



INSTRUCTION MANUAL
Tension Indicator
MODEL TI15

DOC 801-1846

5 YEAR WARRANTY



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READ THIS!

Your TI15 Indicator has been properly configured at our factory. To install it and start it up, it should only be necessary to use these sections of this manual:

Section 2 - Installation

Section 3 - Calibration

**Section 4 - Setup of Standard & Optional
Features**

Section 5 - Operating Instructions

The other sections are for reference and for instruction if you wish to change the configuration at some later time.

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1.1 GENERAL DESCRIPTION

The TI15 tension indicator displays web tension in any of three ways. A three position rotary switch on the front of the enclosure allows the machine operator to select total tension or display the tension at either side of the web. This makes it easy to equalize the tension at the edges by means of appropriate manual or automatic adjustments to the machine. The TI15 works with any width web. DFE tension transducers are used to measure web tension. The transducers are mounted on each end of a dead or live shaft idler roll. The output signal from the transducers is amplified by the TI15 and displayed on a large meter which is calibrated to read actual tension. The voltage output, proportional to tension, can be used simultaneously from each channel, with a recorder, computer or automatic control system. No risk. The TI15 is covered by DFE's 5 year warranty.

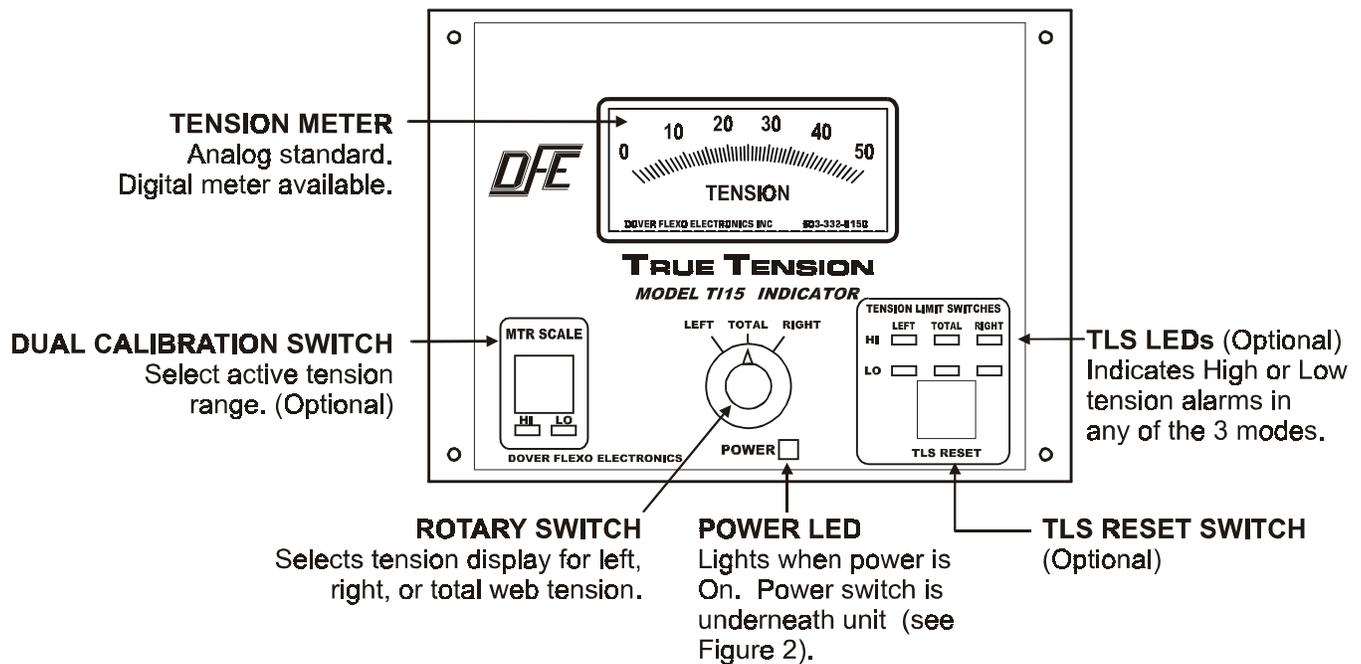


Figure 1 - FRONT PANEL

1.2 OUTPUTS

The TI15 has six standard outputs.

1. Three 0 to +10 Vdc outputs, proportional to left, right, and total tension.
2. A 0 to 1 mA meter output for a remotely located tension meter for total tension.
3. Two 0 to 1 mA meter outputs for individual, remote display of left and right side tension.

1.3 T115 INDICATOR EXPLODED VIEW

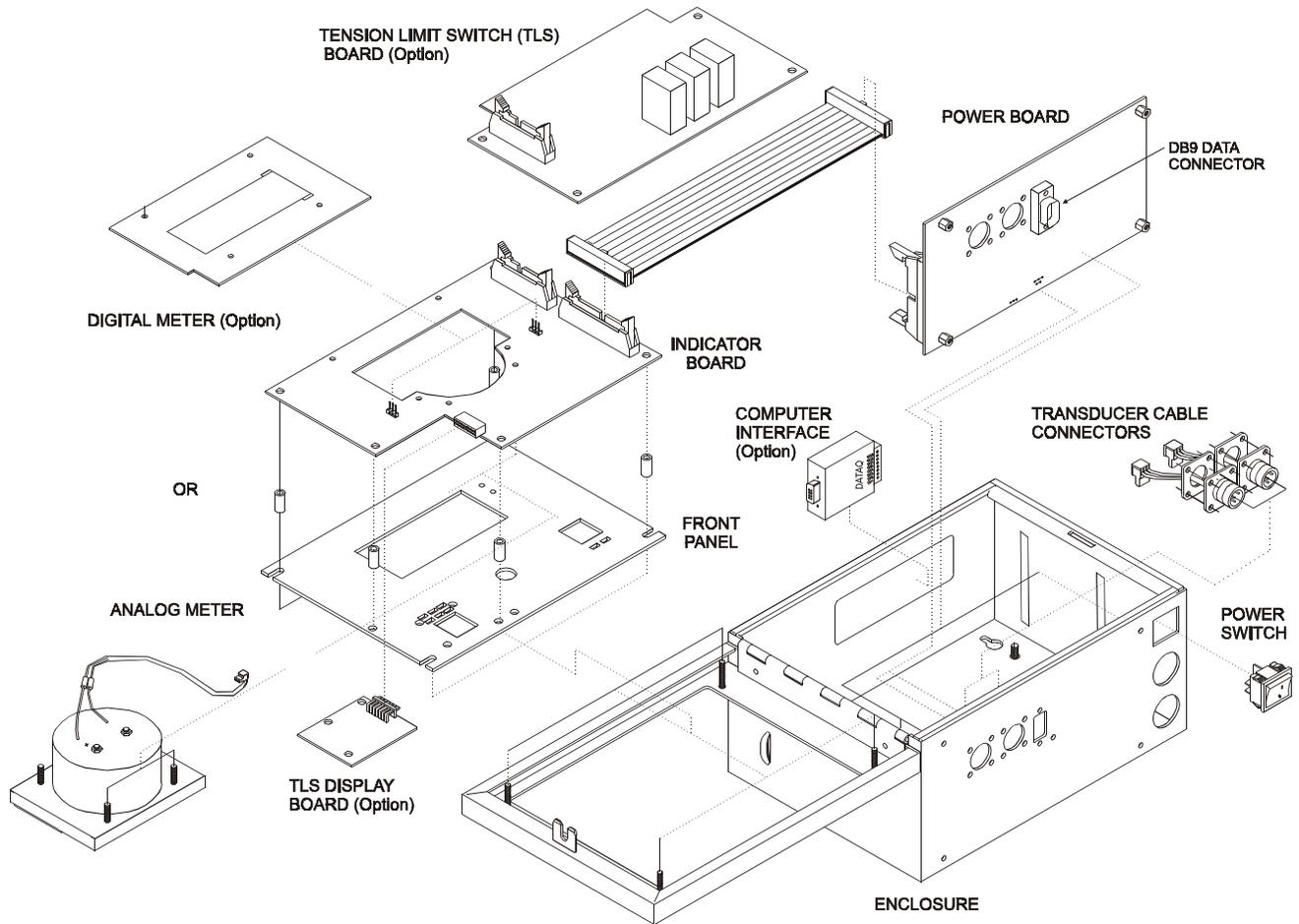


Figure 2 - T115 INDICATOR - EXPLODED VIEW

1.4 SPECIFICATIONS

Power Input	.....	115 Volts 60/50Hz single phase @ 1/4 Amp
	.....	230 Volts 60/50Hz single phase @ 1/8 Amp
Tension Signal Outputs	.....	0 to +10 Volts dc @ 10 mA x3
	.....	Three 0 to 1mA meter outputs
	.....	0 to +10V Isolated (Option), (x3)
	.....	4-20mA (Option), (x3)
	.....	-10 to +10 Volts dc differential (Option) @ 2 mA
Weight	.....	8.1 lbs. (3.67 KG)
Transducer Signal In	.....	500 mV dc at rated load (per pair) maximum
Transducer Excitation	.....	5 Volts dc (10 Volts dc with XR option)
Mating Transducer Cable Connectors	.....	Amphenol MS3106A-10SL-3S (DFE #721-1445)
Zero (Tare) Range	.....	95% of transducer rating, minimum
Calibration Range	.....	25:1
Temperature Range	.....	32 to 104 deg.F (0-40 deg.C)
System Accuracy	.....	1 - 3% typical
Tension Meter	.....	Analog, 2%, 1mA, 48 ohm
Standard Tension Meter Scales	.....	0 - 1,5,10,25,50,100,150,250,500,1000
Tension Limit Switch Relay	.....
Contacts (Option)	.....	SPDT rated @ 10A/30Vdc, 10A/250Vac

1.5 STANDARD FEATURES

SOME OF THESE FUNCTIONS REQUIRE CONFIGURING OR EXTERNAL WIRING. REFER TO SECTION 4 FOR CONFIGURING AND SECTION 2 FOR WIRING.

- 115 Vac 60 Hz power input.
- NEMA 12, 13 wall mounted steel enclosure with all operator devices on cover.
- Power LED
- 3.5" analog tension meter with choice of scale
- Independent 0-10Vdc outputs proportional to left, right, and total tension
- 0 to 1mA outputs for Left, Right, and Total tension for external tension meters.
- 3 -position rotary switch to allow alternate display of left side, right side, and total tension.

1.6 OPTIONS (The option code is shown in parentheses)

SOME OF THESE OPTIONAL FUNCTIONS REQUIRE CONFIGURING OR EXTERNAL WIRING. REFER TO SECTION 5 FOR CONFIGURING AND SECTION 2 FOR WIRING.

- **230 Volt Power (230)**. 230 volt 50/60 Hz power input.
- **Attached Power Cord (APC)**. A heavy duty 3 conductor power cord wired to the device by DFE.
- **Computer Interface (CI)**. Includes a serial data device for data collection.
- **Digital Meter (DM)**. Digital tension meter in place of internal analog meter. 4 full digits, red 1" high LED's with over and under range indicators. The maximum range is 0000 to 9999. An over-range indicator lights at values over 9999, and an under-range indicator lights at values below 0. Can be read from further away than the analog meter. Up to 2 decimal places. Not compatible with Dual Cal option.
- **Differential Output (DO)**. Can be configured to provide -10V to +10V output with center-zero meter, for use in automatic side-to-side tensioning equipment. Replaces the 0-10V total tension output.
- **Dual Calibration (DC)**. Includes dual meter scale (Hi/Lo) and front panel switch. The meter scales may have any ratio, limited only by the range of the transducers. Used in those cases in which a wide range of materials having very wide tension requirements are being run. Not compatible with Digital Meter option.
- **Extended Range (XRE)**. The transducers are excited by 10 volts instead of the standard 5 volts. Used for low tension applications. The transducers must also have the XR option.
- **Isolated 10Volt (I10)**. A 0 to 10 Volt output not connected to circuit common or to earth ground. Can be selected on any, or all, 0 to 10V outputs.
- **Isolated 4-20mA (I420)**. A 4 to 20mA output not connected to circuit common or to earth ground. Can be selected on any, or all, 0 to 10V outputs.
- **Nonstandard Meter Scale (NMS)**. Any nonstandard analog meter scale. See Specifications, page 2, for standard scales.
- **Tension Limit Switch (TLS)**. Operates one of three relays when tension reaches an adjustable set point for left, right, or total tension. Front panel LEDs indicate Hi or Low tension levels. Used for web break detection or over/under tension warning. Can be set to latch in "on" state. Has reset switch on front panel.

1.7 ACCESSORIES

- **Remote Tension Meter**. A separate tension meter for remote installation. Analog, 1 mA, 48 ohm movement. (DFE Part # 722-1385).
- **Remote Tension Meter in Enclosure**. Tension meter in steel enclosure for protection with 2-pin amphenol connector (DFE Part # 723-1453).

SECTION 2

INSTALLATION

2.1 DIMENSIONS inches (mm)

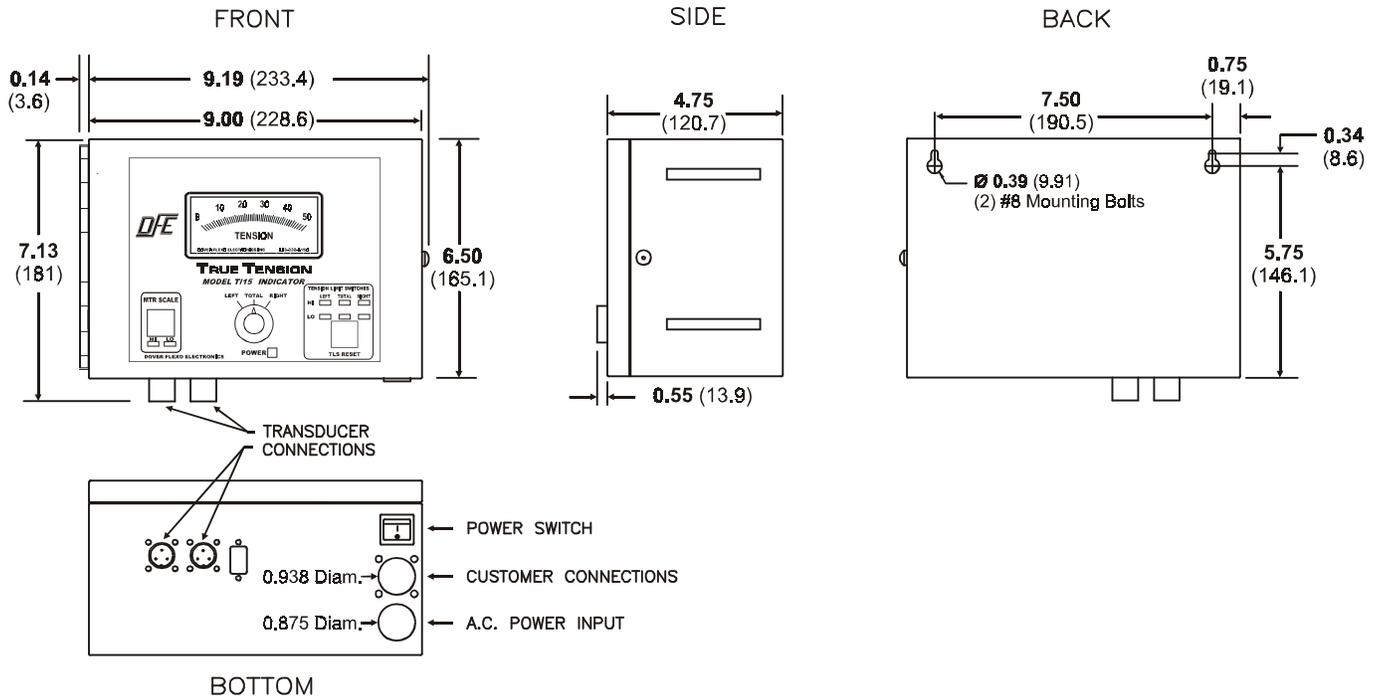


Figure 3 - ENCLOSURE DIMENSIONS

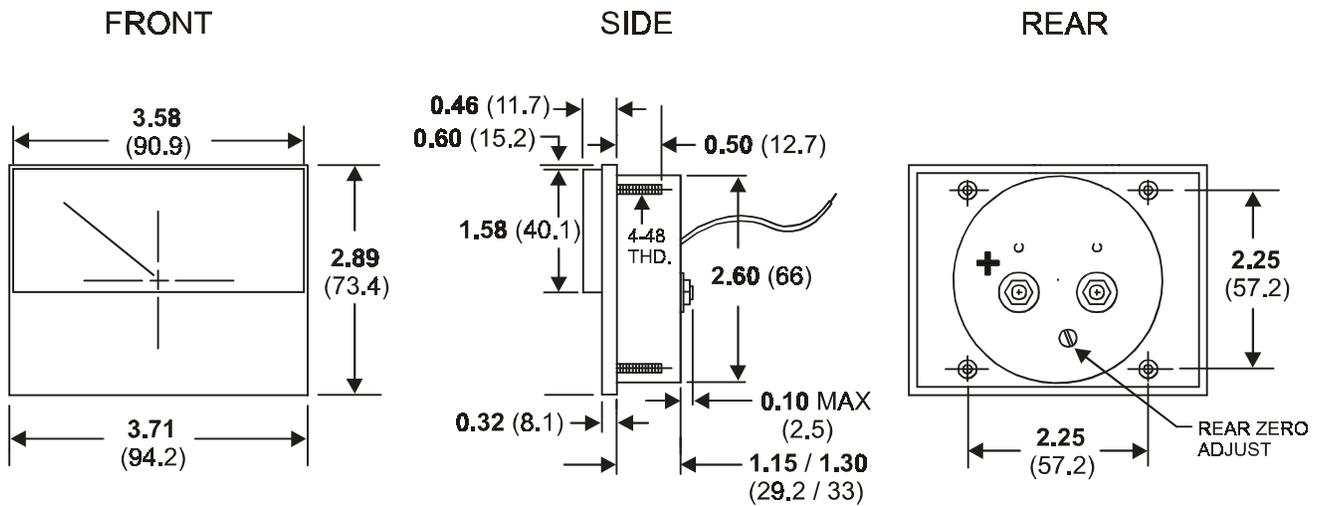


Figure 4 - REMOTE TENSION METER (Accessory)

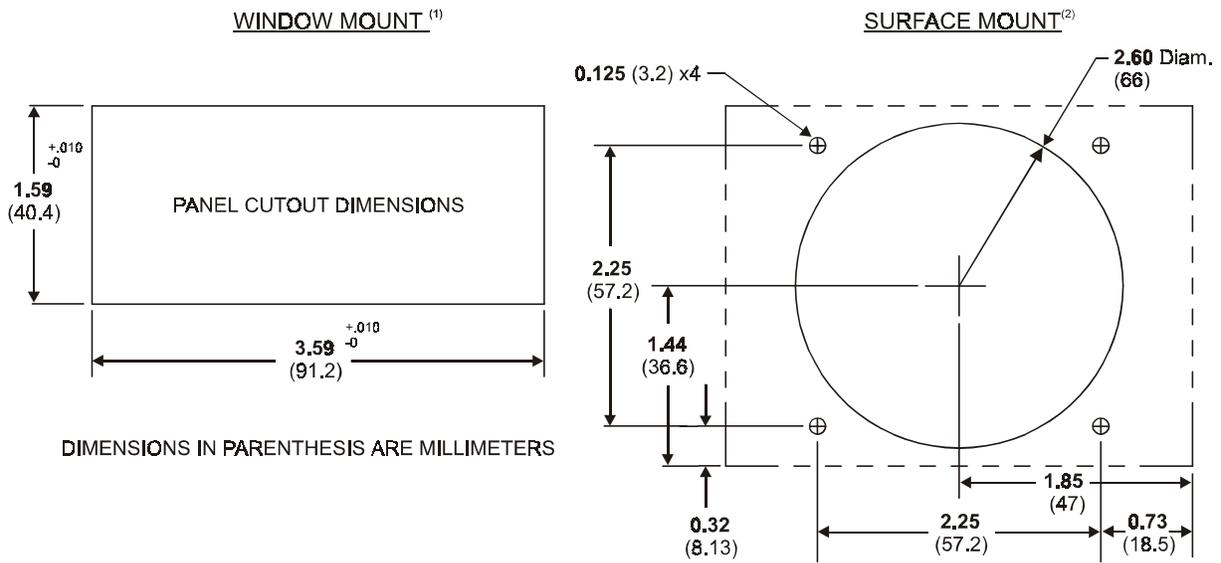


Figure 5 - REMOTE METER MOUNTING DIMENSIONS

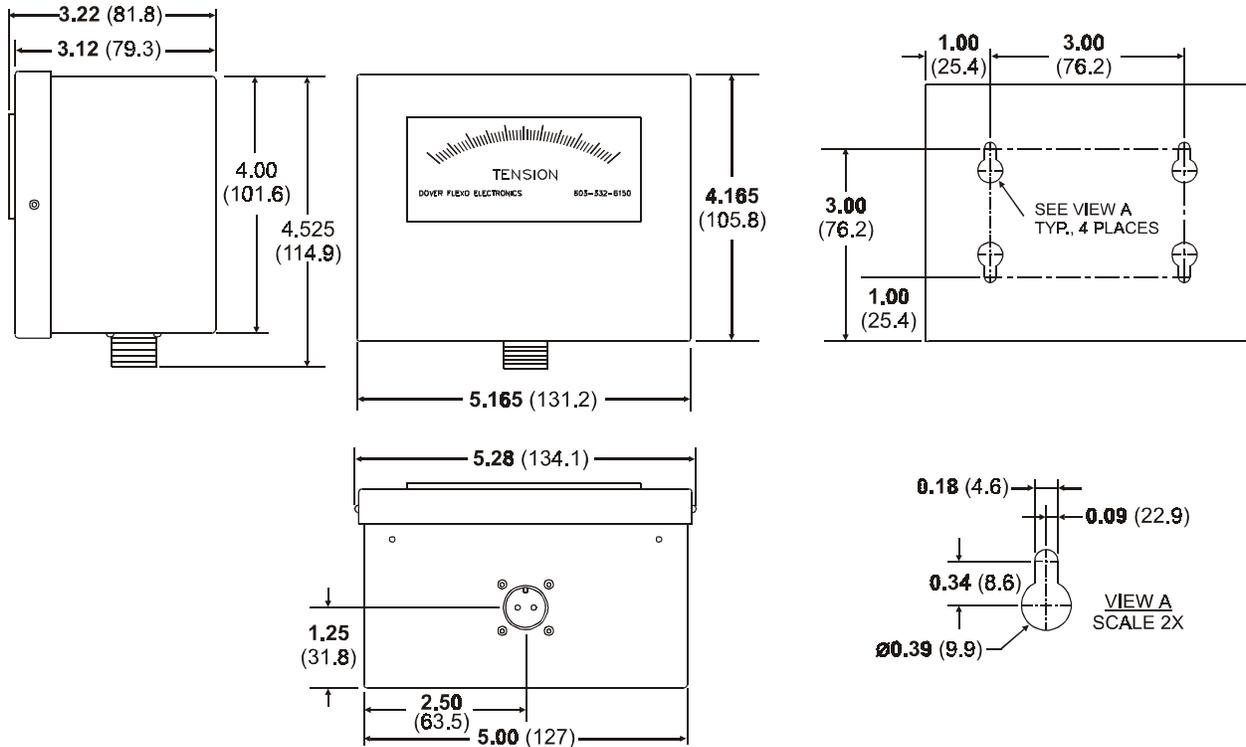


Figure 6 - REMOTE METER ENCLOSURE DIMENSIONS

2.2 MOUNTING LOCATION and INSTRUCTIONS

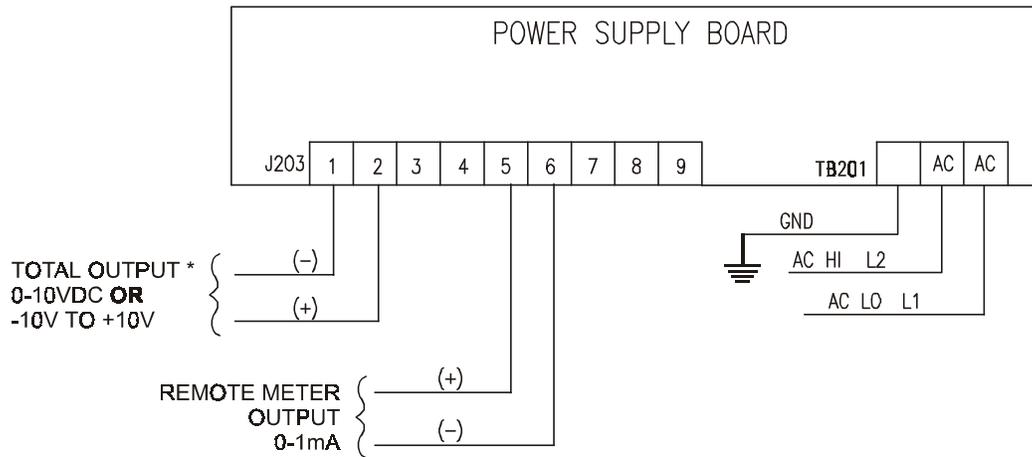
Select a location on the machine frame or a wall that will be convenient for the machine operator to operate the indicator and to see the tension meter easily. Be sure the location is free of vibration, and is dry and clean. Take care to choose a place that the indicator won't be struck and damaged by anything or anyone.

Refer to the dimensions listed in Figure 3 (Figures 4 and 5 if optional remote meter is required) for exact fit.

The enclosure is fastened to the mounting surface you have chosen by two socket head cap screws, full thread, (supplied by you). Install the screws in the mounting surface to the dimensions shown in Figure 3. Leave them loose - about six turns. Position the keyholes in the back panel of the enclosure over the screws and slide it down until it locks in place. Open the door and tighten the mounting screws.

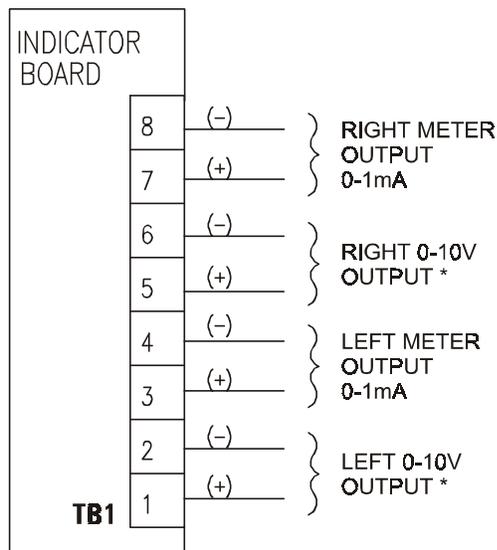
2.3 STANDARD ELECTRICAL CONNECTIONS

See Fig. 12 for location of terminal strips



* NO POLARITY IF ISOLATED OUTPUT OPTION IS INSTALLED

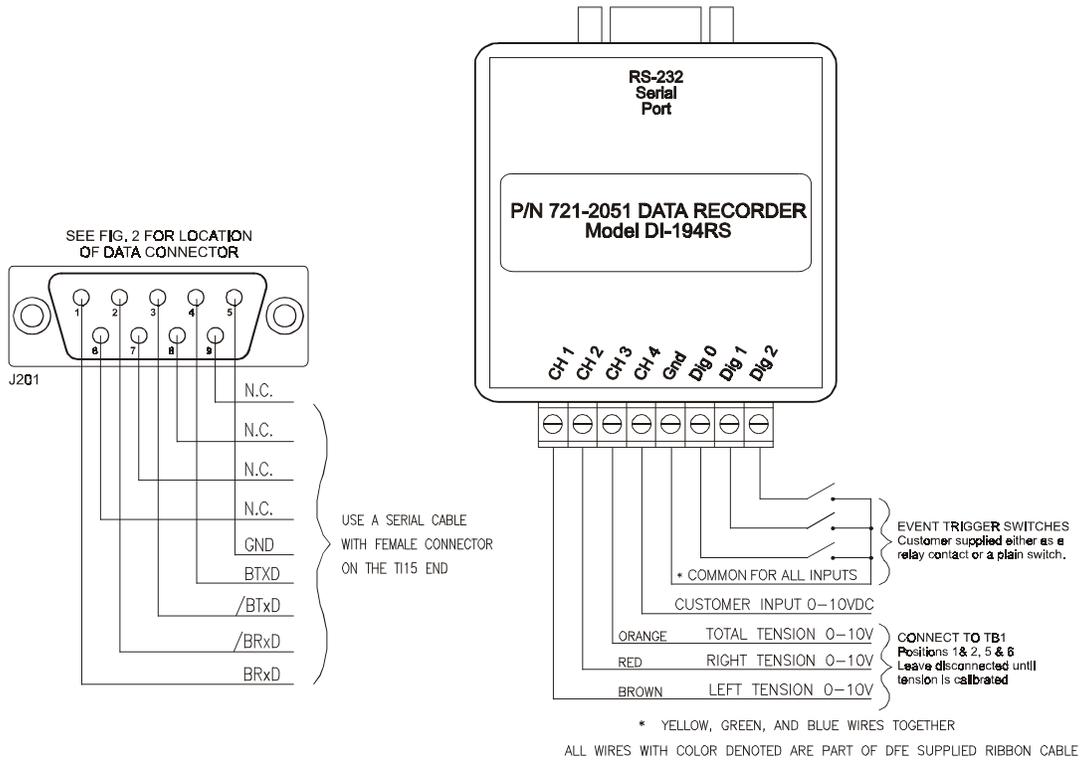
See Fig. 13 for location of terminal strips



* NOT RELATIVE TO GROUND IF ISOLATED OUTPUT OPTION IS INSTALLED

Figure 7 - STANDARD ELECTRICAL CONNECTIONS

2.4 OPTIONAL ELECTRICAL CONNECTIONS



Refer to Instruction Manual 801-1890 for the CI Option

Figure 8 - COMPUTER INTERFACE DATA RECORDER (CI) OPTION

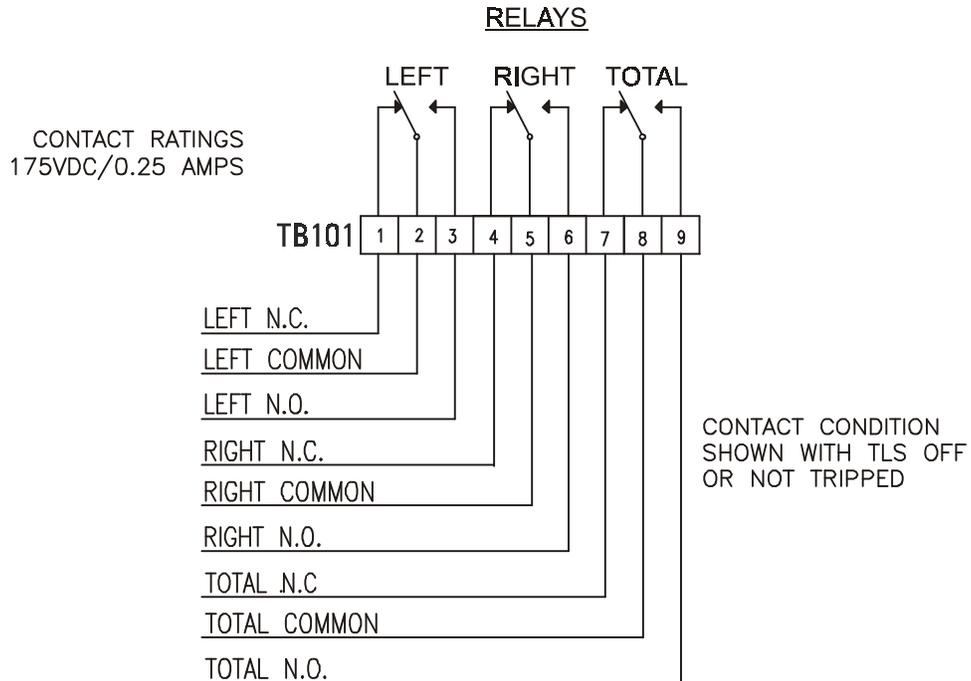


Figure 9 - TENSION LIMIT SWITCH (TLS) OPTION RELAY CONTACTS

3.1 OPENING THE INDICATOR

The loosening of the hex screw on the right side of the indicator front cover is all that is needed to open the cover. The tool required for this is a M3 (HEX) allen wrench. Opening up the unit is necessary for the following things to be accomplished:

- Zeroing and calibrating the tension meter for the transducer roll (Tension sensing roll).
- Changing the signal output.
- Changing the transducer excitation voltage.
- Changing the power selection switch.
- Damping the meter. Adjusting tension meter damping
- Adjusting TLS trip levels (Option)
- Calibrating the Data Acquisition module

CAUTION!

Many of the parts inside the T115 can be damaged by sparks caused by static electricity. You can prevent this by making sure both you and your work surface are properly grounded before you open the case of the indicator.

3.2 ZERO THE TENSION METER (Refer to Figure 13, page 11 for adjustment pots.)

1. Turn the power "off" to the indicator. Observe the tension meter. If the needle is not on zero, adjust the screw on the meter back until the needle rests on zero.
2. Turn on power and allow the indicator to warm up for five minutes.
3. Turn the meter damping pot (RT9) fully counter-clockwise to allow immediate meter response to adjustments.
4. Switch the L-R-T switch to Left (L). Open the door of the indicator to the Indicator Board mounted to the cover and, using a small screwdriver, turn the "Left Zero" pot. (RT2) until the meter reads zero. The needle moves upscale when the pot. is turned clockwise (CW). Note: This is a 25 turn pot.
5. Switch the L-R-T switch to Right (R). Using a small screwdriver turn the "Right Zero" pot. (RT1) until the meter reads zero. The needle moves upscale when the pot. is turned clockwise (CW). Note: This is a 25 turn pot.

3.3 CALIBRATE THE TENSION METER (Refer to Figure 13, page 11 for adjustment pots.)

1. Find an object of known weight at least as heavy as 25% of the tension meters full scale number. A spring scale can also be used. Get a length of rope, wire, or cable about 15 feet (3 meters) long.
2. Keeping the switch in the (R) position, thread the length of rope, wire or cable over the *center* of the tension sensing roll following the *exact* same path the web will take.

NOTE: Each transducer is calibrated separately and it is important for proper calibration that the rope is centered on the sensing roll.

Do NOT pass the rope over dead-bars, driven rolls, braces, or any other non-free wheeling member. The sliding friction introduced by these members will cause inaccurate calibration. Fasten one end of the rope securely. Refer to Figure 10.

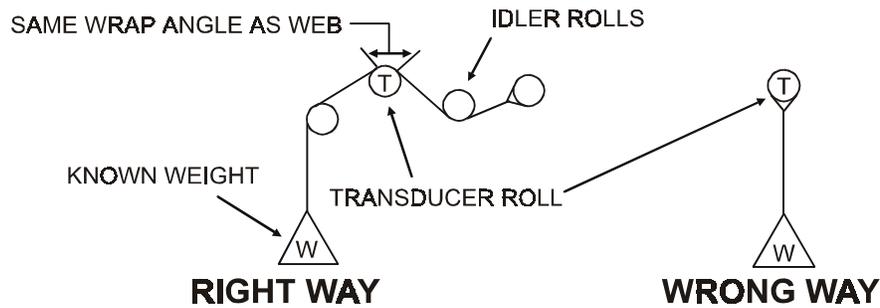


Figure 10 - WEB PATH FOR METER CALIBRATION

3. Attach your weight to the other end of the rope.
4. Adjust the "Right Cal" pot. (RT6) until the tension meter reads exactly half of the known weight being applied to the sensing roll. *
5. With the weight applied, switch the L-R-T switch to the (L) position. Adjust the "Left Cal" pot. (RT8) until the tension meter reads exactly half of the known weight being applied to the sensing roll. *
6. Turn the L-R-T switch to the Total (T) position. The tension meter should read the same value as the known weight being applied over the sensing roll.
7. Remove the load from the sensing roll and observe the tension meter. If it does not read zero, repeat, starting at Step 3 of the Zero procedure in Section 3.2.
8. Turn the L-R-T switch to Right (R) position and observe the tension meter. If it does not read zero, repeat, starting at Step 3 of the zeroing procedure.
9. Continue to repeat steps above until the tension meter reads correctly the applied weight AND returns to zero when the weight is removed.

TENSION METER CALIBRATION IS COMPLETED!

10. Adjust the METER DAMPING pot. (RT9) while the machine is running to minimize meter needle movement. Turn the METER DAMPING pot. clockwise (CW) to stabilize the meter reading. This only affects the meter. Other tension output signals are not damped.

* NOTE: For UPB-type transducers: As web tension is applied, the tension needle (or the reading on the digital meter) should increase. If it goes downward instead, you must reverse the connections. This can be done by removing the plugs from the standard connectors on the Power board (J204 and J205), and using the reverse connectors (J206 and J207). Then move the sampling cable from J206 to J204 (std) on the power board. See Figures 12 and 13.

YOUR TI15 LEFT-RIGHT-TOTAL INDICATOR HAS BEEN PROPERLY CONFIGURED AT THE FACTORY. IT SHOULD NOT BE NECESSARY TO MAKE ANY CHANGES. USE THIS SECTION ONLY TO VERIFY THE CONFIGURATION OR TO RECONFIGURE THE INDICATOR IF YOUR APPLICATION REQUIREMENTS CHANGE.

4.1 TENSION ZONES

Tension zones are created by driven or braked nip rolls, drag bars, braked or driven unwind or rewind shafts, or anything else that can increase or decrease web tension. One of these elements is at each end of every tension zone.

Almost all machines that process a continuous web have more than one tension zone. The TI15 Tension Indicator can be used in any tension zone, however it may need to be configured for the zone it will be used in. The information below will be used later to determine the correct configuration.

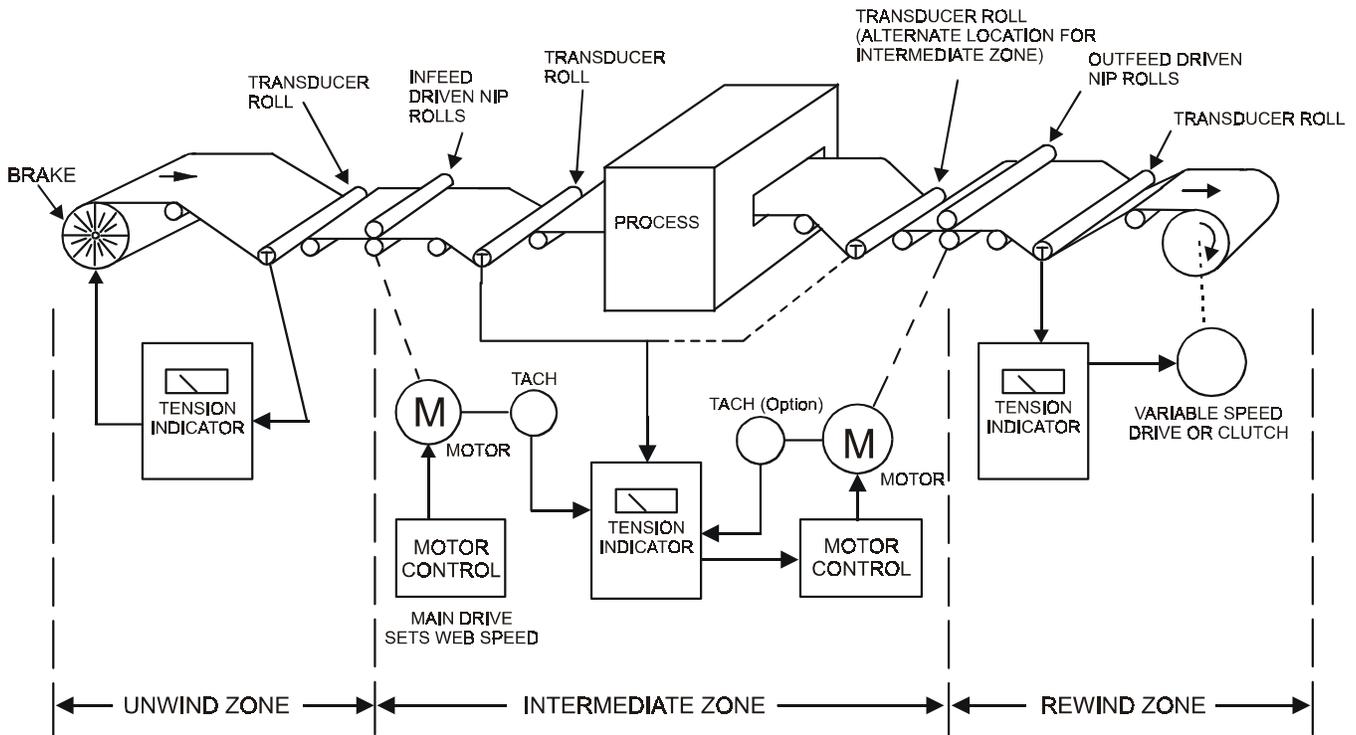
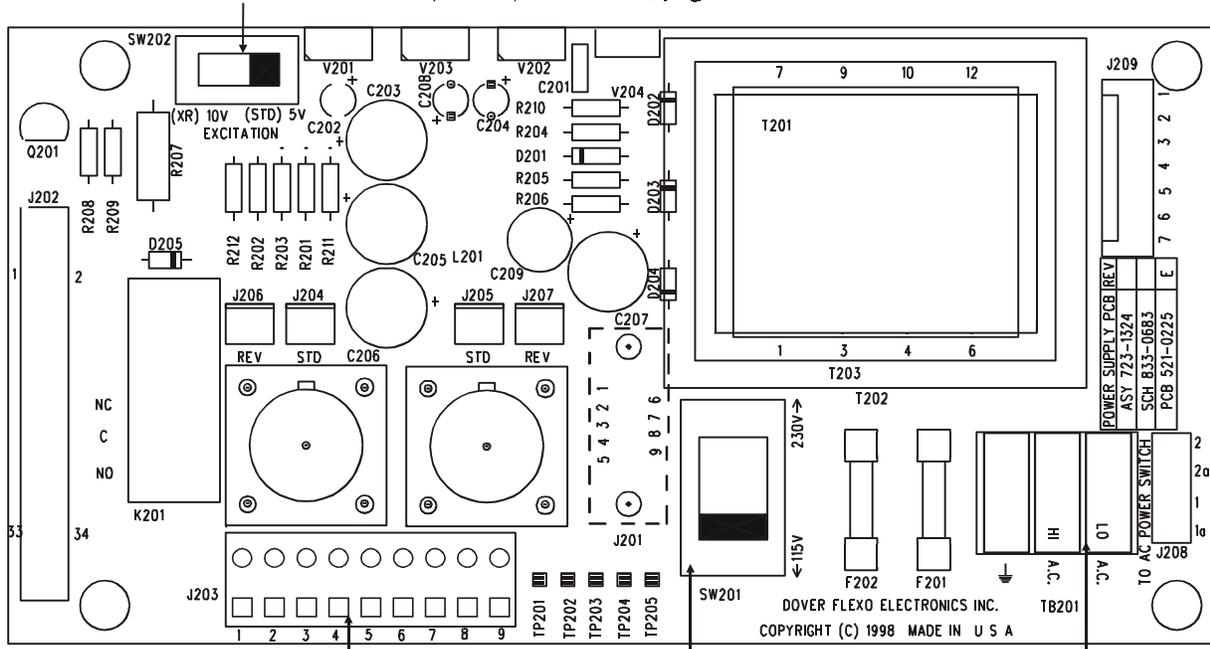


Figure 11 - TENSION ZONES

4.2 THE POWER BOARD

TRANSDUCER EXCITATION VOLTAGE (SW202) Section 2.4, page 7



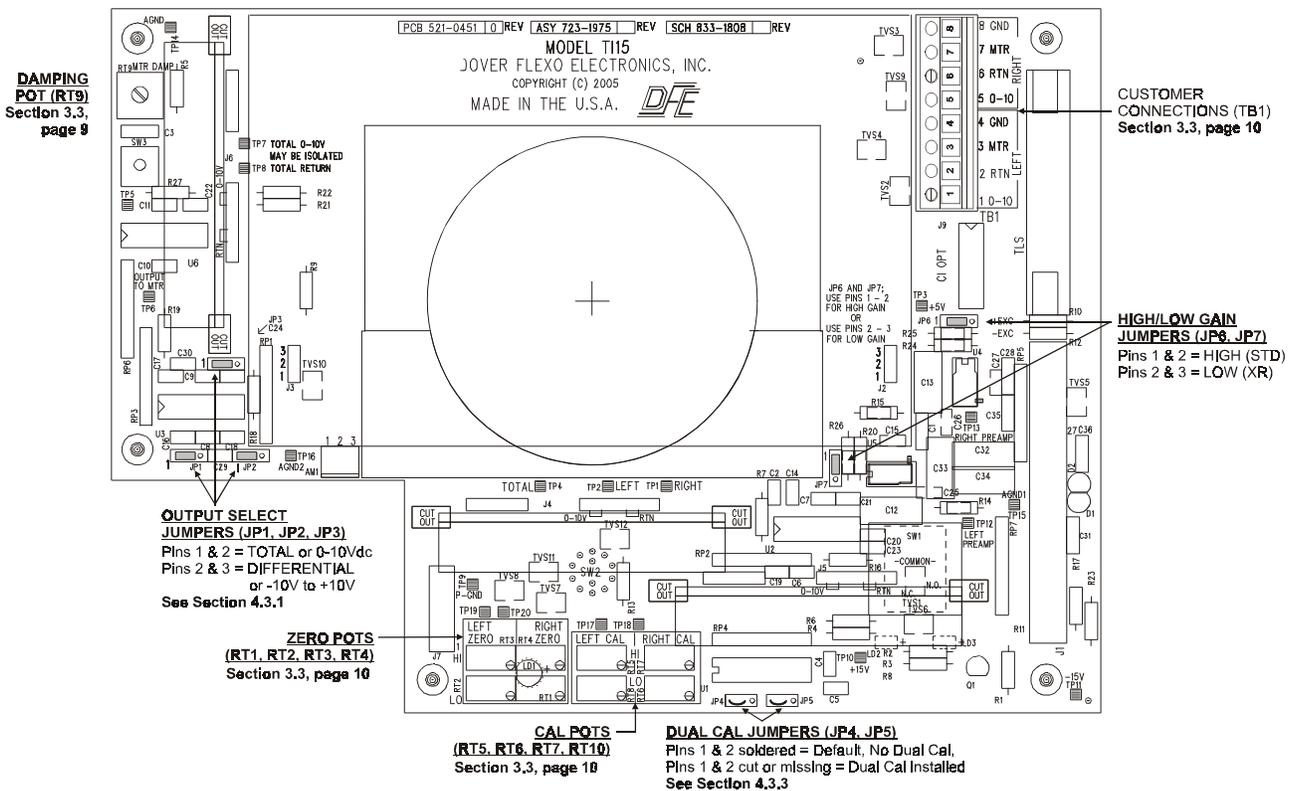
EXTERNAL CONNECTION TERMINALS (J203)
Section 2.6, page 8
Section 4.2, page 13

AC VOLTAGE SELECTOR (SW201)
Section 4.1, page 12
Section 2.4, page 7

AC POWER TERMINALS (TB201)
Section 2.6, page 8

Figure 12 - POWER BOARD

4.3 THE INDICATOR BOARD



DAMPING POT (RT9)
Section 3.3,
page 9

CUSTOMER CONNECTIONS (TB1)
Section 3.3, page 10

HIGH/LOW GAIN JUMPERS (JP6, JP7)
Pins 1 & 2 = HIGH (STD)
Pins 2 & 3 = LOW (XR)

OUTPUT SELECT JUMPERS (JP1, JP2, JP3)
Pins 1 & 2 = TOTAL or 0-10Vdc
Pins 2 & 3 = DIFFERENTIAL or -10V to +10V
See Section 4.3.1

ZERO POTS (RT1, RT2, RT3, RT4)
Section 3.3, page 10

CAL POTS (RT5, RT6, RT7, RT10)
Section 3.3, page 10

DUAL CAL JUMPERS (JP4, JP5)
Pins 1 & 2 soldered = Default, No Dual Cal,
Pins 1 & 2 cut or missing = Dual Cal Installed
See Section 4.3.3

Figure 13 - INDICATOR BOARD

4.4 POWER VOLTAGE SELECTION (See Figure 12 for location of switch sw201)

The TI15 indicator is designed to operate on either 115V-60Hz or 230V-50/60Hz power. Select the correct voltage for your installation with the SW201 switch. (See Figure 14). You also need to change fuses. Use 0.25A/250V fuses for 115V operation, or use 0.125A/250V fuses for 230V operation. Note: Your unit will have the correct fuses according to the specifications given at time of order.

CAUTION! The wrong selection will damage the Indicator!



Figure 14 - POWER SELECTION SWITCH SW201

Preparing the power cord:

The cord must be equipped with a third grounding wire. Strip the free end of the wires evenly as shown in Fig. 15. Make the connections of power cord wires to terminal block TB201 shown in Fig. 7. (NOTE: Green is ground)

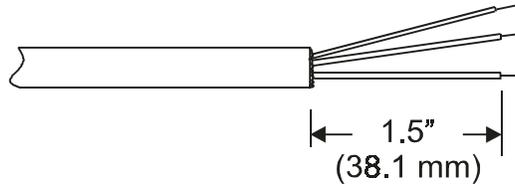


Figure 15 - PREPARING THE POWER CORD

4.5 TRANSDUCER EXCITATION VOLTAGE SELECTION (See Fig. 12 for location of switch SW202)

This unit can be set to provide two levels of excitation voltage. The "standard/extended range" selection switch (SW202) is located towards the back of the unit on the Power Board. When the switch is set toward the right, the switch is in the normal or 5V excitation position. When the switch is set toward the left, it is in the extended range or 10V position. The excitation voltage is marked on the silk screen in front of the switch. Slide the switch actuator to the position appropriate for the transducer(s) you are using.

You must also move jumpers JP6 and JP7 (on the indicator board, see figure 13) to short pins 2 and 3.

CAUTION! Do not use extended range excitation unless the transducer has the XR option. The wrong excitation voltage will damage the transducer! If in doubt about the correct excitation voltage, contact the Service Department at Dover Flexo Electronics for assistance.

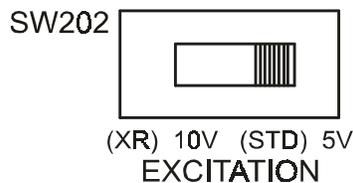


Figure 16 - TRANSDUCER EXCITATION VOLTAGE SWITCH

4.6 CONNECTING THE TRANSDUCERS

The sensor roll includes two transducers. These parts sense the tension on the roll, and send a signal back to the unit. Make the connections for the transducers. If you are using pre-wired connectors supplied by Dover Flexo Electronics, plug in the connectors. Plug the left transducer into the left-hand plug (as viewed from the TI15), and the right transducer into the right-hand plug. Reference Figure 3.

Refer to Section 1.6 for descriptions of options, and Section 2.4 for Electrical Connections.

5.1 COMPUTER INTERFACE DATA RECORDER (CI) See Fig. 8 for Electrical Connections

The computer interface (CI) can be used for diagnostic applications. This four (4) channel serial module allows the simultaneous display and recording of Left, Right, total tensions on a computer using software provided with the option. When this option is implemented, connections for serial signals are obtained at the 9 pin D-sub connector located on the bottom of the enclosure. See Fig. 8 on page 7 for connections. You may also connect a fourth signal (-10V to +10V) into the interface module to be displayed and recorded along with tension. Also up to 3 trigger signals (Normal-Open; Close to trigger) may be entered to record events of interest in a file containing recorded data. Refer to Data Recorder manual (Doc 801-1890) for specific setup and operating functions.

5.2 DUAL CALIBRATION (DC) See Fig. 13

First determine if your unit has Dual Calibration. Units with this feature will have a label and pushbutton switch on the front panel located on the lower left corner of the enclosure. If your unit does not have this option and you wish to have it installed, you will need to send the unit back to the factory for installation (refer to Terms and Conditions, page 35, paragraph 8).

To calibrate for a second scale, follow the calibration procedure in section 3.2 and use RT3 for the LEFT ZERO pot. and RT4 for the RIGHT ZERO pot. Use RT5 for the LEFT CAL, and RT7 for the RIGHT CAL pot. Push the front panel button to select between the two different scales, HI and LO, and the LED indicators will light to indicate which scale is active.

5.3 DIGITAL METER (DM) See Fig 18

1. Calibrating for tension with the digital meter

If the Digital meter was ordered from the factory, it had already been set for your maximum tension range, and **NO CHANGES TO THE DIGITAL METER SHOULD BE NEEDED**. Simply calibrate for tensions shown in Section 3, **EXCEPT** pay attention to the Under-Range Indicator (see Fig. 17). The correct Zero setting is when the Under-Range Indicator just goes out as the Zero potentiometer is turned clockwise.

2. Changing the maximum tension range, and calibrating for tension

If you need to change your Maximum tension Range because your application has changed, use the following procedure to reset the range and then calibrate for tension.

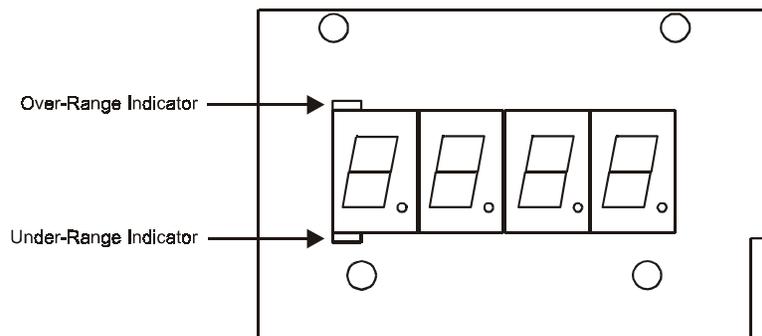


Figure 17 - DIGITAL METER DISPLAY

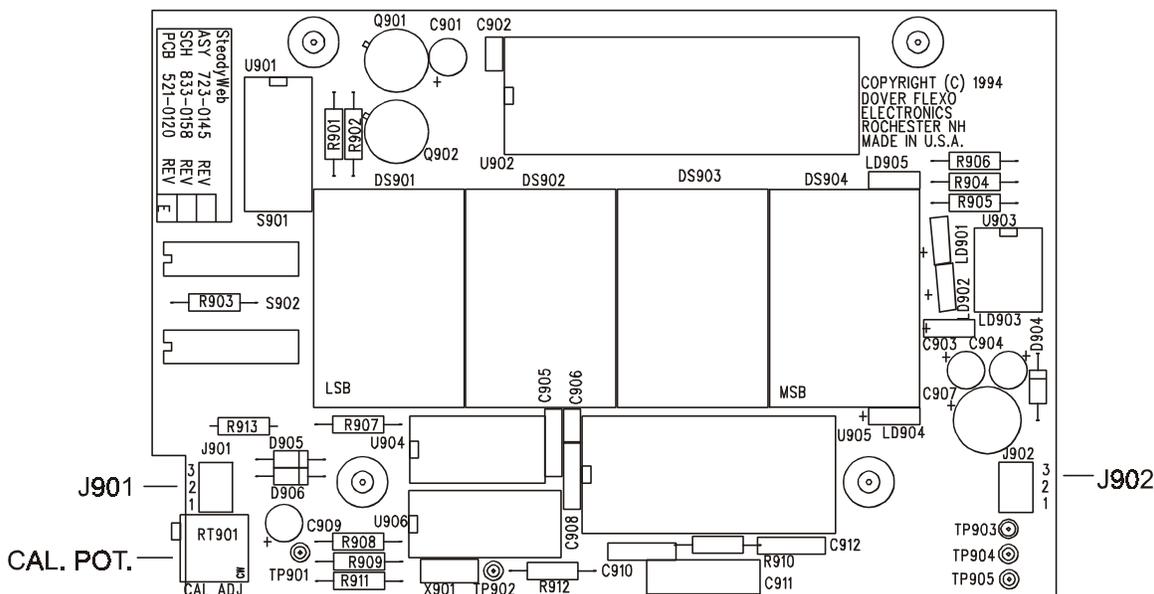


Figure 18 - DIGITAL METER BOARD

1. Determine the maximum tension to be used. Refer to Specifications, Section 1.4, and select the next highest analog meter scale.
2. Determine the number of decimal places for the display. Unless the full-scale tension is very low, it is best to use the minimum of decimal places. This produces a stable display.
3. Turn off power. Open the unit to expose the back side of the Digital Meter. Set the S901 and S902 switches as in the following table.

RANGE	SWITCH S901								SWITCH S902							
	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
0 - 9.9*	O	O	C	O	O	C	O	O	O	O	C	O	O	C	C	--
0 - 99	O	O	C	O	O	C	O	O	O	O	O	O	O	C	C	--
0 - 999	O	C	O	O	C	O	O	C	O	O	O	O	C	C	C	--
0 - 9999	C	O	O	C	O	O	C	O	O	O	O	C	C	C	C	--

O = Open C = Closed

* Use this range only if you really need the decimal point. Otherwise use the 0-99 range settings.

4. Measure the input voltage to the digital meter at TP5 (+) and TP9 (-) on the indicator board.
5. Adjust the ZERO LO pot. (RT2) on the indicator board for 5Vdc at the points in step 4 above.
6. Adjust the CAL ADJ pot. (RT901) on the Digital Meter board to half of the full-scale value selected.
7. Calibrate the meter according to the procedure in Section 3. **CAUTION:** When setting the ZERO pots., pay attention to the under-range indicator. The correct setting is where the light just goes out as the ZERO pot. is turned clockwise.

5.4 DIFFERENTIAL TENSION OUTPUT (DO) See Fig. 19 for setting jumpers.

With this option the TI15 is capable of producing a -10V to +10V Differential tension output signal, such that when left and right tension are the same, the output is zero. When left tension exceeds right, a negative proportional output is produced, and when right tension exceeds left, a positive proportional output is produced. This option also includes a center-zero meter so that the meter reads zero when tension is balanced, and deflects to the left or right when tension is unbalanced.

Verify that the Output Select Jumpers (on the Indicator board) are set as shown in Figure 19.

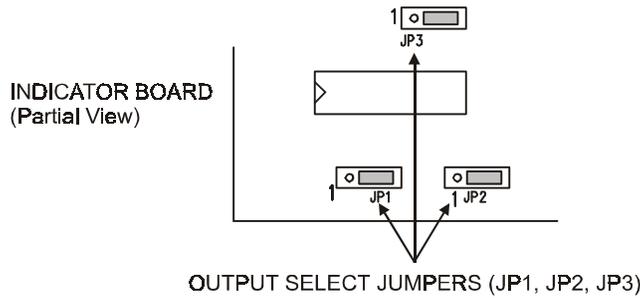


Figure 19 - DIFFERENTIAL OUTPUT JUMPERS

Make your connections for the Differential tension output at the Power Board J203 pins 2 (Sig+) and pin 1 See Fig. 20.

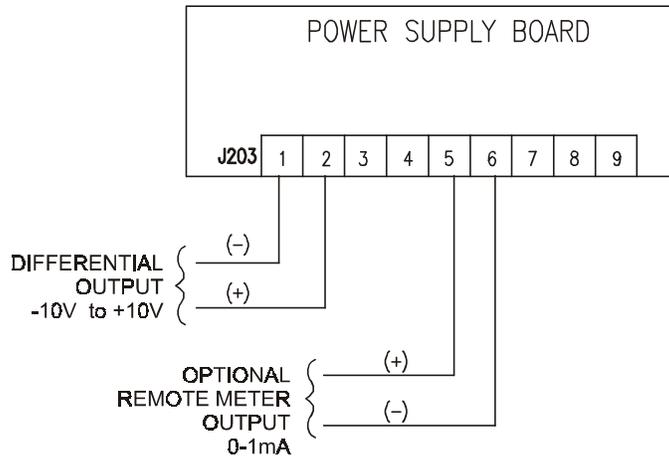


Figure 20 - DIFFERENTIAL OUTPUT CONNECTION and OPTIONAL REMOTE METER

5.5 ISOLATED 0-10V or 4-20mA OUTPUT (I10 or 420) See Fig 21

Isolated outputs may be necessary if you want to provide output signals to external equipment which is not referenced to a reliable earth ground. Not using isolation in these cases can result in voltage offsets and equipment damage. Using Isolated outputs eliminates these problems.

There is one Isolation card for each output channel (Left, Right, and Total) to be isolated. Each Isolation card must first be configured to produce your choice of 0-10V or 4-20mA output by placing jumper JP1 in positions 1 and 2 for 0-10V operation, and in positions 2 and 3 for 4-20mA operation.

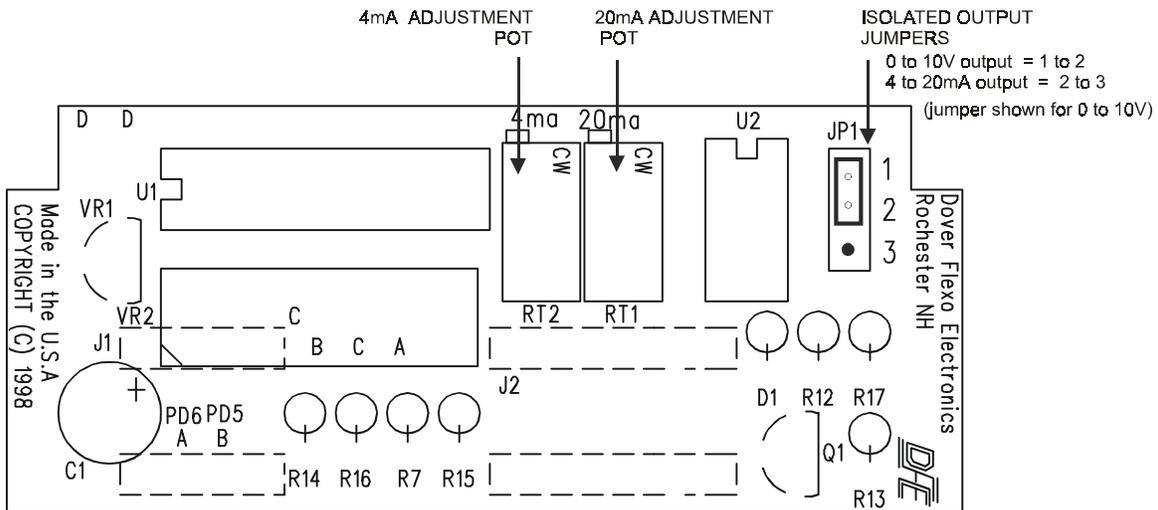


Figure 21 - ISOLATED OUTPUT JUMPERS and ADJUSTMENTS

Then for your Total output, make your connections to J203 on the Power board, positions 2 and 1. For your Right output, make your connections to TB1 on the Indicator board, positions 5 and 6. For your Left output, make your connections to TB1 on the Indicator board, positions 1 and 2. See Fig. 22.

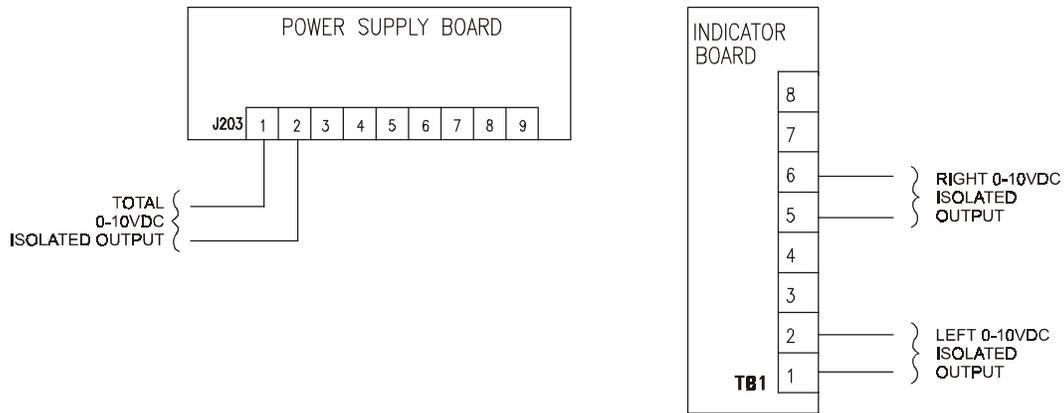


Figure 22 - ISOLATED OUTPUT CONNECTIONS

5.6 TENSION LIMIT SWITCH (TLS)

Refer to Figures 13 (page 11) and 23 (below) for locations of adjustment pots and switches on the Indicator board and optional TLS board. TLS on the TI15 can have a low set-point and a high set-point for each of the Left, Right, and Total values. There is also a relay for each Left, Right, and Total. These relays can be latched when the low or high set-points have been exceeded. Each relay has a N.O. (normally opened) and N.C. (normally closed) connection. Use the one best suited to the application.

The relays can be enabled (armed) or disabled (off) by configuring the appropriate jumpers: Left = JP101, Right = JP103, and Total = JP105. To enable the latching feature, use the appropriate jumpers as show in Fig 23. If the relay for a channel is disabled, the LED's for that channel are also disabled.

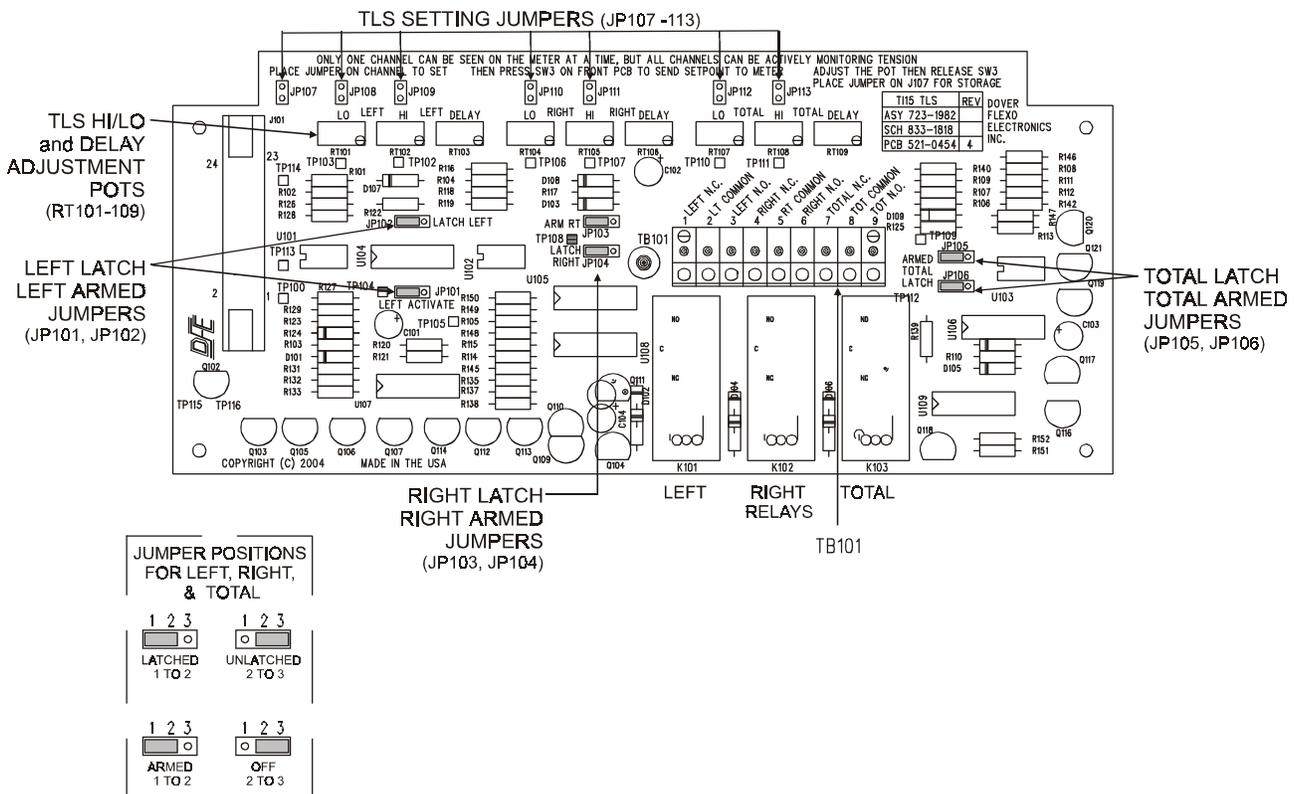


Figure 23 - TLS BOARD (Option)

1. Adjusting the Low and High limits on Left, Right, and Total TLS circuits

The low and high set-point adjustments are made by pushing a switch (SW2), located on the left side of the Indicator board (see Fig. 13), and holding the switch in while adjusting the appropriate pot. on the TLS board.

Before pushing in SW2 on the Indicator board, move the jumper header off of JP107 (TLS Board) and place it on the appropriate jumper pins (JP108 thru JP113). The reason for holding in SW2 is to permit the user to view the actual set-point on the front panel tension meter. This output is directly proportional to the full scale reading on the meter.

2. Connections for TLS

Make connections at TB101 on the TLS board as shown in Figure 24 below. Left connections are in positions 1 to 3, Right Connections are in positions 4 to 6, and Total connections are in positions 7 to 9.

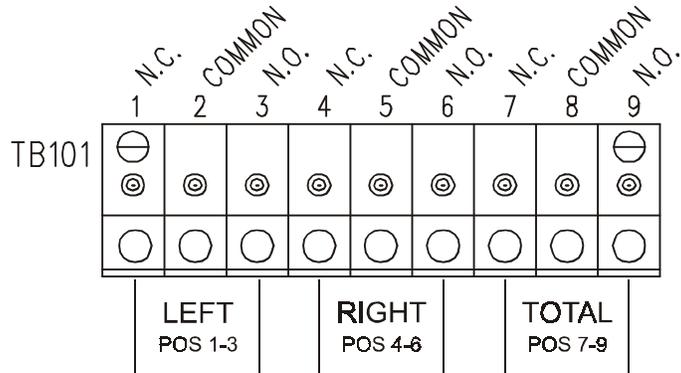


Figure 24 - TENSION LIMIT SWITCH CONNECTIONS

6.1 BASIC OPERATION

Once the unit has been installed and electrical connections have been made, turn on the power using the Power On/Off switch located at the bottom of the enclosure. Wait for five minutes for the unit to warm up and for the power supplies to stabilize. If you have not zeroed and calibrated the unit, do so now (refer to section 3). Once the unit has been zeroed and calibrated, the user can choose which features to use. Refer to Section 3, Calibration and Setup to configure the particular feature you wish to use. If any of the features do not seem to work correctly, refer to Section 7 for troubleshooting hints or call Dover technical service.

6.2 OPERATION OF TENSION LIMIT SWITCH (OPTION)

The Tension Limit Switch (TLS) option, allows for High or Low tension conditions, on either Left, Right, or Total tension channels, to trigger alarm relays. A relay is available for the Left, the Right, and the Total alarms. One of a series of six front-panel LEDs illuminate when a particular condition is present.

The relays in the TI15 can be connected to other equipment, for example, to activate external machinery, trigger an audible arm, or shut the machine down, at the customer's discretion.

The TLS option can be configured to operate in Momentary mode (which means the alarm goes away when the fault tension condition goes away), or in Latched mode (in which case the alarm persists even after the tension condition goes away). In Latched mode, the momentary-action TLS RESET switch will reset the relays. In either mode, the switch will reset the relays for as long as the switch is pressed. This feature may be helpful during machine make-ready if the relays are wired to trigger an external condition.

6.3 OPERATION OF DUAL CALIBRATION (OPTION)

The Dual Calibration option is used to provide two different switch-selectable calibration settings. This can be helpful to provide better resolution when materials requiring different tensions are to be processed. It can also be used to select between calibration settings if your tension transducers are used in alternate web paths. The Dual Calibration option includes a tension meter with two scale ranges, and the higher scale range on top.

To select between the calibration settings, press the alternate-action METER SCALE HI/LO switch. An LED will show which setting is selected. The selected setting should also correspond with the scale range in use.

The TI15 unit requires very little maintenance. If necessary, clean the overlay on the front panel using a small amount of a gentle solvent like Windex[®]. Do not use strong petroleum-based solvents - these could damage the panel material. Do not use large amounts of water.

Monitor the tension meter any time there is no web in the machine. It should read near zero. Periodically (at least annually) re-calibrate the unit to verify accuracy.

8.1 TROUBLESHOOTING PROCEDURE

Following is a list of common troubleshooting problems. You may want to contact DFE Technical Support at (603) 332-6150 for immediate help, or if necessary, instructions for return for repair.

1. *Unable to zero*

This may happen if, during zeroing, the output from the transducers is equal to 95% of the full range of the indicator. (After zeroing, this would only allow the indicator to use 5% of the range.) Before zeroing, be sure the web and any other weights have been removed from the sensor roll.

Inability to zero can also happen if there is a lot of variation in the signals from the transducers while the tension indicator is trying to zero. This could be caused by some sort of weight or load on the sensor roll, or by a problem with the transducers or connecting cables. If necessary, check for a hardware problem by substituting the transducers and cables. Note that you should not be able to zero without transducers connected. This symptom could also be caused by a faulty power supply.

2. *Unable to calibrate*

This may happen if the setting for the calibration point is not logical (below the zero point). Attach the weight as shown in Fig. 10 on page 9 in the calibration section.

Inability to calibrate can also happen if there is a lot of variation in the signals from the transducers while the True Tension is trying to calibrate. This could be caused by a problem with the transducers or connecting cables. Do not use stretchy material for your rope. Do not let the weight sway. Do not pass the rope over any driven or braked rolls, or drag bars.

3. *Analog output not working correctly*

If you have chosen the 0-10V voltage output, and the voltage is not present, check for a short-circuit or very low impedance in the circuit to the remote indicator.

If you have chosen 0-20 mA or 4-20mA current-loop output, and the remote indicator does not go through the full range, check for a very low impedance in the circuit to the remote indicator (I420 option).

4. *If the LED for power will not light*

Check the AC connections to the terminals on the Power PCB of the TI15. Check the fuses inside the unit (See Fig. 12, F201 and F202). There may also be a problem with the 5V power supply inside the unit.

5. *If the Tension Limit Switch is not operating*

Check to be sure the operating mode has been set correctly (momentary or latching). Check that the high and low trip points have been set correctly. The relay for this function may be set up for either normally-open or normally-closed action. Check the terminals at the terminal block on the Power PCB. Check to see if channel is disabled (See Set-up).

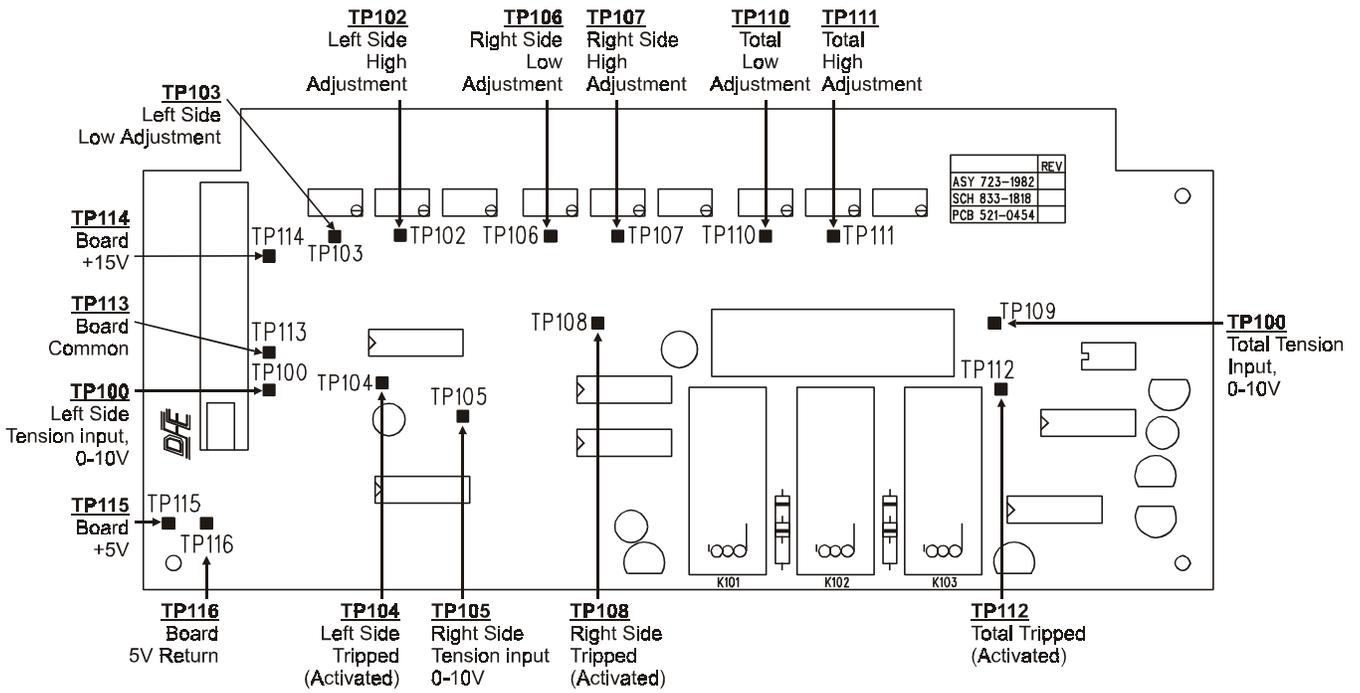
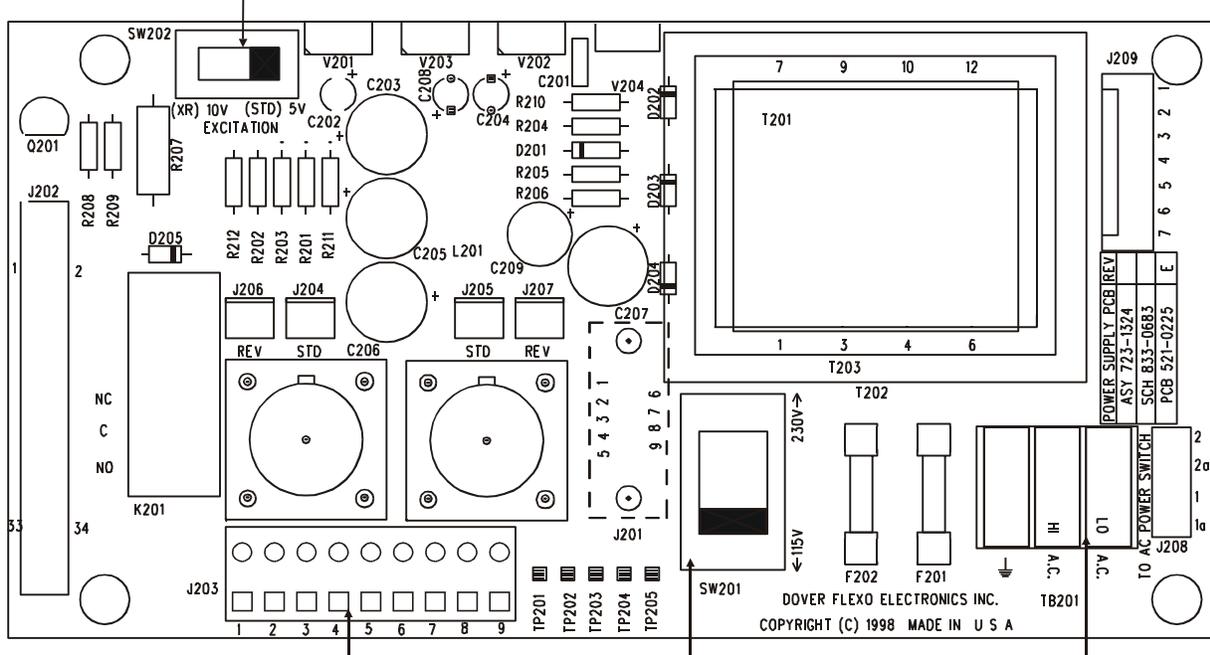


Figure 27 - TENSION LIMIT SWITCH BOARD TEST POINTS

9.1 REPLACEMENT PARTS

Tension meter, analog	722-1385 (specify scale)
Fuses: 115V 0.250A/250V	108-0046 SLO-BLO type
230V 0.125A/250V	108-0045 SLO-BLO type
Fuse cover	108-0005
Ribbon cable, 24 conductor	723-1362
Ribbon cable, 34 conductor	723-1313
TLS Relay	105-0028
Indicator Board	723-1975
Power Board	723-1324
TLS Board (TLS option)	723-1982
Aux Front Board (TLS option)	723-1983
Digital Meter (Option)	723-1423
Cable Connector	106-0076
Instruction Manual	801-1846
Instruction Manual for Data Recorder	801-1890 (option)

TRANSDUCER EXCITATION VOLTAGE (SW202) Section 2.4, page 7



EXTERNAL CONNECTION TERMINALS (J203)
Section 2.6, page 8
Section 4.2, page 13

AC VOLTAGE SELECTOR (SW201)
Section 4.1, page 12
Section 2.4, page 7

AC POWER TERMINALS (TB201)
Section 2.6, page 8

Figure 28 - POWER BOARD

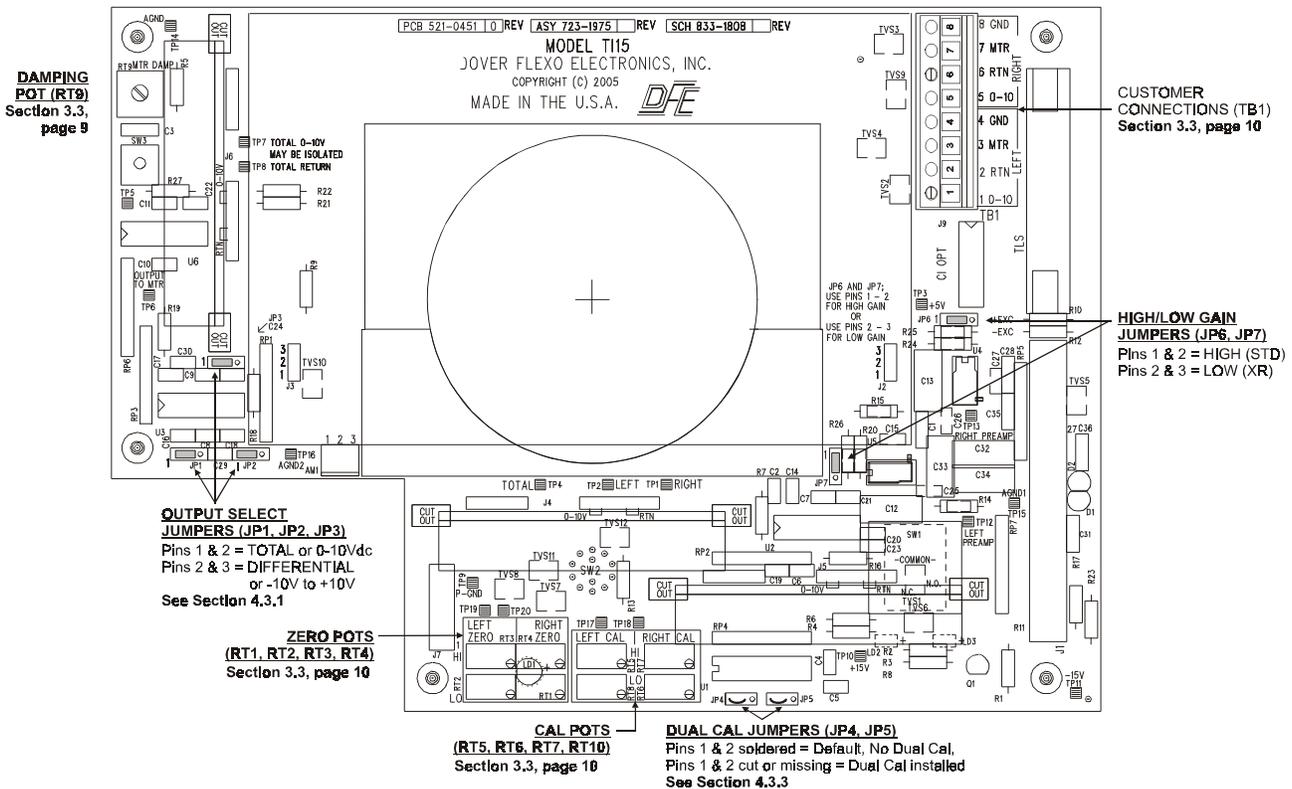


Figure 29 - INDICATOR BOARD

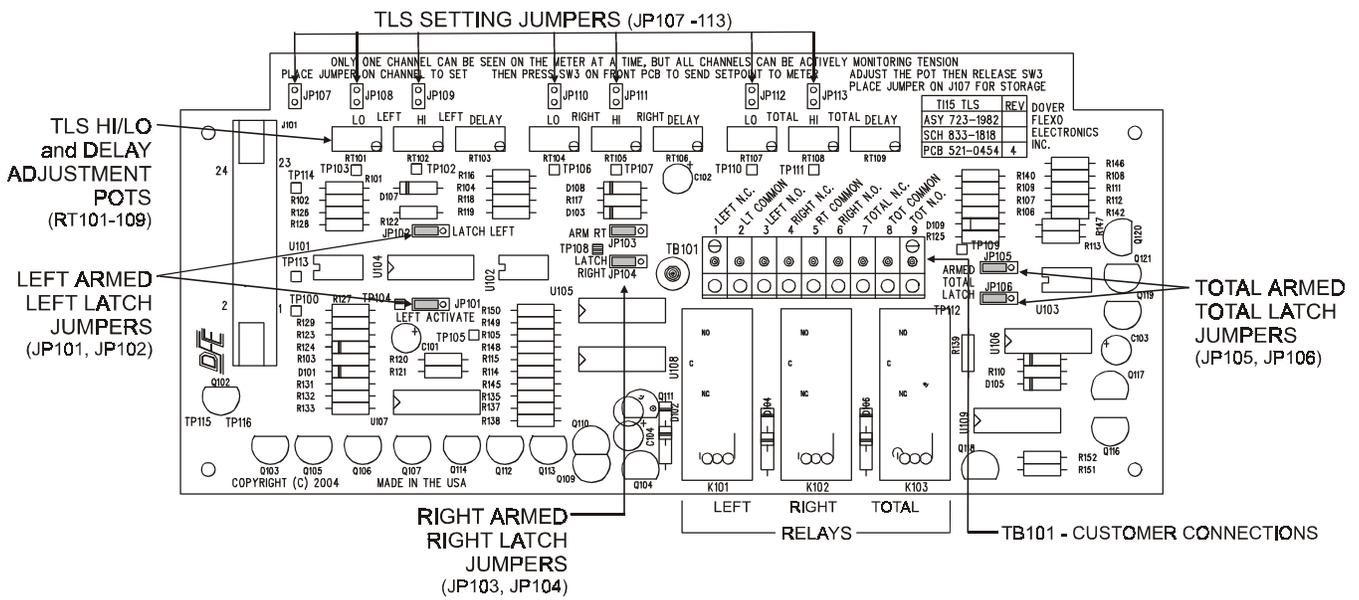


Figure 30 - TENSION LIMIT SWITCH BOARD

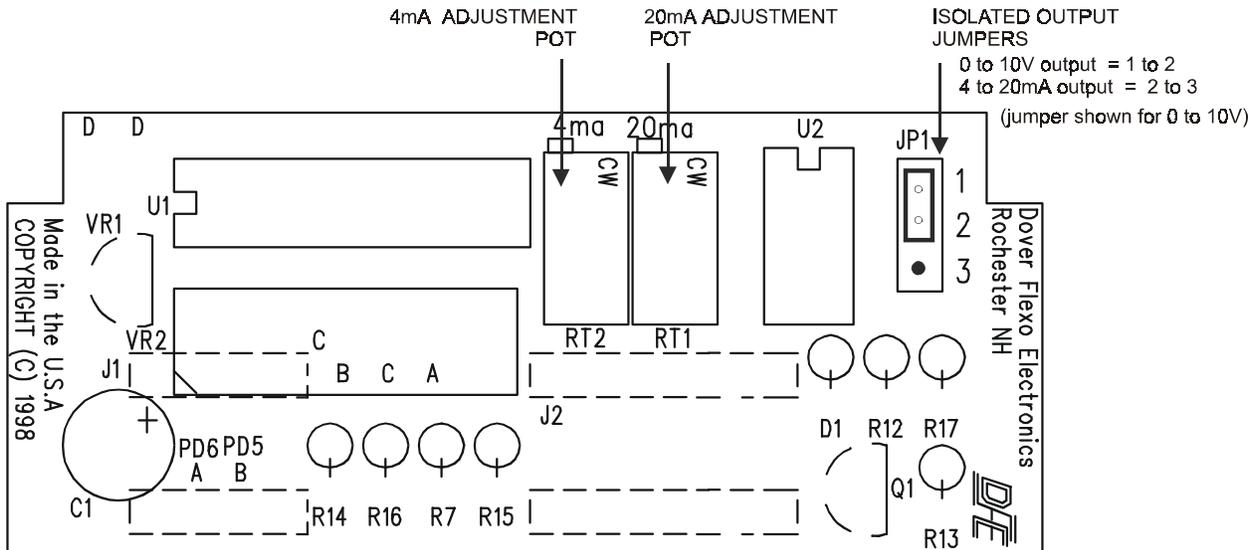


Figure 31 - ISOLATED OUTPUT BOARD

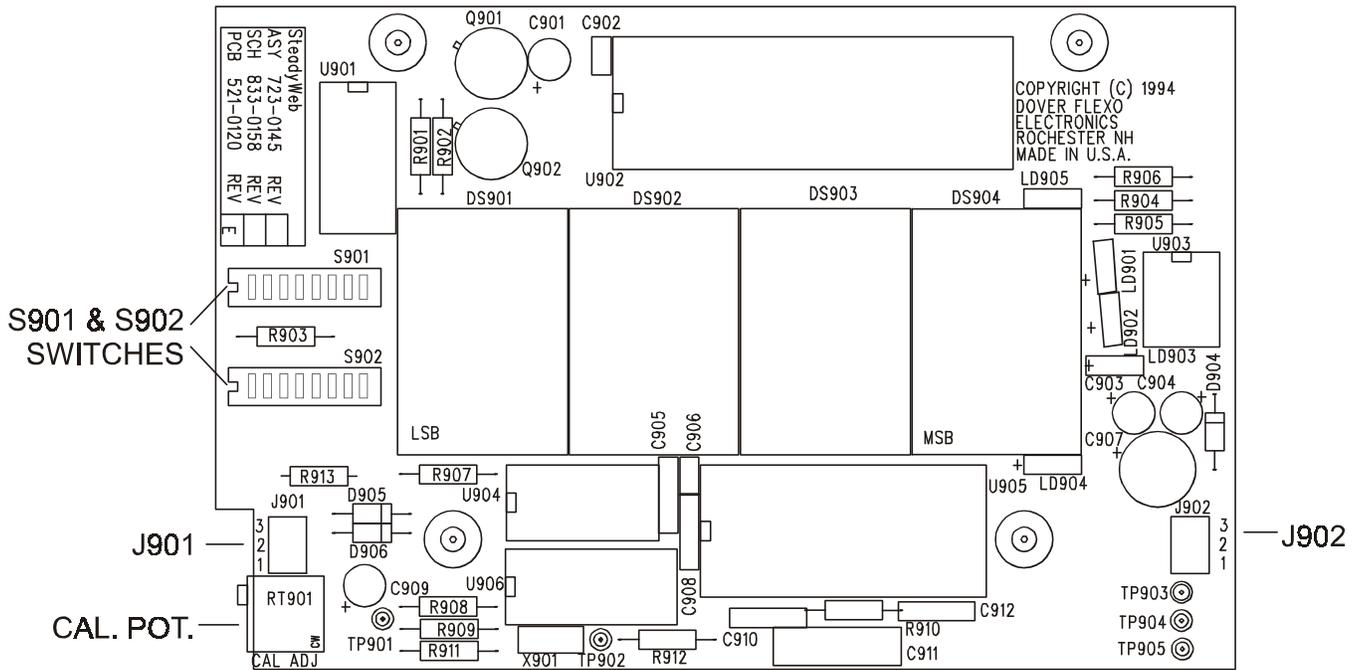


Figure 32 - DIGITAL METER BOARD

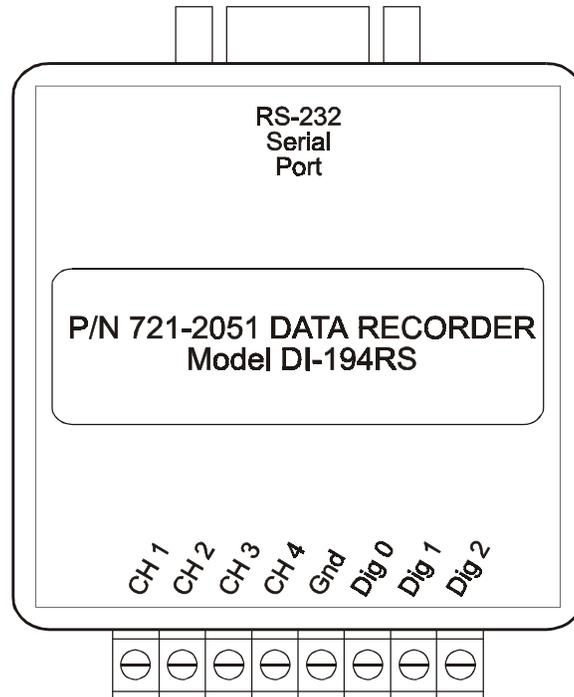


Figure 33 - COMPUTER INTERFACE (CI) DATA RECORDER MODULE

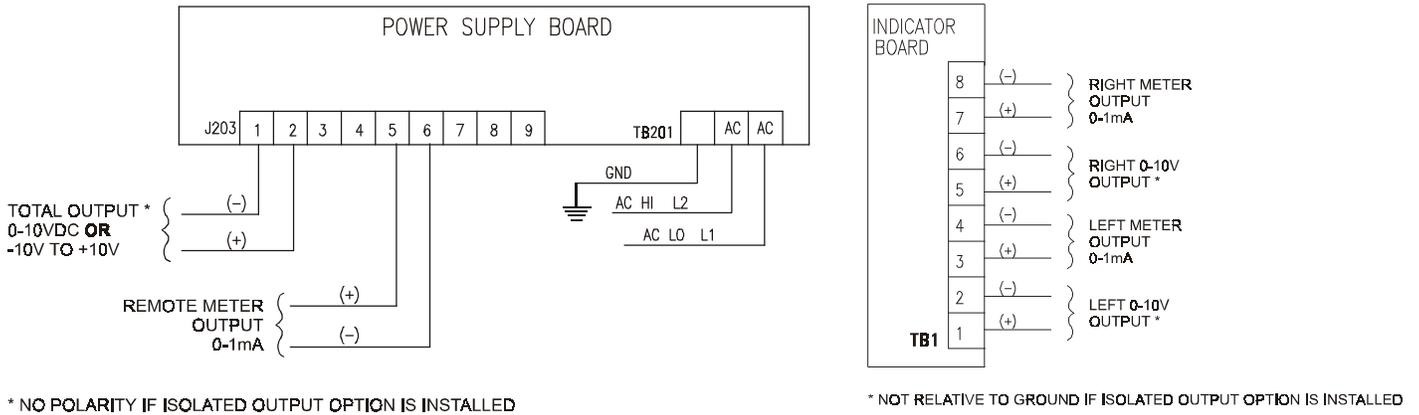


Figure 34 - STANDARD ELECTRICAL CONNECTIONS

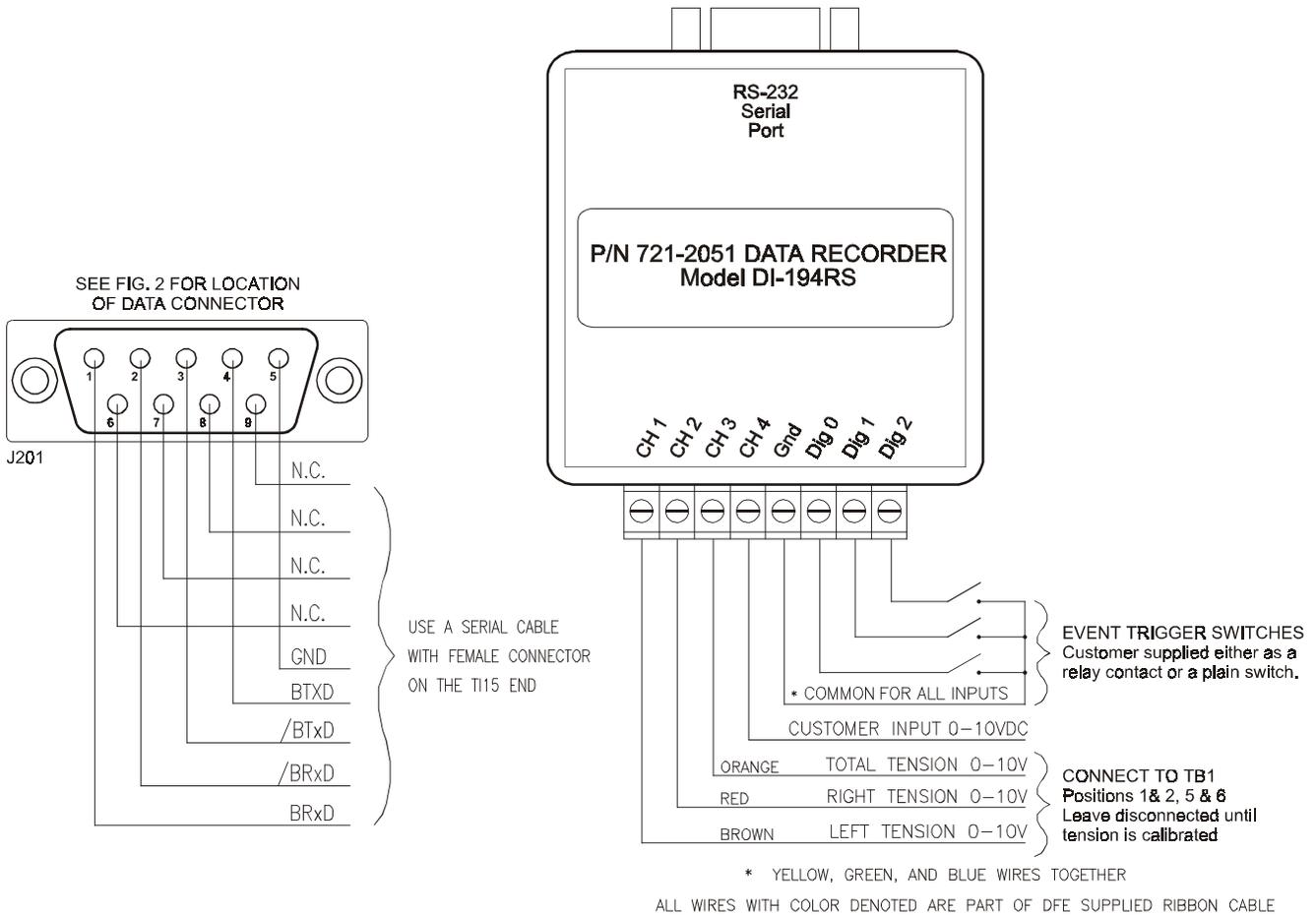


Figure 35 - COMPUTER INTERFACE (CI) DATA RECORDER CONNECTIONS

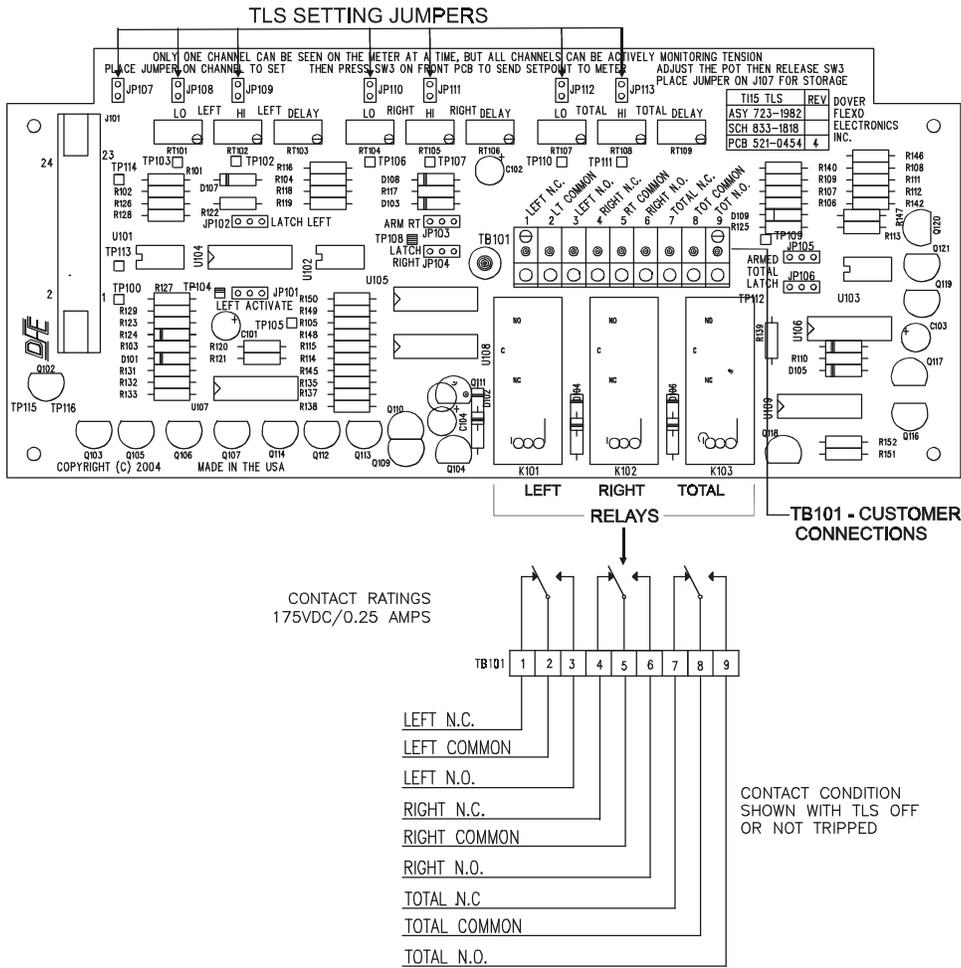


Figure 36 - TENSION LIMIT SWITCH RELAY CONNECTIONS

Appendix C:

Jumper & Switch Settings

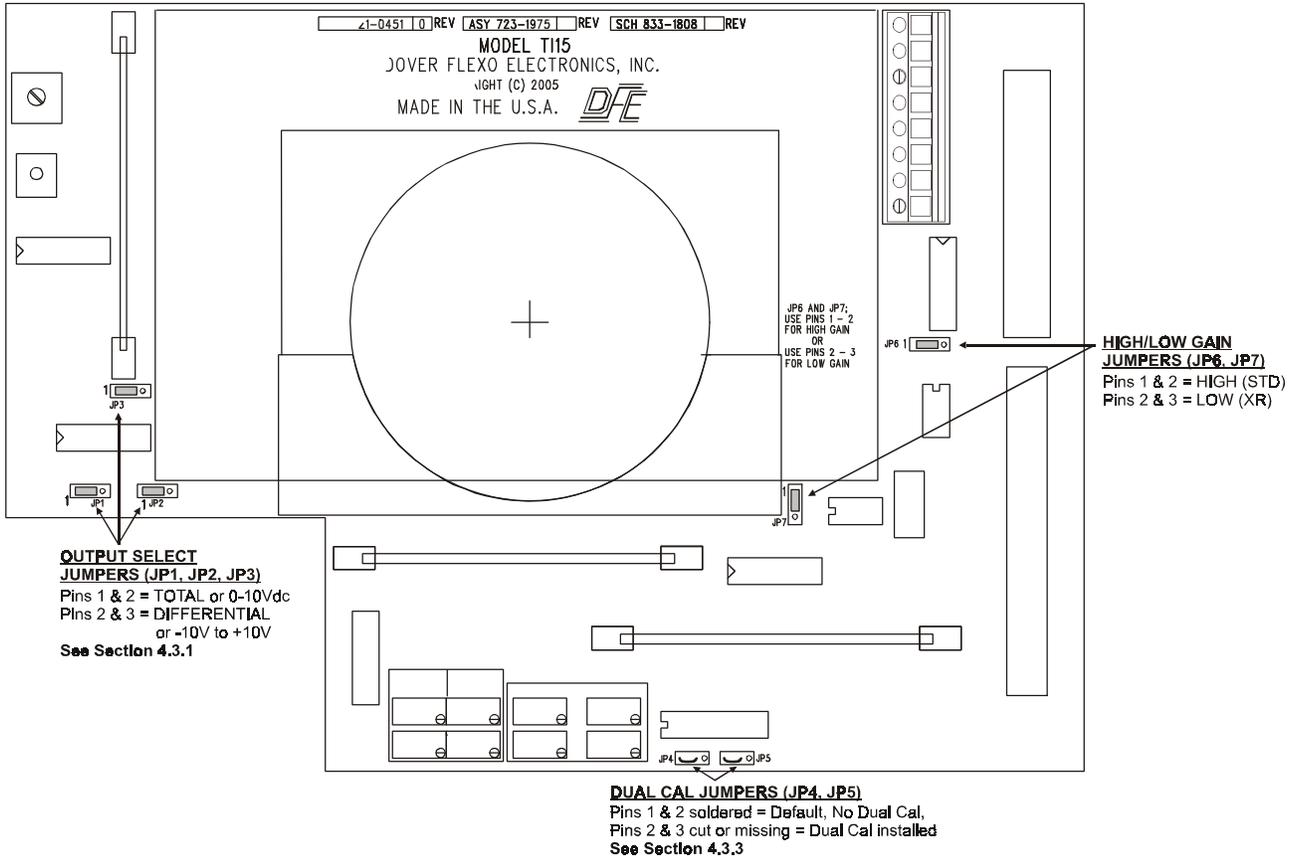


Figure 37 - INDICATOR BOARD JUMPERS

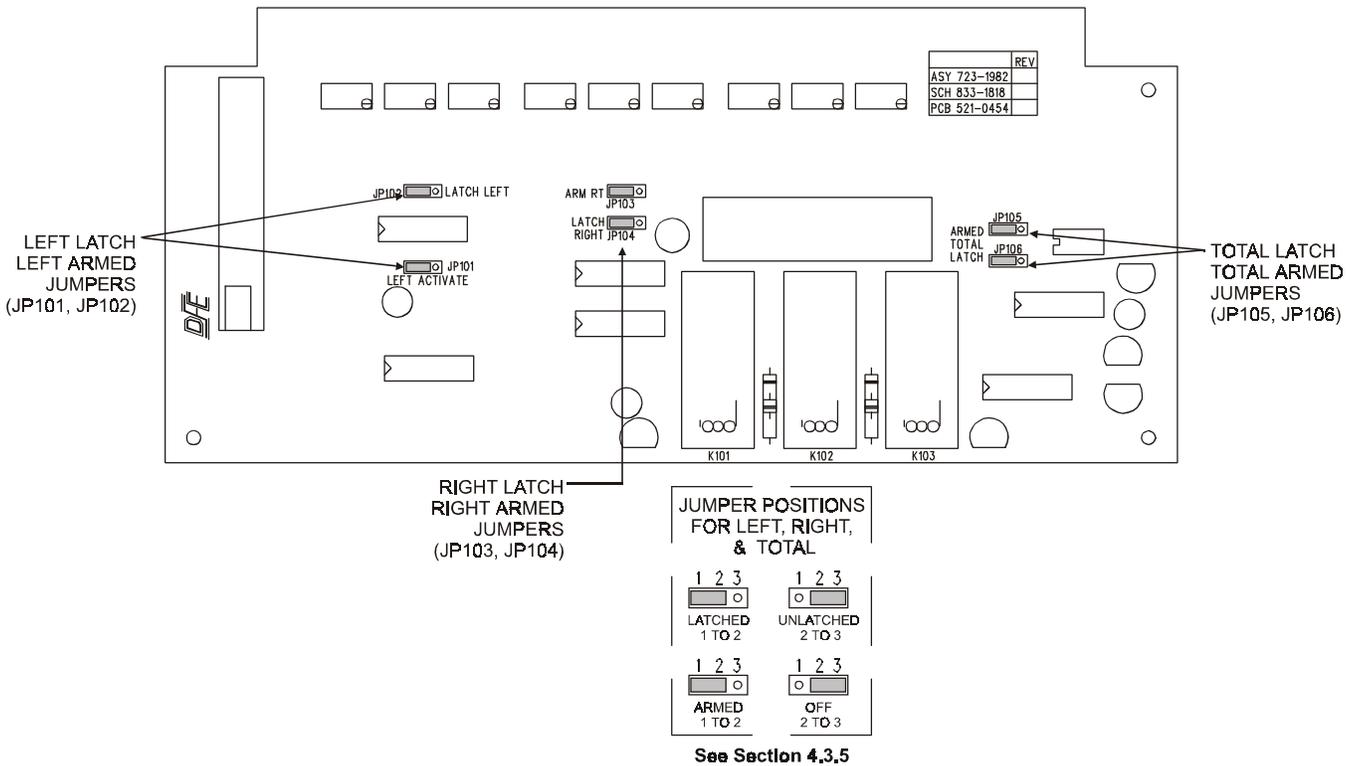


Figure 38 - TENSION LIMIT SWITCH BOARD JUMPERS

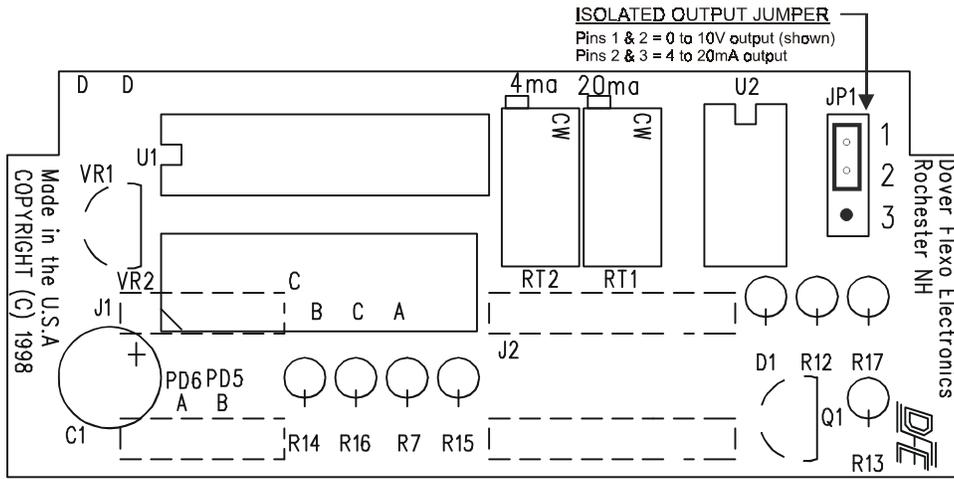
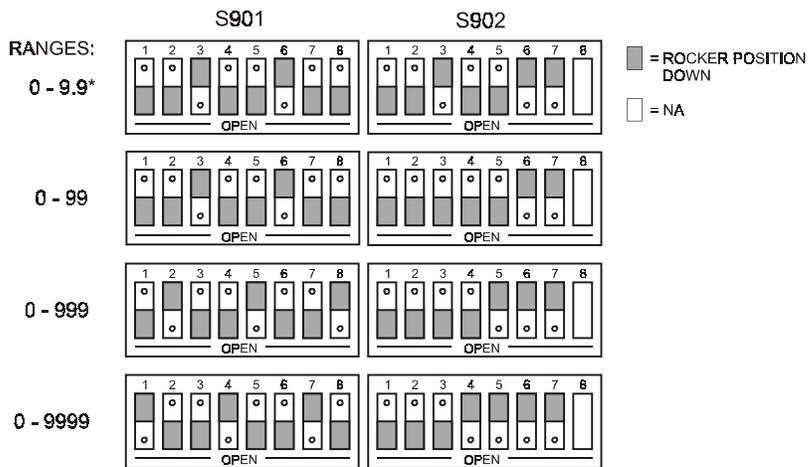
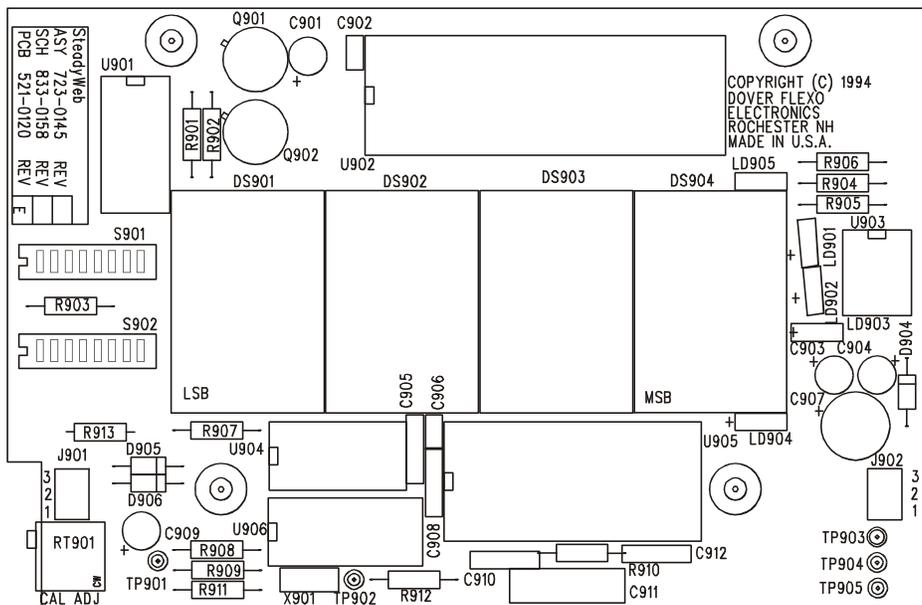


Figure 39 - ISOLATED OUTPUT BOARD JUMPERS (See Section 4.3.4)



* Use this range only if you really need the decimal point. Otherwise, use the 0-99 range settings

Figure 40 - DIGITAL METER BOARD SWITCHES (See Section 4.3.5)

Appendix D: Transducer Electrical Connections

MODELS C, RS, THN, AND UPB 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.

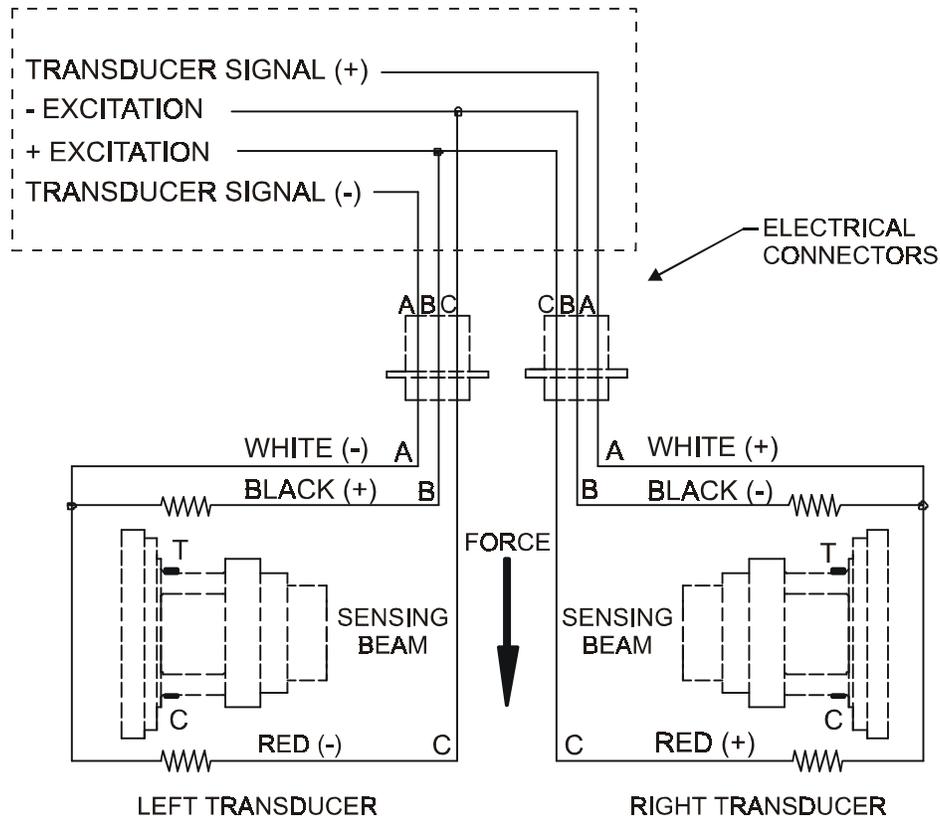


Figure 41 - MODELS C, RS, & UPB TRANSDUCER WIRING

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.

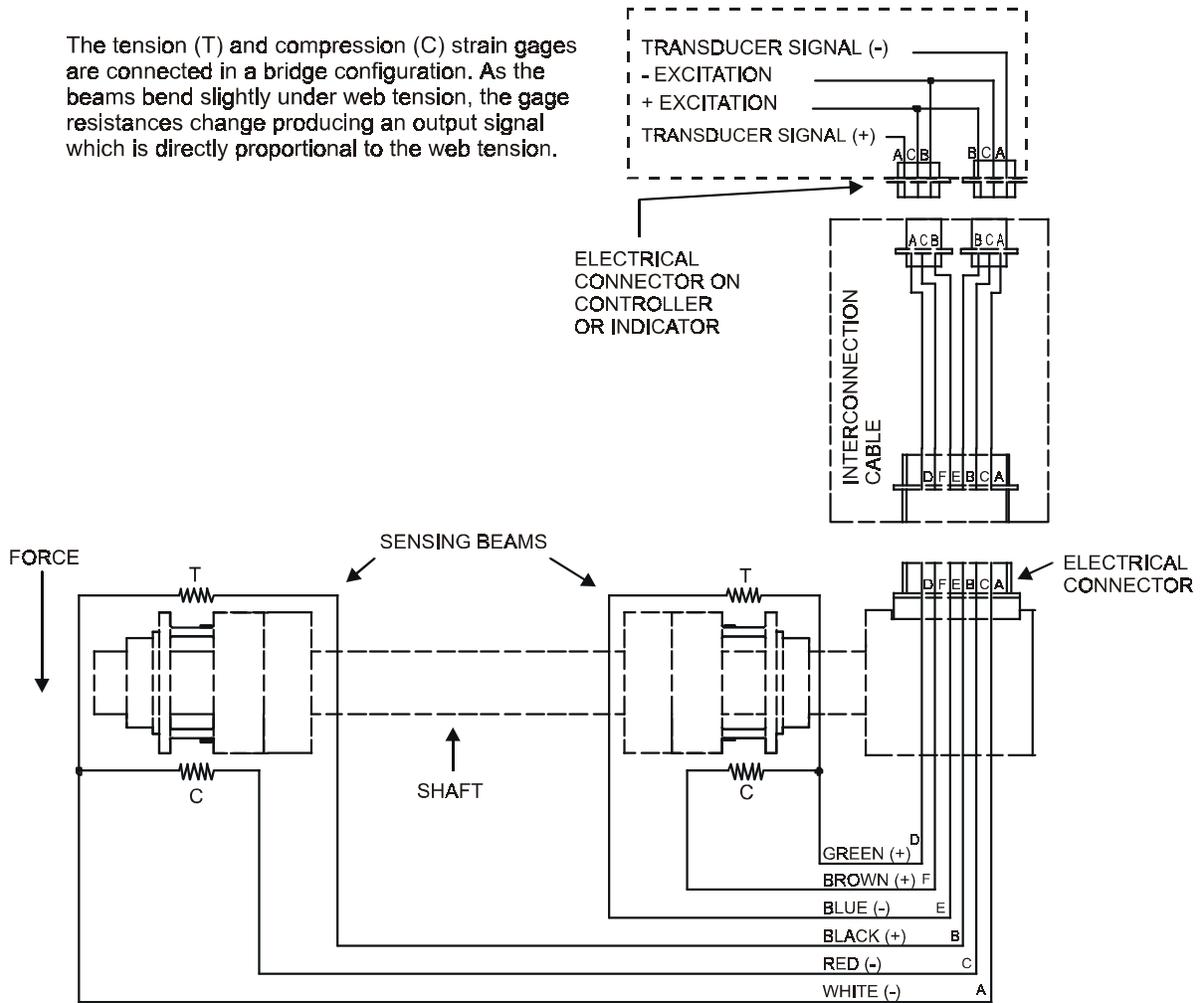


Figure 42 - TR & NWI TRANSDUCER WIRING

Appendix E: 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.

TERMS AND CONDITIONS OF SALE AND SHIPMENT

1. THE COMPANY

5/1/00

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 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.

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 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.

NOTES

NOTES

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