MOORE INDUSTRIES

TPD

Programmable
Temperature Input Display

USER'S MANUAL

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Introduction

Moore Industries' Programmable Temperature Input Display (TPD) is a compact, panel-mount meter that accepts inputs from standard ISA thermocouples (T/C's) or 100-ohm platinum resistance temperature detectors (RTD's) and digitally displays a value that is proportional to the input.

This manual contains calibration, installation, and operation information for the TPD. Notes, Cautions, and Warnings are provided to avoid minor inconveniences, equipment damage, and personal injury while calibrating or installing this device.

Description

The TPD is a highly reliable instrument designed to monitor millivolt inputs from T/C's or resistance inputs from RTD's. It converts the input to a user-scalable value and provides a digital readout on a 4-digit LED display in degrees Celsius or Fahrenheit.

The standard TPD is equipped with an 8-position terminal strip for connecting the sensor input and ac power. All electrical connections are made at the rear of the unit. Units configured with special options have additional connectors, which are also accessible at the rear of the unit.

The TPD is powered by an external 115- or 230-Vac source. A switch on the main PCB allows the user to select the appropriate ac power setting.

Other controls that the user can manipulate include selection of Celsius or Fahrenheit display readings, display resolution, span and zero adjustments, sensor input type, and T/C or RTD type. These controls allow the user to calibrate the TPD and configure it for a variety of applications.

This sturdy, light-weight meter is packaged in a thermoplastic housing that mounts directly on an instrument panel in a user-provided cutout. Mounting hardware is provided with each unit.

Table 1 contains the equipment specifications for the standard TPD.

Configuration Options

The TPD is available with one-of-two factory-configured options; the multiple input option (FS6) or the alarm option (C).

FS6 Option – Allows the TPD to accept as many as six T/C or RTD inputs. A rotary switch on the front panel allows the user to select which input will be displayed. Units equipped with this option have a special terminal block to connect the inputs from the additional T/C's or RTD's. (This option is not available with C Option.)

C Option – Provides a single trip point alarm that energizes a Form C relay. This relay is rated for 0.5 A at 120 Vac, non-inductive. Units configured with the C Option have an LED, which illuminates when the Alarm Relay energizes, to indicate alarm conditions, and pushbuttons to set the alarm trip point. (This option is not available with FS6 Option.)

Serial Number. A complete history is kept on every product Moore Industries sells and services. This information is keyed to the unit's serial number. Whenever service information is required on a particular product, it is necessary to provide the factory with the serial number of the unit. The serial number for the TPD is located on a label affixed to the top of the housing.

Model Number. Moore Industries' model numbers identify the type of instrument, functional characteristics, operating parameters, any options ordered, and the unit's housing type. If all documentation for a unit is missing, the model number can be used to obtain configuration information about the TPD. The model number for the TPD is located on the same label as the serial number, which is affixed to the top of the unit.

TPD

Table 1. TPD Equipment Specifications

Characteristic	Specification
Input	**Thermocouple:** ISA type J, K, T, E, S, R, or B **RTD:** 100-ohm platinum; PT1, alpha = 0.00385; PT2, alpha = 0.00392
Output	Displayed in Celsius or Fahrenheit readings
Display Range	-999 to 9999 (user-scaleable), with user-select decimal point
Power Requirements	115/230 Vac (±10%), 60/50 Hz (switch-selectable)
Accuracy	±1 count of least significant digit (LSD)
Repeatability	±1 count
Stability with Temperature	**Zero:** 0.1 ppm/°C **Span:** 0.01% reading/°C
Stability with Time	1°/year, maximum
Noise Rejection	**Normal Mode Rejection Ratio** (NMRR): ≥60 dB @ 50/60 Hz, ±0.1 Hz **Common Mode Rejection Ratio** (CMRR): ≥120 dB @ 50/60 Hz, ±0.1 Hz with 250Ω unbalance
Overload Protection	Power lead to ground: 1500 Vdc or Vac rms; **Across T/C Inputs:** Up to 250 Vdc or Vac for one minute, +T/C to –T/C **Across RTD Inputs:** Up to 125 Vdc or Vac for one minute, A to B; Up to 62 Vdc or Vac for one minute, B to C
Input Impedance	**T/C:** 20 MΩ (exclusive of break detect current effects) **RTD:** 16.9 kΩ. A input; 16.9 kΩ C input
Read Rate	2/second, nominal for 1° readings; 1/second, nominal for 0.1° readings
Display	Each digit is a seven-segment red/orange LED,14.2 mm (0.56 in.) high
Environmental Conditions	**Operating:** 5 to 45 °C (41 to 113 °F) **Storage:** -40 to 65 °C (-40 to 149 °F) **Humidity:** ≤80% relative humidity (non-condensing)
Weight	454 grams (1 lb)
NOTE: Refer to the Installation Section for physical dimensions.	

The example below identifies the significance of each field in the TPD model number. The following paragraphs describe the entries found in a typical TPD model number.

Unit Type – This field contains the model designation of the unit. For this device, the designation is **TPD.**

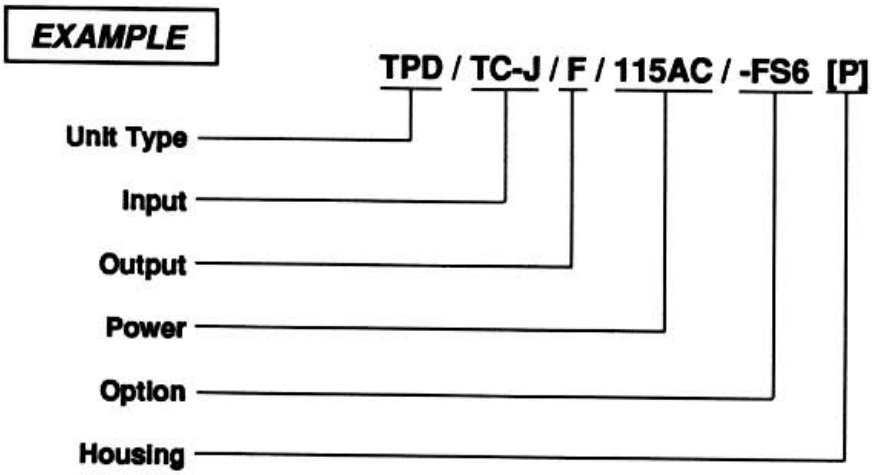
Input – This field identifies the input sensor type the unit was configured for at the factory. This field will contain the T/C or RTD type. This field contains: **TC-J, TC-K, TC-T, TC-E, TC-R, TC-S, TC-B, PT1,** or **PT1A.**

Output – This field identifies the display output type (°C or °F) the unit was configured for at the factory. This field contains either **C** for Celsius of **F** for Fahrenheit.

Power – This field identifies the ac power requirement the unit was configured for at the factory. This field contains either **115AC** or **230AC.**

Option – If this field is used, it identifies the option the TPD was configured for at the factory. This field may contain **-FS6** (multiple input option) or **-C** (alarm option).

Housing – This field contains the type housing in which the DPD is enclosed. This field contains **P** for plastic housing.



Calibration

Every TPD is factory-calibrated prior to shipment. But, to verify a unit's configuration setup or to change the setup, the unit must be field-calibrated. The calibration procedure in this section should be performed at least once a year.

Most of the controls used for calibration are directly behind the front lens cover. However, accessing other controls requires that the electronics be removed from the housing.

Controls

The most frequently used controls on the standard TPD are behind the front lens cover. The lens snaps into place and can be removed with a small slotted-head screwdriver or pulled off by hand to access these controls. A narrow cutout at the bottom of the lens is provided to gently pry it away from the housing. Figure 1 shows the location of the controls that are behind the front lens cover.

The controls located behind the front lens cover include:

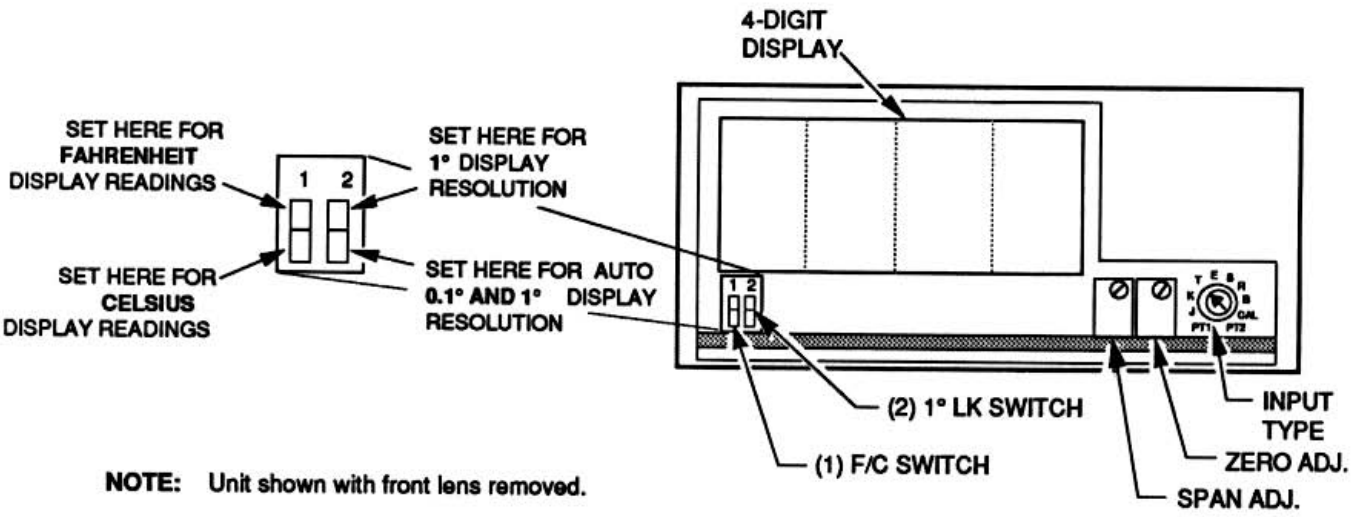
- F/C switch – used to select Fahrenheit or Celsius display readings
- 1° LK switch – used to lock the display resolution to 1 degree or allow the display resolution to auto-adjust between 0.1 and 1 degree
- SPAN and ZERO potentiometers – used to adjust the span and zero settings during calibration
- T/C, RTD, and CALibration rotary switch – used to configure the unit's input for the desired thermocouple or RTD type, and to place the unit in the calibration mode

Other controls on the standard TPD include:

- AC selection switch – used to set the unit for 115- or 230-Vac mains power operation
- RTD T/C jumper – used to select the input sensor type of either RTD or T/C

Indicators

The 4-digit, red/orange, LED display is the only visual indicator on the standard TPD. It displays temperature readings in Celsius (°C) or Fahrenheit (°F) over the user-specified range. The digital display is also used for calibration as well as for setting the alarm trip point on units configured with the C Option.



NOTE: Unit shown with front lens removed.

Figure 1. *Standard TPD Controls Behind Front Lens*

Accessing the Electronics

To set the ac power configuration, the input sensor type, and to set some parameters required by configuration options, the electronics must be removed from the housing.

The electronics of the standard TPD are built as one fixed assembly. This assembly is held in the housing by a built-in retainer located on the inside-bottom surface of the housing. This retainer is visible from the front of the unit with the lens cover removed.

To remove the electronics: first, the front lens must be removed; then, the sides of the housing by the front opening must be squeezed so the opening bows just enough for the electronics to clear the built-in retainer. When the electronic assembly clears the retainer, it can be pulled out the front of the housing, or pushed out from the rear by pushing forward on the terminal strip.

WARNING
DO NOT attempt to push the electronics out from the terminal strip with ac applied to the unit.

TPD's configured with the C Option must have the spade lugs disconnected before removing the electronics. The FS6 Option PCB has an edge connector that simply slides into the FS6 terminal block. With the FS6 terminal block secured to the housing with the two Phillips-head screws provided, the electronics can be pushed out of the housing in the same manner as described previously.

AC Power Selection

The TPD is factory-configured to user-specifications. These specifications include the type of ac power that is intended for the unit. If the power available for the TPD is different than when initially ordered, the user may change the ac selection with a switch on the Main PCB.

A slide switch on the Main PCB is used to select either 115- or 230-Vac operation. To access this switch, the entire electronics assembly must be removed from the housing.

Figure 2 shows the location of the ac selection switch on the Main PCB. The 115V and 230V positions are marked on the PCB. Simply slide the switch to the desired position. Once the selection is made, the electronics may be slid back into the housing.

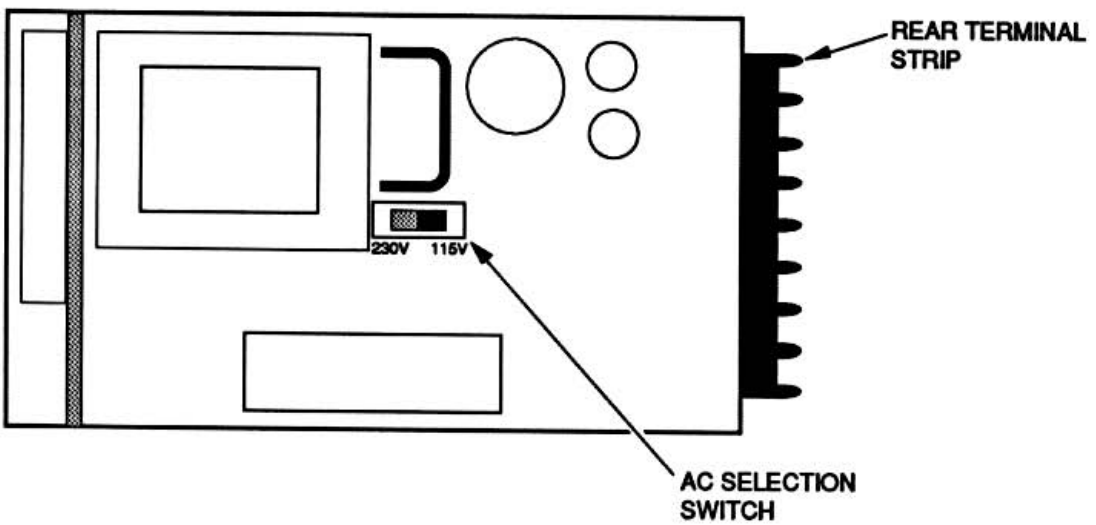


Figure 2. *115/230 Vac Selection Switch Location (Main PCB)*

Input Sensor Selection

The TPD accepts inputs from either T/C's or RTD's. An internal jumper must be set to the appropriate input type for the TPD to process the input properly. If this jumper does not match the actual input sensor, the readings will be incorrect.

A removable jumper located on the right and to the rear of the Main PCB is used to set the sensor input type. Figure 3 shows the location of the jumper set and the connections required for each. Of the three pins in this jumper set, the center pin is common. Either of the outside pins jumpered to the center pin selects the sensor type indicated by the markings on the PCB.

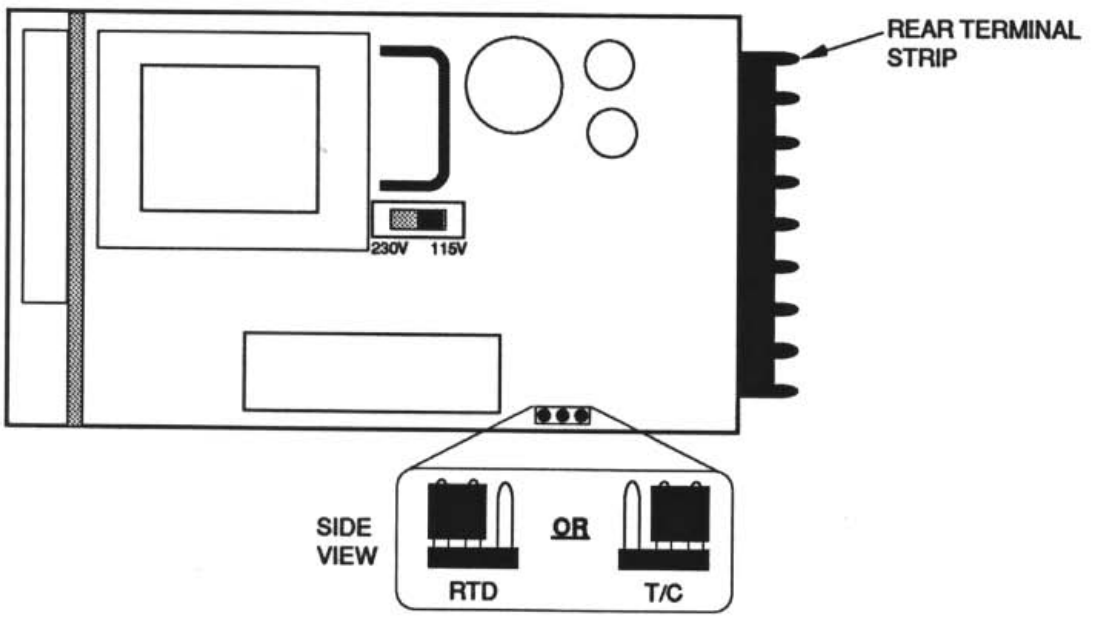


Figure 3. *Sensor Input Selection Jumper Location*

Calibration Equipment

Table 2 contains the equipment required to calibrate the TPD. Optional equipment is identified and is required only for conditions so indicated.

Calibration Setup

Figure 4 shows the equipment setup required to calibrate the TPD. See figure 8 in the Installation Section for terminal assignments.

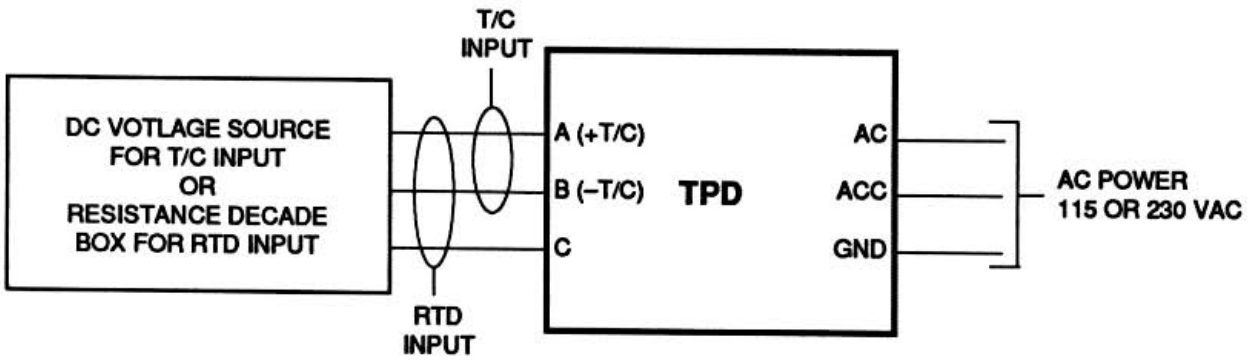
The following calibration procedure may be performed on a workbench or with the TPD mounted in its intended operating location. However, it is easier to access the electronics when the unit is not mounted on an instrument panel.

Standard TPD Calibration Procedure

1. Remove front panel lens cover.
2. Remove electronics from housing.

Table 2. TPD Calibration Equipment

Equipment	Specification
Precesion DC Voltage Source (optional)	To simulate **T/C** inputs; Accuracy of ±0.01%, resolution of 1 μV
Precision Resistance Decade Box (optional)	To simulate **RTD** inputs; Accuracy of ±0.02%, resolution of 0.01Ω
Interconnecting Copper Wire	For T/C inputs: to connect dc source to the unit For RTD inputs: to connect resistance source to the unit
Trimmer Adjusting Tool	Blade-type trimmer for adjusting potentiometers and changing sensor type
Small Slotted-head Screwdriver (optional)	To remove front lens cover, if necessary



NOTE: Refer to the Installation Section for TPD terminal assignments.

Figure 4. TPD Calibration Setup

3. Set ac power selection switch to required setting. See figure 2.
4. Set RTD or T/C jumper as required. See figure 3.
5. Place electronics back into housing.
6. Set F/C DIP switch to desired output type. See figure 1.
7. Set 1°LK switch to desired resolution. See figure 1.
8. Using a blade-type trimmer, set rotary sensor selection switch to CAL.
9. Connect TPD to appropriate input source as shown in figure 4. Apply ac power.

WARNING

The ac power terminals at the rear of the TPD are exposed. To avoid electrical shock, remove ac power before rewiring and avoid contact with exposed terminals while power is applied.

10. For T/C-simulated inputs, set adjustable voltage source for 0.00 mV. (For RTD-simulate inputs, skip to step 14.)

11. Using a blade-type trimmer, adjust ZERO potentiometer for a display reading of 0.0 (±0.1).

NOTE

Display readings can take up to 3 seconds to respond to changes in ZERO or SPAN potentiometer settings.

12. Set adjustable voltage source for 39.000 mV.

13. Adjust SPAN potentiometer for a display reading of 560.0 (±0.1). Skip to step 18.

14. For RTD-simulated inputs, set resistance decade box for 0.00Ω.

15. Using a blade-type trimmer, adjust SPAN potentiometer for a display reading of 0.0 (±0.1).

NOTE

Display readings can take up to 3 seconds to respond to changes in ZERO or SPAN potentiometer settings.

16. Set resistance decade box for 265.00Ω.

17. Adjust ZERO potentiometer for a display reading of 543.8 (±0.1).

18. Set rotary sensor selection switch to desired T/C or RTD setting and replace front lens cover.

19. Remove ac power source, and THENdisconnect input source. This completes TPD calibration.

Calibration Considerations for the FS6 and C Options

Units configured with the FS6 or C Option require additional attention during calibration beyond that required for standard units.

FS6 Option. Each input to a unit configured with the FS6 Option must be from identical sensor types; same type T/C or RTD. Also, each sensor must have the same operational characteristics.

For units configured with FS6 Option, each channel should be checked by connecting an input to it and setting the front panel rotary switch so the corresponding channels can be viewed.

After calibrating the TPD with an input on channel 1, the same input should be moved on channel 2, then 3, and so on. The rotary switch on the front panel must be changed accordingly. The display reading for each channel should be identical.

The OUT terminals on the FS6 terminal block must be connected to the normal input terminals on the standard terminal block using the same T/C wire will be used by the input sensors. Internal board connections for the FS6 Option are made with T/C wire.

See figure 9 in the Installation Section for FS6 Option terminal assignments

C Option. Along with completing the standard calibration procedure, units configured with the C Option also require the user to select the high/low alarm function and to set the alarm trip point.

Before setting the trip point, the high- or low-alarm function must be selected. A removable jumper is used for this selection. The jumper set pins on the Alarm PCB are marked "HI" and "LO". A jumper is used to connect two-of-three pins for the desired selection. (The center pin is common to both HI and LO.)

Figure 5 shows the location of the jumper set pins, and the required connections for the desired selection.

To access the HI/LO jumper, the electronics must be pulled out of the housing at least one inch. Refer to Accessing the Electronics subsection earlier in this section for information on removal of the electronics.

Once the jumper is set, the electronics should be carefully pushed back into the housing until it locks behind the built-in retainer.

After the TPD is configured for a high or low alarm, the alarm trip point must be set. The SET and VIEW pushbuttons on the front panel are used to set the alarm trip point.

To set and verify the alarm trip point, the TPD must be setup for calibration as shown in figure 4. Using an adjustable input allows for verification of the trip point setting.

There are two ways of verifying the response of the alarm option; the reaction of the ALARM LED, and the reaction of the Alarm Relay . An ohmmeter is required to monitor the reaction of the relay contacts. (See figure 11 in the Installation Section for the C Option terminal assignments.)

The ALARM LED illuminates when the Alarm Relay energizes, and it extinguishes when the relay de-energizes. If the alarm override feature is used, the LED will illuminate but the Alarm Relay will not energize.

To set the alarm trip point, perform the following procedure.

1. If unit is set for high alarm, set input to a value slightly less than the desired trip point.

   If unit is set for low alarm, set input to a value slightly higher than the desired trip point.

2. Press and hold VIEW pushbutton to verify current trip point setting.

3. Simultaneouly press SET and VIEW pushbuttons. The current trip point setting will appear with first digit flashing.

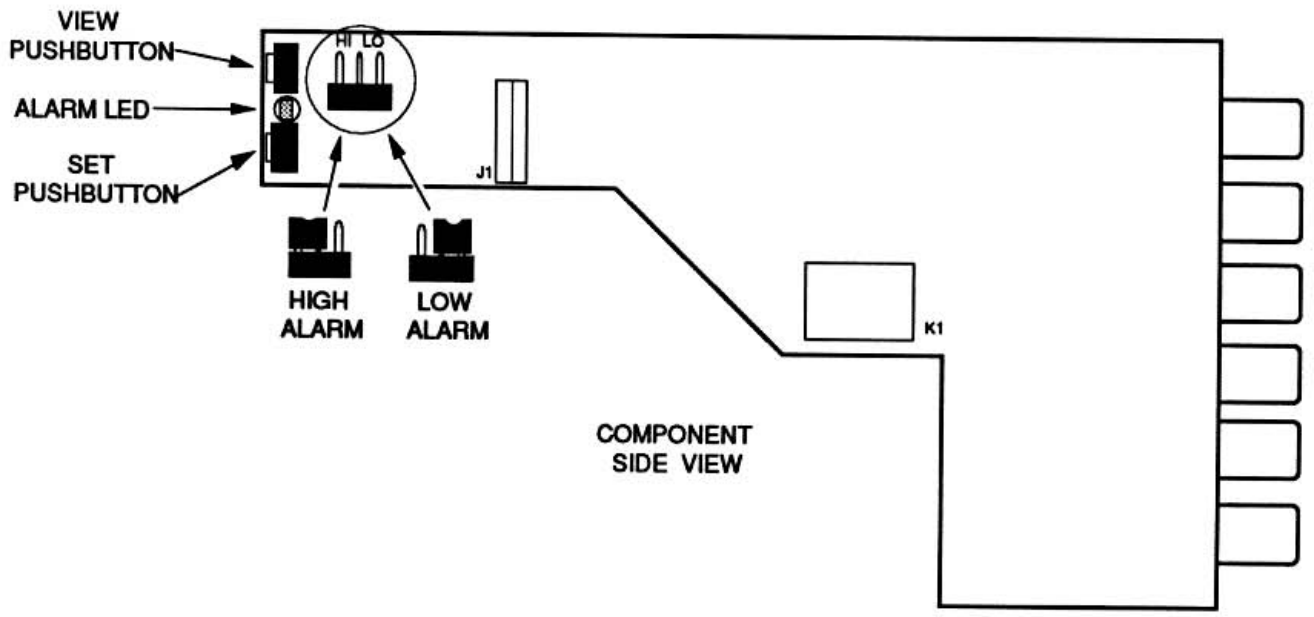


Figure 5. *High/Low Alarm Jumper Location*

4. Press SET pushbutton to sequence (scroll) first digit to desired setting.
5. Press VIEW pushbutton to move to next digit.
6. Repeat steps 4 and 5 until last digit is set.
7. Simultaneously press SET and VIEW pushbuttons to register trip point setting.
8. Vary adjustable input in the appropriate direction to surpass trip point setting. Verify that ALARM LED illuminates when trip point is exceeded, and extinguishes when trip point is no longer exceeded.

If ac power is removed from the TPD, the trip point setting will remain where last set in non-volatile memory. If the latest trip point setting is not registered by simultaneously pressing the SET and VIEW pushbuttons, the previous setting will remain.

Installation

Installing the TPD consists of physically mounting the unit and completing the necessary electrical connections. Each of these tasks are described in the following subsections.

Mounting the TPD

The TPD is designed for mounting in a instrument panel cutout. Figure 6 contains the outline dimensions of the TPD. Figure 7 contains the cutout dimensions required to mount one, two, three, or four panel-mount meters. Mounting hardware is supplied with each unit.

The cutouts shown in figure 7 afford the user a few mounting options. If only one meter is to be mounted, the single cutout dimensions should be used. However, if stacking meters in a vertical arrangement is desirable, then a double, triple, or larger cutout is required.

The maximum panel thickness should not exceed 5.08 mm (0.2 inch).

When TPD's are stacked in a vertical cutout, the front panel of each meter rests slightly on the meter beneath it. The user should be aware that accessing the front lens covers may be more difficult with the front panels in such close proximity.

After selecting and making the appropriate cutout, perform the following steps to physically mount the TPD.

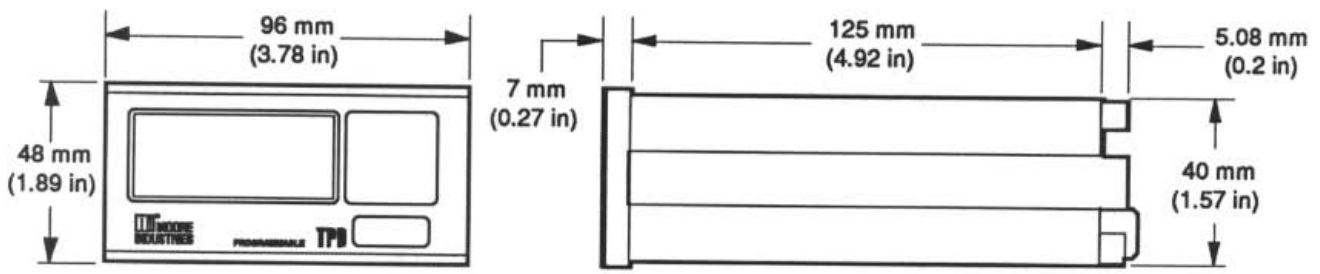


Figure 6. *TPD Outline Dimensions*

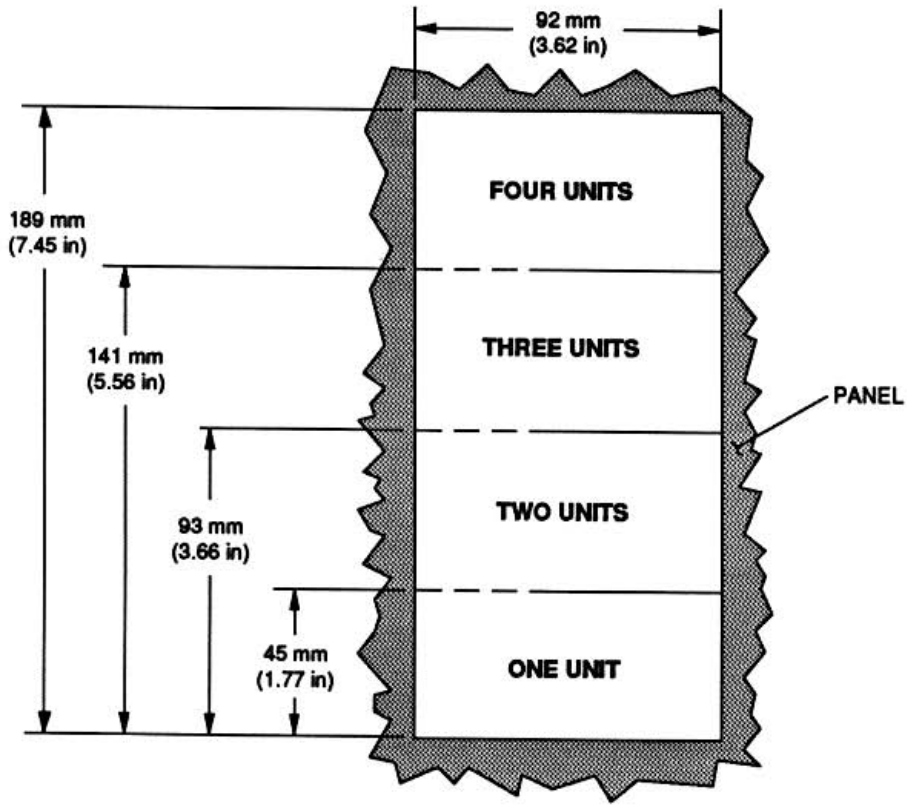


Figure 7. *Panel Cutout Dimensions*

1. Using a small Phillips-head screwdriver, remove mounting bracket from unit by removing two screws at rear of unit securing bracket to housing.

NOTE

Units equipped with the FS6 Option require removal of the additional FS6 connector to remove the mounting bracket. Two screws secure the connector to the housing.

2. From front of instrument panel, slide unit through cutout until flange around front panel is against edge of cutout. (Ensure unit is right-side-up.)

3. Reposition mounting bracket on rear of meter and secure with two Phillips-head screws.

CAUTION

Over-tightening bracket screws or mounting the meter in a panel that is too thick may cause the housing to distort or crack.

4. If meters are being stacked vertically, repeat steps 1 through 3 for each meter. Place first meter at lowest point of cutout.

Electrical Connections for the Standard TPD

On the standard TPD, the electrical connections are made at an 8-location terminal strip at the rear of the unit. Figure 8 shows the electrical connections required for the standard TPD.

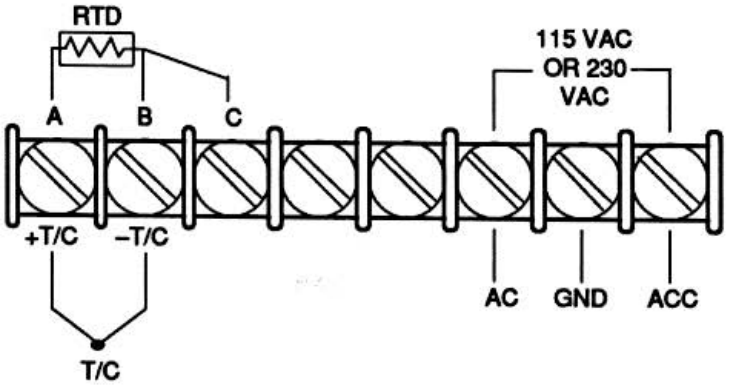


Figure 8. *Standard TPD Electrical Connections*

Terminal lugs may be used to complete the electrical connections, but are not supplied with the unit nor are they required.

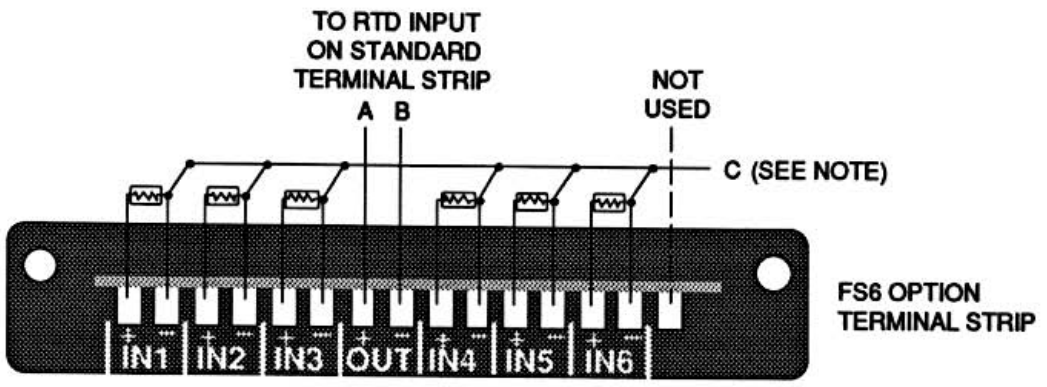
Sensor connections should be made before completing the ac power connections. Always ensure that ac power is removed from the unit before making or changing any electrical connections.

Electrical Connections for the FS6 Option

The FS6 Option allows for six inputs to be applied to and individually displayed by the TPD. This option includes a quick-disconnect terminal block to complete the additional input wire connections.

The additional terminal block mates with the FS6 printed circuit board at the upper rear of the TPD. It is secured to the housing with two Phillips-head screws; one at each end.

Figure 9 shows the electrical connections for the FS6 Option for RTD inputs. Figure 10 shows the electrical connections for T/C inputs. Note that there are six sets of input terminals marked "IN1" through "IN6". There is one set of output terminals marked "OUT".



NOTE: Bus all compensation leads together and connect to C terminal on standard terminal strip.

Figure 9. *FS6 Option Electrical Connections for RTD Inputs*

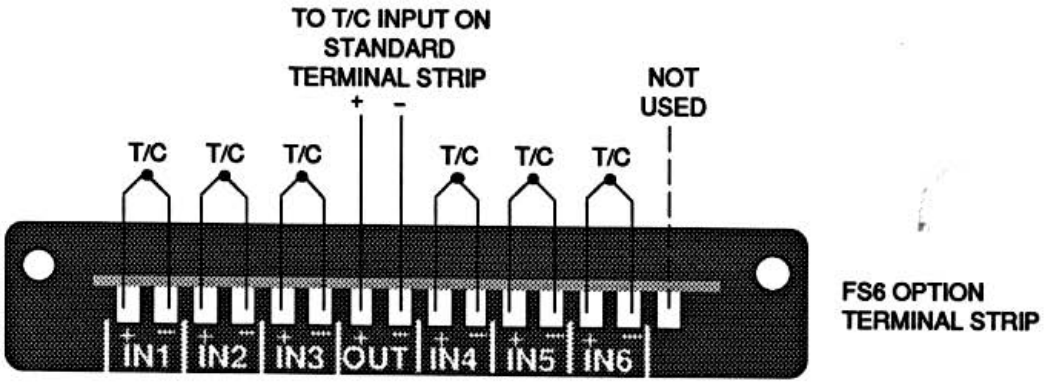


Figure 10. *FS6 Option Electrical Connections for T/C Inputs*

The output terminals of the FS6 terminal block are used to apply the input selected with the front panel rotary switch to the standard input terminals. The OUT terminals of the FS6 Option terminal block will reflect whichever input has been selected by the front panel selector switch.

T/C wire should be used to make all sensor wire connections. The output terminals of the FS6 terminal block should be connected to the standard input terminals with T/C wire of of the same type as that used by the input sensors.

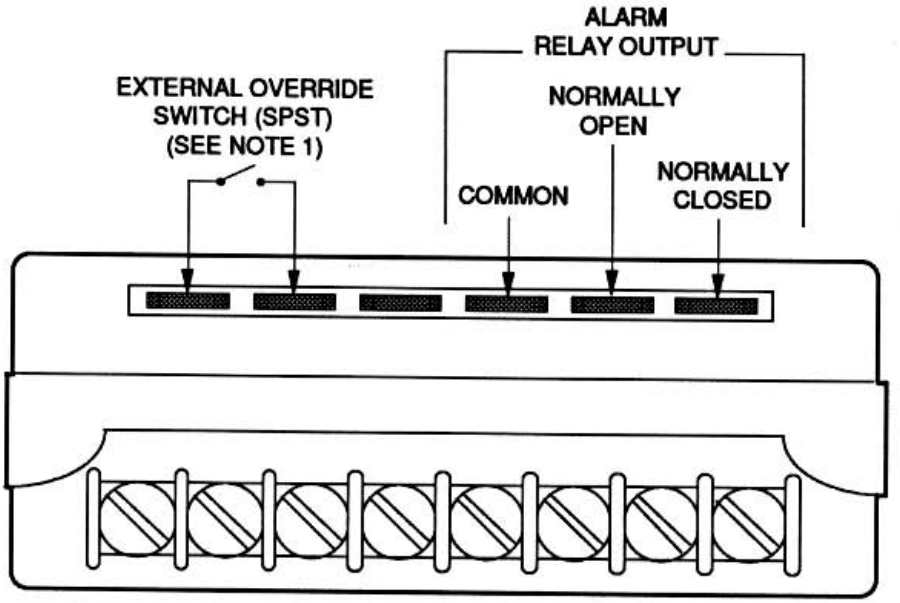
Individual wire connections are made by inserting the uninsulated end of a wire in to the appropriate opening and tightening the corresponding compression screw. Polarity for each connection must be observed and is marked on the terminal block.

C Option. The C Option provides a single-pole, double-throw (SPDT) Alarm Relay that energizes when the input exceeds the user-specified trip point.

Connections for the C Option are made at the upper rear of the TPD on blade terminals. Female connector lugs are supplied with this option to make the appropriate connections. Figure 11 shows the connections for the C Option.

A crimping tool, which is user-supplied, is needed to crimp the lugs to the wires. Thomas & Betts WT1300 Crimping Tool, or equivalent, is required for this purpose.

A relay override feature may be used to prevent the relay from energizing should an alarm condition exist. A SPST toggle switch may be used to override the relay's change of states, which can be used to acknowledge or silence alarms that otherwise would be maintained by the change in contact states.



NOTES: 1. With override switch closed, Alarm Relay is inhibited from changing states.
2. The alarm option connections are made to slide-on spade lugs.

Figure 11. *C Option Electrical Connections*

Operation

Once the standard TPD is calibrated and installed, it will reliably measure millivolt or resistance inputs and display a representative numerical value. The numerical value will be within the range set during calibration.

Figure 12 is a view of the front panel of the standard TPD.

Using the FS6 Option

The FS6 Option features a rotary switch on the front panel with six numbered markings; one for each input. The digital display will show the corresponding reading for the input selected with the rotary switch. The selected input is supplied to the Main PCB via the OUT terminals of the FS6 terminal block and the input terminals on the standard terminal strip.

Figure 13 is a view of the TPD front panel with the FS6 Option.

Using the C Option

The C Option features a red LED and two surface-high pushbuttons. Once the alarm trip point is set, the ALARM LED will illuminate when an alarm condition is detected. It will automatically extinguish when the alarm trip point is no longer exceeded.

The Alarm Relay energizes when the inputs exceeds the trip point and de-energizes when the alarm trip point is no longer exceeded.

If an override switch is wired to the Alarm PCB, the alarm relay can be inhibited from changing states when an alarm condition exists.

Figure 14 is a view of the TPD front panel with the C Option.

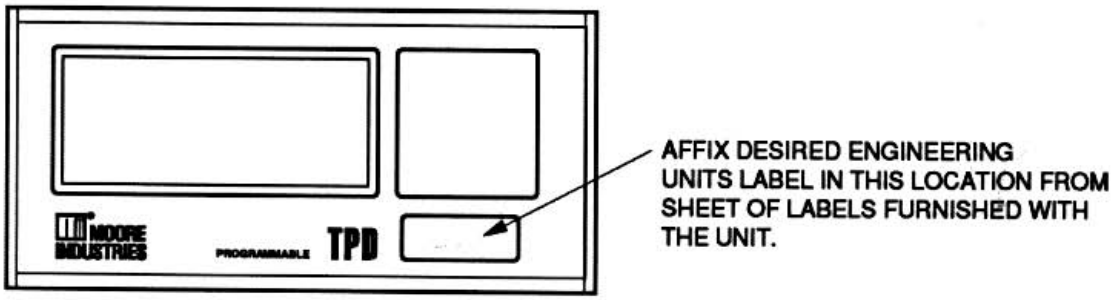


Figure 12. *Standard TPD Front Panel*

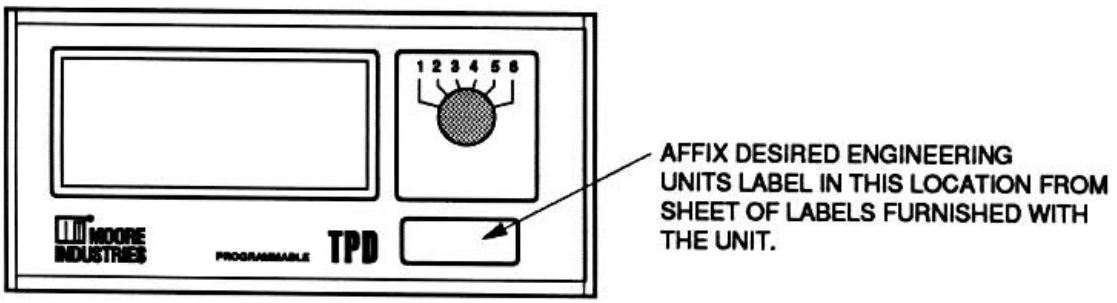


Figure 13. *TPD with FS6 Option Front Panel*

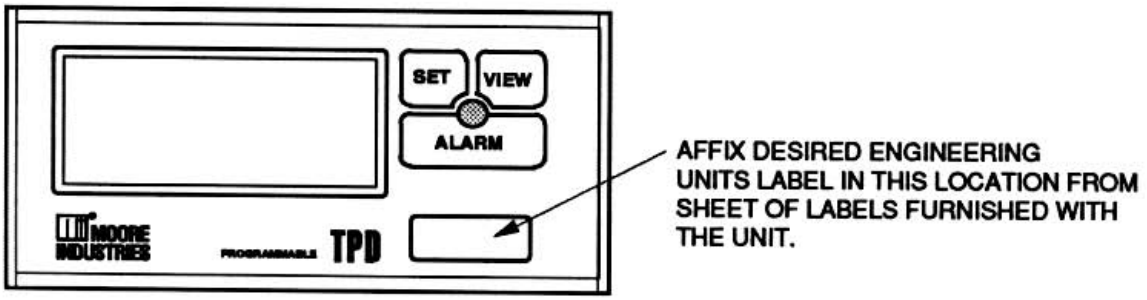


Figure 14. *TPD with C Option Front Panel*

The SET and VIEW pushbuttons are used to set and view the alarm trip point. To view the current trip point value, press and hold the VIEW pushbutton. When the VIEW pushbutton is released, the display returns to the measurement mode. The Calibration Section contains procedures for setting the alarm trip point and configuring the unit for high or low alarm.

Maintenance

Field maintenance for the TPD is limited to keeping the electrical terminals clean and secure. Each unit should be visually inspected at least once every six months to ensure the terminals are free of dirt and oxidation, and the electrical wires are in good condition. Each unit should be calibrated at least once a year.

For reliable operation, frayed wires should be replaced as soon as possible with suitable electrical wire and terminal lugs (if used).

Each terminal should be checked with a screwdriver to ensure that the connections have not become loose over time. When inspecting the rear terminals, avoid contact with the ac power terminals. Anytime the TPD is to be handled, ac power must be removed to eliminate the possibility of electrical shock.

Troubleshooting

If the performance of a TPD is suspect, the unit should be checked out by performing a calibration as described in the Calibration Section of this manual. The calibration setup allows the user to apply controllable, known inputs to the unit to achieve predictable results.

If a problem persists with the TPD, the user should contact their local sales representative or return the unit per the instruction on the back cover of this manual.

RETURN PROCEDURES

To return equipment to Moore Industries for repair, follow these four steps:

1. Call Moore Industries and request a Returned Material Authorization (RMA) number.

   Warranty Repair –
   If you are unsure if your unit is still under warranty, we can use the unit's serial number to verify the warranty status for you over the phone. Be sure to include the RMA number on all documentation.

   Non-Warranty Repair –
   If your unit is out of warranty, be prepared to give us a Purchase Order number when you call. In most cases, we will be able to quote you the repair costs at that time. The repair price you are quoted will be a "Not To Exceed" price, which means that the actual repair costs may be less than the quote. Be sure to include the RMA number on all documentation.

2. Provide us with the following documentation:
   a) A note listing the symptoms that indicate the unit needs repair
   b) Complete shipping information for return of the equipment after repair
   c) The name and phone number of the person to contact if questions arise at the factory

3. Use sufficient packing material and carefully pack the equipment in a sturdy shipping container.

4. Ship the equipment to the Moore Industries location nearest you.

The returned equipment will be inspected and tested at the factory. A Moore Industries representative will contact the person designated on your documentation if more information is needed. The repaired equipment, or its replacement, will be returned to you in accordance with the shipping instructions furnished in your documentation.

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