

# Isolated 4 to 20 mA Transmitters For Demanding Applications

Thermocouples, RTD (Pt100) or Ohms, Millivolts, Milliamps, Volts

## TX1500 Series



- ✓ Isolated to 1500 Vrms
- ✓ 2-Wire 4 to 20 mA Operation
- ✓ 9 to 50V Compliance
- ✓ Turndown Ratio to 10:1
- ✓ NMV Protection to 120 Vac
- ✓ -40 to 85°C (-40 to 185°F) Operation
- ✓ Shock Resistance to 55 g
- ✓ NEMA 4X (IP66) Metal Case
- ✓ Field Scalable
- ✓ RoHS 2 Compliant

### Unmatched Electrical Performance 2-Wire Operation

Power is obtained directly from the 4 to 20 mA loop, with no need for separate power input. This simplifies field wiring and prevents noise pickup from power lines.

TX1502A-K shown actual size.

### Isolation to 1500 Vrms (2100 Vp)

This exceptionally high CMV rating from the input to the case or output eliminates electrical ground loops between the signal source and the receiver. It also provides a high degree of protection for the receiver against electrical hazards, such as accidental contact between the signal source and an AC power line.

### 9 to 50V Compliance

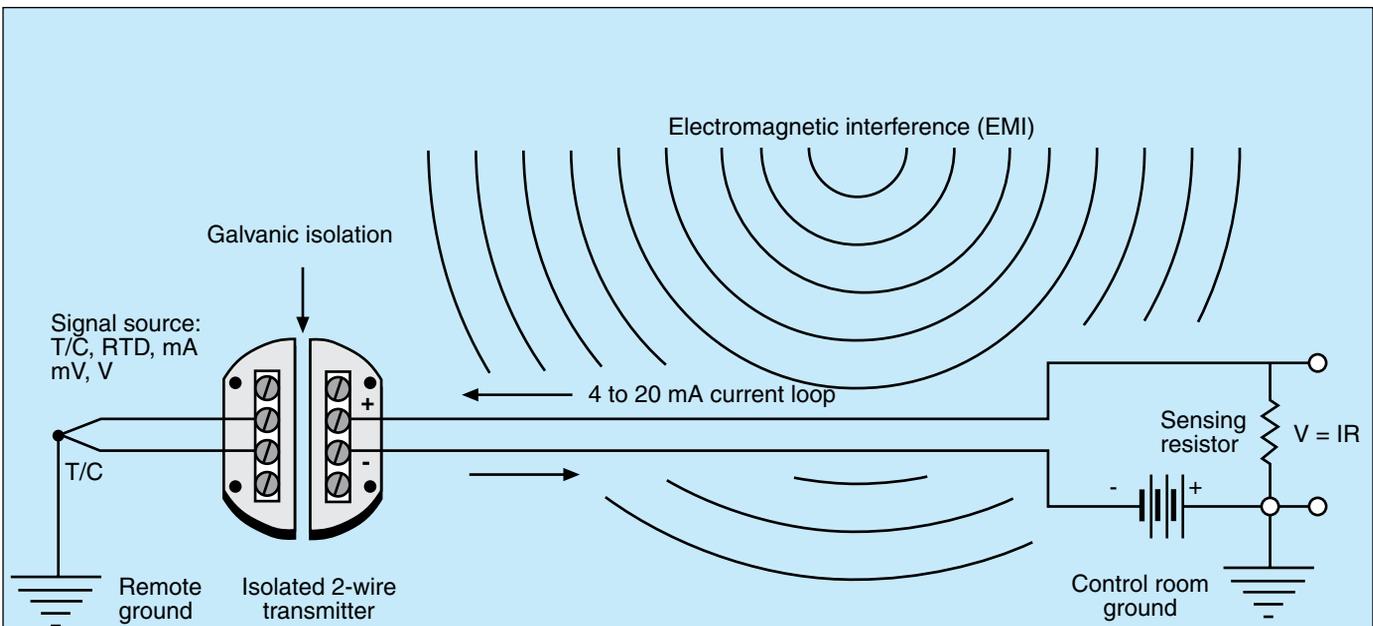
The loop voltage driving the transmitters can be from 9 to 50V without loss of accuracy. The exceptionally low 9V limit allows the transmitters to be used with low loop supply voltages, and it maximizes the voltage drop allowed in the current loop for intrinsic safety

**Custom Scaling Available! Specify Input Signals Corresponding to 4 and 20 mA. Please Contact Engineering for Details®**

barriers and load resistance. For example, at the full 20 mA output of the transmitter, a 750  $\Omega$  load can be used with a 24 Vdc source and a 150  $\Omega$  load can be used with a 12 Vdc source. In either case, there will still be enough voltage left to power the transmitter, namely 9 Vdc.

### 10:1 Turndown Ratio

Turndown ratio is defined as zero suppression divided by span. The exceptionally high 10:1 turndown ratio possible with the TX1500 Series indicates that wide zero offset can be combined with narrow signal span for closed loop control at high gain. The signal span can also be wide for control of batch operations, where a wide range of signal levels may be encountered over the entire batch cycle.



### Classic Application of a TX1500 Series 2-Wire Isolated Transmitter

The transmitter amplifies a low-level voltage signal to a 4 to 20 mA current signal, which is immune to voltage noise pickup. The voltage detected in the control room is  $V = IR$ , where  $I$  is the loop current and  $R$  is the dropping resistor of the receiving equipment. The isolation provided by the transmitter protects the receiving equipment and prevents ground loops between the remote signal ground and the ground of the control room.

### High Overvoltage Protection

Overvoltage of 120 Vac may be applied across the input or output leads for 1 minute for all models with voltage or thermocouple inputs. Reverse polarity of 400 Vp may be applied across the output leads indefinitely. These exceptionally high NMV overvoltage ratings provide further protection against possible electrical faults and wiring errors.

### Designed for Harsh Environments

*Extreme operating temperatures.* The operating temperature can range from -40 to 85°C (-40 to 185°F) while meeting published performance specifications. This allows the TX1500 Series to be used near furnaces or outdoors in the winter. The exceptionally wide operating temperature range is made possible by a proprietary electrical circuit and by extensive use of computer-graded and computer-matched electrical components.

*Resistance to shock and vibration.* The shock rating is 55 g (1.9 oz), which includes a 1.8 m (6') drop onto concrete. This is made possible by a compact die-cast metal case,

which is only 74 mm (2.9") in diameter, and by rugged mounting of the electronics. The circuit board assembly is in the shape of a rigid box and is firmly soldered to the top of the transmitter case.

### Waterproof Case

The case is made of diecast zinc alloy. It is waterproof to 35 kPa (5 psi) and meets NEMA 4X (IP66) standards. The top of the case is sealed against the bottom with a fluorosilicone gasket, and the openings in the top of the case for the zero and span adjustment, are sealed with fluorosilicone plugs.

### Explosion-Proof Housing Options

Three external NEMA 7 explosion-proof and NEMA 4 (IP65) waterproof, sand-cast, copper-free aluminum enclosures with corrosion-resistant "safety-blue" polyester powder-coating for use in hazardous locations. FM, UL, cUL Certification: Class I, Groups B, C, D; Class II, Groups E, F, G; and Class III, Type 4X. Demko/ATEX Certification: EX II 2 G D EEx d IIC. Option EPH1-ATEX is a single-height, all-metal housing for a single TX1500 Series transmitter.

Option EPW2-ATEX is a double-height metal enclosure with a glass window for a TX1500 Series transmitter on the bottom and a TX83A loop-powered indicator on top. The TX83A augments the transmitter with an LCD digital readout scaled in engineering units and only adds a 2.5 V drop to the current loop.

Option EPW3-ATEX is a single-height enclosure for one TX83A loop-powered indicator. This option includes 2 female ½ NPT pipe fittings, all required internal mounting hardware, and mounting flanges for a wall or bulkhead.

### Easy to Calibrate and Install

There is no need to specify different models for different ranges of the same signal type. Zero and span are each set by push-on jumpers for coarse range selection and by a 15-turn precision potentiometer for fine adjustment. The 2 potentiometers are accessible outside the case through openings that are normally sealed by fluorosilicone plugs. To assist in calibration, 2 test terminals provide a 10 mV/mA output (200 mV full scale). The scaling procedure is explained in a comprehensive user's manual, which is shipped with every unit.



TX1501 shown smaller than actual size.

### Quick Selection Guide by Input Type

Model No.	Signal Type	Zero Suppression for 4 mA Output	Maximum Signal for 20 mA Output	Signal Span for 4 to 20 mA Output	Input Impedance
TX1501	RTD Pt100 $\Omega$	-200 to 750°C -328 to 1382°F 0 to 365 $\Omega$	850°C 562°F 400 $\Omega$	100 to 1050°C 180 to 1890°F 35 to 400 $\Omega$	N/A
TX1502A-J	Type J T/C iron-constantan	-50 to 660°C -58 to 1220°F	760°C 1400°F	100 to 810°C 180 to 1458°F	5 M $\Omega$
TX1502A-K	Type K T/C chromel-alumel	-50 to 1272°C -58 to 2322°F	1372°C 2502°F	100 to 1422°C 180 to 2560°F	5 M $\Omega$
TX1502A-T	Type T T/C copper-constantan	-50 to 350°C -58 to 662°F	400°C 752°F	50 to 450°C 90 to 810°F	5 M $\Omega$
TX1502A-E	Type E T/C chromel-constantan	-50 to 900°C -58 to 1652°F	1000°C 1832°F	100 to 1050°C 180 to 1890°F	5 M $\Omega$
TX1504	Millivolts	-30 to 60 mV	160 mV	5 to 100 mV	100 M $\Omega$
TX1505	Milliamps	-30 to 60 mA	160 mA	5 to 100 mA	1 $\Omega$
TX1506-1	Low volts	-3.5 to 6.0V	11V	0.5 to 5V	1 M $\Omega$
TX1506-2	High volts	-35 to 60V	110V	5 to 50V	1 M $\Omega$

## Common Specifications

### Signal Output

**Connection:** 2-wire

**Linear Range:** 4 to 20 mA

**Maximum Output:** 35 mA

**Voltage Compliance:** 9 to 50 Vdc

**Power Supply Rejection:** 0.01% of span/V

### Input/Output Protection:

**CMV, Input to Case or Output:** 2100 Vp per HV test, 354 Vp per IEC spacing

**CMR, Input to Case or Output:** 120 dB, DC to 60 Hz

**NMV Across Output Leads:** 120 Vac for 1 min

**Reverse Polarity Across Output Leads:** 400 Vp

**Accuracy:** -40 to 85°C (-40 to 185°F)

**Hysteresis and Repeatability:**  $\pm 0.1\%$  of span

**6-month Stability Error:**  $\pm 0.2\%$  of zero suppression

**Error Due to 50°C Change in**

**Transmitter Temperature:**

**Zero Error:**  $\pm 0.2\%$  of zero suppression

**Span Error:**  $\pm 0.2\%$  of span

### Environmental

**Operating Temperature:** -40 to 85°C (-40 to 185°F)

**Storage Temperature:** -55 to 125°C (-67 to 257°F)

**Relative Humidity:** 0 to 100% (sealed case)

**Watertight Proof Pressure:** 35 kPa (5 psi)

**Shock:** 55 g, half sine, 9 to 13 ms duration

**Vibration:** 1.52 mm (0.06") double amplitude, 10 to 80 Hz cycled

### Mechanical

**Case Material:** Zamak zinc alloy

**Gasket Material:** Fluorosilicone

**Diameter:** 74 mm (2.9")

**Height, Including Barriers:** 53 mm (2.1")

**Weight:** 380 g (13 oz)

**Electrical Connection:** #6 screws with wire clamps

### Terminal Protection:

**Standard:** Screw terminal barriers plus barrier strip cover

**CPB1 (Optional):** Plastic cover for case top (protects T/C screw terminals from air currents)

## Non-Common Specifications

### RTD Input

#### Model TX1501

**Signal Source:** Pt100 RTD

**Span for 4 to 20 mA Output:**

100 to 1050°C (180 to 1890°F)

**Zero Suppression:**

-200 to 750°C (-328 to 1382°F)

**Source Connection:** 2- or 3-wire

**Excitation Current:** 200  $\mu$ A

**Lead Resistance, Max:** 100  $\Omega$

**Bandwidth:** DC-60 Hz

### Ohms Input

#### Model TX1501

**Signal Source:** 0 to 400  $\Omega$

**Span for 4 to 20 mA Output:**

35 to 400  $\Omega$

**Zero Suppression:** 0 to 365  $\Omega$

**Source Connection:** 2- or 3-wire

**Excitation Current:** 200  $\mu$ A

**Lead Resistance, Max:** 100  $\Omega$

**Bandwidth:** DC-60 Hz

## Thermocouple Input

### Model TX1502A

**Span and Zero Suppression:**

See input table

**Input Resistance (Open T/C Detector**

**Resistance):** 5 M $\Omega$

**Bias Current, Max:** 50 nA

**NMV Across Input Leads:**

120 Vac for 1 min

**NMR Across Input Leads:**

40 dB, 50/60 Hz, 100 mV input

**Thermocouple Lead Resistance:**

**For specified performance:** 100  $\Omega$

**Maximum:** 10 k $\Omega$

**Step Response, Type:** 400 ms

### Millivolt Input

#### Model TX1504

**Span for 4 to 20 mA Output:**

5 to 100 mV

**Zero Suppression:** -30 to 60 mV

**Input Resistance:** 100 M $\Omega$

**Bias Current, Max:** 50 nA

**NMV Across Input Leads:**

120 Vac for 1 min

**NMR Across Input Leads:** 40 dB,

50/60 Hz, 100 mV input

**Step Response, Type:** 400 ms

## Milliamp Input

### Model TX1505

**Span for 4 to 20 mA Output:**

5 to 100 mA

**Zero Suppression:** -30 to 60 mA

**Input Resistance:** 1  $\Omega$

**Step Response, Type:** 400 ms

### Volt Input

#### Model TX1506

**Span for 4 to 20 mA Output:**

0.5 to 5 V (TX506-1); 5 to 50V

(TX506-2)

**Zero Suppression:**

-3.5 to 6.0 V (TX506-1); -35 to 60V

(TX506-2)

**Input Resistance:** 1 M $\Omega$

**Bias Current, Max:** 1 nA

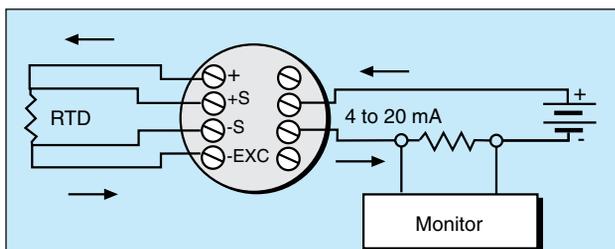
**NMV Across Input Leads:**

120 Vac for 1 min

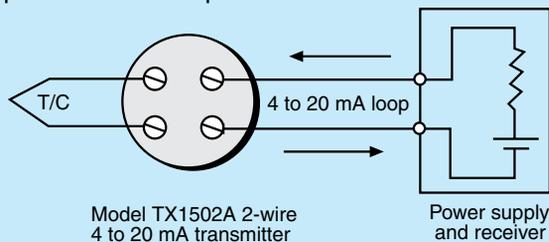
**NMR Across Input Leads:**

40 dB, 50/60 Hz, 100 mV input

**Step Response, Type:** 400 ms



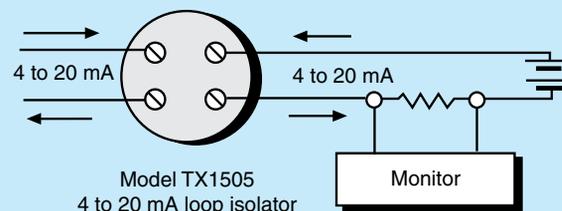
The TX1501 transmitter is designed for 3-wire RTD operation that compensates for lead resistance. The +S terminal is not connected internally. Shorting the -S and -EXC terminals provides 2-wire operation.



Model TX1502A 2-wire  
4 to 20 mA transmitter

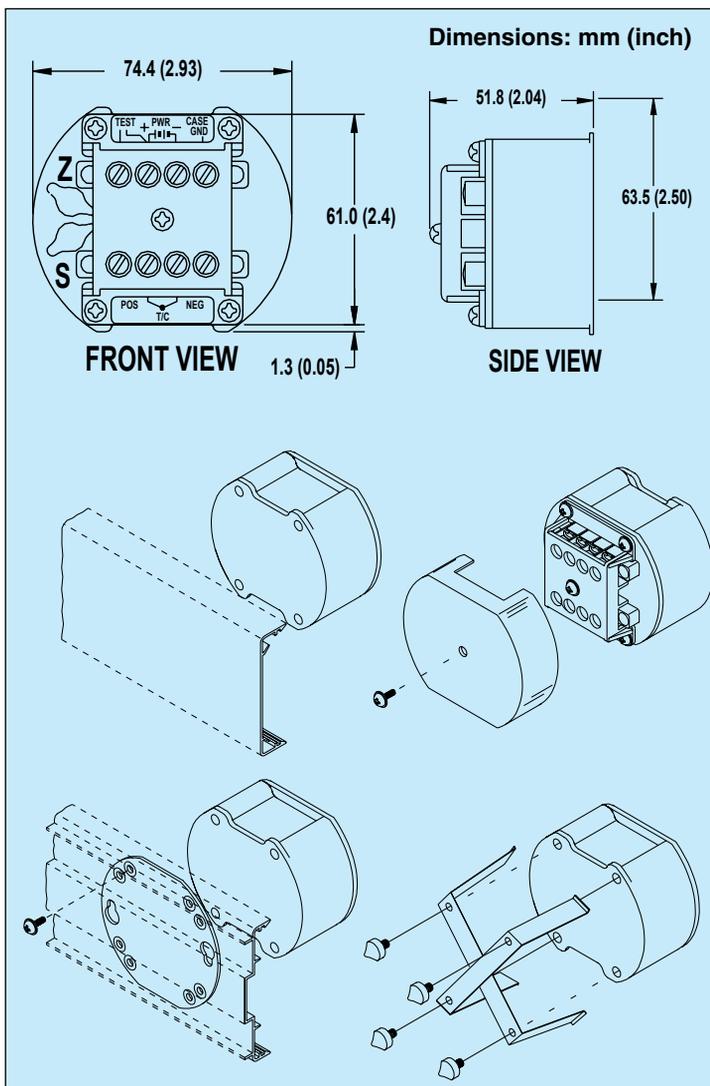
Power supply  
and receiver

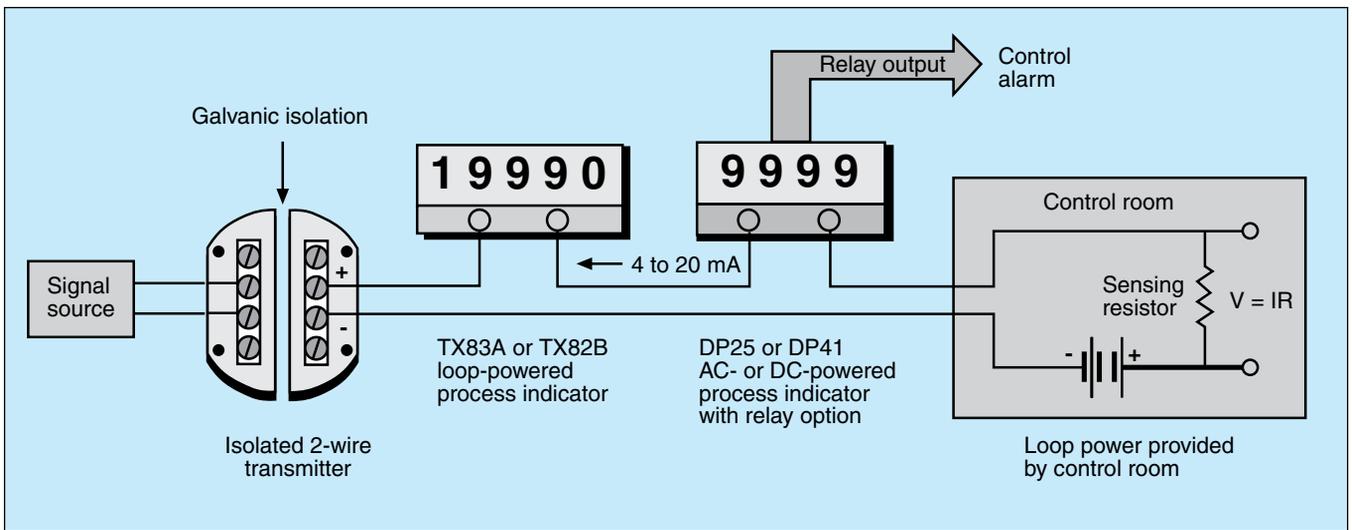
The TX1502A uses the power-supply leads as signal leads. This simplifies field wiring by eliminating separate power and signal leads.



Model TX1505  
4 to 20 mA loop isolator

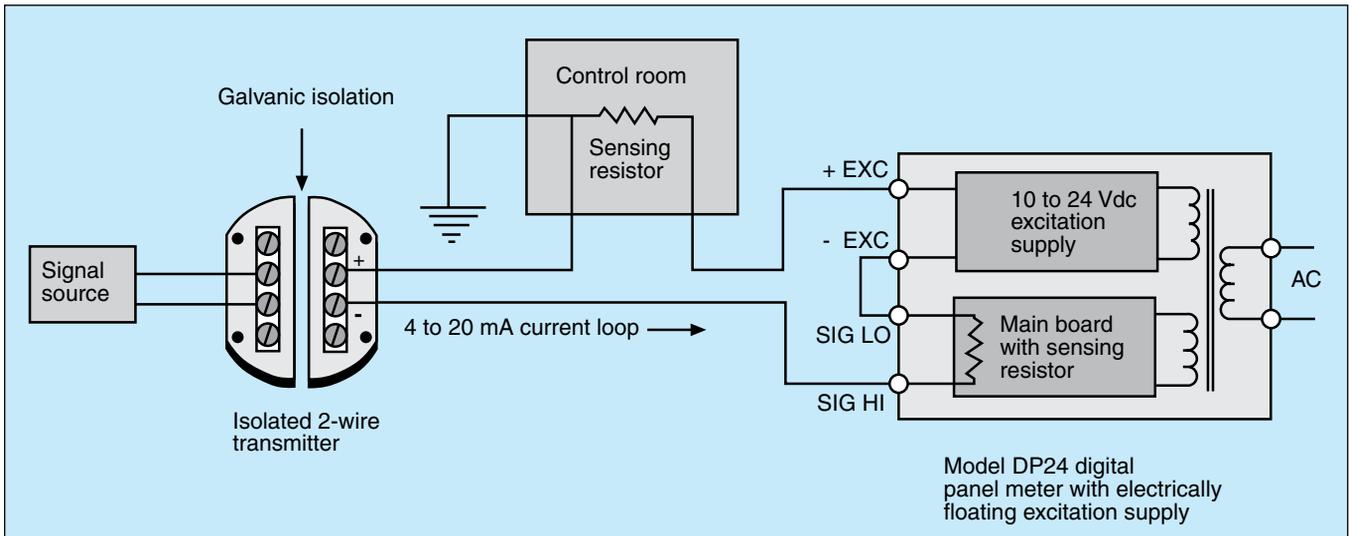
The TX1505 can be used as a 4 to 20 mA current loop isolator. The input and output loops are each powered by their own supply.





**Adding Digital Panel Meters to a 4 to 20 mA Loop**

One or more digital panel meters may be added to a 4 to 20 mA loop for local readout in percent or engineering units, without degrading the accuracy of the 4 to 20 mA signal. OMEGA's TX83A and TX82B loop-powered indicators derive all operating power from the loop itself, with a maximum loop drop of 2.5 V. The use of such indicators simplifies field wiring. OMEGA's DP41 meters insert a loop resistance of only 15 Ω for a maximum loop drop of 0.1 V at 20 mA. DP41 meters are available with dual or quad relay output for control or alarm.



A DP24, DP25 or DP41 panel meter may be used to power the 4 to 20 mA loop, including the isolated 2-wire transmitter. One or more loads may be added to the loop, including receiving equipment in the control room. The excitation supply is electronically floating; thus, the current loop may be grounded anywhere. In addition to powering the loop, the panel meter provides a local display scaled in percent or in engineering units.



TX1502A-J shown smaller than actual size.



### Rail Mounting of TX1500 Series Transmitters

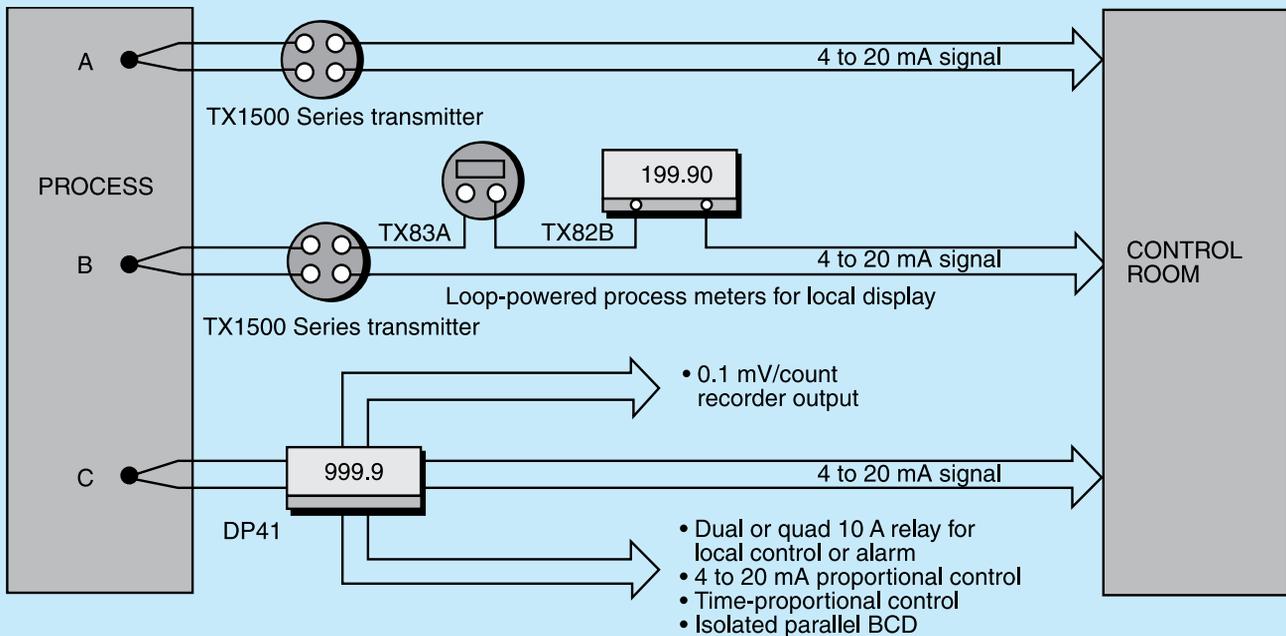
**Top:** Transmitter is clamped to DIN relay track. An MDT1 adaptor is required.

**Lower:** Transmitter is clamped to snap track. The standard housing fits 63.5 mm (2.50") width. An MAT1 adaptor is required for 69.9 mm (2.75") or 76.2 mm (3.00") width.

### Mounting Methods

See N-49 for mounting drawings.

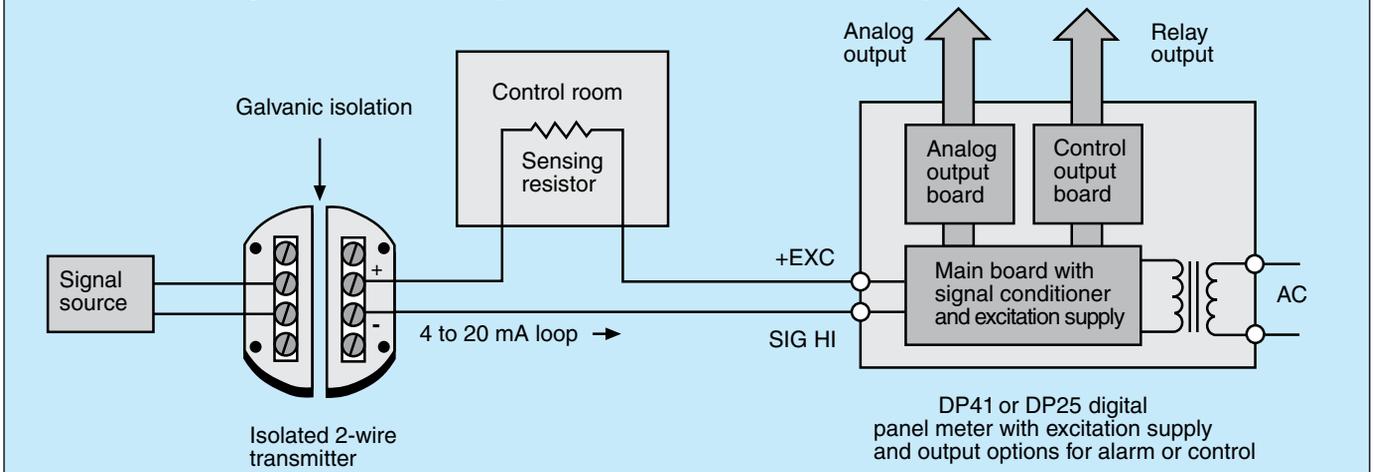
1. Surface mount with four #6 rear-entry screws. Tapped holes are located in back of case. Screws are inserted from backside of bulkhead.
2. Snap mount into 63.5 mm (2.50") relay track.
3. Surface mount with two #8 front-entry screws. Requires optional MAT1 adaptor plate.
4. Snap mount into 69.9 mm (2.75") or 76.2 mm (3.00") relay track. Requires optional MAT1 adaptor plate.
5. Snap mount into DIN relay track. Requires optional MDT1 rail clamp, fits both 69.9 mm (2.75") and 76.2 mm (3.00") DIN rails.
6. Push mount into optional external waterproof or explosion-proof housings EPH1-ATEX or EPW2-ATEX. Includes MXS1 spring retainers.



### 3 Transmitter Strategies

- A. The 4 to 20 mA signal is transmitted directly to the control room, without local readout or alarm.
- B. Local readout is provided by process indicators in series with the 4 to 20 mA current loop. The 2 models shown are loop powered, with no need for external power. Local readout, alarm and control could also have been provided by an DP41 meter/controller in series with the 4 to 20 mA loop.
- C. The 4 to 20 mA transmitter signal as well as local readout, alarm and control are provided by DP41 with no need for a separate transmitter.

**Powering the 4 to 20 mA loop and the transmitter with a DP41 panel meter/controller.**



TX1504 shown smaller than actual size.

To Order	
Model No.	Description
TX1501	RTD (Pt100) or $\Omega$ (default cal 0 to 850°C)
TX1502A-J	Type J thermocouple (default cal 0 to 500°C)
TX1502A-K	Type K thermocouple (default cal 0 to 800°C)
TX1502A-T	Type T thermocouple (default cal 0 to 400°C)
TX1502A-E	Type E thermocouple (default cal 0 to 500°C)
TX1504	Millivolt input 5 to 100 mV span (scalable)
TX1505	Current input (scalable) loop isolator
TX1506-1	500 mV to 5 Vdc input span (default calibration 0 to 5 Vdc)
TX1506-2	5V to 50 Vdc input span (default calibration 0 to 5 Vdc)

Option	
Order Suffix	Description
-FS	Custom scaling option; specify input signals corresponding to 4 and 20 mA

Accessories	
Model No.	Description
DS	Down-scale overrange (under 4 mA) (for TX1502A Series only)
CBP1	Plastic cover for screw-terminal barrier strip
-MAT1	Adaptor plate, surface or 69.9 mm (2.75") relay track
-MDT1	DIN rail clamp
EPH1-ATEX	External single-height environmental enclosure, NEMA 7 and NEMA 4 (IP65) rated; includes MXS1 spring retainers (supplied with Demko/ATEX certificate).
EPW2-ATEX	External double-height environmental enclosure, with window for TX1500 Series transmitter on bottom and one TX83A loop-powered indicator on top; NEMA 7 and NEMA 4 (IP65) rated; includes MXS2 spring retainers (supplied with Demko/ATEX certificate)
MXS1	Replacement spring retainers for EPH1-ATEX or customer-supplied explosion-proof housing
MXS2	Replacement spring retainers for EPW2-ATEX or customer-supplied explosion-proof housing
PSR-24S	Regulated power supply, 24 Vdc, 400 mA, screw terminal
PSR-24L	Regulated power supply, 24 Vdc, 400 mA, UL, stripped leads
PSR-24L-230	Regulated power supply, 24 Vdc, 400 mA, stripped leads, 230 Vac input
PSU-93	Unregulated power supply, 16 to 23 Vdc, 300 mA max, screw terminal

Ordering Examples: TX1504-FS (-1 to 30 mV = 4 to 20 mA).  
 TX1504 (customer will calibrate for 0 to 50 mVdc = 4 to 20 mA).  
 TX1502A-K-FS (0 to 100°C = 4 to 20 mA).  
 TX1505-FS (5 to 12 mA = 4 to 20 mA).