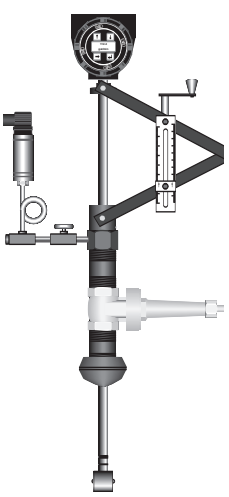
spirax sarco®

S-Turbo-Bar Insertion Turbine
Models S-TMP-600/60S • S-TMP-700 • S-TMP-910/960

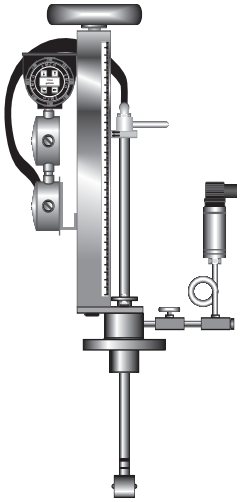
Description

Spirax Sarco S-Turbo-Bar insertion flow meters have three main components: the retractor, the rotor, and the electronics. The retractor positions the rotor within the pipe and houses a pick-up assembly, which detects the rotation of the turbine rotor. The electronics converts the rotational frequency, which is proportional to the velocity of the fluid, to industry standard electrical output signals.

Most S-Turbo-Bar flow meters can be installed on an isolation valve, which permits installation and removal without process shutdown. Integral pressure and/or temperature measurement may be combined with the S-Turbo-Bar and flow processor to provide mass or energy flow measurement from a single pipe tap.


S-TMP-600/60S


S-TMP-700


S-TMP-910/960

Features

- Fluid types: liquid, gas, or steam
- Pipe sizes: 3 to 80”
- Rugged construction
- Interchangeable rotors for a wide variety of applications
- Process pressure up to 5000 psig (345 barg)
- Process temperatures up to 750°F
- Industry standard frequency and/or 4 to 20 mA output signals
- Optional integral pressure and/or temperature measurement
- Negligible head loss
- EZ-Logic™ menu-driven user interface (microprocessor-based)
- Linearization with EZ-Logic for enhanced accuracy at low velocities
- Local programming via EZ-Logic keypad or magnet wand through explosion-proof enclosure

Application Guide

Model	Liquid	Gas	Steam	Hot Tap	Temperature Range °F	Maximum Pressure[1] psi	Seal Type	Line Sizes[2] inches
600	yes	yes	no	yes	-40 to 400	125	Viton®	3 to 80
60S	no	no	yes	yes	-65 to 400	125	E/P[3]	3 to 80
700	yes	yes	yes	no[5]	-200 to 600	5000[4]	Swagelok®	3 to 80
910	yes	yes	yes	yes	-200 to 400	flange rating	Teflon®	3 to 80
960	yes	yes	yes	yes	-200 to 750	flange rating	Grafoil®	3 to 80

Note:

1 Maximum pressure at maximum temperature with appropriate connection.
2 In some cases, especially in large pipe sizes, a one or two foot stem extension may be required (See dimensional outlines).
3 Ethylene-Propylene elastomer.
4 Rating listed is for NPT connection. For flange connections, use ANSI flange rating.
5 The S-TMP-700 is a fixed insertion meter; it cannot be removed or installed under pressure.

S-Turbo-Bar Insertion Turbine
Models S-TMP-600/60S • S-TMP-700 • S-TMP-910/960

Operating Specifications

Measurable Velocity Limits
See Rotor Selection Guide, p. 4, for linear and measurable ranges of available rotors. Continuous operation above the maximum velocity will shorten the life of the rotor and is not recommended.

Process Viscosity
Maximum 5 centipoise

Ambient Temperature Limit
EZ-Logic Electronics
- 32 to 140°F

All Other Electronics
- –20 to 140°F

Ambient Humidity Limit
0 to 100% relative humidity non-condensing

Power Requirements
EZ-Logic Electronics
- 18 to 40 VDC (with totalizer on), 24 VDC nominal
- 12 to 40 VDC (with totalizer off), 24 VDC nominal

Output Signals
EZ-Logic Electronics (LOC-TOT Option)

Analog
4 to 20 mA, 2-wire system, digitally adjusted span

Frequency
3-wire system, 1 to 10,000 Hz square wave, 50% duty cycle.
- Low Level: 0 to 1 volts
- High Level: power supply voltage-load

Pulse
3-wire system. Output can be scaled so that 1 pulse indicates a specific quantity of fluid passing through the pipe.

Hart® Communications Protocol
Display
2-line by 8-character LCD digital display alternately show flow rate and totalized flow in user-selectable engineering units.

Performance Specifications

Accuracy (Linear Ranges)	
L1, G1–G5 Rotors	±1.0% of reading
G6 Rotor	±3.0% of reading
Repeatability (Linear Range)	±0.25% of reading
Rotor Velocity Calibration	Each rotor is factory calibrated in either water or air. Calibration is traceable to NIST.
Accuracy of the Calibration Standard (Linear Range)	
Water	±0.25% of reading
Air	±0.8% of reading

Physical Specifications

Materials	
Rotor	Blades: 17– 4 PH, ten blade, precision machined
	Housing: 316 stainless steel
	Pivots: tungsten carbide
Rotor Bearing Type	Liquid: CSJ stellite jewel
	Gas or Steam: DEV tungsten carbide
Wetted Parts	316L stainless steel stem and housing (bronze and carbon steel housing S-TMP-600/60S)
External Parts	Aluminum, 316 stainless steel, carbon steel (bronze and carbon steel on S-TMP-600/60S, S-TMP- 910/960)
Electrical Connection	Junction box with terminal block for external wiring. 0.75” female NPT connection for conduit.
Electrical Enclosure	383 aluminum. Approved for NEMA 4X for watertight and dust tight requirements
Sensor	Electromagnetic pick–up, 10 mVp–p minimum, 330 Ω nominal resistance.
Retractor Type	
S-TMP-600/60s	Screw thread, rising stem
S-TMP-700	Not retractable
S-TMP-910/960	Acme thread, non-rising stem
Extended Length Stem (Optional)	
Use of the two foot extension is limited to gas applications only.	Longer stems are available for large pipe sizes or when the mounting dimensions exceed the insertion capability. Extended stems are not available for the S-TMP-600/60S.
Process Connection	
S-TMP-600/60S	2” NPT
S-TMP-700	2” NPT
	2” 150#, 300#, 600# or 900# ANSI raised face flange
S-TMP-910/960	2” 150#, 300#, 600#, 900#, or 1500# ANSI raised face flange

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S-Turbo-Bar Insertion Turbine
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Isolation Valve (S-TMP-600/60S only)
2" full-port bronze gate valve, 125 psig (8.62 barg) maximum. For S-TMP-910/960, see Accessories.

Pressure Tap and Bleed Valve
Standard 1/4" NPT pipe nipple with 1/4" stainless steel bleed valve. Provides connections for mounting optional pressure transmitter (Model S-PT).

Model S-PT Pressure Transmitter (Optional)
A pressure transmitter can be mounted using the 1/4" NPT connection on the bleed valve supplied with the meter, eliminating the need for a separate pressure tap. A 4 to 20 mA output, scaled to the desired pressure range, is provided. All pressure transmitters include a siphon tube, bleed valve, plug, nipple, and tee. A pressure transmitter is not available with 110/220 VAC power. See the S-PT TIS for complete details.

Temperature Sensor (RTD Option)
A 1000 Ω, platinum RTD can be mounted inside the stem of the flowmeter probe, eliminating the need for a separate temperature tap.

Temperature Transmitter (TXX Option)
Includes the RTD option with an additional 4 to 20 mA output, scaled to the desired temperature range. A temperature transmitter is not available with 110/220 VAC power and is not CE approved.

Remote Mount Electronics (RMT Option)
30 ft signal cable and U-bolts are provided with remote mount electronics. Cable must be run in conduit (conduit not supplied). Conduit connection is 3/4" NPT.

Note: Remote mount electronics are only available with EZ-Logic electronics (LOC-TOT Option).

FM Approval (FM Option)
Certified by FM for Class I, Division 2, Groups A, B, C and D; Classes II, III, Division 2, Groups F and G NEMA 4X locations.

Note: FM not available when used with 4 to 20 mA temperature transmitter, a pressure transmitter 0 to 1000 psig, or special scaled pressure transmitter.

Accessories

Gate Valve (Model S-2GV) - (for Use with S-TMP-910/960 Only)
Installation with a 2" double flanged, raised-face, full port gate valve enables the flow sensor to be inserted and removed from the pipe under full flow conditions. Both the valve and pipe tap must have a minimum 1.875" internal diameter clearance.

Flow Processor (Model S-FP-93)
A microprocessor-based flow processor may be used to significantly increase the accuracy and functionality of any flow metering application. See the S-FP-93 TIS for complete details.

Straight Run Piping Requirements

	Upstream	Downstream
One 90° elbow before the meter	10 D	5 D
Two 90° elbows before the meter	15 D	5 D
Two 90° elbows out of plane before the meter	30 D	5 D
Reduction before the meter	10 D	5 D
Regulator or valve partially closed before the meter	30 D	5 D

D is equal to the internal diameter of the pipe.

If there is not sufficient straight run of pipe, a flow rectifier may be used to reduce the above diameter measurements.
Consult your local representative or the factory for your specific application.

Other Installation Considerations

Tap Size
1.875" minimum diameter.

Mounting Position
S-Turbo-Bar probes may be installed in vertical, horizontal, or angled pipe sections. The meter is attached perpendicular to the axis of the pipe and should not be mounted "upside-down" (with its top section hanging below the pipe mount). For liquid service, the fluid must completely fill the pipe.

Site Selection
The flow measurement location should be selected to minimize turbulence and swirl. The extent of these flow disturbances depends upon the piping configuration. Valves, elbows, pumps, and other piping components may add disturbances to the flow.

Hot Tap Comapatibility
The S-TMP-600/60S is hot tap compatible, which means that the sensor can be installed and removed under full flow conditions. The S-TMP-910/960 is hot tap compatible when installed with a 2" double flanged, full port ball or gate valve that adheres to the dimensions shown on page 5.

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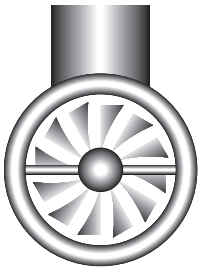
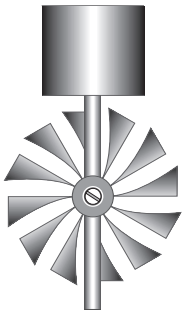
Rotor Selection Guide

G6 (1" rotor)



G1 through G5, L1 (1.5" rotor)



Selection of the turbine rotor model depends upon the fluid type and operating velocity range of the fluid.

- *For all liquids, the model L1 rotor, with a maximum velocity of 30 ft/sec, must be used.*
- *For gases and steam, six different rotors are available with maximum velocities ranging from 55 to 175 ft/sec. See Table for maximum velocity limits (V_{max}) for all rotors.*

The turbine rotor typically will respond linearly over the velocity range from V_{lin} to V_{max} – within ±1.0% (3.0% for G6 rotor). This is defined as the "linear" range of the rotor. The minimum "measurable" velocity (V_{min}) can be considered the application minimum. Velocities from V_{min} to V_{lin} are measurable and repeatable, but less accurate.

When determining the fluid velocity limits for a given rotor, the following equations can be used to compute fluid velocity.

Average Fluid Velocities	
Fluid	
Liquid	$0.4085 \frac{Q_1}{D^2}$
Gas	$3.056 \frac{Q_2}{D^2}$
Steam	$0.051 \frac{M}{\rho \cdot D^2}$
Where:	
V = average fluid velocity	ft/sec
D = pipe inside diameter	in
Q_1 = liquid volumetric flow	gal/min
Q_2 = gas actual volumetric flow	ft²/min
M = mass flow rate	lb/h
ρ = fluid density	lb/ft³

Liquid Minimum and Maximum Velocity Rates								
Rotor	**Flow Units**	**All Sizes**	**3 to 5"**		**6"**		**8+"**	
		V_{max}	V_{lin}	V_{min}	V_{lin}	V_{min}	V_{lin}	V_{min}
L1	ft/sec	30	1.4	0.5	1.5	0.6	1.6	0.7

Gas or Steam Minimum and Maximum Velocity Rates (ft/sec)							
Rotor	**All Sizes**	**3–5 in.**		**6 in.**		**8+ in.**	
	V_{max}	V_{lin}	V_{min}	V_{lin}	V_{min}	V_{lin}	V_{min}
G1 40° pitch	55	$3.19/\sqrt{\rho}$	$1.94/\sqrt{\rho}$	$2.00/\sqrt{\rho}$	$1.23/\sqrt{\rho}$	$1.50/\sqrt{\rho}$	$1.00/\sqrt{\rho}$
G2 30° pitch	70	$3.98/\sqrt{\rho}$	$2.26/\sqrt{\rho}$	$2.27/\sqrt{\rho}$	$1.63/\sqrt{\rho}$	$1.90/\sqrt{\rho}$	$1.31/\sqrt{\rho}$
G3 20° pitch	85	$4.52/\sqrt{\rho}$	$2.42/\sqrt{\rho}$	$2.52/\sqrt{\rho}$	$1.95/\sqrt{\rho}$	$2.18/\sqrt{\rho}$	$1.40/\sqrt{\rho}$
G4 15° pitch	115	$5.84/\sqrt{\rho}$	$3.85/\sqrt{\rho}$	$3.78/\sqrt{\rho}$	$2.84/\sqrt{\rho}$	$3.00/\sqrt{\rho}$	$2.19/\sqrt{\rho}$
G5 10° pitch	145	$6.91/\sqrt{\rho}$	$4.57/\sqrt{\rho}$	$4.78/\sqrt{\rho}$	$3.47/\sqrt{\rho}$	$3.54/\sqrt{\rho}$	$2.81/\sqrt{\rho}$
G6 5° pitch	175	$6.10/\sqrt{\rho}$	N/A	$5.53/\sqrt{\rho}$	N/A	$5.00/\sqrt{\rho}$	N/A

Note: Rotors have moving parts that require periodic maintenance.

Note: All values in the above table are approximate and depend on the density of the fluid. Accuracy in both the linear and nonlinear ranges may be improved by using the advanced curve fitting techniques present in the S-FP-93 flow processors or the EZ-Logic electronics. Consult Spirax Sarco if your application falls outside the above limits.

V_{max} = maximum velocity of fluid [ft/sec]
V_{lin} = minimum velocity of fluid at which rotor response is linear [ft/sec]
V_{min} = minimum measurable velocity of fluid [ft/sec]
ρ = density of fluid [lb/ft³]
N/A = not applicable

Note: Measurable flow rates for your specific application are available using EMCOSIZE (downloadable at www.spiraxsarco.com/us).

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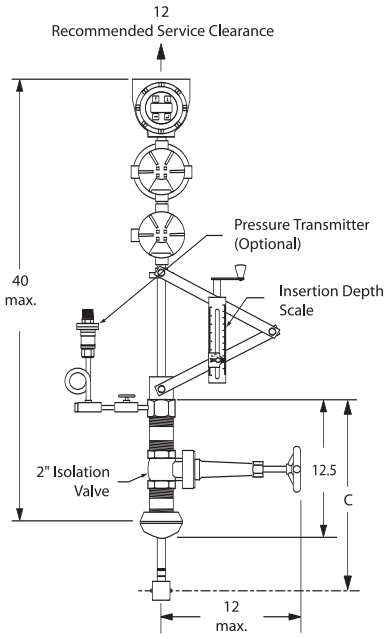
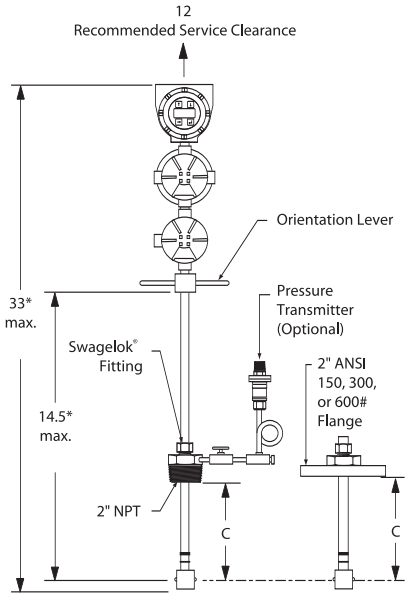
Dimensions and Weights

Dimensions are in inches

S-TMP-600/60S

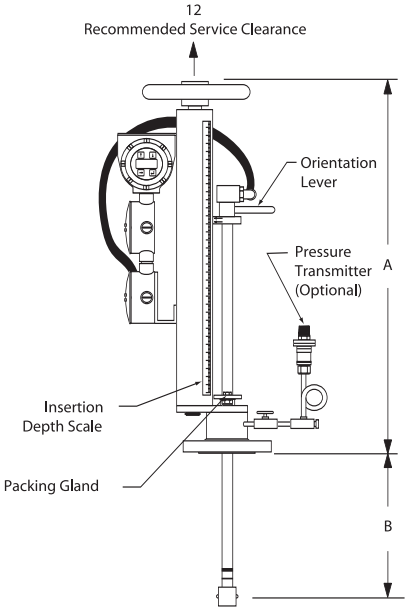


S-TMP-700



* Add 12" for each additional foot of retractor length.

S-TMP-910/960



* Add 12" for each additional foot of retractor length.

Dimensions

Model	Connection	C inches
600/60S	2" NPT	4.5 min 18 max
700	2" NPT	3 min 11.25 max
	2" 150#	3 min 12.75 max
	2" 300#	3 min 12.5 max
	2" 600#	3 min 12.25 max
	2" 900#	3 min 12 max

Weight

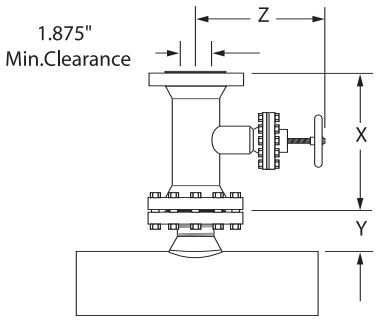
Model	Connection	Weight lb
600/60S	2" NPT	28 max
700[1]	2" NPT	9
	2" 150#	12
	2" 300#	14
	2" 600#	16
	2" 900#	20
910/960[2]	2" 150#	30
	2" 300#	35
	2" 600#	40
	2" 900#	47

1 Add 2.5lb for each additional foot of retractor length.
2 Add 5 lb for each additiona foot of retractor length.

Dimensions

Model	Stem Length	B inches	A inches
910/960	Standard	1.5 min 20 max	30

Gate Valve



Type	X inches	Y inches	Z inches
150#	7	3.5	15.325
300#	8.5	3.75	16.325
600#	11.5	3.75	17.875

Type	Weight lb
2" 150#	46
2" 300#	58
2" 600#	84

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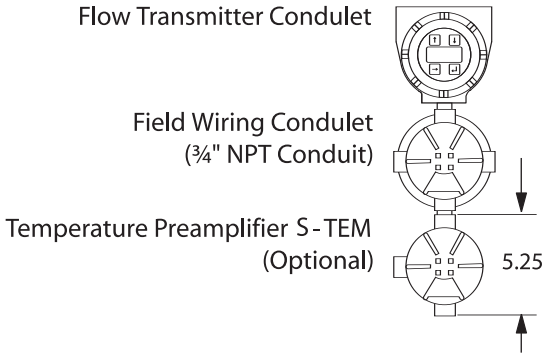
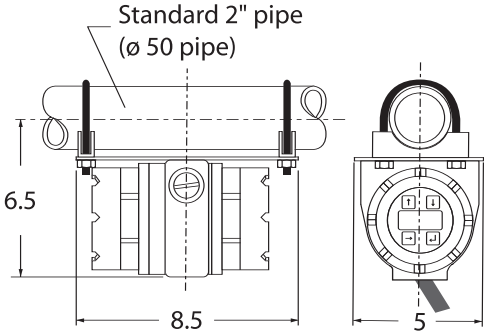
Integral Electronics

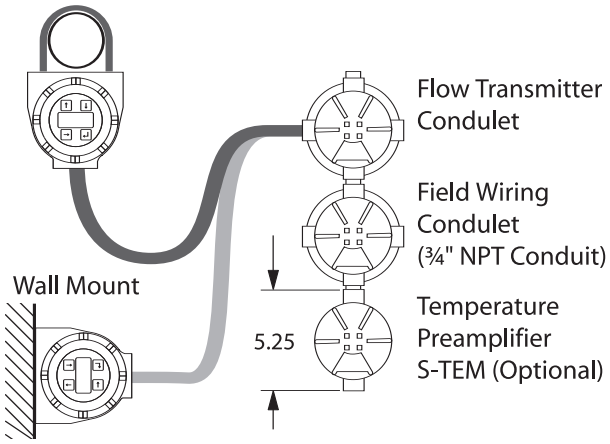


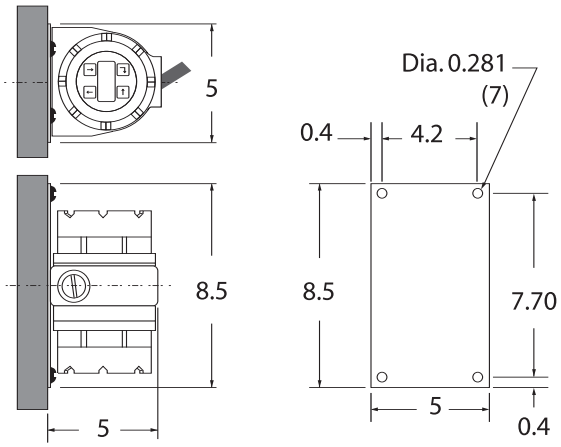
Pipe Mount Remote Electronics



Remote Electronics Configuration

Pipe Mount

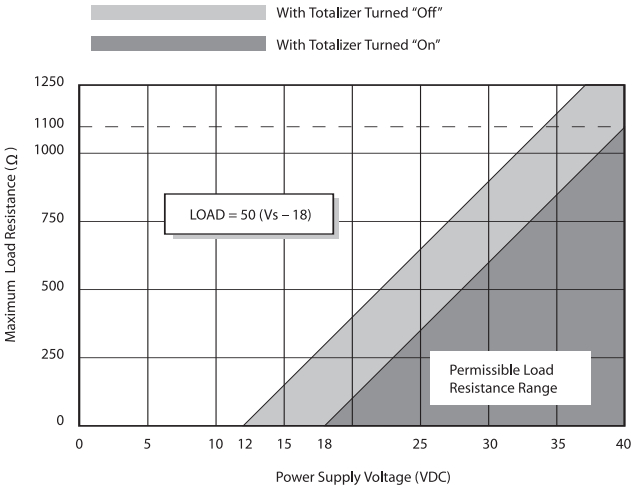


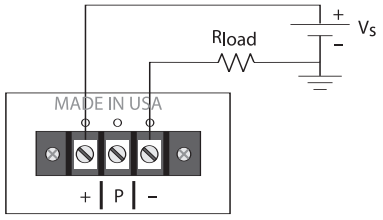


Wiring Diagrams

EZ-Logic Electronics: Analog Output

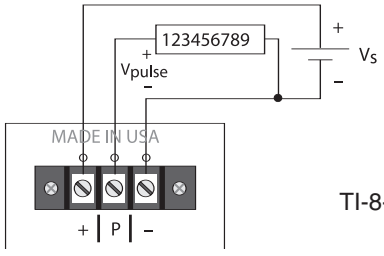
Scalable 4 to 20 mA output, 2-wire principle. Load resistor may be installed on supply or return line. V_s = 18 to 40 VDC. See graph below for permissible R_{load} values.





EZ-Logic Electronics: Pulse Output

3 wire system. Output can be scaled so that 1 pulse indicates a specific quantity of fluid passing through the pipe. V_S = 18 to 40 VDC.



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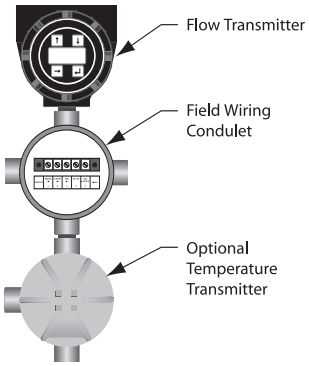
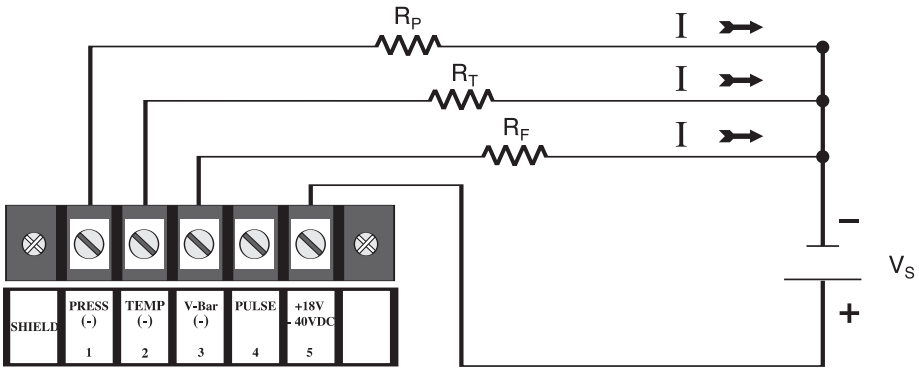
Pressure and Temperature Transmitter Wiring

Remove the field wiring condulet cap to access the field wiring terminal block for power and signal wiring. Flow, pressure, and temperature output wiring connects to the terminal block. Refer to the previous section on 24 VDC power and signal wiring for appropriate load resistance and power supply values. Pressure and temperature transmitters are scaled to the appropriate ranges at the factory.





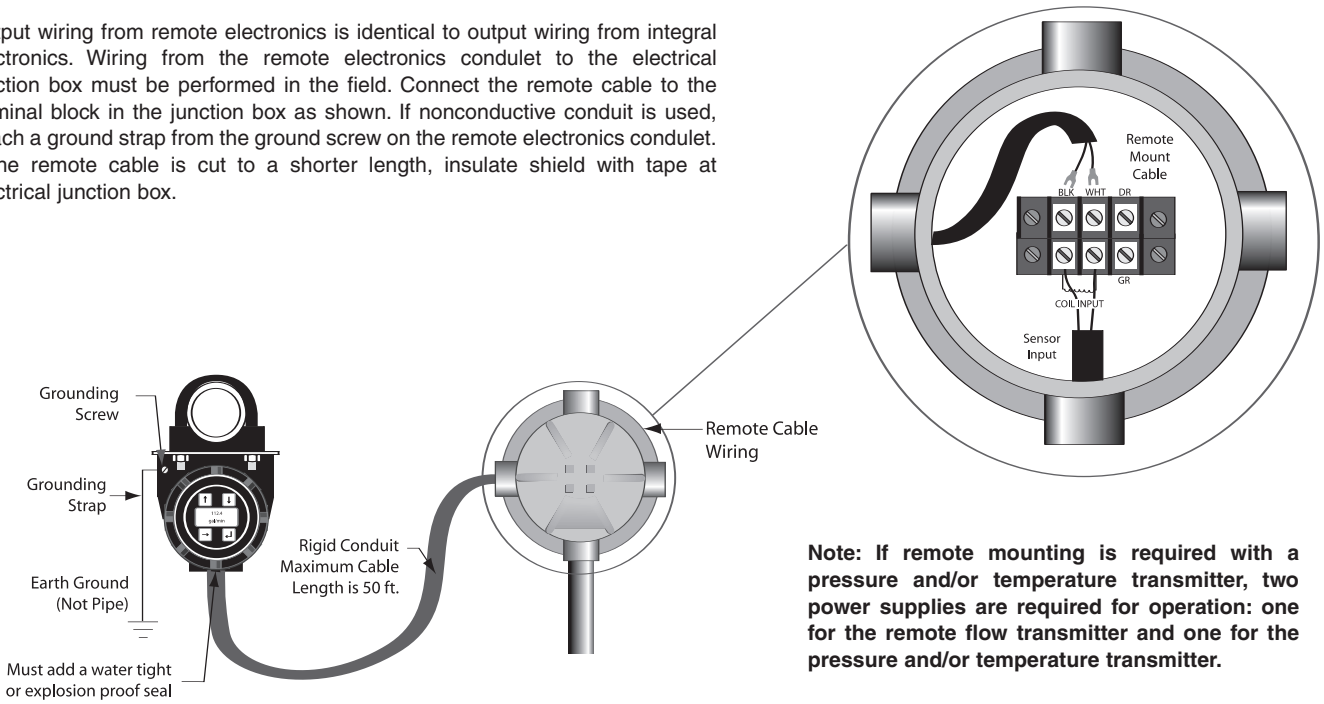
Note: Maximum voltage with optional pressure transmitter is 30 VDC and 110/220 VAC power supply is not available with pressure and/or temperature transmitters.

Wiring with Analog Output

where: V_s = 18 to 30 VDC
R_P = Pressure measuring resistance
R_T = Temperature measuring resistance
R_F = Flow rate measuring resistance

Remote Mount Wiring Diagram (Only Available with EZ-Logic Electronics)

Output wiring from remote electronics is identical to output wiring from integral electronics. Wiring from the remote electronics condulet to the electrical junction box must be performed in the field. Connect the remote cable to the terminal block in the junction box as shown. If nonconductive conduit is used, attach a ground strap from the ground screw on the remote electronics condulet. If the remote cable is cut to a shorter length, insulate shield with tape at electrical junction box.



Note: If remote mounting is required with a pressure and/or temperature transmitter, two power supplies are required for operation: one for the remote flow transmitter and one for the pressure and/or temperature transmitter.

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Category	Suffix Codes							
Model								
Liquid or gas service, 400°F	S-TMP-600							
Steam service, 400°F	S-TMP-60S							
Liquid, gas, or steam service, 600°F	S-TMP-700							
Liquid, gas, or steam service, 400°F	S-TMP-910							
Liquid, gas, or steam service, 750°F	S-TMP-960							
Connection								
2", male NPT (model 700)		2NPT						
2", 150# flange (model 700, 910, 960)		2F150						
2", 300# flange (model 700, 910, 960)		2F300						
2", 600# flange (model 700, 910, 960)		2F600						
2", 900# flange (model 700, 910, 960)		2F900						
2", 1500# flange (model 910, 960)		2F1500						
Thread-o-let, xx = 3 to 80 inches (models 600, 60S) includes 2" isolation valve		VXX						
Rotor								
Liquid, 30 ft/sec maximum (9 m/sec) (40° pitch)			L1					
Gas or steam, 55 ft/sec maximum (40° pitch)			G1					
Gas or steam, 70 ft/sec maximum (30° pitch)			G2					
Gas or steam, 85 ft/sec maximum (20° pitch)			G3					
Gas or steam, 115 ft/sec maximum (15° pitch)			G4					
Gas or steam, 145 ft/sec maximum (10° pitch)			G5					
Gas or steam, 175 ft/sec maximum (5° pitch)[1]			G6					
Electronics								
EZ-Logic with local rate and total[3]				LOC-TOT				
Remote, only available with LOC-TOT option[4]				RMT				
FM Approval[5]				FM				
Pressure Transmitter								
No pressure transmitter					XX			
PT for pressure range 0 to 50 psig (0 to 3.44 barg)					50			
0 to 100 psig (0 to 6.89 barg) (models 600/60S, 700, 910/960)					100			
0 to 150 psig (0 to 10.34 barg) (models 600/60S, 700, 910/960)					150			
0 to 200 psig (0 to 13.79 barg) (models 600/60S, 700, 910/960)					200			
0 to 250 psig (0 to 17.24 barg) (models 700, 910/960)					250			
0 to 500 psig (0 to 34.47 barg) (models 700, 910/960)					500			
0 to 1000 psig (0 to 68.95 barg) (models 700, 910/960)					1000			
Special scaling requests[6]					PXX			
Temperature Sensor or Transmitter								
No temperature transmitter						XXX		
RTD only						RTD		
Temperature sensor with preamplifier scaled from 32 to 68°F[2]						T09		
0 to 250°F[2]						T10		
–40 to 150°F[2]						T11		
212 to 400°F[2]						T12		
212 to 800°F (models 700, 960)[2]						T13		
–17.7 to 121.1°C[2]						T20		
–40 to 65°C[2]						T21		
100 to 204°C[2]						T22		
100 to 260°C (models 700, 910/960)[2]						T23		
Special scaling requests[6, 2]						TXX		
Extended Stem								
None (standard length)							XX	
1' extension (not available for models 600/60S)							E1	
2' extension (gas/steam applications only) (not available for models 600/60S)							E2	
Pick-up Coil Wires								
S-TMP-700 Only: Teflon®, - 200 to 400°F								T
S-TMP-700 Only: Fiberglass, 150 to 600°F								F
	S-TMP-700-	**2F900-**	**G3-**	**LOC-TOT-**	**200-**	**T12-**	**E1-**	**T**

This example represents a liquid, gas, or steam Turbo-Bar S-TMP-700 at 600ºF, 2" 900# flange connection, 85 ft/sec gas or steam rotor, EZ-Logic electronics, 0 to 200 psig pressure transmitter, 212 to 400ºF temperature sensor, 1' extended stem, and Teflon® coil wires.

1 The G6 is the only available 1" shrouded rotor. Not available for use with bidirectional meters.

2 Not available with European CE Mark.

3 Unidirectional only. Unit has 4 to 20 mA and frequency output.

4 Remote mount electronics are required for high process temperatures. The standard remote mount option comes with 30 feet (9.1 meters) of cable.

5 Certified by FM for Class I, Div. 2, Groups A, B, C, & D; Class II,III, Div. 2, Groups F & G; NEMA 4X. FM approval with only LOC-TOT and RMT electronics options. If FM is required, use RTD option only for temperature selection. 0 to 1000 psia and special sealing pressure transmitter not available with FM.

6 Special transmitter scaling is available. Please note scaling range below model code with ordering. If no special scaling is indicated, transmitter will be scaled per model code.

Please specify the following information with your order:

- Fluid type or composition
- Maximum, minimum, & normal operating flow rate
- Maximum, minimum, & normal operating temperatures
- Maximum, minimum, & normal operating pressures
- Specific weight & viscosity at normal operating conditions

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