



# 240/241 Series BACnet

## Instruction Manual

BACnet Device Specification for Models:  
240-V, -VT, -VTP, -LP & 241-V, -VT, -VTP, -LP  
Multivariable Mass Vortex Flow Meters



Part Number: IM240/241 BACnet, Rev. V1  
May 2013



## **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](http://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 Hangtouw 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.

### **© COPYRIGHT SIERRA INSTRUMENTS 2013**

No part of this publication may be copied or distributed, transmitted, transcribed, stored in a retrieval system, or translated into any human or computer language, in any form or by any means, electronic, mechanical, manual, or otherwise, or disclosed to third parties without the express written permission of Sierra Instruments. The information contained in this manual is subject to change without notice.

### **TRADEMARKS**

InnovaFlo® and InnovaMass® are trademarks of Sierra Instruments, Inc. Other product and company names listed in this manual are trademarks or trade names of their respective manufacturers.

# 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

## **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 240/241 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)

# Table of Contents

Table of Contents.....	5
<b>Chapter 1: BACnet MSTP Description .....</b>	<b>6</b>
BACnet MSTP Description.....	6
<b>Chapter 2: Baud Rates on the MS/TP Bus.....</b>	<b>7</b>
Baud Rate and MAC address Configuration.....	7
<b>Chapter 3: Supported BACnet Objects.....</b>	<b>8</b>
Analog Input Object.....	10
Binary Input Object:.....	13
Binary Value Object:.....	13
<b>Chapter 4 ANNEX - BACnet Protocol Implementation Conformance Statement .....</b>	<b>14</b>
<b>Chapter 5: Acronyms and Definitions .....</b>	<b>20</b>

# Chapter 1: BACnet MSTP Description

This document describes the function and operation of the optional BACnet interface for the Sierra Instruments 240/241Series.

## ***BACnet MSTP Description***








The BACnet Master-Slave/Token-Passing (MSTP) 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 device to master device using a small message. The token is passed 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.

## Chapter 2: Baud Rates on the MS/TP Bus

An BACnet MS/TP bus can be configured to communicate at one of four different baud rates. It is very important that all of the devices on an MS/TP bus communicate at the same baud rate. The baud rate settings available on the 240/241 Series vortex mass flow meters are 9600, 19200 and 38400.

### ***Baud Rate and MAC address Configuration***

You will need the following to connect BACnet to your device:

1. Power on the InnovaMass instrument.
2. Press enter button and type in the factory password 16363 (use up and down arrows to enter the numbers).  
**Note:** If your meter was ordered with BACnet steps 3 through 8 would have already been configured for you - skip to step 9.
3. Use the right  button to navigate to the Diagnostics Menu.
4. Press enter then the right  button.
5. Use the down button  to navigate to the *Config Code* screen.
6. After reaching Config Code screen, press the right  to navigate to *Comm. Type* screen.
7. Change the Comm. Type to BACnet and press enter.  
**Note:** BACnet will enable Baud Rate and MAC address screens on the Output Menu.
8. Press Exit twice to reach Diagnostics Menu back
9. Navigate to the Output Menu by using right  or left arrow  buttons.
10. Press down  button until you reach the Baud Rate and MAC address screens.
11. Change the required settings and press Exit then the Enter button to save the configuration.
12. Reboot the vortex meter by powering off and on

Note:

- a) The 240/241 Series supports 9600, 19200, and 38400 baud rates.
- b) MAC address range is 0-127.

# Chapter 3: Supported BACnet Objects

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

- a. Device Object
- b. Analog Input
- c. Binary Input
- d. Binary Value

Each object type defines a data structure composed by properties that allow the access to the object information. The below table shows the implemented properties for each Vortex Mass Flow Meters object type.

Properties	Object Types			
	Device	Analog Input	Binary Input	Binary Value
Object_Identifier	Q	Q	Q	Q
Object_Name	Q	Q	Q	Q
Object_Type	Q	Q	Q	Q
System_Status	R 1			
Vendor_Name	Q			
Vendor_Identifier	Q			
Model_Name	C ~ 1			
Firmware_Revision	Q			
Application-Software-Version	Q			
Protocol_Version	Q			
Protocol_Revision	Q			
Protocol_Services_Supported	Q			
Protocol_Object_Types_Supported	Q			
Object_List	Q			
Max_ADPU_Length_Accepted	Q			
Segmentation_Supported	Q			
ADPU_Timeout	Q			
Number_Of_ADPU_Retries	Q			
Max_Masters	Q			
Max_Info_Frames	Q			
Device_Address_Binding	Q			
Database_Revision	Q			
Status_Flags				
Event_State		Q	Q	Q
Reliability				
Out_Of_Service		Q (W)	Q (W)	Q (W)



Units		Q		
Polarity			Q (W)	
Priority_Array				
Relinquish_Default				
Status_Flag		Q	Q	Q
Present_Value		Q (W)	Q (W)	Q (W)
Inactive_Text				
Active_Text				

(W) –Writable Property.

## Device Object

The Device Object default property values are as follows:

Property Name	Default Values
Object-Identifier	7
Object--Name	Device,1
Object--Type	Device
System-Status	operational
Vendor--Name	VorTek Instruments
Vendor-Identifier	558
Model--Name	Multivariable Flow meter
Firmware-Revision	N/A
Application--Software--Version	1.07
Protocol-Version	1
Protocol-Revision	4
Protocol--Services--Supported	{F,F,F,F,F,F,F,F,F,F,F,F,T,F,T,T,T,T,F,F,F,F,F,F,F,F,F,F,T,T,F,F,F,F}
Protocol--Object--Types--Supported	{T,F,F,T,F,T,F,F,T,F,F,F,F,F,F,F,F,F,F,F,F,F,F}
Object-List	{(analog---in put, 1),(analog---input,2),(analog---input,3),(analog---input,4), (analog-input,5), (analog ---input,6),(analog ---input,7),(analog ---input,8) (analog-input,9),(analog-input,10), (analog---input,11), (analog-input,12), (analog-input,13),(analog-input,14), (analog---input,15),(analog---in put, 16),(analog---input,17), (analog---input,18),(analog---in put, 19),(binary---input,1),(binary---input,2),(binary--- input,3),(binary---input,4), (binary---value,1), (device,7) }
Max--Apdu--Length--Accepted	300
Segmentation-Supported	no-segmentation
Apdu-Timeout	3000
Number--Of--APDU--Retries	1

Max---Master	127	
Max-Info-Frames	1	
Device-Address-Binding	()	
Database-Revision	0	

Note: Device Communication Control: Password – “vortek”

## **Analog Input Object**

Vortex mass flow meters analog input type objects are described in the table below.

<b>Object Instance</b>	<b>Object Name</b>	<b>Unit</b>	<b>Description</b>
1	Volume Flow	cubic-feet-per-second, cubic-feet-per-minute, us-gallons-per-minute, imperial-gallons-per-minute, liters-per-minute, liters-per-second, liters-per-hour, cubic-meters-per-second, cubic-meters-per-minute, cubic-meters-per-hour	This AI object is used to measure volume flow.
2	Mass Flow	pounds-mass-per-second, rams-per-second, kilograms-per-second, kilograms-per-minute, kilograms-per-hour,	This AI object is used to measure mass flow.
		pounds-mass-per-minute, pounds-mass-per-hour, tons-per-hour, grams-per-second, grams-per-minute	
3	Temperature 1	degrees-Celsius, degrees-Kelvin, degrees-Fahrenheit	This AI object measures Temperature in one of the given Units.
4	Temperature 2	degrees-Celsius, degrees-Kelvin, degrees-Fahrenheit	This AI object measures Temperature in one of the given Units. Note: This object is only valid for an EMS type meter.

5	Pressure	pounds-force-per-square-inch, inches-of-water, inches-of-mercury, millimeters-of-mercury, bars, millibars, pascals, kilopascals	This AI Object measures the Pressure of the fluid.
6	Density	kilograms-per-cubic-meter	This AI Object measures the Density of the fluid.
7	Energy Flow	Kilowatts, Horsepower, btus-per-hour, kilo-btus-per-hour, megawatts	This AI Object measures the Energy Flow in the fluid. Note: This object is only valid for an EMS type meter.
8	Totalizer 1 & Totalizer 2	If Totalizer selection for Mass measure- pounds-mass-per-second, grams-per-second, kilograms-per-second, kilograms-per-minute, kilograms-per-hour, pounds-mass-per-minute, pounds-mass-per-hour, tons-per-hour, grams-per-second, grams-per-minute	An electronic counter which records the total accumulated flow since the last time the counter was reset.
		If Totalizer selection for Volume measure- cubic-feet-per-second, cubic-feet-per-minute, us-gallons-per-minute, imperial-gallons-per-minute, liters-per-minute, liters-per-second, liters-per-hour, cubic-meters-per-second, cubic-meters-per-minute, cubic-meters-per-hour If Totalizer selection for Energy measure- Kilowatts, Horsepower, btus-per-hour,, kilo-btus-per-hour, megawatts	

10	StatusRegister	NOUNITS	This Object indicates the current Status of the meter.
11	Channel 1 (4---20mA)	milliamperes	This Object indicates the value of the 1st analog output.
12	Channel 2 (4---20mA)	milliamperes	This Object indicates the value of the 2nd analog output.
13	Channel 3 (4---20mA)	milliamperes	This Object indicates the value of the 3rd analog output.
14	Scaled Freq	hertz	This Object indicates the value of the scaled frequency output.
15	Flow Velocity	feet-per-second	This Object indicates the fluid velocity.
16	Viscosity	centipoises	This Object indicates the fluid viscosity.
17	Frequency	hertz	This Object indicates the shedding frequency of the meter.

18	VorTex Amp	millivolts	This Object indicates the strength of the vortex signal.
19	FilterSetting	hertz	This Object indicates the setting of the tracking filter.

### **Binary Input Object:**

Vortex Mass Flow Meters Binary Input type objects are described in the table below.

Object Instance	Object Name	Description
1	Alarm1	The status of the three alarms may be monitored via the Modbus command. The value returned indicates the state of the alarm, and will be 1 only if the alarm is enabled and active. A zero value is transmitted for alarms that are either disabled or inactive.
2	Alarm2	
3	Alarm3	
4	External	This object is an external bit input which can be used for numerous tasks such as resetting a totalizer. This Object is only valid if an external input board is present on the flow meter.

Note: Binary Input 4, Present value always read zero, because no information available from client, so the polarity property doesn't impact on Present value property when the Out of service property is false.

### **Binary Value Object:**

Vortex Mass Flow Meters Binary Value type objects are described in the below Table.

Object Instance	Object Name	Description
1	Reset	Reset's Totalizer

## **Chapter 4: ANNEX - BACnet Protocol Implementation Conformance Statement**

**Date:** 19-April-2012

**Applications Software Version:** 1.07

**Firmware Revision:** N/A

**BACnet Protocol Revision:** 4

**BACnet Standardized Device Profile (Annex L):**

- 0 BACnet Operator Workstation (B---OWS)
- 0 BACnet Advanced Operator Workstation (B---AWS)
- 0 BACnet Operator Display (B---OD)
- 0 BACnet Building Controller (B ---BC)
- 0 BACnet Advanced Application Controller (B---AAC)
- Q BACnet Application Specific Controller (B---ASC)
- 0 BACnet Smart Sensor (B---SS)
- 0 BACnet Smart Actuator (B---SA)

**List all BACnet Interoperability Building Blocks Supported (Annex K):**

<b>BIBBs</b>
DS-RP-B
DS-WP-B
DM-DDB-B
DM-DOB-B
DM-DCC-B
DS-RPM-B
DS-WPM-B

<b>Services Supported</b>	
Read Property	Execute
Write Property	Execute
Read Property Multiple	Execute
Write Property Multiple	Execute
Who-Is	Execute
I-Am	Initiate
Who-Has	Execute
I-Have	Initiate

Device Communication Control	Execute
------------------------------	---------

**Segmentation Capability**

0 Able to transmit segmented messages  
 0 Able to receive segmented messages

Window Size  
 Window Size

**Standard Object Types Supported**

Standard Object Types Supported				
Object Type	Dynamically Creatable	Dynamically Delete---able	Additional Writable Properties	Range Restrictions
Analog Input (AI)	No	No	None	None
Binary Input (BV)	No	No	None	None
Binary Value	No	No	None	None
Device	No	No	None	None

Standard Object Types Supported Writable Properties			
Object Type	Properties		
Analog Input (AI)	Present Value	Out-Of-Service	
Binary Input (BV)	Present Value	Out-Of-Service	Polarity
Binary Value	Present Value	Out-Of-Service	
Device			

**Object List:**

<b>Properties of Analog Input/Value Objects Type</b>
--



ID	Name	Present Value	I Status Flags	Event State	Out of Service	Units
AI1	Volume Flow	?	F,F,F,F	Normal	False	?
AI2	Mass Flow	?	F,F,F,F	Normal	False	?
AI3	Temperature 1	?	F,F,F,F	Normal	False	?
AI4	Temperature 2	?	F,F,F,F	Normal	False	?
AI5	Pressure	?	F,F,F,F	Normal	False	?
AI6	Density	?	F,F,F,F	Normal	False	?
AI7	Energy Flow	?	F,F,F,F	Normal	False	?
AI8	Totalizer 1	?	F,F,F,F	Normal	False	?
AI9	Totalizer 2	?	F,F,F,F	Normal	False	?
AI10	Status Register	?	F,F,F,F	Normal	False	?
AI11	Channel 1(4---20mA)	?	F,F,F,F	Normal	False	?
AI12	Channel 2 (4---20mA)	?	F,F,F,F	Normal	False	?
AI13	Channel 3 (4---20mA)	?	F,F,F,F	Normal	False	?
AI14	Scaled Freq	?	F,F,F,F	Normal	False	?
AI15	Flow Velocity	?	F,F,F,F	Normal	False	?
AI16	Viscosity	?	F,F,F,F	Normal	False	?
AI17	Frequency	?	F,F,F,F	Normal	False	?
AI18	VorTex Amp	?	F,F,F,F	Normal	False	?
A19	Filter Setting	?	F,F,F,F	Normal	False	?

**Properties of Analog Input/Value Objects Type: Polarity**

ID	Alarm	Present Value	Status Flags	Event State	Out of Service	Polarity
BI1	Alarm1	?	F,F,F,F	Normal	False	Normal
BI2	Alarm2	?	F,F,F,F	Normal	False	Normal
BI3	Alarm3	?	F,F,F,F	Normal	False	Normal
BI4	External	?	F,F,F,F	Normal	False	Normal

Properties of Analog Input/Value Objects Type						
ID	Name	Present Value	Status Flags	Event State	Out of Service	Out-of-Service
BV1	Reset	?	F,F,F,F	Normal	False	False

### **Data Link Layer Options**

0 BACnet IP, (Annex J)  
 0 BACnet IP, (Annex J), Foreign Device  
 0 ISO 8802---3, Ethernet (Clause 7)  
 0 ANSI/ATA 878.1, 2.5 Mb. ARCNET (Clause 8)  
 0 ANSI/ATA 878.1, EIA---485 ARCNET (Clause 8), baud rate(s)  
 QMS/TP master (Clause 9), baud rate(s): 9600, 19200, 38400  
 MS/TP slave (Clause 9), baud rate(s):  
 0 Point---To---Point, EIA 232 (Clause 10), baud rate(s):  
 0 Point---To---Point, modem, (Clause 10), baud rate(s): 0  
 LonTalk, (Clause 11), medium:  
 0 Other:

### **Device Address Binding**

Is static device binding supported?

Note: This is currently necessary for two-way communication with MS/TP slaves and certain other devices.

Yes  No

**Networking**

Router, Clause 6 - List all routing configurations, e.g., ARCNET - Ethernet, Ethernet-MS/TP, etc.

Annex H, BACnet Tunneling Router over IP

BACnet/IP Broadcast Management Device (BBMD)

Does the BBMD support registrations by Foreign Devices?  Yes  No

Does the BBMD support network address translation?  Yes  No

**Network Security Options:**

Non-secure Device - is capable of operating without BACnet Network Security

Secure Device - is capable of using BACnet Network Security (NS---SD BVBB)

Multiple Application-Specific Keys:

Supports encryption (NS---ED BVBB)

Key Server (NS---KS BVBB)

**Character Sets Supported:**

Indicating support for multiple character sets does not imply that they can all be supported simultaneously.

<input type="checkbox"/> R1 ANSI X3.4	<input type="checkbox"/> IBM/TM/Microsoft/MDBCS	<input type="checkbox"/> ISO 8859---1
<input type="checkbox"/> ISO 10646 (UCS---2)	<input type="checkbox"/> ISO 10646 (UCS---4)	<input type="checkbox"/> JIS C 6226

If this product is a communication gateway, describe the types of non-BACnet equipment/networks(s) that the gateway supports:

- N/A

## Chapter 5: 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