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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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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-Calibration

B. Typical Model Number: 250T-MV1-XP-NCR-C

Series	-Input	-Mtg/Display	-Certification[2]	-Calib.[1]
250T	-MV1	-DIN	-NCR	(Blank)[1]
	-MV2	-SM	-Approval[2]	-C[1]
	-MV3	-ST		
	-TC1	-N4		
	-TC3	-N12		
	-JLxx[3]	-XP		
	-KLxx[3]	-XPD1		
	-TLxx[3]	-XPD2		
	-ELxx[3]	-XPD3		
	-RLxx[3]			
	-SLxx[3]			
	-BLxx[3]			

Notes (Table 1):

1. The MV1, MV2 and TC1 can be ordered with or without the factory calibration "-C" option. All other input types except custom linearizer ranges automatically include calibration to the customer's specification (no "-C" needed). Any customer specified calibration information will be included on a separate calibration label on the unit. For thermocouple units, TC type, input calibration, and TC Break Detection (UP, DOWN or NONE) must be specified.
2. Consult the factory for current information on agency (e.g. Canadian Standards Association, etc.) approvals.
3. Range Code Number: Standard range code will have a number (01, 12, etc.). Consult the selection and ordering guide for standard range codes. If the unit requires a custom range for the linearizer a "00" will be used, the unit's label will indicate the range.

DESCRIPTION:

These two-wire transmitters condition millivolt or thermocouple input signals and convert the signal to a 4 to 20mA process current output. Input circuit isolation is standard. The unit also provides high input impedance, thermocouple reference junction compensation, upscale or downscale thermocouple break detection, and wide range zero and span adjustments. Optionally, a 5-segment linearizer is available to correct for thermocouple non-linearity over a customer-specified calibration range. These transmitters are RFI-protected, operate over a wide temperature range, and feature excellent temperature coefficients, which minimize the effects of harsh plant environments.

Following basic two-wire design, the output and the DC power share the same pair of twisted copper wires. The transmitter, acting similar to a variable resistor in series with the load and the DC supply, provides an output loop current proportional to the input sensor signal. See Drawing 4501-077 for a typical installation.

These field mounted two-wire transmitters are designed to utilize one of a number 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, and explosion-proof enclosures. The model number of the unit specifies the mounting/enclosure type.

The transmitter mounted in the explosion-proof enclosure 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, temperature, or engineering units, and is 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 either a millivolt or thermocouple signal, provide input circuit isolation, 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 also has various mounting and enclosure options available.

MODEL/SERIES: 250T-

INPUT: Millivolt and Thermocouple. Input span and zero ranges are adjustable as specified below, except for linearized thermocouples and special ranges which are factory calibrated per customer specifications. Both the Span and Zero adjustment capability are covered in two ranges, and are configured by internal jumpers on the circuit board. The narrow span units (-xx3) are configured and calibrated to customer calibration requirements.

- **-MV1:** Millivolt - Standard Span: Span: 5 to 55mV; Zero: -5 to +25mV.
- **-MV2:** Millivolt - Wide Span: Span: 25 to 250mV; Zero: -25 to +125mV.
- **-MV3:** Millivolt - Narrow Span (Custom Calibration): Unit handles millivolt spans from 3 to 5mV with the range factory calibrated to customer specifications.
- **-TC1:** Thermocouple - Standard Span: TC Types J, K, T, E, R, S and B (Non-linearized): The TC Type is field selected via an internal jumper.
  - **J: ISA Type J**, Iron/Constantan: Span: 100 to 760°C Zero: -100 to +450°C
  - **K: ISA Type K**, Chromel/Alumel: Span: 100 to 1200°C Zero: -100 to +600°C
  - **T: ISA Type T**, Copper/Constantan: Span: 100 to 400°C Zero: -150 to +350°C
  - **E: ISA Type E**, Chromel/Constantan: Span: 100 to 700°C Zero: -100 to +350°C
  - **R: ISA Type R**, Plat/Plat 13% Rhod: Span: 550 to 1750°C Zero: 0 to 1200°C.
  - **S: ISA Type S**, Plat/Plat 10% Rhod: Span: 550 to 1750°C Zero: 0 to 1200°C.
  - **B: ISA Type B**, Plat 6% Rhod/Plat 30% Rhod: Span: 1000 to 1820°C Zero: 0 to 1000°C.
- **-TC3:** Thermocouple - Narrow Span (Custom Calibration): Unit handles temperature equivalent millivolt spans from 3 to 5mV with the range factory calibrated to customer specifications. Note: The Thermocouple type and TC Break (UP, DOWN or NONE) must also be specified. The linearization option is not available (or needed).

  The following group of input types include the linearization circuit. The Standard Span transmitter is linearized per the customer specified calibration range. The range code (xx in field below) is used to represent the input range required. Consult the selection and ordering guide for standard range codes (custom range codes are also available--consult factory).

  - **-JLxx:** ISA Type J, linearized.
  - **-KLxx:** ISA Type K, linearized.
  - **-TLxx:** ISA Type T, linearized.
  - **-ELxx:** ISA Type E, linearized.
  - **-RLxx:** ISA Type R, linearized.
  - **-SLxx:** ISA Type S, linearized.
  - **-BLxx:** ISA Type B, linearized.

Isolation: The input circuit is electrically isolated from 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). Complies with test requirements outlined in ANSI C39.5-1974 for the voltage rating specified.

Output: 4-20mA DC output. Note: A Test Signal of 40mV to 200mV is available at the output terminals, (see Drawing 4501-090); it represents the 4 to 20mA output.

Power: An external loop power supply is required: 12V DC minimum, 50V DC maximum. Under no circumstances must the DC 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: ±0.001% of output span per volt DC.
60/120 Hz ripple: ± 0.01% of output span per volt peak-to-peak of power supply ripple.

Input Impedance:

A. Millivolt and Thermocouple Inputs (Without TC Break Detection): 1.0M ohm at 10mV span, typical; input current, +/-10nA, typical.

B. Thermocouple Inputs (Utilizing TC Break Detection): 400K ohm at 10mV span; input current, +/-25nA, typical (+/-30nA, maximum).

Thermocouple Models:

A. Thermocouple reference junction compensation: Standard on all thermocouple units and functional over the entire operating temperature range. Includes unique circuitry to correct for reference junction non-linearity over ambient temperature. Reference Junction Compensation Ambient Temperature Effect: +/- 0.02^{O}C/^{O}C, typical.

B. Thermocouple break detection: Upscale, downscale, or none, user selectable. Upscale or downscale break detection is selectable via an internal jumper. It is activated via an external jumper.

Reference Test Conditions: Input: 0-10mV with a 100 ohm resistive source; output: 4-20mA into a 500 ohm load; 77^{O}F (25^{O}C); +24V DC supply.

Accuracy: ±0.1% of calibrated span or ±0.01 mV, whichever is greater. The error includes the combined effects of transmitter repeatability, hysteresis, terminal point linearity (conformity instead of linearity for thermocouple inputs, non-linearized), and adjustment resolution. Does not include sensor error.

Linearization (-xLxx) Option: Optional linearized thermocouple units contain a 5 segment linearizer to correct for thermocouple non-linearity. This option offers low cost linearization and provides a minimum 10 to 1 improvement +/-0.1% in the linearity curve for the specified range of type J, K, T, R, S, E, and B ISA rated thermocouples.

Ambient Temperature Range: -13^{O}F to 185^{O}F (-25^{O}C to 85^{O}C).

Ambient Temperature Effect: Less than ±0.01% of output span per ^{O}F (± 0.018% per ^{O}C) over the ambient temperature range for reference test conditions; ± 0.025% of output span per ^{O}F (±0.045% per ^{O}C) for narrow span units at 5mV span. (Specification includes the combined effects of zero and span over temperature).

Load Resistance Effect: Less than +0.005% of output span for 100 ohm change.

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 to be inserted across the load.

Bandwidth: -3dB at 3 Hz, typical.

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

Noise Rejection:

Common Mode: 130dB at 60 Hz, 100 ohm unbalance, typical.
Normal Mode: 30dB at 60 Hz, 100 ohm source, typical.

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

EMI Resistance: Less than ±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.
Circuit Board Coating: Fungus resistant acrylic conformal coat.
Terminals: Compression type, wire size 14 AWG maximum.
Mounting Position: Position insensitive.
Case: Self-extinguishing NYLON Type 6.6 polyamide thermoplastic UL94 V-2, color black. 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.

General Purpose Housing: 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^{TM}. Refer to Drawing 4501-081 for outline and clearance dimensions. Shipping Weight: 1 pound (0.45 Kg.) packed. TM 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 can also 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.

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: Corro-free 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 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 "-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): The minimum and maximum display readings correspond to the minimum and maximum temperature input range specified for the unit by the customer, either in degrees C or F. Requires the linearization option (TC Units) to be linear with temperature, otherwise it will be linear with the thermocouple equivalent millivolts.
- **-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.

Display Range: 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 minus 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%).

Display Characteristics: 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).

Display Ambient Temperature Range: Operating: 0 to +50^{O}C (+32 to +122^{O}F); Storage: -20 to +70^{O}C (-4 to +158^{O}F).

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

Display Accuracy: +/-(0.1% of reading + 2 counts).

Display Ambient Temperature Effect: +/-0.02% per ^{O}C (+/-0.012% per ^{O}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 housing an optionally mounted within a variety of protective enclosures. The transmitter should be 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 that this is not compromised. Maximum operating ambient temperatures should be within -13 ^{O}F to 185^{O}F (-25 ^{O}C to 85^{O}C) for satisfactory performance. If the unit is factory calibrated, it is ready for installation. Connect as shown in Connection Drawing 4501-090. 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.

1. **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 a "T" or "G" Rail. Installation of the transmitter to the rail depends on the type of DIN rail used. Units can be mounted side by side on 1.0 inch centers, if required.
2. **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 and tip 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 enclosure assembly to the designated mounting surface using appropriate hardware. The transmitter is secured within this enclosure using two screws.
5. **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 two screws securing it to the bottom of the enclosure. After the enclosure is installed, install the transmitter into the enclosure. 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 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 output/power wiring be separated from signal wiring for safety as well as for low noise pickup.

1. **Output/Power:** Connect DC power supply and load per Connection Drawing 4501-090. 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 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.

2. **Grounding:** The two-wire transmitter is packaged in a General Purpose plastic housing and does not require an earth ground connection. If the Two-Wire Transmitter is mounted in a metal housing, a ground wire connection is required. Connect the ground terminal (Green Screw) to a suitable earth ground using suitable wire per applicable codes.

3. **Input:** Connect input per connection diagram, observe polarity, see label for input type. If unit is factory calibrated, calibration label indicates range of input. Note: The input circuit is electrically isolated from the output/power circuit allowing the input to operate up to 250V AC, or 354V DC off ground, on a continuous basis.

If your input is a thermocouple, the thermocouple break circuit will be activated by placing a short jumper wire between the Input [+] and [L] terminals on the transmitter. The type of Break Detection, UP or DOWN, is configured internal to the transmitter (see CALIBRATION).

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.

CALIBRATION:

A. TRANSMITTER:

This section provides information for unit configuration and calibration. If the unit was factory calibrated, jumpers have been placed in their proper positions and verification of the calibration can be made per the Adjustment Procedure. If the calibration of the unit is to be changed, first go to the "Shunt Block Configuration Procedure" before going to the Transmitter Adjustment Procedure."

1. Transmitter - Shunt Block Configuration Procedure:

The Thermocouple transmitter is quite universal in that it can be configured for any of the standard Thermocouple types. The Zero and Span adjustment range and the Thermocouple Break, UP or DOWN, can be configured. Before the adjustment procedure can proceed, the jumpers have to be configured to the requirements of the application (refer to Drawing 4501-092 for details). To gain access to the Configuration Jumpers, first remove transmitter from the installation. Second, remove the circuit boards from the plastic enclosure as described in the Disassembly Procedure below. Third, configure jumpers (shunt blocks) as described in the Jumper Configuration procedure below. Note, calibration, per the Adjustment Procedure, should be performed before the circuit boards are reassembled within the plastic enclosure.

Disassembly Procedure for the 250T Plastic Housing:

The plastic housing has no screws, it "snaps" together. A flat-head screwdriver (Acromag 5021-216 or equivalent) is needed to pry the housing apart as described in the following steps.

CAUTION: Do not push the screwdriver blade into the housing more than approximately 0.1 inches while prying it apart. Handling of the printed circuit boards should only be done at a static-free workstation, otherwise, damage to the electronics could result.

1. To begin disassembly (refer to Drawing 4501-092) place the screwdriver at point A (left side of the transmitter). While pressing the blade into the seam, use a twisting motion to separate the sides slightly. Repeat this operation at point B.
2. Now that the two pieces have been partially separated, use the screwdriver blade to work the left side of the package loose by working around the transmitter and carefully prying the sides further apart. Repeat this action until it is easy to remove the left side from the plastic pins holding the pieces together.
3. Repeat this operation for right side starting at points C and D.

CAUTION: If the two pc boards become separated while taking the package apart, re-align the boards making sure that the two headers (pins) and sockets at locations E and F are properly aligned and carefully push the boards back together.

Jumper Configuration (Shunt Blocks):

Shunt blocks are provided to accommodate in-field configuration changes. In case of misplacement, additional shunt blocks may be ordered from the factory. When ordering additional shunt blocks, refer to Acromag Part Number 1004-332.

1. **Thermocouple Input**: Determine the thermocouple type that you want to configure the transmitter for. Refer to table on Drawing 4501-092 for proper jumper (shunt) position.
2. **Zero / Span Range:** The Zero and Span shunt blocks should initially be placed in their default position, "IN" for each case, see Drawing 4501-092. During the process of Calibration, the need to change these jumper positions will be determined.
3. **Thermocouple Break Detection**: Determine whether Up, Down or No Break detection is required in your application, refer to the table on Drawing 4501-092 for proper jumper (shunt) position. Note: This break circuit is activated by a small jumper wire connected between the "+" and "L" input terminals; if TC break detection isn't desired do NOT install the jumper. On millivolt units, this jumper wire is not installed.
   NOTE: For TC units it is important to calibrate the transmitter with the TC break configured per your requirements. Changing the TC break configuration afterward will affect your calibration.
4. **Important:** Mark the Transmitter's Configuration on the calibration label located on the enclosure.
   Example: IN: Type J, UP, 100 to 400^{O}C.

Jumper Configuration Example:

The following is the configuration for the example below, configure as required by your application: Configure internal jumpers as follows:

A. Thermocouple Type: Type J.
B. Zero / Span Range: Zero & Span Jumpers both "IN".
C. Thermocouple Break: Upscale. Requires jumper between the "+" and "L" input terminals, too.

2. Transmitter - Adjustment Procedure:

The calibration example below is for a thermocouple input, which requires an ice-point temperature reference. Calibration of millivolt units is similar, but a reference is not required. To simulate a thermocouple input, an Acromag Series 320 Reference, an ice-bath, or other suitable reference must be used. Refer to Drawing 4501-091. Narrow span and linearized units are factory calibrated for best performance.

Connect the transmitter as shown in the Connection Drawing 4501-091. For best results, the input signal source should be adjustable from -5mV to +80mV DC, settable to an accuracy of 0.1% or better, and have a source resistance of 100Ω or less. 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 0.1% accuracy or better for proper results.

The Zero and Span adjustments are accessible on the front panel of the transmitter (see Drawing 4501-091 for location). The screwdriver blade used to adjust the potentiometers should not be more than 0.1 inch (2.54mm) wide. For optimum performance, the span and zero capability of the unit are covered in two ranges which are programmed by internal jumpers on the circuit board. The Span (S) and Zero (Z) jumpers change the range of adjustment of the span and zero potentiometers. During calibration, if the zero potentiometer range is found to be inadequate, move the Zero Shunt from "IN" (Default Position), to "OUT". If the span potentiometer range is found to be inadequate, move the Span Shunt from "IN" (Default Position), to "OUT". Only move the Shunt Jumpers when it is required. For Shunt Block location refer to Drawing 4501-092.

The voltage representing the temperatures at Zero and at Full-Scale are set on the millivolt source to obtain the two calibration points. Use Table 2 on the following page to convert each temperature to its equivalent millivolts (Reference = 0^{O}C) for the thermocouple type used.

Transmitter - Calibration Example:

MODEL: 250T-TC1-XPD1-NCR
Input: 100 to 400^{O}C., Type J Thermocouple, TC Break: Upscale
Output: 4-20mA

NOTE: To obtain the most accurate calibration of thermocouple transmitters, apply power to the unit and allow several minutes for thermal stabilization before completing calibration.

1. Set the input source to 5.268mV (100^{O}C). Adjust the Zero (Z) pot until the output reads 4.000mA DC.
2. Set the input source to 21.846mV (400^{O}C). Adjust the Span (S) pot until the output reads 20.000mA DC.
3. Repeat steps 1 and 2 above, until the readings converge. The instrument is now calibrated. Several mid-point values should also be checked to verify proper operation of the transmitter. Remember that the transmitter will be linear with millivolts and not temperature, unless the transmitter includes a linearizer, only then will it will be linear with temperature.
   Note: If a transmitter is linearized, the transmitter can only be trimmed to the range specified on the label--no other range of calibration will give acceptable results.
4. After the above calibration procedure is complete, install the transmitter PC Board assembly back into its case as described n the assembly procedure below. Note: If the transmitter has the Display Option, install it at this time also.

Assembly Procedure for the 250T Plastic Housing:

NOTE: The Model/Serial label is attached to the left plastic side.

1. Refer to Drawing 4501-092 and line up the left plastic side with the board and terminal assembly. Carefully but firmly press the pieces together.
2. Before installing the right side, place the mounting bracket (unique to the mounting type you have) around the pins at the back of the housing.
3. Line up the right side of the housing with the assembly and carefully but firmly press the pieces together.

TABLE 2: Thermocouple Voltages vs. Temperature:
(Reference: National Bureau of Standards Thermocouple Tables)

	Thermoelectric Voltage In Millivolts (With Reference Junction at 0°C)						
TEMP °C	**J**	**K**	**T**	**E**	**R**	**S**	**B**
- 250		-6.404	-6.181	-9.719			
- 200	-7.890	-5.891	-5.603	-8.824			
- 150	-6.499	-4.912	-4.648	-7.279			
- 100	-4.632	-3.553	-3.378	-5.237			
- 50	-2.431	-1.889	-1.819	-2.787			
0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
+ 50	2.585	2.022	2.035	3.047	0.296	0.299	
+ 100	5.268	4.095	4.277	6.317	0.647	0.645	
+ 150	8.008	6.137	6.702	9.787	1.041	1.029	
+ 200	10.777	8.137	9.286	13.419	1.468	1.440	
+ 250	13.553	10.151	12.011	17.178	1.923	1.873	
+ 300	16.325	12.207	14.860	21.033	2.400	2.323	
+ 350	19.089	14.292	17.816	24.961	2.896	2.786	
+ 400	21.846	16.395	20.869	28.943	3.407	3.260	
+ 450	24.607	18.513		32.960	3.933	3.743	1.002
+ 500	27.388	20.640		36.999	4.471	4.234	1.241
+ 550	30.210	22.772		41.045	5.021	4.732	1.505
+ 600	33.096	24.902		45.085	5.582	5.237	1.791
+ 650	36.066	27.022		49.109	6.155	5.751	2.100
+ 700	39.130	29.128		53.110	6.741	6.274	2.430
+ 800		33.277		61.022	7.949	7.345	3.154
+ 900		37.325		68.783	9.203	8.448	3.957
+1000		41.269		76.358	10.503	9.585	4.833
+1200		48.828			13.224	11.947	6.783
+1400					16.035	14.368	8.952
+1600					18.842	16.771	11.257
+1700					20.215	17.942	12.462
+1750					20.878	18.504	13.008
+1800							13.585

B. DISPLAY:

Display - Adjustment Procedure:

If the unit you are calibrating has a display, it is calibrated separately from the transmitter. The calibration of the transmitter must be verified FIRST (see above procedure), before verifying the calibration of the display module. Refer to Drawing 4501-090 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 particular customer specified range -- the Zero (DZ) and Span (DS) adjustments are trim adjustments only.

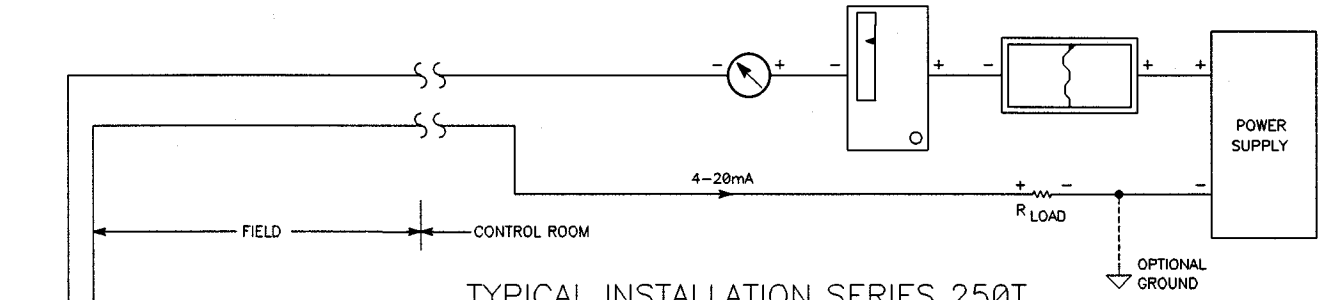
Display - Calibration Example:

MODEL: 250T-TC1-XPD2-NCR
Input: 100 to 400^{O}C., Type J Thermocouple (Iron-Constantan)
Display: 100 to 400^{O}C

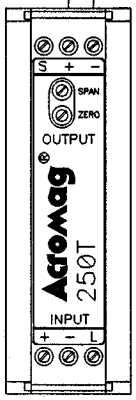
1. Set the millivolt input to 5.268mV (100^{O}C) (the Zero point of the transmitter's span). Adjust the Zero (DZ) pot of the Display module for the zero of the display range (not necessarily the same as the transmitter's range), 100^{O}C in this example.
2. Set the millivolt input to 21.846mV (400^{O}C) (the full-scale point of the transmitter's span). Adjust the Span (DS) pot on the Display module for the correct full-scale display reading (not necessarily the same as the transmitter's range), 400^{O}C in this example.
3. Repeat steps 1 and 2 above, until the readings converge. The display is 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.

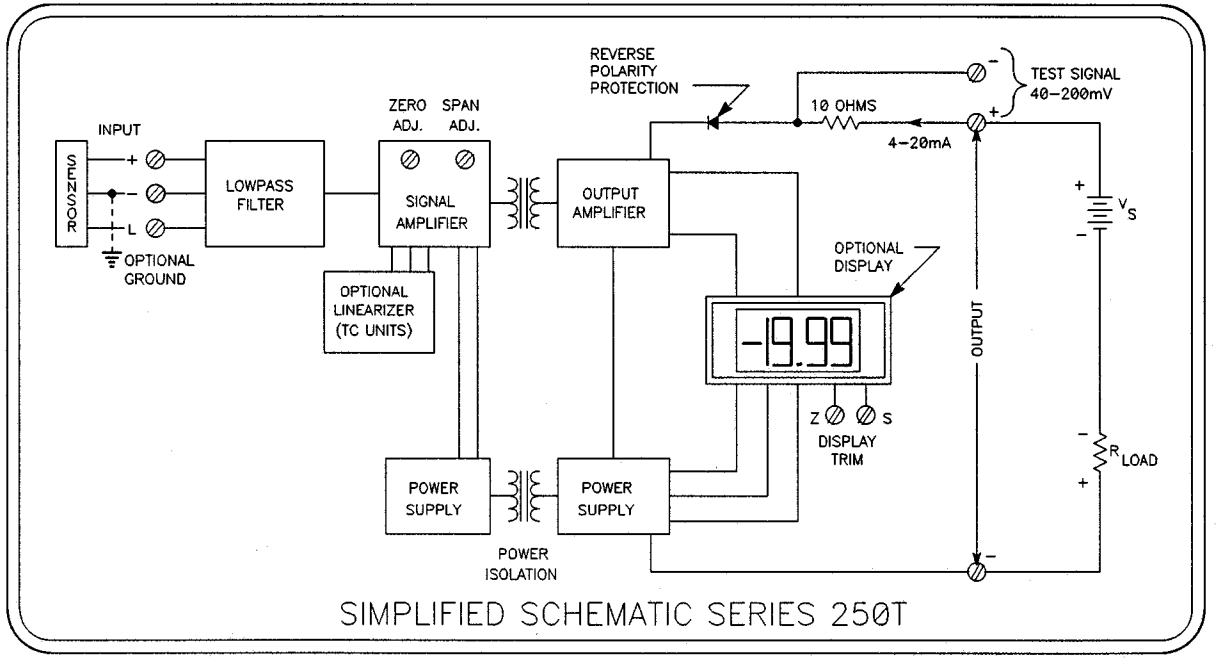


TYPICAL INSTALLATION SERIES 250T



INPUT

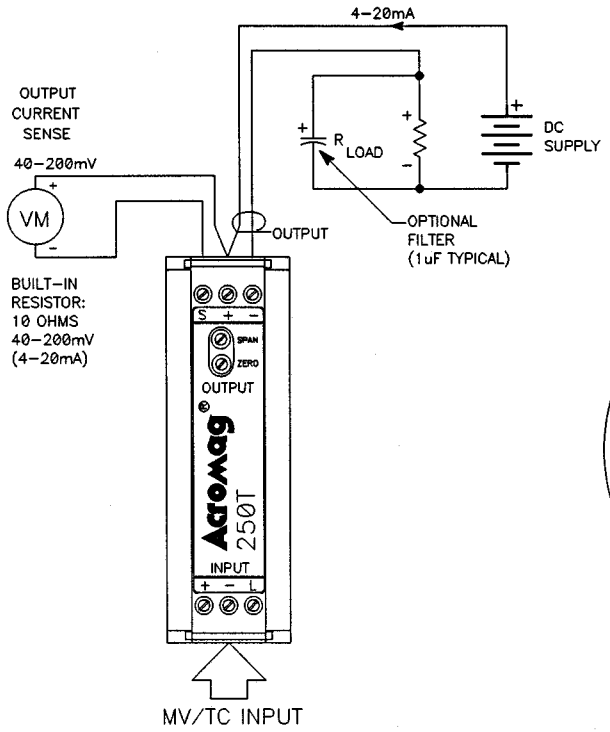
TWO–WIRE TRANSMITTER
SERIES 250T

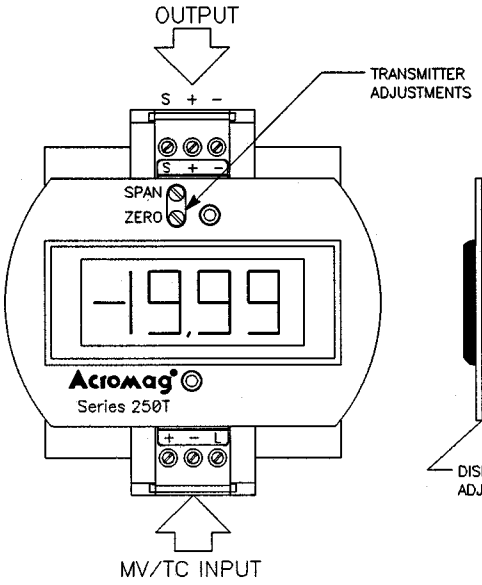


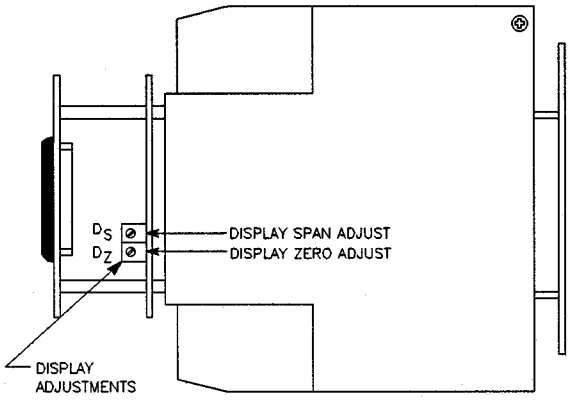
SIMPLIFIED SCHEMATIC SERIES 250T

Acromag WIXOM, MICH.							
	28 AUG 98	–	—	TAV	KG	KG
	DATE	REV	ECN	DR	ENG	CLP
TITLE: TYPICAL INSTALLATION						
D	SERIES: 250T	1 of 1	DWG NO. 4501–077			

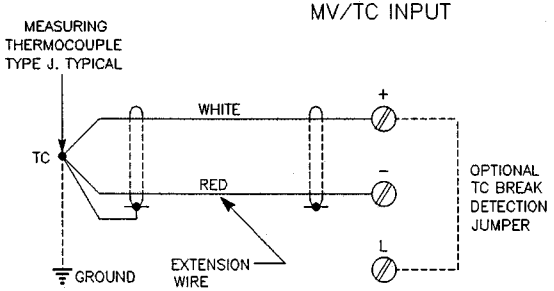
ANSI STANDARD THERMOCOUPLE COLOR CODE				
TYPE	(+) INPUT	COLOR	(−) INPUT	COLOR
J	IRON	WHITE	CONSTANTAN	RED
K	CHROMEL	YELLOW	ALUMEL	RED
T	COPPER	BLUE	CONSTANTAN	RED
R	PLAT./13% RHOD.	BLACK	PLATINUM	RED
S	PLAT./10% RHOD.	BLACK	PLATINUM	RED
E	CHROMEL	PURPLE	CONSTANTAN	RED
B	PLAT./30% RHOD.	GRAY	PLAT./6% RHOD.	RED



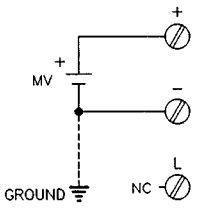




DISPLAY OPTION ADJUSTMENTS



THERMOCOUPLE

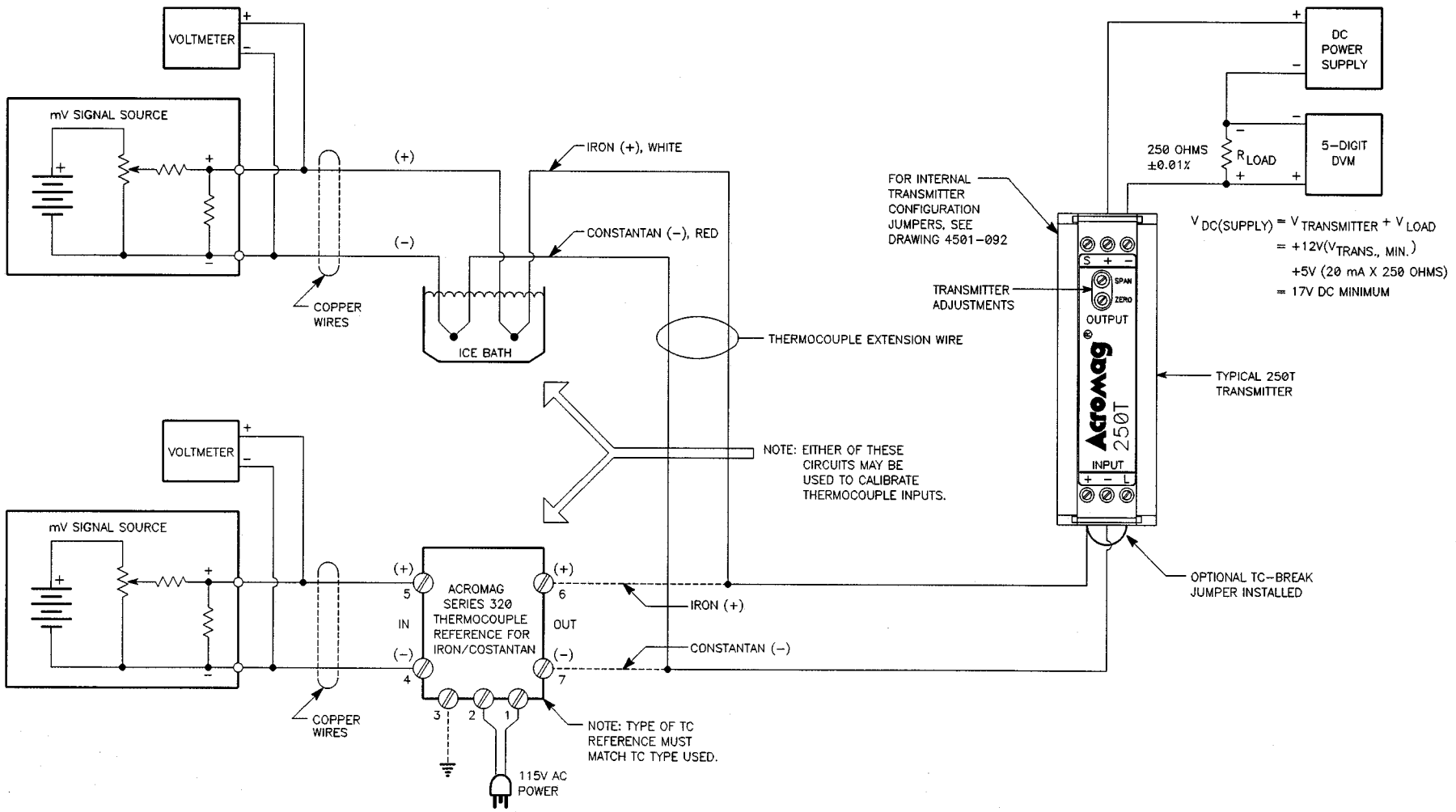


MILLIVOLT

INPUT CONNECTIONS

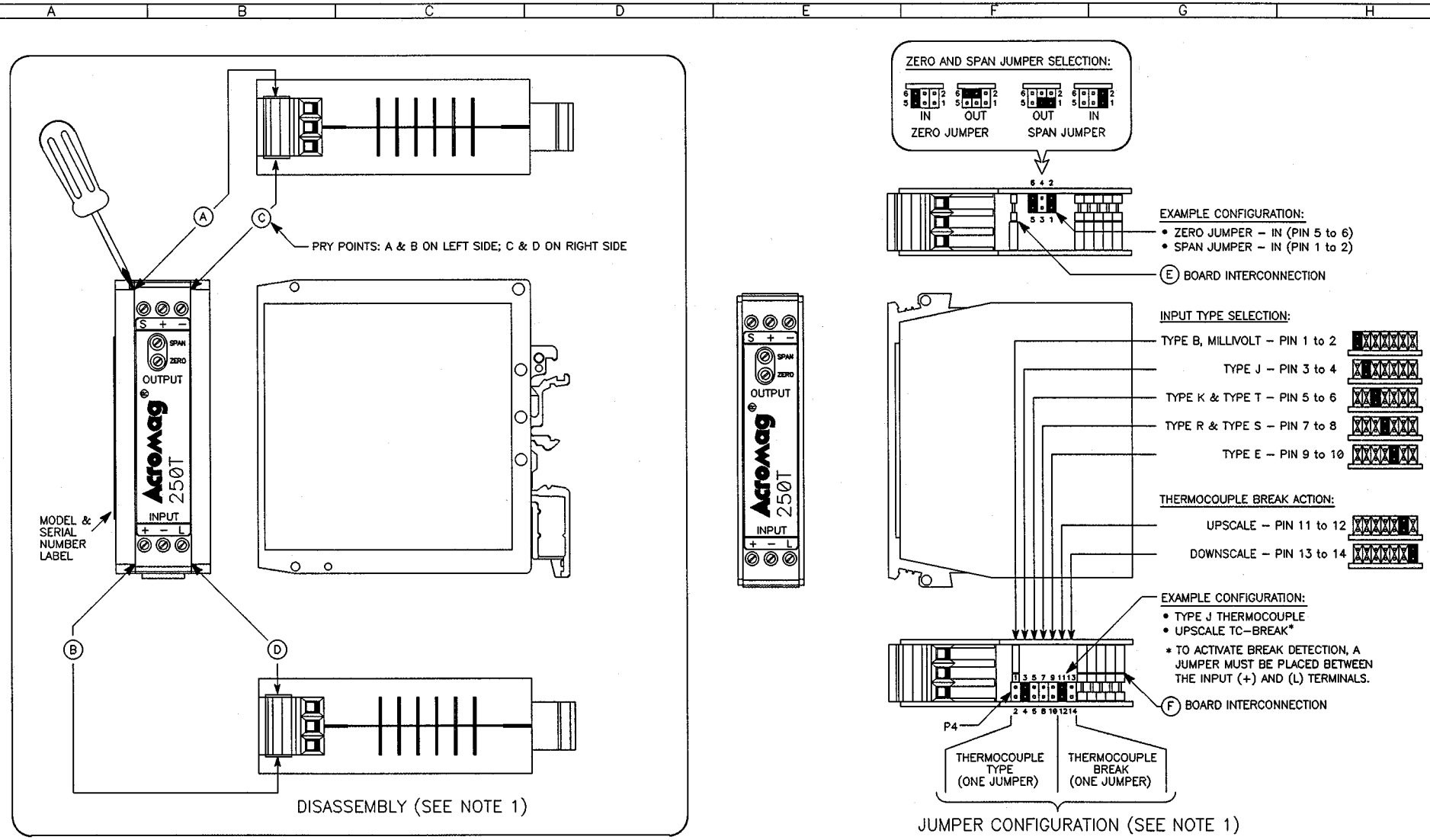
MILLIVOLT/THERMOCOUPLE TRANSMITTER ELECTRICAL CONNECTIONS

Acromag WIXOM, MICH.						
29 AUG 90	–		TAV	KG	KG	
DATE	REV	ECN	DR	ENG	CUP	
TITLE: 250T MV/TC INPUT CONNECTIONS						
D	SERIES: 250T	1 of 1	DWG NO. 4501–090			REV



THERMOCOUPLE CALIBRATION CONNECTIONS

Acromag WIXOM, MICH	15 OCT 96	A	96K007	TAV	LB	GRL
	29 AUG 98	−	——	TAV	KG	KG
	DATE	REV	ECN	DR	ENG	CLP
TITLE: 250T mV/TC CALIBRATION CONNECTIONS						
D	SERIES: 250T	1 of 1	DWG NO. 4501−091	A REV



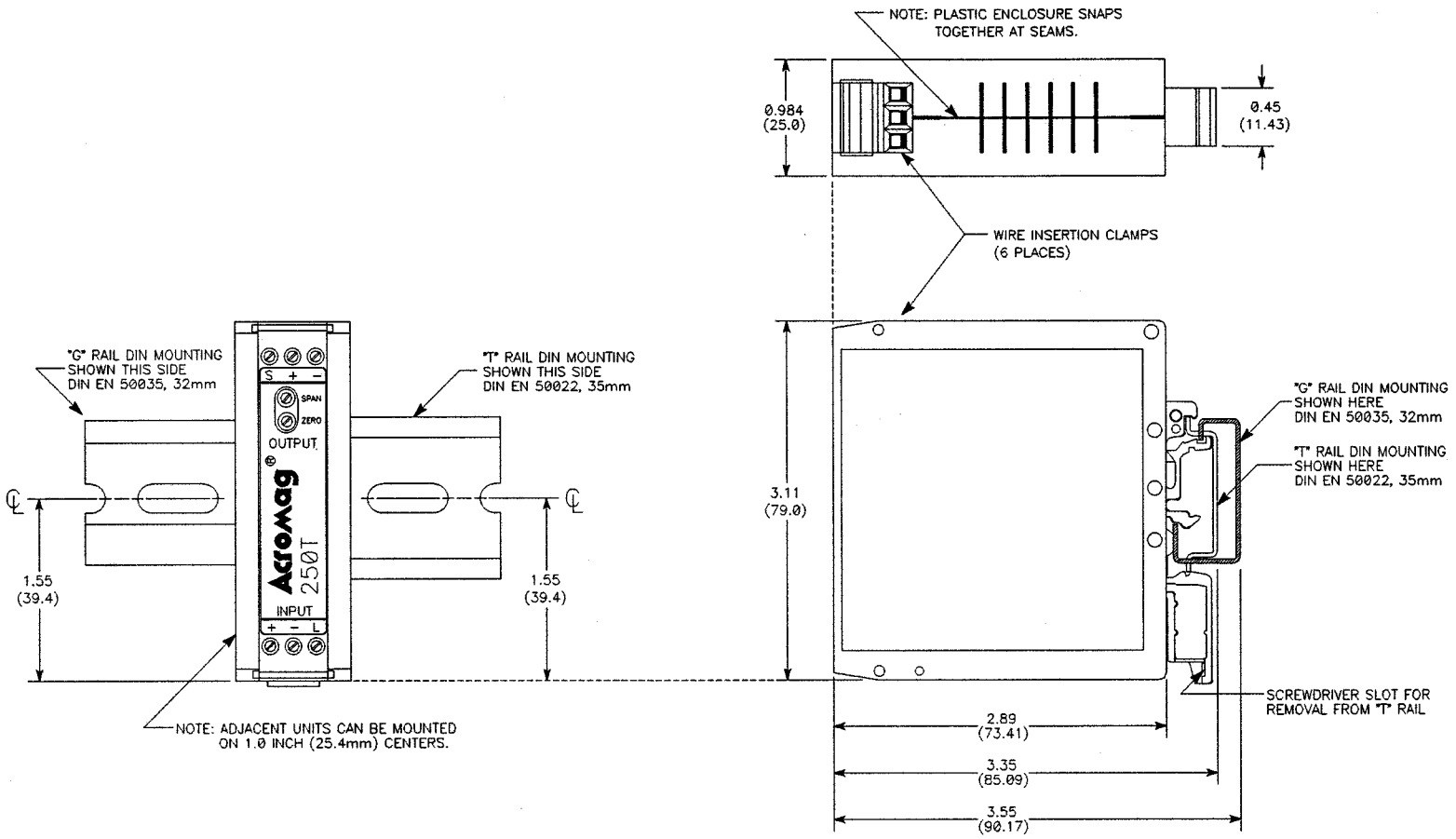
NOTE: 1. REFER TO THE CALIBRATION SECTION OF THE MANUAL FOR DETAILED INSTRUCTIONS.

SERIES 250T mV/TC JUMPER CONFIGURATION

Acromag WIXOM, MICH. | 29 AUG 98 | – | TAV | JGV | KG

TITLE: 250T mV/TC JUMPER CONFIGURATION

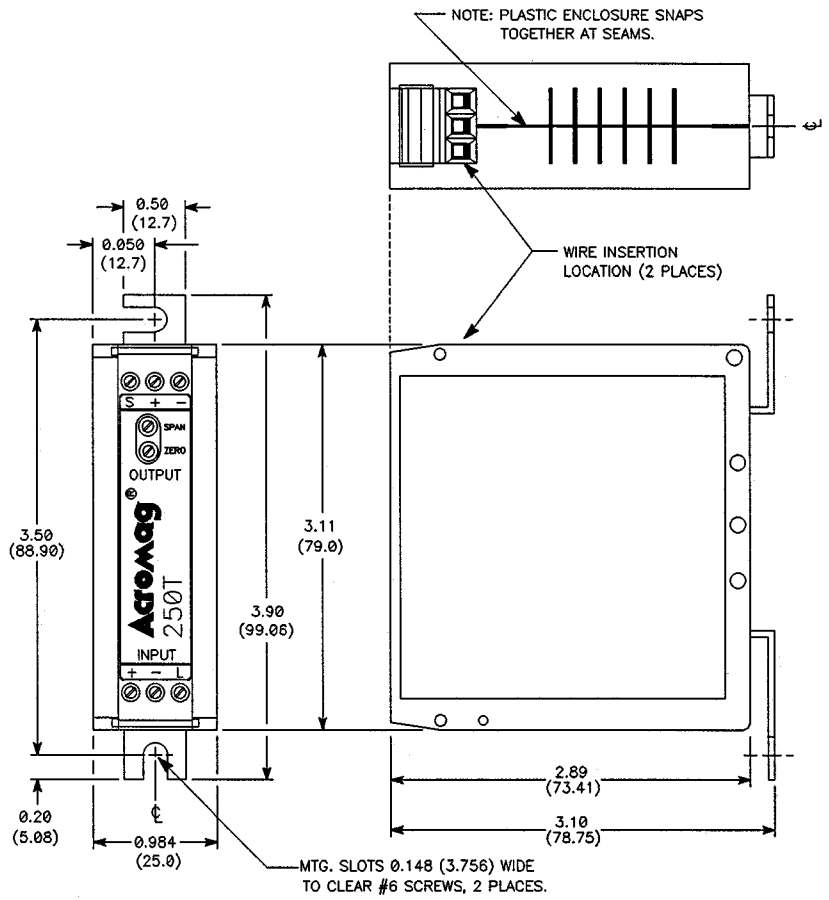
D | SERIES: 250T | 1 OF 1 | DWG NO. 4501-092



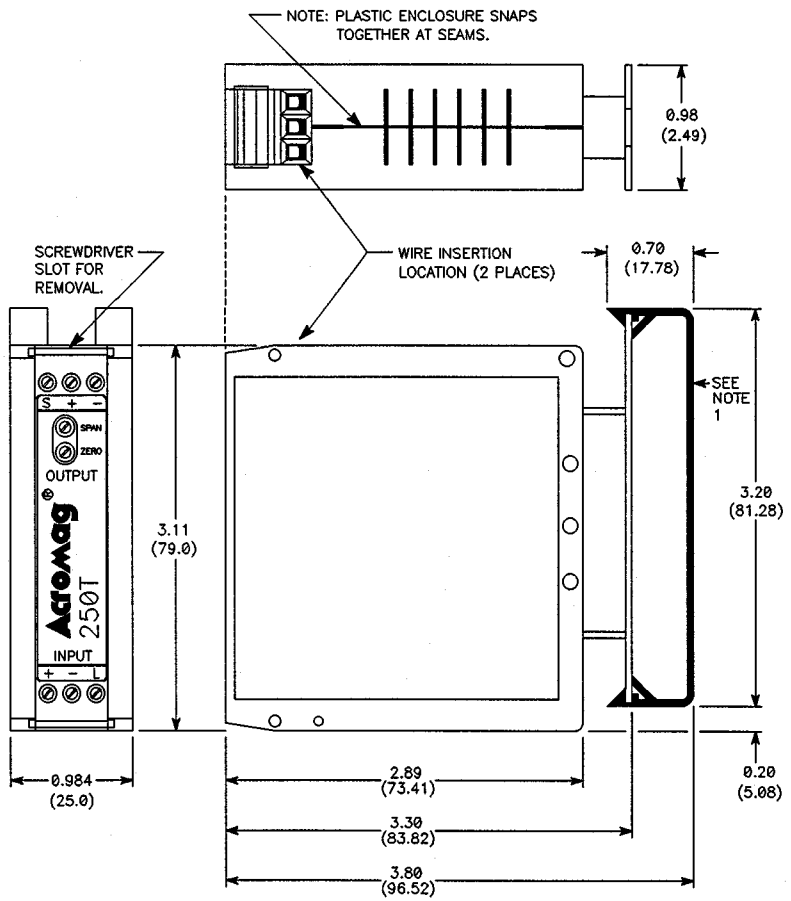
ENCLOSURE DIMENSIONS
DIN RAIL MOUNTING
(-DIN OPTION)

NOTE: ALL DIMENSIONS ARE IN INCHES (MILLIMETERS).

Acromag WIXOM, MICH.					BC	KG	KG
	28 AUG 90	–	——		BC	KG	KG
	DATE	REV	ECN		DR	ENG	CUP
TITLE: 250T HOUSING: DIN RAIL MOUNT							
D	SERIES: 250T		1 OF 1	DWG NO. 4501-080			REV



ENCLOSURE DIMENSIONS
SURFACE MOUNTING
–SM OPTION



ENCLOSURE DIMENSIONS
SNAPTRACK MOUNTING
–ST OPTION

NOTE 1: PLASTIC RAIL RATED TO 122°F (50°C).

NOTE: ALL DIMENSIONS ARE IN INCHES (MILLIMETERS).

Acromag WIXOM, MICH.	28 OCT 91	A	10921	TAV	KG	KG
	29 AUG 98	–	——	TAV	KG	KG
	DATE	REV	ECN	DR	ENG	CLP
TITLE: HOUSING: –SM, –ST OPTION						
D	SERIES 250T	1 OF 1	DWG NO. 4501–081			A

250T TRANSMITTER ASSEMBLY
FOR –XPDx ENCLOSURES

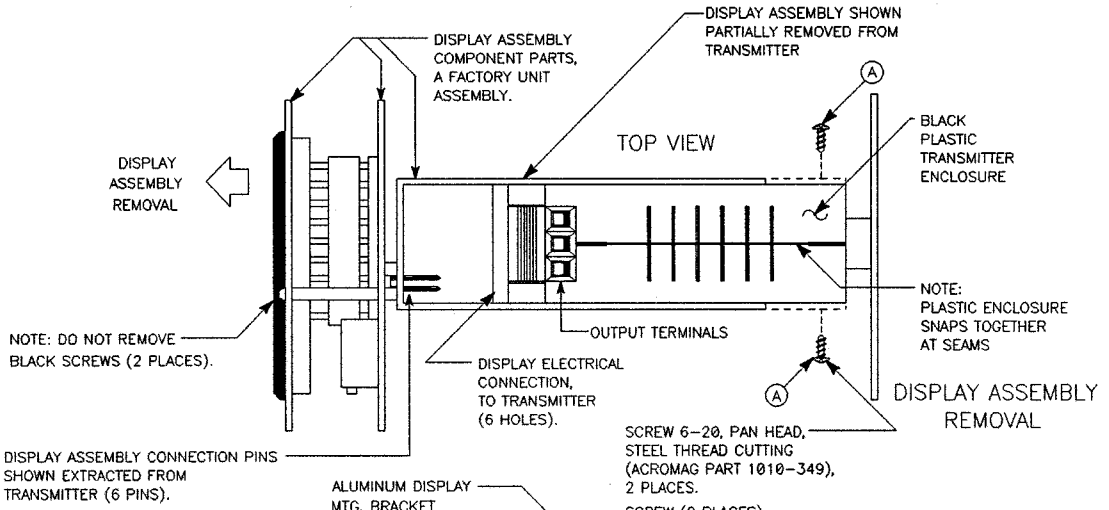
NOTE: TO REMOVE TRANSMITTER FROM DISPLAY ASSEMBLY PROCEED AS FOLLOWS.

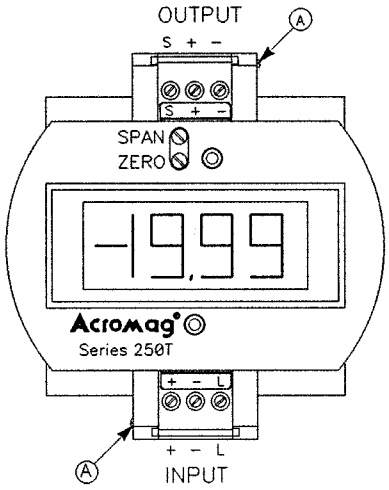
A. REMOVE SCREWS, ITEM A, (2 PLACES).

B. PULL DISPLAY ASSEMBLY AND DISPLAY MTG. BRACKET (B) FROM TRANSMITTER, A SIX PIN CONNECTOR WILL DISCONNECT FROM TRANSMITTER.

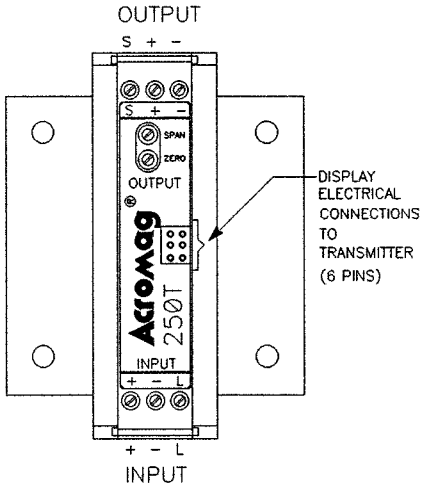
C. FOR ACCESS TO INTERNAL CONFIGURATION JUMPERS TAKE PLASTIC ENCLOSURE APART AT SEAMS USING A FLAT BLADE SCREWDRIVER.

D. MOUNTING BRACKET, ITEM C, IS HELD IN PLACE BY THE TWO HALVES OF THE PLASTIC ENCLOSURE.

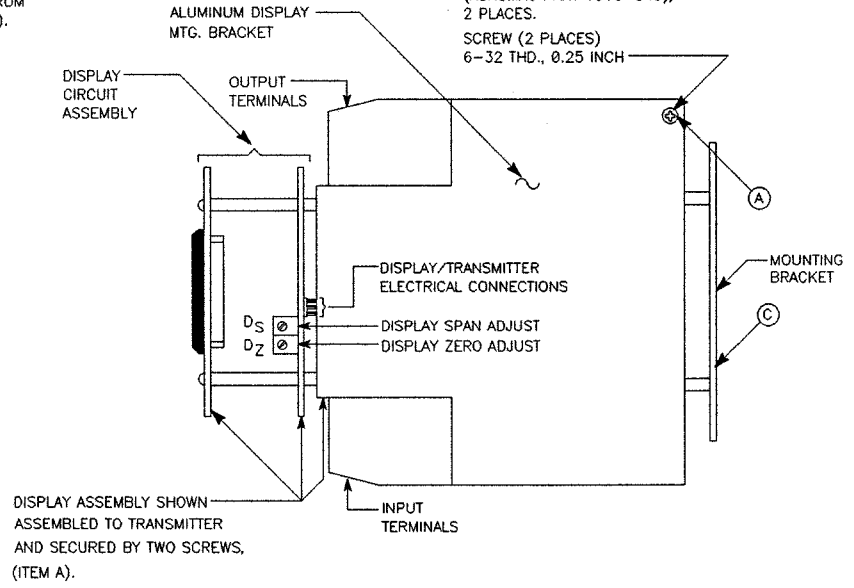




TRANSMITTER ASSEMBLY
WITH
DISPLAY ASSEMBLY MOUNTED



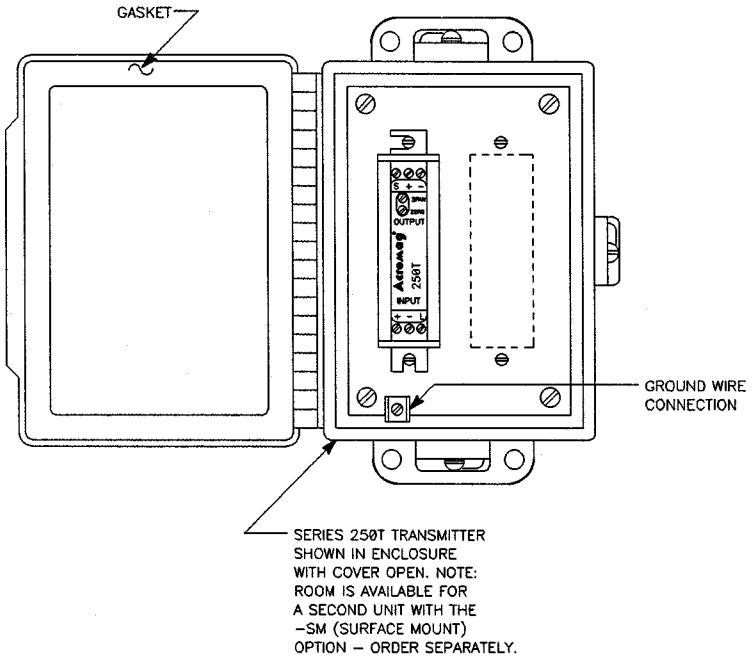
TRANSMITTER ASSEMBLY
WITH
DISPLAY ASSEMBLY REMOVED

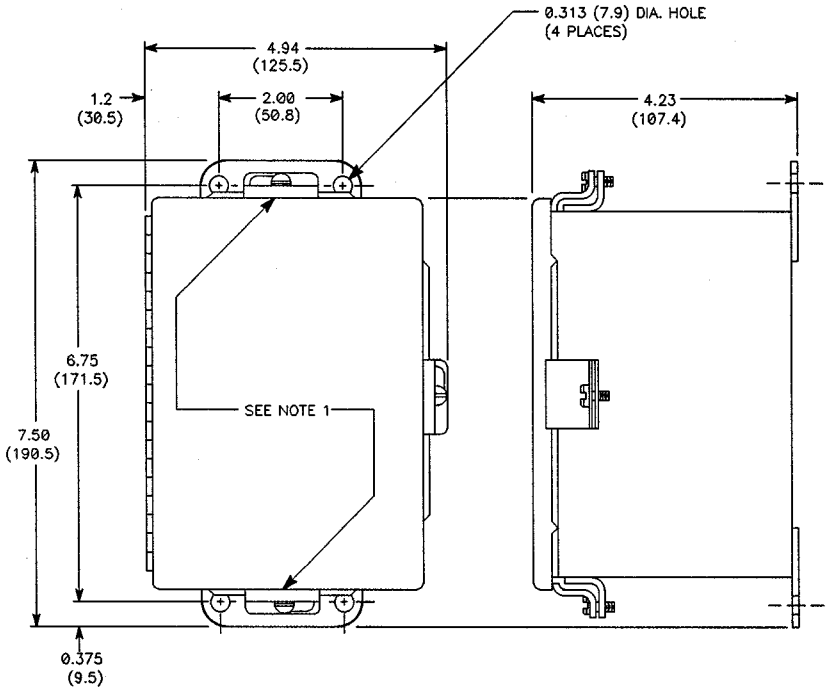


Acromag WIXOM, MICH.						
14 APR 94	A	940007	TAV	BC	BC
28 AUG 99	–	——	TAV	KG	KG
DATE	REV	ECN	DR	ENG	CLP

TITLE: TRANSMITTER/DISPLAY ASSEMBLY

D	SERIES 250T	1 of 1	DWG NO. 4501-082	A REV





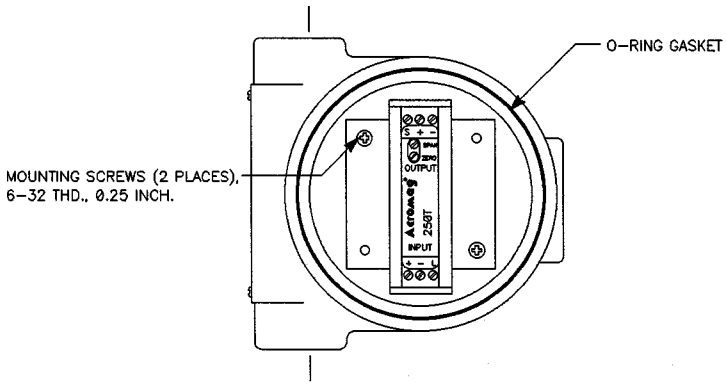
NOTES:

1. THESE SPECIFIC CLAMPS ON NEMA 4 ENCLOSURES ONLY.
2. CONDUIT MOUNTING HOLES AND FITTINGS ARE CUSTOMER SUPPLIED.

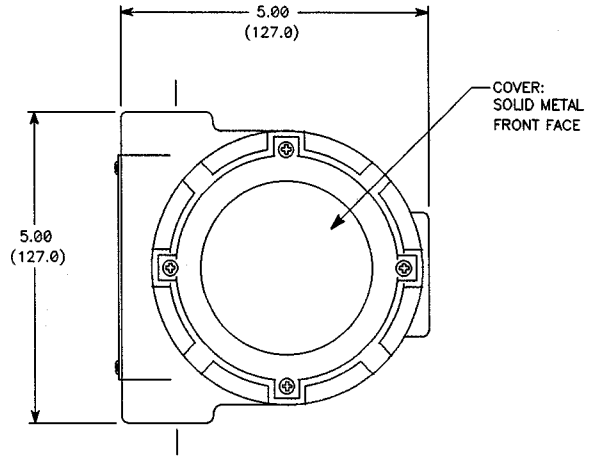
–N4 & –N12 OPTION ENCLOSURE DIMENSIONS

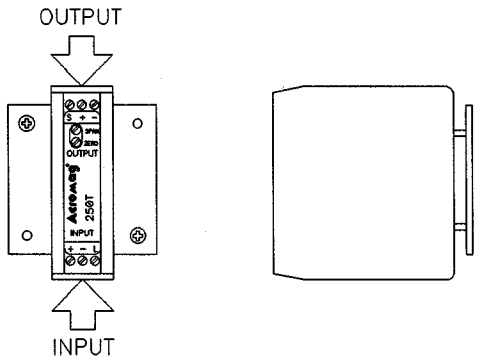
NOTE: ALL DIMENSIONS ARE IN INCHES (MILLIMETERS).

Acromag WIXOM, MICH.						
	28 AUG 98	–	—	TAV	KG	KG
	DATE	REV	ECN	DR	ENG	CLP
TITLE: ENCLOSURE: –N4 & –N12 OPTION						
SIZE: D	SERIES: 250T		1 OF 1	DWG NO: 4501-083		REV: C

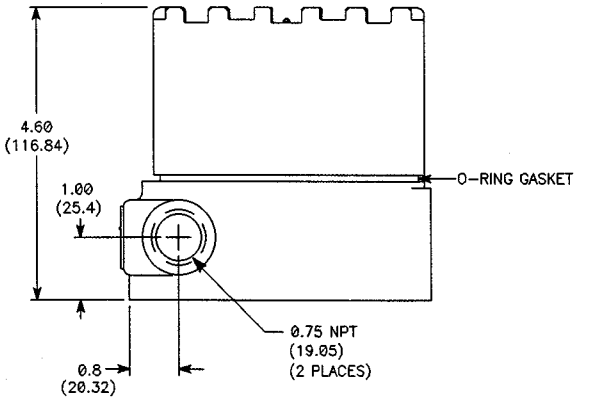


SERIES 250T TRANSMITTER
SHOWN INSTALLED IN ENCLOSURE
WITH COVER REMOVED.





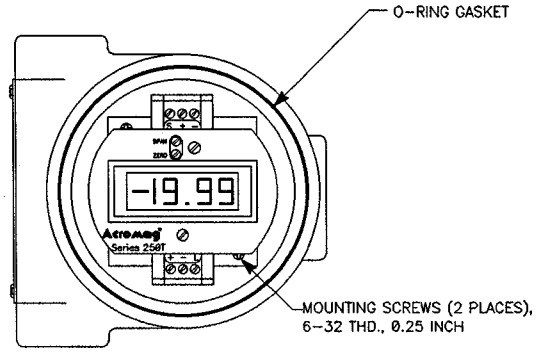
SERIES 250T TRANSMITTER
SHOWN REMOVED FROM
ENCLOSURE.



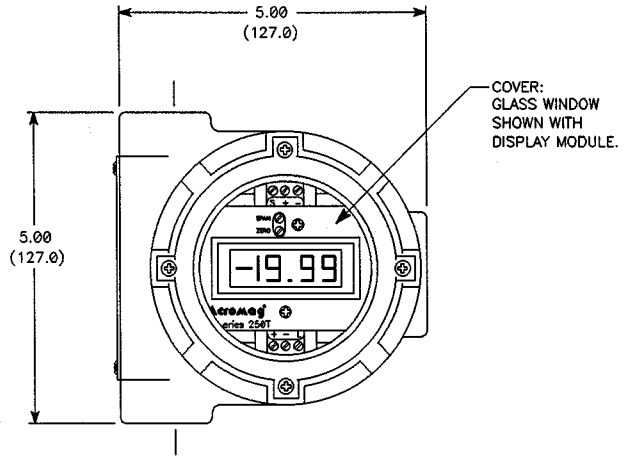
ENCLOSURE DIMENSIONS
-XP OPTION

NOTE: ALL DIMENSIONS ARE IN INCHES (MILLIMETERS).

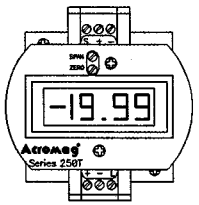
Acromag WIXOM, MICH.						
	28 AUG 98	-	—	TAV	KG	KG
	DATE	REV	ECN	DR	ENG	CUP
TITLE: ENCLOSURE, -XP OPTION						
D	SERIES: 250T	1 or 1	DWG NO. 4501-084			

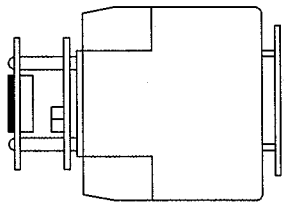


SERIES 250T TRANSMITTER
WITH DISPLAY OPTION SHOWN IN
ENCLOSURE WITH COVER REMOVED.

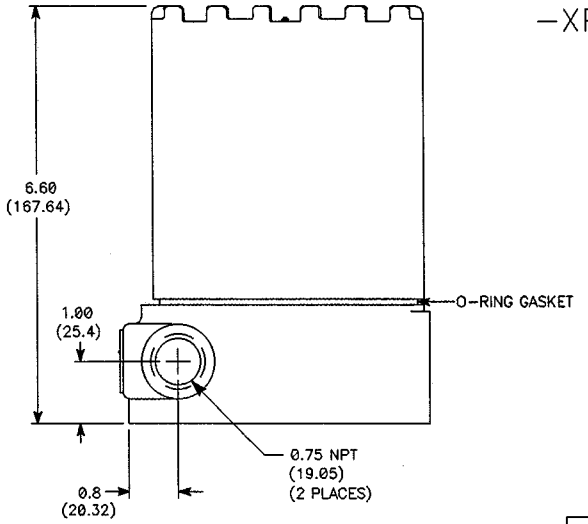


ENCLOSURE DIMENSIONS
-XPDx OPTION





SERIES 250T TRANSMITTER
WITH DISPLAY OPTION SHOWN
REMOVED FROM ENCLOSURE.



NOTE: ALL DIMENSIONS ARE IN INCHES (MILLIMETERS).

Acromag WIXOM, MICH.							
	28 AUG 98	-	——	TAV	KG	KG	
	DATE	REV	ECN	DR	ENG	CLP	
TITLE: ENCLOSURE, -XPDx OPTION							
D	SERIES: 250T	1 OF 1	DWG NO. 4501-085				REV C