RoHS 2 Compliant

505
4-20 mA LOW-DROP ISOLATOR TWO-WIRE TRANSMITTER

10689ML-01

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TABLE OF CONTENTS

1.0 GENERAL INFORMATION

The 505 two-wire transmitter takes in milliampere signals using only millivolts of drop, provides 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 and the output circuits is tested at 1500 V rms. As much as 750 ohms dropping resistance may be used in the power leads of the 505 when the unit is energized from a 24 V dc source because of the small compliance voltage needed by the unit.

1.1 ACCURACY AND STABILITY

Selected resistors in a temperature-sensing output bridge provide cancellation of both input and output Span temperature effects. High-ambient-temperature compensation points are checked. The unit is certified for accuracy from -40 to +85°C (-40 to +185°F).

1.2 ADAPTABILITY/TURNDOWN

The Span of the 505 can be ranged anywhere from 5 to 100 mA by selection of one of four jumper positions, with fine tuning provided by a multiturn, top-accessible potentiometer. Sixteen Zero steps, also provided by 505 jumpers, allow placement of the input for 4-mA output zero at an input anywhere from -30 to +60 mA, with fine tuning provided by another top-accessible, multiturn potentiometer.

1.3 LINEARITY

The 505 zero-suppression capabilities (high turndown ratio) allow high-gain control for continuous processes with good linearity for many nonlinear transducers when small span is selected.

1.4 WIRING ISOLATION

Input (and shield) and output (DC power) barrier strips accept wires up to 2 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 505 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 505 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 505 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 505 (less than 75 mm or 3 in OD) permits mounting in many small spaces, including explosion-proof housing 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 exposed environments.

2.0 SPECIFICATIONS

2.1 INPUT

Configuration: Isolated, mA input, mA output

Input impedance:	1 Ω
Common mode voltage, input to case:	Test, 2100 V peak; IEC spacing for 354 V peak
Common mode rejection, input to case:	120 dB min at 60 Hz

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 10 µA ±0.1% of Span
Six month stability:	Within 10 µA ±0.2% of base input
Power supply effect:	Within ±0.005%/V
Ambient temperature effect for 50°C change:	Zero: Within ±25 µA Span: Within 0.3% Suppression: ±0.2% of base input

2.4 ENVIRONMENTAL

Operating temperature:	-40 to 85°C
Storage temperature:	-55 to 125°C
Humidity:	Waterproof (sealed case)
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 MECHANICAL ASSEMBLY AND INSTALLATION

3.1 UNPACKING AND INSPECTION

Your 505 transmitter was systematically inspected and tested, then carefully packed before shipment. Unpack the instrument and inspect for shipping damage. If possible, remove the casing and visually inspect the internal circuitry. Notify the freight carrier immediately if damage exists.

Each package includes an assembled transmitter and an owners' manual. If these items are not according to your order, contact your local distributor or Newport Electronics.

3.2 SAFETY CONSIDERATIONS

As delivered from the factory/distributor, this instrument complies with required safety regulations. To prevent fire or electrical hazard and to ensure safe operation, please follow the guidelines below.

VISUAL INSPECTION: Do not attempt to operate the unit if damage is found.

MOUNTING: Observe the mounting instructions in Sections 3.3 through 3.6, as applicable. The transmitter must be tightly secured at the time of installation. Case dimensions are provided in Section 6.

POWER VOLTAGE: Verify that the instrument is connected for the power voltage rating that will be used (9-50 V dc). If not, make the required changes as indicated in Section 4.

POWER WIRING - This instrument has no power-on switch; it will be in operation as soon as the power is connected.

SIGNAL WIRING - Do not make signal wiring connections or changes when power is on. Make signal connections before power is applied. If connection changes are required, first disconnect the power.

EXERCISE CAUTION - As with any electronic instrument, high voltage may exist when attempting to install, calibrate, or change the push-on jumpers of the transmitter.

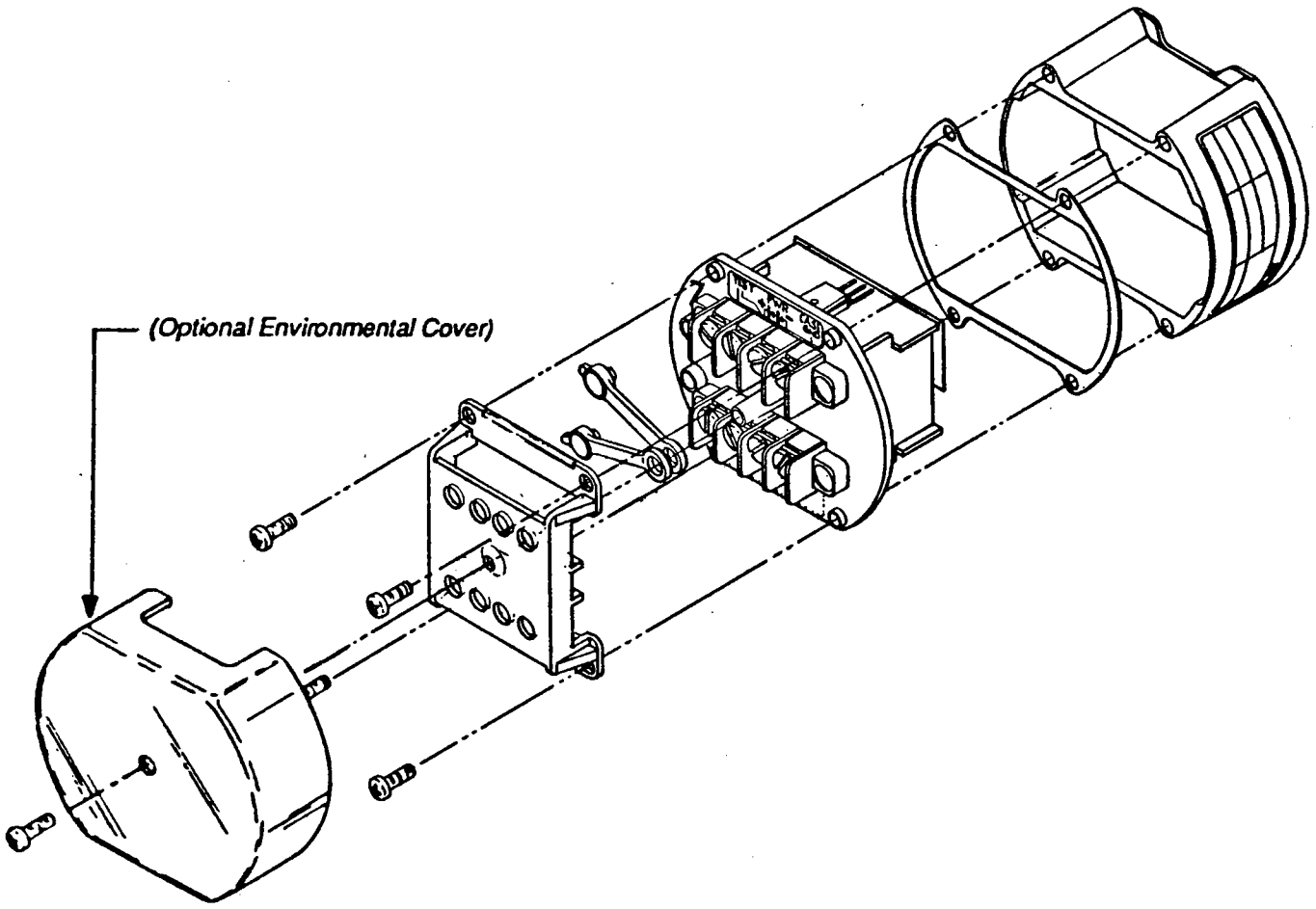


Figure 3-1 Exploded View of Model 505

The very low input voltage requirement of the 505 (1Ω, or 20 mV drop for 20 mA input) means that a 505 can be added to almost any current loop for expansion and isolation purposes.

The low output voltage requirement of the 505 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.

3.3 OPTIONAL ADAPTERS FOR MOUNTING

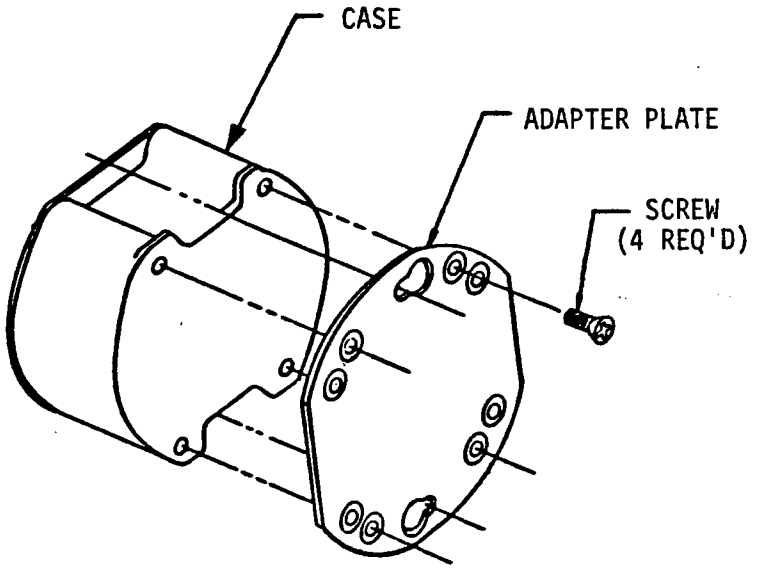
The following optional adaptors provide various mounting choices:

a. Adaptor plate for either front-screw-entry surface mount, or TR2/2TK relay track mount (see Figure 3-2).

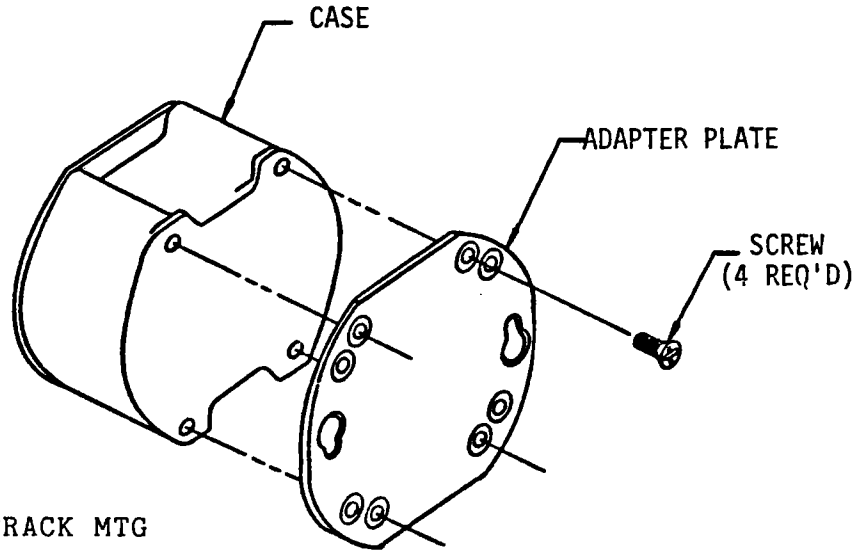
b. Rail clamp for DIN EN 50 022 relay track mount (Figure 3-3).

c. Spring retainers for external 76.4 to 88.9 mm (3 to 3.5 in) explosion-proof housing mount (see Figure 3-4).

3.4 SURFACE AND TR2/2TK RELAY TRACK MOUNTING PROCEDURE



BULKHEAD MTG



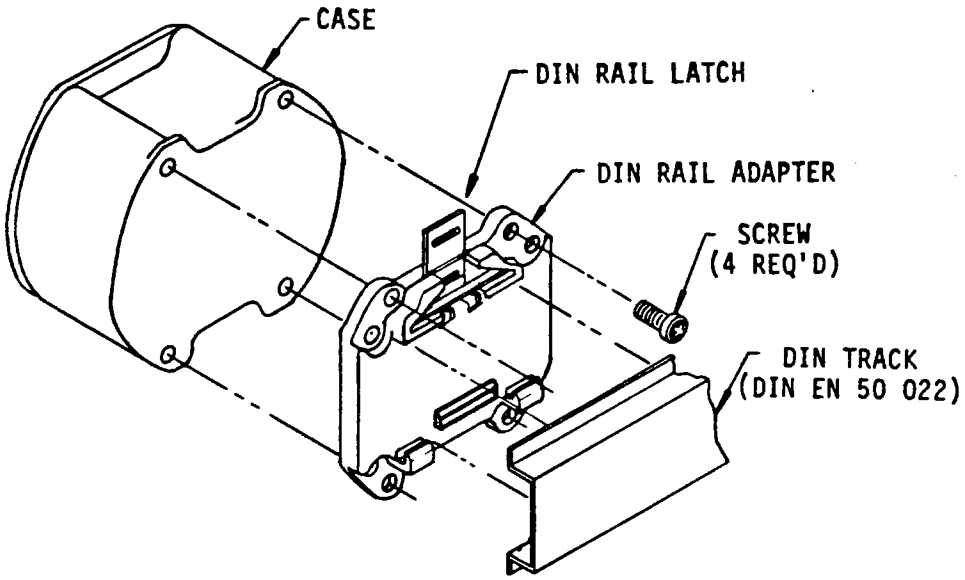
TRACK MTG

Figure 3-2 Bulkhead and Track Mounting

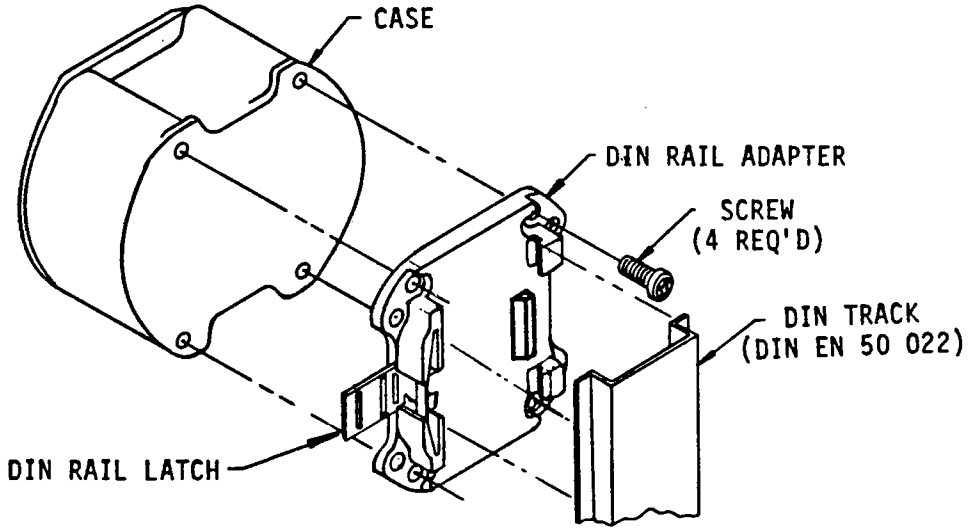
1. Position plate for desired application.

2. Use #6 hardware to mount plate to back of 505 case.

3.5 DIN EN-50-022 RELAY TRACK MOUNTING PROCEDURE



DIN TRACK MTG: SHOWN FOR HORIZONTAL TRACK

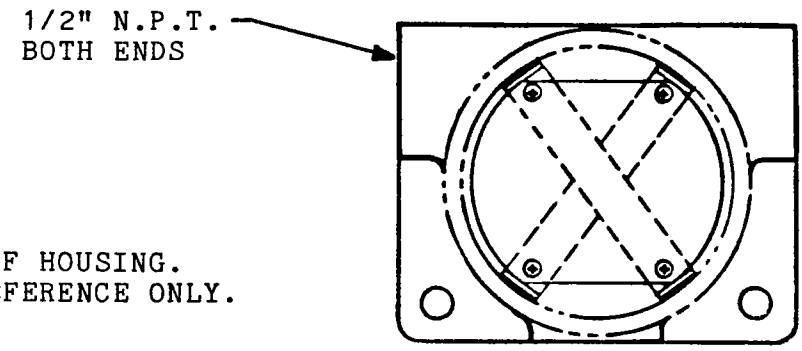


DIN TRACK MTG: SHOWN FOR VERTICAL TRACK

Figure 3-3 DIN Track Mounting

1. Position plate for desired track direction.
2. Use #8 flathead screws to mount plate to back of 505 case.
3. Snap 505 case assembly onto DIN rail.

3.6 EXTERNAL EXPLOSION-PROOF HOUSING MOUNTING



TOP VIEW OF EXPLOSION-PROOF HOUSING.
UNIT AND HOUSING SHOWN FOR REFERENCE ONLY.

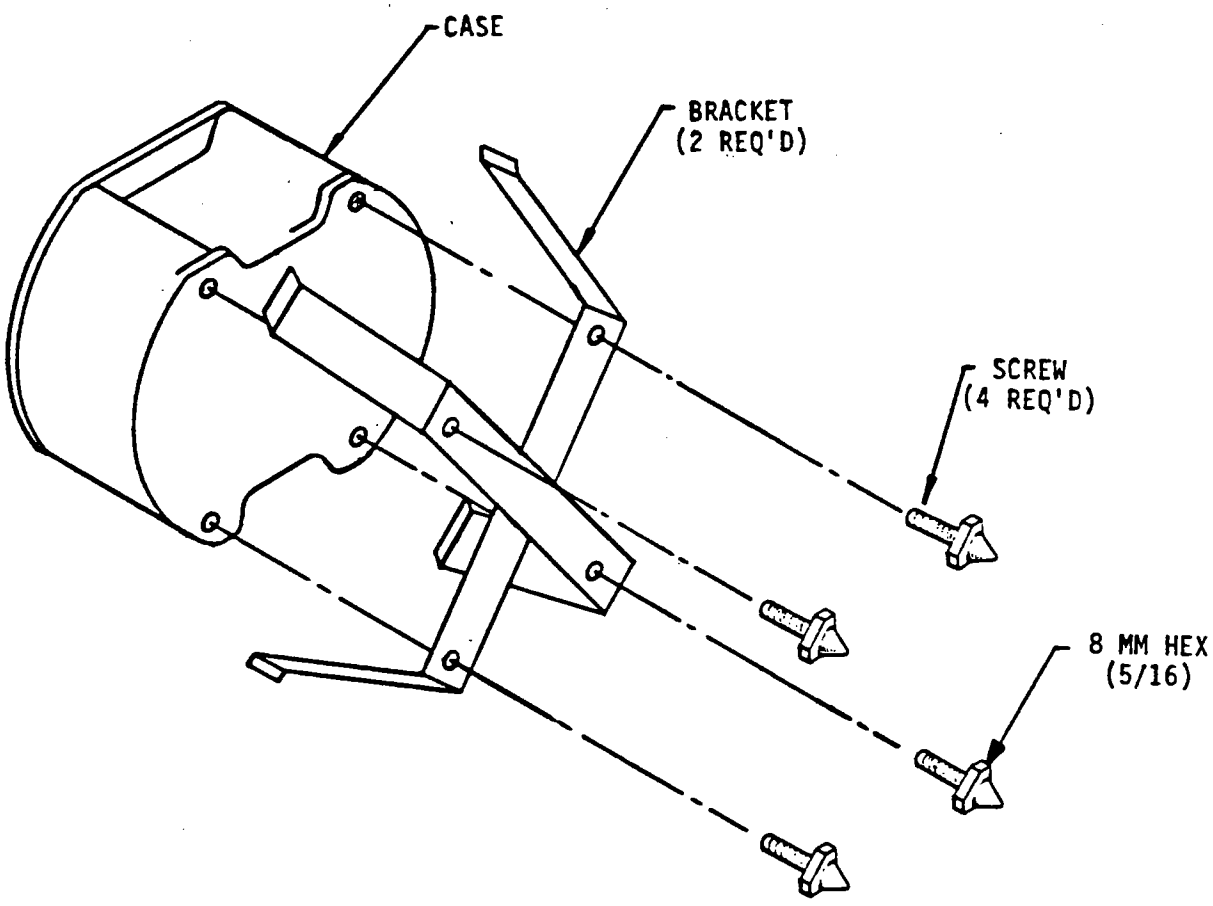


Figure 3-4 Spring Retainer for Explosion-Proof Housing

1. Position spring retainer across back of 505 case.
2. Use wire protector feet (4 provided with above option) to hold spring retainers in place.
3. Press 505 case assembly into explosion-proof housing.

4.0 POWER AND SIGNAL INPUT CONNECTIONS

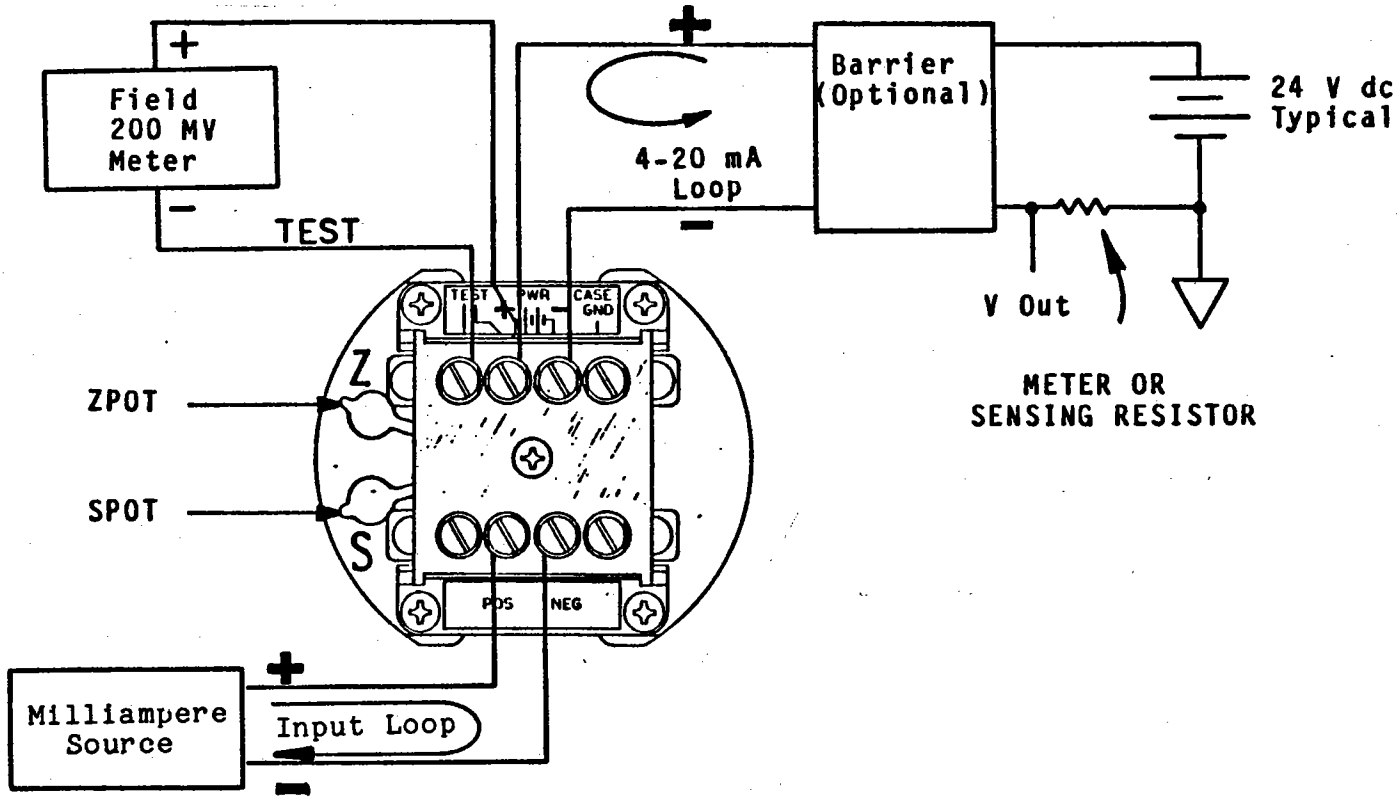


Figure 4-1 Power Input Connections

4.1 GENERAL

TEST, PWR +, and PWR - screws accept 2 mm (13 gauge) or lighter wire. CASE GND is grounded to the case. Power 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	SIG HI
C	SIG LO
D	N/C

5.0 CONFIGURATION

Model 505 is normally delivered configured for 4/20 mA in = 4/20 mA out.

5.1 TOOLS AND EQUIPMENT

#1 Phillips screwdriver
3/32" flat blade screwdriver, VACO 17764 or equivalent
Two 4 1/2 digit DVMs (digital voltmeters)
10 or 100 ohm 1% resistor
Fixed or variable DC power supply or battery (range of 11-30 V dc)
Milliampere source

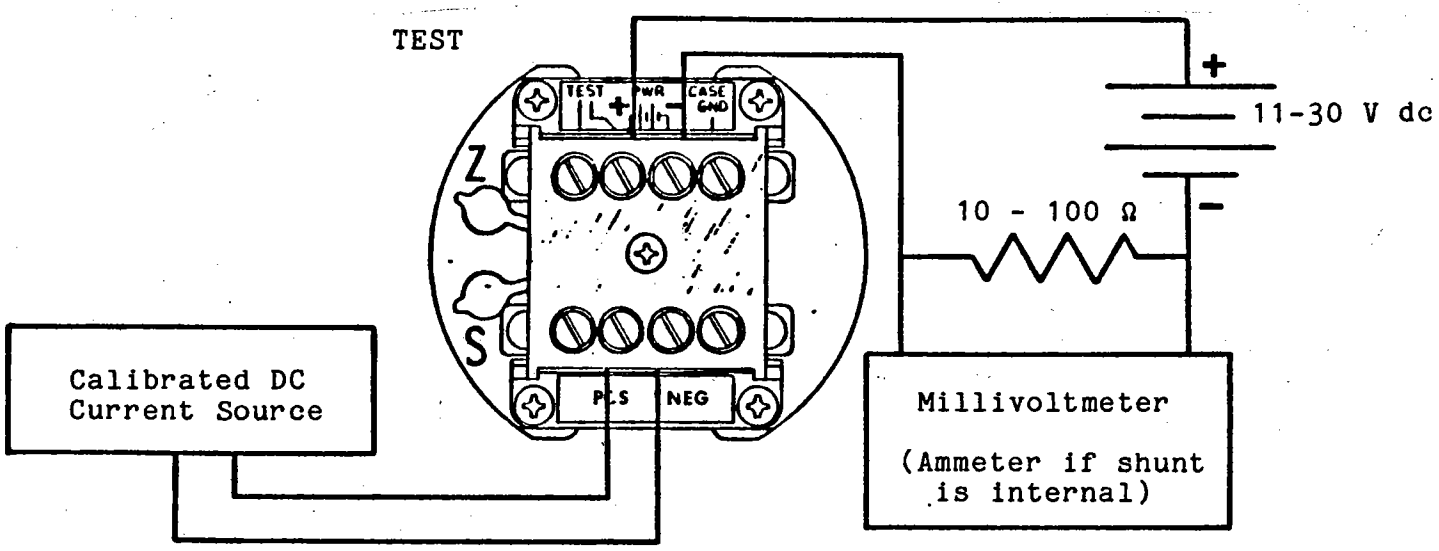


Figure 5-1 Calibration Using Precision Current Source

5.2 CALIBRATION PROCEDURE

Refer to Figure 5-3 (Calibration flowchart) and familiarize yourself with the general procedure to be followed.

1. Remove the four Phillips-head screws from the case top and set aside the plastic barrier.
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 five turns clockwise (CW) from the full counter-clockwise (CCW) position (SPOT and ZPOT are both multi-turn pots).

NOTE: SPOT is never used more than 3/4 of the way clockwise, since full clockwise disconnects the feedback.

4. Refer to Table 5-2 and select the range which comes closest to your desired Base and Top milliampere leveles. Having done this, note which zero and span jumpers are called out by the table for the range that you have selected.
5. Turn the transmitter so that the jumper pin-forest is at hand, and move the push-on jumpers to the positions indicated in Figure 5-2 for the range chosen in the previous step. Place unused jumpers in storage positions.
6. Refer to Figure 5-1 and connect the transmitter to the power supply, milliampere source, current shunt, and millivoltmeter. Greater calibration stability can be obtained if the electronic assembly is installed in the case.
7. Using Table 5-1, determine LO-IN, the Base milliampere level.
8. Determine HI-IN, the Top milliampere level.
9. Set the milliampere calibration source to LO-IN and adjust ZPOT for 4.00 mA output current.

10. 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.

5.3 PIN ASSIGNMENTS (Jumper Pin-forest P1)

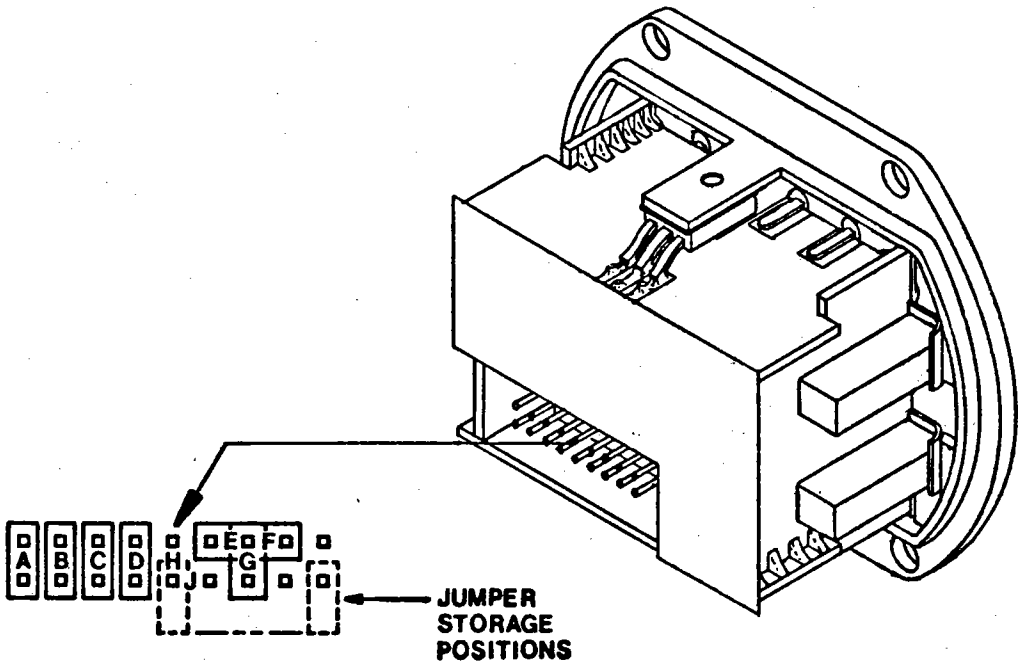


Figure 5-2 Jumper Diagram

Pin	Function
P1-1 P1-2	"A" Zero Jumper
P1-3 P1-4	"B"
P1-5 P1-6	"C"
P1-7 P1-8	"D"
P1-9	Preamp divider center
P1-10	Input tempco control
P1-11	V ref input
P1-12	"E" Span jumper point
P1-13	"G" Span jumper point
P1-14	Span jumper common ground
P1-15	Zero pot wiper (Input high)
P1-16	"F" Span jumper point
P1-17	Input low
P1-18	Preamp regulated supply voltage

WITHOUT SPAN JUMPERS

Z JUMPERS	Adjustable Range (mA) Base	Top
NONE	-35	15 to 55
D (ONLY)	-30	20 to 60
C (ONLY)	-25	40 to 65
C AND D	-25	45 to 75
B (ONLY)	-20	50 to 80
B AND D	-15	55 to 85
B AND C	-10	60 to 90
B,C AND D	-5	65 to 95
A (ONLY)	0	70 to 100
A AND D	5	75 to 105
A AND C	10	80 to 110
A,C AND D	15	85 to 110
A AND B	25	90 to 120
A,B AND D	35	95 to 130
A,B AND C	45	100 to 140
A,B,C AND D	60	105 to 160

USING SPAN JUMPER 'E'

Z JUMPERS	Adjustable Range (mA) Base	Top
NONE	-35	-20 to 10
D (ONLY)	-35	-20 to 15
C (ONLY)	-30	-15 to 20
C AND D	-25	-10 to 25
B (ONLY)	-20	-5 to 30
B AND D	-15	0 to 35
B AND C	-10	5 to 40
B,C AND D	-5	10 to 45
A (ONLY)	0	15 to 50
A AND D	5	20 to 55
A AND C	10	25 to 60
A,C AND D	15	30 to 65
A AND B	25	40 to 75
A,B AND D	35	50 to 85
A,B AND C	45	60 to 95
A,B,C AND D	60	75 to 110

USING SPAN JUMPER 'F'

Z JUMPERS	Adjustable Range (mA) Base	Top
NONE	-35	-25 to -10
D (ONLY)	-35	-25 to -5
C (ONLY)	-30	-20 to 0
C AND D	-25	-15 to 5
B (ONLY)	-20	-10 to 10
B AND D	-15	-5 to 15
B AND C	-10	0 to 20
B,C AND D	-5	5 to 25
A (ONLY)	0	10 to 30
A AND D	5	15 to 35
A AND C	10	20 to 40
A,C AND D	15	25 to 45
A AND B	20	30 to 50
A,B AND D	30	40 to 60
A,B AND C	45	55 to 75
A,B,C AND D	60	70 to 90

USING SPAN JUMPER 'G'

Z JUMPERS	Adjustable Range (mA) Base	Top
NONE	-35	-30 to -25
D (ONLY)	-35	-30 to -20
C (ONLY)	-30	-25 to -15
C AND D	-25	-20 to -10
B (ONLY)	-20	-15 to -5
B AND D	-15	-10 to 0
B AND C	-10	-5 to 5
B,C AND D	-5	0 to 10
A (ONLY)	0	5 to 15
A AND D	5	10 to 30
A AND C	10	15 to 25
A,C AND D	20	25 to 35
A AND B	30	35 to 45
A,B AND D	40	45 to 55
A,B AND C	50	55 to 65
A,B,C AND D	60	65 to 75

Table 5-1 Span Ranges In Milliamperes Obtained With Jumpers

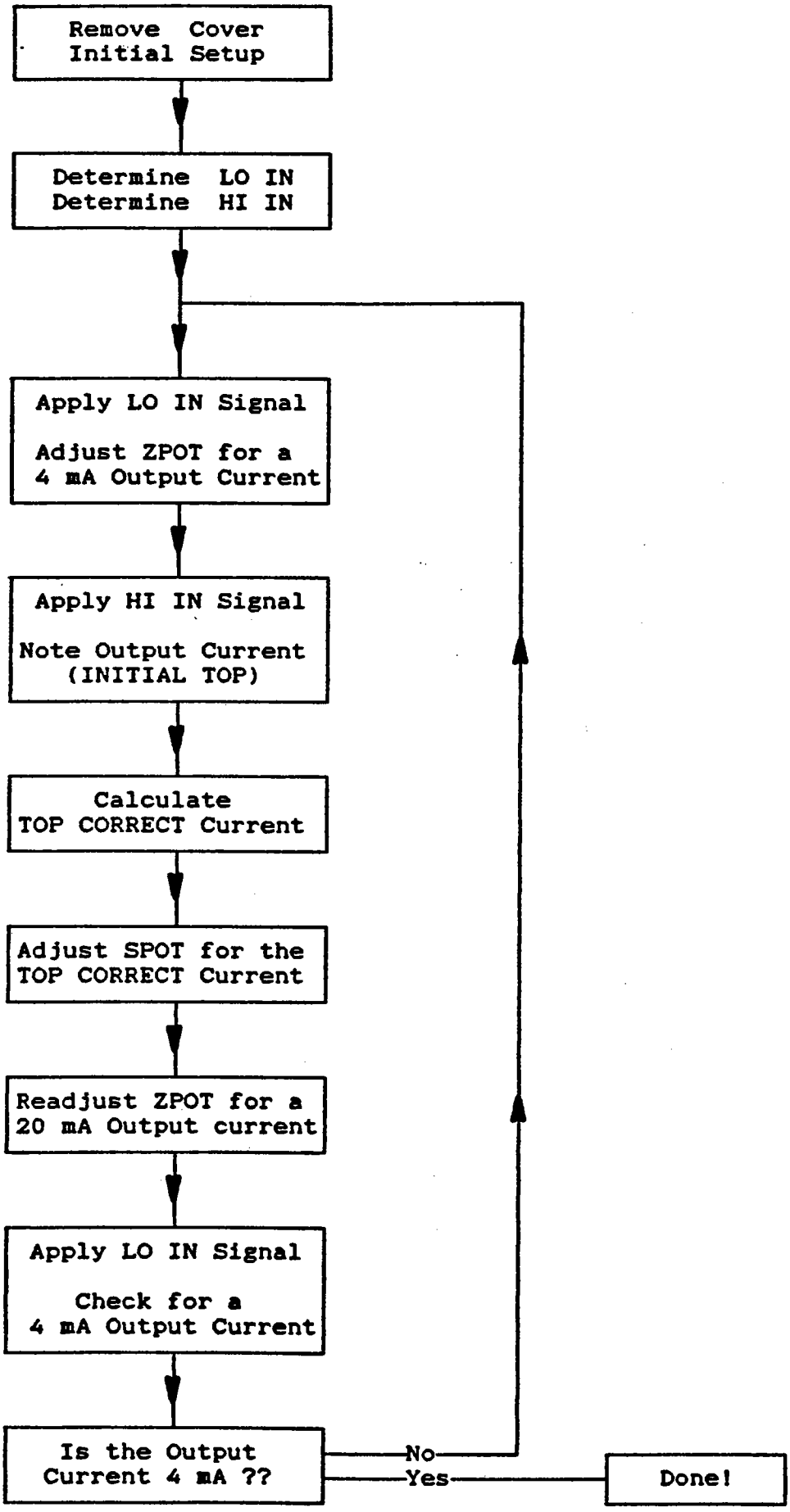


Figure 5-3 Calibration Flowchart

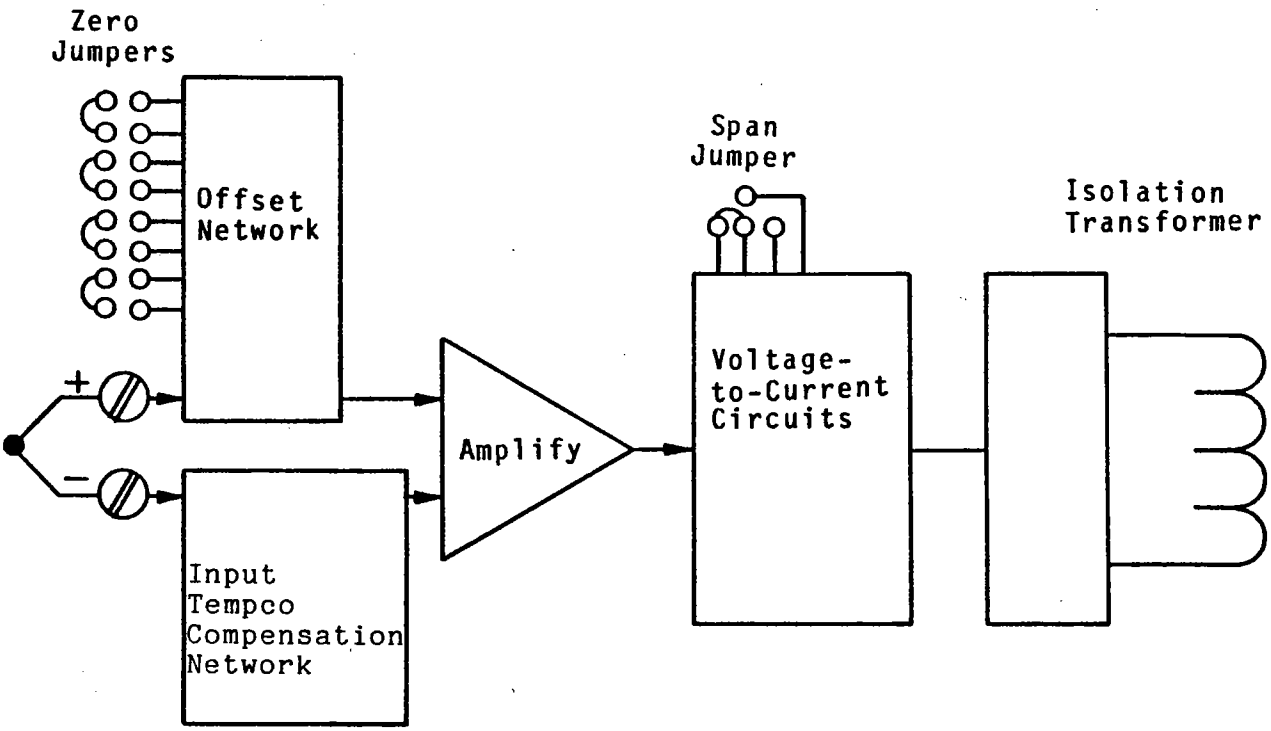


Figure 6-1 505 Preamp Block Diagram

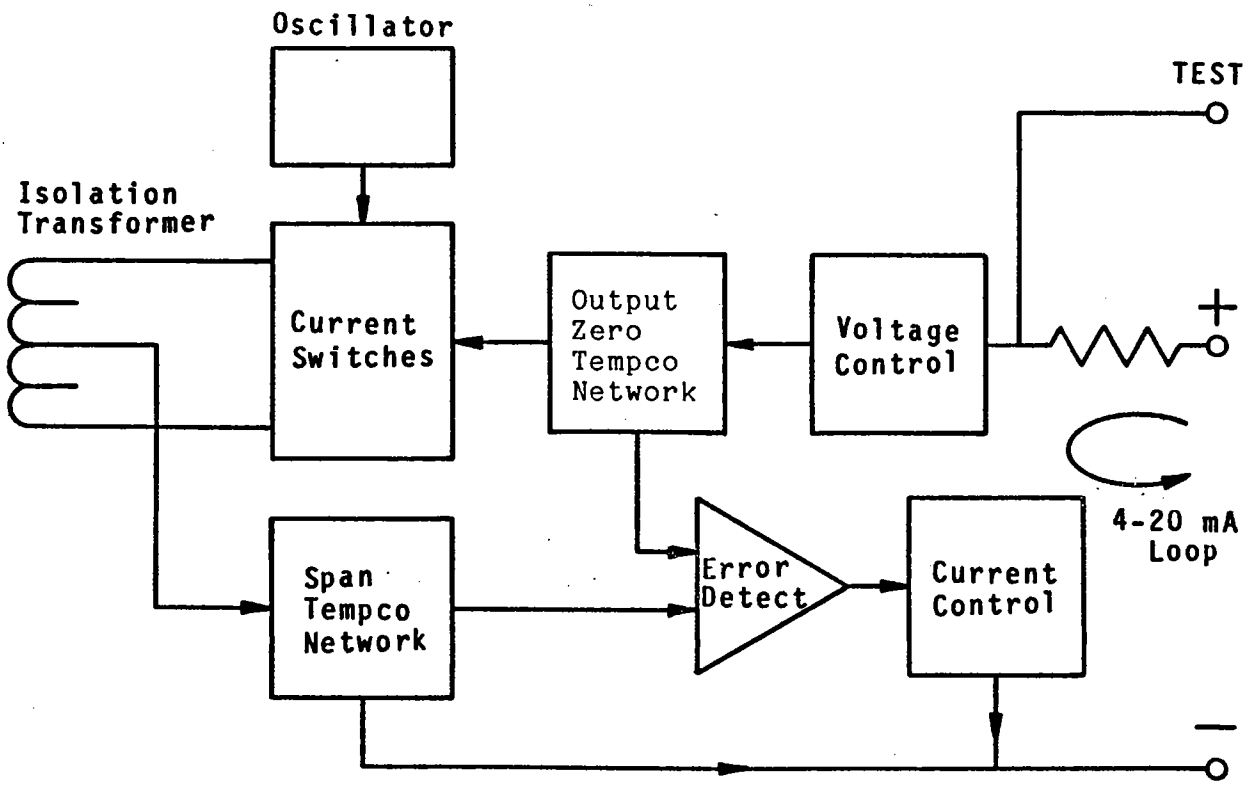


Figure 6-2 505 Postamp Block Diagram

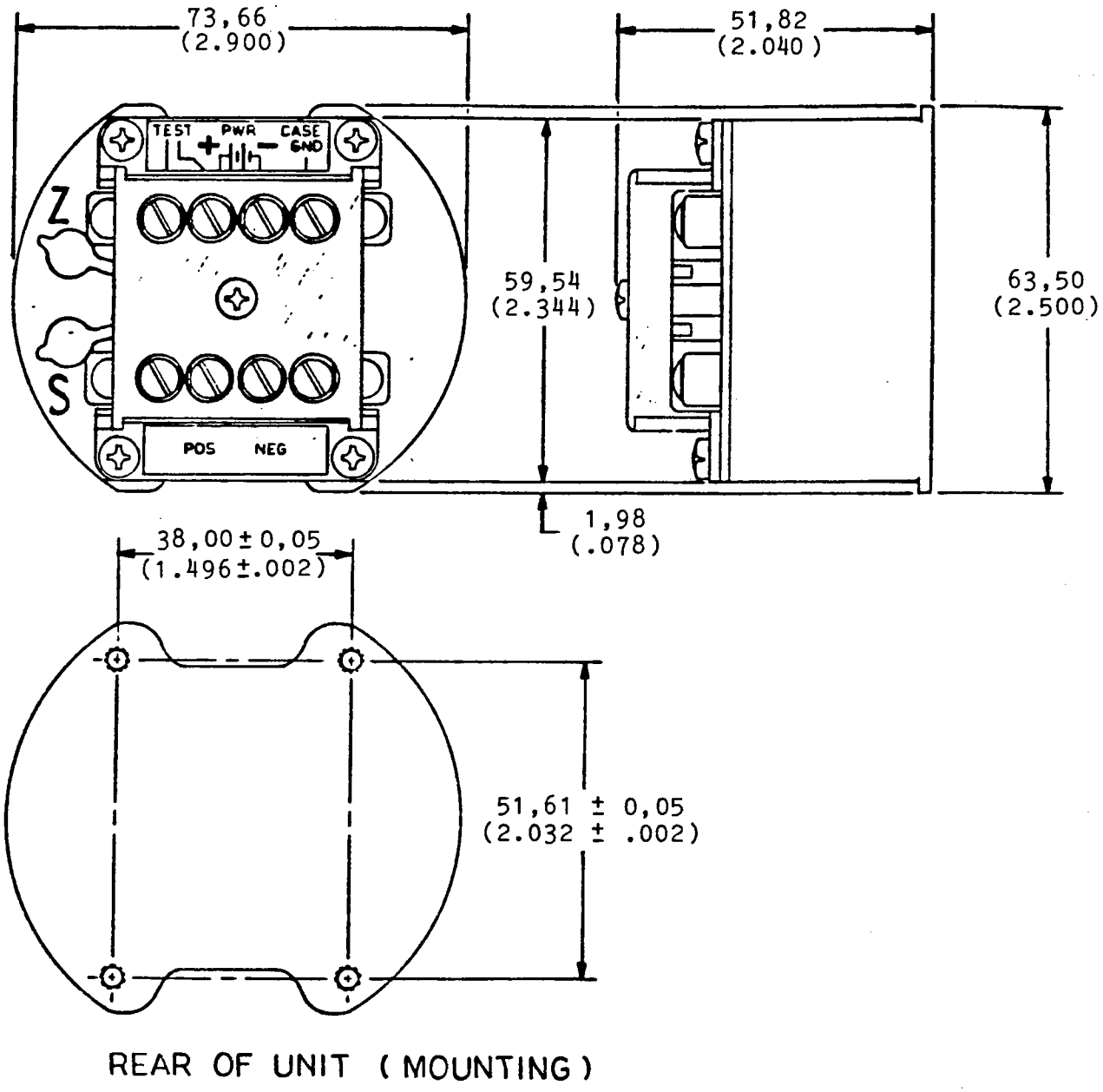


Figure 6-3 505 Case Dimensions

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.

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 505 specifications, however, are detailed in order to present the complete performance accuracy.

505 input and output errors are logically expressed in microamperes, since both input and output are currents.

A 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.

In addition to the Zero and Span 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 505, 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 505 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 10 uA tolerance for the calibration accuracies.