MOORE INDUSTRIES

USER'S MANUAL

TIX

Isolated Linear Thermocouple Transmitter

No. 140-705-00 B

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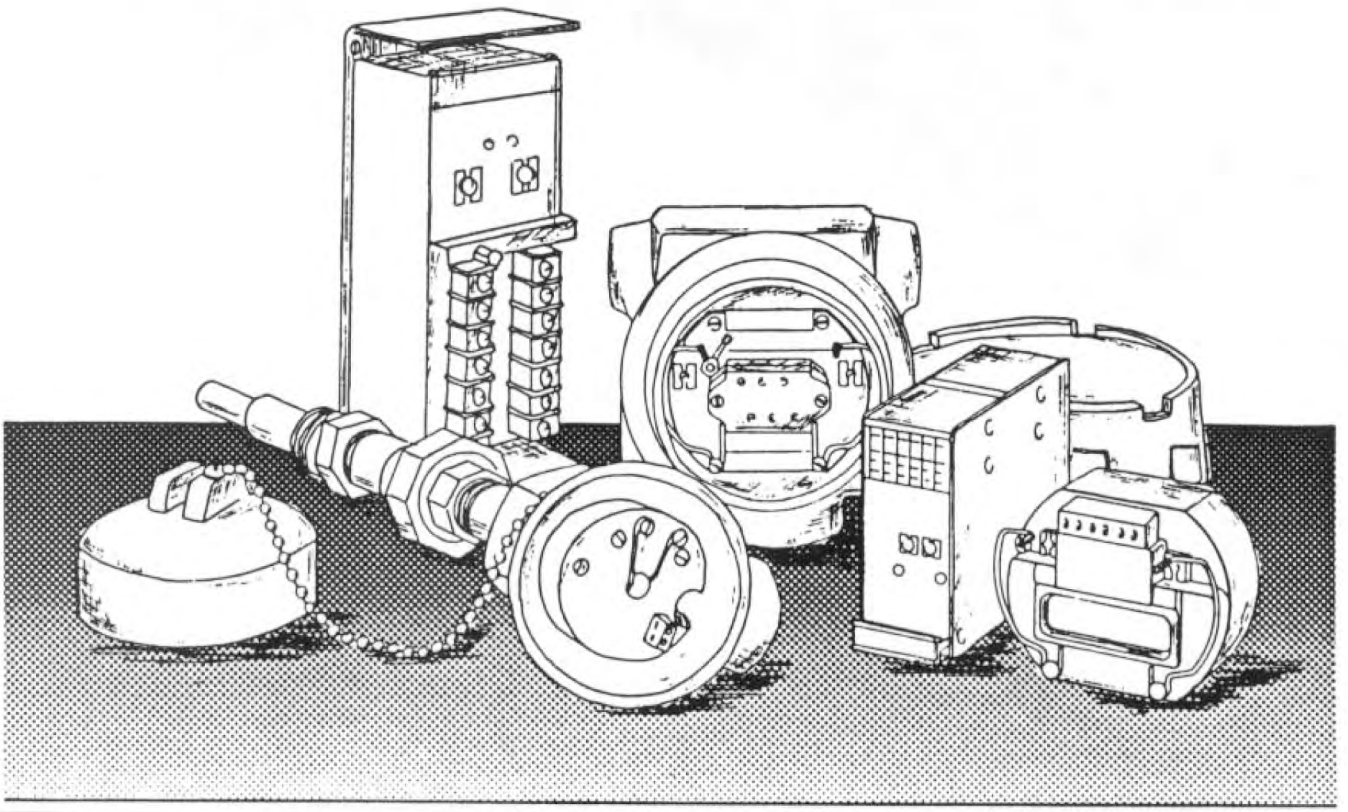

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Introduction

This manual contains calibration and installation information for Moore Industries' Isolated, Linear Thermocouple Transmitter (TIX). Along with a description of the TIX, this manual contains theory of operation and troubleshooting information. Associated tables and illustrations are provided for reference purposes.

The TIX is a loop-powered, linear transmitter that converts a thermocouple input into a proportional current output. It is suitable for interfacing with a process controller, recorder, or visual monitor.

This manual contains notes and cautions that must be observed to avoid equipment damage or minor inconveniences during calibration or installation. The following definitions describe these captions:

A ***NOTE*** shall contain technical or literary information of a helpful nature. This information is intended to aid the reader's understanding of the subject being discussed and/or minimize inconveniences while performing technical tasks.

A ***CAUTION*** shall contain technical information of a serious nature, which if ignored may cause equipment damage.

Description

The TIX is a 2-wire (loop-powered), linear, thermocouple transmitter that produces an isolated output. When connected in series to a power source of 10-42 volts direct current (Vdc), the TIX converts a thermocouple input to a proportional linear current ouput. The TIX accepts inputs from any standard Instrument Society of America (ISA) type thermocouple. It produces a standard 4-20 milliamp (mA) output that is proportional to the input. The TIX can also be configured for an optional 10-50mA output, if required.

The TIX maintains the output loop current at a level proportional to the millivolt (mV) changes from the thermocouple input, regardless of ambient temperature changes. This is accomplished through the use of an automatic reference junction compensator bridge, which is custom adjusted (factory set and sealed) for each type thermocouple.

The TIX is available in two housing styles; a hockey-puck (HP) and a DIN-style. When equipped with spring clips, the HP unit is mounted in an explosion-proof enclosure, without any drilling or tapping. When equipped with flange plates (FL model), the HP units are either surface or rack mounted. The DIN-style housing is designed for standard rail mounting. Both housings provide external access to the ZERO and SPAN potentiometers, which are used to calibrate the TIX.

Options available with the TIX include:

- an output that goes low when input lines are opened (option DD)
- trimmed temperature drift (option TD)
- RFI/EMI protection (option RF)

Table 1 contains the TIX equipment specifications, including inputs, ouputs, power requirements, and performance characterisitcs.

Model Number. The TIX model number describes the equipment type, functional characteristics, operating parameters, and configuration options. If all other documentation is missing, this number is used to identify equipment characteristics. On HP units, the model number is located on a stainless steel tag fastened to the face of the unit. On DIN-style units, the model number is on a label attached to the left-side of the unit.

Serial Number. Moore Industries maintains a complete history on every unit it sells and services. This information is keyed to the serial number. When service information is required on the TIX, it is necessary to provide the factory with this number. The serial number is located adjacent to the model number on both HP and DIN-style housings.

Table 1. TIX Equipment Specifications

Characteristic	Specification
Input	Any standard ISA thermocouple (types J,K,R,S,T,E,N)
Output	4-20mA (standard) 10-50mA (optional)
Performance	**Calibration Capability:** ±0.05% of Span **Effect on Cold Junction Compensation:** 1°F maximum error per 40°F ambient change over –31 to 185°F range **Ripple:** Less than 5mV p-p typical; 10mV p-p maximum **Burnout Protection:** *4-20mA,* upscale to 28mA (standard); *10-50mA,* upscale to 70mA (standard) **Output Current Limiting:** 150% of span typical (160%, maximum) **Load Capability:** *4-20mA:* $\frac{V_s - 10V}{0.02A}$ = Ohms *10-50mA:* $\frac{V_s - 10V}{0.05A}$ = Ohms **Common Mode Rejection:** At least 120dB at 50Hz **Output Protection:** Transient Protection, 2000µF @ 40Vdc; Reverse Polarity, 45Vdc
Power	10-42Vdc
Adjustments	Adjustable with multiturn potentiometers **Span:** Adjusts output to 20mA (50mA) for inputs from 50% to 100% of range **Zero:** Adjusts output to 4mA (10mA) for offset of up to ±10% of range span
Operating Temperature	**Ambient:** –31°F to 185°F (–35°C to +85°C) **Effect:** Spans greater than 10mV; ±0.01%/°F (TD Option; ±0.005%/°F) Spans between 5 and 10mV; ±0.015%/°F (TD Option; ±0.005%/°F)
Weight	**HP Housing:** 6.5 oz. (184 grams) **DIN Housing:** 7.5 oz. (213 grams)
Note: See Installation Section for physical dimensions.	

Calibration

Every TIX is calibrated and checked at the factory prior to shipment. Each of these custom-ordered units are factory calibrated for optimum performance and their potentiometers are then sealed to prevent accidental movement. This calibration ensures that each unit meets equipment specifications and is operating properly before it leaves the factory.

Prior to installation, every TIX should be checked by the user for proper operation. To checkout the TIX, connect the unit as shown in figure 1 and verify that the output is at the required level. Although readjusting the TIX is not recommended, if necessary, the ZERO and SPAN potentiometers are accessed by removing the caps or tabs covering them (refer to Calibration Procedures). If the unit fails to perform as specified, contact the factory for assistance.

Zero and Span Adjustments

If the TIX requires calibration, the ZERO and SPAN settings are the only field adjustments to be performed. These two 15-turn potentiometers are accessible on the front panel of both the HP and DIN-style housings. The ZERO potentiometer adjusts the output to 4mA (or 10mA) for offsets of up to ±10 percent of the base range span. The SPAN potentiometer adjusts the output to 20mA (or 50mA) for inputs ranging from 50 percent to 100 percent of the base range. Turning these potentiometers clockwise causes the related output to increase in quantity or become more positive; while turning them counter-clockwise causes the related output to decrease in quantity or become more negative.

Calibration Equipment

Table 2 lists the tools and test equipment required to calibrate the TIX, including optional equipment. This equipment is not supplied with the TIX and must be furnished by the user.

Calibration Setup

Figure 1 is an illustration of a typical calibration setup, including options. To checkout or calibrate the TIX, connect the unit as shown in this illustration. (refer to Calibration Procedures)

Calibration Procedures

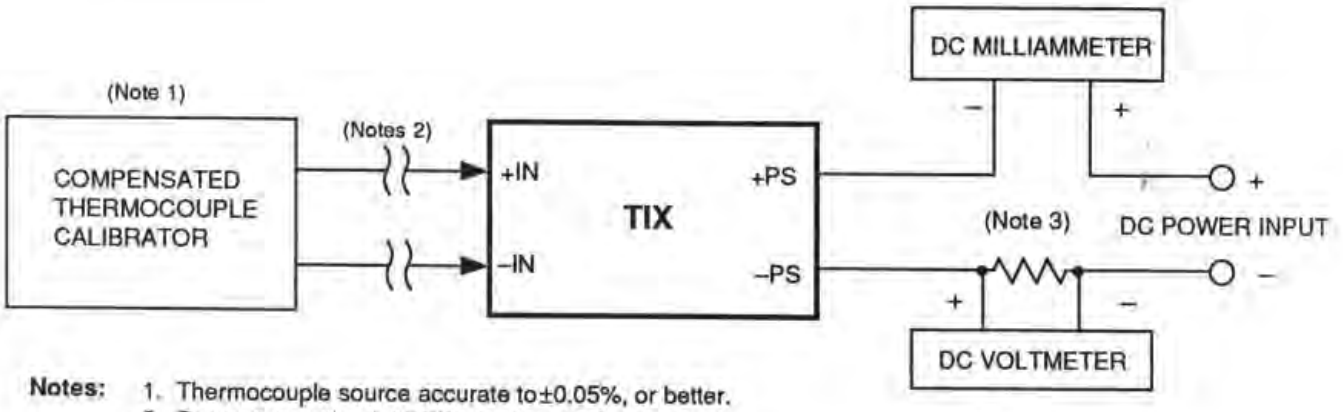
There are two options shown in figure 1 for monitoring the output of the TIX. Either a DC milliammeter or a DC voltmeter, with a load resistor, is used to monitor and set output levels. When connecting this equipment to the TIX, a slotted screwdriver of the appropriate size should be used. Wire terminations are clearly marked on the front panel of the TIX.

When using a voltmeter and load resistor, the output reading should be 1-5 volts, corresponding to current output readings of both 4-20mA and 10-50mA when using a milliammeter. A load resistor of 100 ohms produces a 1-5 volts output equivalent to 10-50mA. Using a load resistor of 250 ohms produces a 1-5 volts output equivalent to 4-20mA.

Should a compensated thermocouple calibrator be used as the input device, there is no need for additional calculations for ambient temperature variations. If using an input device that does not compensate for ambient temperature, reference appropriate temperature-vs-resistance tables to calculate the necessary adjustments to the input signal to achieve accurate output readings. When connecting the TIX to the

Table 2. *Calibration Equipment*

Equipment	Characteristic
Compensated Thermocouple Calibrator	Analogic 6520, or equivalent, accuracy of ±0.05% or better
DC Milliammeter (optional)	Fluke 8600A, or equivalent, accuracy of ±0.05% or better
DC Voltmeter, w/Resistor (optional)	Voltmeter: accuracy of 0.05% or better; Resistor: 100Ω (±0.1%) for 10-50mA, 250Ω (±0.1%) for 4-20mA
Power Supply	12-42VDC
Screwdriver (slotted)	Head width no greater than 0.1 inch (2.54mm)
Thermocouple (T/C) wire	Appropriate for the T/C to be used in installation



Notes:
1. Thermocouple source accurate to±0.05%, or better.
2. Connect negative (–) RED wire to negative terminals.
3. Either milliammeter or voltmeter may be used for monitoring output.

Figure 1. *Calibration Setup*

input device, use the same length and type thermocouple wire as the wire to be used during installation.

The following procedures contain step-by-step instructions to setup and calibrate the TIX. (See figure 1 while performing these procedures.)

1. Using the same type and length wire to be used during installation, connect compensated thermocouple calibrator to TIX. Ensure negative lead (red) wire is connected to negative terminal of TIX.

CAUTION

Ensure proper polarity is maintained when connecting equipment for calibration. See figure 1.

2. If using a milliammeter to monitor output, connect 10-42Vdc power source in series with milliammeter to TIX. Go to step 4.

3. If using a voltmeter with specified load resistor to monitor output, connect 10-42Vdc power source in series with load resistor to TIX; connect voltmeter across load resistor.

4. Set compensated thermocouple calibrator to lowest operating temperature required.

5. Apply power and allow TIX to warm-up for 10 minutes.

6. Ensure input to TIX is equal to the lowest operating temperature required.

CAUTION

To avoid damaging their housings, use a screwdriver with a head no wider than 0.1 inch (2.54mm) to adjust the ZERO and SPAN potentiometers.

7. If using a milliammeter to monitor TIX output, adjust ZERO potentiometer for 4mA (or 10mA) output (zero percent). Go to step 9.

8. If using a voltmeter with specified load resistor to monitor output, adjust ZERO potentiometer for 1 volt.

9. Set compensated thermocouple calibrator to highest operating temperature required.

10. If using a milliammeter to monitor TIX output, adjust SPAN potentiometer for 20mA (or 50mA) output (100 percent). Go to step 12.

11. If using a voltmeter with specified load resistor to monitor output, adjust SPAN potentiometer for 5 volts.

12. Repeat steps 6 through 11 (as applicable) until no further adjustments are required.

13. Divide operating temperature range into 10 equal parts and set compensated thermocouple calibrator to each setting (ascending or descending).

14. Observe output at each setting calulated in step 13 and verify output is linear for operating range selected.

Installation

Installation of the TIX is divided into two phases; mounting and electrical connections. In most cases, it is easier to mount the TIX before completing the electrical connections.

Mounting

When mounting either the HP or DIN-style unit, ensure the unit is mounted in an area free of dust, moisture, and corrosive elements. Figures 2 and 3 contain the mounting dimensions for the HP and DIN-style housings.

The TIX in a HP housing is mounted inside an explosion-proof enclosure, if equipped with spring clips to hold it in place. When equipped with flange plates (FL model), the HP housing is either surface or rack mounted. It is recommended that the TIX be mounted on a surface that helps dissipate heat away from it, especially if the ambient temperature is usually high.

The DIN-style housing is designed for mounting on standard DIN rails. The rear of the unit is equipped

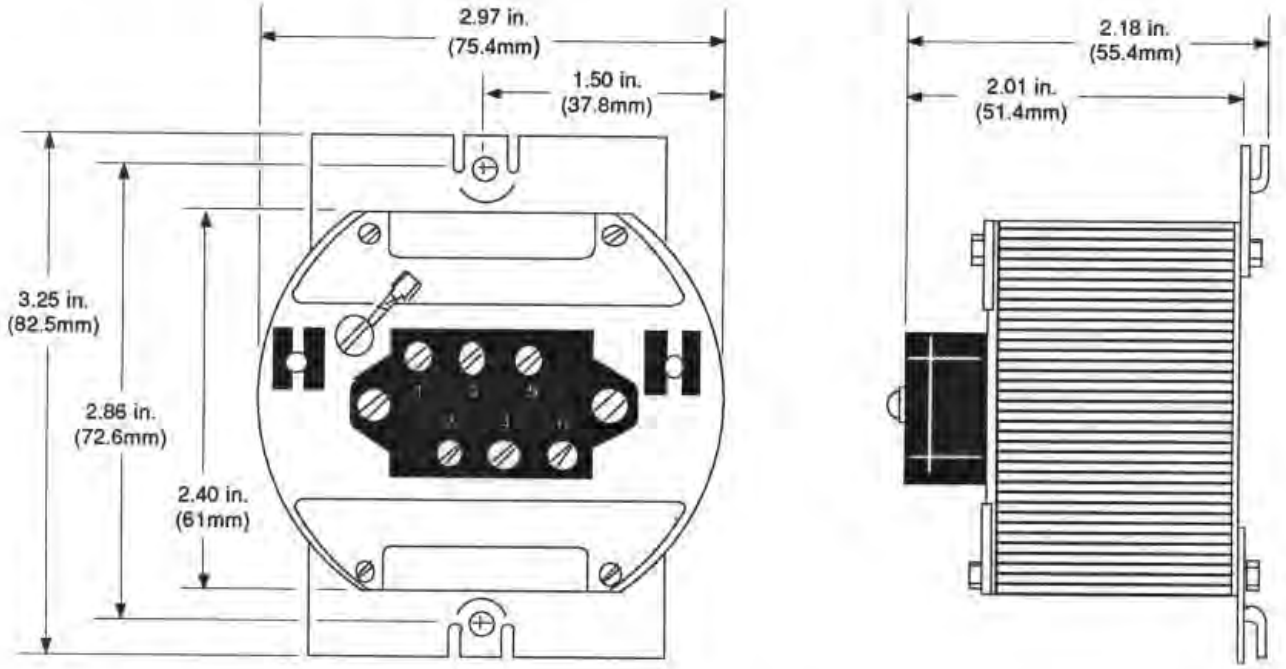


Figure 2. HP Mounting Dimensions

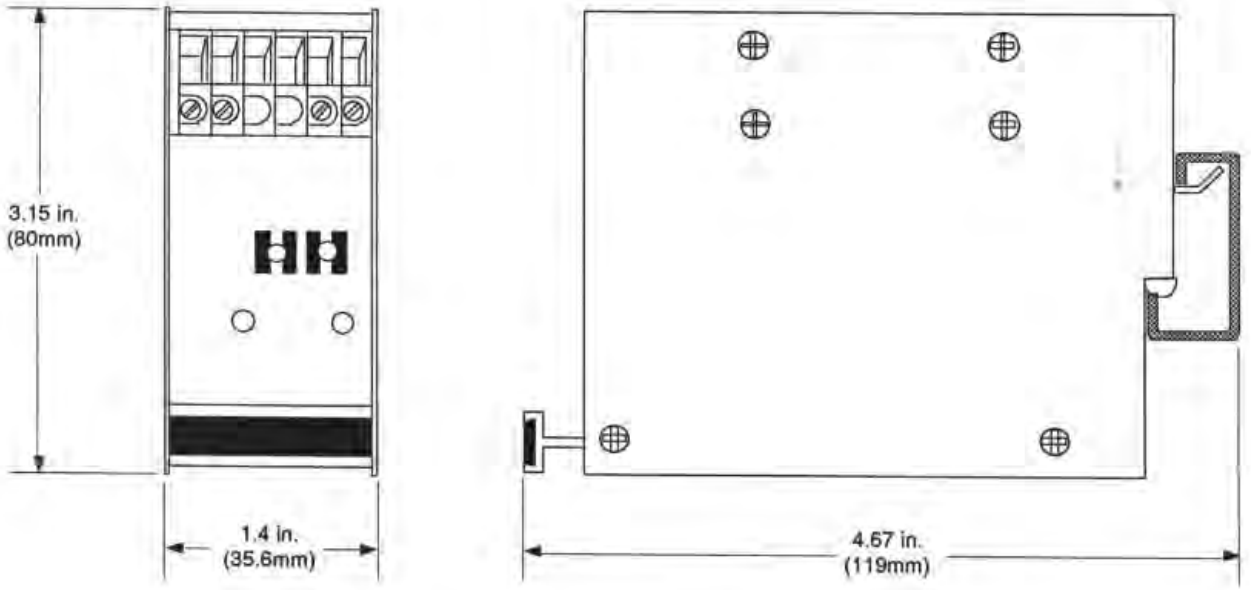


Figure 3. *DIN Mounting Dimensions*

with a rigid lip and a spring clip to attach it to standard 1.26-inch (32mm) rails.

Electrical Connections

There are four terminals on the TIX for connecting signal lines; two for an input device and two for an output device (see figure 4). For installation, the +IN and –IN terminals are for the input from the thermocouple (T/C) device. Ensure that the red wire (negative polarity) is connected to the –IN terminal. The +PS and –PS terminals are for the loop-power (output) connections, which are connected to a power source of 10-42Vdc and a current driven instrument.

To complete these connections, use a slotted screwdriver with a head approximately 0.125 inch in width to secure the wire leads to the TIX. The screws tighten down a clamp, which provides electrical contact between the wire and the terminal. Loosen each screw prior to inserting the wire being terminated. Strip and then tin the end of each wire with 60/40 solder. Then, while holding the un-insulated end of the wire in place, tighten the screw of the corresponding terminal.

NOTE

Inside the terminal block of both the HP and DIN-style units is a temperature compensation sense resistor, which should not be tampered with.

Operation

Once the TIX has been calibrated and installed, it will operate virtually attended. There are no visual indicators on the TIX, and since it is built with highly reliable solid state components, it will operate maintenance free for extended periods of time.

During normal operation, a unit may become warm, especially where the ambient temperature is above normal. This operating condition is acceptable and is no reason for alarm, unless a malfunction is also detected.

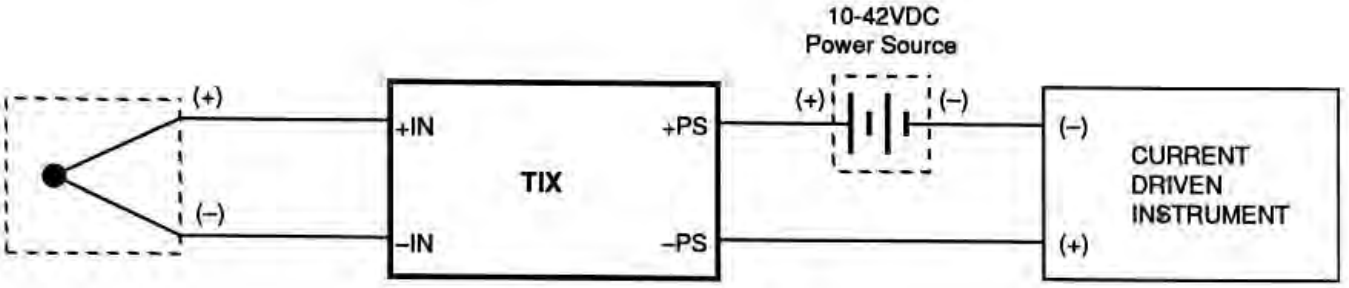


Figure 4. *Typical Hookup Configuration*

Theory of Operation

This section describes the theory of operation for the TIX based on the simplified block diagram shown in figure 5.

The TIX accepts standard ISA thermocouple input signals and generates a proportional 4-20mA or 10-50mA. The TIX requires a power source of 10-42Vdc for normal operation. A computer optimized bridge circuit provides reference junction temperature compensation over the unit's operating temperature range.

The compensated low-level input signal is fed through a pre-amp, which is configured as a two pole active filter. Part of the resulting high level signal is fed back to the input via a seven-stage computer optimized linearizer circuit, which compensates for thermo-couple non-linearities. The pre-amp's output is also fed to a pulse width modulator, which in turn drives a signal isolation transformer. The secondary of this transformer feeds a demodulator, which amplifies and filters the signal. The amplified signal is then fed to the output stage, which proportionately controls the current through the TIX transmitter and the output loop.

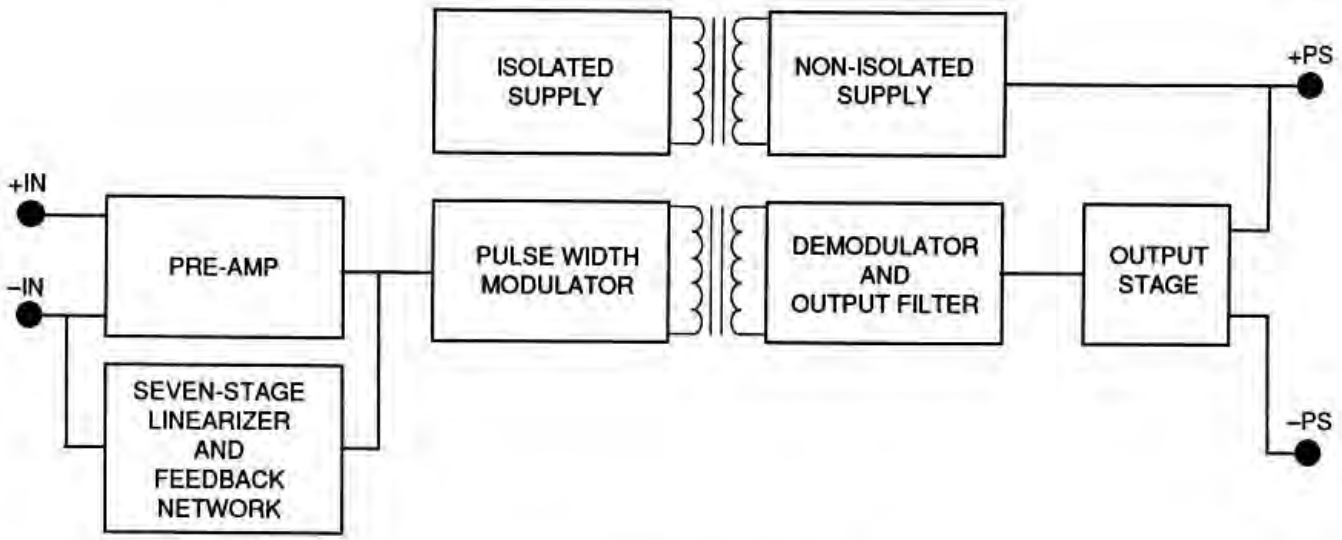


Figure 5. *TIX Simplified Block Diagram*

Maintenance

Maintenance of the TIX is primarily limited to keeping the input and output terminals clean and tight, and ensuring that there is adequate ventilation or heat dissipation for the unit. It is recommended that the user check the terminals on the TIX at least every six months for cleanliness and mechanical tightness.

Troublshooting

The TIX is a highly reliable instrument, which is produced with many of its components group selected using a computer-aided design program. This process is one of the design elements that allows Moore Industries to produce such high quality products. However, this process makes field repairs generally unadvisable, due to inconsistencies that arise in matching components by other means. Therefore, it is recommended that any TIX found to be performing below specifications be retrurned to the factory for service, in accordance with the instructions on the back cover of this manual.

Field troubleshooting of the TIX is limited to visual inspections of the housing and terminals, and verification of proper signal response. To check the unit's operational functionality, the TIX must be connected as shown in figure 1 (Calibration Section). If a unit is performing below specifications, and the urgency of repair does not allow for the unit to be sent back to the factory, the user may contact the Customer Service Department at Moore Industries. Telephone assistance will be provided to diagnose the problem and make emergency repairs, when possible.

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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