CE

MADE IN THE U.S.A.

# 502A-K

## THERMOCOUPLE 4-20 mA TWO-WIRE TRANSMITTER

**10633ML-01**

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

It is the policy of NEWPORT to comply with all worldwide safety and EMC/EMI regulations that apply. NEWPORT is constantly pursuing certification of its products to the European New Approach Directives. NEWPORT will add the CE mark to every appropriate device upon certification.

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# SAFETY CONSIDERATIONS

This device is marked with the international Caution symbol. It is important to read this manual before installing or commissioning this device as it contains important information relating to Safety and EMC (Electromagnetic Compatibility).

**Unpacking & Inspection**

Note: Unpack the instrument and inspect for obvious shipping damage. Do not attempt to operate the unit if damage is found.

This instrument is a panel mount device protected in accordance with Class I of EN 61010 (115/230 AC power connections). Installation of this instrument should be done by Qualified personnel. In order to ensure safe operation, the following instructions should be followed.

This instrument has no power-on switch. An external switch or circuit-breaker shall be included in the building installation as a disconnecting device. It shall be marked to indicate this function, and it shall be in close proximity to the equipment within easy reach of the operator. The switch or circuit-breaker shall not interrupt the Protective Conductor (Earth wire), and it shall meet the relevant requirements of IEC 947–1 and IEC 947-3 (International Electrotechnical Commission). The switch shall not be incorporated in the mains supply cord.

Furthermore, to provide protection against excessive energy being drawn from the mains supply in case of a fault in the equipment, an overcurrent protection device shall be installed.

- The **Protective Conductor** must be connected for safety reasons. Check that the power cable has the proper Earth wire, and it is properly connected. It is not safe to operate this unit without the Protective Conductor Terminal connected.

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Note:

- Do not exceed voltage rating on the label located on the top of the instrument housing.
- Always disconnect power before changing signal and power connections.
- Do not use this instrument on a work bench without its case for safety reasons.
- Do not operate this instrument in flammable or explosive atmospheres.
- Do not expose this instrument to rain or moisture.

**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.

# 1.0 GENERAL INFORMATION

The 502A-K two-wire transmitter takes in microvolt signals generated by a type K thermocouple, provides cold (reference) junction compensation, amplification, common-mode isolation, and controls the current drawn from a 9-to-50 V dc source to produce the 4-to-20 milliampere output signal.

Common-mode voltage between the input thermocouple and the output current circuit is tested at 1500 V rms. As much as 750 ohms dropping resistance may be used in the power leads of the 502A-K when the unit is energized from a 24 V dc source because of the small compliance voltage needed by the unit. Accidental overloads of over one minute by 120 V rms on either input or output leads do not damage the 502A-K.

## 1.1 ACCURACY AND STABILITY

The 502A-K has tailored resistance values installed to provide curvilinear cold-junction compensation matched to the NBS K thermocouple table. Selected bridge resistors in a temperature-sensing bridge also provide cancellation of Span temperature effects. High-ambient-temperature compensation points are checked. The unit is certified for accuracy from -40 to +85°C (-104°F to +185°F).

## 1.2 ADAPTABILITY/TURNDOWN

The Span of the 502A-K can be ranged anywhere from 100°C to 1300°C by selection of one of four jumper positions, with fine tuning provided by a multiturn, top-accessible potentiometer. Sixteen Zero steps, also provided by 502A-K jumpers, allow placement of the 4-mA output temperature anywhere from -50°C to 1150°C, with fine tuning provided by another top-accessible, multiturn potentiometer. This 502A-K turndown capability exceeds that of any other known transmitter.

## 1.3 LINEARITY

The span and zero suppression capabilities (high turndown ratio) allow high-gain control for continuous processes and close conformity to the NBS tables over narrow temperature ranges. Downstream linearization of the 4-20 mA signal is required for accurate absolute temperature readout over a wide span.

## 1.4 ELECTRICAL ISOLATION

502A-K input (thermocouple and shield) and output (DC power) barrier strips accept wires up to two mm in diameter (13 gauge), and are mechanically isolated from each other to prevent input/output wiring contact during installation.

## 1.5 SHOCK RESISTANCE

Lightweight 502A-K circuit boards are formed into a rigid box structure and firmly soldered and epoxied to the case top. The circuit-board box is doubly coated with RTV silicone for environmental protection. When installed in the rugged, die-cast case, the 502A-K can withstand the shock of a 6-foot drop onto a hard surface (although scarring of the case and/or deformation of the plastic cover can occur).

1.6 WATERPROOF/RFI-RESISTANT CASE

The 502A-K case is made from Zamac (zinc alloy), coated with polyurethane, and gasketed with fluorosilicone. Fluorosilicone plugs protect the top-access Span and Zero potentiometers.

1.7 MOUNTING ADAPTABILITY

The small size of the 502A-K (less than 75 mm or 3 in OD) permits mounting in many small spaces, including explosion-proof housings for wiring compatability with other equipment in hazardous environments. A bulkhead adaptor provides for wall-mounting. A snaptrack adaptor mounts on either American or European relay tracks. Tapped holes in the case rear provide for custom mounting on any surface, indoor or out. An optional opaque top cover shields the barrier strips from uneven heating or cooling in exposed environments.

1.8 FIELD SERVICEABILITY

Serviceability of the 500 Series transmitters is limited to zero and span adjustment, as described in this owners manual. This limitation is required because the accuracy and stability depend upon factory-matched and graded components. For environmental protection and structural strength, Newport transmitters have conformally-coated circuitry and box-soldered construction, which also inhibit field repair.

## 2.0 SPECIFICATIONS

2.1 INPUT

Configuration: Isolated input

Thermocouple type: K ("Chromel/Alumel")

| | |
|---|---|
| Input impedance: | 5 megohms |
| Thermocouple break-detect current: | 50 nA max |
| Burnout indication: | Selectable up or down overscale |
| Thermocouple lead resistance: | Up to 500 ohms for specified performance |
| Common mode voltage, input to case: | Test, 2100 V peak; IEC spacing for over 354 V peak |
| Common mode rejection, input to case: | 100 dB min at 60 Hz |
| Overvoltage protection | 120 V ac max/1 min exposure |

2.2 OUTPUT

| | |
|---|---|
| Linear range: | 4 mA to 20 mA dc |
| Compliance (supply-voltage range): | 9 to 50 V dc |
| Overvoltage protection: | 120 V ac |
| Reverse polarity protection: | 400 V peak |
| Common mode voltage, output to case: | 1500 V ac max |
| Common mode rejection, output to case: | 100 dB min at 60 Hz |

## 2.3 ACCURACY

| | |
|---|---|
| Hysteresis and repeatability: | Within ±0.2°C ±0.1% of Span |
| Conformity, 100°C Span: | ±1°C |
| Six month stability: | Within ±0.2°C ±0.2% of base temperature |
| Power supply effect: | Within ±0.005%/V |
| Ambient temperature effect for 50°C change: | Zero and conformity: Within ±0.5°C<br>Span: Within 0.2%<br>Suppression: ±0.2% of base temperature |

## 2.4 ENVIRONMENTAL

| | |
|---|---|
| Operating temperature: | -40 to 85°C |
| Storage temperature: | -55 to 125°C |
| Humidity: | To 99% (Splashproof) |
| Vibration: | 1.52 mm (.06 in) double amplitude, 10-80 Hz cycled |
| Shock: | 55g, half-sine, 9-13 msec duration, 6' drop to hard surface |
| Watertight pressure limit: | 35 kPa (5 psi) |
| Mounting position: | Any |

## 2.5 MECHANICAL

| | |
|---|---|
| Case material: | Zamac (zinc alloy), polyurethane-coated, fluorosilicone-gasketed |
| Weight: | 300 g (10 oz) |
| Diameter: | 74 mm (2.9 in) |
| Height (including barriers): | 52 mm (2.1 in) |
| Connections: | #6 screws with wire clamps |

# 3.0 SAFETY INSTRUCTIONS

As delivered from the factory/distributor, this instrument complies with required safety regulations. In order to maintain this condition and to ensure safe operation, the following instructions should be followed.

1. Unpacking - After visual inspection, do not attempt to operate the unit if damage is found.

2. Power Voltage - Check that the instrument is connected for the correct power voltage (9-50 V dc).

3. Mounting - Observe the specifications in Section 2.4 to ensure that mounting meets environmental requirements.

4. Power Wiring - This instrument has no mains switch; it will be in operation as soon as the power is connected.

5. Signal Wiring - Do not make signal wiring connections or changes when power is applied to the instrument; make signal connections before power is applied and, if reconnection is required, disconnect the power before rewiring is attempted.

6. Exercise Caution - As with any electronic instrument, high voltage may exist when attempting to install, calibrate, or remove parts of the meter.

# 4.0 POWER AND SIGNAL CONNECTIONS

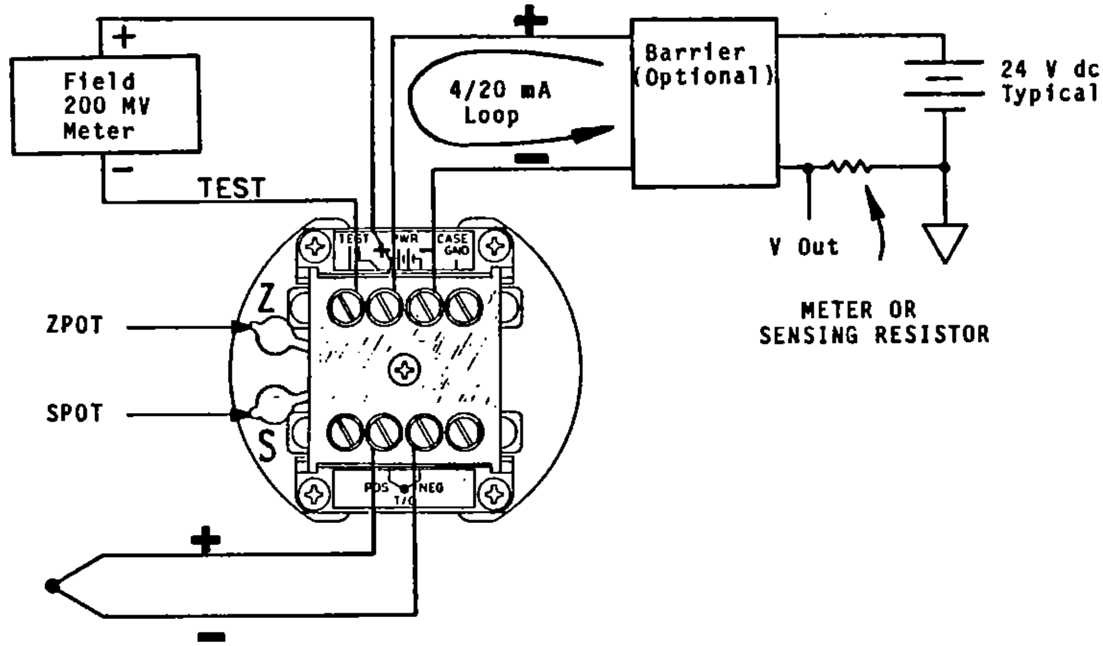



Figure 4-1 Power Input Connections

## 4.1 GENERAL

TEST, PWR +, and PWR - screws accept 2 mm (13 gauge) or lighter wire. CASE GND is grounded to the case. Input range is 9-50 V dc.

SCREW-TERMINAL PIN ASSIGNMENT

| | |
|---|---|
| 1 | TEST |
| 2 | + POWER/OUTPUT |
| 3 | - POWER/OUTPUT |
| 4 | CASE GND |
| A | N/C |
| B | + TC |
| C | -TC |
| D | N/C |

# 5.0 CONFIGURATION

The 502A-K is normally delivered configured for 4/20 mA = 0/800°C. Basic reconfiguration procedures are listed in Sections 5.2 and 5.3. Calibration formulas are included in Section 5.5.

## 5.1 TOOLS AND EQUIPMENT

#1 Phillips screwdriver
VACO 17764 or equivalent flathead screwdriver
Two 4 1/2 digit DVM voltage meters
10 ohm or 100 ohm 1% resistor
Fixed or variable DC power supply or battery (in the range of 11-30 V dc)

Ambient temperature readout
Microvolt calibration source (in the range of -2000 to 55000 UV)

KAYE 140 or equivalent 0°C ice-point cell (Optional)

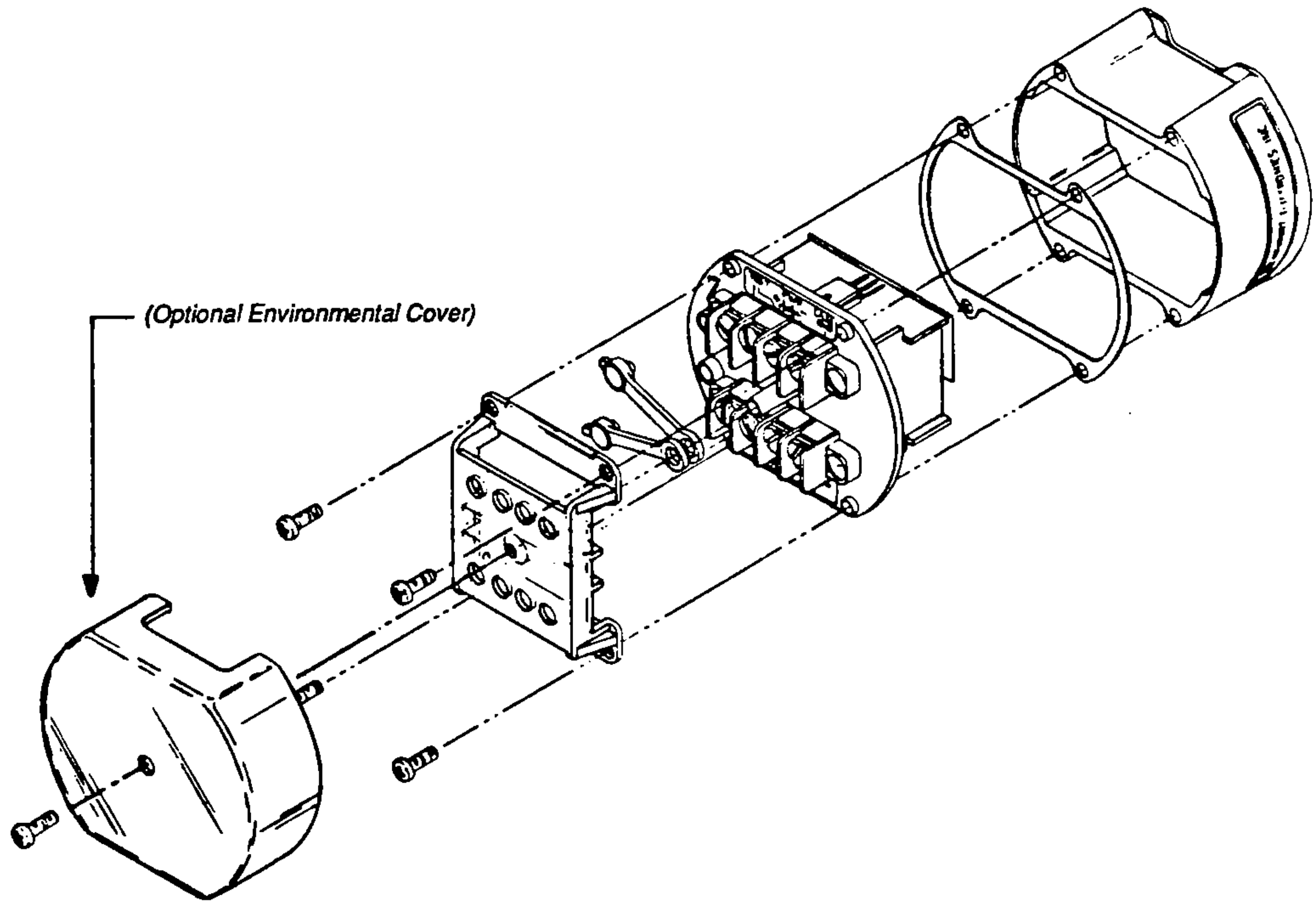



Figure 5-1 Exploded View

## 5.2 CONFIGURATION AND CALIBRATION PROCEDURE USING AMBIENT THERMOMETER

1. Refer to Figure 5-1. Remove the four Phillips-head screws from the 502A-K case top, and set aside the plastic barrier cover.

2. Lift out the electronics assembly (attached to the case lid).

3. Setting aside the case and sealing gasket, pull out the two sealing plugs which cover the Span and Zero potentiometers (**SPOT** and **ZPOT**). Adjust SPOT to about 3/4 CCW. SPOT is never more than 3/4 CW; ZPOT can be anywhere.

4. Refer to Figure 5-2, Page 6. Attach two insulated copper wires to the 502A-K T/C input terminals from the microvolt calibration source (twisted-shielded pair recommended for pickup rejection).

   Note: Microvolt source + to T/C Pos, Microvolt source - to T/C Neg.

5. Attach two insulated copper wires from the output terminals, connecting the + terminal to the + terminal of a 11-to-30 V power supply or battery, and the - terminal to the + terminal of an ammeter. Close the 4/20 mA loop by connecting the - terminal of the ammeter to the - terminal of the power source.

6. Refer to Table 5-3 for Temperature Range Zero and Span jumper positions. Turn the 502A-K so that the jumper pin-forest is at hand, and move the five push-on jumpers to the positions indicated in Figure 5-4 for the jumpers chosen from Table 5-2 to yield the desired Zero and Span ranges.

   Note: Better calibration stability is obtained if the electronic assembly is installed in the case.

7. Put the accurate temperature probe as close as possible to the 502A-K input terminals (insulating attachment tape can be used).

8. Using Table 5-1, determine the amount of microvolts that the ambient (Room) temperature represents. Subtract this from the microvolts corresponding to the desired Base Temperature, also found in Table 5-1. This value is **LO-IN.**

9. Set the microvolt calibration source to LO-IN microvolts and adjust ZPOT for 4.00 mA output current.

10. Using Table 5-1, subtract the ambient microvolts from the microvolts for the desired Top Temperature. This value is **HI-IN.**

11. Set the microvolt calibration source to HI-IN microvolts and read the output current, designated IFT (normally not equal to 20 mA).

12. Calculate IFS = 16·IFT/(IFT-4) milliamperes. (In general IFS will also not be equal to 20 mA.)

13. Adjust <u>SPOT</u> to obtain the IFS output.

14. Now readjust <u>ZPOT</u> so that the output reads 20.00 mA.

15. Set the microvolt calibration source to LO-IN microvolts. If the output current is not 4.00 mA, retrim starting at Item 9, above.

16. When calibrated, remove wires, replace pot sealing plugs, and install unit in the case with firmly compressed (but not flattened) gasket for a good seal, using the four screws.

EXAMPLE:

Temperature Range = -50 to 350°C

Base Temperature = -50°C
Top Temperature = 350°C

| | | |
|---|---|---|
| Z Jumpers | None | Table 5-2 |
| Span Jumper | E | Table 5-2 |

Ambient Temperature = 25°C    Temperature Readout

| | | | | |
|---|---|---|---|---|
| Ambient Microvolt | at | 25°C = | 1000.2 | Table 5-1 |
| Base Temperature Microvolt | at | -50°C = | -1889.07 | Table 5-1 |
| Top Temp (Max.) Microvolt | at | 350°C = | 14292.2 | Table 5-1 |

LO-IN = -1889.07 - 1000.2 = -2889.27
HI-IN = 14292.2 - 1000.2 = 13292.0

Calibrate:

1. Set SPOT to about 3/4 CCW.
2. Set microvolt source to -2889.
3. Adjust ZPOT to 4.00 mA.
4. Set microvolt source to 13292.
5. Read current, designated IFT.
6. Calculate IFS = 16·IFT/(IFT-4)mA.
7. Adjust <u>SPOT</u> to obtain IFS current.
8. Adjust <u>ZPOT</u> to obtain 20 mA current.
9. Set microvolt source to -2889.
10. If the output is not 4.00 mA, retrim starting at Item 2 above.

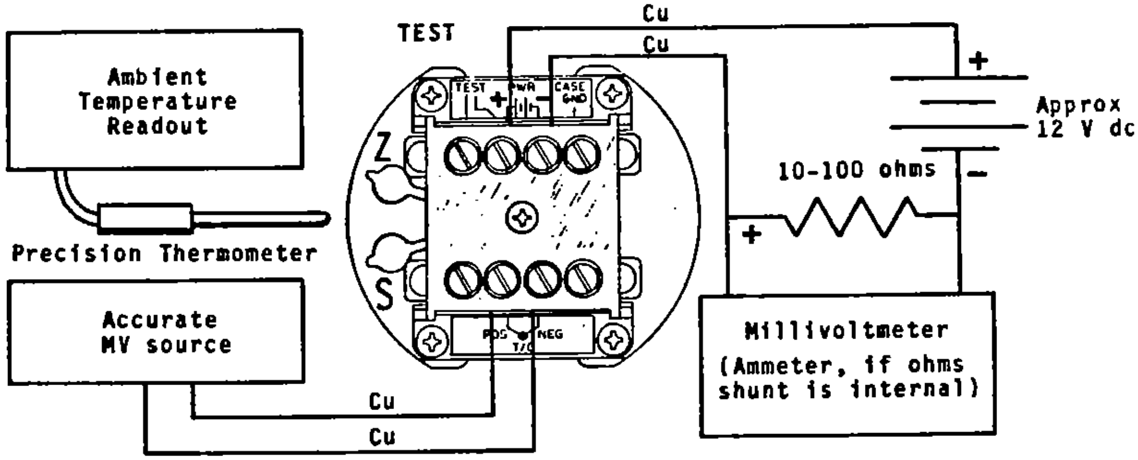



Figure 5-2 Copper-Wire Calibration Using Room-Temperature Thermometer

## 5.3 CONFIGURATION AND CALIBRATION PROCEDURE USING ICE-POINT CELL

1. Referring to Figure 5-1, remove 4 Phillips-head screws from top of 502A-K case, and lift out the electronics.
2. Refer to Table 5-2 for Temperature Range Zero and Span jumper positions. Move the five push-on jumpers to the positions indicated in Figure 5-4 for the jumpers chosen from Table 5-2. This will yield the desired temperature range.

Note: Better calibration stability is obtained if the electronic assembly is installed back into the case.

3. Pull out two sealing plugs that cover 502A-K Span and Zero potentiometer screw heads. Set SPOT to about 3/4 CCW; ZPOT can be anywhere.
4. Referring to Figure 5-3, hook up the calibration and output circuits.
5. Using Table 5-1, determine the microvolt level for the desired Base Temperature.
6. Set the microvolt calibration source to these Base Temperature microvolts.
7. Adjust ZPOT for 4.00 mA out.
8. Using Table 5-1, determine the microvolts for the desired Top Temperature.
9. Set the microvolt calibration source to these Top Temperature microvolts.
10. <u>Without</u> adjusting SPOT, read the output current, designated IFT (not yet 20 mA).

11. Calculate IFS = 16·IFT/(IFT-4) milliamperes. (In general, IFS will not be equal to 20 mA.)

12. Adjust the SPOT to obtain the IFS output.

13. Now readjust the ZPOT so that the output reads 20.00 mA.

14. Set the microvolt calibration source back to the Base Temperature microvolts. If the output is not 4.00 mA, retrim starting at Item 7, above.

15. Remove 502A-K from calibration setup.

16. Replace two sealing plugs over 502A-K Span and Zero potentiometer screw heads.

17. Replace 502A-K main unit in casing. Be sure fluorosilicone gasket is firmly compressed, but not entirely flattened, to ensure a good seal.

18. Replace 4 Phillips-head screws that hold 502A-K unit to case.

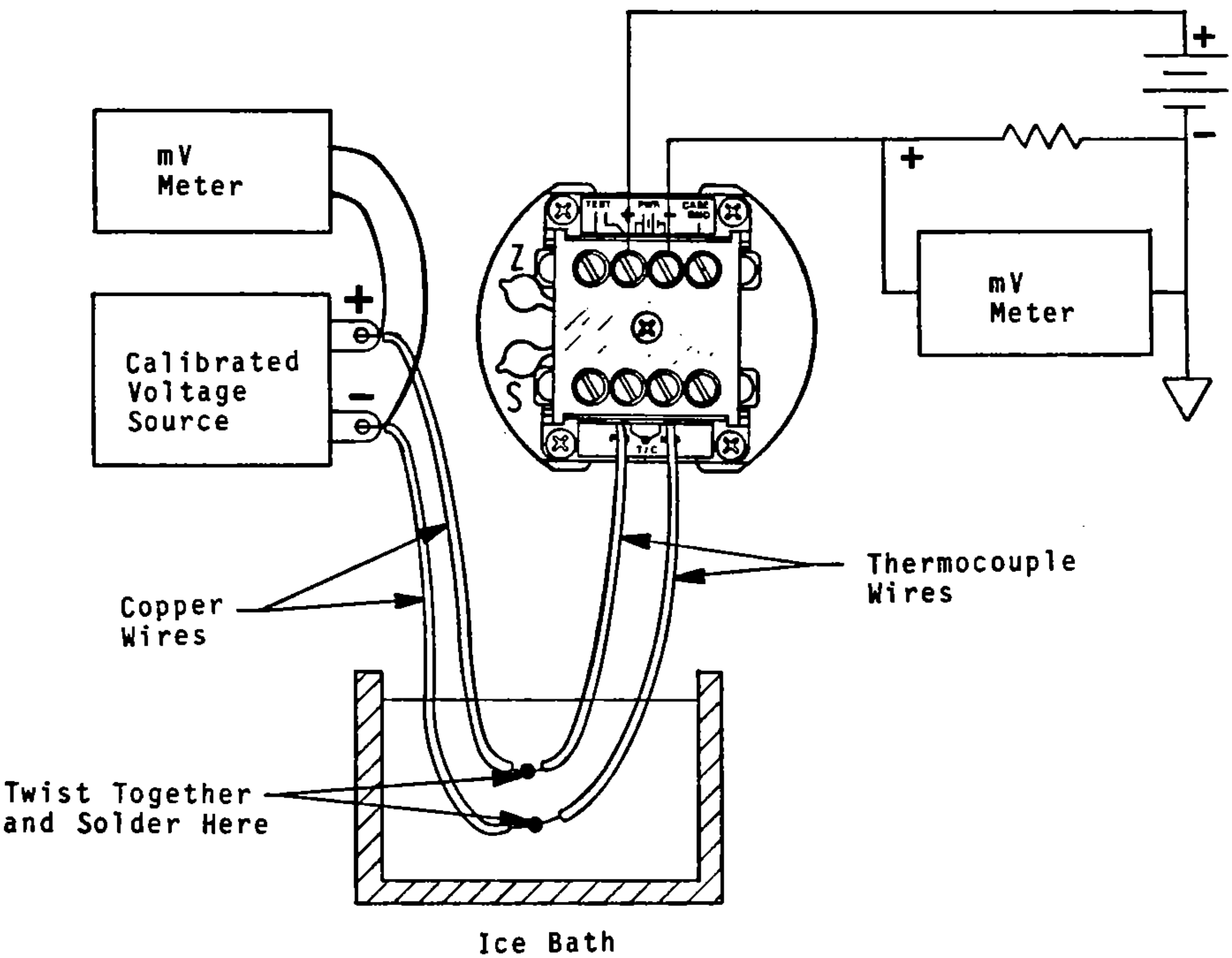



Figure 5-3 Calibration Setup

| T °C | E µV | S µV/°C | T °C | E µV | S µV/°C |
|---|---|---|---|---|---|
| -270 | -6457.82 | 0.739 | 80 | 3265.70 | 41.541 |
| -260 | -6441.15 | 2.664 | 85 | 3473.30 | 41.526 |
| -250 | -6403.68 | 4.853 | 90 | 3680.90 | 41.492 |
| -240 | -6343.92 | 7.096 | 100 | 4095.30 | 41.371 |
| -230 | -6261.93 | 9.288 | 110 | 4508.10 | 41.191 |
| -220 | -6158.49 | 11.383 | 120 | 4919.00 | 40.969 |
| -210 | -6034.63 | 13.373 | 130 | 5327.40 | 40.727 |
| -200 | -5891.36 | 15.264 | 140 | 5733.50 | 40.485 |
| -190 | -5729.62 | 17.070 | 150 | 6137.20 | 40.266 |
| -180 | -5550.21 | 18.802 | 160 | 6538.90 | 40.087 |
| -170 | -5353.80 | 20.469 | 170 | 6939.20 | 39.963 |
| -160 | -5141.03 | 22.076 | 180 | 7338.40 | 39.899 |
| -150 | -4912.48 | 23.626 | 190 | 7737.30 | 39.898 |
| -140 | -4668.71 | 25.118 | 200 | 8136.60 | 39.953 |
| -130 | -4410.30 | 26.553 | 210 | 8536.60 | 40.058 |
| -120 | -4137.85 | 27.927 | 220 | 8937.80 | 40.199 |
| -110 | -3851.96 | 29.241 | 230 | 9340.60 | 40.364 |
| -100 | -3553.23 | 30.494 | 240 | 9745.20 | 40.542 |
| -90 | -3242.30 | 31.684 | 250 | 10151.50 | 40.722 |
| -80 | -2919.77 | 32.811 | 260 | 10559.60 | 40.896 |
| -70 | -2586.30 | 33.874 | 270 | 10969.30 | 41.058 |
| -60 | -2242.51 | 34.872 | 280 | 11380.70 | 41.207 |
| -50 | -1889.07 | 35.805 | 290 | 11793.40 | 41.340 |
| -45 | -1708.94 | 36.246 | 300 | 12207.40 | 41.459 |
| -40 | -1526.64 | 36.672 | 310 | 12622.60 | 41.565 |
| -35 | -1342.25 | 37.081 | 320 | 13038.70 | 41.660 |
| -30 | -1155.85 | 37.474 | 330 | 13455.70 | 41.746 |
| -20 | -777.38 | 38.211 | 340 | 13873.60 | 41.825 |
| -15 | -585.45 | 38.555 | 350 | 14292.20 | 41.899 |
| -10 | -391.86 | 38.881 | 360 | 14711.60 | 41.969 |
| -5 | -196.67 | 39.189 | 370 | 15131.60 | 42.035 |
| 0 | 0.00 | 39.475 | 380 | 15552.30 | 42.099 |
| 5 | 197.90 | 39.699 | 390 | 15973.60 | 42.159 |
| 10 | 397.00 | 39.914 | 400 | 16395.40 | 42.217 |
| 15 | 597.10 | 40.118 | 410 | 16817.90 | 42.273 |
| 20 | 798.10 | 40.313 | 420 | 17240.90 | 42.325 |
| 25 | 1000.20 | 40.498 | 430 | 17664.40 | 42.375 |
| 30 | 1203.10 | 40.670 | 440 | 18088.40 | 42.421 |
| 35 | 1406.90 | 40.831 | 450 | 18512.80 | 42.464 |
| 40 | 1611.40 | 40.977 | 460 | 18937.60 | 42.502 |
| 45 | 1816.60 | 41.109 | 470 | 19362.80 | 42.536 |
| 50 | 2022.40 | 41.226 | 480 | 19788.40 | 42.566 |
| 55 | 2228.80 | 41.325 | 490 | 20214.10 | 42.592 |
| 60 | 2435.70 | 41.407 | 500 | 20640.20 | 42.612 |
| 65 | 2642.90 | 41.470 | 510 | 21066.40 | 42.628 |
| 70 | 2850.30 | 41.513 | 520 | 21492.70 | 42.638 |
| 75 | 3058.00 | 41.537 | | | |

Table 5-1 NBS Type K Output and Slope (Sensitivity)

| T °C | E µV | S µV/°C | T °C | E µV | S µV/°C |
|---|---|---|---|---|---|
| 530 | 21919.10 | 42.643 | 950 | 39309.60 | 39.439 |
| 540 | 22345.50 | 42.643 | 960 | 39703.40 | 39.337 |
| 550 | 22771.90 | 42.637 | 970 | 40096.30 | 39.234 |
| 560 | 23198.30 | 42.626 | 980 | 40488.10 | 39.132 |
| 570 | 23624.40 | 42.609 | 990 | 40878.90 | 39.029 |
| 580 | 24050.40 | 42.587 | 1000 | 41268.70 | 38.926 |
| 590 | 24476.20 | 42.560 | 1010 | 41657.50 | 38.823 |
| 600 | 24901.60 | 42.527 | 1020 | 42045.20 | 38.719 |
| 610 | 25326.70 | 42.489 | 1030 | 42431.80 | 38.614 |
| 620 | 25751.40 | 42.445 | 1040 | 42817.50 | 38.509 |
| 630 | 26175.60 | 42.397 | 1050 | 43202.00 | 38.402 |
| 640 | 26599.30 | 42.344 | 1060 | 43585.50 | 38.293 |
| 650 | 27022.40 | 42.286 | 1070 | 43967.90 | 38.183 |
| 660 | 27445.00 | 42.224 | 1080 | 44349.10 | 38.071 |
| 670 | 27866.90 | 42.157 | 1090 | 44729.30 | 37.957 |
| 680 | 28288.10 | 42.086 | 1100 | 45108.30 | 37.840 |
| 690 | 28708.60 | 42.011 | 1110 | 45486.10 | 37.720 |
| 700 | 29128.30 | 41.933 | 1120 | 45862.70 | 37.598 |
| 710 | 29547.20 | 41.851 | 1130 | 46238.00 | 37.473 |
| 720 | 29965.30 | 41.766 | 1140 | 46612.10 | 37.344 |
| 730 | 30382.50 | 41.678 | 1150 | 46984.90 | 37.212 |
| 740 | 30798.90 | 41.587 | 1160 | 47356.30 | 37.077 |
| 750 | 31214.30 | 41.494 | 1170 | 47726.40 | 36.937 |
| 760 | 31628.70 | 41.398 | 1180 | 48095.10 | 36.795 |
| 770 | 32042.20 | 41.301 | 1190 | 48462.30 | 36.649 |
| 780 | 32454.70 | 41.202 | 1200 | 48828.00 | 36.499 |
| 790 | 32866.30 | 41.102 | 1210 | 49192.30 | 36.346 |
| 800 | 33276.80 | 41.000 | 1220 | 49555.00 | 36.190 |
| 810 | 33686.30 | 40.897 | 1230 | 49916.10 | 36.032 |
| 820 | 34094.70 | 40.794 | 1240 | 50275.60 | 35.871 |
| 830 | 34502.10 | 40.689 | 1250 | 50633.50 | 35.708 |
| 840 | 34908.50 | 40.585 | 1260 | 50989.70 | 35.545 |
| 850 | 35313.80 | 40.480 | 1270 | 51344.40 | 35.381 |
| 860 | 35718.10 | 40.375 | 1280 | 51697.40 | 35.217 |
| 870 | 36121.30 | 40.270 | 1290 | 52048.70 | 35.055 |
| 880 | 36523.50 | 40.165 | 1300 | 52398.50 | 34.897 |
| 890 | 36924.60 | 40.061 | 1310 | 52746.70 | 34.742 |
| 900 | 37324.70 | 39.956 | 1320 | 53093.30 | 34.593 |
| 910 | 37723.80 | 39.852 | 1330 | 53438.60 | 34.451 |
| 920 | 38121.80 | 39.748 | 1340 | 53782.40 | 34.319 |
| 930 | 38518.70 | 39.645 | 1350 | 54125.00 | 34.199 |
| 940 | 38914.70 | 39.542 | 1360 | 54466.40 | 34.093 |
| | | | 1370 | 54806.90 | 34.004 |

Table 5-1 Continuation

**Example:** For 28.2°C, use 1000.2 + (3.2)40.5 = 1129.8 uV or, slightly more accurately, 1203.1 - (1.8)40.67 = 1129.9 uV.

## 5.4 PIN ASSIGNMENTS (Jumper Pin-Group P1)

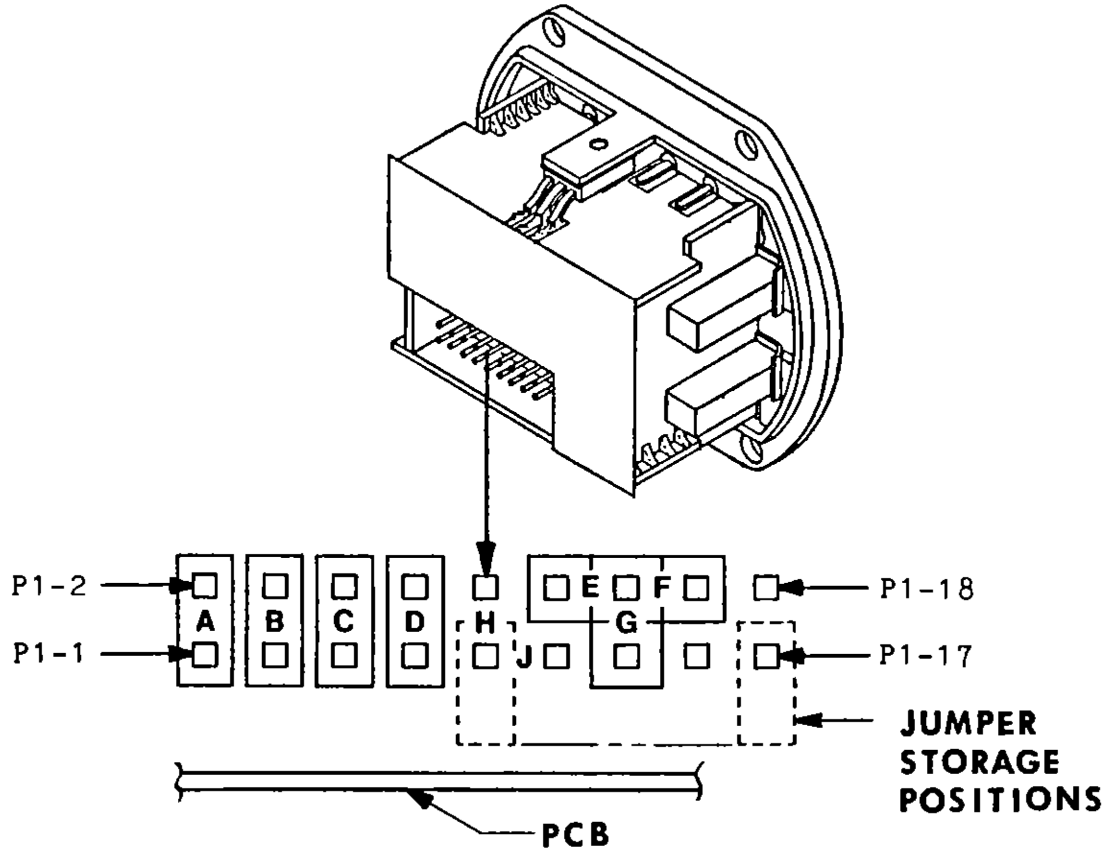



Figure 5-4 Jumper Diagram

| Jumper Function | P1 Pins Used |
|---|---|
| 'A' Zero | 1 and 2 |
| 'B' Zero | 3 and 4 |
| 'C' Zero | 5 and 6 |
| 'D' Zero | 7 and 8 |
| 'E' Span | 12 and 14 |
| 'F' Span | 14 and 16 |
| 'G' Span | 13 and 14 |

NOTE: P1 connector pins 9, 10, 11, 15, 17 and 18 are used solely for computerized testing by the factory.

## 5.5 CALIBRATION FORMULA (Alternate to Using Base/Top Tables)

### 5.5.1 Calculation of ZEXTRA

When the SPAN pot is turned Clockwise it increases the output, decreasing the SPAN required for full-scale output and adding ZEXTRA, which is used to set the Zero (Base Temperature) jumpers.

$$ZEXTRA = (MAXSPAN - SPAN) / 4$$

### 5.5.2 Zero Jumper Selection (Equation alternate to Table 5-2)

From zero to four jumpers may be placed on the connector to suppress the ZERO (temperature corresponding to 4 mA output). The equation is:

$$(ZERO+ZEXTRA) = 90\ (8A+4B+2C+D) + 70 \times ZPOT\ ,\ °C$$

where a "1" is used for each jumper (A,B,C,D) and the value of Zero pot ranges from +1.0 to 0 to -1.0 as it is turned clockwise.

NOTE: Store the unused jumpers between the bottom connector pins and the printed-circuit board as shown on in Figure 5-4.

| WITHOUT SPAN JUMPERS | | |
|---|---|---|
| Z JUMPERS | Base | Top |
| NONE | -75 | 950 to 1325 |
| D (ONLY) | -25 | 1025 to 1372 |
| C (ONLY) | 0 | 1075 to 1372 |
| C AND D | 75 | 1150 to 1372 |
| B (ONLY) | 175 | 1225 to 1372 |
| B AND D | 275 | 1300 to 1372 |

| USING SPAN JUMPER 'E' | | |
|---|---|---|
| Z JUMPERS | Base | Top |
| NONE | -75 | 300 to 575 |
| D (ONLY) | -5 | 370 to 645 |
| C (ONLY) | 65 | 440 to 715 |
| C AND D | 135 | 510 to 785 |
| B (ONLY) | 205 | 580 to 855 |
| B AND D | 275 | 650 to 915 |
| B AND C | 345 | 720 to 995 |
| B,C AND D | 415 | 790 to 1065 |
| A (ONLY) | 485 | 860 to 1135 |
| A AND D | 555 | 930 to 1205 |
| A AND C | 625 | 1000 to 1275 |

| USING SPAN JUMPER 'F' | | |
|---|---|---|
| Z JUMPERS | Base | Top |
| NONE | -75 | 180 to 325 |
| D (ONLY) | 5 | 260 to 405 |
| C (ONLY) | 85 | 340 to 485 |
| C AND D | 165 | 420 to 565 |
| B (ONLY) | 245 | 500 to 645 |
| B AND D | 325 | 580 to 725 |
| B AND C | 405 | 660 to 805 |
| B,C AND D | 485 | 740 to 885 |
| A (ONLY) | 565 | 820 to 965 |
| A AND D | 645 | 900 to 1045 |
| A AND C | 725 | 980 to 1125 |
| A,C AND D | 805 | 1060 to 1205 |
| A AND B | 885 | 1140 to 1285 |
| A,B AND D | 965 | 1220 to 1372 |

| USING SPAN JUMPER 'G' | | |
|---|---|---|
| Z JUMPERS | Base | Top |
| NONE | -75 | 20 to 155 |
| D (ONLY) | 0 | 100 to 235 |
| C (ONLY) | 85 | 180 to 315 |
| C AND D | 165 | 260 to 395 |
| B (ONLY) | 245 | 340 to 475 |
| B AND D | 325 | 420 to 555 |
| B AND C | 405 | 500 to 635 |
| B,C AND D | 485 | 580 to 715 |
| A (ONLY) | 565 | 660 to 795 |
| A AND D | 645 | 740 to 875 |
| A AND C | 725 | 820 to 955 |
| A,C AND D | 805 | 900 to 1035 |
| A AND B | 885 | 980 to 1115 |
| A,B AND D | 965 | 1060 to 1195 |
| A,B AND C | 1045 | 1140 to 1275 |

Table 5-2 Span Ranges In °C Obtained With Jumpers

Reference Sections 5.5.1 and 5.5.2.

## 6.0 MECHANICAL ASSEMBLY AND INSTALLATION

### 6.1 GENERAL INFORMATION

The low voltage requirement of the 502A-K enables its use with a current-loop indicator (Newport Model 508 recommended). Tapped holes on the back of the case provide for custom mounting to a flat surface; flanges on the back of the case provide for standard 8TK2 relay track mounting.

For flat surface mounting, use #6 hardware.
For 8TK2 relay track mounting, simply push onto track.

### 6.2 OPTIONAL ADAPTERS FOR MOUNTING

The following optional adaptors provide various mounting choices:

a. Adaptor plate for either front-screw-entry surface mount, or TR2/2TK relay track mount (see Figure 6-1).

b. Rail clamp for DIN-EN-50 022 relay track mount (Figure 6-2).

c. Spring retainers for external 76.4 to 88.9 mm (3 to 3.5 in) explosion-proof housing mount (see Figure 6-3).

### 6.3 SURFACE AND TR2/2TK RELAY TRACK MOUNTING PROCEDURE

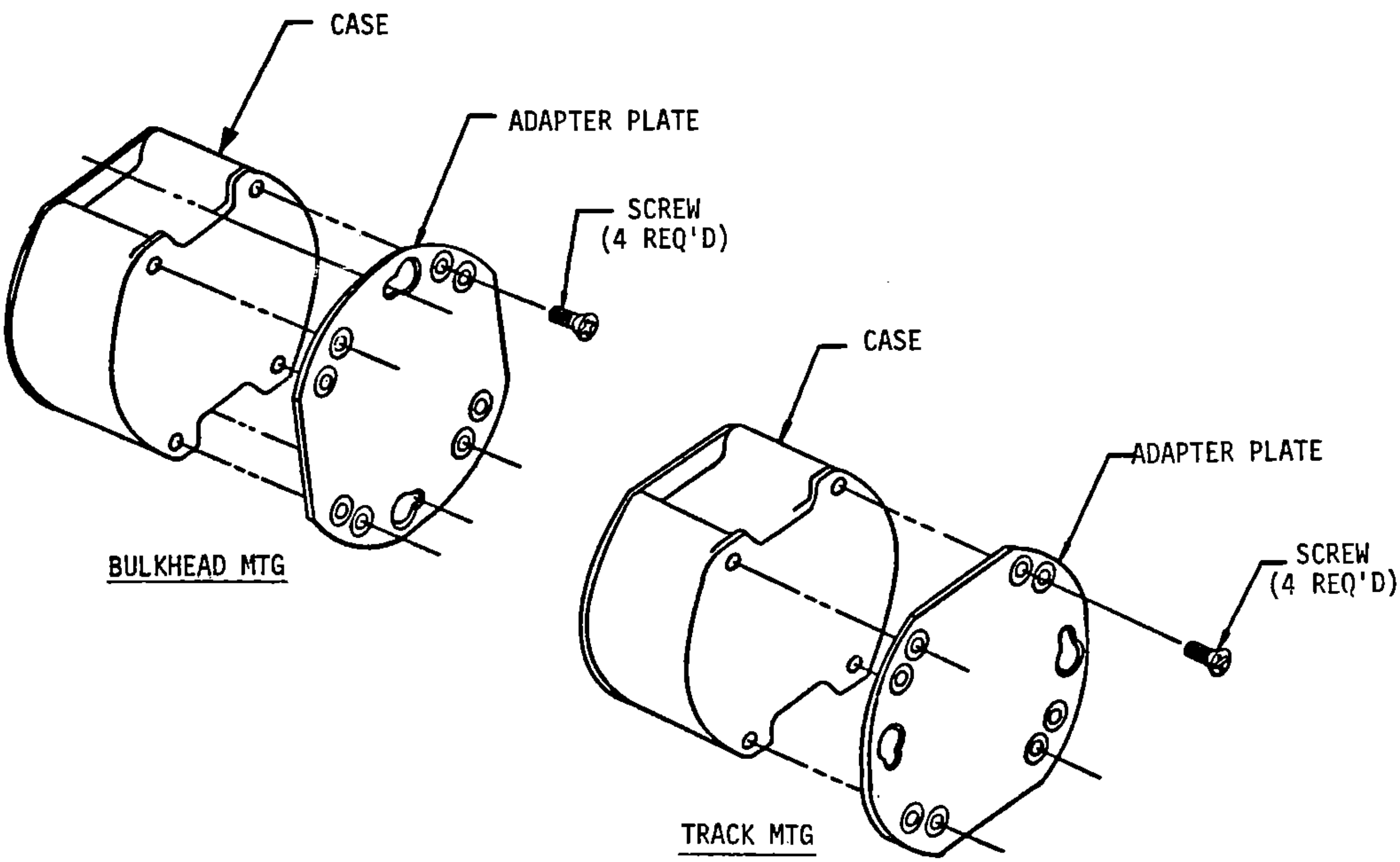
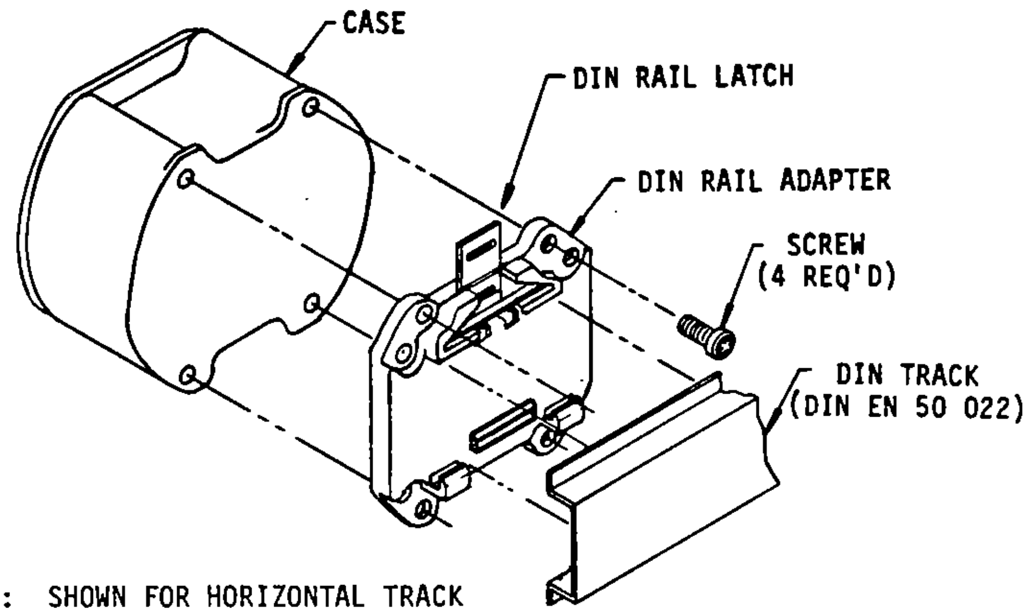


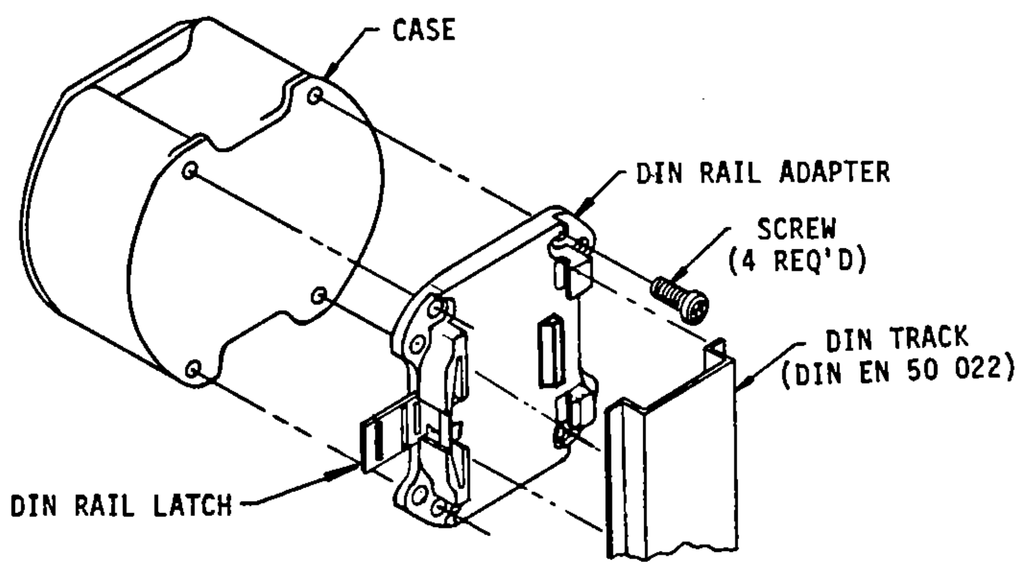

Figure 6-1 Bulkhead and Track Mounting

1. Position plate for desired application.
2. Use #6 hardware to mount plate to back of 502A-K case.

## 6.4 DIN EN-50-022 RELAY TRACK MOUNTING PROCEDURE




DIN TRACK MTG: SHOWN FOR HORIZONTAL TRACK




DIN TRACK MTG: SHOWN FOR VERTICAL TRACK

Figure 6-2 DIN Track Mounting

1. Position plate for desired track direction.
2. Use #8 flathead screws to mount plate to back of 502A-K case.
3. Snap 502A-K case assembly onto DIN rail.

## 6.5 EXTERNAL EXPLOSION-PROOF HOUSING MOUNTING

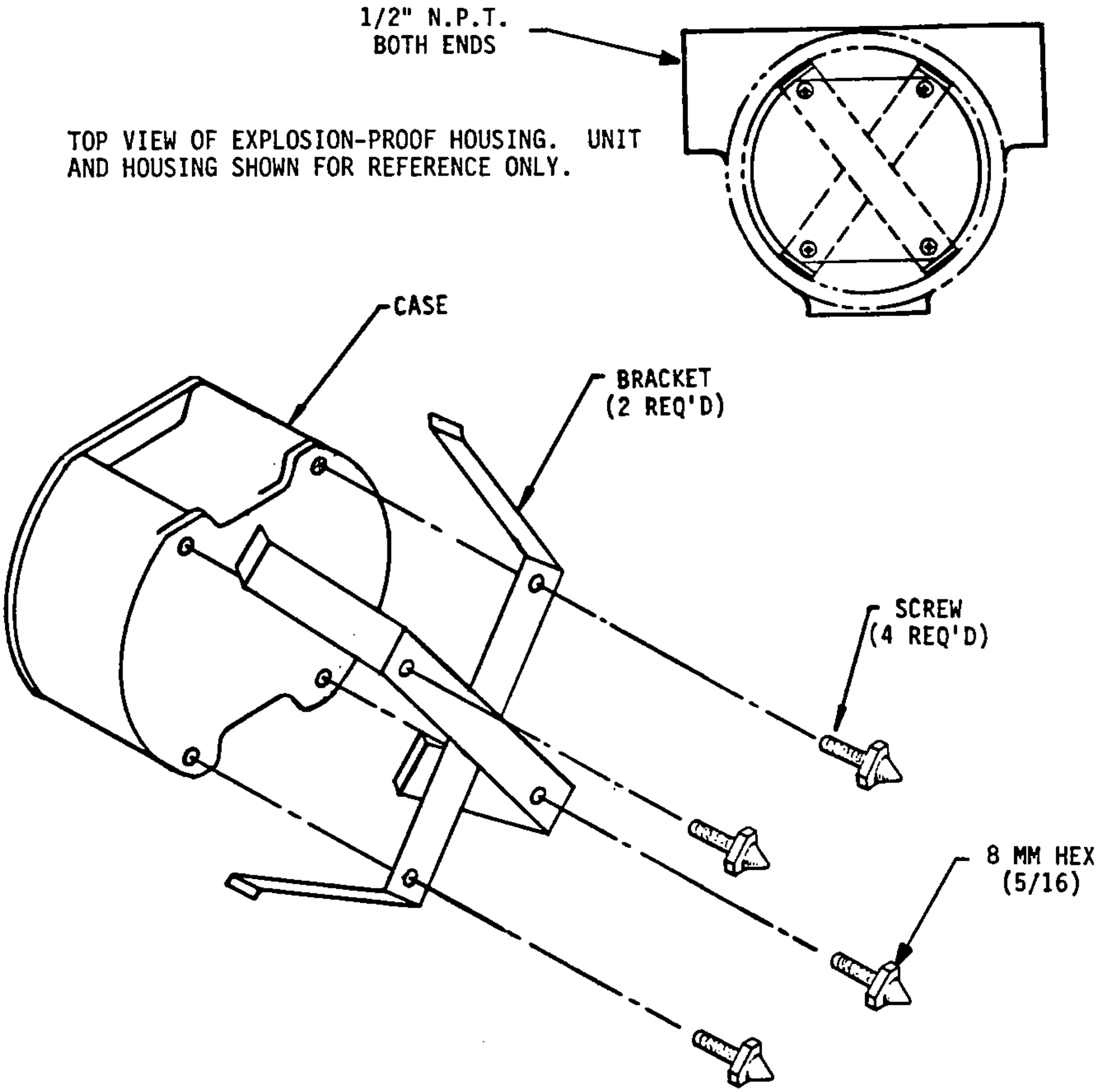



Figure 6-3 Spring Retainer for Explosion-Proof Housing

1. Position spring retainer across back of 502A-K case.
2. Use wire protector feet (4 provided with above option) to hold spring retainers in place.
3. Press 502A-K case assembly into explosion-proof housing.

## 7.0 DRAWINGS

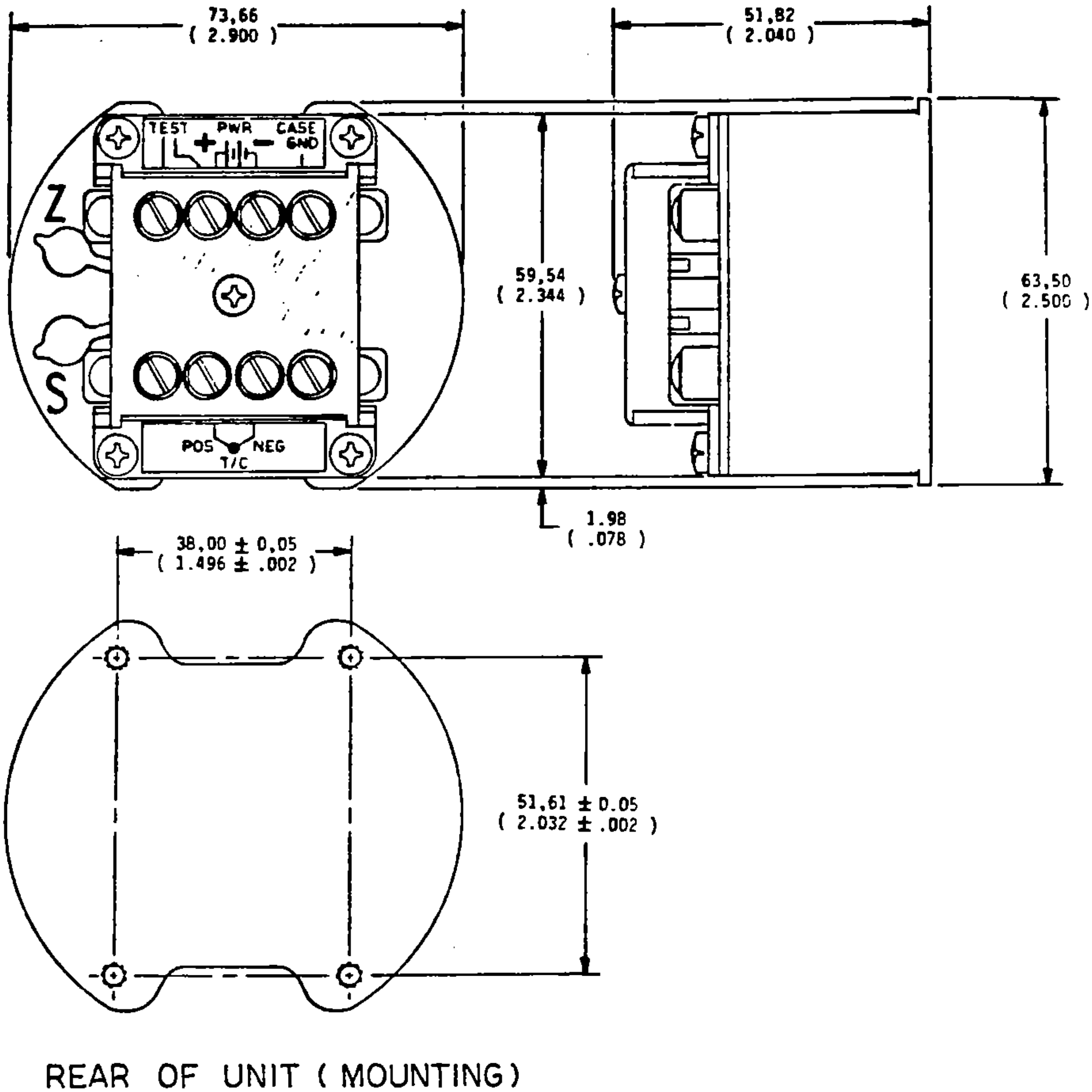



Figure 7-1 502A-K Case Dimensions

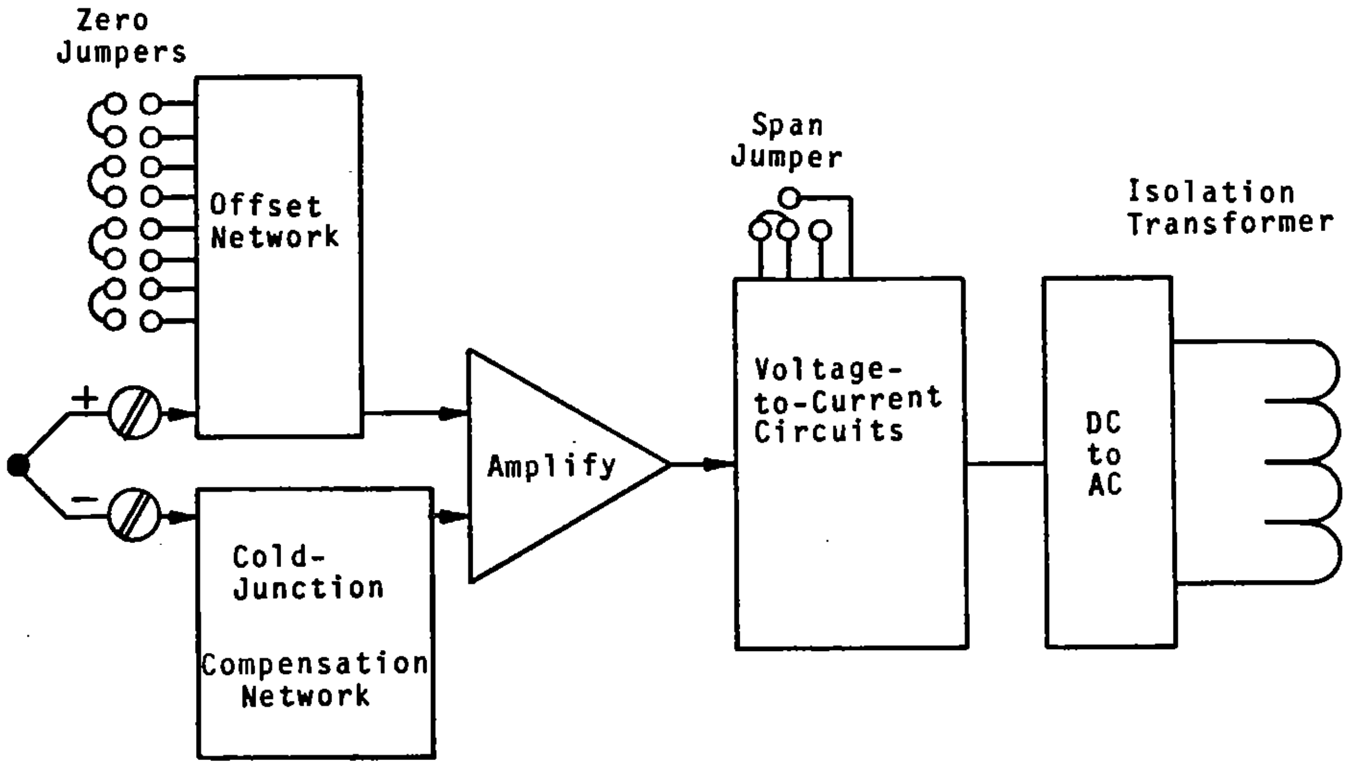



Figure 7-2 502A-K Preamp Block Diagram

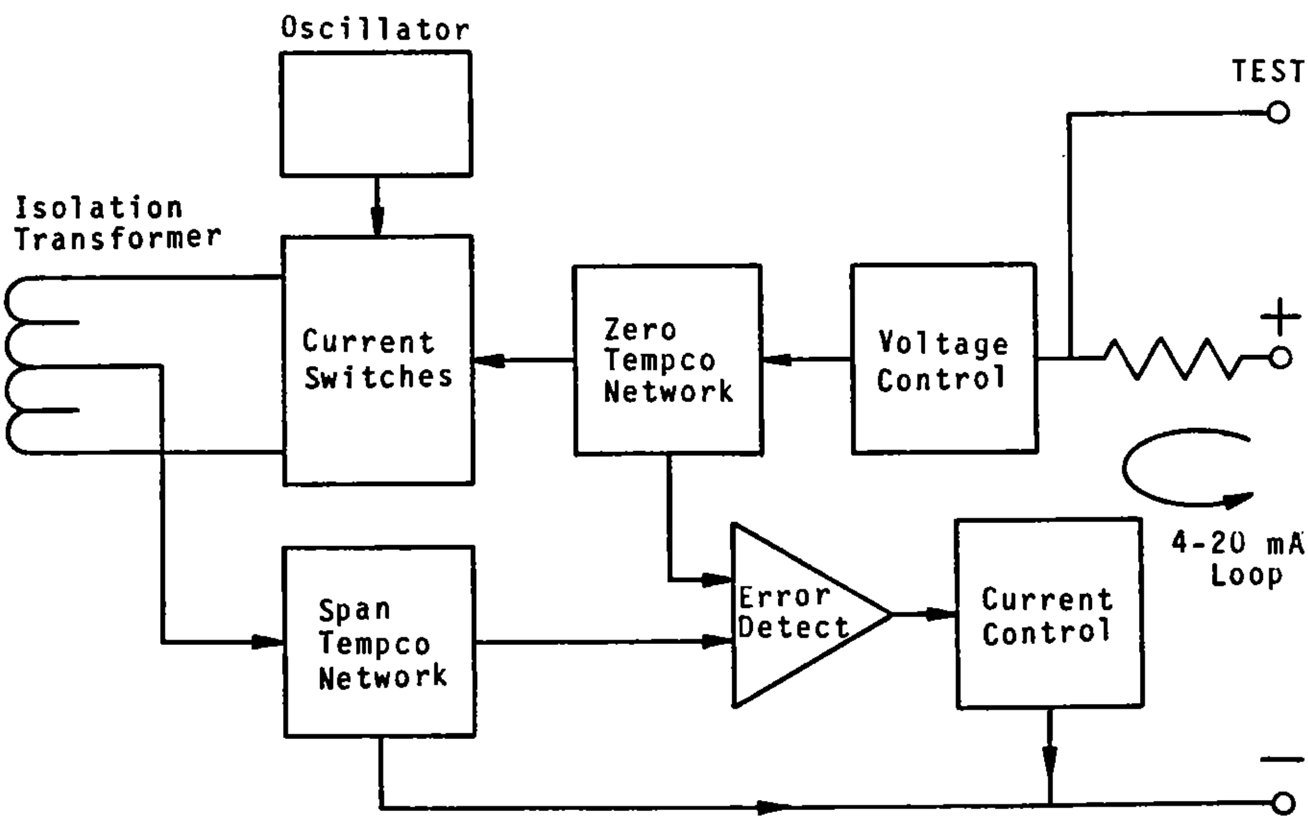



Figure 7-3 502A-K Postamp Block Diagram

## APPENDIX A

## TRANSMITTER ACCURACY SPECIFICATIONS

The complex current-transmitter circuitry necessary to amplify, isolate, protect, and offset weak input signals while consuming only small amounts of power can distort the signal in many ways. Additional accuracy limitations occur in thermocouple transmitters, which require precise cold-junction compensation and large Zero-suppression ranges in order to obtain good sensitivity and linearity for high temperatures.

Many transmitter data sheets omit key accuracy factors and/or express performance in percentage values without mentioning the full-scale value. Design limitations can be disguised by such "specsmanship"; the 502A-K specifications, however, are detailed in order to present the complete performance accuracy.

For a given thermocouple type, input errors are logically expressed in degrees (rather than microvolts), and output errors are readily expressed in microamperes, since output is current. Transmitter users are rarely interested in microamperes. Therefore, these output current errors are translated back to input degrees as a percentage (or ppm) of the selected Span.

Another fundamental division of errors is that of independence or dependence on Zero and Reading. Resistor aging and tempco mismatch in the Zero and Voltage Reference circuits will produce errors which increase with Zero suppression but which are independent of the amount of Reading (value above the Zero). Resistor aging and tempco mismatch in the amplifier gain (feedback) circuits will usually affect both Zero and Reading accuracy; amplifier gain tempco variations are important to just the Reading stability. A complete error specification needs a term proportional to Zero (suppression) and a term proportional to Reading.

For thermocouple transmitters, the Cold-Junction Compensation (CJC) is never perfect, even when factory-tailored over wide ambient excursions with curvilinear adjustments, as in the 502A-K. This error component is readily stated as a percentage of the ambient temperature excursion from the nominal temperature at which the Zero was set (assuming, as in the 502A-K, that the Zero potentiometer has ample resolution on all Zero and Span ranges). For transmitters with restricted turndown ratios (low Zero Suppression capability), the tempco errors may be lumped into a single error term.

In addition to these three components of tempco (ambient temperature effects), there are other possible errors, often referred to as "hysteresis," "repeatability," "drift," or "time" errors. No statistically-significant errors of these types have yet been observed for the 502A-K, which utilizes a solid-state, band-gap input voltage reference, matched-pair input PNP transistors, integrated-circuit current source and imbalance control, and matched-tempco bridge resistors. The 502A-K also provides a variable-tempco output adjustment (factory-set) which eliminates many of the errors lumped in this category for other units. Its specification includes a 0.2°C tolerance for the calibration accuracies.