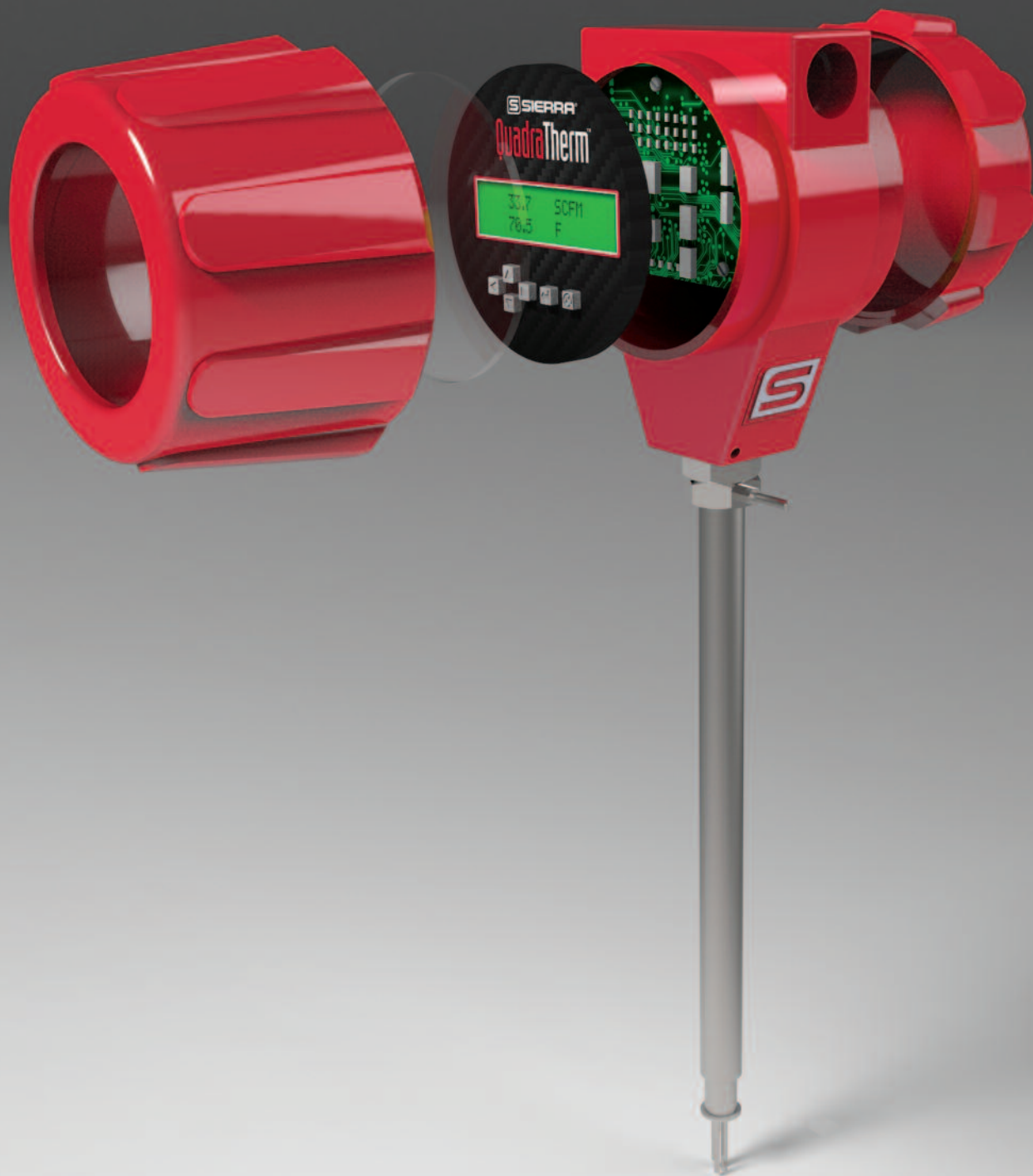


# QuadraTherm<sup>®</sup> 640i / 780i

HIGH ACCURACY : FOUR-SENSOR : MASS FLOW METER





# Introducing the World's Most Accurate Thermal Mass Flow Meter

From Sierra's beginning over forty years ago, Founder Dr. John G. Olin was driven by the vision of supplying industrial customers with the world's most accurate mass flow meter. And, he knew it was a "sensor" game.

The development of an industrialized metal-sheathed sensor in the early 80s was Sierra's first big step, but Dr. Olin is a driven innovator, and this was only the beginning for someone who saw "Thermal Mass Flow" as his life's work. Many successful innovations followed, but in 1999 Sierra experienced a major breakthrough with the introduction of their patented no-drift DrySense™ mass velocity sensor. Sierra engineers now recognized they were on the cusp of realizing Dr. Olin's vision.

## Realizing the Vision

Thermal technology, by its very nature, uses the physics of heat transfer and conservation of energy in an open system to measure mass flow rate. This means that for a thermal mass flow meter to achieve the greatest accuracy, it must solve the First Law of Thermodynamics (Heat Energy In = Heat Energy Out) for each data point.

As you can imagine, solving the First Law in a flow instrument was no easy task. By Dr. Olin's own accounting, decades of "hard-nosed dedication to excellence" by himself and Sierra's engineering team, years of testing, and his stack of yellow note pads over five feet high, jammed with his handwritten equations and designs, finally yielded the secret in the form of two revolutionary technologies—QuadraTherm® and qTherm™, now both patented worldwide.

## QuadraTherm, Beyond Traditional Thermal

Traditional thermal sensors have two sensors—one temperature sensor and one velocity sensor, each in a separate probe sheath. QuadraTherm (the term "Quad" meaning "four") introduces four sensors—three precision platinum temperature sensors and one patented DrySense mass velocity sensor. Sensor performance improvements never thought possible are gained with QuadraTherm as forced convection is completely isolated (the critical variable for measuring gas mass flow rate) by calculating and then eliminating unwanted heat-transfer components, like sensor stem conduction, one of the major causes of false flow readings.

## qTherm, the Brains Behind it

qTherm is the true "Brain" of the instrument and a revolutionary, living, learning algorithm set made possible by today's hyper-fast microprocessors and QuadraTherm sensor inputs. qTherm manages changes in gas flow, gas temperature and gas pressure, as well as outside temperature, via a comprehensive heat-transfer model. The result is a proprietary, fundamentally different gas mass flow rate calculation using all pertinent variables for the most precise, stable and accurate mass flow measurement possible.

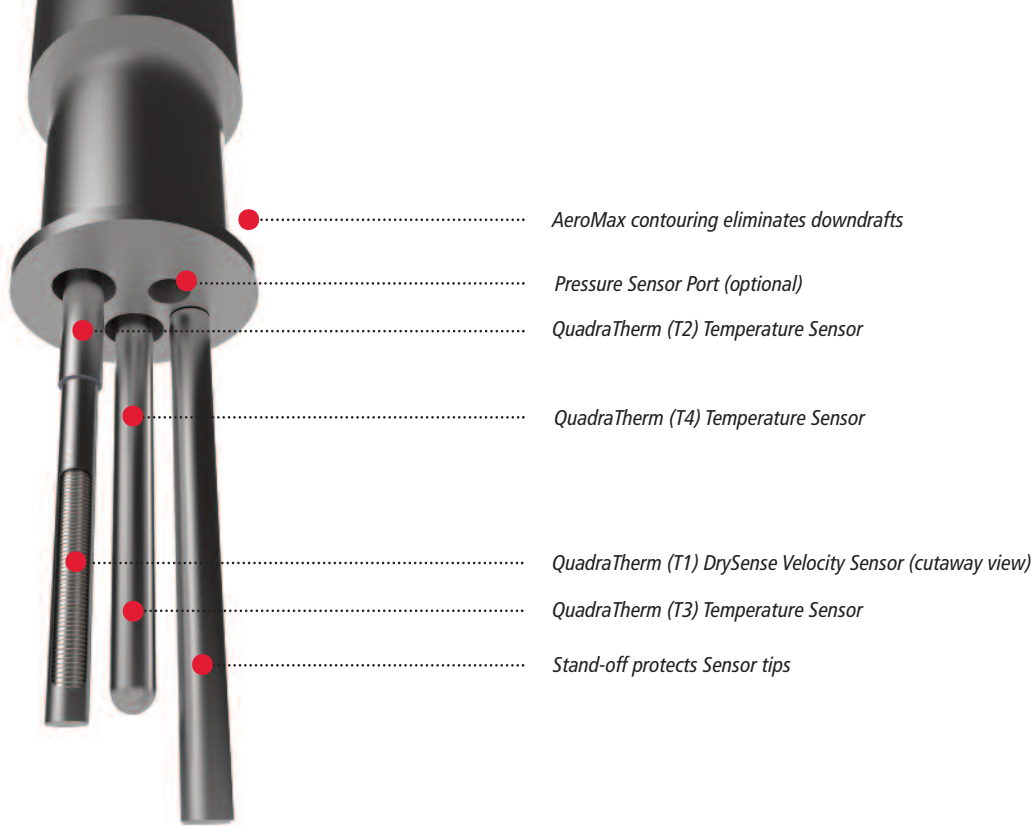
## QuadraTherm 640i / 780i

- Accuracy: +/- 0.5% of Reading\*
- Multivariable: Mass flow rate, temperature & pressure
- Revolutionary QuadraTherm® four-sensor design
- DrySense™ no-drift sensor with lifetime warranty
- qTherm™ living, learning "Brain" manages all inputs
- Dial-A-Pipe™ : Change pipe size
- Dial-A-Gas® : Change gas type
- qTherm Gas Library: Most common gases & mixtures (growing & improving)
- ValidCal™ Diagnostics: Assure performance
- Smart Interface Program: Computer interface software
- Foundation Fieldbus, Modbus, Profibus DP, HART
- CE, cFMus, ATEX, IECEx approved



- 780i inline version has built-in flow conditioning (note transparent pipe)

\* Verified by an independent NIST and NVLAP accredited metrology laboratory



# QuadraTherm Makes it Possible

The challenge for Dr. Olin and the Sierra engineering team was to develop a sensor that isolated forced convection, a prominent source of heat loss.

In traditional thermal mass flow meters, the heated velocity sensor is inserted into the tip of a tubular probe and is surrounded by potting compounds, such as epoxy, ceramic cement, thermal grease, or alumina powder. These so-called “wet” sensors have several weaknesses. They have an increased skin resistance which creates a “droop” in the output curve and decreased sensitivity (specially at high flows) as a consequence. They are hard to produce repeatably, which ultimately means reduced accuracy. And finally, wet sensors can create long-term measurement errors caused by aging and cracking due to differential thermal expansion between the parts of the heated velocity sensor.

QuadraTherm builds on the long-term stability of our patented no-drift DrySense velocity sensor technology. As the name implies, Sierra’s velocity sensor is the only thermal sensor in the world that is truly “dry”. Our proprietary swaging process eliminates all air gaps between the heated velocity sensor and the tubular probe without the need for any potting compounds. The result is maximum sensitivity, reproducibility, immunity to cracking and shifting over time, and ultimately greatly improved accuracy. We back our DrySense Technology with a lifetime warranty.

In addition, by radically reworking the physical sensor head design, Sierra’s engineering team minimized the effects of downdrafts and other interferences that cause false flow readings in traditional thermal flow meters. As Dr. Olin states, “We are trying to create a flow field for the velocity sensor where it is unaffected by anything else around it, so it can do what it was meant to do—measure the free-stream mass flow rate.” Wind-tunnel testing and CFD modeling verified that we accomplished our goal.

## QuadraTherm’s Four-Sensor Design

Sierra’s biggest breakthrough occurred when two new temperature sensors (T2 and T4—See Figure) were added to the existing two-sensor design (T3 temperature & T1 DrySense velocity) used in previous models. The two additional sensors perform real-time correction for the heat lost to the outside environment due to a phenomenon called “stem conduction.” To better understand the benefits, let’s look at a typical example.

Let’s say the temperature of the flowing gas is higher than the outside temperature. In this case, stem conduction causes a substantial fraction (between 10% to 25%) of the electrical power supplied to the heated velocity sensor to be lost through the probe shaft to the outside environment. What happens if this is a traditional thermal mass flow meter and the outside temperature in the field application drops by a few degrees? The heat lost via stem conduction will increase and a flow measurement error will occur. QuadraTherm eliminates this source of error by first accurately measuring, and then correcting for, the heat lost via stem conduction.

# And with qTherm, it Learns.

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.



qTherm solves the First Law of Thermodynamics in a fraction of a second for each mass flow data point. It calculates stem conduction and all other unwanted heat loss components, subtracts them out, and then computes the mass flow rate from the remaining forced convection component.

And, with Dial-A-Pipe, it lets you relocate the probe to different pipe sizes and types in the field. With Dial-A-Gas, it provides gas change capability with highly accurate readings. Totalize each gas independently using the flow totalizer feature in the Smart Interface Program (SIP).

## qTherm's Expanding Gas Library

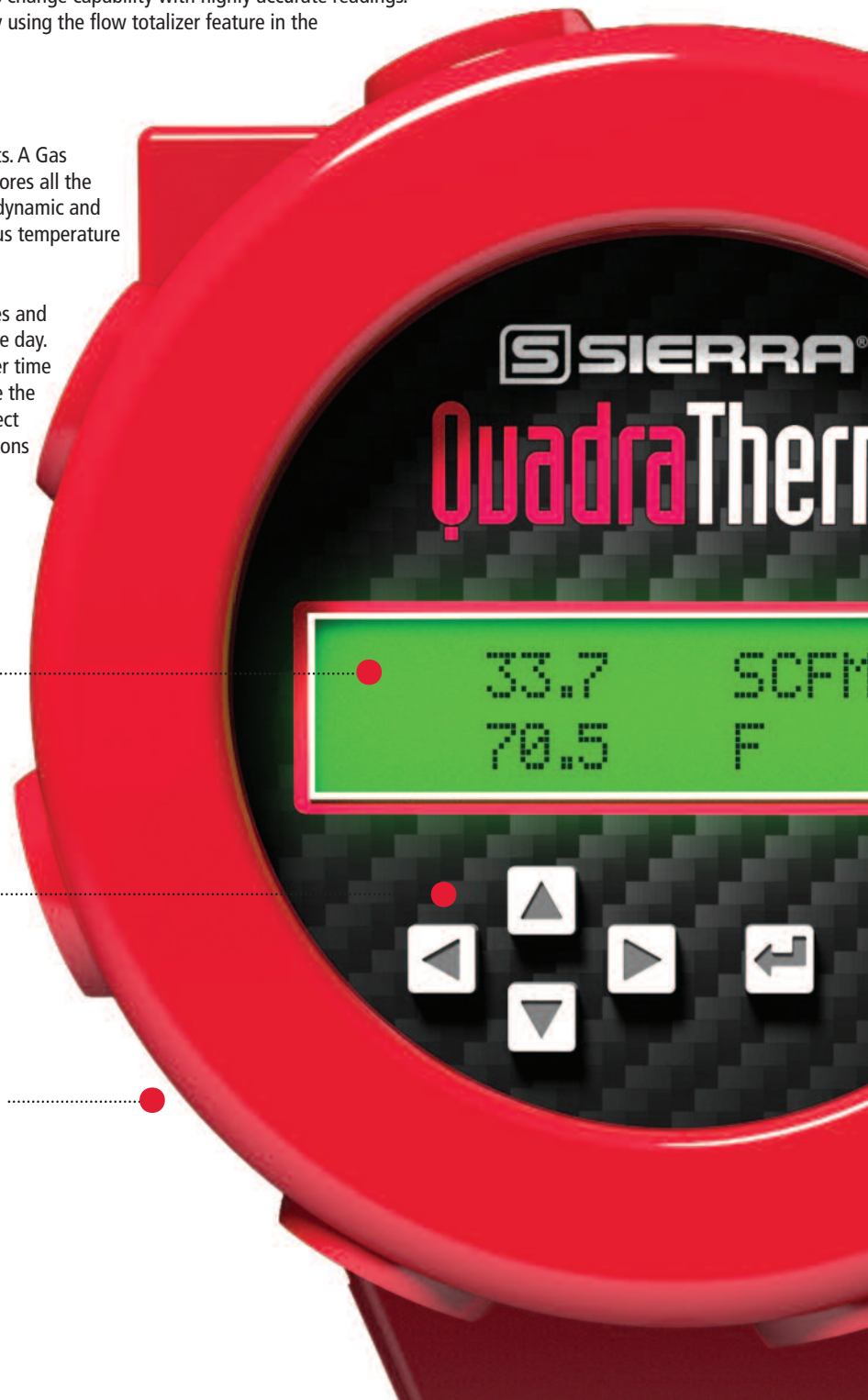
The qTherm Gas Library stores proprietary Gas Packets. A Gas Packet is analogous to the DNA of a specific gas. It stores all the parameters needed to instantly calculate the thermodynamic and transport properties of every gas or gas mixture versus temperature and pressure.

Currently, the library has mapped most common gases and mixtures, and it continues to grow and improve by the day. Furthermore, the millions of data points collected over time in Sierra's metrology laboratories can be used to tune the instrument for better performance and accuracy. Expect hundreds of data sets and gas/gas mixture combinations in the future that can be downloaded to your QuadraTherm meter via the internet.

*Multivariable Readout:  
Mass flow, temperature, pressure,  
totalizer, and alarms*

*Pushbutton control for  
Dial-A-Gas, Dial-A-Pipe, alarms,  
and engineering units*

*Explosion proof glass  
and enclosure*



## PERFORMANCE SPECIFICATIONS

### Gas Measured

All inert gases and all non-condensing clean gases  
Flammable gases: methane, propane, hydrogen, digester gas, natural gas  
Corrosive gases compatible with 316L stainless steel  
qTherm Gas Library: most common gases and mixtures; air is standard;  
qTherm Dial-A-Gas option for choice of three additional gases

### Mass Velocity Range for Air

0 to 60,000 sfpm (0 to 305 smps) at 21.1°C (70°F), 1 atm

### Multivariable Outputs

Mass flow rate (standard)  
Temperature (standard)  
Pressure (optional)  
Totalized flow: totalized value is stored in non-volatile memory

### Mass Flow Accuracy

780i Inline version accuracy (highest accuracy):\*  
+/- 0.5% of reading above 50% of the full scale flow  
+/- 0.5% of reading plus 0.5% of full scale below 50% of full scale flow

640i Insertion version accuracy:\*  
+/- 0.75% of reading above 50% of the full scale flow  
+/- 0.75% of reading plus 0.5% of full scale below 50% of full scale flow

See Table 1: qTherm Dial-A-Gas Selection Chart on next page for accuracy.  
Gas pressure accuracy +/- 1.0% full scale  
Totalize each gas independently with the flow totalizer

\* Accuracy statements verified by an independent NIST and NVLAP accredited metrology laboratory.

### Gas Temperature Accuracy

+/- 1°C (1.8°F)

### Gas Pressure Ranges

30 psia (2.1 bara), 100 psia (6.9 bara), 300 psia (20.7 bara),  
500 psia (34.5 bara), VTP only.

### Repeatability

Mass flow rate: +/- 0.15% of full scale  
Gas temperature: +/- 0.5°C (0.9°F)  
Gas pressure: +/- 0.5% of full scale

### Response Time

Three seconds to achieve 63% (one time constant) of final value

### Mass Flow Rate Turndown

100:1

## ANALOG AND DIGITAL OUTPUTS

### Output Signals

4-20 mA flow, 4-20 mA temperature, 4-20 mA pressure (optional)  
Alarm output (contact SPST/opto relays)  
User definable pulse output for totalized flow

### Optional Communications Modules

Modbus, Foundation Fieldbus, Profibus DP, HART

## SOFTWARE

### Smart Interface Program (SIP) Software

Use Dial-A-Gas and Dial-A-Pipe for easy field setup  
Use Meter Tune to optimize performance  
Use ValidCal to validate all meter functions  
Use flow totalizer to totalize all four Dial-A-Gases independently

## POWER REQUIREMENTS

### Input Power

100 to 240 VAC (0.4 Amps RMS at 230 VAC)  
24 VDC +/- 10%, 1 Amp

## OPERATING SPECIFICATIONS

### 780i Inline Version Gas Pressure Requirements

NPT: 500 psia (34.5 bara) maximum

Flange process connections defined by the ASME B 16.5a – 1998 spec. group rating of 316L stainless steel ANSI class 150 or 300 class flanges (special)

316L stainless steel 150 class flanges:  
230 psia at -20°F to 100°F; 195 psia at 200°F;  
145 psia at 300°F; 160 psia at 400°F; and 145 psia at 500°F  
Equivalent DN PN16 flanges are available (see page 10 for sizes)

316L stainless steel 300 class flanges (special):  
600 psia at -20°F to 100°F; 505 psia at 200°F; 455 psia at 300°F;  
415 psia at 400°F; and 380 psia at 500°F

### 640i Insertion Version Gas Pressure Requirements

Compression fittings: 500 psia (34.5 bara)  
1-inch 150 class flange (-40°F to 250°F) 185 psia (12.8 bara)  
Low pressure hot tap: 150 psia (10.3 bara)  
High pressure hot tap: 230 psia (15.9 bara)

### Gas Temperature Requirements (all versions)

-40°F (-40°C) to 392°F (200°C)  
High temperature (HT) option to 750°F (400°C) available in 640S model only

### Ambient Temperature (NAA and cFMus versions)

-40°F (-40°C) to 140°F (60°C)  
ATEX/IECEX Versions -4°F (-20°C) to 140°F (60°C)

## PHYSICAL SPECIFICATIONS

### User Interface

Local keypad with a six-button interface  
Exit ⊗ Enter ← Four-way directional arrows ◀ ▶ ▶ ▶  
RS-232 with PC software for communication and programming

### Digital Display

UltraBright, backlit, LCD digital display, 2 x 16, 2 x 32 scrolling

### 780i Inline Version Process Connections

See page 9 and 10 for NPT, ANSI class 150 flange and PN16 DN sizes.

### 640i Insertion Version Process Connections

See page 6 through 8 for insertion sizes.  
ANSI 1-inch - ANSI class 150 flange (optional)  
Low pressure hot tap rated to 150 psia (10.3 bara)  
High pressure hot tap and retractor 230 psia (15.9 bara)

### Wetted Materials

316 SS and 316L SS flow body and Pt/Ir (velocity sensor)  
Viton® VTP Pressure Option  
Neoprene®, Kal-Rez® optional

### Leak Integrity

1 x 10<sup>-4</sup> sccs of helium

### Approval Agencies

cFMus—Explosion proof for Class I, Div I, Groups B,C,D  
CE—European Conformity  
ATEX/IECEX

### Enclosure

NEMA 4 (IP66), hazardous-area explosion proof, flow pointer, meter information tag. NEMA 4X (E2 option only).

TABLE 1: qTherm Dial-A-Gas Selection Chart				
Gas	780i Accuracy		640i Accuracy	
	Actual Gas <sup>(1)</sup>	qTherm Dial-A-Gas <sup>(2)</sup>	Actual Gas <sup>(1)</sup>	qTherm Dial-A-Gas <sup>(2)</sup>
Air <sup>(3)</sup>	±0.5%	N/A	±0.75%	N/A
Argon	±0.5%	±3.0%	±0.75%	±3.0%
Carbon Dioxide	±0.5%	±3.0%	±0.75%	±3.0%
Chlorine	N/A	±3.0%	N/A	±3.0%
Digester Gas (60% CH <sub>4</sub> , 40% CO <sub>2</sub> )	±0.5%	±3.0%	±0.75%	±3.0%
Helium	±0.5%	±3.0%	±0.75%	±3.0%
Hydrogen	±0.5%	±3.0%	±0.75%	±3.0%
Methane	±0.5%	±3.0%	±0.75%	±3.0%
Nitrogen	±0.5%	±3.0%	±0.75%	±3.0%
Oxygen	N/A	±3.0%	N/A	±3.0%
Propane	±0.5%	±3.0%	±0.75%	±3.0%
Other <sup>(4)</sup> —Consult Factory	Special Calibration Request (SCR)	Special Calibration Request (SCR)	Special Calibration Request (SCR)	Special Calibration Request (SCR)

Notes: (1) % of reading at >50% of full scale flow; add 0.5% of full scale below 50% of full scale flow

(2) % of full scale

(3) Air is standard on the instrument and cannot be removed

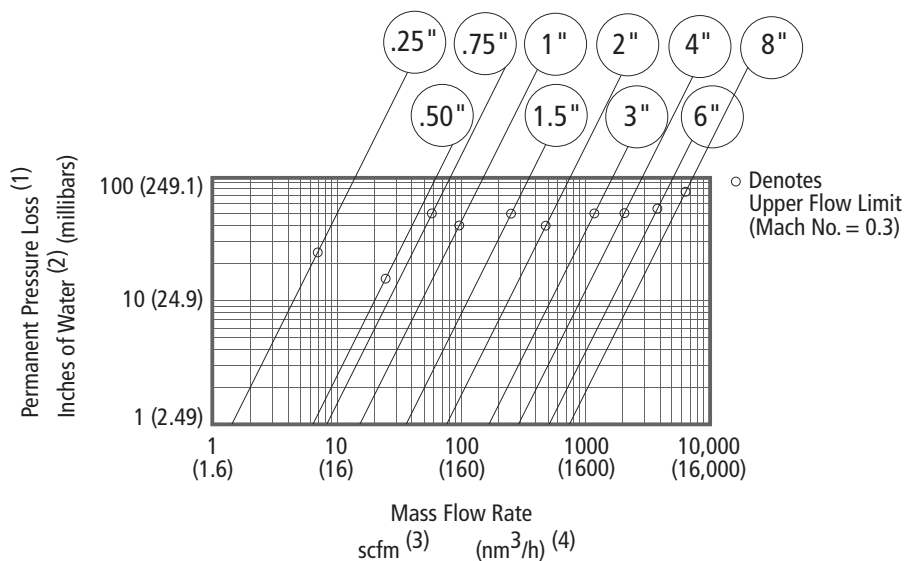
(4) The qTherm Gas Library is a proprietary gas property index that is continually updated and improved

TABLE 2: 640i/780i Straight Run Requirements			
Piping Condition	Upstream 640i Insertion	Upstream 780i Inline with Flow Conditioning <sup>(1)</sup>	Downstream <sup>(2)</sup>
Single 90° Elbow or T-Piece	15D	1D	0D
Reduction (4:1)	20D	3D	0D
Expansion (4:1)	40D	3D	0D
After Control Valve	15D	3D	0D
Two 90° Elbows (in same plane)	30D	3D	0D
Two 90° Elbows (different planes)	40D	5D	0D

Notes: (1) Number of diameters (D) of straight pipe required between upstream disturbance and the flow meter

(2) Number of diameters (D) of straight pipe required downstream of the flow meter

### 780i INLINE PRESSURE DROP



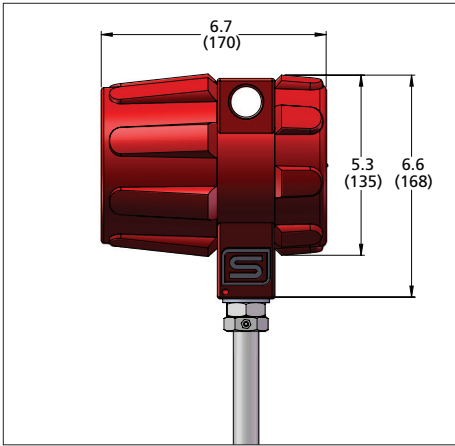
Notes: (1) For air and nitrogen at 20°C temperature and 1 atmosphere pressure

(2) 1 inch of water at 60°F = 0.0361 psi

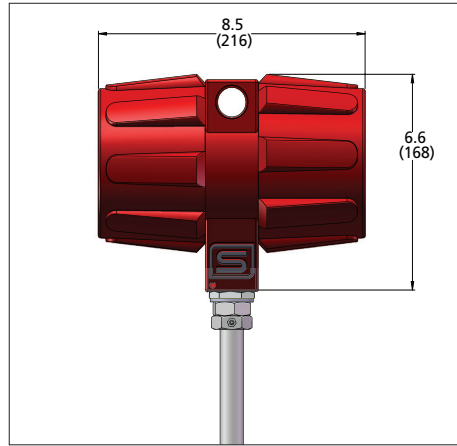
(3) At base conditions of 21.1°C temperature and 1 atmosphere pressure

(4) At base conditions of 0°C temperature and 1 atmosphere pressure

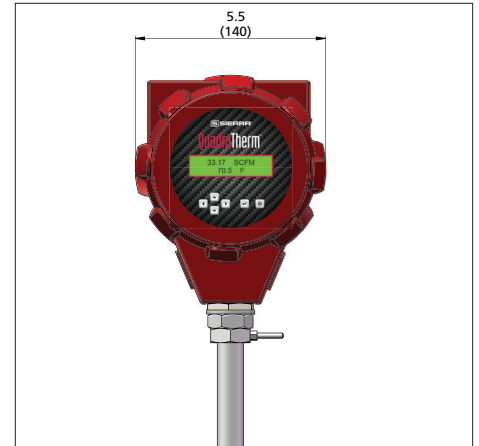
P2-DD—Side View



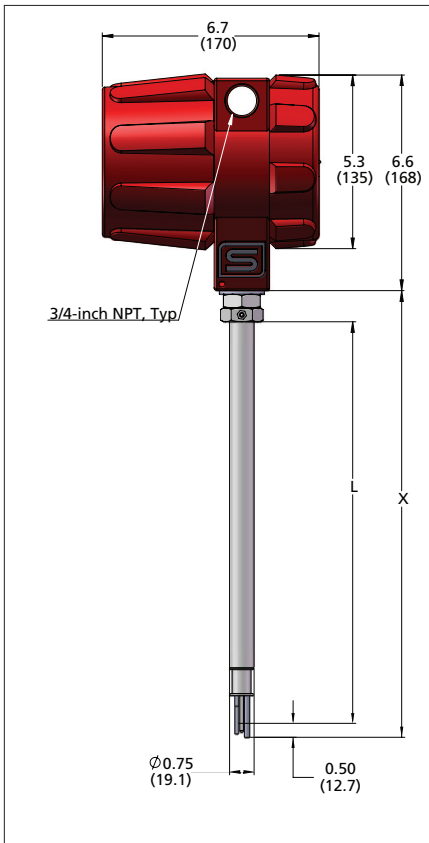
P3-DD—Side View



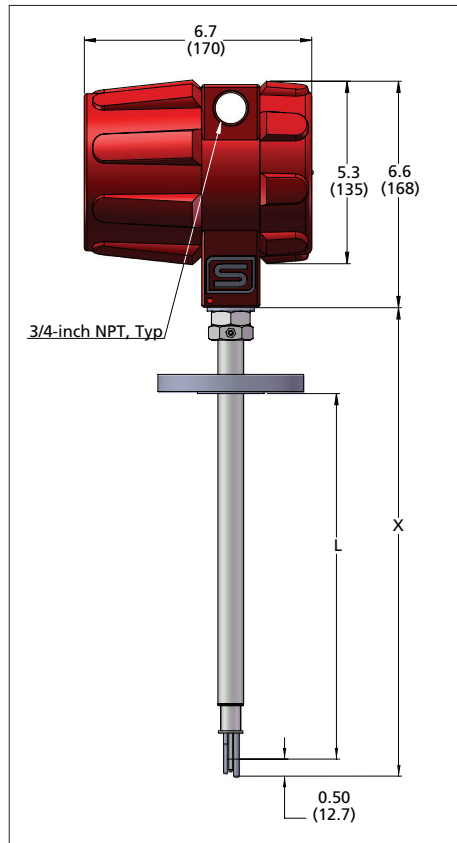
All Versions—Front View



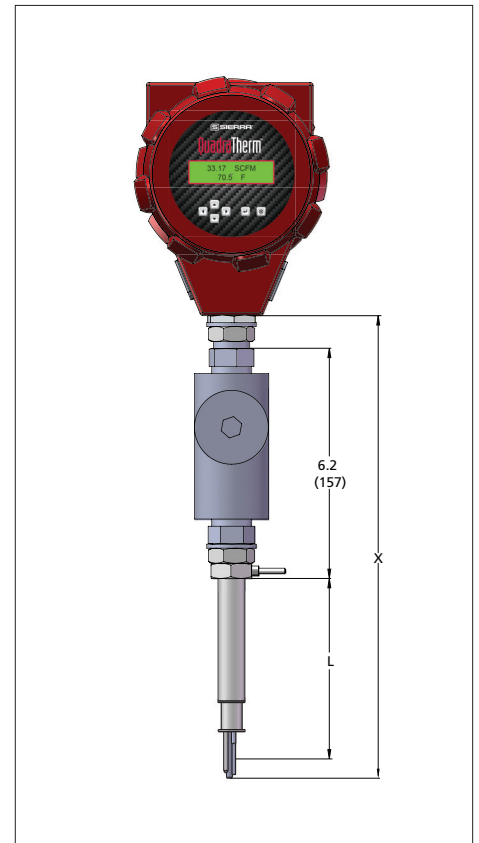
P2-DD Compression Fitting—Side View



P2-DD Flange Fitting—Side View



FM Approved Probes (> 13")



Note: All dimensions in inches with (mm) in brackets; certified drawings available upon request

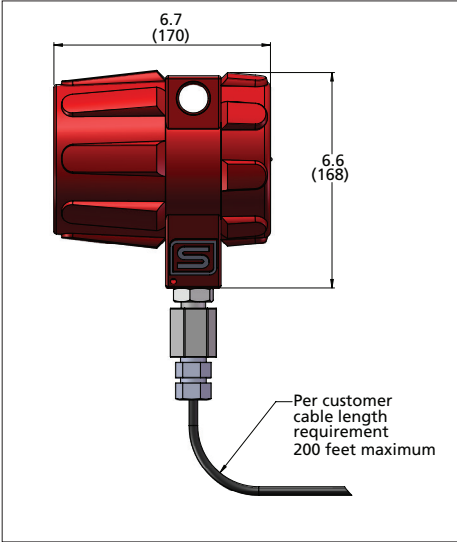
Length Chart 640i Compressions Fittings		
Code	L	X
L06	6.0 (152)	7.5 (191)
L09	9.0 (229)	10.5 (267)
L13	12.0 (305)	13.5 (343)
L18	18.0 (457)	19.5 (495)
L24	21.5 (546)	23.0 (584)
L36	35.5 (902)	37.0 (940)
L48	47.5 (1207)	49.0 (1245)

Length Chart 640i Flange Mounting		
Code	L	X
L06	4.4 (112)	7.5 (191)
L09	7.4 (188)	10.5 (267)
L13	10.4 (264)	13.5 (343)
L18	16.4 (417)	19.5 (495)
L24	19.9 (505)	23.0 (584)
L36	33.9 (861)	37.0 (940)
L48	45.9 (1166)	49.0 (1245)

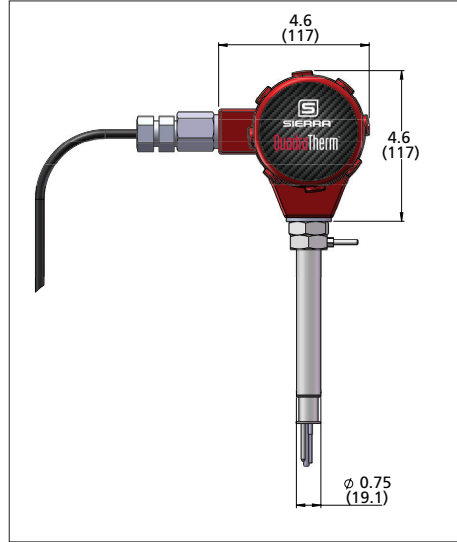
Length Chart 640i FM Version		
Code	L	X
L06	6.0 (152)	7.5 (191)
L09	9.0 (229)	10.5 (267)
L13	12.0 (305)	13.5 (343)
L18	18.0 (457)	25.7 (653)
L24	21.5 (546)	29.2 (742)
L36	35.5 (902)	43.2 (1097)
L48	47.5 (1207)	55.2 (1402)



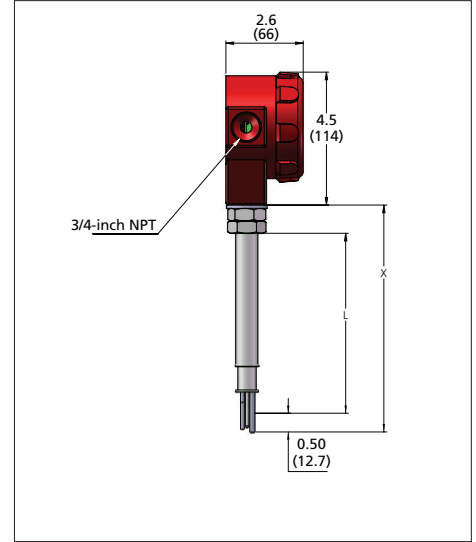
Remote Electronics—Side View



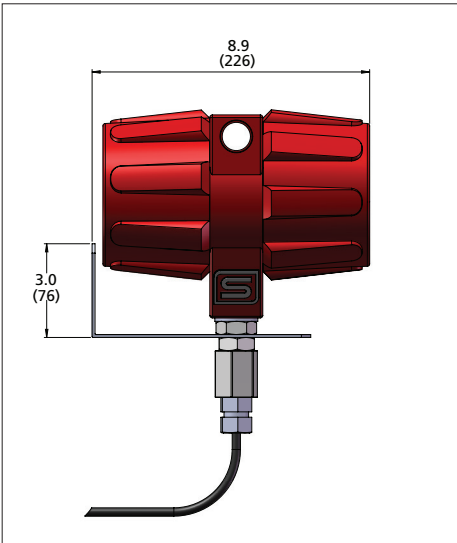
Remote Probe—Front View



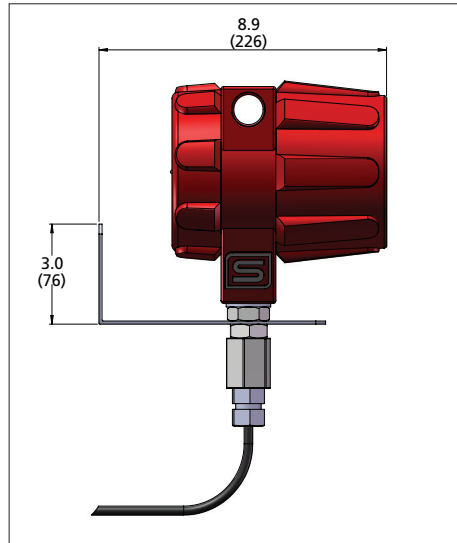
Remote Probe—Side View



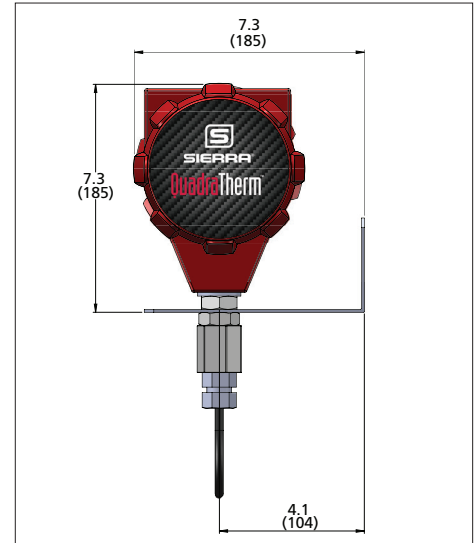
P3-DD Remote Bracket—Side View



P2-DD Remote Bracket—Side View

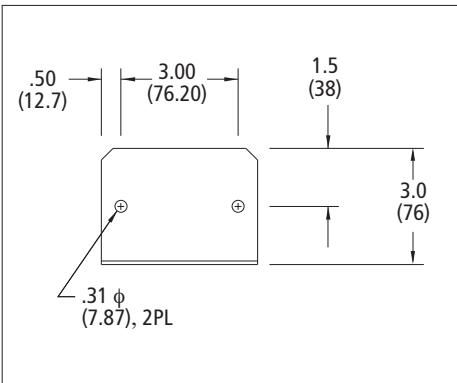


Remote Bracket—Front View



Note: All dimensions in inches with (mm) in brackets; certified drawings available upon request

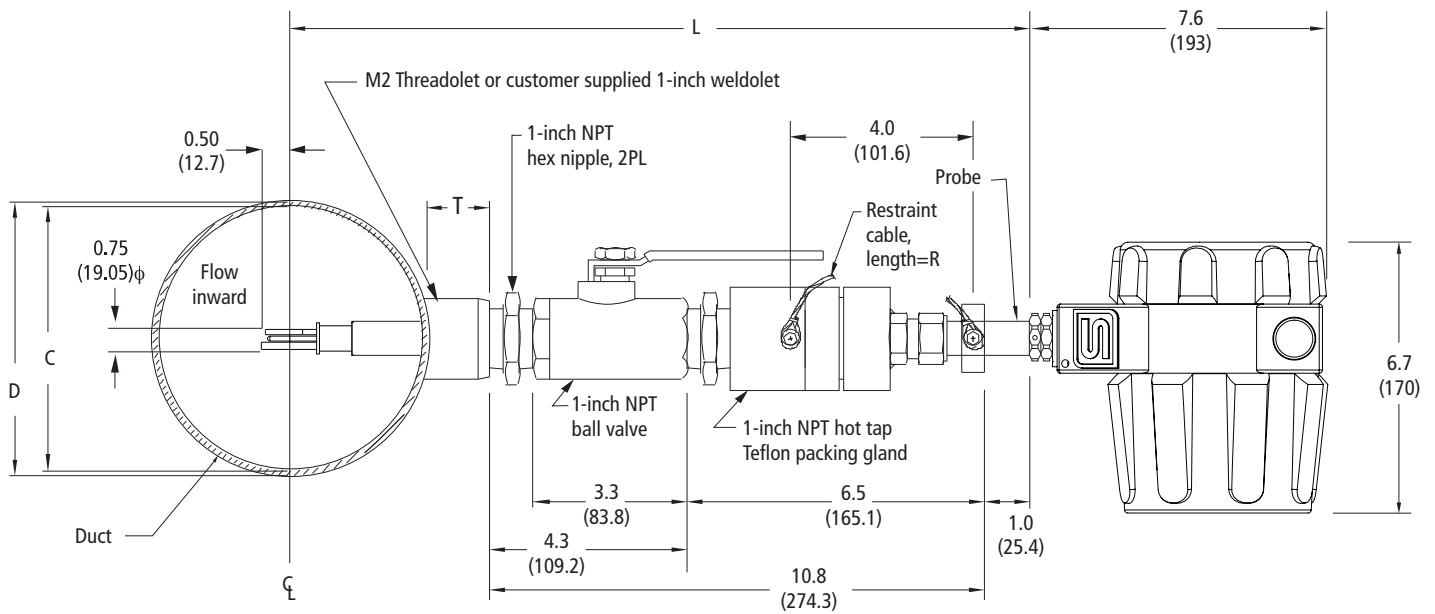
**Mounting Holes for Remote Bracket**



Length Chart 640i Remote Mount Junction Box		
Code	L	X
L06	6.0 (152)	7.5 (191)
L09	9.0 (229)	10.5 (267)
L13	12.0 (305)	13.5 (343)
L18	18.0 (457)	19.5 (495)
L24	21.5 (546)	23.0 (584)
L36	35.5 (902)	37.0 (940)
L48	47.5 (1207)	49.0 (1245)

Note: All dimensions in inches with (mm) in brackets; certified drawings available upon request

## 640i INSERTION LOW PRESSURE HOT TAP to 150 psia (10 bara)



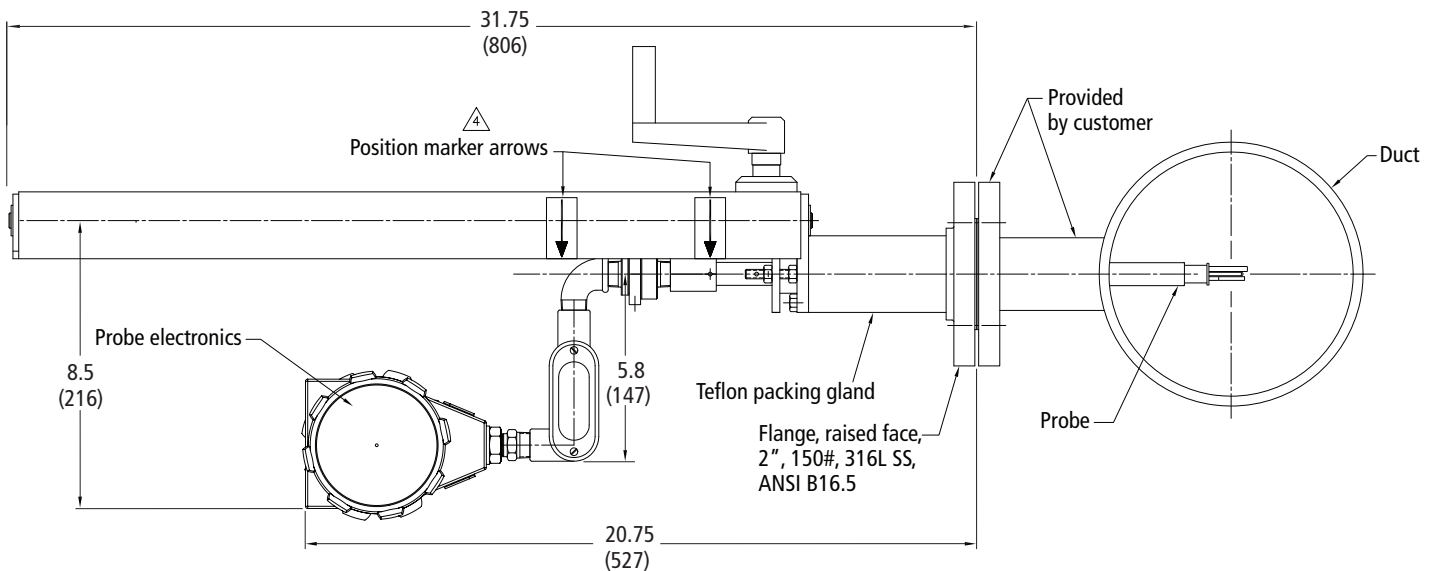
### Variables

L = Nominal Probe Length  
 D = Duct O.D.  
 C = Duct I.D.  
 T = Height of "Threadolet"  
 or Customer Provided Weldolet  
 R = Restraint Cable Length

### Formula

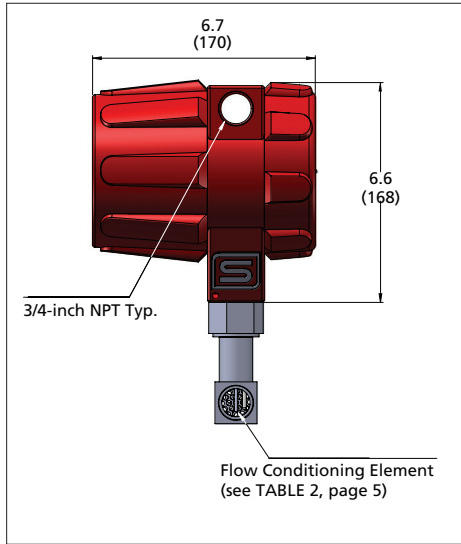
$L > 12.3 + T + D/2$   
 So L must be equal  
 or greater than 12.3-inches  
 plus the height of the  
 "Threadolet" plus half the duct O.D.  
 $R = D/2 + T + 7.3$

## 640i HIGH PRESSURE HOT TAP to 230 psia (15.3 bara)

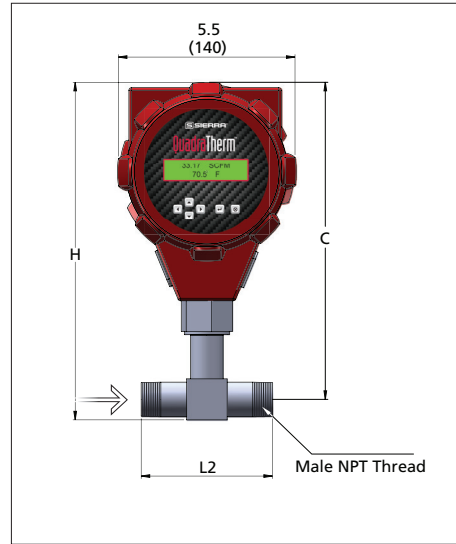


Note: All dimensions in inches with (mm) in brackets; certified drawings available upon request

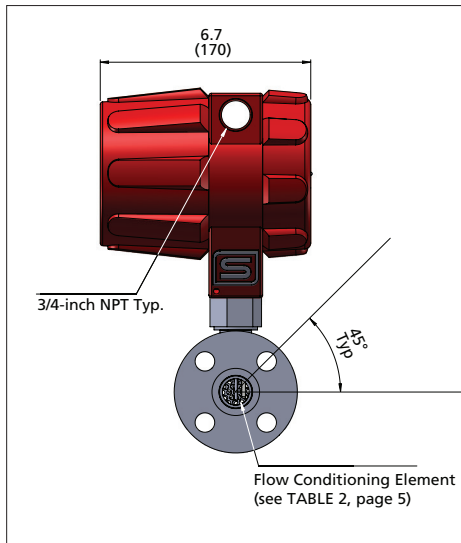
1/2" and 1 1/2" NPT—Side View



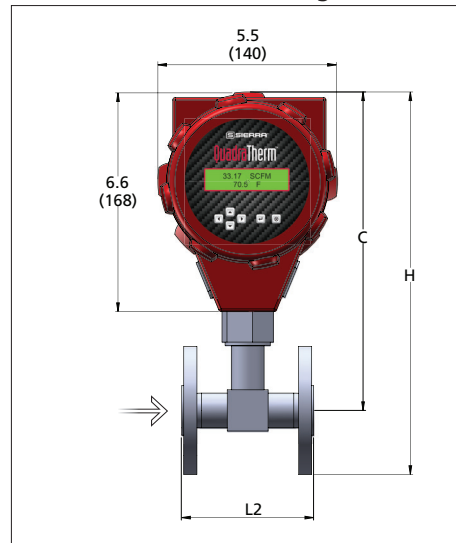
1/2" and 1 1/2" NPT—Front View



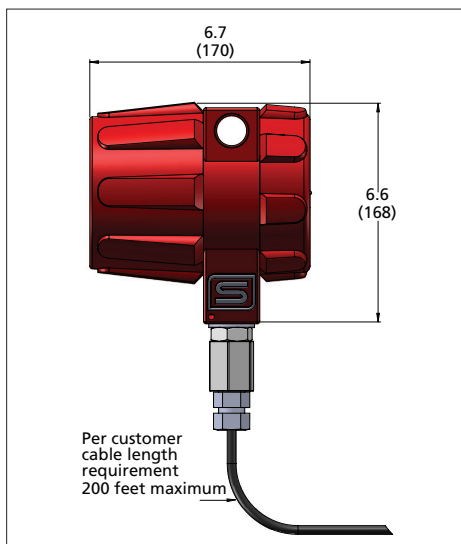
Sizes for NPT			
Size	H	C	L2
1/2-inch	10.5 (267)	9.9 (251)	7.5 (191)
3/4-inch	10.8 (274)	9.9 (251)	7.9 (201)
1-inch	11.2 (284)	9.9 (251)	8.3 (211)
1 1/2-inch	11.5 (292)	9.9 (251)	9.5 (241)



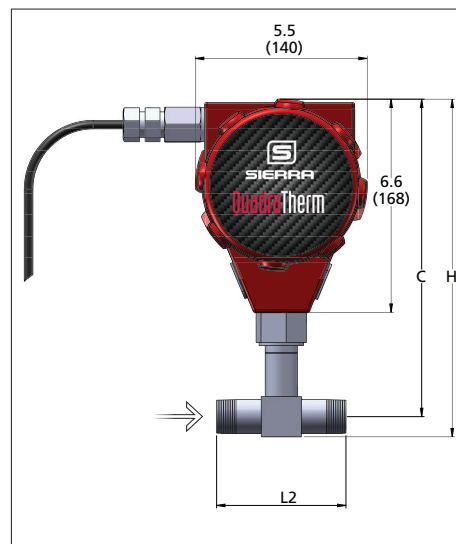
1/2" and 1 1/2" 150 Class Flange—Front View



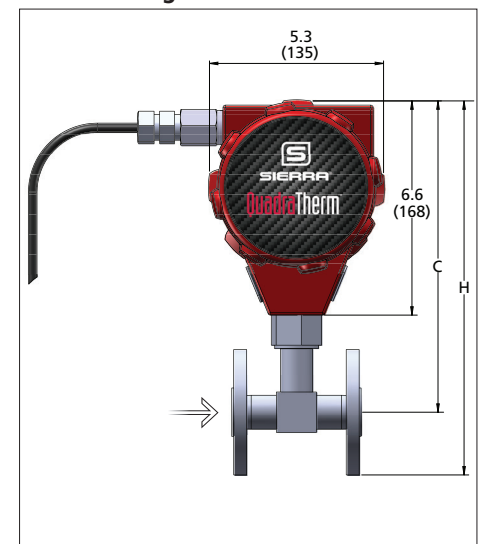
Sizes For ANSI Class 150 Flange			
Size	H	C	L2
1/2-inch	11.6 (295)	9.9 (251)	7.5 (191)
3/4-inch	11.8 (300)	9.9 (251)	7.9 (201)
1-inch	12.0 (304)	9.9 (251)	8.3 (211)
1 1/2-inch	12.2 (310)	9.9 (251)	9.5 (241)



NPT Remote—Front View



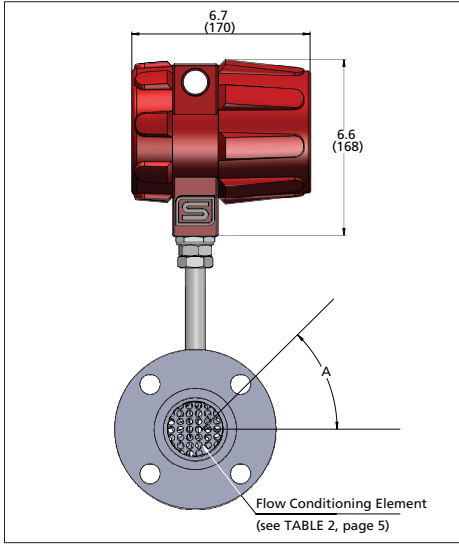
150 Class Flange Remote—Front View



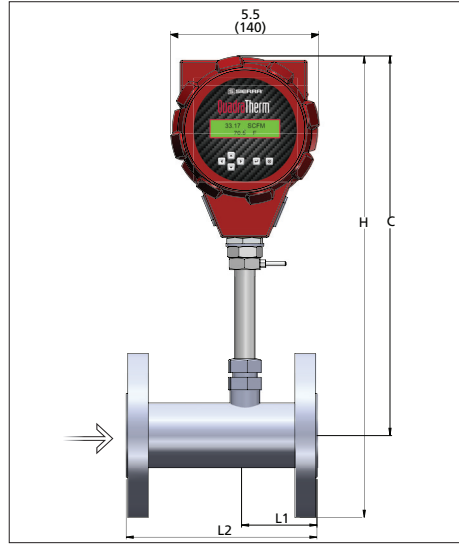
Note: All dimensions in inches with (mm) in brackets; certified drawings available upon request

## 780i INLINE DIMENSIONAL DRAWINGS

**2" Through 8" 150 Class Flange—Side View**

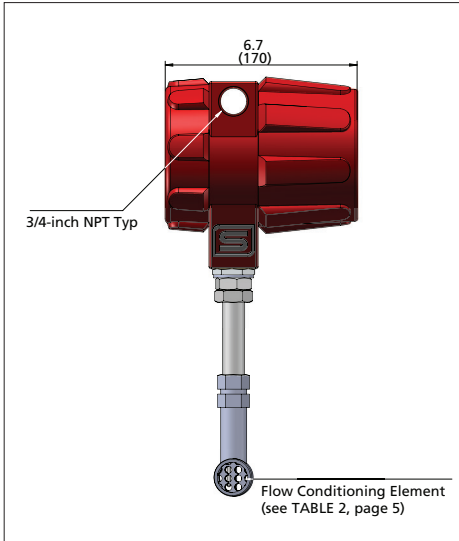


**2" Through 8" 150 Class Flange—Front View**

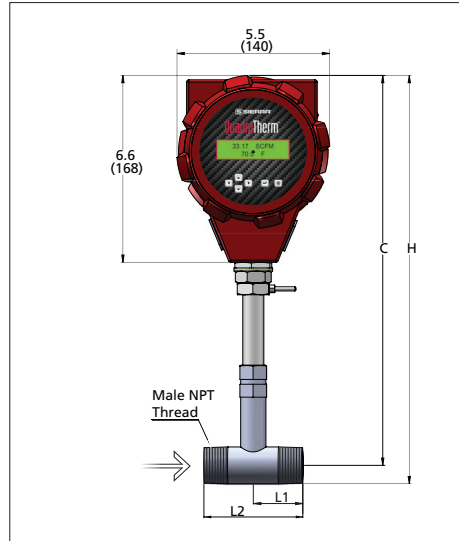


Sizes for ANSI Class 150 Flanges					
Size	H	C	L1	L2	A
2-inch	17.0 (432)	14.0 (356)	2.6 (66)	7.0 (178)	45
3-inch	17.7 (450)	14.0 (356)	2.6 (66)	10.0 (254)	45
4-inch	18.5 (470)	14.0 (356)	3.6 (91)	12.0 (305)	22.5
6-inch	19.5 (495)	14.0 (356)	5.6 (142)	18.0 (547)	22.5
8-inch	20.7 (526)	14.0 (356)	7.6 (193)	29.0 (737)	22.5

**2" Through 8" NPT—Side View**

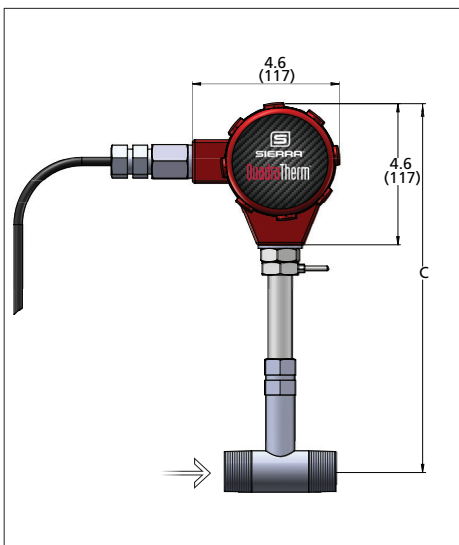


**2" Through 8" NPT—Front View**

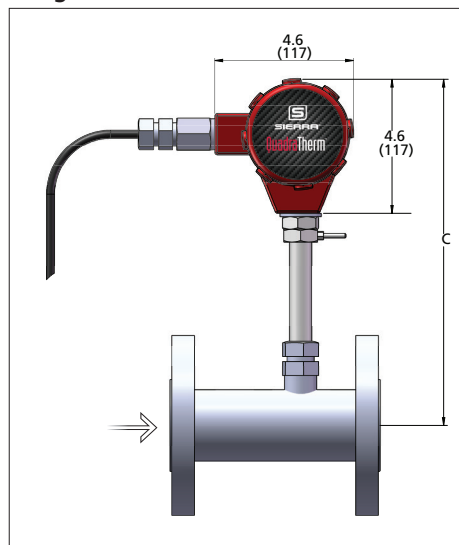


Sizes for 1-inch Through 8-inch NPT				
Size	H	C	L1	L2
2-inch	15.1 (384)	14.0 (356)	3.50 (89)	7.50 (191)
3-inch	15.7 (399)	14.0 (356)	4.00 (102)	10.00 (254)
4-inch	16.2 (411)	14.0 (356)	4.00 (102)	12.00 (305)
6-inch	17.3 (439)	14.0 (356)	6.00 (152)	18.00 (457)
8-inch	18.3 (465)	14.0 (356)	8.00 (203)	24.00 (610)

**NPT Remote—Front View**



**Flange Remote—Front View**



Sizes for PN16 DN Flanges				
Size	H	C	L1	L2
DN50	17.2 (437)	14.0 (356)	3.34 (85)	7.10 (180)
DN80	17.9 (455)	14.0 (356)	4.14 (105)	10.20 (259)
DN100	18.3 (465)	14.0 (356)	4.57 (116)	12.60 (320)
DN150	19.6 (498)	14.0 (356)	6.77 (172)	18.90 (480)
DN200	20.7 (526)	14.0 (356)	8.47 (215)	24.40 (620)



**ORDERING THE 640i INSERTION (continued)**

**Feature 8: Display**

<b>DD</b>	UltraBright, local LCD digital display indicates mass flow rate, T, P and totalized mass in engineering units
<b>NR</b>	No readout

**Feature 9: Pressure**

<b>MP1</b>	30 psia (2.1 bara), VTP only
<b>MP2</b>	100 psia (6.9 bara), VTP only
<b>MP3</b>	300 psia (20.7 bara), VTP only
<b>MP4</b>	500 psia (34.5 bara), VTP only

Note: Put N/A in feature block 9 for VT or E4 meters. Maximum operating pressure must not exceed the full scale of the pressure transducer if the VTP option is ordered or damage may occur.

**Feature 10 Through 13: qTherm Dial-A-Gas**

Choose three gases in addition to air:

Gas	Actual Gas Code	Dial-A-Gas Code
<b>Air (standard)</b>	0	0
<b>Argon</b>	1A	1
<b>Carbon Dioxide</b>	2A	2
<b>Chlorine</b>	N/A	3
<b>Digester Gas (60% CH<sub>4</sub>, 40% CO<sub>2</sub>)</b>	4A	4
<b>Helium</b>	6A	6
<b>Hydrogen</b>	7A	7
<b>Methane</b>	8A	8
<b>Nitrogen</b>	10A	10
<b>Oxygen</b>	N/A	11
<b>Propane</b>	12A	12
<b>Other—Consult Factory</b>	99	99

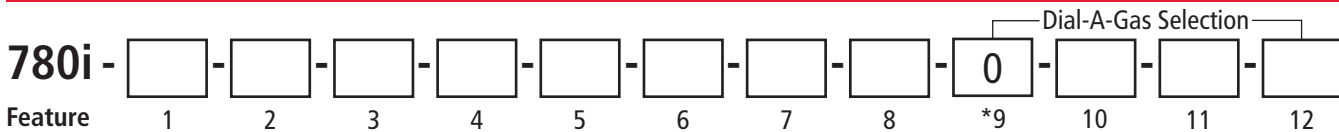
**Option 1: Digital Communications**

<b>DP1</b>	Profibus DP using an M12 connector, NAA only
<b>DP2</b>	Profibus DP using a 2-wire terminal block connection
<b>FF</b>	Foundation Fieldbus output.
<b>MB</b>	Modbus RTU
<b>HART</b>	HART with full device description (DD)

Note: Only Available in P2 For All Digital Communications Options.

Note: See Table 1 qTherm Dial-A-Gas Selection Chart on page 5 to choose your three gases in addition to air and calibration accuracy.

## ORDERING THE 780i INLINE



Instructions: To order a 780i, please fill in each feature number block by selecting the codes from the corresponding features below.

\*Feature 9 is air (always included)

Feature 1: Multivariable	
<b>VT</b>	Inline Thermal Mass Flow Meter with Flow Conditioning; all 316L stainless steel construction; linear 4-20 mA output signals for Mass Flow Rate and Temperature; temperature range -40°F to 392°F (-40°C to 200°C) and pressure to 500 psia (34.5 bara); standard accuracy +/- 0.5% of reading above 50% of full scale flow and +/- 0.5% of reading plus 0.5% of full scale below 50% of full scale flow; configurable alarm and pulse outputs; CE, cFMus, ATEX, and IECEx approved
<b>VTP</b>	Add a pressure output to the 780i VT version; three analog 4-20 mA linear outputs for Mass Flow Rate; includes pressure sensor to 500 psia (34.5 bara)

Feature 2: Approvals	
<b>1</b>	<b>NAA.</b> Non-agency approved.
<b>2</b>	<b>cFMus.</b> Maximum probe length is 48 inches (1.22 m).
<b>3</b>	<b>ATEX / IECEx.</b> Maximum probe length is 48 inches (1.22 m).

Feature 3: Inline Flow Bodies with Flow Conditioning	
<b>N2</b>	1/2-inch (1 cm) NPT male 316 SS
<b>N3</b>	3/4-inch (2 cm) NPT male 316 SS
<b>N4</b>	1-inch (2.5 cm) NPT male 316 SS
<b>N5</b>	1.5-inch (4 cm) NPT male 316 SS
<b>N6</b>	2-inch (5 cm) NPT male 316 SS
<b>N7</b>	3-inch (8 cm) NPT male 316 SS
<b>N8</b>	4-inch (10 cm) NPT male 316 SS
<b>N9</b>	6-inch (15 cm) NPT male 316 SS
<b>N10</b>	8-inch (20 cm) NPT male 316 SS
<b>F2</b>	1/2-inch ANSI class 150 flange 316 SS
<b>F3</b>	3/4-inch ANSI class 150 flange 316 SS
<b>F4</b>	1-inch ANSI class 150 flange 316 SS
<b>F5</b>	1.5-inch ANSI class 150 flange 316 SS
<b>F6</b>	2-inch ANSI class 150 flange 316 SS
<b>F7</b>	3-inch ANSI class 150 flange 316 SS
<b>F8</b>	4-inch ANSI class 150 flange 316 SS
<b>F9</b>	6-inch ANSI class 150 flange 316 SS
<b>F10</b>	8-inch ANSI class 150 flange 316 SS
<b>FD6</b>	DN50, PN16, flange
<b>FD7</b>	DN80, PN16, flange
<b>FD8</b>	DN100, PN16, flange
<b>FD9</b>	DN150, PN16, flange
<b>FD10</b>	DN200, PN16, flange
<b>GD4</b>	DN25, PN40, DIN flange
<b>GD5</b>	DN40, PN40, DIN flange
<b>GD6</b>	DN50, PN40, DIN flange
<b>GD7</b>	DN80, PN40, DIN flange
<b>GD8</b>	DN100, PN40, DIN flange
<b>GD9</b>	DN150, PN40, DIN flange
<b>GD10</b>	DN200, PN40, DIN flange

Feature 4: Electronics Enclosure	
<b>E2</b>	Hazardous-area location enclosure NEMA 4X (IP66) mounted directly on probe
<b>E4( )</b>	Remote hazardous-area location enclosure includes NEMA 4X (IP66) junction box mounted on probe and mounting bracket for remote electronics enclosure; specify cable length in parenthesis; maximum 200 feet (61m) housing mounted up to 200 feet (61m) from flow body. Note: VTP E4 not agency approved.

Feature 5: Input Power	
<b>P2</b>	24 VDC +/- 10.0%
<b>P3</b>	100-240 VAC

Feature 6: Output	
<b>V4</b>	Two linear 4-20mA outputs for T and mass flow rate
<b>V6 (VTP only)</b>	Three linear 4-20mA outputs for T, P, mass flow rate

Feature 7: Display	
<b>DD</b>	UltraBright, local LCD display indicates mass flow rate, T, P and totalized mass in engineering units
<b>NR</b>	No readout

Feature 8: Pressure	
<b>MP1</b>	30 psia (2.1 bara), VTP only
<b>MP2</b>	100 psia (6.9 bara), VTP only
<b>MP3</b>	300 psia (20.7 bara), VTP only
<b>MP4</b>	500 psia (34.5 bara), VTP only

Note: Put N/A in feature block 9 for VT or E4 meters.  
Maximum operating pressure must not exceed the full scale of the pressure transducer if the VTP option is ordered or damage may occur.

**ORDERING THE 780i IN-LINE (continued)**

Feature 10 Through 13: qTherm Dial-A-Gas Choose three gases in addition to air:		
Gas	Actual Gas Code	Dial-A-Gas Code
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<b>Chlorine</b>	N/A	3
<b>Digester Gas (60% CH<sub>4</sub>, 40% CO<sub>2</sub>)</b>	4A	4
<b>Helium</b>	6A	6
<b>Hydrogen</b>	7A	7
<b>Methane</b>	8A	8
<b>Nitrogen</b>	10A	10
<b>Oxygen</b>	N/A	11
<b>Propane</b>	12A	12
<b>Other—Consult Factory</b>	99	99

Option 1: Digital Communications	
<b>DP1</b>	Profibus DP using an M12 connector, NAA only
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<b>HART</b>	HART with full device description (DD)

Note: Only Available in P2 For All Digital Communications Options.

Note: See Table 1 qTherm Dial-A-Gas Selection Chart on page 5 to choose your three gases in addition to air and calibration accuracy.







**SIERRA®**

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