



## Flow Sensors

### Insert Style Flow Sensors

#### SDI Series

#### DESCRIPTION

The Data Industrial SDI Series insert flow sensors from Badger Meter offer accurate liquid flow measurement in closed pipe systems in an easy to install economical package. Impeller sensors offer a quick response to changes in flow rate and are well suited to flow control and batch type applications in addition to flow monitoring. The four-bladed impeller design is rugged, non-fouling and does not require custom calibration. Coupled with the proprietary patented digital detection circuit, the sensor measures flows from under 0.5 ft/sec (0.15 m/sec) to more than 20 ft/sec (6.1 m/sec) regardless of the conductivity or turbidity of the liquid. The standard frequency output produces a low impedance square wave signal proportional to flow rate that may be transmitted up to 2000 ft (610 m) without amplification. The SDI Series includes:

- Single direction powered insert with raw, scaled pulse and analog output
- Bidirectional powered insert with analog and scaled pulse output
- Battery powered insert with a local or remote display and scaled pulse output

#### APPLICATIONS

SDI insert style flow sensors are intended for general clean liquid flow measurement applications. They are available in either brass or stainless steel construction.

#### FUNCTIONALITY

These insert style sensors are intended for direct installation into pipelines through a 1 in. (25 mm) tap. The pipeline must be out of service and not under pressure at the time of installation. For any pipeline that is in service at the time of installation or cannot be de-pressurized and drained for service, the SDI hot tap model equipped with isolation valves is recommended.

Three different stem lengths in both the direct insert and hot tap versions accommodate pipe diameters 1-1/2...36 in. (38...914 mm) depending on the pipe material and tapping methods. Larger sizes usually require the use of hot tap models.

In pipe sections with at least 10 diameters of straight pipe upstream of the sensor and 5 diameters of straight pipe downstream, accuracies of  $\pm 1\%$  of rate may be achieved when the flow sensor is installed at the correct insertion depth and properly aligned.



#### HOT TAP SENSORS (OPTIONAL)

Hot tap sensors feature an isolation valve and mounting hardware to install or remove the sensor from a pipeline that would be difficult to shut down or drain. In a true hot tap installation the sensor is mounted in the pipe under pressure by attaching a service saddle or weld-on fitting to the pipe and mounting the isolating valve to the threaded connection. A hole is then cut in the wall of the pipe through the valve using a commercial tapping machine with a 1 in. size cutter. Once the hole is cut, the tapping machine is removed and the valve is shut. Then the sensor assembly is mounted to the isolation valve and extended into the pipeline to measure flow. Even in new construction a hot tap sensor may be appropriate for service considerations. The hot tap sensor is constructed of 316 stainless steel and is rated for service to 1000 psi at 70° F (21° C) (see "Maximum Pressure Rating for SST Stem" on page 4). The sensor installs in a 1 in. NPT tap for both wet and dry installations. The small stem diameter allows the sensor to be inserted into the pressurized pipeline by hand without the need for an installation tool. Mounting hardware holds the sensor firmly in place at the correct depth and alignment.

#### BATTERY POWERED SENSORS (OPTIONAL)

Battery powered versions are complete flow measuring systems providing a local or remote programmable display of rate, total or both, powered by a C size lithium battery that has a five year life span.



## OUTPUT CONFIGURATIONS

### Standard Frequency

Sensor output is a pulse proportional to flow. The signal is similar to all 200 Series flow sensors and will interface with all existing Data Industrial transmitters and monitors. The power supply to the sensor and the output signal from the sensor is carried on the same two wires. Wire connections are made at screw terminals on removable headers inside the NEMA 4X housing.

### Analog Output

The sensor is also available with a two-wire loop powered 4...20 mA output. The analog output is produced by an onboard micro-controller for precise, drift-free signals. Sensors may be preprogrammed at the factory or field programmed using the a computer with the programming kit and Windows® based software program. All information is stored in the flow sensor nonvolatile memory.

### Scaled Pulse Output

The scaled pulse is produced by an onboard micro-controller for precise, accurate outputs. This option may be programmed to produce an isolated solid state contact closure scaled to any number of engineering units of measure. Sensors may be preprogrammed at the factory or field programmed using the a computer with the programming kit and Windows® based software program. All information is stored in nonvolatile memory in the flow sensor. This is a four-wire option.

### Bidirectional Flow, Analog Output

This option provides a programmable 4...20 mA signal proportional to flow rate and a contact closure to indicate the direction of flow. The unit may be preprogrammed at the factory or field programmed using a computer with the programming kit and Windows® based software program. The user can program the unit for pipe size, flow scale and the direction of flow. This is a six-wire option.

### Bidirectional Flow, Scaled Pulse Output

This option provides the user with a choice of outputs. In one case the sensor provides an output scaled to the required number of engineering units on one set of terminals and a contact closure to indicate the direction of flow on another. The other choice provides two isolated scaled pulse outputs, one for each direction. Programming the output choice, pipe size, output scale and direction of flow by the user are also accomplished by using a computer with the programming kit and Windows® based software program. This option also requires six wires.

### Display Options

All models except the standard frequency output version may also be equipped with a display. Integrated into the NEMA 4X housing, the eight digit LCD may be programmed to show rate of flow, flow total or toggle between the two. Bidirectional models also show flow direction.

The eight character 3/8 in. LCD is mounted on the sensor visible through a lens at the top of the electronics housing.

For battery powered versions only, an optional remote display is available where the LCD is located in a wall mount NEMA 4 enclosure. The remote may be connected to the flow sensor up to a maximum of 50 ft (15 m) away using extension cables.

## SPECIFICATIONS

<b>Wetted Materials</b>	Sensor stem, mounting adapter, isolation valve, and nipple:	316 Stainless steel	
		Brass, B16, UNS C36000	
<b>Sensor Tip</b>		Polyphenylene sulfide (PPS)	
		Polyetheretherketone (PEEK)	
<b>O-rings, Bearings, Shaft</b>	See ordering matrix		
<b>Operating Temperature</b>	Electronics	14...150° F (-10...65° C)	
	LCD	-4...150° F (-20...65° C)	
<b>Maximum Pressure Rating Stainless Steel (Non Shock)</b>	1000 psi (68.9 bar) @ 70° F (21° C)		
	900 psi (62 bar) @ 100° F (37.8° C)		
	670 psi (46.1 bar) @ 140° F (60° C)		
	225 psi (15.5 bar) @ 180° F (82° C)		
	600 psi (41.3 bar) @ up to 140° F (60° C)		
	225 psi (15.5 bar) @ 180° F (82° C)		
<b>Optimum Design Flow Range</b>	1...20 ft/sec. (0.30...6 m/sec.)		
	Extended flow range < 0.5...20 fps		
<b>Pressure Drop</b>	0.5 psi or less at 10 ft/sec (3 m/sec.) for all pipe sizes 1.5 in. (38 mm) diameter and up		
<b>Accuracy</b>	Standard: to ±1% of rate over optimum flow range		
<b>Straight Pipe Requirement</b>	Install sensor in straight pipe section with a minimum distance of 10 diameters upstream and 5 diameters downstream to any bend, transition, or obstruction.		
<b>Repeatability</b>	±0.5%		
<b>Enclosure</b>	Sensor- battery	Polypropylene with Viton® sealed acrylic cover. Meets NEMA 6P specifications	
	Sensor	Polypropylene with Viton® sealed acrylic cover. Meets NEMA 4X specifications	
	Remote	Polycarbonate w/ Neoprene® sealed cover. Meets NEMA 4X specifications.	
<b>Programming</b>	Battery powered version	A-303 connector cable and SDI Series software	
	Bidirectional, pulse, and analog versions	USB to DIC converter programming kit (840134-0002)	
<b>Display (Optional)</b>	8 character, 3/8 in. (10 mm) LCD		
	STN (Super Twisted Nematic) display		
	Annunciators for rate, total, totalizer multipliers, low battery, flow direction		
<b>Accessories</b>	USB to DIC converter programming kit (840134-0002)		
	ASDIB-20 programming kit- battery powered A-301 connector cable or USB		
	Battery powered version	07101 5 ft (1.5 m) extension cable	
		07108 10 ft (3 m) extension cable	
		07102 20 ft (6 m) extension cable	
07109 50 ft (15 m) extension cable			

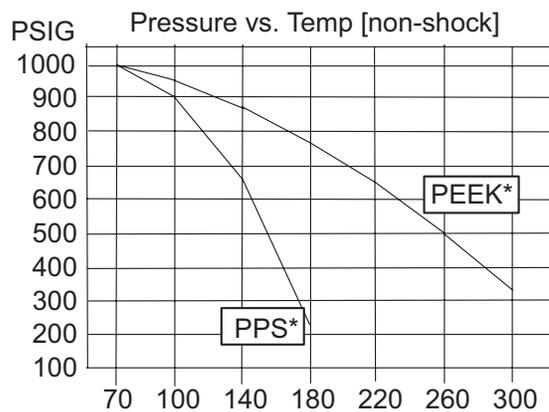
**Power Specifications**

		Unidirectional			Bidirectional		Battery Operated
		Raw Pulse Option 0	Analog Loop Option 1	Scaled Pulse Option 2	Analog Loop Option 5	Scaled Pulse Option 6	Scaled Pulse Option 2
<b>Number of Wire Connections</b>		<b>2</b>	<b>2</b>	<b>4</b>	<b>6</b>	<b>6</b>	<b>2</b>
<b>Pulse Units</b>	Operating Voltage	8...35V DC	n/a	12...30V AC 12...35V DC	12...30V AC 12...35V DC	12...30V AC 12...35V DC	n/a
	Overvoltage Protection	30V AC ± 40V DC	± 40V DC	30V AC ± 40V DC	30V AC ± 40V DC	30V AC ± 40V DC	n/a
	Quiescent Current Draw @ 12V DC or 24V AC	330 µA typical	Software-controlled current of 3.5...20.5 mA	< 2.0 mA	< 5.0 mA	< 5.0 mA	n/a
	Short Circuit Current	50 mA typical	n/a	> 100 mA	For direction > 100 mA	> 100 mA	> 100 mA
	Output Frequency	800 Hz max	n/a	Scaled by customer	n/a	Scaled by customer	Scaled by customer
	Output Pulse Width	5 mS below 100 Hz	n/a	Adjustable 50 mS to 5.0 seconds in 50 mS increments	n/a	Adjustable 50 mS to 5.0 seconds in 50 mS increments	Selectable 50 mS 100 mS 250 mS
	Output Isolation	n/a	n/a	Opto-isolated	Opto-isolated	Opto-isolated	Opto-isolated
<b>Analog Units</b>	Operating Voltage	n/a	8...25V DC	n/a	8...25V DC	n/a	n/a
	Output Response Time	n/a	Varies with programmable filter	n/a	Varies with programmable filter	n/a	n/a

The battery operated version is powered by a C size lithium battery with a five year life span

**Maximum Pressure Rating for SST Stem**

(Note: PPS or PEEK Tip)



\* Max. Pressure Temp. Ratings for Brass:  
 • 600 PSI up to 140°F  
 • 225 PSI up to 180°F

**ORDERING MATRIX**

**SDI Series Single Direction Insert Powered Version Ordering Matrix**

	SDI	0	H1	N	0	0	-	0	2	0	0
<b><u>MATERIAL</u></b>											
Stainless Steel / PPS Tip		0									
Brass / PPS Tip ( <i>not available with hot tap</i> )		1									
Stainless Steel / Peek Tip		2									
<b><u>TYPE</u></b>											
Direct Insert for Pipe 1½" - 10" *			D1								
Direct Insert for Pipe 12" - 36" *			D2								
Direct Insert 36" and UP*			D3								
Hot Tap for Pipe 1½" - 10" *			H1								
Hot Tap for Pipe 12" - 36" *			H2								
Hot Tap for Pipe 36" and UP *			H3								
<b><u>ELECTRONIC HOUSING</u></b>											
NEMA 4X				N							
<b><u>OUTPUT</u></b>											
Standard Frequency Pulse					0						
Analog 4-20mA					1						
Scaled Pulse					2						
<b><u>DISPLAY</u></b>											
No Display					0						
LCD Option ( <b>requires output option 1 or 2</b> )					1						
<b><u>O-RING</u></b>											
Viton®								0			
EPDM								1			
AFLAS								2			
<b><u>SHAFT</u></b>											
Tungsten Carbide [Standard]									2		
Hastelloy® C-276 [optional - consult factory]									1		
<b><u>IMPELLER</u></b>											
Stainless Steel										0	
<b><u>BEARING</u></b>											
Torlon®											0
Ketron											2

\* Pipe size is for reference only. Depending on pipe size, tapping saddle or existing hardware, longer sensor length may be required. Consult the factory. For material details, consult the factory.

**SDI Series Bidirectional Insert Powered Ordering Matrix**

	SDI	0	H1	N	5	0	-	0	2	0	0
<b><u>MATERIAL</u></b>											
Stainless Steel / PPS Tip		0									
Stainless Steel / PEEK Tip		2									
<b><u>TYPE</u></b>											
Hot Tap for Pipe 1½" - 10" *			H1								
Hot Tap for Pipe 12" - 36" *			H2								
Hot Tap for Pipe 36" and up*			H3								
<b><u>ELECTRONIC HOUSING</u></b>											
NEMA 4X				N							
<b><u>OUTPUT</u></b>											
Bi-Directional 4-20mA + Direction					5						
Bi-Directional Scaled Pulse					6						
<b><u>DISPLAY</u></b>											
No Display						0					
LCD Option						1					
<b><u>O-RING</u></b>											
Viton®								0			
EPDM								1			
AFLAS								2			
<b><u>SHAFT</u></b>											
Tungsten Carbide [Standard]									2		
Hastelloy® C-276 [optional - consult factory]									1		
<b><u>IMPELLER</u></b>											
Stainless Steel										0	
<b><u>BEARING</u></b>											
Torlon®											0
Ketron											2

\* Pipe size is for reference only. Depending on pipe size, tapping saddle or existing hardware, longer sensor length may be required. Consult the factory. For material details, consult the factory.

**SDI Series Battery Powered Ordering Matrix**

	SDI	0	D1	B	N	1	-	0	2	0	0
<b><u>MATERIAL</u></b>											
Stainless Steel / PPS Tip		0									
Brass / PPS Tip (not available with hot tap)		1									
Stainless Steel / PEEK Tip		2									
<b><u>TYPE</u></b>											
Direct Insert for Pipe 1-1/2" thru 10" *			D1								
Direct Insert for Pipe 12" thru 36" *			D2								
Direct Insert 36" and UP*			D3								
Hot Tap for Pipe 1-1/2" thru 10" *			H1								
Hot Tap for Pipe 12" thru 36" *			H2								
Hot Tap for Pipe 36" and UP *			H3								
<b><u>ELECTRONIC HOUSING</u></b>											
Battery Powered/NEMA 6				B							
<b><u>OUTPUT</u></b>											
No Output					N						
Scaled Pulse					2						
2 Pulse Output					9						
<b><u>DISPLAY</u></b>											
LCD Option						1					
Remote Display/NEMA 4X						2					
<b><u>O-RING</u></b>											
Viton®								0			
EPDM								1			
AFLAS								2			
<b><u>SHAFT</u></b>											
Tungsten Carbide [Standard]									2		
Hastelloy® C-276 [optional - consult factory]									1		
<b><u>IMPELLER</u></b>											
Stainless Steel										0	
<b><u>BEARING</u></b>											
Torlon®											0

\* Pipe size is for reference only. Depending on pipe size, tapping saddle or existing hardware, longer sensor length may be required. Consult the factory. For material details, consult the factory.

## Control. Manage. Optimize.

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### OPIS

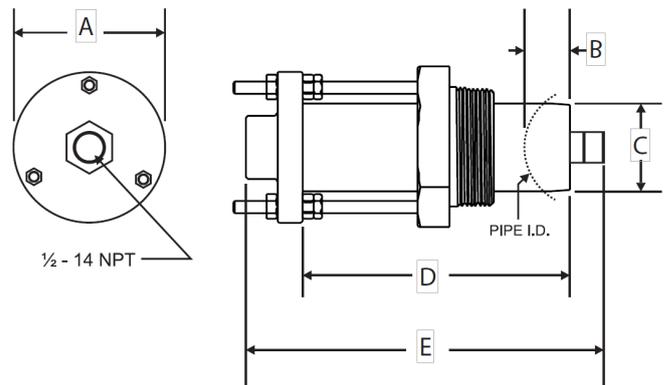
Czujniki przepływu serii 200 cechują się układem sześciostopniowego wirnika z opatentowanym niemagnetycznym mechanizmem. Specjalny kształt wirnika umożliwia wyższe, stałe obroty i jest mniej podatny na działanie zanieczyszczeń lub części stałych. Wirnik w połączeniu z brakiem oporu magnetycznego, zapewnia dokładne działanie i powtarzalność, nawet przy małym natężeniu przepływu. Ma to szczególne znaczenie, kiedy wirnik narażony jest na kontakt z metalowymi lub zardzewiałymi częściami stałymi pojawiającymi się w stalowych lub żelaznych rurach. Przepływająca ciecz porusza wirnik, który wytwarza sygnał o niskiej impedancji z częstotliwością proporcjonalną do natężenia przepływu. Sygnał może być przesyłany na dystans do 600 m pomiędzy czujnikiem a wyświetlaczem bez konieczności wzmacniania. Wszystkie czujniki za wyjątkiem wersji IR wyposażone są w 6 m, 2 przewodowy, ekranowany kabel Belden typ 9320.



### MODEL 220BR (Z BRĄZU) I MODEL 220SS (ZE STALI NIERDZEWNEJ)

Model 220BR i 220SS są stosowane głównie przy pomiarach przepływu w metalowych i niemetalowych rurociągach. Czujnik montuje się w gnieździe gwintowanym 2" NPT lub przy pomocy systemu Threadolet® w rurociągach od 3" do ponad 40". Nakrętki pozycjonujące umieszczone na gwintowanych wspornikach umożliwiają dokładne wypozyjonowanie czujnika na standardową głębokość 1 1/2". W przypadku gdy czujnik zostanie zamocowany na tej głębokości oraz gdy zostanie zapewnione 10 średnic prostego odcinka przed i 5 średnic za punktem pomiarowym z niezakłóconym przepływem, dokładność pomiaru może wynieść + 1 % pełnej skali w zakresie prędkości od 0,15 do 9 m/s (+4,0% odczytu w zakresie kalibracji).

### WYMIARY 220BR, 220SS



A	B	C	D	E
3 in.	1-1/2 in.	1-3/4 in.	5-1/4 in.	7-1/8 in.
76 mm	38 mm	44 mm	133 mm	181 mm

## SPECYFIKACJA

<b>Materiały mające kontakt z cieczą</b>	<ul style="list-style-type: none"> <li>• Patrz macierz zamówienia</li> </ul>		
<b>Tuleja czujnika i nakrętka dla modelu 220BR</b>	<ul style="list-style-type: none"> <li>• Tuleja: mosiądz okrętowy, UNS C44300; nakrętka: brąz zaworowy, UNS C83600</li> </ul>		
<b>Tuleja czujnika i nakrętka dla modelu 220SS</b>	<ul style="list-style-type: none"> <li>• Stal nierdzewna 316</li> </ul>		
<b>Zakresy temperatur pracy</b>	<ul style="list-style-type: none"> <li>• Wersja standardowa: 105°C (221°F) ciągłej pracy</li> <li>• Wersja irygacyjna: 66°C (150°F) ciągłej pracy</li> <li>• Wersja PVC: 60°C (140°F) ciągłej pracy</li> <li>• Wersja do wysokich temperatur: (nie dostępna z PVC)</li> <li>• 140.6°C (285°F) ciągłej pracy, 150°C (305°F) temp. szczytowa (ograniczony czas pracy)</li> </ul>		
<b>Wartości ciśnienia</b>	<b>Czujniki metalowe</b>	<b>Przy 24°C</b>	<b>Przy 135°C</b>
	220BR	27 bar	22 bar
	220SS	27 bar	22 bar
<b>Zalecana prędkość przepływu</b>	<ul style="list-style-type: none"> <li>• 0,15 do 9 m/s</li> <li>• początkowa detekcja poniżej 0,1 m/s</li> </ul>		
<b>Dokładność</b>	<ul style="list-style-type: none"> <li>• ± 1.0% pełnej skali ponad zalecaną prędkość przepływu</li> <li>• ± 4.0% odczytu w zakresie kalibracji</li> </ul>		
<b>Powtarzalność</b>	<ul style="list-style-type: none"> <li>• ± 0.3% pełnej skali ponad zalecaną prędkość przepływu</li> </ul>		
<b>Liniowość</b>	<ul style="list-style-type: none"> <li>• ± 0.2% pełnej skali ponad zalecaną prędkość przepływu</li> </ul>		
<b>Pobudzenie przetwornika</b>	<ul style="list-style-type: none"> <li>• Prąd spoczynkowy 600 µA @ 8 VDC do 35 VDC maks.</li> <li>• Napięcie spoczynkowe (<math>V_{high}</math>) napięcie zasilania –(600 µA*impedancja zasilania)</li> <li>• Stan ON (<math>V_{low}</math>) maks. 1.2 VDC @ 40 mA limit prądu (150 Ω+ 0.7 VDC)</li> </ul>		
<b>Częstotliwość wyjściowa</b>	<ul style="list-style-type: none"> <li>• 3.2 Hz do 200 Hz</li> </ul>		
<b>Szerokość impulsu wyjściowego</b>	<ul style="list-style-type: none"> <li>• 5 msec ± 25%</li> </ul>		
<b>Kabel elektryczny dla czujnika standardowego</b>	<ul style="list-style-type: none"> <li>• 6 m 2-przewodowego 20 AWG ekranowanego U.L. typu PTLC kabla przeznaczonego do podłączenia do wyświetlacza lub przekaźnika analogowego. Temperatura do 105°C. Może zostać rozszerzony do maks. 600 m takim samym kablem i izolacją odpowiednią do aplikacji.</li> </ul>		
<b>Kabel elektryczny dla czujnika IR</b>	<ul style="list-style-type: none"> <li>• 1,2 m U.L. style 116666 miedzianego kabla AWG 18 z izolacją do bezpośredniego umieszczenia w ziemi. Temperatura do 105°C.</li> </ul>		

## MACIERZ DOBORU CZUJNIKÓW WPUSZCZANYCH SERII 200 (ŚREDNICE OD 3" I WIĘKSZYCH)

<b>Typ</b>	Przykład: 2	20	BR	00	0	5	-	1	2	1	1
Wpuszczany		20									
<b>Materiał</b>											
Mosiądz			BR								
Stal nierdzewna 316			SS								
PVC / stal nierdzewna 316			PVS								
<b>Średnica</b>											
Model wpuszczany				00							
<b>Obudowa elektroniki</b>											
PPS					0						
<b>Elektronika</b>											
Standard						5					
IR-irygacja						6					
<b>O-ring</b>											
Viton®								0			
EPDM								1			
Buna N								8			
<b>Walek</b>											
Cyrkon ceramiczna									0		
Węglik wolframu									2		
Stal nierdzewna 316									6		
<b>Wirnik</b>											
Nylon										1	
Tefzel®										2	
<b>Łożyskowanie</b>											
Pennlon											1
Tefzel®											2
Teflon®											3

## Wysoka temperatura

<b>Typ</b>	Przykład: 2	20	BR	00	4	8	-	0	2	2	3
Wpuszczany		20									
<b>Materiał</b>											
Mosiądz			BR								
Stal nierdzewna 316			SS								
<b>Średnica</b>											
Model wpuszczany				00							
<b>Obudowa elektroniki</b>											
PEEK					4						
<b>Elektronika</b>											
Wysoka temperatura						8					
<b>O-ring</b>											
Viton®								0			
<b>Walek</b>											
Węglik wolframu									2		
<b>Wirnik</b>											
Tefzel®										2	
<b>Łożyskowanie</b>											
Teflon®											3

### DESCRIPTION

The Series 200 flow sensors feature a six-bladed impeller design with a proprietary non-magnetic sensing mechanism. The forward swept impeller shape provides higher, more consistent torque and is less prone to be fouled by water borne debris. The forward curved shape coupled with the absence of magnetic drag provides improved operation and repeatability at lower flow rates. This is especially true where the impeller is exposed to metallic or rust particles found in steel or iron pipes. As the liquid flow turns the impeller, a low impedance square wave signal is transmitted with a frequency proportional to the flow rate. The signal can travel up to 2000 ft (610 m) between the flow sensor and the display unit without the need for amplification. All sensors except irrigation versions are supplied with 20 ft (6 m) of 2-conductor 20 AWG shielded UL type PTLT 221° F (105° C) cable.

### MODEL 225BR AND 226BR/226SS SENSORS

The 225BR and 226BR/226SS flow sensors are used for flow measuring applications in most metallic or non-metallic pipes where it would be difficult to shut down or drain the line for installation or service. The 225 flow sensor features a gate valve for isolation. The 226 flow sensor uses a ball valve. If the pipe is to be hot tapped, the ball valve is recommended. The sensor mounts in a 2 in. NPT pipe saddle or Thredolet® for installation in pipe sizes from 3...40 in. Positioning nuts on the three threaded retaining rods allow the sensor to be accurately positioned to a standard insertion depth of 1-1/2 in. into the pipe.

When this insertion depth is maintained and there are at least 10 upstream and 5 downstream diameters of straight uninterrupted flow, an accuracy of ±1 percent of full scale can be obtained between flow velocities of 0.5...30 feet/second. Each sensor has an isolation valve and pipe nipple to allow the sensor to be installed in a pressurized pipe. This is accomplished by first attaching a saddle or Thredolet to the pipe and screwing the nipple and isolation valve into the saddle or Thredolet fitting. A hole is then drilled through the pipe using a commercial tapping machine. When completed, the tapping apparatus is removed, the isolation valve is closed, and the sensor is installed using the Model HTT Hot Tap Tool. For installation information, see the *Hot Tap Flow Sensor, Series 225/226, Application Data Sheet*, available in the Resource Library at [www.badgermeter.com](http://www.badgermeter.com).

**NOTE:** The overall length of the sensor tube is 18 in. (46 cm), however, a clearance height of 35 in. (89 cm) should be allowed for the fully extended length of the sensor tube outside the isolation valve.



### SPECIFICATIONS

<b>Wetted Materials for All Sensors</b>	See "Part Number Construction" on page 3		
<b>Sensor Sleeve and Hex Adapter for 225BR and 226BR</b>	Sleeve: Admiralty Brass, UNS C44300 Hex Adapter: Lead-free Brass C89833		
<b>Sensor Sleeve and Hex Adapter for 226SS</b>	316 Series Stainless Steel		
<b>Temperature Ratings</b>	Standard Version: 221° F (105° C) continuous service Irrigation Electronics: 150° F (66° C)		
<b>Pressure Ratings</b>	<b>Model</b>	<b>At 100° F</b>	<b>At 300° F (High Temperature Model Only)</b>
	225BR	300 psi	210 psi
	226BR	400 psi	250 psi
	226SS	400 psi	300 psi
<b>Recommended Design Flow Range</b>	0.5...30 ft/sec Initial detection below 0.3 ft/sec		
<b>Accuracy</b>	± 1.0% of full scale over recommended design flow range ± 4.0% of reading within calibration range		
<b>Repeatability</b>	± 0.3% of full scale over recommended design flow range		
<b>Linearity</b>	± 0.2% of full scale over recommended design flow range		
<b>Transducer Excitation</b>	Supply voltage = 8V DC min. 35V DC max.		
	Quiescent current = 600 uA (typical)		
	OFF State ( $V_{High}$ ) = Supply voltage - (600 uA * Supply impedance) ON State ( $V_{Low}$ ) = 1.2V DC @ 40 mA (15 Ω + 0.7V DC)		
<b>Output Frequency</b>	3.2...200 Hz		
<b>Output Pulse Width</b>	5 msec ±25%		
<b>Electrical Cable for Standard Sensor Electronics</b>	20 feet (6 m) of 2-conductor 20 AWG shielded U.L. type PTLT wire provided for connection to display or analog transmitter unit. Rated to 105° C. May be extended to a maximum of 2000 feet (610 m) with similar cable and insulation appropriate for application.		
<b>Electrical Cable for IR Sensor Electronics</b>	48 inches (122 cm) of U.L. Style 116666 copper solid AWG 18 wire with direct burial insulation. Rated to 221° F (105° C).		

**DIMENSIONS**

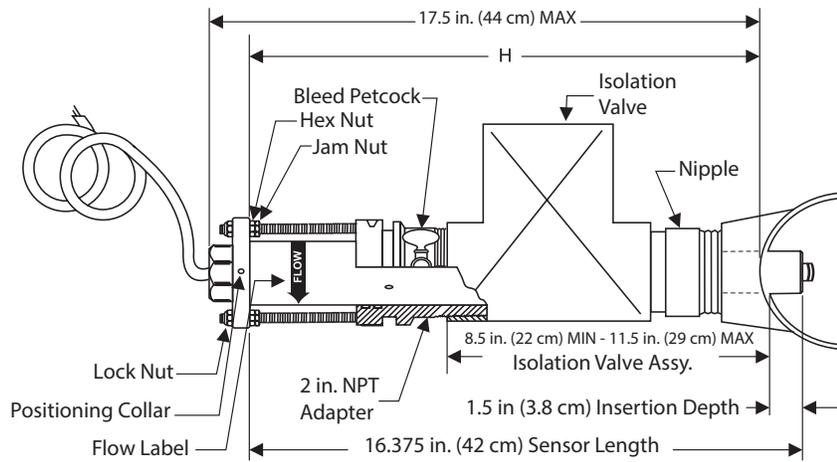


Figure 1: 225/226 Dimensions

**NOTE:** All dimensions are for reference only. To remove the flow sensor, there must be 25 in. (89 cm) clearance above the outside wall of the pipe. A cutting tool may require additional clearance.

**PART NUMBER CONSTRUCTION**

**225 Standard Sensor**

Example:	2	25	BR	00	0	5	-	1	2	1	1
<b>STYLE</b>											
Hot Tap Insert - Gate Valve		25									
<b>MATERIAL</b>											
Brass			BR								
<b>SIZE</b>											
Insert Style				00							
<b>ELECTRONICS HOUSING</b>											
PPS					0						
<b>ELECTRONICS</b>											
Standard Flow (STANDARD)						5					
IR-Irrigation						6					
<b>O-RING</b>											
Viton®								0			
EPDM (STANDARD)								1			
Buna N								8			
<b>SHAFT</b>											
Zirconia Ceramic									0		
Tungsten Carbide (STANDARD)									2		
316 Stainless Steel									6		
<b>IMPELLER</b>											
Nylon (STANDARD)										1	
Tefzel®										2	
<b>BEARING</b>											
UHMWPE (STANDARD)											1
Tefzel®											2
Teflon®											3

### 225 High Temperature Sensor

Example: 2		25	BR	00	4	8	-	0	2	2	3	
<b>STYLE</b>												
Hot Tap Insert - Gate Valve		25										
<b>MATERIAL</b>												
Brass		BR										
<b>SIZE</b>												
Insert Style		00										
<b>ELECTRONICS HOUSING</b>												
PEEK				4								
<b>ELECTRONICS</b>												
High Temperature				8								
<b>O-RING</b>												
Viton®								0				
<b>SHAFT</b>												
Tungsten Carbide (STANDARD)										2		
<b>IMPELLER</b>												
Tefzel®												2
<b>BEARING</b>												
Teflon®												3

### 226 Standard Sensor

Example: 2		26	SS	00	0	5	-	1	2	1	1	
<b>STYLE</b>												
Hot Tap Insert - Ball Valve		26										
<b>MATERIAL</b>												
Brass		BR										
Stainless Steel (Model 226 Only)		SS										
<b>SIZE</b>												
Insert Style		00										
<b>ELECTRONICS HOUSING</b>												
PPS				0								
<b>ELECTRONICS</b>												
Standard Flow (STANDARD)						5						
IR-Irrigation						6						
<b>O-RING</b>												
Viton®												0
EPDM (STANDARD)												1
Buna N												8
<b>SHAFT</b>												
Zirconia Ceramic												0
Tungsten Carbide (STANDARD)												2
316 Stainless Steel												6
<b>IMPELLER</b>												
Nylon (STANDARD)												1
Tefzel®												2
<b>BEARING</b>												
UHMWPE (STANDARD)												1
Tefzel®												2
Teflon®												3

**226 High Temperature Sensor**

Example:	2	26	SS	00	4	8	-	0	2	2	3
<b>STYLE</b>											
Hot Tap Insert - Ball Valve	26										
<b>MATERIAL</b>											
Brass	BR										
Stainless Steel (Model 226 Only)	SS										
<b>SIZE</b>											
Insert Style	00										
<b>ELECTRONICS HOUSING</b>											
PEEK	4										
<b>ELECTRONICS</b>											
High Temperature	8										
<b>O-RING</b>											
Viton®	0										
<b>SHAFT</b>											
Tungsten Carbide (STANDARD)	2										
<b>IMPELLER</b>											
Tefzel®	2										
<b>BEARING</b>											
Teflon®	3										

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### DESCRIPTION

The Series 228 flow sensors from Badger Meter® feature a six-bladed impeller design with a proprietary non-magnetic sensing mechanism. The forward swept impeller shape provides higher, more consistent torque than four-bladed impeller designs and is less prone to be fouled by water-borne debris. The forward curved shape coupled with the absence of magnetic drag provides improved operation and repeatability, even at lower flow rates. This is especially true where the impeller is exposed to metallic or rust particles found in steel or iron pipes. As the liquid flow turns the impeller, a low impedance square wave signal is transmitted with a frequency proportional to the flow rate. The signal can travel up to 2000 feet between the flow sensor and the display unit without the need for amplification.

All sensors, except irrigation versions, are supplied with 20 feet of 2-conductor 20 AWG shielded UL type PTLC 221° F (105° C) cable.

### MATERIALS

The 228SS tee-mounted flow sensor consists of a standard 220SS sensor mounted in a 2 inch stainless steel tee.



### SPECIFICATIONS

<b>Wetted Materials (except tees)</b>	See "Part Number Construction" on page 3	
<b>Sensor Sleeve and Hex Adapter</b>	Series 300 stainless steel	
<b>Tee for 228SS</b>	Cast 316 stainless, Class 150, per MSS SP-114	
<b>Temperature Ratings</b>	<i>Standard Version</i>	221° F (105° C) continuous service
	<i>Irrigation Version</i>	150° F (66° C) continuous service
<b>Pressure Ratings</b>	<b>Temperature (F)</b>	<b>Pressure (psi)</b>
	-20...150	300
	200	265
	250	225
	300	165
<b>Recommended Design Flow Range</b>	0.5...30 ft/sec	
<b>Accuracy</b>	±1.0% of full scale over recommended design flow range	
<b>Repeatability</b>	±0.3% of full scale over recommended design flow range	
<b>Linearity</b>	±0.2% of full scale over recommended design flow range	
<b>Transducer Excitation</b>	Supply voltage = 8V DC min. 35V DC max.	
	Quiescent current = 600 uA (typical)	
	OFF State ( $V_{High}$ ) = Supply voltage - (600 $\mu$ × Supply impedance)	
	ON State ( $V_{Low}$ ) = 1.2V DC @ 40 mA (15 $\Omega$ + 0.7V DC)	
<b>Electrical Cable for Standard Sensor Electronics</b>	20 ft (6 m) of 2-conductor 20 AWG shielded UL type PTLC wire provided for connection to display or analog transmitter unit. Rated to 221° F (105° C). May be extended to a maximum of 2000 feet with similar cable and insulation appropriate for application.	
<b>Electrical Cable for IR Sensor Electronics</b>	48 in. (122 cm) of UL Style 116666 copper solid AWG 18 wire with direct burial insulation. Rated to 221° F (105° C).	

## DIMENSIONS

### 228SS Standard Sensor

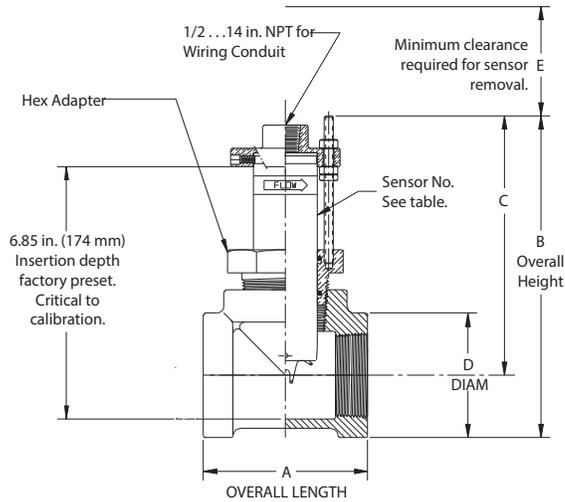


Figure 1: Standard 228SS flow sensor

Series No.	Tee No.	NPT Threads per inch	A	B *	C *	D	E
228SS	711338T	2...11.5	4.50 in. (114.30 mm)	8.38 in. (212.85 mm)	6.89 in. (175.01 mm)	2.98 in. (75.69 mm)	6 in. (152.40 mm)

\* Dimensions (B, C) may vary  $\pm 0.25$  in., depending on the makeup of the pipe threads.

### 228SS High Temperature Sensor

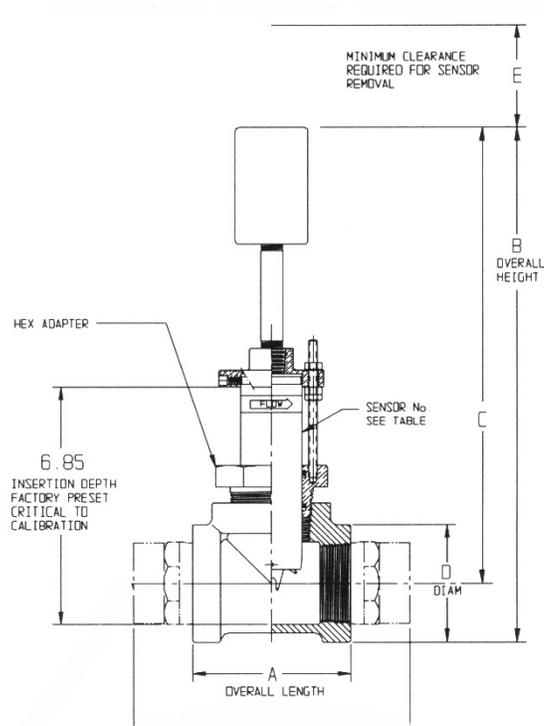


Figure 2: High temperature 228SS flow sensor

Series No.	Tee No.	NPT Threads per inch	A	B *	C *	D	E
228SS	711338T	2...11.5	4.50 in. (114.30 mm)	18.00 in. (457.20 mm)	16.50 in. (419.10 mm)	2.98 in. (75.69 mm)	6 in. (152.40 mm)

\* Dimensions (B, C) may vary  $\pm 0.25$  in., depending on the makeup of the pipe threads.

## PART NUMBER CONSTRUCTION

### Standard Sensor

Example: 2	28	SS	20	0	5	-	1	2	1	1
<b>STYLE</b>										
Tee Mounted Insert Sensor	28									
<b>MATERIAL</b>										
Stainless Steel		SS								
<b>SIZE</b>										
2"			20							
<b>ELECTRONICS HOUSING</b>										
PPS				0						
<b>ELECTRONICS</b>										
Standard Flow (STANDARD)					5					
IR-Irrigation					6					
<b>O-RING</b>										
Viton®							0			
EPDM (STANDARD)							1			
Buna N							8			
<b>SHAFT</b>										
Zirconia Ceramic								0		
Tungsten Carbide (STANDARD)								2		
316 Stainless Steel								6		
<b>IMPELLER</b>										
Nylon (STANDARD)									1	
Tefzel®									2	
<b>BEARING</b>										
UHMWPE (STANDARD)										1
Tefzel®										2
Teflon®										3

### High Temperature Sensor

Example: 2	28	SS	20	4	8	-	0	2	2	3
<b>STYLE</b>										
Tee Mounted Insert Sensor	28									
<b>MATERIAL</b>										
Stainless Steel		SS								
<b>SIZE</b>										
2"			20							
<b>ELECTRONICS HOUSING</b>										
PEEK				4						
<b>ELECTRONICS</b>										
High Temperature					8					
<b>O-RING</b>										
Viton®							0			
<b>SHAFT</b>										
Tungsten Carbide								2		
<b>IMPELLER</b>										
Tefzel®									2	
<b>BEARING</b>										
Teflon®										3

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#### DESCRIPTION

Used in conjunction with any Badger Meter® flow monitor or transmitter, Badger Meter non-magnetic flow sensors provide an accurate reading of the rate of liquid flow and total accumulated flow. The available sensor models cover applications for a wide range of pipe sizes and pressure/temperature specifications.

The flow sensors generate a frequency proportional to flow rate. An internal preamplifier allows the pulse signal to travel up to 2000 feet (610 meters) without further amplification. Power to operate the sensor is provided by the flow monitor. The impeller bearing assembly, shaft and O-rings are replaceable in the field.

Badger Meter flow sensors feature a closed, six-bladed impeller design, using a proprietary, non-magnetic sensing technology. The forward-swept impeller shape provides higher, more constant torque than four-bladed impeller designs, and is less prone to fouling by water-borne debris. The forward-curved shape, coupled with the absence of magnetic drag, provides improved operation and repeatability, even at lower flow rates. As the liquid flow turns the impeller, a low impedance signal is transmitted with a frequency proportional to the flow rate.

Sensors of similar type are interchangeable, so there is no need for recalibration after servicing or replacement.

#### Series 228PV

These models feature a modified PVC tee with solvent weld socket end connections, and a removable PPS or PVDF sensor insert. Sizes include 1-1/2, 2, 3, and 4 inch.

#### ELECTRONIC TYPES

Badger Meter provides several basic sensor configurations, using the same impeller element, allowing for a wide range of applications and pipe sizes. Sensors are normally supplied with 20 feet (6 meters) of 2-conductor 20 AWG shielded UL type PTLC 221° F (105° C) cable. All Series 200 sensor electrical components are self-contained. Pressure/temperature ratings for the models are contained in the specifications section of this document. These models are further described as follows.



#### Standard Sensor

These sensors are designed for indoor or protected area applications such as HVAC, pump control, and industrial process monitoring where flow rates are between 0.5...30 feet/second and temperatures are below 140° F (60° C). Standard sensors are supplied with 20 feet (6 meters) of 2-conductor 20 AWG shielded UL type PTLC 221° F (105° C) cable.

#### IR Sensor

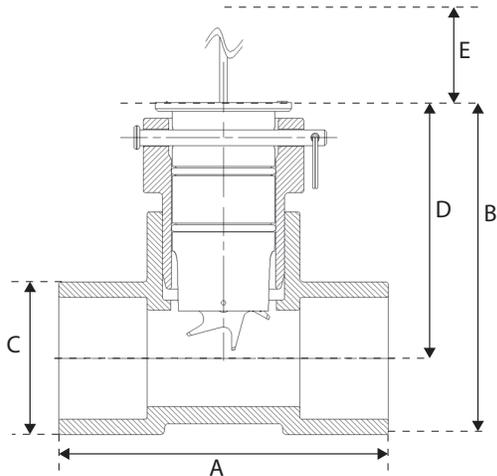
These sensors are designed for below grade applications such as irrigation, municipal, and groundwater monitoring where the flow rates are between 0.5...30 feet/second and temperatures are below 140° F (60° C). IR sensors are supplied with two single conductor, 18 AWG solid copper wire leads, 48 inches (122 cm) in length, with UL Style 116666 direct burial insulation.

## SPECIFICATIONS

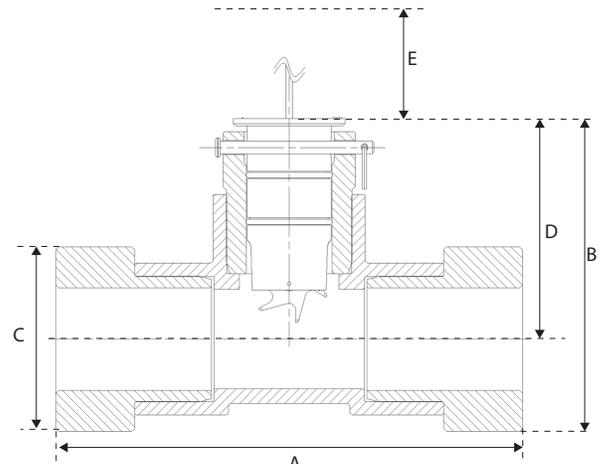
<b>Wetted Materials (except tees)</b>	See Ordering Matrix								
<b>Tee for 228PV</b>	Schedule 80 PVC per ASTM D-2462 and D-2467, Virgin, unplasticized PVC resin, Type 1 cell classification 12454-B. Fittings and solvent carry approval for potable water by NSF and IAMPO.								
<b>Pressure/Temperature Ratings (DO NOT EXCEED)</b>	<p>Depends on hardware configurations.</p> <table border="1"> <caption>Pressure/Temperature Rating Data</caption> <thead> <tr> <th>Temperature (°C)</th> <th>Pressure (psi)</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>100</td> </tr> <tr> <td>25</td> <td>100</td> </tr> <tr> <td>60</td> <td>40</td> </tr> </tbody> </table>	Temperature (°C)	Pressure (psi)	0	100	25	100	60	40
Temperature (°C)	Pressure (psi)								
0	100								
25	100								
60	40								
<b>Rated Temperature (DO NOT EXCEED)</b>	Operating: 35...110° F (2...43° C) Storage 14...110° F (-10...43° C)								
<b>Recommended Design Flow Range</b>	0.5...30 ft/sec								
<b>Accuracy</b>	± 1.0% of full scale over recommended design flow range								
<b>Repeatability</b>	± 0.3% of full scale over recommended design flow range								
<b>Linearity</b>	± 0.2% of full scale over recommended design flow range								
<b>Transducer Excitation</b>	<p>Supply voltage = 8V DC min. 35V DC max.</p> <p>Quiescent current = 600 uA (typical)</p> <p>OFF State (<math>V_{High}</math>) = Supply voltage - (600 <math>\mu</math> * Supply impedance)</p> <p>ON State (<math>V_{Low}</math>) = 1.2V DC @ 40 mA (15 <math>\Omega</math> + 0.7V DC)</p>								
<b>Output Frequency</b>	3.2...200 Hz								
<b>Output Pulse Width</b>	5 msec ±25%								
<b>Environmental</b>	<ul style="list-style-type: none"> <li>• IP 68 / NEMA 4X</li> <li>• Suitable for pollution degree 4 environments</li> <li>• Suitable for outdoor use above grade, IR version below grade</li> <li>• Suitable for use in 100% humidity</li> </ul>								
<b>Electrical Cable for Standard Sensor Electronics</b>	20 feet (6 meters) of 2-conductor AWG 20 with AWG 22 drain wire shielded UL type PTLT wire provided for connection to display or transmitter unit. Rated to 221° F (105° C). May be extended to a maximum of 2000 feet (610 meters) with similar cable and insulation appropriate for application.								
<b>Electrical Cable for IR Sensor Electronics</b>	48 inches (122 cm) of UL Style 116666 copper solid AWG 18 wire w/direct burial insulation. Rated to 221° F (105° C).								

**DIMENSIONS**

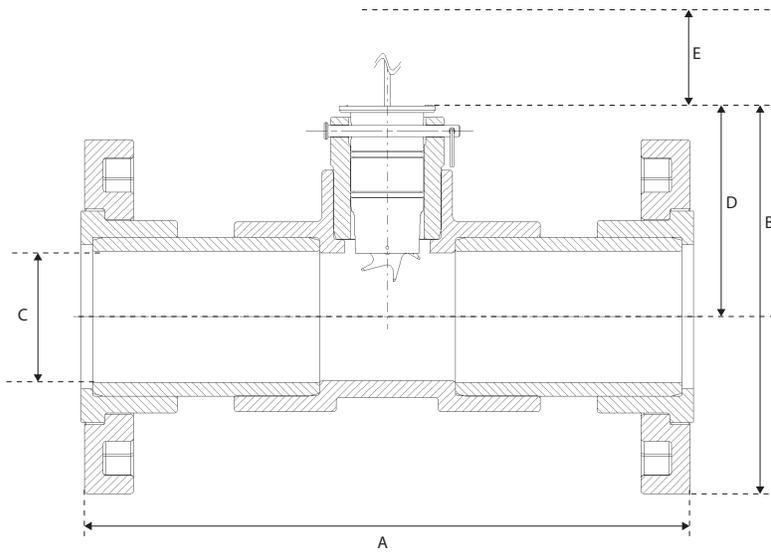
Dimensions	Series No. Complete			
	228PV15XX-XXX	228PV2XXX-XXXX	228PV3XXX-XXXX	228PV4XXX-XXXX
A	5.0 in. (127 mm)	5.63 in. (143 mm)	6.50 in. (165 mm)	7.38 in. (187 mm)
B	5.16 in. (131 mm)	5.64 in. (143 mm)	6.83 in. (173 mm)	6.83 in. (199 mm)
C	2.38 in. (60 mm)	2.88 in. (73 mm)	4.23 in. (107 mm)	5.38 in. (137 mm)
D	3.97 in. (101 mm)	4.20 in. (107 mm)	4.68 in. (119 mm)	5.10 in. (130 mm)
E	5.0 in. (127 mm)	5.0 in. (127 mm)	5.0 in. (127 mm)	5.0 in. (127 mm)



**No Fittings**



**BSP Fittings**



**Flanged (4 in. only)**

A = Overall Length; B = Overall Height; C = Diameter; D = Center of Tube to Top Height; E = Minimum Clearance for Sensor Removal

## PART NUMBER CONSTRUCTION

Example: 2		28	PV	15	0	5	-	1	2	1	1
<b>STYLE</b>											
Tee Mounted Insert Sensor		28									
<b>MATERIAL</b>											
PVC (1.5", 2", 3", 4" Sch 80 only)			PV								
<b>SIZE</b>											
1.5"				15							
2"				20							
3"				30							
4"				40							
1.5" with BSP Adapters				16							
2" with BSP Adapters				21							
3" with BSP Adapters				31							
4" with Flange Adapters				41							
<b>ELECTRONICS HOUSING</b>											
PPS					0						
<b>ELECTRONICS</b>											
Standard Flow (STANDARD)						5					
IR-Irrigation						6					
<b>O-RING</b>											
Viton®								0			
EPDM (STANDARD)								1			
Buna N								8			
<b>SHAFT</b>											
Zirconia Ceramic										0	
Tungsten Carbide (STANDARD)										2	
316 Stainless Steel										6	
<b>IMPELLER</b>											
Nylon (STANDARD)											1
Tefzel®											2
<b>BEARING</b>											
UHMWPE (STANDARD)											1
Tefzel®											2
Teflon®											3

**NOTE:** See *Parts & Accessories* at [www.badgermeter.com](http://www.badgermeter.com) for additional items. Special order shaft material and O-rings are available. Consult factory for pricing and delivery.

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### DESCRIPTION

The Series 250 flow sensor from Badger Meter® features a six-bladed impeller design with a proprietary non-magnetic sensing mechanism, mounted in a cast bronze housing, with female NPT threads.

The unique impeller design is less prone to be fouled by waterborne debris. The forward curved shape coupled with the absence of magnetic drag provides improved operation and repeatability even at lower flow rates. This is especially true where the impeller is exposed to metallic or rust particles found in steel or iron pipes. As the liquid flow turns the impeller, a low impedance square wave signal is transmitted with a frequency proportional to the flow rate. The signal can travel up to 2000 ft (610 m) between the flow sensor and the receiving unit without the need for amplification.

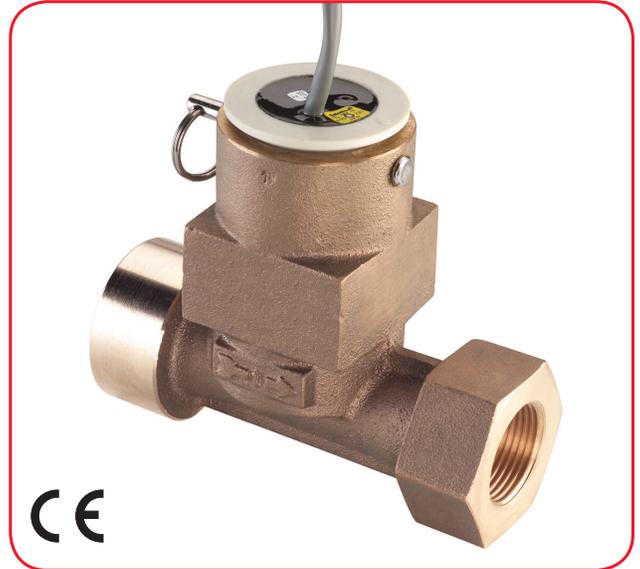
All sensors except irrigation versions are supplied with 20 ft (610 cm) of 2-conductor 20 AWG shielded UL type PTLT 221° F (105° C) cable and meet CE standards for noise immunity and susceptibility.

### FEATURES

- Sensor electronics easily removed from the tee
- Impeller, bearing and shaft are easily replaced in the field, without changing calibration
- Two-wire sensor. Power and signal transmit on a single pair of wires, up to a distance of 2000 ft (610 m)
- Digital signal easily interfaced with transmitters, monitors or PLCs

### APPLICATIONS

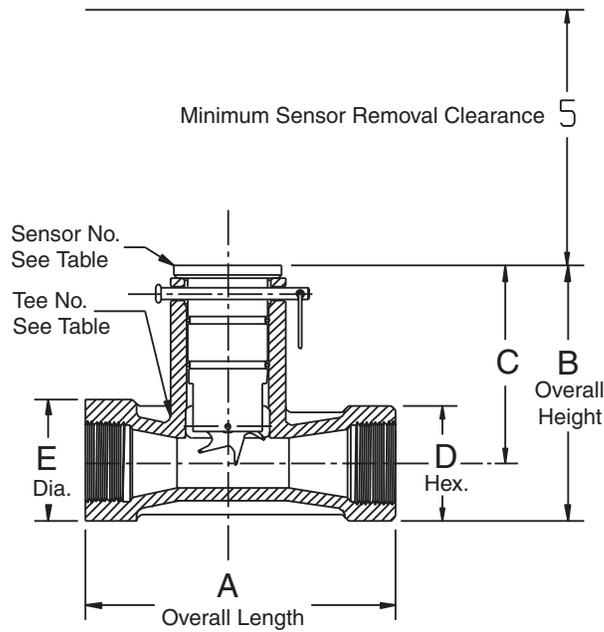
- Energy management and building management systems
- BTU sub-metering systems
- Cooling tower treatment systems
- Condensate return lines



### SPECIFICATIONS

<b>Wetted Materials</b>	See "Part Number Construction" on page 3
<b>Tee for 250B</b>	Cast valve bronze, UNS C83600
<b>Maximum Temperature</b>	Standard electronics: 221° F (105° C) Irrigation electronics: 150° F (66° C)
<b>Maximum Pressure at 100° F</b>	400 psi
<b>Recommended Design Flow Range</b>	0.3...15 ft/sec (0.15...9 m/sec)
<b>Accuracy</b>	± 1.0% of rate
<b>Repeatability</b>	± 0.7% over recommended design flow range
<b>Linearity</b>	± 0.7% over recommended design flow range
<b>Rangeability</b>	60:1
<b>Transducer Excitation</b>	Supply voltage = 8V DC min. 35V DC max. Quiescent current = 600 uA (typical) OFF State ( $V_{High}$ ) = Supply voltage - (600 uA * Supply impedance) ON State ( $V_{Low}$ ) = 1.2V DC @ 40 mA (15 Ω + 0.7V DC)
<b>Electrical Cable for IR Sensor Electronics</b>	48 in (122 cm) of UL style 116666 copper solid AWG 18 wire with direct burial insulation. Rated to 221° F (105° C).
<b>Electrical Cable for Standard Sensor Electronics</b>	20 ft (610 cm) of 2-conductor AWG 20 with AWG 22 drain wire shielded UL type PTLT wire provided for connection to display or transmitter unit. Rated to 221° F (105° C). May be extended to a maximum of 2000 ft (610 m) with similar cable and insulation appropriate for application.
<b>Certifications</b>	CE certified

**DIMENSIONS**



Series No. Complete	Sensor No.	Tee No.	NPT	A	B	C	D	E
250B-0.5	See Matrix	813168T	1/2 - 14	4.0 in. (102 mm)	4.67 in. (119 mm)	3.61 in. (92 mm)	N/A	1.63 in. (41 mm)
250B-0.75	See Matrix	813169T	3/4 - 14	4.0 in. (102 mm)	4.67 in. (119 mm)	3.61 in. (92 mm)	N/A	1.63 in. (41 mm)
250B-1.0	See Matrix	81940T	1.00 - 11.5	5.45 in. (138 mm)	4.75 in. (121 mm)	3.75 in. (95 mm)	2.0 in. (51 mm)	2.12 in. (54 mm)
250B-1.25	See Matrix	81941T	1.25 - 11.5	6.06 in. (154 mm)	5.0 in. (127 mm)	3.88 in. (99 mm)	2.25 in. (57 mm)	2.38 in. (60 mm)
250B-1.5	See Matrix	811193T	1.50 - 11.5	6.5 in. (165 mm)	5.19 in. (132 mm)	3.94 in. (100 mm)	2.5 in. (64 mm)	2.62 in. (67 mm)

Figure 1: Dimensions

## PART NUMBER CONSTRUCTION

### Standard Sensor

	50	BR	05	0	5	-	1	2	1	1
<b>STYLE</b>										
Cast Bronze Tee	50									
<b>MATERIAL</b>										
Brass		BR								
<b>SIZE</b>										
0.5"			05							
0.75"			07							
1"			10							
1.25"			12							
1.5"			15							
<b>ELECTRONICS HOUSING</b>										
PPS				0						
<b>ELECTRONICS</b>										
Standard Flow (STANDARD)					5					
IR-Irrigation					6					
<b>O-RING</b>										
Viton®							0			
EPDM (STANDARD)							1			
Buna N							8			
<b>SHAFT</b>										
Zirconia Ceramic								0		
Tungsten Carbide (STANDARD)								2		
316 Stainless Steel								6		
<b>IMPELLER</b>										
Nylon (STANDARD)									1	
Tefzel®									2	
<b>BEARING</b>										
UHMWPE (STANDARD)										1
Tefzel®										2
Teflon®										3

### High Temperature Sensor

	Example: 2	50	BR	05	4	8	-	0	2	2	3
<b>STYLE</b>											
Cast Bronze Tee		50									
<b>MATERIAL</b>											
Brass			BR								
<b>SIZE</b>											
0.5"				05							
0.75"				07							
1"				10							
1.25"				12							
1.5"				15							
<b>ELECTRONICS HOUSING</b>											
PEEK					4						
<b>ELECTRONICS</b>											
High Temperature						8					
<b>O-RING</b>											
Viton®								0			
<b>SHAFT</b>											
Tungsten Carbide									2		
<b>IMPELLER</b>											
Tefzel®										2	
<b>BEARING</b>											
Teflon®											3

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### DESCRIPTION

The Series 380 BTU Systems provide a low cost system for metering cold or hot systems. The 380DS can accurately measure flow and temperature differential to compute energy. Using either BACnet or Modbus RS-485 communications protocols or a scaled pulse output, the BTU Meter can interface with many existing control systems.

The rugged design incorporates an impeller flow sensor and two temperature probes. One temperature probe is conveniently mounted directly in the flow sensor tee. The second temperature probe is placed on either the supply or the return line, depending on ease of installation for the application. These minimal connections help simplify installation and save time.

The main advantage of the Series 380 BTU meters is the cost savings over other systems offered on the market today. The integration of flow and temperature sensors provide a single solution for metering. With this system it will be possible to meter energy where it has not been cost effective before.

Commissioning of this meter can be completed in the field via a computer connection. Setup includes energy measurement units, measurement method, communication protocol, pulse output control, fluid density, and specific heat parameters.

#### RS-485 Configuration

All Series 380 BTU meters are equipped with BACnet and Modbus protocols as standard features. The protocol of choice can be selected and set up in the field at the user's discretion. These common protocols allow for quick and easy commissioning while gaining valuable application data beyond energy total. Information such as Flow Rate, Flow Total, Energy Rate, Energy Total, Temp 1, Temp 2, and Delta T can all be transmitted on the RS-485 connection.

#### Scaled Pulse Output

If the RS-485 is not required for the application, a simple scaled pulse output is available. The pulse output would represent energy total and can be set in various units of measure. The pulse output is an open drain scaled pulse output that is compatible with a variety of PLCs, counters and the Badger Meter® 350 wireless system, so the unit is easily compatible with most inputs.

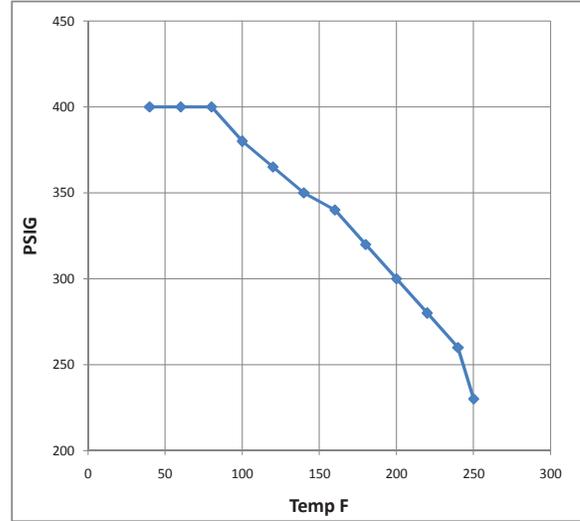


### SPECIFICATIONS

<b>Electrical Input</b>	Power	12...35V DC, 12...28V AC
	Communication	Modbus RTU, BACnet MSTP
<b>Electrical Output</b>	Scaled Pulse	Open drain, 0.01...100 Hz max.
<b>Materials</b>	Housing	Polycarbonate
	Flow Sensor	PEEK
	Potting Material	Polyurethane
	Tee Material	Brass
<b>Sensor Body Sizes</b>	Tee Sizes	3/4 in., 1 in., 1-1/4 in., 1-1/2 and 2 in.
<b>Environmental</b>	Fluid Temperature	20...260° F (-6.7...126.7° C)
	Ambient Temperature	-4...149° F (-20...65° C)
<b>Accuracy</b>	± 2% of flow rate within flow range	
	± 0.5% repeatability	
	RTD meets IEC751 Class B	
<b>Flow Range</b>	1...15 ft/sec	
	<b>Diameter</b>	<b>380 BTU Meter Flow Range</b>
	0.75 in. (19 mm)	1.65...24.69 gpm (6...93 lpm)
	1 in. (25 mm)	2.70...40.48 gpm (10...153 lpm)
	1.25 in. (32 mm)	4.66...69.93 gpm (17...265 lpm)
	1.5 in. (38 mm)	6.35...95.18 gpm (24...360 lpm)
	2 in. (50 mm)	10.49...157.34 gpm (40...595 lpm)
This chart is based on ASME/ANSI B336.10 <i>Welded and Seamless Wrought Steel Pipe</i> and ASME/ANSI B3619 <i>Stainless Steel Pipe</i> .		

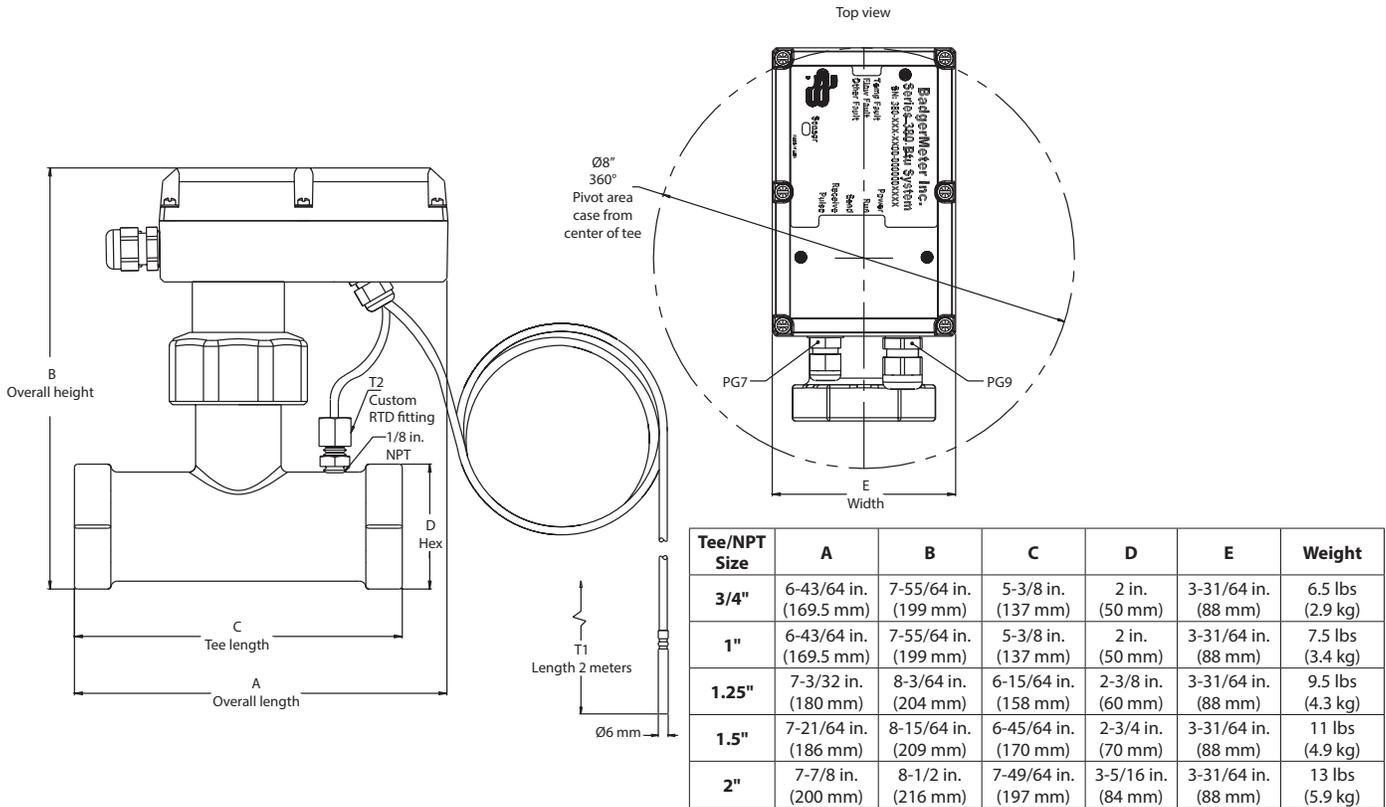
**Series 380 Btu System Ordering Matrix**  
380 DS Meter

<b>TYPE</b>	Example: 380	2	07	0	0	0	-	1	2	0	2
DS - Dual Service		2									
<b>SIZE</b>											
0.75"			07								
1"			10								
1.25"			12								
1.5"			15								
2"			20								
<b>ELECTRONIC HOUSING</b>											
Polycarbonate			0								
<b>OUTPUT</b>											
Scaled Pulse and RS-485 (Modbus and BACnet)			0								
<b>DISPLAY</b>											
N/A											0
<b>O-RING</b>											
EPDM											1
<b>SHAFT</b>											
Tungsten Carbide (STANDARD)											2
<b>IMPELLER</b>											
Stainless Steel											0
<b>BEARING</b>											
Ketron®											2



\*Max. Temp. 260° F (126.7° C) 230 psig  
Unit can be used to 20° F (-6.7° C) @ 400 psig

**DIMENSIONS**



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### DESCRIPTION

The Series 735 Impeller flow sensors feature a four-blade impeller design, using a proprietary, non-magnetic sensing technology. When used in conjunction with any Badger Meter® flow monitor or transmitter, the sensor provides an accurate reading of the rate of liquid flow as well as total accumulated flow. A number of sensor models are offered, which cover applications for a wide range of pipe sizes and pressure/temperature specifications.

### OPERATING PRINCIPLE

As the liquid flow turns the impeller, a low impedance signal is transmitted with a frequency proportional to the flow rate. An internal preamplifier allows the pulse signal to travel up to 2000 ft (609.6 m) without further amplification. The impeller bearing assembly, shaft and O-rings are replaceable in the field. Sensors of similar type are interchangeable, so there is no need for recalibration after servicing or replacement.

### FEATURES

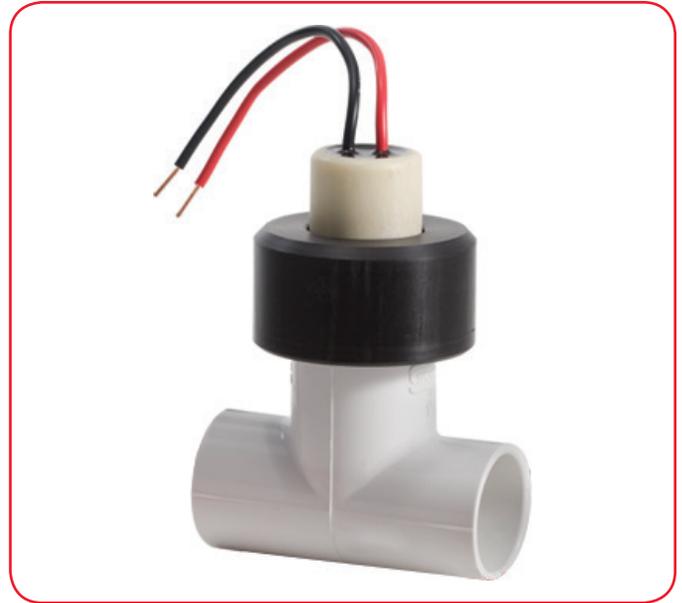
- Modified PVC tee with solvent weld socket end connections and a removable PPS sensor insert.
- Available sizes include 1/2 in., 3/4 in. and 1 in.
- Threaded BSP adapters.

### IR SENSOR

Designed for below grade applications such as irrigation, municipal and groundwater monitoring where the flow rates are between 2...20 ft/sec. (0.61...6.1 m/sec.) and temperatures are below 110° F (43.3° C). IR sensors are supplied with two single conductor, 18 AWG solid copper wire leads.

### ORDERING MATRIX

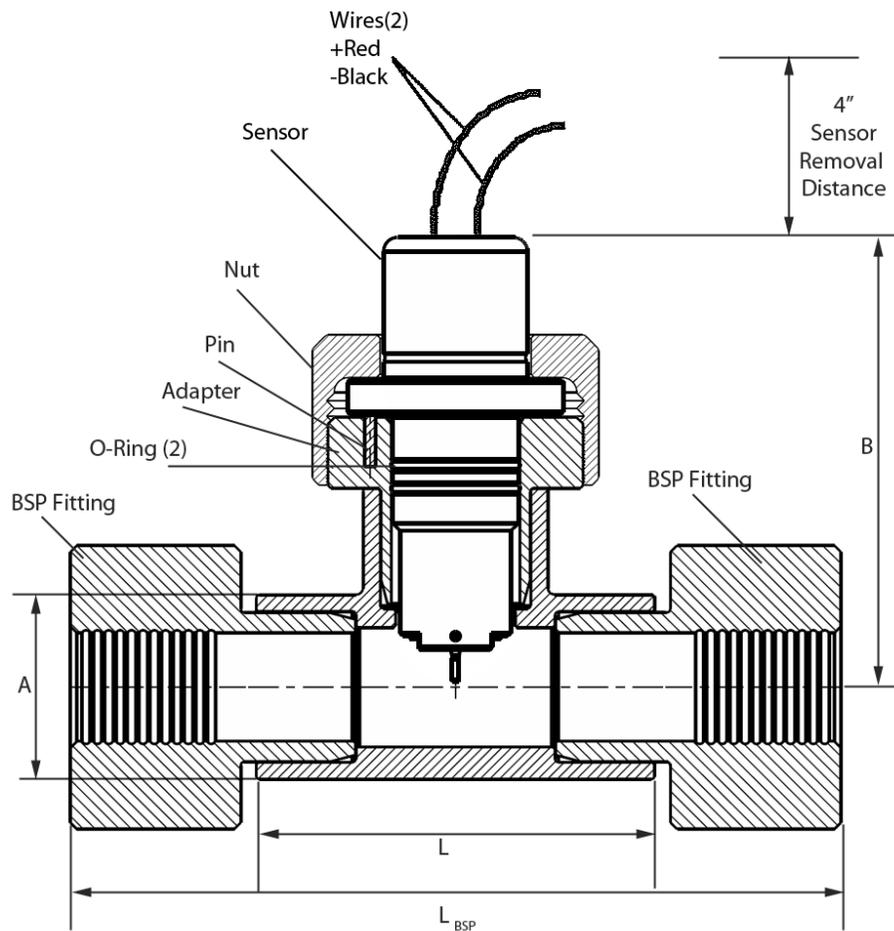
<b>STYLE</b>	Example: 7   35   PV   05   0   6   1   2   0   1
Tee Mounted Insert Sensor	35
<b>MATERIAL</b>	PV
PVC (.5", .75", 1" Sch 40 only)	
<b>SIZE</b>	
0.5"	05
0.75"	07
1"	10
0.5" with BSP Adapters	06
0.75" with BSP Adapters	08
1" with BSP Adapters	11
<b>ELECTRONICS HOUSING</b>	
PPS	0
<b>ELECTRONICS</b>	
IR-Irrigation	6
<b>O-RING</b>	
EPDM	1
<b>SHAFT</b>	
Tungsten Carbide	2
<b>IMPELLER</b>	
300 SST	0
<b>BEARING</b>	
UHMWPE	1



### SPECIFICATIONS

<b>Wetted Materials (except tees)</b>	See "Ordering Matrix"
<b>Materials</b>	
Tee	PVC Type 1, white
Adapter	PVC Type 1, gray
BSP Fitting	PVC Type 1
Sensor Housing	PPS
Retaining Nut	Acetal copolymer, black
Locating Pin	300SST
Impeller	300SST
Shaft	Tungsten Carbide
Bearing	UHMWPE
O-Rings	EPDM
Wires	18 AWG Irrigation Wire (solid copper)
<b>Pressure, Temperature Ratings</b>	150 psig @ 73° F (22.8° C) 75 psig @ 110° F (43.3° C)
<b>Recommended Design Flow Range</b>	2...20 FPS
<b>Accuracy</b>	± 3.0% of full scale over recommended design flow range
<b>Repeatability</b>	± 1.5% of full scale over recommended design flow range
<b>Linearity</b>	± 1.5% of full scale over recommended design flow range
<b>Transducer Excitation</b>	Quiescent current 600 uA @ 8...35V DC max. Quiescent voltage (Vhigh) Supply Voltage — (600 uA*Supply impedance) ON State (Vlow) Max. 1.2V DC @ 40 mA current limit (15W + 0.7V DC)
<b>Output Frequency</b>	3.2...200 Hz
<b>Output Pulse Width</b>	5 msec ± 25%
<b>Electrical Cable for IR Sensor Electronics</b>	UL Style 116666 copper solid AWG 18 wire w/ direct burial insulation. Rated to 105° C.

## DIMENSIONS



A Soc Size, NPS	B Centerline to Top	L	L <sub>BSP</sub> Optional
1/2 in. [Ø 0.840"]	3.85 in. (97.8 mm)	3.06 in. (77.7 mm)	6.086 in. (154.6 mm)
3/4 in. [Ø 1.050"]	3.85 in. (97.8 mm)	3.31 in. (84.1 mm)	6.775 in. (172.1 mm)
1 in. [Ø 1.315"]	3.94 in. (100.1 mm)	3.50 in. (88.9 mm)	6.775 in. (172.1 mm)

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### DESCRIPTION

The Series 4000 Flow Sensor has an in-line, flow-through design using a tangential six bladed impeller.

The Series 4000 Flow Sensor is available in 1/2 in., 3/4 in. and 1 in. pipe sizes and is molded of PVC or PVDF materials. The compact design allows the Series 4000 flow sensor to replace old style magnetic sensors with little or no piping changes.

The proprietary non-magnetic detection circuit is available with two outputs: a low-impedance, 3-wire, 5V DC square wave signal (that can be pulled up to 20V) capable of traveling up to 2000 ft (609 m) without amplification, or a 2-wire, loop-powered, 4...20 mA current analog signal. These two signal formats are compatible with most data acquisition or PLC equipment.

PVDF versions are compatible with all PVDF piping systems including SYGEF, KYNAR, SUPER PROLINE and SANITECH. Adapters are available for use with other plastic or metallic piping systems.

### FEATURES

- 4...20 mA analog output programmable in field.
- Enhanced versions can accurately measure flow rates as low as 0.25 fps.
- Flow detection electronics can be serviced or replaced without opening the pipe. No exposure to wetted parts.
- Impeller bearings and shaft can be easily replaced without removing the sensor from the pipe.
- Documented operating service life in high temperature ultra-pure water throughout 40 months of continuous 24 hr/day operation.
- Superior particle-shedding performance verified by independent laboratory testing. Particle sizes from 0.1 micron to 1.0 micron representing "on wafer" metallic contamination (ELYMAT) and liquid-borne particles were monitored.
- CE tested and approved by an independent laboratory.



The analog output is controlled by an on-board microprocessor and digital circuitry producing precise drift free signals. The unit is programmed from a PC using Windows® based software and a connection cable. Units may be pre-programmed at the factory or field programmed. All programming information is stored in non-volatile memory in the sensor.



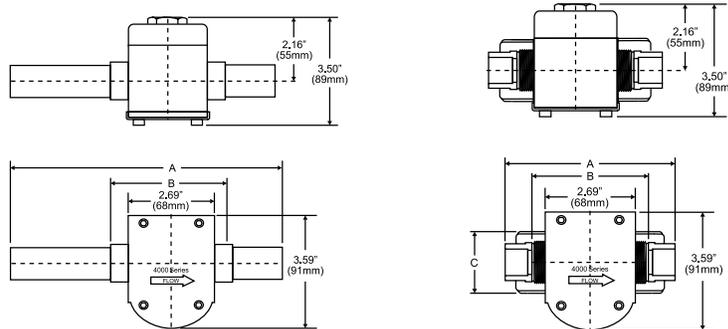
<b>Mechanical Specifications</b>	Nominal Pipe Size	1/2 in. (20 mm), 3/4 in. (25 mm), 1 in. (32 mm)
	End Connections	PVC Plain end pipe PVDF Socket weld/union
	Standard Flow Range	1...20 fps
	Low Flow Range	0.25...8 fps
	Accuracy	Better than 1%
	Repeatability	± 0.5%
	Max Temp Rating	PVC 140° F (60° C) PVDF 220° F (104° C)
	Max Pressure Rating	PVC 350 psi @ 73° F (23° C) PVDF 275 psi @ 65° F (18° C)
<b>Electrical Specifications</b>	Cable	Digital Output 3-wire Analog Output 2-wire
	Signal Digital Output	5V CMOS and LSTTL compatible, can be forced up to 20 volts by an external pull-up resistor
	Analog Output	4...20 mA analog output with offset compensation for ripple less than 0.25% of full scale
	Sink Current	2...10 mA
<b>Power</b>	Digital Output	Supply voltage 9...20V DC Supply current 2 mA maximum
	Analog Output	10...35V DC. Loop power supply voltage and loop series resistance must make sure that the device voltage remains within these limits over the 4...20 mA output span
	Accessories	840134-0002 USB Converter Model A301-20 programming kit with 20 foot cable



**SERIES 4000 ORDERING MATRIX**

	Example	4	0	0	7	10	-	0	0	2	2
<b>Series</b>		4									
4000		4									
<b>Style</b>											
Standard Flow			0								
Enhanced Flow (available with 1/2 in. and 3/4 in. only)			1								
<b>Size</b>											
1/2 in.				0							
3/4 in.				1							
1 in.				2							
<b>Material</b>											
PVC furnished with schedule 80 tail pieces					2						
PVDF socket					3						
PVDF union threaded					4						
PVDF with unions and socket ends					5						
PVDF with 316 stainless steel FNPT union end					7						
PVDF with CPVC socket union end					9						
<b>Electronics</b>											
Pulse output						00					
Pulse output with EFI foil shield						01					
Pulse output with CE housing						05					
4...20 mA analog output						10					
4...20 mA analog output with EFI foil shield						11					
4...20 mA with CE housing						15					
<b>O-Ring (set of 3 rings)</b>											
Viton®							0				
EPDM							1				
<b>Shaft</b>											
Zirconia Ceramic										0	
Hastelloy® C										1	
Tungsten Carbide										2	
316 Stainless Steel										6	
Tantalum										7	
<b>Impeller</b>											
Tefzel®											2
<b>Bearing</b>											
UHMWPE											1
Tefzel											2
Teflon®											3

**Dimensions**



PVC			PVDF			
Model	A	B	Model	A	B	C
1/2 in.	8.77 in. ± 0.25 in. (222 mm ± 6.35 mm)	4.33 in. (104 mm)	1/2 in.	5.03 in. (128 mm)	3.54 in. (90 mm)	1.85 in. (47 mm)
3/4 in.	10.57 in. ± 0.25 in. (268 mm ± 6.35 mm)	4.69 in. (119 mm)	3/4 in.	5.55 in. (141 mm)	3.92 in. (100 mm)	2.24 in. (57 mm)
1 in.	13.03 in. ± 0.25 in. (331 mm ± 6.35 mm)	5.40 in. (137 mm)	1 in.	6.10 in. (155 mm)	4.32 in. (110 mm)	2.52 in. (64 mm)

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### DESCRIPTION

The Badger Meter® Model THT Temperature Sensor provides accurate remote temperature sensing for use with Badger Meter Series 340 BN/MB Btu Transmitter, 3050 Series Monitor and other building automation applications.

The THT includes unique mounting hardware incorporating an isolation valve allowing the temperature probe to be "hot tapped", or installed in a working pipeline without shutting down or draining the line. This hot tap capability allows temperature sensors to be retrofit to existing pipelines at a fraction of the cost of thermowell installations. For Btu measurement or submetering applications, THT temperature sensors should always be installed in pairs to match their reaction time to temperature change.

The THT sensor features a precision 10 KΩ thermistor element encapsulated with a temperature conductive compound within a 316 stainless steel probe. These two-wire devices have a thermal accuracy of ± 0.36° F (0.2° C).



Model THT Sensor



Temperature Probe Removed from Valve

### SPECIFICATIONS

<b>Sensing Element</b>	2-wire thermistor (thermal resistor)
<b>Accuracy</b>	± 0.36° F (0.2° C) from 32...158° F (0...70° C)
<b>Temperature Range</b>	0...250° F (-17...121° C)
<b>Stability</b>	0.024° F (0.13° C) over 5 years
<b>Head Dissipation</b>	2 mW/ °C typical before plotting
<b>Wetted Materials</b>	316 stainless steel, Viton® O-rings
<b>Service Connection Size</b>	1" NPT
<b>Pressure Rating</b>	1000 psi (69 bar)
<b>Insertion Force Required</b>	Approximately 20% of line pressure
<b>Mounting</b>	1" tap, tapping saddle or weldment
<b>Electrical Connection</b>	6" 24 AWG flying leads with 1/2" conduit thread

### ORDERING INFORMATION

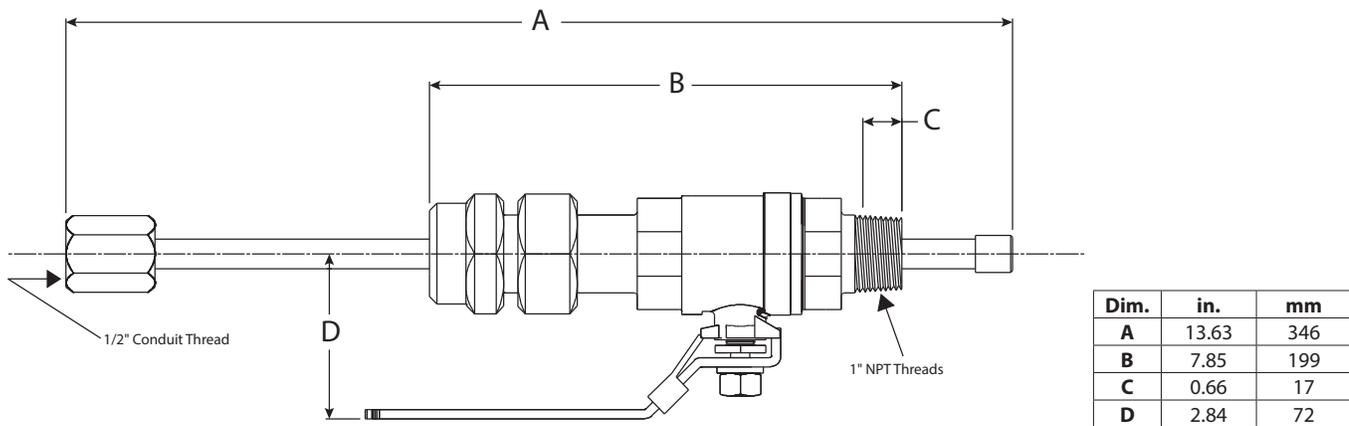
Model Number	Description
THT-000	1 in. stainless steel hot tap temperature sensor, complete
XTHT-000	Replacement thermistor probe
A-1027	Brass tapping nipple; adapts thread to NPT for tapping machine; reuseable

### Temperature vs Resistance (10 KΩ Thermistors)

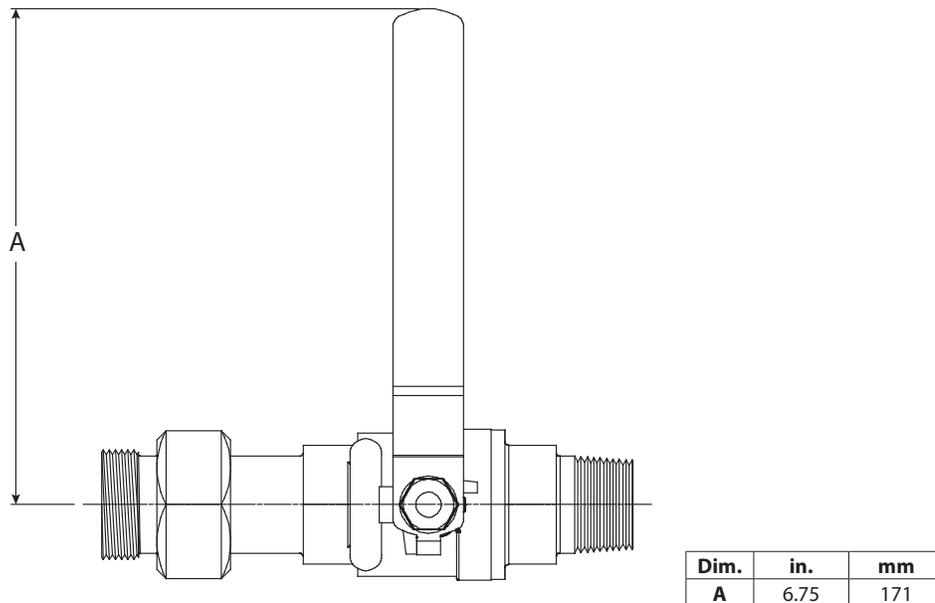
Temperature		Resistance Ohms
° F	° C	
32	0	32,654
50	10	19,903
68	20	12,493
77	25	10,000
86	30	8056
104	40	5325
122	50	3602
140	60	2488
158	70	1753
176	80	1257
194	90	917
212	100	679

## DIMENSIONS

### Model THT Sensor Dimensions



### Model THT Ball Valve Dimensions



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