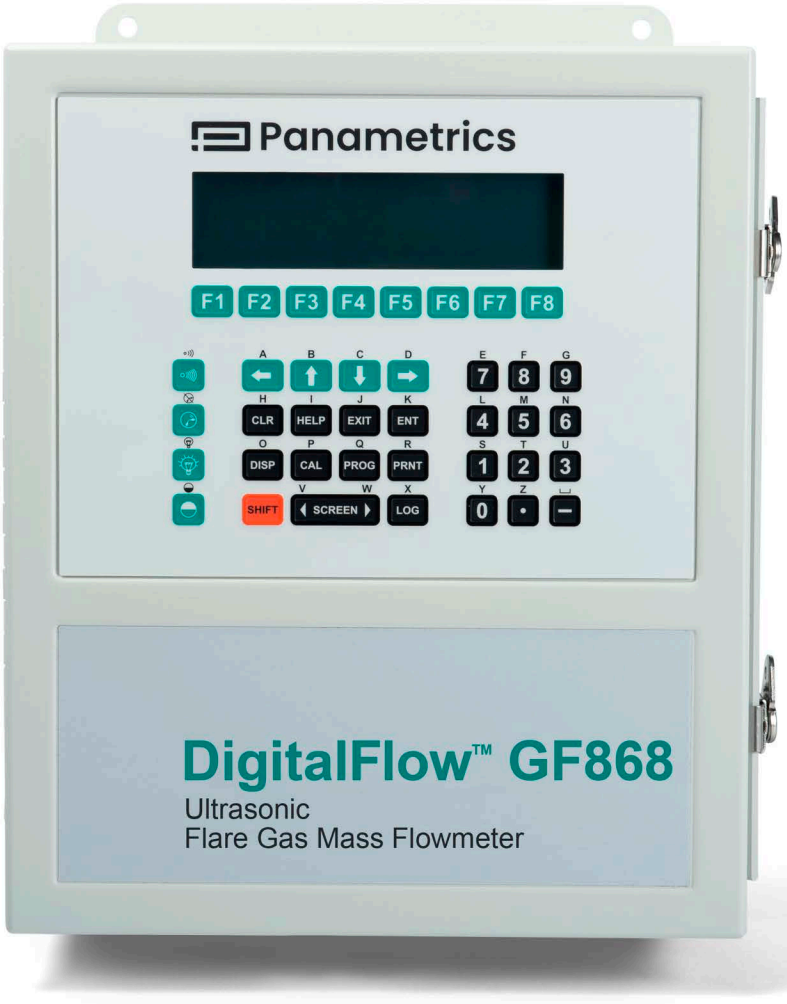
Panametrics
a Baker Hughes business

Communications Options

User's Guide



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BH073C11 Rev. H
March 2025

panametrics.com

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Services

Panametrics provides customers with an experienced staff of customer support personnel ready to respond to technical inquiries, as well as other remote and on-site support needs. To complement our broad portfolio of industry-leading solutions, we offer several types of flexible and scalable support services including: Training, Product Repairs, Service Agreements and more.

Please visit https://www.bakerhughes.com/panametrics/panametrics-services for more details.

Typographical Conventions

Note: *These paragraphs provide information that provides a deeper understanding of the situation, but is not essential to the proper completion of the instructions.*

IMPORTANT: These paragraphs provide information that emphasizes instructions that are essential to proper setup of the equipment. Failure to follow these instructions carefully may cause unreliable performance.

CAUTION! **This symbol indicates a risk of potential minor personal injury and/or severe damage to the equipment, unless these instructions are followed carefully.**

WARNING! **This symbol indicates a risk of potential serious personal injury, unless these instructions are followed carefully.**

Safety Issues

WARNING! **It is the responsibility of the user to make sure all local, county, state and national codes, regulations, rules and laws related to safety and safe operating conditions are met for each installation.**

Attention European Customers!To meet CE Mark requirements for all units intended for use in the EU, all electrical cables must be installed as described in this manual.

Auxiliary Equipment

Local Safety Standards

The user must make sure that he operates all auxiliary equipment in accordance with local codes, standards, regulations, or laws applicable to safety.

Working Area

WARNING! **Auxiliary equipment may have both manual and automatic modes of operation. As equipment can move suddenly and without warning, do not enter the work cell of this equipment during automatic operation, and do not enter the work envelope of this equipment during manual operation. If you do, serious injury can result.**

WARNING! **Make sure that power to the auxiliary equipment is turned OFF and locked out before you perform maintenance procedures on this equipment.**

Qualification of Personnel

Make sure that all personnel have manufacturer-approved training applicable to the auxiliary equipment.

Personal Safety Equipment

Make sure that operators and maintenance personnel have all safety equipment applicable to the auxiliary equipment. Examples include safety glasses, protective headgear, safety shoes, etc.

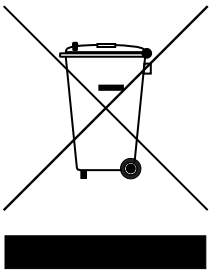
Unauthorized Operation

Make sure that unauthorized personnel cannot gain access to the operation of the equipment.

Environmental Compliance

Waste Electrical and Electronic Equipment (WEEE) Directive

Panametrics is an active participant in Europe's *Waste Electrical and Electronic Equipment* (WEEE) take-back initiative, directive 2012/19/EU.



The equipment that you bought has required the extraction and use of natural resources for its production. It may contain hazardous substances that could impact health and the environment.

In order to avoid the dissemination of those substances in our environment and to diminish the pressure on the natural resources, we encourage you to use the appropriate take-back systems. Those systems will reuse or recycle most of the materials of your end of life equipment in a sound way.

The crossed-out wheeled bin symbol invites you to use those systems.

If you need more information on the collection, reuse and recycling systems, please contact your local or regional waste administration.

Please visit www.bakerhughes.com/health-safety-and-environment-hse for take-back instructions and more information about this initiative.

Chapter 1. Modbus Communications

Chapter 2. Modbus Over Ethernet Communications 1

Chapter 3. Modbus Over Ethernet Communications 2

Chapter 4. Ethernet Only Communications

Chapter 5. Modbus Over WI-FI Communications

Chapter 6. WI-FI Only Communications

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Chapter 1. Modbus Communications

1.1 Introduction

Panametrics ultrasonic flowmeters have the ability to provide Modbus communications using an option card. The MODBUS option card provides an RS485 interface with a host system, while the main circuit board continues to support RS232 communications for use with a PC running PanaView™ software.

Note: *PanaView™ does not support Modbus.*

To properly set up the instrument, use this addendum along with the standard flowmeter *User's Manual*. This document shows how to install the MODBUS option card and how to program the modified flowmeter to access this special feature.

When equipped with the optional MODBUS output card, the flow transmitter can send flow data and diagnostic information to a flow computer (or SCADA) serially, using a Gould-type RTU protocol. In this case, only the Modbus function command, 3 (read multiple registers), 6 (write multiple registers) is valid. The format for the data exchange is as follows:

- The **send** command (initiated by the host flow computer or controller) comes in the form:
  [time delimiter]<Addr><3><First Register MSB>
  <First Register LSB><Register Count MSB>
  <Register Count LSB><CRC Low><CRC High>[time delimiter]
- The response (initiated by the host flow computer or controller) comes in the form:
  [time delimiter]<Addr><3><Byte count><Data.....>
  <CRC Low><CRC High>[time delimiter]

The format for the returned data types is as follows:

- Integer (16 bit Integer) <MSB><LSB>
  1 Register - 16 bit integer
- Integer (32 bit Integerl) <MSB><LSB><LSB><LSB>
  2 Registers - 32 bit long integer
- Floating Point (FP) <EXP><MAN><MAN><MAN>
  2 Registers - 32 bit IEEE floating point number

1.2 Installing the MODBUS Option Card

IMPORTANT: The installation information presented here supersedes the information in the standard flowmeter User's Manual.

The Modbus option card uses the RS485 standard for Modbus communications. This standard allows up to 32 nodes (drivers and receivers) on one multidrop network, at distances up to 4,000 ft (1,200 m). To connect the instrument(s) to the host system, Panametrics recommends using a 24-gauge (24 AWG) twisted-pair cable with a characteristic impedance of 120 ohms and a 120-ohm termination at each end of the communications line.

For ultrasonic flow meters (DF868, GC868, GF868, GF868 PLUS, GM868, GS868), the MODBUS option card must be plugged into slot 5 or slot 6 of the flowmeter. If two Modbus cards are plugged in, only the slot 5 option card will be recognized.

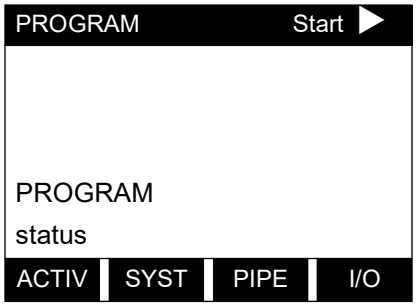
For ultrasonic transmitters (XGF868i, XGM868i, XGS868i), the MODBUS option card must be plugged into slot 2.

On the option card, pin 1 is the *[TMT-]* inverting or negative connection and pin 2 is the *[TMT+]* non-inverting or positive connection. To link the flowmeter to the control system, connect the two wires of the twisted-pair cable from these terminals to the corresponding terminals at the control system.

1.3 Setting Up Modbus Communications

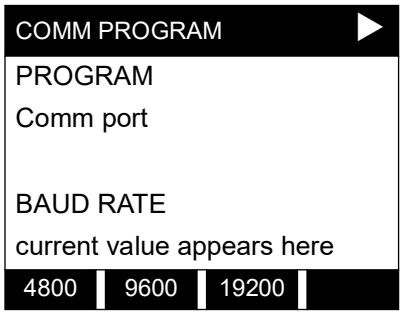
To set up Modbus communications, enter the *User Program* as described in your *Programming Manual*. Then, refer to the *menu map* in *Figure 2 on page 31* and complete the following steps:

Note: *Any time the following settings are changed, the flowmeter must be rebooted to load the new settings into the option card.*



Press the [➡]key and then the *[F3]* key to select the *COMM* submenu. (On a two-channel flowmeter, pressing the [➡] key and the *[F3]* key accesses the *GLOBL* menu. Then press *[F4]* to select the *COMM* submenu.)

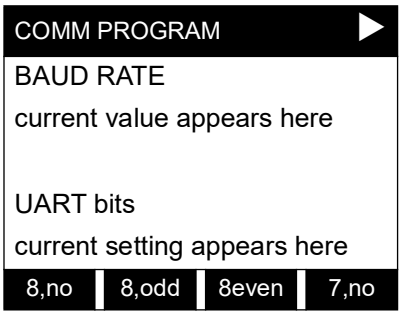
The serial port settings of the flowmeter must match those of the Modbus control system.



[This baud rate applies only to the RS232 serial port.] Press the [➡] until the desired RS232 baud rate appears on the option bar and press the appropriate *[Fx]* function key to select it.

The available RS232 baud rates are 300, 600, 1200, 2400, 4800, 9600, and 19200.

1.3 Setting Up Modbus Communications (cont.)

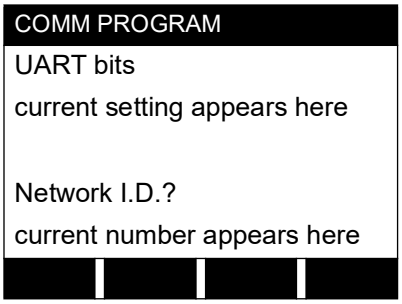


[The UART bits setting applies only to the RS232 serial port.] Press the [➡] until the desired RS232 UART bits setting appears on the option bar and then press the appropriate *[Fx]* function key to select it.

See *Table 1* for a description of the options available at the above prompt.

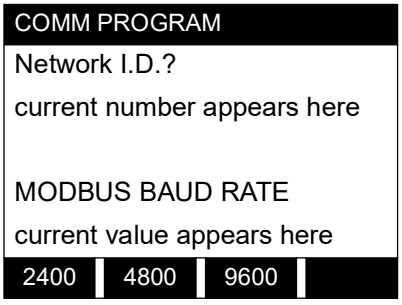
Table 1: UART Bits Options

Option Bar	# Data Bits	# Stop Bits	Parity
8,no	8	0	None
8,odd	8	0	Odd
8even	8	0	Even
7,odd	7	1	Odd
7even	7	1	Even

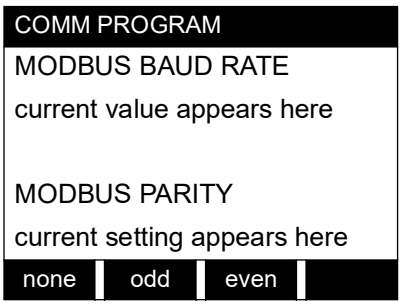


[The Network ID number is used by the IDM software only.] Enter a Network ID number between 1 and 254 and then press *[ENT]*. The default ID number is 1.

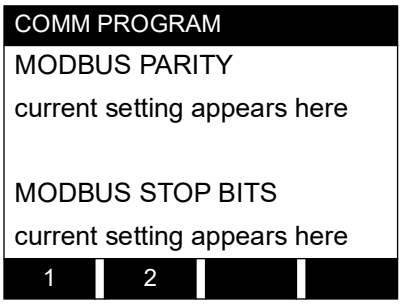
If more than one meter is connected to a network, each meter must have a unique *Network I.D.*



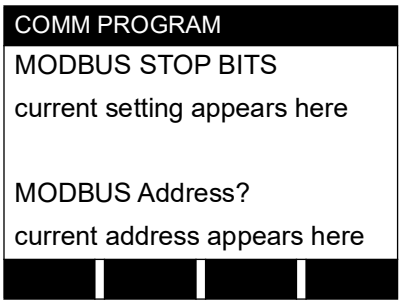
Press the appropriate *[Fx]* function key to select *[2400]*, *[4800]*, or *[9600]* for the MODBUS baud rate.



Press the appropriate *[Fx]* function key to select *[NONE]*, *[ODD]*, or *[EVEN]* for the MODBUS parity setting.



Press the appropriate *[Fx]* function key to select *[1]* or *[2]* for the MODBUS stop bits setting.



Enter a MODBUS Address number between 1 and 247. Then, press *[ENT]*.

Press *[EXIT]* until you return to *RUN* mode and the screen resumes the display of data measurements. Then reboot the meter to load the new settings into memory.

1.4 Modbus Register Map

To request specific parameters from the flowmeter using Modbus, the control system must enter the appropriate register number.

Registers 0 through 508 may contain flowmeter parameter information, depending on the particular Modbus map being used. Registers 508 through 512 are used by the flowmeter to store the MODBUS parameters. For details, see:

Table 2 on page 5 for a 1-Channel gas flowmeter (GC868, GF868, GM868, GN868, GS868, XGM868, XGS868)
Table 3 on page 8 for a 2-Channel gas flowmeter (GC868, GF868, GM868, GN868, GS868, XGM868, XGS868)
Table 4 on page 13 for a 1-Channel GF868 PLUS flowmeter
Table 5 on page 15 for a 2-Channel GF868 PLUS flowmeter
Table 6 on page 20 for a 1-Channel liquid flowmeter (DF868, XMT868i)
Table 7 on page 22 for a 2-Channel liquid flowmeter (DF868, XMT868i)
Table 8 on page 24 for a Sentinel flowmeter

Refer to **Notes** on page 19, page 24, or page 26 for information about the numerical references.

1.4.1 Modbus Map Configuration

For some products (GF868, GF868 PLUS, XGF868i) there are multiple Modbus Map configurations available. This allows the user to select a small map, such as Legacy, for faster Modbus update times. Or, the user may prefer a large map, such as "flare.IQ Map", which populates a different set of registers with much more flow diagnostics information for the flare.IQ product to analyze. This larger data set will take longer to populate and may result in more dropped packets over the Modbus network. As a compromise, the "Legacy + Diag" map adds a few more diagnostics to the Legacy map.

- Legacy map populates registers 1 through 42 for 1-channel or 1 through 110 for 2-channel meter.
- Legacy + Diag populates registers 1 though 42 and 341 through 374 for 1-channel meter.
- Legacy + Diag populates registers 1 though 102 and 341 through 450 for 2-channel meter.
- Flare IQ Map populates registers 300 through 374 and 500 through 502 for 1-channel meter.
- Flare IQ Map populates registers 300 through 473 and 500 through 502 for 2-channel meter.

1.4.2 MODBUS Inputs

All of these maps may also use registers 200 through 221 as input registers, depending on firmware version. If you have a Modbus card installed, and you select PROG, I/O, T, P, and the Modbus option card slot appears as an option for Temperature input, then your firmware version supports these registers. See your specific user manual instructions on assigning these Modbus registers to input values.

1.4.3 GF868 PLUS Modbus Map

The GF868 PLUS has the added option of the "GF PLUS Map", which is selected by default. This map includes many diagnostics not available anywhere in the other flare meters. These parameters may be loaded into the Panametrics Digital Twin tool to assess the uncertainty of the flare measurement. When not conducting uncertainty measurements, the user may prefer to select one of the three Modbus maps for better communication performance.

- GF PLUS Map populates registers 1 through 76 for a 1-channel meter, but is a different map than Legacy.
- GF PLUS Map populates registers 1 through 174 for a 2-channel meter, but is different from Legacy.
- GF PLUS Map may take inputs from registers 200 through 227.

1.4.4 Modbus Map Selection

Selection of Modbus Map version is available under PROG, OPTI, SLOTn. Choose the slot in which the Modbus option card is installed.

Note: *Depending on the type of flowmeter being programmed, some MODBUS register numbers may have zero readings. If this is the case, those register types are not available for that flowmeter.*

Note: *If you request Ch2 or AVE data from a 1-Channel meter, the values will all be zero.*

Table 2: MODBUS Registers for a 1-Channel Gas Flowmeter

MODBUS Reg #	Description	Scaling (decimal places)	Size in Bytes
1	[1]"Clear Ch1 Totalizers"	--	2 (16 bit signed)
2	[1]"Clear Ch2 Totalizers"	--	2 (16 bit signed)
3, 4**	Velocity	2	4 (2 16-bit int)
5, 6**	[2]Act Volumetric	#Q DIGITS	4 (IEEE 32 bit)
7, 8**	[2]Std Volumetric	#Q DIGITS	4 (IEEE 32 bit)
9, 10**	[3]Fwd Totals	#T DIGITS	4 (2 16-bit int)
11, 12**	[3]Rev Totals	#T DIGITS	4 (2 16-bit int)
13	#Tot Digits	0	2
14, 15**	[2]Mass Flow	#M DIGITS	4 (IEEE 32 bit)
16, 17**	[4]Fwd Mass Totals	#MT DIGITS	4 (2 16-bit int)

Table 2: MODBUS Registers for a 1-Channel Gas Flowmeter (Continued)

MODBUS Reg #	Description	Scaling (decimal places)	Size in Bytes
18, 19**	[4]Rev Mass Totals	#MT DIGITS	4 (2 16-bit int)
20	#Mass Tot Digits	0	2
21, 22**	Timer	2	4 (2 16-bit int)
23	[9]Error Code	0	2
24, 25**	Sound Speed	3	4 (2 16-bit int)
26, 27**	[10]Density	4	4 (2 16-bit int)
28, 29**	Signal Strength Upstream	1	4 (2 16-bit int)
30, 31**	Signal Strength Downstream	1	4 (2 16-bit int)
32, 33**	Temperature to Modbus	2	4 (2 16-bit int)
34, 35**	Pressure to Modbus	3	4 (2 16-bit int)
36, 37**	Signal Quality Up	--	4 (IEEE 32 bit)
38, 39**	Signal Quality Down	--	4 (IEEE 32 bit)
40, 41**	Amp Discriminator Up	--	4 (IEEE 32 bit)
42, 43**	Amp Discriminator Down	--	4 (IEEE 32 bit)
44, 45**	SNR Up (not used)	--	4 (IEEE 32 bit)
46, 47**	SNR Down (not used)	--	4 (IEEE 32 bit)
116, 117**	CH1 NHV	4	4 (2 16-bit int)
118, 119**	CH1 NHV+H2	4	4 (2 16-bit int)
Modbus Inputs			
200	Temperature A from Modbus	1	2
201	[11]Temperature A Units	0	2
202	[13]T input A Error Code	0	2
203	Pressure A from Modbus	2	2
204	[12]Pressure A Units	0	2
205	[13]P input A Error Code	0	2
206	N2% A from Modbus	1	2
207	[13]N2% A Error Code	0	2
216	H2% from Modbus	1	2
217	[13]H2% Error Code	0	2
220	Tw in usec (flare.IQ only)	1	2
New Diagnostics List for flare.IQ			
300, 301**	Velocity	2	4 (2 16-bit int)
302, 303**	[2]Act Volumetric	#Q DIGITS	4 (IEEE 32 bit)
304, 305**	[2]Std Volumetric	#Q DIGITS	4 (IEEE 32 bit)
306, 307**	[3]Fwd Totals	#T DIGITS	4 (2 16-bit int)
308, 309**	[3]Rev Totals	#T DIGITS	4 (2 16-bit int)
310	#Tot Digits	0	2
311, 312**	[2]Mass Flow	#M DIGITS	4 (IEEE 32 bit)

Table 2: MODBUS Registers for a 1-Channel Gas Flowmeter (Continued)

MODBUS Reg #	Description	Scaling (decimal places)	Size in Bytes
313, 314**	[4]Fwd Mass Totals	#MT DIGITS	4 (2 16-bit int)
315, 316**	[4]Rev Mass Totals	#MT DIGITS	4 (2 16-bit int)
317	#Mass Tot Digits	0	2
318, 319**	Timer	2	4 (2 16-bit int)
320	[9]Error Code	0	2
321, 322**	Sound Speed	3	4 (2 16-bit int)
323, 324**	Molecular Weight	4	4 (2 16-bit int)
325, 326**	Sig Strength Upstream	1	4 (2 16-bit int)
327, 328**	Sig Strength Downstream	1	4 (2 16-bit int)
329, 330**	Temperature to Modbus	2	4 (2 16-bit int)
331, 332**	Pressure to Modbus	3	4 (2 16-bit int)
333, 334**	Signal Quality Up	--	4 (IEEE 32 bit)
335, 336**	Signal Quality Down	--	4 (IEEE 32 bit)
337, 338**	Amp Discriminator Up	--	4 (IEEE 32 bit)
339, 340**	Amp Discriminator Down	--	4 (IEEE 32 bit)
341, 342**	Tup	3	4 (2 16-bit int)
343, 344**	Tdown	3	4 (2 16-bit int)
345, 346**	DELTA	3	4 (2 16-bit int)
347, 348**	Peak%	0	4 (2 16-bit int)
349, 350**	P#up	0	4 (2 16-bit int)
351, 352**	P#dn	0	4 (2 16-bit int)
353, 354**	Tu S	1	4 (2 16-bit int)
355, 356**	Td S	1	4 (2 16-bit int)
357, 358**	DT S	3	4 (2 16-bit int)
359, 360**	Tu M	1	4 (2 16-bit int)
361, 362**	Td M	1	4 (2 16-bit int)
363, 364**	DT M	3	4 (2 16-bit int)
365, 366**	Vinst	2	4 (2 16-bit int)
367	# of Errors	0	2
368, 369**	Reynolds#	0	4 (2 16-bit int)
370, 371**	Tot K Factor	4	4 (2 16-bit int)
372, 373**	Path Length	3	4 (2 16-bit int)
374, 375**	Axial Path Length	3	4 (2 16-bit int)
500	[13]Active Chan Status	0	2
501	[15]English / Metric Flag	0	2
502	[16]Global Pressure Units	0	2
Modbus Communication Parameters			
508	[6]MODBUS Baud Rate	0	2
509	[7]MODBUS Parity	0	2

Table 2: MODBUS Registers for a 1-Channel Gas Flowmeter (Continued)

MODBUS Reg #	Description	Scaling (decimal places)	Size in Bytes
510	[8]MODBUS Stop Bits	0	2
511	MODBUS Meter Addr	0	2
512	RESERVED	---	---

*The complete floating point value is constructed by combining readings from the first register with a second register. An eight Hex digits number will represent the IEEE-754 hexadecimal floating point value. 32-bit Hexadecimal Representation To Decimal Floating-Point conversion can be performed if needed.

Example: Reg 14 reading is 44d7, Reg 15 reading is 4000, Mass Flow is 44d74000, which corresponds to 1722.

**The complete Long integer value is constructed by combining readings from the first register with the second register. Eight Hex digits will represent the Long integer value.

Example: Reg 24 is 0019, Reg 25 is ED30, Hexadecimal Sound Speed is 0019ED30, which is converted to 1699120 decimal. Taking into account that Sound Speed has 3 decimal places (from the map), it corresponds to a value of 1699.120.

Table 3: MODBUS Registers for a 2-Channel Gas Flowmeter

MODBUS Reg #	Description	Scaling (decimal places)	Size in Bytes
1	[1]"Clear Ch1 Totalizers"	--	2 (16 bit signed)
2	[1]"Clear Ch2 Totalizers"	--	2 (16 bit signed)
3, 4**	Ch1 Velocity	2	4 (2 16-bit int)
5, 6**	[2]Ch1 Act Volumetric	#Q DIGITS	4 (IEEE 32 bit)
7, 8**	[2]Ch1 Std Volumetric	#Q DIGITS	4 (IEEE 32 bit)
9, 10**	[3]Ch1 Fwd Totals	#T DIGITS	4 (2 16-bit int)
11, 12**	[3]Ch1 Rev Totals	#T DIGITS	4 (2 16-bit int)
13	Ch1 #Tot Digits	0	2
14, 15**	[2]Ch1 Mass Flow	#M DIGITS	4 (IEEE 32 bit)
16, 17**	[4]Ch1 Fwd Mass Totals	#MT DIGITS	4 (2 16-bit int)
18, 19**	[4]Ch1 Rev Mass Totals	#MT DIGITS	4 (2 16-bit int)
20	Ch1 #Mass Tot Digits	0	2
21, 22**	Ch1 Timer	2	4 (2 16-bit int)
23	[9]Ch1 Error Code	0	2
24, 25**	Ch1 Sound Speed	3	4 (2 16-bit int)
26, 27**	[10]Ch1 Density	4	4 (2 16-bit int)
28, 29**	Ch1 Signal Strength Upstream	1	4 (2 16-bit int)
30, 31**	Ch1 Signal Strength Downstream	1	4 (2 16-bit int)
32, 33**	Ch1 Temperature to Modbus	2	4 (2 16-bit int)
34, 35**	Ch1 Pressure to Modbus	3	4 (2 16-bit int)
36, 37**	Ch2 Velocity	2	4 (2 16-bit int)
38, 39**	[2]Ch2 Act Volumetric	#Q DIGITS	4 (IEEE 32 bit)
40, 41**	[2]Ch2 Std Volumetric	#Q DIGITS	4 (IEEE 32 bit)
42, 43**	[3]Ch2 Fwd Totals	#T DIGITS	4 (2 16-bit int)
44, 45**	[3]Ch2 Rev Totals	#T DIGITS	4 (2 16-bit int)

Table 3: MODBUS Registers for a 2-Channel Gas Flowmeter (Continued)

MODBUS Reg #	Description	Scaling (decimal places)	Size in Bytes
46	Ch2 #Tot Digits	0	2
47, 48**	[2]Ch2 Mass Flow	#M DIGITS	4 (IEEE 32 bit)
49, 50**	[4]Ch2 Fwd Mass Totals	#MT DIGITS	4 (2 16-bit int)
51, 52**	[4]Ch2 Rev Mass Totals	#MT DIGITS	4 (2 16-bit int)
53	Ch2 #Mass Tot Digits	0	2
54, 55**	Ch2 Timer	2	4 (2 16-bit int)
56	[9]Ch2 Error Code	0	2
57, 58**	Ch2 Sound Speed	3	4 (2 16-bit int)
59, 60**	[10]Ch2 Density	4	4 (2 16-bit int)
61, 62**	Ch2 Signal Strength Upstream	1	4 (2 16-bit int)
63, 64**	Ch2 Signal Strength Downstream	1	4 (2 16-bit int)
65, 66**	Ch2 Temperature to Modbus	2	4 (2 16-bit int)
67, 68**	Ch2 Pressure to Modbus	3	4 (2 16-bit int)
69, 70**	Avg Velocity	2	4 (2 16-bit int)
71, 72**	[2]Avg Act Volumetric	#Q DIGITS	4 (IEEE 32 bit)
73, 74**	[2]Avg Std Volumetric	#Q DIGITS	4 (IEEE 32 bit)
75, 76**	[3]Avg Fwd Totals	#T DIGITS	4 (2 16-bit int)
77, 78**	[3]Avg Rev Totals	#T DIGITS	4 (2 16-bit int)
79	Avg #Tot Digits	0	2
80, 81**	[2]Avg Mass Flow	#M DIGITS	4 (IEEE 32 bit)
82, 83**	[4]Avg Fwd Mass Totals	#MT DIGITS	4 (2 16-bit int)
84, 85**	[4]Avg Rev Mass Totals	#MT DIGITS	4 (2 16-bit int)
86	Avg #Mass Tot Digits	0	2
87, 88**	Avg Timer	2	4 (2 16-bit int)
89	[5]Avg Error Code	0	2
90, 91**	Avg Sound Speed	3	4 (2 16-bit int)
92, 93**	Ch1 Signal Quality Up	--	4 (IEEE 32 bit)
94, 95**	Ch1 Signal Quality Down	--	4 (IEEE 32 bit)
96, 97**	Ch1 Amp Discriminator Up	--	4 (IEEE 32 bit)
98, 99**	Ch1 Amp Discriminator Down	--	4 (IEEE 32 bit)
104, 105**	Ch2 Signal Quality Up	--	4 (IEEE 32 bit)
106, 107**	Ch2 Signal Quality Down	--	4 (IEEE 32 bit)
108, 109**	Ch2 Amp Discriminator Up	--	4 (IEEE 32 bit)
110, 111**	Ch2 Amp Discriminator Down	--	4 (IEEE 32 bit)
116, 117**	Ch1 NHV	4	4 (2 16-bit int)
118, 119**	Ch1 NHV+H2	4	4 (2 16-bit int)
120, 121**	Ch2 NHV	4	4 (2 16-bit int)
122, 123**	Ch2 NHV+H2	4	4 (2 16-bit int)

Table 3: MODBUS Registers for a 2-Channel Gas Flowmeter (Continued)

MODBUS Reg #	Description	Scaling (decimal places)	Size in Bytes
124, 125**	Avg NHV	4	4 (2 16-bit int)
126, 127**	Avg NHV+H2	4	4 (2 16-bit int)
Modbus Inputs			
200	Temperature A from Modbus	1	2
201	[11]Temperature A Units	0	2
202	[13]T input A Error Code	0	2
203	Pressure A from Modbus	2	2
204	[12]Pressure A Units	0	2
205	[13]P input A Error Code	0	2
206	N2% A from Modbus	1	2
207	[13]N2% A Error Code	0	2
208	Temperature B from Modbus	1	2
209	[11]Temperature B Units	0	2
210	[13]T input B Error Code	0	2
211	Pressure B from Modbus	2	2
212	[12]Pressure B Units	0	2
213	[13]P input B Error Code	0	2
214	N2% B from Modbus	1	2
215	[13]N2% B Error Code	0	2
216	H2% A from Modbus	1	2
217	[13]H2% A Error Code	0	2
218	H2% B from Modbus	1	2
219	[13]H2% B Error Code	0	2
220	Ch1 Tw in usec	1	2
221	Ch2 Tw in usec	1	2
New Diagnostics List for flare.IQ			
300, 301**	Ch1 Velocity	2	4 (2 16-bit int)
302, 303**	[2]Ch1 Act Volumetric	#Q DIGITS	4 (IEEE 32 bit)
304, 305**	[2]Ch1 Std Volumetric	#Q DIGITS	4 (IEEE 32 bit)
306, 307**	[3]Ch1 Fwd Totals	#T DIGITS	4 (2 16-bit int)
308, 309**	[3]Ch1 Rev Totals	#T DIGITS	4 (2 16-bit int)
310	Ch1 #Tot Digits	0	2
311, 312**	[2]Ch1 Mass Flow	#M DIGITS	4 (IEEE 32 bit)
313, 314**	[4]Ch1 Fwd Mass Totals	#MT DIGITS	4 (2 16-bit int)
315, 316**	[4]Ch1 Rev Mass Totals	#MT DIGITS	4 (2 16-bit int)
317	Ch1 #Mass Tot Digits	0	2
318, 319**	Ch1 Timer	2	4 (2 16-bit int)

Table 3: MODBUS Registers for a 2-Channel Gas Flowmeter (Continued)

MODBUS Reg #	Description	Scaling (decimal places)	Size in Bytes
320	[9]Ch1 Error Code	0	2
321, 322**	Ch1 Sound Speed	3	4 (2 16-bit int)
323, 324**	Ch1 Molecular Weight	4	4 (2 16-bit int)
325, 326**	Ch1 Sig Strength Upstream	1	4 (2 16-bit int)
327, 328**	Ch1 Sig Strength Downstream	1	4 (2 16-bit int)
329, 330**	Ch1 Temperature to Modbus	2	4 (2 16-bit int)
331, 332**	Ch1 Pressure to Modbus	3	4 (2 16-bit int)
333, 334**	Ch1 Signal Quality Up	--	4 (IEEE 32 bit)
335, 336**	Ch1 Signal Quality Down	--	4 (IEEE 32 bit)
337, 338**	Ch1 Amp Discriminator Up	--	4 (IEEE 32 bit)
339, 340**	Ch1 Amp Discriminator Down	--	4 (IEEE 32 bit)
341, 342**	Ch1 Tup	3	4 (2 16-bit int)
343, 344**	Ch1 Tdown	3	4 (2 16-bit int)
345, 346**	Ch1 DELTA	3	4 (2 16-bit int)
347, 348**	Ch1 Peak%	0	4 (2 16-bit int)
349, 350**	Ch1 P#up	0	4 (2 16-bit int)
351, 352**	Ch1 P#dn	0	4 (2 16-bit int)
353, 354**	Ch1 Tu S	1	4 (2 16-bit int)
355, 356**	Ch1 Td S	1	4 (2 16-bit int)
357, 358**	Ch1 DT S	3	4 (2 16-bit int)
359, 360**	Ch1 Tu M	1	4 (2 16-bit int)
361, 362**	Ch1 Td M	1	4 (2 16-bit int)
363, 364**	Ch1 DT M	3	4 (2 16-bit int)
365, 366**	Ch1 Vinst	2	4 (2 16-bit int)
367	Ch1 # of Errors	0	2
368, 369**	Ch1 Reynolds#	0	4 (2 16-bit int)
370, 371**	Ch1 Tot K Factor	4	4 (2 16-bit int)
372, 373**	Ch1 Path Length	3	4 (2 16-bit int)
374, 375**	Ch1 Axial Path Length	3	4 (2 16-bit int)
376, 377**	Ch2 Velocity	2	4 (2 16-bit int)
378, 379**	[2]Ch2 Act Volumetric	#Q DIGITS	4 (IEEE 32 bit)
380, 381**	[2]Ch2 Std Volumetric	#Q DIGITS	4 (IEEE 32 bit)
382, 383**	[3]Ch2 Fwd Totals	#T DIGITS	4 (2 16-bit int)
384, 385**	[3]Ch2 Rev Totals	#T DIGITS	4 (2 16-bit int)
386	Ch2 #Tot Digits	0	2
387, 388**	[2]Ch2 Mass Flow	#M DIGITS	4 (IEEE 32 bit)
389, 390**	[4]Ch2 Fwd Mass Totals	#MT DIGITS	4 (2 16-bit int)
391, 392**	[4]Ch2 Rev Mass Totals	#MT DIGITS	4 (2 16-bit int)
393	Ch2 #Mass Tot Digits	0	2

Table 3: MODBUS Registers for a 2-Channel Gas Flowmeter (Continued)

MODBUS Reg #	Description	Scaling (decimal places)	Size in Bytes
394, 395**	Ch2 Timer	2	4 (2 16-bit int)
396	[9]Ch2 Error Code	0	2
397, 398**	Ch2 Sound Speed	3	4 (2 16-bit int)
399, 400**	Ch2 Molecular Weight	4	4 (2 16-bit int)
401, 402**	Ch2 Sig Strength Upstream	1	4 (2 16-bit int)
403, 404**	Ch2 Sig Strength Downstream	1	4 (2 16-bit int)
405, 406**	Ch2 Temperature to Modbus	2	4 (2 16-bit int)
407, 408**	Ch2 Pressure to Modbus	3	4 (2 16-bit int)
409, 410**	Ch2 Signal Quality Up	--	4 (IEEE 32 bit)
411, 412**	Ch2 Signal Quality Down	--	4 (IEEE 32 bit)
413, 414**	Ch2 Amp Discriminator Up	--	4 (IEEE 32 bit)
415, 416**	Ch2 Amp Discriminator Down	--	4 (IEEE 32 bit)
417, 418**	Ch2 Tup	3	4 (2 16-bit int)
419, 420**	Ch2 Tdown	3	4 (2 16-bit int)
421, 422**	Ch2 DELTA	3	4 (2 16-bit int)
423, 424**	Ch2 Peak%	0	4 (2 16-bit int)
425, 426**	Ch2 P#up	0	4 (2 16-bit int)
427, 428**	Ch2 P#dn	0	4 (2 16-bit int)
429, 430**	Ch2 Tu S	1	4 (2 16-bit int)
431, 432**	Ch2 Td S	1	4 (2 16-bit int)
433, 434**	Ch2 DT S	3	4 (2 16-bit int)
435, 436**	Ch2 Tu M	1	4 (2 16-bit int)
437, 438**	Ch2 Td M	1	4 (2 16-bit int)
439, 440**	Ch2 DT M	3	4 (2 16-bit int)
441, 442**	Ch2 Vinst	2	4 (2 16-bit int)
443	Ch2 # of Errors	0	2
444, 445**	Ch2 Reynolds#	0	4 (2 16-bit int)
446, 447**	Ch2 Tot K Factor	4	4 (2 16-bit int)
448, 449**	Ch2 Path Length	3	4 (2 16-bit int)
450, 451**	Ch2 Axial Path Length	3	4 (2 16-bit int)
452, 453**	Avg Velocity	2	4 (2 16-bit int)
454, 455**	[2]Avg Act Volumetric	#Q DIGITS	4 (IEEE 32 bit)
456, 467**	[2]Avg Std Volumetric	#Q DIGITS	4 (IEEE 32 bit)
458, 459**	[3]Avg Fwd Totals	#T DIGITS	4 (2 16-bit int)
460, 461**	[3]Avg Rev Totals	#T DIGITS	4 (2 16-bit int)
462	Avg #Tot Digits	0	2
463, 464**	[2]Avg Mass Flow	#M DIGITS	4 (IEEE 32 bit)
465, 466**	[4]Avg Fwd Mass Totals	#MT DIGITS	4 (2 16-bit int)
467, 468**	[4]Avg Rev Mass Totals	#MT DIGITS	4 (2 16-bit int)

Table 3: MODBUS Registers for a 2-Channel Gas Flowmeter (Continued)

MODBUS Reg #	Description	Scaling (decimal places)	Size in Bytes
469	Avg #Mass Tot Digits	0	2
470, 417**	AvgTimer	2	4 (2 16-bit int)
472	[9]Avg Error Code	0	2
473, 474**	Avg Sound Speed	3	4 (2 16-bit int)
500	[14]Active Chan Status	0	2
501	[15]English / Metrics Flag	0	2
502	[16]Global Pressure Units	0	2
Modbus Communication Parameters			
508	[6]MODBUS Baud Rate	0	2
509	[7]MODBUS Parity	0	2
510	[8]MODBUS Stop Bits	0	2
511	MODBUS Meter Addr	0	2
512	RESERVED	---	---

*The complete floating point value is constructed by combining readings from the first register with a second register. An eight Hex digits number will represent the IEEE-754 hexadecimal floating point value. 32-bit Hexadecimal Representation To Decimal Floating-Point conversion can be performed if needed.

Example: Reg 14 reading is 44d7, Reg 15 reading is 4000, Mass Flow is 44d74000, which corresponds to 1722.

**The complete Long integer value is constructed by combining readings from the first register with the second register. Eight Hex digits will represent the Long integer value.

Example: Reg 24 is 0019, Reg 25 is ED30, Hexadecimal Sound Speed is 0019ED30, which is converted to 1699120 decimal. Taking into account that Sound Speed has 3 decimal places (from the map), it corresponds to a value of 1699.120.

Table 4: MODBUS Registers for a 1-Channel GF868 PLUS Flowmeter

MODBUS Reg #	Description	Scaling (decimal places)	Size in Bytes
1	[1]"Clear Ch1 Totalizers"	--	2 (16 bit signed)
2	[1]"Clear Ch2 Totalizers"	--	2 (16 bit signed)
3, 4**	V_averaged	2	4 (2 16-bit int)
5, 6**	[2]Act Volumetric	#Q DIGITS	4 (IEEE 32 bit)
7, 8**	[2]Std Volumetric	#Q DIGITS	4 (IEEE 32 bit)
9, 10**	[3]Fwd Totals	#T DIGITS	4 (2 16-bit int)
11, 12**	[3]Rev Totals	#T DIGITS	4 (2 16-bit int)
13	#Tot Digits	0	2 (16 bit unsigned)
14, 15**	[2]Mass Flow	#M DIGITS	4 (IEEE 32 bit)
16, 17**	[4]Fwd Mass Totals	#MT DIGITS	4 (2 16-bit int)
18, 19**	[4]Rev Mass Totals	#MT DIGITS	4 (2 16-bit int)
20	#Mass Tot Digits	0	2 (16 bit unsigned)

Table 4: MODBUS Registers for a 1-Channel GF868 PLUS Flowmeter (Continued)

MODBUS Reg #	Description	Scaling (decimal places)	Size in Bytes
21, 22**	Timer	2	4 (2 16-bit int)
23	[9]Error Code	0	2 (16 bit unsigned)
24, 25**	Sound Speed	3	4 (2 16-bit int)
26, 27**	Molecular Weight	4	4 (2 16-bit int)
28, 29**	Sig Strength Upstream	1	4 (2 16-bit int)
30, 31**	Sig Strength Downstream	1	4 (2 16-bit int)
32, 33**	Temperature to Modbus	2	4 (2 16-bit int)
34, 35**	Pressure to Modbus	3	4 (2 16-bit int)
36, 37**	Signal Quality Up	--	4 (IEEE 32 bit)
38, 39**	Signal Quality Down	--	4 (IEEE 32 bit)
40, 41**	Amp Discriminator Up	--	4 (IEEE 32 bit)
42, 43**	Amp Discriminator Down	--	4 (IEEE 32 bit)
44, 45**	SNR Up (not used)	--	4 (IEEE 32 bit)
46, 47**	SNR Down (not used)	--	4 (IEEE 32 bit)
48, 49**	Tup	3	4 (IEEE 32 bit)
50, 51**	Tdown	3	4 (IEEE 32 bit)
52, 53**	Delta-t	3	4 (IEEE 32 bit)
54, 55**	V_instantaneous	2	4 (IEEE 32 bit)
56, 57**	Dynamic Viscosity	5	4 (IEEE 32 bit)
58, 59**	Re	0	4 (IEEE 32 bit)
60, 61**	k (Velocity/Re)	4	4 (IEEE 32 bit)
62, 63**	k_RPK (Re)	4	4 (IEEE 32 bit)
64, 65**	MFtotal	4	4 (IEEE 32 bit)
66, 67**	V_inst_final	2	4 (IEEE 32 bit)
68, 69**	Line Compressibility	4	4 (IEEE 32 bit)
70, 71**	Standard Compressibility	4	4 (IEEE 32 bit)
72, 73**	Nitrogen Composition%	4	4 (IEEE 32 bit)
74, 75**	Line Density	3	4 (IEEE 32 bit)
76, 77**	Standard Density	3	4 (IEEE 32 bit)
200	Temperature A from Modbus	1	2
201	[11]Temperature A Units	0	2
202	[13]T input A Error Code	0	2
203	Pressure A from Modbus	2	2
204	[12]Pressure A Units	0	2
205	[13]P input A Error Code	0	2
206	N2% A from Modbus	1	2
207	[13]N2% A Error Code	0	2
216	H2% A from Modbus	1	2

Table 4: MODBUS Registers for a 1-Channel GF868 PLUS Flowmeter (Continued)

MODBUS Reg #	Description	Scaling (decimal places)	Size in Bytes
217	[13]H2% A Error Code	0	2
220	MW A from Modbus	2	2
221	[13]MV A Error Code	0	2
224	NU A from Modbus	2	2
225	[13]NU A Error Code	0	2
508	[6]MODBUS Baud Rate	0	2
509	[7]MODBUS Parity	0	2
510	[8]MODBUS Stop Bits	0	2
511	MODBUS Meter Addr	0	2
512	RESERVED	---	---

*The complete floating point value is constructed by combining readings from the first register with a second register. An eight Hex digits number will represent the IEEE-754 hexadecimal floating point value. 32-bit Hexadecimal Representation To Decimal Floating-Point conversion can be performed if needed.

Example: Reg 14 reading is 44d7, Reg 15 reading is 4000, Mass Flow is 44d74000, which corresponds to 1722.

**The complete Long integer value is constructed by combining readings from the first register with the second register. Eight Hex digits will represent the Long integer value.

Example: Reg 24 is 0019, Reg 25 is ED30, Hexadecimal Sound Speed is 0019ED30, which is converted to 1699120 decimal. Taking into account that Sound Speed has 3 decimal places (from the map), it corresponds to a value of 1699.120.

Table 5: MODBUS Registers for a 2-Channel GF868 PLUS Flowmeter

MODBUS Reg #	Description	Scaling (decimal places)	Size in Bytes
1	[1]"Clear Ch1 Totalizers"	--	2 (16 bit signed)
2	[1]"Clear Ch2 Totalizers"	--	2 (16 bit signed)
3, 4**	Ch1 V_averaged	2	4 (2 16-bit int)
5, 6**	[2]Ch1 Act Volumetric	#Q DIGITS	4 (IEEE 32 bit)
7, 8**	[2]Ch1 Std Volumetric	#Q DIGITS	4 (IEEE 32 bit)
9, 10**	[3]Ch1 Fwd Totals	#T DIGITS	4 (2 16-bit int)
11, 12**	[3]Ch1 Rev Totals	#T DIGITS	4 (2 16-bit int)
13	Ch1 #Tot Digits	0	2 (16 bit signed)
14, 15**	[2]Ch1 Mass Flow Rate	#M DIGITS	4 (IEEE 32 bit)
16, 17**	[4]Ch1 Fwd Mass Totals	#MT DIGITS	4 (2 16-bit int)
18, 19**	[4]Ch1 Rev Mass Totals	#MT DIGITS	4 (2 16-bit int)
20	Ch1 #Mass Tot Digits	0	2 (16 bit signed)
21, 22**	Ch1 Timer	2	4 (2 16-bit int)
23	[9]Ch1 Error Code	0	2 (16 bit signed)
24, 25**	Ch1 Sound Speed	3	4 (2 16-bit int)
26, 27**	Ch1 Molecular Weight	4	4 (2 16-bit int)

Table 5: MODBUS Registers for a 2-Channel GF868 PLUS Flowmeter (Continued)

MODBUS Reg #	Description	Scaling (decimal places)	Size in Bytes
28, 29**	Ch1 Sig Strength Upstream	1	4 (2 16-bit int)
30, 31**	Ch1 Sig Strength Downstream	1	4 (2 16-bit int)
32, 33**	Ch1 Temperature to Modbus	2	4 (2 16-bit int)
34, 35**	Ch1 Pressure to Modbus	3	4 (2 16-bit int)
36, 37**	Ch1 Signal Quality Up	--	4 (IEEE 32 bit)
38, 39**	Ch1 Signal Quality Down	--	4 (IEEE 32 bit)
40, 41**	Ch1 Amp Discriminator Up	--	4 (IEEE 32 bit)
42, 43**	Ch1 Amp Discriminator Down	--	4 (IEEE 32 bit)
44, 45**	Ch1 SNR Up (not used)	--	4 (IEEE 32 bit)
46, 47**	Ch1 SNR Down (not used)	--	4 (IEEE 32 bit)
48, 49**	Ch1 Tup	3	4 (IEEE 32 bit)
50, 51**	Ch1 Tdown	3	4 (IEEE 32 bit)
52, 53**	Ch1 Delta-t	3	4 (IEEE 32 bit)
54, 55**	Ch1 V_instantaneous	2	4 (IEEE 32 bit)
56, 57**	Ch1 Dynamic Viscosity	5	4 (IEEE 32 bit)
58, 59**	Ch1 Re	0	4 (IEEE 32 bit)
60, 61**	Ch1 k (Velocity/Re)	4	4 (IEEE 32 bit)
62, 63**	Ch1 k_RPK (Re)	4	4 (IEEE 32 bit)
64, 65**	Ch1 MFtotal	4	4 (IEEE 32 bit)
66, 67**	Ch1 V_inst_final	2	4 (IEEE 32 bit)
68, 69**	Ch1 Line Commpressibility	4	4 (IEEE 32 bit)
70, 71**	Ch1 Standard Compressibility	4	4 (IEEE 32 bit)
72, 73**	Ch1 Nitrogen Composition%	4	4 (IEEE 32 bit)
74, 75**	Ch1 Line Density	3	4 (IEEE 32 bit)
76, 77**	Ch1 Standard Density	3	4 (IEEE 32 bit)
78, 79**	Ch2 V_averaged	2	4 (2 16-bit int)
80, 81**	[2]Ch2 Act Volumetric	#Q DIGITS	4 (IEEE 32 bit)
82, 83**	[2]Ch2 Std Volumetric	#Q DIGITS	4 (IEEE 32 bit)
84, 85**	[3]Ch2 Fwd Totals	#T DIGITS	4 (2 16-bit int)
86, 87**	[3]Ch2 Rev Totals	#T DIGITS	4 (2 16-bit int)
88	Ch2 #Tot Digits	0	2 (16 bit signed)
89, 90**	[2]Ch2 Mass Flow Rate	#M DIGITS	4 (IEEE 32 bit)
91, 92**	[4]Ch2 Fwd Mass Totals	#MT DIGITS	4 (2 16-bit int)
93, 94**	[4]Ch2 Rev Mass Totals	#MT DIGITS	4 (2 16-bit int)
95	Ch2 #Mass Tot Digits	0	2 (16 bit signed)
96, 97**	Ch2 Timer	2	4 (2 16-bit int)
98	[9]Ch2 Error Code	0	2 (16 bit signed)
99, 100**	Ch2 Sound Speed	3	4 (2 16-bit int)
101, 102**	Ch2 Molecular Weight	4	4 (2 16-bit int)

Table 5: MODBUS Registers for a 2-Channel GF868 PLUS Flowmeter (Continued)

MODBUS Reg #	Description	Scaling (decimal places)	Size in Bytes
103, 104**	Ch2 Sig Strength Upstream	1	4 (2 16-bit int)
105, 106**	Ch2 Sig Strength Downstream	1	4 (2 16-bit int)
107, 108**	Ch2 Temperature to Modbus	2	4 (2 16-bit int)
109, 110**	Ch2 Pressure to Modbus	3	4 (2 16-bit int)
111, 112**	Ch2 Signal Quality Up	--	4 (IEEE 32 bit)
113, 114**	Ch2 Signal Quality Down	--	4 (IEEE 32 bit)
115, 116**	Ch2 Amp Discriminator Up	--	4 (IEEE 32 bit)
117, 118**	Ch2 Amp Discriminator Down	--	4 (IEEE 32 bit)
119, 120**	Ch2 SNR Up (not used)	--	4 (IEEE 32 bit)
121, 122**	Ch2 SNR Down (not used)	--	4 (IEEE 32 bit)
123, 124**	Ch2 Tup	3	4 (IEEE 32 bit)
125, 126**	Ch2 Tdown	3	4 (IEEE 32 bit)
127, 128**	Ch2 Delta-t	3	4 (IEEE 32 bit)
129, 130**	Ch2 V_instantaneous	2	4 (IEEE 32 bit)
131, 132**	Ch2 Dynamic Viscosity	5	4 (IEEE 32 bit)
133, 134**	Ch2 Re	0	4 (IEEE 32 bit)
135, 136**	Ch2 k (Velocity/Re)	4	4 (IEEE 32 bit)
137, 138**	Ch2 k_RPK (Re)	4	4 (IEEE 32 bit)
139, 140**	Ch2 MFtotal	4	4 (IEEE 32 bit)
141, 142**	Ch2 V_inst_final	2	4 (IEEE 32 bit)
143, 144**	Ch2 Line Commpressibility	4	4 (IEEE 32 bit)
145, 146**	Ch2 Standard Compressibility	4	4 (IEEE 32 bit)
147, 148**	Ch2 Nitrogen Composition%	4	4 (IEEE 32 bit)
149, 150**	Ch2 Line Density	3	4 (IEEE 32 bit)
151, 152**	Ch2 Standard Density	3	4 (IEEE 32 bit)
153, 154**	Avg Velocity	2	4 (2 16-bit int)
155, 156**	[2]Avg Act Volumetric	#Q DIGITS	4 (IEEE 32 bit)
157, 158**	[2]Avg Std Volumetric	#Q DIGITS	4 (IEEE 32 bit)
159, 160**	[3]Avg Fwd Totals	#T DIGITS	4 (2 16-bit int)
161, 162**	[3]Avg Rev Totals	#T DIGITS	4 (2 16-bit int)
163	Avg #Tot Digits	0	2
164, 165**	[2]Avg Mass Flow Rate	#M DIGITS	4 (IEEE 32 bit)
166, 167**	[4]Avg Fwd Mass Totals	#MT DIGITS	4 (2 16-bit int)
168, 169**	[4]Avg Rev Mass Totals	#MT DIGITS	4 (2 16-bit int)
170	Avg #Mass Tot Digits	0	2
171, 172**	Avg Timer	2	4 (2 16-bit int)
173	[5]Avg Error Code	0	2
174, 175**	Avg Sound Speed	3	4 (2 16-bit int)

Table 5: MODBUS Registers for a 2-Channel GF868 PLUS Flowmeter (Continued)

MODBUS Reg #	Description	Scaling (decimal places)	Size in Bytes
200	Temperature A from Modbus	1	2
201	[11]Temperature A Units	0	2
202	[13]T input A Error Code	0	2
203	Pressure A from Modbus	2	2
204	[12]Pressure A Units	0	2
205	[13]P input A Error Code	0	2
206	N2% A from Modbus	1	2
207	[13]N2% A Error Code	0	2
208	Temperature B from Modbus	1	2
209	[11]Temperature B Units	0	2
210	[13]T input B Error Code	0	2
211	Pressure B from Modbus	2	2
212	[12]Pressure B Units	0	2
213	[13]P input B Error Code	0	2
214	N2% B from Modbus	1	2
215	[13]N2% B Error Code	0	2
216	H2% A from Modbus	1	2
217	[13]H2% A Error Code	0	2
218	H2% B from Modbus	1	2
219	[13]H2% B Error Code	0	2
220	MW A from Modbus	2	2
221	[13]MW A Error Code	0	2
222	MW B from Modbus	2	2
223	[13]MW B Error Code	0	2
224	NU A from Modbus	2	2
225	[13]NU A Error Code	0	2
226	NU B from Modbus	2	2
227	[13]NU B Error Code	0	2
508	[6]MODBUS Baud Rate	0	2
509	[7]MODBUS Parity	0	2
510	[8]MODBUS Stop Bits	0	2
511	MODBUS Meter Addr	0	2
512	RESERVED	---	---

*The complete floating point value is constructed by combining readings from the first register with a second register. An eight Hex digits number will represent the IEEE-754 hexadecimal floating point value. 32-bit Hexadecimal Representation To Decimal Floating-Point conversion can be performed if needed.

Example: Reg 14 reading is 44d7, Reg 15 reading is 4000, Mass Flow is 44d74000, which corresponds to 1722.

**The complete Long integer value is constructed by combining readings from the first register with the second register. Eight Hex digits will represent the Long integer value.

Example: Reg 24 is 0019, Reg 25 is ED30, Hexadecimal Sound Speed is 0019ED30, which is converted to 1699120 decimal. Taking into account that Sound Speed has 3 decimal places (from the map), it corresponds to a value of 1699.120.

1.4.5 Notes for a Gas Flowmeter:

1. **Clear Totalizers:**
   Write 1 to Reg 1 to clear Channel 1 totalizers.
   Write 1 to Reg 2 to clear Channel 2 totalizers.
2. Values in these registers are floating point numbers and require no scaling. The number of decimal digits is set in meter programming.
3. Require scaling by value in register 13.
4. Require scaling by value in register 20.
5. **AVG Error Code:**
   0=Both Ch1 and Ch2 are in error.
   1=Ch1 only is in error
   2=Ch2 only is in error
   3=Both channels are error free
6. **MODBUS baud rate:**
   5 = 2400, 6 = 4800, 7 = 9600
7. **MODBUS parity:**
   0 = none, 1 = odd, 2 = even
8. **MODBUS stop bits:**
   1 = 1 stop bit, 2 = 2 stop bits
9. **Error Code:**
   Highest single number, or combination of error numbers, listed without an "E". Error codes should be explained in the user's manual or guide.

IMPORTANT: If the unit is reading over range, an error condition will occur and output 20mA (for a 0-20mA range) or 21.10mA (for a 4-20mA range).

10. **Descriptions:**
    For the GF868, register numbers 26, 27 and 59, 60 have the description Molecular Weight.
    For the GN868, register numbers 26, 27 and 59, 60 have the description Fpv.
11. **Temperature Units:**
    0=degC, 1=F, any other number=degC
12. **Pressure Units:**
    0=bar, 1=kPa, 2=PSI, any other number=bar
13. **Modbus Input Error Code:**
    0=No Error, 1=Error, any other number=Error
14. **ActiveChan Status**
    0=No Connection, 1=1CH meter, 2=2CH both active, 3=2CH Ch1 active only, 4=2CH Ch2 active only
15. **English/Metric Flag:**
    0=English Units, 1=Metric
16. **Global Pressure Units:**
    0=psia, 1=psig, 2=bara, 3=barg, 4=kpaa, 5=kpag; (a=actual, g=gage)

1.4.6 Calculating Hex Values for Input Registers

Input registers start at register 200. If available, there may be registers for sending Temperature, Pressure, N2%, H2%, and for the GF868 PLUS even kinematic viscosity (NU) and molecular weight (MW). These registers expect a 16-bit signed value in hexadecimal.

The input value has to be calculated with the number of expected decimal places in mind. For example, we see from the table that Temperature has one decimal place, so if we write the value 100 to that register, the temperature will be interpreted as 10.0 degrees.

In hexadecimal notation, 1000 hex =4096 decimal. So, if we write 1000 hex to the Temperature register, it will be interpreted as 409.6 degrees. The pressure register would interpret that value as 40.96, and the N2% register would interpret it as 409.6.

Positive values are in range of 0 to 7FFF hex.
Negative values are in the range of 8000 to FFFF hex.

The negative value = the magnitude as a positive value + 8000 hex.
Therefore, 1000 hex = 4096 (with the decimal point placed per the decimal place value in the Modbus table).
1000 hex + 8000 hex = 9000 hex, so 9000 hex =–4096 with the decimal place factored in just as it is for the positive values.

To calculate the hex value for the input register, use this formula:

If the value > 0, multiply the integer value by 10^ (number of decimal places), round it to a whole number and convert to HEX.

If the value < 0, multiply the magnitude of value by 10^ (number of decimal places), round it to a whole number, and convert to HEX. Then add 8000 HEX to the value.

If the value = 0, enter 0. It's the same in HEX.

Example:

Temperature has 1 decimal place, so:

-100 degrees = 100 * 10^1 = 1000. Convert to HEX = 03E8. Add 8000 HEX to make it negative = 83E8.

If you write 83E8 to holding register 200, the Modbus input will interpret the measurement as -100 degrees.

If you write 0 to register 201, the Modbus input will interpret that as degrees C.

If you write 0 to register 202, the Modbus input will interpret that as an error-free measurement and will apply it to whatever is assigned to Modbus Temperature A.

If the error code is any other number, the Modbus input routine will treat that like a broken temperature sensor and will set a temperature input error to whatever is assigned to Modbus Temperature A.

Table 6: MODBUS Registers for a 1-Channel Liquid Flowmeter

MODBUS Reg #	Description	Scaling (decimal places)	Size in Bytes
1	[1]Clear Totalizers		2 (16 bit signed int)
2, 3**	Velocity	2	4 (32 bit Long Integer)
4, 5*	Volumetric	--	4 (IEEE 32 bit Float)
6, 7**	+Totals	Register 10	4 (32 bit Long Integer)
8, 9**	–Totals	Register 10	4 (32 bit Long Integer)
10	#T Digits	0	2 (16 bit signed int)
11, 12**	Totalizer Time	2	4 (32 bit Long Integer)
13	[2]Error Value	0	2 (16 bit signed int)
14, 15**	SSUP	1	4 (32 bit Long Integer)
16, 17**	SSDN	1	4 (32 bit Long Integer)
18, 19**	SNDSP	0	4 (32 bit Long Integer)
56, 57*	Power	--	4 (IEEE 32 bit Float)
58, 59**	+Energy	Register 62	4 (32 bit Long Integer)
60, 61**	–Energy	Register 62	4 (32 bit Long Integer)
62	# Energy Digits	0	2 (16 bit signed int)

Table 6: MODBUS Registers for a 1-Channel Liquid Flowmeter (Continued)

MODBUS Reg #	Description	Scaling (decimal places)	Size in Bytes
63, 64**	TempS	2	4 (32 bit Long Integer)
65, 66**	TempR	2	4 (32 bit Long Integer)
67, 68**	TS-TR	2	4 (32 bit Long Integer)
69, 70**	DELTH	2	4 (32 bit Long Integer)
86, 87*	[5]Slot 1 Input A		4 (IEEE 32 bit Float)
88, 89*	[5]Slot 1 Input B		4 (IEEE 32 bit Float)
90, 91*	Slot 2 Input A		4 (IEEE 32 bit Float)
92, 93*	Slot 2 Input B		4 (IEEE 32 bit Float)
94, 95*	Slot 3 Input A		4 (IEEE 32 bit Float)
96, 97*	Slot 3 Input B		4 (IEEE 32 bit Float)
98, 99*	Slot 4 Input A		4 (IEEE 32 bit Float)
100, 101*	Slot 4 Input B		4 (IEEE 32 bit Float)
102, 103*	Slot 5 Input A		4 (IEEE 32 bit Float)
104, 105*	Slot 5 Input B		4 (IEEE 32 bit Float)
106, 107*	Slot 6 Input A		4 (IEEE 32 bit Float)
108, 109*	Slot 6 Input B		4 (IEEE 32 bit Float)
508	[6]MODBUS baud rate	0	2 (16 bit signed int)
509	[7]MODBUS parity	0	2 (16 bit signed int)
510	[8]MODBUS stop bits	0	2 (16 bit signed int)
511	MODBUS meter address	0	2 (16 bit signed int)
512	RESERVED	--	--

*The complete floating point value is constructed by combining readings from the first register with a second register. An eight Hex digits number will represent the IEEE-754 hexadecimal floating point value. 32-bit Hexadecimal Representation To Decimal Floating-Point conversion can be performed if needed.

Example: Reg 4 reading is 44d7, Reg 5 reading is 4000, Volumetric is 44d74000, which corresponds to 1722.

**The complete Long integer value is constructed by combining readings from the first register with the second register. Eight Hex digits will represent the Long integer value.

Example: Reg 2 is 0019, Reg 3 is ED30, Hexadecimal Velocity is 0019ED30, which corresponds to 1699120 decimal. Taking into account that Velocity has 2 decimal places (from the map), it corresponds to a value of 16991.20.

Table 7: MODBUS Registers for a 2-Channel Liquid Flowmeter

MODBUS Reg #	Description	Scaling (decimal places)	Size in Bytes
1	[1]Clear Totalizers		2 (16 bit signed int)
2, 3**	CH 1 Velocity	2	4 (32 bit Long Integer)
4, 5*	CH 1 Volumetric	--	4 (IEEE 32 bit Float)
6, 7**	CH 1 +Totals	Register 10	4 (32 bit Long Integer)
8, 9**	CH 1 -Totals	Register 10	4 (32 bit Long Integer)
10	CH 1 #T Digits	0	2 (16 bit signed int)
11, 12**	CH 1 Totalizer Time	2	4 (32 bit Long Integer)
13	[2]CH 1 Error Value	0	2 (16 bit signed int)
14, 15**	CH 1 SSUP	1	4 (32 bit Long Integer)
16, 17**	CH 1 SSDN	1	4 (32 bit Long Integer)
18, 19**	CH 1 SNDSP	0	4 (32 bit Long Integer)
20, 21**	CH 2 Velocity	2	4 (32 bit Long Integer)
22, 23*	CH 2 Volumetric	--	4 (IEEE 32 bit Float)
24, 25**	CH 2 + Totals	Register 28	4 (32 bit Long Integer)
26, 27**	CH 2 - Totals	Register 28	4 (32 bit Long Integer)
28	CH 2 # T Digits	0	2 (16 bit signed int)
29, 30**	CH 2 Totalizer Time	2	4 (32 bit Long Integer)
31	[2]CH 2 Error Value	0	2 (16 bit signed int)
32, 33**	CH 2 SSUP	1	4 (32 bit Long Integer)
34, 35**	CH 2 SSDN	1	4 (32 bit Long Integer)
36, 37**	CH 2 SNDSP	0	4 (32 bit Long Integer)
38, 39**	[3]AVG Velocity	2	4 (32 bit Long Integer)
40, 41*	[3]AVG Volumetric	--	4 (IEEE 32 bit Float)
42, 43**	[3]AVG + Totals	Register 46	4 (32 bit Long Integer)
44, 45**	[3]AVG - Totals	Register 46	4 (32 bit Long Integer)
46	AVG #T Digits	0	2 (16 bit signed int)
47, 48**	[3]AVG Totalizer Time	2	4 (32 bit Long Integer)
49	[4]AVG Error Value	0	2 (16 bit signed int)
50, 51**	[3]AVG SSUP	1	4 (32 bit Long Integer)
52, 53**	[3]AVG SSDN	1	4 (32 bit Long Integer)
54, 55**	[3]AVG SNDSP	0	4 (32 bit Long Integer)
56, 57*	CH 1 Power	--	4 (IEEE 32 bit Float)
58, 59**	CH 1 +Energy	Register 62	4 (32 bit Long Integer)
60, 61**	CH 1 -Energy	Register 62	4 (32 bit Long Integer)
62	CH 1 # Energy Digits	0	2 (16 bit signed int)
63, 64**	CH 1 TempS	2	4 (32 bit Long Integer)
65, 66**	CH 1 TempR	2	4 (32 bit Long Integer)
67, 68**	CH 1 TS-TR	2	4 (32 bit Long Integer)
69, 70**	CH 1 DELTH	2	4 (32 bit Long Integer)

Table 7: MODBUS Registers for a 2-Channel Liquid Flowmeter (Continued)

MODBUS Reg #	Description	Scaling (decimal places)	Size in Bytes
71, 72*	CH 2 Power	--	4 (IEEE 32 bit Float)
73, 74**	CH 2 +Energy	Register 77	4 (32 bit Long Integer)
75, 76**	CH 2 -Energy	Register 77	4 (32 bit Long Integer)
77	CH 2 # Energy Digits	0	2 (16 bit signed int)
78, 79**	CH 2 TempS	2	4 (32 bit Long Integer)
80, 81**	CH 2 TempR	2	4 (32 bit Long Integer)
82, 83**	CH 2 TS-TR	2	4 (32 bit Long Integer)
84, 85**	CH 2 DELTH	2	4 (32 bit Long Integer)
86, 87*	[5]Slot 1 Input A		4 (IEEE 32 bit Float)
88, 89*	[5]Slot 1 Input B		4 (IEEE 32 bit Float)
90, 91*	Slot 2 Input A		4 (IEEE 32 bit Float)
92, 93*	Slot 2 Input B		4 (IEEE 32 bit Float)
94, 95*	Slot 3 Input A		4 (IEEE 32 bit Float)
96, 97*	Slot 3 Input B		4 (IEEE 32 bit Float)
98, 99*	Slot 4 Input A		4 (IEEE 32 bit Float)
100, 101*	Slot 4 Input B		4 (IEEE 32 bit Float)
102, 103*	Slot 5 Input A		4 (IEEE 32 bit Float)
104, 105*	Slot 5 Input B		4 (IEEE 32 bit Float)
106, 107*	Slot 6 Input A		4 (IEEE 32 bit Float)
108, 109*	Slot 6 Input B		4 (IEEE 32 bit Float)
508	[6]MODBUS baud rate	0	2 (16 bit signed int)
509	[7]MODBUS parity	0	2 (16 bit signed int)
510	[8]MODBUS stop bits	0	2 (16 bit signed int)
511	MODBUS meter addr	0	2 (16 bit signed int)
512	RESERVED	--	--

*The complete floating point value is constructed by combining readings from the first register with a second register. An eight Hex digits number will represent the IEEE-754 hexadecimal floating point value. 32-bit Hexadecimal Representation To Decimal Floating-Point conversion can be performed if needed.

Example: Reg 4 reading is 44d7, Reg 5 reading is 4000, Volumetric is 44d74000, which corresponds to 1722.

**The complete Long integer value is constructed by combining readings from the first register with the second register. Eight Hex digits will represent the Long integer value.

Example: Reg 2 is 0019, Reg 3 is ED30, Hexadecimal Velocity is 0019ED30, which is converted to 1699120 decimal. Taking into account that Velocity has 2 decimal places (from the map), it corresponds to a value of 16991.20.

1.4.7 Notes for a Liquid Flowmeter:

1. **Clear Totalizers:** Write 1 to Reg 1 to clear Channel 1 and Channel 2 totalizers.
2. **Error Value:** see table in DF868 manual for error codes
3. **Average:**
   average of channel 1 and channel 2 if both channels out of error,
   channel 1 value if channel 2 is in error,
   channel 2 value if channel 1 is in error,
   zero if both channels are in error.
4. **Average Error Status:**
   0 = both in error
   1 = chan 2 in error,
   2 = chan 1 in error,
   3 = both ok
5. **MODBUS baud rate:**
   5 = 2400, 6 = 4800, 7 = 9600
6. **MODBUS parity:**
   0 = none, 1 = odd, 2 = even
7. **MODBUS stop bits:**
   1 = 1 stop bit, 2 = 2 stop bits
8. **General:**
   Registers are written if corresponding functions are actuated by the user. Registers for unactuated functions are initialized to zero at startup.
9. **Error Code:**
   Highest number (single or combination of errors) listed, without an "E". Error codes should be explained in the user's manual.

Table 8: MODBUS Registers for a Sentinel Flowmeter

MODBUS Reg #	Description	Default	Unit	Refresh	Size in Bytes
1, 2*	Actual Volumetric Flow	0	am^3/hr	1s	4 (IEEE 32 bit Float)
3, 4*	Soundspeed	0	m/s	1s	4 (IEEE 32 bit Float)
5	Measurement Status	0		1s	2 (16 bit Int)
6, 7*	Area Average Velocity	0	m/s	1s	4 (IEEE 32 bit Float)
8, 9*	Normal Volumetric Flow	0	sm^3/hr	1s	4 (IEEE 32 bit Float)
10, 11, 12, 13**	Actual Volume Forward Total	0	am^3	2s	8 (64 bit double precision)
14, 15, 16, 17**	Actual Volume Reverse Total	0	am^3	2s	8 (64 bit double precision)
18, 19, 20, 21**	Normal Volume Forward Total	0	sm^3	2s	8 (64 bit double precision)
22, 23, 24, 25**	Normal Volume Reverse Total	0	sm^3	2s	8 (64 bit double precision)
26, 27*	Mass Flow	0	kg/hr	2s*	4 (IEEE 32 bit Float)
28, 29*	Forward Mass Total	0	kg	2s*	4 (IEEE 32 bit Float)
30, 31*	Reverse Mass Total	0	kg	2s*	4 (IEEE 32 bit Float)
32, 33*	Energy Flow	0	J/hr	5s*	4 (IEEE 32 bit Float)
34, 35*	Forward Energy Total	0	J	5s*	4 (IEEE 32 bit Float)
36, 37*	Reverse Energy Total	0	J	5s*	4 (IEEE 32 bit Float)
38, 39*	Pressure	10^5	Pa	10s/Fixed	4 (IEEE 32 bit Float)

Table 8: MODBUS Registers for a Sentinel Flowmeter (Continued)

MODBUS Reg #	Description	Default	Unit	Refresh	Size in Bytes
40, 41*	Temperature	20	C	10s/Fixed	4 (IEEE 32 bit Float)
42	Super Compressibility Factor x 1000	1000		10s/Fixed	2 (16 bit Int)
43	Density x 1000	1000	lb/ft^3	10s/Fixed	2 (16 bit Int)
44	Kinematic Viscosity x 10^8	1000	m^2/s	10s/Fixed*	2 (16 bit Int)
45	Heating Value	25000	kJ/m^3	10s/Fixed*	2 (16 bit Int)
46	Path A Velocity	0	m/s x 1000	10s	2 (16 bit Int)
47	Path A Sound Speed	0	m/s x 10	10s	2 (16 bit Int)
48	Path A% Readings in Error	0		10s	2 (16 bit Int)
49	Path A Last Error	0		10s*	2 (16 bit Int)
50	Path B Velocity	0	m/s x 1000	10s	2 (16 bit Int)
51	Path B Sound Speed	0	m/s x 10	10s	2 (16 bit Int)
52	Path B% Readings in Error	0		10s	2 (16 bit Int)
53	Path B Last Error	0		10s*	2 (16 bit Int)
54	Path C Velocity	0	m/s x 1000	10s	2 (16 bit Int)
55	Path C Sound Speed	0	m/s x 10	10s	2 (16 bit Int)
56	Path C% Readings in Error	0		10s	2 (16 bit Int)
57	Path C Last Error	0		10s*	2 (16 bit Int)
58	Path D Velocity	0	m/s x 1000	10s	2 (16 bit Int)
59	Path D Sound Speed	0	m/s x 10	10s	2 (16 bit Int)
60	Path D% Readings in Error	0		10s	2 (16 bit Int)
61	Path D Last Error	0		10s*	2 (16 bit Int)
62	Path E Velocity	0	m/s x 1000	10s	2 (16 bit Int)
63	Path E Sound Speed	0	m/s x 10	10s	2 (16 bit Int)
64	Path E% Readings in Error	0		10s	2 (16 bit Int)
65	Path E Last Error	0		10s*	2 (16 bit Int)
66	Path F Velocity	0	m/s x 1000	10s	2 (16 bit Int)
67	Path F Sound Speed	0	m/s x 10	10s	2 (16 bit Int)
68	Path F% Readings in Error	0		10s	2 (16 bit Int)
69	Path F Last Error	0		10s*	2 (16 bit Int)
70	Internal Update Rate	10	Hz	On Init.	2 (16 bit Int)
71	Sound Speed Low Limit	300	m/s	On Init.	2 (16 bit Int)
72	Sound Speed High Limit	500	m/s	On Init.	2 (16 bit Int)
73	Velocity High Limit	40	m/s	On Init.	2 (16 bit Int)
74	Velocity Low Limit	–40	m/s	On Init.	2 (16 bit Int)
75	Signal Strength High Limit	100	dB	On Init.	2 (16 bit Int)
76	Signal Strength Low Limit	20	dB	On Init.	2 (16 bit Int)
77	Amplitude High Limit	95		On Init.	2 (16 bit Int)
78	Amplitude Low Limit	35		On Init.	2 (16 bit Int)
79	Number in Average	32		On Init.	2 (16 bit Int)
80	Software Version	(2 ASCII)		On Init.	2 (16 bit Int)
81	Checksum			On Init.	2 (16 bit Int)

Table 8: MODBUS Registers for a Sentinel Flowmeter (Continued)

MODBUS Reg #	Description	Default	Unit	Refresh	Size in Bytes
82	Number of Paths	4		On Init.	2 (16 bit Int)
83	Modbus Address	32		On Init.	2 (16 bit Int)

*The complete floating point value is constructed by combining readings from the first register with a second register. An eight Hex digits number will represent the IEEE-754 hexadecimal floating point value. 32-bit Hexadecimal Representation To Decimal Floating-Point conversion can be performed if needed.

Example: Reg 1 reading is 44d7, Reg 2 reading is 4000, Actual Volumetric Flow is 44d74000, which corresponds to 1722.

**The complete double precision floating point value is constructed by combining readings from all four registers according to IEEE-754 for double precision.

1.4.8 Notes for a Sentinel Flowmeter

The **Sentinel Flowmeter**, when equipped with the optional Modbus output card, can transmit flow data and diagnostic information to a flow computer or SCADA, serially, using a Gould-type RTU protocol. For security and audit-trail purposes, the unit must be programmed through the PanaView interface. This means that only the Modbus function command 3 (read multiple registers), is valid.

Communication parameters: 9600, n, 8, 1

The format for the data exchange is as follows:

- The ***send*** command (initiated by host flow computer or controller) is of the form:

<time delimiter> <Addr> <3> <First Register MSB>
<First Register LSB> <Register Count MSB>
<Register Count LSB> <CRC Low> <CRC High> <time delimiter>

- The ***response*** (initiated by host flow computer or controller) is of the form:

[time delimiter] <Addr> <3> <Byte count> < Data ..... >
<CRC Low> <CRC High> <time delimiter>

Table 8 on page 24 is the data map for the **IGM878** and **Sentinel**. The refresh rate indicates how often the central controller updates the memory map, available using the ModBus port. The most time-critical information is stored at the top of the register. This limits how deep the user has to go into the resister stack to gather the real-time information. All values are IEEE format MSB first (big-endian).

Note: *Regarding meter status, each bit field indicates the error number from LSB corresponding to E1, and from MSB corresponding to E32.*

Note: *Writing any non-zero value will clear the totals (unless they are locked using* TOT LOCK/KEY LOCK *switches on the front panel - per MID requirements).*

Note: *Writing to* COMP *will clear all channels.*

Note: Modbus Registers for the Sentinel LCT or Sentinel LNG Flowmeter*, Table 7 on page 17, has some fields with a grey background. These are currently not supported and will return a value of –1.0.*

Table 9: Modbus Registers for the Sentinel LCT or Sentinel LNG Flowmeter

Category	Measurement	Type	Size Format	Composite Register Address	Channel 1 Register Address	Channel 2 Register Address	Channel 3 Register Address	Channel 4 Register Address
Primary Measurand	Velocity	F	2 LSW float	1 0x0000	1025 0x0400	2049 0x0800	3073 0x0C00	4097 0x1000
	Volumetric	F	2 LSW float	3 0x0002	1027 0x0402	2051 0x0802	3075 0x0C02	4099 0x1002
	Std Volumetric	F	2 LSW float	5 0x0004	1029 0x0404	2053 0x0804	3077 0x0C04	4101 0x1004
	Mass Flow	F	2 LSW float	7 0x0006	1031 0x0406	2055 0x0806	3079 0x0C06	4103 0x1006
	Energy Rate	F	2 LSW float	9 0x0008	1033 0x0408	2057 0x0808	3081 0x0C08	4105 0x1008
Transit Time	Soundspeed	F	2 LSW float	11 0x000A	1035 0x040A	2059 0x080A	3083 0x0C0A	4107 0x100A
	Up Transit	F	2 LSW float	13 0x000C	1037 0x040C	2061 0x080C	3085 0x0C0C	4109 0x100C
	Dn Transit	F	2 LSW float	15 0x000E	1039 0x040E	2063 0x080E	3087 0x0C0E	4111 0x100E
	DeltaT	F	2 LSW float	17 0x0010	1041 0x0410	2065 0x0810	3089 0x0C10	4113 0x1010
Receiver Diagnostics	UP Sig Strength	F	2 LSW float	19 0x0012	1043 0x0412	2067 0x0812	3091 0x0C12	4115 0x1012
	DN Sig Strength	F	2 LSW float	21 0x0014	1045 0x0414	2069 0x0814	3093 0x0C14	4117 0x1014
	Gain Up[dB]	F	2 LSW float	23 0x0016	1047 0x0416	2071 0x0816	3095 0x0C16	4119 0x1016
	Gain Dn[dB]	F	2 LSW float	25 0x0018	1049 0x0418	2073 0x0818	3097 0x0C18	4121 0x1018
	UP DAC	U	2 Unsigned integer	27 0x001A	1051 0x041A	2075 0x081A	3099 0x0C1A	4123 0x101A
	DN DAC	U	2 Unsigned integer	29 0x001C	1053 0x041C	2077 0x081C	3101 0x0C1C	4125 0x101C
	UP Amp Discrim	F	2 LSW float	31 0x001E	1055 0x041E	2079 0x081E	3103 0x0C1E	4127 0x101E
	DN Amp Discrim	F	2 LSW float	33 0x0020	1057 0x0420	2081 0x0820	3105 0x0C20	4129 0x1020
Signal Processing Diagnostics	PEAK%	F	2 LSW float	35 0x0022	1059 0x0422	2083 0x0822	3107 0x0C22	4131 0x1022
	UP Signal Q	F	2 LSW float	37 0x0024	1061 0x0424	2085 0x0824	3109 0x0C24	4133 0x1024
	DN Signal Q	F	2 LSW float	39 0x0026	1063 0x0426	2087 0x0826	3111 0x0C26	4135 0x1026
	UP +– Peak	F	2 LSW float	41 0x0028	1065 0x0428	2089 0x0828	3113 0x0C28	4137 0x1028
	DN +– Peak	F	2 LSW float	43 0x002A	1067 0x042A	2091 0x082A	3115 0x0C2A	4139 0x102A
	UP Norm Factor	F	2 LSW float	45 0x002C	1069 0x042C	2093 0x082C	3117 0x0C2C	4141 0x102C
	DN Norm Factor Theta 3 CEE1	F	2 LSW float	47 0x002E	1071 0x042E	2095 0x082E	3119 0x0C2E	4143 0x102E
		F	2 LSW float	49 0x0030	1073 0x0430	2097 0x0830	3121 0x0C30	4145 0x1030
		F	2 LSW float	51 0x0032	1075 0x0432	2099 0x0832	3123 0x0C32	4147 0x1032
Correction Factors	Reynolds #	F	2 LSW float	53 0x0034	1077 0x0434	2101 0x0834	3125 0x0C34	4149 0x1034
	K(RE)	F	2 LSW float	55 0x0036	1079 0x0436	2103 0x0836	3127 0x0C36	4151 0x1036
	CTL[1]	F	2 LSW float	57 0x0038	1081 0x0438	2105 0x0838	3129 0x0C38	4153 0x1038
	CPL[2]	F	2 LSW float	59 0x003A	1083 0x043A	2107 0x083A	3131 0x0C3A	4155 0x103A
	CTPL[3]	F	2 LSW float	61 0x003C	1085 0x043C	2109 0x083C	3133 0x0C3C	4157 0x103C

1 Correction factor for the effect of Temperature on the Liquid.
2 Correction factor for the effect of Pressure on the Liquid.
3 Correction factor for the effects of Temperature and Pressure on the Liquid, a.k.a. “full VCF,” is product of CTL and CPL

Table 9: Modbus Registers for the Sentinel LCT or Sentinel LNG Flowmeter (Continued)

Category	Measurement	Type	Size Format	Composite Register Address	Channel 1 Register Address	Channel 2 Register Address	Channel 3 Register Address	Channel 4 Register Address
Temp-erature Inputs	Supply Temp	F	2 LSW float	63 0x003E	1087 0x043E	2111 0x083E	3135 0x0C3E	4159 0x103E
	Return Temp	F	2 LSW float	65 0x0040	1089 0x0440	2113 0x0840	3137 0x0C40	4161 0x1040
	Supply-Rtn	F	2 LSW float	67 0x0042	1091 0x0442	2115 0x0842	3139 0x0C42	4163 0x1042
	Supply Dens	F	2 LSW float	69 0x0044	1093 0x0444	2117 0x0844	3141 0x0C44	4165 0x1044
	Return Dens	F	2 LSW float	71 0x0046	1095 0x0446	2119 0x0846	3143 0x0C46	4167 0x1046
	Delta h	F	2 LSW float	73 0x0048	1097 0x0448	2121 0x0848	3145 0x0C48	4169 0x1048
Pressure Inputs	Pressure Input	F	2 LSW float	75 0x004A	1099 0x044E	2123 0x084A	3147 0x0C4A	4171 0x104A
Special Inputs	Special Input 1	F	2 LSW float	77 0x004C	1101 0x044C	2125 0x084C	3149 0x0C4C	4173 0x104C
	Special Input 2	F	2 LSW float	79 0x004E	1103 0x044E	2127 0x084E	3151 0x0C4E	4175 0x104E
	Special Input 3	F	2 LSW float	81 0x0050	1105 0x0450	2129 0x0850	3153 0x0C50	4177 0x1050
	Special Input 4	F	2 LSW float	83 0x0052	1107 0x0452	2131 0x0852	3155 0x0C52	4179 0x1052
Flow Totals	FWD Total	D	4 LSW double	129 0x0080	1153 0X0480	2177 0X0880	3201 0X0C80	4225 0X1080
	REV Total	D	4 LSW double	133 0x0084	1157 0X0484	2181 0X0884	3205 0X0C84	4229 0X1084
	FWD Mass	D	4 LSW double	137 0x0088	1161 0X0488	2185 0X0888	3209 0X0C88	4233 0X1088
	REV Mass	D	4 LSW double	141 0x008C	1165 0X048C	2189 0X088C	3213 0X0C8C	4237 0X108C
	FWD Energy	D	4 LSW double	145 0x0090	1169 0X0490	2193 0X0890	3217 0X0C90	4241 0X1090
	REV Energy	D	4 LSW double	149 0x0094	1173 0X0494	2197 0X0894	3221 0X0C94	4245 0X1094
	Totl. Time	D	4 LSW double	153 0x0098	1177 0X0498	2201 0X0898	3225 0X0C98	4249 0X1098
	STD FWD Total	D	4 LSW double	157 0x009C	1181 0X049C	2205 0X089C	3229 0X0C9C	4253 0X109C
	STD REV Total	D	4 LSW double	161 0x00A0	1185 0X04A0	2209 0X08A0	3233 0X0CA0	4257 0X10A0
	STD Totl. Time	D	4 LSW double	165 0x00A4	1189 0X04A4	2213 0X08A4	3237 0X0CA4	4261 0X10A4
Flow Totals (scientific notation)	FWD Total Register 0	L	2 LSW float	257 0x0100	1281 0X0500	2305 0X0900	3329 0X0D00	4353 0X1100
	FWD Total Register 1	L	2 LSW float	259 0x0102	1283 0X0502	2307 0X0902	3331 0X0D02	4355 0X1102
	FWD Total Register 2	L	2 LSW float	261 0x0104	1285 0X0504	2309 0X0904	3333 0X0D04	4357 0X1104
	REV Total Register 0	L	2 LSW float	263 0x0106	1287 0X0506	2311 0X0906	3335 0X0D06	4359 0X1106
	REV Total Register 1	L	2 LSW float	265 0x0108	1289 0X0508	2313 0X0908	3337 0X0D08	4361 0X1108
	REV Total Register 2	L	2 LSW float	267 0x010A	1291 0X050A	2315 0X090A	3339 0X0D0A	4363 0X110A
	FWD Mass Register 0	L	2 LSW float	269 0x010C	1293 0X050C	2317 0X090C	3341 0X0D0C	4365 0X110C
	FWD Mass Register 1	L	2 LSW float	271 0x010E	1295 0X050E	2319 0X090E	3343 0X0D0E	4367 0X110E

4 1 day = 86,400 seconds

Table 9: Modbus Registers for the Sentinel LCT or Sentinel LNG Flowmeter (Continued)

Category	Measurement	Type	Size Format	Composite Register Address	Channel 1 Register Address	Channel 2 Register Address	Channel 3 Register Address	Channel 4 Register Address
Meter Status	Error Code5	B	2 LSW unsigned long integer	385 0x0180	1409 0x0580	2433 0x0980	3457 0x0D80	4481 0x1180
Meter Control	Reset Totals6	I	1 Unsigned integer	513 0x0200	1537 0x0600	2561 0x0A00	3585 0x0E00	4609 0x1200
	Reset Batch Total	I	1 Unsigned integer	514 0x0201	1538 0x0601	2562 0x0A01	3586 0x0E01	4610 0x1201
	Error Code7	I	1 Unsigned integer	515 0x0202	1539 0x0602	2563 0x0A02	3587 0x0E02	4611 0x1202
Comm Settings	Word Order	I	1 Unsigned integer	5121 0x1400				
	Baud Rate	I	1 Unsigned integer	5122 0x1401				
	Parity	I	1 Unsigned integer	5123 0x1402				
	Stop Bits	I	1 Unsigned integer	5124 0x1403				
	Meter Address	I	1 Unsigned integer	5125 0x1404				
	All Ones	I	1 Unsigned integer	5126 0x1405				

5 Each of the 32 bits represents an error type.
6 Writing any non-zero value will clear totals (unless locked per MID requirements).
7 Represented as integer value (i.e. E1, E2, E3, etc.)

Table 10: Data Type/Symbol for the Sentinel LCT or Sentinel LNG Flowmeter

Symbol	Numeric Type	Size Register Sequence				Comments*
		1	2	3	4	
I	Integer	1W				Single, signed 16-bit word
L	Long integer	2LSW	MSW			32-bit signed integer may be listed as double word on some types of programmable logic controller (PLC).
U	Unsigned long integer	2LSW	MSW			32-bit signed unsigned integer may be listed as double word on some types of programmable logic controller (PLC).
F	Floating point	2LSW	MSW			Single-precision floating point number specified in IEEE Standard for Binary Floating-Point Arithmetic (ANSI/IEEE Std 754-1985), also known as IEC60559:1989, Binary floating-point arithmetic for microprocessor systems.
D	Double-precision floating point	4LSW	W	W	MSW	Double-precision IEEE 754 floating point number is not supported by many PLCs.
B	Bit field	2LSW	MSW			32-bit field where each field represents a particular status (i.e. 0=off/inactive and 1=on/active).

*For data stored in multiple 16-bit registers, the Least Significant Word is usually transmitted first. The sequence can be inverted, i.e.: the Most Significant Word is sent first and the LSW last, by toggling a global meter setting. Within each two-byte register, the most significant byte must always be sent first.

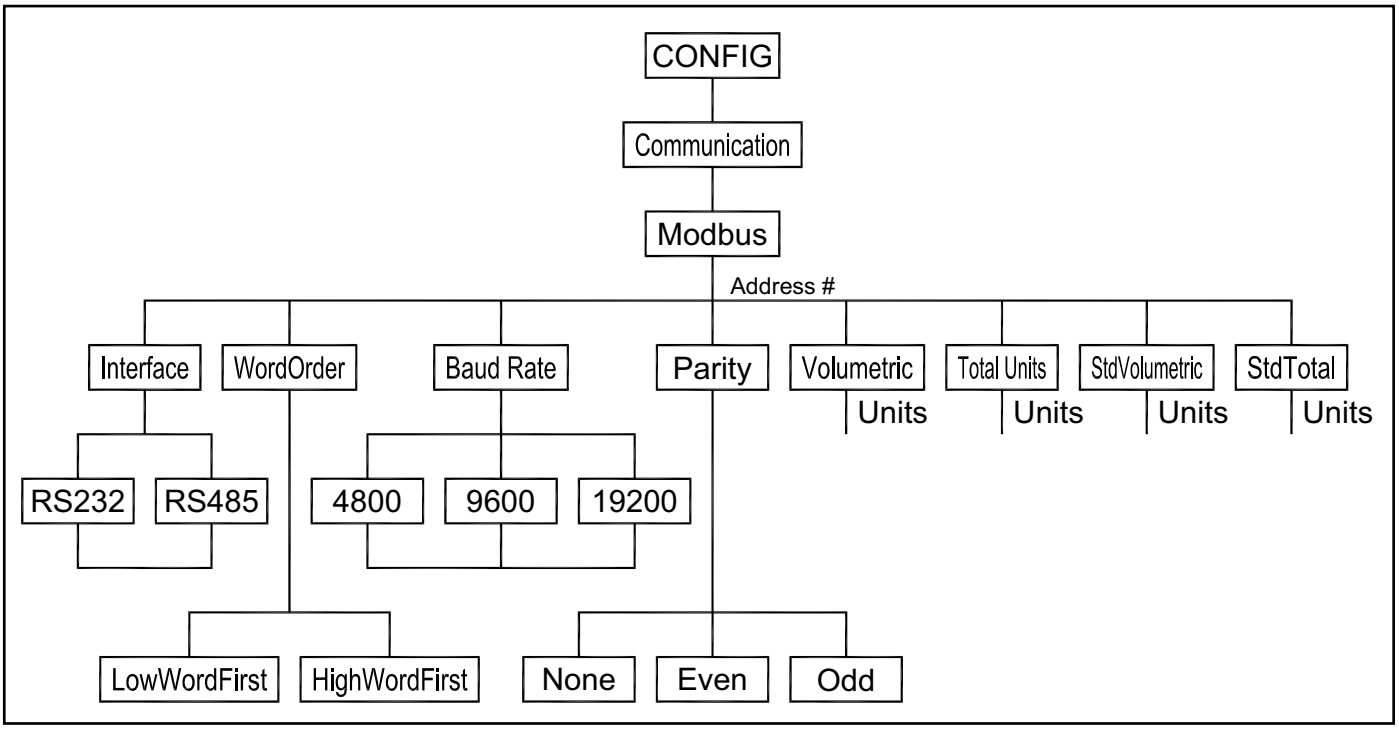


Figure 1: Menu Map for Sentinel LCT or Sentinel LNG Flowmeter

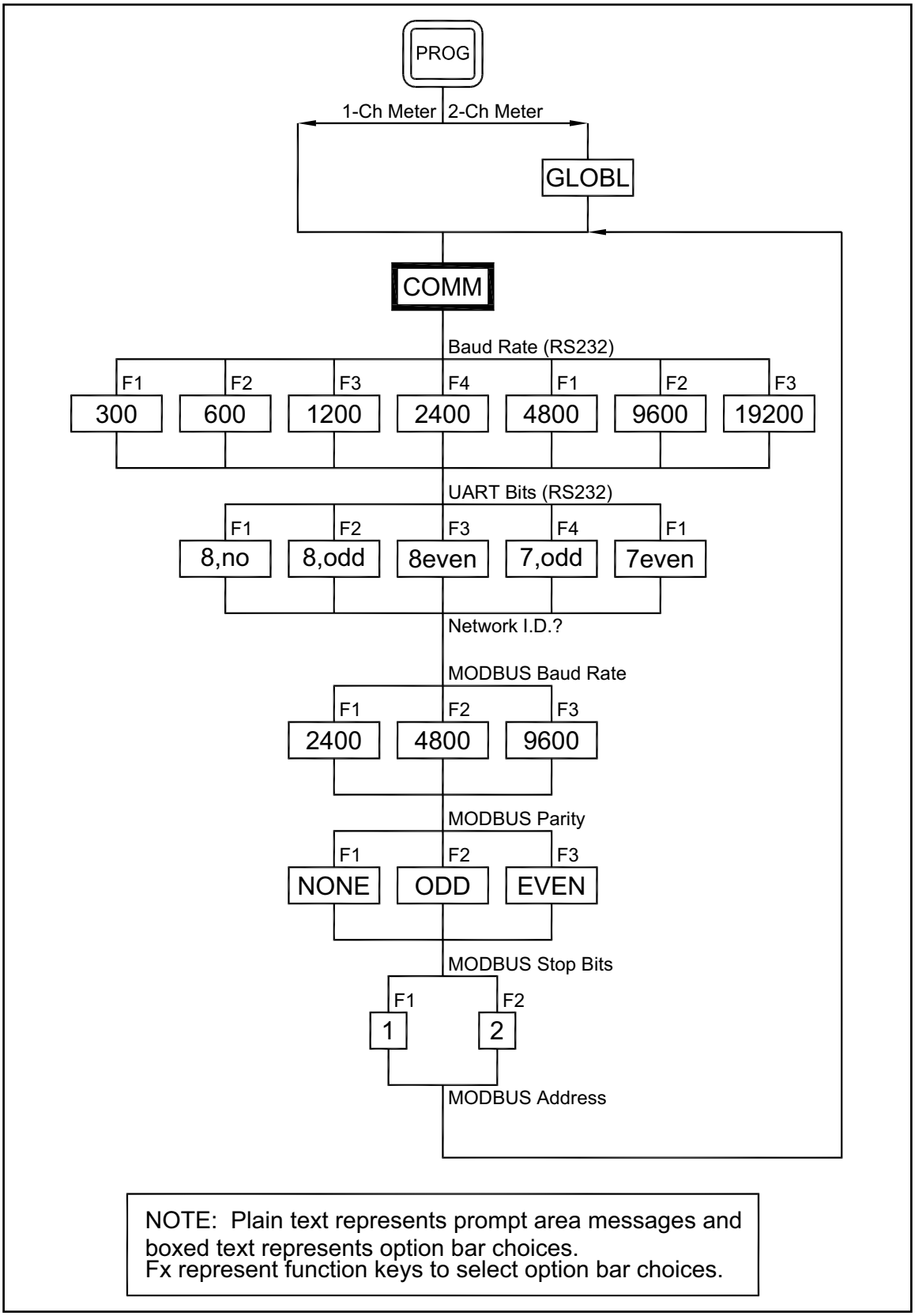


Figure 2: MODBUS Menu Map

1.5 Swapping the Floating Point

To represent a correct floating point value, you may need to swap the reading from two registers. Some applications allow you to swap the registers. Some do not.

When using the Modscan32 utility in order to monitor register values, you need to select **03: HOLDING REGISTER** (see *Figure 3*), select the corresponding communications parameters in the menu item **Connection-Connect**, and hit **OK** to make a connection.

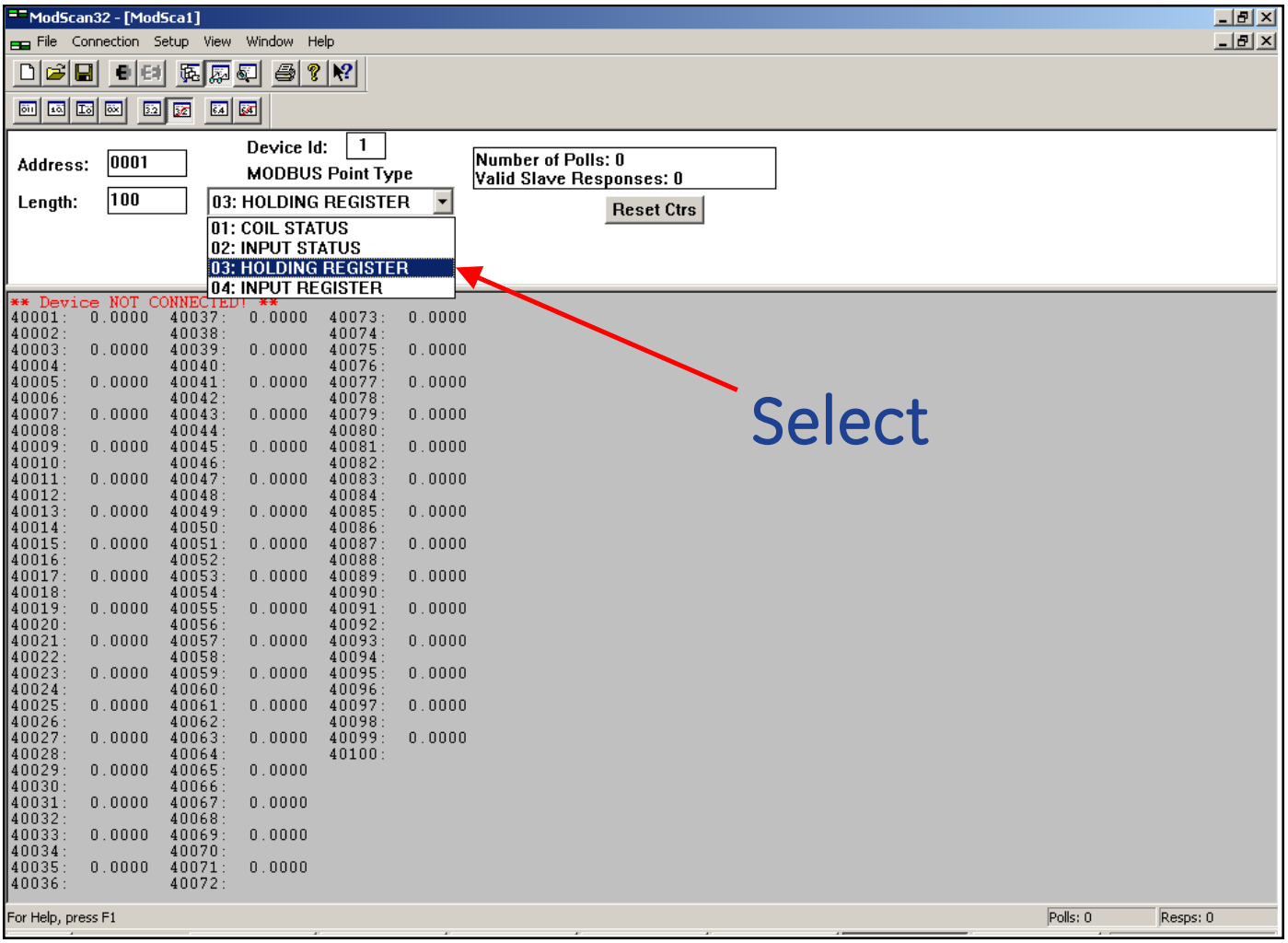


Figure 3: Selecting the Holding Register

1.5 Swapping the Floating Point (cont.)

To see all the register readings in Hexadecimal form, select **Menu-Setup-Display Options-Hex** (see *Figure 4*).

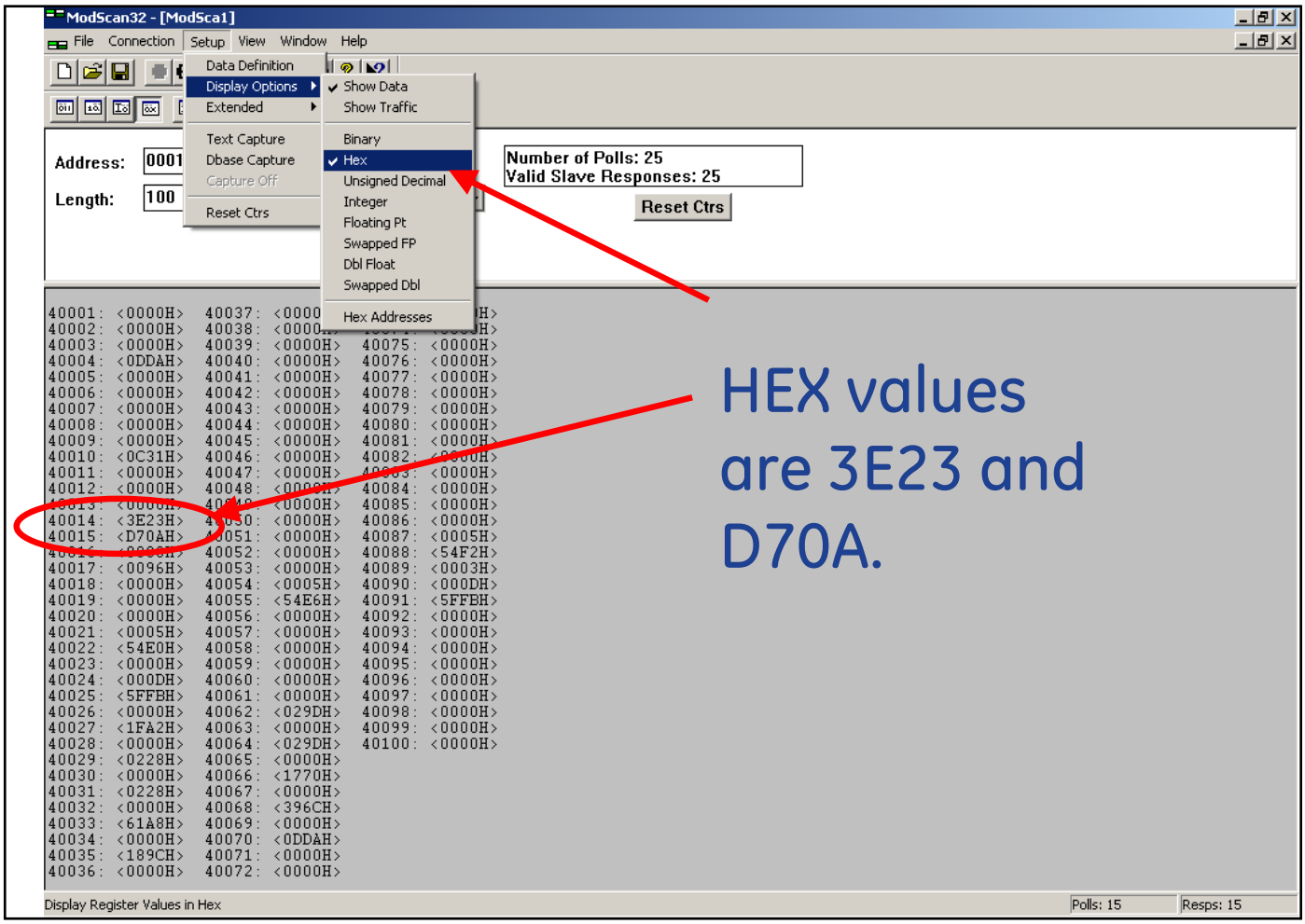


Figure 4: Finding the Hex Values

1.5 Swapping Floating Point (cont.)

To monitor the floating point variable, enter the first register of the variable in the **Address** (see *Figure 7*), and set the **Length** to "**2**".

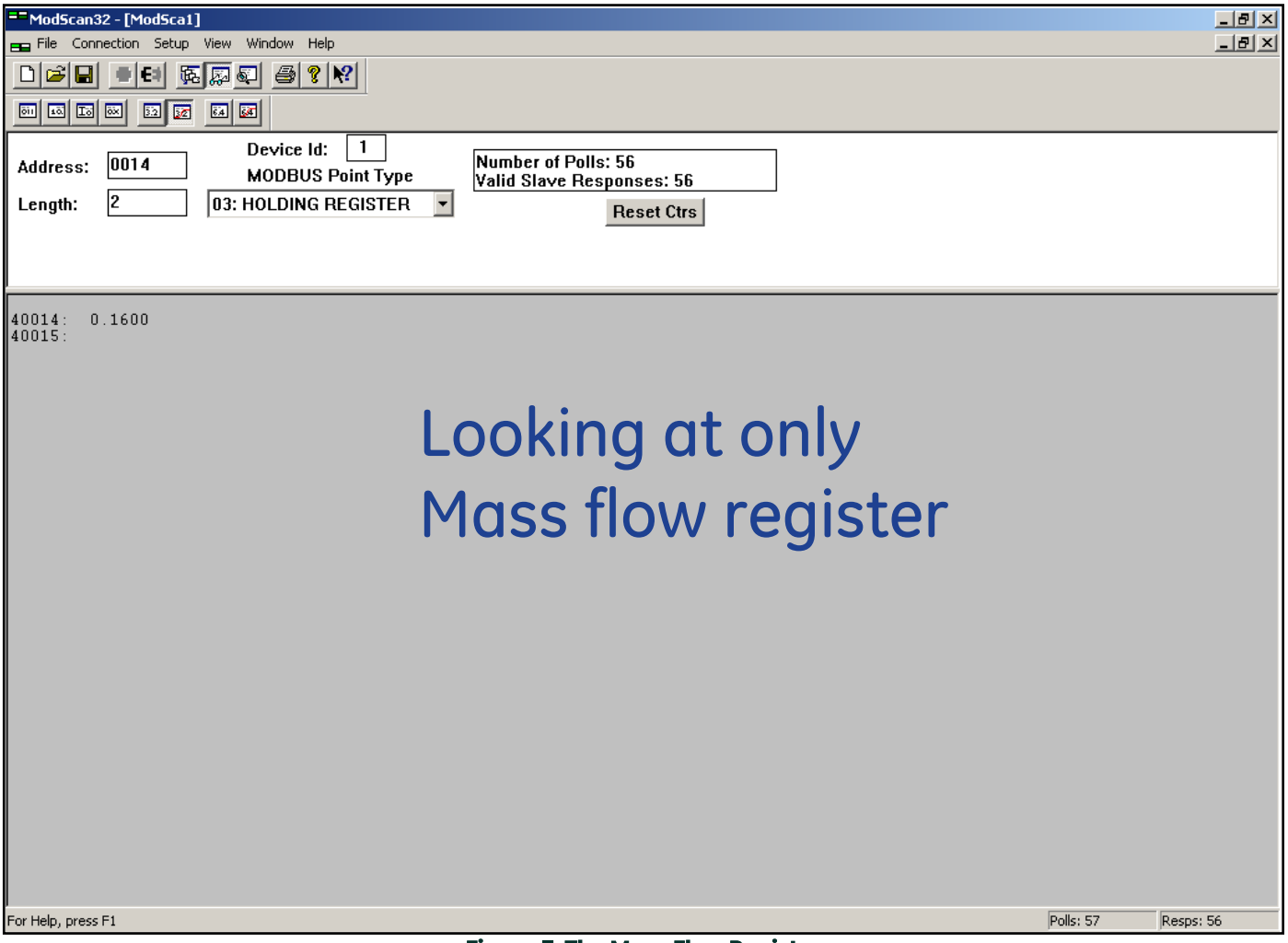


Figure 5: The Mass Flow Register

1.5 Swapping the Floating Point (cont.)

Then select **Menu-Setup-Display Options-Swapped FP** (see *Figure 6*). Modscan32 will swap the register and display the floating point variable correctly.

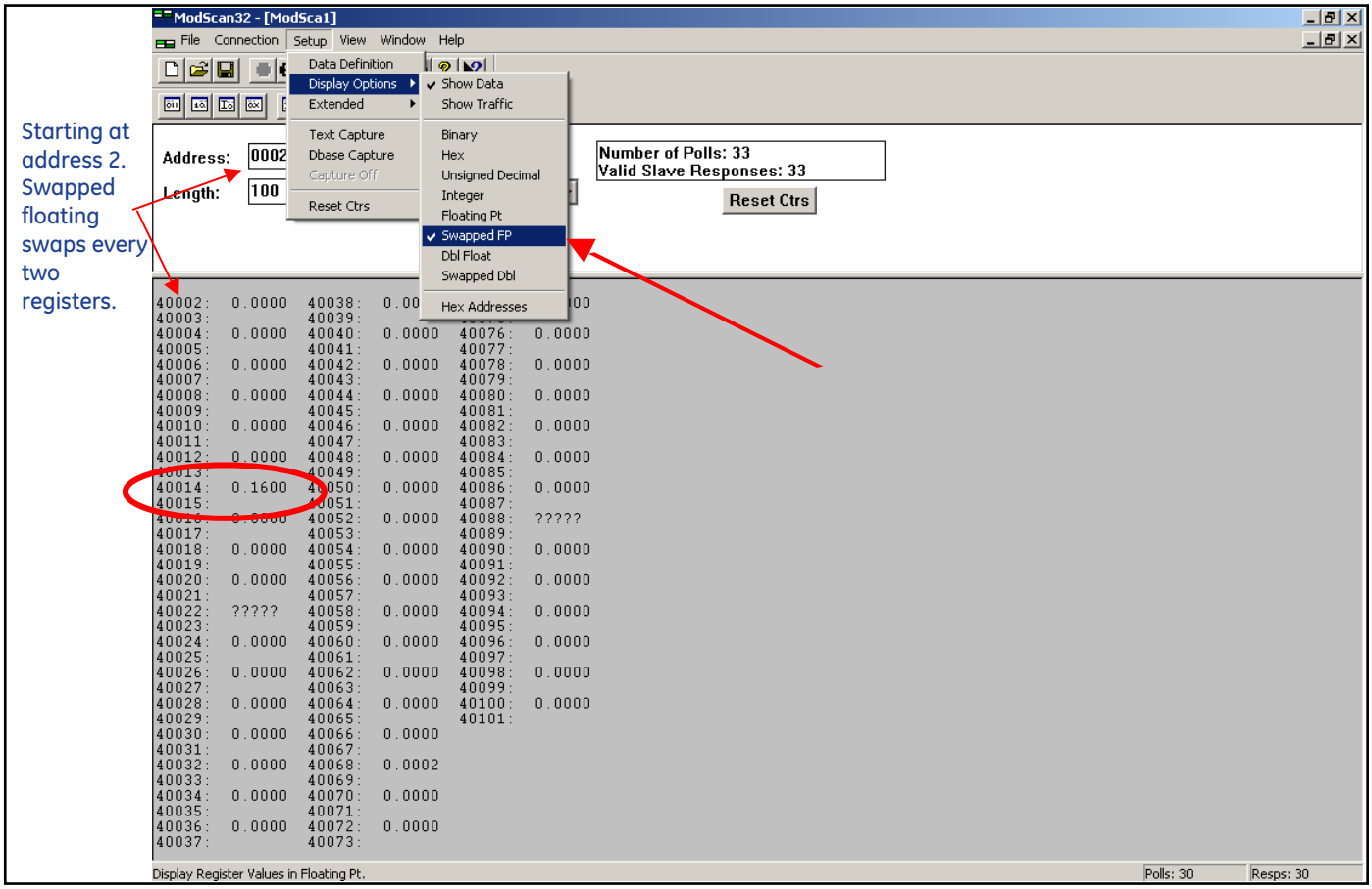


Figure 6: Swapped Floating Point

1.5 Swapping the Floating Point (cont.)

Web utilities can also be used to convert hexadecimal register readings into floating point values (see *Figure 7*).

Note: *How to construct an 8-digit hexadecimal value from two registers is explained at the bottom of the* Modbus Register *tables, Table 2 on page 5 for 1-Channel flow meters and Table 3 on page 8 for 2-Channel flow meters.*

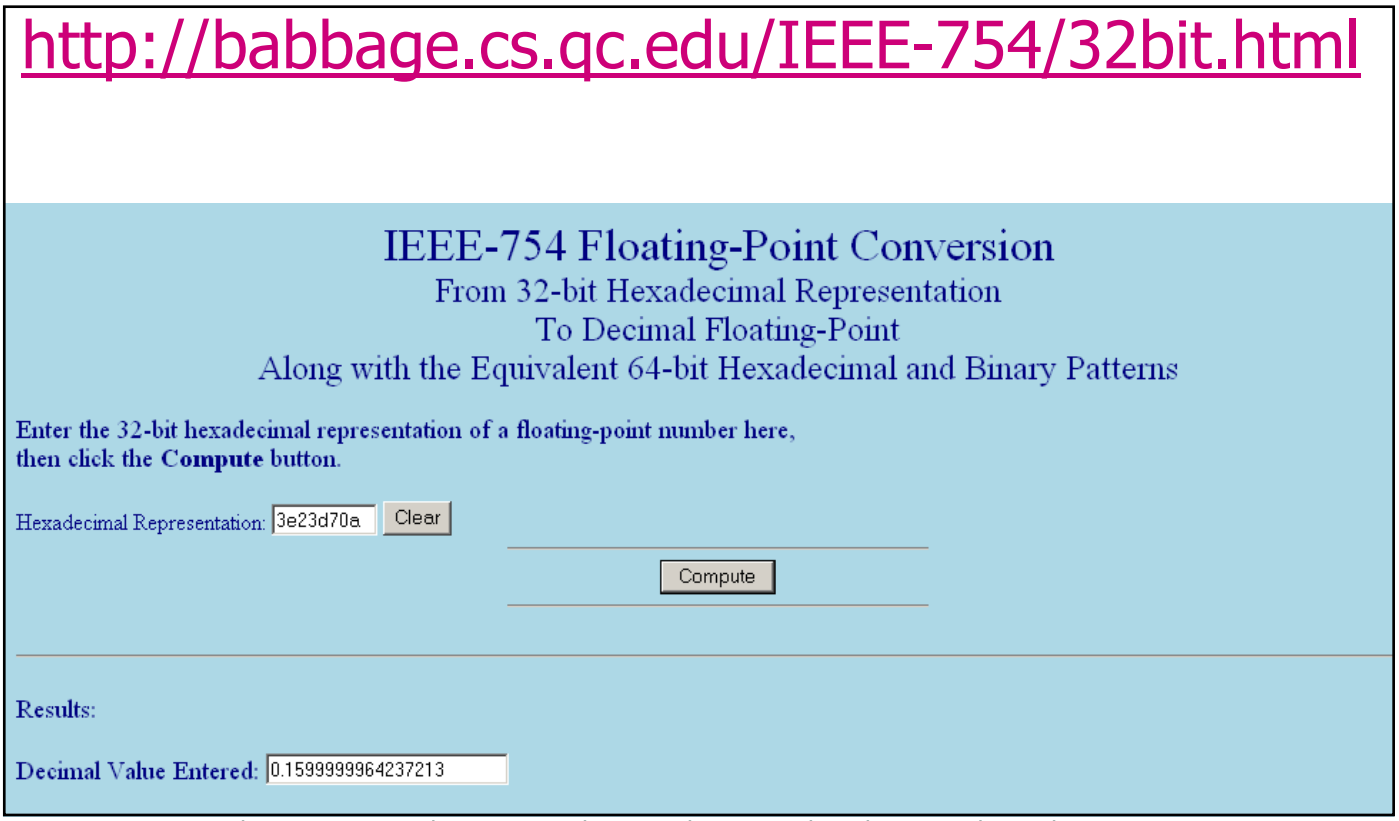


Figure 7: Converting Hexadecimal Register Readings into Floating Point Values

Chapter 2. Modbus Over Ethernet Communications 1

IMPORTANT: These setup instructions apply only when using option card 703-1476-05, rev. A, or option card 703-1477-03, rev. C and lower.

2.1 Introduction

This document provides instructions for setting up a flowmeter equipped with *Modbus Over Ethernet* (Modbus/TCP) communications. To apply these procedures, the flowmeter must have the option card installed. The option card, based on the features that were ordered, will have many components. (See the examples in *Figure 8* and *Figure 9*).

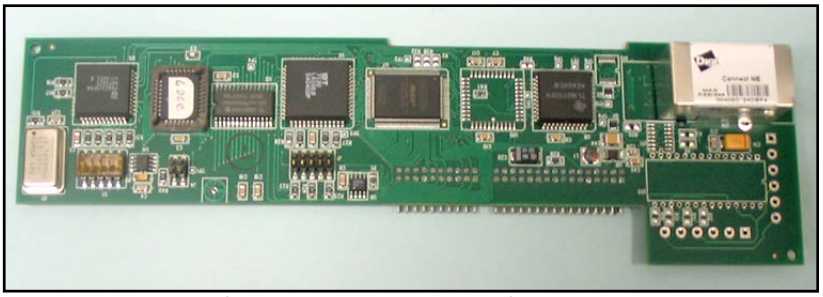


Figure 8: DF Ethernet Option Card

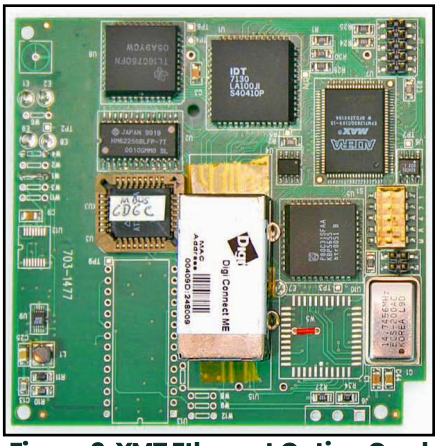


Figure 9: XMT Ethernet Option Card

Note: *To install an option card, consult the user's manual(s) which apply to your instrument.*

2.2 Setup

The default IP address in setting up the Ethernet option card is Dynamic (DHCP). If it has to be changed to a static IP address, the instrument must first be connected to the DHCP network.

Note: *The following are setup procedure examples.*

2.2.1 Finding the Assigned IP Address

Example:
Find the IP address of a module with Media Access Control (MAC) address 00409d25da0b.

1. Open a DOS command prompt. Go to the directory containing the executable *ruiping.exe.*
2. Type ruiping -e and hit **Enter**.

Note: *Once the module containing the MAC address has been found, it will be displayed along with the assigned IP address (see Figure 10). In this example the assigned address is 3.112.161.79.*

3. Stop the process by hitting the **Esc** key.

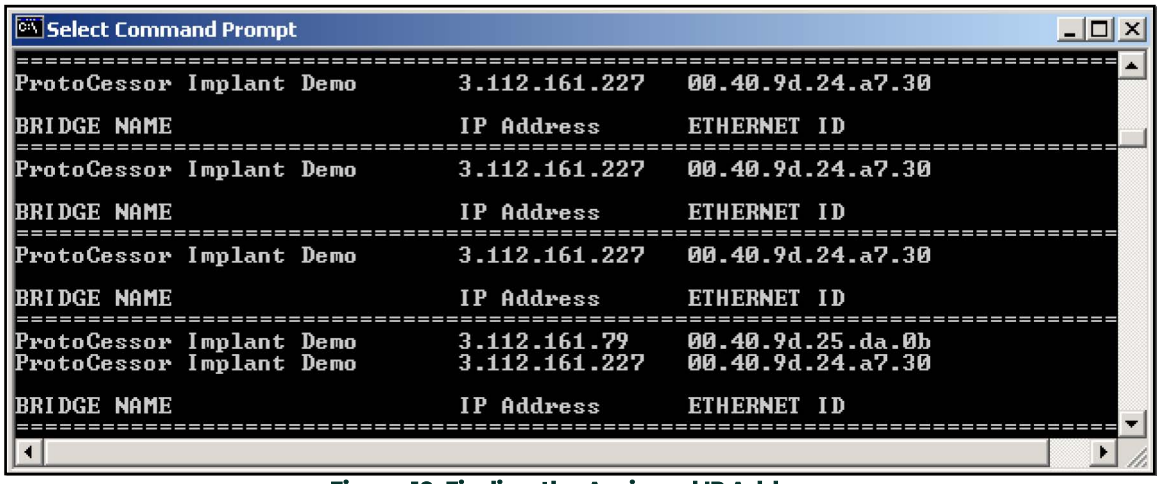


Figure 10: Finding the Assigned IP Address

2.2.2 Changing the Password

Example:
Change the Password for the module with IP address 3.112.161.79 (see *Figure 11*).

1. Open a DOS command prompt.
2. Type **telnet 3.112.161.79 10000** and hit **Enter**.
3. Enter the current Login and Password. The factory defaults are *root* and *Netsilicon*.

Note: *The Login and Password are case sensitive.*

4. Enter Selection number **2**.
5. Enter the current Password and the new Password when prompted.

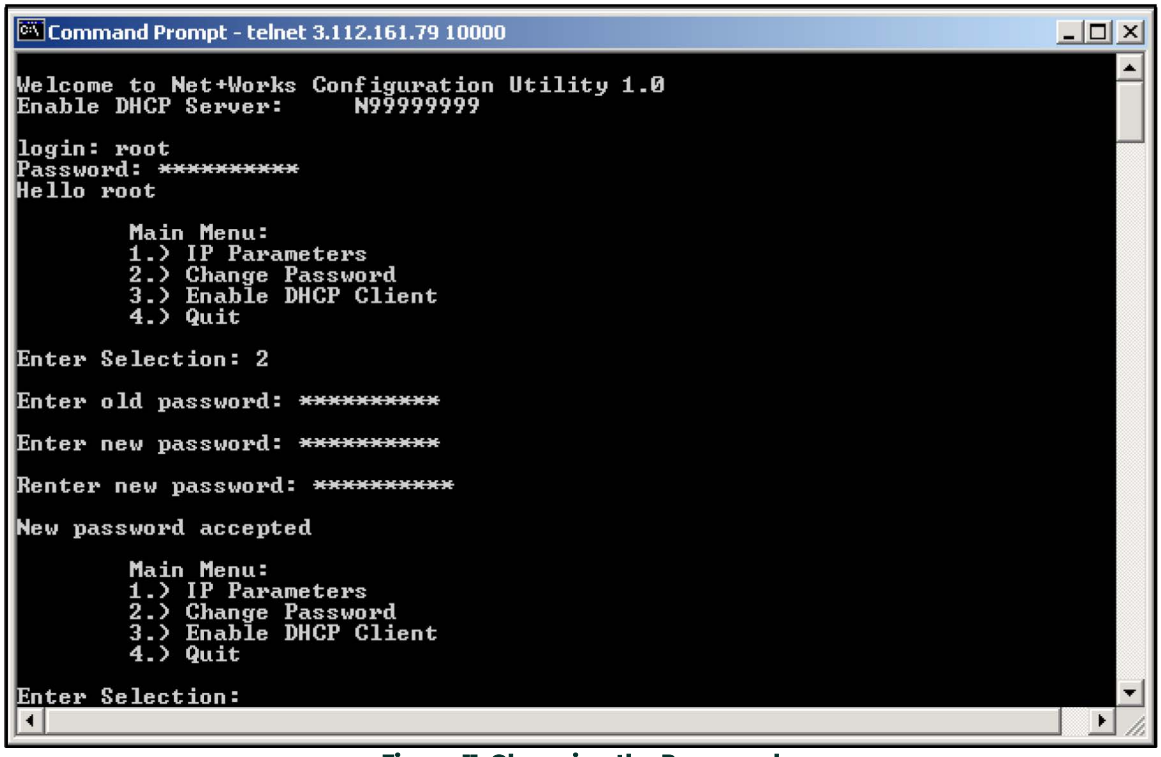


Figure 11: Changing the Password

2.2.3 Changing IP Parameters

Example:
Change the DHCP-assigned IP address to static address 192.168.2.225 and disable DHCP for the module with IP-assigned address 3.112.161.79 (see *Figure 12 on page 41* and *Figure 13 on page 42*).

1. Open a DOS command prompt.
2. Type **telnet 3.112.161.79 10000** and hit **Enter**.
3. Enter the current Login and Password.

Note: *The Login and Password are case sensitive.*

4. From the Main Menu select *1. IP Parameters*.
5. From the IP Parameters menu select *1. IP Address*.
6. Enter the new static IP address **192.168.2.225.**

Note: *If necessary, change the Subnet Main and a default Gateway by entering 2 and 3 in the IP parameters menu.*

7. Select **4** to return to the Main Menu.
8. From the Main Menu select **3**. *Enable DHCP Client*.
9. Enter **2** to disable the DHCP. Once the update has taken place, the new IP address will be shown.
10. Select **4**. *Main Menu* and Quit.
11. Cycle the power on the unit.

2.2.3 Changing IP Parameters (cont.)

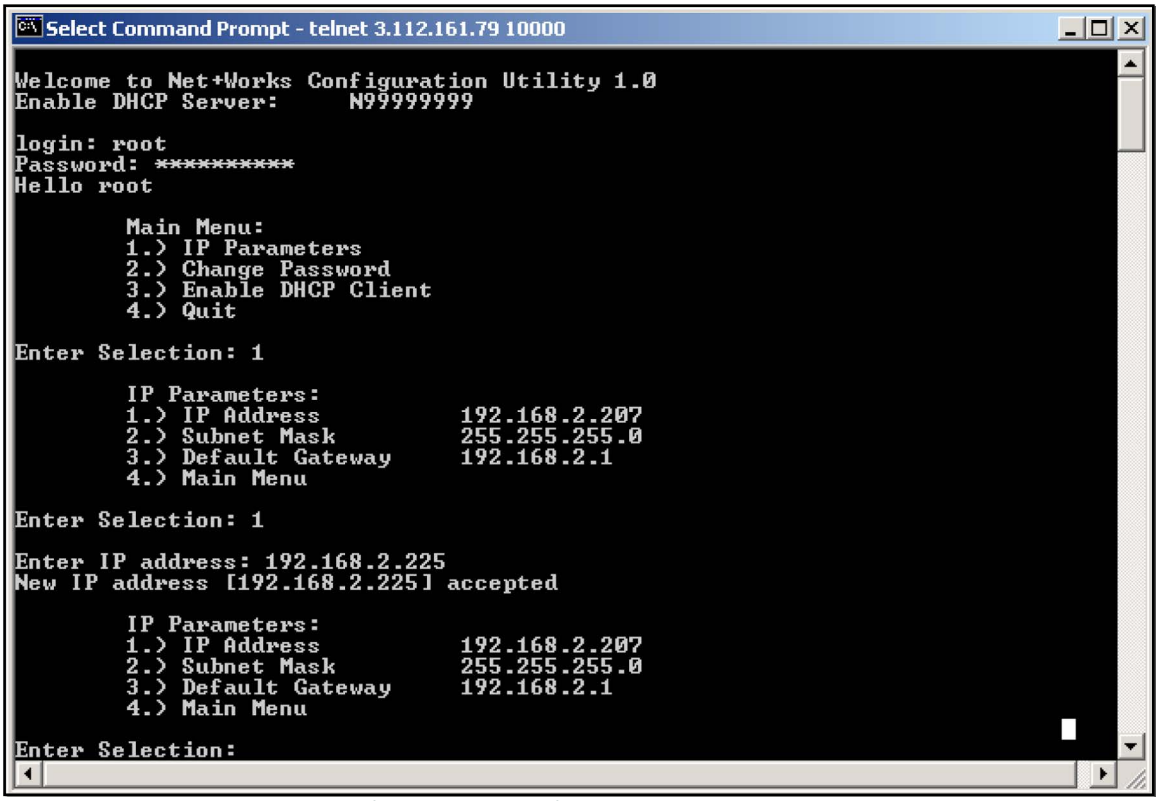


Figure 12: Changing IP Parameters - 1

2.2.3 Changing IP Parameters (cont.)

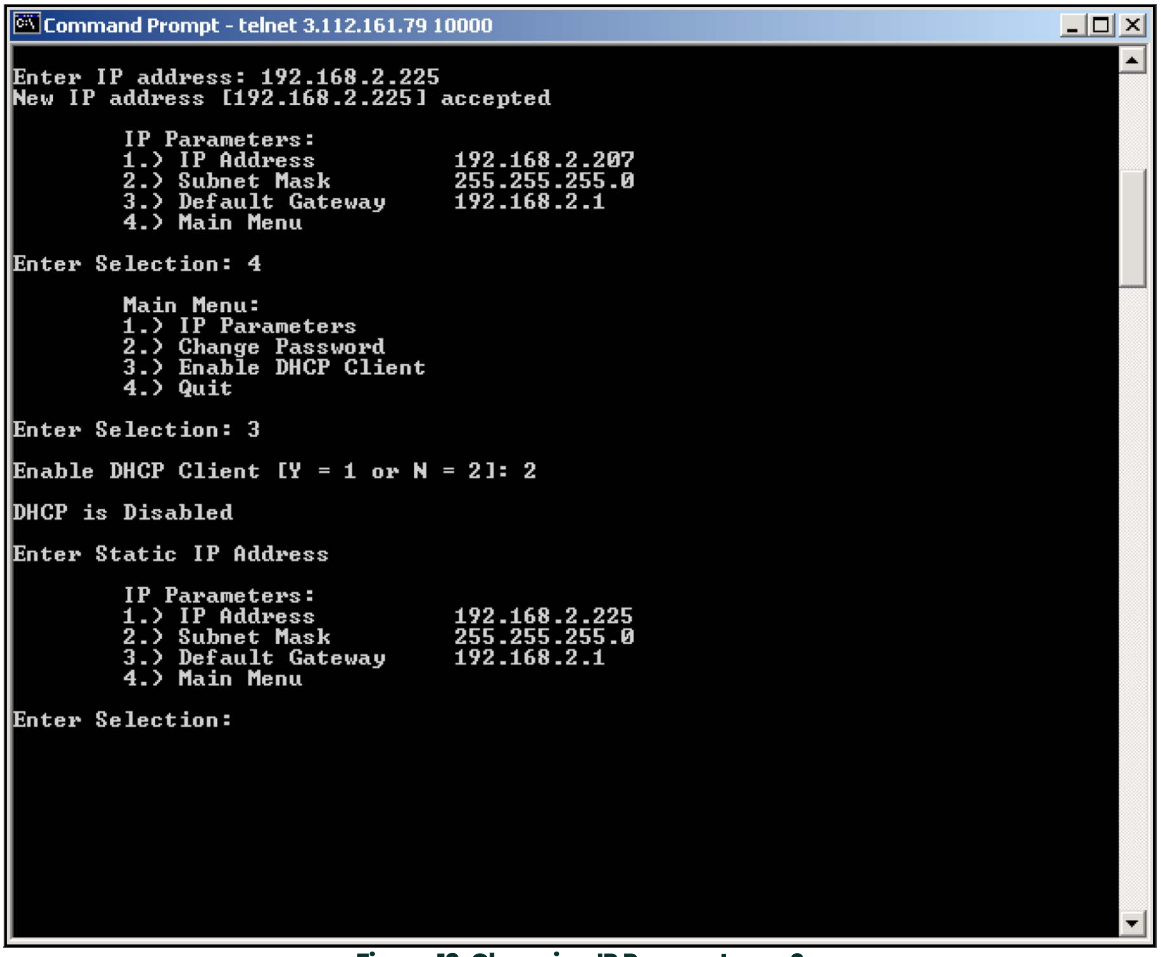


Figure 13: Changing IP Parameters - 2

Chapter 3. Modbus Over Ethernet Communications 2

IMPORTANT: These setup instructions apply only when using option card 703-1476-05, rev. B and higher, or option card 703-1477-03, rev. D and higher.

3.1 Introduction

This document provides instructions for setting up a flowmeter equipped with *Modbus Over Ethernet* (Modbus/TCP) communications. To apply these procedures, the flowmeter must have the option card installed. See the option card examples in *Figure 14* and *Figure 15*.

Note: *To install an option card, consult the user's manual(s) which apply to your instrument.*

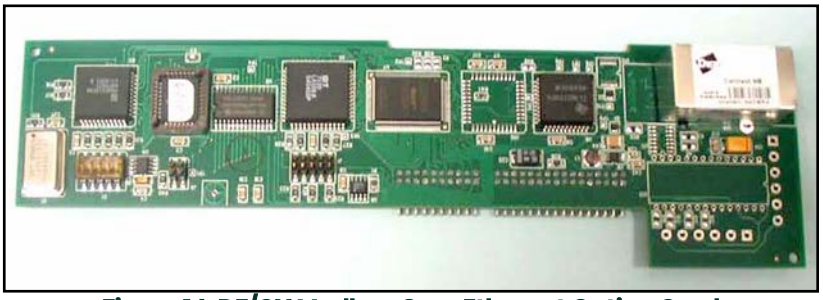


Figure 14: DF/GX Modbus Over Ethernet Option Card

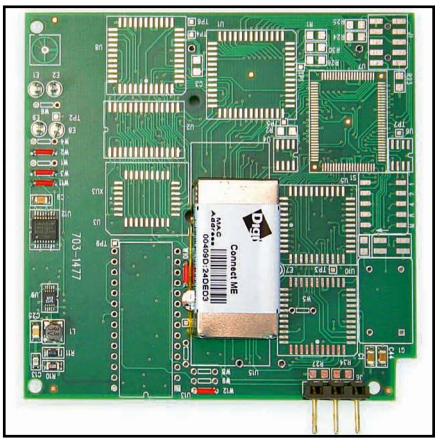


Figure 15: XMT Modbus Over Ethernet Option Card

3.2 Setup

The *Digi Device Discovery Program* is required to set up Ethernet parameters. To download the program, proceed with the following steps:

3.2.1 Downloading the Digi Device Discovery Program

1. Go to www.digi.com on the internet.
2. Move the cursor to the SUPPORT button and select *Diagnostics, Utilities and MIBs* from the menu.
3. Open the Select Your Product for Support menu and select *Digi Connect ME*. Then click on Submit.
4. From the OS Specific Diagnostics, Utilities and MIBs menu select *Microsoft Windows NT 4.0, 2000* or *XP*. Then, under the window, select *Device Discovery Utility for Windows*, and the File Download window appears.
5. Select Save this file to a disk, click on OK, and save the file to your computer.
6. Install the program from the downloaded file.

3.2.2 Module LED Behaviors

- **Yellow ON:** a link has been detected
- **Yellow OFF:** no link has been detected

3.2.3 Default Parameters

- **Baud Rate:** 9600 bps
- **Data Bits:** 8
- **Parity:** None
- **Stop Bits:** 1
- **Flow Control:** None
- **TCP/UDP Port:** 502

IMPORTANT: The option card is shipped with DHCP (not static) IP addressing which may not work in your LAN network. If your network requires static IP, you must follow the procedure on page 4. Otherwise, this card will not be operational.

Note: *The username and password are case sensitive.*

3.2.4 Finding the Assigned IP Address

Note: *The following are setup procedure examples.*

Example:
Find the IP address of the module with Media Access Control (MAC) address 00409d24ded5.

1. Run the *Digi Device Discovery Program* (see *Figure 16*).

Note: *To access the* Digi Device Discovery Program, *see page 44.*

Note: *The MAC address of all found units and the assigned IP address will be displayed. In this example the assigned address is 3.112.162.129.*

Note: *Refresh the display to find the MAC address of all units.*

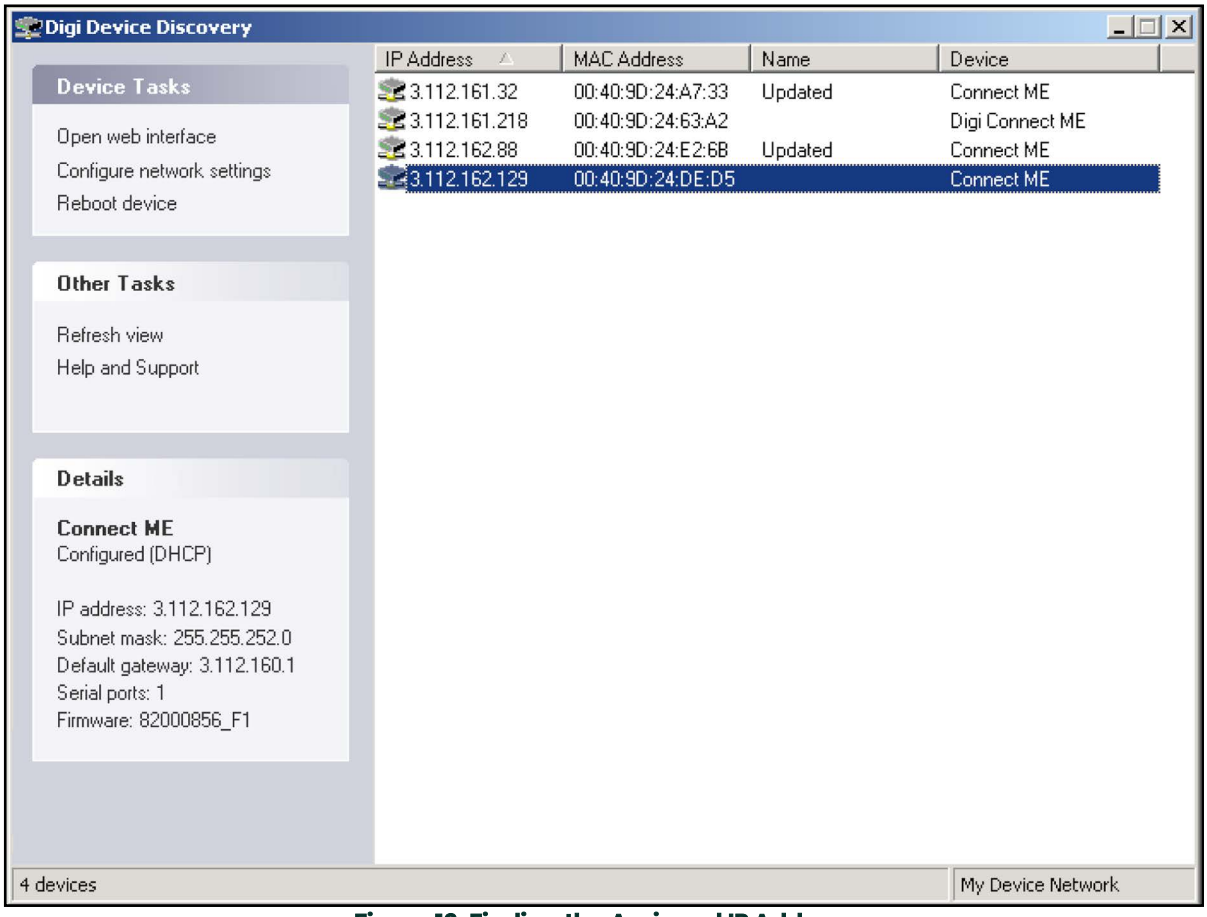


Figure 16: Finding the Assigned IP Address

3.2.5 Changing IP Parameters

Example: (to change the dynamic DHCP IP address to static).
Change the DHCP-assigned IP address to static address 192.168.2.207 and disable DHCP for the unit with IP assigned address 3.112.162.129 (see *Figure 17*).

1. Plug the option card into the DHCP network. The DHCP network server has to assign an IP address to this card.
2. Under Device Task at *Digi Device Discovery* Program (page 45), highlight the corresponding device and select *Open web interface*.
3. Enter Username and Password. Factory defaults are *root* and *dbps*.

Note: *The username and password are case sensitive.*

Panemetrics recommends changing the default password and disabling unused ports and services.

4. Click on **Login**.
5. Select *Configuration / Network*.
6. Select *Use the following IP address:* and enter IP address **192.168.2.207**.
7. Click on **Apply**.

Note: *Changes will require a reboot to take effect.*

Select *Administration / Reboot*, then wait for the reboot to complete.

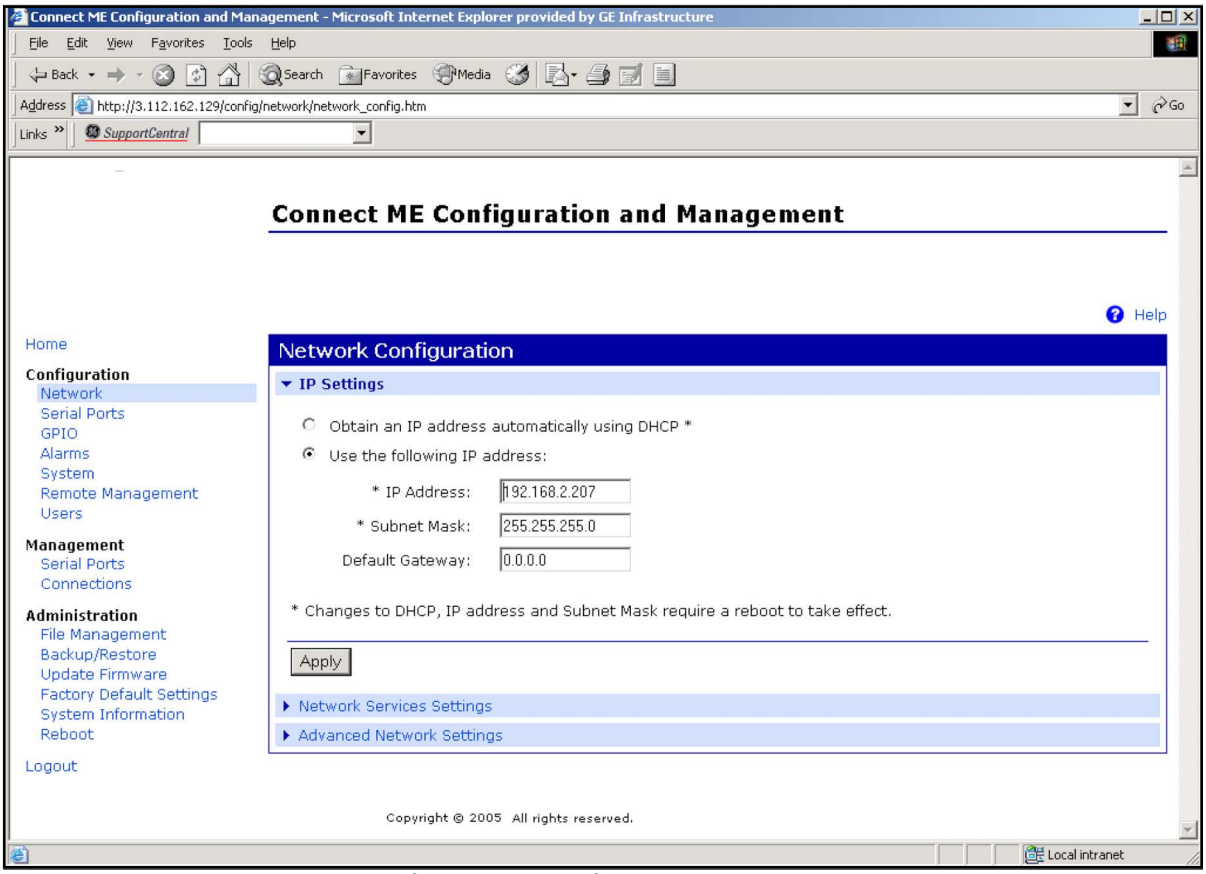


Figure 17: Changing IP Parameters

3.2.6 Changing Modbus/TCP Network Parameters

1. Select Configuration → Serial Ports → Port 1 → Modbus/TCP Network Setting
2. Accept incoming Modbus/TCP connection: TCP Port: XXX

3. Accept incoming Modbus/TCP in UDP/IP: UDP Port: XXX
4. → Apply

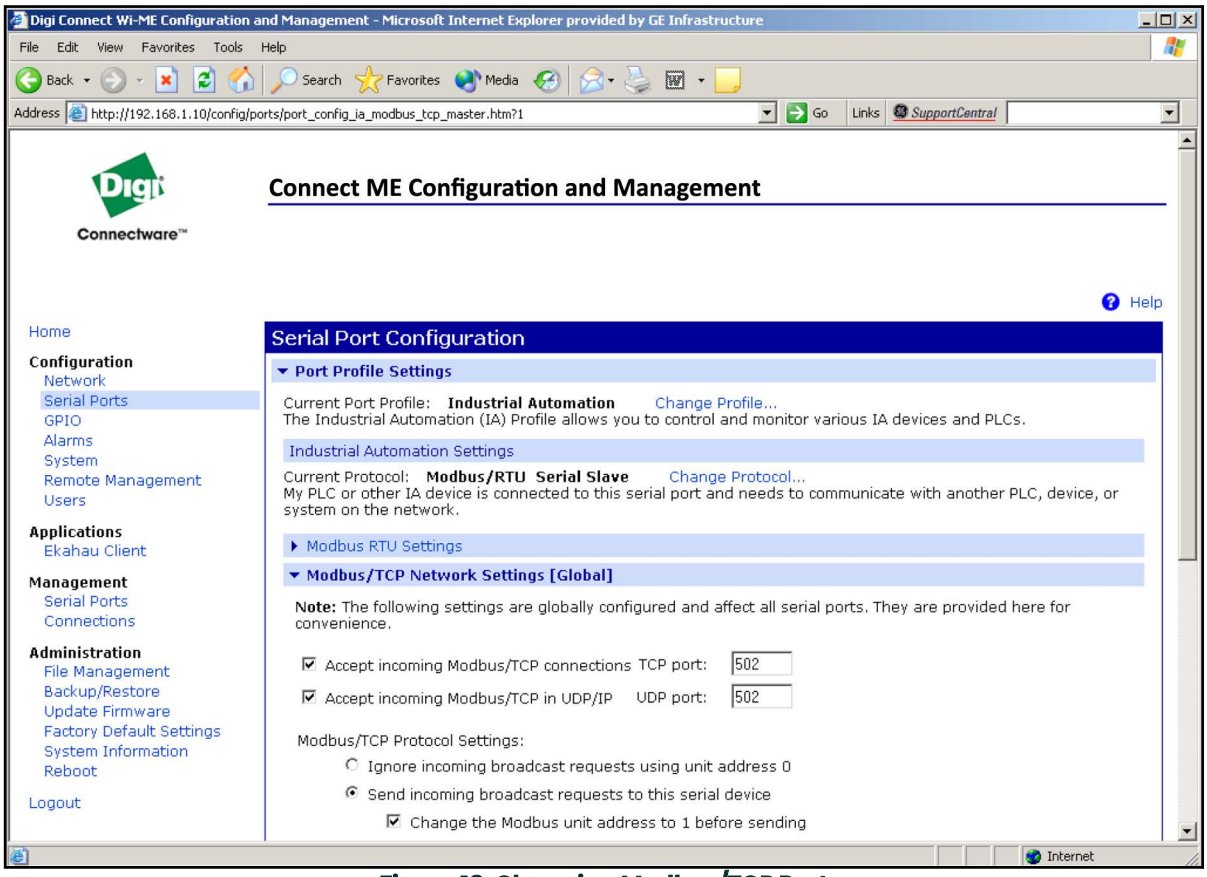


Figure 18: Changing Modbus/TCP Port

3.2.7 Changing User's Information

To change the user name and/or password:

1. Under Device Task select *Open web interface*.
2. Enter the Username and Password. The factory defaults are *root* and *dbps*.

Note: *The username and password are case sensitive.*
Panemetrics recommends changing the default password and disabling unused ports and services.

3. Click on **Login**. *Figure 19* appears.
4. Select *Configuration* / *Users*.
5. Click on **New...**. *Figure 20 on page 49* appears.

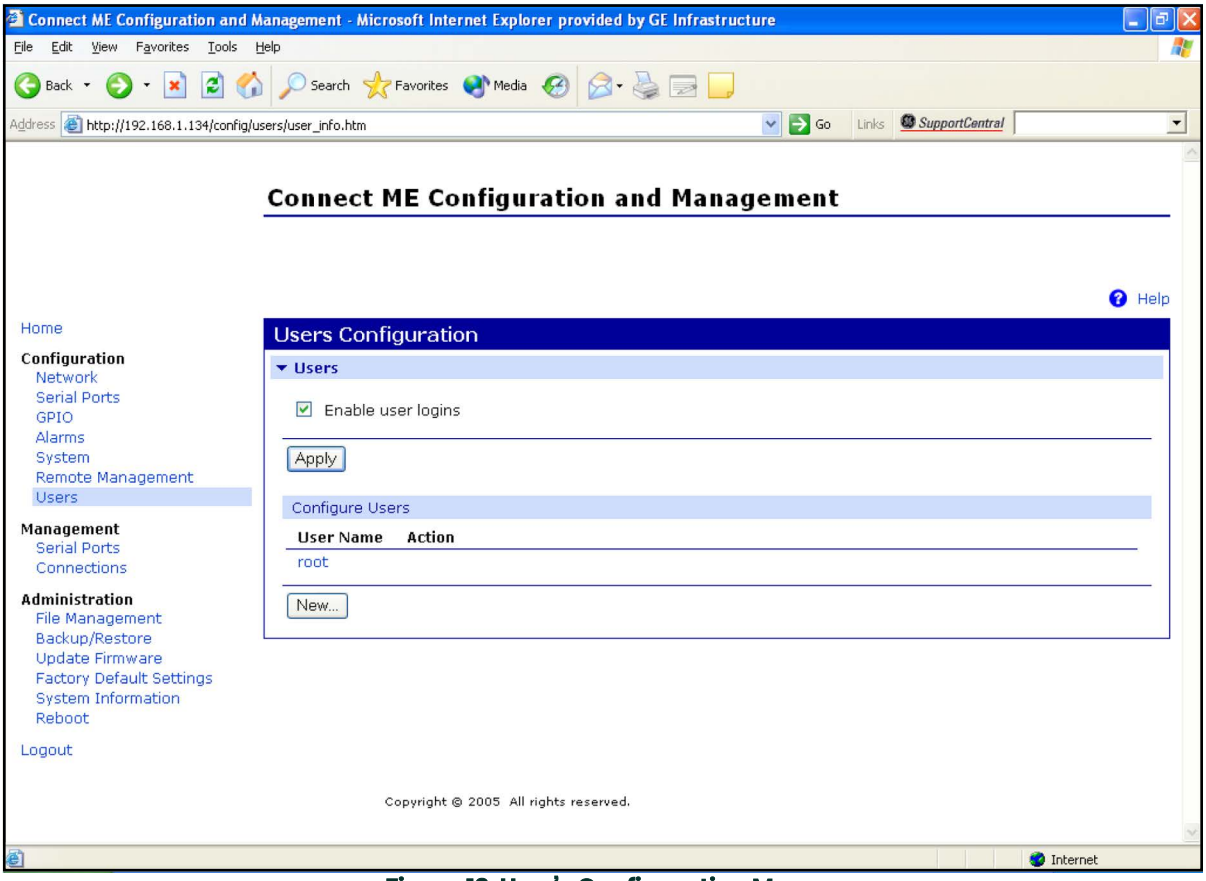


Figure 19: User's Configuration Menu

3.2.7 Changing User's Information (cont.)

6. To change the User Name, click in the box, delete the current name, and type in the new name.
7. To create a New Password, click in the box, delete the current password, and type in the new password.
8. To Confirm the new Password, click in the box, delete the current password and type in the new password.

Note: *For the password to be changed, the New Password and Confirm Password must be identical.*

9. Click on **Apply**.

Note: *Changes will require a reboot to take effect.*

Select *Administration / Reboot*, then wait for the reboot to be completed.

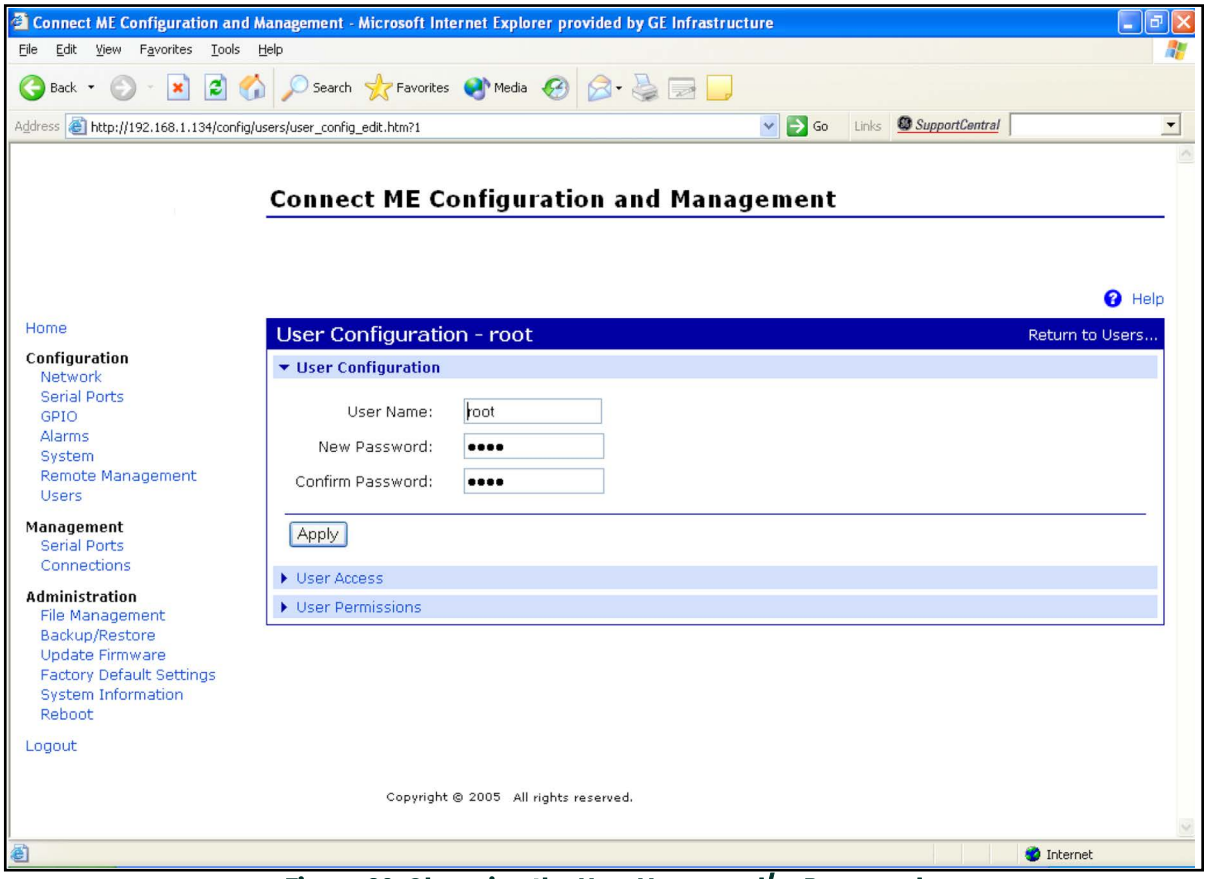


Figure 20: Changing the User Name and/or Password

[no content intended for this page]

Chapter 4. Ethernet Only Communications

4.1 Introduction

This document provides instructions for setting up a flowmeter equipped with *Ethernet Only* communications. To apply these procedures, the flowmeter must have the option card installed. See the option card examples in *Figure 21* and *Figure 22*.

Note: *To install an option card, consult the user's manual(s) which apply to your instrument.*

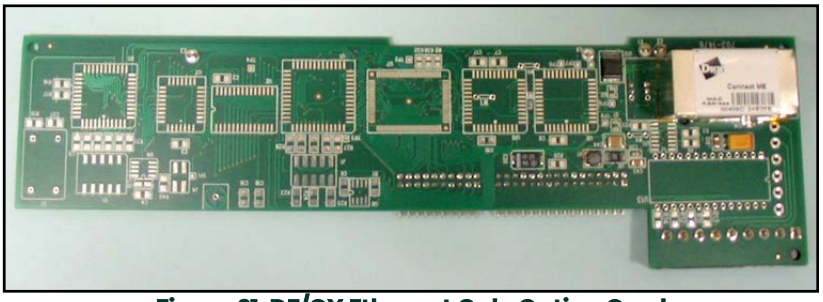


Figure 21: DF/GX Ethernet Only Option Card

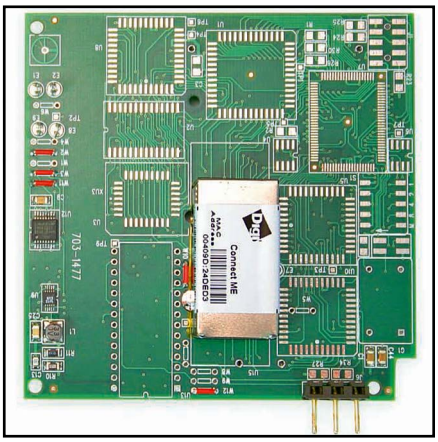


Figure 22: XMT Ethernet Only Option Card

4.2 Setup

The *Digi Device Discovery Program* is required to set up Ethernet parameters for the *Ethernet Only* board. To download the program, proceed with the following steps:

4.2.1 Downloading the Digi Device Discovery Program

1. Go to www.digi.com on the internet.
2. Move the cursor to the SUPPORT button and select *Diagnostics, Utilities and MIBs* from the menu.
3. Open the Select Your Product for Support menu and select *Digi Connect ME*. Then click on Submit.
4. From the OS Specific Diagnostics, Utilities and MIBs menu select *Microsoft Windows NT 4.0, 2000* or *XP*. Then, under the window, select *Device Discovery Utility for Windows*, and the File Download window appears.
5. Select Save this file to a disk, click on OK, and save the file to your computer.
6. Install the program from the downloaded file.

4.2.2 Module LED Behaviors

- **Yellow ON:** a link has been detected
- **Yellow OFF:** no link has been detected

4.2.3 Default Parameters

- **Baud Rate:** 9600 bps
- **Data Bits:** 8
- **Parity:** None
- **Stop Bits:** 1
- **Flow Control:** None

4.2.4 Finding the Assigned IP Address

Note: *The following are setup procedure examples.*

Example:
Find the IP address of the module with Media Access Control (MAC) address 00409d24ded5.

1. Run the *Digi Device Discovery Program* (see *Figure 23*).

Note: *To access the* Digi Device Discovery Program, *refer to page 52.*

Note: *The MAC address of all found units and the assigned IP address will be displayed. In this example the assigned address is 3.112.162.129.*

Note: *Refresh the display to find the MAC address of all units.*

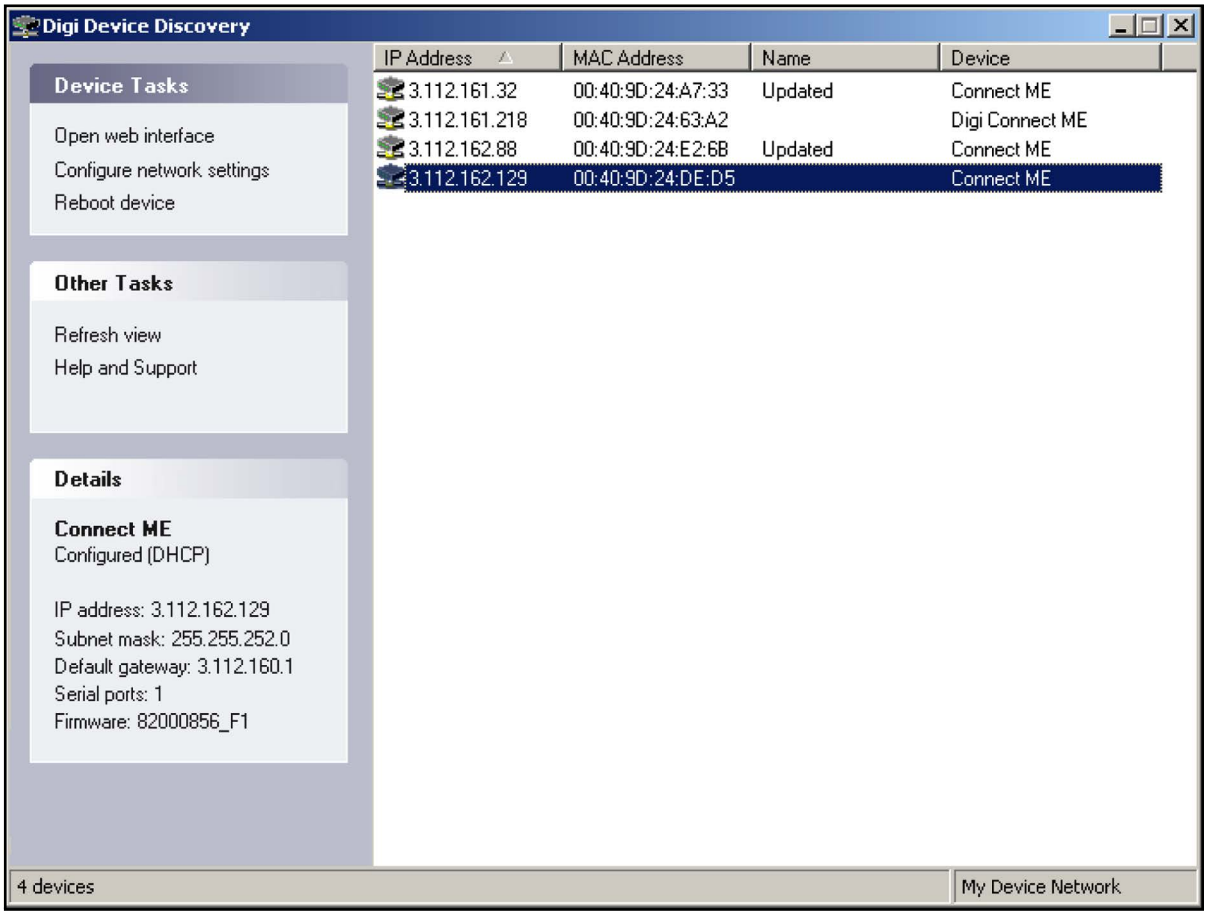


Figure 23: Finding the Assigned IP Address

4.2.5 Changing IP Parameters

Example:
Change the DHCP-assigned IP address to static address 192.168.2.207 and disable DHCP for the unit with IP assigned address 3.112.162.129 (see *Figure 24*).

1. Under Device Task select *Open web interface*.
2. Enter the Username and Password. The factory defaults are *root* and *dbps*.

Note: *The username and password are case sensitive.*
Panemetrics recommends changing the default password and disabling unused ports and services.

3. Click on **Login**.
4. Select *Configuration | Network*.
5. Select *Use the following IP address:* and enter IP address 192.168.2.207.
6. Click on **Apply**.

Note: *Changes will require a reboot to take effect.*

Select *Administration / Reboot*, then wait for the reboot to complete.

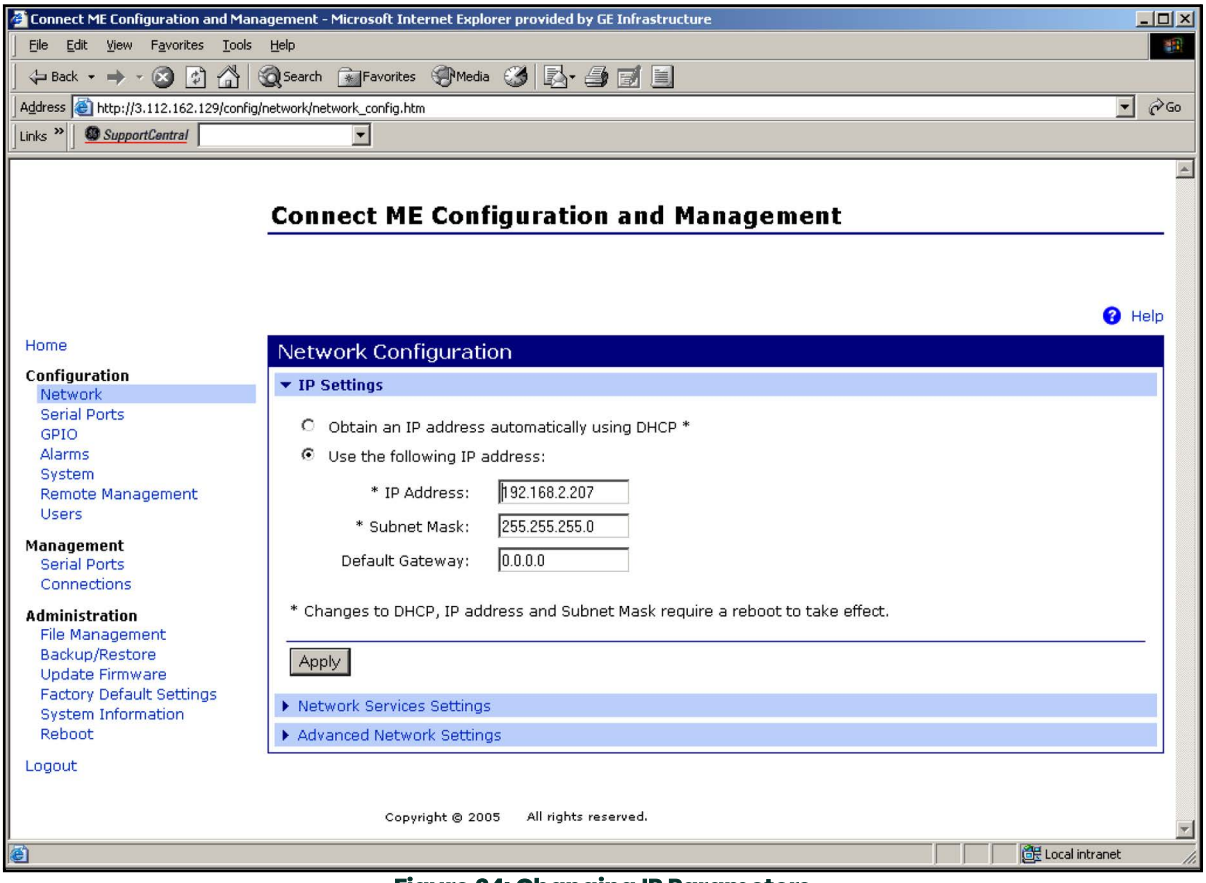


Figure 24: Changing IP Parameters

4.2.6 Changing User's Information

To change the user name and/or password:

1. Under Device Task select *Open web interface*.
2. Enter the Username and Password. The factory defaults are *root* and *dbps*.

Note: *The username and password are case sensitive.*
Panemetrics recommends changing the default password and disabling unused ports and services.

3. Click on **Login**. *Figure 25* appears.
4. Select *Configuration / Users*.
5. Click on **New...**. *Figure 26 on page 56* appears.

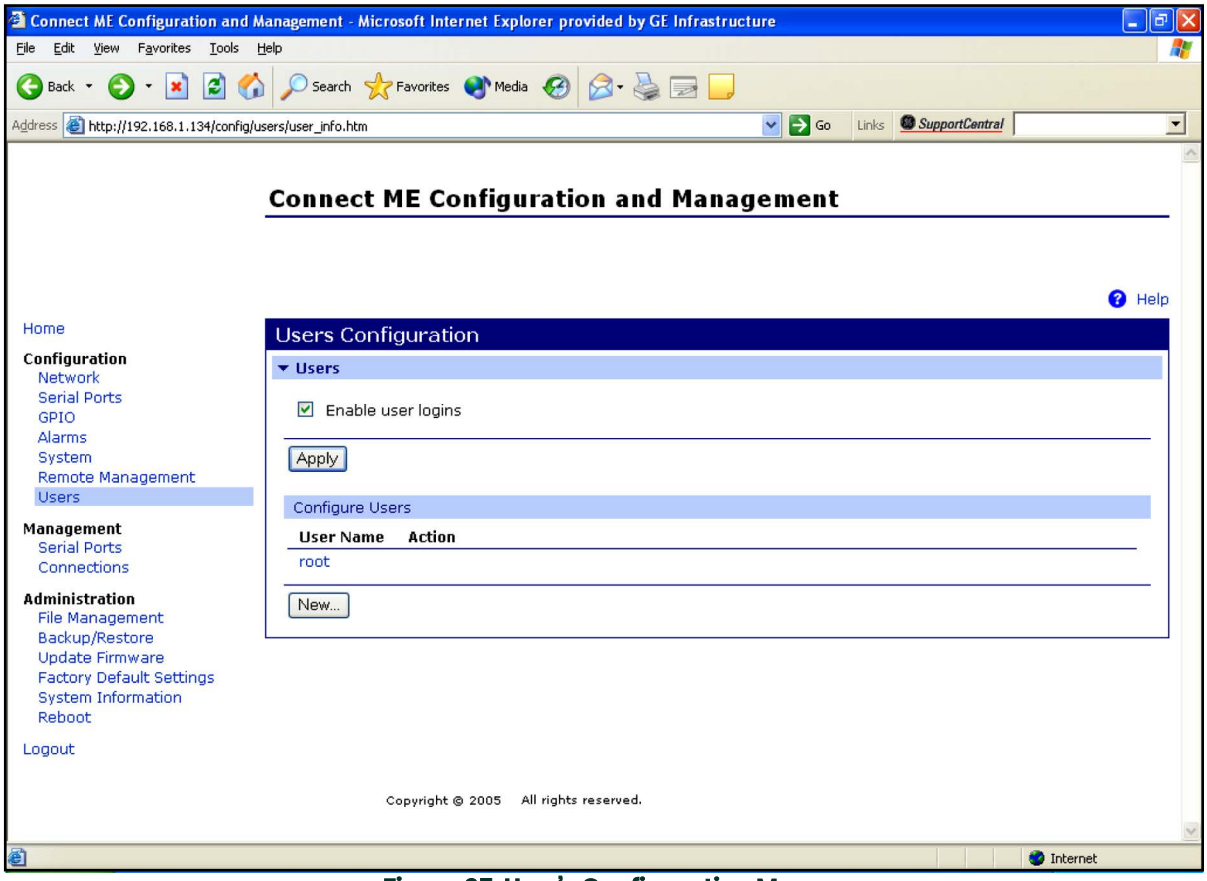


Figure 25: User's Configuration Menu

4.2.6 Changing User's Information (cont.)

6. To change the User Name, click in the box, delete the current name, and type in the new name.
7. To create a New Password, click in the box, delete the current password, and type in the new password.
8. To Confirm the new Password, click in the box, delete the current password and type in the new password.

Note: *For the password to be changed, the New Password and Confirm Password must be identical.*

9. Click on **Apply**.

Note: *Changes will require a reboot to take effect.*

Select *Administration / Reboot*, then wait for the reboot to be completed.

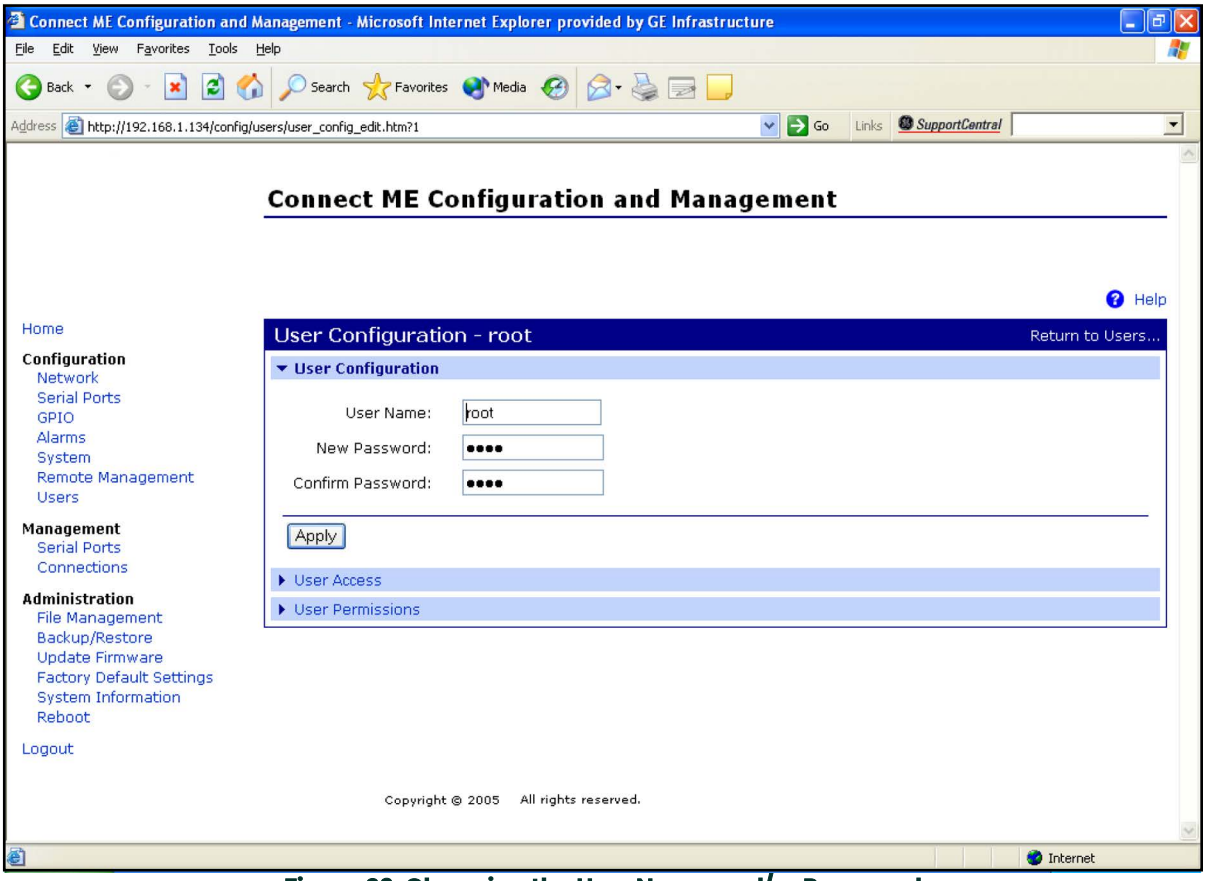


Figure 26: Changing the User Name and/or Password

Chapter 5. Modbus Over WI-FI Communications

5.1 Introduction

This document provides instructions for setting up a flowmeter equipped with *Modbus Over WI-FI* communications. To apply these procedures, the flowmeter must have the option card installed (see the example in *Figure 27*) and connected to a WI-FI antenna.

Note: *To install an option card, consult the user's manual(s) which apply to your instrument.*

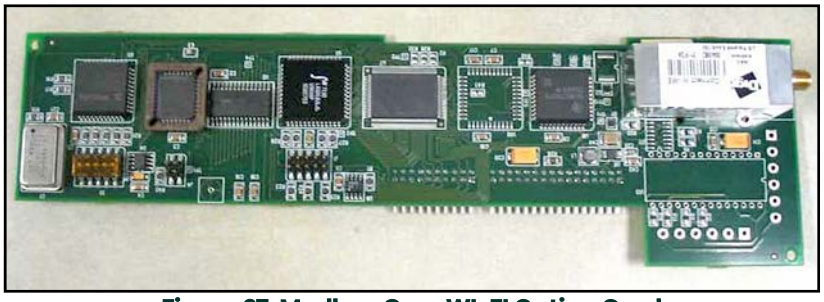


Figure 27: Modbus Over WI-FI Option Card

5.2 WI-FI Components

The WI-FI antenna should be mounted on top of the flowmeter enclosure (see *Figure 28*) and connected to the *Modbus Over WI-FI* option card as shown in *Figure 29* and *Figure 30 on page 58*.

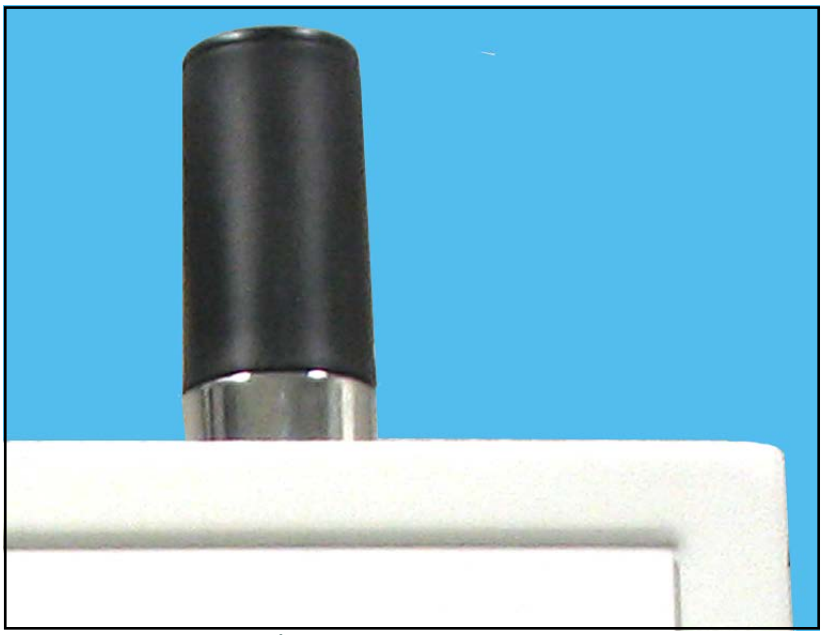


Figure 28: WI-FI Antenna

5.2 WI-FI Components (cont.)

Figure 29: WI-FI Cable Antenna Connection

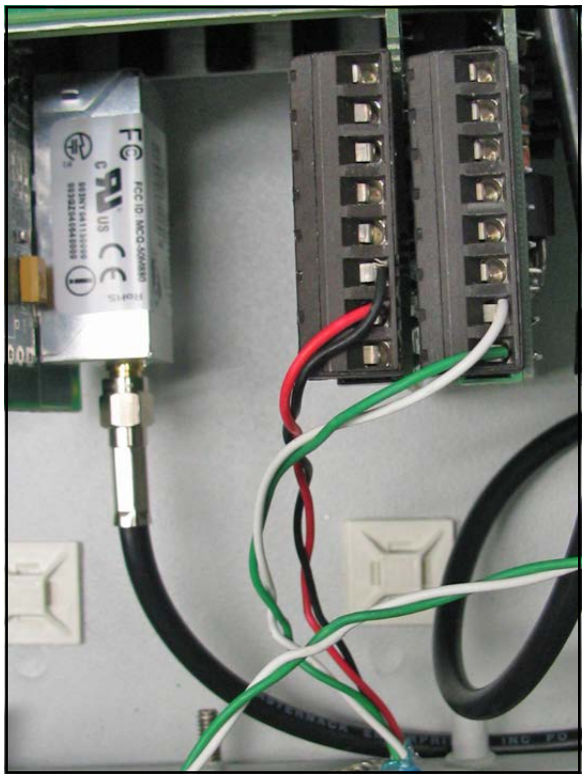


Figure 30: WI-FI Cable PC Board Connection

5.3 Setup

The default IP address in setting up the Modbus Over WI-FI option card is Dynamic (DHCP). If it has to be changed to a static IP address, the instrument must first be linked to the DHCP network.

Note: *The following are setup procedure examples.*

The *Digi Device Discovery Program* is required to set up WI-FI parameters. To download the program, proceed with the following steps:

5.3.1 Downloading the Digi Device Discovery Program

1. Go to www.digi.com on the internet.
2. Move the cursor to the SUPPORT button and select *Diagnostics, Utilities and MIBs* from the menu.
3. Open the Select Your Product for Support menu and select *Digi Connect ME*. Then click on Submit.
4. From the OS Specific Diagnostics, Utilities and MIBs menu select *Microsoft Windows NT 4.0, 2000* or *XP*. Then, under the window, select *Device Discovery Utility for Windows*, and the File Download window appears.
5. Select Save this file to a disk, click on OK, and save the file to your computer.
6. Install the program from the downloaded file.

5.3.2 Module LED Behaviors

- **Yellow ON:** Associated with Access Point
- **Yellow Blinking Slowly:** Ad hoc mode
- **Yellow Blinking Quickly:** Scanning for a network

5.3.3 Default Parameters

- **Baud Rate:** 9600 bps
- **Data Bits:** 8
- **Parity:** None
- **Stop Bits:** 1
- **Flow Control:** None
- **TCP/UDP Port:** 502

IMPORTANT: This Modbus over WI-FI option card is shipped with DHCP IP addressing, and all the security options disabled. If your wireless LAN has any security set, it should be disabled to have this card join your wireless network. A solid yellow LED on the card indicates the card is joined to the wireless network.

5.3.4 Finding the Assigned IP Address

Note: *The following are setup procedure examples.*

Example:
Find the IP address of the module with Media Access Control (MAC) address 00409d24ded5.

1. Run the *Digi Device Discovery Program* (see *Figure 31*).

Note: *To access the* Digi Device Discovery Program, *see page 59.*

Note: *The MAC address of all found units and the assigned IP address will be displayed. In this example the assigned address is 3.112.162.129.*

Note: *Refresh the display to find the MAC address of all units.*

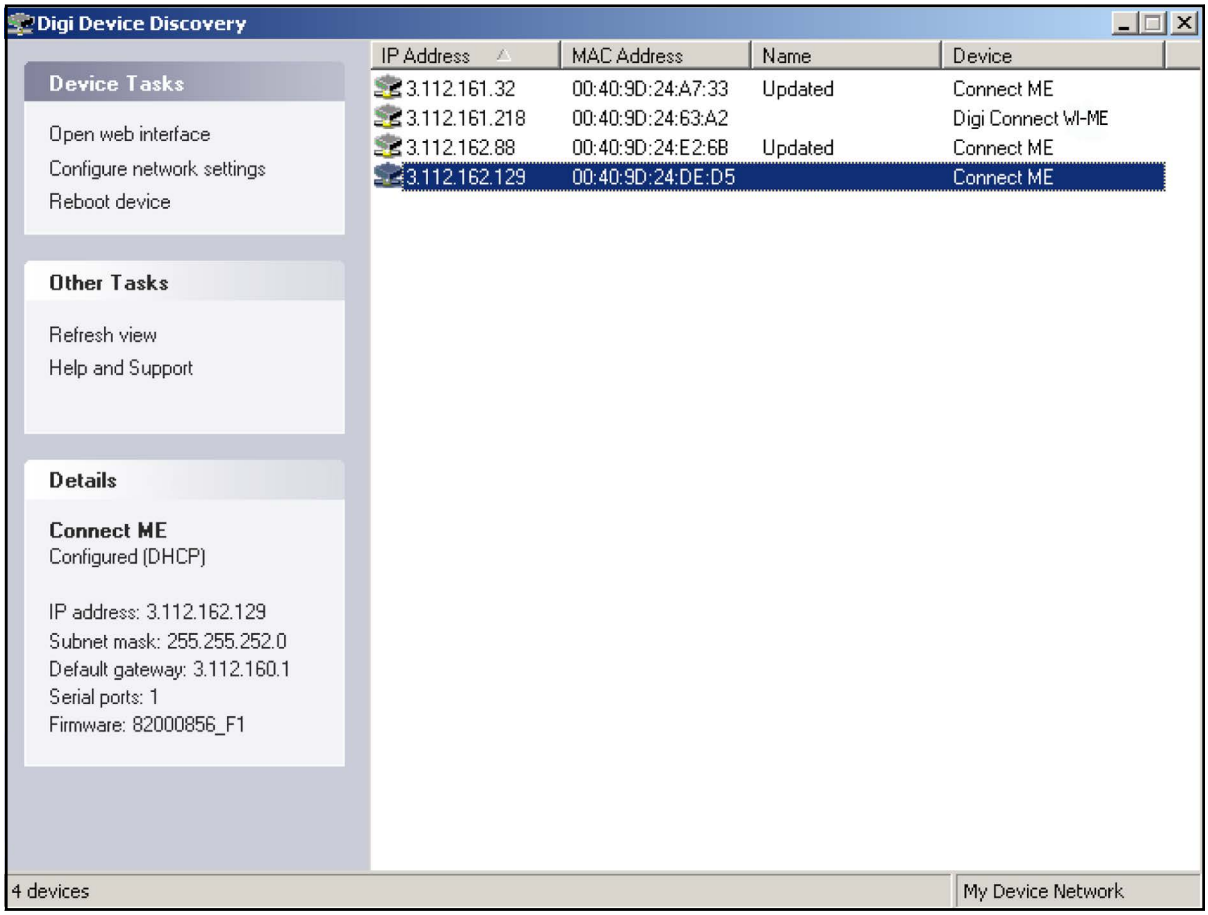


Figure 31: Finding the Assigned IP Address

5.3.5 Changing IP Parameters

Example:
Change the DHCP-assigned IP address to static address 192.168.2.207 and disable DHCP for the unit with IP assigned address 3.112.162.129 (see *Figure 32*).

1. Have your option card joined to the wireless network.
2. Under Device Task select *Open web interface*.
3. Enter Username and Password. Factory defaults are *root* and *dbps*.

Note: *The username and password are case sensitive.*
Panemetrics recommends changing the default password and disabling unused ports and services.

4. Click on **Login**.
5. Select *Configuration* / *Network*.
6. Select *Use the following IP address:* and enter IP address 192.168.2.207.
7. Click on **Apply**.

Note: *Changes will require a reboot to take effect.*

Select *Administration* / *Reboot*, then wait for the reboot to be completed.

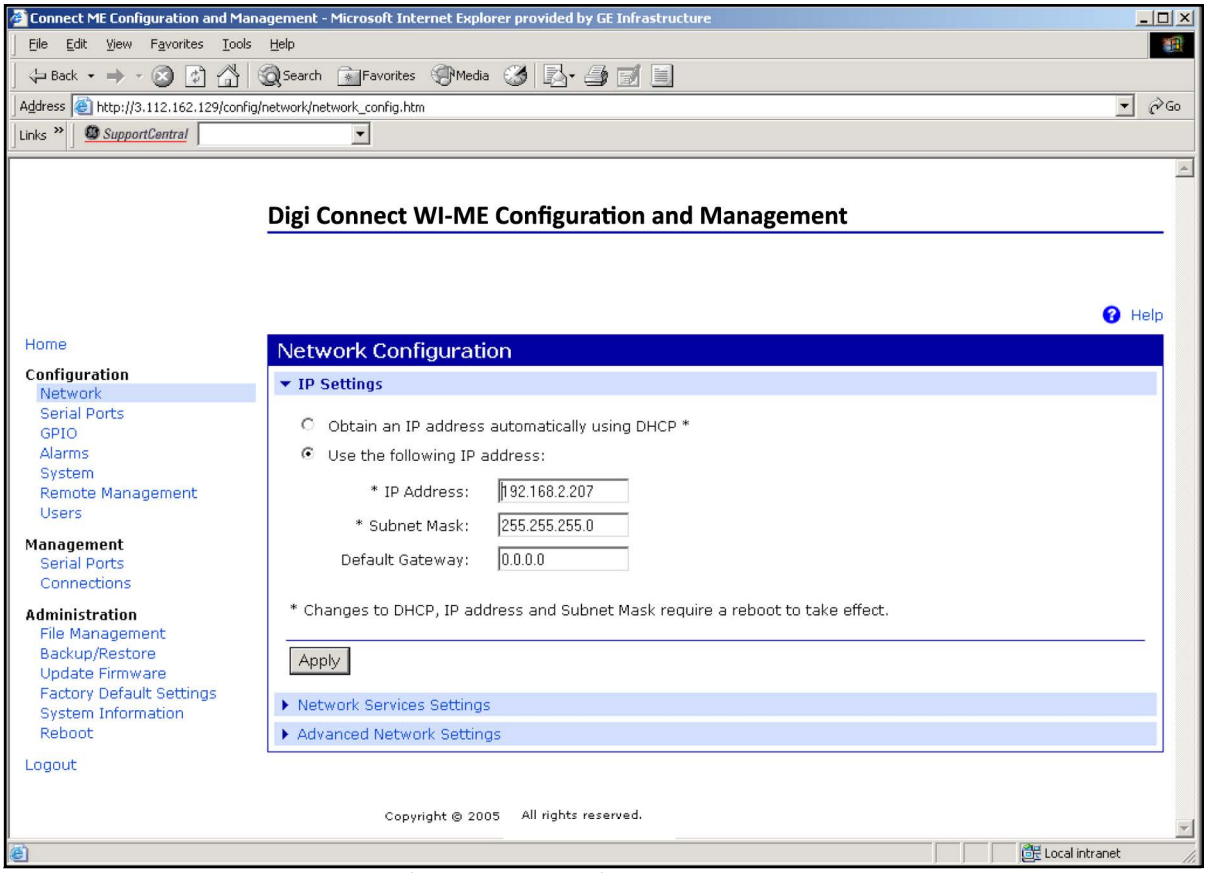


Figure 32: Changing IP Parameters

5.3.6 Changing Modbus/TCP Network Parameters

1. Select Configuration → Serial Ports → Port 1 → Modbus/TCP Network Setting
2. Accept incoming Modbus/TCP connection: TCP Port: XXX
3. Accept incoming Modbus/TCP in UDP/IP: UDP Port: XXX
4. → Apply

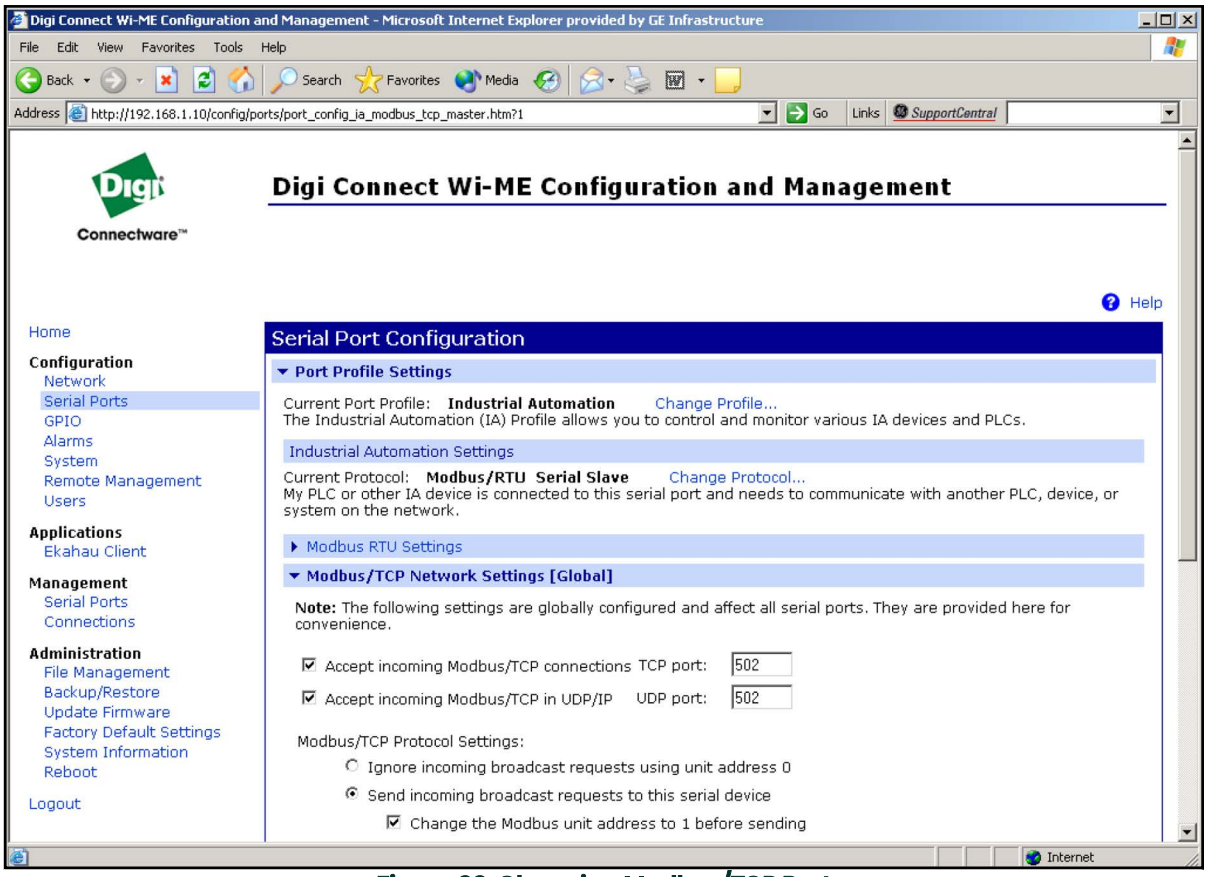


Figure 33: Changing Modbus/TCP Port

5.3.7 Changing User's Information

To change the user name and/or password:

1. Under Device Task select *Open web interface*.
2. Enter the Username and Password. The factory defaults are *root* and *dbps*.

Note: *The username and password are case sensitive.*
Panemetrics recommends changing the default password and disabling unused ports and services.

3. Click on **Login**. *Figure 34* appears.
4. Select *Configuration | Users*.
5. Click on **New...**. *Figure 35 on page 64* appears.

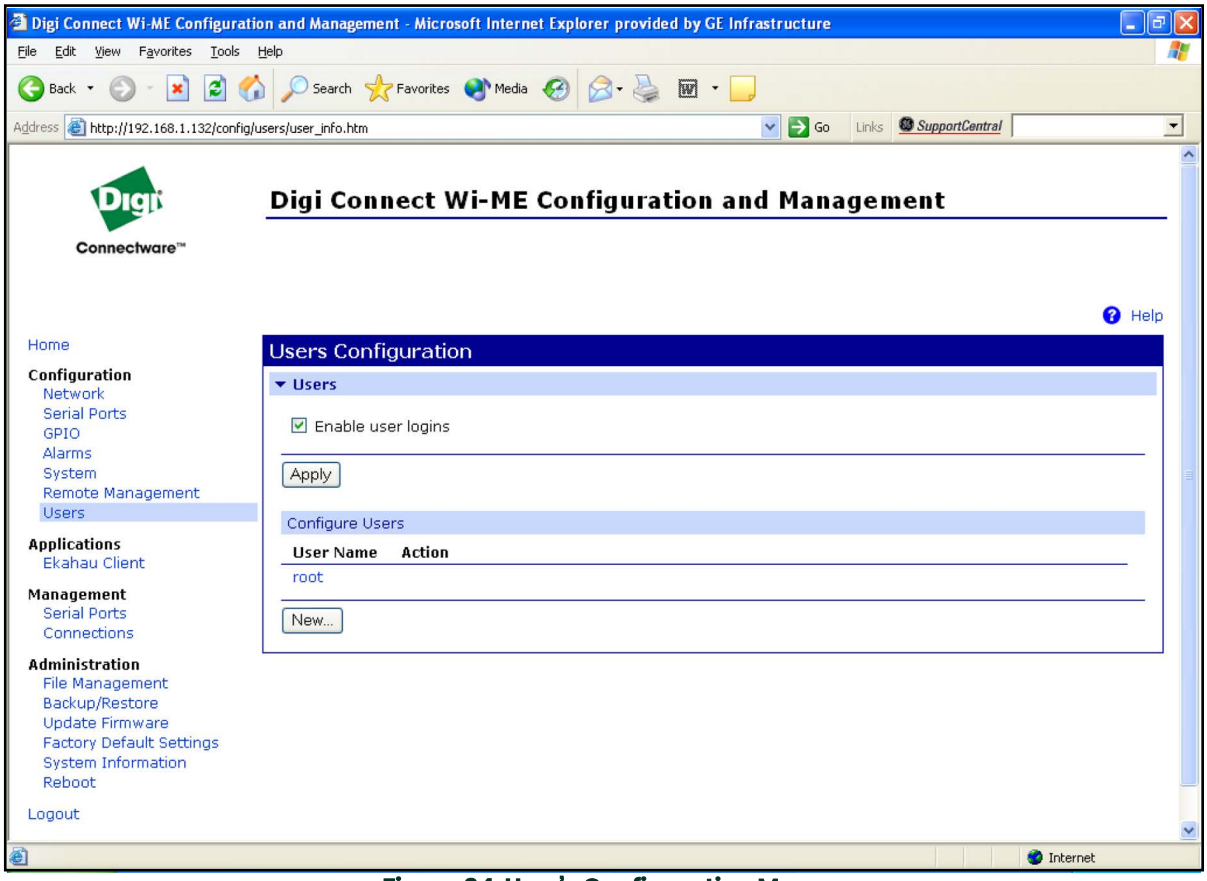


Figure 34: User's Configuration Menu

5.3.7 Changing User's Information (cont.)

6. To change the User Name, click in the box, delete the current name, and type in the new name.
7. To create a New Password, click in the box, delete the current password, and type in the new password.
8. To Confirm the new Password, click in the box, delete the current password and type in the new password.

Note: *For the password to be changed, the New Password and Confirm Password must be identical.*

9. Click on **Apply**.

Note: *Changes will require a reboot to take effect.*

Select *Administration / Reboot*, then wait for the reboot to be completed.

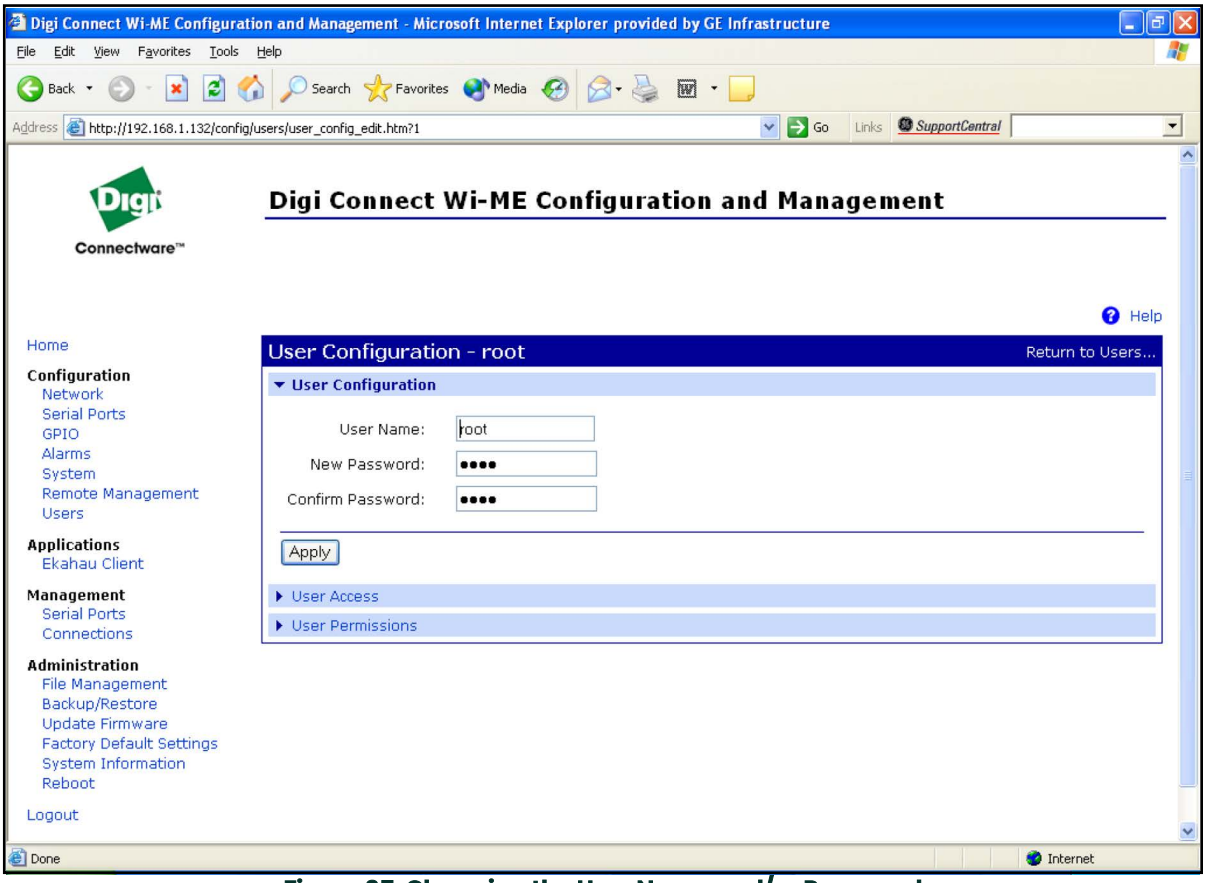


Figure 35: Changing the User Name and/or Password

5.4 Tips for Improving Wireless Data Communications

A suitable installation site should locate the antenna in a transmission path as unobstructed as possible; in the direction of the associated router.

When a wireless transducer is linked to a router, a yellow LED on the WI-FI option board remains on. Received Signal Strength Indication (RSSI) is an important indicator of wireless link quality. The higher the RSSI, the stronger the performance a wireless system can provide. Signal Strength is calculated by a wireless transceiver and can be viewed on Administration-System Information - WI-FI LAN - Active Settings of the device home page (see *Figure 37 on page 66*).

If constant interference is present in a particular frequency zone, it might be necessary to change the operational channel in the WI-FI network. If interference problems persist, try reducing the length of data streams by reading less registers in one request. Groups of short data streams have a better chance of getting through in the presence of interference than do long streams.

Figure 36: Installation Site

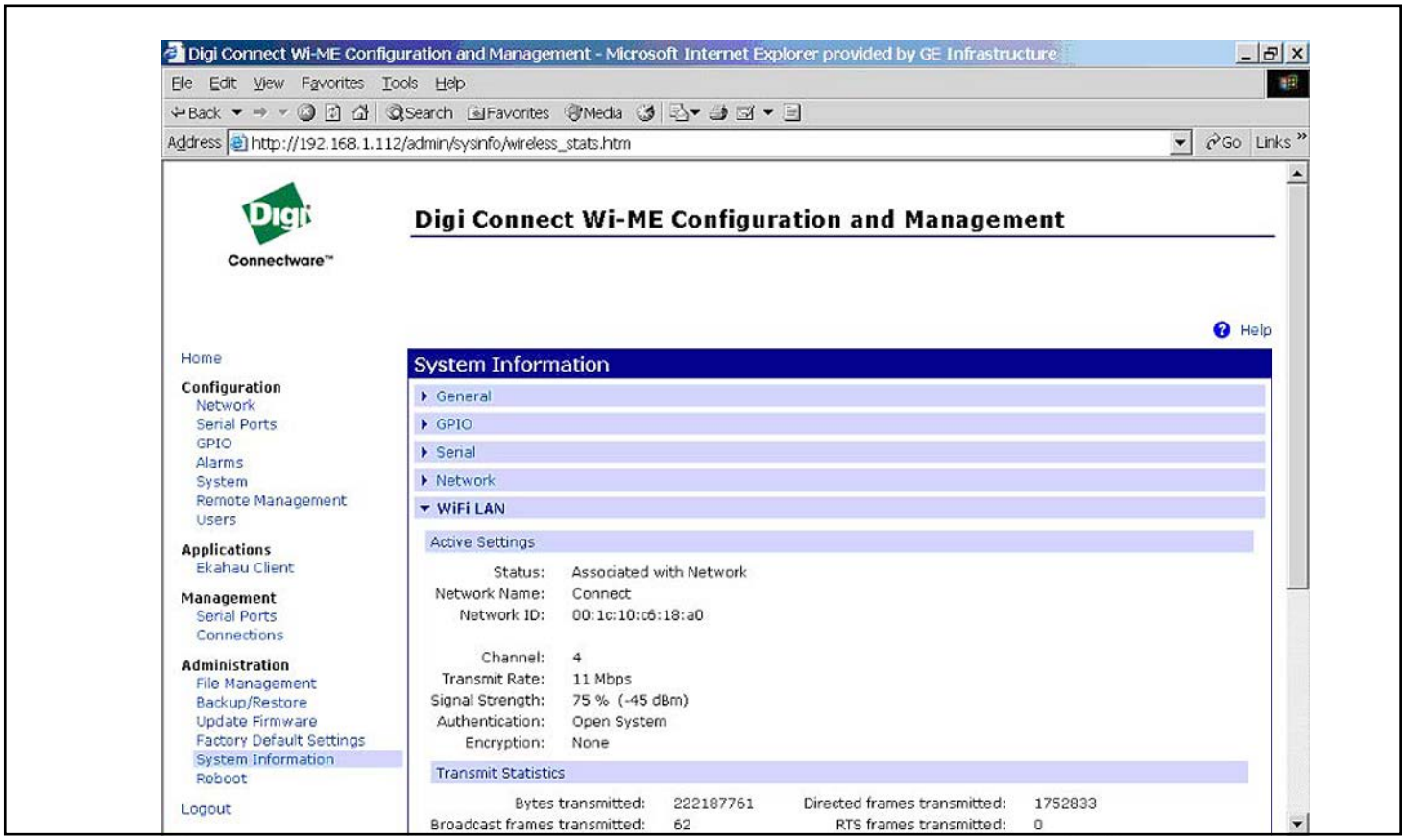


Figure 37: System Information Menu - WI-FI Lan

Chapter 6. WI-FI Only Communications

6.1 Introduction

This document provides instructions for setting up a flowmeter equipped with *WI-FI Only* communications. To apply these procedures, the flowmeter must have the option card installed (see the example in *Figure 38*) and connected to a WI-FI antenna.

Note: *To install an option card, consult the user's manual(s) which apply to your instrument.*

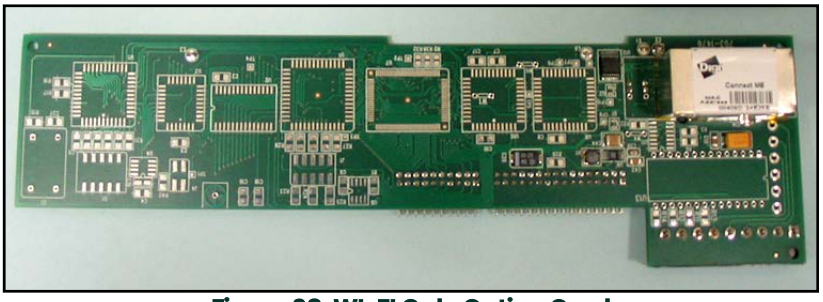


Figure 38: WI-FI Only Option Card

6.2 WI-FI Components

The WI-FI antenna should be mounted on top of the flowmeter enclosure (see *Figure 39*) and connected to the *WI-FI Only* option card as shown in *Figure 40* and *Figure 41 on page 68*.

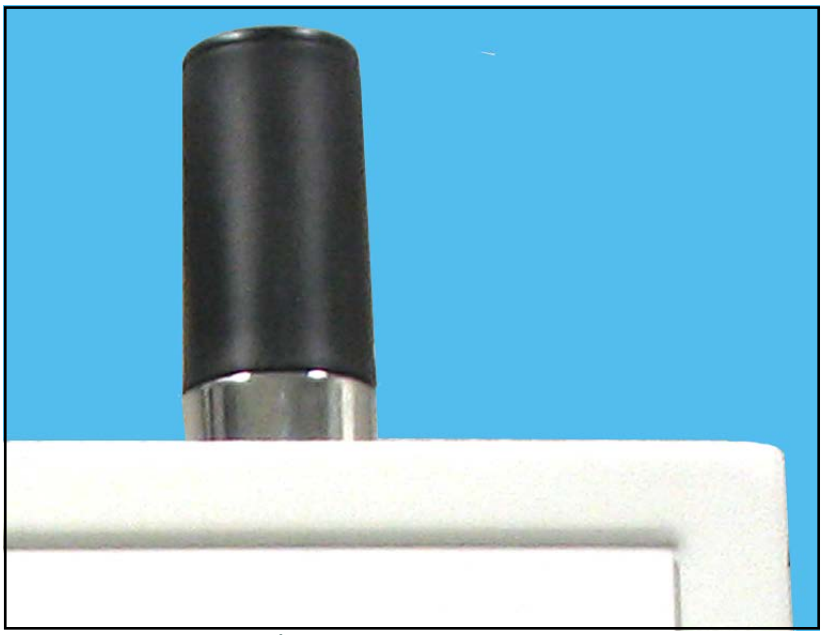


Figure 39: WI-FI Antenna

6.2 WI-FI Components (cont.)

Figure 40: WI-FI Cable Antenna Connection

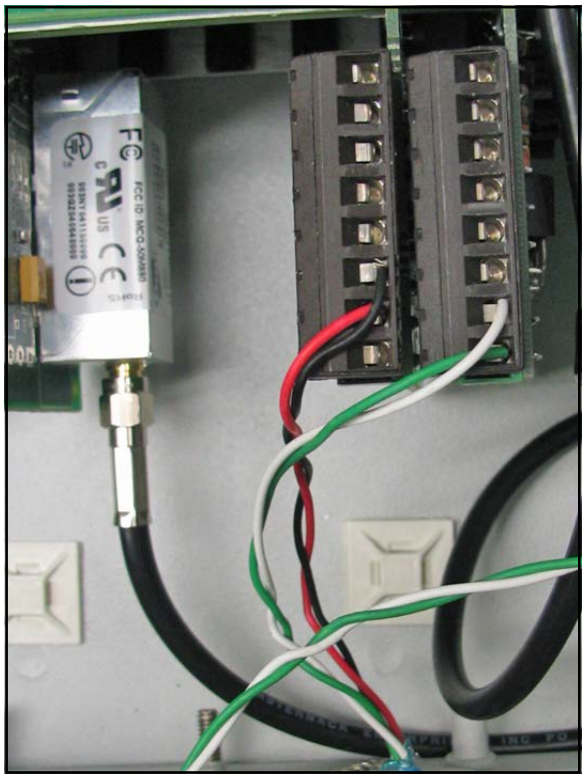


Figure 41: WI-FI Cable PC Board Connection

6.3 Setup

The default IP address in setting up the WI-FI Only option card is Dynamic (DHCP). If it has to be changed to a static IP address, the instrument must first be wirelessly linked to the DHCP network. You may need a WI-FI router in order to activate that.

Note: *The following are setup procedure examples.*

The *Digi Device Discovery Program* is required to change communications parameters if needed. To download the program, proceed with the following steps:

6.3.1 Downloading the Digi Device Discovery Program

1. Go to www.digi.com on the internet.
2. Move the cursor to the SUPPORT button and select *Diagnostics, Utilities and MIBs* from the menu.
3. Open the Select Your Product for Support menu and select *Digi Connect ME*. Then click on Submit.
4. From the OS Specific Diagnostics, Utilities and MIBs menu select *Microsoft Windows NT 4.0, 2000* or *XP*. Then, under the window, select *Device Discovery Utility for Windows*, and the File Download window appears.
5. Select Save this file to a disk, click on OK, and save the file to your computer.
6. Install the program from the downloaded file.

6.3.2 Module LED Behaviors

- **Yellow ON:** Associated with Access Point
- **Yellow Blinking Slowly:** Ad hoc mode
- **Yellow Blinking Quickly:** Scanning for a network

6.3.3 Default Parameters

- **Baud Rate:** 9600 bps
- **Data Bits:** 8
- **Parity:** None
- **Stop Bits:** 1
- **Flow Control:** None

IMPORTANT: This WI-FI Only option card is shipped with DHCP IP addressing, and all the security options disabled. If your wireless LAN has any security set, it should be disabled to have this card join your wireless network. A solid yellow LED on the card indicates the card is joined to the wireless network.

6.3.4 Finding the Assigned IP Address

Note: *The following are setup procedure examples.*

Example:
Find the IP address of the module with Media Access Control (MAC) address 00409d24ded5.

1. Run the *Digi Device Discovery Program* (see *Figure 42*).

Note: *To access the* Digi Device Discovery Program, *see page 69.*

Note: *The MAC address of all found units and the assigned IP address will be displayed. In this example the assigned address is 3.112.162.129.*

Note: *Refresh the display to find the MAC address of all units.*

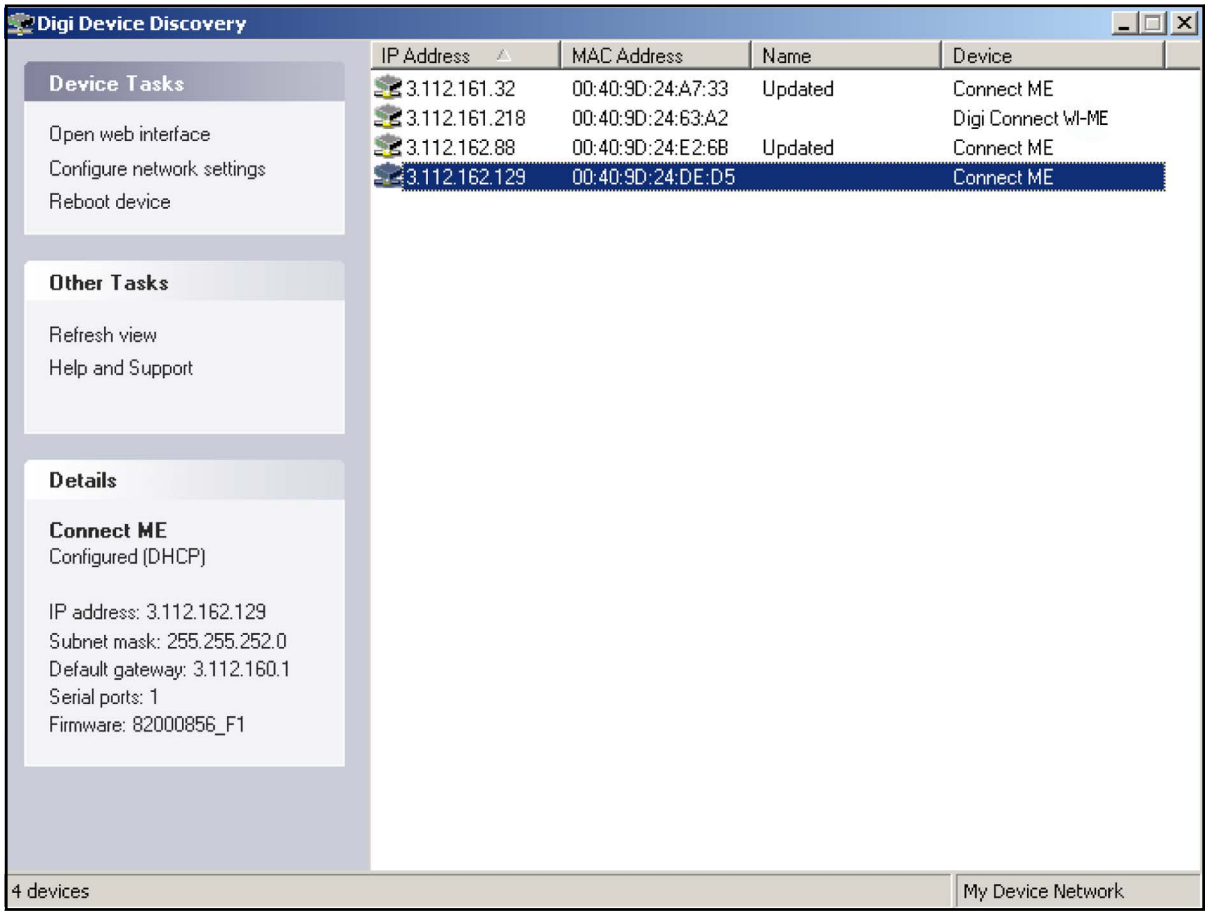


Figure 42: Finding the Assigned IP Address

6.3.5 Changing IP Parameters

Example:
Change the DHCP-assigned IP address to static address 192.168.2.207 and disable DHCP for the unit with IP assigned address 3.112.162.129 (see *Figure 43*).

1. Have your option card joined to the wireless network.
2. Under Device Task select *Open web interface*.
3. Enter Username and Password. Factory defaults are *root* and *dbps*.

Note: *The username and password are case sensitive.*
Panemetrics recommends changing the default password and disabling unused ports and services.

4. Click on **Login**.
5. Select *Configuration* / *Network*.
6. Select *Use the following IP address:* and enter IP address **192.168.2.207**.
7. Click on **Apply**.

Note: *Changes will require a reboot to take effect.*

Select *Administration* / *Reboot*, then wait for the reboot to be completed.

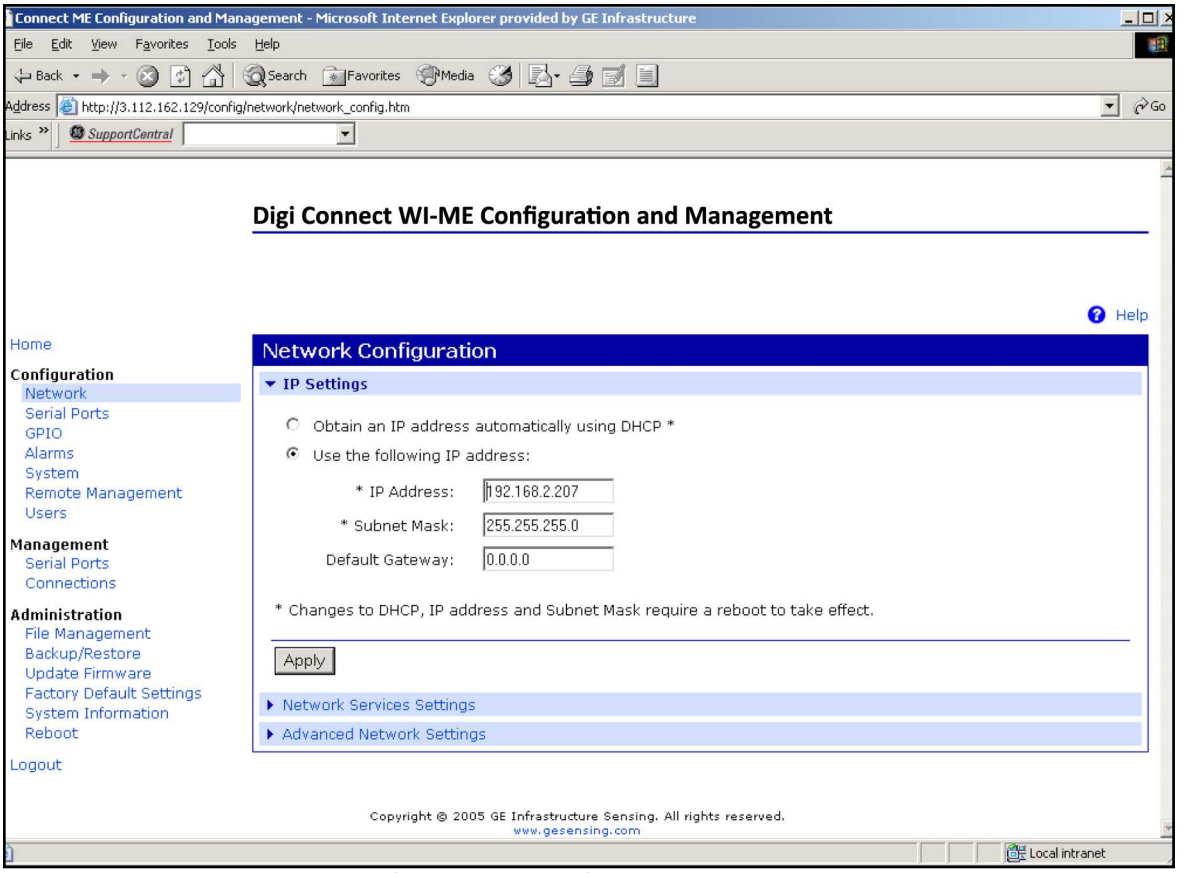


Figure 43: Changing IP Parameters

6.3.6 Changing User's Information

To change the user name and/or password:

1. Under Device Task select *Open web interface*.
2. Enter the Username and Password. The factory defaults are *root* and *dbps*.

Note: *The username and password are case sensitive.*
Panemetrics recommends changing the default password and disabling unused ports and services.

3. Click on **Login**. *Figure 44* appears.
4. Select *Configuration | Users*.
5. Click on **New...**. *Figure 45 on page 73* appears.

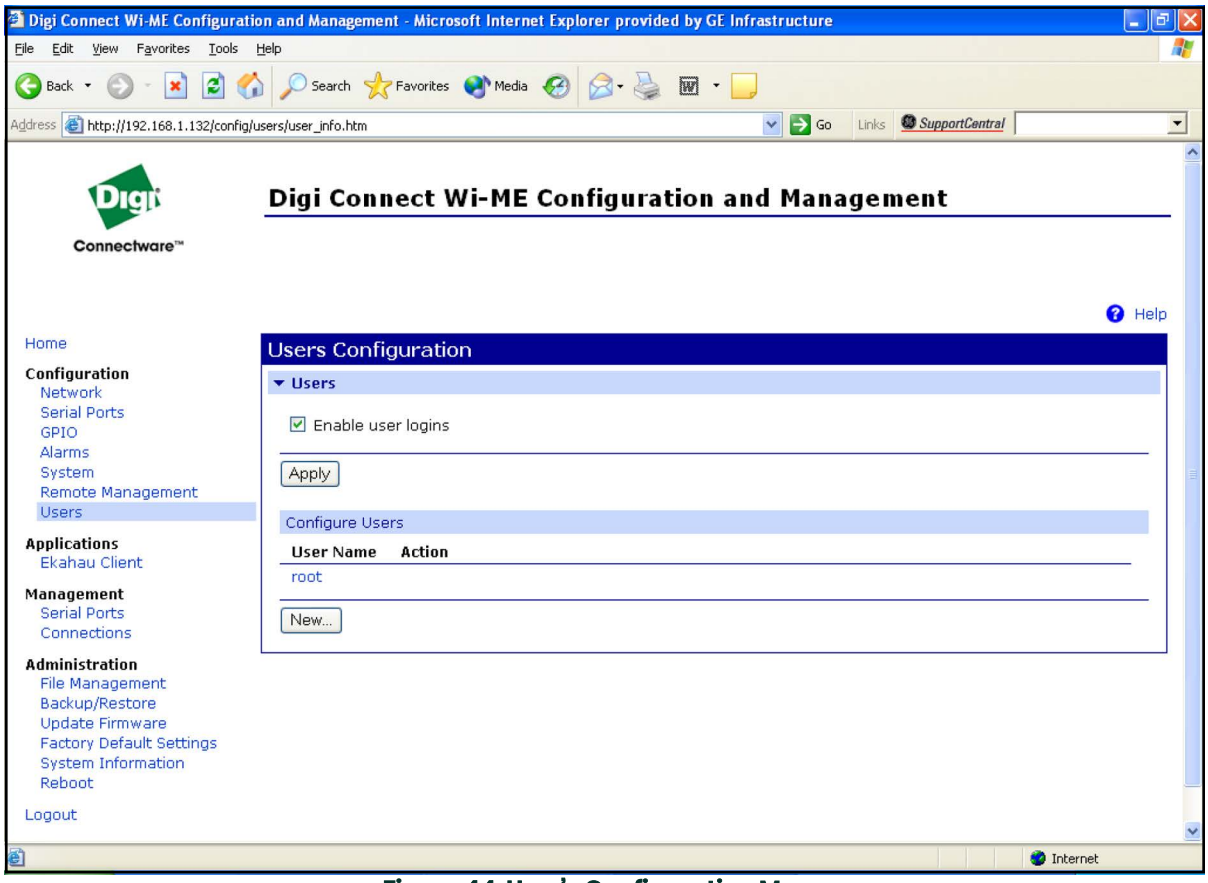


Figure 44: User's Configuration Menu

6.3.6 Changing User's Information (cont.)

6. To change the User Name, click in the box, delete the current name, and type in the new name.
7. To create a New Password, click in the box, delete the current password, and type in the new password.
8. To Confirm the new Password, click in the box, delete the current password and type in the new password.

Note: *For the password to be changed, the New Password and Confirm Password must be identical.*

9. Click on **Apply**.

Note: *Changes will require a reboot to take effect.*

Select *Administration / Reboot*, then wait for the reboot to be completed.

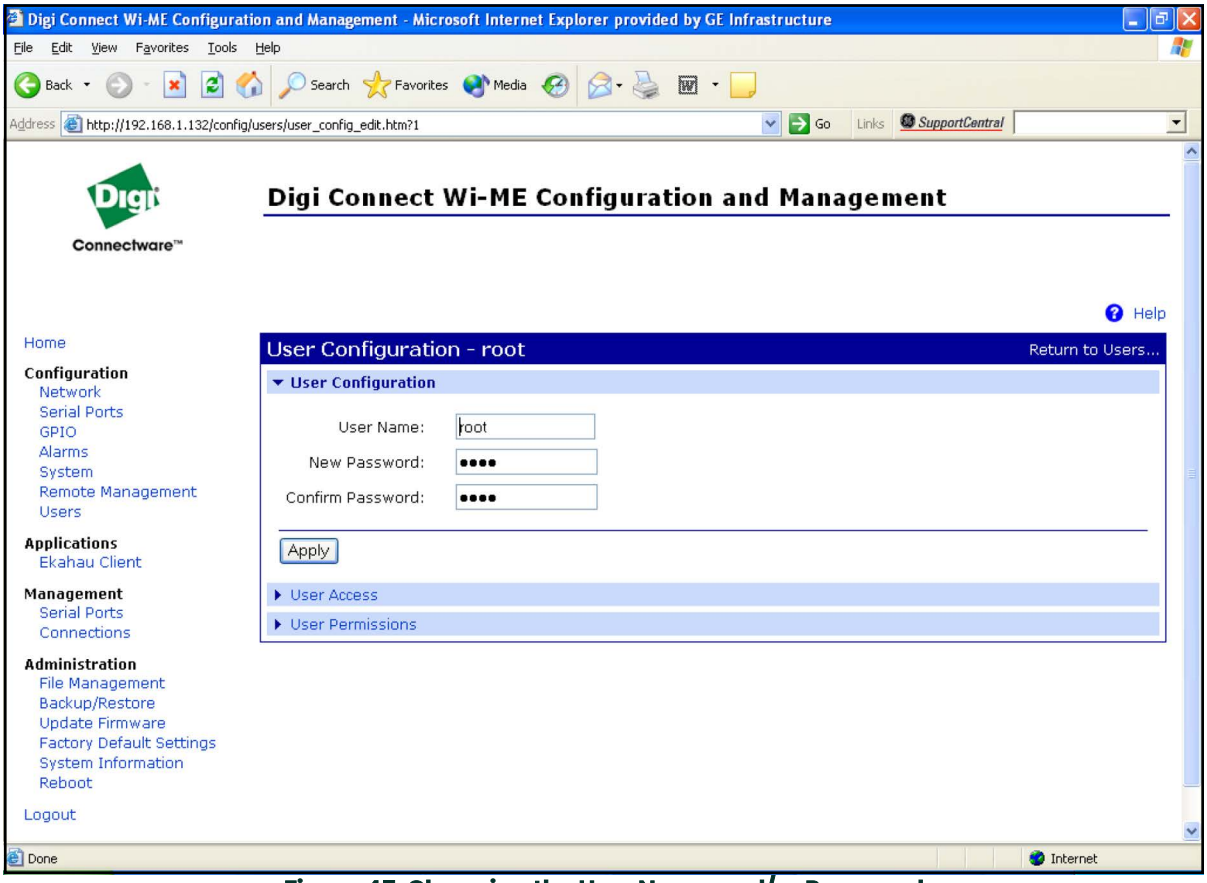


Figure 45: Changing the User Name and/or Password

6.4 Tips for Improving Wireless Data Communications

Figure 46: Installation Site

A suitable installation site should locate the antenna in a transmission path as unobstructed as possible; in the direction of the associated router.

When a wireless transducer is linked to a router, a yellow LED on the WI-FI option board remains on. Received Signal Strength Indication (RSSI) is an important indicator of wireless link quality. The higher the RSSI, the stronger the performance a wireless system can provide. Signal Strength is calculated by a wireless transceiver and can be viewed on Administration-System Information - WI-FI LAN - Active Settings of the device home page (see *Figure 47*).

If constant interference is present in a particular frequency zone, it might be necessary to change the operational channel in the WI-FI network. If interference problems persist, try reducing the length of data streams. Groups of short data streams have a better chance of getting through in the presence of interference than do long streams.

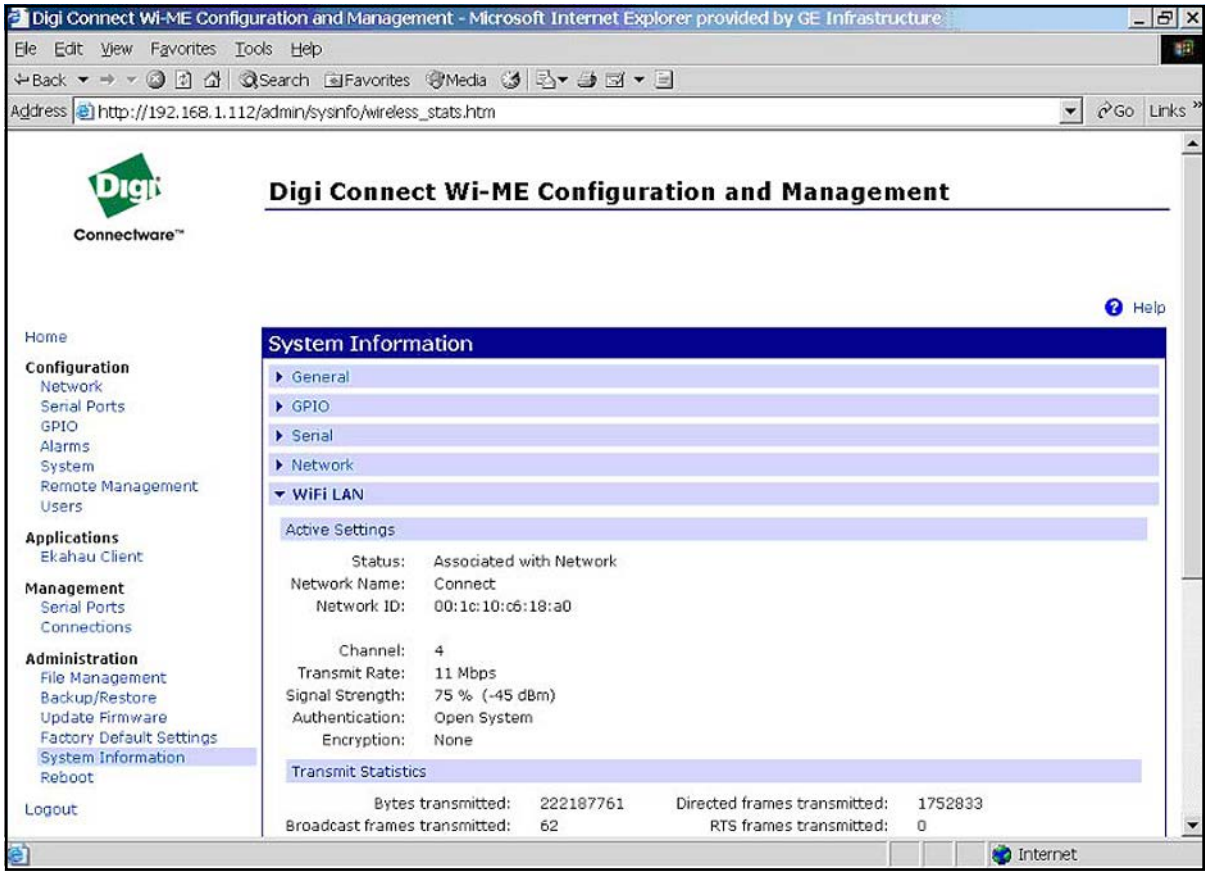


Figure 47: System Information Menu - WI-FI Lan

Chapter 7. Foundation Fieldbus Communications

7.1 Optional Measurements

Foundation Fieldbus provides a means of communicating with the flowmeter. The patent numbers which apply are 5,909,363 and 6,424,872.

Note: *The Foundation Fieldbus option card works with the Modbus map in the flowmeter. Some flowmeters (GF868, GF868 PLUS, XGF868i) have a choice of Modbus maps. Be sure to select the Legacy or Legacy + Diag map for compatibility with Foundation Fieldbus communications. See section 1.4.1, Modbus Map Configuration for details.*

This Foundation Fieldbus device supports 6 Analog Input (AI) blocks, which can be configured to supply the following measurements on the network (see *Table 11* below).

Table 11: Available Measurements for the DF868

Channel 1	Units	Channel 2	Units	Average	Units
Ch1 Velocity	ft/s or m/s*	Ch2 Velocity	ft/s or m/s*	Avg Velocity	ft/s or m/s*
Ch1 Act Volumetric	VOL_U	Ch2 Act Volumetric	VOL_U	Avg Act Volumetric	VOL_U
Ch1 Std Volumetric	VOL_U	Ch2 Std Volumetric	VOL_U	Avg Std Volumetric	VOL_U
Ch1 Fwd Totals	TOT_U	Ch2 Fwd Totals	TOT_U	Avg Fwd Totals	TOT_U
Ch1 Rev Totals	TOT_U	Ch2 Rev Totals	TOT_U	Avg Rev Totals	TOT_U
Ch1 #Tot Digits**	none	Ch2 #Tot Digits**	none	Avg #Tot Digits	none
Ch1 Mass Flow	MASS_U	Ch2 Mass Flow	MASS_U	Avg Mass Flow	MASS_U
Ch1 Fwd Mass Totals	MTOT_U	Ch2 Fwd Mass Totals	MTOT_U	Avg Fwd Mass Totals	MTOT_U
Ch1 Rev Mass Totals	MTOT_U	Ch2 Rev Mass Totals	MTOT_U	Avg Rev Mass Totals	MTOT_U
Ch1 #Mass Tot Digits	none	Ch2 #Mass Tot Digits	none	Avg #Mass Tot Digits	none
Ch1 Timer	sec	Ch2 Timer	sec	Avg Timer	sec
Ch1 Error Code	none	Ch2 Error Code	none	Avg Error Code	none
Ch1 SSUP	none	Ch2 SSUP	none	Avg SSUP	none
Ch1 SSDN	none	Ch2 SSDN	none	Avg SSDN	none
Ch1 Sound Speed	ft/s or m/s*	Ch2 Sound Speed	ft/s or m/s*	Avg Sound Speed	ft/s or m/s*
Ch1 Density***	see note	Ch2 Density***	see note		
Ch1 Temperature	Deg F or C*	Ch2 Temperature	Deg F or C*		
Ch1 Pressure	PRESS_U	Ch2 Pressure	PRESS_U		

*Metric or English units are determined by the setup of the flowmeter.

**Totalizer digits are available for informational purposes only. Respective totals are automatically scaled by the Tot Digits value selected in the flowmeter setup.

***If the meter is outputting Mole Weight, the unit is “mw”, otherwise it is the programmed pressure unit.

VOL_U, TOT_U, MASS_U, MTOT_U and PRESS_U are determined by the units chosen for these measurements in the flowmeter setup. See the instrument User's Manual for the setup of these parameters.

7.2 Configuration Utility Setup

The following is an example setup using National Instruments Configuration Utility v3.1.

Figure 48 below shows the Configuration Utility with a flowmeter on the network (Panemetrics Flow-XMT).

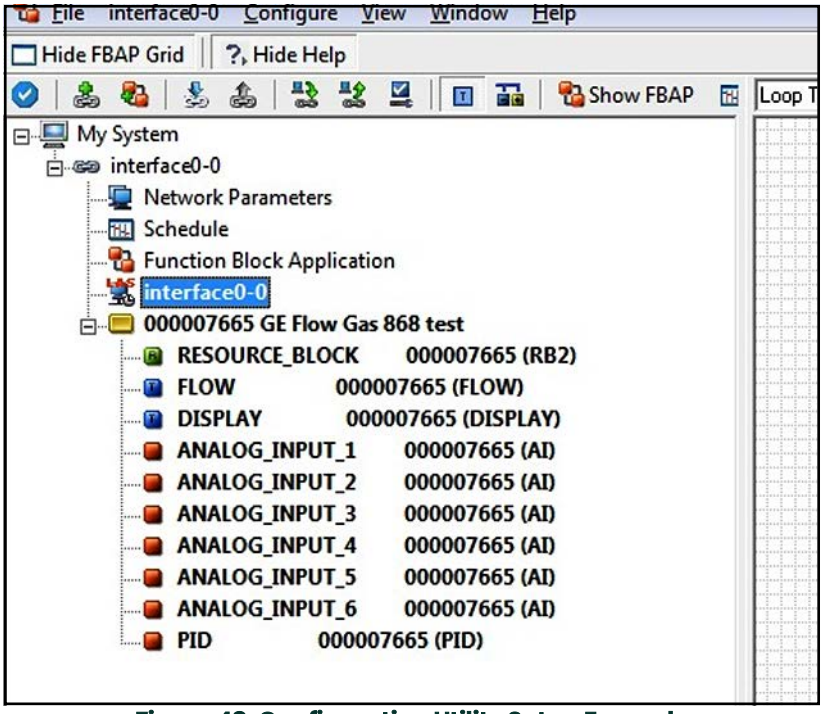


Figure 48: Configuration Utility Setup Example

Note: *The following procedures assume that the device has been placed in the OOS (out-of-service) mode before executing.*

7.3 Selecting the Desired Measurements

To set the measurement unit for each AI:

1. Double click on the FLOW Transducer Block (in the tree under GEFlow-XMT).
2. Select the **Others** tab and open the drop down list for the PRIMARY_SELECTOR through **6th_SELECTOR** (refer to *Figure 49 on page 77*).
3. Choose the unit from the list (see *Figure 49 on page 77*).

This unit will correspond to the unit that is available in the AI block for network connection. The PRIMARY_SELECTOR unit will correspond to ANALOG_INPUT_1, SECONDARY_SELECTOR to ANALOG_INPUT_2, and so forth up to 6th_SELECTOR and ANALOG_INPUT_6.

7.3 Selecting the Desired Measurements (cont.)

4. After the desired measurements have been selected, choose the unit system (UNIT_SELECTOR) that has been programmed in the flowmeter (English or SI).

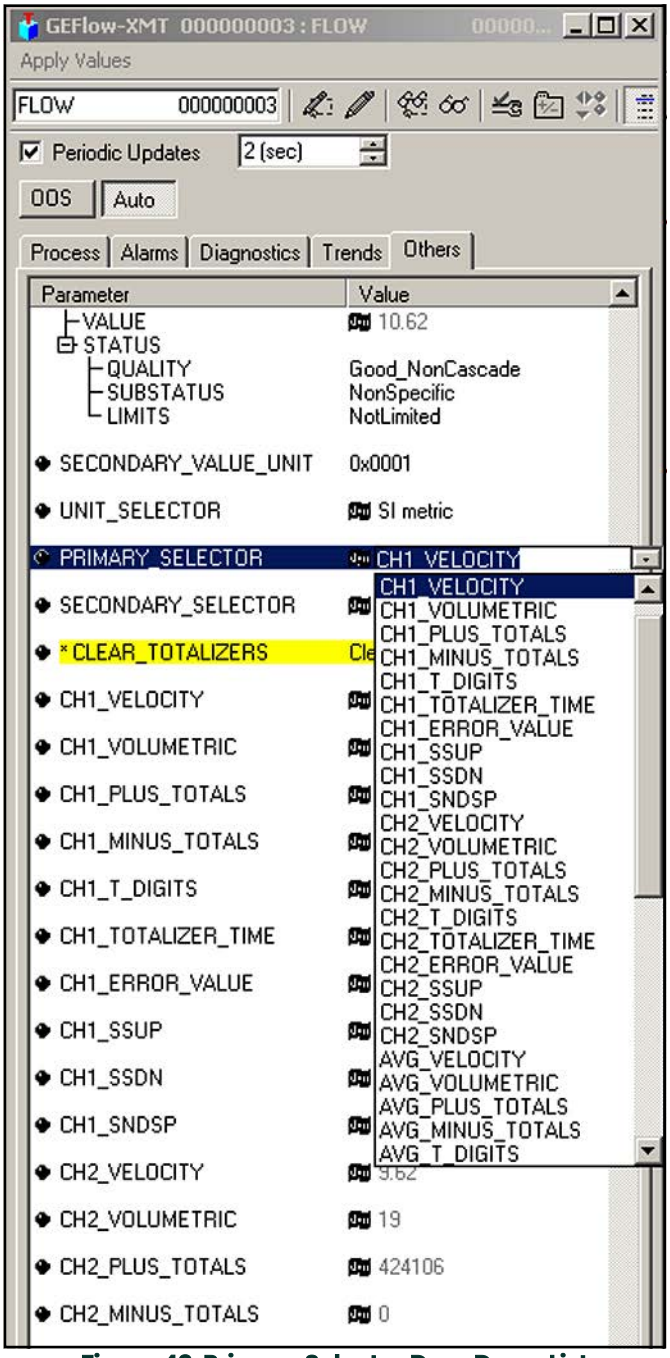


Figure 49: Primary Selector Drop Down List

7.4 Selecting Units for AI Blocks

To select the units for the individual AI blocks:

1. Double click on the AI block for which you wish to set the units (in the tree under GEFlow-XMT; see *Figure 48 on page 76*).
2. Select the **Scaling** tab and set the unit for the measurement based on the flowmeter settings.

For example, if the flowmeter was set to use the metric unit system and the PRIMARY_SELECTOR was set to use VELOCITY you would choose **m/s** for the unit as shown in *Figure 50*.

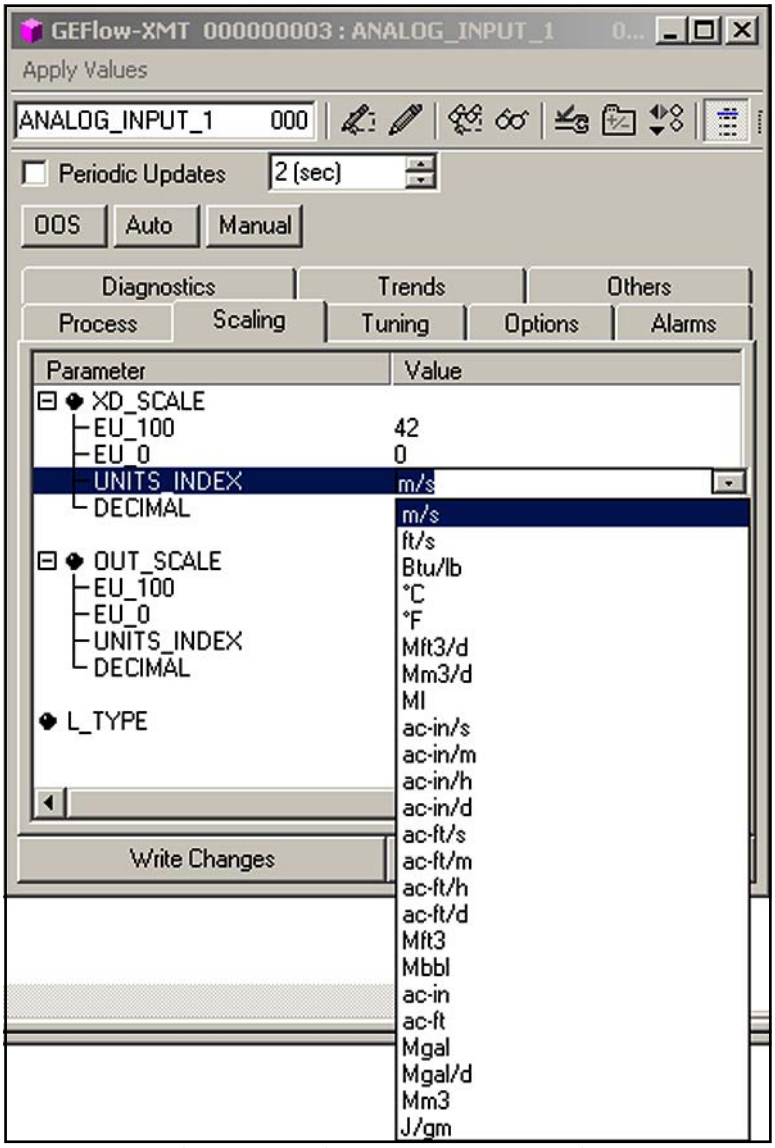


Figure 50: Units Index Drop Down List

7.5 Resetting Instrument Totalizers

To reset the instrument totalizers:

1. Double click on the FLOW transducer block (in the tree under GEFlow-XMT; see *Figure 48 on page 76*).
2. Select the **Others** tab and scroll down to the CLEAR_TOTALIZERS listing.
3. Select **Clear** from the drop down list box (see *Figure 51*).
4. After the totals have been reset, select **Normal** from the drop down list box to resume total accumulation.

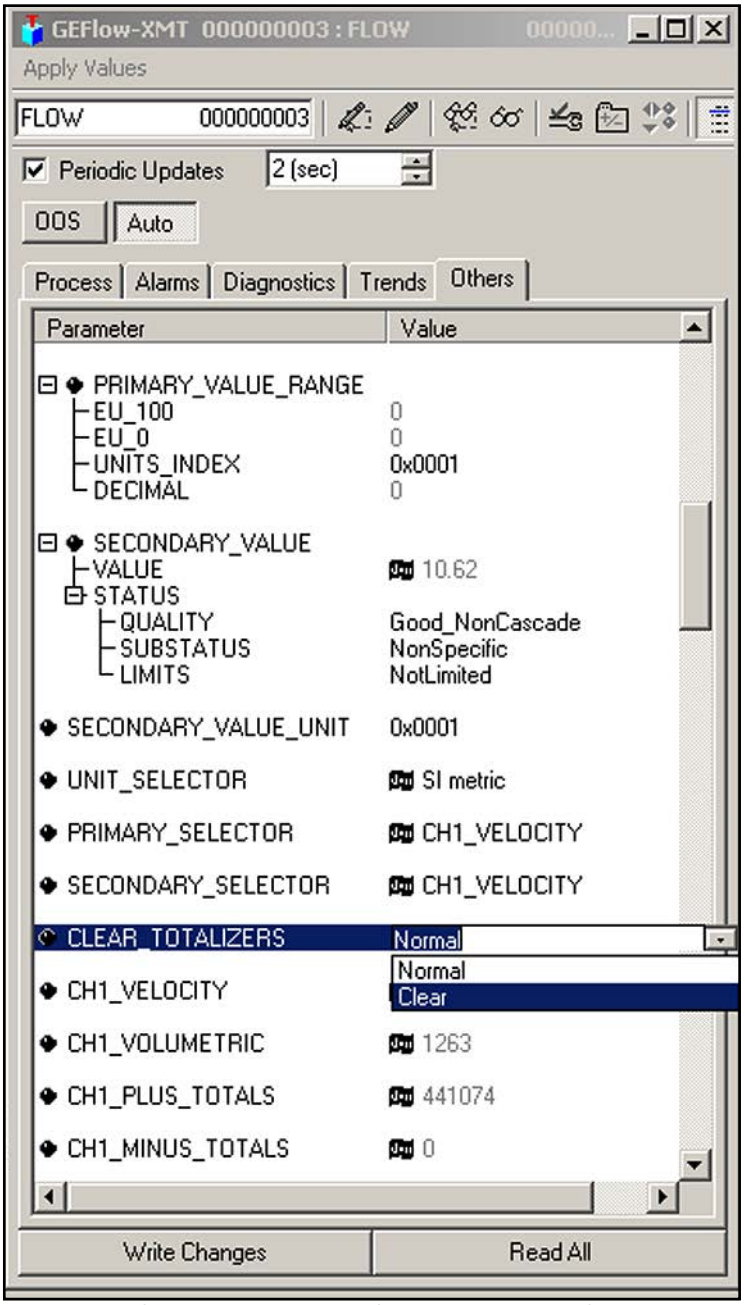


Figure 51: Clear Totalizers Drop Down List

7.6 Function Block Application

Figure 52 is an example setup using the Function Block Application editor. The flowmeter AI blocks, along with the AO and PID of another device on the network, are displayed. We have connected the AI_1 OUT of the flowmeter to the CAS IN of the AO block. We have also connected the AI_2 OUT of the flowmeter to the CAS IN of the PID block.

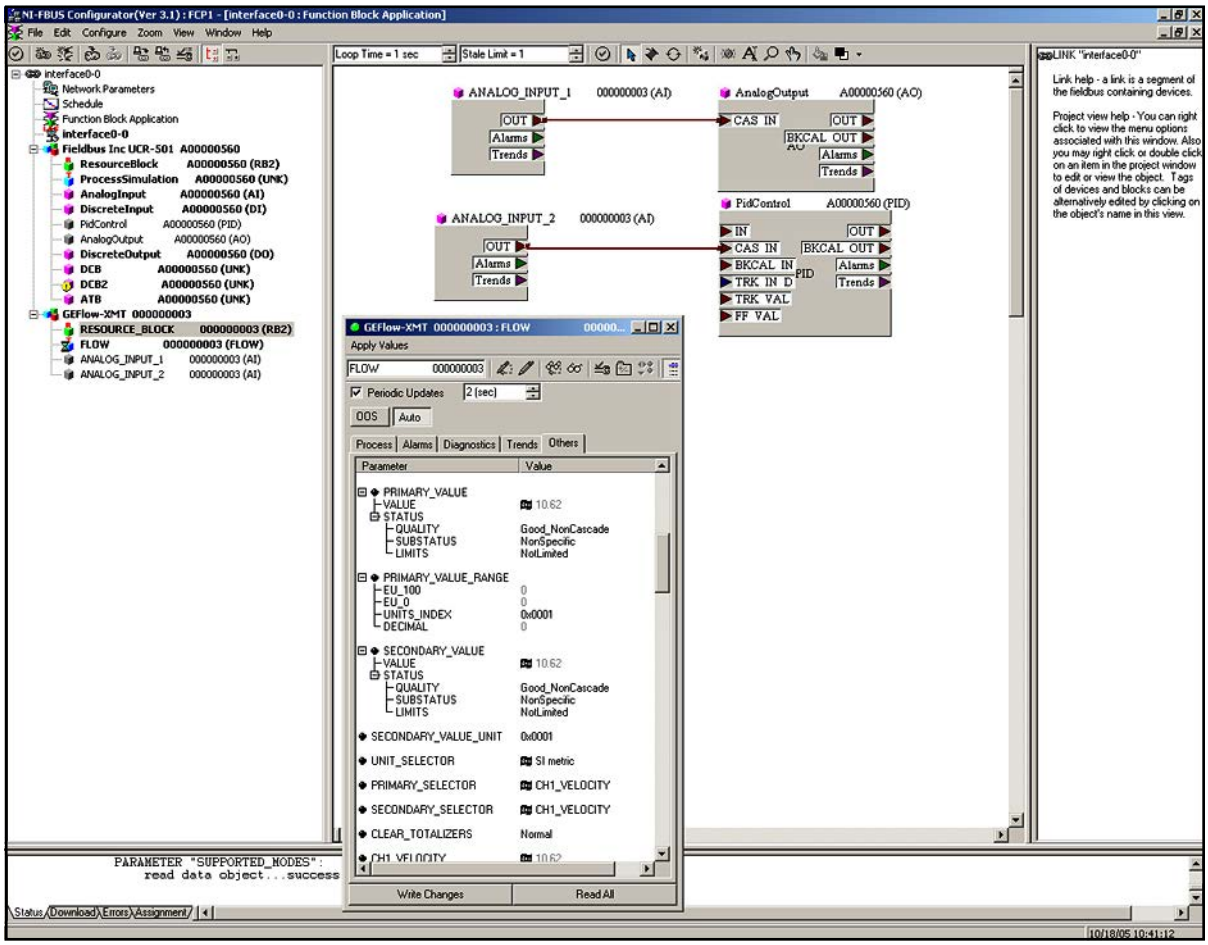


Figure 52: Function Block Application

7.7 NAMUR NE107 Recommended Settings

NAMUR NE107 provides guidelines for instruments to publish diagnostic information to the Fieldbus Network. *Table 12* below shows the diagnostic information available for the ultrasonic flowmeter as well as the recommended settings.

Note: *A check mark means that masking is active and the error will not be reported. No check mark means that the error will be reported per the error mapping.*

Table 12: NAMUR NE107 Recommended Values and Error Mapping (for Channel 1, Channel 2 and Channel Average)

Status Icons:							
				FD_FAIL_MAP	FD_OFFSET_MAP	FD_MAIN_MAP	FD_CHECK_MAP
E1	Low Signal	-20 - 100	20			X	
E2	Sound Speed	1% to 50%	20%		X		
E3	Velocity Range	-500 - +500 ft/sec	+150/-150		X		
E4	Signal Quality	0 - 500	100			X	
E5	Amplitude Error	0 - 100	14/34			X	
E6	Cycle Skip/ Acceleration	0 - 250 ft/sec	15 ft/sec		X		
E7	Analog Output				X		
E8	Temp Input				X		
E9	Pressure Input				X		
E10	Special Input				X		
				FD_FAIL_MASK	FD_OFFSET_MASK	FD_MAIN_MASK	FD_CHECK_MASK
E1	Low Signal	-20 - 100	20				
E2	Sound Speed	1% to 50%	20%				
E3	Velocity Range	-500 - +500 ft/sec	+150/-150				
E4	Signal Quality	0 - 500	100				
E5	Amplitude Error	0 - 100	14/34				
E6	Cycle Skip/ Acceleration	0 - 250 ft/sec	15 ft/sec				
E7	Analog Output						
E8	Temp Input						
E9	Pressure Input						
E10	Special Input						

7.8 Panametrics Fieldbus Device Capability for Gx868 & XGx868 Meter Families

Table 13: Panametrics Fieldbus Device Capability for Gx868 & XGx868 Meter Families

Category	Feature Description	Models GF868, GS868, GM868, XGF868, XGM868, XGS868
1 - General		
1.1	Is the Device registered at the Fieldbus Foundation (Yes/No)	Yes
1.2	Is the Unit released to production and if not when?	Yes
1.3	Is there any special functionality that device supports (e.g., display blocks, diagnostic blocks)?	No
1.4	Manufacturer Name	Panametrics
1.5	Model	Panametrics Gas Flowmeter
1.6	Device Type	0002
1.7	FF Device Revision	02
1.8	Does the device require special programming software to configure a 'Good' status on the PV?	Yes
1.9	Does the Device feature a Non-Volatile Memory protection feature?	No
1.10	HOST System registered	Emerson, Honeywell, Invensys
1.11	Design Concept	Entity Concept
1.12	FISCO Compliant?	No
1.13	Namur 107 Compliant?	Yes
1.14	FNICO Compliant?	Yes: models XGM868i, XGS868i, XGF868i only
1.17	Meter Software version (minimum and higher)	GF868: GF3S; GM868:GM3Q; GS868: GS3N; GC868: GC4C; XGM868i: Y4DM; XGS868: Y4DS; XGF868i:Y4DF
1.18	Firmware on FF card version	868_GAS_FF_206
1.19	Interoperability Test Kit (ITK) revision	6.1.1
1.2	Protocol	H1
1.21	Protocol Baud (bps)	31.25k
2 - DD and CFF		
2.1	Device Description File Name (.ffo and .sym) and rev	See Foundation Fieldbus Site for latest Rev
2.2	Capabilities File Name and rev	See Foundation Fieldbus Site for latest Rev
2.3	Methods (list all methods available)	none
3- Physical		
3.1	Polarity Sensitive (Yes / No)	Yes (Protected from failure if installed incorrectly)
3.2	Quiescent Current Draw (mA)	10 mA idle/18 mA max
3.3	Startup Current Draw (mA)	18 mA
3.32	Working voltage	9-32 VDC
3.33	Device Minimum Voltage	9 VDC
3.41	Device Resistance (Ohms) fieldbus terminal (+) to (-)	30 Mega Ohms increasing
3.42	Device Resistance (Ohms) fieldbus terminal (+) to Ground	open circuit >20 MOhm
3.43	Device Resistance (Ohms) fieldbus terminal (-) to Ground	open circuit >20 MOhm

Table 13: Panametrics Fieldbus Device Capability for Gx868 & XGx868 Meter Families (Continued)

Category	Feature Description	Models GF868, GS868, GM868, XGF868, XGM868, XGS868
3.51	Capacitance (microF) (+) to (-)	1 pF
3.52	Capacitance (microF) (+) to Ground	634.7 pF
3.53	Capacitance (microF) (-) to Ground	635.7 pF
3.6	4-wire Device (if so, what AC/DC Voltage, Single or 3-phase	Yes, (85-250 VAC 50/60 Hz, single phase or 12-28 VDC)
3.7	Connection type	Terminal block, 2-wire twisted pair
4 - Comm		
4.1	Stack Manufacturer	National Instruments
4.2	Does the Device support Backup LAS functionality? (If it does, then the functionality will be tested.)	No
4.3	Total Number of VCRs	20
4.4	Number of Fixed VCRs for user configuration (Publisher, Subscriber, Alarming, and Trending)	1 fixed for System Management, 19 variable for user configuration
5 - User Layer General		
5.1	Function Block Application Manufacturer	Fieldbus Inc.
5.2	Registered Function Blocks	6 - AI(e), 1 - PID(e), 2 -TB(c), 1 - RB2(e)
5.3	Device support block instantiation (Yes/No)	No
5.4	Number of Link Objects	20
5.5	Device support firmware upgrade over fieldbus segment? (Yes/No)	No
5.6	Configuration write protect?	Hardware jumper only
5.7	Zero trim, sensor trim, factory recall/Upgrade device master reset	None
6 - Resource Block		
6.1	Block Class (Std, Enhanced, Custom)	Enhanced
6.2	Special Features	Detailed errors, supported modes, revision id and date
7 - Transducer Blocks		
7.1	Transducer Blocks based on which latest version of the FF spec	FF-902 FS 1.4
7.2	Block Type	Flow/Display
7.3	Block Class (Std, Enhanced, Custom)	Custom/Custom
	Does the Device support Methods in the Resource and Transducer Blocks?	No
7.4	Special Features besides Methods (multiple VIEWS, etc.)	Multiple View3s and View4s
	Device specific advanced diagnostics	Yes
8 - Function Blocks		
8.1	Does the Device support Custom Function Blocks?	No
8.2	Block Type	AI/PID
8.3	Number Available	6/1
8.4	Execution Time (ms)	50/100

Table 13: Panametrics Fieldbus Device Capability for Gx868 & XGx868 Meter Families (Continued)

Category	Feature Description	Models GF868, GS868, GM868, XGF868, XGM868, XGS868
8.5	Block Class (Std, Enhanced, Custom)	Enhanced
8.6	Function Block Special Features (e.g., Configuration required for non-standard parameters by host)	None

Chapter 8. HART 5 Communications

8.1 Introduction

The Panametrics GF868, XGM868, XGS868 and XMT868 ultrasonic flowmeters may be modified to permit two-way communication with a HART communication device. This requires the installation of a HART 5 option card in the flowmeter. The option card generates a 4-20 mA analog output signal that can be read by the HART device. Proceed to the appropriate section for detailed instructions on installing and using the HART option card.

8.2 Installing the HART 5 Option Card

To install a HART 5 option card in your flowmeter, complete the following steps:

WARNING! This procedure should be performed only by qualified service personnel.

1. Disconnect the main power from the flowmeter.

WARNING! Failure to disconnect the power before proceeding may result in serious injury.

2. Refer to your *User's Manual* for step-by-step instructions, and install the HART option card in **Slot 6** for a GF868 flowmeter or in **Slot 2** for an XGM868, XGS868 or XMT868 flowmeter.

IMPORTANT: If a **MODBUS** option card is installed in Slot 5 of a GF868 flowmeter, the **HART** option card in Slot 6 will be ignored.

3. Interconnect the HART option card and the HART device as shown in *Figure 53*.

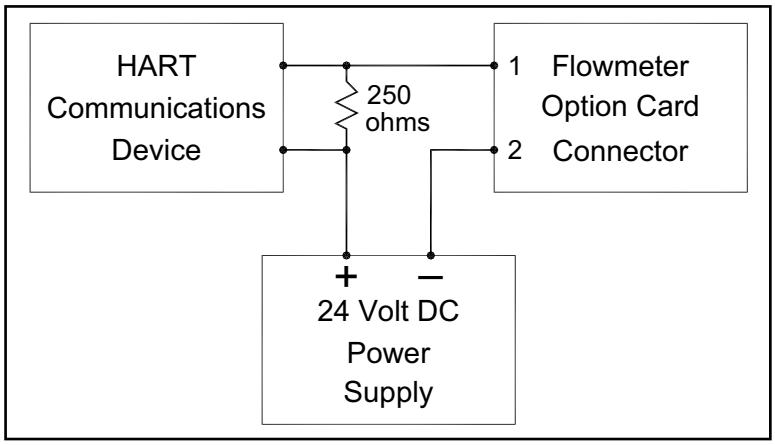


Figure 53: Option Card Wiring

8.2 Installing the HART Option Card (cont.)stalling the HART Option Card (cont.)

For a GF868 flowmeter, the option card connector is mounted on the card, and the HART device leads should go to pins 1 and 2 of this connector. As for other option cards installed in the same meter as the HART option card, the HART device will not recognize any option card installed in Slots 3-5 and it will only recognize option cards installed in Slots 1-2 if they are Analog Input, Analog Output, or RTD option cards.

Note: *For XGM868i, XGS868i and XMT868i flow meters the HART device connections are found on the PCB output for HART card installed in Slot 2. Note the polarity of signals (pin 1 HART+, pin2 HART- on Figure 54 below.*

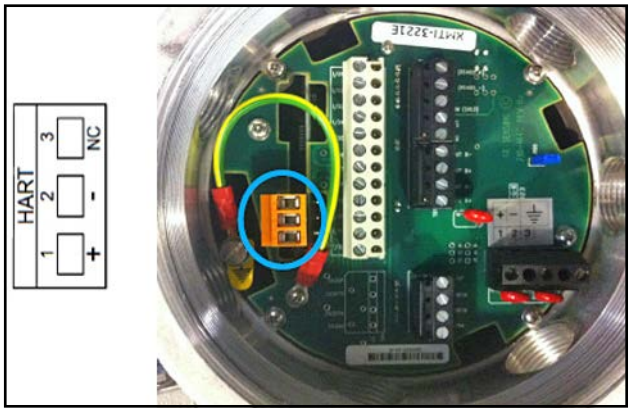


Figure 54: PCB Output for HART Card

8.3 Flowmeter Software Setup

Panametrics flowmeters that are shipped with a factory-installed HART option card require no special setup procedures by the user. The meter automatically configures itself for HART communication on startup. However, for field-installation of a HART option card, the card must be configured in the factory test menu before it will be recognized by the meter. Thereafter, the initialization will be automatic on startup. Contact the factory for specific instructions.

In addition to setting up the HART option card so that it is recognized by the meter, the analog output of the option card may be configured using any of the following methods (if available):

- The flowmeter keypad
- Instrument Data Manager (IDM™) software
- PanaView™ graphical user interface software
- The HART device

Note: *Because HART communication is unreliable at analog outputs below 4 mA, the flowmeter automatically changes a HART option card analog output configuration of* 0-20 mA *or* OFF *to a* 4-20 mA *configuration upon startup. Check to make sure that the analog output configuration is set to 4-20mA. If for some reason, it has not been automatically changed, set it to 4-20mA from the front panel.*

8.3 Flowmeter Software Setup (cont.)

To configure your HART option card analog output using any of the first three methods, follow the instructions in the appropriate *User's Manual*. During configuration, the choice of parameter must be limited to those listed in *Table 14*. To use the HART device for configuration of the analog output, refer to the instructions that came with that device.

Table 14: Valid HART Parameters and Units

Parameter	English Units	Metric Units
Velocity	ft/sec	m/s
Volumetric (liquid)	gal/s, gal/m, gal/h, mgal/day, cuf/s, cuf/m, cuf/h, mcf/day, bbls/s, bbl/m, bbl/h, mbl/d, acre-inch/day	l/s, l/m, l/h, ml/d, cum/s, cum/m, cum/h, mcm/d, bbl/s, bbl/m, bbl/h, mbl/d
Volumetric (gas)	acf/m, acf/h, scf/m, scf/h	acm/h, scm/h, scm/d
+Tot, -Tot (liquid)	gal, cuf,bbl, acre-in, acre-ft	liter, cum, bbl
+Tot, -Tot (gas)	acf, scf	acm, scm
Mass Flow	lb/s, lb/m, lb/h, mlb/d, ton/m, ton/h, mton/d	kg/s, kg/h, mkg/d, tne/m, tne/h, tne/d
+Mass, -Mass	lb, ton	kg, tne
Power	kbtu/h, kw	mcal/h, kw
+Energy, -Energy	btu, kw-hr	mcal, kw-hr
Temperature	°F	°C
Pressure	psia	bar, bara
Mol Weight	none	none
NOTE: "acf" is reported as "normal cubic feet" in HART. Also, "Mega" units (i.e. mgal/day, mcf/day, etc.) are reported as standard units x 10^6 in HART. For example, 1 mgal is 1x10^6 gal in HART.		

Some flowmeter parameters can only be read by the HART device during startup. Therefore, it is recommended that both the flowmeter and the HART device be rebooted after any reprogramming of the HART option card analog output. Failure to do so may result in erroneous information or a communication failure between the flowmeter and the HART device.

8.4 Using the HART Interface

The HART communications option card installed in Panametrics flowmeters has been successfully tested with the **Rosemount 275 Hand-Held Communicator** and the **Rosemount AMS Computer-Based Communications Software**. Although some flowmeter functions may be performed using the HART device, many other functions (i.e. data logging, site file uploading, site file downloading, printing, etc.) must still be programmed by the methods described in the flowmeter *User's Manual*. This is because the HART protocol was developed for use with simple transmitters and it cannot handle the multitude of sophisticated functions built into the Panametrics flowmeters.

8.4.1 Unit Types

Due to limitations of the HART protocol, only those unit types listed in *Table 14* are acceptable. If a meter parameter is set to any other measurement units, the HART device displays an "*Unknown Enumerator, Can not resolve*" error message and may terminate communications entirely. In some cases, both the Hart device and the flowmeter may have to be rebooted to clear the error. To address this potential problem, the flowmeter has been programmed to force all measurement units to HART compliant units if a HART option card is detected upon startup.

8.4.2 HART Functions

After HART communications has been properly set up, the following flowmeter functions may be accessed using the HART device:

- Static temperature and static pressure

Note: *To view the static temperature or pressure for a channel using the HART device, the fixed value for that parameter must be assigned to that channel at the flowmeter. See your* User's Manual *for instructions.*

- Tracking windows (XMT868 only)

- Minimum and maximum soundspeed (XMT868 only)
- 2-path error handling
- Velocity averaging response time
- Static density
- Error handling
- mA error level (if selected)
- Clear totals

Note: *Refer to your* User's Manual *for a complete description of each of the above functions.*

When information is viewed through the HART device, the input variable always appears as either *Channel 1 Temperature* or *Channel 1 Pressure*. Although these inputs are not necessarily assigned to Channel 1, the HART protocol labels all inputs as channel-specific. For example, a Slot 1 analog input that is programmed at the meter as a temperature input assigned to Channel 1, Channel 2, Both, or Neither is always reported by the HART device as a *Channel 1* Temperature input.

Note: *Inputs cannot be assigned using the HART device. Also, any input assigned as* "Special" *is always reported as a Channel 1 Temperature input by the HART device*

In addition to the functions listed on the previous page, the following procedures may be performed through the HART device:

- Calibration and setup of the HART option card analog output
- Calibration and some programming of analog inputs, analog outputs, and RTD inputs on option cards installed in Slots 0 (all), 1 (all), and 2 (GF868 only)
- Viewing some of the flowmeter's diagnostic parameters

8.5 List of Programmable Variables

For convenient reference, all of the programmable variables for the four flowmeter models are listed in *Table 15*.

Table 15: Programmable Variables

Description	Format*	R/W/B*	XMT868	XGS868	XGM868	GF868
Channel Process Variables						
Ch1, Ch2, or Ave vel	f.p.	R	Y	Y	Y	Y
Ch1, Ch2, or Ave vol	f.p.	R	Y	Y	Y	Y
Ch1, Ch2, or Ave mdot	f.p.	R	Y	Y	if mass	*Table 15*Y
Ch1, Ch2, or Ave power	f.p.	R	if energy	N	N	N
Ch1, Ch2, or Ave Temper	f.p.	R	N	Y	Y	Y
Ch1, Ch2, or Ave Pressure	f.p.	R	N	Y	Y	Y
Ch1, Ch2, or Ave Mw	f.p.	R	N	N	N	Y
Ch1, Ch2, or Ave +tot	f.p.	R	Y	Y	Y	Y
Ch1, Ch2, or Ave -tot	f.p.	R	Y	Y	Y	Y
Ch1, Ch2, or Ave +mass	f.p.	R	Y	Y	if mass	Y
Ch1, Ch2, or Ave -mass	f.p.	R	Y	Y	if mass	Y
Ch1, Ch2, or Ave +energy	f.p.	R	if energy	N	N	N
Ch1, Ch2, or Ave -energy	f.p.	R	if energy	N	N	N
Ch1 or Ch2 Ssup	f.p.	R	Y	Y	Y	Y
Ch1 or Ch2 ssDO	f.p.	R	Y	Y	Y	Y
Ch1, Ch2, or Ave tUP	f.p.	R	Y	Y	Y	Y
Ch1, Ch2, or Ave tDO	f.p.	R	Y	Y	Y	Y
Ch1, Ch2, or Ave deltaT	f.p.	R	Y	Y	Y	Y
Ch1 or Ch2 peak%	f.p.	R	Y	Y	Y	Y
Ch1, Ch2, or Ave DeltaT(s)	f.p.	R	N	if meas	if meas	if meas
Ch1, Ch2, or Ave DeltaT(M)	f.p.	R	N	if meas	if meas	if meas
Ch1 or Ch2 qUP	f.p.	R	Y	Y	Y	Y
Ch1 or Ch2 qDOWN	f.p.	R	Y	Y	Y	Y
Ch1 or Ch2 ampUP	f.p.	R	Y	Y	Y	Y
Ch1 or Ch2 ampDOWN	f.p.	R	Y	Y	Y	Y
Ch1 or Ch2 peak#UP	f.p.	R	Y	Y	Y	Y
Ch1 or Ch2 peak#DOWN	f.p.	R	Y	Y	Y	Y
Ch1, Ch2, or Ave t.S	f.p.	R	if energy	N	N	N
Ch1, Ch2, or Ave t.R	f.p.	R	if energy	N	N	N
Ch1, Ch2, or Ave t.S-t.R	f.p.	R	if energy	N	N	N
Ch1 or Ch2 inco1	f.p.	R	if transfl.	N	N	N
Ch1 or Ch2 onco2	f.p.	R	if transfl.	N	N	N
Ch1 or Ch2 Rpowr	f.p.	R	if transfl.	N	N	N
Ch1 or Ch2 Rqual	f.p.	R	if transfl.	N	N	N
Ch1 or Ch2 Repp	f.p.	R	if transfl.	N	N	N
Ch1, Ch2, or Ave c3	f.p.	R	Y	Y	Y	Y
Ch1, Ch2, or Ave Temp_super	f.p.	R	N	Y	N	N

Table 15: Programmable Variables (Continued)

Description	Format*	R/W/B*	XMT868	XGS868	XGM868	GF868
Ch1, Ch2, or Ave Rho	f.p.	R	N	Y	N	N
Ch1 or Ch2 Err code	int	R	Y	Y	Y	Y
Ch1 or Ch2 re#	f.p.	R	Y	N	N	N
Global Meter Information						
MeterType (Model)	int	R	Y	Y	Y	Y
#Channels	int	R	Y	N	N	N
2-Path?	int	B	Y	N	N	N
Resp_time	int	B	Y	Y	Y	Y
Static Density?	int	B	Y	Y	Y	Y
Static Density Value	f.p.	B	Y	Y	Y	Y
Error Mode	int	B	Y	Y	Y	Y
Aout Error Level	f.p.	B	Y	Y	Y	Y
Meter Units (Eng. or Metric)	uchar	B	Y	Y	Y	Y
EnergyMeter?	uchar	R	Y	N	N	N
Clear-totals?	int	W	Y	Y	Y	Y
CH1 Information						
Ch1 Fixed Temp	f.p.	B	N	Y	Y	Y
Ch1 Fixed Press	f.p.	B	N	Y	Y	Y
Ch1 Tracking?	int	B	Y	N	N	
Ch1 Min Sound Spd	f.p.	B	Y	N	N	N
Ch1 Max Sound Spd	f.p.	B	Y	N	N	N
CH2 Information (if applicable)						
Ch2 Fixed Temp	f.p.	B	N	Y	Y	Y
Ch2 Fixed Press	f.p.	B	N	Y	Y	Y
Ch2 Tracking?	int	B	Y	N	N	
Ch2 Min Sound Spd	f.p.	B	Y	N	N	N
Ch2 Max Sound Spd	f.p.	B	Y	N	N	N
Slot Information						
Slot 0 A or B Device	uchar	R	Y	Y	Y	Y
Slot 0 A or B Type	uchar	B	Y	Y	Y	Y
Slot 0 A or B Chan	uchar	B	if 2-Ch	if 2-Ch	if 2-Ch	if 2-Ch
Slot 0 A or B Variable	uchar	B	Y	Y	Y	Y
Slot 0 A or B Units	uchar	R	Y	Y	Y	Y
Slot 0 A or B Zero	f.p.	B	Y	Y	Y	Y
Slot 0 A or B Span	f.p.	B	Y	Y	Y	Y
Slot 1 or 2 Active	int	R	Y	Y	Y	Y
Slot 1 or 2 A, B, C, or D Device	uchar	R	if active	if active	if active	if active
Slot 1 or 2 A, B, C, or D Type	uchar	B	if active	if active	if active	if active
Slot 1 or 2 A, B, C, or D Chan	uchar	B	if active	if active	if active	if active
Slot 1 or 2 A, B, C, or D Variable	uchar	B	if active	if active	if active	if active
Slot 1 or 2 A, B, C, or D Units	uchar	R	if active	if active	if active	if active

Table 15: Programmable Variables (Continued)

Description	Format*	R/W/B*	XMT868	XGS868	XGM868	GF868
Slot 1 or 2 A, B, C, or D Zero	f.p.	B	if active	if active	if active	if active
Slot 1 or 2 A, B, C, or D Span	f.p.	B	if active	if active	if active	if active
HART Variables						
Universal Rev	uchar	R	Y	Y	Y	Y
Software Rev	uchar	R	Y	Y	Y	Y
Transmitter Rev	uchar	R	Y	Y	Y	Y
Hardware Rev	uchar	R	Y	Y	Y	Y
Device ID	uchar	R	Y	Y	Y	Y
PollAddress	uchar	B	Y	Y	Y	Y
Message	uchar24	B	Y	Y	Y	Y
Tag	uchar6	B	Y	Y	Y	Y
Descriptor	uchar12	B	Y	Y	Y	Y
Date	uchar3	B	Y	Y	Y	Y
Final Assy No	uchar3	B	Y	Y	Y	Y
Derial No.	uchar3	R	Y	Y	Y	Y
Pvt. Label Dist	uchar	R	Y	Y	Y	Y
Pri Var Code	uchar	R	Y	Y	Y	Y
Alarm Select	f.p.	B	Y	Y	Y	Y
Write Protect Code	uchar	B	Y	Y	Y	Y
Config Chgd Flag	uchar	B	Y	Y	Y	Y
Response Preambles	uchar	B	Y	Y	Y	Y
HART Device	uchar	R	Y	Y	Y	Y
HART Type	uchar	B	Y	Y	Y	Y
HART Channel	uchar	B	Y	Y	Y	Y
HART Variable	uchar	B	Y	Y	Y	Y
HART Units	uchar	R	Y	Y	Y	Y
HART Zero	f.p.	B	Y	Y	Y	Y
HART Span	f.p.	B	Y	Y	Y	Y

Format:f.p. = IEEE floating point, int = integer, uchar = unsigned character, ucharX = X bytes of unsigned characters.

R/W/B:R = read only, W = write only, B = read or write using HART

[no content intended for this page]

Chapter 9. HART 7 Communications

9.1 HART 7 FOR X868I AND GF868 FLOWMETERS

The Panametrics XGM868i, XGS868i, XGF868i and GF868 ultrasonic flowmeters may be equipped for two-way communication with a HART master. This requires installation of a HART 7 option card into the flowmeter. The option card is passive, meaning it requires an external power supply and sinks 4-20mA proportional to the programmed parameter.

9.2 Hardware Setup

9.2.1 Installing the HART Option Card

To install a HART 7 option card in your flowmeter, complete the following steps:

WARNING! **This procedure should be performed only by qualified service personnel.**

1. Disconnect the main power from the flowmeter.

WARNING! **Failure to disconnect the power before proceeding may result in serious injury.**

2. Refer to the Meter user's manual for step by step instructions. Install the 703-2001 HART option card into slot 2 of the XGM868i, XGS868i or XGF868i flowmeter. Install the 703-2003 HART option card into slot 6 of the GF868 equipped with HART main code.

IMPORTANT: If a **MODBUS** option card is installed in Slot 5 of a GF868 flowmeter, the **HART** option card in Slot 6 will be ignored.

9.2.2 Hart Connection Point to Point

Note that the 4-20mA output on the HART option card for the GF868 and XGX868i flowmeters is passive, meaning an external power supply is required. Connect to the HART communications device as shown below:

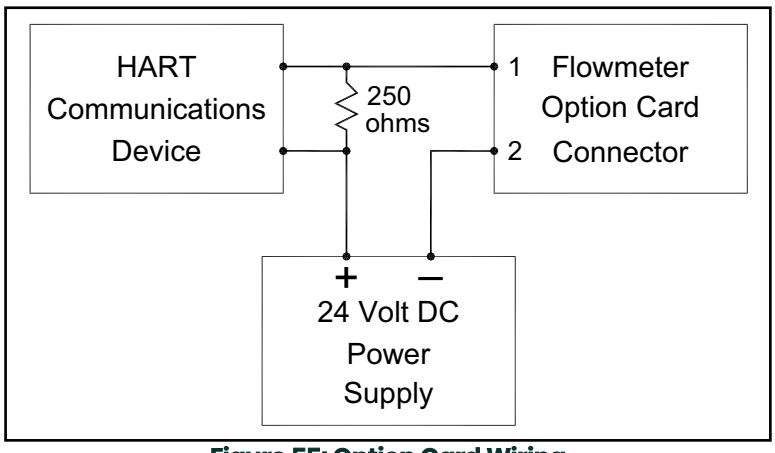


Figure 55: Option Card Wiring

For the GF868 HART flowmeter the connector for wiring is mounted on the card, and the HART device leads should be connected to pins 1 and 2. Please note that for the GF868 HART model only a limited number of slots and cards are available. The GF868 HART meter will not recognize any option cards installed in slots 3-5 and only in slots 1-2 if the option cards are Analog Input, Analog Output or RTD option.

For the XGF868i, XGM868i and XGS868i flowmeters the HART device connections are found on the HART card external connector that protrudes from the terminal board. The HART card must be installed in slot 2. See below picture for connection to HART terminal.

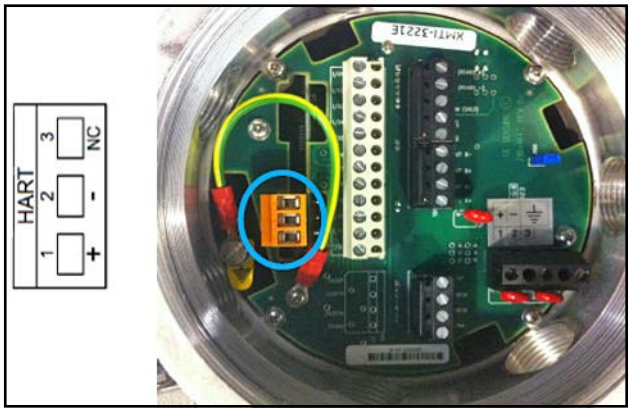


Figure 56: PCB Output for HART Card

9.2.3 Hart Connection Multidrop

Multidrop mode allows for several devices to be connected to the same 2 wires and communicate with the HART master. The meters are typically set to addresses other than 0 and the lop current mode is set to disabled.

In Multidrop mode the devices will communicate with digital HART communications only. The 4-20mA control signal for the PV is set to a constant 4mA. Note that for each device connected in multidrop mode the current drawn is 4mA, so for two devices the total current draw from the external supply is 8mA.

After setting each device to a unique address and disabling the loop current mode in the Detailed Setup/HART Setup menu connected the devices together as shown below.

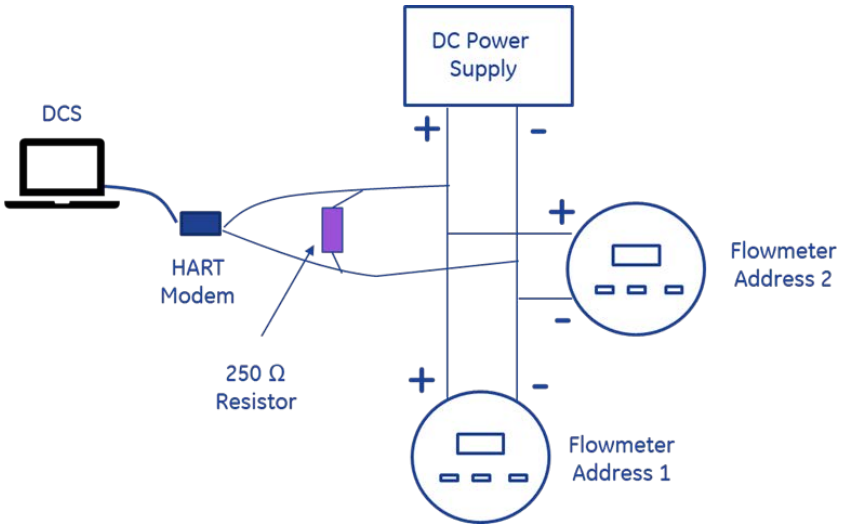


Figure 57: HART Connection

Depending on the HART master software each device should be recognized with scan set to include the range of each address.

9.3 Software Setup

Panametrics flowmeters that are shipped with a factory-installed HART option card require no special setup procedures by the user. The meter automatically configures itself for HART communication on startup. However, for field-installation of a HART option card, the card must be configured in the factory test menu before it will be recognized by the meter. Thereafter, the initialization will be automatic on startup. Contact the factory for specific instructions.

In addition to setting up the HART option card so that it is recognized by the meter, the analog output of the option card may be configured using any of the following methods (if available):

- The flowmeter keypad
- Instrument Data Manager (IDM™) software
- PanaView™ graphical user interface software
- The HART device

Note: *Because HART communication is unreliable at analog outputs below 4 mA, the flowmeter automatically changes a HART option card analog output configuration of* 0-20 mA *or* OFF *to a* 4-20 mA *configuration upon startup. Check to make sure that the analog output configuration is set to 4-20mA. If for some reason, it has not been automatically changed, set it to 4-20mA from the front panel.*

To configure your HART option card analog output using any of the first three methods, follow the instructions in the appropriate *User's Manual*. During configuration, the choice of parameter must be limited to those listed in *Table 16*. To use the HART device for configuration of the analog output, refer to the instructions that came with that device.

Table 16: Valid HART Parameters and Units

Parameter	English Units	Metric Units
Velocity	ft/sec	m/s
Volumetric (liquid)	gal/s, gal/m, gal/h, mgal/day, cuf/s, cuf/m, cuf/h, mcf/day, bbls/s, bbl/m, bbl/h, mbl/d, acre-inch/day	l/s, l/m, l/h, ml/d, cum/s, cum/m, cum/h, mcm/d, bbl/s, bbl/m, bbl/h, mbl/d
Volumetric (gas)	acf/m, acf/h, scf/m, scf/h	acm/h, scm/h, scm/d
+Tot, -Tot (liquid)	gal, cuf,bbl, acre-in, acre-ft	liter, cum, bbl
+Tot, -Tot (gas)	acf, scf	acm, scm
Mass Flow	lb/s, lb/m, lb/h, mlb/d, ton/m, ton/h, mton/d	kg/s, kg/h, mkg/d, tne/m, tne/h, tne/d
+Mass, -Mass	lb, ton	kg, tne
Power	kbtu/h, kw	mcal/h, kw
+Energy, -Energy	btu, kw-hr	mcal, kw-hr
Temperature	°F	°C
Pressure	psia	bar, bara
Mol Weight	none	none
NOTE: "acf" is reported as "normal cubic feet" in HART. Also, "Mega" units (i.e. mgal/day, mcf/day, etc.) are reported as standard units x 10^6 in HART. For example, 1 mgal is 1x10^6 gal in HART.		

Some flowmeter parameters can only be read by the HART device during startup. Therefore, it is recommended that both the flowmeter and the HART device be rebooted after any reprogramming of the HART option card analog output. Failure to do so may result in erroneous information or a communication failure between the flowmeter and the HART device.

9.3.1 Unit Types

Due to the limitations of the HART protocol specification, only the units listed above are acceptable. If the meter parameter is set to any other unit the HART device will display "Unknown Enumerator: and may terminate entirely. In some cases, the meter may have to be rebooted to resolve the issue. The 868 flowmeter is designed to limit the units available if it recognizes a HART card during power on to minimize this issue.

Note: *Note that units must be programmed from the meter side.*

9.3.2 HART Functions

The HART 7 interface for the 868 series flowmeters allows for setup of 4 dynamic variables, calibration of the HART DAC and limited programming of the meter configuration parameters. Note that many of the functions normally associated with setting up the 868 series meters will still require programming by methods described in the flowmeters user's manual.

After HART communications has been properly set up, the following flowmeter functions may be accessed using the HART device:

- Static temperature and static pressure

Note: *To view the static temperature or pressure for a channel using the HART device, the fixed value for that parameter must be assigned to that channel at the flowmeter. See your* User's Manual *for instructions.*

- Tracking windows (XMT868 only)
- Minimum and maximum soundspeed (XMT868 only)
- 2-path error handling
- Velocity averaging response time
- Static density
- Error handling
- mA error level (if selected)
- Clear totals

Note: *Refer to your* User's Manual *for a complete description of each of the above functions.*

When information is viewed through the HART device, the input variable always appears as either *Channel 1 Temperature* or *Channel 1 Pressure*. Although these inputs are not necessarily assigned to Channel 1, the HART protocol labels all inputs as channel-specific. For example, a Slot 1 analog input that is programmed at the meter as a temperature input assigned to Channel 1, Channel 2, Both, or Neither is always reported by the HART device as a *Channel 1* Temperature input.

Note: *Inputs cannot be assigned using the HART device. Also, any input assigned as* "Special" *is always reported as a Channel 1 Temperature input by the HART device*

In addition to the functions listed on the previous page, the following procedures may be performed through the HART device:

- Calibration and setup of the HART option card analog output
- Calibration and some programming of analog inputs, analog outputs, and RTD inputs on option cards installed in Slots 0 (all), 1 (all), and 2 (GF868 only)
- Viewing some of the flowmeter's diagnostic parameters

9.3.3 List of Programmable Variables

For convenient reference, all of the programmable variables for the four flowmeter models are listed in *Table 17*.

Table 17: Programmable Variables

Description	Format*	R/W/B*	XMT868	XGS868	XGM868	GF868
Channel Process Variables						
Ch1, Ch2, or Ave vel	f.p.	R	Y	Y	Y	Y
Ch1, Ch2, or Ave vol	f.p.	R	Y	Y	Y	Y
Ch1, Ch2, or Ave mdot	f.p.	R	Y	Y	if mass	*Table 17*Y
Ch1, Ch2, or Ave power	f.p.	R	if energy	N	N	N
Ch1, Ch2, or Ave Temper	f.p.	R	N	Y	Y	Y
Ch1, Ch2, or Ave Pressure	f.p.	R	N	Y	Y	Y
Ch1, Ch2, or Ave Mw	f.p.	R	N	N	N	Y
Ch1, Ch2, or Ave +tot	f.p.	R	Y	Y	Y	Y
Ch1, Ch2, or Ave -tot	f.p.	R	Y	Y	Y	Y
Ch1, Ch2, or Ave +mass	f.p.	R	Y	Y	if mass	Y
Ch1, Ch2, or Ave -mass	f.p.	R	Y	Y	if mass	Y
Ch1, Ch2, or Ave +energy	f.p.	R	if energy	N	N	N
Ch1, Ch2, or Ave -energy	f.p.	R	if energy	N	N	N
Ch1 or Ch2 Ssup	f.p.	R	Y	Y	Y	Y
Ch1 or Ch2 ssDO	f.p.	R	Y	Y	Y	Y
Ch1, Ch2, or Ave tUP	f.p.	R	Y	Y	Y	Y
Ch1, Ch2, or Ave tDO	f.p.	R	Y	Y	Y	Y
Ch1, Ch2, or Ave deltaT	f.p.	R	Y	Y	Y	Y
Ch1 or Ch2 peak%	f.p.	R	Y	Y	Y	Y
Ch1, Ch2, or Ave DeltaT(s)	f.p.	R	N	if meas	if meas	if meas
Ch1, Ch2, or Ave DeltaT(M)	f.p.	R	N	if meas	if meas	if meas
Ch1 or Ch2 qUP	f.p.	R	Y	Y	Y	Y
Ch1 or Ch2 qDOWN	f.p.	R	Y	Y	Y	Y
Ch1 or Ch2 ampUP	f.p.	R	Y	Y	Y	Y
Ch1 or Ch2 ampDOWN	f.p.	R	Y	Y	Y	Y
Ch1 or Ch2 peak#UP	f.p.	R	Y	Y	Y	Y
Ch1 or Ch2 peak#DOWN	f.p.	R	Y	Y	Y	Y
Ch1, Ch2, or Ave t.S	f.p.	R	if energy	N	N	N
Ch1, Ch2, or Ave t.R	f.p.	R	if energy	N	N	N
Ch1, Ch2, or Ave t.S-t.R	f.p.	R	if energy	N	N	N
Ch1 or Ch2 inco1	f.p.	R	if transfl.	N	N	N
Ch1 or Ch2 onco2	f.p.	R	if transfl.	N	N	N
Ch1 or Ch2 Rpowr	f.p.	R	if transfl.	N	N	N
Ch1 or Ch2 Rqual	f.p.	R	if transfl.	N	N	N
Ch1 or Ch2 Repp	f.p.	R	if transfl.	N	N	N
Ch1, Ch2, or Ave c3	f.p.	R	Y	Y	Y	Y
Ch1, Ch2, or Ave Temp_super	f.p.	R	N	Y	N	N

Table 17: Programmable Variables (Continued)

Description	Format*	R/W/B*	XMT868	XGS868	XGM868	GF868
Ch1, Ch2, or Ave Rho	f.p.	R	N	Y	N	N
Ch1 or Ch2 Err code	int	R	Y	Y	Y	Y
Ch1 or Ch2 re#	f.p.	R	Y	N	N	N
Global Meter Information						
MeterType (Model)	int	R	Y	Y	Y	Y
#Channels	int	R	Y	N	N	N
2-Path?	int	B	Y	N	N	N
Resp_time	int	B	Y	Y	Y	Y
Static Density?	int	B	Y	Y	Y	Y
Static Density Value	f.p.	B	Y	Y	Y	Y
Error Mode	int	B	Y	Y	Y	Y
Aout Error Level	f.p.	B	Y	Y	Y	Y
Meter Units (Eng. or Metric)	uchar	B	Y	Y	Y	Y
EnergyMeter?	uchar	R	Y	N	N	N
Clear-totals?	int	W	Y	Y	Y	Y
CH1 Information						
Ch1 Fixed Temp	f.p.	B	N	Y	Y	Y
Ch1 Fixed Press	f.p.	B	N	Y	Y	Y
Ch1 Tracking?	int	B	Y	N	N	
Ch1 Min Sound Spd	f.p.	B	Y	N	N	N
Ch1 Max Sound Spd	f.p.	B	Y	N	N	N
CH2 Information (if applicable)						
Ch2 Fixed Temp	f.p.	B	N	Y	Y	Y
Ch2 Fixed Press	f.p.	B	N	Y	Y	Y
Ch2 Tracking?	int	B	Y	N	N	
Ch2 Min Sound Spd	f.p.	B	Y	N	N	N
Ch2 Max Sound Spd	f.p.	B	Y	N	N	N
Slot Information						
Slot 0 A or B Device	uchar	R	Y	Y	Y	Y
Slot 0 A or B Type	uchar	B	Y	Y	Y	Y
Slot 0 A or B Chan	uchar	B	if 2-Ch	if 2-Ch	if 2-Ch	if 2-Ch
Slot 0 A or B Variable	uchar	B	Y	Y	Y	Y
Slot 0 A or B Units	uchar	R	Y	Y	Y	Y
Slot 0 A or B Zero	f.p.	B	Y	Y	Y	Y
Slot 0 A or B Span	f.p.	B	Y	Y	Y	Y
Slot 1 or 2 Active	int	R	Y	Y	Y	Y
Slot 1 or 2 A, B, C, or D Device	uchar	R	if active	if active	if active	if active
Slot 1 or 2 A, B, C, or D Type	uchar	B	if active	if active	if active	if active
Slot 1 or 2 A, B, C, or D Chan	uchar	B	if active	if active	if active	if active
Slot 1 or 2 A, B, C, or D Variable	uchar	B	if active	if active	if active	if active
Slot 1 or 2 A, B, C, or D Units	uchar	R	if active	if active	if active	if active

Table 17: Programmable Variables (Continued)

Description	Format*	R/W/B*	XMT868	XGS868	XGM868	GF868
Slot 1 or 2 A, B, C, or D Zero	f.p.	B	if active	if active	if active	if active
Slot 1 or 2 A, B, C, or D Span	f.p.	B	if active	if active	if active	if active
HART Variables						
Universal Rev	uchar	R	Y	Y	Y	Y
Software Rev	uchar	R	Y	Y	Y	Y
Transmitter Rev	uchar	R	Y	Y	Y	Y
Hardware Rev	uchar	R	Y	Y	Y	Y
Device ID	uchar	R	Y	Y	Y	Y
PollAddress	uchar	B	Y	Y	Y	Y
Message	uchar24	B	Y	Y	Y	Y
Tag	uchar6	B	Y	Y	Y	Y
Descriptor	uchar12	B	Y	Y	Y	Y
Date	uchar3	B	Y	Y	Y	Y
Final Assy No	uchar3	B	Y	Y	Y	Y
Derial No.	uchar3	R	Y	Y	Y	Y
Pvt. Label Dist	uchar	R	Y	Y	Y	Y
Pri Var Code	uchar	R	Y	Y	Y	Y
Alarm Select	f.p.	B	Y	Y	Y	Y
Write Protect Code	uchar	B	Y	Y	Y	Y
Config Chgd Flag	uchar	B	Y	Y	Y	Y
Response Preambles	uchar	B	Y	Y	Y	Y
HART Device	uchar	R	Y	Y	Y	Y
HART Type	uchar	B	Y	Y	Y	Y
HART Channel	uchar	B	Y	Y	Y	Y
HART Variable	uchar	B	Y	Y	Y	Y
HART Units	uchar	R	Y	Y	Y	Y
HART Zero	f.p.	B	Y	Y	Y	Y
HART Span	f.p.	B	Y	Y	Y	Y
Format:f.p. = IEEE floating point, int = integer, uchar = unsigned character, ucharX = X bytes of unsigned characters. **R/W/B:**R = read only, W = write only, B = read or write using HART						

9.3.4 Field Device Specification

The field device specification provides the user with the device specification, product overview, dynamic and device variables and all supported commands. The FDS also details the device specific commands required to view some data from the flowmeter. Please consult the factory for a copy of the Field Device Specification.

9.4 Standard DD File

The Device Driver file for field device rev 2 for HART 7 is available from the Fieldcomm group web site www.fieldcommgroup.org .The DD file contains the standard table view and enhanced view.

The standard DD has three top level menus, Process Variables, Diag/Service and Detailed Setup. Each of these menus have several submenus providing the user with access to the meter variables, diagnostics, and some programming capability.

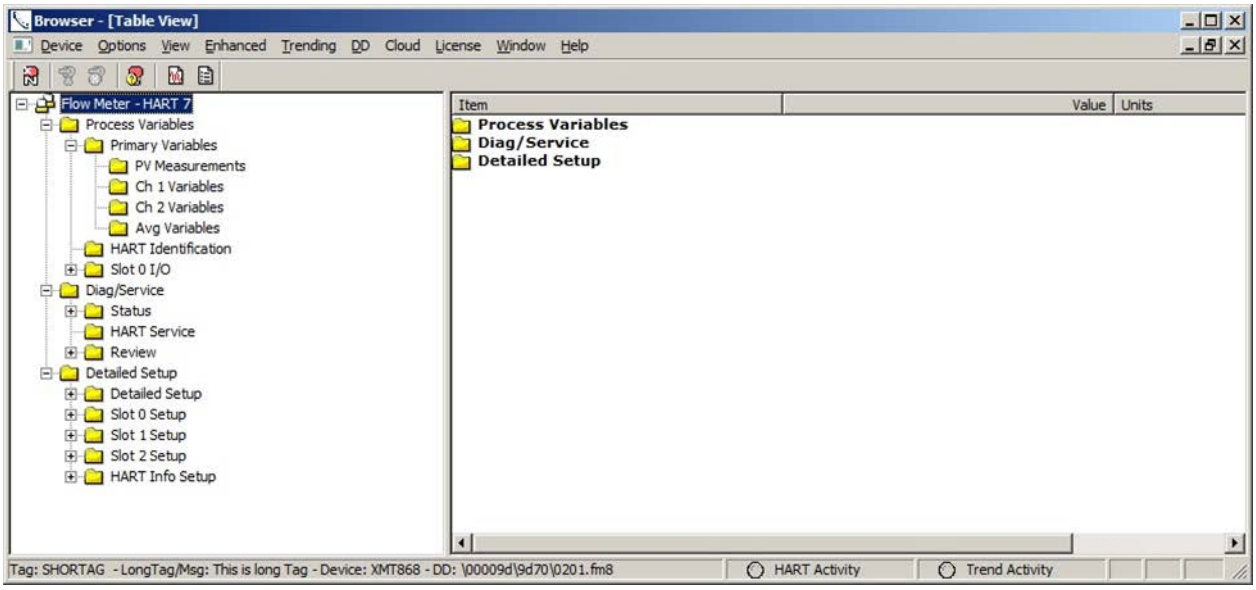


Figure 58: Standard DD File

9.4.1 Process Variables Menu

The process variables menu provides real time data for measurement variables available from the meter. You can view measurement PV, CH1, CH2 or average values (if 2 channel meter).

**Note that CH2 and average value screens will not show valid data if the meter is a 1 channel meter or CH2 is not turned on.

9.4.1.1 PV Measurements

The PV measurements screen shows the primary variable along with the loop current, % of range, Upper and Lower Range values. The screen also shows the digital values for the secondary value (SV), tertiary value (TV) and quaternary value (4V).

**Note the SV, TV and 4V values are programmed in the Detailed Setup/Detailed Setup menu. They must be programmed from the HART DD and are not available from the meter side.

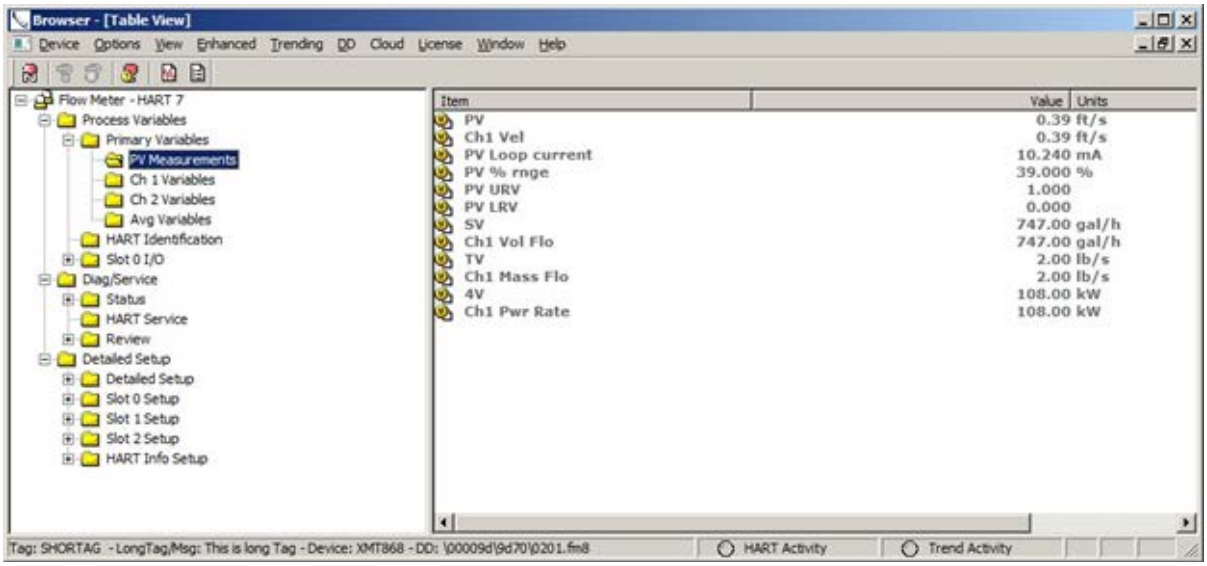


Figure 59: PV Measurements

9.4.1.2 Channel Variables

The channel variables screen shows the measurement values for each individual channel or the average of the two channels.

** Note that the values shown may be different depending on meter model and setup. Review the list of programmable variables for more detail.

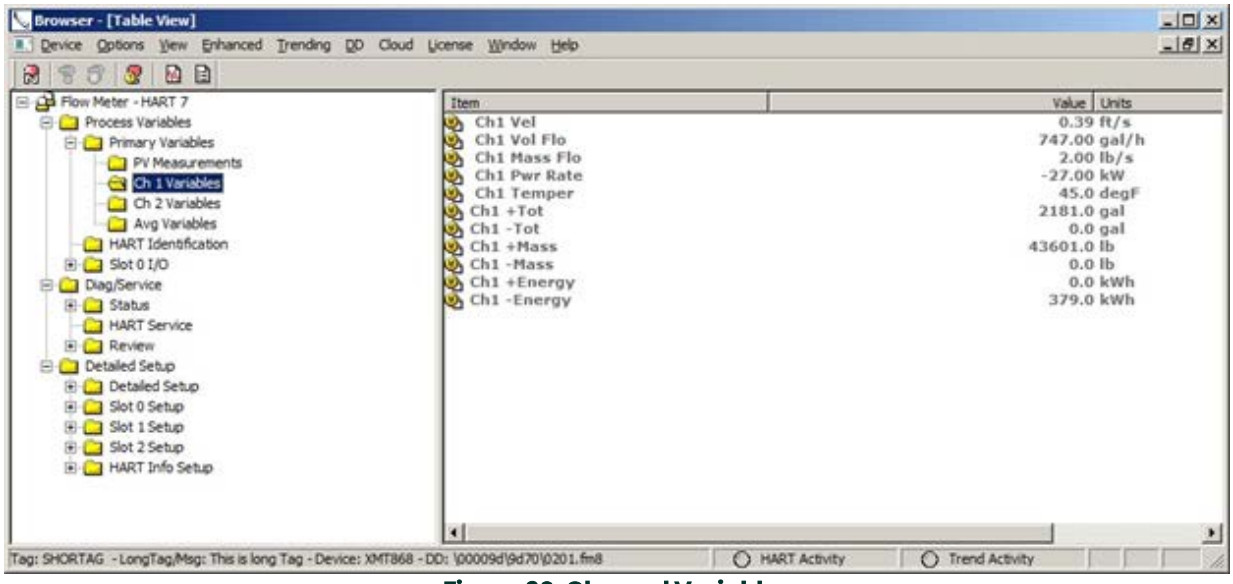


Figure 60: Channel Variables

9.4.1.3 HART Identification

The HART identification screen shows HART parameters that are useful to identify the device and its revision information.

** Note the Tag and Long Tag are the only writable parameters here and can only be written in the Detailed Setup\HART Info Setup\User Info screen.

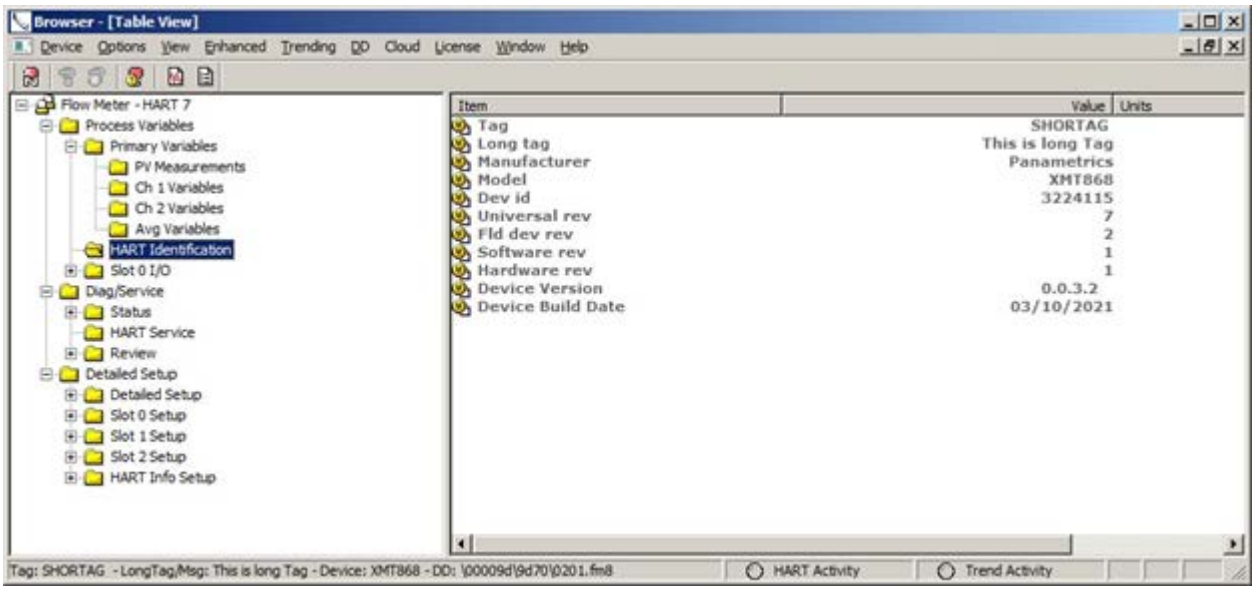


Figure 61: HART Identification

9.4.1.4 Slot IO

The slot 0 IO screen shows the selected parameter and value for analog out A and Analog output B on the main board.

The slot 1 IO screen shows the selected parameter and value for analog outputs or inputs for each of the 4 channels of the Slot 1 option card.

**Note only programmed IO will show on Slot 1 IO screen.

9.4.2 Diagnostics / Service Menu

The diagnostics and service menu will allow the user to perform standard HART functions and view the health of the meter through status bits. The device and measurement status bits will show “clear” for no error and “set” when the error is present.

9.4.2.1 Device Status

The device status bits are a set of general error conditions that map to the operation of the flowmeter. Note these error conditions are standard to HART but may not apply to every field device. They include:

- Field Device has malfunctioned due to a hardware error or failure
- A reset or self-test of the field device has occurred, or power has been removed or applied
- Field device has more status available
- PV Analog Channel Fixed
- PV Analog Channel Saturated
- Process applied to the non-primary variable is outside the operating limits of the device
- Process applied to the primary variable is outside the operating limits of the device

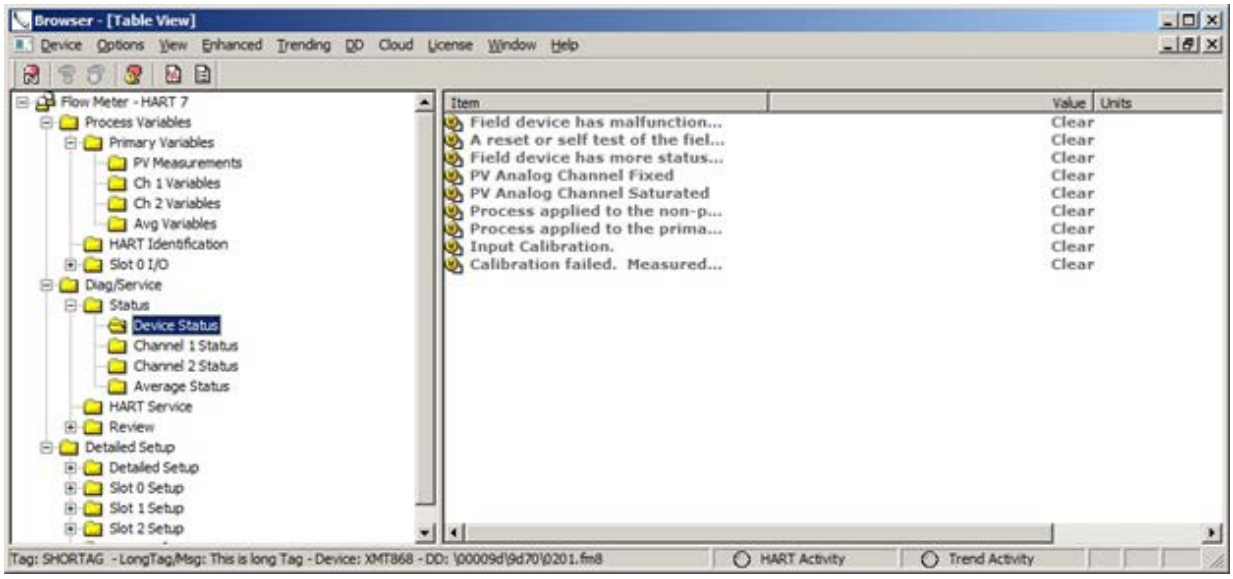


Figure 62: Device Status

9.4.2.2 Channel Status

The channel status bits are a set of error conditions relating to the flowmeter measurement process. Refer to the meter Users Guide for a detailed explanation of the measurement error codes along with possible causes and actions. The error codes may include:

- Input Calibration
- Calibration Failed. Measured input is out of range.
- E0: No Errors

  Problem: No error condition currently exists

  Cause: Message appears briefly to confirm that the response to another error condition has resolved the issue.

  Action: No action required

- E1: Low signal

  Problem: Poor ultrasonic signal strength or the signal exceeds the limits

Cause: Poor signal strength may be caused by a defective cable, a flowcell problem, a defective transducer or a problem in the electronics console. A signal that exceeds the programmed limits is probably caused by the entry of an improper value in the Channelx-Set up-Signal submenu of the Keypad Program

Action: Check the components listed above and check the limit values entered in the Channelx-Set up-Signal submenu.

- E2: Soundspeed is out of range

  Problem: The sound speed exceeds the limits programmed in the Channelx-Set up-Signal submenu of the Keypad Program.

  Cause: The error may be caused by incorrect programming, poor flow conditions or poor transducer orientation.

  Action: Compare the measured sound speed to tabulated nominal values for the gas being used and correct any programming errors.

- E3: Velocity Range exceeded

  Problem: The velocity exceeds the limits programmed in the Channelx-Set up-Signal submenu of the Keypad Program.

  Cause: This error may be caused by the entry of improper programming data or by poor flow conditions and/or excessive turbulence.

  Action: Make sure the actual flow rate is within ±75 ft/sec (±23 m/sec). Correct any flowcell and/or transducer problems.

- E4: Signal Quality is poor

  Problem: The signal quality is outside the limits programmed in the Channelx-Set up-Signal submenu of the Keypad Program.

  Cause: The peak of the upstream or downstream correlation signals has fallen below the correlation peak limit, as set in the Channelx-Set up-Signal submenu. This may be caused by a flowcell or electrical problem.

  Action: Check for sources of electrical interference and verify the integrity of the electronics console by temporarily substituting a test flowcell that is known to be good. Check the transducers and relocate them, if necessary.

- E5: Amplitude is poor

  Problem: The signal amplitude exceeds the limits programmed in the Channelx-Set up-Signal submenu of the Keypad Program.

  Cause: Excessive levels of an attenuating gas, such as CO2, may be present in the flowcell. Solid or liquid particulates may be present in the flowcell.

  Action: Correct any process, transducer or flowcell problems

- E6: Cycle Skip/Acceleration error

  Problem: The acceleration exceeds the limits programmed in the Channelx-Set up-Signal submenu of the Keypad Program.

  Cause: This condition is usually caused by poor flow conditions or improper transducer alignment.

  Action: Correct any flowcell and/or transducer problems.

- E7: Analog output out of range

  Problem: The current in the analog output circuit exceeds the limits for the analog output port.

  Cause: The output load exceeds the specified limits for the analog output port.

  Action: Make sure the output load is <600 ohms for the Slot 0 analog outputs or is <1,000 ohms for an analog outputs option card in Slot 1.

- E8: Temperature input out of range

  Problem: This message indicates a temperature input error.

  Cause: The temperature exceeds the specified limits for the analog/RTD inputs option card, or no input device is connected.

  Action: Check the temperature transmitter and the connecting cable. Refer to Chapter 1, Calibration, and recalibrate the analog/RTD inputs option card.

- E9: Pressure input out of range

  Problem: This message indicates a pressure input error.

  Cause: The pressure exceeds the specified limits for the analog inputs option card, or no input device is connected.

  Action: Check the pressure transmitter and the connecting cable. Refer to Chapter 1, Calibration, and recalibrate the analog inputs option card.

- E10: Special Input out of range

  Problem: This message indicates a special input error.

  Cause: The special input exceeds the specified limits for the analog inputs option card.

  Action: Check the special input device and the connecting cable. Refer to Chapter 1, Calibration, and recalibrate the analog inputs option card.

- E11: Super Saturated Steam

  Used in XGS868i only.

- E12: Low Pressure Limit

  Problem: This error code is triggered when the pressure measurement is below the low-pressure switch setting.

  Cause: The pressure measurement exceeds the specified limits as set in the Channelx-Input/Output submenu.

  Cause: Check the limit value (0 to 5,000 psia) entered into the Channelx-Input/Output submenu, as described in meter the Programming Manual.

- E13: Over Range error. Calculation overflow

  Problem: This error code message indicates that the present measurement exceeds the range of the meter.

  Cause: A internal mathematical overflow has occurred in either the volumetric or mass flow calculations.

  Action: Select larger measurement units or a shorter time interval for the current measurement parameter. For example, choose KSCF/M instead of SCF/M in the Channelx-System menu. See Chapter 2, Initial Setup, of the Startup Guide for instructions.

- E14: Totals Overflow

  Problem: The totalizers are unable to keep up with the total accumulated flow signals.

  Cause: The programmed units/pulse value is too small.

  Action: Select a larger number of units/pulse value.

- E15: Equation limits exceeded

  Problem: The meter cannot resolve the molecular weight of the gas based on the measured sound speed, temperature, pressure and N2 concentration.

  Note: The mw reading will appear as 2.0e3 or 3.0e3 in order to “flag” this condition.

  Cause: One or more of the above measurements must be incorrect.

Action: Verify the pressure and temperature readings are correct. Verify the programmed (or input) nitrogen concentration is correct. Verify that the acoustic transit time measurements are operating properly, and that the programmed path and axial length dimensions are correct.

**Note that not all Channel status bits may not be applicable to all meter model numbers. For example, the E11 error code only applies to the XGS868i Steam Flowmeter.

9.4.2.3 HART Service

The HART service menu allows the user to perform standard HART functions like checking the HART status, testing the loop and calibrating the HART DAC. Double click on each item and the HART DD with invoke a method that will take you through each of the steps.

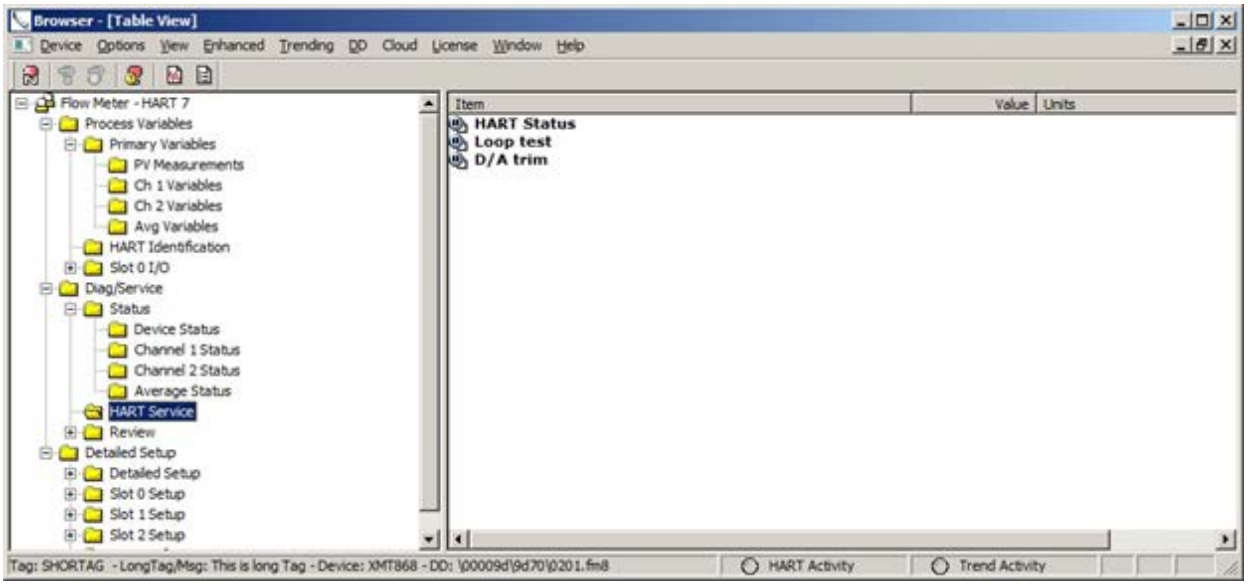


Figure 63: HART Service

HART Status: The HART status check will return the current error condition for the meter (See Device Status and Channel Status section). If the meter is not in error the HART status check will return OK.

Loop Test: The loop test method will allow the user to set loop current to different values as a verification of the instruments control. The loop test allows for setting the loop current to 4mA, 20mA or any value in between by selection of the "Other" entry. Double click the Loop Test icon and follow the wizard that will guide you through the process.

D/A Trim: The DA trim method calibrates the 4-20mA DAC associated with the instrument's HART output. Calibration points of 4mA and 20mA are checked and offsets entered and stored into the instrument. Double click the D/A Trim icon and follow the wizard that will guide you through the process.

9.4.2.4 Channel Review

The channel review screen shows live data for the available meter diagnostics. Each diagnostic has a particular use and expected limits that can be seen in the flowmeter users guide.

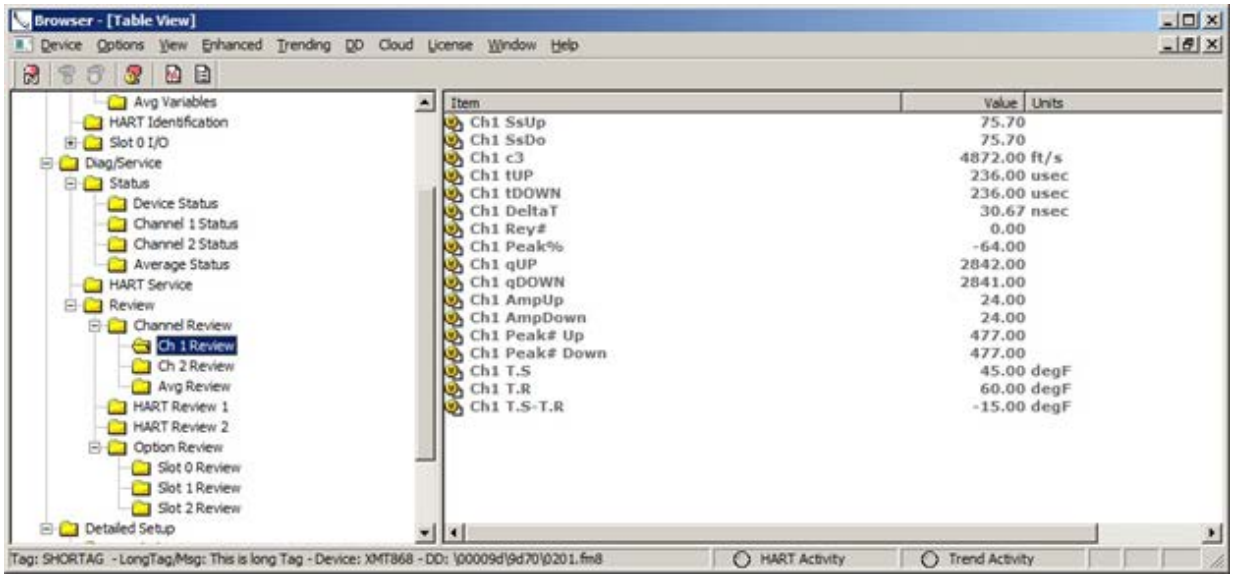


Figure 64: Channel Review

**Note that different diagnostics may be available for different instrument models

**Note that CH2 and AVG diagnostics are only valid for a 2-channel meter

Typical diagnostic codes and their meaning are:

- SSUp: Displays the signal strength for the upstream transducer
- SSDn: Displays the signal strength for the downstream transducer
- C3: Displays the measured speed of sound
- tUP: Displays the upstream ultrasonic signal transit time
- tDN: Displays the downstream ultrasonic signal transit time
- DeltaT: Displays the transit time difference between the upstream and downstream signals.
- Rey#: Displays the Reynolds Number factor
- Peak%: Displays the percentage of peak (set to +50 by default).
- qUP: Displays the signal quality for the upstream transducer.
- qDOWN: Displays the signal quality for the downstream transducer
- AmpUP: Displays the value for the signal amplitude of the upstream transducer.
- AmpDN: Displays the value for the signal amplitude of the downstream transducer.
- Peak# UP: Displays signal peaks for the upstream transducer
- Peak# DN: Displays signal peaks for the downstream transducer.

9.4.2.5 HART Review 1

The HART Review 1 screen shows the 4 dynamic variables (PV, SV, TV and QV) along with some identification parameters such as Model, Manufacturer and Device ID.

**Note that the dynamic variables in this screen are read only, they can be programmed in the Detailed Setup menu

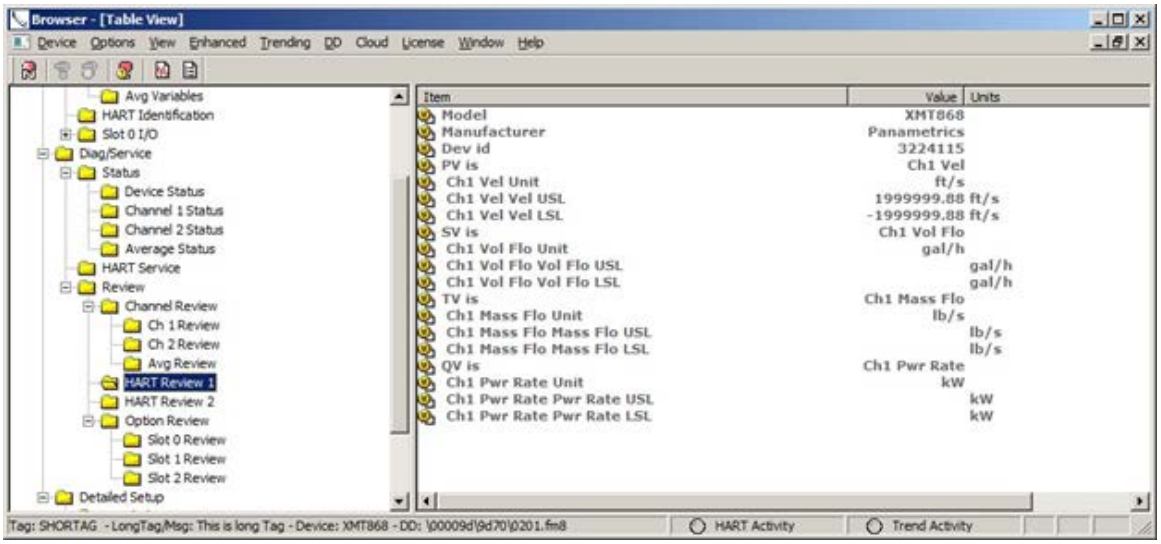


Figure 65: RART Review1

9.4.2.6 HART Review 2

The HART Review 2 screen continues to provide information on the device and the current HART revision implementation. The device version and build information refer to the version of firmware in the HART option card.

**Note that Message, tag and Long tag are read only here and can be edited in the Detailed Setup, HART Info menu.

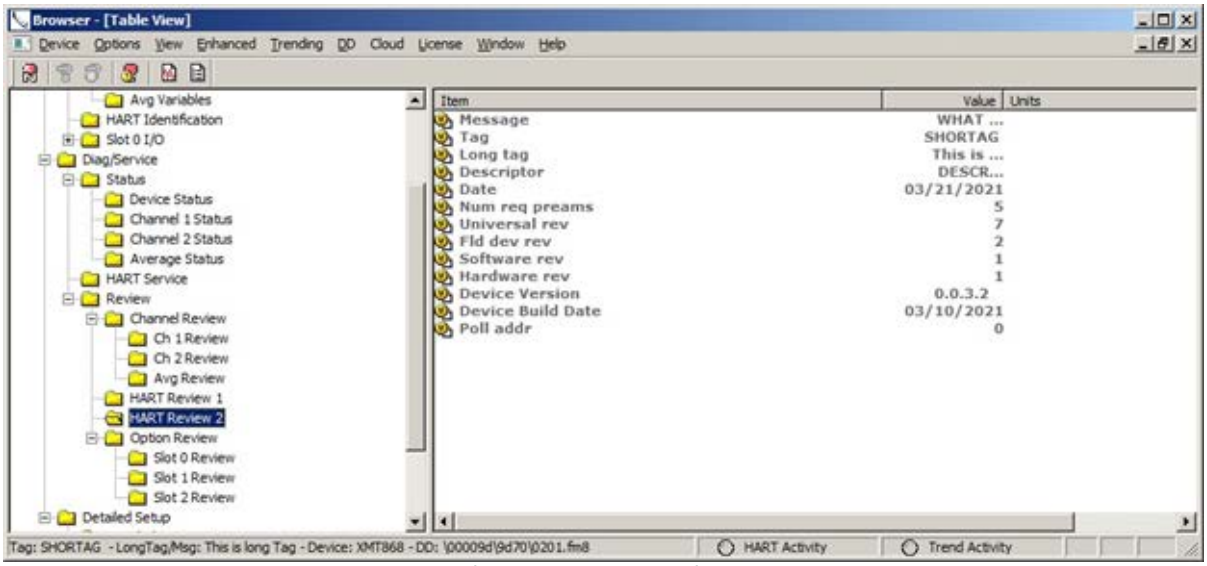


Figure 66: HART Review2

9.4.2.7 Option Review

The option review screen shows the programmed variables, units and their range values for analog outputs on the main system for Slot 0 and any available outputs for Slot 1 (If installed).

9.4.3 Detailed Setup Menu

The detailed setup menu provides capability to program certain parameters in the meter.

**Note that changing meter parameters from the HART DD may require a reboot of the system and reconnection of HART communications

** Note that most of the configuration functions for HART can also be done from the Main system side as well.

9.4.3.1 Detailed Setup – PV, SV, TV and QV

The dynamic variables can be setup from this screen. Click on the "PV is" item and chose desired parameter from the drop-down list and download to the meter. Note the units are read only and can only be changed from the main system side.

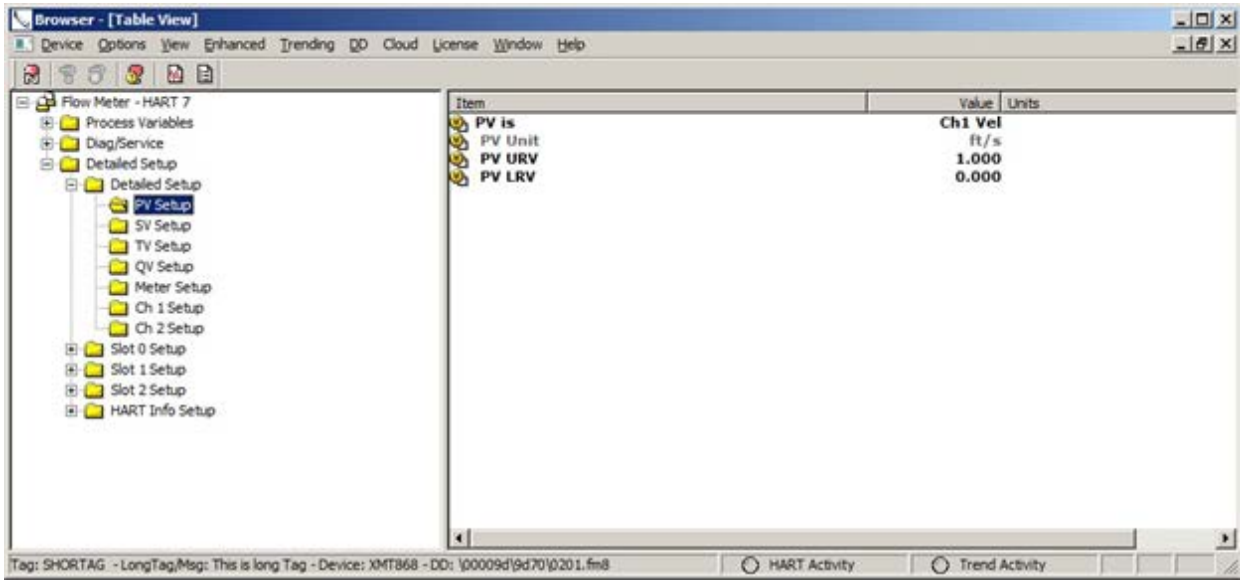


Figure 67: Detailed Setup – PV, SV, TV and QV

9.4.3.2 Detailed Setup – Meter Setup

The meter setup menu allows changing of some global settings.

Two Path : This is an error handling option for two channel meters. It is either set ON or OFF. See meter users guide for more detail.

Response Time : The meter can average a number of consecutive flow measurements to provide a steady reading . The options for this parameter can be 1, 2, 5, 20, 30, 60 and statistics. Refer to the meters users guide for more detail.

Static Density: The static density fields allows you to turn on use of fixed static density and to set the value.

Error Mode : The error mode setting tells the meter what to do with the 4-20mA output when the meter is in error. It can hold last value, go Low (4mA), go high (20mA), go higher (22mA) and go to Other where the user can set any value between 2 and 22mA.

Clear Totals: The Clear totals method, when selected, will clear the forward and reverse volumetric and mass flow totalizers in the meter.

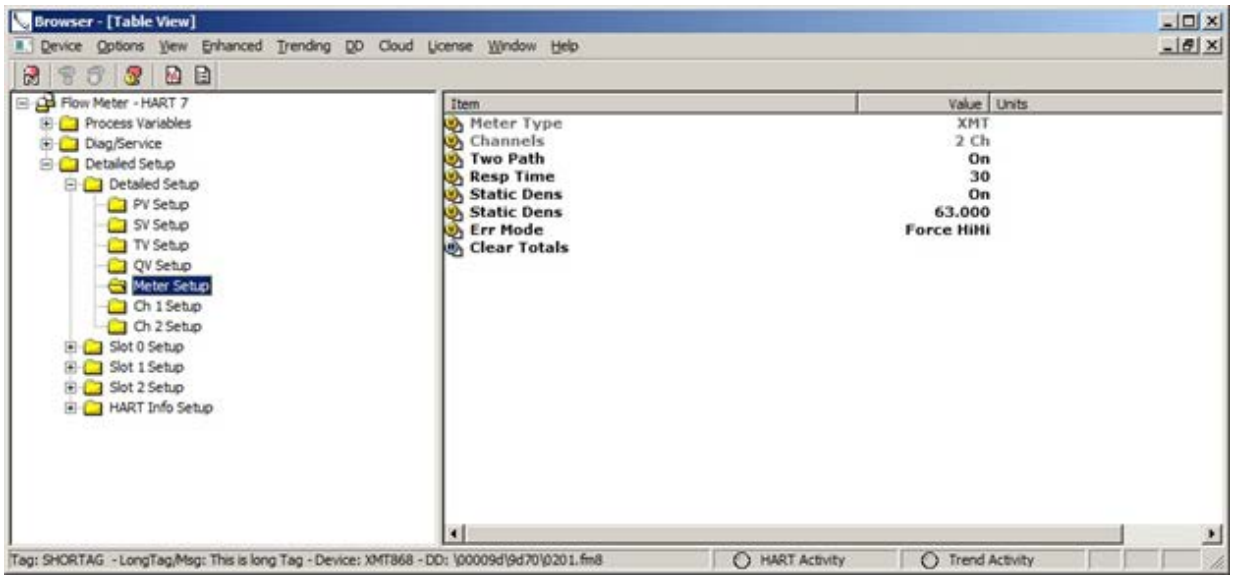


Figure 68: Detailed Setup – Meter Setup

9.4.3.3 Slot Setup

The Slot setup screen allows for configuration of the variables and range values for main (Slot 0) and option (Slot 1) 4-20mA outputs. Note the units are read only and can only be changed from the meter side.

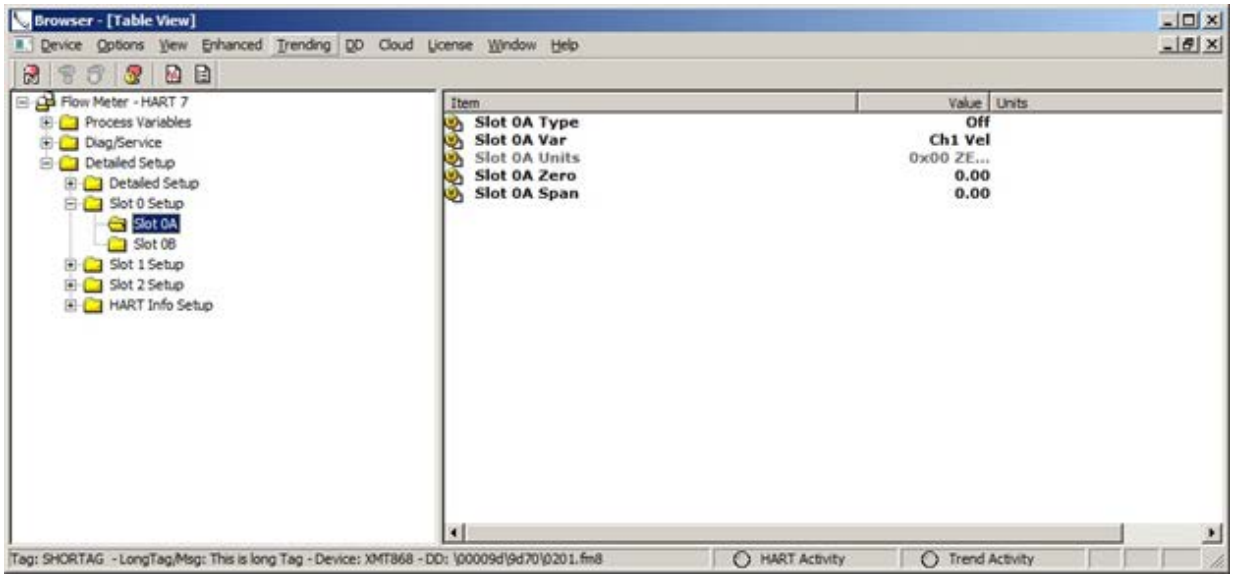


Figure 69: Slot Setup

9.4.3.4 HART Setup – User Info

The User information screen is where site specific information about the meter can be entered.

Tag : 8-character text field that can be used to identify the instrument

Long Tag : 32-character text field with same purpose as the tag only more characters allowed

Descriptor : An additional 32-charater description field.

Message : Message text field.

Date : A date can be manually added to the HART device.

Final Assembly Number : Assembly number text field.

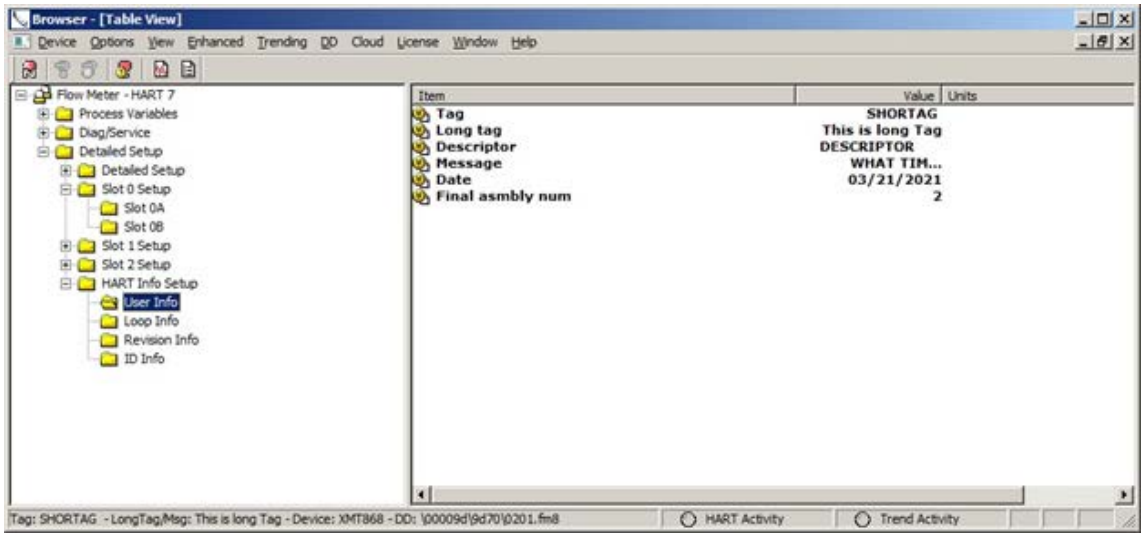


Figure 70: HART Setup–User Info

9.4.3.5 HART Setup – Loop Info

The loop information screen is where the meters HART polling address and loop current mode can be configured.

Polling Address : The polling address change be set from 0 to 63 where the addresses 1 to 63 are typically used in multidrop mode.

Loop Current Mode : The loop current mode determines whether the meter sinks the loop current based on the PV parameter. If the loop current mode is enabled the meter does set the loop current per the PV, if disabled the meter sets its loop current to 4mA and communicates to the HART DCS Master using digital communications only.

The Number of request and response preambles are read only and useful to know when setting up HART communications.

9.4.3.6 HART Setup – Revision Info

The revision information screen allows us to see the revisions for the HART 7 design. These are read only parameters.

Universal Rev : This is the HART protocol revision which is currently HART 7.

Field Device Revision : The revision of the flowmeter HART design. In our case there is a HART 5 design which is revision 1 so the HART 7 design is revision 2.

Software Revision : The revision of the HART PCBA Software.

Hardware Revision : The revision of the HART PCBA electronics.

9.4.3.7 HART Setup – ID Info

The HART ID screen shows the manufacturer name Panametrics, the meter model number and the device ID of the instrument.

9.5 Enhanced DD File

The enhanced DD file view provides a graphical interface with most of the same information described the standard dd file section. There are three entry points to Enhanced DD file, the Process Variables, Diag/Service and Flow Meter screens.

9.5.1 Process Variables

The Process Variables entry point gives access to the Overview, Charts and About screens. This where the user can look and trend the four dynamic variables.

9.5.1.1 Overview

The overview screen gives a real time look at the PV, SV, TQ and QV data and a graphical look at the values versus their range limits. The overview screen also gives the user a quick indication of the health of the flowmeter measurement. When there is no error the overview screen shows “Device OK” and when there is an error the screen will show the error code.

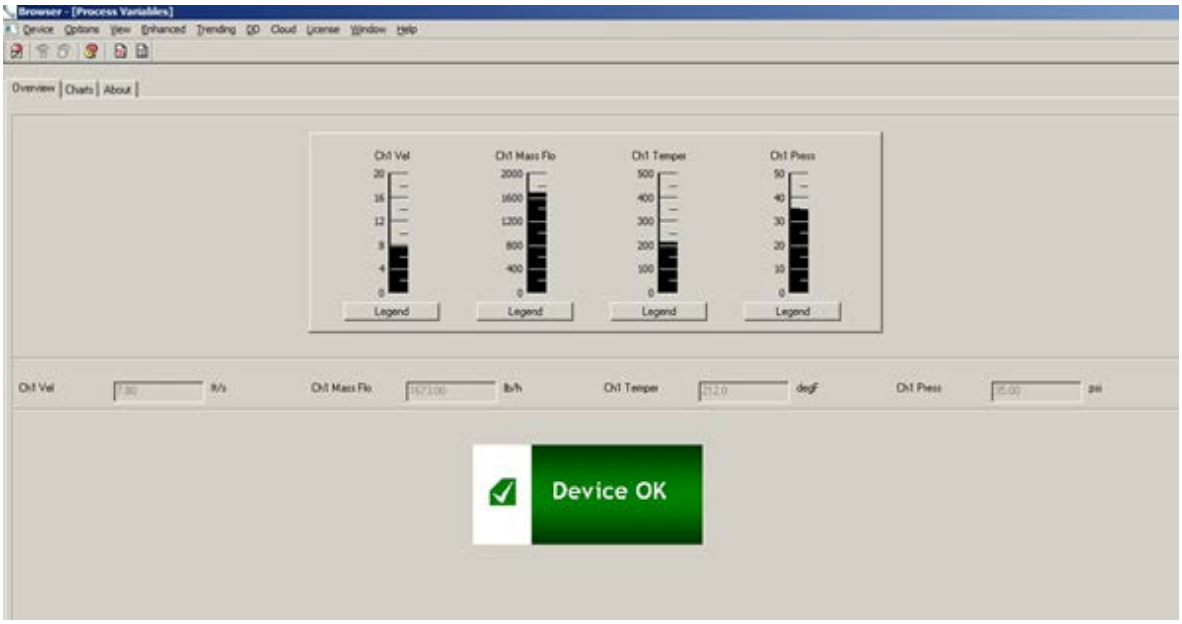


Figure 71: Overview

9.5.1.2 Charts

The charts screen has trending charts for each of the four dynamic variables. The charts can be configured using the axis zoom and properties buttons, and the data can be saved to file or printed.

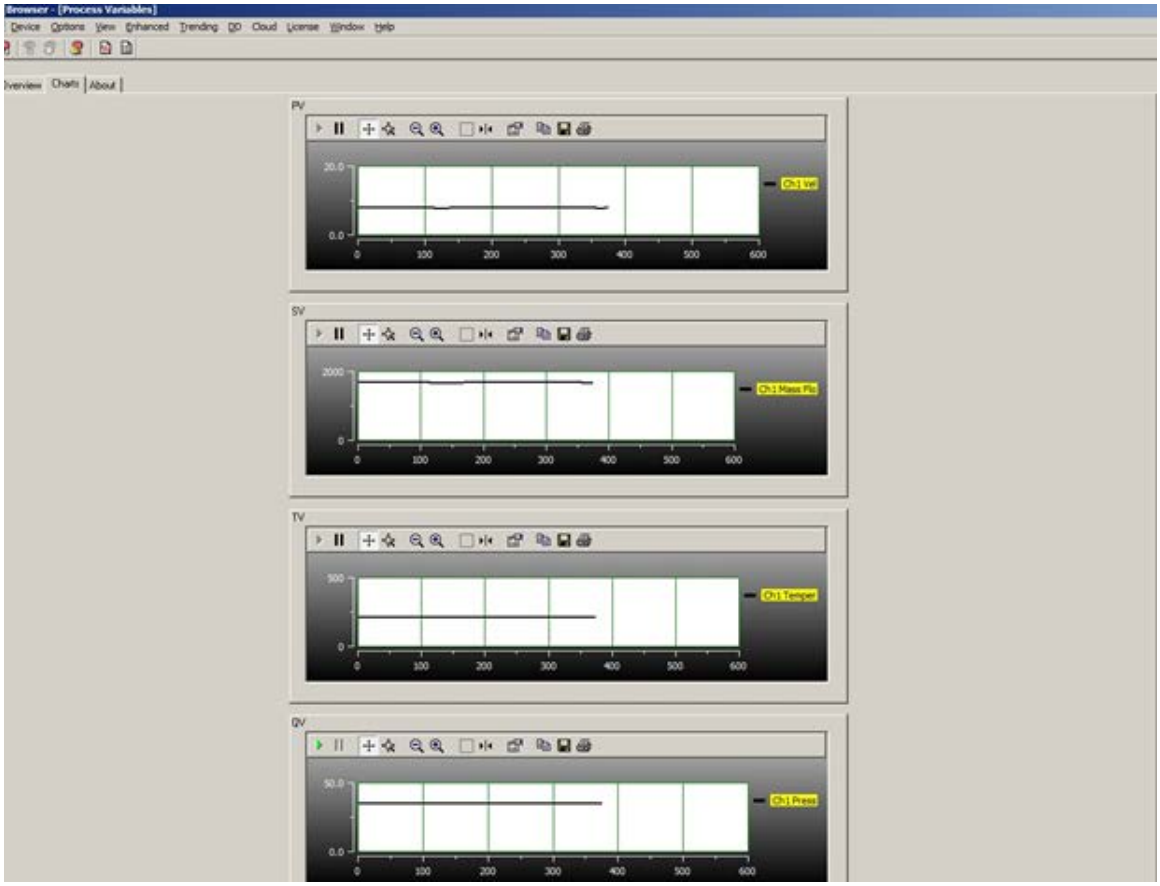


Figure 72: Charts

9.5.1.3 About

The About screen contains a picture of the meter type, the device version of code and the code build date.

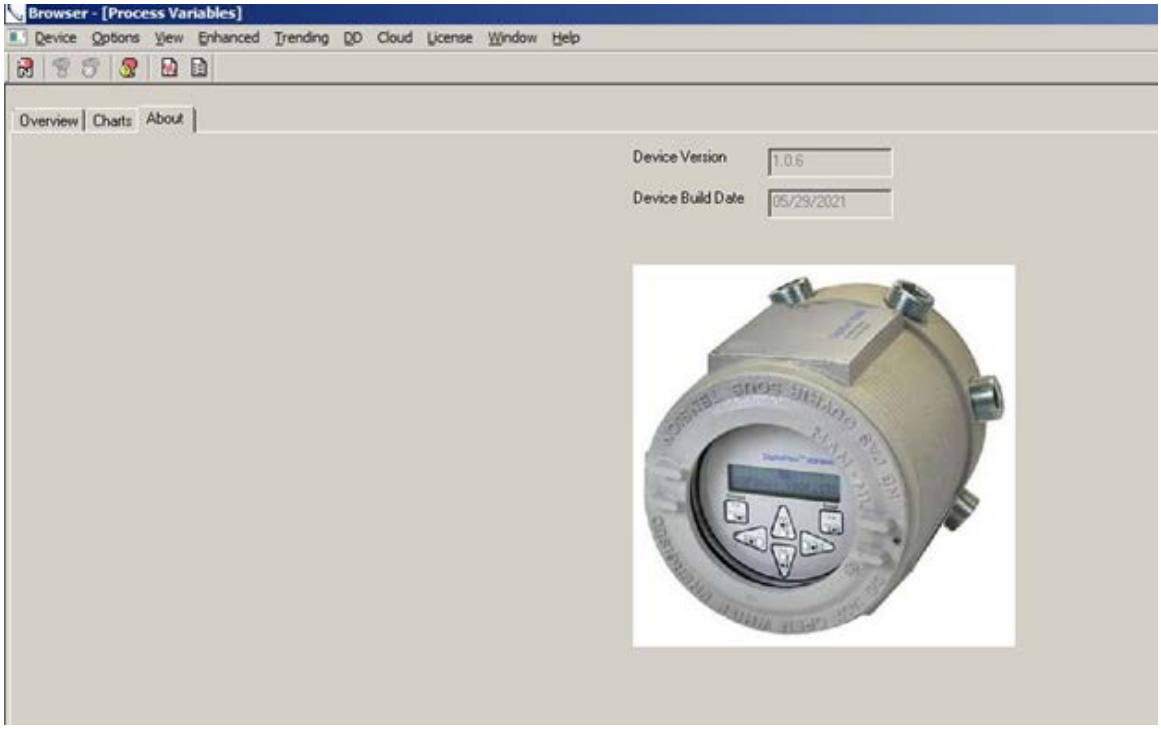


Figure 73: About

9.5.2 Diag/Service

The diagnostics and service menu will allow the user to perform standard HART functions and view the health of the meter through status bits. The device and measurement status bits will show “clear” for no error and “set” when the error is present.

9.5.2.1 Specific Status

The Specific Status tab shows the Device and Chanel status bits graphically. Green color is OK and red means the status bit is set.

The device status bits are a set of general error conditions that map to the operation of the flowmeter. Note these error conditions are standard to HART but may not apply to every field device.

The channel status bits are a set of error conditions relating to the flowmeter measurement process. Refer to the meter Users Guide for a detailed explanation of the measurement error codes along with possible causes and actions.

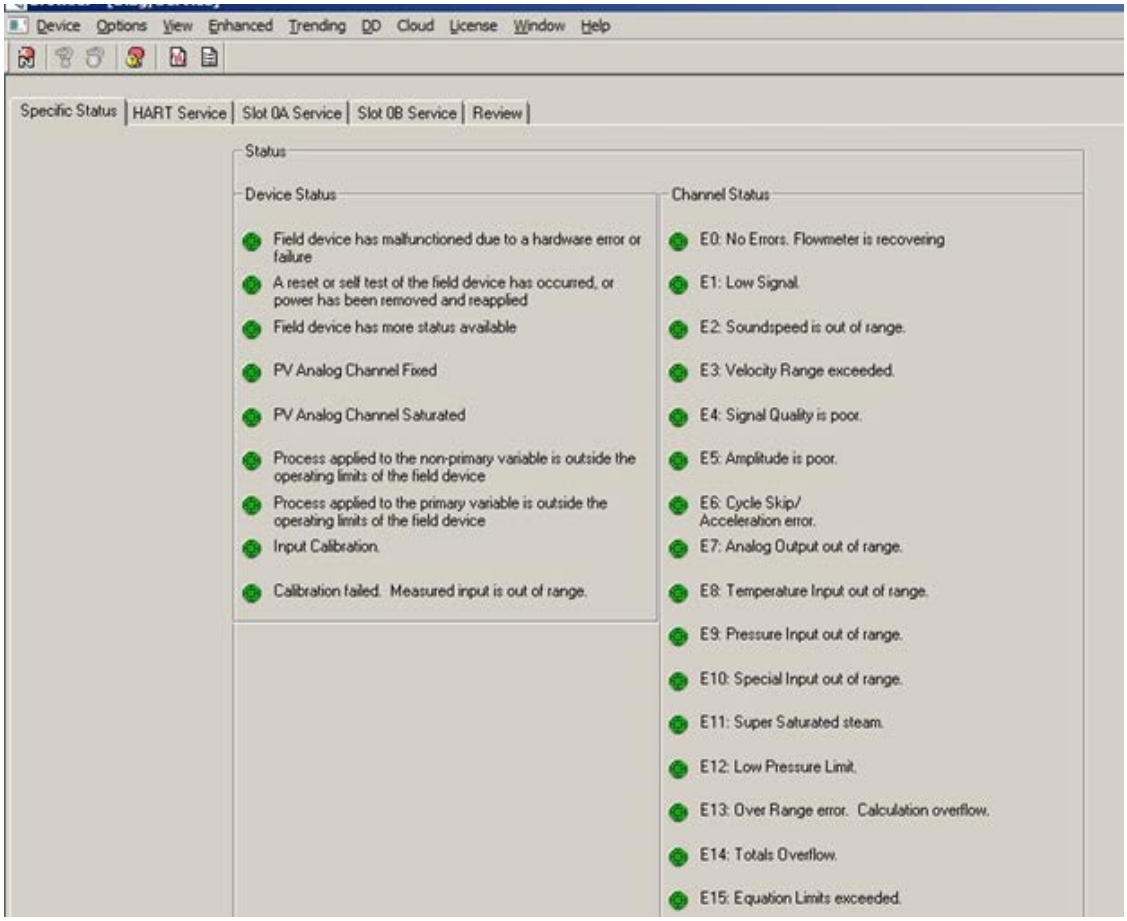


Figure 74: Specific Status

9.5.2.2 HART Service

The HART Service tab contains the HART methods used to check HART Status, Loop Test and DA calibration. There are two additional methods that can be used to reset the HART device and clear the HART Non-volatile Menu. These last two methods are password protected and require contacting the factory for access.

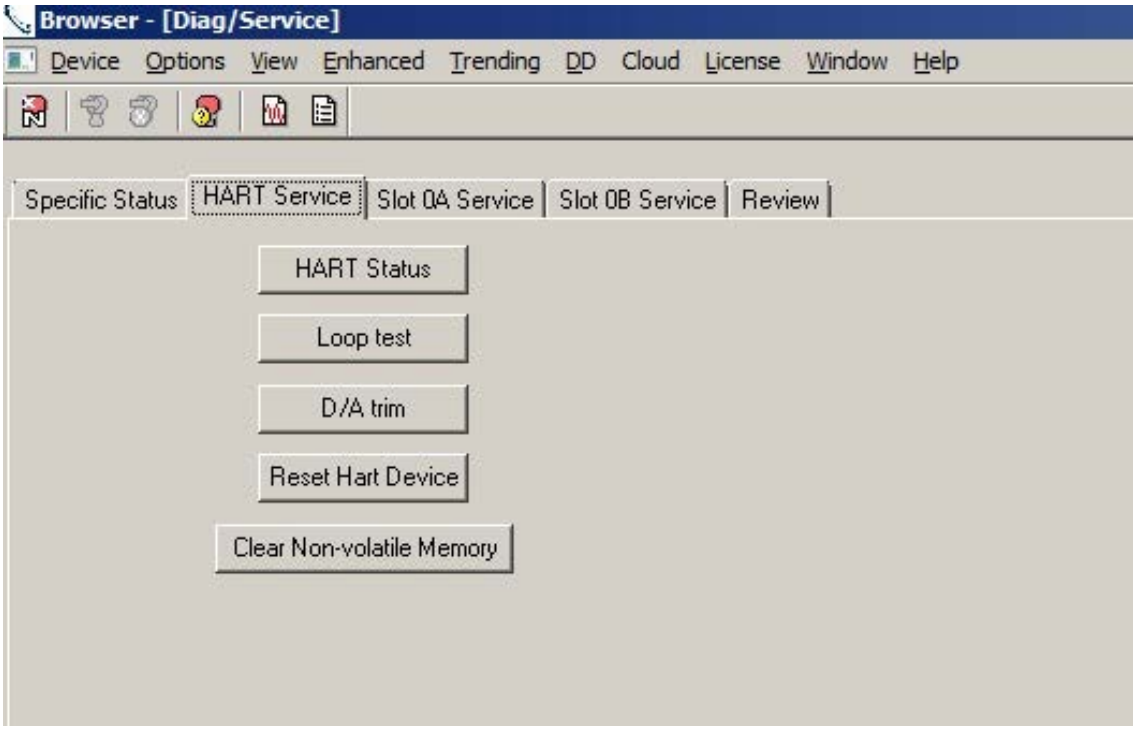


Figure 75: HART Service

9.5.2.3 Slot Service

The Slot Service tab allows for the user to perform a loop test and DA calibration for the two 4-20mA outputs found on the main system. Please refer to the system users guide for location of the 4-20mA connections.

9.5.2.4 Review

The Review Tab gives a complete one-page view of Channel 1, 2 and Average diagnostics as well as some HART parameters and option card settings.

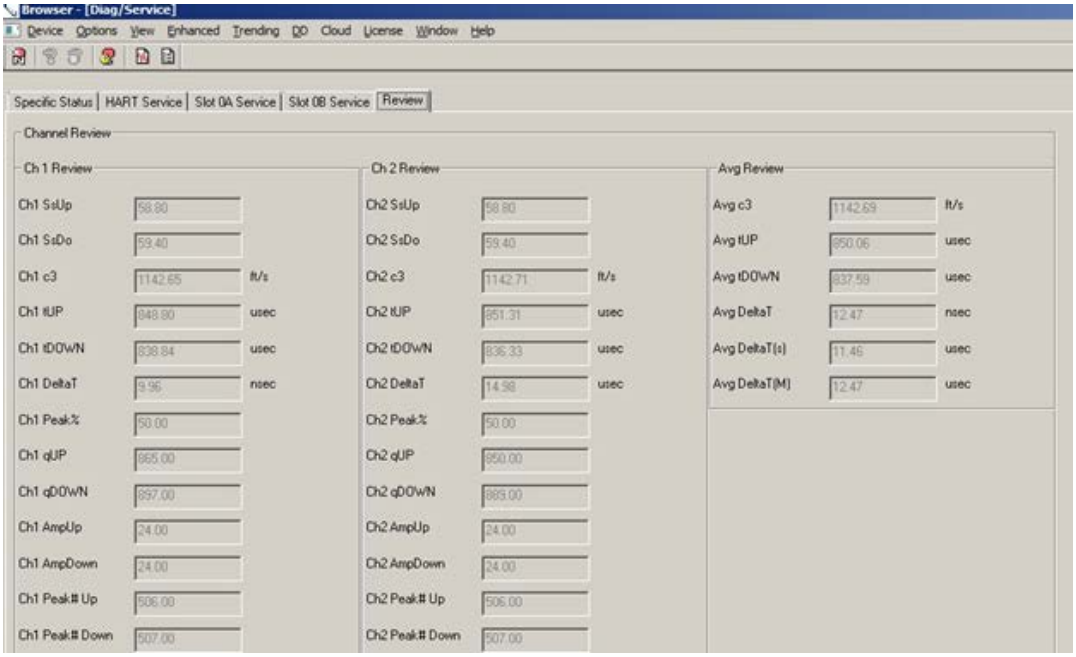


Figure 76: Review

9.5.2.5 Flow Meter HART 7 – EDD

The Flow Meter HART 7 EDD entry point of the enhanced DD file contains many of the screens from the Process Variables and Diag/Service entry points along with a programming tab.

9.5.2.6 Process Variables

The process variables menu provides real time data for measurement variables available from the meter. You can view measurement PV, CH1, CH2 or average values (if 2 channel meter).

**Note that CH2 and average value screens will not show valid data if the meter is a 1 channel meter or CH2 is not turned on.

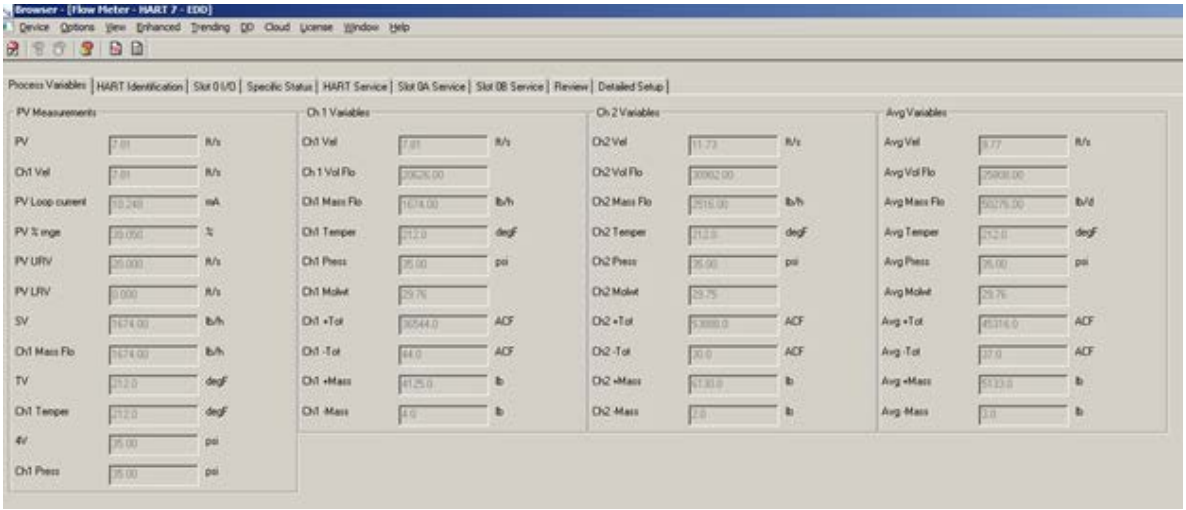


Figure 77: Process Variables

9.5.2.7 HART Identification

The HART Identification screen provides information on the device and the current HART revision implementation. The device version and build information refer to the version of firmware in the HART option card.

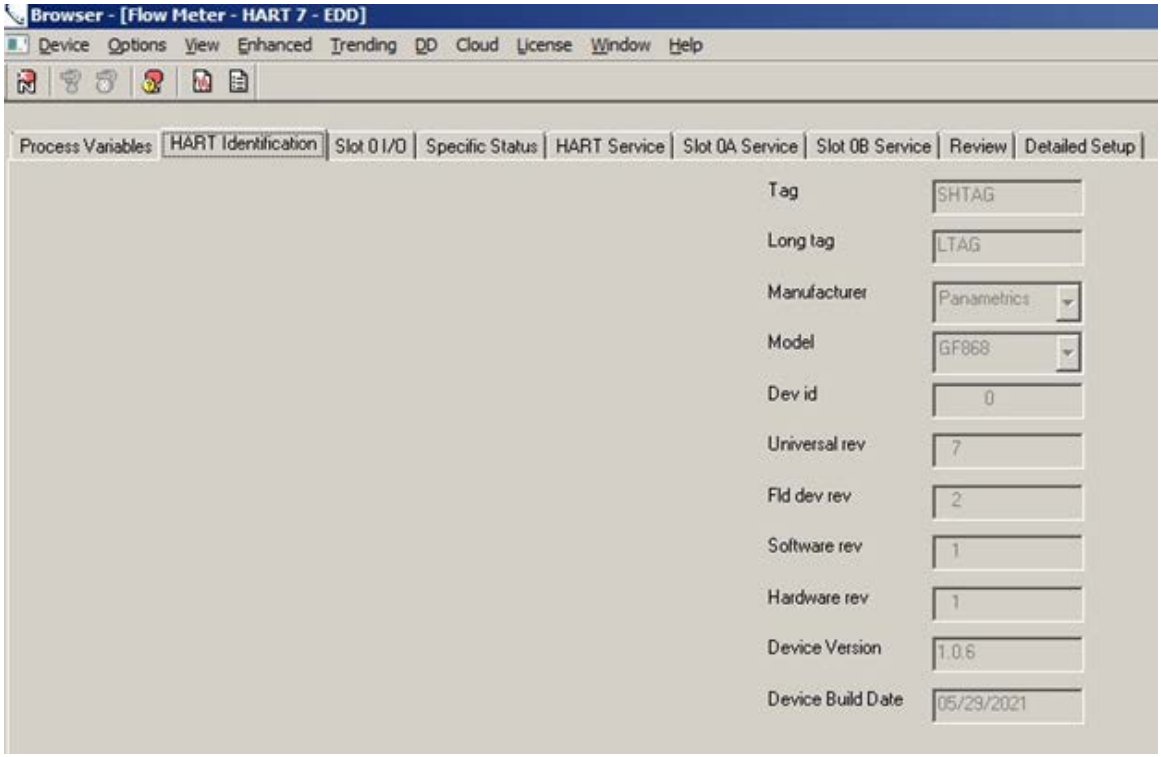


Figure 78: HART Identification

9.5.2.8 Slot 0 I/O

The SLOT 0 I/O screen shows the parameter, values and units for the main board standard 4-20mA outputs.

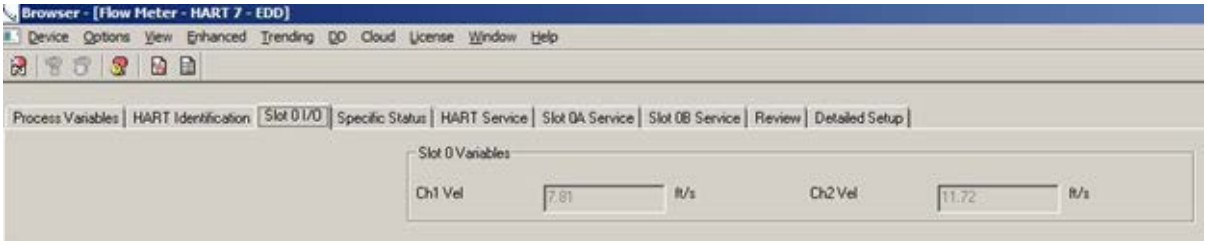


Figure 79: Slot 0I/O

9.5.2.9 Specific Status

This is the same screen as discussed in the Diag/Service Specific Status section of this user's guide.

9.5.2.10 HART Service

This is the same screen as discussed in the Diag/Service HART Service section of this user's guide.

9.5.2.11 Slot 0 Service

This is the same screen as discussed in the Diag/Service Slot Service section of this user's guide.

9.5.2.12 Review

This is the same screen as discussed in the Diag/Service Review section of this user's guide.

9.5.2.13 Detailed Setup

The Detailed Setup screen is where the user can change meter programming. The PV, SV, TV and QV variables are selected, and the range limits can be set. Other meter parameters as well as Slot 0 settings are also configured here.

Please note that after each change from this screen the flowmeters must be power cycled and HART communications re-established..

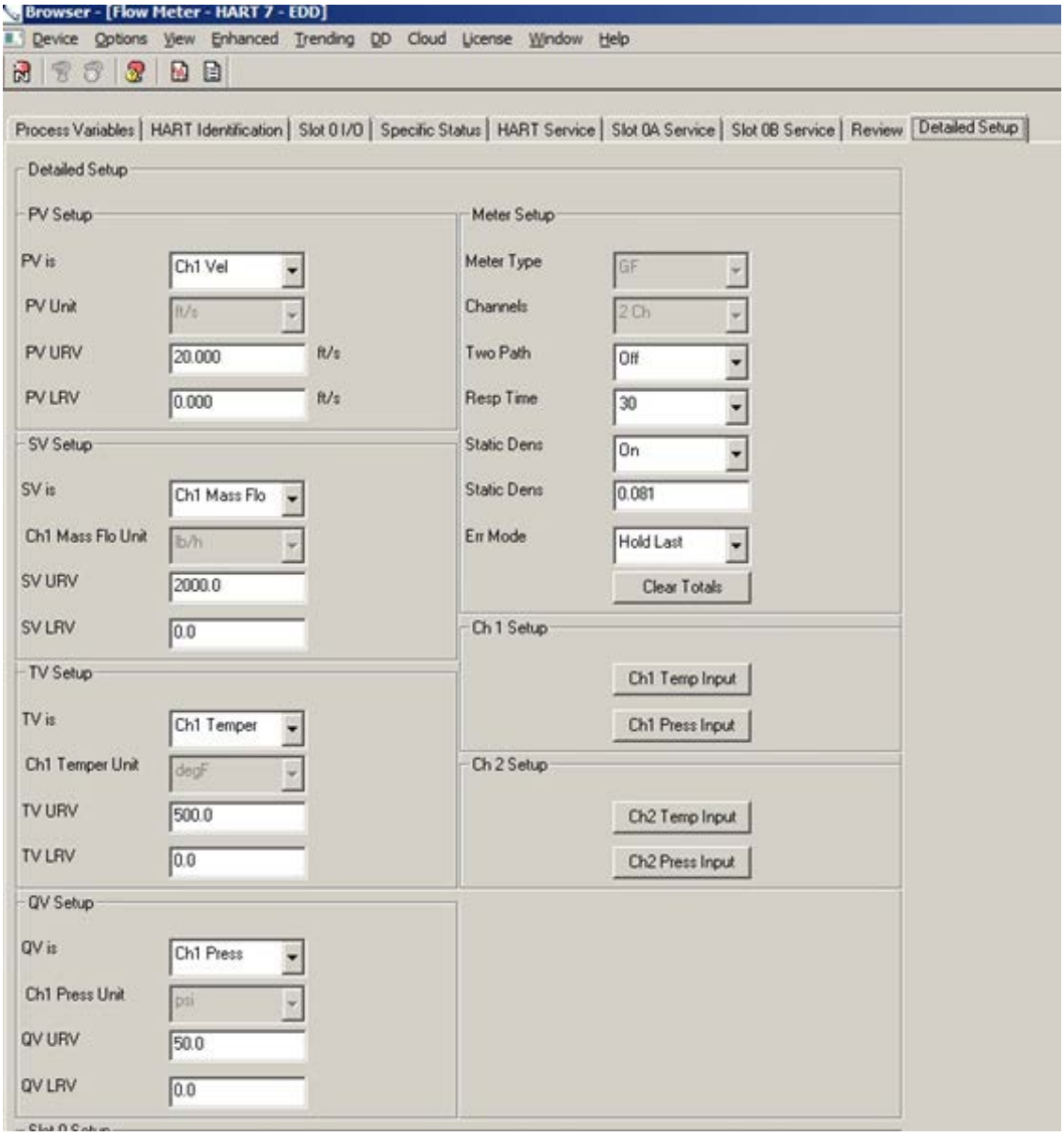


Figure 80: Detailed Setup

Warranty

Each instrument manufactured by Panametrics is warranted to be free from defects in material and workmanship. Liability under this warranty is limited to restoring the instrument to normal operation or replacing the instrument, at the sole discretion of Panametrics. Fuses and batteries are specifically excluded from any liability. This warranty is effective from the date of delivery to the original purchaser. If Panametrics determines that the equipment was defective, the warranty period is:

- One year from delivery for electronic or mechanical failures.
- One year from delivery for sensor shelf life.

If Panametrics determines that the equipment was damaged by misuse, improper installation, the use of unauthorized replacement parts, or operating conditions outside the guidelines specified by Panametrics, the repairs are not covered under this warranty.

The warranties set forth herein are exclusive and are in lieu of all other warranties whether statutory, express or implied (including warranties or merchantability and fitness for a particular purpose, and warranties arising from course of dealing or usage or trade).

Return Policy

If a Panametrics instrument malfunctions within the warranty period, the following procedure must be completed:

1. Notify Panametrics, giving full details of the problem, and provide the model number and serial number of the instrument. If the nature of the problem indicates the need for factory service, Panametrics will issue a Return Material Authorization (RMA), and shipping instructions for the return of the instrument to a service center will be provided.
2. If Panametrics instructs you to send your instrument to a service center, it must be shipped prepaid to the authorized repair station indicated in the shipping instructions.
3. Upon receipt, Panametrics will evaluate the instrument to determine the cause of the malfunction.

Then, one of the following courses of action will then be taken:

- If the damage is covered under the terms of the warranty, the instrument will be repaired at no cost to the owner and returned.
- If Panametrics determines that the damage is not covered under the terms of the warranty, or if the warranty has expired, an estimate for the cost of the repairs at standard rates will be provided. Upon receipt of the owner's approval to proceed, the instrument will be repaired and returned.

[no content intended for this page]

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BH073C11 EN H (03/2025)

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