InnovaMass® 240i/241i
Foundation Fieldbus

Preliminary Instruction Manual
Foundation Fieldbus Specification for Models: 240i and 241i

Volumetric & Multivariable Mass Vortex Flow Meter

Part Number: IM240i/241i-FF
V1 December 2015

SIERRA®

GLOBAL SUPPORT LOCATIONS: WE ARE HERE TO HELP!

CORPORATE HEADQUARTERS

5 Harris Court, Building L Monterey, CA 93940
Phone (831) 373-0200 (800) 866-0200 Fax (831) 373-4402
www.sierrainstruments.com

EUROPE HEADQUARTERS

Bijlmansweid 2 1934RE Egmond aan den Hoef
The Netherlands
Phone +31 72 5071400 Fax +31 72 5071401

ASIA HEADQUARTERS

Second Floor Building 5, Senpu Industrial Park
25 Hangdu Road Hangtou Town
Pu Dong New District, Shanghai, P.R. China
Postal Code 201316
Phone: + 8621 5879 8521 Fax: +8621 5879 8586

IMPORTANT CUSTOMER NOTICE- OXYGEN SERVICE

Sierra Instruments, Inc. is not liable for any damage or personal injury, whatsoever,resulting from the use of Sierra Instruments standard mass flow meters for oxygen gas. You are responsible for determining if this mass flow meter is appropriate for your oxygen application. You are responsible for cleaning the mass flow meter to the degree required for your oxygen flow application.

Warnings and Cautions

Warning! Agency approval for hazardous location installations varies between flow meter models. Consult the flow meter nameplate for specific flow meter approvals before any hazardous location installation.

Warning! Hot tapping must be performed by a trained professional. U.S. regulations often require a hot tap permit. The manufacturer of the hot tap equipment and/or the contractor performing the hot tap is responsible for providing proof of such a permit.

Warning! All wiring procedures must be performed with the power off.

Warning! To avoid potential electric shock, follow National Electric Code safety practices or your local code when wiring this unit to a power source and to peripheral devices. Failure to do so could result in injury or death. All AC power connections must be in accordance with published CE directives.

Warning! Do not power the flow meter with the sensor remote (if applicable) wires disconnected. This could cause over-heating of the sensors and/or damage to the electronics.

Warning! Before attempting any flow meter repair, verify that the line is de-pressurized.

Warning! Always remove main power before disassembling any part of the mass flow meter.

Caution! Before making adjustments to the device, verify the flow meter is not actively monitoring or reporting to any master control system. Adjustments to the electronics will cause direct changes to flow control settings.

Caution! All flow meter connections, isolation valves and fittings for hot tapping must have the same or higher pressure rating as the main pipeline.

Caution! Changing the length of cables or interchanging sensors or sensor wiring will affect the accuracy of the flow meter. You cannot add or subtract wire length without returning the meter to the factory for re-calibration.

Caution! When using toxic or corrosive gases, purge the line with inert gas for a minimum of four hours at full gas flow before installing the meter.

Caution! The AC wire insulation temperature rating must meet or exceed 80°C (176°F).

Caution! Printed circuit boards are sensitive to electrostatic discharge. To avoid damaging the board, follow these precautions to minimize the risk of damage:

- before handling the assembly, discharge your body by touching a grounded, metal object
- handle all cards by their edges unless otherwise required
- when possible, use grounded electrostatic discharge wrist straps when handling sensitive components

Warnings and Cautions

Note and Safety Information

We use caution and warning statements throughout this book to draw your attention to important information.

Warning!

This statement appears with information that is important to protect people and equipment from damage. Pay very close attention to all warnings that apply to your application.

Caution!

This statement appears with information that is important for protecting your equipment and performance. Read and follow all cautions that apply to your application.

Receipt of System Components

When receiving a Sierra mass flow meter, carefully check the outside packing carton for damage incurred in shipment. If the carton is damaged, notify the local carrier and submit a report to the factory or distributor. Remove the packing slip and check that all ordered components are present. Make sure any spare parts or accessories are not discarded with the packing material. Do not return any equipment to the factory without first contacting Sierra Customer Service.

Technical Assistance

If you encounter a problem with your flow meter, review the configuration information for each step of the installation, operation, and setup procedures. Verify that your settings and adjustments are consistent with factory recommendations. Installation and troubleshooting information can be found in the InnovaMass®240i/241i product manual.

If the problem persists after following the troubleshooting procedures outlined in the InnovaMass240i/241i product manual, contact Sierra Instruments by fax or by E-mail (see inside front cover). For urgent phone support you may call (800) 866-0200 or (831) 373-0200 between 8:00 a.m. and 5:00 p.m. PST. In Europe, contact Sierra Instruments Europe at +31 20 6145810. In the Asia-Pacific region, contact Sierra Instruments Asia at +86-21-58798521. When contacting Technical Support, make sure to include this information:

- The flow range, serial number, and Sierra order number (all marked on the meter nameplate)
- The software version (visible at start up)
- The problem you are encountering and any corrective action taken
- Application information (gas, pressure, temperature and piping configuration)

Table of Contents

Chapter 1: Introduction

This manual will explain how to add a Sierra flow meter equipped with Foundation Fieldbus to your network. The Foundation Fieldbus interface allows access to all relevant data available in the flow meter.

This manual is intended to document the configuration of the Sierra Instruments' InnovaMass 240i and 241i vortex mass flow meter with the Foundation Fieldbus Communication Interface to your network. It assumes the reader already has a working knowledge of Foundation Fieldbus. For specific operations of the Sierra Instruments' 240i and 241i thermal flow meters, consult the InnovaMass® 240i/241iSeries instruction manual.

For detailed information about Foundation Fieldbus go to: http://www.fieldbus.org/

The Sierra Instruments' 240i/241iSeries mass flow meters can be ordered with the optional Foundation Fieldbus (FF-BUS) Communication interface for use on a Foundation Fieldbus H1 network. This Interface complies with the new ITK version 6.

FF-BUS differs from other digital communication protocols, it is designed for process control rather than just transfer of data between a device and a central controller. It supports peer-to-peer communication and allows for functional blocks to operate independently between themselves without main controller intervention.

Foundation Fieldbus H1 networks are connected using a shielded twisted wire pairs. For more information about FF-BUS H1 wiring see:
http://www.fieldbus.org/images/stories/enduserresources/technicalreferences/documents/wiringinstallationguide.pdf

Chapter 2 – Connecting the InnovaMass 240i/241i to your FF-BUS Network

The InnovaMass 240i/241imeters use 24VDC (+/-10%) at 1.1 Amp. Due to the current needed, the meter cannot be powered from the H1 network. The separate 24VDC (+/-10%) power is connected to terminals 1 and 2.

The Foundation Fieldbus H1 network connections are labeled as FF-1(terminal 13 and FF-2 (terminal 14). These are not polarity dependent and will work reversed. The EMC ground on terminal 15 can be connected to Earth ground or the wire shield if you are using shielded wire. This can help eliminate Electromagnetic and Electrostatic noise on the data.

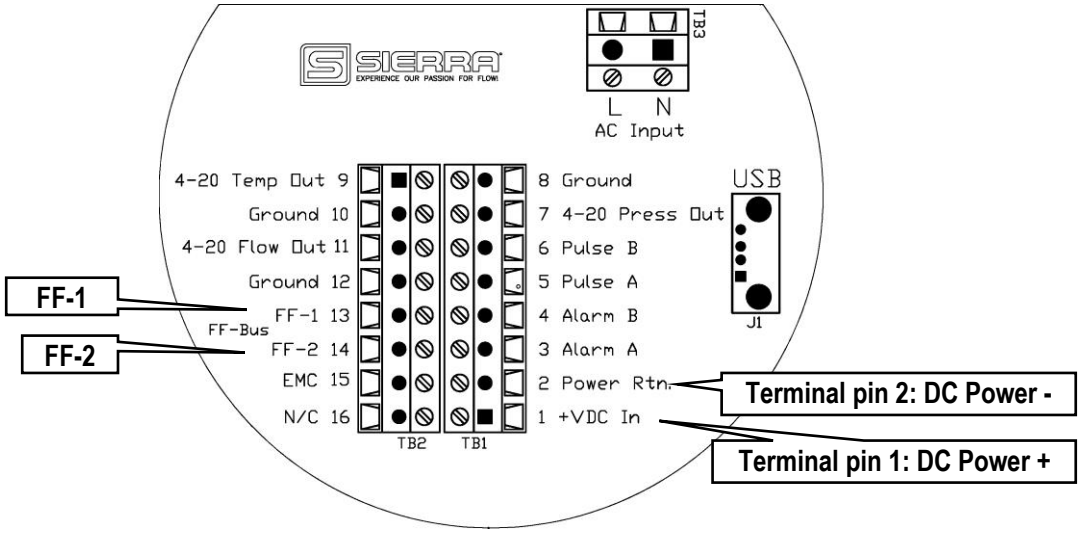

Figure 1. InnovaMass 240i/241i Foundation Fieldbus minimum wiring

Chapter 3 - Definitions

DD: Device Description files are necessary to configure your FF-BUS host software. The DD files explain the specific configuration and features to your host network so it understands how to use the device.

Resource Block (RS): This function block contains basic information about the FF-BUS interface.

Transducer Block (TB): This block makes the connection to the meter and presents the process variables to the lower blocks. Most of the configuration setup is done in this block.

AI (Analog Input) Block: Although this is actually digital process data coming from the instrument (output), it is still referred to as an AI Block. This FF-BUS interface has four analog input blocks: AI1, AI2, AI3, and AI4.

AO (Analog Output) Block: Although this is a digital command being sent to the instrument (input), it is still referred to as an AO Block. The 240i/241iFF-BUS interface has one, labeled AO.

Modbus: Modbus is another digital communication protocol and is only relevant here because the Sierra FF-BUS interface uses Modbus as an intermediary between the meter and the FF-BUS interface. For special configuration, the user will only need a rudimentary knowledge of Modbus.

MODBUS_REG_SETUP_1 to 4: This is where AI1,2,3,4 and AO are configured as PV1,2,3,4, and Final Value. These are 32-bit registers the can configured multiple data types in various Byte order.

MODBUS_REGS_1 to 4: There are four groups of ten Modbus R/W registers that can be used for static variables such as serial number, calibration date, total reset, and meter full scale. These only have limited use, and may not be able to be seen with all FF-BUS devices.

32-bit float: Also known as Real or IEEE-754 single precision. The 32-bit float is a common data encoding scheme that provides 1 bit for the sign, 8 bits for an exponent, and 23 bits of significant numbers. In Modbus the Byte order is normally 1-0,3-2, however FF-BUS interface allows it to be changed if needed.

16-bit short integer: This is a 16-bit number ranging from 0-65,535 (2^{16}). The Byte order is 0,1.

32-bit long integer: This combines two 16-bit Modbus registers to make a number as high as 4,294,967,296 (2^{32}). The Byte order is 1-0,3-2. The FF-BUS will see this as one 32-bit integer.

String (Character): A 16-bit Modbus register would contain 2 ASCII characters (8 bits each) in 0-1 Byte order. So ox 41 42 would equal “A B”.

Chapter 4 – Foundation Fieldbus configuration

The 240i/241iFF-BUS interfaces uses a Modbus to FF-BUS translator board inside the flow meter. This allows the user to configure variables accessible to our Modbus interface. For the most part, the Modbus to FF-BUS translation is invisible to the end user unless they want to reconfigure the Transducer Block (TB) to access other Modbus variables.

AI/AO Blocks:

The Foundation Fieldbus Transducer Block (SIERRA_TB) provides four analog inputs (AI1 through AI4) and one analog output (AO). These are all configurable as 16 or 32-bit integer or Float data types. We have pre-configured these blocks as shown below in Table 1. However, the user can reconfigure them as needed.

AI/AO Blocks	Primary Value	Channel	Data Type	Analog Signal
AI1	PV1	1	32-bit Float/Real	Flow Rate
AI2	PV2	2	32-bit Float/Real	Temperature
AI3	PV3	3	32-bit Float/Real	Pressure
AI4	PV4	4	32-bit Float/Real	Total
AO	Final Value	5	*	*

*Unassigned, open for customer configuration.

Table 1: Factory AI/AO Blocks

MODBUS_REGS_ (1 through 4):

The Transducer Block also has four groups of Modbus registers. These can be used for static setup inputs and outputs for variables such as reading the Serial Number, Calibration Date or changing the Gas Index, or resetting the totalizer. This data is not cyclic as it only updates occasionally, and might not be accessible to all devices on the fieldbus. These variables are limited to an unsigned short integer, Byte order 0-1. There are four groups of ten. Each group can only be configured in consecutive Modbus register order.

To use these groups, a starting registers number (MODBUS_REG_START_ADDRESS) and the number of registers after (NUM_OF_MODBUS_REG) is needed. These have been pre-configured as shown below in Table 2. However, the user can reconfigure them as needed.

Variable	MODBUS_REGS Group	REG_START ADDRESS	NUM_OF_REGS
Alarm status	1	8	10
Gas name ASCII Char 1-2			
Gas name ASCII Char 3-4			
Gas name ASCII Char 5-6			
Gas name ASCII Char 7-8			
Gas name ASCII Char 9-10			
Gas name ASCII Char 11-12			
Gas name ASCII Char 13-14			
Gas name ASCII Char 15-16			
Gas index			
Flow units ASCII Char 1-2	2	18	10
Flow units ASCII Char 3-4			
Flow units ASCII Char 5-6			
Flow units ASCII Char 7-8			
Flow unit - index			
User full scale – low word			
User full scale – high word			
Totalizer units Char 1-2			

Totalizer units Char 3-4			
Totalizer unit - index			
Temp. units ASCII Char 1-2	3	28	7
Temperature unit - index			
Pressure units ASCII Char 1-2			
Pressure units ASCII Char 3-4			
Pressure units ASCII Char 5-6			
Pressure units ASCII Char 6-7			
Pressure unit - index			
Alarm active	4	61	2
Alarm mode			

Table 2: Factory Static MODBUS Registers

Chapter 5 – Re-configuring the FF-BUS Using NI-FBUS Configurator

The National Instruments F-BUS Configurator software is widely used for testing and configuration of FF-BUS devices. Consult your NI-FBUS Configurator manual for more information on this NI software (included in NI-FBUS help on the software).

Before starting the NI-FBUS Configurator, you must import the DD using the NI-FBUS Interface Configurator Utility. The DD files are available can be downloaded from our web site at: http://www.sierrainstruments.com/userfiles/file/Tested_Sierra_FF_DD_files.zip
Or from the Fieldbus Foundation web site at:
http://www.fieldbus.org/index.php?option=com_mtree&task=viewlink&link_id=1958&ffbstatus=Registered&Itemid=324

Getting Started Configuring FF-Bus Using NI-FBUS Configurator

1. Start the NI-FBUS COM manager then start the NI-FBUS Configurator.
2. When NI-FBUS Configurator starts, choose the FF-BUS interface used.
3. If the 240i or 241i is connected correctly, SIERRA_DEVICE should appear on your screen as shown below.
4. The node address (factory set) is set to 247. We suggest it be changed to suit the FF-BUS application. Change the Tag names as needed.
5. Make other configuration changes as needed.

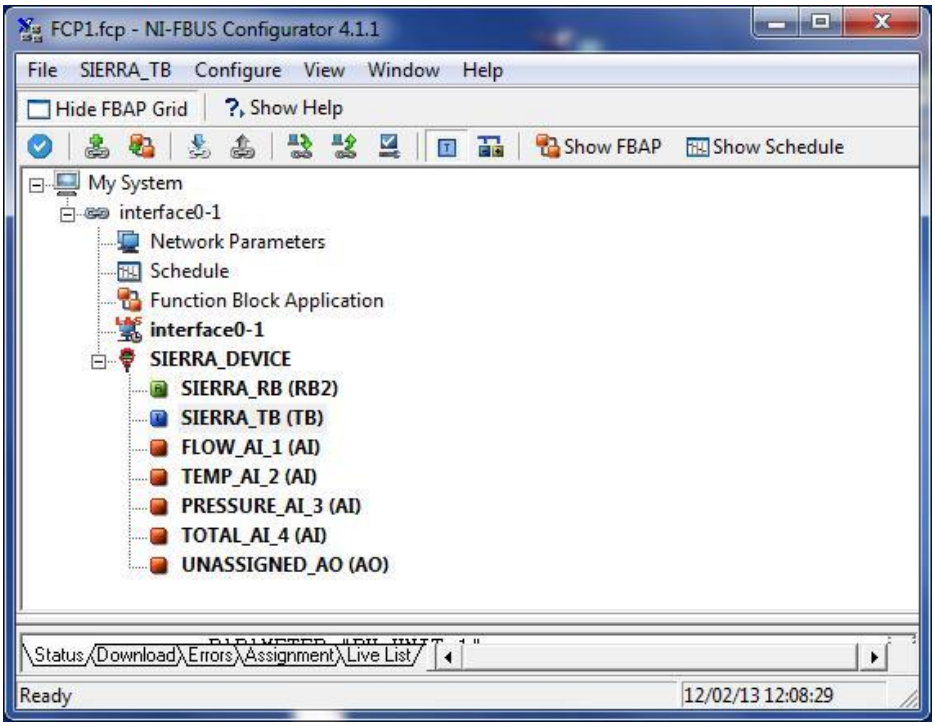

Figure 2: NI Screen after SIERRA_DEVICE Is Found

Configuration

Most of the configuration will be done in the Transducer Block (SIERRA_TB) under the "Others" tab (see the screen shots below). In order to write any changes, the Block Mode must be set to OOS (out of service). Make your changes and click "Write Changes." Once the yellow highlights disappear, click Auto mode. The configuration below was already done at the factory.

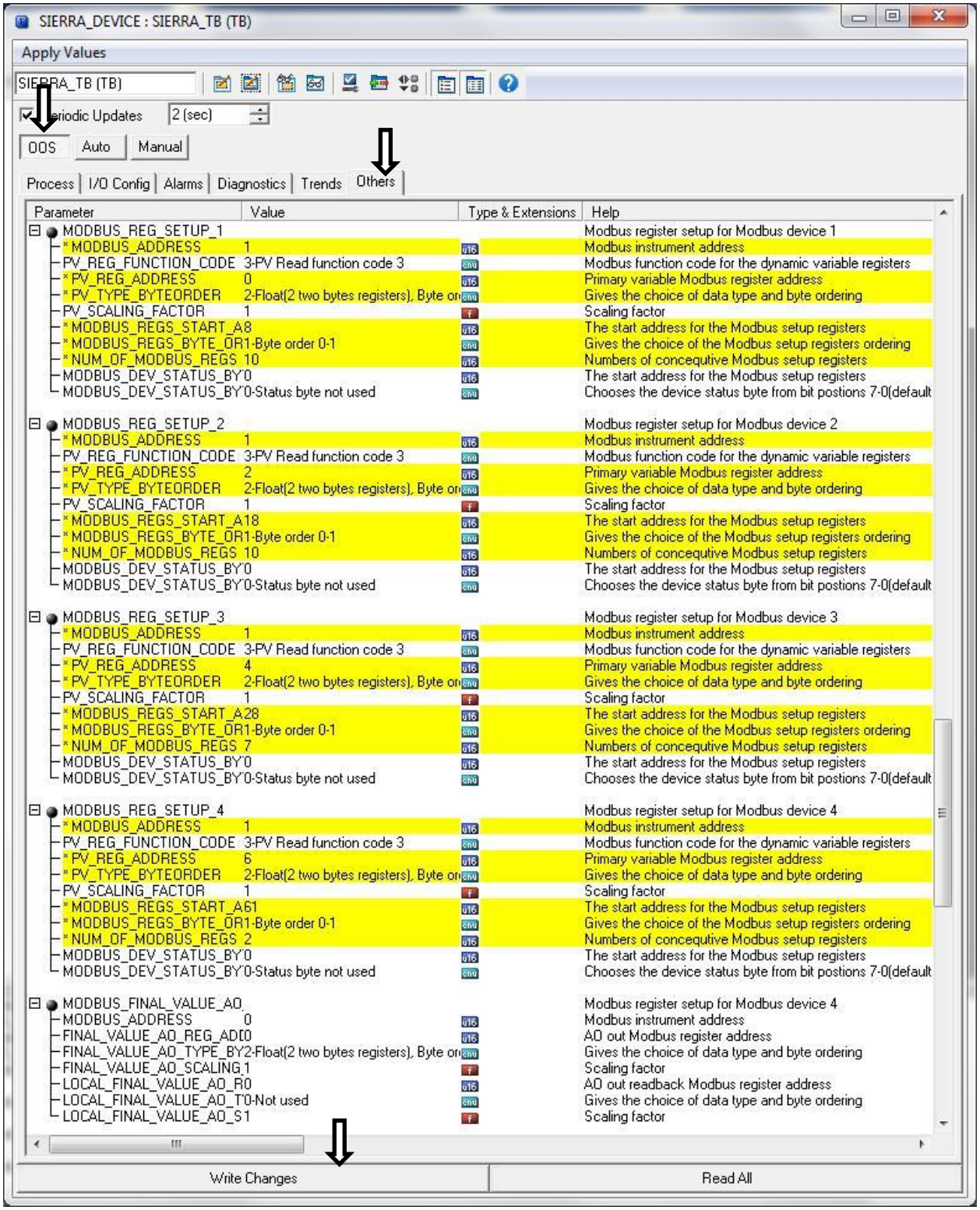

Figure 3: Screen before Writing Changes

After completing the configuration, you should be able to read the variables being returned from your flow meter on the same SIERRA_TB block on the "Others" tab. Flow (PV_1) and Pressure (PV_2), etc. are shown below (See Figure 4). If you scroll down futher, you will also see the static MODBUS_REGS_ values being read from the meter (See Figure 5).

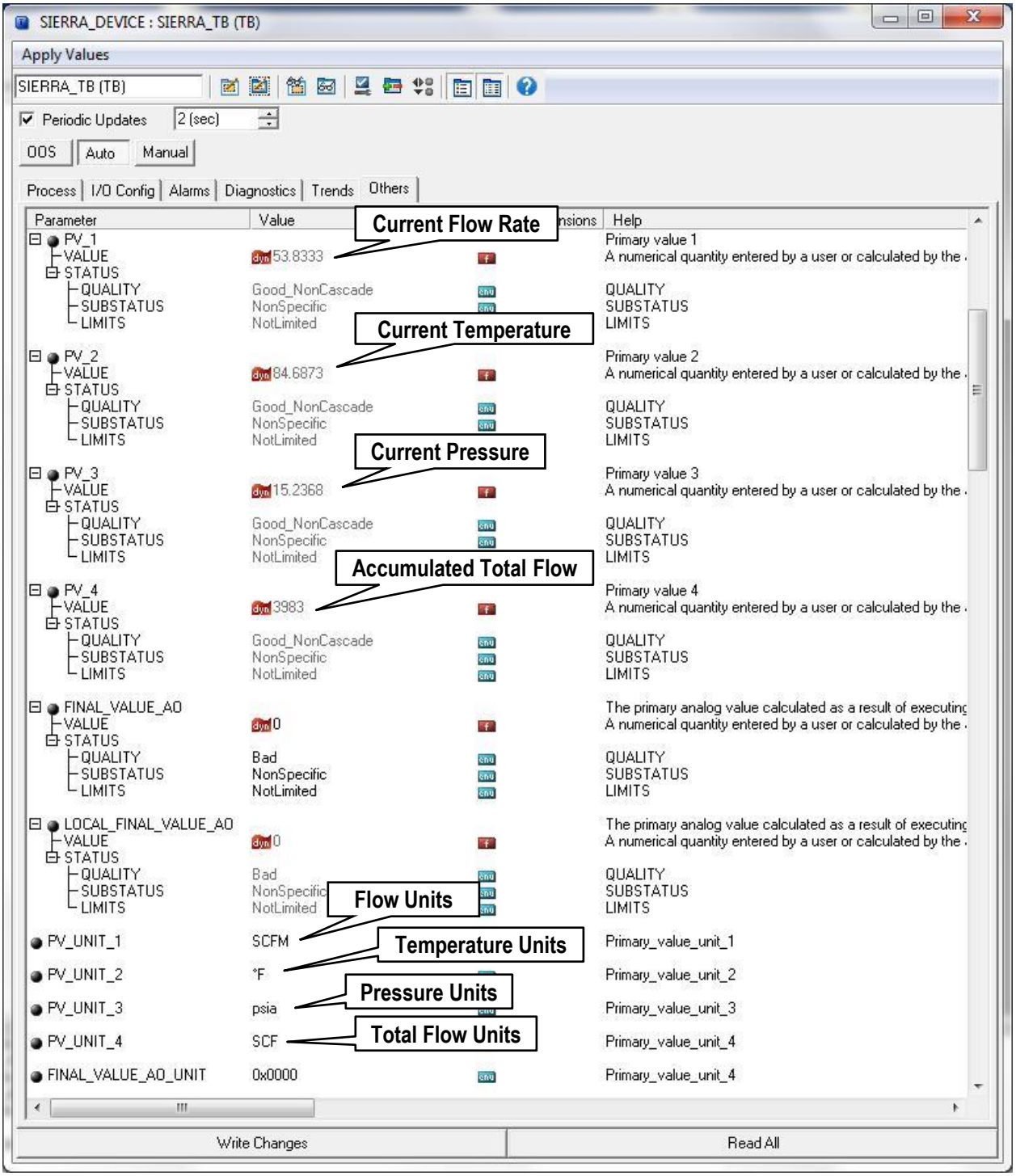

Figure 4 Screen Showing PV1,2,3,4 & Units From Meter

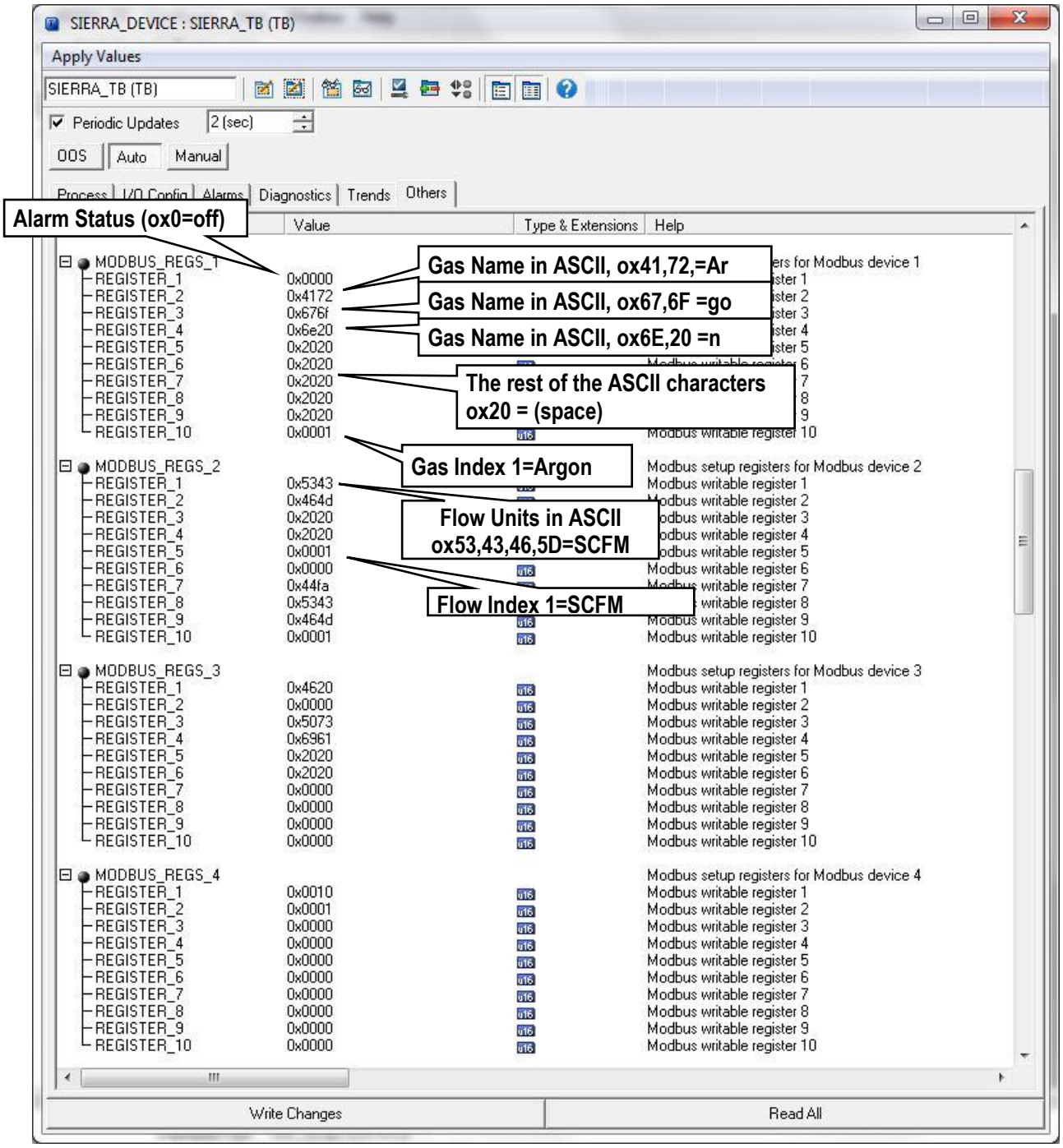

Fig. 5 Screen showing MODBUS_REGS static register values from meter

You may also set the engineering units in the NI-FBUS Configurator so they can be read by the FF-BUS under PV_UNIT_1,2,3,4 and FINAL_VALUE_AO_UNIT (See Figure 6). To change the engineering units the meter is using requires changing the flow units, temperature unit, or pressure unit index in the Modbus registers.

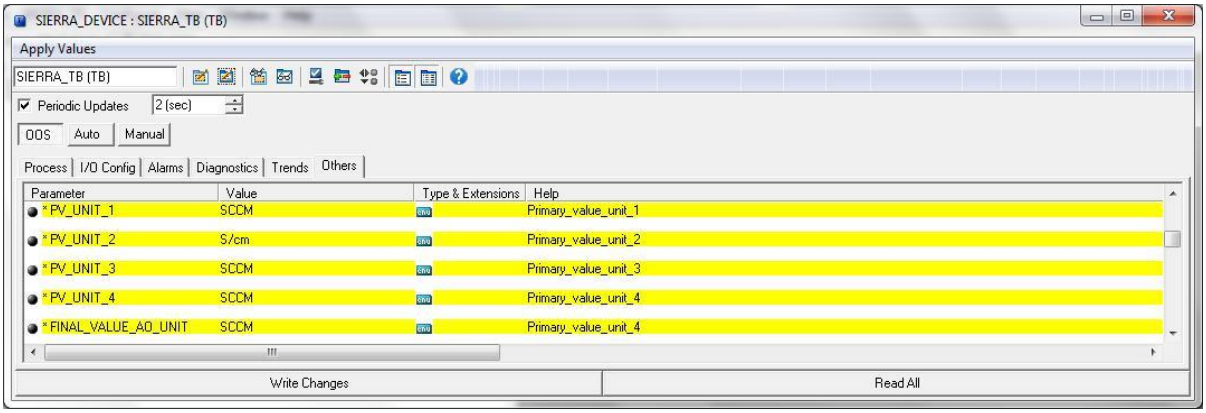

Figure 6: TB Block Engineering Unit Setup

MODBUS_COM_SETUP

The Modbus com settings are needed for the communication connection between the Modbus and the FF-BUS boards inside the meter. The Modbus Instrument Address ***must*** always be set to 1. The MODBUS _COM_SETUP ***must*** always set as shown below:

BaudRate: 9600 Baud
Stop_Bits: 1
Parity: None
CRC_ORDER: Normal

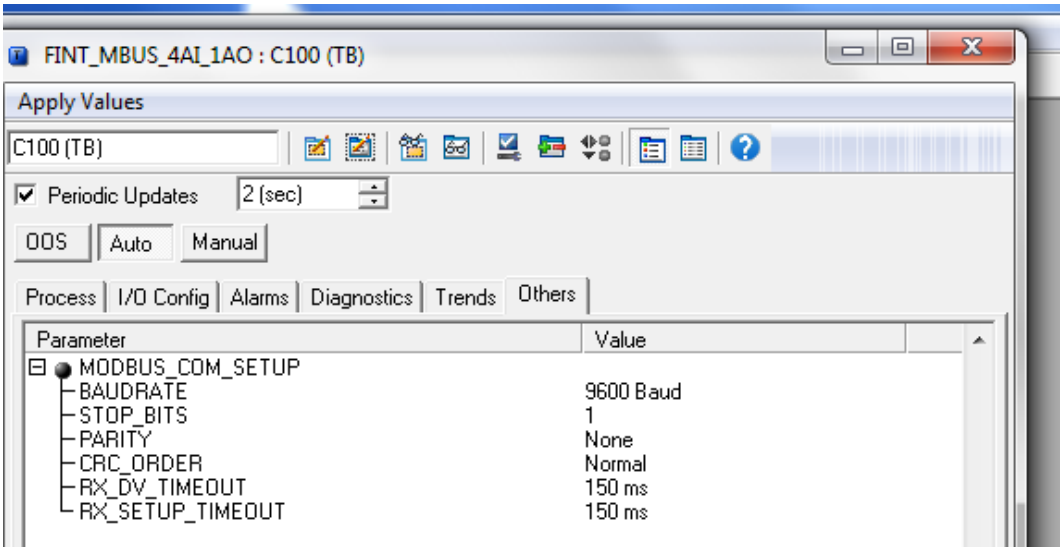

Figure 7: Screen Showing MODBUS_COM_SETUP

Chapter 6 – Available Modbus Registers

Although most users will be satisfied using the default configuration, other Modbus registers can be configured for Foundation Fieldbus access. Below (Table 3) is a list of all available Modbus registers. These would need to be configured in the transducer block.

Register	Description	Read/ Write	Data Type
00	Actual flow - low word	R	32 bits real
01	Actual flow - high word	R	
02	Actual temp - low word	R	32 bits real
03	Actual temp - high word	R	
04	Actual pressure - low word	R	32 bits real
05	Actual pressure - high word	R	
06	Actual total - low word	R	32 bits real
07	Actual total - high word	R	
08	Alarm status	R	integer
09	Gas name	R	16 bits , 2 ASCII per reg.
~			
10			16 Characters total
17	Gas index	R/W	integer
18	Flow units	R	16 bits , 2 ASCII per reg.
~			
21			8 Characters total
22	Flow unit - index	R/W	integer
23	User full scale – low word	R/W	32 bits real
24	User full scale – high word	R/W	
25	Totalizer units	R	16 bits ASCII
26			
27	Totalizer unit - index	R	integer
28	Temperature units	R	16 bits, 2 ASCII Char.
29	Temperature unit - index	R/W	integer
30	Pressure units	R	16 bits ASCII
~			
33			8 Characters total
34	Pressure unit - index	R/W	16-bit integer
35	Standard Temperature - low word	R/W	32 bits real
36	Standard Temperature - high word	R/W	
37	Standard Temperature - index	R/W	16-bit integer
38	Standard pressure - low word	R/W	32 bits real
39	Standard pressure - high word	R/W	
40	Standard pressure - index	R/W	16-bit integer
41	Normal Temperature - low word	R/W	32 bits real
42	Normal Temperature - high word	R/W	
43	Normal Temperature - index	R/W	16-bit integer
44	Normal pressure - low word	R/W	32 bits real
45	Normal pressure - high word	R/W	
46	Normal pressure - index	R/W	16-bit integer
47	Adjust DAC for flow – 4mA	R/W	16-bit integer
48	Adjust DAC for flow – 20mA	R/W	16-bit integer
49	Adjust DAC for Temperature – 4mA	R/W	16-bit integer
50	Adjust DAC for Temperature – 20mA	R/W	16-bit integer
51	Adjust DAC for pressure – 4mA	R/W	16-bit integer

52	Adjust DAC for pressure – 20mA	R/W	16-bit integer
53	Temperature 4mA value – low word	R/W	32 bits real
54	Temperature 4mA value – high word	R/W	
55	Temperature 20mA value – low word	R/W	32 bits real
56	Temperature 20mA value – high word	R/W	
57	Pressure 4mA value – low word	R/W	32 bits real
58	Pressure 4mA value – high word	R/W	
59	Pressure 20mA value – low word	R/W	32 bits real
60	Pressure 20mA value – high word	R/W	
61	Alarm active	R/W	16-bit integer
62	Alarm mode	R/W	16-bit integer
63	Low alarm flow trig – low word	R/W	32 bits real
64	Low alarm flow trig – high word	R/W	
65	High alarm flow trig – low word	R/W	32 bits real
66	High alarm flow trig – high word	R/W	
67	Low alarm temp trig – low word	R/W	32 bits real
68	Low alarm temp trig – high word	R/W	
69	High alarm temp trig – low word	R/W	32 bits real
70	High alarm temp trig – high word	R/W	
71	Low alarm pressure trig – low word	R/W	32 bits real
72	Low alarm pressure trig – high word	R/W	
73	High alarm pressure trig – low word	R/W	32 bits real
74	High alarm pressure trig – high word	R/W	
75	Low alarm total trig – low word	R/W	32 bits real
76	Low alarm total trig – high word	R/W	
77	High alarm total trig – low word	R/W	32 bits real
78	High alarm total trig – high word	R/W	
79	Pipe diameter – low word	R/W	32 bits real
80	Pipe diameter – high word	R/W	
81	Pipe roughness	R/W	16-bit integer
82	Pipe diameter units - index	R/W	16-bit integer
83	Flow correction – low word	R/W	32 bits real
84	Flow correction – high word	R/W	
85	Totalizer enable	R/W	16-bit integer
86	Totalizer units per pulse – low word	R/W	32 bits real
87	Totalizer units per pulse – high word	R/W	
88	Totalizer pulse width	R/W	16-bit integer
89	Totalizer reset	R/W	16-bit integer
90	Password	R/W	16-bit integer
91	Standard temperature units	R	16 bits , 2 ASCII per reg.
92	Normal temperature units	R	16 bits , 2 ASCII per reg.
93	Standard pressure units	R	16 bits ASCII
~			
96			8 Characters total
97	Normal pressure units	R	16 bits ASCII
~			
100			8 Characters total
101	Pipe diameter units	R	16 bits ASCII
102			4 Characters total
103	Pipe roughness description	R	16 bits ASCII
~			
107			10 Characters total
108	Alarm status	R	16 bits ASCII
109			4 Characters total

110	Alarm active	R	16 bits ASCII
111			4 Characters total
112	Alarm mode	R	16 bits ASCII
~			
114			6 Characters total
115	Serial number	R	16 bits ASCII
~			
118			8 Characters total
119	Firmware version	R	16 bits ASCII
~			
122			8 Characters total
123	Calibration date	R	16 bits ASCII
~			
127			10 Characters total
128	PCA version	R	16 bits ASCII
~			
130			6 Characters total

Table 3: All Available Modbus Registers

Chapter 7 – Modbus Registers Explained

The Modbus registers can be divided into two groups. The first group (00 - 08) represents the dynamic data used in AI1,2,3, and 4. The second group (09 – 130) contains the settings in the flow meter. Most of these may be used in the MODBUS_REGS rather than the AI/AO blocks.

Caution!

To fully understand the registers and their functions, we suggest you also read the InnovaMass® 240i/241i Instruction manual.

Register Descriptions

00-01: Actual Flow

The actual flow as measured by the flow meter. 32-bit real data type.

02-03: Actual Temperature

The actual gas temperature as measured by the flow meter. 32-bit real data type.

04-05: Actual Pressure

The actual pressure as measured by the flow meter (if applicable). 32-bit real data type.

06-07: Actual Total

The actual accumulated total over time also referred to as a totalizer. 32-bit real data type.

08: Alarm Status

This 16-bit integer value represents the status of the alarm.
0 – Alarm of Off/Inactive
1 – Alarm is On/Active

09-16: Gas Name

These eight registers contain a 16 character ASCII string showing the name of the currently selected gas. Use Register 17, to select a different gas.

17: Gas Index

Value indicates which gas is selected on the flow meter. The value can range between 0 and 3. 0 is always Air and 1-3 are the alternate gases. The Gas type can be changed by changing this value.

18-21: Flow Units

This eight-character ASCII string shows the currently selected flow engineering unit on the flow meter. Use Register 22 to select a different flow unit

22: Flow Unit Index

This 16-bit integer value shows which flow unit is selected on the flow meter. The value can range between 0 and 49:

Mass Flow Units:

0 - SCFS	23 - NCFD	51 - NLPM	109 - Lton/yr
1 - SCFM	24 - NCFY	52 - NLPH	110 - Mton/sec
2 - SCFH	25 - SM3/sec	53 - NLPD	111 - Mton/min
3 - SCFD	26 - SM3/min	54 - NLPY	112 - Mton/hr
4 - SCFY	27 - SM3/hr	55 - Lbs/sec	113 - Mton/day
5 - MSCFS	28 - SM3/day	56 - Lbs/min	114 - Mton/yr
6 - MSCFM	29 - SM3/yr	57 - Lbs/hr	115 - Gram/sec
7 - MSCFH	35 - NM3/sec	58 - Lbs/day	116 - Gram/min
8 - MSCFD	36 - NM3/min	59 - Lbs/yr	117 - Gram/hr
9 - MSCFY	37 - NM3/hr	100 - Ston/sec	118 - Gram/day
10 - MMSCFS	38 - NM3/day	101 - Ston/min	119 - Gram/yr
11 - MMSCFM	39 - NM3/yr	102 - Ston/hr	120 - Kg/sec
12 - MMSCFH	40 - SLPS	103 - Ston/day	121 - Kg/min
13 - MMSCFD	41 - SLPM	104 - Ston/yr	122 - Kg/hr
14 - MMSCFY	42 - SLPH	105 - Lton/sec	123 - Kg/day
20 - NCFS	43 - SLPD	106 - Lton/min	124 - Kg/yr
21 - NCFM	44 - SLPY	107 - Lton/hr	
22 - NCFH	50 - NLPS	108 - Lton/day	

Volume Flow Units:

15 - ACFS	60 - Gal/sec	75 - bbl/sec	90 - m3/sec
16 - ACFM	61 - Gal/min	76 - bbl/min	91 - m3/min
17 - ACFH	62 - Gal/hr	77 - bbl/hr	92 - m3/hr
18 - ACFD	63 - Gal/day	78 - bbl/day	93 - m3/day
19 - ACFY	64 - Gal/yr	79 - bbl/yr	94 - m3/yr
30 - AM3/sec	65 - MilG/sec	80 - lit/sec	95 - ft3/sec
31 - AM3/min	66 - MilG/min	81 - lit/min	96 - ft3/min
32 - AM3/hr	67 - MilG/hr	82 - lit/hr	97 - ft3/hr
33 - AM3/day	68 - MilG/day	83 - lit/day	98 - ft3/day
34 - AM3/yr	69 - MilG/yr	84 - lit/yr	99 - ft3/yr
45 - ALPS	70 - ImpG/sec	85 - MilL/sec	150 - bl/s
46 - ALPM	71 - ImpG/min	86 - MilL/min	151 - bl/m
47 - ALPH	72 - ImpG/hr	87 - MilL/hr	152 - bl/hr
48 - ALPD	73 - ImpG/day	88 - MilL/day	153 - bl/day
49 - ALPY	74 - ImpG/yr	89 - MilL/yr	154 - bl/yr

Mass Velocity:

125 - SFPS	129 - SFPY	143 - SMPD	147 - NMPH
126 - SFPM	140 - SMPS	144 - NMPY	148 - NMPD
127 - SFPH	141 - SMPM	145 - NMPS	149 - NMPY
128 - SFPD	142 - SMPH	146 - NMPM	

Actual Velocity:

130 - FPS	134 - FPY	138 - MPD	157 - In/hr
131 - FPM	135 - MPS	139 - MPY	158 - In/day
132 - FPH	136 - MPM	155 - In/sec	159 - In/yr
133 - FPD	137 - MPH	156 - In/min	

Warning!

The totalizer only works when Flow units are chosen, it will not work when if Velocity units are selected.

23-24: User Full Scale

Registers 23-24 is the "4-20mA Flow Out" full scale value. Changing this only affects the 4-20 mA flow output and will not affect the Modbus data. 32-bit real data type.

25-26: Totalizer Flow Units

This 4-character ASCII string shows the currently selected totalizer unit on the flow meter. The totalizer unit is linked to the flow unit. Changing the flow unit index will change the totalizer unit.

27: Totalizer Unit Index

This 16-bit integer value shows which unit is selected on the flow meter (read only). These correspond with the Flow Unit Index shown with the integral time stripped off. Examples: 1= SCFM flow unit or SCF total unit, 2= SCFH flow unit or SCF total unit.

28: Temperature Unit

This 2-character ASCII data string shows the currently selected temperature unit on the flow meter. Use Register 29, to select a different unit.

29: Temperature Unit Index

This 16-bit integer value shows which temperature unit is selected on the flow meter:

- 0 – F
- 1 – C
- 2 – K
- 3 – R

30: Pressure Unit

This 8-character ASCII string shows the currently selected pressure unit on the flow meter. Use Register 34 to select a different unit

34: Pressure Unit Index

This 16-bit integer value shows which pressure unit is selected on the flow meter:

- 0 – PSIA
- 1 – PSIG
- 2 – Bar A
- 3 – Bar G
- 4 – KPa A
- 5 – KPa G
- 6 – Kg

35-36: Standard Temperature

Value shows the standard temperature. 32-bit real data type.

37: Standard Temperature Unit Index

This 16-bit integer value shows which temperature unit is selected as standard temperature:

- 0 – F
- 1 – C
- 2 – K
- 3 – R

38-39: Standard Pressure

Value shows the standard pressure. 32-bit real data type.

40: Standard Pressure Index

This 16-bit integer value shows which pressure unit is selected as the standard pressure:

- 0 – PSIA
- 1 – PSIG
- 2 – Bar A
- 3 – Bar G
- 4 – KPa A
- 5 – KPa G
- 6 – Kg/Cm2 A
- 7 – Kg/Cm2 G
- 8 – In H2O A
- 9 – InH2O G
- 10 – MM H2O A
- 11– MM H2O G

41-42: Normal Temperature

Value shows the normal temperature. 32-bit real data type.

43: Normal Temperature Unit Index

This 16-bit integer shows which temperature unit is selected as the normal temperature:

- 0 – F
- 1 – C
- 2 – K
- 3 – R

44-45: Normal Pressure

Value shows the normal pressure. 32-bit real data type.

46: Normal Pressure Index

This 16-bit integer shows which pressure unit is selected as the normal pressure:

- 0 – PSIA
- 1 – PSIG
- 2 – Bar A
- 3 – Bar G
- 4 – KPa A
- 5 – KPa G
- 6 – Kg/Cm2 A
- 7 – Kg/Cm2 G
- 8 – In H2O A
- 9 – InH2O G
- 10 – MM H2O A
- 11– MM H2O

Caution!

Registers 47 to 59 only affect the three 4-20mA outputs on the meter, and have no effect on the Modbus or FF-BUS data.

47: Flow - 4mA Tuning
This 16-bit integer is the DAC value that represents 4 mA for the flow output

48: Flow - 20mA Tuning

This 16-bit integer is the DAC value that represents 20 mA for the flow output

49: Temperature - 4mA Tuning

This 16-bit integer is the DAC value that represents 4 mA for the temperature output

50: Temperature - 20mA Tuning

This 16-bit integer is the DAC value that represents 20 mA for the temperature output

51: Pressure - 4mA Tuning

This 16-bit integer is the DAC value that represents 4 mA for the pressure output

52: Pressure - 20mA Tuning

This 16-bit integer is the DAC value that represents 20 mA for the pressure output

53-54: Temperature - 4mA Value

Temperature value that 4 mA equals, in a 32-bit real data type.

55-56: Temperature - 20mA Value

Temperature value that 20mA equals, in a 32-bit real data type.

57-58: Pressure - 4mA Value

Pressure value that 4mA equals, in a 32-bit real data type.

59-60: Pressure - 20mA Value

Pressure value that 20 mA equals, in a 32-bit real data type.

61: Alarm Active

This 16-bit integer value indicates which alarm is active (see below). This is a read/write 16-bit integer value.

- 0 - Off
- 1 - Always On (use this to test the alarm circuit)
- 16 - Flow
- 32 - Pressure
- 64 - Temperature
- 128 – Totalizer

Caution!

Only one alarm can be active when the flow meter is online. This is the meter internal Alarm. FF-BUS alarms will not affect this alarm.

62: Alarm Mode

Value indicates the mode of the currently active alarm (flow, temperature, pressure or totalizer): This is a read/write 16-bit integer value.

- 0 – Alarm set to "Low" mode
- 1 – Alarm set to "High" mode
- 2 – Alarm set to "Window"

The Window Mode (2) is a combination of both "Low" and "High" alarm modes working together. You will need to provide both "Low" and "High" threshold values for this mode to work correctly. Example: If the "Low" is set to 10 and the "High" is set to 20, the alarm will only be active below 10 and above 20.

63-64: Flow – Low Alarm Threshold

Value at which the low alarm is triggered in a 32-bit real data type

65-66: Flow – High Alarm Threshold

Value at which the high alarm is triggered in a 32-bit real data type

67-68: Temperature – Low Alarm Threshold

Value at which the low alarm is triggered in a 32-bit real data type

69-70: Temperature – High Alarm Threshold

Value at which the high alarm is triggered in a 32-bit real data type

71-72: Pressure – Low Alarm Threshold

Value at which the low alarm is triggered in a 32-bit real data type

73-74: Pressure – High Alarm Threshold

Value at which the high alarm is triggered in a 32-bit real data type

75-76: Total – Low Alarm Threshold

Value at which the low alarm is triggered in a 32-bit real data type

77-78: Total – High Alarm Threshold

Value at which the high alarm is triggered in a 32-bit real data type

79-80: Pipe Diameter

Value of the pipe diameter in the units that are currently active in a 32-bit real data type

81: Pipe Roughness

This 16-bit integer value indicates the pipe material:

- 0 – PVC
- 1 – Glass
- 2 – Stainless steel-smooth
- 3 – Stainless steel -normal
- 4 – Stainless steel -rough
- 5 – Carbon steel -smooth
- 6 – Carbon steel -normal
- 7 – Carbon steel -rough
- 8 – Carbon-fiber
- 9 – Cast-iron
- 10 – Concrete

82: Pipe Diameter Units

This 16-bit integer value indicates the current pipe diameter units:

- 0 – Inches
- 1 – Feet
- 2 – Millimeters
- 3 – Meters

83-84: Flow Correction

This 32-bit real value is used to alter the flow reading (default = 1.000)

85: Enable Totalizer

This 16-bit integer is used to enable or disable the totalizer:

0 = off
1 = on

86-87: Totalizer units per pulse

This 32-bit real value determines when the totalizer output will pulse. Maximum frequency of the pulse output is 1 Hz.

88: Totalizer Pulse Output Width

This 16-bit integer value selects the pulse width of the pulse output:

- 0 – Off
- 1 – On used for testing
- 2 – 50ms
- 3 – 100ms
- 4 – 250ms

89: Totalizer Reset

Write any 16-bit integer value to reset the totalizer.

90: Password

This 16-bit register shows the currently active password as a integer. Note: the password is only used to control access to the display module and is not used during FF-BUS communication.

91: Standard Temperature Unit

This 2 character ASCII string shows the temperature unit of the standard temperature:

- F
- C
- K
- R

92: Normal Temperature Unit

This 2 character ASCII string shows the temperature unit of the normal temperature:

- F
- C
- K
- R

93-96: Standard Pressure Unit

This 8 character ASCII string shows the pressure unit of the standard pressure:

- Psia
- Psig
- Bar A
- Bar G
- KPa A
- KPa G
- Kg/CM2 A
- Kg/CM2 G
- In H20 A
- In H20 G
- MM H20 A
- MM H20 G

97-100: Normal Pressure Unit

This 8 character ASCII string shows the pressure unit of the normal pressure:

- Psia
- Psig
- Bar A
- Bar G
- KPa A
- KPa G
- Kg/CM2 A
- Kg/CM2 G
- In H20 A
- In H20 G
- MM H20 A
- MM H20 G

101-102: Pipe Diameter Units

This 2 character ASCII string shows the pipe diameter units:

- Inches
- Feet
- Millimeters
- Meters

103-107: Pipe Roughness Description

This 10 character ASCII string shows the selected pipe roughness:

- PVC
- Glass
- Stainless steel-smooth
- Stainless steel -normal
- Stainless steel -rough
- Carbon steel -smooth
- Carbon steel -normal
- Carbon steel -rough
- Carbon-fiber
- Cast-iron
- Concrete

108-109: Alarm Status Description

This 4 character ASCII string shows the alarm status:

- Off
- On

110-111: Alarm Active Description

This 4 character ASCII string shows the active alarm:

- Off
- Flow
- Pressure
- Temperature
- Totalizer

112-114: Alarm Mode Description

This 6 character ASCII string shows the alarm mode:

- Low
- High
- Window

115-118: Serial Number

This 8-character ASCII string shows the serial number of the unit.

119-122: Firmware Revision

This 8 character ASCII string shows the firmware version of the unit.

123-127: Calibration Date

This 10 character ASCII string shows the date the unit was calibrated.

128-130: PCA Version

This 6 character ASCII string shows the revision number of the PCA.

Chapter 8 – Communication Diagnostic LEDS

Communication Diagnostic LEDS

The photo below is taken from the Display side of the enclosure. If the FF-BUS in the meter is working:
LED 1 will be green with a slight blink off after initialization. This Indicates the 240i is talking to the Modbus board.
LED 2 will flash red every time the FF-Bus board talks to the Modbus board. This will cause the LED to blink about 3 times a second.

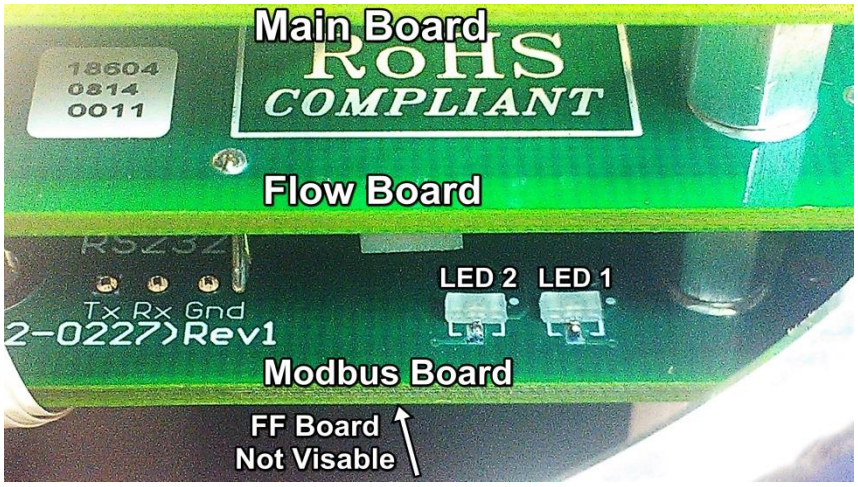

Figure 8: Diagnostic LED locations