7274	Meter #1 Mass Total	Read
7275	Meter #1 Energy Total	Read
7282	Meter #1 Flowing Time	Read
7283	Meter #1 Average SG	Read
7284	Meter #1 Average DP	Read
7285	Meter #1 Average Temperature	Read
7286	Meter #1 Average Pressure	Read
7295	Meter #2 Gross Total	Read
7296	Meter #2 Net Total	Read
7297	Meter #2 Mass Total	Read
7298	Meter #2 Energy Total	Read
7701	Meter #2 Flowing Time	Read
7702	Meter #2 Average SG	Read
7703	Meter #2 Average DP	Read
7704	Meter #2 Average Temperature	Read
7705	Meter #2 Average Pressure	Read

FLOATING POINTS

Yesterday's Data

7257	Meter #1 Flowing Time in Minutes (One Decimal Resolution)	Read
7258	Meter #1 Average SG	Read
7259	Meter #1 Average DP	Read
7260	Meter #1 Average Temperature	Read
7261	Meter #1 Average Pressure	Read
7276	Meter #1 Gross Total	Read
7277	Meter #1 Net Total	Read
7278	Meter #1 Mass Total	Read
7279	Meter #1 Energy Total	Read
7706	Meter #2 Flowing Time in Minutes (One Decimal Resolution)	Read
7707	Meter #2 Average SG	Read
7708	Meter #2 Average DP	Read
7709	Meter #2 Average Temperature	Read
7710	Meter #2 Average Pressure	Read
7456	Meter #2 Gross Total	Read
7457	Meter #2 Net Total	Read
7458	Meter #2 Mass Total	Read
7459	Meter #2 Energy Total	Read
7724	Meter #1 Flowing Time in Minutes (Floating Format)	Read
7725	Meter #1 Flowing Time in Seconds	Read
7726	Meter #2 Flowing Time in Minutes (Floating Format)	Read
7727	Meter #2 Flowing Time in Seconds	Read

FLOATING POINTS

Previous Daily Data – Meter

3026 **Last Daily Report Request (1=Latest,35=Oldest)**

(3026,16 bits Integer, Write only)

7201	Date	Read
7202	Time	Read
7203	Meter#1 Flow Time (Hour)	Read
7204	Meter#1 Average DP	Read
7205	Meter#1 Average Pressure	Read
7206	Meter#1 Average Temperature	Read
7207	Meter#1 Average DP/EXT	Read
7208	Meter#1 Gross Total	Read
7209	Meter#1 Net Total	Read
7210	Meter#1 Mass Total	Read
7211	Meter#1 Energy Total	Read
7212	Meter#1 Average Heating Value	Read
7213	Meter#1 Average SG	Read
7214	Meter#1 Average N2 Percent	Read
7215	Meter#1 Average CO2 Percent	Read
7216	Meter#1 Average Methane Percent	Read
7217	Meter#1 Average Ethane Percent	Read
7218	Meter#1 Average Propane Percent	Read
7219	Meter#1 Average Water Percent	Read
7220	Meter#1 Average H2S Percent	Read
7221	Meter#1 Average H2 Percent	Read
7222	Meter#1 Average CO Percent	Read
7223	Meter#1 Average Oxygen Percent	Read
7224	Meter#1 Average I-Butane Percent	Read
7225	Meter#1 Average n-Butane Percent	Read
7226	Meter#1 Average I-Pentane Percent	Read
7227	Meter#1 Average n-Pentane Percent	Read
7228	Meter#1 Average n-Hexane Percent	Read
7229	Meter#1 Average n-Heptane Percent	Read
7230	Meter#1 Average n-Octane Percent	Read
7231	Meter#1 Average n-Nonane Percent	Read
7232	Meter#1 Average n-Decane Percent	Read
7233	Meter#1 Average Helium Percent	Read
7234	Meter#1 Average Argon Percent	Read
7235	Spare	

7401	Date	Read
7402	Time	Read
7403	Meter#2 Flow Time (Hour)	Read
7404	Meter#2 Average DP	Read
7405	Meter#2 Average Pressure	Read
7406	Meter#2 Average Temperature	Read
7407	Meter#2 Average DP	Read
7408	Meter#2 Average DP/EXT	Read
7409	Meter#2 Gross Total	Read
7410	Meter#2 Net Total	Read
7411	Meter#2 Mass Total	Read
7412	Meter#2 Energy Total	Read

FLOATING POINTS

7413	Meter#2 Average Heating Value	Read
7414	Meter#2 Average SG	Read
7415	Meter#2 Average N2 Percent	Read
7416	Meter#2 Average CO2 Percent	Read
7417	Meter#2 Average Methane Percent	Read
7418	Meter#2 Average Ethane Percent	Read
7419	Meter#2 Average Propane Percent	Read
7420	Meter#2 Average Water Percent	Read
7421	Meter#2 Average H2S Percent	Read
7422	Meter#2 Average CO Percent	Read
7423	Meter#2 Average Oxygen Percent	Read
7424	Meter#2 Average I-Butane Percent	Read
7425	Meter#2 Average n-Butane Percent	Read
7426	Meter#2 Average I-Pentane Percent	Read
7427	Meter#2 Average n-Pentane Percent	Read
7428	Meter#2 Average n-Hexane Percent	Read
7429	Meter#2 Average n-Heptane Percent	Read
7430	Meter#2 Average n-Octane Percent	Read
7431	Meter#2 Average n-Nonane Percent	Read
7432	Meter#2 Average n-Decane Percent	Read
7433	Meter#2 Average Helium Percent	Read
7434	Meter#2 Average Argon Percent	Read

FLOATING POINTS

Previous Hourly Data

3029 **Last Hourly Report Request(1=Latest,840=Oldest)**
(3029,16 bits Integer, Write only)

7241	Date	Read
7242	Time	Read
7243	Meter#1 Flow Time	Read
7244	Meter#1 Average DP	Read
7245	Meter#1 Average Temperature	Read
7246	Meter#1 Average Pressure	Read
7247	Meter#1 Average DP/EXT	Read
7248	Meter#1 Hourly Gross	Read
7249	Meter#1 Hourly Net	Read
7250	Meter#1 Hourly Mass	Read
7251	Meter#1 Hourly Energy	Read

7443	Meter #2 Flow Time	Read
7444	Meter #2 Average DP	Read
7445	Meter #2 Average Temperature	Read
7446	Meter #2 Average Pressure	Read
7447	Meter #2 Average DP/EXT	Read
7448	Meter #2 Hourly Gross	Read
7449	Meter #2 Hourly Net	Read
7450	Meter #2 Hourly Mass	Read
7451	Meter #2 Hourly Energy	Read

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

Previous Daily Data – Prog.Var

3026 **Last Daily Report Request (1=Latest,35=Oldest)**
(3026,16 bits Integer, Write only)

7056	Program Variable #1	Read
7057	Program Variable #2	Read
7058	Program Variable #3	Read
7059	Program Variable #4	Read
7060	Program Variable #5	Read

FLOATING POINTS

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 35 day's data. The daily pointer will be 1 through 35. The pointer will roll over at 35 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 POINTS

Daily Archive 703, 705 - 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 840 hour's data. The hourly pointer will be 1 through 840. (The pointer will roll over at 840 to 1).

Hourly Archive 704, 706) 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

FLOATING POINTS

Programmable Floating Point Variable

Scratch Pad for Floating Point Variables – 7801-7830

7831-7899 – Programmable Variable Statements

Hourly Programmable Variables 7051-7055

3029 = Last Hourly Report Request (3029,16 bits Integer, Write only)

Set last hourly report request to 1 for latest

7051	Hourly Programmable Variables #1
7052	Hourly Programmable Variables #2
7053	Hourly Programmable Variables #3
7054	Hourly Programmable Variables #4
7055	Hourly Programmable Variables #5

Alarms, Audit Trail, and Calibration

Previous Alarms and Status Codes

Set last alarm status request (3030) to 1. (3030,16 bits Integer, Write only)
4001-4005 (2x16 bits 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#1
12	Meter#2

CODE (Only For ID=Meter)

1	Net Flowrate (Gross –AGA7)
2	Density Out of Range

7	Down
8	Start

ACODE

N/A

STATUS

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

1	ID=18	Calib.Mode
	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 Area

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

8101-8109 (2x16 bits 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 #1
2	Meter #2

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

Audit Codes

1	DP Cut Off
2	Spare
3	Heating Value
4	Flowing Density Override
5	Base Density Override
6	Pipe ID
7	Orifice ID
8	Temperature Override
9	Pressure Override
10	Spare
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	Analog Output @4mA
133	Analog Output @20mA
137	Maintenance
138	Override
139	Low Limit
140	High Limit

162	Disable Alarms
163	
164	Product
165	History Monthly Report Var#1
166	History Monthly Report Var#2
167	History Daily Report Var#1
168	History Daily Report Var#2
170	Gas or Liquid
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

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 Area

3020	**Last Calib./Verification Rpt Req.(1=Latest,20=Oldest) 0 InferredRead/Write**
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#1 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#1 Down
02	00	00	00	Meter#1 Density Out of Range
04	00	00	00	Meter#1 Net Flowrate High(Gross Flowrate High if AGA7 is selected)
08	00	00	00	Meter#1 Net Flowrate Low (Gross Flowrate Low if AGA7 is selected)
10	00	00	00	Meter#2 Down
20	00	00	00	Meter#2 Density Out of Range
40	00	00	00	Meter#2 Net Flowrate High(Gross Flowrate High if AGA7 is selected)
80	00	00	00	Meter#2 Net Flowrate Low (Gross Flowrate Low if AGA7 is selected)

Other Alarms (Modbus Address 9533)

4 Bytes in Hex - FF FF FF FF

00	80	00	00	Calibration Mode 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

Current Alarms Status Section Ends

Data Packet

Previous Hourly Data Packet (101-268)

Hourly archive flow data 101, 102, .. 268 are fixed length arrays. The data field is used to address an 5 hours individual group record.(101=Latest, 268=Oldest)

RTU MODE -

ADDR	FUNC CODE	ARCHIVE NUMBER		METER NUMBER		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 (24 Bits)/ Hour (8 Bits)	0 Inferred	First Hour
Alarm Status	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 (24 Bits)/ Hour (8 Bits)	0 Inferred	Second Hour
Alarm Status	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

DESCRIPTION	DECIMAL	HOUR
Date (24 Bits)/ Hour (8 Bits)	0 Inferred	Third Hour
Alarm Status	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 (24 Bits)/ Hour (8 Bits)	0 Inferred	Fourth Hour
Alarm Status	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 (24 Bits)/ Hour (8 Bits)	0 Inferred	Fifth Hour
Alarm Status	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

DATA PACKET

*Note: Alarm Status

Bit 0	0 – Meter #1 Live DP 1 – Meter #1 DP maintenance value.
Bit 1	0 – Meter #1 Live Pressure 1 – Meter #1 Pressure maintenance or override value
Bit 2	0 – Meter #1 Live Temperature 1 – Meter #1 Temperature maintenance or override value
Bit 3	Spare
Bit 4	0 – Meter #2 Live DP 1 – Meter #2 DP maintenance value.
Bit 5	0 – Meter #2 Live Pressure 1 – Meter #2 Pressure maintenance or override value
Bit 6	0 – Meter #2 Live Temperature 1 – Meter #2 Temperature maintenance or override value

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

DATA PACKET

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

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

Number	Hour
251	751-755
252	756-760
253	761-765
254	766-770
255	771-775
256	776-780
257	781-785
258	786-790
259	791-795
260	796-800
261	801-805
262	806-810
263	811-815
264	816-820
265	821-825
266	826-830
267	831-835
268	836-840

DATA PACKET

Previous Daily Data Packet (601- Meter#1, 602-Meter#2)

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, 35=Oldest)

RTU MODE -

ADDR	FUNC CODE	ARCHIVE NUMBER		DATA FIELD		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)	VAR#1 (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)	VAR#2 (1st Part)

Variable#3 (16 Bits)

16 Bits (2nd Part VAR#2)
VAR#2

Report Format Selection

Meter Number	**Variable #1**	**Variable #2**
1	2669	2670
2	2671	2672

Selection	**VAR#1**	**Decimal Inferred**
0	Gross Total	1
1	Net Total	1
2	Mass Total	1
3	Energy Total	1

Selection	**VAR#2**	**Decimal Inferred**
0	Gross Total	1
1	Net Total	1
2	Mass Total	1
3	Energy Total	1
4	DP/EXT	4

DATA PACKET

Previous Month Data Packet (411,421)

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

RTU MODE -

ADDR	FUNC CODE	ARCHIVE NUMBER		METER NUMBER		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 (GAS)	6 Inferred
N2	4 Inferred
CO2	4 Inferred
Heating Value (GAS)	3 Inferred
Pipe ID	4 Inferred
Orifice ID	4 Inferred
Base Temperature	2 Inferred
Base Pressure…	4 Inferred
Atmospheric Pressure…	4 Inferred
DP Cut Of (Gas) / Flow Cut Off (Liquid)	4 Inferred
Flowing Time	1 Inferred
Month Total – VAR#1	1 Inferred
Month Total – VAR#2	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.

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
VAR#1	1 Inferred	First Day
VAR#2	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
VAR#1	1 Inferred	Eighth Day
VAR#2	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

VAR#1 and VAR #2 Modbus Register

Meter Number	Variable #1	Variable #2
1	2665	2666
2	2667	2668

Selection	VAR#1	Decimal Inferred
0	Gross Total	1
1	Net Total	1
2	Mass Total	1
3	Energy Total	1

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	ARCHIVE NUMBER		METER NUMBER		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	Meter #1 Daily Average Gas Quality
702	Archive	Meter #2 Daily Average Gas Quality
703	Archive	Meter #1 Daily Flow Data Log
704	Archive	Meter #1 Hourly Flow Data Log
705	Archive	Meter #2 Daily Flow Data Log
706	Archive	Meter #2 Hourly Flow Data Log

Archive 701,702 Previous Daily Data-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 35 day's data. The daily pointer will be 1 through 35. The pointer will roll over at 35 to 1.

Meter #1 Data - 701, Meter #2 Data - 702

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

DFM ENRON MODBUS

ARCHIVE 703, 704 – 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 35 day's data. The daily pointer will be 1 through 35. (The pointer will roll over at 35 to 1).

Meter #1 Data - 703, Meter #2 Data – 705

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, 706 –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 840 hour's data. The hourly pointer will be 1 through 840. (The pointer will roll over at 840 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

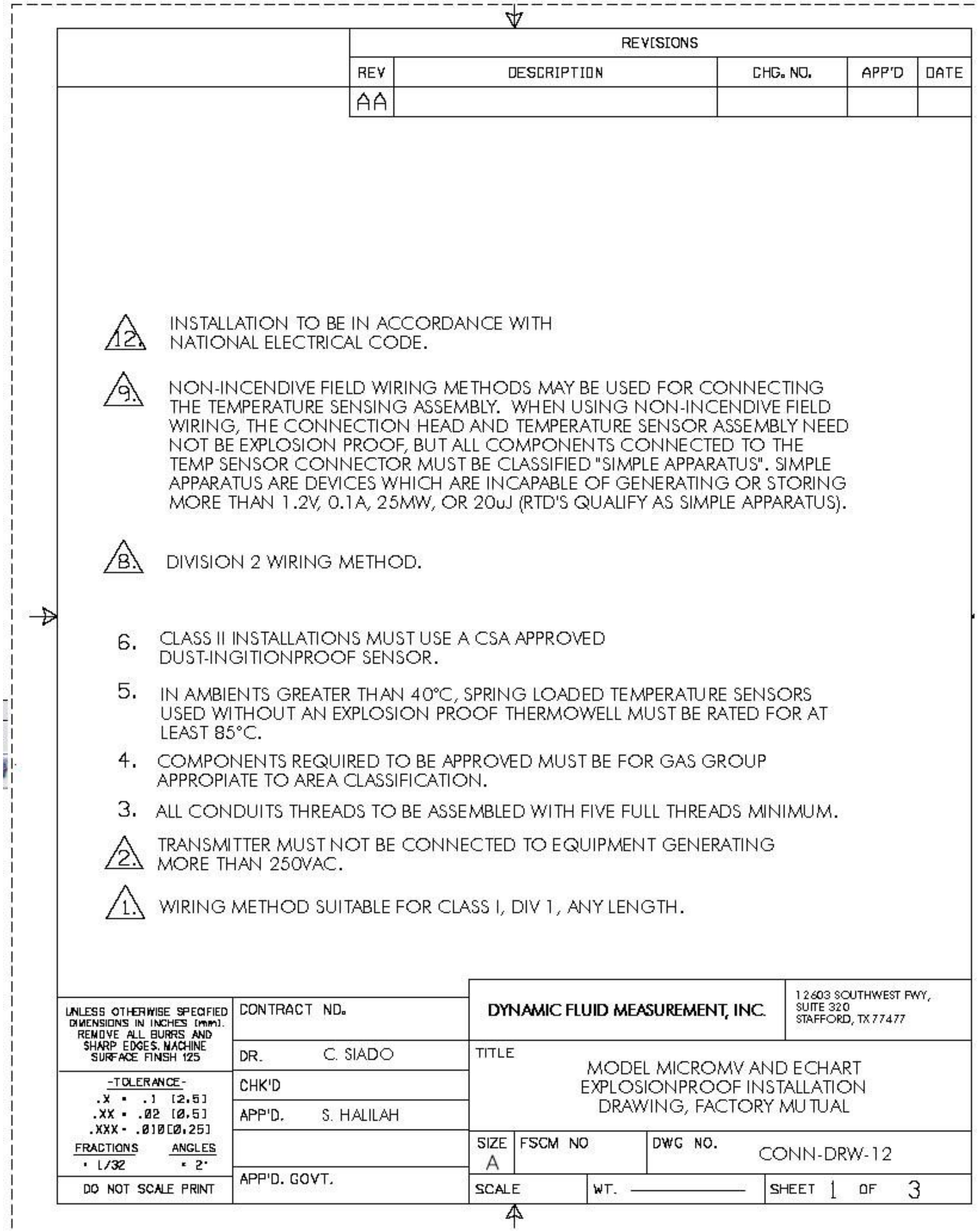
Address	Func	Start HI	Start LO	Data HI	Data Lo	CRC	
01	05	00	20	ff	00		

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 FINSH 125

-TOLERANCE-
.X ± .1 [2.5]
.XX ± .02 [0.5]
.XXX ± .010[0.25]
FRACTIONS ± 1/32
ANGLES ± 2°

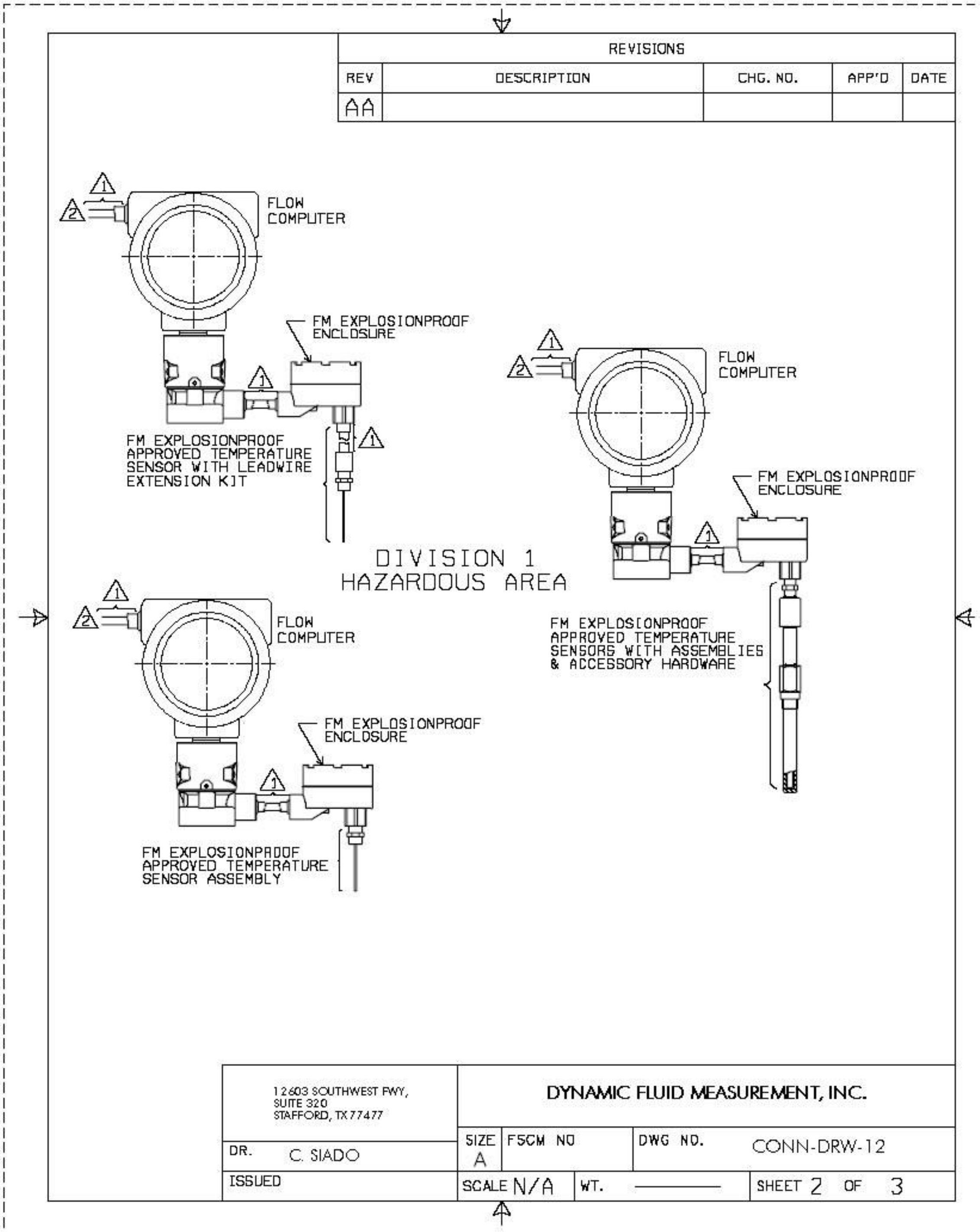
DO NOT SCALE PRINT

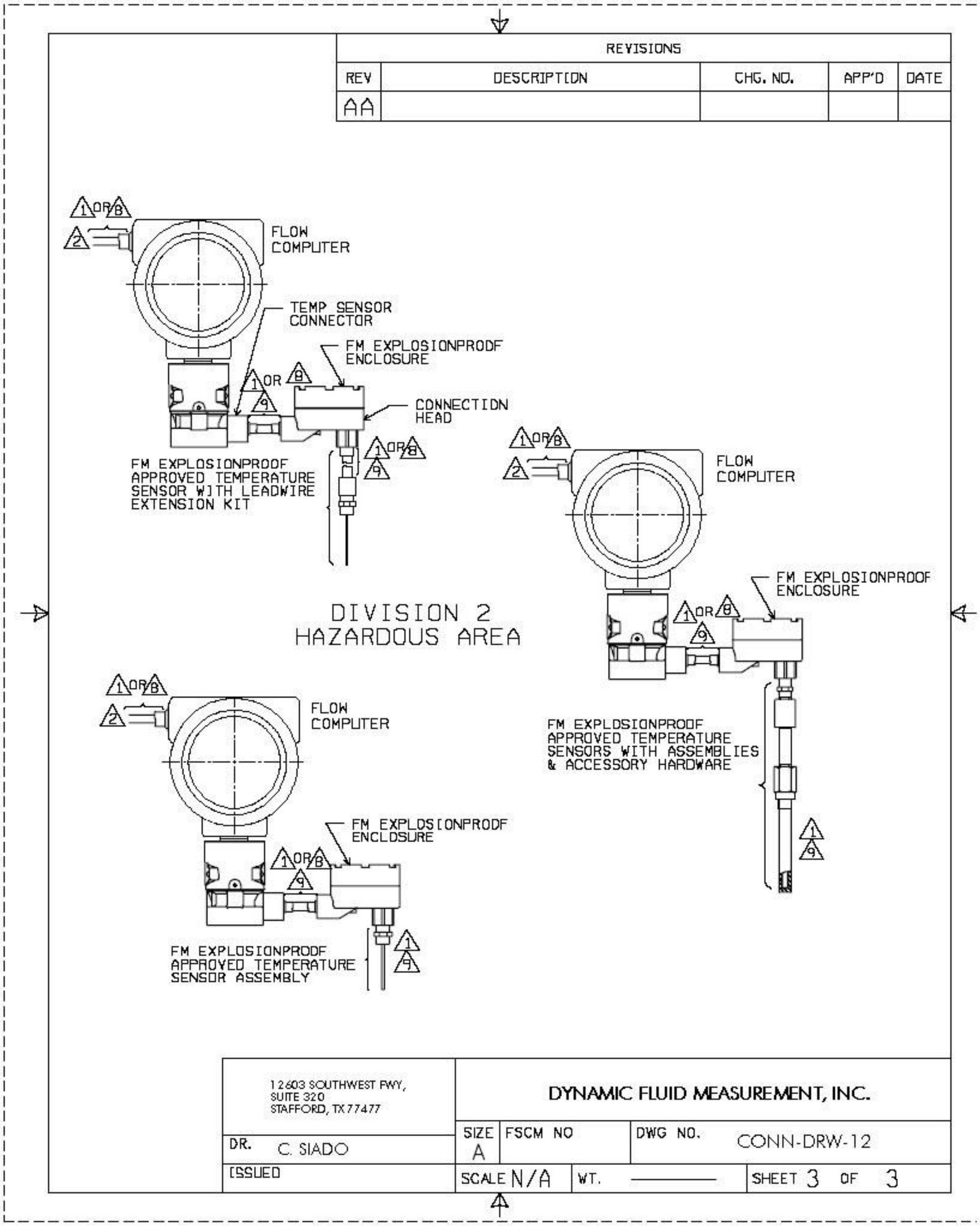
CONTRACT NO.
DR. C. SIADO
CHK'D
APP'D. S. HALILAH
APP'D. GOVT.

DYNAMIC FLUID MEASUREMENT, INC.
12603 SOUTHWEST FWY,
SUITE 320
STAFFORD, TX 77477

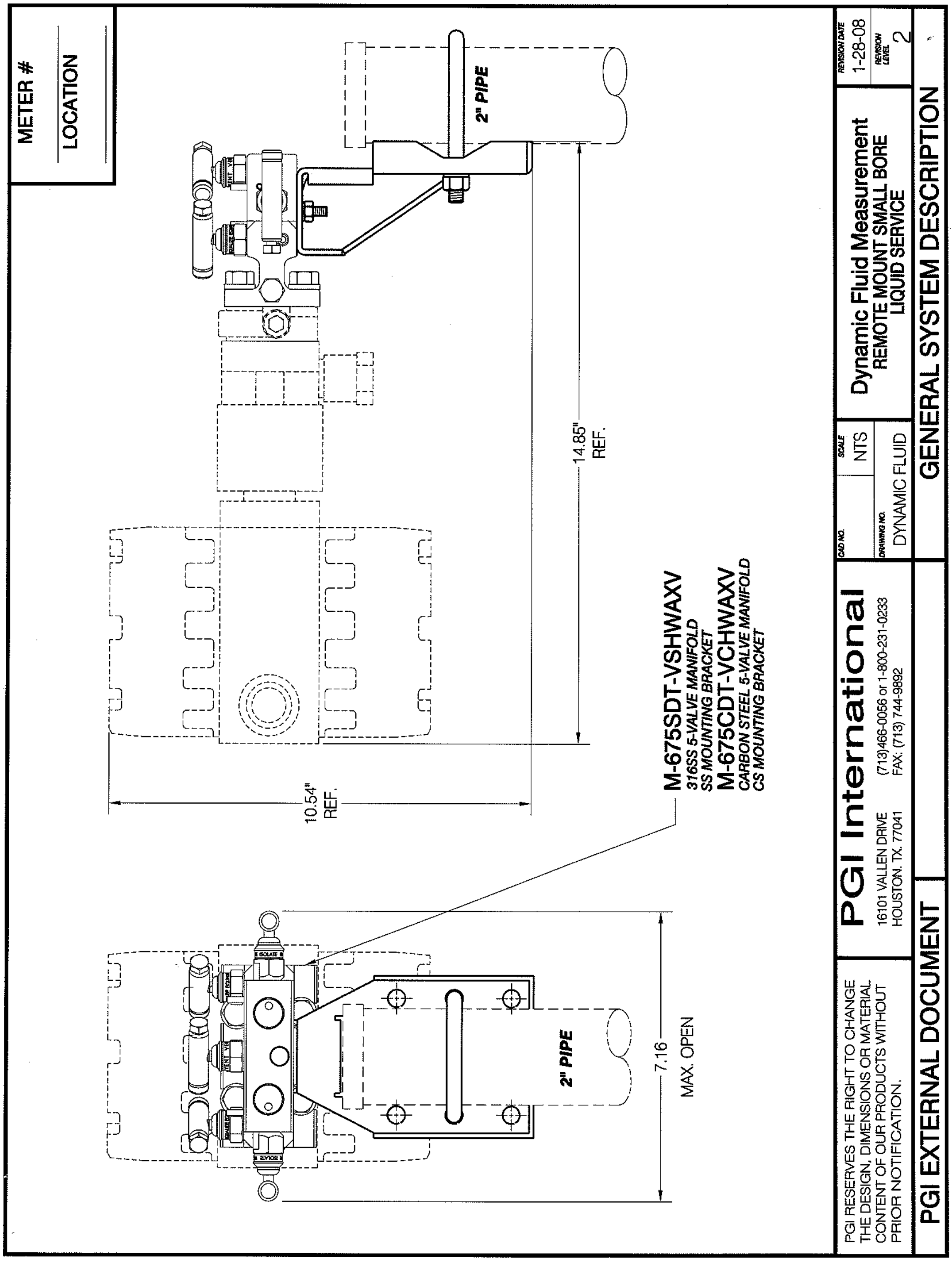
TITLE
MODEL MICROMV AND ECHART
EXPLOSIONPROOF INSTALLATION
DRAWING, FACTORY MUTUAL

SIZE A
FSCM NO
DWG NO. CONN-DRW-12
SCALE
WT. ————
SHEET 1 OF 3


REVISIONS
REV
DESCRIPTION
CHG. NO.
APP'D
DATE
AA
1
2
FLOW COMPUTER
FM EXPLOSIONPROOF ENCLOSURE
1
FM EXPLOSIONPROOF APPROVED TEMPERATURE SENSOR WITH LEADWIRE EXTENSION KIT
1
1
2
FLOW COMPUTER
FM EXPLOSIONPROOF ENCLOSURE
1
DIVISION 1 HAZARDOUS AREA
FM EXPLOSIONPROOF APPROVED TEMPERATURE SENSORS WITH ASSEMBLIES & ACCESSORY HARDWARE
1
2
FLOW COMPUTER
FM EXPLOSIONPROOF ENCLOSURE
1
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

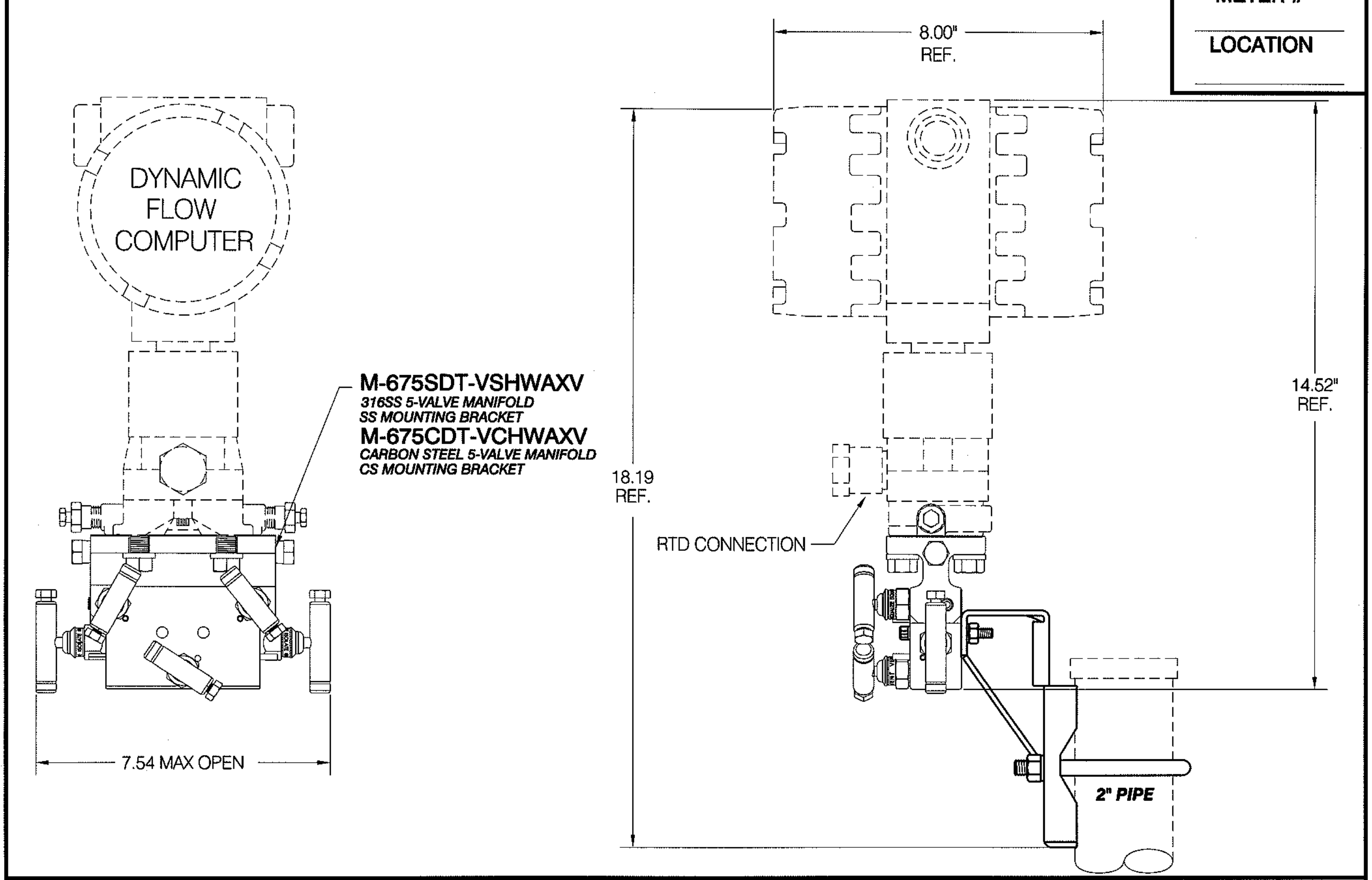

REVISIONS
REV
DESCRIPTION
CHG. NO.
APP'D
DATE
AA
1 OR 8
2
FLOW COMPUTER
TEMP SENSOR CONNECTOR
FM EXPLOSIONPROOF ENCLOSURE
1 OR 8
9
CONNECTION HEAD
1 OR 8
1
9
FM EXPLOSIONPROOF APPROVED TEMPERATURE SENSOR WITH LEADWIRE EXTENSION KIT
1 OR 8
2
FLOW COMPUTER
FM EXPLOSIONPROOF ENCLOSURE
1 OR 8
9
DIVISION 2 HAZARDOUS AREA
FM EXPLOSIONPROOF APPROVED TEMPERATURE SENSORS WITH ASSEMBLIES & ACCESSORY HARDWARE
1
9
1 OR 8
2
FLOW COMPUTER
FM EXPLOSIONPROOF ENCLOSURE
1 OR 8
9
FM EXPLOSIONPROOF APPROVED TEMPERATURE SENSOR ASSEMBLY
1
9
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



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PGI International

16101 VALLEN DRIVE
HOUSTON, TX. 77041

(713)466-0056 or 1-800-231-0233
FAX: (713) 744-9892

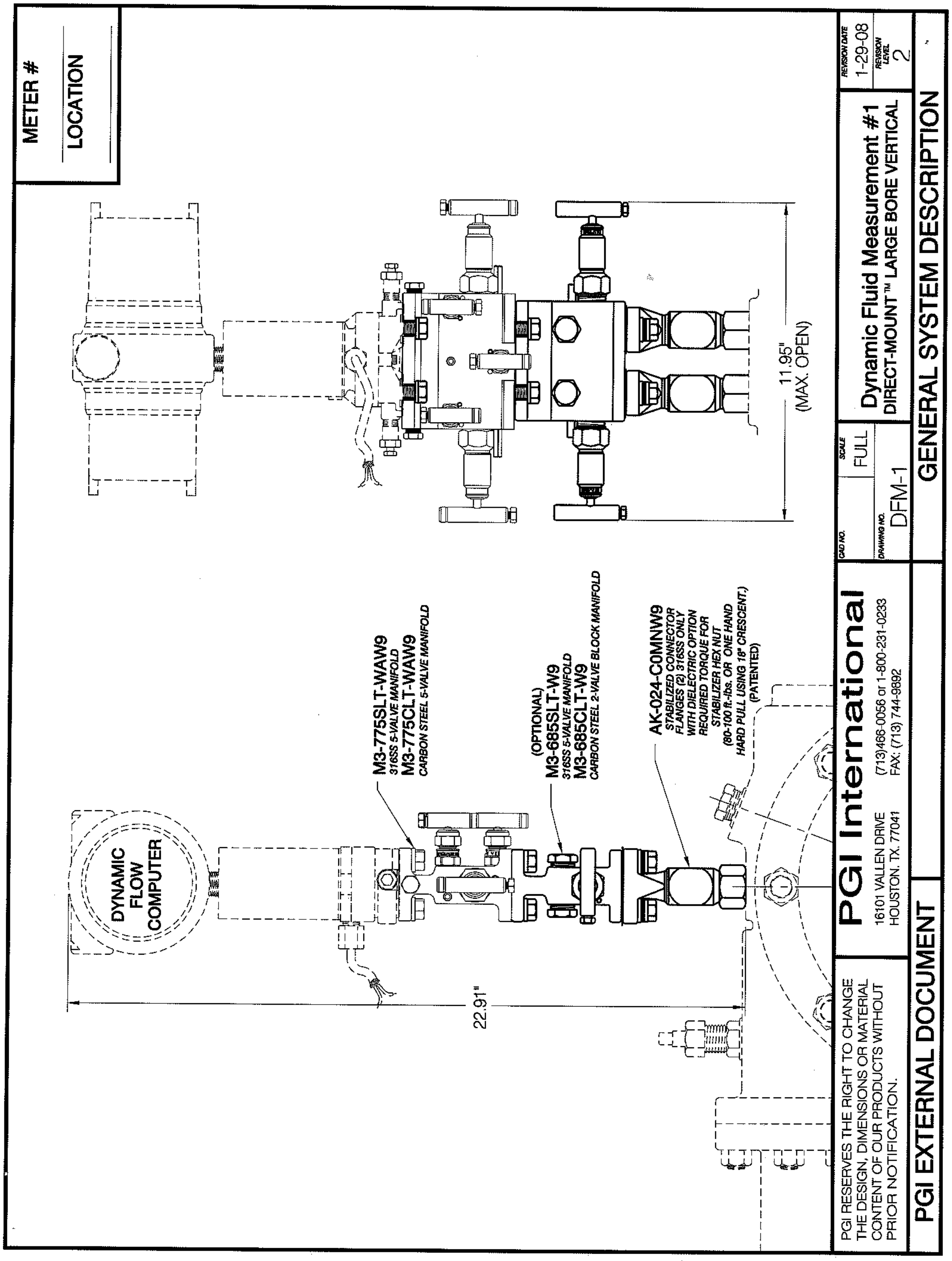
CAD NO.	SCALE NTS
DRAWING NO. DYNAMIC FLUID2	

Dynamic Fluid Measurments #2
REMOTE MOUNT SMALL BORE

REVISION DATE
1-28-08
REVISION LEVEL
2

PGI EXTERNAL DOCUMENT

GENERAL SYSTEM DESCRIPTION


METER #
LOCATION
DYNAMIC FLOW COMPUTER
22.91"
11.95" (MAX. OPEN)
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)
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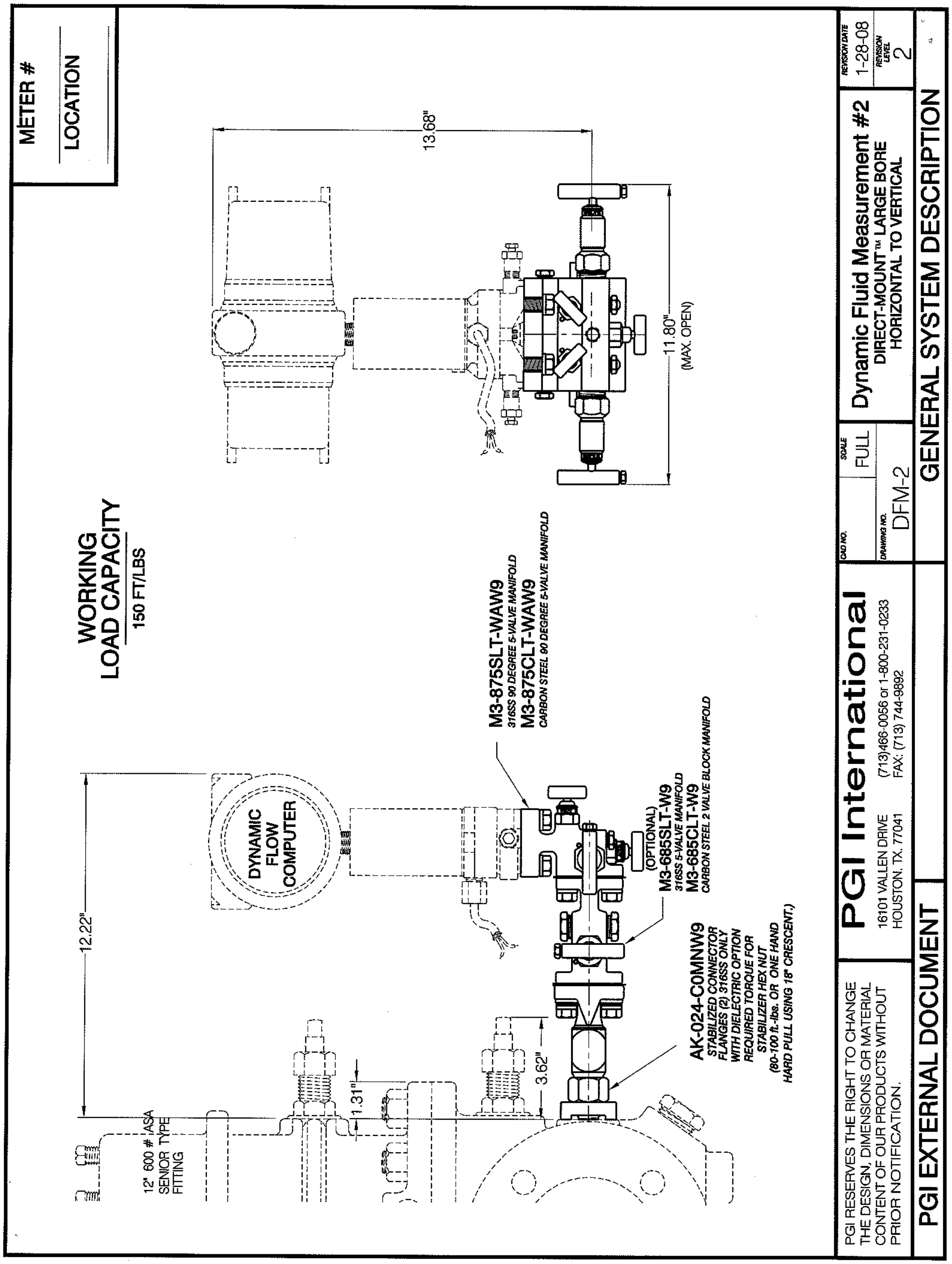
PGI International
16101 VALLEN DRIVE HOUSTON, TX. 77041
(713)466-0056 or 1-800-231-0233 FAX: (713) 744-9892
CAD NO.
SCALE FULL
DRAWING NO. DFM-1
Dynamic Fluid Measurement #1
DIRECT-MOUNT™ LARGE BORE VERTICAL
REVISION DATE 1-29-08
REVISION LEVEL 2
PGI EXTERNAL DOCUMENT
GENERAL SYSTEM DESCRIPTION

]


METER #
LOCATION
13.68"
11.80"
(MAX. OPEN)
WORKING
LOAD CAPACITY
150 FT/LBS
M3-875SLT-WAW9
316SS 90 DEGREE 5-VALVE MANIFOLD
M3-875CLT-WAW9
CARBON STEEL 90 DEGREE 5-VALVE MANIFOLD
12.22"
DYNAMIC
FLOW
COMPUTER
(OPTIONAL)
M3-685SLT-W9
316SS 5-VALVE MANIFOLD
M3-685CLT-W9
CARBON STEEL 2 VALVE BLOCK MANIFOLD
AK-024-COMNW9
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.)
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**

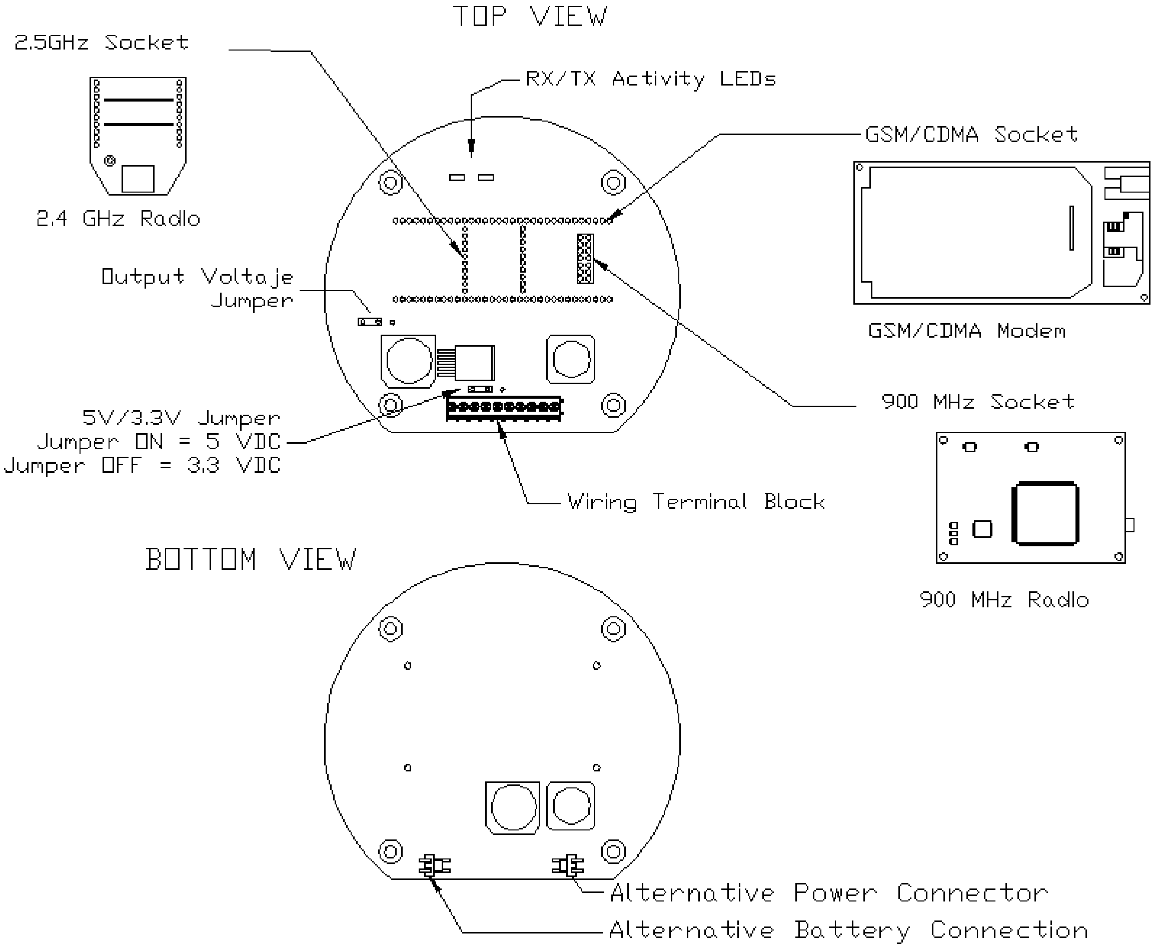
We hope that your experience with our products will be a simple pleasant experience, not intimidating in any way.

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

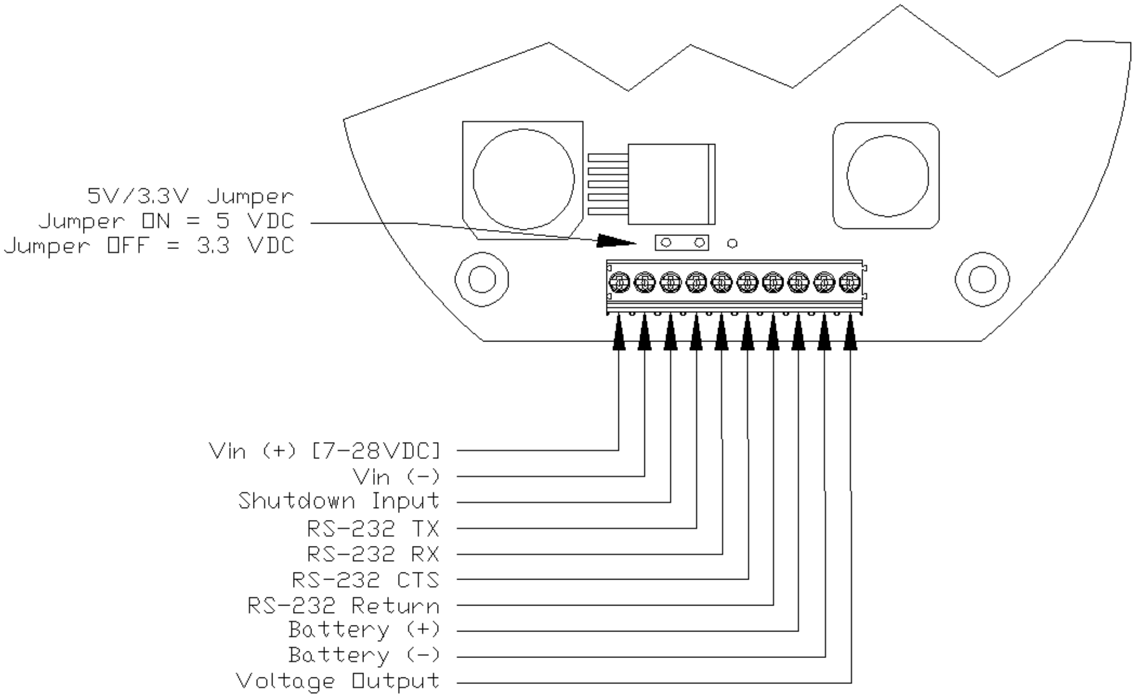

TOP VIEW
2.5GHz Socket
2.4 GHz Radio
RX/TX Activity LEDs
GSM/CDMA Socket
GSM/CDMA Modem
Output Voltaje Jumper
900 MHz Socket
5V/3.3V Jumper
Jumper ON = 5 VDC
Jumper OFF = 3.3 VDC
Wiring Terminal Block
900 MHz Radio
BOTTOM VIEW
Alternative Power Connector
Alternative Battery Connection

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	5 VDC
MAX. CURRENT CONSUMPTION	770 mA
SERIAL INTERFACE	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.

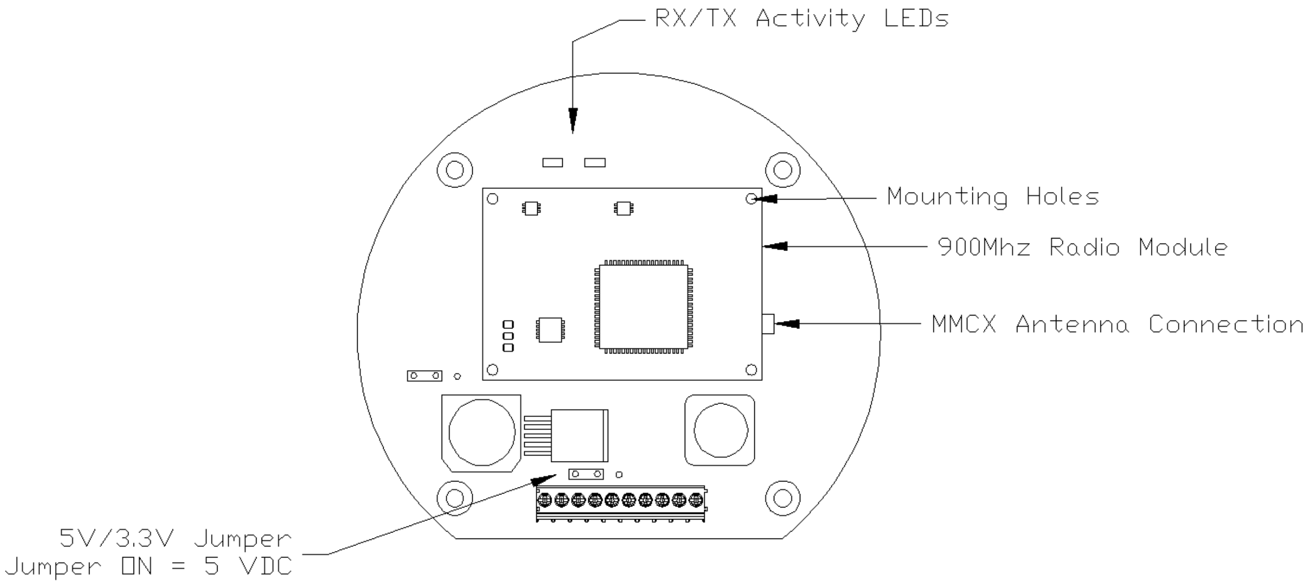
Getting acquainted with the wiring:

Wiring Terminal Block



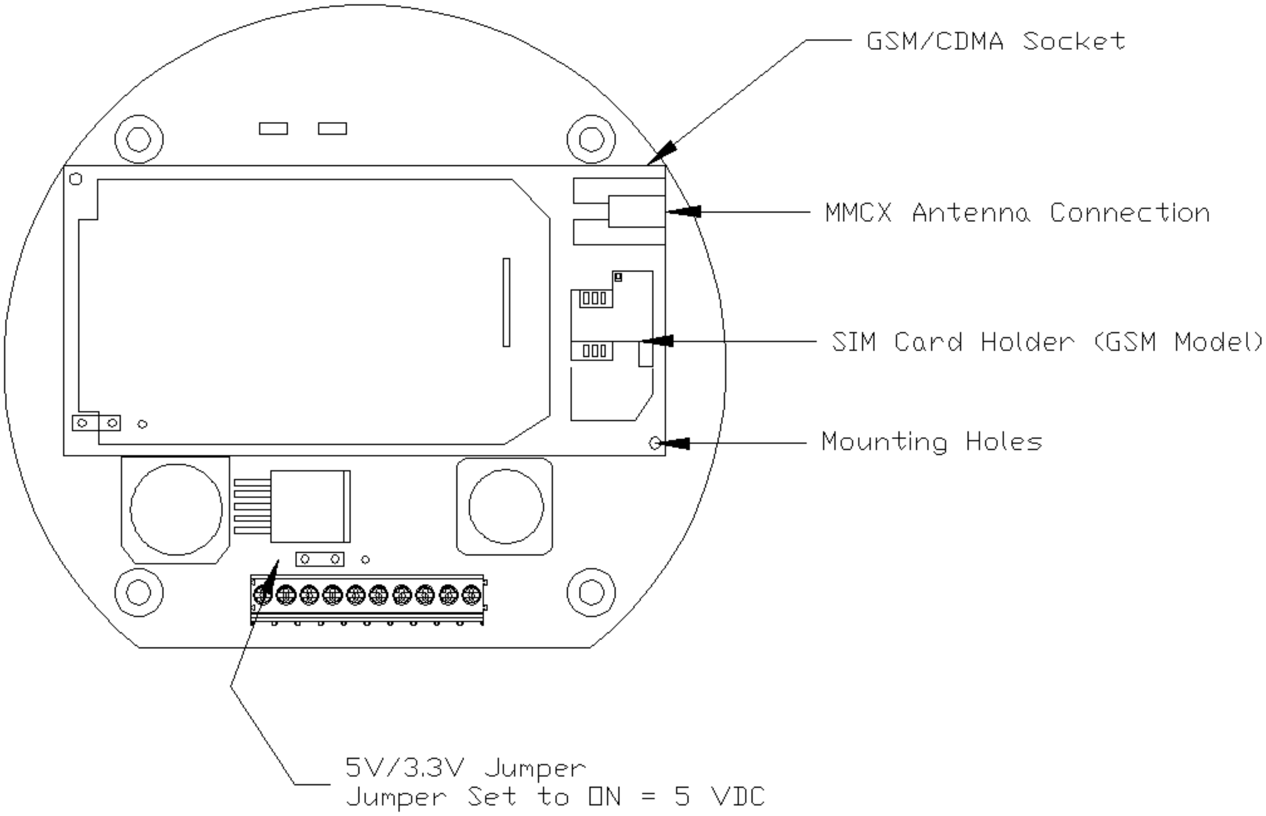
Installation of 900 Mhz Module

- 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.



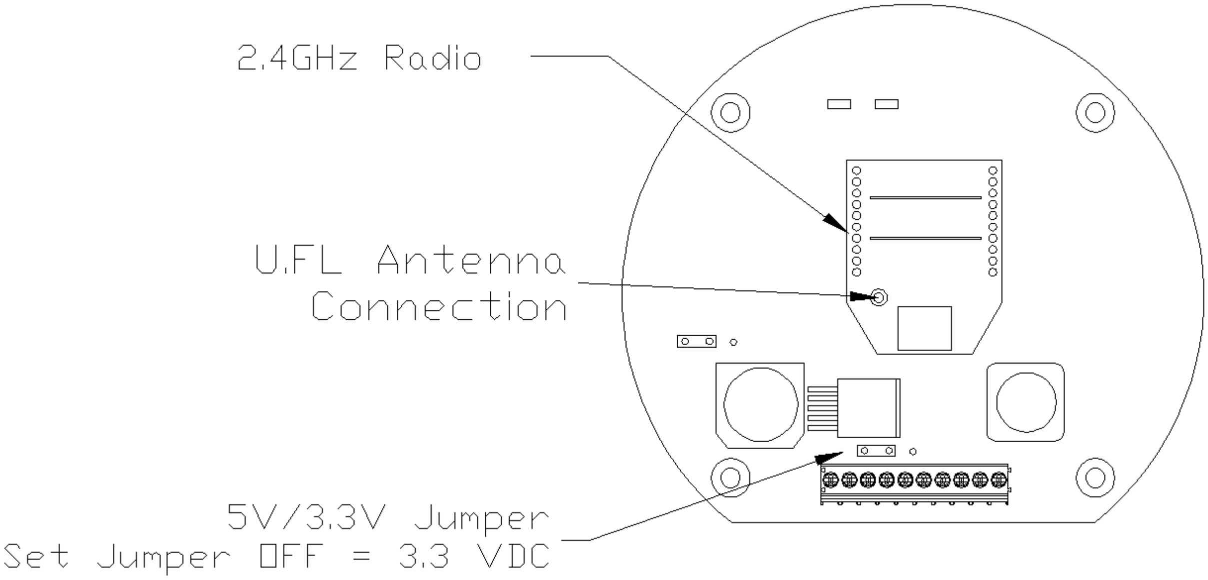
Installation of Socket Modem Module

- 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.



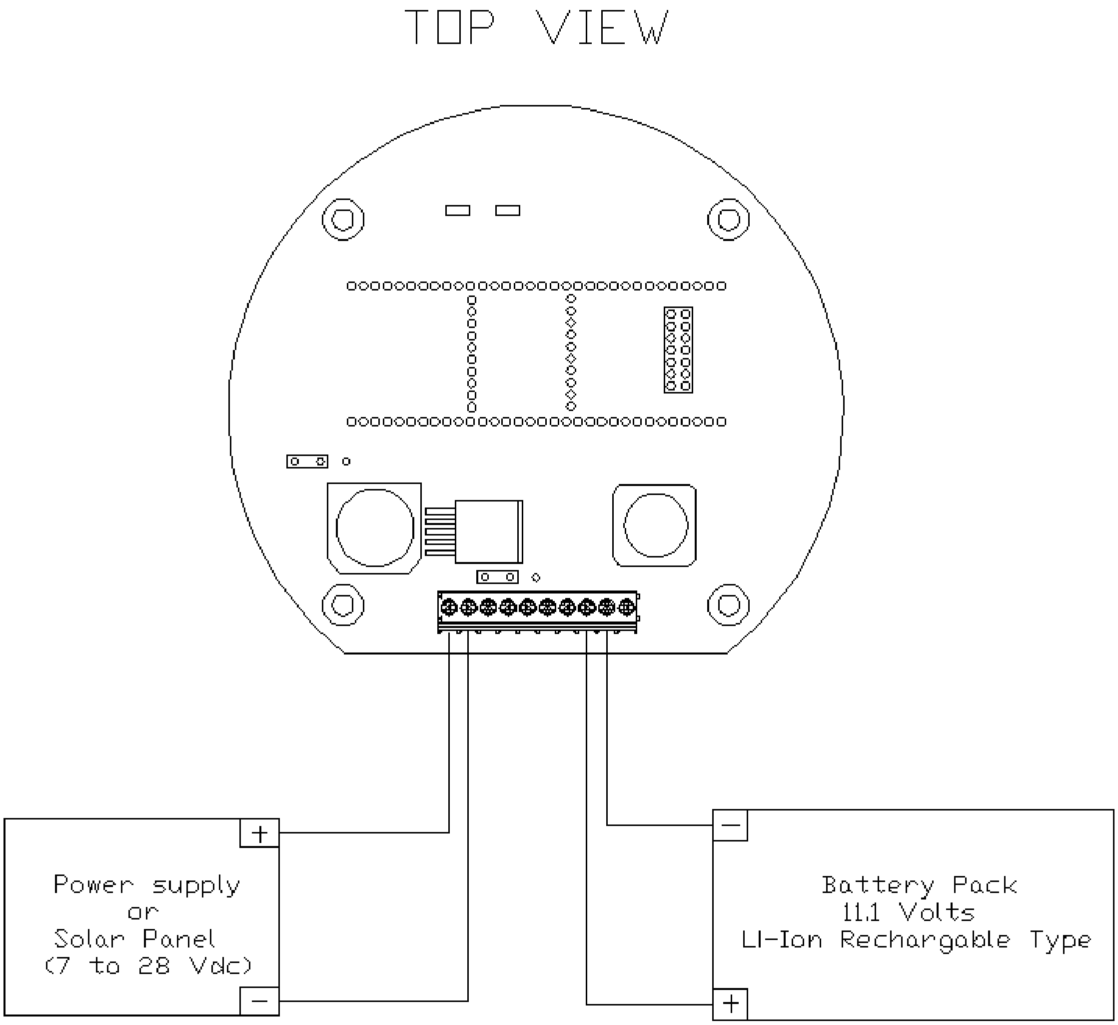
Installation of 2.4 Ghz Module

- 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.

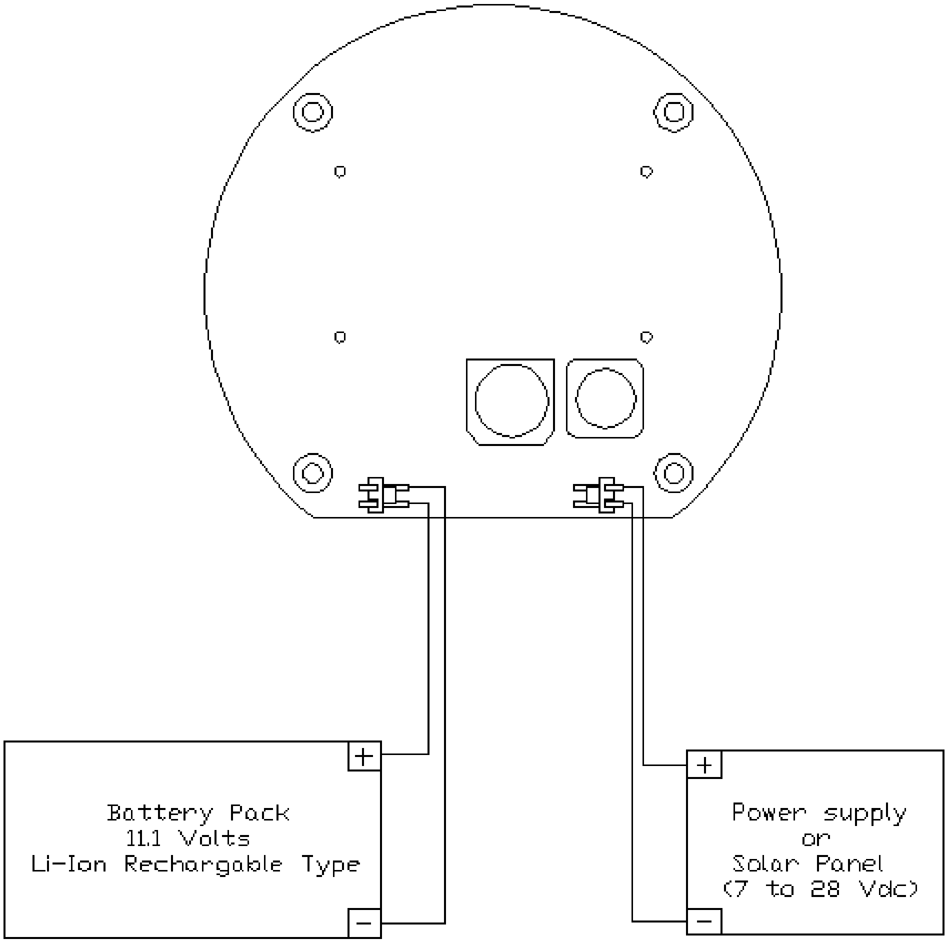


Warning

- 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

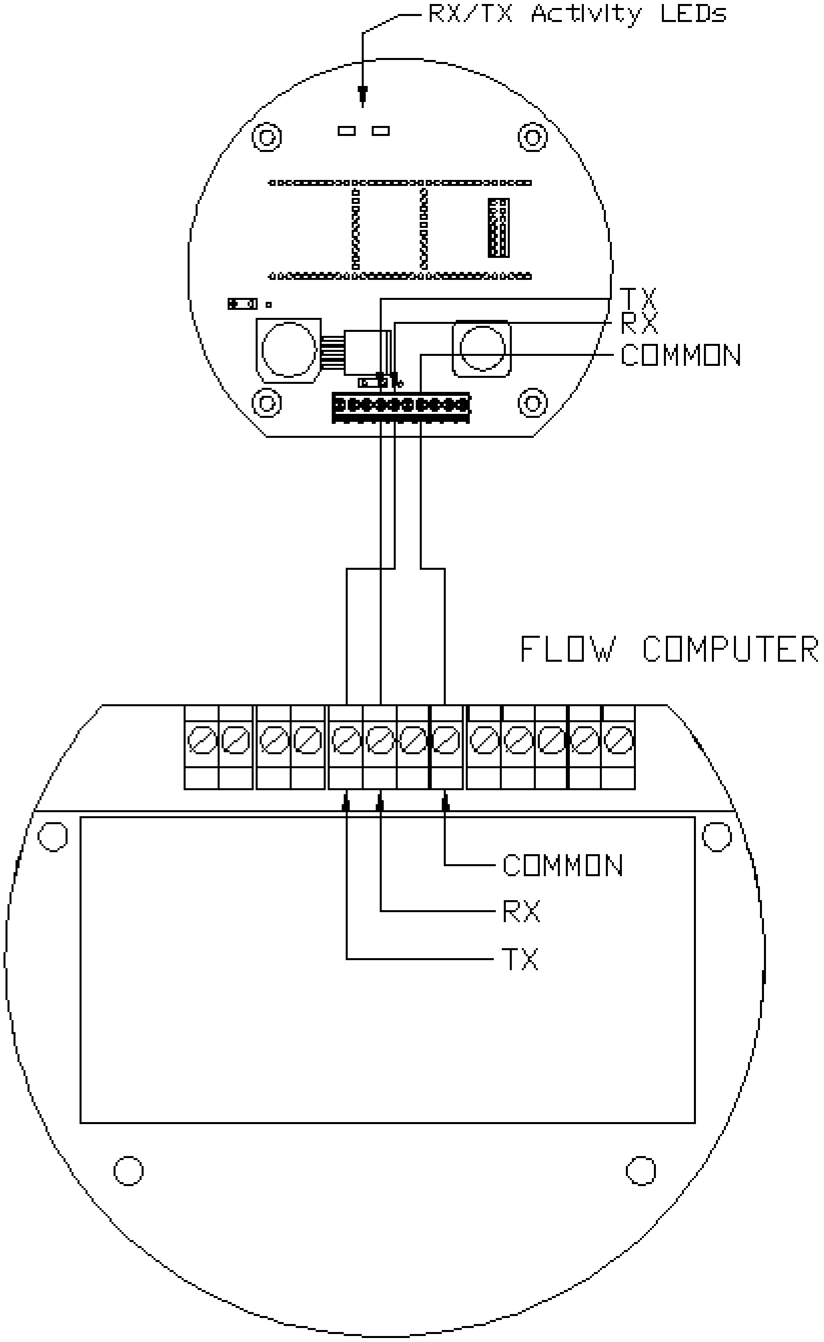


Warning

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

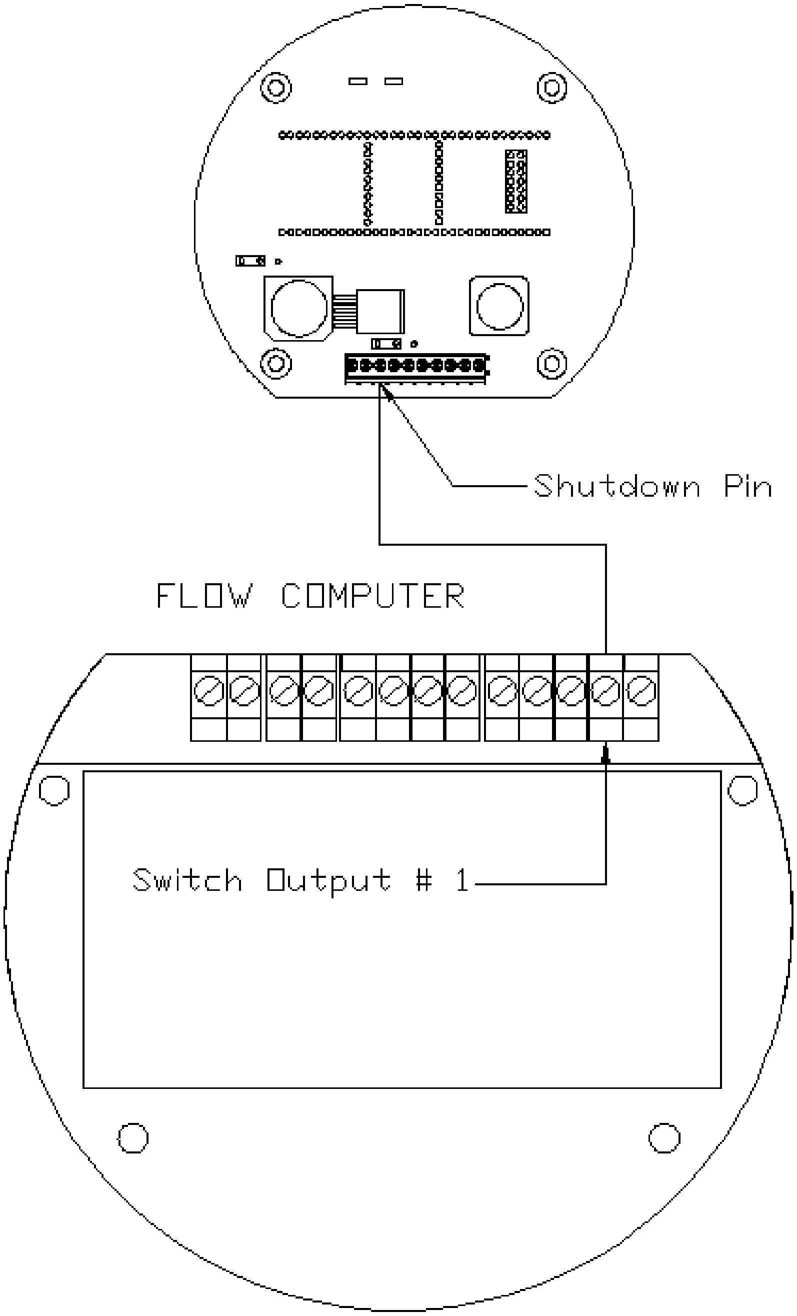
Wiring of RS-232 Interface

- 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.



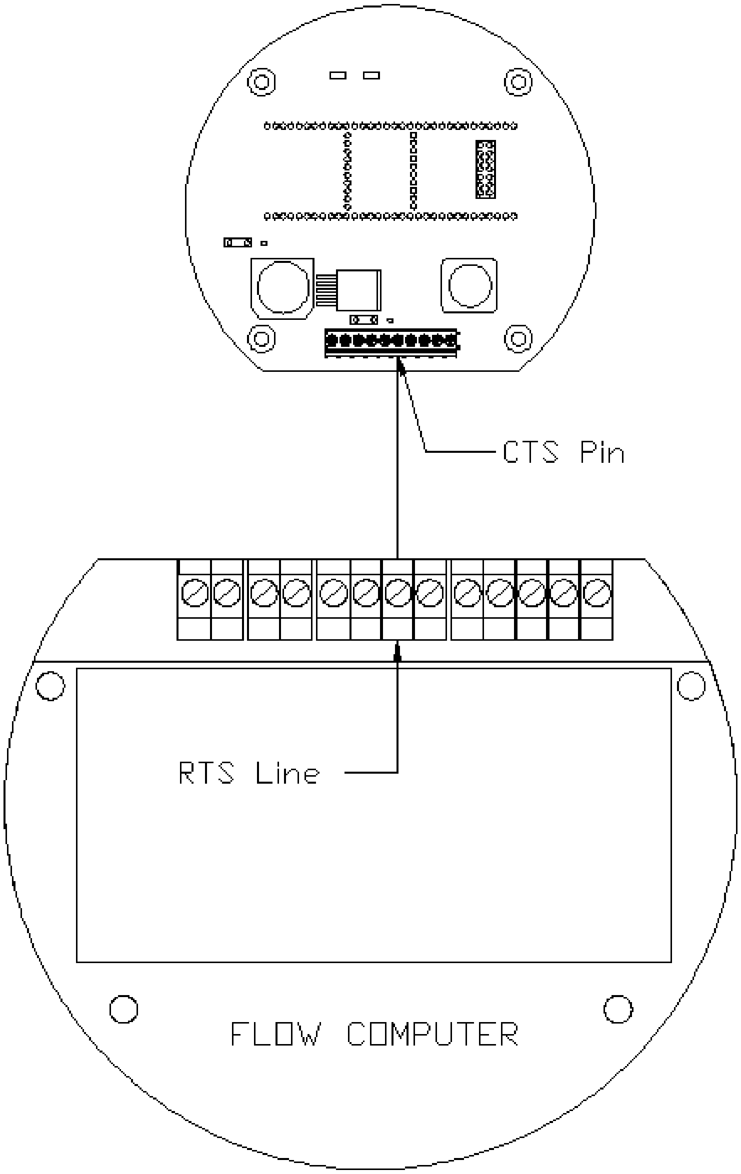
Wiring of Shutdown Input

- 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

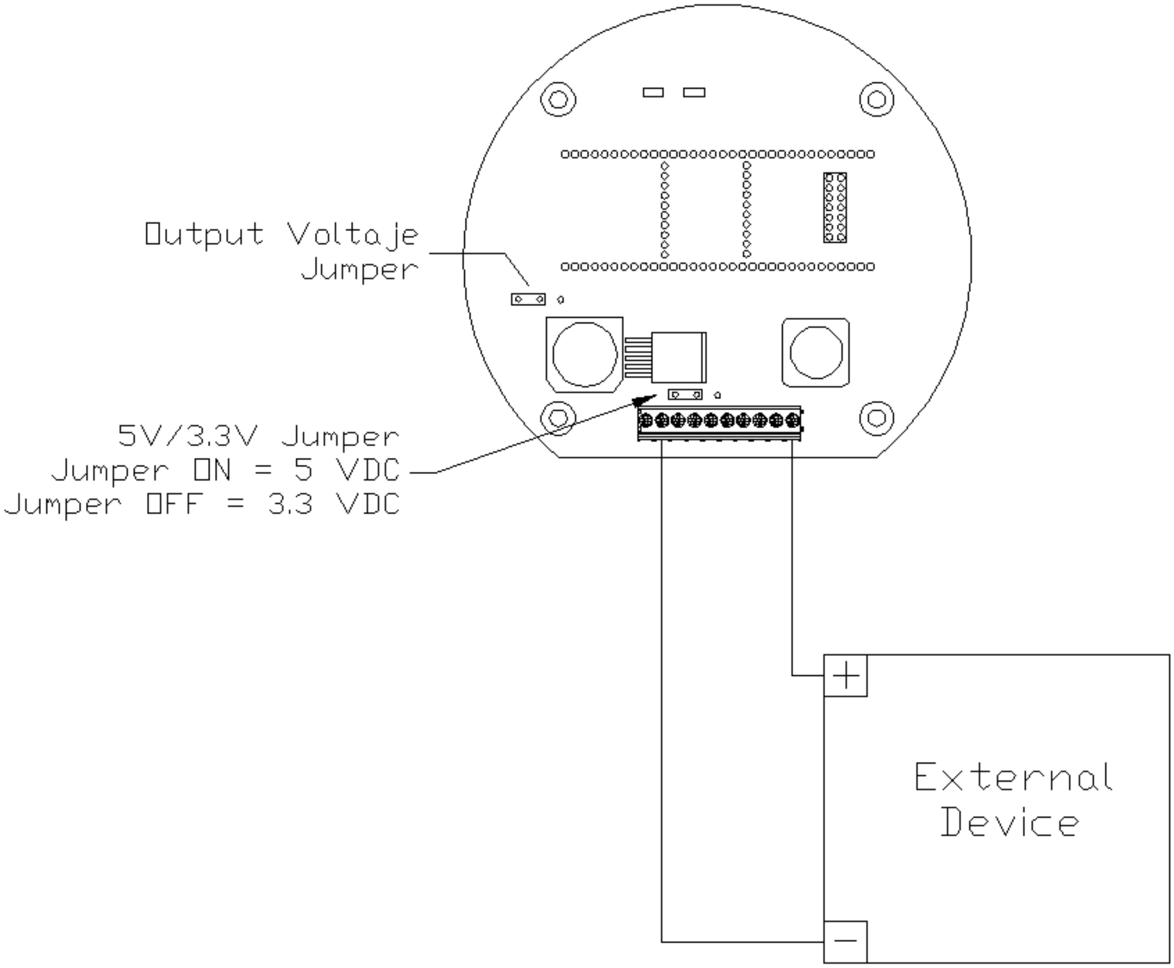
- The CTS pin allows us to optimize power consumption of the radio module using the RS-232 RTS Hardware handshake line.
- For optimal power saving use the Shutdown pin shown above, for power radio power saving only use the CTS option.
- If the CTS pin (Pin 6) is not wired the radio is always ON.
- Because 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



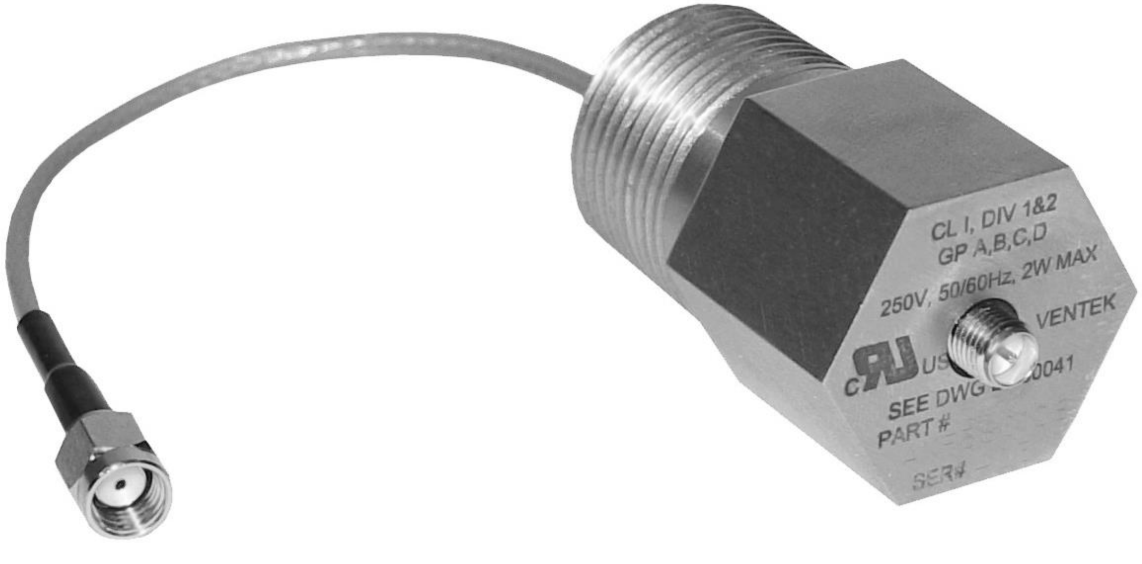
Explosion Proof External Antenna Conection

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

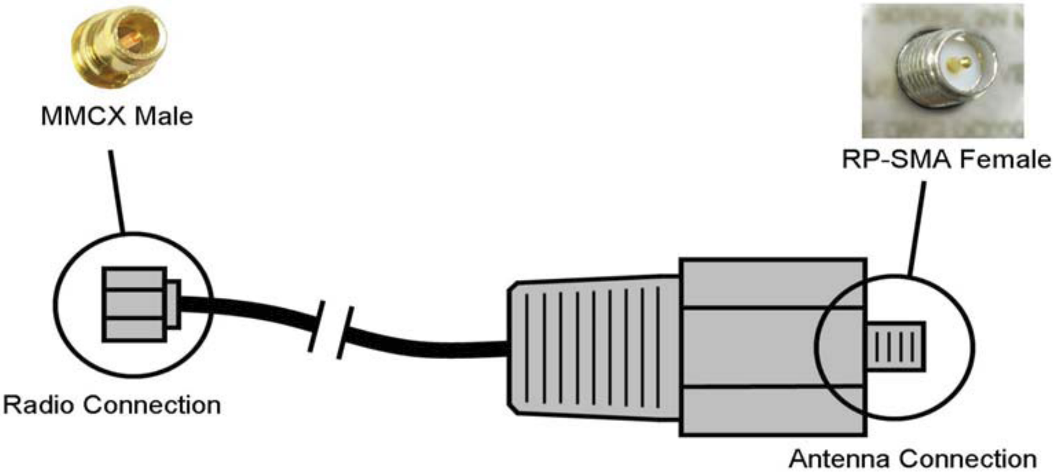
Coupler Drawing



Part Numbers

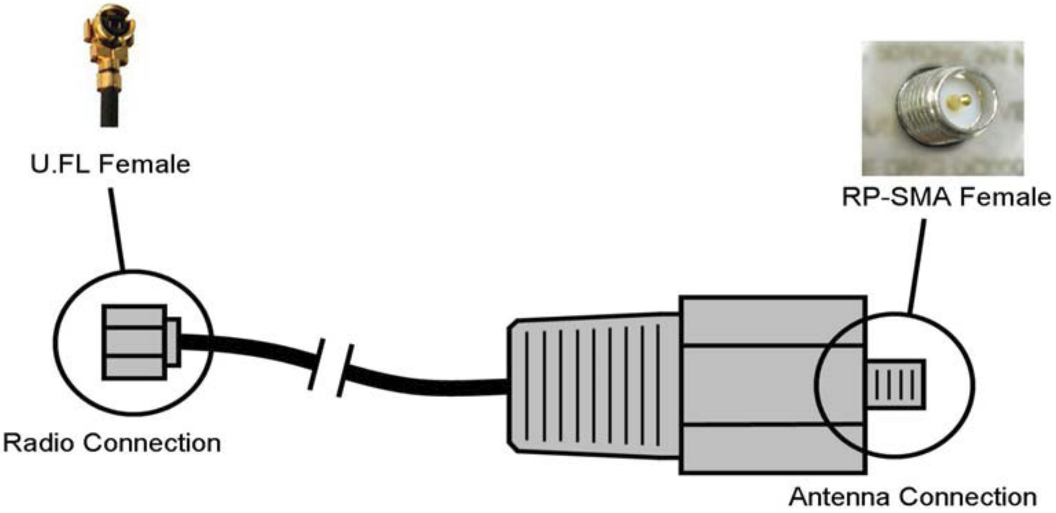
There are two models to fir our radio options:

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.



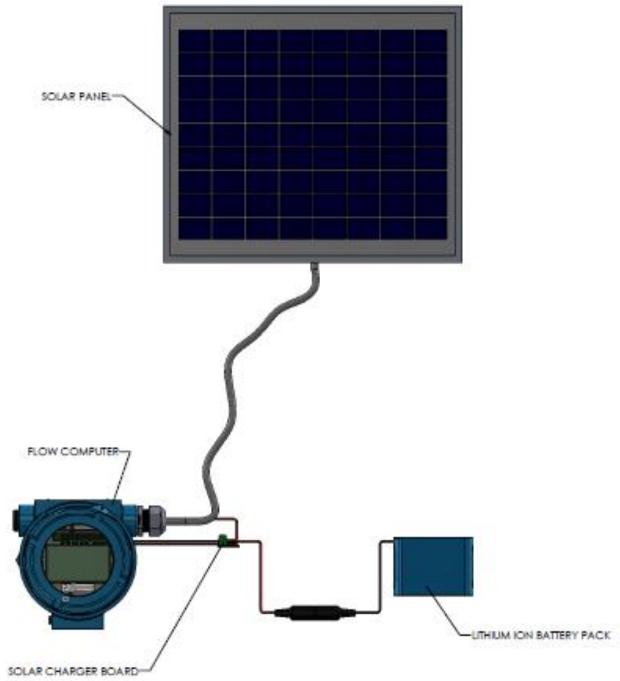
Model AXF3S2410

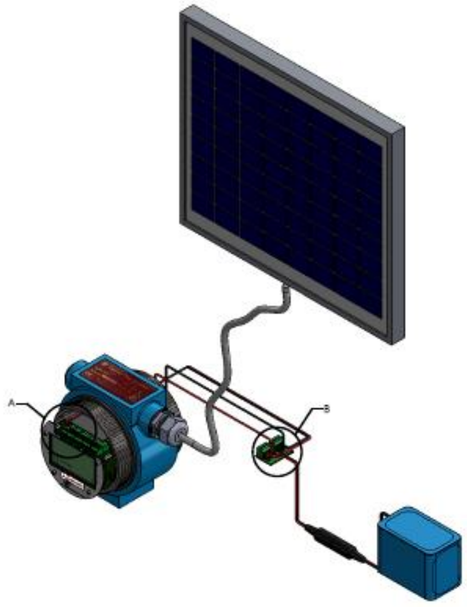
NOTE: Both models have a female RP-SMA connector for an external antenna.

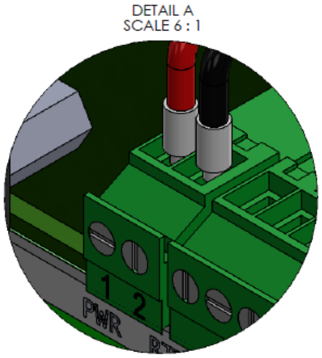
Appendix B: Battery and Solar Panel Wiring

Battery Wiring and Connection

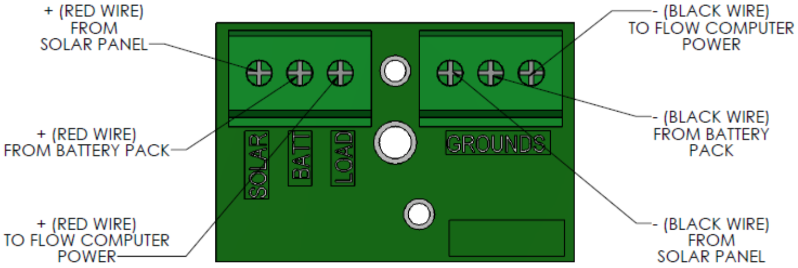
There is no need for an external diode. The Solar Panel connects directly to the terminal 1 & 2 on the terminal block like a regular power supply.



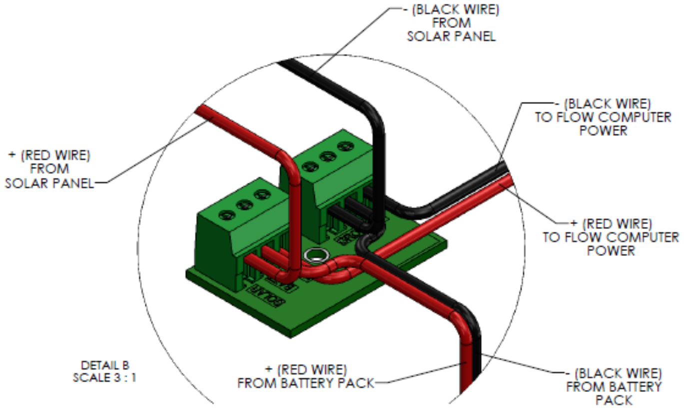




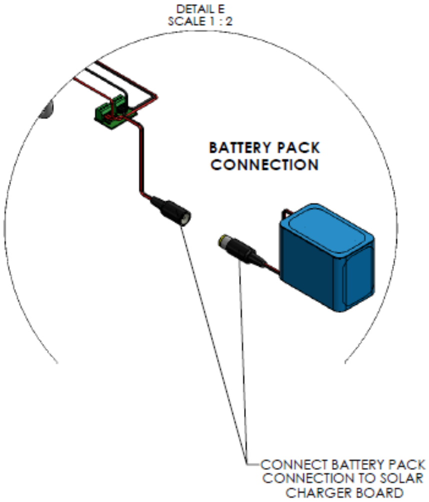
FLOW COMPUTER POWER CONNECTION

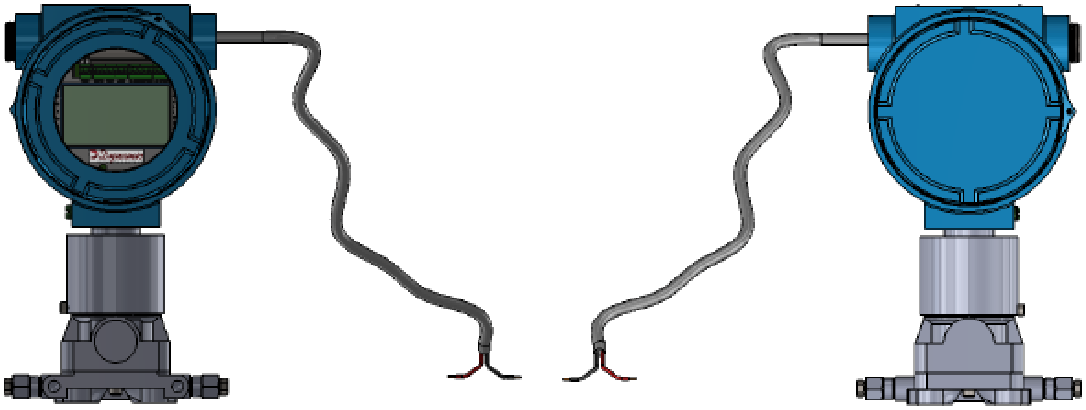


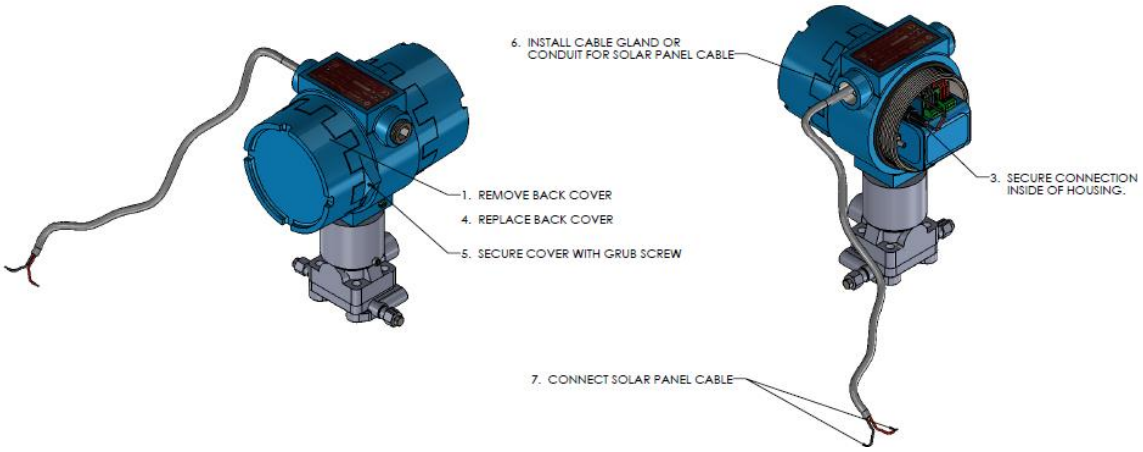
SOLAR CHARGER BOARD

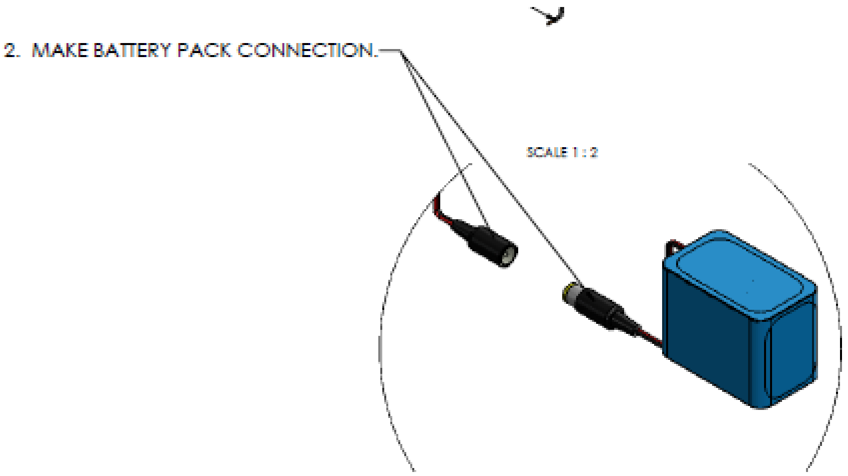


SOLAR CHARGER BOARD (CONNECTIONS MADE)









DETAIL J
SCALE 1 : 2