InnovaMass® 240i/241i HART®

Preliminary Instruction Manual

HART Specification for Models: 240i and 241i

Volumetric & Multivariable Mass Vortex Flow Meter

Part Number: IM-24i-HART, V1 December 2015

SIERRA®

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IMPORTANT CUSTOMER NOTICE- OXYGEN SERVICE
Unless you have specifically ordered Sierra's optional O_2 cleaning, this flow meter may not be fit for 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 cleaning the mass flow meter to the degree required for your oxygen flow application. **However, some models can only be properly cleaned during the manufacturing process.**

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.

Warning!

Consult the flow meter nameplate for specific flow meter approvals before any hazardous location installation.

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.

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

For insertion flow meter installations, an insertion tool must be used for any installation where a flow meter is inserted under pressure greater than 50 psig.

To avoid serious injury, DO NOT loosen a compression fitting under pressure.

To avoid potential electric shock, follow National Electric Code or your local code when wiring this unit to a power source. Failure to do so could result in injury or death. All AC power connections must be in accordance with published CE directives. All wiring procedures must be performed with the power off.

Before attempting any flow meter repair, verify that the line is not pressurized. Always remove main power before disassembling any part of the mass flow meter.

Caution!

Calibration must be performed by qualified personnel. Sierra strongly recommends that you return your flow meter to the factory for calibration.

In order to achieve accurate and repeatable performance, the flow meter must be installed with the specified minimum length of straight pipe upstream and downstream of the flow meter's sensor head.

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 flow meter.

For insertion flow meter installations, the sensor alignment pointer must point downstream in the direction of flow.

The AC wire insulation temperature rating must meet or exceed 85°C (185°F)

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 tothe 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 Chapter 6 of this manual.

If the problem persists after following the troubleshooting proceduresoutlined in Chapter 6 of this 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 72 5071400. In the Asia-Pacific region, contact Sierra Instruments Asia at +8621 5879 8521. 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

240i/241i HART Introduction

This document describes the function and operation of the optional HART interface for the Sierra Instruments flow meter. The InnovaMass 240i/241i complies with HART Protocol Revision 7.4. This document specifies all the device specific features and documents HART Protocol implementation details (e.g., the engineering unit codes supported). The functionality of the InnovaMass (field device) is described sufficiently to allow its proper application in a process and its complete support in HART capable host applications.

This manual is designed to complement other documentation (e.g., the InnovaMass 240i/241i product manual) by providing a complete, unambiguous description of the InnovaMass 240i/241i from a HART Communication perspective. It is also intended to be a technical reference for HART capable host application developers, system integrators and knowledgeable end users. This manual provides functional specifications used during Field Device configuration, maintenance and testing. This document assumes the reader is familiar with HART Protocol requirements and terminology.

Note
In this manual 240i/241i HART refers to product models 240i and 241i.

Abbreviations and Definitions

Abbreviation	Definition
ADC	Analog to Digital Converter
CPU	Central Processing Unit (of microprocessor)
DAC	Digital to Analog Converter
EEPROM	Electrically-Erasable Read-Only Memory
ROM	Read-Only Memory

References

To access references used to create this manual, see below:

- **HART Smart Communications Protocol Specification (**HCF_SPEC-13) is available from http://hartcomm.org .
- InnovaMass 240i/241i **product instruction manual** is available for download at www.sierrainstruments.com.

Device Description Identification

Manufacturer Name:	Sierra Instruments	**Model Name(s):**	Sierra i Series
Manufacture ID Code:	165 (0x00A5)	**Device Type Code:**	42367 (0xA57F)
HART Protocol Revision	7.4	**Device Revision:**	2
Number of Device Variables	4		
Physical Layers Supported	FSK		
Physical Device Category	InnovaMass® 240i/241i Air Mass Flow Meters		

Process Interface

Sensor Input

The InnovaMass 240i/241i HART can have up to 3 three internal sensors — a piezo electric Vortex shedding sensor, a precision platinum temperature sensors and one absolute pressure transducer sensor.

Host Interface

4-20 mA Flow Out:

The active two-wire 4-20 mA current loop is connected on the (+) and (-) wires. HART communication is supported on this loop. At least one 250 ohm resistor will needed in the loop to access the HART signal.
The InnovaMass is powered from 24 VDC +/- 10% (1.1A load, maximum)

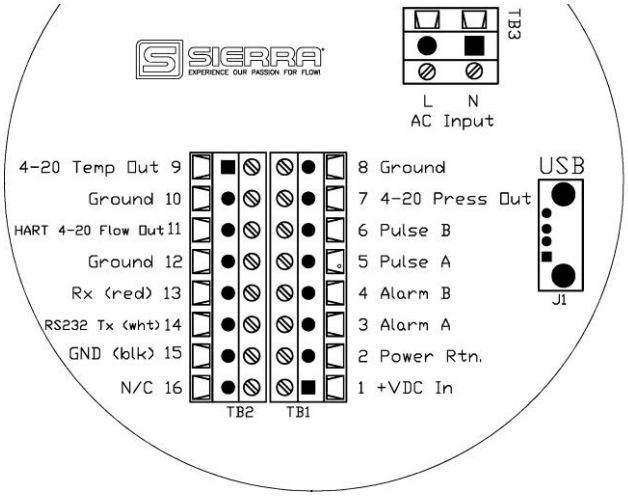


Figure 1. InnovaMass 240i/241i HART

Local Interfaces, Jumpers, and Switches

Local Controls and Displays

The InnovaMass 240i/241i is a Volumetric & Multivariable mass vortex flow meter with a local display and a pushbutton keypad.

Device Description Files

The 240i/241i Series meters support two Device Description (DD) Files: PC interface programs and 475 Field Communicators.
The following DD files are for using PC interface programs

- 0201.fm8
- 0201.im8
- 0201.sym
- shapes.txt

The following DD files are for using 475 Field Communicator

- 00A5A57F0201.hdd
- 00A5A57F0201.hhd

You will need the "Field Communicator Easy Upgrade Utility" software in order to load the device description files into 475 Field Communicator.

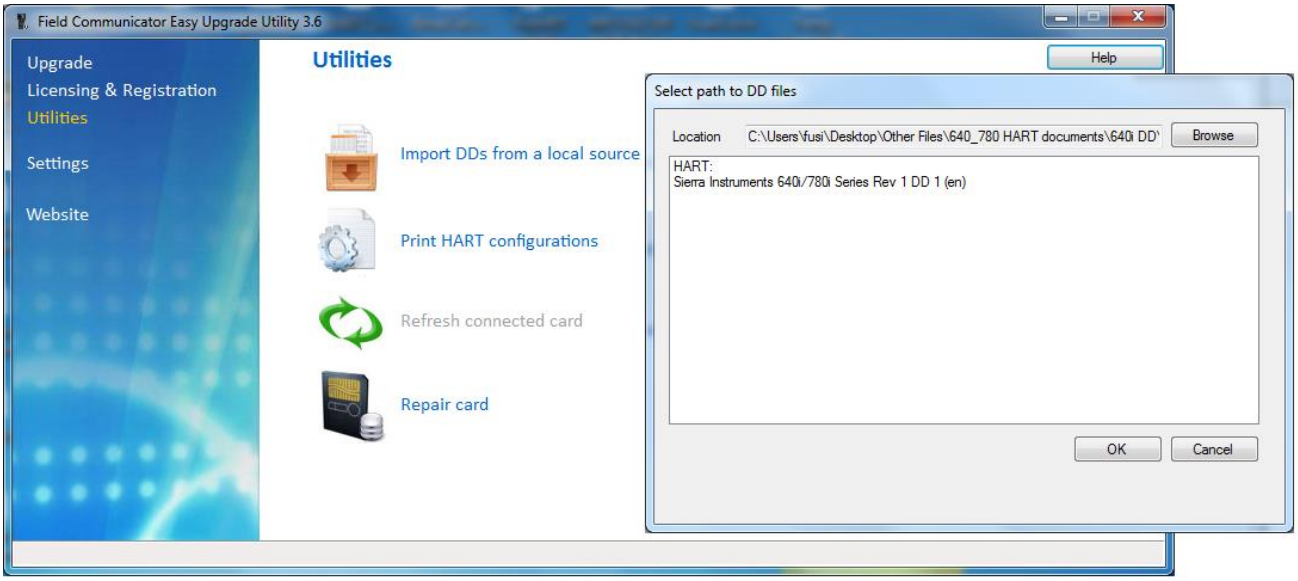
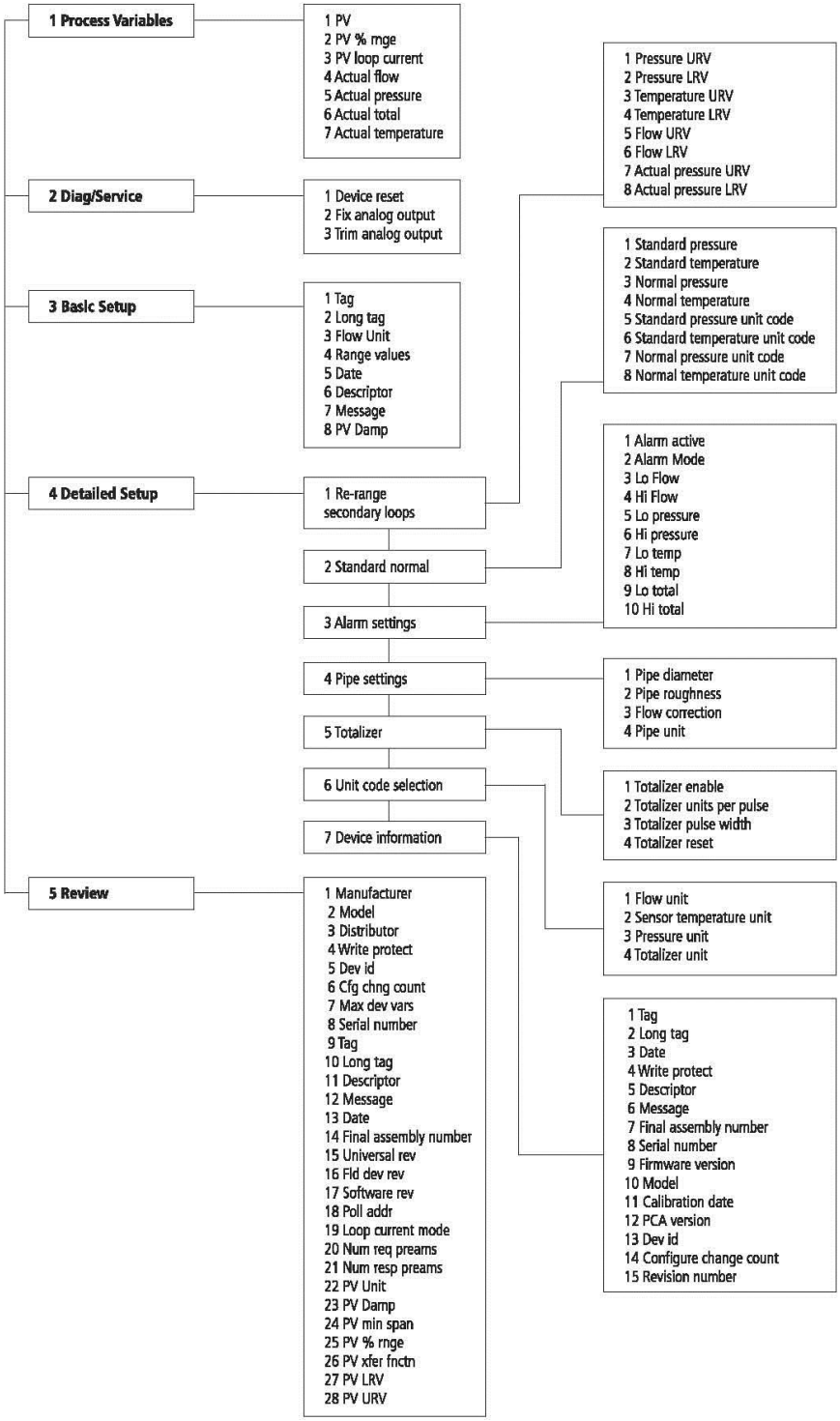


Figure 19: Screen shot of the "Field Communicator Easy Upgrade Utility" Software

240i/241i Series HART Device Menu Tree



Device Variables

As with most HART devices, InnovaMass has four dynamic variables, PV, SV, TV, and QV.

Device Variables			
Hart Commands	**Variable Name**	**Classification Code**	**Units**
0	Actual flow (or velocity)	72	As configured
1	Actual temperature	64	°F, °C,°K,°R
2	Actual pressure	65	As configured
3	Actual total	71	Volume/mass units
244	% Of full flow rate	00	Percentage
245	Loop current	84	Milliamps
246	PV	66, 67, 72	Flow rate/Velocity
247	SV	64	Temperature
248	TV	65	Pressure
249	QV	68, 71	Totalizer

Table 11: Dynamic Variables

Device Status

Bit 0 (PV out of limits) is set if the PV value is exceeding the sensor limits.
Bit 1 (non-PV out of limits) is set if the temperature or voltage measurements value is exceeding their sensor limits
Bit 2 (analog output saturated) is set if the loop current tries to exceed the over and under range limits of 3.8 and 20.5 mA. The digital value will continue, until the sensor limit is reached.
Bit 3 (analog output fixed) is set if the device is in multi-drop mode or in fixed current mode for testing purposes.
Bit 4 (more status available) is set whenever any alarm or failure is detected. Command #48 gives further detail (see Table 12).
Bit 5 (cold start) is set at power-up.
Bit 6 is not used
Bit 7 (field device malfunction) is set when there is a permanent failure of the device. See Table 12

Extended Device Status

Extended device status is not used with the InnovaMass 240i/241i HART.

Additional Device Status (Command #48)

Command #48 returns 8 bytes of data, with the following status information shown in the table below. Note: "Not used" bits are always set to 0.

Byte	Bit	Meaning	Class	Device Status Bits Set
0 Alarm status	0	Velocity and temperature sensors comparable reading	Error	4, 7
	1	Pressure warning	Error	4, 7
	2-7	Not used	N/A	N/A
1	0-7	Not used	N/A	N/A
2	0-7	Not used	N/A	N/A
3	0-7	Not used	N/A	N/A
4	0-7	Not used	N/A	N/A
5	1	Non-volatile memory defect	N/A	N/A
6	2	Not used	N/A	N/A
	3	Watchdog reset executed	N/A	N/A
	4	Power supply out of range	N/A	N/A
	5	Not used	N/A	N/A
7	6	Not used	N/A	N/A
8	7	Not used	N/A	N/A

Table 12: Additional Device Status

Commands

Universal Commands

No special arrangements.

Common-Practice Commands

Supported Commands

The following common-practice commands shown in the table below are implemented in the InnovaMass 240i/241i HART device:

Command	Description
34	Write damping value
35	Write PV range values
38	Reset “config change” flag only
40	Enter/exit fixed current mode
41	None
42	Perform master reset
43	Write PV units index
44	Trim DAC zero
45	Trim DAC gain
53	Write device variable units
59	Write number of response preambles
66	Enter/exit fixed analog output mode (For DAC calibration of pressure and temperature)
67	Trim analog output zero
68	Trim analog output gain

Table 13: Common-practice Commands

Burst Mode

The InnovaMass does not support burst mode.

Catch Device Variable

The InnovaMass does not support catch device variable.

Device-Specific Commands

The following device-specific commands are implemented in the InnovaMass 240i/241i HART.

Command #130: Read Gas Name

Request Data Bytes

Byte	Format	Description
None	N/A	N/A

Response Data Bytes

Byte	Format	Description
0-15	ASCII	Gas name

Command Specific Response Codes

Code	Class	Description
0	Success	No command-specific errors
1-127	N/A	Undefined

Command #131: Read Gas Index

See "Tables" section starting on page 86 to view indexes.

Request Data Bytes

Byte	Format	Description
None	N/A	N/A

Response Data Bytes

Byte	Format	Description
0 - 1	Enum	Gas index

Command Specific Response Codes

Code	Class	Description
0	Success	No command-specific errors
1-127	N/A	Undefined

Command #132: Write Gas Index

See "Tables" section starting on page 86 to view indexes.

Request Data Bytes

Byte	Format	Description
0 - 1	Enum	Gas index

Response Data Bytes

Byte	Format	Description
0 - 1	Enum	Gas index

Command Specific Response Codes

Code	Class	Description
0	Success	No command-specific errors
1-2	N/A	Undefined
2	Error	Invalid selection
3-4	N/A	Undefined
5	Error	Too few data bytes
6-127	N/A	Undefined

Command #133 Read Flow Unit Index (PV)

See "Tables" section starting on page 86 to view indexes.

Request Data Bytes

Byte	Format	Description
None	N/A	N/A

Response Data Bytes

Byte	Format	Description
0 - 1	Enum	Flow unit index

Command Specific Response Codes

Code	Class	Description
0	Success	No command-specific errors
1-127	N/A	Undefined

Command #134: Write Flow Unit Index (PV)

See "Tables" section starting on page 86 to view indexes.

Request Data Bytes

Byte	Format	Description
0 - 1	Enum	Flow unit index

Response Data Bytes

Byte	Format	Description
0 - 1	Enum	Flow unit index

Command Specific Response Codes

Code	Class	Description
0	Success	No command-specific errors
1-2	N/A	Undefined
2	Error	Invalid selection
3-4	N/A	Undefined
5	Error	Too few data bytes
6-127	N/A	Undefined

Command #135 Read Total Unit Index (QV)

See "Tables" section starting on page 86 to view indexes.

Request Data Bytes

Byte	Format	Description
None	N/A	N/A

Response Data Bytes

Byte	Format	Description
0 - 1	Enum	Totalizer unit index, see flow units index

Command Specific Response Codes

Code	Class	Description
0	Success	No command-specific errors
1-127	N/A	Undefined

Command #136: Write Total Unit Index (QV)

See "Tables" section starting on page 86 to view indexes.

Request Data Bytes

Byte	Format	Description
0 - 1	Enum	Totalizer unit index, see flow units index

Response Data Bytes

Byte	Format	Description
0 - 1	Enum	Totalizer unit index, see flow units index

Command Specific Response Codes

Code	Class	Description
0	Success	No command-specific errors

Code	Class	Description
1-2	N/A	Undefined
2	Error	Invalid selection
3-4	N/A	Undefined
5	Error	Too few data bytes
6-127	N/A	Undefined

Command #137 Read Temperature Unit Index (SV)

See "Tables" section starting on page 86 to view indexes.

Request Data Bytes

Byte	Format	Description
None	N/A	N/A

Response Data Bytes

Byte	Format	Description
0 - 1	Enum	Temperature unit index

Command Specific Response Codes

Code	Class	Description
0	Success	No command-specific errors
1-127	N/A	Undefined

Command #138: Write Temperature Unit Index (SV)

See "Tables" section starting on page 86 to view indexes.

Request Data Bytes

Byte	Format	Description
0 - 1	Enum	Temperature unit index

Response Data Bytes

Byte	Format	Description
0 - 1	Enum	Temperature unit index

Command Specific Response Codes

Code	Class	Description
0	Success	No command-specific errors
1-2	N/A	Undefined
2	Error	Invalid selection
3-4	N/A	Undefined

Code	Class	Description
5	Error	Too few data bytes
6-127	N/A	Undefined

Command #139 Read Pressure Unit Index (TV)

See "Tables" section starting on page 86 to view indexes.

Request Data Bytes

Byte	Format	Description
None	N/A	N/A

Response Data Bytes

Byte	Format	Description
0 - 1	Enum	Pressure unit index

Command Specific Response Codes

Code	Class	Description
0	Success	No command-specific errors
1-127	N/A	Undefined

Command #140: Write Pressure Unit Index (TV)

See "Tables" section starting on page 86 to view indexes.

Request Data Bytes

Byte	Format	Description
0 - 1	Enum	Pressure unit index

Response Data Bytes

Byte	Format	Description
0 - 1	Enum	Pressure unit index

Command Specific Response Codes

Code	Class	Description
0	Success	No command-specific errors
1-2	N/A	Undefined
2	Error	Invalid selection
3-4	N/A	Undefined
5	Error	Too few data bytes
6-127	N/A	Undefined

Command #150: Write Standard Temperature Value

Request Data Bytes

Byte	Format	Description
0-3	Float	Standard temperature value

Response Data Bytes

Byte	Format	Description
0-3	Float	Standard temperature value

Command Specific Response Codes

Code	Class	Description
0	Success	No command-specific errors
1-2	N/A	Undefined
3	Error	Passed parameter too large
4	Error	Passed parameter too small
5	Error	Too few data bytes
6-127	N/A	Undefined

Command #151: Read Standard Temperature

Request Data Bytes

Byte	Format	Description
None	N/A	NA

Response Data Bytes

Byte	Format	Description
0-3	Float	Standard temperature value

Command Specific Response Codes

Code	Class	Description
0	Success	No command-specific errors
1-127	N/A	Undefined

Command #152 Read Standard Temperature Unit Index

Request Data Bytes

Byte	Format	Description
None	N/A	N/A

Response Data Bytes

Byte	Format	Description
0 - 1	Enum	Standard temperature unit index, 0=°F, 1=°C, 2=°K, 3=°R

Command Specific Response Codes

Code	Class	Description
0	Success	No command-specific errors
1-127	N/A	Undefined

Command #153: Write Standard Temperature Unit Index

Request Data Bytes

Byte	Format	Description
0 - 1	Enum	Standard temperature unit index, 0=°F, 1=°C, 2=°K, 3=°R

Response Data Bytes

Byte	Format	Description
0 - 1	Enum	Standard temperature index, 0=°F, 1=°C, 2=°K, 3=°R

Command Specific Response Codes

Code	Class	Description
0	Success	No command-specific errors
1-2	N/A	Undefined
2	Error	Invalid selection
3-4	N/A	Undefined
5	Error	Too few data bytes
6-127	N/A	Undefined

Command #154: Write Standard Pressure Value

Request Data Bytes

Byte	Format	Description
0-3	Float	Standard pressure value

Response Data Bytes

Byte	Format	Description
0-3	Float	Standard Pressure value

Command Specific Response Codes

Code	Class	Description
0	Success	No command-specific errors
1-2	N/A	Undefined
3	Error	Passed parameter too large
4	Error	Passed parameter too small
5	Error	Too few data bytes
6-127	N/A	Undefined

Command #155: Read Standard Pressure

Request Data Bytes

Byte	Format	Description
None	N/A	NA

Response Data Bytes

Byte	Format	Description
0-3	Float	Standard Pressure value

Command Specific Response Codes

Code	Class	Description
0	Success	No command-specific errors
1-127	N/A	Undefined

Command #156 Read Standard Pressure Unit Index

See "Tables" section starting on page 86 to view indexes.

Request Data Bytes

Byte	Format	Description
None	N/A	N/A

Response Data Bytes

Byte	Format	Description
0 - 1	Enum	Standard pressure unit index

Command Specific Response Codes

Code	Class	Description
0	Success	No command-specific errors
1-127	N/A	Undefined

Command #157: Write Standard Pressure Unit Index

See "Tables" section starting on page 86 to view indexes.

Request Data Bytes

Byte	Format	Description
0 - 1	Enum	Standard pressure unit index

Response Data Bytes

Byte	Format	Description
0 - 1	Enum	Standard pressure unit index

Command Specific Response Codes

Code	Class	Description
0	Success	No command-specific errors
1-2	N/A	Undefined
2	Error	Invalid selection
3-4	N/A	Undefined
5	Error	Too few data bytes
6-127	N/A	Undefined

Command #160: Write Normal Temperature Value

Request Data Bytes

Byte	Format	Description
0-3	Float	Normal temperature value

Response Data Bytes

Byte	Format	Description
0-3	Float	Normal temperature value

Command Specific Response Codes

Code	Class	Description
0	Success	No command-specific errors
1-2	N/A	Undefined
3	Error	Passed parameter too large
4	Error	Passed parameter too small
5	Error	Too few data bytes
6-127	N/A	Undefined

Command #161: Read Normal Temperature Value

Request Data Bytes

Byte	Format	Description
None	N/A	NA

Response Data Bytes

Byte	Format	Description
0-3	Float	Normal temperature value

Command Specific Response Codes

Code	Class	Description
0	Success	No command-specific errors
1-127	N/A	Undefined

Command #162 Read Normal Temperature Unit Index

Request Data Bytes

Byte	Format	Description
None	N/A	N/A

Response Data Bytes

Byte	Format	Description
0 - 1	Enum	Normal temperature unit index, 0=°F, 1=°C, 2=°K, 3=°R

Command Specific Response Codes

Code	Class	Description
0	Success	No command-specific errors
1-127	N/A	Undefined

Command #163: Write Normal Temperature Index

Request Data Bytes

Byte	Format	Description
0 - 1	Enum	Normal temperature unit index, 0=°F, 1=°C, 2=°K, 3=°R

Response Data Bytes

Byte	Format	Description
0 - 1	Enum	Normal temperature unit index, 0=°F, 1=°C, 2=°K, 3=°R

Command Specific Response Codes

Code	Class	Description
0	Success	No command-specific errors
1-2	N/A	Undefined
2	Error	Invalid selection
3-4	N/A	Undefined
5	Error	Too few data bytes
6-127	N/A	Undefined

Command #164: Write Normal Pressure Value

Request Data Bytes

Byte	Format	Description
0-3	Float	Normal Pressure value

Response Data Bytes

Byte	Format	Description
0-3	Float	Normal Pressure value

Command Specific Response Codes

Code	Class	Description
0	Success	No command-specific errors
1-2	N/A	Undefined
3	Error	Passed parameter too large
4	Error	Passed parameter too small
5	Error	Too few data bytes
6-127	N/A	Undefined

Command #165: Read Normal Pressure Value

Request Data Bytes

Byte	Format	Description
None	N/A	N/A

Response Data Bytes

Byte	Format	Description
0-3	Float	Normal pressure value

Command Specific Response Codes

Code	Class	Description
0	Success	No command-specific errors
1-127	N/A	Undefined

Command #166 Read Normal Pressure Unit Index

See "Tables" section starting on page 86 to view indexes.

Request Data Bytes

Byte	Format	Description
None	N/A	N/A

Response Data Bytes

Byte	Format	Description
0 - 1	Enum	Normal pressure Unit index

Command Specific Response Codes

Code	Class	Description
0	Success	No command-specific errors
1-127	N/A	Undefined

Command #167: Write Normal Pressure Unit Index

See "Tables" section starting on page 86 to view indexes.

Request Data Bytes

Byte	Format	Description
0 - 1	Enum	Normal pressure Unit index

Response Data Bytes

Byte	Format	Description
0 - 1	Enum	Normal pressure Unit index

Command Specific Response Codes

Code	Class	Description
0	Success	No command-specific errors
1-2	N/A	Undefined
2	Error	Invalid selection
3-4	N/A	Undefined
5	Error	Too few data bytes
6-127	N/A	Undefined

Command #170 Read Alarm Active

Request Data Bytes

Byte	Format	Description
None	N/A	N/A

Response Data Bytes

Byte	Format	Description
0 - 1	Enum	Alarm 0-Off, 1-Test ON, 16-Flow, 32-Press, 64-Temp, 128–Total

Command Specific Response Codes

Code	Class	Description
0	Success	No command-specific errors
1-127	N/A	Undefined

Command #171: Write Alarm Active

Request Data Bytes

Byte	Format	Description
0 - 1	Enum	Alarm 0-Off, 1-Test ON, 16-Flow, 32-Press, 64-Temp, 128–Total

Response Data Bytes

Byte	Format	Description
0 - 1	Enum	Alarm 0-Off, 1-Test ON, 16-Flow, 32-Press, 64-Temp, 128–Total

Command Specific Response Codes

Code	Class	Description
0	Success	No command-specific errors
1-2	N/A	Undefined
2	Error	Invalid selection
3-4	N/A	Undefined
5	Error	Too few data bytes
6-127	N/A	Undefined

Command #172 Read Alarm Mode

Request Data Bytes

Byte	Format	Description
None	N/A	N/A

Response Data Bytes

Byte	Format	Description
0 - 1	Enum	0–Alarm set to “Low” mode, 1–Alarm set to “Hi” mode, 2–Alarm set to “Window”

Command Specific Response Codes

Code	Class	Description
0	Success	No command-specific errors
1-127	N/A	Undefined

Command #173: Write Alarm Mode

Request Data Bytes

Byte	Format	Description
0 - 1	Enum	0–Alarm set to “Low” mode, 1–Alarm set to “Hi” mode, 2–Alarm set to “Window”

Response Data Bytes

Byte	Format	Description
0 - 1	Enum	0–Alarm set to “Low” mode, 1–Alarm set to “Hi” mode, 2–Alarm set to “Window”

Command Specific Response Codes

Code	Class	Description
0	Success	No command-specific errors
1-2	N/A	Undefined
2	Error	Invalid selection
3-4	N/A	Undefined
5	Error	Too few data bytes
6-127	N/A	Undefined

Command #174: Write Low Alarm Flow Trigger Value

Request Data Bytes

Byte	Format	Description
0-3	Float	Low alarm flow trigger value

Response Data Bytes

Byte	Format	Description
0-3	Float	Low alarm flow trigger value

Command Specific Response Codes

Code	Class	Description
0	Success	No command-specific errors
1-2	N/A	Undefined
3	Error	Passed parameter too large
4	Error	Passed parameter too small
5	Error	Too few data bytes
6-127	N/A	Undefined

Command #175: Read Low Alarm Flow Trigger Value

Request Data Bytes

Byte	Format	Description
None	N/A	NA

Response Data Bytes

Byte	Format	Description

0-3	Float	Low alarm flow trigger value

Command Specific Response Codes

Code	Class	Description
0	Success	No command-specific errors
1-127	N/A	Undefined

Command #176: Write High Alarm Flow Trigger

Request Data Bytes

Byte	Format	Description
0-3	Float	High alarm flow trigger value

Response Data Bytes

Byte	Format	Description
0-3	Float	High alarm flow trigger value

Command Specific Response Codes

Code	Class	Description
0	Success	No command-specific errors
1-2	N/A	Undefined
3	Error	Passed parameter too large
4	Error	Passed parameter too small
5	Error	Too few data bytes
6-127	N/A	Undefined

Command #177: Read High alarm flow trigger Value

Request Data Bytes

Byte	Format	Description
None	N/A	N/A

Response Data Bytes

Byte	Format	Description
0-3	Float	High alarm flow trigger value

Command Specific Response Codes

Code	Class	Description
0	Success	No command-specific errors
1-127	N/A	Undefined

Command #178: Write Low Alarm Temperature Trigger

Request Data Bytes

Byte	Format	Description
0-3	Float	Low alarm temperature trigger value

Response Data Bytes

Byte	Format	Description
0-3	Float	Low alarm temperature trigger value

Command Specific Response Codes

Code	Class	Description
0	Success	No command-specific errors
1-2	N/A	Undefined
3	Error	Passed parameter too large
4	Error	Passed parameter too small
5	Error	Too few data bytes
6-127	N/A	Undefined

Command #179: Read Low Alarm Temperature Trigger Value

Request Data Bytes

Byte	Format	Description
None	N/A	NA

Response Data Bytes

Byte	Format	Description
0-3	Float	Low alarm temperature trigger value

Command Specific Response Codes

Code	Class	Description
0	Success	No command-specific errors
1-127	N/A	Undefined

Command #180: Write High Alarm Temperature Trigger Value

Request Data Bytes

Byte	Format	Description
0-3	Float	High alarm temperature trigger value

Response Data Bytes

Byte	Format	Description
0-3	Float	High alarm temperature trigger value

Command Specific Response Codes

Code	Class	Description
0	Success	No command-specific errors
1-2	N/A	Undefined
3	Error	Passed parameter too large
4	Error	Passed parameter too small
5	Error	Too few data bytes
6-127	N/A	Undefined

Command #181: Read High Alarm Temperature Trigger Value

Request Data Bytes

Byte	Format	Description
None	N/A	N/A

Response Data Bytes

Byte	Format	Description
0-3	Float	High alarm temperature trigger value

Command Specific Response Codes

Code	Class	Description
0	Success	No command-specific errors
1-127	N/A	Undefined

Command #182: Write Low Alarm Pressure Trigger

Request Data Bytes

Byte	Format	Description
0-3	Float	Low alarm pressure trigger value

Response Data Bytes

Byte	Format	Description
0-3	Float	Low alarm pressure trigger value

Command Specific Response Codes

Code	Class	Description
0	Success	No command-specific errors
1-2	N/A	Undefined
3	Error	Passed parameter too large
4	Error	Passed parameter too small
5	Error	Too few data bytes

Code	Class	Description
6-127	N/A	Undefined

Command #183: Read Low Alarm Pressure Trigger Value

Request Data Bytes

Byte	Format	Description
None	N/A	N/A

Response Data Bytes

Byte	Format	Description
0-3	Float	Low alarm pressure trigger value

Command Specific Response Codes

Code	Class	Description
0	Success	No command-specific errors
1-127	N/A	Undefined

Command #184: Write High Alarm Pressure Trigger

Request Data Bytes

Byte	Format	Description
0-3	Float	High alarm pressure trigger value

Response Data Bytes

Byte	Format	Description
0-3	Float	High alarm pressure trigger value

Command Specific Response Codes

Code	Class	Description
0	Success	No command-specific errors
1-2	N/A	Undefined
3	Error	Passed parameter too large
4	Error	Passed parameter too small
5	Error	Too few data bytes
6-127	N/A	Undefined

Command #185: Read High Alarm Pressure Trigger Value

Request Data Bytes

Byte	Format	Description
None	N/A	NA

Response Data Bytes

Byte	Format	Description

0-3	Float	High alarm pressure trigger value

Command Specific Response Codes

Code	Class	Description
0	Success	No command-specific errors
1-127	N/A	Undefined

Command #186: Write Low Alarm Total Trigger

Request Data Bytes

Byte	Format	Description
0-3	Float	Low alarm total trigger value

Response Data Bytes

Byte	Format	Description
0-3	Float	Low alarm total trigger value

Command Specific Response Codes

Code	Class	Description
0	Success	No command-specific errors
1-2	N/A	Undefined
3	Error	Passed parameter too large
4	Error	Passed parameter too small
5	Error	Too few data bytes
6-127	N/A	Undefined

Command #187: Read Low Alarm Total Trigger Value

Request Data Bytes

Byte	Format	Description
None	N/A	N/A

Response Data Bytes

Byte	Format	Description
0-3	Float	Low Alarm total Trigger value

Command Specific Response Codes

Code	Class	Description
0	Success	No command-specific errors
1-127	N/A	Undefined

Command #188: Write High Alarm Total Trigger Value

Request Data Bytes

Byte	Format	Description
0-3	Float	High alarm total trigger value

Response Data Bytes

Byte	Format	Description
0-3	Float	High alarm total trigger value

Command Specific Response Codes

Code	Class	Description
0	Success	No command-specific errors
1-2	N/A	Undefined
3	Error	Passed parameter too large
4	Error	Passed parameter too small
5	Error	Too few data bytes
6-127	N/A	Undefined

Command #189: Read High Alarm Total Trigger

Request Data Bytes

Byte	Format	Description
None	N/A	N/A

Response Data Bytes

Byte	Format	Description
0-3	Float	High alarm total trigger value

Command Specific Response Codes

Code	Class	Description
0	Success	No command-specific errors
1-127	N/A	Undefined

Command #190: Write Pipe Diameter Value

Request Data Bytes

Byte	Format	Description
0-3	Float	Pipe ID value

Response Data Bytes

Byte	Format	Description

0-3	Float	Pipe ID value

Command Specific Response Codes

Code	Class	Description
0	Success	No command-specific errors
1-2	N/A	Undefined
3	Error	Passed parameter too large
4	Error	Passed parameter too small
5	Error	Too few data bytes
6-127	N/A	Undefined

Command #191: Read Pipe Diameter Value

Request Data Bytes

Byte	Format	Description
None	N/A	N/A

Response Data Bytes

Byte	Format	Description
0-3	Float	Pipe ID value

Command Specific Response Codes

Code	Class	Description
0	Success	No command-specific errors
1-127	N/A	Undefined

Command #192 Read Pipe Roughness Index

NOTE: For indexes see Chapter 5: Tables

Request Data Bytes

Byte	Format	Description
None	N/A	N/A

Response Data Bytes

Byte	Format	Description
0 - 1	Enum	Roughness index

Command Specific Response Codes

Code	Class	Description
0	Success	No command-specific errors
1-127	N/A	Undefined

Command #193: Write Pipe Roughness Index

NOTE: For indexes see Chapter 5: Tables

Request Data Bytes

Byte	Format	Description
0 - 1	Enum	Roughness index

Response Data Bytes

Byte	Format	Description
0 - 1	Enum	Roughness index

Command Specific Response Codes

Code	Class	Description
0	Success	No command-specific errors
1-2	N/A	Undefined
2	Error	Invalid selection
3-4	N/A	Undefined
5	Error	Too few data bytes
6-127	N/A	Undefined

Command #194 Read Pipe Diameter Unit Index

Request Data Bytes

Byte	Format	Description
None	N/A	N/A

Response Data Bytes

Byte	Format	Description
0 - 1	Enum	Pipe diameter unit index, 0–Inches, 1–Feet, 2–Millimeters, 3–Meters

Command Specific Response Codes

Code	Class	Description
0	Success	No command-specific errors
1-127	N/A	Undefined

Command #195: Write Pipe Diameter Unit Index

Request Data Bytes

Byte	Format	Description
0 - 1	Enum	Pipe diameter unit index, 0–Inches, 1–Feet, 2–Millimeters, 3–Meters

Response Data Bytes

Byte	Format	Description

0 - 1	Enum	Pipe diameter unit index, 0–Inches, 1–Feet, 2–Millimeters, 3–Meters

Command Specific Response Codes

Code	Class	Description
0	Success	No command-specific errors
1-2	N/A	Undefined
2	Error	Invalid selection
3-4	N/A	Undefined
5	Error	Too few data bytes
6-127	N/A	Undefined

Command #196: Write MeterTune Correction Value

Request Data Bytes

Byte	Format	Description
0-3	Float	Flow MeterTune correction value

Response Data Bytes

Byte	Format	Description
0-3	Float	Flow MeterTune correction value

Command Specific Response Codes

Code	Class	Description
0	Success	No command-specific errors
1-2	N/A	Undefined
3	Error	Passed parameter too large
4	Error	Passed parameter too small
5	Error	Too few data bytes
6-127	N/A	Undefined

Command #197: Read Flow Correction

Request Data Bytes

Byte	Format	Description
None	N/A	N/A

Response Data Bytes

Byte	Format	Description
0-3	Float	Flow MeterTune correction value

Command Specific Response Codes

Code	Class	Description
0	Success	No command-specific errors
1-127	N/A	Undefined

Command #200 Read Totalizer Enable Index

Request Data Bytes

Byte	Format	Description
None	N/A	N/A

Response Data Bytes

Byte	Format	Description
0 - 1	Enum	Totalizer enable index, 0 = off, 1 = on

Command Specific Response Codes

Code	Class	Description
0	Success	No command-specific errors
1-127	N/A	Undefined

Command #201: Write Totalizer Enable

Request Data Bytes

Byte	Format	Description
0 - 1	Enum	Totalizer enable index, 0 = off, 1 = on

Response Data Bytes

Byte	Format	Description
0 - 1	Enum	Totalizer enable index, 0 = off, 1 = on

Command Specific Response Codes

Code	Class	Description
0	Success	No command-specific errors
1-2	N/A	Undefined
2	Error	Invalid selection
3-4	N/A	Undefined
5	Error	Too few data bytes
6-127	N/A	Undefined

Command #202: Write Totalizer Units per Pulse

Request Data Bytes

Byte	Format	Description

0-3	Float	Totalizer units per pulse

Response Data Bytes

Byte	Format	Description
0-3	Float	Totalizer units per pulse

Command Specific Response Codes

Code	Class	Description
0	Success	No command-specific errors
1-2	N/A	Undefined
3	Error	Passed parameter too large
4	Error	Passed parameter too small
5	Error	Too few data bytes
6-127	N/A	Undefined

Command #203: Read Totalizer Units per Pulse

Request Data Bytes

Byte	Format	Description
None	N/A	N/A

Response Data Bytes

Byte	Format	Description
0-3	Float	Totalizer units per pulse

Command Specific Response Codes

Code	Class	Description
0	Success	No command-specific errors
1-127	N/A	Undefined

Command #204: Write Totalizer Pulse Width Index

Request Data Bytes

Byte	Format	Description
0-1	Enum	Totalizer pulse width index, 0–Off, 1–On test, 2–50ms, 3–100ms, 4–250ms

Response Data Bytes

Byte	Format	Description
0-1	Enum	Totalizer pulse width index, 0–Off, 1–On test, 2–50ms, 3–100ms, 4–250ms

Command Specific Response Codes

Code	Class	Description
0	Success	No command-specific errors
1-2	N/A	Undefined
3	Error	Passed parameter too large
4	Error	Passed parameter too small
5	Error	Too few data bytes
6-127	N/A	Undefined

Command #205: Read Totalizer Pulse Width

Request Data Bytes

Byte	Format	Description
None	N/A	N/A

Response Data Bytes

Byte	Format	Description
0-1	Enum	Totalizer pulse width index, 0–Off, 1–On test, 2–50ms, 3–100ms, 4–250ms

Command Specific Response Codes

Code	Class	Description
0	Success	No command-specific errors
1-127	N/A	Undefined

Command #206 Read Totalizer Reset Index

Request Data Bytes

Byte	Format	Description
None	N/A	N/A

Response Data Bytes

Byte	Format	Description
0 - 1	Enum	Totalizer reset index, 3 = reset count

Command Specific Response Codes

Code	Class	Description
0	Success	No command-specific errors
1-127	N/A	Undefined

Command #207: Write Totalizer Reset

Request Data Bytes

Byte	Format	Description
0 - 1	Enum	Totalizer reset index, 3 = reset count

Response Data Bytes

Byte	Format	Description
0 - 1	Enum	Totalizer reset index, 3 = reset count

Command Specific Response Codes

Code	Class	Description
0	Success	No command-specific errors
1-2	N/A	Undefined
2	Error	Invalid selection
3-4	N/A	Undefined
5	Error	Too few data bytes
6-127	N/A	Undefined

Command #208: Write Password Value

Request Data Bytes

Byte	Format	Description
0-1	Enum	Password, (any 4 digits number)

Response Data Bytes

Byte	Format	Description
0-1	Enum	Password, (any 4 digits number)

Command Specific Response Codes

Code	Class	Description
0	Success	No command-specific errors
1-2	N/A	Undefined
3	Error	Passed parameter too large
4	Error	Passed parameter too small
5	Error	Too few data bytes
6-127	N/A	Undefined

Command #209: Read Password Value

Request Data Bytes

Byte	Format	Description
None	N/A	N/A

Response Data Bytes

Byte	Format	Description
0-1	Enum	Password, (any 4 digits number)

Command Specific Response Codes

Code	Class	Description
0	Success	No command-specific errors
1-127	N/A	Undefined

Command #210 Read Serial Number Value

Request Data Bytes

Byte	Format	Description
None	N/A	N/A

Response Data Bytes

Byte	Format	Description
0-7	ASCII	Serial number value

Command Specific Response Codes

Code	Class	Description
0	Success	No command-specific errors
1-127	N/A	Undefined

Command #211 Read Firmware Version Value

Request Data Bytes

Byte	Format	Description
None	N/A	N/A

Response Data Bytes

Byte	Format	Description
0-7	ASCII	Firmware version value

Command Specific Response Codes

Code	Class	Description
0	Success	No command-specific errors
1-127	N/A	Undefined

Command #212 Read Calibration Date

Request Data Bytes

Byte	Format	Description
None	N/A	N/A

Response Data Bytes

Byte	Format	Description
0-9	ASCII	Calibration date, (mm/dd/yyyy)

Command Specific Response Codes

Code	Class	Description
0	Success	No command-specific errors
1-127	N/A	Undefined

Command #213 Read PCA Version

Request Data Bytes

Byte	Format	Description
None	N/A	N/A

Response Data Bytes

Byte	Format	Description
0-5	ASCII	PCA version

Command Specific Response Codes

Code	Class	Description
0	Success	No command-specific errors
1-127	N/A	Undefined

Tables

Flow Units (PV)

Device Variables		
Velocity	*Index*	*Units*
Device Variable Classification Code 67	125	(SFPS), standard feet per second
	126	(SFPM), standard feet per minute
	127	(SFPH), standard feet per hour
	128	(SFPD), standard feet per day
	129	(SFPY), standard feet per year
	130	(FPS), feet per second (actual)
	131	(FPM), feet per second (actual)
	132	(FPH), feet per second (actual)
	133	(FPD), feet per second (actual)
	134	(FPY), feet per second (actual)
	135	(MPS),meters per second (actual)
	136	(MPM),meters per minute (actual)
	137	(MPH),meters per hour (actual)
	138	(MPD),meters per day (actual)
	139	(MPY),meters per year (actual)
	140	(SMPS), standard meters per second
	141	(SMPM), standard meters per minute
	142	(SMPH), standard meters per hour
	143	(SMPD), standard meters per day

	144	(SMPY), standard meters per year
	145	(NMPS), normal meters per second
	146	(NMPM), normal meters per minute
	147	(NMPH), normal meters per hour
	148	(NMPD), normal meters per day
	149	(NMPY), normal meters per year
Volumetric Flow	*Index*	*Units*
Device Variable Classification Code 66	15	(ACFS), actual cubic feet per second
	16	(ACFM), actual cubic feet per minute
	17	(ACFH), actual cubic feet per hour
	18	(ACFD), actual cubic feet per day
	19	(ACFY), actual cubic feet per year
	30	(AM3/sec), actual meters per second
	31	(AM3/min, actual meters per minute
	32	(AM3/hr, actual meters per hour
	33	(AM3/day, actual meters per day
	34	(AM3/yr, actual meters per year
	45	(ALPS),actual liters per second
	46	(ALPM), actual liters per minute
	47	(ALPH), actual liters per hour
	48	(ALPD), actual liters per day
	49	(ALPY), actual liters per year
	60	(Gal/sec), US gallons per second
	61	(Gal/min), US gallons per minutes
	62	(Gal/hr), US gallons per hour
	63	(Gal/day), US gallons per day
	64	(Gal/yr), US gallons per year
	65	(MilG/sec), million US gallons per second
	66	(MilG/min), million US gallons per minute
	67	(MilG/hr), million US gallons per hour
	68	(MilG/day), million US gallons per day
	69	(MilG/year), million US gallons per year
	70	(ImpG/sec), imperial gallons per second
	71	(ImpG/min), imperial gallons per minute
	72	(ImpG/hr), imperial gallons per hour
	73	(ImpG/day), imperial gallons per day
	74	(ImpG/yr), imperial gallons per year
	75	(bbl/sec), barrels per second
	76	(bbl/min), barrels per minute
	77	(bbl/hr), barrels per hour
	78	(bbl/day), barrels per day
	79	(bbl/yr), barrels per year
	80	(lit/sec), actual liters per second
	81	(lit/min), actual liters per minute
	82	(lit/hr), actual liters per hour
	83	(lit/day), actual liters per day
	84	(lit/yr), actual liters per year
	85	(MilL/sec), actual milliliters per second
	86	(MilL/min), actual milliliters per minute
	87	(MilL/hr), actual milliliters per year
	88	(MilL/day), actual milliliters per day
	89	(MilL/yr), actual milliliters per year
	90	(m3/sec), actual cubic meters per second
	91	(m3/min), actual cubic meters per minute
	92	(m3/hr), actual cubic meters per hour
	93	(m3/day), actual cubic meters per day

	94	(m3/yr), actual cubic meters per year
	95	(ft3/sec), actual cubic feet per second
	96	(ft3/min), actual cubic feet per minute
	97	(ft3/hr), actual cubic feet per hour
	98	(ft3/day), actual cubic feet per day
	99	(ft3/yr), actual cubic feet per year
Mass Flow	*Index*	*Units*
Device Variable Classification Code 72	0	(SCFS), standard cubic feet per second
	1	(SCFM), standard cubic feet per minute
	2	(SCFH), standard cubic feet per hour
	3	(SCFD), standard cubic feet per day
	4	(SCFY), standard cubic feet per year
	5	(MSCFS), thousand standard cubic feet per second
	6	(MSCFM), thousand standard cubic feet per minute
	7	(MSCFH), thousand standard cubic feet per hour
	8	(MSCFD), thousand standard cubic feet per day
	9	(MSCFY), thousand standard cubic feet per year
	10	(MMSCFS),million standard cubic feet per second
	11	(MMSCFM), million standard cubic feet per minute
	12	(MMSCFH), million standard cubic feet per hour
	13	(MMSCFD), million standard cubic feet per day
	14	(MMSCFY), million standard cubic feet per year
	20	(NCFS), normal cubic feet per second
	21	(NCFM), normal cubic feet per minute
	22	(NCFH), normal cubic feet per hour
	23	(NCFD), normal cubic feet per day
	24	(NCFY), normal cubic feet per year
	25	(Sm3/sec), standard cubic meters per second
	26	(Sm3/min), standard cubic meters per minute
	27	(Sm3/hr), standard cubic meter per hour
	28	(Sm3/day), standard cubic meter per day
	29	(Sm3/yr), standard cubic meter per year
	35	(Nm3/sec), normal cubic meters per second
	36	(Nm3/min), normal cubic meters per minute
	37	(Nm3/hr), normal cubic meter per hour
	38	(Nm3/day), normal cubic meter per day
	39	(Nm3/yr), normal cubic meter per year
	40	(SLPS), standard liters per second
	41	(SLPM), standard liters per minute
	42	(SLPH), standard liters per hour
	43	(SLPD), standard liters per day
	44	(SLPY), standard liters per year
	50	(NLPS), normal liters per second
	51	(NLPM), normal liters per minute
	52	(NLPH), normal liters per hour
	53	(NLPD), normal liters per day
	54	(NLPY), normal liters per year
	55	(Lbs/sec), pounds per second
	56	(Lbs/min), pounds per minute
	57	(Lbs/hr), pounds per hour
	58	(Lbs/day), pounds per day
	59	(Lbs/yr), pounds per year
	100	(Ston/sec), short tons per second
	101	(Ston/min), short tons per minute
	102	(Ston/hr), short tons per hour
	103	(Ston/day), short tons per day
	104	(Ston/yr), short tons per year

	105	(Lton/sec), long tons per second
	106	(Lton/min), long tons per second
	107	(Lton/hr), long tons per second
	108	(Lton/day), long tons per second
	109	(Lton/yr), long tons per second
	110	(Mton/sec), metric tonnes per second
	111	(Mton/min), metric tonnes per minute
	112	(Mton/hr), metric tonnes per hour
	113	(Mton/day), metric tonnes per day
	114	(Mton/yr), metric tonnes per year
	115	(Gram/sec), grams per second
	116	(Gram/min), grams per minute
	117	(Gram/hr), grams per hour
	118	(Gram/day), grams per day
	119	(Gram/yr), grams per year
	120	(Kg/sec), killograms per second
	121	(Kg/min), killograms per minute
	122	(Kg/hr), killograms per hour
	123	(Kg/day), killograms per day
	124	(Kg/yr), killograms per year

Temperature Units (SV)

HART Classification Cod	*Index*	*Units*
64	0	°F
	1	°C
	2	°K
	3	°R

Pressure Units (TV)

HART Classification Code	*Index*	*Units*
65	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	In H2O G
	10	MM H2O A
	11	MM H2O G

Totalizer Units (QV)

Volumetric Flow Totalizer	*Units*
Device Variable Classification Code 68	(SCF), standard cubic feet (NCF), normal cubic feet (Sm3), Standard cubic meters (Nm3), normal cubic meters (SL), standard liters (NL), normal liters
Mass Flow Totalizer	*Units*
Device Variable Classification Code 71	(lbs), pounds (Kg), kilograms

Pipe Roughness Index Table

Index	Description
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

Performance

Power-Up

When you first power up the, the Cold Flag is set.

Reset

Command #42 ("Device Reset") causes the device to reset its communication microcontroller. The resulting restart is identical to the normal power-up sequence.

HART Alarm Mode Codes

(Subset of HART Common Table 14, Alarm selection code)

HCF codes	Alarm Status	Description
0	High	21 mA alarm current (4 – 20 mA loop)
1	Low	3.6 mA alarm current (4 – 20 mA loop)
2-249	Not defined	N/A
250	Not used	N/A
251-255	Not defined	N/A

Command Response Times

Description	Response Time
Minimum	1.2 ms
Typical	1.5 ms
Maximum	5 ms

Busy and Delayed Response

Busy response and delayed response features are not used on the QuadarTherm 240i/241i HART

Long Messages

Long messages are not supported.

Non-Volatile Memory

EEPROM is used to hold the device's configuration parameters. New data is written to this memory immediately on execution of a write command.

Modes

Fixed current mode is not supported.

Write Protection

Write protection is not supported.

Damping

Damping affects only the PV and the loop current signal.

Transfer Function

Transfer function is a subject of HART Common Table 13, "Transfer Function Codes."
Code 0, linear transfer function is supported.

Appendix A: Capability Checklist

Manufacturer, Model, and Revision	InnovaMass 240i/241i
Device Type	Flow meter
HART Revision	7.4
Device Description Available	Yes
Number and Type Of Sensors	4
Number and Type Of Actuators	0
Number and Type Of Host Side Signals	Two 4-20 mA analog, One 4-20 mA analog /HART
Number of Device Variables	4
Number of Dynamic Variables	4
Mappable Dynamic Variables?	No
Number of Common-Practice Commands	13
Number of Device-Specific Commands	69
Bits of Additional Device Status	3
Alternative Operating Modes	No
Burst Mode	No
Write-Protection	No

Appendix B: Default Configuration

Parameter	Default value
Number of Response Preambles	5