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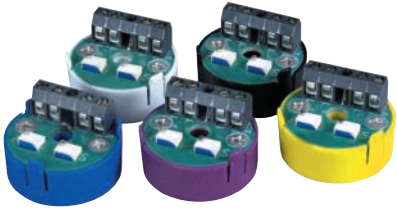

TX93A (J, K, T, E)

4-20 mA Ultra-Mini Temperature Transmitter

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The information contained in this document is believed to be correct, but OMEGA Engineering, Inc. accepts no liability for any errors it contains, and reserves the right to alter specifications without notice.

WARNING: These products are not designed for use in, and should not be used for, patient-connected applications.

This device is marked with the international caution symbol. It is important to read the Setup Guide before installing or commissioning this device as the guide contains important information relating to safety and EMC.

TABLE OF CONTENTS

FIGURES & TABLES

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 35 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 Thermocouple Two-Wire Temperature Transmitter accepts thermocouple sensor types J, K, T, or E and will produce a standard 4-20mA 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.

1.3 General Description (continued)

The transmitter is normally powered by an unregulated power supply as shown in **Figure 1-1**. The proportionally-transmitted signal begins at 4mA, at the low end of its temperature range, and increases to 20mA, at the high end of its temperature range. (There are various temperature ranges/ thermocouple types available for the transmitter. To order, refer to **Section 1.5** for correct Model Numbers and Range Codes.)

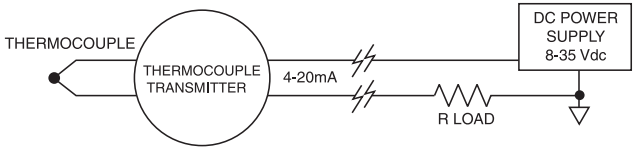

Figure 1-1 Thermocouple Transmitter

The two-wire transmitter receives and measures signals from themocouples and sends an output current of 4-20mA 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 transmitter is mounted inside a protection head, (see **Figure 2-1**), the thermocouple extension wires are replaced by two copper wires that carry the 4-20mA signal and dc voltage to operate the transmitter.

The transmitter has reverse supply polarity protection and will operate with a wide range of supply voltages (8 to 35 Vdc). It has an input sensor break protection circuit that forces the output current to go upscale when the thermocouple wire opens.

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.

1.3 General Description (continued)

Most thermocouple transmitters with 4-20 mA outputs, including this transmitter , 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 1-2.**

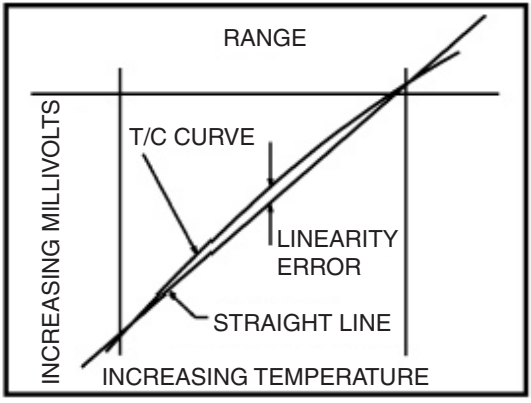

Figure 1-2 Straight Line Approximation of a Curve

1.4 Features

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

1.5 Models Available

Table 1-1 Range Code

	INPUT TYPES			
RANGE	**J**	**K**	**T**	**E**
-40 to 120 F (-40 to 49 C)	J1	-	-	E1
0 to 200 F (-18 to 93 C)	J2	K2	T2	E2
0 to 300 F (-18 to 149 C)	J3	K3	T3	E3
0 to 500 F (-18 to 260 C)	J4	K4	T4	E4
0 to 750 F (-18 to 399 C)	J5	K5	T5	E5
0 to 1000 F (-18 to 538 C)	J6	K6	-	E6

Table 1-2 Model Numbers

Model Number	Description
TX93A-(*)	Thermocouple Transmitter (J, K, T, or E)
NB2TX93A-(*)	NB2 thermocouple probe, 12"L, 1/4” O.D., ungrounded junction, 304SS sheath

*Insert range code from **Table 1-1**

2.1 Mounting

The transmitter may be:

1. surface mounted
2. mounted inside a protection head (shown in **Figure 2-1**)

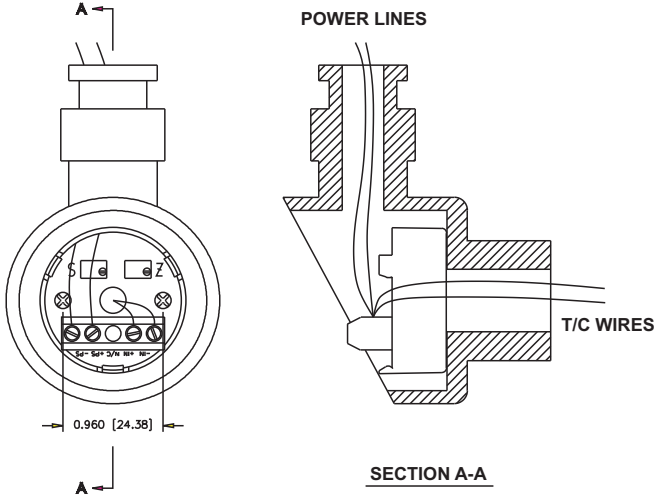

Figure 2-1 Assembly of the Transmitter inside an NB2 Protection Head

2.2 Wiring

Refer to **Figure 2-2**

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.

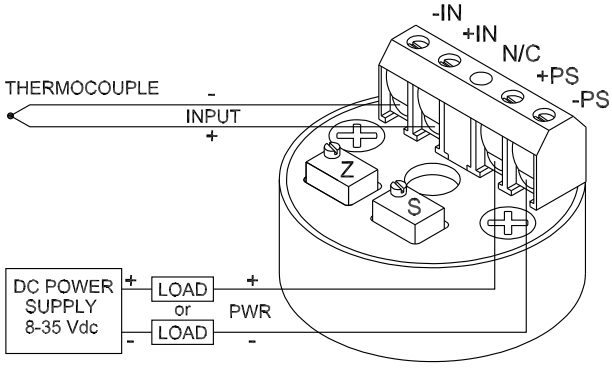

Figure 2-2 Wiring Diagram for Thermocouple Transmitter

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 Part Number: TRP-(*)

  *Thermocouple Type J, K, T, E

3.2 Set-Up of Equipment

To prepare the ice bath: Refer to **Figure 3-1**

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 Model CL511, replaces the DVM, ice bath, voltage source, etc.

3.3 Calibration Procedures

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 TX93A-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 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.

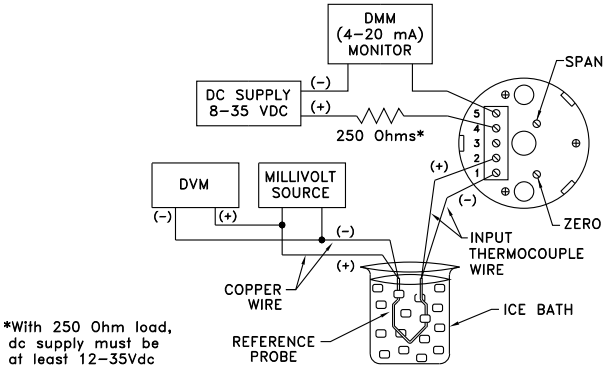

Figure 3-1 Transmitter Calibration Set-Up

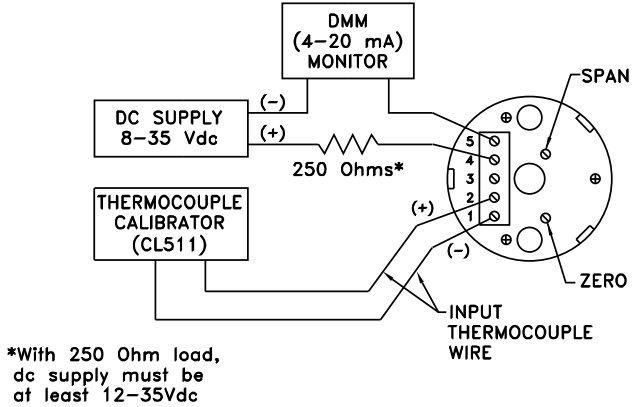

Figure 3-2 Transmitter Calibration Set- Up (Alternate)

Table 3-1. Calibration Values

Temperature Input Range Zero/Span	Model TX93A	mV Input Ref 32°F Zero/Span	Model TX93A	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
-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

4.1 Troubleshooting Guide

Malfunction or incorrect operation may be caused by:

1. Reversed polarity:

   Check the wiring using **Figure 2-2** 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

4.1 Troubleshooting Guide (continued)

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) = $\frac{\text{Vsupply} - 8\ \text{V}}{0.020\text{A}}$

   For example, a 24V power supply would give a maximum loop resistance of: 16 V/0.020A = 800 ohms.

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

5.1 Specifications

General

Size:

1.40” dia. x 0.93” high
(includes terminal strip)

Weight:

0.53 oz (15g);
0.83 oz (25g) if potted

Ambient Temperature:
-13°F to 185°F
(-25°C to 85°C)

Storage Temperature
-85°F to 257°F
(-65°C to 125°C)

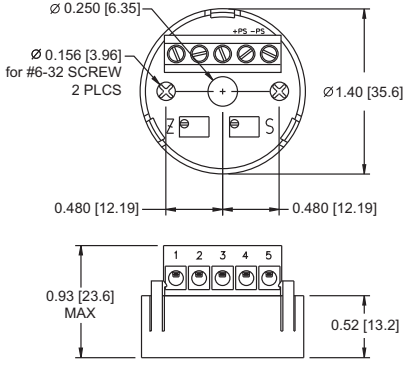

Figure 5-1 Dimensions

5.1 Specifications (continued)

Zero/Span Adj Range:	±25%
Power Supply Voltage	
Operating Range:	+8 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
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

Output

Current Output Span:	4-20 mA dc
Current Output Limits:	3 to 28 mA, typical
Max Loop Resistance:	(Vsupply – 8V)/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 M
Source Current:	4 mA typical

Notes:

Notes:

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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:

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2. Model and serial number of the product under warranty, and
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