



INSTRUCTION MANUAL
TRUE TENSION INDICATOR
Models TI17B and TI18B
DOC 801-1741 R3

5 YEAR WARRANTY



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TABLE OF CONTENTS

SECTION ONE	PRODUCT DESCRIPTION	
1.1	General Description	1
1.2	Exploded View of T117B and T118B	1
1.3	Specifications	2
1.4	Environmental Conditions	2
1.5	Standard Features	2
1.6	Options	3
1.7	Accessories	3
SECTION TWO	INSTALLATION	
2.1	Dimensions	4
2.2	Selection of Mounting Location	5
2.3	Safety & EMC Requirements	5
2.4	Installation Instructions	6
2.5	Power Voltage Selection	6
2.6	Transducer Voltage	6
2.7	Tension Output	7
2.8	Standard Electrical Connections	7
2.9	Optional Electrical Connections	8
SECTION THREE	CALIBRATION AND SETUP	
3.1	Preparation	9
3.2	Mechanically Zero the Tension Meter	9
3.3	Calibrate the Output for Accuracy	9
3.4	Installation and Adjustment of Isolated Tension Output	10
3.5	Calibration and Adjustment of Tension Limit Switch	10
SECTION FOUR	OPERATING INSTRUCTIONS	12
SECTION FIVE	CARE AND MAINTENANCE	13
SECTION SIX	TROUBLESHOOTING GUIDE	14
SECTION SEVEN	REPLACEMENT PARTS	15

APPENDICES

APPENDIX: A	Location of Jumpers and Adjustments	16
B	Electrical connections	18
C	Transducer Electrical Connections	20
D	Typical Tensions of Various Materials	24
E	Environmental Terms	25
	TERMS AND CONDITIONS OF SALE AND SHIPMENT	26
	INDEX	27

LIST OF ILLUSTRATIONS

FIGURE:	1	Exploded View of TI17B and/or TI8B	1
	2	Horizontal Mounting Dimensions	4
	3	Vertical Mounting Dimensions	4
	4	Optional Meter Dimensions	5
	5	Option Meter Enclosure Dimensions	5
	6	Power Voltage Selection	6
	7	Transducer Voltage Jumpers	7
	8	Tension Output Jumpers	7
	9	Standard Electrical Connections	7
	10	Optional Electrical Connections	8
	11	Web Path	9
	12	Isolated Output Jumpers	10
	13	Tension Limit Switch Board Adjustments	11
	14	Replacement Part Numbers	15
	15	TI17B PC Board	16
	16	TI18B Isolated Output Board	16
	17	Optional Tension Limit Switch Board	17
	18	Standard Electrical Connections	18
	19	Optional TLS External Relay Electrical Connections	19
	20	Models C, RS, & UPB Transducer Wiring	20
	21	RFA Transducer Wiring	21
	22	TR & NWI Transducer Wiring	22
	23	LT Transducer Wiring	23

1.1 GENERAL DESCRIPTION

The TI17B and TI18B Tension Indicators are designed to provide an interface between any type of DFE tension transducer, and a variable speed drive system, computer, tension recorder, or other devices for tension control and display purposes. It also has a separate output to allow the user to connect an analog meter to indicate operating tension. The circuit card plugs into a single terminal block, to which all external connections are made. This plug-in feature allows easy field installation and servicing.

Models TI17B and TI18B are available with two mounting configurations and a choice of 0-10 Vdc or 4-20mA outputs, including those choices as isolated outputs. Dual calibration is a standard feature.

The only difference between the TI17B and the TI18B indicators is their power input requirements. The TI17B operates on 115Vac 60Hz (230Vac 50Hz optional) and the TI18B operates on 24Vdc, power supplied separately.

1.2 EXPLODED VIEW OF TI17B and/or TI18B

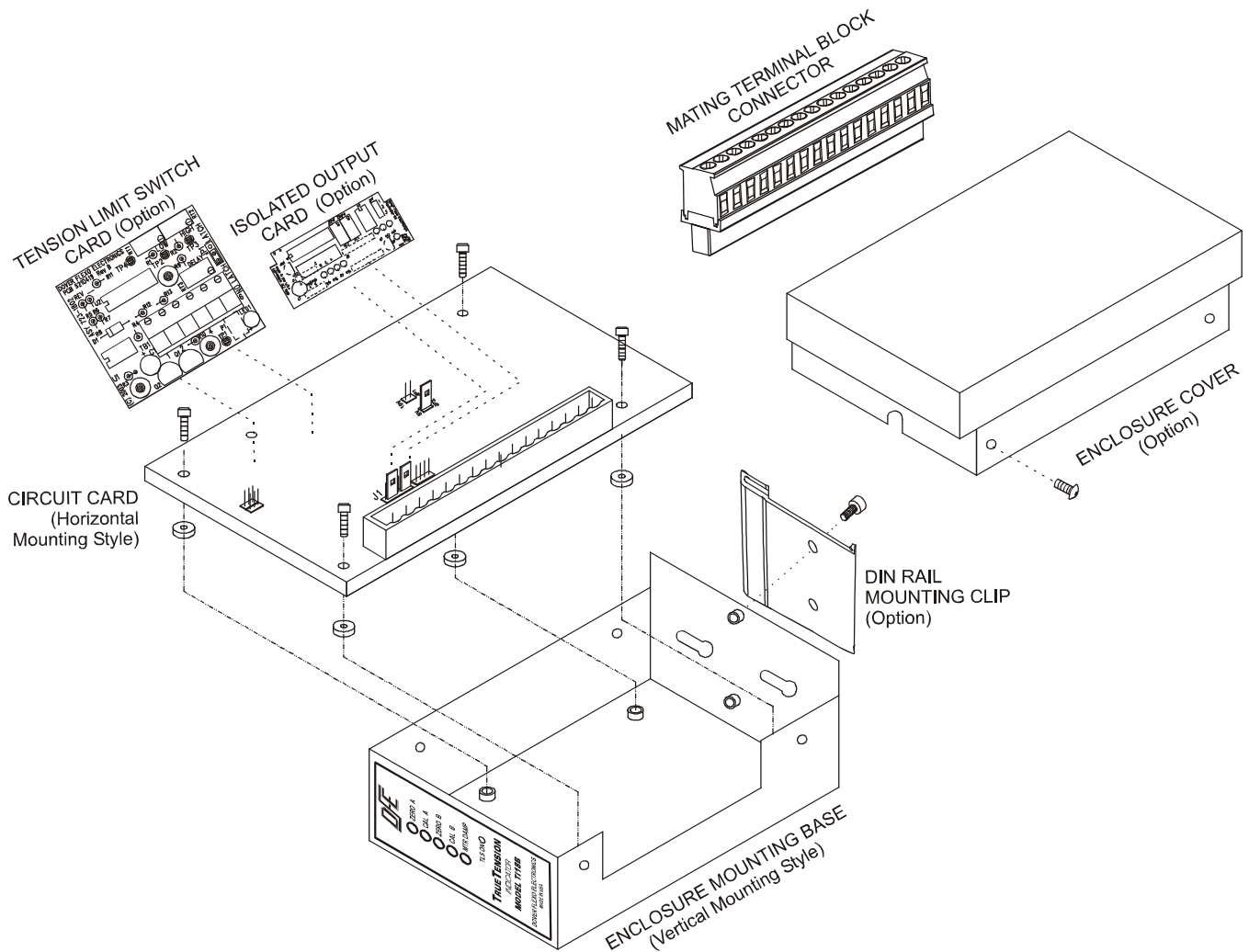


Figure 1 - EXPLODED VIEW OF TI17B and/or TI18B

1.3 SPECIFICATIONS

Power Input:	Voltage	.....	TI17B = 115/230V 50/60Hz, TI18B = 24 Vdc
	Current	.....	TI17B = 0.125 / 0.080A, TI18B = 250 mA
Tension Signal Outputs		.....	0 to +10Vdc @ 2mA OR 4 to 20mA (available isolated)
		.....	0 to 1mA damped meter for optional tension meter
Weight		.....	0.5 lbs (0.23 kg) to 2.0 lbs (0.91 kg), depending on version.
Transducer Signal Input		.....	500 mVdc at rated load per pair (1.00Vdc for XRE option)
Transducer excitation		.....	5Vdc (10V for the XRE option) jumper selectable
Zero (tare) range		.....	95% of transducer rating
Calibration range		.....	20 : 1
Ambient temperature range		.....	32°F to 104°F (0°C to 40°C)
Optional tension meter types		.....	Analog 1mA, 3.5" (DFE P/N: 722-1385), or meter in enclosure (P/N: 723-1453)
Standard tension meter scales		.....	0 to: 1, 5, 10, 25, 50, 100, 150, 250, 500, 1000

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

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

- Indoor use
- Altitude up to and above 2000 meters
- Temperature 41° F to 104° F (5° C to 40° C)
- Maximum relative humidity 80% for temperatures up to 88° F (31° C) decreasing linearly to 50% relative humidity at 104° F (40° C).
- Main supply voltage fluctuations not to exceed +/-10% of the nominal voltage.
- Transient Overvoltages according to Overvoltage Categories I, II, and III. For main supply the minimum and normal category is II
- Pollution Degree 1 or 2 in accordance with IEC 664

1.5 STANDARD FEATURES

SOME OF THESE FEATURES REQUIRE CONFIGURATION OR EXTERNAL WIRING. REFER TO SECTION 2.4 FOR INSTALLATION INSTRUCTIONS AND SECTION 2.8 FOR WIRING.

- **0 to +10V Tension Output OR 4 to 20mA Tension Output.** Proportional to tension. Used as an input to a controller or instrumentation system. Both are also available as isolated outputs. See Section 3.4 for installation and adjustment.
- **0-1mA Tension Output.** A separate output used for driving an optional analog tension meter.
- **Meter Damping.** Minimizes variation of the optional analog tension meter needle.
- **Power Voltage Selection.** The TI17B Interface / Indicator is designed to operate at either 115Vac (standard) or 230Vac. The TI18B operates on 24Vdc.
- **Easily serviceable.** The unit can easily be removed after unplugging the mating connector (see Accessories)
- **Small size.** Fits where many other products cannot.
- **Flexible Options.** Options and features can be tailored for each application.
- **Economical.** Provides many important features at a reasonable price.
- **Isolated from Earth Ground.** A transformer provides isolation from earth ground, simplifying installations.

- **Dual Calibration.** Allows two calibration settings. Dual calibration option may be used in the following applications:
 - a. One set of transducers operating in a wide tension range. Dual calibration and dual meter scale is used to enhance the resolution of indicated tension.
 - b. One set of transducers that may be subject to two different wrap angles or web paths. In this case a dual meter scale may, or may not, be required.
- **Mating Terminal Block Connector.** Allows easy connection of external wiring.

1.6 OPTIONS

SOME OF THESE OPTIONAL FEATURES REQUIRE CONFIGURATION OR EXTERNAL WIRING. REFER TO SECTION 2.4 FOR INSTALLATION INSTRUCTIONS AND SECTION 2.9 FOR WIRING.

- **230 Volt Input (230).** 230Volt 60/50 Hz Ac power input. TI17B only.
- **4 to 20mA Output (420).** 4 to 20 mA current output.
- **Cover (COV).** Cover restricts access to board and provides complete enclosure. V version only.
- **DIN Rail Clip (DRC).** To be used with 35 mm DIN rail. V version only.
- **Isolated 10V Output (I10).** 0 to 10Volt output which is not connected to circuit common or to earth ground.
- **Isolated 20mA Output (I420).** 4 to 20mA output which is not connected to circuit common or to earth ground.
- **Extended Range (XRE).** 10 Vdc excitation for Extended Range transducers. Allows measurement of a much lower tension than usual. Transducers must also have the XR option.
- **Tension Limit Switch (TLS).** An open collector output actuates at a pre-set adjustable trip point. Can be used as a web break detector, or high tension warning.

1.7 ACCESSORIES

- **Remote Tension meter.** Analog, 1 mA (P/N: 722-1385) supplied as a single unit. Must be installed by user. This meter is also available in its own enclosure (P/N: 723-1453).
- **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.

2.1 DIMENSIONS inches (mm)

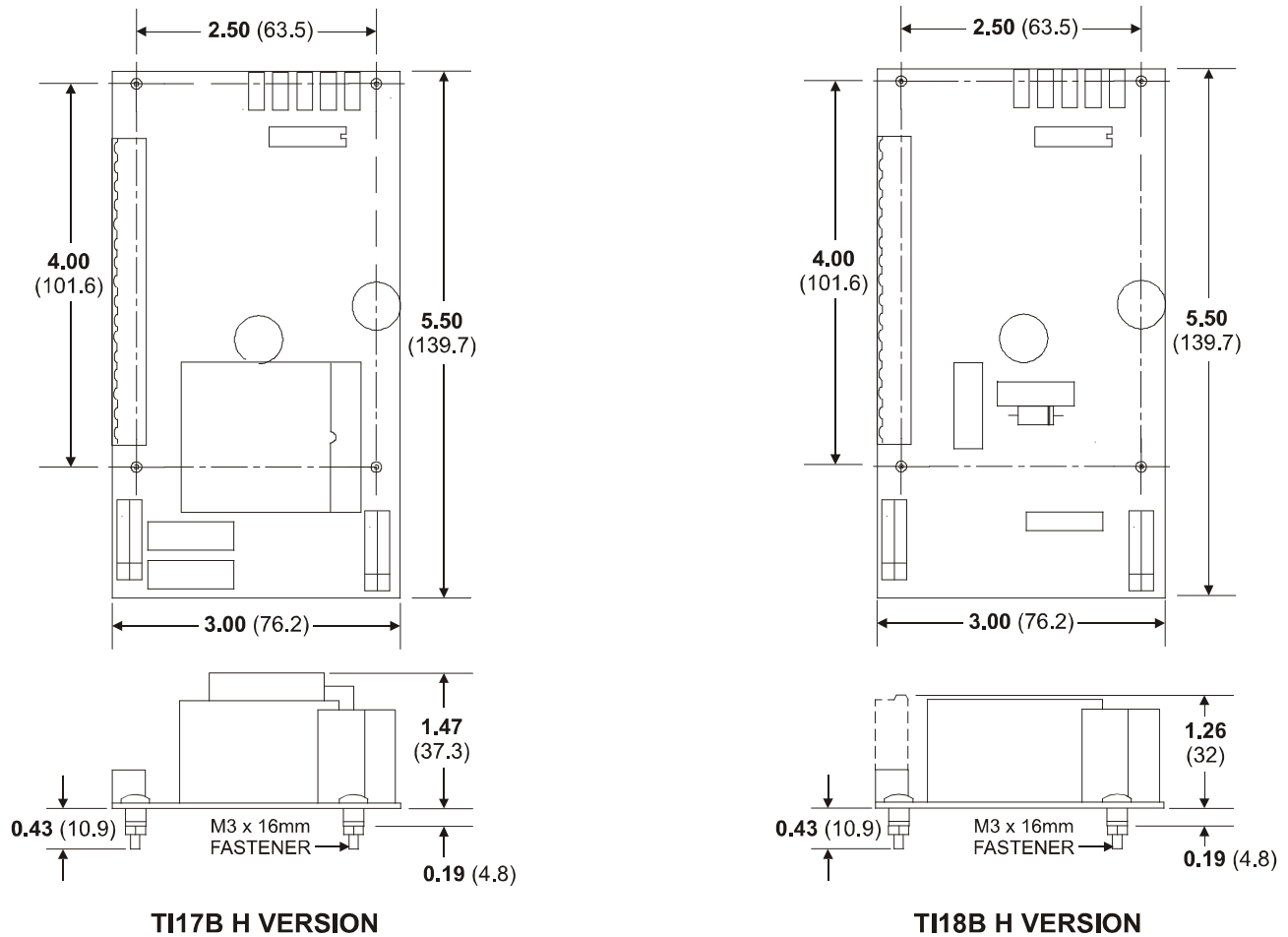
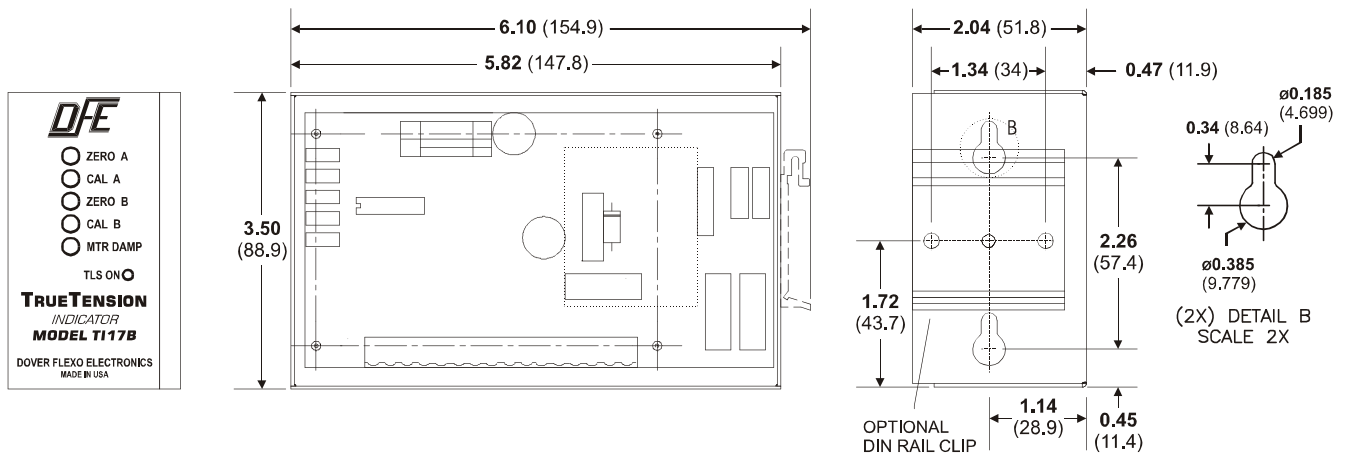


Figure 2 - HORIZONTAL MOUNTING DIMENSIONS



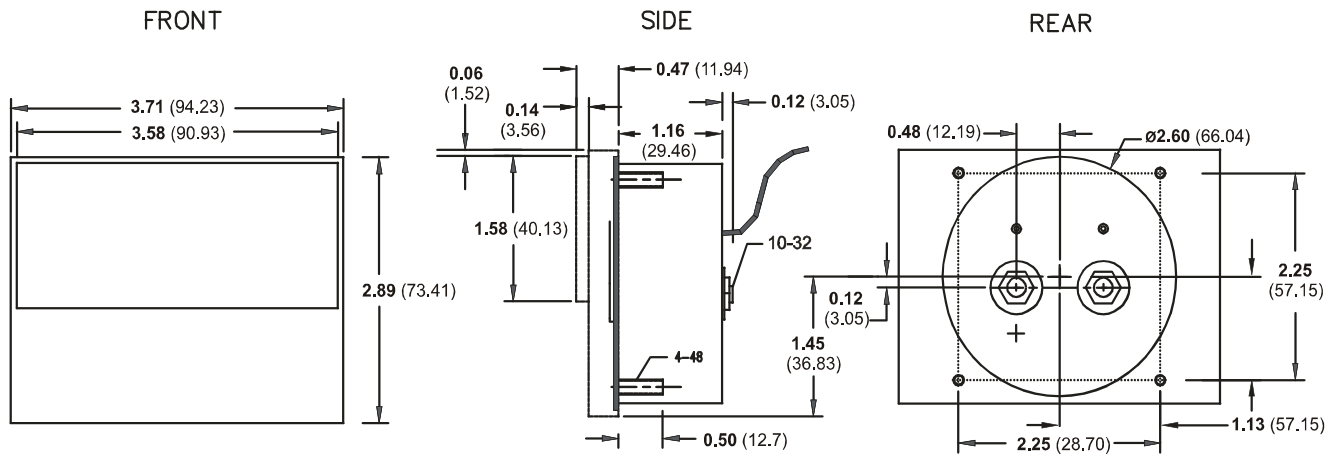


Figure 4 - OPTIONAL TENSION METER DIMENSIONS

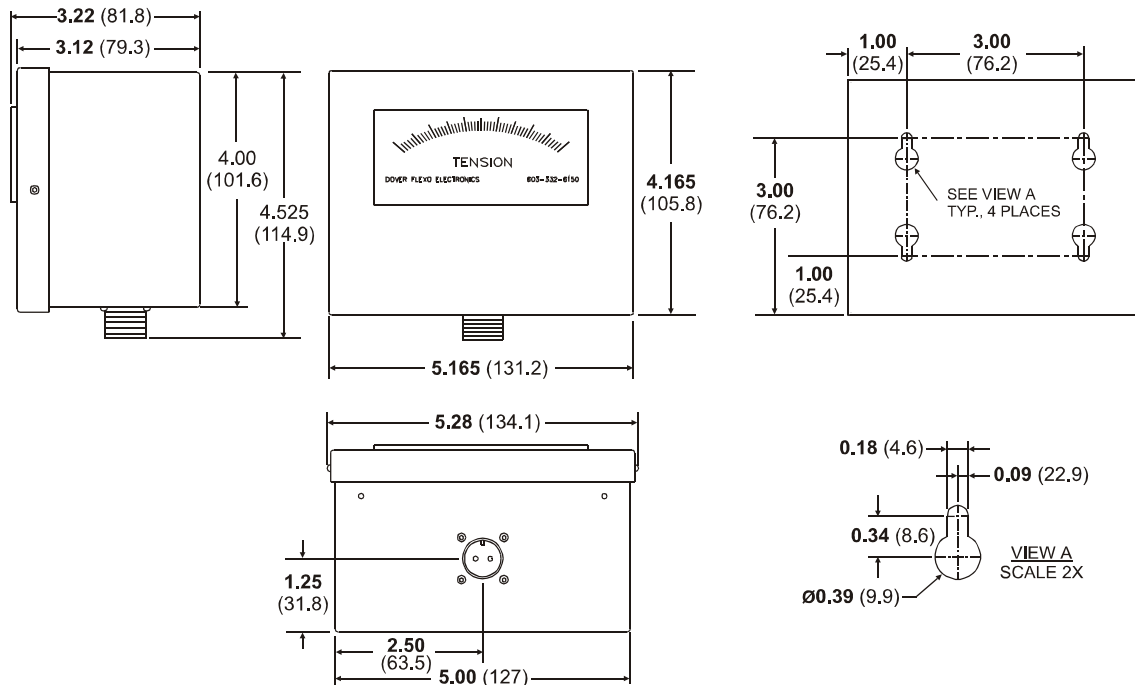


Figure 5 - OPTIONAL TENSION METER ENCLOSURE DIMENSIONS

2.2 SELECTION OF MOUNTING LOCATION

The TI17B or TI18B must be located away from dusty or wet environments. The TI17B or TI18B Horizontal version should be installed in a cabinet or enclosure.

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 DFE Model TI17B you have purchased has been tested and meets the European Union's Low Voltage Directive and EMC Directive only when the available enclosure has been used and when installation is done correctly. 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 1mm²). Make your line voltage connection to TB1 positions 14 and 16 using wire with a gauge of at least 16 AWG (or a

cross-sectional area of at least 1mm²) for each conductor. Attach this wiring to the panel to prevent inadvertent removal.

An external switch or circuit breaker is required for power disconnection on the TI17B, and it is recommended that this switch or circuit breaker be near the equipment.

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, and UPB transducers
- 721-0964 CN 6-conductor cable for type RFA, LT, VNW, and TR1 transducers
- 721-0984 CN 6-conductor cable for NWI and TR2.

Cable shielding must be attached to chassis ground. If you wish to assemble your own cables, contact DFE for assembly instructions.

2.4 INSTALLATION INSTRUCTIONS

Drill your mounting holes for the mounting style you will be using. Be sure to allow ample clearance beside or in front of the unit for tool access and for wiring.

If you are using the vertical mounting style, drill and tap 2 holes 2.26" (57.4 mm) apart vertically. Insert your M4 or #8 screws and tighten but at the end reverse them out 3 turns. Place the enclosure keyholes over the screwheads and lower unit into place. Tighten the screws. If you are using the horizontal mounting style, mount the indicator circuit card to your panel. If an optional analog meter is used, drill mounting holes per dimensions in Figure 4.

2.5 POWER VOLTAGE SELECTION (TI17B Only. Refer to Appendix A for board drawing.)

The True Tension TI17B is designed to operate on either 115V-50/60Hz or 230V-50/60Hz power. Verify that your unit is set up for the correct line voltage. See below for location of jumpers for this selection. Also verify that the correct value fuses are installed based upon your line voltage selection. Note: These jumpers are soldered in. If you do not feel comfortable changing these, please contact the factory before starting.

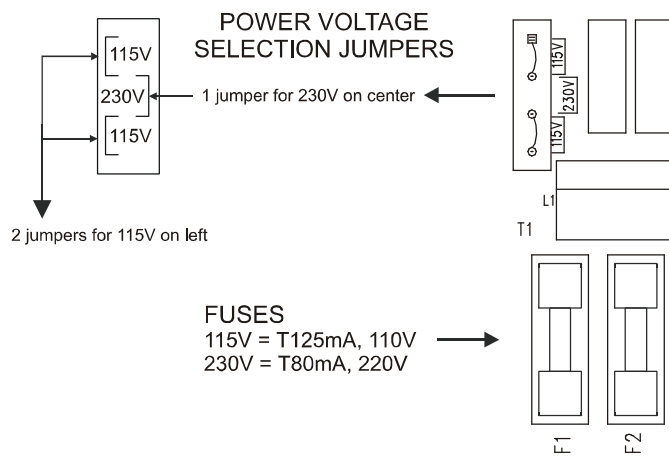


Figure 6 - POWER VOLTAGE SELECTION

The True Tension TI18B is designed to operate on 24 Vdc so no voltage selection is necessary.

2.6 TRANSDUCER VOLTAGE (Refer to Appendix A for board drawing.)

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 WILL be DAMAGED!

Set the transducer excitation jumpers as follows: 5 Vdc - jumper on JP2 10 Vdc - jumper on JP1

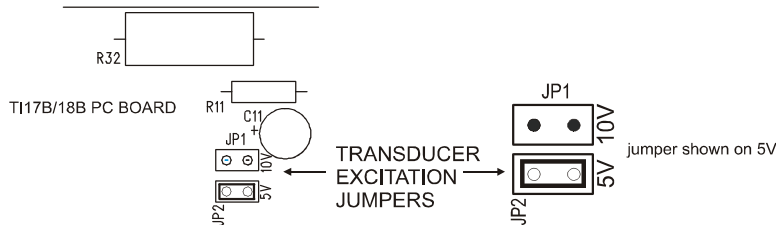


Figure 7 - TRANS-DUCER VOLTAGE JUMPERS

2.7 TENSION OUTPUT (Refer to Appendix A for board drawing.)

Verify that your TI17B or TI18B is set-up with the correct tension output. There will be a set of jumpers on J1 on the main board. If 0 to 10V is required, pins 1 to 2, and 4 to 5 will have a jumper. If 4-20mA is required, pins 2 to 3, and 4 to 5 will have a jumper. See figure below.

J1 FOR TENSION OUTPUT

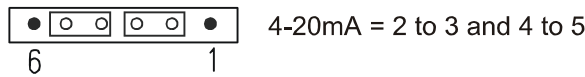
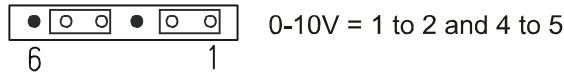
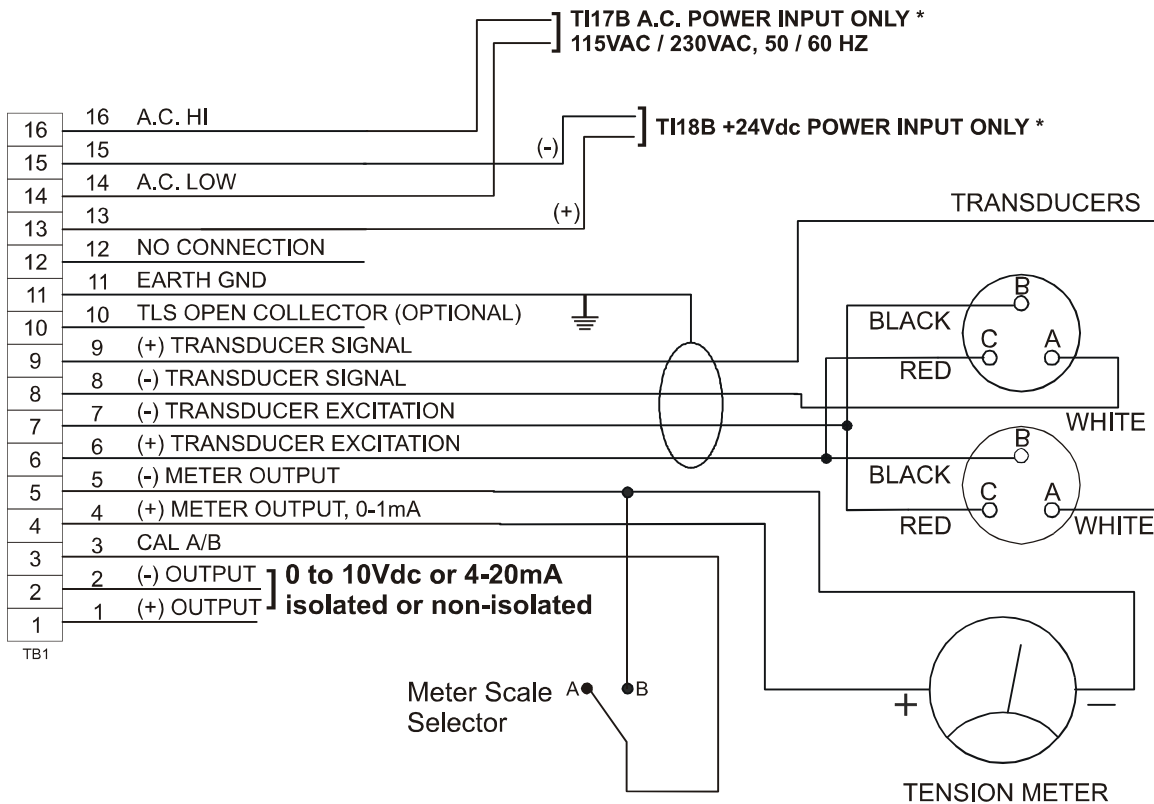


Figure 8 - TENSION OUTPUT JUMPERS

2.8 ELECTRICAL CONNECTIONS - STANDARD

Keep in mind that the indicator is designed to provide a 0-1mA damped meter output, and either a 0-10V OR a 4-20mA output. If more than one output is used simultaneously, the outputs may not agree.



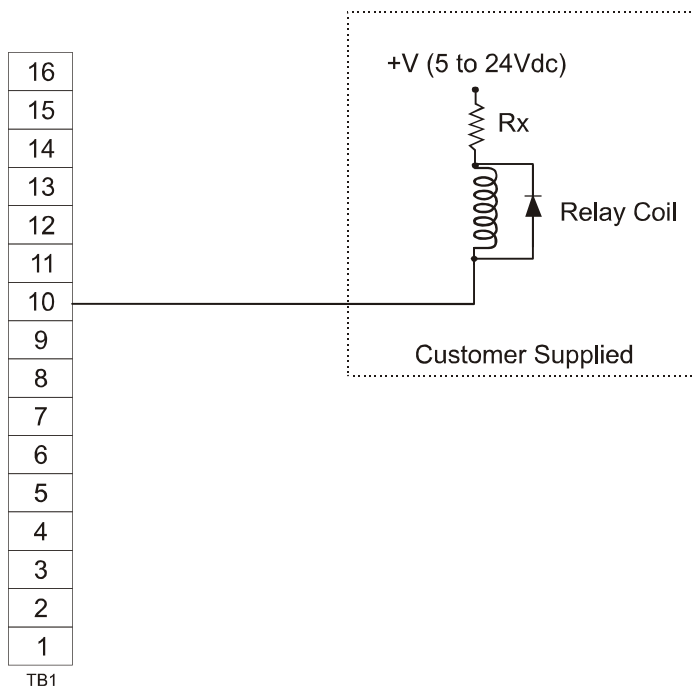
* Do **NOT** make both power connections at the same time. The 115/230Vac connection is only for the TI17B. The 24Vdc connection is only for the TI18B. Leave the unused terminals empty

Figure 9 - STANDARD ELECTRICAL CONNECTIONS

Make your wiring connections as follows:

1. The insulation rating of all line voltage wiring must be at least 300V
2. Keep line voltage wiring physically separated from signal wiring at the terminal block and at any other point in the installation. If this is not possible, the insulation rating of your signal wiring must also be at least 300V.
3. Connect cable shields to earth ground.

2.9 TENSION LIMIT SWITCH EXTERNAL RELAY CONNECTIONS (Option)



Note: Maximum current through terminal 10 is 250mA. Choose Rx based upon applied voltage and coil resistance so current does not exceed 250mA.
Do not use with isolated output option installed.

Figure 10 - TLS EXTERNAL RELAY CONNECTIONS (Option)

3.1 PREPARATION

The best way to calibrate your system is to attach the device which will be accepting the output from the indicator. Otherwise attach a voltmeter or milliammeter, as appropriate for the type of output you intend to use.

3.2 MECHANICALLY ZERO THE TENSION METER

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

Turn off power to the TI17B or TI18B 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.

3.3 CALIBRATE THE OUTPUT FOR ACCURACY

1. Find an object of known weight at least as heavy as 25% of the tension meters full scale output, and preferably as close to 100% as you can find. A spring scale can also be used. Get a length of rope, wire or cable about 15 feet (3 meters) long.
2. Turn on power to the TI17B or TI18B
3. Turn the CAL pot (Cal A or Cal B as appropriate) clockwise at least 5 turns (this makes the ZERO A or B pot setting more accurate). Then turn the ZERO pot as required to make the output equal to its zero point (0V for the 0 to 10V output; 4 mA for the 4-20mA output; 0 mA for the meter output).
4. Fasten one end of the rope in the machine and thread the other end around the transducer roll in exactly the same path as the web will take. Be sure it does not pass around any driven rolls, drag bars, or anything else that can affect tension. Refer to figure below.

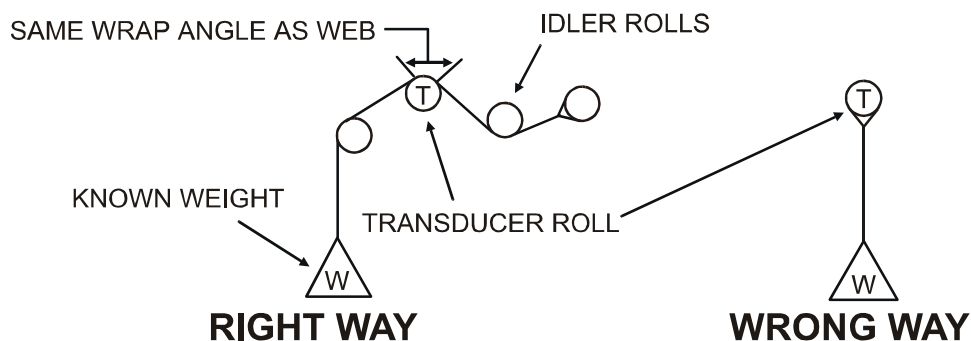


Figure 11 - WEB PATH

5. Attach the weight to the free end of the rope as shown above. The weight should not touch anything. Adjust the CAL pot (Cal A or Cal B as appropriate) as required to set the meter needle at the value of the weight.
6. Remove the weight and observe the tension meter. If the needle is not on zero, adjust the ZERO pot (A or B) as needed. Repeat step 5.
7. Repeat steps 5 and 6 if needed.
8. If the optional analog meter is used, adjust the DAMP pot while the machine is running to minimize meter needle movement.
9. Repeat steps 3 through 8 with Cal A/B line grounded (TB1, position 3) for Dual Calibration only.

The output calibration procedure is now complete.

3.4 INSTALLATION AND ADJUSTMENT OF ISOLATED TENSION OUTPUT

(Refer to Appendix A for board drawing.)

Regular 0 to +10V and 4 to 20mA tension outputs are configured at factory. Verification instructions are in Section 2.7. Isolated 0 to +10V or 4 to 20mA requires the installation of an ISO card to the main TI17B or TI18B board. The following instructions are for the installation of this card and adjustment of your output.

If your TI17B or TI18B was received with this Isolation card already installed, you need not make the above adjustments as they already have been done at the factory.

CAUTION! Standard precautions against static discharge should be taken when working with any electronic components.

1. You will need to select your output on the isolation card prior to installing on main card by configuring jumper JP1. If 0 to 10V is required, install jumper on pins 1 and 2. If 4-20mA is required, install jumper on pins 2 and 3. See diagram below

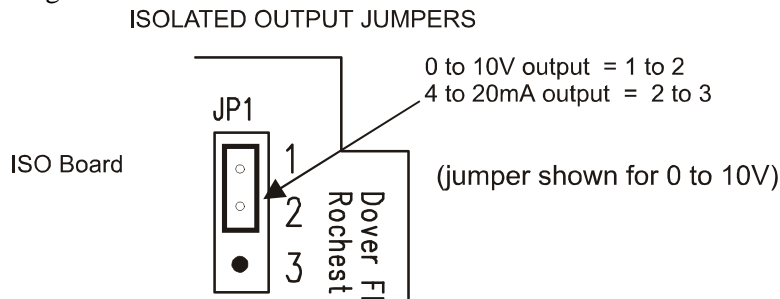


Figure 12 - ISOLATED OUTPUT JUMPERS

2. To install the isolation card, it will be necessary to remove the jumpers from J1 on the main card.
3. Install the isolation card by lining up the 4 position and 6 position connectors to the J1 pin on the main card. Press the card down firmly.
4. If the output for the 4mA or 20mA is not exactly 4 or 20, some further calibration can be accomplished by adjusting RT1 (20mA) and RT2 (4mA).

3.5 CALIBRATION AND ADJUSTMENT OF TENSION LIMIT SWITCH OPTION

The TLS feature is used to provide an visual LED indication when output exceeds one value or goes below another value. You can also connect an external relay as described in Section 2.9 to sound an external alarm, turn a machine off, and so forth.

To calibrate the TLS card, you need to know your system's full scale tension indication (TFULL). You also need to decide what you want for your Low tension trip point (TLO) and your high tension trip point (THI). Note that you can set up TLS for one and not the other or both.

Your system should be calibrated to measure tension prior to setting up TLS. Do NOT change the CAL A or CAL B pot settings during this procedure. Changing your cal pot settings will invalidate your calibration. Changing the Zero pot setting will not invalidate the calibration.

See Figure 12 for adjustment locations.

1. On the TLS card, turn RT1 (TLS Lo Trip point) 20 turns counterclockwise, RT2 (TLS Hi trip point) 20 turns clockwise, and RT3 (TLS delay) 20 turns counterclockwise.
2. Setting TLS Low Trip Point (If only TLS high is needed, skip step 2 and go to step 3).
 - a) To set the TLS low trip point, calculate the TLO voltage as follows: Take the Low tension trip point (TLO) divide it by your full scale tension (TFULL), and multiply the result by 10 Volts:

$$\text{TLO voltage} = \text{TLO/TFULL} \times 10 \text{ Volts}$$

- b) Attach a meter to the output of the TI17B or TI18B. Connect your (-) lead to TB1-1 and + to TB1-2. Adjust the zero pot RT1 on the main TI17B or TI18B board so that your meter reads the “TLO voltage” you just calculated (for example, if your TLS low trip point TLO is 30 lbs and your full scale tension TFULL is 75 lbs, adjust RT1 to produce $30/75 \times 10V = 4.00V$).
- c) On the TLS option card, adjust RT1 upward (clockwise) until the TLS LED just turns on.

3. Setting TLS High Trip Point

- a) To set the TLS high trip point, calculate the THI voltage as follows: Take the High tension trip point (THI) divide it by your full scale tension (TFULL), and multiply the result by 10 Volts:

$$\text{THI voltage} = \text{THI}/\text{TFULL} \times 10 \text{ Volts}$$

- b) With your meter still connected to TB1-1 and -2, adjust the zero pot RT1 on the main TI17B or TI18B board so that your output voltage reads the “THI voltage” you just calculated (for example, if your TLS high trip point THI is 50 lbs. and your full scale tension is 75 lbs, adjust RT1 to produce $50/75 \times 10V = 6.67V$).
 - c) On the TLS option card, adjust RT2 downward (counterclockwise) until the TLS LED just turns on.
4. If the TI17B or TI18B was calibrated prior to setting up TLS, adjust the zero pot RT1 on the main TI17B or TI18B board so that the output is 0V (make sure no web is touching the roll when you do this). You can then remove your meter leads from TB1, and TLS setup is complete.

After your unit is in operation for a while, you may find that you want to adjust RT3 (TLS delay) upward (clockwise) to prevent false triggering.

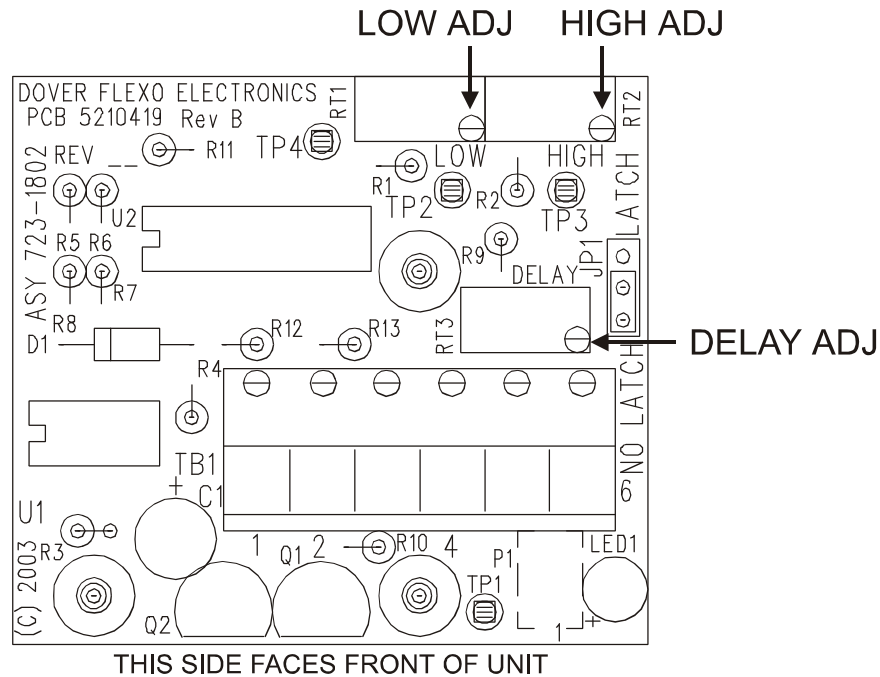


Figure 13 - TENSION LIMIT SWITCH BOARD ADJUSTMENTS

Your tension interface / indicator 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 calibration.

SECTION 5

CARE AND MAINTENANCE

It is not necessary to perform any type of maintenance on the indicator. 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 enclosure.

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 potentiometer and jumper settings.

If your unit fails to operate, check fuses on the TI17B or TI18B. If they need to be replaced, use the correct values listed below:

TI17B:	<u>115V Operation</u>	<u>230V Operation</u>
	T125mA, 250V	T80mA, 250V

TI18B: T250mA, 250V

Warning! Equipment must be disconnected from the **HAZARDOUS LIVE** voltage before changing the fuses.

If you have any problems with the functions on your TI17B or TI18B Tension Indicator, please call Technical Service at 603-332-6150 or fax 603-332-3758. E-mail: techsupport@dfc.com.

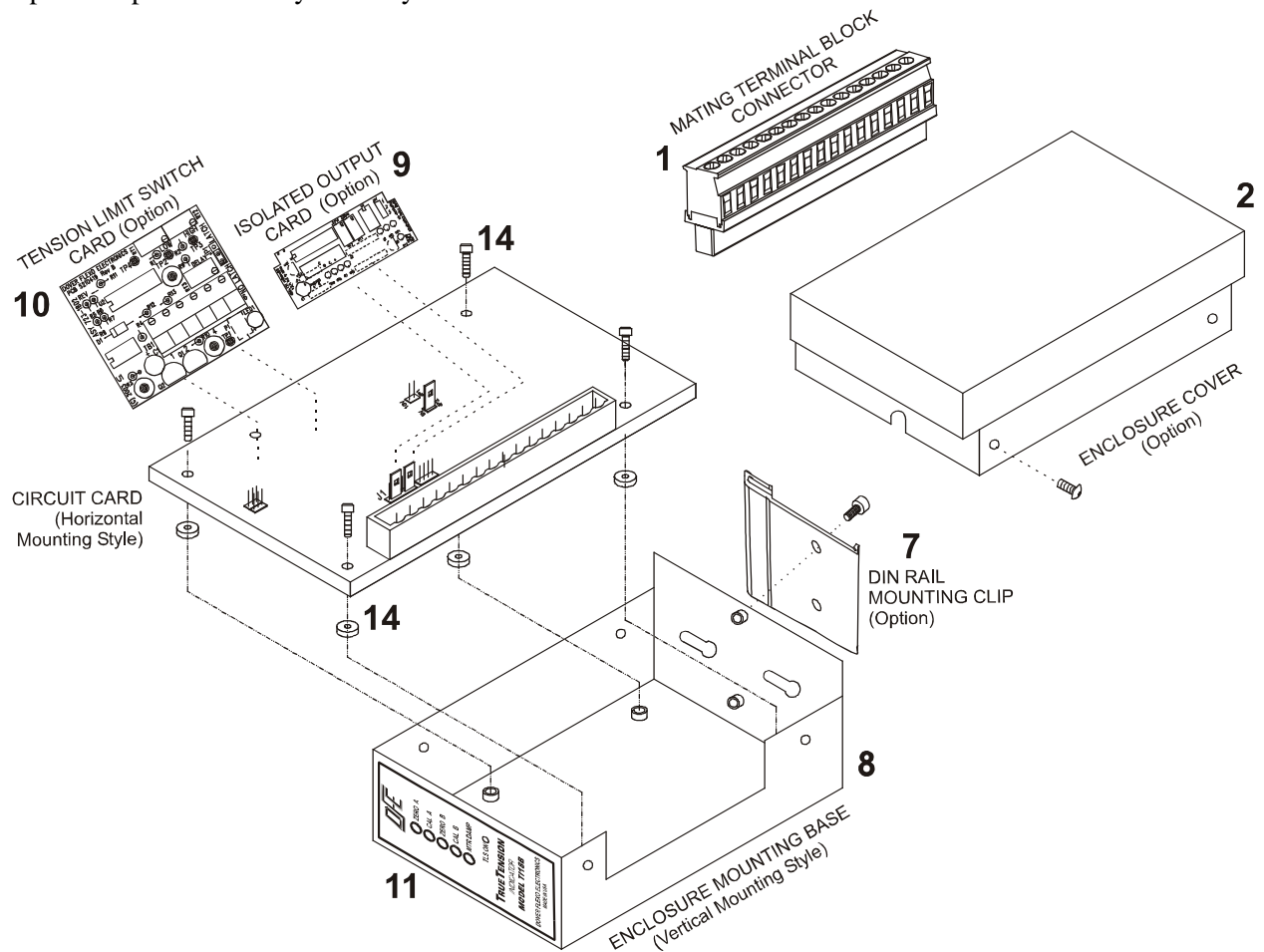
DFE's experienced technicians are responsible to ensure that you are satisfied with your DFE equipment. They will be pleased to assist you.

SECTION 7

REPLACEMENT PARTS

See diagram below for separate components.

Warning!: When replacing fuses, use only fuses with ratings as shown below, or a lower rating. Failure to do this may compromise personal safety and may create a fire hazard!



- 1 - 721-1960 **Mating Terminal Block Connector**
- 2 - 620-1941 **Enclosure Cover**
123-0032 Replacement Screws, M3 x 6
- 3 - 108-0045 **(2) Fuses, T125mA 250V for 115Vac - T117B**
- 4 - 108-0057 **(2) Fuses, T80mA 250V for 230Vac - T117B**
- 5 - 108-0038 **(1) Fuse, T250mA, 250V for 24Vdc - T118B**
- 6 - 108-0005 **Fuse Covers - 2 for T117B, 1 for T118B**
- 7 - 620-1937 **DIN Rail Mounting Clip (Optional)**
123-0311 Replacement Screws, M4 x 0.7 x 6mm
- 8 - 620-1938 **Enclosure Base**
- 9 - 723-1439 **Isolated Output Card (Optional)**
- 10 - 723-1802 **Tension Limit Switch Card (Optional)**
- 11 - 323-0773 **Front Overlay - T117B**
323-0774 **Front Overlay - T118B**
- 12 - **Spare Circuit Cards - T117B:**
723-1949 T117B H version, 723-1950 T117B V version
- 13 - **Spare Circuit Cards - T118B:**
723-1953 T118B H Version, 723-1954 T118B V version
- 14 - **Circuit Card Mounting Hardware**
123-0025 Screws, M3 x 8, 124-0048 Washer
801-1741 **Instruction Manual**

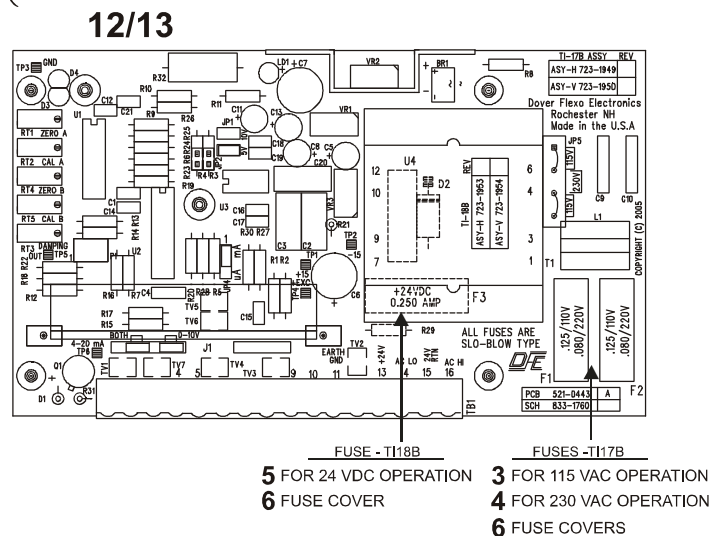


Figure 14 - REPLACEMENT PART NUMBERS

Appendix A: Locations of Jumpers and Adjustments

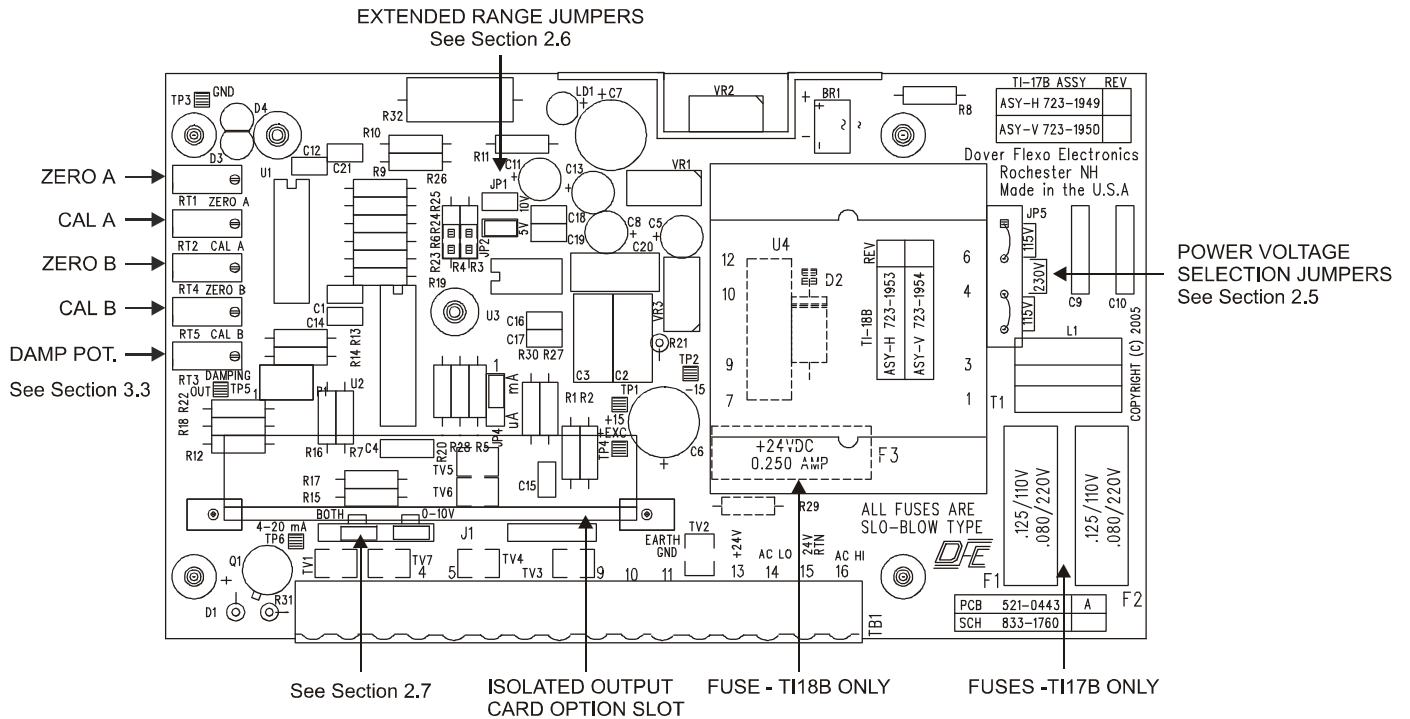


Figure 15 - TI17B and/or TI18B PC BOARD (Enlarged for clarity)

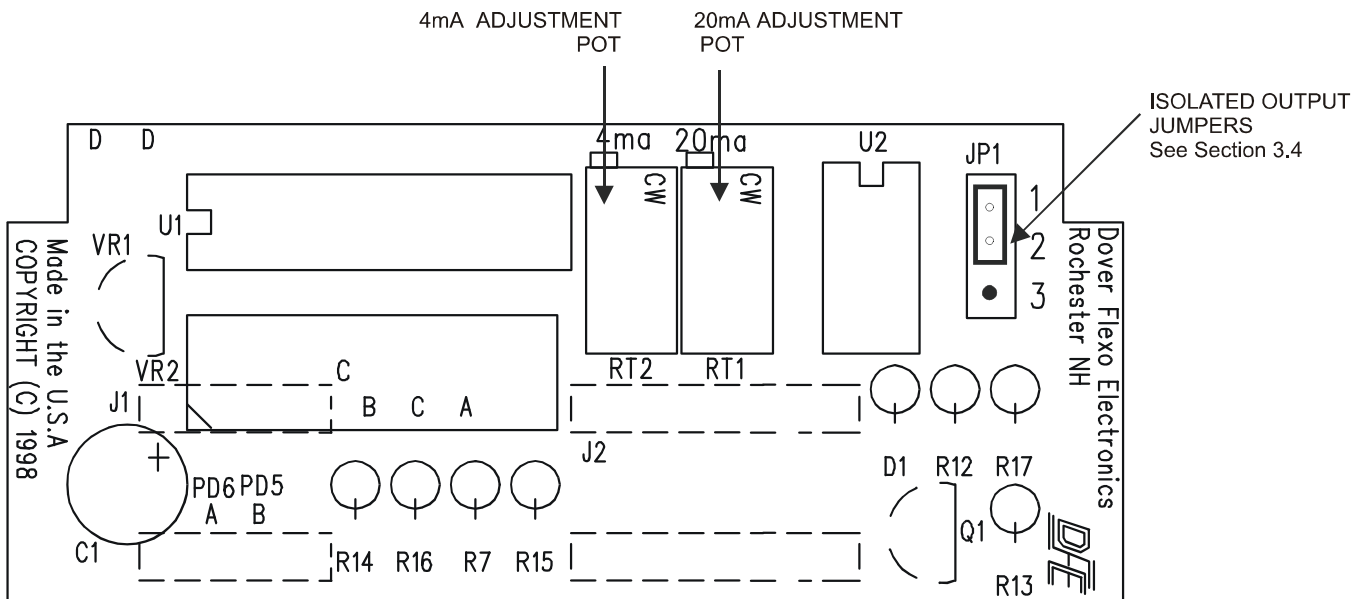


Figure 16 - TI17B and/or TI18B ISOLATED OUTPUT BOARD (Enlarged for clarity)

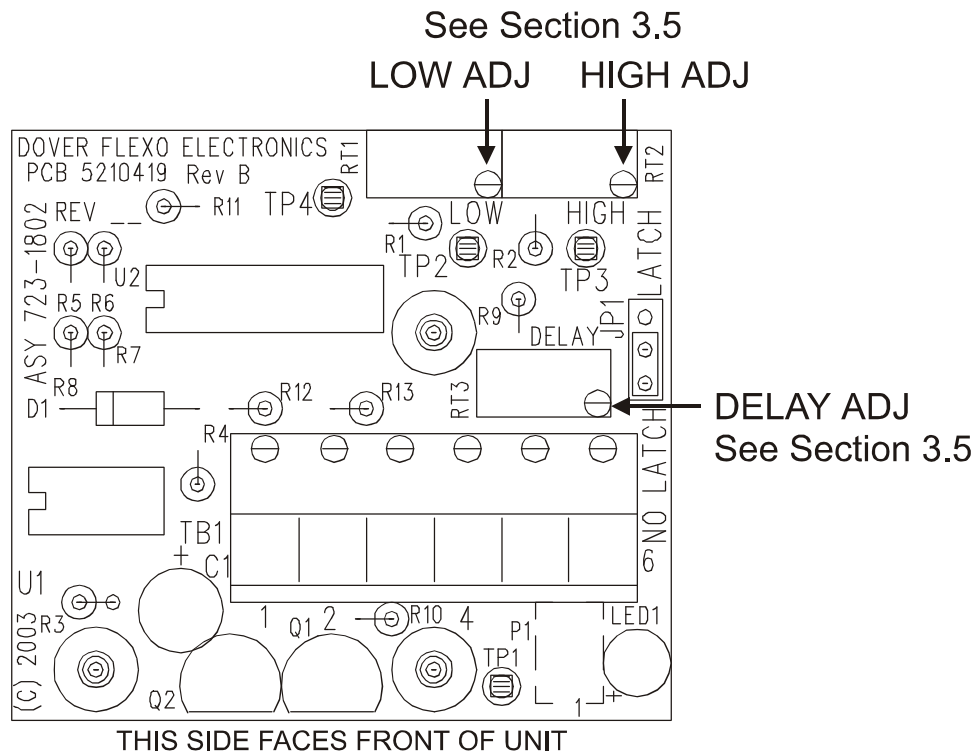
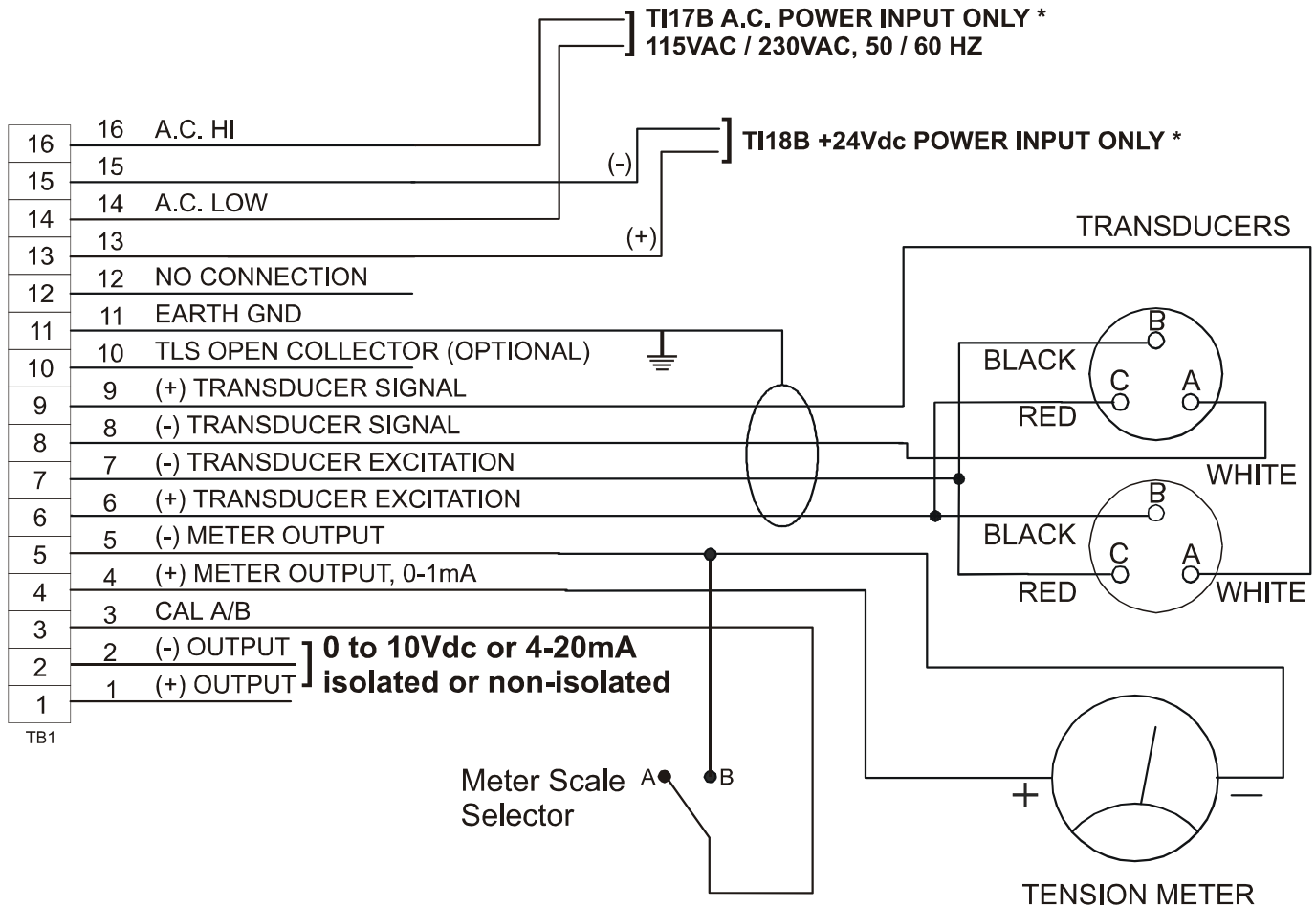


Figure 17 - OPTIONAL TENSION LIMIT SWITCH BOARD (Enlarged for clarity)



* Do **NOT** make both power connections at the same time. The 115/230Vac connection is only for the TI17B. The 24Vdc connection is only for the TI18B. Leave the unused terminals empty

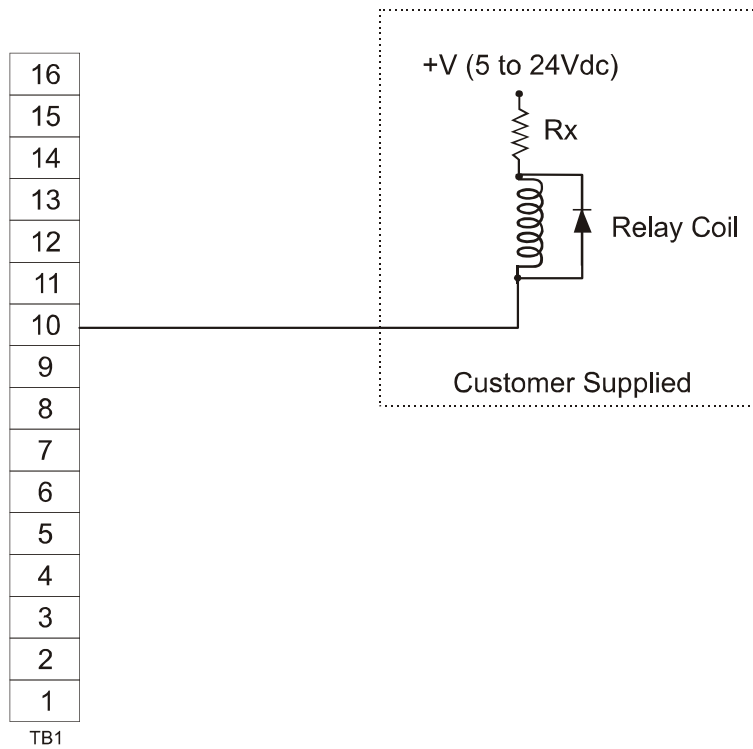
TI17/18B STANDARD CONNECTIONS:

Make your wiring connections as follows:

1. The insulation rating of all line voltage wiring must be at least 300V
2. Keep line voltage wiring physically separated from signal wiring at the terminal block and at any other point in the installation. If this is not possible, the insulation rating of your signal wiring must also be at least 300V.
3. Connect cable shields to earth ground.

Figure 18 - STANDARD ELECTRICAL CONNECTIONS

TENSION LIMIT SWITCH EXTERNAL RELAY CONNECTIONS (Option):



Note: Maximum current through terminal 10 is 250mA. Choose Rx based upon applied voltage and coil resistance so current does not exceed 250mA. Do not use with isolated output option installed.

Figure 19 - TLS EXTERNAL RELAY CONNECTIONS (OPTION)

Appendix C: Transducer Electrical Connections

MODELS C, RS, AND UPB TRANSDUCERS

THE TENSION (T) AND COMPRESSION 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.

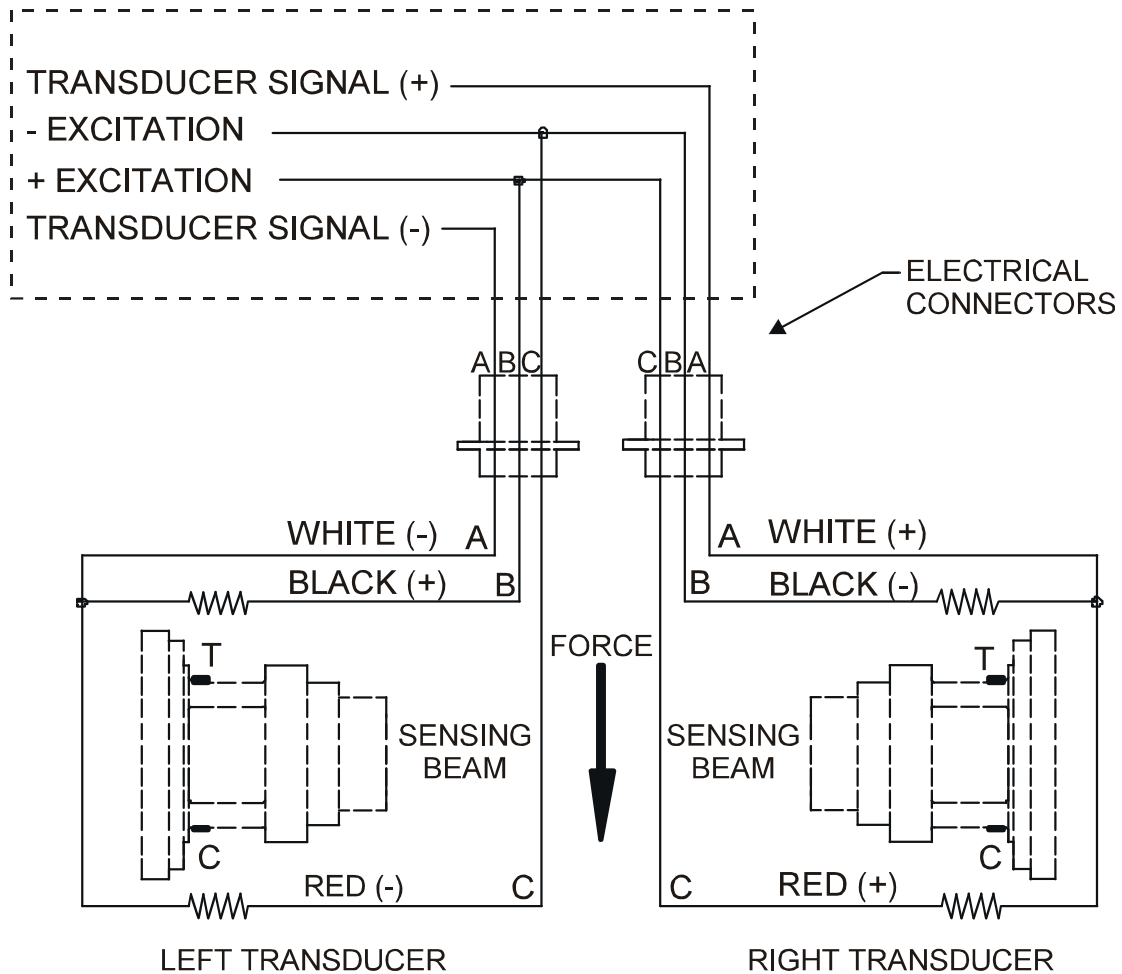


Figure 20 - MODELS C, RS, & UPB TRANSDUCER WIRING

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.

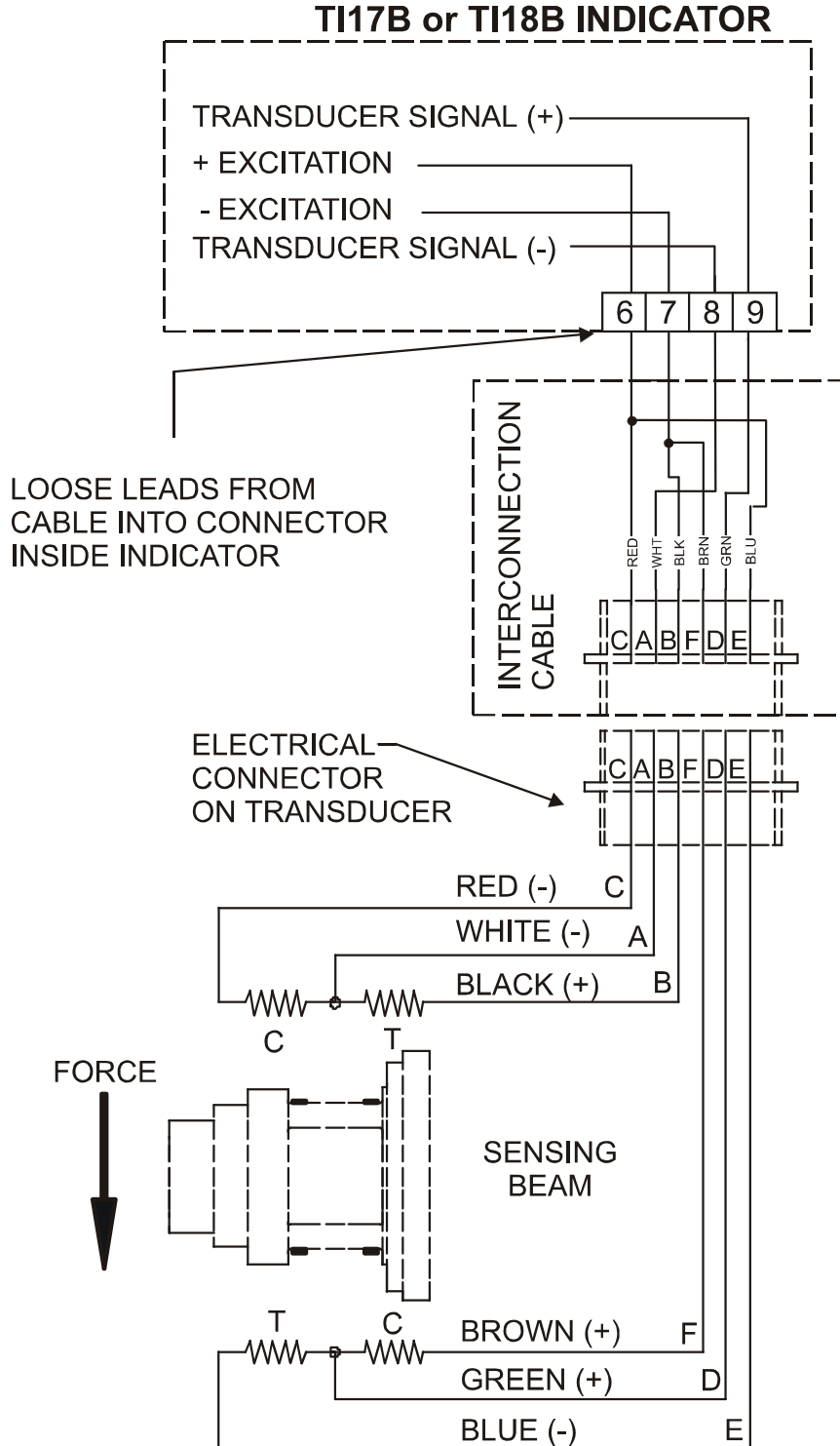


Figure 21 - RFA TRANSDUCER WIRING

TENSION ROLL (TR) AND NARROW WEB (NWI) 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.

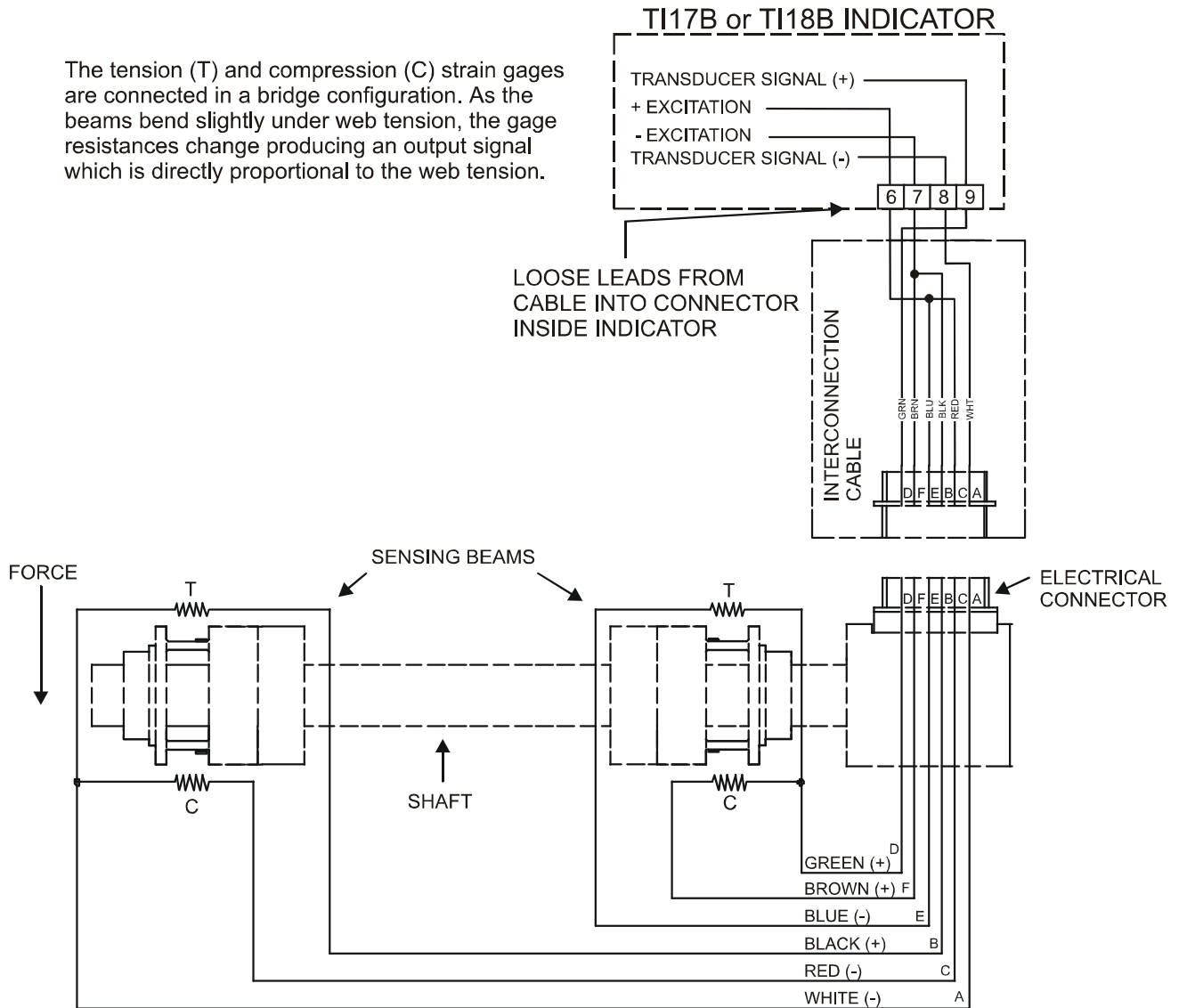
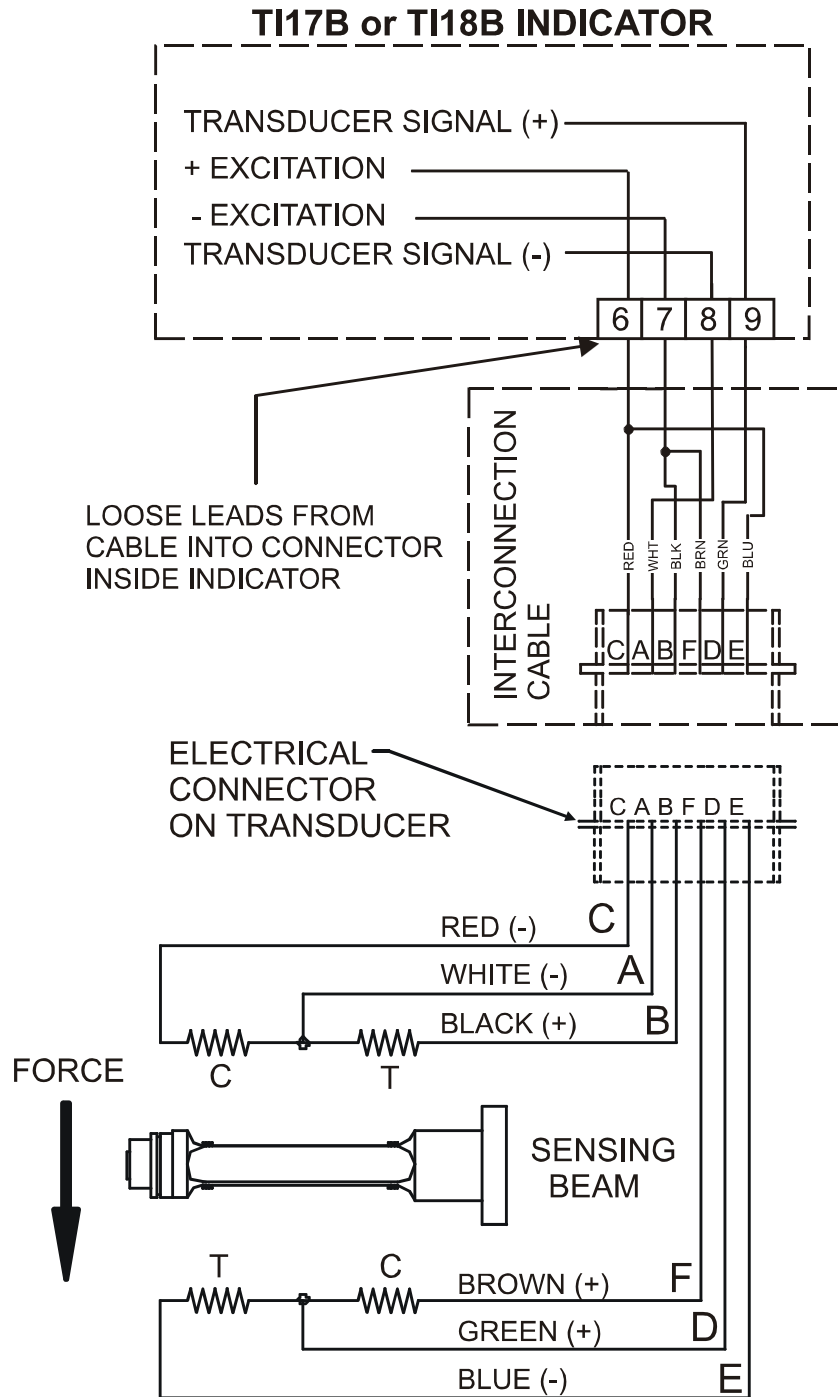


Figure 22 - TR & NWI TRANSDUCER WIRING

LOW TENSION (LT) TRANSDUCERS



Note: XR Option must be used with LT Transducers

Figure 23 - 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	<u>GAUGE</u>	<u>AT 25% STRETCH</u>	<u>AT 50% STRETCH</u>
	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	<u>GAUGE - INS</u>	<u>UNWIND-PSI</u>	<u>REWIND-PSI</u>
	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.

OVERVOLTAGE CATEGORY: Classification of parts of installation systems or circuits with standardized limits for transient overvoltages, dependent on the normal line voltage to earth. (Ref. IEC 664)

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: For the purpose of evaluating clearances the following two degrees of POLLUTION in the micro-environment are recognized for use in accordance with IEC 664.

POLLUTION DEGREE 1: No POLLUTION or only dry non-conductive POLLUTION occurs. The POLLUTION has no influence.

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 its' products to be free of defects in material and workmanship for five years from date of original shipment. Warranty is valid on products purchased on or after April 2, 1999. 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 warranted. 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.

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 re-

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serves 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 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 F.O.B. 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.

10. CANCELLATION, CHANGES, RESCHEDULING

Buyer shall reimburse Company for costs incurred for any item on order with the Company which is canceled 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 canceled 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 of 10% will apply to any letter of credit. There will 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.

INDEX

0-1 mA	2	Mounting Location	5
0-10 Volt Tension Output	2	Operating Instructions	11
230 Volt Power	2	Options	3
4-20mA	2	Output,	
AC Power Connections	17	0-1 mA	2
Accessories	3	4-20mA	2, 17
Cables	6	0 to +10V	2, 17
Calibration,		Isolated	10
range	2	PC Boards	15-16
tension meter	8	Power Voltage Selection	2, 6
Care and Maintenance	12	Replacement Parts	14
Circuit Card	14-16	Safety Requirements	5
connector,	1, 3, 14	Set-up	8
Descriptions	1	Specifications	2
Dimensions	4-5	Standard Features	2
Din Rail Clip	3	Tension Limit Switch	3, 18
Disassembly	1	Tension Meter	2,9
Electrical Connections		output	7
standard.	7, 17	standard scales	2
optional	7, 18	Temperature Range	2
transducer	19-22	Terms & Conditions	26
Environmental Conditions	2	Transducer,	
terms	24	cables	6
Excitation	2	connections	19-22
Exploded View	1	excitation	2, 7
Extended Range	3	input	2
Fuses	6, 14	Troubleshooting	13
Input	2	Typical Tensions	23
Installation	4	Weight	2
Isolation from Earth Ground	2	Zero	8
Meter,		range	2
analog	2		
calibration	8		
damping	2, 8		
dimensions	5		
mechanical Zero	8		
meter scales	2		
non-standard meter scales	3		
remote tension meter	3		



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