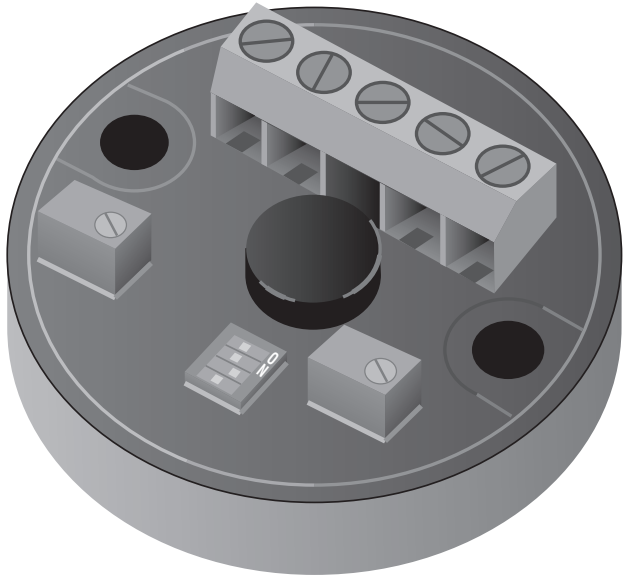
5 YEAR WARRANTY



OMEGA®

User's Guide

TX901, TX903
Field Rangeable Thermocouple Two-Wire Temperature Transmitter

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

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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:

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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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TABLE OF CONTENTS

Introduction

1.1 General Description

The OMEGA® TX901 and TX903 transmitters are field rangeable miniature two-wire temperature transmitters that are dip switch selectable for input type and range. The transmitters accept thermocouple sensor types J, K, T, E, R or S and will produce a standard 4-20 mA output signal proportional to the millivolt signal produced by its attached input temperature sensor. Transmission of the proportional current output may be accomplished by using inexpensive copper wire. The TX901 is non-isolated (does not provide isolation between its input and the 4-20 mA output); therefore an ungrounded thermocouple junction is suggested for the TX901 to avoid possible ground loops. The TX903 is isolated (provides 500V RMS isolation between its input and the 4-20 mA output).

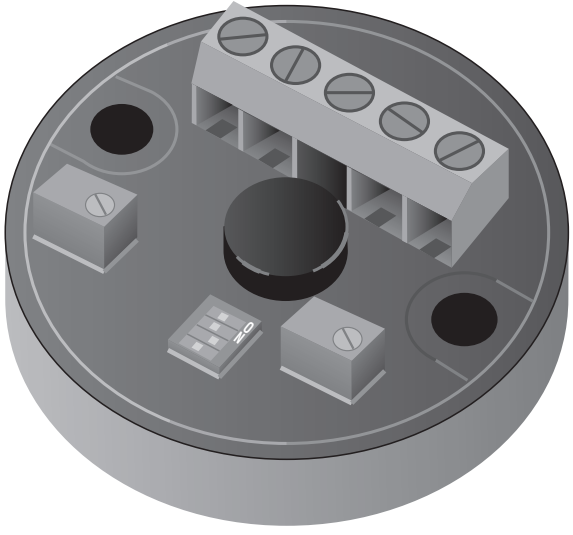
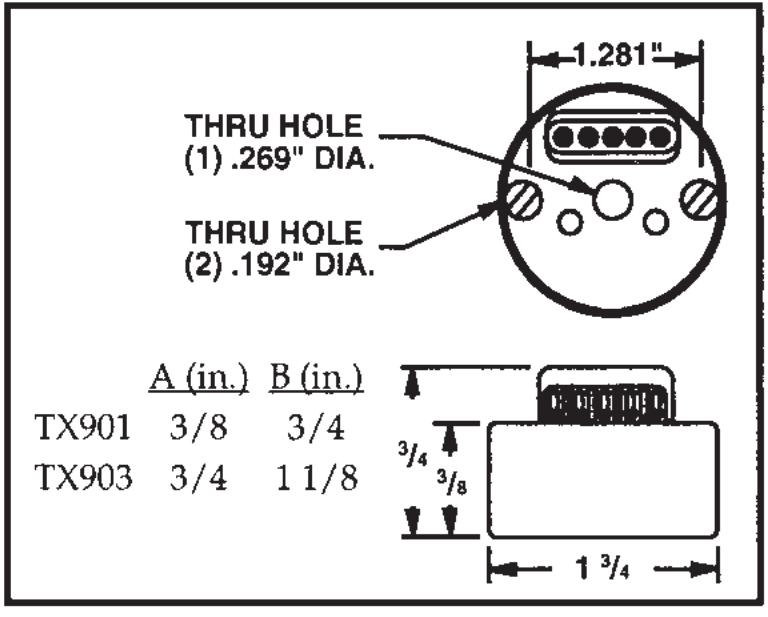


Figure 1-1 TX901, TX903 Transmitter



	A (in.)	B (in.)
TX901	3/8	3/4
TX903	3/4	1 1/8

Figure 1-2 Dimensions (in Inches)

The TX901 or 903 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.

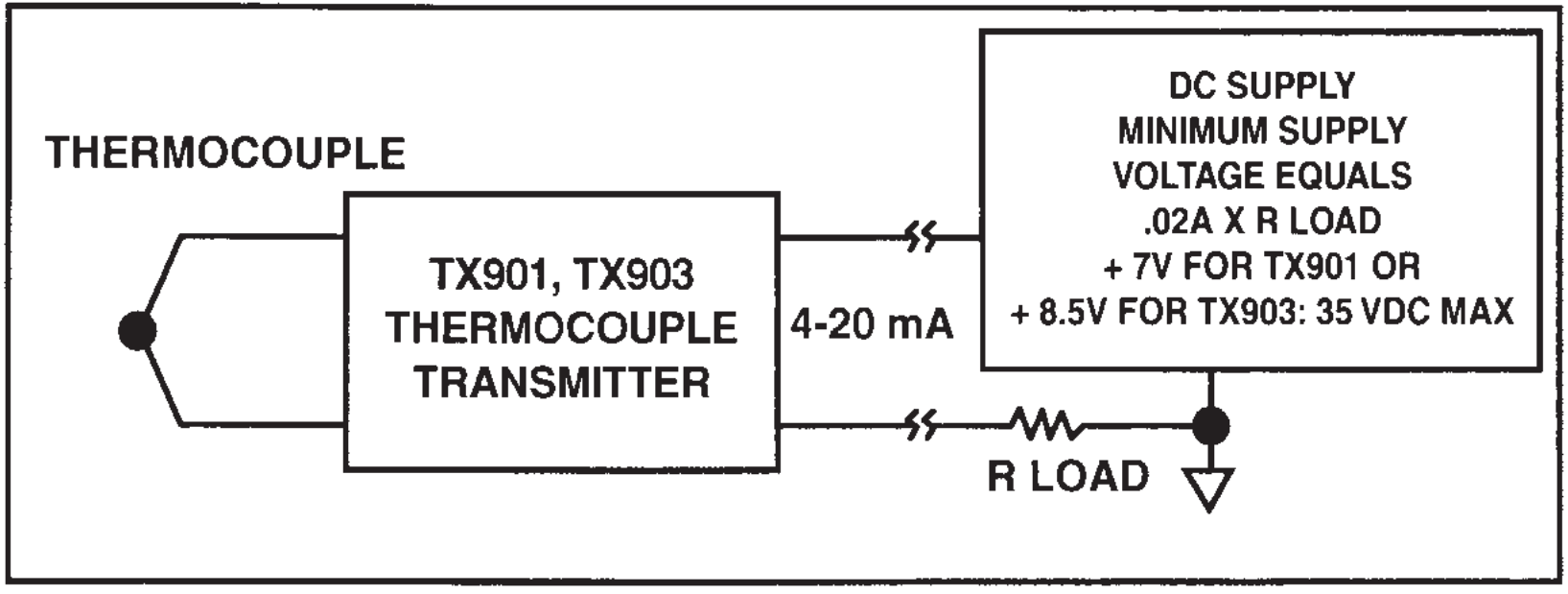


Figure 1-3 TX901, TX903 Thermocouple Transmitter

The TX901 or TX903 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 then used for recording, computing or controlling.

If the TX901 or TX903 is mounted inside a protection head, 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 TX901 or TX903 has reverse supply polarity protection and will operate with a wide range of supply voltages 7 to 35 Vdc (TX901), 8.5 to 35 Vdc (TX903). It has an input sensor break-protection circuit that forces the output current to go upscale when the thermocouple wire opens. The TX901 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 TX903 DOES provide isolation (500V RMS) between its input and the 4-20 mA output.

Note that most thermocouple transmitters with 4-20 mA outputs, including the TX901 and TX903, 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.

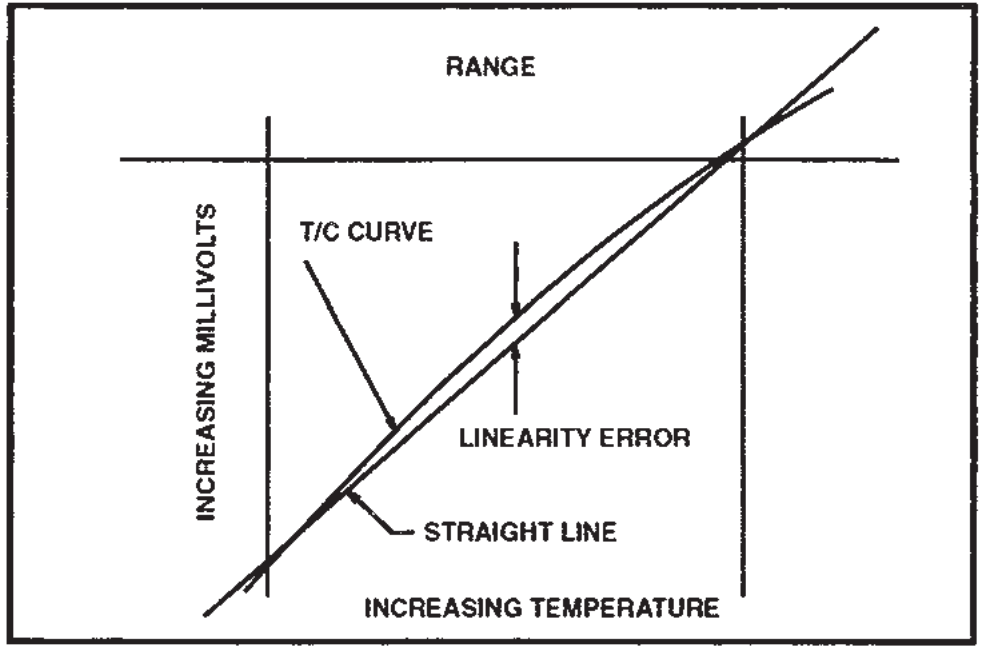


Figure 1-4 Straight Line Approximation of a Curve

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 TX901, TX903 Models Available

Model Number	Description
TX901	J/K/T/E/R/S field rangeable thermocouple input transmitter, non-isolated
TX903	J/K/T/E/R/S field rangeable thermocouple input transmitter, isolated
NB1TX901-(*)	NB1 thermocouple probe, 12" L, ¼" O.D., ungrounded junction, 304SS sheath, with TX901 transmitter

Model Number	Description
NB1TX903-(*)	NB1 thermocouple probe, 12" L, ¼" O.D., ungrounded junction, 304SS sheath, with TX903 transmitter

*Insert J, K, T or E for thermocouple type. Contact OMEGA for probe/transmitter assemblies for types R or S.

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

2 Unpacking Instructions

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

- TX901 or TX903 Field Rangeable Thermocouple 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

The carrier will not honor damage claims unless all shipping material is saved for inspection. After examining and removing contents, save packing material and carton in the event reshipment is necessary.

3 Installation

3.1 Mounting the TX901 or TX903

The TX901 or TX903 transmitter may be:

1. surface mounted,
2. mounted inside a protection head (refer to figure 3-1), 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 3-2 shows the RT mounting track. Figure 3-3 shows the TX90-BR mounting bracket.

Figure 3-4 shows a typical installation of two transmitters using the bracket and mounting track. Figure 3-5 shows the TX90-DIN rail mounting adapter.

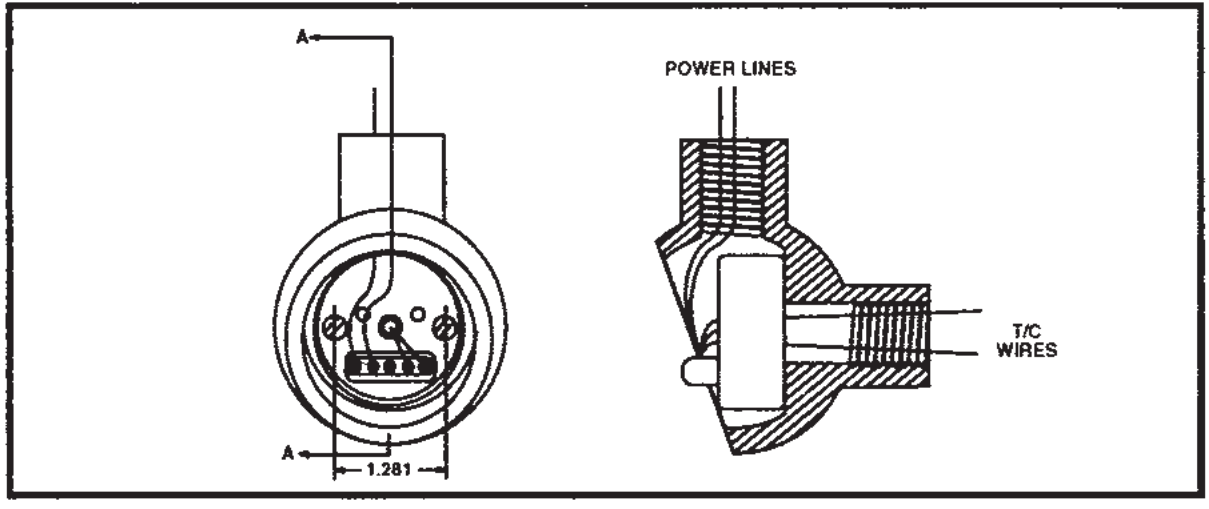
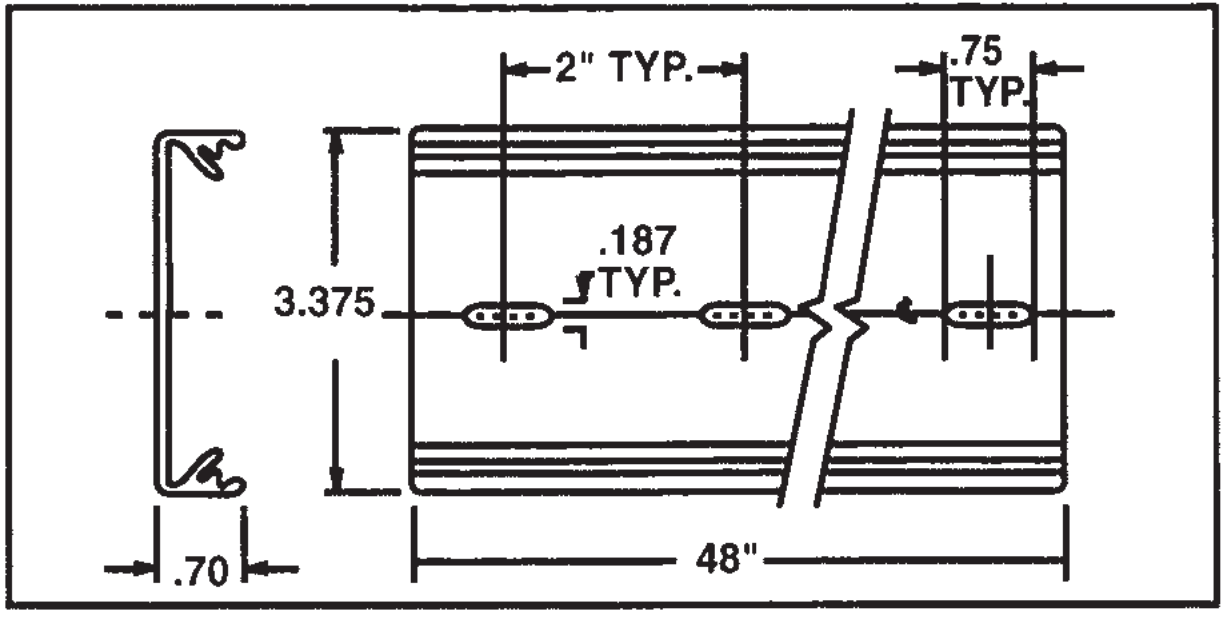


Figure 3-1 Assembly of Transmitter inside an OMEGA NB1 Protection Head (Dimensions in Inches)



CAUTION

Hand tighten transmitter mounting screws only. Do not overtighten.

Figure 3-2 RT Mounting Track (in Inches)

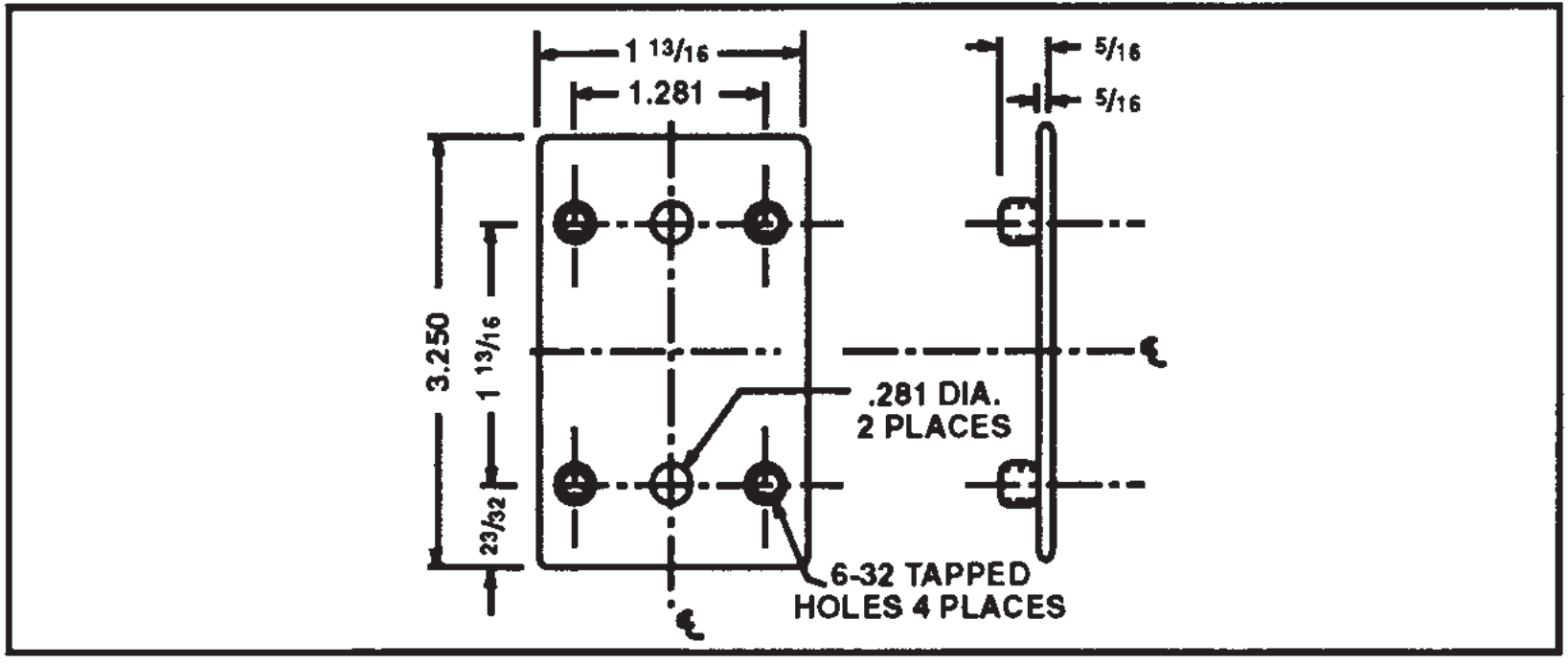


Figure 3-3 TX90-BR Mounting Bracket (in Inches)

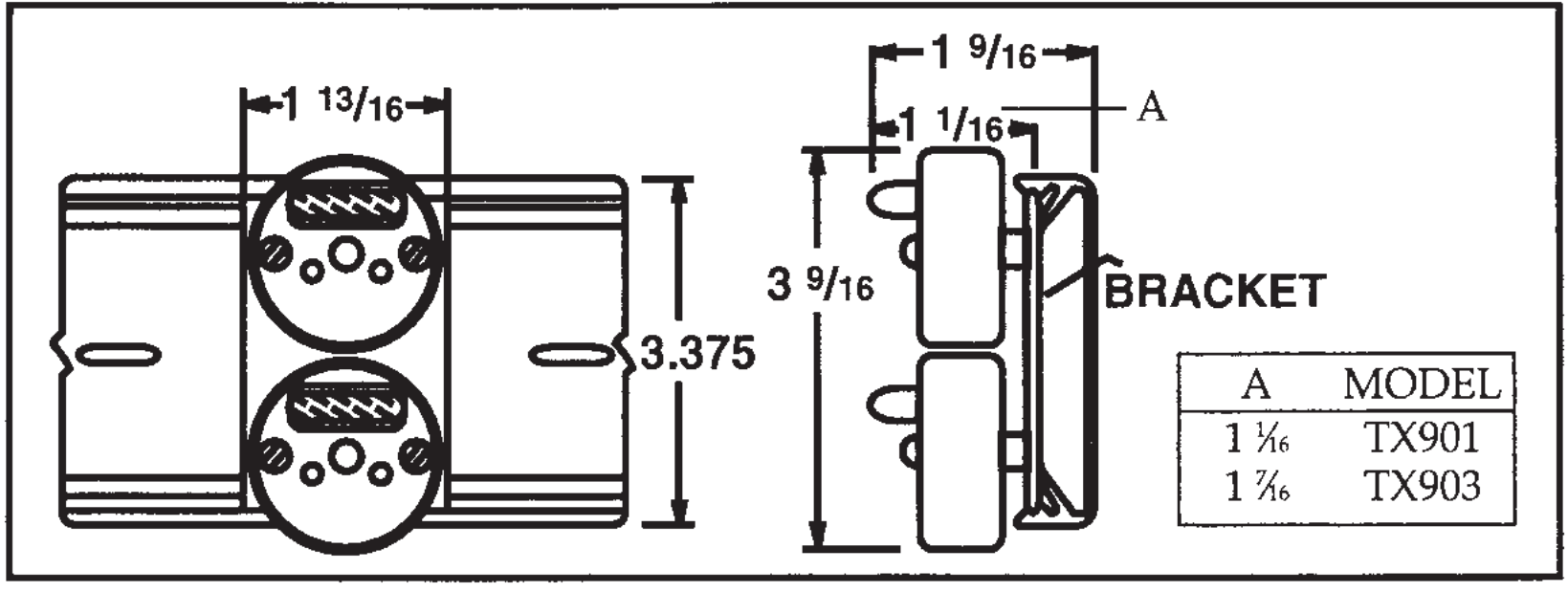


Figure 3-4 Installation with the Bracket and Track (in Inches)

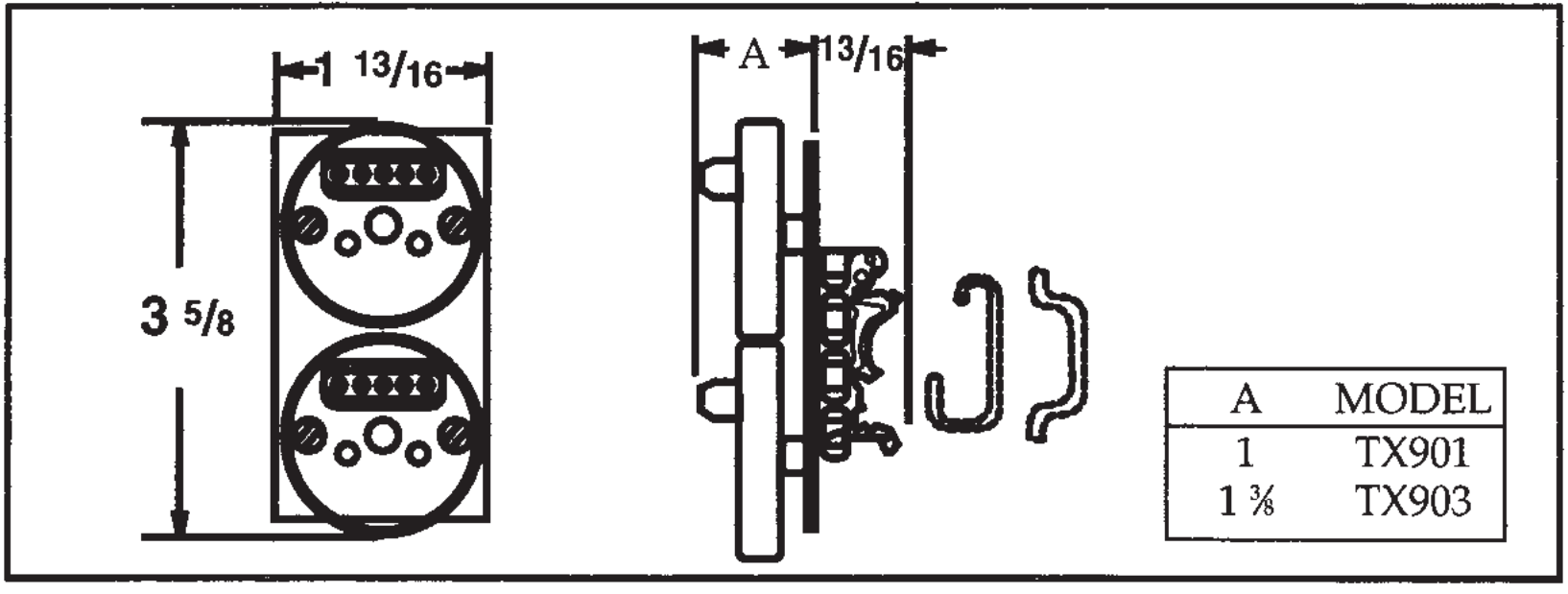


Figure 3-5 TX90-DIN DIN Rail Mounting Adapter (Dimensions in Inches)

3.2 Wiring the TX901 or TX903 (Refer to Figure 3-6)

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.

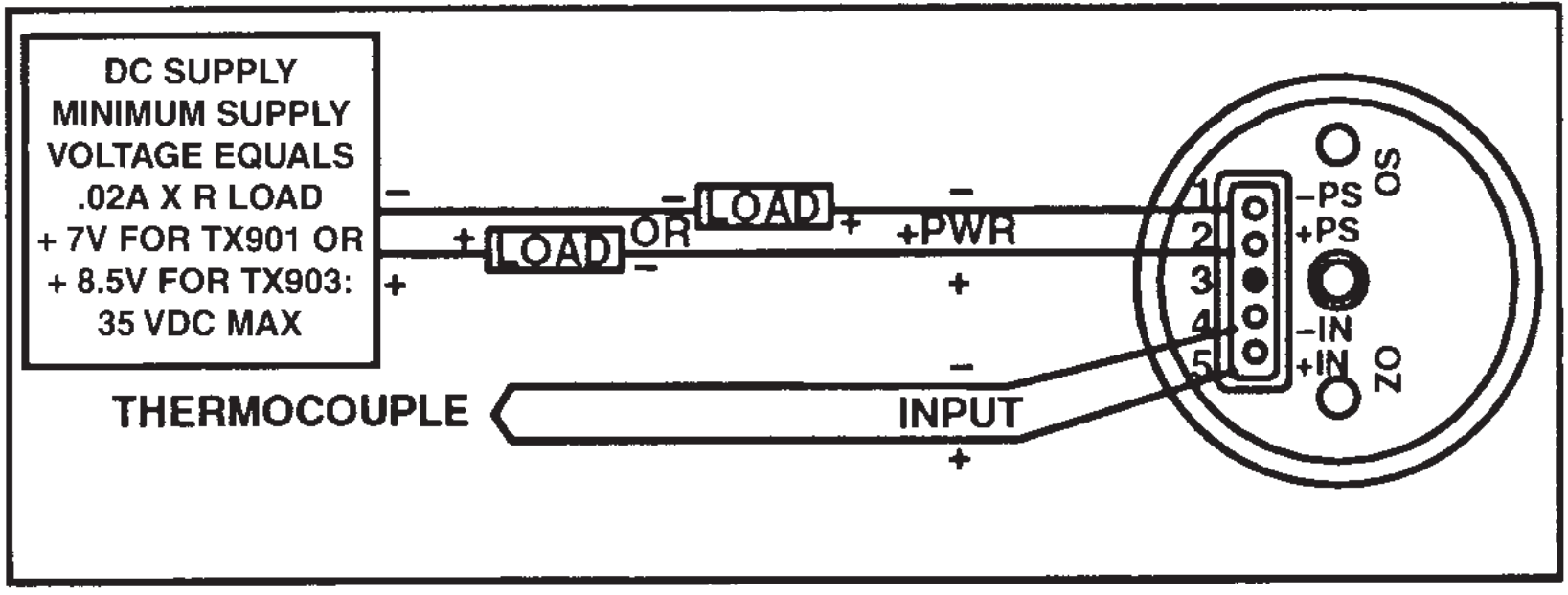


Figure 3-6 Wiring Diagram for the TX901 or TX903

4 Calibration Instructions

4.1 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, R, S

4.2 Set-Up 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 4-2 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.

4.3 Calibration Procedures (Refer to Figure 4-1)

Connect the calibration equipment according to Figure 4-1 or 4-2. The thermocouple wire (J, K, T, E, R or S) must be of the same type as required for 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. Select the temperature range and thermocouple type. **Note** that the top of the range can be 4 to 64 mV above the bottom of the range. The bottom of the range is always 0 mV (or 0°C) ±25% of the millivolt span.

2. If you are calibrating using an ice bath and millivolt source, find the millivolt values in a thermocouple reference table corresponding to the top and bottom of your temperature range. For example, for type J, 60 to 200°F, the millivolt input will be .791 to 4.906 mV. Note that the zero offset of .791 mV is less than 25% of the millivolt span of 4.115 mV.

   If you are calibrating using a Thermocouple Calibrator/ Simulator the above step is not necessary. This is because the output of the calibrator is given directly in units of temperature rather than in millivolts.

3. Referencing Table 4-1 set the DIP switch positions for the required thermocouple type and input span.

4. Locate the span "S" and zero "Z" potentiometers on the transmitter.
5. Set the calibration source to the bottom of the input range and adjust the zero potentiometer for an output of 4 mA.
6. Set the calibration source to the top of the input range and adjust the zero potentiometer for an output of 20 mA.
7. Repeat steps 5 and 6 until the output readings are exactly 4,000 mA and 20,000 mA. This procedure is necessary as there is some interaction between the two potentiometers.

Table 4-1. Dip Switch Settings for the Thermocouple Types and Ranges

Millivolt Span		4/8	8/16	12/24	16/32	20/40	24/48	28/56	32/64
SWITCH SETTINGS	SW4	ON	OFF	ON	OFF	ON	OFF	ON	OFF
	SW5	ON	ON	OFF	OFF	ON	ON	OFF	OFF
	SW6	ON	ON	ON	ON	OFF	OFF	OFF	OFF
TYPE J SW1 ON	°C	0 TO 80/150	0 TO 150/290	0 TO 220/420	0 TO 290/600	0 TO 370/710	0 TO 420/760		
SW2 OFF SW3 OFF	°F	0 TO 140/270	0 TO 270/530	0 TO 400/790	0 TO 530/1050	0 TO 560/1320	0 TO 790/1390		
TYPE K SW1 OFF	°C	0 TO 100/200	0 TO 200/390	0 TO 290/580	0 TO 390/770	0 TO 480/970	0 TO 580/1180	0 TO 670/1370	
SW2 ON SW3 OFF	°F	0 TO 175/355	0 TO 355/705	0 TO 530/1045	0 TO 705/1385	0 TO 875/1740	0 TO 1045/2115	0 TO 1210/2500	
TYPE T SW1 OFF	°C	0 TO 95/175	0 TO 175/320	0 TO 250/400					
SW2 ON SW3 OFF	°F	0 TO 175/320	0 TO 320/585	0 TO 460/750					

Table 4-1. Dip Switch Settings for the Thermocouple Types and Ranges (Continued)									
TYPE E SW1 OFF	°C	0 TO 65/125	0 TO 125/235	0 TO 180/325	0 TO 235/440	0 TO 285/535	0 TO 325/635	0 TO 385/735	0 TO 435/835
SW2 OFF SW3 OFF	°F	0 TO 120/230	0 TO 230/430	0 TO 335/615	0 TO 430/795	0 TO 525/975	0 TO 615/1155	0 TO 705/1330	0 TO 795/1515
TYPE R SW1 OFF	°C	0 TO 450/800	0 TO 800/1400	0 TO 1115/1700					
SW2 OFF SW3 ON	°F	0 TO 840/1470	0 TO 1470/2540	0 TO 2025/3100					
TYPE S SW1 OFF	°C	0 TO 480/860	0 TO 860/1535	0 TO 1200/1760					
SW2 OFF SW3 ON	°F	0 TO 875/1565	0 TO 1565/2785	0 TO 2190/3210					

NOTE: Zero Adjustment is Approximately ±25% of span Centered Around 0°C.

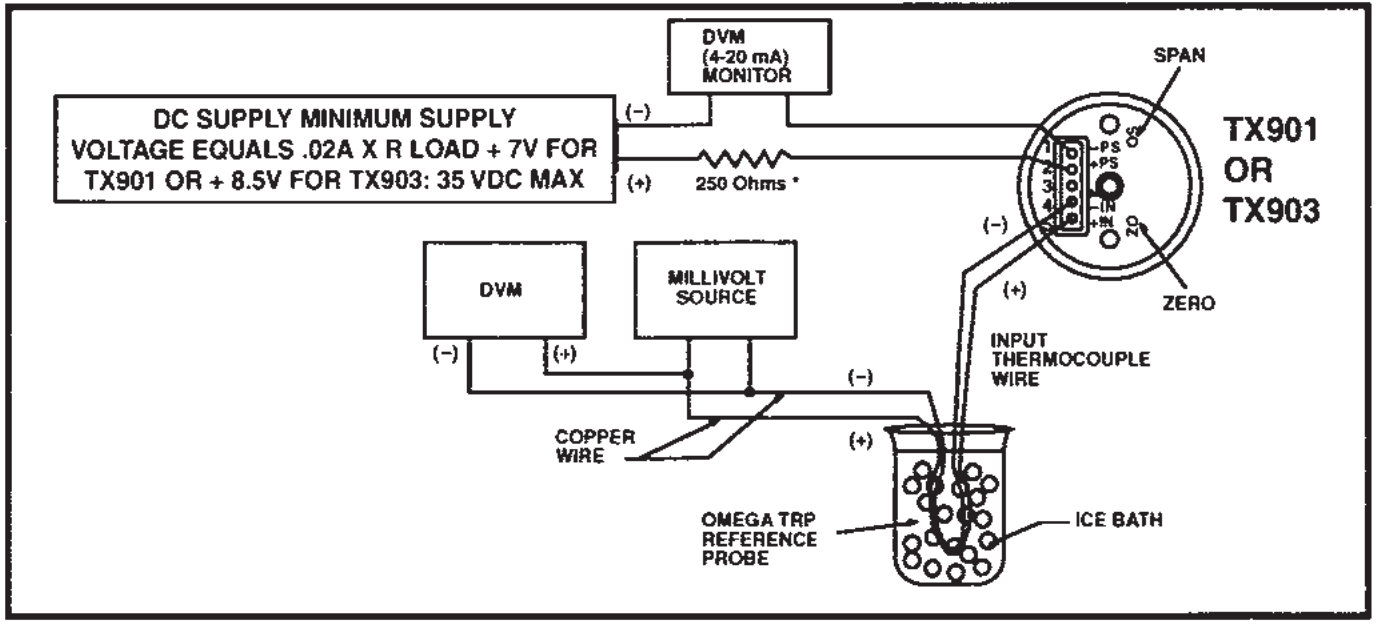


Figure 4-1 Calibration Set-Up

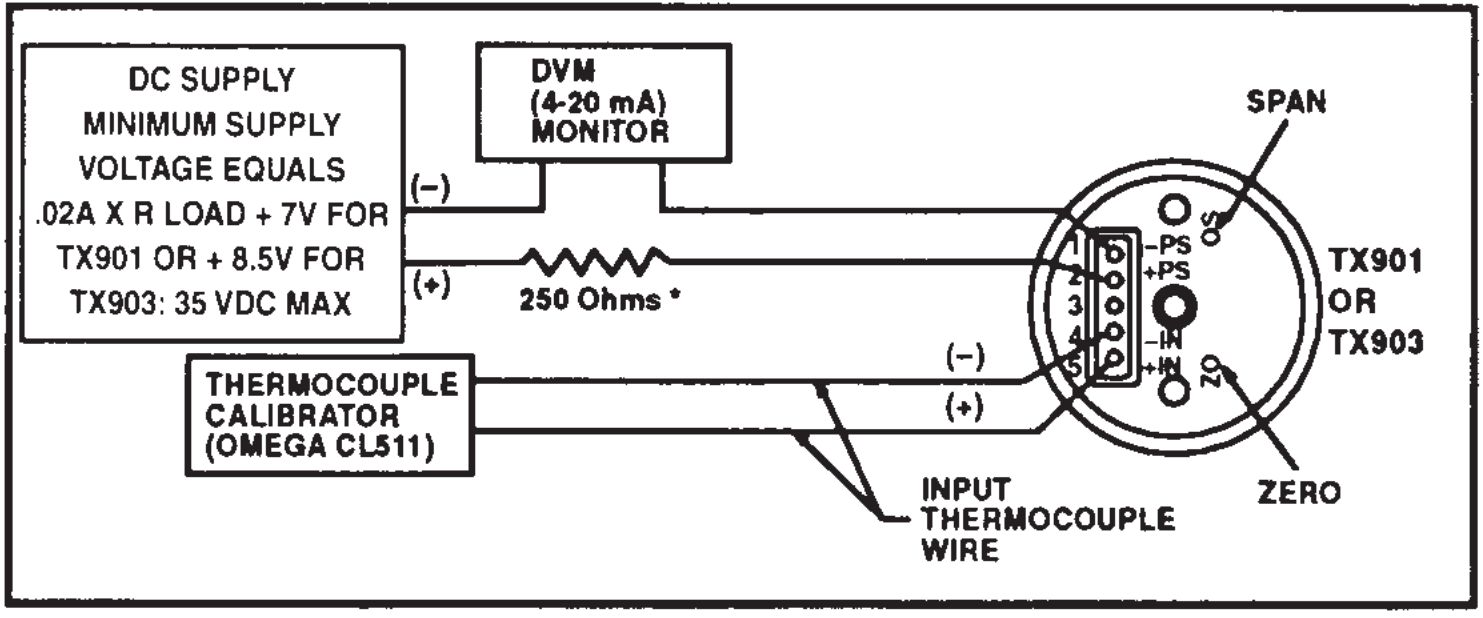


Figure 4-2 Calibration Set-Up

5 Troubleshooting Guide

Malfunction or incorrect operation may be caused by:

1. Reversed polarity:

   Check the wiring using Figure 3-6 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 the maximum allowable loop resistance using the formula:

$$\text{Loop Resistance (maximum)} = \frac{V_{supply} - V_T}{0.020A}$$

For example, a 24V power supply would give a maximum loop resistance of: 17V/0.020A = 850 ohms for TX901.

c) Make sure the power supply is rated for at least 28 mA times the number of TX901 or TX903 transmitters being powered. For example, if the supply is powering 5 transmitter, the supply should be rated for at least 140 mA.

V_T	MODEL
7V	TX901
8.5V	TX903

6 Accessories

Model No.	Description
TX90-BR	Mounting Bracket
PSU-93	Unregulated Power Supply
TX82B	Process Loop-Powered Indicator
RT	48" Mounting Track
TX90-DIN	DIN Rail Mounting Adapter
RAIL-35-2	6.5' Section 35mm DIN Rail

Specifications 7

General

Size:	TX901: 1.75" dia. X 0.75" high (includes terminal strip) TX903: 1.75" dia. X 1.125" high (includes terminal strip)
Span Adjustment:	4 to 64 mV
Zero Adjustment:	±25% of mV span centered around 0 mV (or °C)
Isolation (TX903 only):	500 V RMS
Power Supply Voltage Operating Range:	+7 V for TX901 and +8.5V for TX903 to +35 VDC max 28 mA max required per transmitter

Specifications

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:	2.5 oz (71g)

Output

Current Output Span:	4-20 mA dc
Current Output Limits:	3 to 28 mA, typical
Maximum Loop Resistance:	(V_{supply} — +7V) for TX901 and +8.5V for TX903)/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 nA typical

MADE IN USA

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. The OMEGA® 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; or 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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