



Ω OMEGA™ User's Guide



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**TX91A
(J, K, T, E) 4-20 mA
Mini Temperature Transmitter**



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SECTION 1 GETTING STARTED

1.1 Unpacking

Remove the packing list and verify that you have received all equipment. If you have any questions, contact the nearest Customer Service Department, as listed on the cover of this manual.

Upon receipt of shipment, inspect the container and equipment for any signs of damage. Note any evidence of rough handling in transit. Immediately report any damage to the shipping agent.

Note: The carrier will not honor any claims unless all shipping material is saved for their examination. After examining and removing contents, save packing materials and carton in the event reshipment is necessary.

1.2 Safety and EMC Considerations

This instrument is a Class III device (8 to 50 Vdc).

Always use a power supply, which complies with EN 60950 safety standard.

- Do not expose the transmitter to rain or condensing moisture.
- Do not operate the transmitter in flammable or explosive atmosphere.
- As with any electronic instrument, you may encounter high voltage exposure when installing, calibrating or removing parts of the transmitter.

EMC Considerations

- Whenever EMC is an issue, always use shielded cables.
- Never run signal and power wires in the same conduit.
- Use signal wire connections with twisted-pair cables.
- Install Ferrite Bead(s) on signal wires close to the instrument if EMC problems persist.

Failure to follow all instructions and warnings may result in injury!

1.3 General Description

The TX91A Series transmitter accepts thermocouple sensor types J, K, T, and E and will produce a standard 4-20 mA output signal proportional to that produced by its attached thermocouple millivolt input. The transmitter does NOT provide isolation between its input and the 4-20 mA output; therefore, an ungrounded thermocouple junction is suggested to prevent possible ground loops.

The transmitter provides cold reference junction compensation for the thermocouple types as well as amplification, common-mode rejection and controlling the current drawn from an 8-to-50 Vdc source to produce the 4-to-20 mA output signal. As much as 800 ohms dropping resistance may be used in the power leads of the TX91A when the unit is energized from a 24 Vdc source because of the small compliance voltage needed by the unit.

1.4 Available Ranges

As specified in Table 1-1, the transmitter has 10 ranges. Depending upon the range, the transmitter can measure temperature span as narrow as 160°F or as wide as 1000°F. A multi-turn, top-accessible potentiometer provides fine span tuning. A second top-accessible, multi-turn potentiometer provides a zero adjustment which allows placement of the 4-mA output temperature within +/- 25% for Fahrenheit and +/- 10% for Celsius of nominal span (refer to Section 3.0, Calibrating the Transmitter, for more details).

Table 1-1. Range/Models

Range	Model			
0 to 200°F	J2	K2	T2	E2
0 to 300°F	J3	K3	T3	E3
0 to 500°F	J4	K4	T4	E4
0 to 750°F	J5	K5	T5	E5
0 to 1000°F	J6	K6	N/A	E6
-0 to 100°C	J7	K7	T7	E7
-0 to 150°C	J8	K8	T8	E8
-0 to 250°C	J9	K9	T9	E9
-0 to 400°C	J10	K10	T10	E10
-0 to 500°C	J11	K11	N/A	E11

1.5 Ordering Guide

The model number describes the functionality of the transmitter.

	Model	Temperature Range	
TX91A-	J		
	K		
	T*		
	E		
		2	-0 to 200°F
		3	-0 to 300°F
		4	-0 to 500°F
		5	-0 to 750°F
		6	-0 to 1000°F
		7	-0 to 100°C
		8	-0 to 150°C
		9	-0 to 250°C
		10	-0 to 400°C
		11	-0 to 500°C
		OPTION:	
	FS**	Factory Scaling	

* 0 to 1000°F (0 to 500°C) is not available for type T thermocouple.

**Factory Scaling available for additional charge. Consult factory.

To order additional transmitters, write TX91A followed by the model letter and number.
For example:

TX91A-J3 = Transmitter with thermocouple type J and a temperature range of -0 to 300°F.

TX91A-E9 = Transmitter with thermocouple type E and a temperature range of -0 to 250°C.

1.6 Shock Resistance

Lightweight TX91A transmitter circuit boards are fabricated from rigid, shock resistant materials with the components soldered to the circuit board.

The TX91A transmitter's small size permits mounting into thermowells or wall mounting in confined areas.

SECTION 2 CONNECTING POWER AND SIGNAL INPUTS

- Verify that the transmitter is connected for the correct power voltage rating.
- The transmitter has no power on switch, so it will be in operation as soon as you apply power.

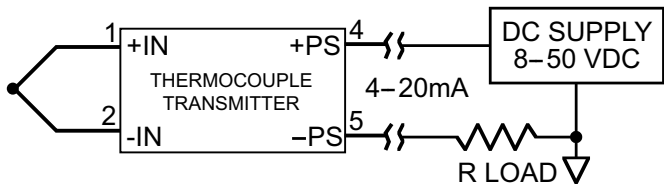


Figure 2-1 Power Input Setup

+PS and -PS screws accept 2mm (13 gauge) or lighter wire. Input range is 8-50 Vdc.

SECTION 2 CONNECTING POWER AND SIGNAL INPUTS (continued)

Table 2-1. Screw-Terminal Pin Assignment

1	+ Thermocouple
2	- Thermocouple
3*	Earth Ground
4	+Power/Signal Output
5	-Power/Signal Output

Note ENR

* For improved EMC performance, connect Pin 3 to Earth Ground.

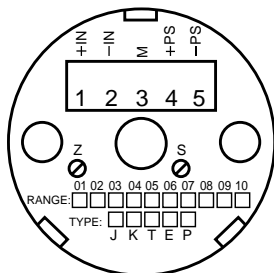


Figure 2-2 Pin Assignment

3.0 CALIBRATING THE TRANSMITTER

Calibration Setup:

To prepare the ice bath:

1. Fill a glass beaker with crushed ice made from distilled water.
2. Fill the beaker with enough distilled water so that the ice bath just becomes slush, but not enough to float the ice.
3. Insert the reference thermocouple.

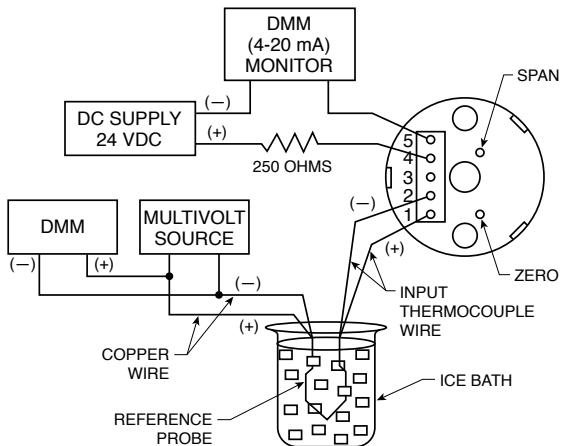


Figure 3-1. Calibration Setup using a Millivolt Source

3.0 CALIBRATING THE TRANSMITTER (Continued)

To calibrate the transmitter, follow these steps (refer to Figure 3-1):

1. Locate the model number in Table 3-1 or 3-2 and set the millivolt source to the LO-IN value.
2. Adjust the Zero potentiometer until the milliammeter reads 4.00 mA.
3. Set the millivolt source to the HI-IN value (in your appropriate table) and read the output current on the milliammeter. This current level is designated Initial Top Current (ITC), normally not equal to 20.00mA.
4. Calculate the Corrected Top Current (CTC) using the following equation (generally this will not equal 20.00mA):

$$CTC = 16 \times ITC / (ITC - 4 \text{ mA})$$

5. Adjust the Span potentiometer to obtain the CTC on the milliammeter.
6. Now re-adjust the Zero potentiometer so that the milliammeter reads 20.00 mA.
7. Set the millivolt source to LO-IN millivolts. If the output current is not 4.00 mA, repeat steps 2 through 7.
6. When calibration is complete, remove the transmitter from the setup.

An thermocouple calibrator may be used in place of the millivolt source - refer to Figure 3-2.

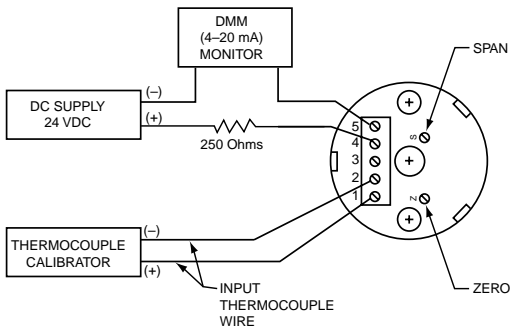


Figure 3-2. Calibration using a Thermocouple Simulator

3.0 CALIBRATING THE TRANSMITTER (Continued)

Table 3-1. Fahrenheit Temperature to Millivolt Conversion Chart

Value	Model Number/Range				
TX91A-	J2	J3	J4	J5	J6
	(0 to 200°F)	(0 to 300°F)	(0 to 500°F)	(0 to 750°F)	(0 to 1000°F)
LO IN	-0.885	-0.885	-0.885	-0.885	-0.885
HI IN	4.906	7.947	14.108	21.785	29.515
TX91A-	K2	K3	K4	K5	K6
	(0 to 200°F)	(0 to 300°F)	(0 to 500°F)	(0 to 750°F)	(0 to 1000°F)
LO IN	-0.692	- 0.692	- 0.692	- 0.692	- 0.692
HI IN	3.819	6.092	10.560	16.349	22.251
TX91A-	T2	T3	T4	T5	-
	(0 to 200°F)	(0 to 300°F)	(0 to 500°F)	(0 to 750°F)	-
LO IN	-0.674	- 0.674	- 0.674	- 0.674	-
HI IN	3.967	6.647	12.572	20.801	-
TX91A-	E2	E3	E4	E5	E6
	(0 to 200°F)	(0 to 300°F)	(0 to 500°F)	(0 to 750°F)	(0 to 1000°F)
LO IN	-1.026	- 1.026	- 1.026	- 1.026	- 1.026
HI IN	5.869	9.708	17.942	28.854	40.056

3.0 CALIBRATING THE TRANSMITTER (Continued)

Table 3-2. Celsius Temperature to Millivolt Conversion Chart

Value	Model Number/Range				
TX91A-	J7	J8	J9	J10	J11
	(0 to 100°C)	(0 to 150°C)	(0 to 250°C)	(0 to 400°C)	(0 to 500°C)
LO IN	0.000	0.000	0.000	0.000	0.000
HI IN	5.268	8.008	13.553	21.846	27.388
TX91A-	K7	K8	K9	K10	K11
	(0 to 100°C)	(0 to 150°C)	(0 to 250°C)	(0 to 400°C)	(0 to 500°C)
LO IN	0.000	0.000	0.000	0.000	0.000
HI IN	4.095	6.137	10.151	16.395	20.640
TX91A-	T7	T8	T9	T10	-
	(0 to 100°C)	(0 to 150°C)	(0 to 250°C)	(0 to 400°C)	-
LO IN	0.000	0.000	0.000	0.000	
HI IN	4.277	6.702	12.011	20.869	-
TX91A-	E7	E8	E9	E10	E11
	(0 to 100°C)	(0 to 150°C)	(0 to 250°C)	(0 to 400°C)	(0 to 500°C)
LO IN	0.000	0.000	0.000	0.000	0.000
HI IN	6.317	9.787	17.178	28.943	36.999

4.0 SPECIFICATIONS

INPUT

Configuration:	Non-isolated thermocouple input
Thermocouple types:	J, K, T, or E
Thermocouple current:	1 μ A max
Burnout indication:	Upscale over-range indication, 40 mA max.
Thermocouple lead resistance:	to 500 ohms for specified performance

OUTPUT

Linear range:	4 to 20 mAdc
Current Output limits:	<2 to >40 mA (open TC)
Compliance (supply-voltage):	8 to 50 Vdc
Reverse polarity protection:	350 V peak
Maximum loop resistance:	(Supply Voltage - 8V)/20 mA

ACCURACY

Hysteresis and repeatability:	Within $\pm 0.1\%$ of FS
Linearity with respect to input:	$\pm 0.1\%$ of FS
Power supply effect:	Within $\pm 0.01\%/V$
Temperature effect:	Zero and Span: Within $\pm 0.1\%$ FS/ $^{\circ}$ F

ENVIRONMENTAL

Operating temperature:	-40 to 185 $^{\circ}$ F (-40 to 85 $^{\circ}$ C)
Storage temperature:	-50 to 250 $^{\circ}$ F (-45 to 121 $^{\circ}$ C)
Humidity:	To 90% (non-condensing)

MECHANICAL

Weight:	less than 1.2 oz (34g)
Diameter:	1.75 in (44.34 mm)
Height (including barriers):	1.25 in (31.75 mm)

4.0 SPECIFICATIONS (Continued)

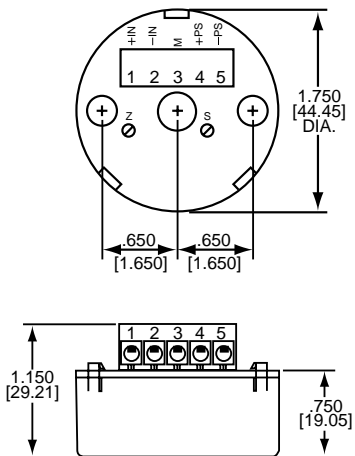


Figure 4-1. Case Dimensions

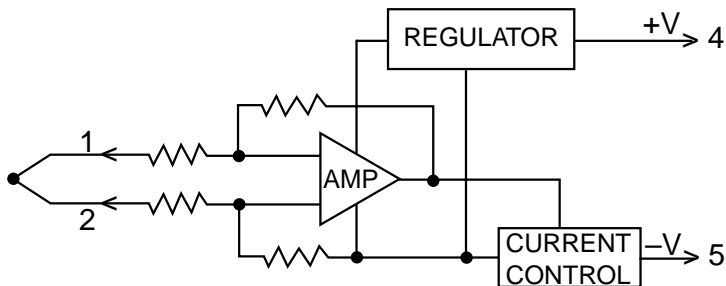


Figure 4-2. Transmitter Block Diagram

- NOTES -

WARRANTY/DISCLAIMER

OMEGA ENGINEERING, INC. warrants this unit to be free of defects in materials and workmanship for a period of **61 months** from date of purchase. OMEGA's WARRANTY adds an additional one (1) month grace period to the normal **five (5) year product warranty** to cover handling and shipping time. This ensures that OMEGA's customers receive maximum coverage on each product.

If the unit malfunctions, it must be returned to the factory for evaluation. OMEGA's Customer Service Department will issue an Authorized Return (AR) number immediately upon phone or written request. Upon examination by OMEGA, if the unit is found to be defective, it will be repaired or replaced at no charge. OMEGA's WARRANTY does not apply to defects resulting from any action of the purchaser, including but not limited to mishandling, improper interfacing, operation outside of design limits, improper repair, or unauthorized modification. This WARRANTY is VOID if the unit shows evidence of having been tampered with or shows evidence of having been damaged as a result of excessive corrosion; or current, heat, moisture or vibration; improper specification; misapplication; misuse or other operating conditions outside of OMEGA's control. Components in which wear is not warranted, include but are not limited to contact points, fuses, and triacs.

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RETURN REQUESTS/INQUIRIES

Direct all warranty and repair requests/inquiries to the OMEGA Customer Service Department. BEFORE RETURNING ANY PRODUCT(S) TO OMEGA, PURCHASER MUST OBTAIN AN AUTHORIZED RETURN (AR) NUMBER FROM OMEGA'S CUSTOMER SERVICE DEPARTMENT (IN ORDER TO AVOID PROCESSING DELAYS). The assigned AR number should then be marked on the outside of the return package and on any correspondence.

The purchaser is responsible for shipping charges, freight, insurance and proper packaging to prevent breakage in transit.

FOR **WARRANTY** RETURNS, please have the following information available BEFORE contacting OMEGA:

1. Purchase Order number under which the product was PURCHASED,
2. Model and serial number of the product under warranty, and
3. Repair instructions and/or specific problems relative to the product.

FOR **NON-WARRANTY** REPAIRS, consult OMEGA for current repair charges. Have the following information available BEFORE contacting OMEGA:

1. Purchase Order number to cover the COST of the repair,
2. Model and serial number of the product, and
3. Repair instructions and/or specific problems relative to the product.

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