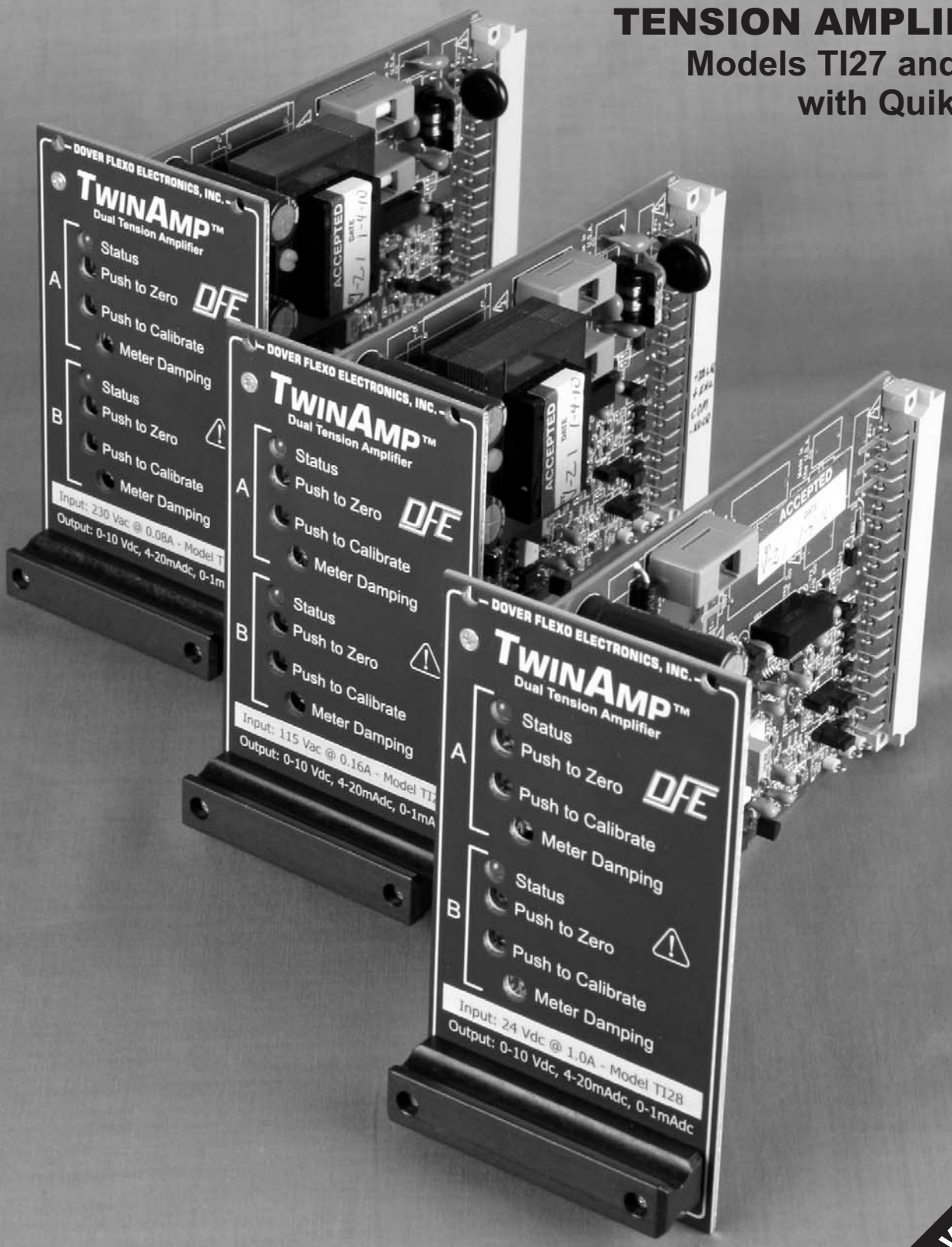
DOVER FLEXO ELECTRONICS, INC.
ISO 9001 CERTIFIED

INSTRUCTION MANUAL

TwinAmp™

TENSION AMPLIFIER

Models TI27 and TI28 with Quik-Cal™



5 YEAR WARRANTY

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NEW!

QUIK-CAL™ PUSHBUTTON ZERO-SET AND CALIBRATION-SET

The TwinAmp™ tension amplifiers are built with a labor-saving technology called Quik-Cal! **They do not have potentiometers for zero and calibration settings**. Instead, they have pushbuttons. Push the button once, hold for one second, and you are done!

No tension display is needed. No screwdriver is needed. No second-person is needed.

ZERO SET

The weight of the transducer roll produces an output that is not caused by web tension. This is not desirable because it is not a tension measurement. To set the output of the indicator to zero when there is no tension, just press the ZERO button and hold for one second.

You can even eliminate the need to press the ZERO button! The indicator can automatically set the output to zero when power is turned on. Just change a jumper setting on the circuit board.

CAL SET

The weight you select for calibration determines the full-scale tension signal output. The indicator automatically multiplies the weight by the built-in calibration ratio to calculate full output.

The calibration ratio is the ratio of the calibration weight to the tension at full output.

The standard calibration ratio is 1:10, or 10%. For example, if you hang a 15 lb. weight and push the CAL button, the indicator will produce full output at 150 lbs. tension.

A calibration ratio of 25% is available for low tensions. (This is selected by jumpers on the circuit board). If you use of a 15 lb. calibration weight, this will produce full output at 60 lbs. tension. The A and B amps can have different calibration ratio values.

STABILITY is another benefit of this technology. The zero and calibration settings are stored digitally, so there is no drift over time and temperature variations as there can be with potentiometers.

Read Section 3.3 for details.

TABLE OF CONTENTS

APPENDICES

LIST OF ILLUSTRATIONS

SECTION 1 PRODUCT DESCRIPTION

1.1 GENERAL DESCRIPTION

The TwinAmp™ dual tension amplifiers are designed to provide two isolated interfaces in one package between any type of DFE tension transducers and variable speed drive systems, computers, tension recorders, or other devices for tension control and display purposes. Outputs from each amplifierr are 0-10Vdc, 4-20mA, and 0-1mA. The 0-1mA outputs to allow the user to connect analog or digital meters to indicate operating tension.

The TwinAmp™ contains two independent tension amplifier circuits on one card. Each has its own calibration adjustments and outputs. The card is an IEC/ANSI/IEEE type 2 plug-in unit for installation in a standard size 3U 19 inch rack. This plug-in feature allows for easy field installation and servicing.

Quik-Cal™ pushbutton zero and calibration comes standard..

The only difference between the Ti27 and the Ti28 versions is their power input requirements. The Ti27 operates on 115Vac 60Hz (230Vac 50Hz optional) and the Ti28 operates on 24Vdc.

⚠ **WARNING:** The isolated output is designed to prevent ground loops and noise. It is not intended or approved for safety isolation of hazardous voltages. Do not install unit where the isolated circuit and chassis ground are more than **40Vpk** differential.

⚠ **WARNING:** Ti27 models are designed for single phase AC operation only. Do not connect them across three phase lines or to three phase circuits, to prevent product damage and potential hazard.

1.2 FRONT VIEW OF TWINAMP™

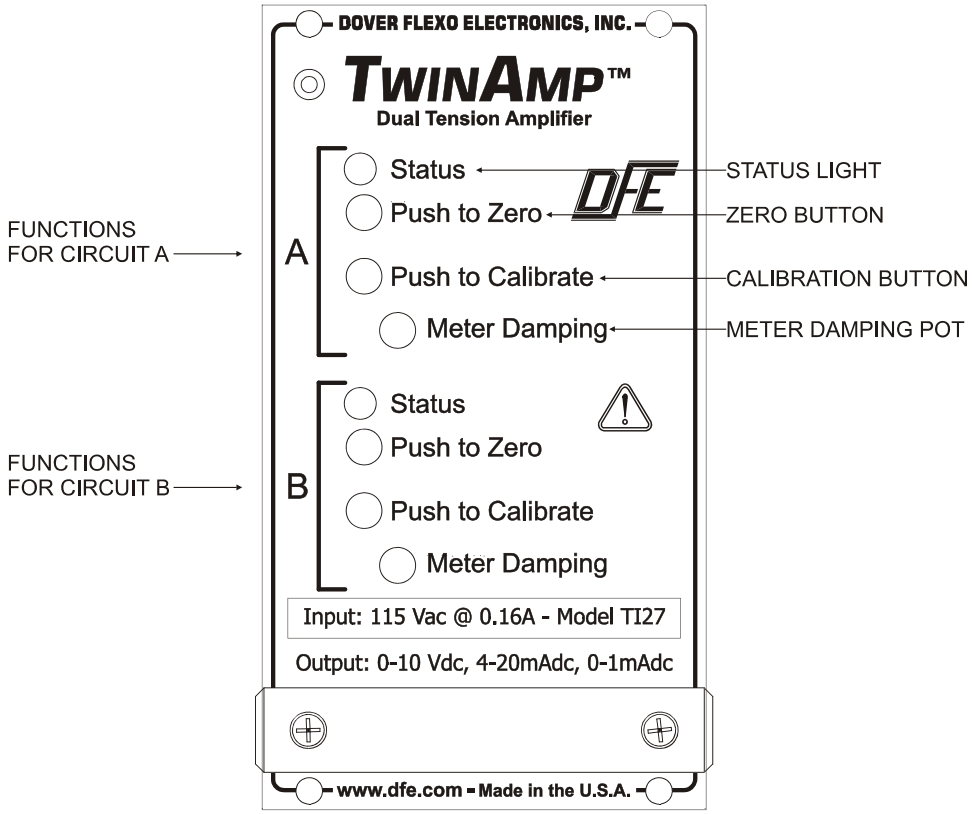


Figure 1 **- FRONT VIEW OF TWINAMP™**

1.3 SPECIFICATIONS

Power Input: Voltage	. . . . .	**Ti27** = 120 Vac/60Hz +/- 10%, (230Vac/50Hz optional) Single Phase AC operation only.
	. . . . .	**Ti28** = 24 Vdc +/- 10%.
Typical Current	. . . . .	**Ti27** = 120 Vac, 60 Hz = 0.105 Amp AC
	. . . . .	230 Vac, 50 Hz = 0.054 Amp AC
	. . . . .	**Ti28** = 0.10 Amp dc.
Maximum Current:	. . . . .	**Ti27** = 120/230 Vac = 0.160/0.080 Amp AC
	. . . . .	**Ti28** = 1.0 A dc
Tension Signal Outputs (3 outputs per channel):	. . . . .	1. 0 to +10Vdc, Isolated from input power and transducer circuits.
	. . . . .	• 0 to +10Vdc capable of over-range, -15% to 120% of full scale (-1.5Vdc to 12Vdc), to indicate over-range or error conditions.
	. . . . .	• 0 to +10Vdc max loading is 5mA. This requires a 2000 Ohm or greater input resistance for equipment connected to this output.
		2. 4-20mA capable of over-range, -15% to 120% of full scale (1.6mA to 23mA), to indicate over-range or error conditions. 4-20mA maximum loop resistance is 500 Ohms.
		3. 0 to 1mA meter output with adjustable damping for optional tension meter.
Weight:	. . . . .	Ti27 = 1.25 lbs (0.57 kg), Ti28 = 1.0 lbs (0.45 kg)
Transducer Signal Input: (per channel)	. . . . .	500 mVdc maximum at rated load per pair (1 Vdc with XRE option)
Transducer Excitation: (per channel)	. . . . .	5Vdc (10Vdc for the XRE option) jumper selectable.
Accuracy:	. . . . .	Max error of 1% over temperature range. 0.1% Typical.
Zero (Tare) Range:	. . . . .	Minimum 95% of transducer rating.
Calibration Range:	. . . . .	Minimum 50 : 1.
Ambient Temperature Range:	. . . . .	32°F to 104°F (0°C to 40°C).
Accessory tension meter types:	. . . . .	Analog:1mA, 49 ohm movement, 3.5" (P/N: 722-1385), in enclosure (P/N: 723-2682) **or**
	. . . . .	Digital:4 digit display, LED (P/N:723-2307), in enclosure (P/N:723-2660).
Standard tension meter scales:	. . . . .	0 to: 1, 5, 10, 25, 50, 100, 150, 250, 500, 1000.

1.4 ENVIRONMENTAL CONDITIONS (Ref. Appendix E for further information)

This section applies to equipment designed to be safe at least under the following conditions:

- Indoor use.
- Altitude up to 6500 ft (2000 meters).
- Temperature range: 32° F to 104° F (0° C to 40° C).
- Maximum relative humidity 95% over the temperature range (non-condensing).
- Main supply voltage fluctuations not to exceed +/-10% of the nominal voltage.
- Main supply transient overvoltages according to overvoltage category II of IEC 60364-4-443.
- Pollution Degree 2 in accordance with EN61010-1:2001.

1.5 STANDARD FEATURES

SOME OF THESE FEATURES REQUIRE CONFIGURATION OR EXTERNAL WIRING. REFER TO SECTION 2.4 FOR INSTALLATION INSTRUCTIONS AND SECTION 2.7 FOR WIRING.

- **Quik-Cal™** push-button zero and calibration eliminates pot adjustments to make calibrating simple and fast.
- **2 separate sets of 0 to +10V** and **4 to 20mA Isolated Tension Outputs.** Proportional to tension. Used as an input to a controller or instrumentation system. Both are isolated outputs standard. See Section 3.1 for installation and adjustment.

⚠ **WARNING:** The isolated output is designed to prevent ground loops and noise. It is not intended or approved for safety isolation of hazardous voltages. Do not install unit where isolated circuit and chassis ground are more than **40Vpk** differential.

- **Two 0-1mA Tension Outputs**. A separate output on each amplifier with adjustable damping, used for driving an optional analog tension meter.
- **Adjustable Meter Damping.** Used to adjust the responsiveness of the optional analog tension meter. Does not affect the 0-10V/4-20mA output.
- **Power Voltage Selection.** The Ti27 version is designed to operate at either 115Vac (standard) or 230Vac (optional factory modification). The Ti28 operates on 24Vdc.
- **Easily serviceable**. The unit can easily be removed from the rack mount.
- **Standard size**. Fits in standard size 3U 19 inch rack, up to 6 units to a rack.
- **Flexible Operation.** Features can be tailored for each application.
- **Economical**. Provides many important features at a reasonable price.
- **Short Circuit Protection.** Unit automatically protects transducer excitation and tension output from short circuits or excessive loading. If a short circuit is detected, the unit will safely shut that portion of the circuit off until the fault is cleared. Unit automatically recovers when the fault is removed (Power may have to be cycled off for 15 seconds in extreme cases).

1.6 OPTIONS

SOME OF THESE OPTIONAL FEATURES REQUIRE CONFIGURATION OR EXTERNAL WIRING. REFER TO SECTION 2.4 FOR INSTALLATION INSTRUCTIONS AND SECTION 2.7 FOR WIRING.

- **0-100 µA Tension Output (100M)**. Alternate to the standard 0-1mA meter output. Jumper selectable.
- **230 Volt Input (230).** 230Volt, 50 Hz AC power input. Ti27 only. Set at factory.

⚠ **WARNING:** Ti27 models are designed for single phase AC operation only. Do not connect them across three phase lines or to three phase circuits, to prevent product damage and potential hazard.

- **25% Calibration Weight (25CW).** Used when 25% of full scale calibration weight is desired instead of the standard 10% calibration weight. Jumper selected between 10% and 25%.
- **Auto Zero (AZ).** Unit will auto zero the output on each power up. Jumper selected on or off for each amp.
- **Extended Range (XRE).** 10 Vdc excitation for Extended Range transducers. Allows measurement of much lower tension than usual. Transducers must also have the XR option. Jumper selected between 5Vdc and 10Vdc for each amplifier.

1.7 ACCESSORIES

- **Remote Tension Meter**. Analog, 1 mA (DFE P/N: 722-1385) supplied as a single unit. Must be installed by user. This meter is also available in its own enclosure (DFE P/N: 723-2682).
- **Nonstandard Meter Scale.** Any other meter scale than standard ones offered by DFE. See Specifications for standard scales. Applies to remote tension meter listed above.
- **Remote Digital Tension Meter**. 4 digit, 0-1 mA (DFE P/N: 723-2307) supplied as a single unit without enclosure, or with enclosure (DFE P/N: 723-2660). Must be installed and powered (+24V) by user.
- **Type 5 Plug-in Adapter**. Plug the Ti27/28 into this adapter instead of a 19 inch rack. Terminal strips for hard-wired connections. Install the unit in your own enclosure (DFE P/N: 143-0000).

SECTION 2

INSTALLATION

2.1 DIMENSIONS inches (mm)

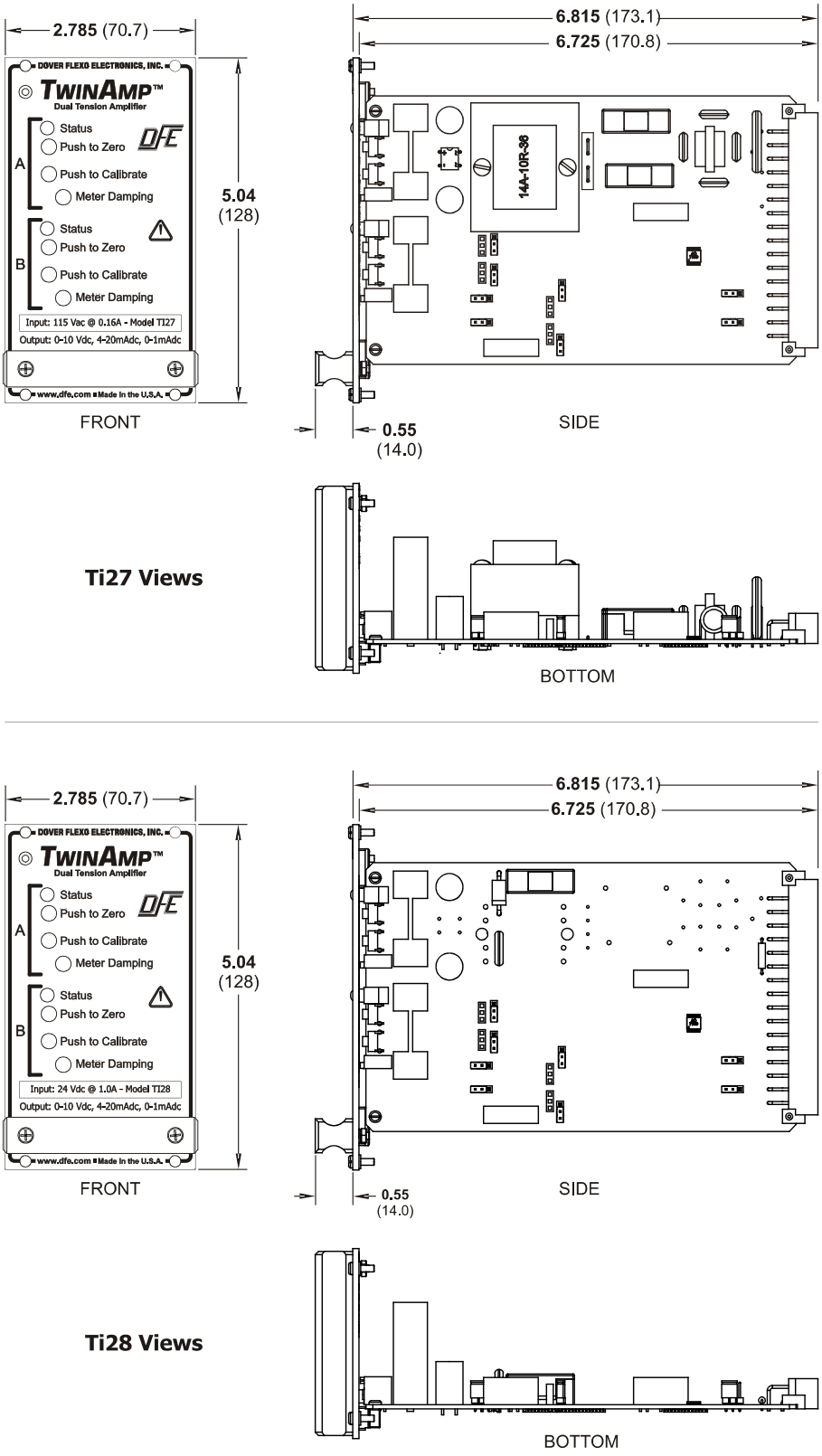


Figure 2 **- Ti27 and Ti28 UNIT DIMENSIONS and VIEWS**

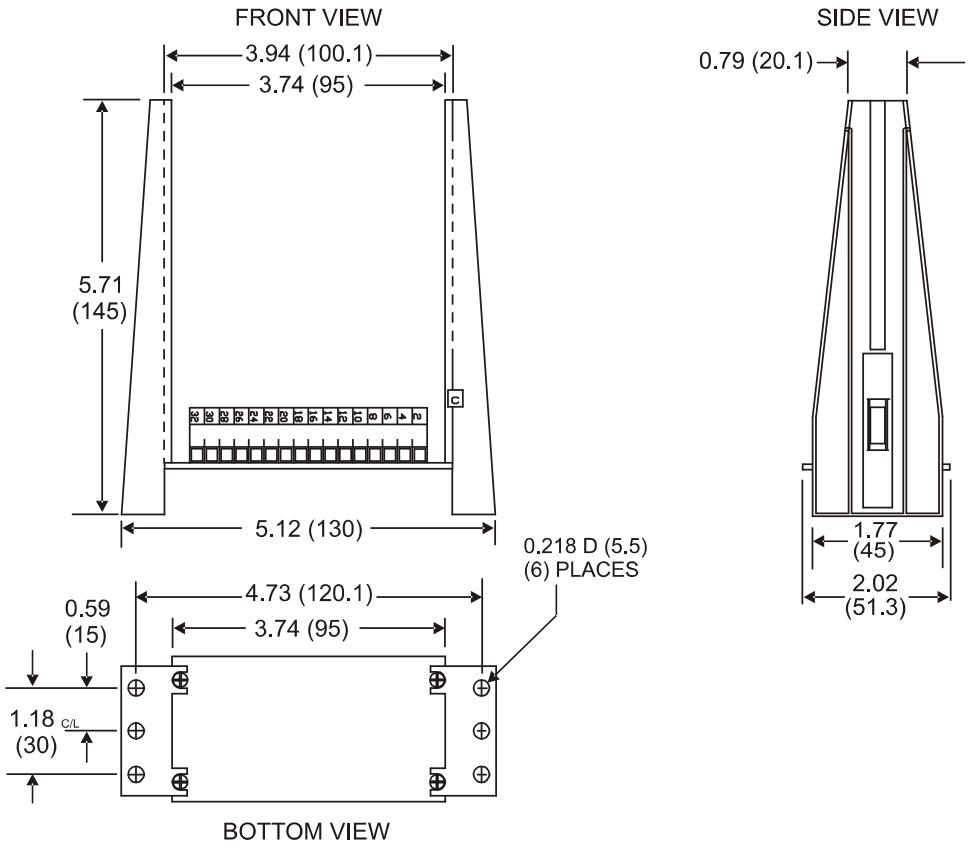


Figure 3 **- ACCESSORY PLUG-IN CARD ADAPTER DIMENSIONS**

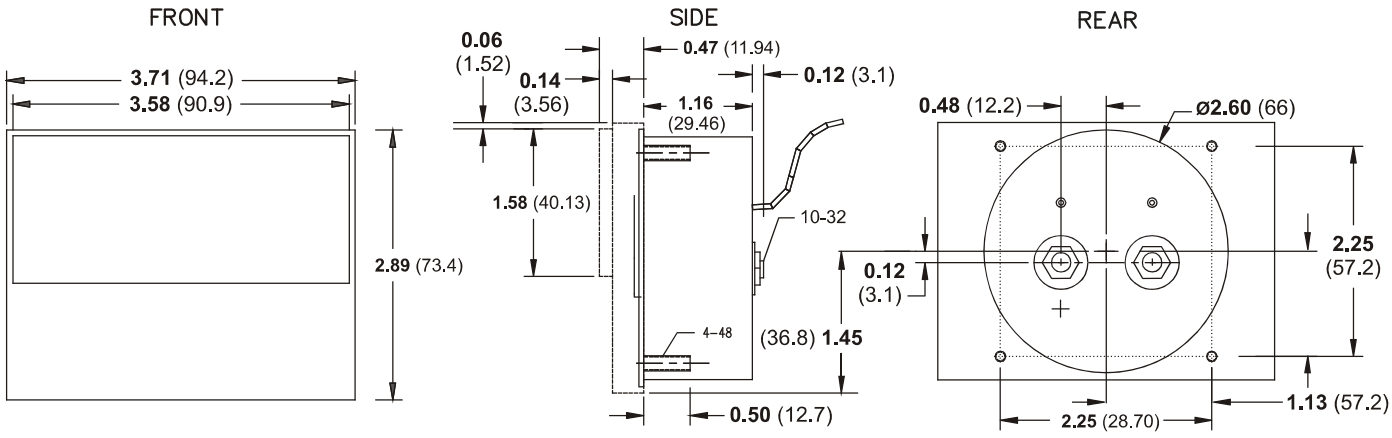


Figure 4 **- ACCESSORY TENSION METER DIMENSIONS**

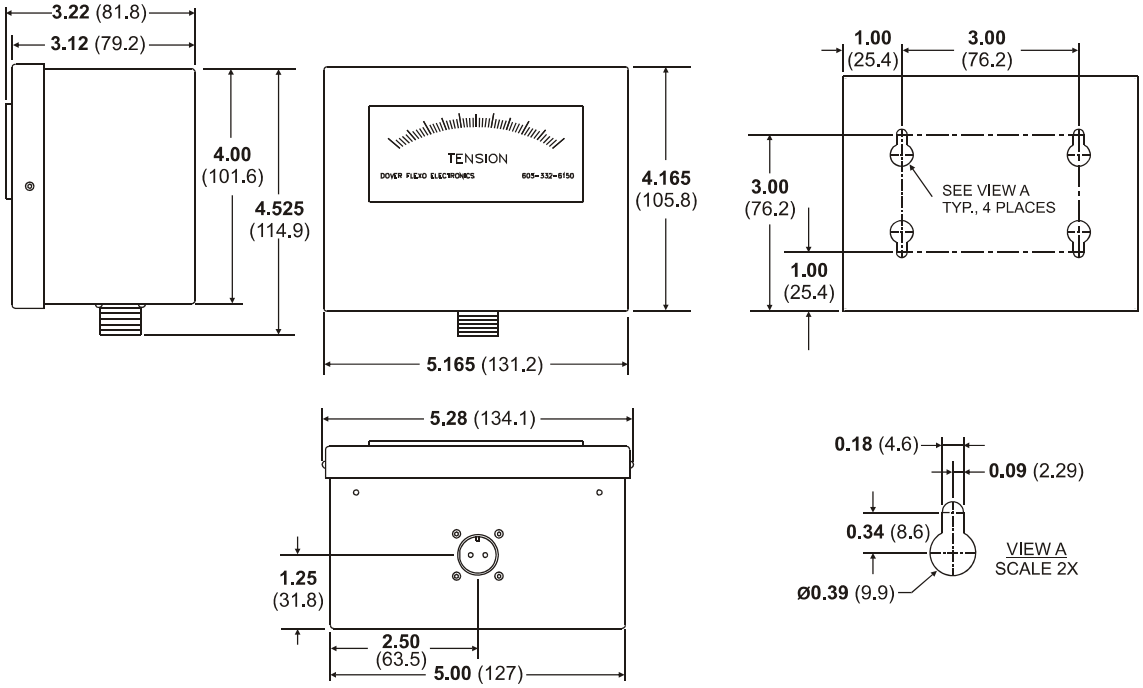


***Figure 5* - ACCESSORY TENSION METER ENCLOSURE DIMENSIONS**

2.2 SELECTION OF MOUNTING LOCATION

The TwinAmp Ti27 or Ti28 is plugged into a standard 19 inch rack having an opening 3U high by 14HP wide. The optional plug-in adapter may also be used.

Note: The Ti27 and Ti28 have been designed to meet the EMC directive, and for that compliance, the unit must be installed in a shielded enclosure and used with shielded cables (DFE cables are shielded).

2.3 SAFETY AND EMC REQUIREMENTS

⚠ **WARNING:** If this equipment is not connected or operated in the manner specified, the operating safety of this unit or of connected equipment cannot be guaranteed.

⚠ **WARNING:** The isolated output is designed to prevent ground loops and noise. It is not intended or approved for safety isolation of hazardous voltages. Do not install unit where isolated circuit and chassis ground are more than **40Vpk** differential.

⚠ **WARNING:** Ti27 and Ti28 models require a full enclosure to protect against shock hazard.

! IMPORTANT: For safety reasons, it is necessary to use appropriate wiring for your line voltage connections and for safety grounding. Make your ground connection between a reliable earth ground and the safety ground of your indicator using a wire with a gauge of at least 16 AWG (or a cross-sectional area of at least 1mm^2) and insulation rating of at least 600V. Make your AC line voltage connections with wire gauge of at least 16 AWG (or a cross-sectional area of at least 1mm^2) and insulation rating of at least 600V for each conductor. Secure this wiring to prevent inadvertent removal or strain on the input terminal.

An external switch or circuit breaker is required for power disconnection on the Ti27, and it is recommended that this switch or circuit breaker be near the equipment, and be well labeled.

:

In addition, to meet the EMC Directive, a proper transducer installation, including shielded cables must also be used. The following is a list of cables available from DFE which meet this requirement

721-0084 CN 3-conductor cable for type C, RS, THN, and UPB transducers. Use 2 cables, 1 cable per transducer.

721-0964 CN 6-conductor cable for type RFA, LT, VNW, NW, and TR transducers.

Other cables manufactured by DFE also meet this requirement. Contact DFE for more information.

In addition to the transducer cable shielding, a shielded meter cable (DFE P/N: 721-0967, 15 ft., other lengths available) and meter in enclosure (DFE P/N: 723-1453) are required to meet the EMC directive when an accessory meter is used.

Cable shielding must be attached to the SHIELD connection on the terminal block, or to an appropriately grounded enclosure. If you wish to assemble your own cables, contact DFE for assembly instructions.

! IMPORTANT: The DFE **Model Ti28** you have purchased has been designed to meet the European Union's Low Voltage Directive and EMC Directive only when installation is done correctly. To meet the EMC Directive, a proper transducer installation, including shielded cables must be used. The following is a list of cables available from DFE which meet this requirement:

721-0084 CN 3-conductor cable for type C, RS, THN, and UPB transducers. Use 2 cables, 1 cable per transducer.

721-0964 CN 6-conductor cable for type RFA, LT, VNW, NW, and TR transducers.

Other cables manufactured by DFE also meet this requirement. Contact DFE for more information.

In addition to the transducer cable shielding, a shielded meter cable (DFE P/N: 721-0967, 15 ft., other lengths available) and analog meter in enclosure (DFE P/N: 723-2682) are required to meet the EMC directive when an accessory meter is used.

Cable shielding must be attached to the SHIELD connection on the terminal block, or to an appropriately grounded enclosure.

2.4 INSTALLATION INSTRUCTIONS

The TwinAmp is plugged into a standard 19 inch rack having an opening 3U high by 14HP wide. The optional plug-in adapter may also be used.

Note: The TwinAmp has been tested to meet the EMC directive, and for that compliance, the unit must be installed in a shielded enclosure and used with shielded cables (DFE cables are shielded).

2.5 TRANSDUCER VOLTAGE SELECTION (Refer to Figure 6)

The tension transducers are excited by either the standard 5 Vdc, or 10 Vdc with the Extended Range option or LT (low tension) transducer.

!!CAUTION Do NOT use the 10 Vdc excitation unless the transducers are LT type transducers or have the extended range option! The **TRANSDUCERS MAY BE DAMAGED!**

Set the Amplifier A transducer excitation jumpers as follows:

5 Vdc - Jumper on JP1, pins 1-2. 10 Vdc (XRE) - Jumper on JP1, pins 2-3.

The B Amp uses JP2 and may be set independent of the A Amp selection.

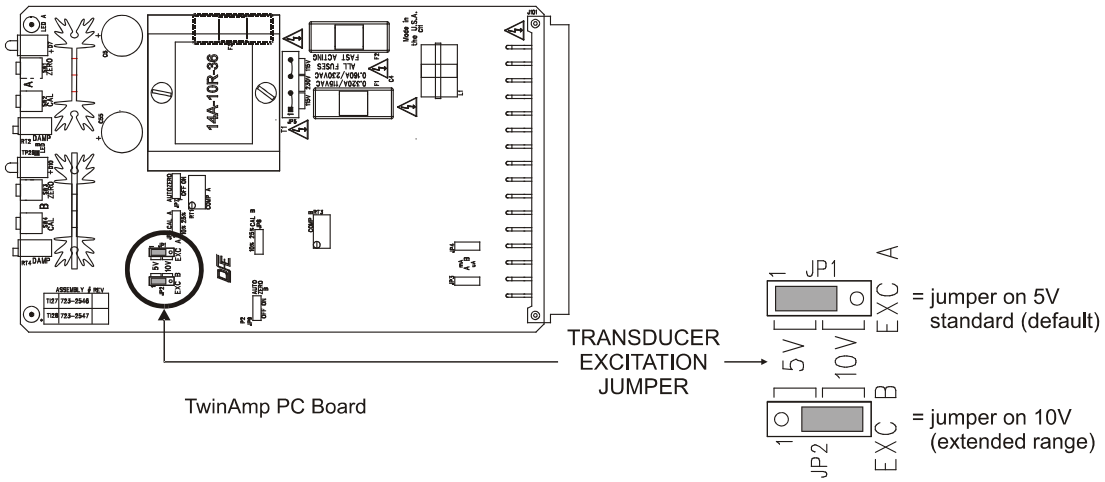


Figure 6 **- TRANSDUCER VOLTAGE JUMPERS**

2.6 TENSION METER OUTPUT SELECTION

Select the 0-1mA current outputs by setting jumpers JP3 (Indicator A) and JP4 (Indicator B) to the desired output. The unit ships from the factory set for 0-1mA meter output.

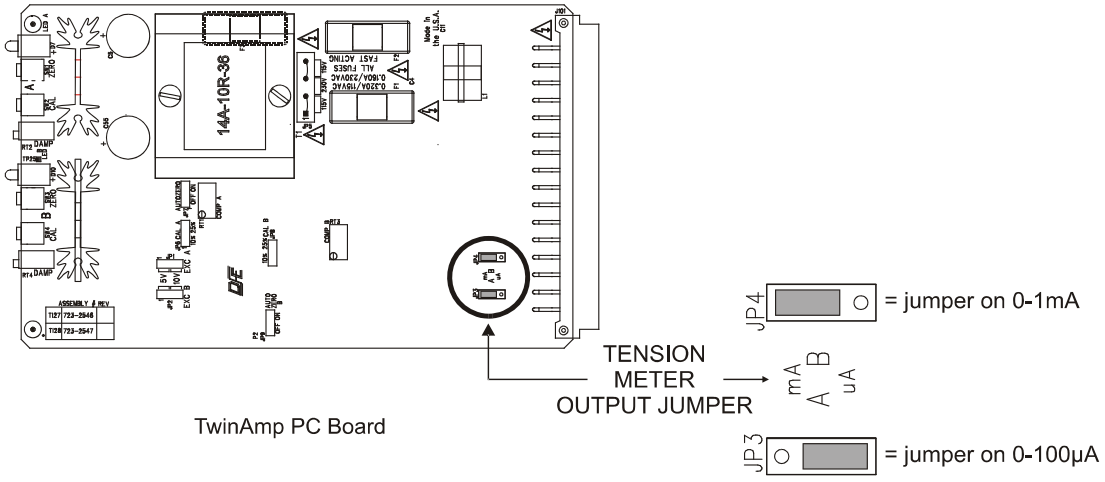


Figure 7 **- TENSION METER OUTPUT JUMPERS**

2.7 STANDARD ELECTRICAL CONNECTIONS

Keep in mind that each channel of the TwinAmp (amplifier A or B) is designed to provide a 0-1mA damped meter output, and a 0-10V isolated and a 4-20mA isolated output. These outputs are not isolated from each other within an Amplifier. All A amp outputs share an isolated common. All B amp outputs share a separate isolated common. Connecting the 2 isolated commons will not cause problems in normal operation. Avoid connecting them to Transducer Common which is not isolated. Also note that the 4-20mA A & B returns must be connected to the correct pins. The 4-20mA will not function correctly if returned to another pin. See Fig 8 for connections.

NOTE: If connecting outputs to Drive motor inputs, Avoid connecting A and B Amp Commons together. Past issues have often been solved by isolating drives from all other electronics.

2.7 ELECTRICAL CONNECTIONS *continued.....*

Connect Power to the Appropriate pins.

Warning! Do not connect +24Vdc to Ti27 units. Likewise, Do not connect AC Voltage to Ti28 units.

Make your wiring connections as follows:

1. The insulation rating of all line voltage wiring must be at least 600V
2. Keep line voltage wiring physically separated from signal wiring at the terminal block and at any other point in the installation.
3. Connect cable shields to Earth Ground.

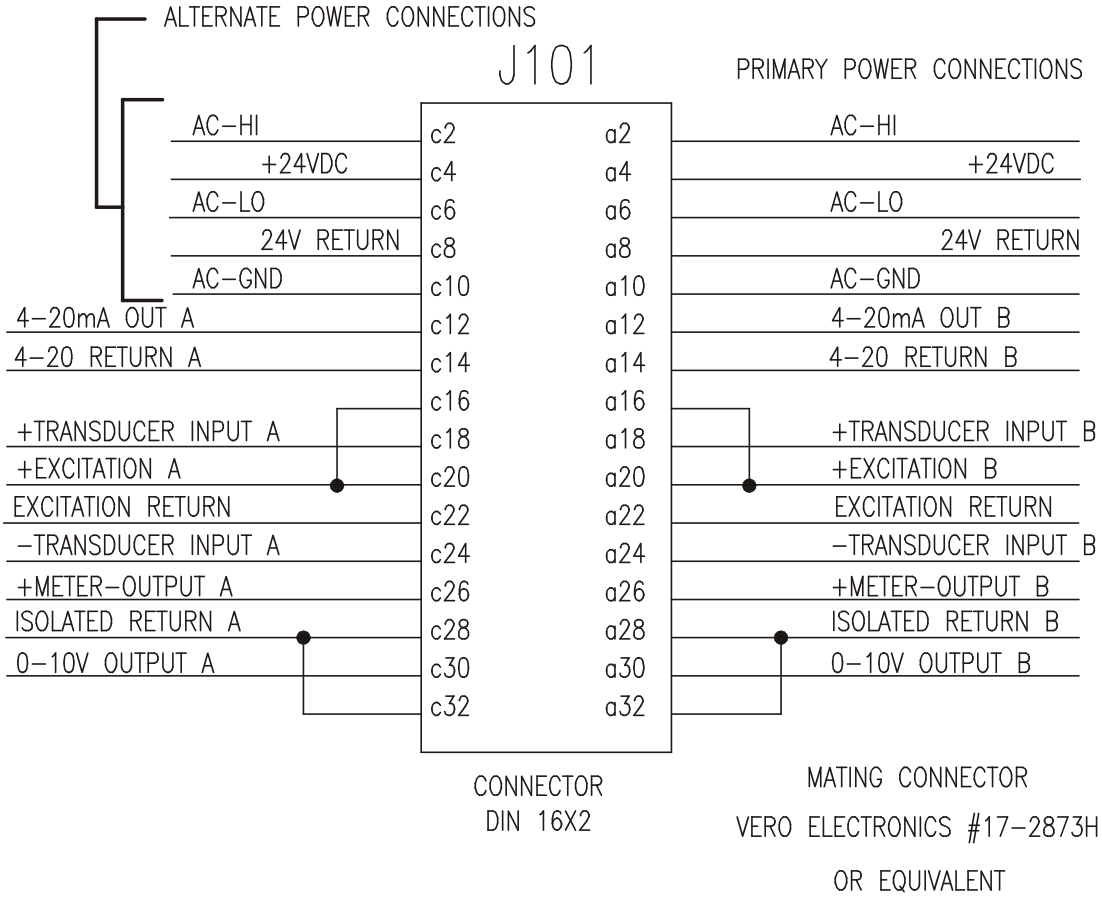


Figure 8 **- STANDARD ELECTRICAL CONNECTIONS**

SECTION 3

CALIBRATION and SETUP

3.1 PREPARATION

1. For each amplifier (channel), Amp A and Amp B, select an appropriate calibration weight. Remember that the weight determines the value of web tension that will produce full output from each amplifier. Example: a 15 lb. weight will result in full output at 150 lbs. tension with the standard calibration ratio of 10%. (If the optional cal. ratio of 25% is used, a calibration weight of 15 lbs. will result in a full output at 60 lbs. tension for example). A spring scale can also be used, but absolute accuracy may be reduced. Repeatability will not change.
2. Get a length of rope, wire, or cable of appropriate length. It must NOT be extensible (stretchy). This will cause inaccurate calibration.
3. If you wish to use a calibration ratio of 25% for Amp A, locate jumper JP6 on the PCB and move it to the 25% position.
4. If you wish to use a calibration ratio of 25% for Amp B, locate jumper JP8 on the PCB and move it to the 25% position.

3.2 MECHANICALLY ZERO THE TENSION METER

(This step is necessary only if the optional analog tension meter(s) is/are to be used).

Turn off power to the TwinAmp and observe whether the tension meter needle rests at 0. If not, turn the adjustment screw on the rear of the meter as required to set the meter needle at 0 on the scale. Note that the meter is sensitive to changes in mounting attitude. (Tilt from vertical meter face)

3.3 CALIBRATE THE OUTPUT FOR ACCURACY

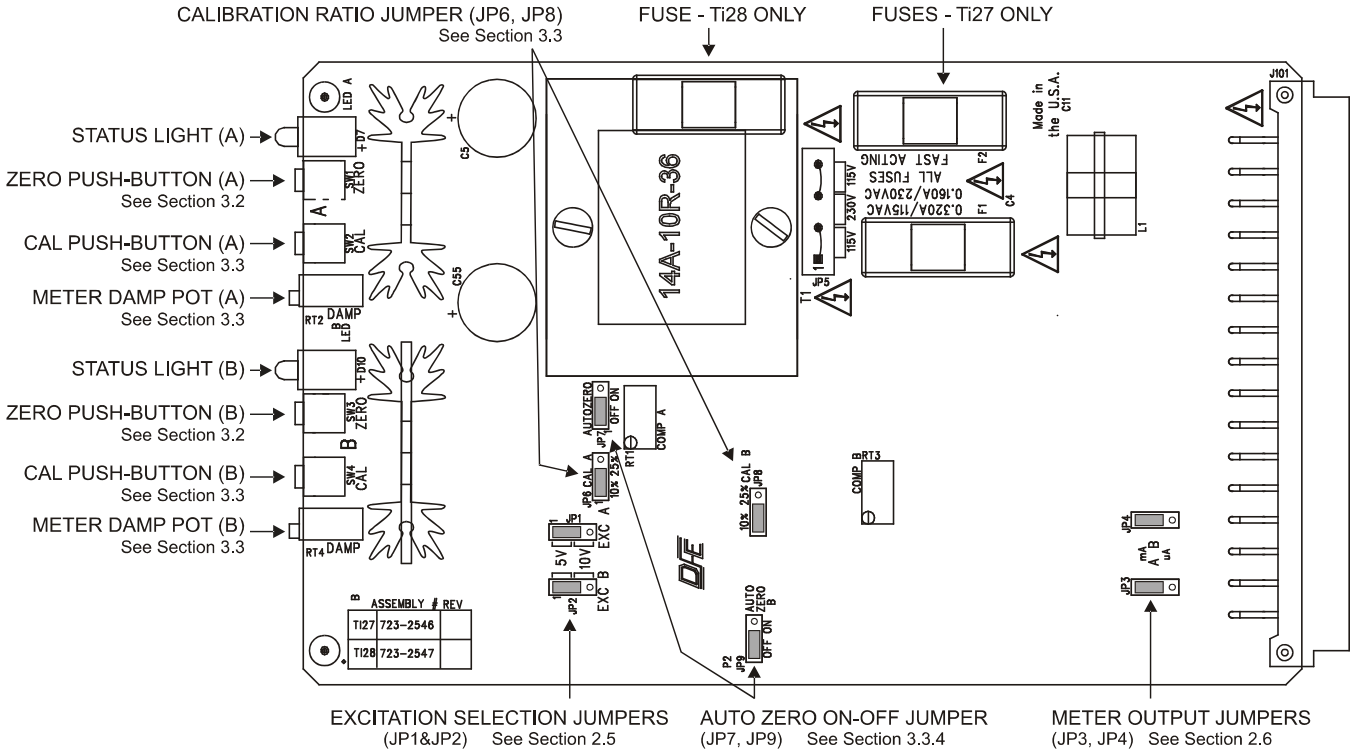


Figure 9 **- TWINAMP SHOWING CAL, ZERO, and JUMPER LOCATIONS**

1. **ZERO:** Ensure nothing is hanging on or pressing on the tension rolls (including the calibration rope). Press the ZERO A pushbutton on the unit front panel for at least 1 second. The unit will store the tension zero one second after the button is pressed. The unit will flash the green STATUS A LED (located above the ZERO A button) ONCE to indicate the zero has been stored. Release the button. The A outputs will produce 0Vdc and 4mA. The tension meter (if attached) will read zero.

   Press the ZERO B pushbutton on the unit front panel for at least 1 second. The unit will store the tension zero one second after the button is pressed. The unit will flash the green STATUS B LED (located above the ZERO B button) ONCE to indicate the zero has been stored. Release the button. The B outputs will produce 0Vdc and 4mA. The tension B meter (if attached) will read zero.

   Manual re-zero can be performed at any time. Simply ensure nothing is touching the tension roller, and press ZERO until the green LED (above the ZERO button) flashes once, then release. The zero setting is updated, and the CALIBRATION is maintained.

2. **CALIBRATION**: Fasten one end of the rope in the machine and thread the other end around the transducer roll in exactly the same path the web will take for the A amplifier. Be sure the rope does not pass around any driven rolls, drag bars, or anything else that can affect tension. Ideally the rope should hit an idler roll immediately before and after the tension sensing roll. It does not have to pass over any other rollers once these three are strung.

   1. Attach the weight to the free end of the rope as shown in Figure 10. The weight should not touch anything. Wait for the weight to stop swinging.

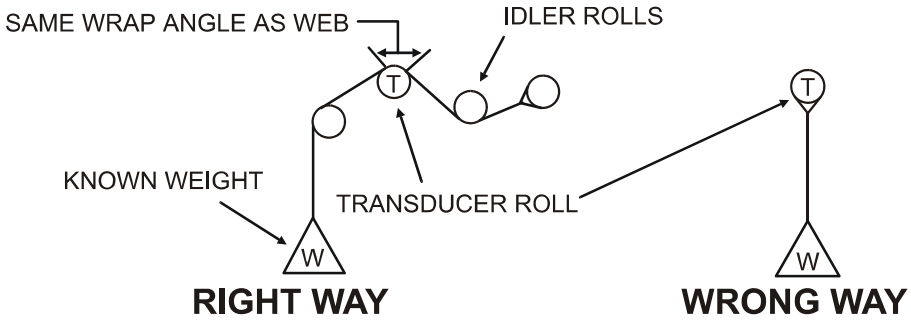


***Figure 10* - WEB PATH**

   2. Press the CAL A pushbutton on the unit front panel for at least 1 second. The unit will store the calibration information one second after the button is pressed. The unit will flash the green STATUS A LED (located above the ZERO A button) ONCE to indicate the calibration has been stored. The A outputs will read 1.0Vdc and 5.6mA (For 10% calibration percentage) or 2.5Vdc and 8mA (For 25% calibration percentage). The A meter will read 10% of full scale or 25% depending upon JP6 setting.
   3. Remove the weight and observe the A output. It should read 0Vdc or 4mA with nothing touching the tension sensing roller, and if steps 2.1 to 2.3 above were done correctly.
   4. Thread the rope around the Amp B transducer as detailed above.
   5. Attach the weight to the free end of the rope as shown in Figure 10. The weight should not touch anything. Wait for the weight to stop swinging.
   6. Press the CAL B pushbutton on the unit front panel for at least 1 second. The unit will store the calibration information one second after the button is pressed. The unit will flash the green STATUS B LED (located above the ZERO B button) ONCE to indicate the calibration has been stored. The B outputs will read 1.0Vdc and 5.6mA (For 10% calibration percentage) or 2.5Vdc and 8mA (For 25% calibration percentage). The B meter will read 10% of full scale or 25% depending upon JP6 setting.
   7. Remove the weight and observe the B output. It should read 0Vdc or 4mA with nothing touching the tension sensing roller, and if steps 2.4 to 2.6 above were done correctly.

!CAUTION: Do NOT press ZERO or CAL pushbuttons while the web is running. The unit will store ZERO or CALIBRATION and the old settings will not be recovered. The only way to recover CALIBRATION is to perform this procedure starting at step 1.

3. **METER DAMPING:** If the optional analog meter is used, adjust the MTR DAMP potentiometer while the machine is running to minimize needle movement. Damping only affects the 0-1mA meter output and not the 0-10Vdc or 4-20mA isolated outputs. (See Fig. 9). A and B Damping is set independently.
4. **AUTO-ZERO:** If you want the unit to automatically re-zero every time power is applied, move jumper JP7 (A amp) and/or JP9 (B amp) to pins 2-3 (Auto-Zero ON). The default is Auto-Zero OFF (JP7 Pins 1-2 and JP9 pins 1-2). (See Fig. 9).

   !CAUTION: Auto-Zero must be used with care. If power can be cycled to the unit (for any reason) while the web is resting on the tension roller, Auto-Zero should NOT be activated. The unit will store the updated tension input as the new zero on power up. This can damage the web as the actual tension would be higher than reported by the unit.

   Manual re-zero can be performed at any time. Simply ensure nothing is touching the tension roller, and press ZERO until the green LED (above the ZERO button) flashes once, then release. The zero setting is updated, and the CALIBRATION is maintained.

The output calibration is now complete.

SECTION 4

OPERATING INSTRUCTIONS

Your TwinAmp dual tension amplifier will indicate tension in your system without any further operator intervention. It is a good idea to make a check at roughly one month intervals to verify that no one has changed the calibrations. See Section 3 for calibration and setup.

SECTION 5

CARE AND MAINTENANCE

It is not necessary to perform any type of maintenance on the TwinAmp. However, you may find it worthwhile to observe whether there is a buildup of dust, debris, or moisture on or near the unit after a period of time. If so, you may consider putting the unit in a more appropriate location.

SECTION 6

TROUBLESHOOTING GUIDE

Most problems are caused by incorrect installation and misapplication of the equipment. It is very important to be sure these factors are correct before making any changes to calibration and jumper settings.

The green status LEDs (located on the left edge of the board) indicate the operating status of the unit. They should be on steady within one second of power application. The green status LED should not be flashing during operation except when pressing ZERO or CALIBRATION pushbuttons (LED will flash once indicating acceptance of ZERO or CAL). Continuous flashing is an indication of a problem - contact DFE technical support if this condition is observed.

If both green status LEDs are not lit when power is applied, check fuses on the TwinAmp. If they need to be replaced, use the correct values listed below (all fuses 5mm x 20mm type):

Ti27 (2 Fuses): 115V Operation = 160mA, 250V IEC Fast Acting (DFE P/N: 108-0082)
230V Operation = 80mA, 250V IEC Fast Acting (DFE P/N: 108-0091)

Ti28 (1 Fuse): 1A, 250V IEC Fast Acting (DFE P/N: 108-0097)

⚠ **WARNING:** Equipment must be disconnected from **HAZARDOUS LIVE** voltage before changing the fuses. (Removing the unit from the rack will fulfill this requirement)

⚠ **WARNING:** Only replace fuses with the correct size, value, and speed rating. Use of non-certified fuses or fuses with incorrect ratings **MAY CAUSE A SHOCK OR FIRE HAZARD.**

The test points on the circuit card can provide an indication of proper operation or problems if they exist. Typical voltages on the test points follow: (See Appendix A for test point locations).

Voltmeter positive lead	Voltmeter negative lead	Typical Voltage
TP1	TP20	15.5 Vdc (A)
TP26	TP20	15.5Vdc (B)
TP9	TP20	5Vdc (A)
TP15	TP20	5Vdc (B)
TP4 (+EXC A)	TP20	5Vdc (STD), 10.1Vdc (XR)
TP28 (+EXC B)	TP20	5Vdc (STD), 10.1Vdc (XR)
TP5 (Amp A)	TP11	0-10Vdc output, changes depending on tension input and ZERO/CAL settings.
TP27 (Amp B)	TP22	0-10Vdc output, changes depending on tension input and ZERO/CAL settings.

Some variation of the listed voltages should be expected. If any voltage deviation greater than 10% of typical is measured, contact DFE technical support for assistance.

NOTE: The unit must be plugged into a properly wired connector/rack to check these values. An extender card can be used in the rack. These tests should only be performed by qualified technical personnel following normal safety procedures.

If you have any problems with the functions on your TwinAmp Dual Tension Amplifier, please call Technical Service at 603-332-6150 or Fax 603-332-3758. E-mail: techsupport@dfe.com.

SECTION 7

REPLACEMENT PARTS

See diagram below for separate components.

⚠ **WARNING:** When replacing fuses, use only fuses with ratings as shown below. Failure to do this may compromise personal safety and may create a fire hazard!

1. 323-0943 **Front Overlay - Ti27**
321-0953 **Voltage Input Sticker - Specify Unit Voltage**
2. 108-0082 **(2) Fuses, 160mA 250V for 115Vac** - Ti27
3. 108-0091 **(2) Fuses, 80mA 250V for 230Vac** - Ti27
4. 108-0002 **(1) Fuse, 1A, 250V for 24Vdc** - Ti28
5. 108-0105 **Fuse Covers** - (2) for Ti27, (1) for Ti28
7. Accessory Tension Meters (not shown)
722-1385 Analog Tension Meter,
723-2682 Analog Tension Meter in enclosure,
723-2307 Digital Tension Meter
723-2660 Digital Tension Meter in enclosure
721-0967 Shielded Meter Cable, 15 ft.
8. 801-2336 **Instruction Manual** (not shown)

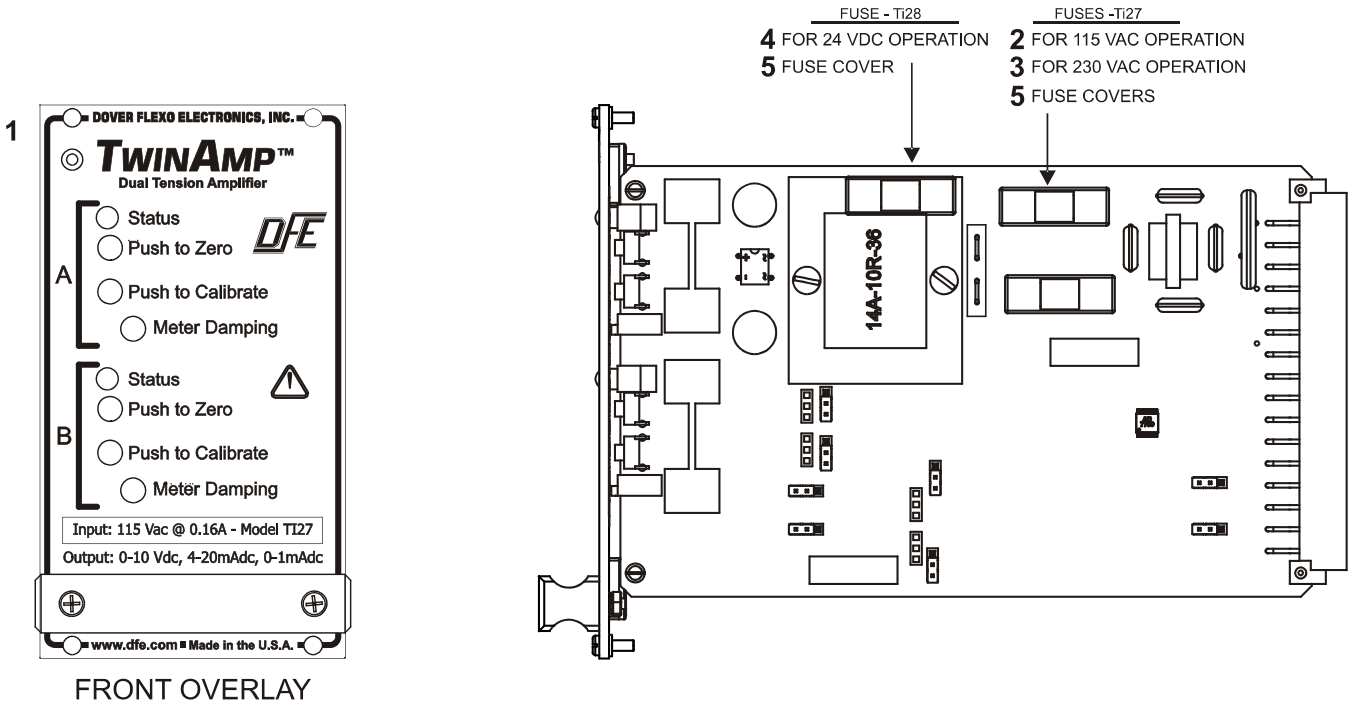
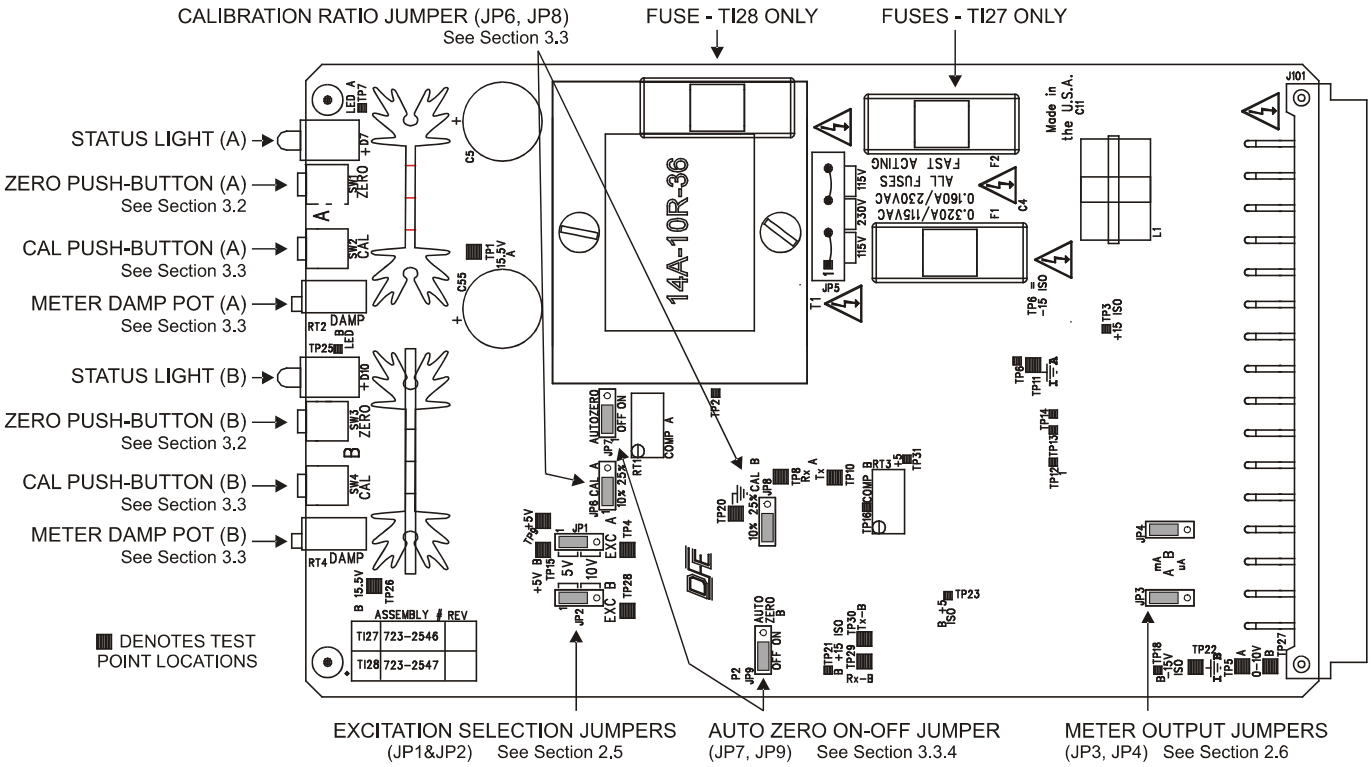
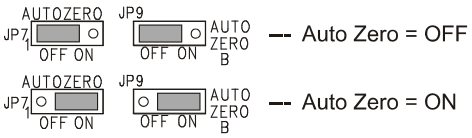


Figure 11 **- REPLACEMENT PART NUMBERS**

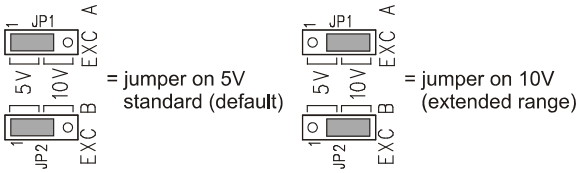
Appendix A: Locations of Jumpers and Adjustments



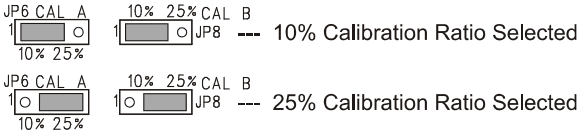
AUTO ZERO ON-OFF JUMPER
(JP7, JP9) See Section 3.3.4



EXCITATION SELECTION JUMPERS
(JP1&JP2) See Section 2.5



CALIBRATION RATIO JUMPER
(JP6, JP8) See Section 3.3



METER OUTPUT JUMPERS
(JP3, JP4) See Section 2.6

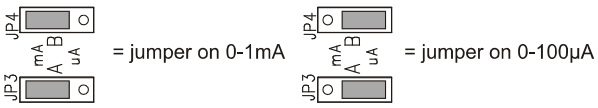


Figure 12 **- TWINAMP PC BOARD SHOWING COMPONENT LOCATIONS** (Simplified for clarity)0

TWINAMP STANDARD CONNECTIONS:

Make your wiring connections as follows:

Warning! Do not connect +24Vdc to Ti27 units. Likewise, Do not connect AC Voltage to Ti28 units.

1. The insulation rating of all line voltage wiring must be at least 600V.
2. Keep line voltage wiring physically separated from signal wiring at the terminal block and at any other point in the installation.
3. Connect cable shields to earth ground.

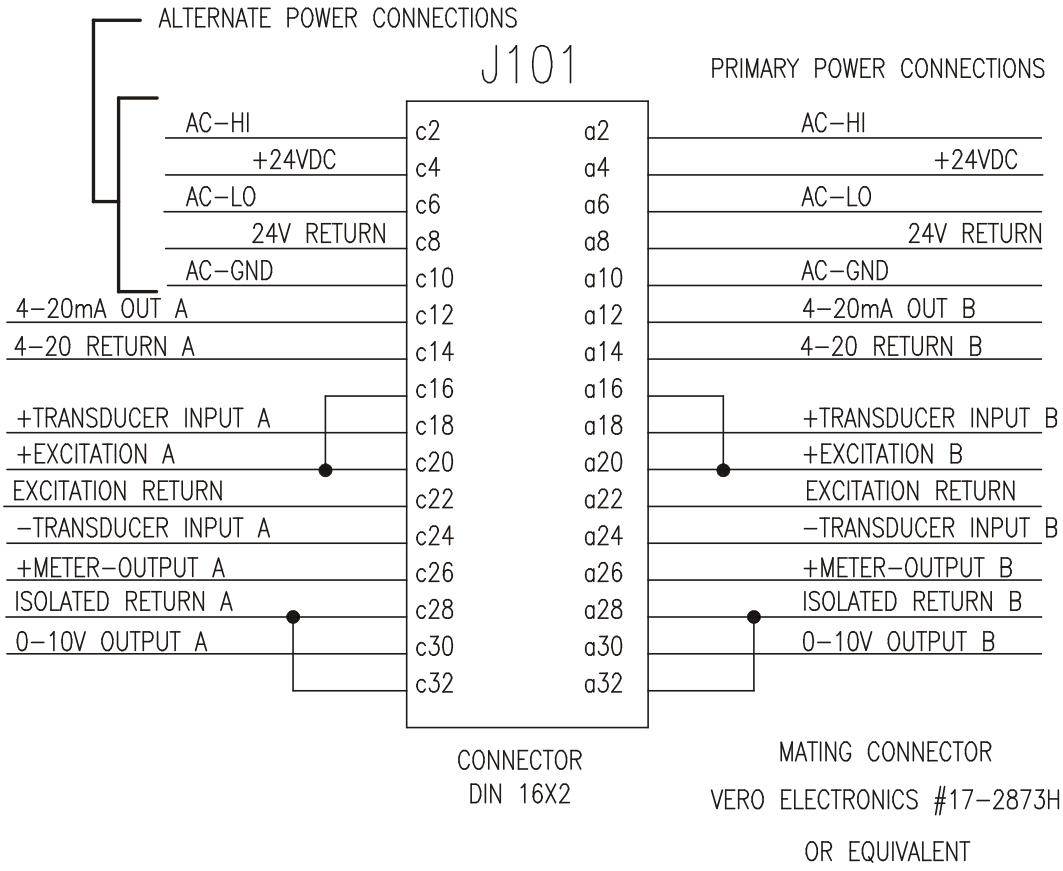


Figure 13 **- STANDARD ELECTRICAL CONNECTIONS**

Appendix C: Transducer Electrical Connections

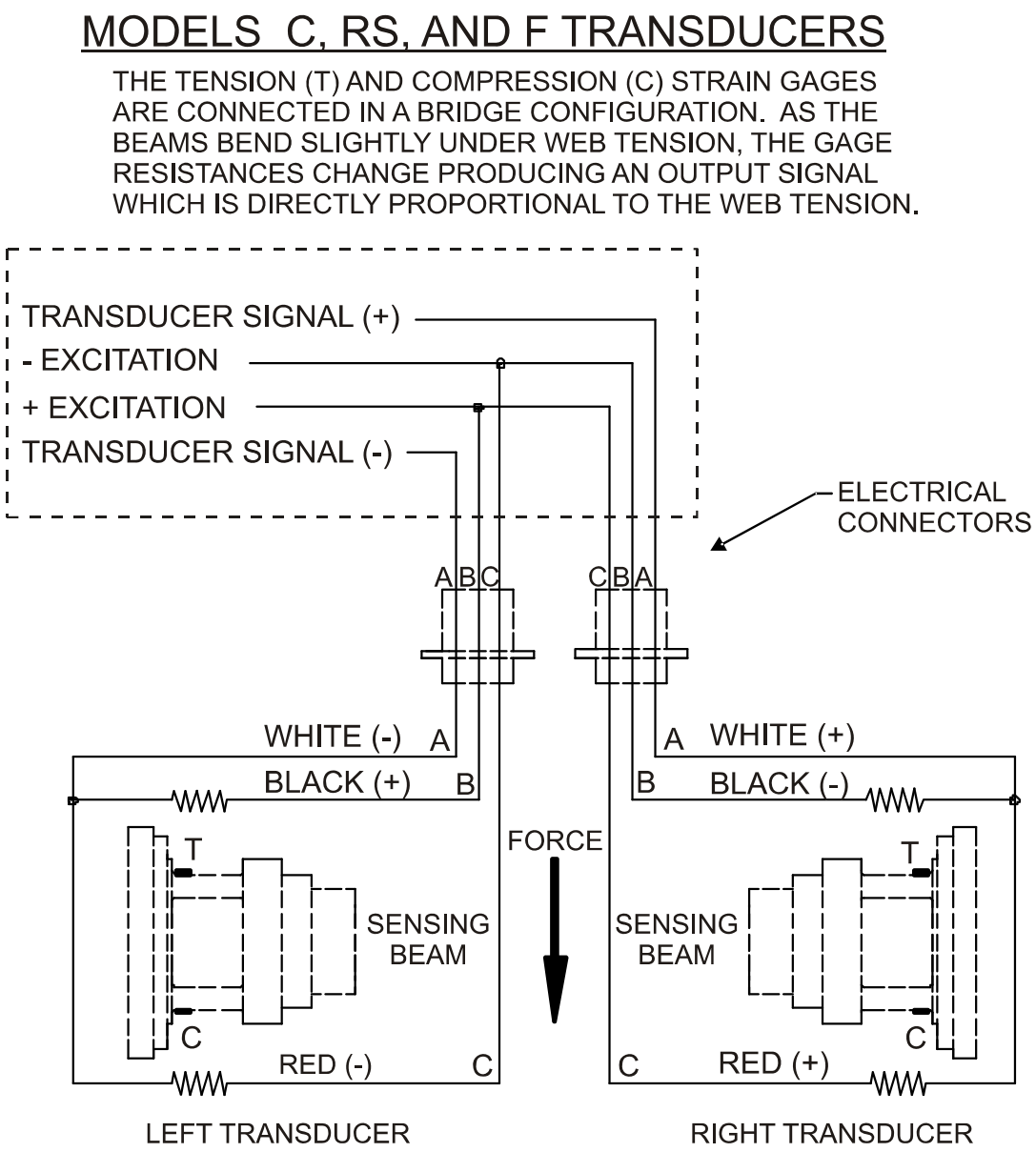


Figure 14 **- MODELS C, RS, & F TRANSDUCER WIRING**

RIBBON FILAMENT (RFA) TRANSDUCERS

THE TENSION (T) AND COMPRESSION (C) STRAIN GAGES ARE CONNECTED IN A BRIDGE CONFIGURATION. AS THE BEAMS BEND SLIGHTLY UNDER WEB TENSION, THE GAGE RESISTANCES CHANGE PRODUCING AN OUTPUT SIGNAL WHICH IS DIRECTLY PROPORTIONAL TO THE WEB TENSION.

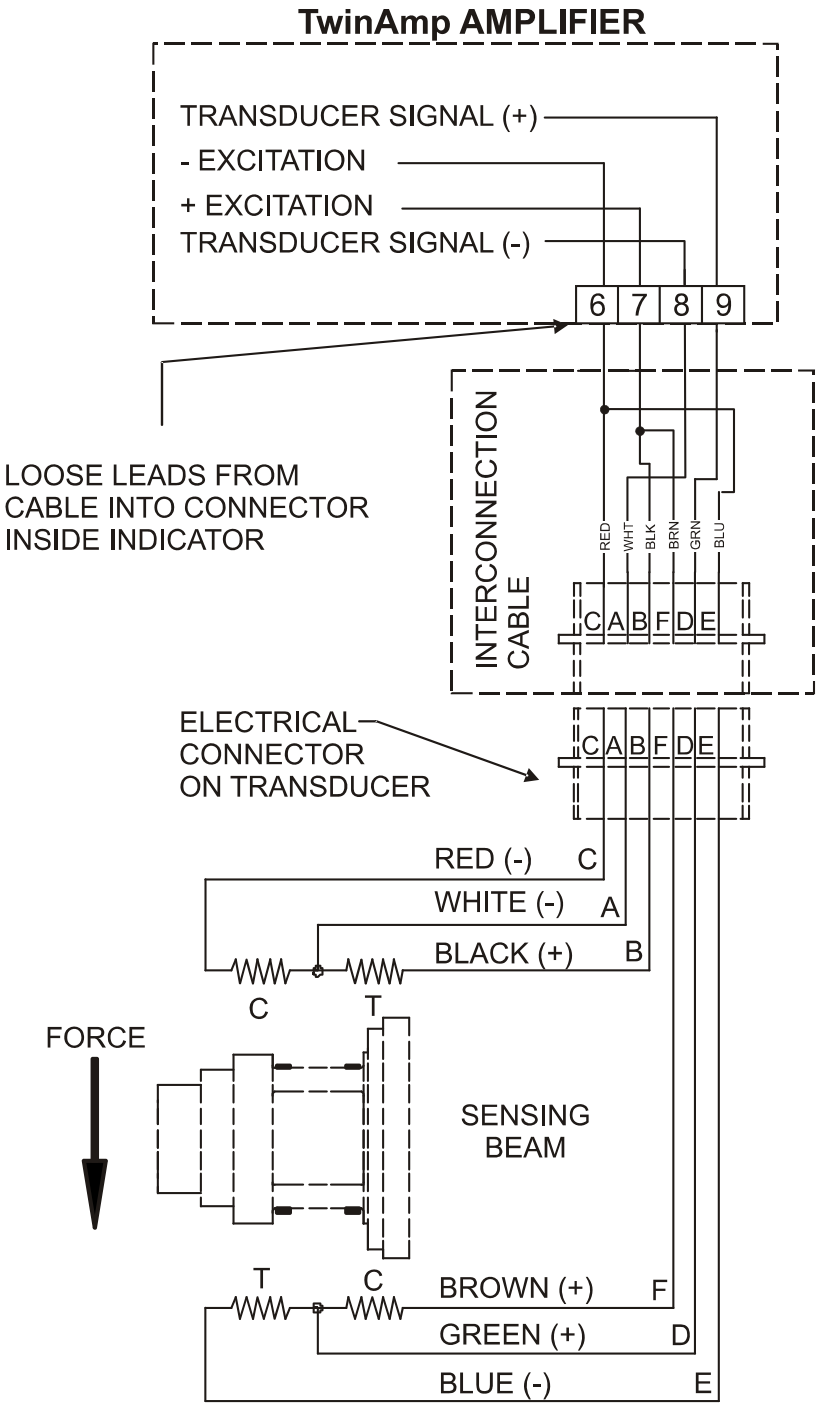


Figure 15 **- RFA TRANSDUCER WIRING**

TENSION ROLL (TR) AND NARROW WEB (NW) TRANSDUCERS

The tension (T) and compression (C) strain gages are connected in a bridge configuration. As the beams bend slightly under web tension, the gage resistances change producing an output signal which is directly proportional to the web tension.

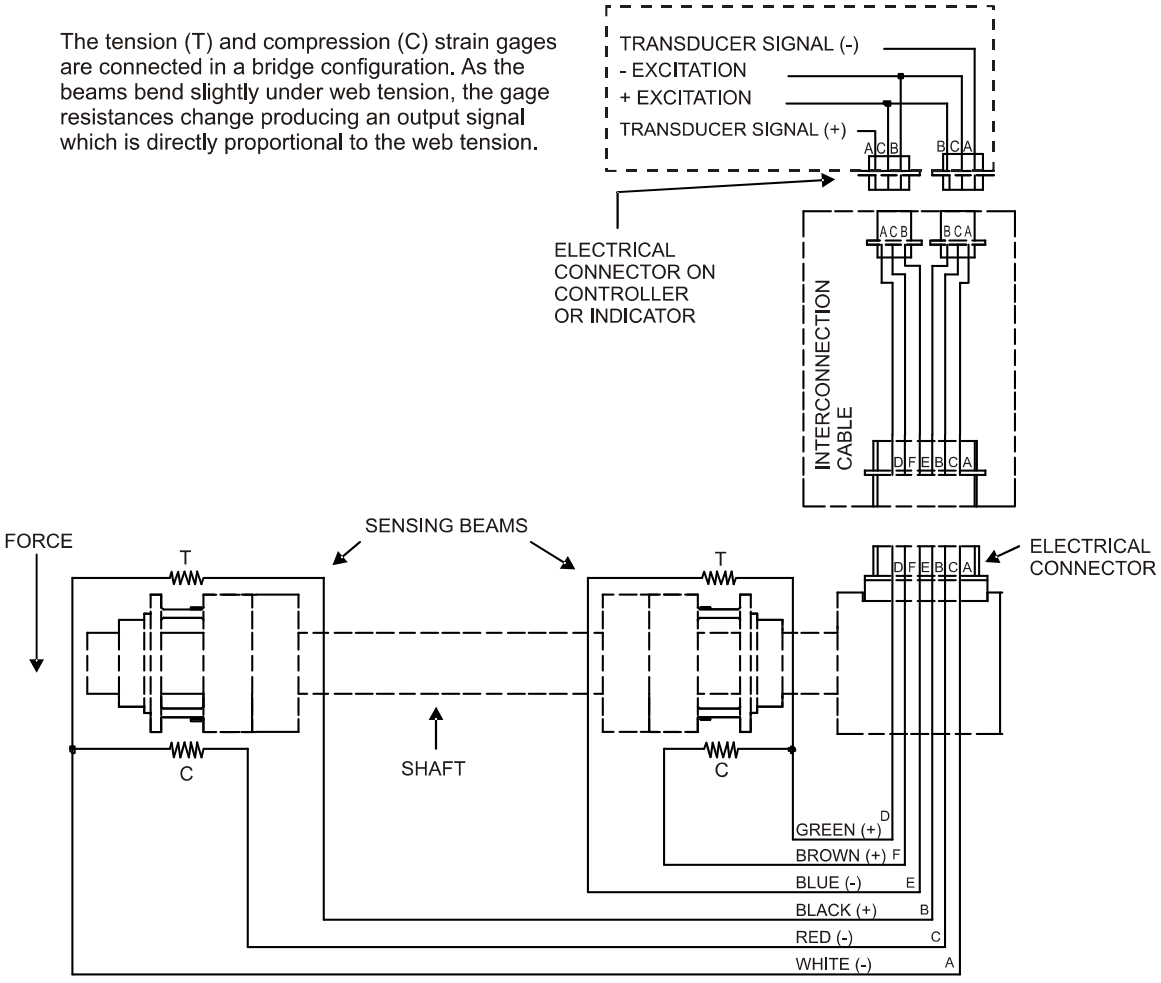
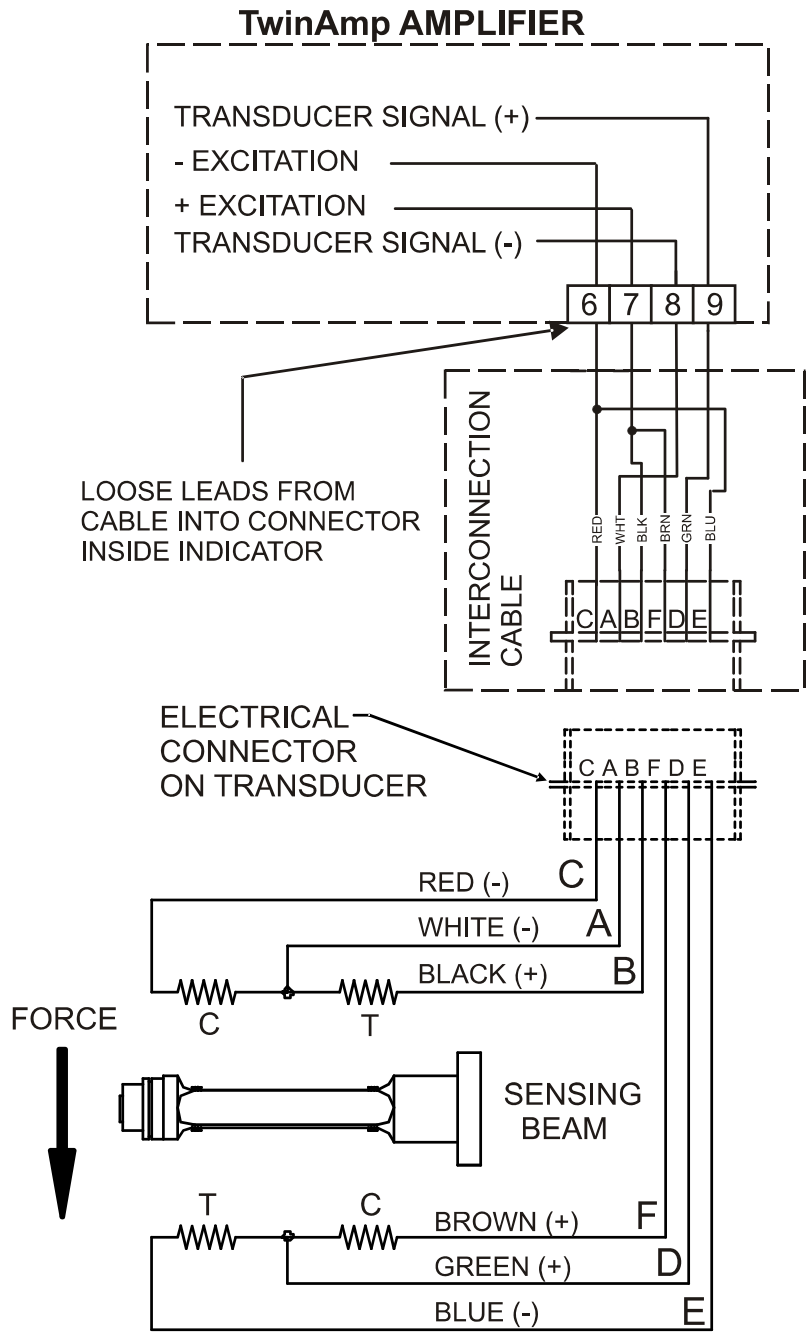


Figure 16 **- TR & NW TRANSDUCER WIRING**

LOW TENSION (LT) TRANSDUCERS



Note: Extended Range Option (XR) must be used with LT Transducers

Figure 17 **- LT TRANSDUCER WIRING**

Appendix D: Typical Tensions for Various Materials

TYPICAL TENSIONS FOR WEB MATERIALS

ACETATE		0.5 lb. per mil per inch of width
FOIL	Aluminum	0.5 lb. per mil per inch of width
	Copper	0.5 lb. "
CELLOPHANE		0.75 lb. per mil per inch of width
NYLON		0.25 lb. per mil per inch of width
PAPER 15 lb *		0.4 lb. per inch of width
	20 lb	0.5 lb. "
	30 lb	0.75 lb. "
	40 lb	1.25 lb. "
	60 lb	2.0 lb. "
	80 lb	3.0 lb. "
	100 lb	4.0 lb. "
* based on 3000 sq. ft. ream		
PAPERBOARD	8pt	3.0 lb. per inch of width
	12pt	4.0 lb. "
	15pt	4.5 lb. "
	20pt	5.5 lb. "
	25pt	6.5 lb. "
	30pt	8.0 lb. "
POLYETHYLENE		0.12 lb. per mil per inch of width
POLYESTER (Mylar)		0.75 lb. per mil per inch of width
POLYPROPYLENE		0.25 lb. per mil per inch of width
POLYSTYRENE		1.0 lb. per mil per inch of width

RUBBER	GAUGE	AT 25% STRETCH	AT 50% STRETCH
	10 mil	1.75	3.68
	12 mil	1.10	2.03
	16.5 mil	4.09	8.17
	26 mil	2.47	4.97

SARAN		0.15 lb per mil per inch of width	
STEEL	GAUGE - INS	UNWIND-PSI	REWIND-PSI
	0.001 -0.005	1000	4000
	0.006 -0.025	850	3500
	0.026 -0.040	750	3000
	0.041 -0.055	650	2600
	0.058 -0.070	550	2200
	0.071 -0.090	450	1800
	0.091 -0.120	450	1400
	0.121 -0.140	400	1200
	0.141 -0.165	400	1000
	0.166 -0.200	400	900
	0.201 -0.275	400	800
	0.276 -0.380	300	700
VINYL		0.05 lb. per mil per inch of width	

*** For laminated webs, sum the tension for the individual webs and add 0.1 lb per inch of width.

Appendix E: Environmental Terms

OVERVOLTAGE CATEGORY: Classification of parts of installation systems or circuits with standardized limits for transient overvoltages, dependent on the normal line voltage to earth.

POLLUTION: Any addition of foreign matter, solid, liquid or gaseous (ionized gases), that may produce a reduction of dielectric strength or surface resistivity.

POLLUTION DEGREE 2: Normally only non-conductive POLLUTION occurs. Occasionally, however, a temporary conductivity caused by condensation must be expected.

TERMS AND CONDITIONS OF SALE AND SHIPMENT

1. THE COMPANY
Dover Flexo Electronics, Inc. is hereinafter referred to as the Company.

2. CONFLICTING OR MODIFYING TERMS
No modification of, additions to or conflicting provisions to these terms and conditions of sale and shipment, whether oral or written, incorporated into Buyer's order or other communications are binding upon the Company unless specifically agreed to by the Company in writing and signed by an officer of the Company. Failure of the Company to object to such additions, conflicts or modifications shall not be construed as a waiver of these terms and conditions nor an acceptance of any such provisions.

3. GOVERNING LAW
This contract shall be governed by and construed according to the laws of the state of New Hampshire, U.S.A. The parties agree that any and all legal proceedings pursuant to this contract shall take place under the jurisdiction of the courts of the State of New Hampshire in the judicial district of Strafford County.

4. PENALTY CLAUSES
Penalty clauses of any kind contained in orders, agreements or any other type of communication are not binding on the Company unless agreed to by an officer of the Company in writing.

5. WARRANTY
Dover Flexo Electronics,Inc. warrants, to the original Buyer, its' products to be free of defects in material and workmanship for five years from date of original shipment. Repairs on products are warranted for 90 days from date of shipment. During the warranty period the Company will repair or replace defective products free of charge if such products are returned with all shipping charges prepaid and if, upon examination, the product is shown to be defective. This warranty shall not apply to products damaged by abuse, neglect, accident, modification, alteration or mis-use. Normal wear is not warranteed. All repairs and replacements under the provisions of this warranty shall be made at Dover Flexo Electronics or at an authorized repair facility. The Company shall not be liable for expenses incurred to repair or replace defective products at any other location or by unauthorized persons or agents. This warranty contains all of the obligations and warranties of the Company. There are no other warranties, either expressed or implied. No warranty is given regarding merchantability or suitability for any particular purpose. The Company shall not be liable in either equity or law for consequential damages, losses or expenses incurred by use of or inability to use its' products or for claims arising from same. No warranty is given for products of other manufacturers even though the Company may provide these products with its' own or by themselves. The provisions of this warranty can not be changed in any way by any agent or employee of the Company. Notice of defects must be received within the warranty period or the warranty is void. The warranty is void if the serial number tag is missing or not readable.

6. PAYMENTS
Standard terms of credit are net 30 days from date of shipment, providing satisfactory credit is established with the Company. Amounts past due are subject to a service charge of 1.5% per month or portion thereof or 18% per annum. The Company reserves the right to submit any unpaid late invoices to a third party for collection and Buyer shall pay all reasonable costs of such collection in addition to the invoice amount. All quoted prices and payments shall be in U.S. Dollars.
If the Company judges that the financial condition or payment practices of the Buyer does not justify shipment under the standard terms or the terms originally specified, the Company may require full or partial payment in advance or upon delivery. The Company reserves the right to make collection on any terms approved in writing by the Company's Finance Department. Each shipment shall be considered a separate and independent transaction and payment therefore shall be made accordingly. If the work covered by the purchase order is delayed by the Buyer, upon demand by Company payments shall be made on the purchase price based upon percentage of completion.

7. TAXES
Any tax, duty, custom, fee or any other charge of any nature whatsoever imposed by any governmental authority on or measured by any transaction between the Company and the Buyer shall be paid by the Buyer in addition to the prices quoted or invoiced.

8. RETURNS
Written authorization must be obtained from the Company's factory before returning any material for which the original Buyer expects credit, exchange, or repairs under the Warranty. Returned material (except exchanges or repairs under the Warranty) shall be subject to a minimum re-stocking charge of 15%. Non-standard material or other material provided specially to the Buyer's specification shall not be returnable for any reason. All material returned, for whatever reason, shall be sent with all freight charges prepaid by the Buyer.

9. SHIPPING METHOD AND CHARGES
All prices quoted are EXW the Company's factory. The Company shall select the freight carrier, method and routing. Shipping charges are prepaid and added to the invoice of Buyers with approved credit, however the Company reserves the right to ship freight-collect if it prefers. Shipping charges will include a charge for packaging. Company will pay standard ground freight charges for items being returned to Buyer which are repaired or replaced under the Warranty. Claims of items missing from a shipment must be received, in writing, within 30 days of original shipment

10. CANCELLATION, CHANGES, RESCHEDULING
Buyer shall reimburse Company for costs incurred for any item on order with the Company which is cancelled by the Buyer. Costs shall be determined by common and accepted accounting practices.
A one-time hold on any item ordered from the Company shall be allowed for a maximum of 30 days. After 30 days, or upon notice of a second hold, Company shall have the right to cancel the order and issue the appropriate cancellation charges which shall be paid by Buyer. Items held for the Buyer shall be at the risk and expense of the Buyer unless otherwise agreed upon in writing. Company reserves the right to dispose of cancelled material as it sees fit without any obligation to Buyer.
If Buyer makes, or causes to make, any change to an order the Company reserves the right to change the price accordingly.

11. PRICES
Prices published in price lists, catalogs or elsewhere are subject to change without notice and without obligation. Written quoted prices are valid for thirty days only.

12. EXPORT SHIPMENTS
Payment for shipments to countries other than the U.S.A. and Canada or to authorized distributors shall be secured by cash in advance or an irrevocable credit instrument approved by an officer of the Company. An additional charge will apply to any letter of credit. There will also be an extra charge for packaging and documentation.

13. CONDITION OF EQUIPMENT
Buyer shall keep products in good repair and shall be responsible for same until the full purchase price has been paid.

14. OWNERSHIP
Products sold are to remain the property of the Company until full payment of the purchase price is made.

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INDEX

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