

**Electronic Remote Temperature Transmitters
General Instructions**

APPLICATION

Electronic remote temperature transmitters are used with integral sensors for Duct, Immersion and Outdoor Air sensing applications for measuring and transmitting temperature readings to the input of an Energy Management System (EMS) or Building Automation System (BAS). The transmitters also have the capability of displaying locally the temperature reading using an optional ASP-500 series indication meter.

SPECIFICATIONS

Sensing Element:

Thin Film Platinum, 1000ohm $\pm 0.1\%$ at 32°F (0°C).

Balco Sensor, 1000 ohm $\pm 1\%$ at 70°F (21°C) used on duct averaging transmitters.

Resistance Change,

Platinum 2.14ohm per °F (3.85ohm per °C).

Balco Sensor 2.2ohm per °F (0.5°C) @ 70°F (21°C).

Construction: Self-contained temperature transmitter employing a platinum sensing element. Duct Averaging models, TSP-84X04 and TSP-85X03, employ Balco sensing element. All models are housed in a sturdy plastic enclosure.

Output Signal: Variable 4-20 mAdc Direct Acting (an increase in sensed temperature produces an increase in output signal).

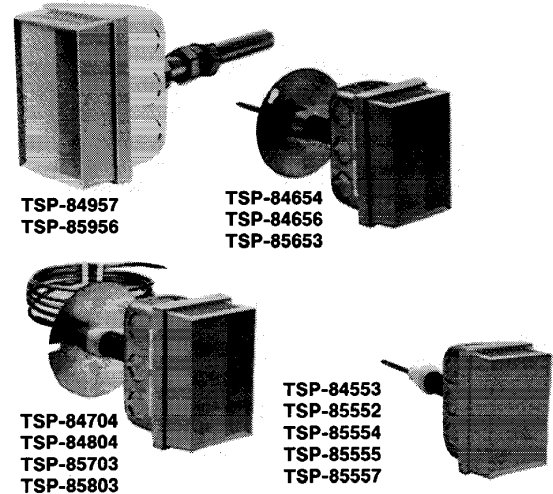
Span, 16 mAdc (non-adjustable).

Maximum Error over Span, $\pm 0.8\%$ of span. ($\pm 1.8\%$ of span for Duct Averaging models.)

Linearity, 0.01% of span.

Table-1 SPECIFICATIONS.

Part Number	Description	Accuracy \pm °F (°C)	Ambient Temperature Operating Limits °F (°C)	Sensor Dimension in. (mm)	Enclosure Dimensions in. (mm) H X W X D
TSP-84553	Chilled Water Immersion	0.4 (0.24)	30 to 80 (-1 to 27)	4" (102 mm)	4-3/8 x 2-7/8 x 3-5/8 (112 x 73 x 92)
TSP-84654	Duct/Immersion	1.6 (1.0)	0 to 200 (-17 to 93)	6" (152 mm)	
TSP-84656			40 to 240 (4 to 116)		
TSP-84704	Duct Averaging	1.8 (1.1)	30 to 130 (-1 to 54)	5' (152 cm)	
TSP-84804				22' (671 cm)	
TSP-84957	Outdoor Air	1.6 (1.0)	-40 to 160 (40 to 71)	4" (102 mm)	
TSP-85552	Immersion	0.8 (0.44)	30 to 130 (-1 to 54)	4" (102 mm)	
TSP-85554		1.68 (0.93)	30 to 240 (-1 to 116)		
TSP-85555		1.2 (0.7)	100 to 250 (38 to 121)		
TSP-85557		2.4 (1.33)	200 to 500 (93 to 260)		
TSP-85653	Duct/Probe	0.8 (0.44)	40 to 140 (4 to 60)	6" (152 mm)	
TSP-85703	Duct Averaging	1.8 (1.1)	40 to 140 (4 to 60)	5' (152 cm)	
TSP-85803				22' (671 cm)	
TSP-85956	Outdoor Air	1.28 (0.71)	-30 to 130 (-35 to 54)	4" (102 mm)	



Note: TSP-8XXXX series transmitters are highly accurate devices. No field calibration is required.

Hysteresis (Deadband), 0%.

Short Circuit Duration, Continuous.

Response Time, 400 microsec. @ full load.

Maximum Current, 30 mAdc, for above range or disconnected sensor.

Power Requirements: 25 mA, 14 to 30 Vdc input varies with selection of load resistor. 25 mA required per transmitter. See EMS/BAS Transmitter Input Power Requirements on page 7.

Environment:

Ambient Temperature Limits,

Shipping and Storage -40° to 140°F (-40 to 60°C).

Operating

Electronic Transmitter Assembly 40° to 140°F (5° to 60°C).

Sensor See Table 1.

Humidity, 5% to 95% RH, non-condensing.

Location, NEMA Type 1 indoor only.

Connections: Coded screw terminals.

Cover: Beige plastic.

Mounting: Mounting procedures are given for each particular style of transmitter on the following pages.

Dimensions: See Table 1.

ACCESSORIES

ASP-500 Series	Analog indication meter
ASP-8301 Series	Power supply
AT-215	Stainless steel bulb well (required with immersion type sensors), 6.25" insertion length
AT-225	Stainless steel bulb well (required with immersion type sensors), 4" insertion length.
M-500	Temperature conductive grease
TOOL-82	Wrench

PRE-INSTALLATION

Inspection

Inspect the carton for damage, if damaged notify the appropriate carrier immediately. Inspect the device for obvious damage. Return damaged products.

Required Installation Items

- Wiring diagrams
- Tools (not provided):
 - Digital MultiMeter (DMM) with 20 mA scale and 0.01 mA accuracy
 - Appropriate screwdriver(s) for mounting screws
 - Appropriate drill and drill bit for mounting screws
- Mounting screws, two (2) provided for securing to a 2 x 4 conduit box
- Diagonal wire cutters and strippers

Caution:

1. Installer must be a qualified, experienced technician.
2. Make all connections in accordance with electrical wiring diagrams, and in compliance with national and local codes. *Use copper conductors only.*
3. NEMA Type 1 covers are intended for indoor use primarily to provide a degree of protection against contact with the enclosed components.

INSTALLATION

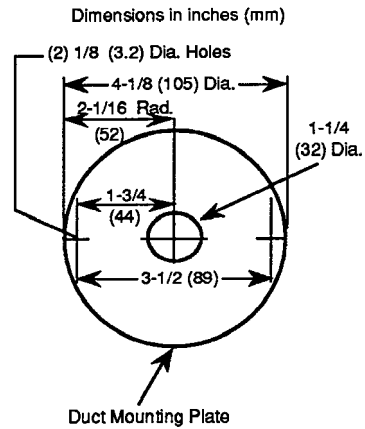


Figure-1 Mounting Plate Dimensions.

Note: The mounting plate is included with TSP-84654, TSP-84656, TSP-84704, TSP-84804, TSP-85653, TSP-85703, and TSP-85803.

TSP-84553, TSP-85552, TSP-85554, TSP-85555 and TSP-85557 Immersion Transmitters (AT-225 Bulb Well required)

See Figure 2.

1. Mount AT-225 bulb well on the liquid line or tank.
2. Thread the enclosure into the AT-225 bulb well.

Note: Fill the AT-225 bulb well with a temperature conductive grease, Part Number M-500, prior to element insertion for optimum medium temperature sensing.

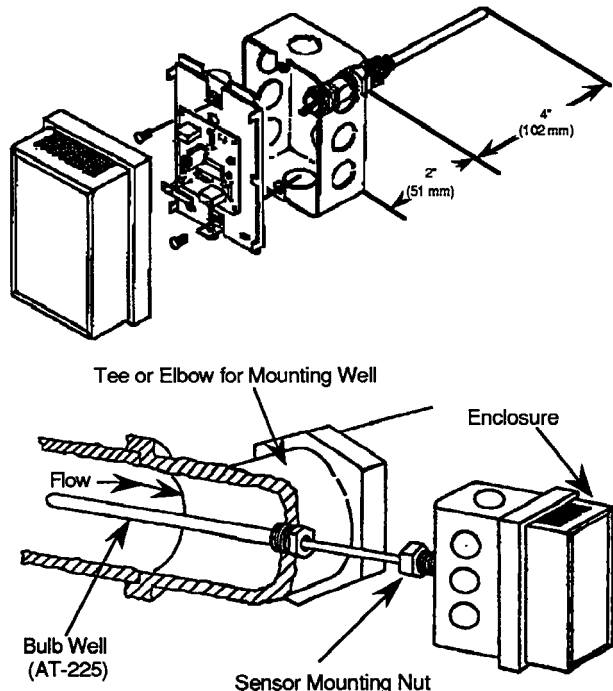


Figure-2 TSP-84553, TSP-85552, TSP-85554, TSP-85555 and TSP-85557 Mounting Diagram.

**TSP-84654, TSP-84656 and TSP-85653
Duct/Immersion and Duct/Probe Transmitters**

See Figure 3.

Duct Mounting

1. Determine the controller enclosure mounting location on the duct. The sensing element is located within 1" of the end of the sensing probe. Locate it in the air stream typical of the temperature requiring sensing.
2. For duct installation, use the mounting plate supplied as a template (Figure 1) for mounting hole location.
3. Mount the enclosure to the duct using the (2) #10 x 3/4" sheet metal screws provided.

Immersion Well Mounting

1. Mount AT-215 bulb well on the liquid line or tank.
2. Remove mounting plate from sensor assembly by removing the conduit nut from the adaptor plug.
3. Thread the enclosure into the AT-215 bulb well.

Note: Fill the AT-215 bulb well with a temperature conductive grease, Part Number M-500, prior to element insertion for optimum medium temperature sensing.

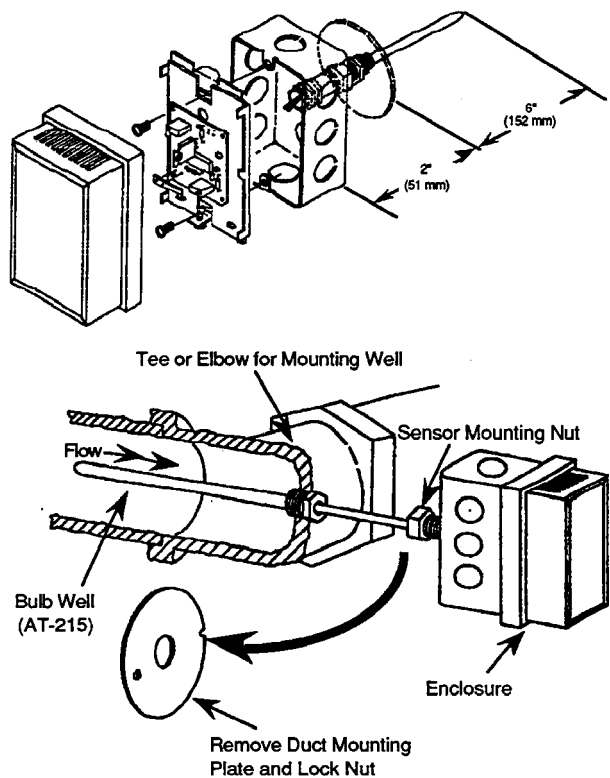


Figure-3 TSP-84654, TSP-84656 and TSP-85653 Mounting Diagram.

**TSP-84704, TSP-84804, TSP-85703 and TSP-85803
Duct Averaging Transmitters**

See Figure 4.

Caution: Do not make sharp bends in the element.

1. Determine the controller enclosure mounting location on the duct. Use the mounting plate supplied as a template (Figure 4) for mounting hole location.
2. Serpentine the sensor through the duct in a pattern that exposes it to all areas where variations of temperature may occur. If duct cannot be entered, securely wrap the element around a section of conduit and place the conduit diagonally in the duct.
3. Mount the enclosure to the duct using the (2) #10 x 3/4" sheet metal screws provided.

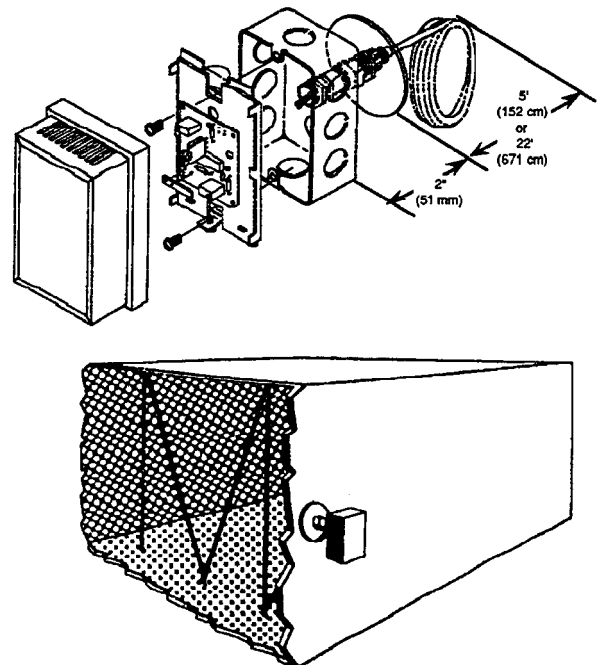


Figure-4 TSP-84704, TSP-84804, TSP-85703 and TSP-85803 Mounting Diagram.

TSP-84957, TSP-85956 Outside Air/Duct Probe Transmitters

See Figure 5.

Duct Mounting

1. Remove the cover and the transmitter base plate.
2. Cut a 1-1/8" diameter hole in the duct.
3. Using the handy box as a template, drill two pilot holes for the selected sheet metal mounting screws.
4. Insert the sensor in the 1-1/8" diameter hole and secure the handy box to the duct with the mounting screws.
5. Replace the transmitter base plate and cover.

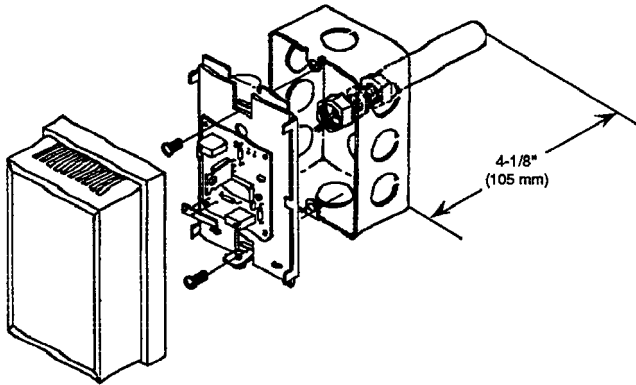


Figure-5 TSP-84957 Mounting Diagram.

Outside Air Mounting

See Figures 6 and 7.

1. Locate the sensor high on the outside wall, shielded from direct sun rays and away from exhaust outlets or other building openings.
2. Bore a 1-1/8" diameter hole through the outside wall.
3. Remove the cover and transmitter base plate.
4. Using the handy box as a template, drill two holes for the mounting screws.
5. Remove the sensor and add sufficient length of EMT to project through the building. Mount the sensor in the outdoor air where the sun is not a factor (Figure 6). Shield sensor from direct sun light.
6. Insert the sensor into the 1-1/8" diameter hole (Figure 7) and secure the handy box to the outside wall using the mounting screws.
7. Replace the transmitter base plate and cover.

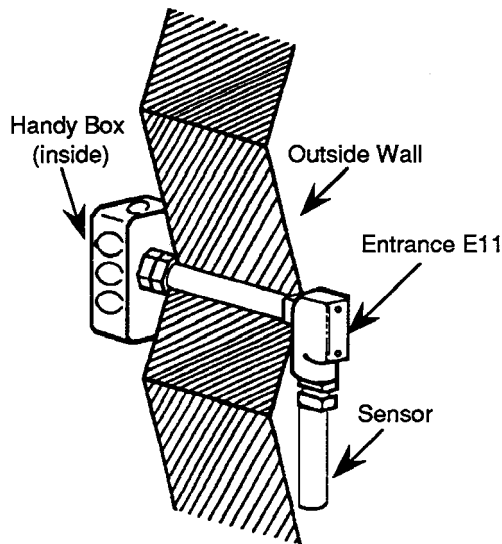


Figure-6 Wall Mounting Diagram.

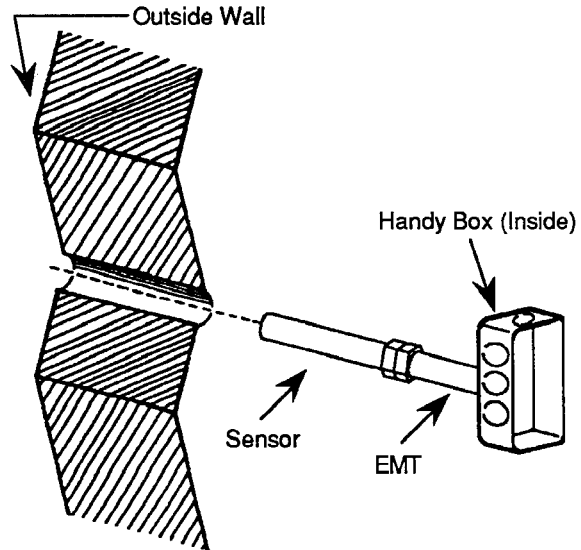


Figure-7 Wall Mounting Diagram.

Wiring

Restrict wiring leads to shortest length practical.

Table-2 Recommended Transmitter Wiring Lengths*

Wire Gage	Length of Run - ft. (m)
	Total Wiring in Loop
22	150 (46)
18	1000 (305)
16	2250 (686)
14	4000 (1219)

*Based on using a 250 or 500 ohm load resistor (and includes minimum 100K ohm control device input impedance).

Make all electrical connections in accordance with job wiring diagrams and in compliance with national and local electric codes. No. 18 multi-conductor thermostat cable may be used. Wire should be twisted with minimum of six (6) turns per foot. *Use copper conductors only.*

Caution:

Do not use the unshielded transmitter cable in the same conduit with 120/240 Vac power wiring or in areas with high RFI/EMI generating devices.

Shielded cable must be used when it is necessary to install the transmitter leads in the same conduit with power wiring or when it is known that high RFI/EMI generating devices are near. Ground the shield according to the controller or controlled device manufacturer's specification.

Do not use inside of the transmitter cover or junction box as a termination location for other control circuits.

1. Using TOOL-82, loosen the cover screw on the bottom of the transmitter to remove the cover.
2. Pull all wires to the electrical box.

3. Strip 1/4" (6 mm) of insulation from end of wires and connect to the (+) and (-) coded screw terminals on back of base plate. (Typical Schematic, Figure 9.)
4. Using the two (2) #6-32 flat head screws provided, mount the transmitter base assembly to the electrical box. Make sure all wires are within the electrical box before tightening the mounting screws.
5. Replace the cover and tighten the cover screw on the bottom of the cover.

CHECKOUT

1. Refer to the wiring diagram (Figure 8) and make certain that polarity of wiring is correct.
2. Apply power to the transmitter.
3. Measure the supply voltage with a digital multimeter at the power supply (+) and (-) output terminals. Make certain the measured voltage is within the Operating Region specified in Figure 9.
4. Connect a milliamp meter in the control loop (Figure 8). The output signal must be between 4 and 20 mAdc.

Note: This is a function check only. The TSP transmitters are highly accurate devices. Laboratory quality meters (0.001 mA accuracy) and temperature sensors (± 0.01 °F) are required to properly check temperature transmitter accuracy.

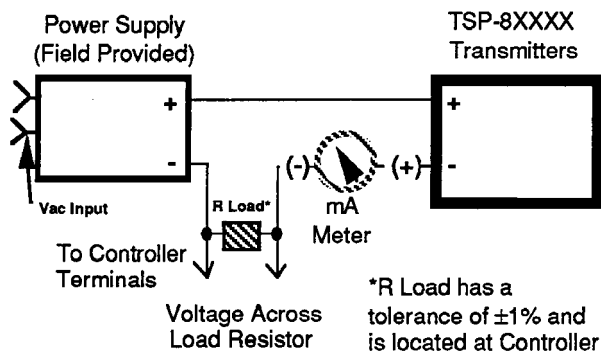


Figure-8 Checkout of TSP-8XXXX Series Transmitters.

5. Replace the transmitter with a functioning unit if the current measured in step 4 is not between 4 and 20 mA.

MAINTENANCE

Regular maintenance of the total system is needed to assure sustained optimum performance. Transmitter should be periodically inspected for dirt or blockage of air over or through the unit.

FIELD REPAIR

No field repair is possible. Replace transmitter with a functioning unit.

TRANSMITTER INPUT POWER REQUIREMENTS FOR USE WITH EMS/BAS CONTROLLERS

TSP-8XXXX Series Transmitter Power Supply Requirements

TSP-8XXXX series transmitters require a minimum Vdc power supply for proper operation. To determine the minimum Vdc supply required, the total load resistance (closed loop) connected to the two TSP-8XXXX Series transmitter terminals must be known. The closed loop load resistance is the series sum of the load resistor used, wire resistance connecting the transmitter to the EMS/BAS or controller and any indicating devices (analog and/or digital) input resistance. The minimum Vdc supply for the TSP-8XXXX series transmitter is determined from the following relationship.

Minimum Vdc Supply = 0.02 A (Transmitter Closed Loop Resistance) + 11.6 Vdc

EXAMPLE: Load resistor of 250 ohms, wire resistance of control loop of 50 ohms and 100 ohm input resistance to a digital indicator.

$$\text{Total closed loop resistance} = 250 \text{ ohms} + 50 \text{ ohms} + 100 \text{ ohms} = 400 \text{ ohms}$$

$$\text{Minimum Vdc Supply} = 0.02 \text{ A (Transmitter Closed Loop Load Resistance)} + 11.6 \text{ Vdc}$$

$$= 0.02\text{A (400 ohms)} + 11.6 \text{ Vdc}$$

$$= 19.6 \text{ Vdc}$$

A minimum of 19.6 Vdc power supply required for a 400 ohm closed loop load. A power supply greater than 19.6 Vdc permissible (maximum of 30 Vdc) for use with the TSP-8XXXX series transmitter and a closed loop load of 400 ohms.

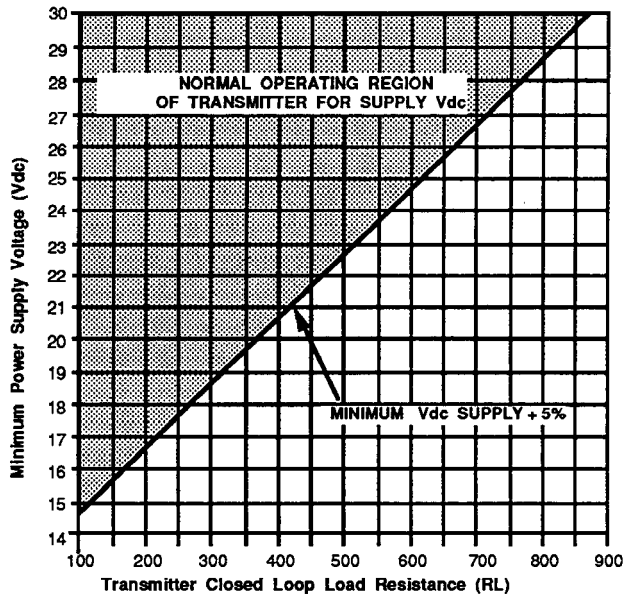


Figure-9 Transmitter Load Resistance VS Minimum Vdc Power Supply Requirements.

The use of the TSP-8XXXX series transmitters with EMS/BAS controls and TAC SYSTEM 8000 has been simplified and refined from the number of combinations of loads and Vdc power supplies possible. In general a $20.0 \pm 5\%$ Vdc regulated power supply and a 250 ohm load resistor are used with TAC SYSTEM 8000. In general a $24.0 \pm 5\%$ Vdc regulated power supply and a 500 ohm load resistor are used with EMS/BAS controls.

Referring to Figure 9 it can be seen that a 250 ohm transmitter load resistor and a 20 Vdc regulated supply places the TSP-8XXXX series transmitters in the normal operating range. Also Figure 9 reveals that an additional 120 ohms in series with the closed loop of the transmitter system is permissible (for wire resistance, indicating devices, etc.). Figure 9 can be read as follows: 250 ohm (RL) line to the 20 (Vdc) line across to Minimum Vdc Supply +5% line down to the (RL) line equals 370 ohms minus 250 ohm transmitter load resistor equals 120 ohms available for additional series resistance in the transmitter closed loop. Once again, referring to Figure 9, it can be seen that a 500 ohm transmitter load resistor and a 24 Vdc regulated supply places the TSP-8XXXX Series transmitter in the normal operating range. Also revealed, an additional 70 ohms (570 minus 500) in series within the closed loop of the transmitter is permissible for wire resistance, indicating devices, etc.

Transmitter Minimum Current Input Requirements

A minimum of 25 mA must be available at each transmitter.

POWER SUPPLY SELECTION

ASP-8301-XXX Power Supplies

The ASP-8301-XXX power supply has a field selectable 24 Vdc output for EMS/BAS applications. Power supply is UL listed and CSA certified. Output connections are short circuit protected.

Table-3 ASP-8301-XXX Power Supplies for TSP-8XXXX Transmitters.

Part Number	Input Vac	mA Available
ASP-8301-120	120	150
ASP-8301-240	240	150

Comments:

1. Use 24 Vdc power supply.
2. 25 mA is required for each transmitter.

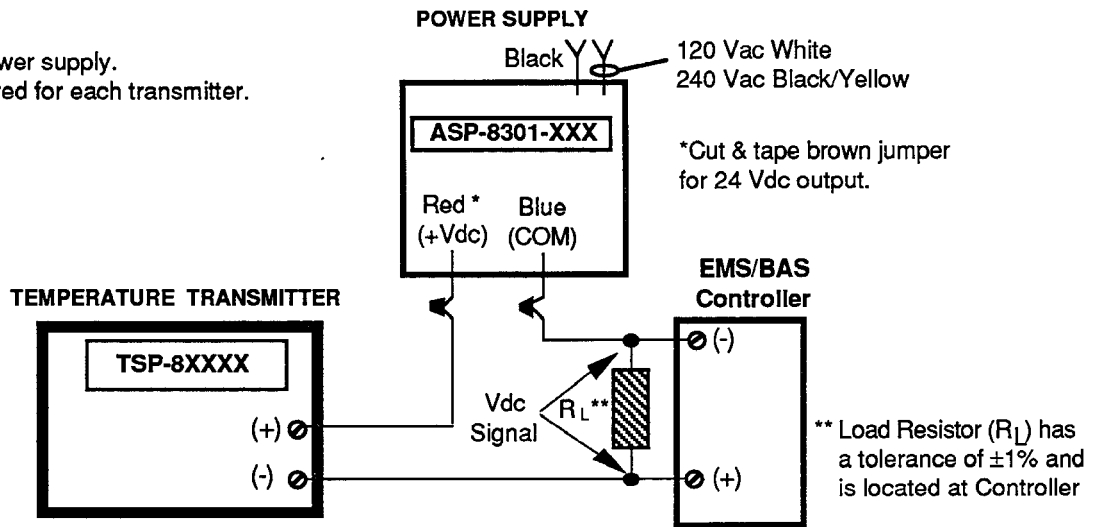


Figure-10 Typical Wiring for TSP-8XXXX Transmitters.

Table-4 Output Signals vs. °F from TSP-84XXX Transmitter used with EMS/BAS Systems.

SIGNALS	°F as Sensed by TSP-84XXX Temperature Transmitter										
	4.00	5.60	7.20	8.80	10.40	12.00	13.60	15.20	16.80	18.40	20.00
Transmitter mA Output	4.00	5.60	7.20	8.80	10.40	12.00	13.60	15.20	16.80	18.40	20.00
TSP-84553 (30 to 80°F)	30	35	40	45	50	55	60	65	70	75	80
TSP-84654 (0 to 200°F)	0	20	40	60	80	100	120	140	160	180	200
TSP-84656 (40 to 240°F)	40	60	80	100	120	140	160	180	200	220	240
TSP-84704 (30 to 130°F)	30	40	50	60	70	80	90	100	110	120	130
TSP-84804 (30 to 130°F)	30	40	50	60	70	80	90	100	110	120	130
TSP-84957 (-40 to 160°F)	-40	-20	0	20	40	60	80	100	120	140	160

Table-5 TRANSMITTER mA OUTPUT VS. VOLTAGE ACROSS SELECTED LOAD RESISTORS.

Transmitter mA Output	4.00	5.60	7.20	8.80	10.40	12.00	13.60	15.20	16.80	18.40	20.00
Vdc Across 250 ohm Resistor	1.00	1.40	1.80	2.20	2.60	3.00	3.40	3.80	4.20	4.60	5.00
Vdc Across 500 ohm Resistor	2.00	2.80	3.60	4.40	5.20	6.00	6.80	7.60	8.40	9.20	10.00

Table-6 OUTPUT SIGNALS VS. °F FROM TSP-85XXX TRANSMITTER USED WITH EMS/BAS SYSTEMS.

SIGNALS	°F as Sensed by TSP-85XXX Temperature Transmitter										
	4.00	5.60	7.20	8.80	10.40	12.00	13.60	15.20	16.80	18.40	20.00
Transmitter mA Output	4.00	5.60	7.20	8.80	10.40	12.00	13.60	15.20	16.80	18.40	20.00
TSP-85552 (30 to 130°F)	30	40	50	60	70	80	90	100	110	120	130
TSP-85554 (30 to 240°F)	30	51	72	93	114	135	156	177	198	219	240
TSP-85555 (100 to 250°F)	100	115	130	145	160	175	190	205	220	235	250
TSP-85557 (200 to 500°F)	200	230	260	290	320	350	380	410	440	470	500
TSP-85703 (40 to 140°F)	40	50	60	70	80	90	100	110	120	130	140
TSP-85803 (40 to 140°F)	40	50	60	70	80	90	100	110	120	130	140
TSP-85653 (40 to 140°F)	40	50	60	70	80	90	100	110	120	130	140
TSP-85956 (-30 to 130°F)	-30	-14	2	18	34	50	66	81	97	113	130

Table-7 TRANSMITTER mA OUTPUT VS. VOLTAGE ACROSS SELECTED LOAD RESISTORS.

Transmitter mA Output	4.00	5.60	7.20	8.80	10.40	12.00	13.60	15.20	16.80	18.40	20.00
Vdc Across 250 ohm Resistor	1.00	1.40	1.80	2.20	2.60	3.00	3.40	3.80	4.20	4.60	5.00
Vdc Across 500 ohm Resistor	2.00	2.80	3.60	4.40	5.20	6.00	6.80	7.60	8.40	9.20	10.00

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