InnovaMass® 240i/241i Series BACnet

Instruction Manual

BACnet Device Specification for Models:
240i and 241i
Volumetric & Multivariable Mass Vortex Flow Meter

Part Number: IM240i/241i BACnet
Version V3.4/19

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
info@sierrainstruments.com
www.sierrainstruments.com

EUROPE HEADQUARTERS
Bijlmansweid 2 1934RE Egmond aan den Hoef
The Netherlands
Phone +31 72 5071400 Fax +31 72 5071401
sales@sierrainstruments.nl

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
orders@sierra-asia.com

For Global Service Centers, go to http://www.sierrainstruments.com/facilities.html

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," "Attention," and "Note" statements are used throughout this manual to draw your attention to important information.

Symbol Key		
Symbol	**Symbol Meaning**	**Descripition**
	Warning	"Warning" statements appear with information that is important to protect people and equipment from damage. Pay very close attention to all warnings that apply to your application. **Failure to comply with these instructions may damage the meter and cause personal injury.**
	Caution	"Attention" indicates that failure to comply with stated instructions **may result in damage or faulty operation of the meter.**
	Note	"Note" indicates that ignoring the relevant requirements or precautions may result in flow meter damage or malfunction.

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 component

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 Series Product Instruction Manual.

If the problem persists after following the troubleshooting procedures outlined in the 640S or 780S product manuals, 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)

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Warranty Statement

All Sierra products are warranted to be free from defects in material and workmanship and will be repaired or replaced at no charge to Buyer, provided return or rejection of product is made within a reasonable period but no longer than one (1) year for calibration and non-calibration defects, from date of delivery. To assure warranty service, customers must register their products online on Sierra's website. Online registration of all of your Sierra products is required for our warranty process. Read complete warranty policy at www.sierrainstruments.com/warranty.

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Chapter 1: Introduction

This manual will explain the function and operation of the optional BACnet interface for Sierra Instruments InnovaMass® 240i/241i iSeries vortex mass flow meter.

This document is intended to be a complement to other 240i/241i® documentation by providing a complete description of the InnovaMass iSeries from a BACnet communication perspective. It is also intended to be a technical reference for BACnet capable host application developers, system integrators and knowledgeable end users. This manual assumes the reader already has a working knowledge of BACnet protocol requirements and terminology. For specific operations of the InnovaMass 240i and 241i vortex flow meter, consult the InnovaMass 240i/241i iSeries Instruction manual.

BACnet MS/TP Description

BACnet is a communications protocol for Building Automation and Control (BAC) networks that is governed by the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE), SSPC 135, ANSI, and ISO 16484-5 standard protocol.

The BACnet Master---slave/token-passing (MS/TP) driver implements a data link protocol that uses the services of the RS-485 physical layer. The MS/TP bus is based on BACnet standard protocol SSPC-135, Clause 9. BACnet MS/TP protocol is a peer-to-peer, multiple master protocols based on token passing. Only master devices can receive the token, and only the device holding the token is allowed to originate a message on the bus. The token is passed from master to master using a small message in consecutive order starting with the lowest address. Slave devices on the bus only communicate on the bus when responding to a data request from a master device.

	**Caution!** To fully understand the InnovaMass and its functions please read the InnovaMass instruction manual.

Chapter 2: BACnet Installation

Overview 2-Wire Topology RS-485 Network

BACnet MS/TP uses a common 2-wire RS-485 (EIA-485) physical layer, so all of the same RS-485 wiring practices apply. Devices should be wired using a daisy chain topology and the last device should have a 120Ω termination resistor to prevent reflections. RS-485 repeaters may be used to exceed 32 devices or to clean up the signal. In some cases, a pull up and pulldown resistor may be used to "stiffen" the bus bias. If stub wires are necessary, they cannot be more than 10 cm long. (See Figure 1).

BACnet MS/TP uses a proprietary RS-485 with master slave token passings so all devices can be a master or a slave. If you need an inexpensive USB to BACnet MS/TP converter for your PC for testing, we recommend Control Solutions, Inc.'s model MTX00 2

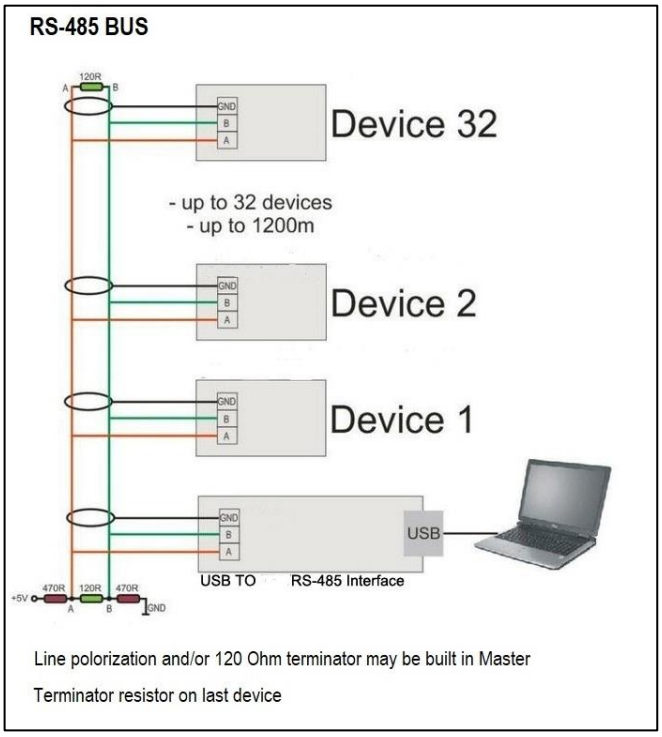

Figure 1. RS-485 Network Example

Electrical Connections-Input

All electrical connections are made on the terminal board inside the InnovaMass enclosure.
For detailed instructions on installing your InnovaMass iSeries meter, please read the InnovaMass 240i/241i Instruction Manual. For complete wiring instructions please see Chapter 2 of the 240i/241i instruction manual.

Input Power Wiring

AC Power Wiring

The AC power wire size must be 26 to 16 AWG with the wire stripped 1/4 inch (6 mm). Connect 100 to 240 VAC (0.2 Amps RMS at 230 VAC) to the neutral and line terminals on the terminal block. Connect the ground wire to the safety ground lug. Torque all connections to 4.43 to 5.31 in-lbs (0.5 to 0.6 Nm) (See Figure 2).

The Hazardous-Area enclosure has two separate conduit entries to maintain separation between AC input power and output signal wiring. To eliminate the possibility of noise interference, use a separate cable entry for the AC power and signal lines.

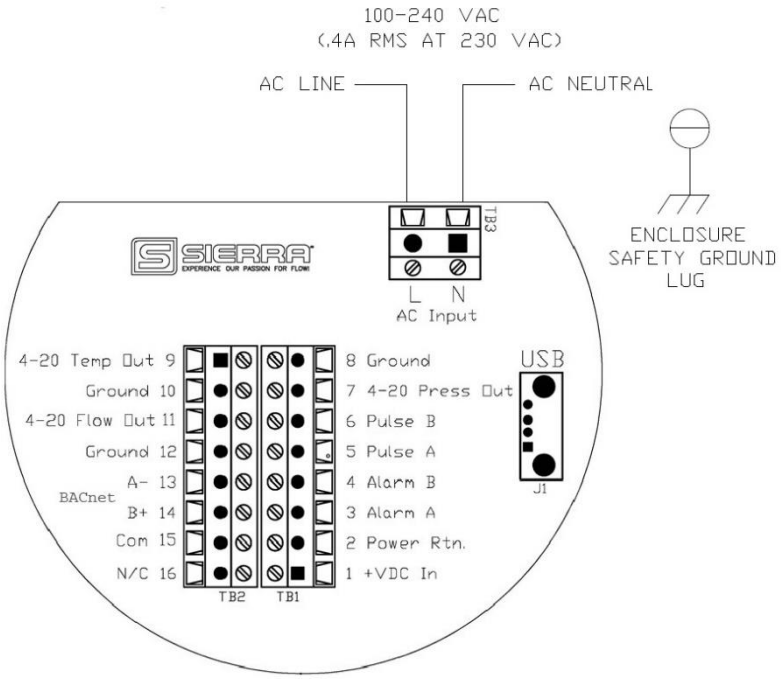

Figure 2. AC Input Power Wiring Connections

	All wiring procedures must be performed with the power Off.
	The AC wire insulation temperature rating must meet or exceed 80 °C (176°F).

DC Power Wiring

The DC power wire size must be 26 to 16 AWG with the wire stripped 1/4 inch (6 mm). Connect 24 VDC +/- 10% (0.4 amp load, maximum) to the terminals marked on the terminal block. Connect the earth ground wire to the safety ground log. Torque all connections to 4.43 to 5.31 in-lbs (0.5 to 0.6 Nm). See Figure 3.

If conduit seals are used, they must be installed within 18 inches of the enclosure.

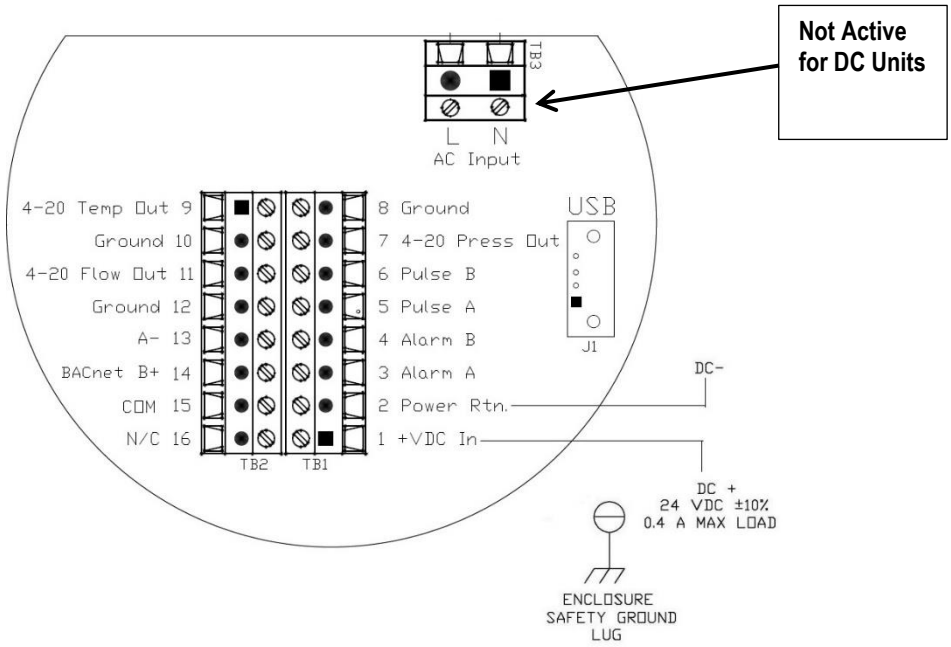

Figure 3. DC Input Power Wiring Connections

	All wiring procedures must be performed with the power off.

Connecting the RS-485 Network Wires

	Caution! The InnovaMass is equipped with an optical isolated RS-485 interface. Grounding the RS-485 common (15) would defeat this.

1. Connect your 2-wire RS-485 network to terminal 13 (A-) and your wire RS-485 to terminal 14 (B +).
2. Connect the RS-485 common (sheild wire) to terminal Com 15 (See Figure 4).

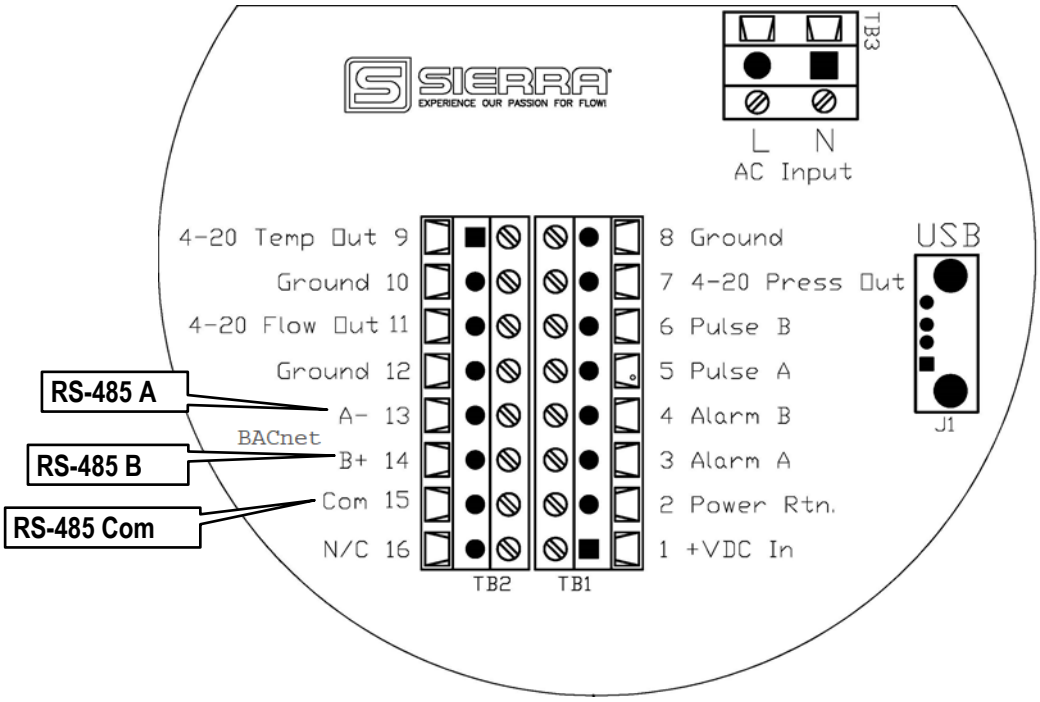

Figure 4. BACnet RS-485 Network Wire Connection

Cable

It is recommended that you use a shielded twisted pair type of cable (reduces radiated and received EMI). Use a 24 AWG shielded twisted pair cable, with low capacitance like Belden 9841.

Terminator

Reflections in a transmission line can cause communication errors. To minimize the reflection, it is required to place 120Ω terminator resistors at both ends of the cable. Never place a terminator resistor somewhere along the cable. Some gateways, PLCs, and other types of devices have terminator resistors built-in. If so, do not add another one. Using an Oscilloscope, you can see what a reflection looks like, and how it can confuse the data (See Figure 5):

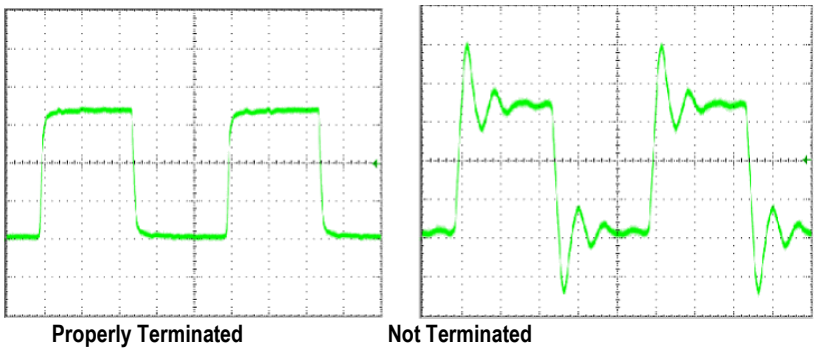

Figure 5. Reflections in Transmission Line

Line Polarization

RS-485 uses three voltage levels, "1", "0", and idle. In noisy environments, it may be necessary to polarize the lines to ensure that the receivers stay in a constant state when the idle "no signal" is present. In most cases, the master does this already.

Commercially available isolated RS-485 repeaters in the middle of your wire run will "clean up" the signals and polarize the idle voltage. This is very useful for long wire runs and noisy environments.

Shield Wire Grounding

We use a RS-485 chip that has 1,5000 volts of isolation (See Figure 4). For electrical noise, it's best to keep the shield wire isolated from Earth ground and only connect it to terminal 16 and the signal ground at the Master.
Occasionally, you may have no choice but to share the network with a device that has a non-isolated RS-485 chip. Usually, you can get by with this. If you still have trouble, you may need to use an isolated RS-485 repeater to separate it from the rest of the network.

Summary: Cabling & Wiring Do's and Don'ts

1. Use a 24 AWG shielded twisted pair cable, with low capacitance, 120Ω impedance like Belden 9841.
2. Never put the RS-485 wires in the same conduit as AC power. Ideally, DC power wires should be run in separate conduit if possible to prevent interference issues.
3. Both ends of the RS-485 network cable should have 120 Ω resistors to prevent reflections. Before the network is running you should be able to verify this with a simple DMM. You should measure about 60Ω total. (Two 120Ω resistors in parallel)
4. Terminals A- and B+ connections will be connected to the twisted wire pair in the center of the cable.
5. The cable shield wire needs be connected terminal C. It's better if the shield it is not connected to Earth ground. However, some other RS-485 devices on your network may already Earth grounded this shield. This is still acceptable, but it's best that this device is near the master.
6. Wires between RS-485 devices need to be wired in a daisy-chain pattern. They should never be wired with separate home-runs back to the master in a Star pattern. When daisy chaining the Modbus A/B wires you should either twist the wires together and solder or use a crimp ferrule, this would still allow the bus to be connected even if the meter A/B wires were disconnected at one 240i.
7. Keep the wires as short as possible inside the enclosure and maintain the wire twist as much as possible.
8. The meter enclosure should always be Earth grounded. This prevents Electrostatic and Electromagnetic noise from interfering with the meter's microprocessor or the BACnet data. In

addition, it also provides for safety, EMI, RFI, and ESD protection. Both the main and remote (if E4 option ordered) enclosures should be connected to Earth ground, see below for more details.

A. **External Earth Grounding:** The external Earth connections are located on the boss on the outside of both the main housing and remote housing (E4 option if ordered) and consist of an 18-8SS pan head Phillips screw (10-24 UNC-2B thread) and a serrated tooth #10 ring terminal for 16-14 AWG wire.

B. **Internal Earth Grounding**: The internal Earth connection is located in the main housing terminal side and consist of an 18-8SS pan head Phillips screw (10-24 UNC-2B thread) and a serrated tooth #10 ring terminal for 16-14 AWG wire.

Chapter 3: InnovaMass 240i/241i Com Settings

The BACnet MS/TP bus must be configured using the InnovaMass 240i/241i SIP version 1.1.72 or higher. BACnet can communicate at one of three baud rates: 9600, 19200 and 38400. It is veryimportant that all of the devices on any MS/TP network be set to communicate at the same baud rate.

Baud Rate and MAC Address Configuration

The Baud rate and MAC (MS/TP) address are changed using the Smart Interface Portal (SIP) software. Download software at http://www.sierrainstruments.com/products/sip/sip-innovamass.html. Once the SIP software is installed, select "Hardware Configuration" from the dropdown list (See Figure 6). In the "Hardware Configuration" screen, select available MS/TP Baud rates are 9600, 19200 and 38400. The "MS/TP MAC Address" of 1 to 127 may be selected, however avoid address 1 and 2. (See Figure 6).

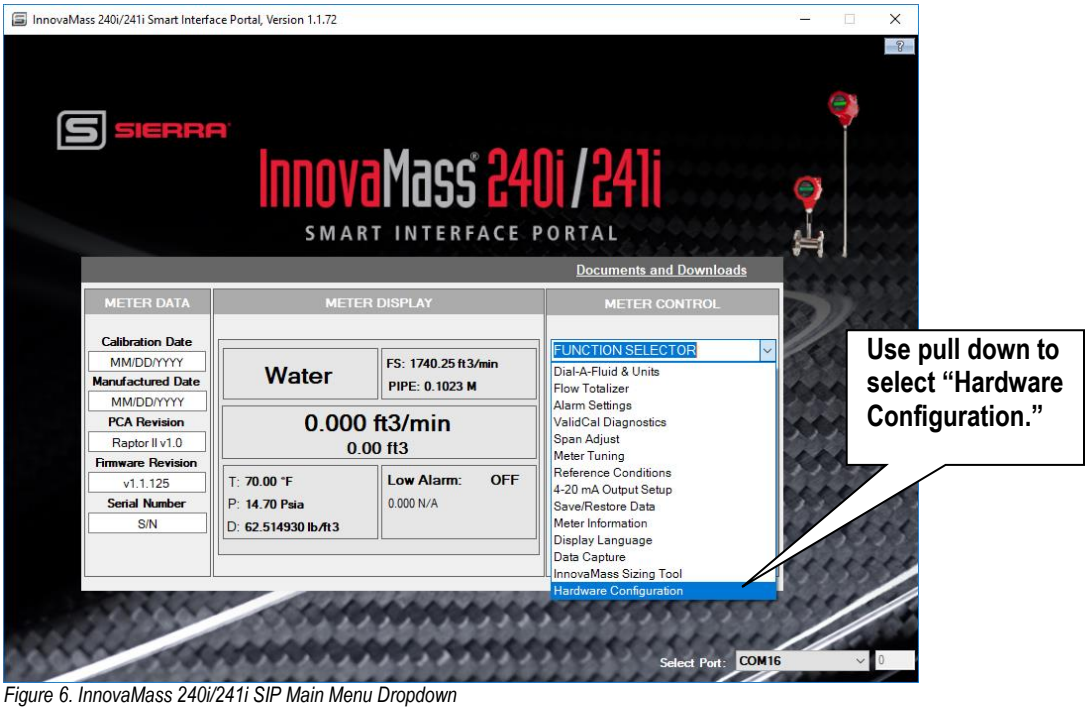

Figure 6. InnovaMass 240i/241i SIP Main Menu Dropdown

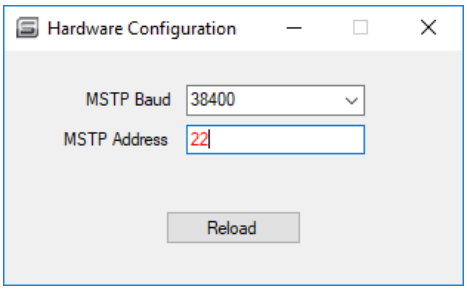

Figure 7. InnovaMass SIP Hardware Configuration Menu

When a new selection is entered it is displayed in red, press Enter and the text becomes black. Once the changes are made, exit the SIP software. The 240i will need the power cycled on and off before the new baud and address changes are loaded into the 240i BACnet board. The 240i reboot will take about 45 seconds.

Chapter 4: Supported BACnet Services/Objects

A BACnet object represents physical or virtual equipment information, as a digital input or parameters. The InnovaMass 240i/241i Series vortex mass flow meter uses the following object types:

a. Device Object (1)
b. Analog Input (21)
c. Binary Input (10)
d. Binary Output (1)

Each object type defines a data structure composed by properties that allow the access to the object information. The table on the following pages shows the implemented properties for each InnovaMass 240i/241i Vortex Mass Flow Meter object type.

Supported BACnet Services/Objects

Supported BACnet Services/Objects		
BACnet Interoperability Building Blocks	**Services**	**Support**
DS-RP-B	Read Property	Execute
DS-WP-B	Write Property	Execute
DM-DDB-B	Read Property Multiple	Execute
DM-DOB-B	Write Property Multiple	Execute
DM-DCC-B	Who-Is	Execute
DS-RPM-B	I--Am	Initiate
DS-WPM-B	Who-Has	Execute
	I-Have	Initiate
	Device Communication Control	Execute

Acronyms and Definitions

Acronyms and Definitions	
Item	**Description**
APDU	Application Protocol Data Unit
BACnet	Building Automation and Control Network--- Data communication protocol
MS/TP	Master---Slave Token passing (a twisted pair RS485 network created by BACnet)
BIBB	BACnet Interoperability Building Block (Specific individual function blocks for data exchange between interoperable devices).
BV	Binary Value
BI	Binary Input
AI	Analog Input
RP	Read Property
WP	Write Property
RPM	Read Property Multiple
WPM	Write Property Multiple.
DDB	Dynamic Device Binding
DOB	Dynamic Object Binding
DCC	Device communication Control

BACnet Supported Device, Object & Property Table

BACnet Object Name	Obj, Instance	BACnet Object Property	Default/Sample Values
Device1	Dev, 1	Object Identifier	MAC
		Object Name	240i Flowmeter
		Object Type	Flowmeter
		System Status	Operational
		Vendor Name	Sierra Instruments
		Vendor Identifier	ASHRA# 722
		Model Name	240i
		Firmware Revision	v1.2.07
		Application Software Version	v1.2.07
		Location	NULL
		Description	NULL
		Protocol Version	1
		Protocol Revision	12
		Protocol Services Supported	
		Protocol Object Types Supported	
		Object List	
		Max APDU Length Accepted	480
		Segmentation Supported	No
		APDU Timeout	6000
		Number Of APDU Retries	3
		Max Master	127
		Max Info Frames	1
		Device Address Binding	
		Database Revision	0
Flow	AI, 1	Object Identifier	AI-1
		Object Name	Flow
		Object Type	Analog Input
		Present Value	1
		Description	Used for measurement of Flow
		Status Flags	F,F,F,F { }
		Event State	NORMAL
		Out Of Service	0
		Units	cubic_feet_per_minute

BACnet Object Name	Obj, Instance	BACnet Object Property	Default/Sample Values
Temperature1	AI, 2	Object Identifier	AI-2
		Object Name	Temperature1
		Object Type	Analog Input
		Present Value	70
		Description	Int. Temperature
		Status Flags	F,F,F,F { }
		Event State	NORMAL
		Out Of Service	0
		Units	degrees_fahrenheit
Temperature2	AI, 3	Object Identifier	AI-3
		Object Name	Temperature2
		Object Type	Analog Input
		Present Value	123.4
		Description	Ext. Temperature
		Status Flags	F,F,F,F { }
		Event State	NORMAL
		Out Of Service	0
		Units	degrees_fahrenheit
Pressure	AI, 4	Object Identifier	AI-4
		Object Name	Pressure
		Object Type	Analog Input
		Present Value	14.7
		Description	Fluid Pressure
		Status Flags	F,F,F,F { }
		Event State	NORMAL
		Out Of Service	0
		Units	pounds_per_square_inch
Energy Flow	AI,5	Object Identifier	AI-5
		Object Name	Energy Flow
		Object Type	Analog Input
		Present Value	1
		Description	Energy Flow in Fluid
		Status Flags	F,F,F,F { }
		Event State	NORMAL
		Out Of Service	0
		Units	btus
Totalizer	AI,6	Object Identifier	AI-6
		Object Name	Totalizer
		Object Type	Analog Input
		Present Value	1235
		Description	Flow Totalizer
		Status Flags	F,F,F,F { }
		Event State	NORMAL
		Out Of Service	0
		Units	cubic_feet

BACnet Object Name	Obj, Instance	BACnet Object Property	Default/Sample Values
Alarm Status	AI,7	Object Identifier	AI-7
		Object Name	Alarm Status
		Object Type	Analog Input
		Present Value	0
		Description	State of Alarm Relay
		Status Flags	F,F,F,F { }
		Event State	NORMAL
		Out Of Service	0
		Units	No units
Alarm active	AI,8	Object Identifier	AI-8
		Object Name	Alarm Active
		Object Type	Analog Input
		Present Value	0
		Description	Source of Alarm
		Status Flags	F,F,F,F { }
		Event State	NORMAL
		Out Of Service	0
		Units	No units
Alarm mode	AI,9	Object Identifier	AI-9
		Object Name	Alarm Mode
		Object Type	Analog Input
		Present Value	0
		Description	Selected Alarm Mode
		Status Flags	F,F,F,F { }
		Event State	NORMAL
		Out Of Service	0
		Units	No units
Velocity	AI,10	Object Identifier	AI-10
		Object Name	Velocity
		Object Type	Analog Input
		Present Value	1
		Description	Point vol. Velocity
		Status Flags	F,F,F,F { }
		Event State	NORMAL
		Out Of Service	0
		Units	feet_per_second
Flow-Pro	AI,11	Object Identifier	AI-11
		Object Name	Flow-Pro
		Object Type	Analog Input
		Present Value	1
		Description	Correction Factor
		Status Flags	F,F,F,F { }
		Event State	NORMAL
		Out Of Service	0
		Units	No units

BACnet Object Name	Obj, Instance	BACnet Object Property	Default/Sample Values
Density	AI,12	Object Identifier	AI-12
		Object Name	Density
		Object Type	Analog Input
		Present Value	1
		Description	Density for mass
		Status Flags	F,F,F,F { }
		Event State	NORMAL
		Out Of Service	0
		Units	No units
Reynolds	AI,13	Object Identifier	AI-13
		Object Name	Reynolds
		Object Type	Analog Input
		Present Value	1
		Description	Reynolds number
		Status Flags	F,F,F,F { }
		Event State	NORMAL
		Out Of Service	0
		Units	No units
Viscosity	AI,14	Object Identifier	AI-14
		Object Name	Viscosity
		Object Type	Analog Input
		Present Value	1
		Description	Dynamic Viscosity
		Status Flags	F,F,F,F { }
		Event State	NORMAL
		Out Of Service	0
		Units	423
Frequency	AI,15	Object Identifier	AI-15
		Object Name	Frequency
		Object Type	Analog Input
		Present Value	1
		Description	Vortex shedder frequency
		Status Flags	F,F,F,F { }
		Event State	NORMAL
		Out Of Service	0
		Units	hertz
Ck factor	AI,16	Object Identifier	AI-16
		Object Name	Ck factor
		Object Type	Analog Input
		Present Value	20
		Description	For dynamic freq.
		Status Flags	F,F,F,F { }
		Event State	NORMAL
		Out Of Service	0
		Units	No units

BACnet Object Name	Obj, Instance	BACnet Object Property	Default/Sample Values
Dynamic frequency	AI,17	Object Identifier	AI-17
		Object Name	Dynamic Frequency
		Object Type	Analog Input
		Present Value	1
		Description	Dynamic frequency value
		Status Flags	F,F,F,F { }
		Event State	NORMAL
		Out Of Service	0
		Units	hertz
Minimum noise level	AI,18	Object Identifier	AI-18
		Object Name	Minimum noise level
		Object Type	Analog Input
		Present Value	1
		Description	Squelch noise lvl
		Status Flags	F,F,F,F { }
		Event State	NORMAL
		Out Of Service	0
		Units	No units
F/S cutoff	AI,19	Object Identifier	AI-19
		Object Name	F/S cutoff
		Object Type	Analog Input
		Present Value	1
		Description	% of full scale
		Status Flags	F,F,F,F { }
		Event State	NORMAL
		Out Of Service	0
		Units	No units
Gain	AI,20	Object Identifier	AI-20
		Object Name	Gain
		Object Type	Analog Input
		Present Value	1
		Description	Signal gain
		Status Flags	F,F,F,F { }
		Event State	NORMAL
		Out Of Service	0
		Units	No units
Amplitude	AI,21	Object Identifier	AI-21
		Object Name	Amplitude
		Object Type	Analog Input
		Present Value	1
		Description	In ADC counts
		Status Flags	F,F,F,F { }
		Event State	NORMAL
		Out Of Service	0
		Units	No units

BACnet Object Name	Obj, Instance	BACnet Object Property	Default/Sample Values
Binary XDR fault	BI-1	Object Identifier	BI-1
		Object Name	Binary XDR fault
		Object Type	Binary Input
		Present Value	0= good, 1=fault
		Description	Binary XDR fault
		Status Flags	F,F,F,F { }
		Event State	0
		Out Of Service	0
Pressure over range	BI-2	Object Identifier	BI-2
		Object Name	Pressure over range
		Object Type	Binary Input
		Present Value	0= good, 1=fault
		Description	Pressure over range
		Status Flags	F,F,F,F { }
		Event State	0
		Out Of Service	0
Temperature fault	BI-3	Object Identifier	BI-3
		Object Name	Temperature fault
		Object Type	Binary Input
		Present Value	0= good, 1=fault
		Description	Temperature fault
		Status Flags	F,F,F,F { }
		Event State	0
		Out Of Service	0
Temperature over range	BI-4	Object Identifier	BI-4
		Object Name	Temperature over range
		Object Type	Binary Input
		Present Value	0
		Description	Temperature overrange
		Status Flags	F,F,F,F { }
		Event State	0
		Out Of Service	0
Flow sensor error	BI-5	Object Identifier	BI-5
		Object Name	Flow sensor error
		Object Type	Binary Input
		Present Value	0= good, 1=fault
		Description	Flow sensor error
		Status Flags	F,F,F,F { }
		Event State	0
		Out Of Service	0
SD card error	BI-6	Object Identifier	BI-6
		Object Name	SD card error
		Object Type	Binary Input
		Present Value	0= good, 1=fault
		Description	SD card error
		Status Flags	F,F,F,F { }
		Event State	0
		Out Of Service	0

BACnet Object Name	Obj, Instance	BACnet Object Property	Default/Sample Values
Communication error	BI-7	Object Identifier	BI-7
		Object Name	Communication error
		Object Type	Binary Input
		Present Value	0= good, 1=fault
		Description	Communication error
		Status Flags	F,F,F,F { }
		Event State	0
		Out Of Service	0
MCU error	BI-8	Object Identifier	BI-8
		Object Name	MCU error
		Object Type	Binary Input
		Present Value	0= good, 1=fault
		Description	MCU error
		Status Flags	F,F,F,F { }
		Event State	0
		Out Of Service	0
Display button stuck	BI-9	Object Identifier	BI-9
		Object Name	Display button stuck
		Object Type	Binary Input
		Present Value	0= good, 1=fault
		Description	Display button stuck
		Status Flags	F,F,F,F { }
		Event State	0
		Out Of Service	0
BACnet communication error	BI-10	Object Identifier	BI-10
		Object Name	BACnet communication error
		Object Type	Binary Input
		Present Value	0= good, 1=fault
		Description	BACnet comm error
		Status Flags	F,F,F,F { }
		Event State	0
		Out Of Service	0
Latched on bad signal	BI-11	Object Identifier	BI-11
		Object Name	Latched on bad signal
		Object Type	Binary Input
		Present Value	0= good, 1=fault
		Description	Latched on bad signal
		Status Flags	F,F,F,F { }
		Event State	0
		Out Of Service	0
Reset	BO-1	Object Identifier	BO-1
		Object Name	Reset Totalizer
		Object Type	Binary Output
		Present Value	0= run, 1=reset
		Description	Reset totalizer
		Status Flags	F,F,F,F { }
		Event State	0
		Out Of Service	0
		Priority	1
		Priority Array	NULL
		Relinquish Default	Inactive

Chapter 5: Engineering Units

BACnet/ASHRAE supports *a defined list of engineering units* using enumerators (base 10 numbers) ranging from 0 to 255. For example, let's say your 240i is using a flow rate in ft^3/min for flow units. The 240i BACnet interface will send a unit enumerator of 84 to your BACnet client. Since 84 is on the standard list of engineering units, the BACnet client will display "cubic-feet-per-minute." When at all possible, we have tried to use standard BACnet engineering units.

Proprietary BACnet engineering units are custom engineering units which the manufacturer (Sierra Instruments) defines that have an enumerator greater than 255. These custom unit enumerators may not be automatically translated into English, so your BACnet client may just display a number greater than 255. You will need to look that number up on the Sierra Custom Units Matrix below. Your BACnet client may have a way for you to add these custom units manually.

Units Not Supported by BACnet

BACnet does not support absolute and gauge pressure, so we have decided to assume gauge pressure. Example: "psig" will be displayed as "pounds-force-per-square-inch" and "psia" will use the custom enumerator of 387.

BACnet does not support standardized volume units like standard-cubic-feet-per-minute and normal-cubic-meters-per-minute. These will use the Sierra Custom Units below.

Sierra Custom Units Matrix			
Enumerator	**Engineering Unit name**	**Enumerator**	**Engineering Unit name**
256	grams-per-hour	346	imperial-gallons-per-second
257	grams-per-day	347	imperial-gallons-per-hour
258	grams-per-year	348	imperial-gallons-per-day
259	kilograms-per-day	349	imperial-gallons-per-year
260	kilograms-per-year	350	us-liquid-barrels-per-second
261	pounds-mass-per-day	351	us-liquid-barrels-per-minute
262	pounds-mass-per-year	352	us-liquid-barrels-per-hour
263	short-tons-per-second	353	us-liquid-barrels-per-day
264	short-tons-per-minute	354	us-liquid-barrels-per-year
266	short-tons-per-day	355	liters-per-day
267	short-tons-per-year	356	liters-per-year
268	long-tons-per-second	357	million-liters-per-second
269	long-tons-per-minute	358	million-liters-per-minute
270	long-tons-per-hour	359	million-liters-per-hour
271	long-tons-per-day	360	million-liters-per-day
272	long-tons-per-year	361	million-liters-per-year

Sierra Custom Units Matrix			
Enumerator	**Engineering Unit name**	**Enumerator**	**Engineering Unit name**
273	metric-tons-per-second	362	cubic-meters-per-day
274	metric-tons-per-minute	363	cubic-meters-per-year
275	metric-tons-per-hour	364	cubic-feet-per-day
276	metric-tons-per-day	365	cubic-feet-per-year
277	metric-tons-per-year	366	beer-barrels-per-second
278	standard-cubic-feet-per-second	367	beer-barrels-per-minute
279	standard-cubic-feet-per-minute	368	beer-barrels-per-hour
280	standard-cubic-feet-per-hour	369	beer-barrels-per-day
281	standard-cubic-feet-per-day	370	beer-barrels-per-year
282	standard-cubic-feet-per-year	381	standard-feet-per-second
283	thousand-standard-cubic-feet-per-second	382	standard-feet-per-minute
284	thousand-standard-cubic-feet-per-minute	383	standard-feet-per-hour
285	thousand-standard-cubic-feet-per-hour	384	standard-feet-per-day
286	thousand-standard-cubic-feet-per-day	385	standard-feet-per-year
287	thousand-standard-cubic-feet-per-year	386	feet-per-hour
288	million-standard-cubic-feet-per-second	387	feet-per-day
289	million-standard-cubic-feet-per-minute	388	feet-per-year
290	million-standard-cubic-feet-per-hour	389	meters-per-day
291	million-standard-cubic-feet-per-day	380	meters-per-year
292	million-standard-cubic-feet-per-year	391	standard-meters-per-second
293	normal-cubic-feet-per-second	392	standard-meters-per-minute
294	normal-cubic-feet-per-minute	393	standard-meters-per-hour
295	normal-cubic-feet-per-hour	394	standard-meters-per-day
296	normal-cubic-feet-per-day	395	standard-meters-per-year
297	normal-cubic-feet-per-year	396	normal-meters-per-second
298	standard-cubic-meters-per-second	397	normal-meters-per-minute
299	standard-cubic-meters-per-minute	398	normal-meters-per-hours
300	standard-cubic-meters-per-hour	399	normal-meters-per-day
301	standard-cubic-meters-per-day	400	normal-meters-per-year
302	standard-cubic-meters-per-year	401	Inches-per-second
303	normal-cubic-meters-per-second	402	Inches-per-minute
304	normal-cubic-meters-per-minute	403	Inches-per-hour

Sierra Custom Units Matrix			
Enumerator	**Engineering Unit name**	**Enumerator**	**Engineering Unit name**
305	normal-cubic-meters-per-hour	404	Inches-per-day
306	normal-cubic-meters-per-day	405	Inches-per-year
307	normal-cubic-meters-per-year	406	standard-cubic-feet
308	standard-liters-per-second	407	thousand-standard-cubic-feet
309	standard-liters-per-minute	408	million-standard-cubic-feet
310	standard-liters-per-hour	409	normal-cubic-feet
311	standard-liters-per-day	410	standard-cubic-meters
312	standard-liters-per-year	411	normal-cubic-meters
313	normal-liters-per-second	412	standard-liters
314	normal-liters-per-minute	413	normal-liters
315	normal-liters-per-hour	415	long-tons
316	normal-liters-per-day	416	metric-tons
317	normal-liters-per-year	420	million-us-gallons
321	pounds-mass-per-day	421	us-liquid-barrels
322	pounds-mass-per-year	422	million-liters
327	cubic-feet-per-year	423	pounds-per-cubic-foot
331	cubic-meters-per-day	425	beer-barrels
332	cubic-meters-per-year	426	degrees-rankin
336	liters-per-day	427	pounds-per-square-inch-absolute
337	liters-per-year	429	bar-absolute
338	us-gallons-per-second	430	kilopascals-absolute
339	us-gallons-per-day	432	pascal-second
340	us-gallons-per-year	433	inches-of-water-absolute
341	million-us-gallons-per-second	434	mm-h2o-absolute
342	million-us-gallons-per-minute	435	mm-h2o-gauge
343	million-us-gallons-per-hour	436	kg-per-square-centimeter-absolute
344	million-us-gallons-per-day	437	kg-per-square-centimeter-gauge
345	million-us-gallons-per-year	1000	Error

*Unit 1000 indicates a unit error, i.e. no total unit for a pure velocity flow unit.

Chapter 6: Troubleshooting Tips

The BACnet board has two LEDs that may help during troubleshooting.

1. "LED1" and "LED2" will light Red during initialization, and then turn off after initialization is over.
2. "LED1" indicates communication between the BACnet board and the 240i/241i. It should blink **green** when the 240i/241i communicates to the BACnet board.
3. "LED2" indicates communication between the BACnet board and your BACnet network. Once the network is running and connected it should also blink **green**.

Other Troubleshooting Tips

1. Verify polarity on the communication cable. RS-485 achieves binary transmission by switching the voltage polarity between A- and B+. The differential voltage should be between 7V and 1.5V while the bus is actively communicating. Sierra verifies the 240i/241i is correct per the EIA RS-485 spec.

	**Caution!** We have found cases where other devices with "A" and "B" reversed and sometimes marked as "A+" and "B-." If in doubt, swap "A" and "B."

2. Ensure that all devices have a unique MAC address and Device Instance.
3. Ensure that all software device instances are unique on the whole network.
4. Validate that the baud rate and parity is the same for all devices including repeaters (if used).
5. Make sure there are no more than two EOL terminations resistors present on the same segment. No intermediate device should have an EOL resistor.
6. If you are having trouble, try removing other devices on the bus temporarily.
7. In order to help narrow down a communication issue, divide the network in half and verify if the devices come online. Repeat the operation until the network is functional.
8. Swap a working and a non-working device. If the problem moved with the device, then it indicates a configuration issue or problematic device. If the problem stays at the same location, then it indicates a wiring issue.