TX93
Thermocouple Two-Wire Temperature Transmitter

User's Guide

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Unpacking Instructions

Remove the Packing List and verify that you have received all equipment, including:

- TX93 Termocouple Two-Wire Temperature Transmitter
- Operator's Manual

If you have any questions about the shipment, please call the Customer Service Department.

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

NOTE

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1 Introduction

1.1 General Description

The OMEGA® TX93 Thermocouple Two-Wire Temperature Transmitter accepts thermocouple sensor types J, K, T, or E and will produce a standard 4-20 mA output signal proportional to that produced by its attached input temperature sensor. Transmission of the proportional current output may be accomplished by using inexpensive copper wire.

Figure 1-1 TX93 Transmitter

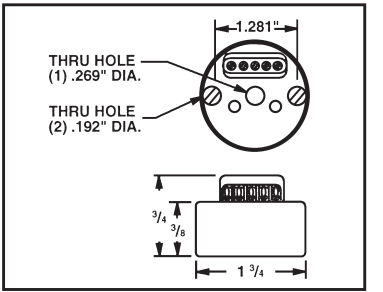


Figure 1-2 Dimensions (in inches)

The TX93 transmitter is normally powered by an unregulated power supply as shown in Figure 1-3. The proportionally-transmitted signal begins at 4 mA, at the low end of its temperature range, and increases to 20 mA, at the high end of its temperature range. (There are various temperature ranges thermocouple types available for the TX93. To order, refer to Section 1.3 for correct Model Numbers and Range Codes.)

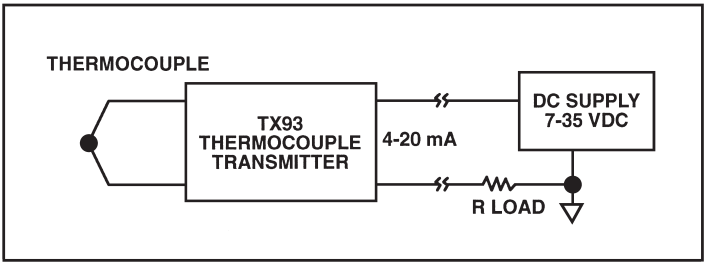


Figure 1-3 TX93 Thermocouple Transmitter

The TX93 two-wire transmitter receives and measures signals from thermocouples and sends an output current of 4-20 mA which is directly proportional to the thermocouple millivolt input. It is designed to connect with only two copper wire leads that will supply the voltage to operate the transmitter from a power supply, and also carry the output current. The output current is used for recording, computing, or controlling.

If the TX93 is mounted inside a protection head, (see Figure 3-1), the thermocouple extension wires are replaced by two copper wires that carry the 4-20 mA signal and dc voltage to operate the transmitter.

The TX93 has reverse supply polarity protection and will operate with a wide range of supply voltages (7 to 35 Vdc). It has an input sensor break-protection circuit that forces the output current to go upscale when the thermocouple wire opens. It also is provided with a screw terminal, where the output current can be measured without interrupting the power loop. The TX93 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. Note that most thermocouple transmitters with 4-20 mA outputs, including the TX93, are proportional with respect to the thermocouple input voltage. However, the relationship between temperature and millivolt for all the thermocouple types is somewhat non-linear.

This leads to maximum error at approximately the midpoint of the range as shown in Figure 1-4.

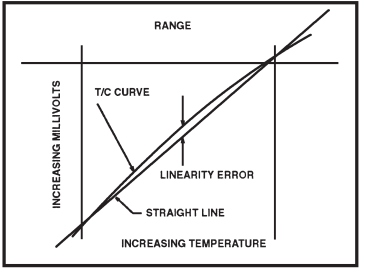


Figure 1-4 Straight Line Approximation of a Curve

1.2 Features

- 4-20 mA output
- ±0.1% full-scale accuracy (with respect to the mV input signal)
- Upscale break protection
- Low Cost

1.3 Models Available

Table 1-1. Range Code

RANGE	INPUT TYPES J	K	T	E
-40 to 120˚F	J1	–	–	E1
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	–	E6

TX93 Models Available

Model Number	Description
TX93-(*)	Thermocouple Transmitter (J, K, T, or E)
NB1TX93-(*)	NB1 thermocouple probe, 12" L, 1/4" O.D., ungrounded junction, 304SS sheath

*Insert range code from Table 1-1

For complete information on NB1 Thermocouple probes, see the OMEGA Temperature Measurement Handbook®.

2 Installation

3.1 Mounting the TX93

The TX93 transmitter may be:

1. surface mounted,
2. mounted inside a protection head (refer to Figure 2-1), or
3. installed into the OMEGA mounting track (part number RT) using an OMEGA mounting bracket (part number TX90-BR).
4. installed into standard 35mm DIN rail using an OMEGA DIN rail mounting adapter (part number TX-90-DIN).

Figure 2-2 shows the RT mounting track. Figure 2-3 shows the TX90-BR mounting bracket.

Figure 2-4 shows a typical installation using the bracket and mounting track. Figure 2-5 shows the TX90-DIN adapter.

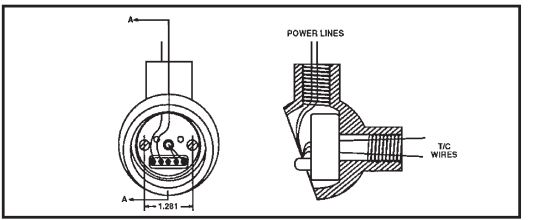
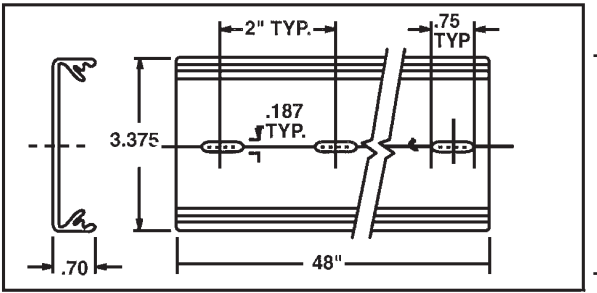


Figure 2-1 Assembly of the Transmitter inside an OMEGA NB1 Protection Head (Dimensions in inches)



CAUTION

Hand tighten transmitter mounting screws only. Do not overtighten.

Figure 2-2 RT Mounting Track (Dimensions in inches)

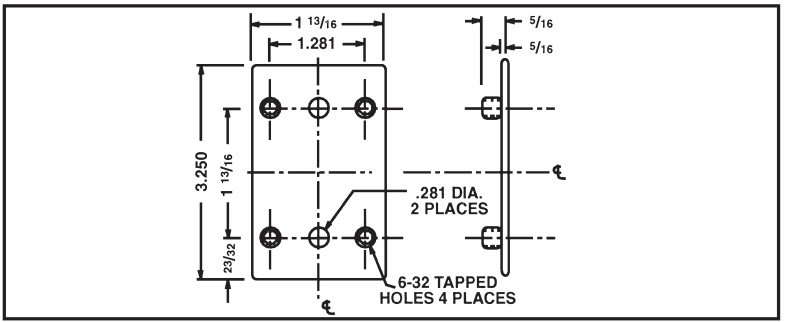


 Figure 2-3 TX90-BR Mounting Bracket (Dimensions in inches)

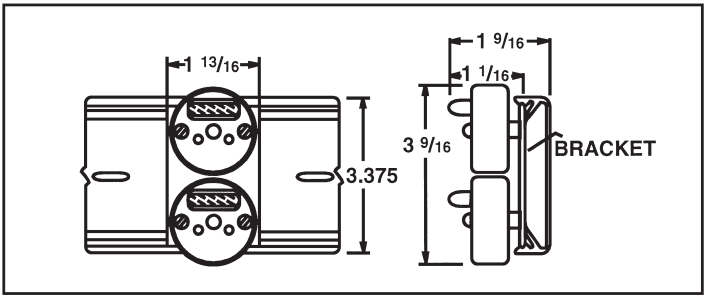


Figure 2-4 Installation with the Bracket and Track (Dimensions in inches)

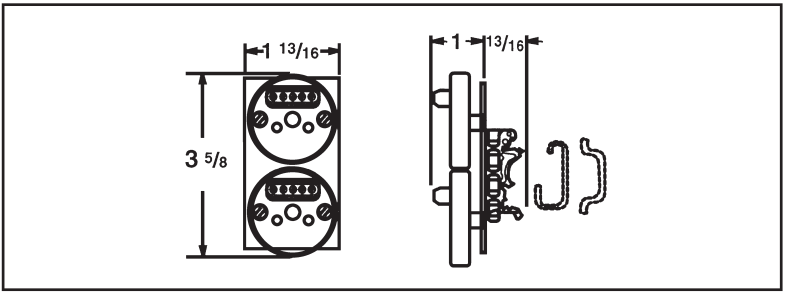


Figure 2-5 TX 90-DIN DIN Rail Mounting Adapter (in Inches)

2.2 Wiring the TX93 (Refer to Figure 2-6)

1. Connect a dc power supply in series with the load to the (+PS) and (-PS) power terminals. Note that the load (usually a monitoring instrument) may be connected to either the (+) or (-) power lead.
2. Connect the thermocouple to the (+IN) and (-IN) input terminals.

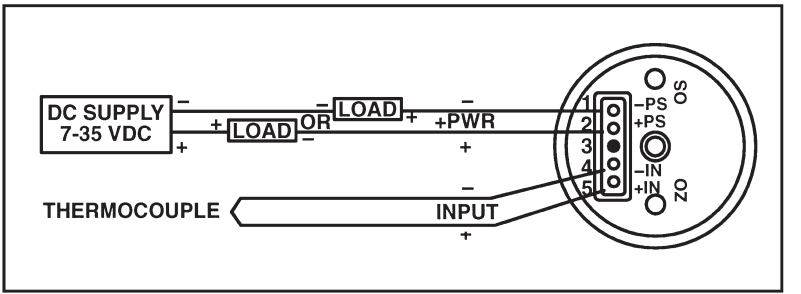


Figure 2-6 Wiring Diagram for the TX 93

3 Calibration Instructions

3.1 Equipment Required

- Precision mV source, with 0.001 mV resolution and ±0.002 mV accuracy or
- Precision DVM with ±0.002 mV accuracy and an adjustable mV source with 0.001 mV resolution
- OMEGA TRC III Ice Point Reference (or stable ice bath)
- Temperature Reference Probe (OMEGA P/N: TRP-(*)
  *Thermocouple Type J, K, T, E

3.2 Set-Up of Equipment

To prepare the ice bath:

a) Fill a glass beaker with crushed ice made from distilled water.

b) Fill the beaker with enough distilled water so that the ice just becomes slush, but not enough to float the ice.

c) Insert the reference thermocouple.

Figure 3-2 shows an alternate set-up. Here, a high precision thermocouple calibrator, such as the OMEGA Model CL511, replaces the DVM, ice bath, voltage source, etc.

3.3 Calibration Procedures (Refer to Figure 3-1)

Connect the calibration equipment according to Figure 3-1 or 3-2. The thermocouple wire must be of the same calibration as the transmitter being calibrated. Make sure that the wiring polarities are correct. (Note that the RED thermocouple wire is NEGATIVE).

To check or adjust the calibration:

1. Locate the Z (zero) and S (span) potentiometers.
2. Select, from Table 3-1, the correct mV input values for the Z (zero) and S (span) adjustments that correspond to the model number. For example, for Model TX93-J2, the Z input is -0.886 mV, and the S input is 4.907 mV.

If a Thermocouple Calibrator/Simulator is used, such as the OMEGA Model CL511 Precision Calibrator, select the Temperature Input Z (zero) and S (span) values.

3. Set the dc mV source to the selected Z (zero) mV value. Adjust the Z potentiometer to read 4.000 mA on the monitoring instrument.
4. Set the dc mV source to the selected S (span) mV value. Adjust the S potentiometer to read 20.000 mA on the monitoring instrument.
5. Repeat steps 3 and 4, as required, until the readings are exactly 4.000 mA and 20.000 mA. This procedure is necessary since there is interaction between the two potentiometers.

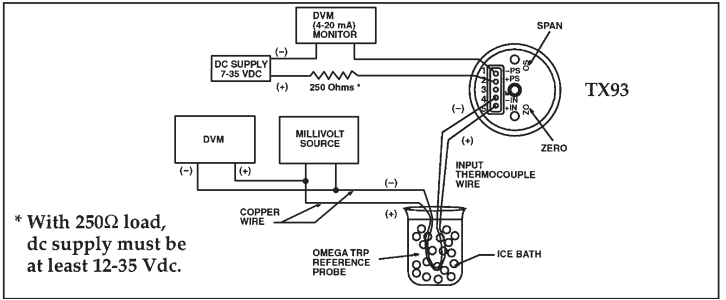


Figure 3-1 TX93 Calibration Set-Up

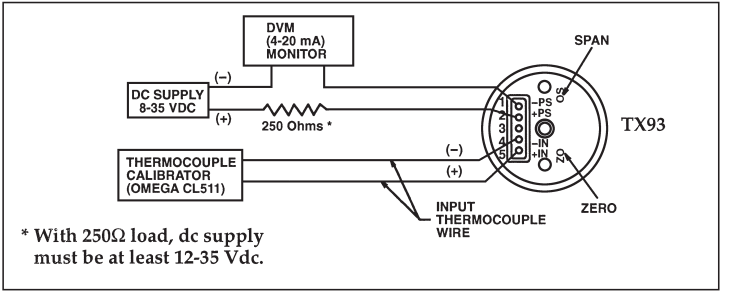


Figure 3-2 TX93 Calibration Set-Up (Alternate)

Table 3-1. Calibration Values for the TX93

Temperature Input Range Zero/Span	Model TX93	mV Input Ref 32°F Zero/Span	Model TX93	mV Input Ref 32°F Zero/Span
-40/120°F	-J1	-1.961/2.527	–	–
0/ 200°F	-J2	-0.886/4.907	-K2	-0.692/3.820
0/ 300°F	-J3	-0.886/7.949	-K3	-0.692/6.094
0/ 500°F	-J4	-0.886/14.110	-K4	-0.692/10.561
0/ 750°F	-J5	-0.886/21.787	-K5	-0.692/16.350
0/1000°F	-J6	-0.886/29.521	-K6	-0.692/22.255

Table 3-1. Calibration Values for the TX93 (Continued)

Temperature Input Range Zero/Span	Model TX93	mV Input Ref 32°F Zero/Span	Model TX93	mV Input Ref 32°F Zero/Span
-40/120°F	–	–	-E1	-2.255/2.977
0/ 200°F	-T2	-0.675/3.968	-E2	-1.026/5.871
0/ 300°F	-T3	-0.675/6.648	-E3	-1.026/9.710
0/ 500°F	-T4	-0.675/12.574	-E4	-1.026/17.945
0/ 750°F	-T5	-0.675/20.803	-E5	-1.026/28.857
0/1000°F	–	–	-E6	-1.026/40.064

4 Troubleshooting Guide

Malfunction or incorrect operation may be caused by:

1. Reversed polarity:

   Check the wiring using Figure 2-6 as a guide. If the temperature of the thermocouple increases while the current magnitude decreases, the problem could be caused by reversed polarity of the:

a) thermocouple wiring

b) power supply leads

c) monitor instrument

2. Loose or broken wires:

   Check each terminal connection for tightness. Move each wire back and forth and note any changes in operation.

3. Too high a load resistance in the output current loop or too low a current rating on the power supply:

a) Measure the total resistance of each device (excluding the transmitter and power supply) in the 20 mA loop, including the resistance of the lead wires.

b) Calculate maximum allowable loop resistance using the formula: Loop Resistance (maximum) = $\frac{V_{supply} - 7V}{0.020A}$

For example, a 24V power supply would give a maximum loop resistance of: 17V/0.020A = 850 ohms.

c) Make sure the power supply is rated for at least 28 mA times the number of TX93 transmitters being powered. For example, if the supply is powering five transmitters, the supply should be rated for at least 140 mA.

5 Accessories

Model No.	Description
TX90-BR	Mounting Bracket
PSU-24B	Unregulated Power Supply, 24 Volts
TX82B	Process Loop-Powered Indicator
RT	48″ Mounting Track
TX90-DIN	DIN Rail Mounting Adapter
RAIL-35-2	6.5' Section 35mm DIN Rail

6 Specifications

General

Size:	1.75" dia. X 0.75" high (includes terminal strip)
Zero/Span Adjustment Range:	±25%
Power Supply Voltage Operating Range:	+7 Vdc to +35 Vdc, 28 mA max required per transmitter
Accuracy:	±0.1% of full scale (includes effects of hysteresis, repeatability and linearity proportional to the T/C)
Frequency Response:	3dB@ 3Hz

Ambient Temperature:	-13˚F to 185˚F (-25˚C to 85˚C)
Storage Temperature Range:	-85˚F to 257˚F (-65˚C to 125˚C)
Thermal Zero Shift:	<0.01%/˚F of span (span >10 mV) <0.02%/˚F of span (4-10 mV span)
Thermal Span Shift:	<0.01%/˚F of span
Weight:	1.0 oz (28g)

Output

Current Output Span:	4-20 mA dc
Current Output Limits:	3 to 28 mA, typical

Maximum Loop Resistance:	$(V_{supply} - 7V)/0.020A$ = ohms
Load Resistance Effect:	0.01% of span per 300 ohms change
Power Supply Effect:	0.002% of output span per volt

Input

Sensor:	Thermocouple
Input Break Protection:	Upscale
Impedance:	>30 MΩ
Source Current:	4 mA typical

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