QuadraTherm® 640i/ 780i HART®

Instruction Manual

HART® Device Specification for Models:
640i and 780i Thermal Mass Flow Meters

Part Number: IM-640i/780iV2-HART, Rev. V2.A
March 2025

GLOBAL SUPPORT LOCATIONS: WE ARE HERE TO HELP!

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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.

TRADEMARKS

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Caution 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! / Note

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, andsetup procedures. Verify that your settings and adjustments are consistent with factory recommendations. Installation and troubleshooting information can be found in the QuadraTherm 640i/780i product manual.

If the problem persists after following the troubleshooting proceduresoutlined in the QuadraTherm 640i/780i product manual, contact Sierra Instruments. For urgent phone support you may call (831) 373-0200 between 8:00 a.m. and 5:00 p.m. PST. In Europe, contact Sierra Instruments EMEA at +31 72 507 1400. 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)

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

Warning! 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.

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

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

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

Caution! In order to achieve accurate and repeatable performance, the flow meter must be installed with the specified minimum length of straight run upstream and downstream of the flow meter.

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

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

TABLE OF CONTENTS

Chapter 1: Introduction

This document describes the function and operation of the optional HART interface for the Sierra Instruments flow meter. The QuadraTherm 640i/780i 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 QuadraTherm (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 QuadraTherm 640i/780i product manual) by providing a complete, unambiguous description of the QuadraTherm 640i/780i 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 640i/780i HART refers to product models 640i and 780i.

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 .
- QuadraTherm 640i/780i **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	QuadraTherm® 640i/780i Air Mass Flow Meters		

Chapter 2: Product Interfaces

Process Interface

Sensor Input

The QuadraTherm 640i/780i HART has four sensors —three precision platinum temperature sensors and one patented DrySense™ mass velocity sensor. There is also one optional absolute pressure transducer sensor that is available.

QuadraTherm's four-sensor technology provides the critical inputs for qTherm's living, learning algorithm set and gas library to accurately manage changes in gas and pipe selection, gas temperature, gas pressure, and outside temperature.

Host Interface

Analog Output 1: 4-20 mA Flow Out

The active two-wire 4-20 mA current loop is connected on the (+) HART 4-20 Flow Out terminal block 11 and (-) Ground terminal block 12. HART communication is supported on this loop. At least one 250 ohm resistor will needed in the loop to access the HART signal.

The QuadraTherm is powered from 24 VDC +/- 10% (1.04 Amps load, maximum) or the optional 100 to 240 VAC (0.4 Amps RMS at 230 VAC).

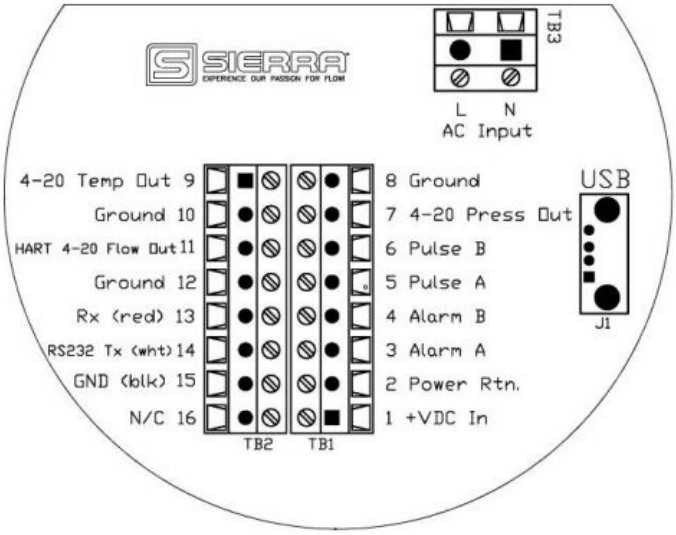


Figure 1 QuadraTherm 640i/780i HART

Local Interfaces, Jumpers, and Switches

Local Controls and Displays

The QuadraTherm 640i/780i a thermal mass flow meter with a local display and a pushbutton keypad.

Device Description Files

The 640i/780i Series 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.

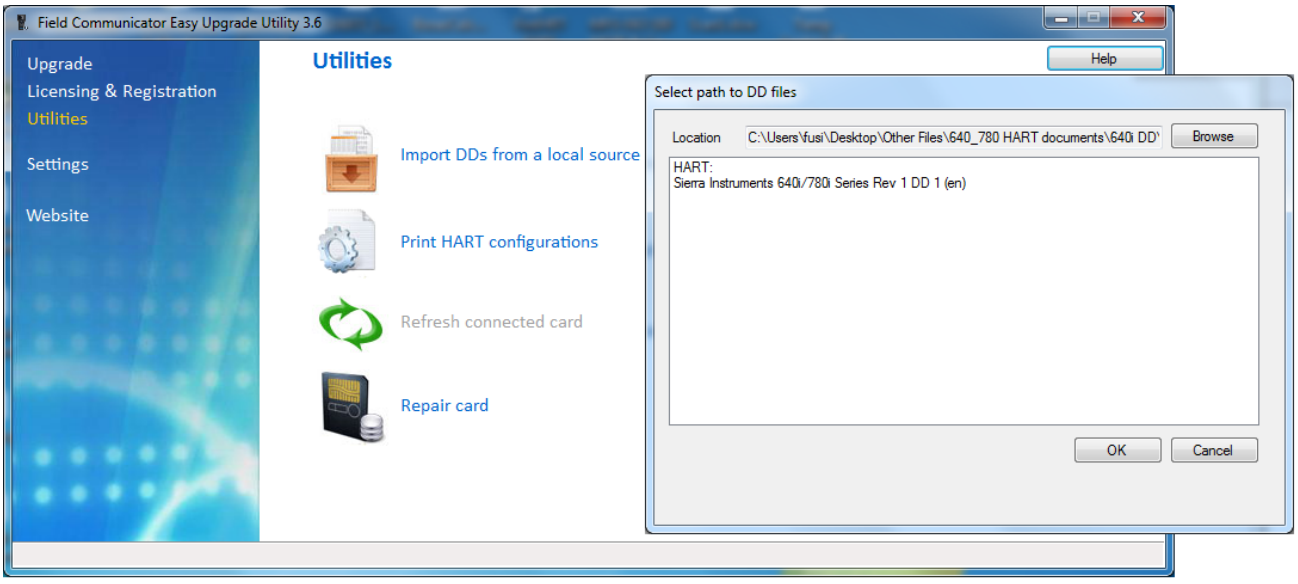
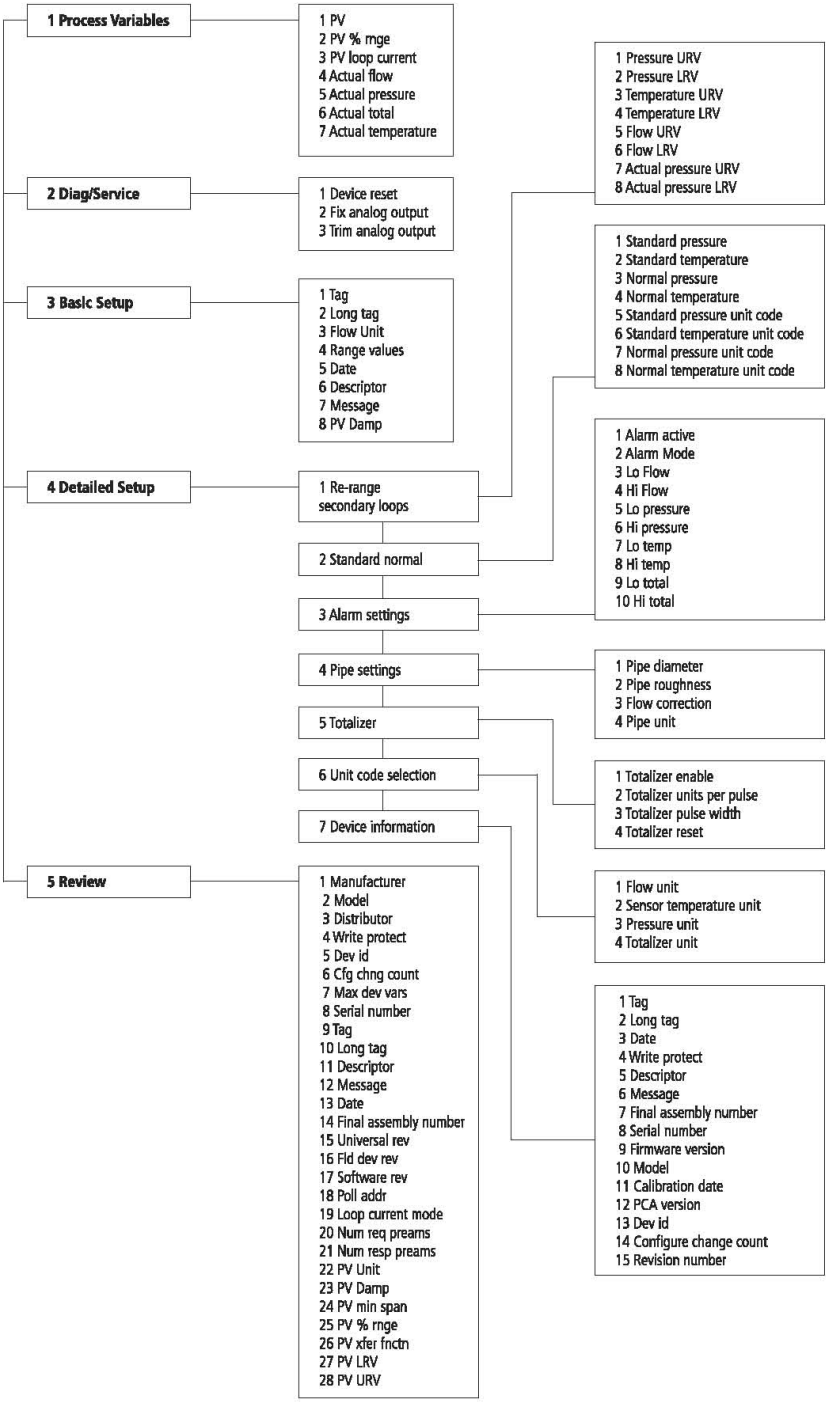


Figure 2: Screen shot of the "Field Communicator Easy Upgrade Utility" Software

640i/780i Series HART Device Menu Tree



Chapter 3 Device Variables

As with most HART devices, QuadraTherm 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 1: 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 2).

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 2

Extended Device Status
Extended device status is not used with the QuadraTherm 640i/780i 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 2: Additional Device Status

Chapter 4 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 QuadraTherm 640i/780i 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 3: Common-practice Commands

Burst Mode

The QuadraTherm does not support burst mode.

Catch Device Variable

The QuadraTherm does not support catch device variable.

Device-Specific Commands

The following device-specific commands are implemented in the QuadraTherm 640i/780i 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 Chapter 5: Tables 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 Chapter 5: Tables 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 Chapter 5: Tables 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 Chapter 5: Tables 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 Chapter 5: Tables 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 Chapter 5: Tables 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
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 Chapter 5: Tables 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 Chapter 5: Tables 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
5	Error	Too few data bytes
6-127	N/A	Undefined

Command #139 Read Pressure Unit Index (TV)

See Chapter 5: Tables 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 Chapter 5: Tables 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

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 #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 Chapter 5: Tables 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 Chapter 5: Tables 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 Chapter 5: Tables 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 Chapter 5: Tables 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

Code	Class	Description
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
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

Code	Class	Description
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

Chapter 5: 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
	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
Mass Flow	**Index**	**Units**
Device Variable Classification Code 66 (Units per year are N/A)	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 44 50 51 52 53 54	(SLPD), standard liters per day (SLPY), standard liters per year (NLPS), normal liters per second (NLPM), normal liters per minute (NLPH), normal liters per hour (NLPD), normal liters per day (NLPY), normal liters per year
Mass Flow	**Index**	**Units**
Device Variable Classification Code 72 (Units per year are N/A)	55 56 57 58 59 120 121 122 123 124	(lbs/sec), pounds per second (lbs/min), pounds per minute (lbs/hr), pounds per hour (lbs/day), pounds per day (lbs/yr), pounds per year (Kg/sec), kilograms per second (kg/min), kilograms per minute (kg/hr), kilograms per hour (kg/day), kilograms per day (kg/yr), kilograms per year

Temperature Units (SV)

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

Pressure Units (TV)

HART Classification Code	Index	Units
65	0 1 2 3 4 5 6 7 8 9 10 11	Psia Psig Bar A Bar G KPa A KPa G Kg/CM2 A Kg/CM2 G In H2O A In H2O G MM H2O A MM H2O G

Totalizer Units (QV)

Volumetric Flow Totalizer	Units
	(SCF), standard cubic feet (NCF), normal cubic feet

Device Variable Classification Code 68	(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

Chapter 6: Performance

Power-Up

When you first power up the device, 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 640i/780i 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	QuadraTherm 640i/780i
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