

User's Manual: Series 250T Potentiometer/Slidewire Input, Two-Wire Transmitters

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## **IMPORTANT SAFETY CONSIDERATIONS**

It is very important for the user to consider the possible adverse effects of power, wiring, component, sensor, or software failures in designing any type of control or monitoring system. This is especially important where economic property loss or human life is involved. It is important that the user employ satisfactory overall system design. It is agreed between the Buyer and Acromag, that this is the Buyer's responsibility.

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## 8500-508-A94A000

## INTRODUCTION:

These instructions cover the model types listed in Table 1 below. Supplementary sheets are attached for units with special options or features.

#### Table 1:

A. Model Number Format:
 250T-Input-Mounting/Display-Certification<sup>1</sup>

B. Typical Model Number: 250T-P-XPD1-NCR1

Series	-Input	-Mounting/Display	-Certification
250T	-P	-DIN	-NCR
		-SM	-Approval <sup>2</sup>
		-ST	
		-N4	
		-N12	
		-4X	
		-4XD1	
		-4XD2	
		-4XD3	
		-XP	
		-XPD1	
		-XPD2	
		-XPD3	

# Notes (Table 1):

- Unit cannot be factory calibrated to customer specifications (no "-C" suffix required).
- Consult the factory for current information on agency (e.g. Canadian Standards Association, etc.) approvals.

## **DESCRIPTION:**

These two-wire transmitters condition a direct three-wire potentiometer or slidewire input and convert the wiper rotation or position to a high-level process current output. The transmitter provides constant voltage excitation to the sensor and allows the use of potentiometers or slidewires with values from 100 ohms to 10K ohms. Applications for this device include the manual control of valves, position sensing for actuators, level sensors, and test equipment. Input circuit isolation is standard. The unit has wide range zero and span adjustments. These transmitters are RFI-protected, operate over a wide temperature range, and feature excellent temperature coefficients, which minimize effects from harsh plant environments.

Following basic two-wire design, the output signal and DC power share the same twisted pair of wires. The transmitter, acting similar to a variable resistor in series with the load and DC supply, provides an output loop current proportional to the input sensor signal. See Drawing 4501-449 for a simplified schematic.

# Series 250T User's Manual Input

These field mounted two-wire transmitters support a variety of customer-specified mounting configurations. The transmitter is available for DIN-rail mounting, Surface Mounting, 3-inch SNAPTRACK™ plastic rail mounting, or in various housings. These housings include NEMA 4, 12, 4X, and explosion-proof enclosures. The model number of the unit specifies the mounting/ enclosure type.

This transmitter with the explosion-proof enclosure mounting option is available with a 3-1/2 digit LCD readout (1/2-inch height) to provide a visual indication of the transmitter's output. The readout is available in percent-of-span or engineering units, and scaled to customer requirements.

Input wiring is inserted in the bottom of the unit, while output wiring is inserted in the top of the unit. Screws to secure the wiring are located on the front panel. Connectors are screw-clamp type and accept wire size up to #14 AWG.

#### **SPECIFICATIONS:**

**Function:** This family of isolated two-wire transmitters condition a three-wire potentiometer or slidewire input using constant voltage excitation and convert the input signal to a 4 to 20mA process current output. Wide range zero and span adjustments utilize 22-turn potentiometers which are accessible from the front of the unit. The transmitter has various mounting and enclosure options available.

#### MODEL/SERIES: 250T-

#### INPUT:

-P: 100 ohm to 10,000 ohm three-wire potentiometer or slidewire.

**Excitation:** 0.175V DC nominal, constant voltage, current limited to 2.0mA nominal.

## Adjustments:

Zero Adjustment: 0 to 75% of slidewire resistance. Span Adjustment: 25% to 100% of slidewire resistance.

Isolation: The input circuit is electrically isolated from the output/power circuits, allowing the input to operate at up to 250V AC, or 354V DC, off ground on a continuous basis (will withstand 1500V AC dielectric strength test for one minute without breakdown). This complies with test requirements outlined in ANSI/ISA-S82.01-1988 for the voltage rating specified.

Output: 4-20mA DC output.

**Note:** A Test Signal of 40mV to 200mV, representing 4 to 20mA of output current, is available at the output terminals (see Drawing 4501-416).

**Power:** An external loop power supply is required: 12V DC minimum, 50V DC maximum. Under no circumstances must this supply ever exceed 75 volts peak instantaneously. Unit has reverse polarity protection.

Output Limits (typical): 3.8mA DC to 26mA DC.

## Load Resistance Range Equation:

R-Load (Maximum) = (V supply - 12V) / 20mA. At 24V supply, R-Load = 0 to 600 ohms.

## **Power Supply Effect:**

DC Volts:  $\pm 0.001\%$  of output span per volt DC. 60/120 Hz ripple:  $\pm 0.01\%$  of output span per volt peak-to-peak of power supply ripple.

Reference Test Conditions: Input: 100 ohm slidewire with a 100 ohm span; Output: 4-20mA into a 500 ohm load; 77<sup>o</sup>F (25<sup>o</sup>C); +24V DC supply.

Accuracy: ±0.1% of calibrated span. The error includes the combined effects of transmitter repeatability, hysteresis, terminal point linearity, and adjustment resolution.

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

Ambient Temperature Effect: Less than ±0.01% of output span per <sup>O</sup>F (± 0.018% per <sup>O</sup>C) over the ambient temperature range for reference test conditions (specification includes the combined effects of zero and span over temperature).

**Load Resistance Effect**: Less than ±0.005% of output span change for a 100 ohm change in load resistance.

Output Ripple: Less than ±0.25% of the maximum output span. Can be reduced to less than ±0.1% by adding a 1uF capacitor across the load resistor. Some loads (such as E/P and I/P devices) may require a 0.1uF capacitor inserted across the load.

Bandwidth: -3dB at 2Hz, typical

**Response Time**: For a step input, the output reaches 98% of output span in 300ms, typical.

## Noise Rejection:

Common Mode: Better than 130dB at 60 Hz, typical, 100 ohm unbalance.

Normal Mode: 50dB at 60Hz, typical, 100 ohm source.

RFI Resistance: Less than ±0.5% ,of output span effect with RFI field strengths of up to 10V/meter at frequencies of 27MHz, 151MHz, and 467 MHz.

**EMI Resistance**: Less than  $\pm 0.25\%$  of output span effect with switching solenoids or commutator motors.

Surge Withstand Capability (SWC): Input/Output terminations rated per ANSI/IEEE C37.90-1978. Unit is tested to a standardized test waveform that is representative of surges (high frequency transient electrical interference) observed in actual installations.

## **Construction (Basic Transmitter):**

Circuit Boards: Military grade FR-4 epoxy glass circuit board. Terminals: Compression type, wire size 14 AWG maximum. Circuit Board Coating: Fungus resistant acrylic conformal coat. Mounting Position: Position insensitive.

Case: Self-extinguishing NYLON Type 6.6 polyamide black thermoplastic UL94 V-2, General Purpose, NEMA Type 1 enclosure. **MOUNTING/DISPLAY:** A wide variety of mounting options and enclosures are available to meet the needs of the installation. The available models are listed below. The transmitter is shipped as a complete assembly.

<u>General Purpose Housing</u>: Available with various mounting options listed below. Case: Self-extinguishing NYLON Type 6.6 polyamide thermoplastic UL94 V-2, color black.

- -DIN: General Purpose Housing, DIN Rail-Mount "G" & "T" rails. "G" Rail (32mm), Type EN50035; "T" Rail (35mm), Type EN50022. Refer to Drawing 4501-080 for outline and clearance dimensions. Shipping Weight: 1 pound (0.45 Kg) packed.
- -SM: General Purpose Housing, Surface-Mount. Refer to Drawing 4501-081 for outline and clearance dimensions. Shipping Weight: 1 pound (0.45 Kg) packed.
- -ST: General Purpose Housing, SNAPTRACK™. Refer to Drawing 4501-081 for outline and clearance dimensions. Shipping Weight: 1 pound (0.45 Kg) packed. SNAPTRACK™ is a registered trademark of Reed Devices, Inc.

NEMA 4 and 12 Enclosures: Option types listed below.

Refer to Drawing 4501-083 for outline and clearance dimensions. Transmitter is mounted within the enclosure at the factory. These enclosures may accommodate a second Series 250T transmitter with the Surface Mount option (-SM option, ordered separately). Conduit mounting holes and fittings are customer supplied.

- -N4: Water-Tight Enclosure, NEMA 4. Enclosure material and finish: 0.075 and 0.060 inch thick steel with gray hammertone enamel finish inside and out. Shipping weight: 6 pounds (2.7 Kg) packed.
- -N12: Oil-Tight Enclosure, NEMA 12. Enclosure material and finish: 0.075 and 0.060 inch thick steel with gray hammertone enamel finish inside and out. Shipping weight: 6 pounds (2.7 Kg) packed.

Non-Corrosive, Water-Tight Enclosures, NEMA 4X: Option types listed below. Refer to Drawing 4501-086 (NO DISPLAY WINDOW), or Drawing 4501-087 (WITH DISPLAY WINDOW) for outline and clearance dimensions. Enclosure material: ADALEX. Finish: Gelcoat. Transmitter is mounted within enclosure at factory.

- -4X: Water-Tight Enclosure, Non-corrosive, NEMA 4X (No Window). Shipping weight: 5 pounds (2.3 Kg) packed.
- -4XD1: Water-Tight Enclosure, Non-corrosive, NEMA 4X (With Window). Includes the Standard Display Option (D1). Shipping weight: 6 pounds (2.7 Kg) packed.
- -4XD2: Water-Tight Enclosure, Non-corrosive, NEMA 4X (With Window). Includes the Temperature Display Option (D2). Shipping weight: 6 pounds (2.7 Kg) packed.
- -4XD3: Water-Tight Enclosure, Non-corrosive, NEMA 4X (With Window). Includes the Engineering Units Display Option (D3). Shipping weight: 6 pounds (2.7 Kg) packed.

Explosion Proof, Water-Tight Enclosures: Option types listed below. Refer to Drawing 4501-084 (NO DISPLAY WINDOW), or Drawing 4501-085 (WITH DISPLAY WINDOW) for outline and clearance dimensions. Enclosure Materials: Body and cover - Copper-free aluminum (less than 0.4%), Glass lens - Heat tempered glass, Gasket - Neoprene. Finish: Corrofree epoxy powder coat, color gray. Hub size: 0.75 inch (Quantity 2). Housing meets Class I - Groups B, C, & D, Class II - Groups E, F, & G, Class III, and NEMA 4 (water-tight) requirements. Transmitter is mounted within enclosure at the factory.

- **-XP**: Explosion Proof, Water-Tight Enclosure (No Window). Shipping weight: 5 pounds (2.3 Kg) packed.
- -XPD1: Explosion Proof, Water-Tight Enclosure (With Window). Includes the Standard Display Option (D1). Shipping weight: 6 pounds (2.7 Kg) packed.
- -XPD2: Explosion Proof, Water-Tight Enclosure (With Window). Includes the Temperature Display Option (D2). Shipping weight: 6 pounds (2.7 Kg) packed.
- -XPD3: Explosion Proof, Water-Tight Enclosure (With Window). Includes the Engineering Units Display Option (D3). Shipping weight: 6 pounds (2.7 Kg) packed.

**DISPLAY OPTION:** The Display is available as an option when specifying the "-4X" or "-XP" Housing. The linear display option assembly includes zero and span trim adjustments. Display Options include:

- -xxD1: Standard Display Option (D1): The minimum and maximum input (any calibration) is represented by 00.0 and 100.0% on the display (normalized). It also represents the 4 to 20mA transmitter output, a resolution of 0.1% of span.
- -xxD2: Temperature Display Option (D2): Not applicable.
- -xxD3: Engineering Units Display Option (D3): The minimum and maximum display readings correspond to the minimum and maximum display readings specified for the unit by the customer.

<u>Display Range</u>: The minimum display reading can be from - 1999 to +1999 counts, while the span range can be from 100 to 2000 counts (span counts = maximum counts minimum counts -- Note: mentally remove the decimal point to determine the display counts). The decimal point is configured as required (such as 00.0 to 100.0%).

- <u>Display Characteristics</u>: The 7-segment reflective Liquid Crystal Display (LCD) contains 3-1/2 digits (1999) with 1/2 inch character height. Also includes a factory programmed 3 position decimal point. Optimal view angle is 60 degrees.
- No Output Burden: Provides a visual indication of the transmitter output without reducing the output compliance (the allowable load resistance range).
- <u>Display Ambient Temperature Range</u>: Operating: 0 <sup>o</sup>C to +50 <sup>o</sup>C (+32 <sup>o</sup>F to +122 <sup>o</sup>F); Storage: -20 <sup>o</sup>C to +70 <sup>o</sup>C (-4 <sup>o</sup>F to +158 <sup>o</sup>F).

Over-range: The three lower order digits blank for >1999 counts.

**Display Accuracy**:  $\pm (0.1\% \text{ of reading + 2 counts}).$ 

<u>Display Ambient Temperature Effect</u>: ±0.02% per <sup>O</sup>C (±0.012% per <sup>O</sup>F), typical.

Conversion Rate: 2.5 per second.

**CERTIFICATION:** Consult the factory for current information on the availability of agency (e.g. Canadian Standards Association, Factory Mutual, etc.) approvals.

-NCR: No Certification Required.

## **INSTALLATION:**

The transmitter is packaged in a general purpose plastic enclosure and available for mounting within a variety of protective enclosures. The transmitter should be located in an area that is protected from dust, moisture, and corrosive atmospheres. The enclosure type determines the protection afforded in a particular environment and location, make sure this is not compromised. Maximum operating ambient temperatures should be within -13 °F to 185°F (-25 °C to 85°C) for satisfactory performance. Factory calibrated units are ready for installation. Connect unit as shown in Connection Drawing 4501-416. If the unit is not factory calibrated, refer to the "CALIBRATION" section.

**Mounting:** Mount transmitter assembly - refer to appropriate outline drawing for mounting and clearance dimensions. Determine which configuration is utilized and consult the proper mounting instructions listed below.

- DIN Rail Mounting: Use suitable fastening hardware to secure the DIN rail to the designated mounting surface. A transmitter ordered with the DIN Rail mounting option (-DIN) can be mounted to either the "T" or "G" Rail. Installation of the transmitter to the rail depends on the type of DIN rail used (see Drawing 4501-080). Units can be mounted side-by-side on 1.0-inch centers, if required.
- Surface Mounting: Secure the transmitter to the designated mounting surface using two 6-32 screws. Note that the mounting bracket has screw slots to facilitate mounting. Units can be mounted side-by-side on 1.0-inch centers, if required.
- 3. SNAPTRACK™ Mounting: Secure the SNAPTRACK™ mounting channel to the designated mounting surface using suitable fastening hardware. To install the unit in the mounting channel, place the bottom end of the mounting bracket between the rails and press the top (notched end) firmly until the bracket "snaps" into place. To remove the transmitter, insert a screwdriver into the upper arm of the connector and twist to release the unit from the track while tipping the unit out. Units can be mounted side-by-side on 1.0-inch centers, if required.
- 4. **NEMA 4 & 12 Enclosure Mounting:** Secure the

assembly to the designated mounting surface using appropriate hardware. The transmitter is secured within this enclosure using two screws. Note: It is recommended that the transmitter be removed from the enclosure during the process of drilling holes, installing fittings and mounting the enclosure.

 NEMA 4X and Explosion-Proof Mounting: Secure the enclosure assembly to the designated mounting position using appropriate hardware.

**Note:** It is recommended that the transmitter be removed from the enclosure during the process of mounting the enclosure. To remove the unit from the enclosure, remove the two screws securing it to the bottom of the enclosure. Install the transmitter into the enclosure after the enclosure is installed. Position the unit at an angle that permits all wiring to be routed unobstructed through both ports. If the transmitter has the display option, make sure the orientation of the display allows for easy reading once installed. Secure the transmitter assembly to the enclosure using two screws.

## **Electrical Connections:**

The wire size used to connect the unit to the control system is not critical. All terminal strips can accommodate wire from 14-26 AWG. Strip back wire insulation 1/4 inch on each lead before installing into the terminal block. Input wiring may be shielded or unshielded twisted pair. Output wires should be twisted pair. Since common mode voltages can exist on signal wiring, adequate wire insulation should be used and proper wiring practices followed. It is recommended that the output/power wiring be separated from the input signal wiring for safety, as well as for low noise pickup.

1. Output/Power: Connect a DC power supply and load per Connection Drawing 4501-416. These transmitters operate from DC power supplies only. Power supply voltage is not critical and normally should be from 12-50V DC. The supply voltage must not exceed 75 volts, even instantaneously. The power supply voltage must be adequate to furnish full-scale current to the load(s), plus transmission line drop, plus 12V DC terminal voltage to the transmitter. Variations in power supply voltage or load resistance have negligible effect on the transmitter accuracy.

Ripple and Noise: Power supply ripple at 60Hz/120Hz is reduced at the load by the transmitter. The ripple at the load will be 0.01% of span per volt peak to peak of power supply ripple. The unit has about 0.25 percent of internally generated ripple; connect an external luf capacitor across the load to reduce this ripple to less than 0.1 percent if desired.

- Grounding: The two-wire transmitter in the General Purpose plastic housing does not require an earth ground connection. If the Transmitter is mounted in a metal housing, a ground wire connection is required. Connect the ground terminal (Green Screw) to earth ground using suitable wire per applicable codes.
- Input: Connect input per connection diagram. Note: The input circuit is electrically isolated from the output/power circuit allowing the input to operate at up to 250V AC, or 354V DC, off ground on a continuous basis.

# **CALIBRATION:**

#### A. TRANSMITTER:

The calibration example below is used for reference.

Calibration is essentially the same for units with other input spans.

## **Transmitter - Adjustment Procedure:**

Connect the transmitter as shown in the Calibration Connection Drawing 4501-449. Calibration should be performed with the actual slidewire or potentiometer used in the end system. The power supply voltage must be adequate to furnish full-scale current to the load, plus wire drop, plus 12V DC terminal voltage to the transmitter. The output current must be measured to 0.05% accuracy or better for proper results.

The Zero and Span adjustments are accessible on the front panel of the transmitter (see Drawing 4501-449 for location). The screwdriver blade used to adjust the potentiometers should not be more than 0.1 inch (2.54mm) wide.

# Transmitter - Calibration Example:

MODEL: 250T-P-DIN-NCR

Input: Slidewire, 100 to 10,000 ohms

Output: 4 to 20mA DC.

- Set the slidewire to its minimum position for your application.
   Adjust the Zero (Z) pot until the output reads 4.000mA DC.
- Set the slidewire to its maximum position for your application. Adjust the Span (S) pot until the output reads 20.000mA DC.
- Repeat steps 1 and 2 until the readings converge. The instrument is now calibrated. Several mid-point values should be checked to verify proper operation of the transmitter.

# B. DISPLAY:

## **Display - Adjustment Procedure:**

If your transmitter has the display option, the display is calibrated separately from the transmitter. The calibration of the transmitter should be verified FIRST, before verifying the calibration of the display module (follow above procedure). Refer to Drawing 4501-416 for location of transmitter's Zero and Span adjustments, and the location of the display's Zero and Span adjustments. NOTE: The display option is factory configured for a specific customer specified range -- the display Zero (DZ) and Span (DS) adjustments are trim adjustments only.

## **Display - Calibration Example:**

MODEL: 250T-P-XPD1-NCR

Input: Slidewire, 100 to 10,000 ohms

Display: 0 to 100.0%

 Set the slidewire to its minimum position for your application (the Zero point of the transmitter span). Adjust the Zero (DZ) pot of the Display module for the zero of the display range, 0.0% in this example.

- Set the slidewire to its maximum position for your application (the full-scale point of the transmitter span). Adjust the Span (DS) pot of the Display module for the correct full-scale display reading, 100.0% in this example.
- 3. Repeat steps 1 and 2 until the readings converge. The display
  - now calibrated.

#### **GENERAL MAINTENANCE:**

The transmitter contains solid-state components and requires no maintenance, except for periodic cleaning and calibration verification. When a failure is suspected, a convenient method for identifying a faulty transmitter is to exchange it with a known good unit. It is highly recommended that a non-functioning transmitter be returned to Acromag for repair, since Acromag used tested and burned-in parts, and in some cases, parts that have been selected for characteristics beyond that specified by the manufacturer. Further, Acromag has automated test equipment that thoroughly checks the performance of each transmitter.



















