DOVER FLEXO ELECTRONICS, INC.
ISO 9001 CERTIFIED

TECHNICAL REFERENCE MANUAL

DIGITAL TENSION CONTROLLER

STEADYWEB™ 5

5 YEAR WARRANTY

DOVER FLEXO ELECTRONICS, INC.

217 Pickering Road

Rochester, NH 03867-4630 U.S.A.

For assistance, please call:

TECHNICAL SERVICE - Installations, Start-Up, Troubleshooting, Repairs, Field Service, Returns. **techsupport@dfe.com**

CUSTOMER SERVICE - Replacement Parts, Individual Products, Questions about Orders, Manuals. **customerservice@dfe.com**

SALES - Product Information, Systems Application Questions, and placing orders for standard products and special systems. **sales@dfe.com**

Telephone: (603) 332-6150 Fax: (603) 332-3758

E-mail: info@dfe.com Internet: www.dfe.com

READ THIS!

*** SAFETY INFORMATION ***

Please read this manual prior to installing and operating the controller. Take care to follow local codes and only allow properly trained individuals to operate or service the equipment. Failure to follow the manual's instructions and practice safe working habits could result in property damage, personal injury and/or death.

⚠ WARNING:
Before servicing the SteadyWeb 5, power should be removed from the device. Failure to do so could result in property damage, personal injury and/or death.

⚠ CAUTION:
The SteadyWeb 5 contains circuit boards with static sensitive devices. When working directly with these circuit boards, users should always practice proper grounding techniques, including the use of ground straps.

*** INSTALLATION AND SETUP INFORMATION ***

Your SteadyWeb5™ Controller 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 4 - Calibration
Section 6 - Tuning Adjustments

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

STEADYWEB™ 5 ORDER CODE

Your unit's order code description matches the labeled digits with your choices.

Example: SW5P-U-E-AC-100-RTA,TLS,

SW5X - X - X - X - XX - OPTIONS (Separated by commas)

OUTPUT	ZONE	PACKAGING	POWER	METER SCALE	OPTIONS
P = Pneumatic	U = Unwind	E = Enclosure	24 = 24 Vdc	1 = 0-1	230 = 230 Volt Power Input **(1,6)**
V = Electric	R = Rewind	O = Open (Panel mount)	AC = 100-240 Vac	3 = 0-3	24 = 24 Vdc Output **(1,6)**
D = Drive	I = Intermediate			5 = 0-5	420 = 4-20mA Output
				7 = 0-7	45 = 45 Vdc Output **(1)**
				10 = 0-10	B10 = Bipolar 10V Output
				15 = 0-15	DA = Diameter Alarm
				20 = 0-20	DB9 = Serial Data Connector **(2)**
				25 = 0-25	DRC = Din Rail Clip **(7)**
				35 = 0-35	MPF = Metric Pneumatic Fittings **(3)**
				50 = 0-50	NET = Ethernet option Card **(4)**
				75 = 0-75	RO = Reverse Output
				100 = 0-100	RS23 = RS232 Interface **(4)**
				125 = 0-125	RS48 = RS485 Interface **(4)**
				150 = 0-150	RTA = Remote Tension Amplifier
				200 = 0-200	SFD = Speed Follow by DC Tach
				250 = 0-250	SFP = Speed Follow by Pulse Tach
				300 = 0-300	TLS = Tension Limit Switch **(5)**
				400 = 0-400	TOR = Tension On Relay **(5)**
				500 = 0-500	TTD = Taper Tension by DC Tachs
				750 = 0-750	TTF = Taper Tension by Diameter Follower
				1000 = 0-1000	TTDP = Taper Tension by DC/Pulse Tachs
				1250 = 0-1250	TTP = Taper Tension by Pulse Tachs
				1500 = 0-1500	Z = Special (SPR)
				2000 = 0-2000	
				2500 = 0-2500	
				3000 = 0-3000	
				4000 = 0-4000	
				5000 = 0-5000	

Notes: **1.** V version only. 230 refers to power input of V module. 24 and 45 refer to output voltage. **2.** Used only for RS23 and RS48 options when having the enclosure configuration. **3.** P version only. **4.** Select only ONE of NET, RS23, or RS48 options. **5.** Select only ONE of TOR or TLS options. **6.** 230 Vac input not compatible with 24 Vdc output. **7.** VOUT enclosure only.

TABLE OF CONTENTS

APPENDICES

LIST OF ILLUSTRATIONS

SECTION 1 PRODUCT DESCRIPTION

1.1 GENERAL DESCRIPTION

The SteadyWeb™5 is a digital tension controller designed to automatically maintain tension of any continuous material at a value selected by the equipment operator. The controller combines ease of use with powerful control features and capability that allow for effortless configuration and utilization over a wide variety of tension control applications.

The SteadyWeb™5 can be powered by 24VDC or with a built-in 100-240VAC power supply and is available in panel mount and enclosure mount configurations. The controller is offered in multiple output versions. The intuitive user interface features a full color display, multipurpose spinning knob and a combination of multi-purpose (display context dependent) and dedicated purpose push buttons. Illustrated prompts and color graphics make set up a breeze and allow for a fast operator learning curve.

Basic functions of the controller are divided into three components: amplifier, tension regulator and output converter.

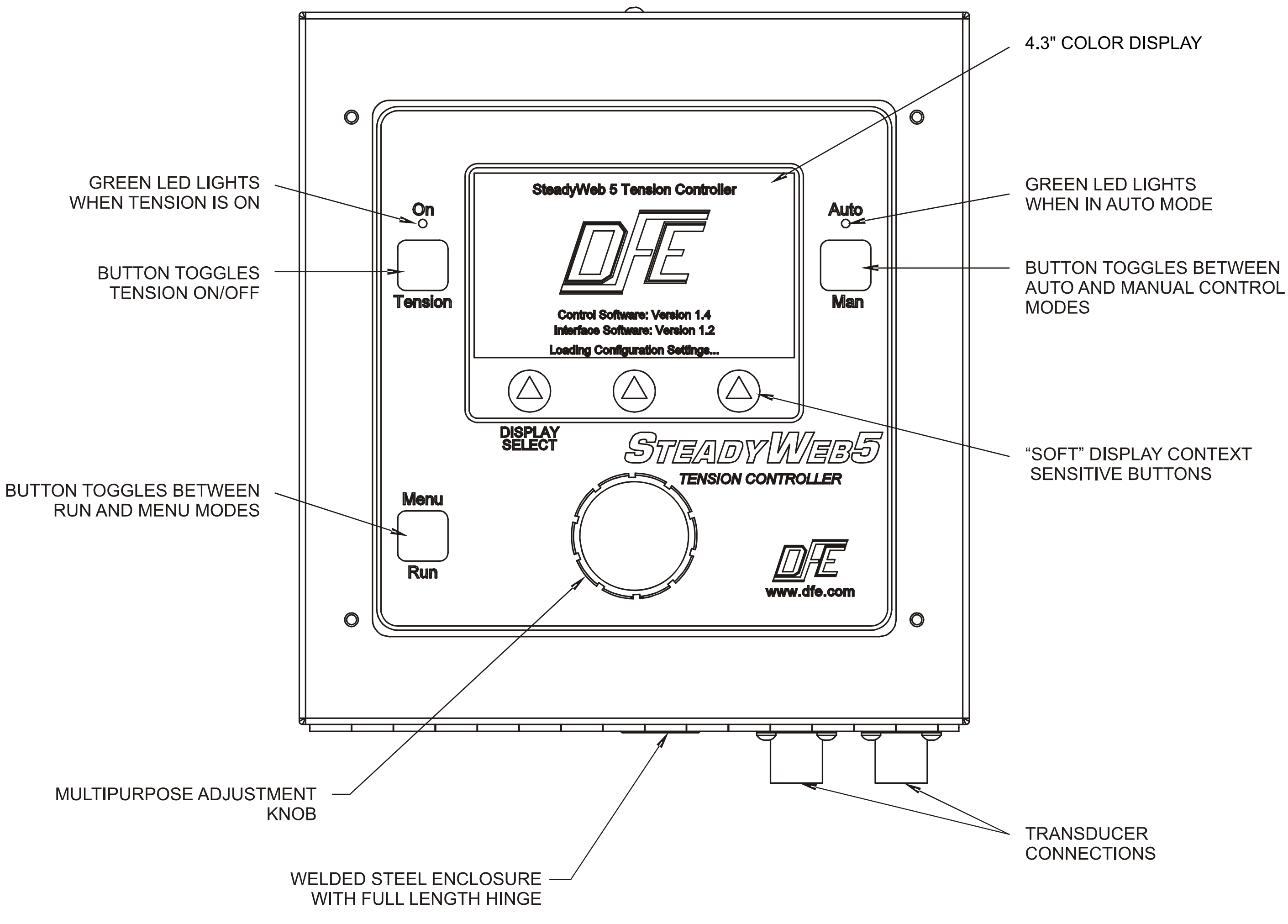


Figure 1 **- FRONT VIEW OF STEADYWEB™5**

Amplifier

The first component is a tension amplifier, which supports all Dover Flexo Electronics tension transducers (the transducers measure the actual web tension). It includes a regulated power supply to excite the transducers and circuitry to amplify and measure the transducer output signal. Intelligent excitation circuitry provides automatic excitation voltage selection and monitors for transducer wiring errors or fault conditions, such as a short circuit or open circuit conditions.

1.1 GENERAL DESCRIPTION *continued....*

Tension Regulator

The second component is the tension regulator. The controller compares the measured tension to the Auto setpoint value and adjusts an output signal to equalize the measured and desired tension. The regulator function is performed by software and may be influenced by other signal inputs, such as web speed and roll diameter, as dictated by operator adjustable settings. Regulation is achieved with a PID (Proportional, Integral, Derivative) based control loop with advanced capabilities such as roll diameter compensation and web acceleration compensation.

Output Converter

The third component is the output circuitry, which may vary depending on the controller version. The standard controller features an isolated control output voltage (adjustable range within the limits of +/- 10 Volts) or current (4-20 mA). Optional output converters include a high power (0 – 24/45/90 VDC @ 5 Amps) electrical output module or a (2 – 75 psi) pneumatic output module. The output signal is used to actuate a brake, clutch, or variable speed DC or AC drive which in turn creates the actual web tension.

⚠ 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:

AC versions of the SteadyWeb™5 controller 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 TENSION ZONES

Tension zones are created by driven or braked nip rolls, drag bars, braked unwind, 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.

Many machines that process a continuous web have more than one tension zone. The SteadyWeb™5 controller can be used in all tension zones, when properly configured for the zone it will be used in. See Figure 2 for examples of tension zones.

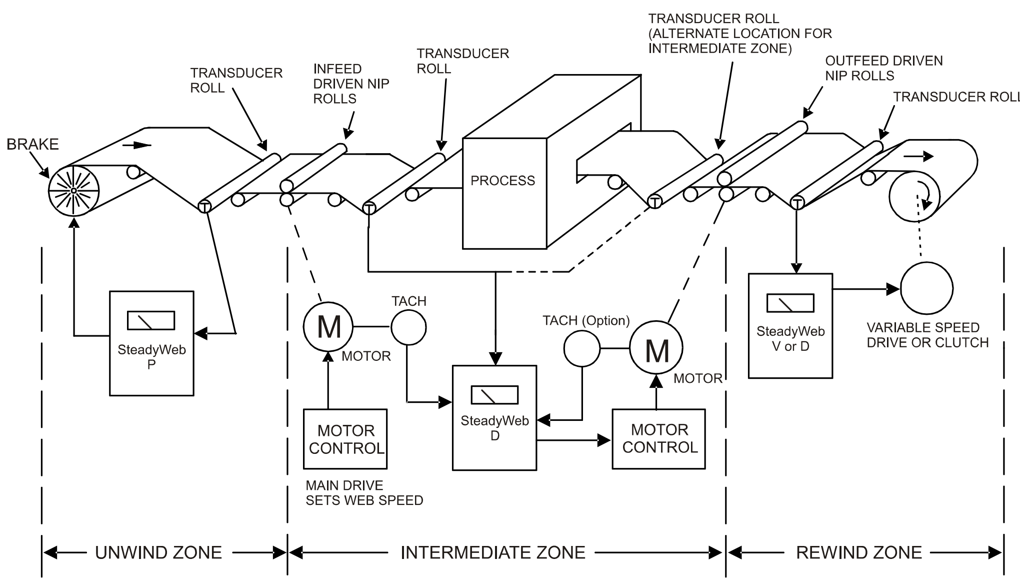


Figure 2 **- EXAMPLES OF TENSION ZONES**

1.3 VERSIONS OF THE CONTROLLER

The SteadyWeb™5 controller is available in multiple output, mounting and power configurations as described below.

A. OUTPUT The SteadyWeb™5 is available with one of three outputs:

1. **Standard Isolated Output (D)**. The standard D version is used to control DC drives or other variable speed drive systems. It offers a jumper selectable voltage or current output. The voltage output is from 0 to +/-10VDC, or a user adjustable range within that window, such as 0 to 10VDC, 0 to +/-5VDC, etc. The current output uses an industry standard 4 to 20mA signal. The control output is isolated from chassis and transducer ground.

1.3 VERSIONS OF THE CONTROLLER *continued...*

⚠ **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.

2. **Pneumatic Output (P).** The P version is used to actuate any air operated brake or clutch. It includes a servo valve, air filter and pressure regulator installed in a separate enclosure which is fed a 4-20mA signal from the D version of the controller (as described above). The pneumatic output range is 1 to 75 psi (0.07 bar to 5.17 bar).
3. **High Voltage Output (V).** The V version uses a Silicon Controlled Rectifier (SCR) to produce a standard variable voltage of up to 90VDC to operate any brake or clutch, including eddy current clutches. 45VDC and 24VDC outputs are optional (24VDC not available with 230VAC input). The high voltage output circuitry is housed in a separate enclosure which is fed a 0-10V signal from the D version of the controller (as described above).

B. MOUNTING The controller is available in two mounting configurations.

1. **Open Mount (O)**. The open (panel) mount version can be mounted directly into a cabinet or enclosure cutout.
2. **Enclosure Mount (E)**. The enclosed version can be mounted against any surface strong enough to reliably support the controller.

C. POWER The controller is available in two power versions.

1. **24VDC (24)**. The DC version is powered from a 24VDC +/-10% supply.
2. **AC (AC)**. The AC version includes a universal AC power supply, which can be powered from a 100-240VAC, 50-60Hz supply.

⚠ **WARNING**:

AC versions of the SteadyWeb™5 controller 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.

1.4 SPECIFICATIONS

Power Input:

DC:

- 24VDC +/-10% , 0.6 Amps Typical, 2.2 Amps Internal Fusing (resetting thermal fuse)

Optional AC Supply:

- 100-240VAC +/-10%, 50-60Hz single phase
- 2.2 Amps @ 115VAC Typical
- 1.2 Amps @ 230VAC Typical
- Inrush Current 40A @ 230VAC (cold start)

Control Output:

Version D

- 0 to +/-10VDC OR 4-20mA (jumper selectable), both isolated from input power and transducer circuitry

  - 0 to +/-10VDC max loading is 5mA. This requires a 2000 Ohm or greater input resistance for equipment connected to this output

  - 4-20mA max loop resistance is 500 Ohms.

Tension Output:

All Versions:

- 0 to +10VDC OR 0 to 1mA (jumper selectable)

  — 0 to +10VDC max loading is 5mA. This requires a 2000 Ohm or greater input resistance for equipment connected to this output
- 0 to +10VDC and 0 to 1mA signal capable of under-range and over-range, -14% to 120% of full scale (-1.4VDC to 12VDC / -0.14mA to 1.2mA), to indicate over-range or error conditions

  — 0 to 1mA meter output designed for 50 Ohm impedance meter.

Transducer Excitation:

- 5VDC for STD transducers, 10VDC for XR transducers (automatically software set per sensed transducer resistance, or manually fixed through user configuration settings)
- 35mA per half bridge (70mA total) software short circuit protection
- Duration of excitation short-circuit: Infinite

1.4 SPECIFICATIONS *continued* . . .

Transducer Signal Input:

- 500mV at rated load per pair of STD transducers
- 1,000mV at rated load per pair of XR transducers

Customer 10/15VDC Supply:

- 10/15VDC (jumper selectable), 100mA max load.

Digital Inputs:

- Soft Start, Hold, Ratio, Remote Tension On, Remote Tension Off, Remote Auto, Remote Manual
- Activated by contact with power ground (falling edge)
- Internal weak pull-up resistors to 3.3VDC
- Max 24VDC input protection

Digital Outputs:

- 3.3V digital diameter alarm output

Analog Signal Inputs:

- Line Speed, Roll Speed, Diameter, Remote Auto Setpoint, Remote Manual Setpoint, RTA1, RTA2
- Designed for 0-10VDC input signal, 0-12VDC range sense capability
- Max 24VDC input protection

Tension Precision:

- Max error of 1% over temperature range. 0.1% Typical

Zero (Tare) Range:

- Minimum 95% of transducer rating

Calibration Range:

- Minimum 50 : 1

Control Loop Time:

- Less than 5mSec

Transducer Tension Analog to Digital Converter (ADC) Resolution:

- 16-Bit at 242Hz sample rate
- 20.62µV Resolution with 5V Excitation (STD Transducers)
- 41.24µV Resolution with 10V Excitation (XR Transducers)

Analog Signals* Analog to Digital Converter (ADC) Resolution:

- * (Line Speed, Roll Speed, Diameter, Remote Auto Setpoint, Remote Manual Setpoint, RTA1, RTA2)
- 12-Bit at 242Hz sample rate
- 2.93mV Resolution

Control Output Digital to Analog Converter (DAC) Resolution (D Version):

- 12-Bit at 242Hz update rate.
- -10VDC to 10VDC Out: 6.0mV Resolution
- 4-20mA Out: 9.6µA Resolution

Tension Output Digital to Analog Converter (DAC) Resolution:

- 12-Bit at 242Hz update rate.
- 0-10VDC Out: 3.3mV Resolution
- 0-1mA Out: 0.33uA Resolution

Pneumatic Enclosure (Version P only):

- Air Input: 125 psi Max.
- Air Output: 2 to 75 psi (0.07 to 5.17 bar)
- Servo Valve Drive: Signal: 4 to 20mA
- Air Connection In: 3/8" NPT
- Air Connection Out: 1/4" NPT

High Voltage Output Module (Version V only):

Power Input:

- 115 OR 230VAC 50/60Hz single phase
  Note: 115 / 230 VAC factory set. Specify when ordered
- Input Power fused at 5,125A @ 115 VAC
  Input Power fused at 5.063A @ 230VAC
- Low Voltage Circuitry fused at 125mA @ 115VAC
  Low Voltage Circuitry fused at 63mA @ 230VAC

Output:

- 0 to 24, 45, or 90VDC, all @ 5 Amp with 115VAC In OR
- 0 to 45 or 90VDC, all @ 5 Amp with 230 VAC In

Signal Input:

- 0-10VDC

1.4 SPECIFICATIONS *continued. . .*

Optional Pulse Tachometer Card:
- Input: 0-50kHz, 1-50VDC pulses

Optional DC Tachometer Card:
- 5-15VDC Input: 0-15VDC
- 15-250VDC Input: 0-250VDC

Optional Relay Card:
- Max Voltage: 230VAC
- Max Current: 5A (with resistive load)

Optional Ethernet Card:
- IEEE 802.3 compliant, 10BASE-T Ethernet Communications
- Embedded Web Server Interface

Optional RS485 Card:
- Selectable Baud Rate: 4800, 9600, 14400, 19200
- Modbus RTU Interface
- Jumper Configurable 2 or 4 wire mode

Optional RS232 Card:
- Selectable Baud Rate: 4800, 9600, 14400, 19200
- Modbus RTU Interface, Jumper Configurable Null Modem or Standard communication

Optional Enclosure:
- Steel, powder resin painted, NEMA 1
- Dual Transducer Connectors - Amphenol MS3106A-10SL-3S

Weight:
- DC Panel Mount: 1.6 lbs. (0.73 kg)
- AC Panel Mount: 3.1 lbs. (1.41 kg)
- DC Enclosure Mount: 5.1 lbs. (2.32 kg)
- AC Enclosure Mount: 6.6 lbs. (3.00 kg)
- Pneumatic Module: 4.6 lbs. (2.09 kg)
- High Voltage Output Module: 2.9 lbs. (1.32 kg)

1.5 ENVIRONMENTAL CONDITIONS (Ref. Appendix F 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.

1.6 STANDARD FEATURES

- **Flexible, Powerful Configuration.** The controller can be utilized in unwind, rewind, or intermediate tension zones. It can be configured for standard (transducer feedback only) tension control, for line speed follow with tension trim or for diameter compensated line speed follow with tension trim modes of control. The PID based control algorithm features adaptive diameter compensation and acceleration compensation capability to handle a wide array of tension control applications.
- **Informative, Intuitive User Interface**. The SteadyWeb™ 5 user interface features a full color 4.3" display for presenting real time tension and related process information and facilitating controller configuration and calibration. Illustrated prompts and color graphics make set up a breeze and allow for a fast operator learning curve. Real time information is displayed in a clear and highly configurable manner with operator selectable use of bar graphs, line graphs, or an analog meter. The menu system is easily navigable and on screen information pages are provided for every menu, setting and function, acting as an on-screen manual. A multipurpose spinning knob and a combination of multipurpose (display context dependent) and dedicated purpose push buttons provide natural user interaction.
- **Multiple Stored Setups**. Up to 30 Setups can be stored in addition to the ACTIVE Setup. Operator programmable descriptive Setup names are possible with the controller's alphanumeric naming capability. Setups can be uploaded and downloaded to a PC via a USB port.

1.6 STANDARD FEATURES *continued...*

- **Anti-Tamper Switch (Operator Lockout)** Disables operator access to certain menu functions and settings.
- **Automatic Excitation Voltage Selection**. An intelligent transducer excitation system allows the controller to automatically adjust the excitation voltage in accordance with the connected transducer type; 5VDC for Standard (STD) transducers or 10VDC for Extended Range (XR) transducers. The system is also capable of detecting transducer wiring errors or fault conditions, such as a short circuit or open circuit conditions. Automatic excitation power shut down during short circuit or over-current conditions help protect both the controller and the connected transducers from damage.
- **Digital Calibration and Control Technology**. Digital transducer calibration and tension control settings mean the controller will not suffer from the time, temperature or vibration induced drift that can be associated with analog circuitry and components.
- **Isolated Control Output**. Standard +/-10VDC (or a user adjustable range within +/-10VDC) or 4-20mA (jumper selectable) control output isolated from chassis and transducer ground. Designed to prevent ground loop and noise issues common in industrial environments.

  ⚠ **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.
- **Remote Tension Readout.** 0 to 10VDC or 0 to 1mA (jumper selectable) external meter or monitoring output proportional to tension. The 0 to 1mA output is designed to drive a 50 Ohm meter.
- **Display Tension Damping.** Adjustable tension damping reduces flicker on the display and makes the tension readout more readable in certain situations.
- **Tension Limit Switch (TLS).** An alarm is triggered to alert operators to preset low or high tension conditions. A TLS alarm message is displayed on the LCD and an optional relay can be energized. The alarm can also be configured to disable the control output. Purchase TLS option to get relay for external alarm use.
- **Soft Start.** Used on braked unwinds. Actuated either automatically upon a loss of tension below a preset trip point (after an adjustable delay), by machine speed dropping below a preset speed trip point (after an adjustable delay), or immediately upon an external contact closure. In Soft Start mode, controller output is reduced to a preset (user adjustable) low level to prevent brake lockup when the machine starts. When tension or line speed rises above their respective trip points or the Soft Start contact opens, the controller output switches to automatic control mode through a bumpless transfer.
- **Taper.** Used in rewind zones. Taper causes tension to decrease as the roll diameter increases. The roll diameter is calculated from line and roll tachometer signals or measured directly by a follower roll or ultrasonic sensor. Taper helps produce a better quality roll by eliminating telescoping, crushed cores and too tight or too loose rolls.
- **Hold / Ratio.** Used to sample and hold and/or ratio the output or setpoint. Ratio can also be used to ratio to the real time line speed to allow for a smooth transfer between rolls in rewind splicing applications.
- **Remote User Control Inputs.** Terminal block inputs are provided to allow for remote Tension On / Tension Off and Auto mode / Manual mode toggling using external switches or relays. Analog terminal inputs are also provided for remote Auto setpoint and Manual setpoint signals, either from a potentiometer or from an external 0-10VDC source, such as from a Programmable Logic Controller (PLC).
- **Remote Tension Amplifier Inputs (RTA) .** Two sets of RTA inputs allow bypassing the internal tension amplifier to provide a tension signal by an external remote amplifier or indicator. This allows use of special amplifier functions, such as intrinsic safety, which are not available in the SteadyWeb™5 controller, or to connect multiple pairs of transducers to the controller.
- **Analog Line, Roll and Diameter Inputs.** 0-10VDC input terminals are provided for Line Speed, Roll Speed, and Roll Diameter input signals. The speed inputs can be fed from tachometer outputs and the diameter input can be fed from a rider assembly or ultrasonic range finder. These signals can be used for Line Speed Follow and Diameter Compensated Line Speed Follow modes of operation. These signals can also be used for advanced tuning functions, such as Acceleration Compensation and Diameter Compensation. Optional tachometer cards can be used to handle voltages outside the 0-10VDC range or to interface with pulse tachometers.
- **+10/15VDC Customer Supply.** A jumper selectable 10VDC or 15VDC, 100mA supply is provided to feed external potentiometers or to power diameter measurement sensors.
- **Manual Control Mode** The controller output is determined only by the setting of the Manual setpoint value. No output change occurs unless the setting is changed. Used during machine set up or troubleshooting.

1.6 STANDARD FEATURES *continued. . .*

- **Automatic Control Mode** The controller output is determined by the difference between the web tension and the Auto setpoint value. The internal regulator automatically varies the output as required to maintain the set tension.
- **Emergency Stop** The controller immediately goes into full output or minimum output (jumper selectable) upon a break in the Emergency Stop circuit. Full output is traditionally used in braked unwind applications, to stop the roll of material quickly. Minimum output is used for other applications. The Emergency Stop circuit can be bypassed if no Emergency Stop function is desired.

1.7 OPTIONS

- **230 Volt Power (230)**. 230 volt 50/60 Hz power input. V version only. (For V-out module, controller can be 24Vdc).
- **24V or 45V Output (24,45).** Version V only. 24V available only with 115Vac power input.
- **4-20mA Output (420)**. 4-20mA current output. This replaces the standard 0-10V control output.
- **Bipolar 10 Volt Output (B10).** -10V to +10V output. Used on bi-directional machines (ex: inspection machine), or in Line Speed Follow. D version only.
- **Diameter Alarm (DA)**. Unit produces an output at a pre-determined roll diameter. Requires diameter signal.
- **Speed Follow**. This is a function normally used on Version D controlling tension in an intermediate zone or surface driven rewinds and unwinds. The Control board contains a regulator circuit, separate from the tension regulator, that can accept a 0 to 10V line speed signal, one from a DC tach **(SFD)**, or a pulse tach **(SFP).** The line speed signal causes the output of the controller to follow (go up and down with) line speed. The output of the tension regulator then trims the follower output as needed to maintain set tension.
- **DIN-Rail Mounting Clip (DRC).** Fits 35mm DIN rail. Available only on V version, for V-Out Module.
- **Metric Pneumatic Fittings (MPF)**. "P" Version only.
- **Reverse Output (RO)**. Increases output when tension exceeds set point, and decreases when tension drops below set point. Used in intermediate applications where transducers are located after the nip rolls being controlled by the transducers or for driven unwinds.
- **RS232 (RS23)** or **RS485 (RS48)**. An optional communications card provides serial communication using the MODBUS RTU protocol, allowing easy integration with computers or PLCs.
- **Serial Data Connector (DB9).** 9-pin connector for data transfer when using the RS232 and RS485 options. Enclosure version only.
- **Ethernet Option Card (NET)**. An optional 10/100 Base-T Ethernet Card with RJ45 Jack for remote web access.
- **Remote Tension Amplifier (RTA)**. The internal tension amplifier is bypassed and the tension signal is provided by an external remote device such as the FireGuard™. This allows use of special indicator functions, such as intrinsic safety, which are not available in the SteadyWeb™5 controller or additional transducers.
- **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. Low and high trip points are independently adjustable. Trigger delay is adjustable. Includes relay for triggering external alarm or light. Not compatible with TOR option - only 1 relay per controller.
- **Tension on Relay (TOR).** Relay Card The Relay card provides a 250V, 5A relay interface. The relay function is operator adjustable, and can be used for various functions such as a Tension On or Tension Limit Switch indicator. Not compatible with TLS relay function - only 1 relay per controller.
- **Taper Tension**. For rewind applications only. Causes tension to decrease as roll diameter increases as calculated electronically using inputs from: two DC tachs **(TTD)**, two pulse tachs. **(TTP)**, one DC tach and one pulse tach **(TTDP)**, or as sensed by a follower roll or ultrasonic sensor **(TTF)**. Helps produce a better quality roll by eliminating telescoping, crushed cores, too tight or too loose rolls. Taper is adjustable from 0 to 100%.

1.8 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, meter included).
- **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, meter included). Must be installed and powered (+24V) by user.
- **Ultrasonic Roll Diameter Sensor.** Compact user-adjustable sensor with a 0-10V output proportional to target distance. P/N 149-0002.

DFE also offers a wide variety of interconnect cables. Please consult your Applications Engineer for more information.

SECTION 2 INSTALLATION

2.1 DIMENSIONS inches (mm)

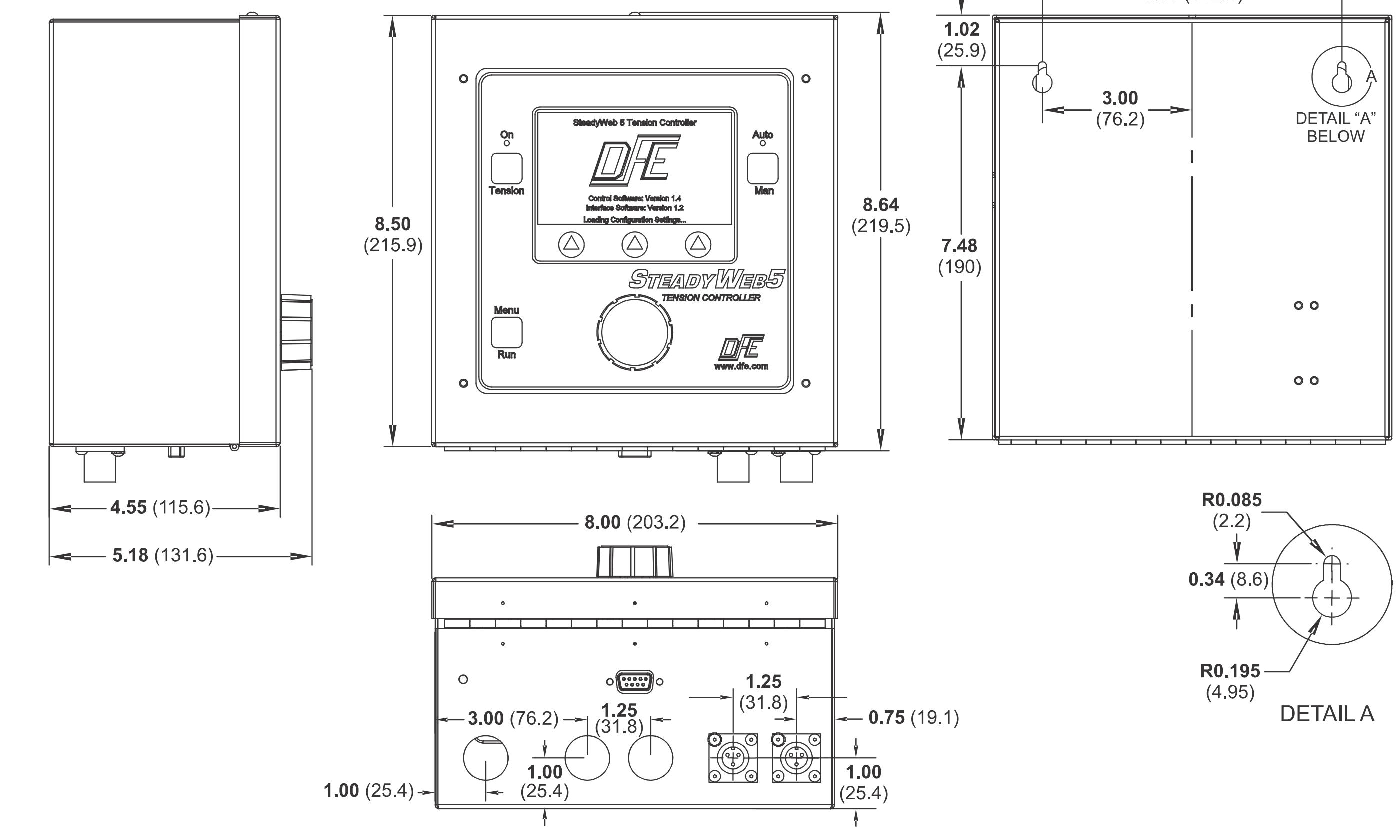


Figure 3 - **ENCLOSURE VERSION DIMENSIONS and VIEWS**

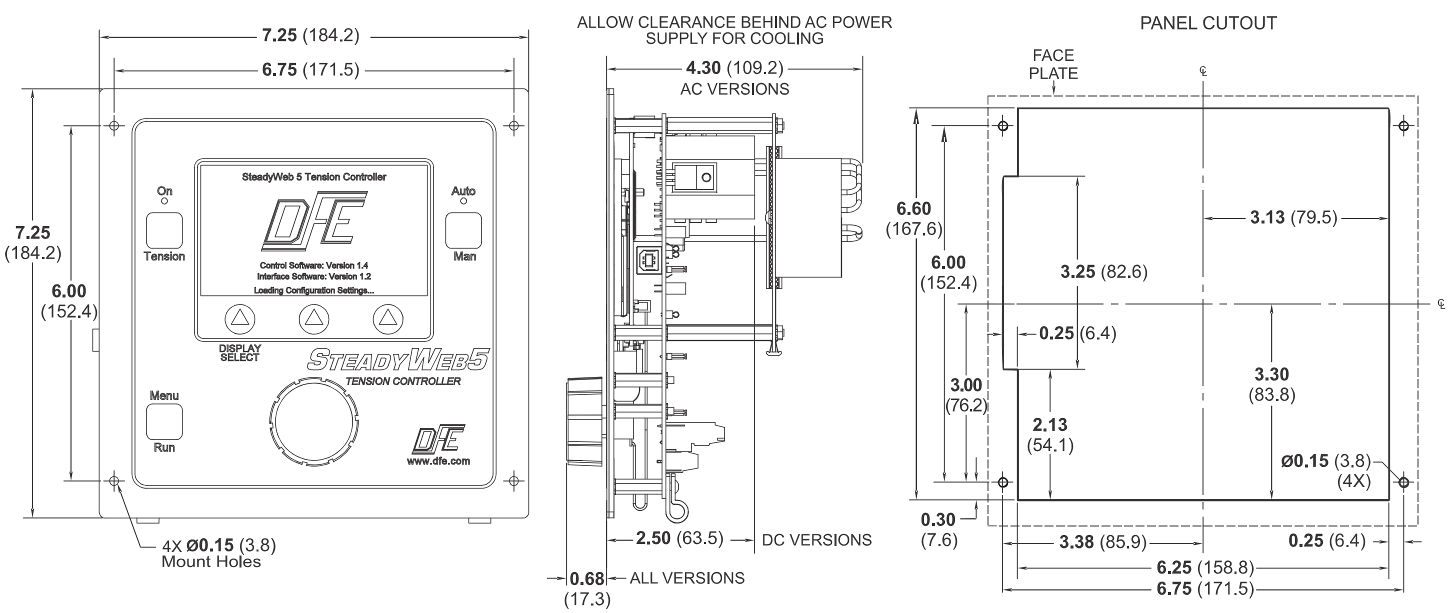


Figure 4 - **PANEL VERSION DIMENSIONS and VIEWS**

2.1 DIMENSIONS *continued...*

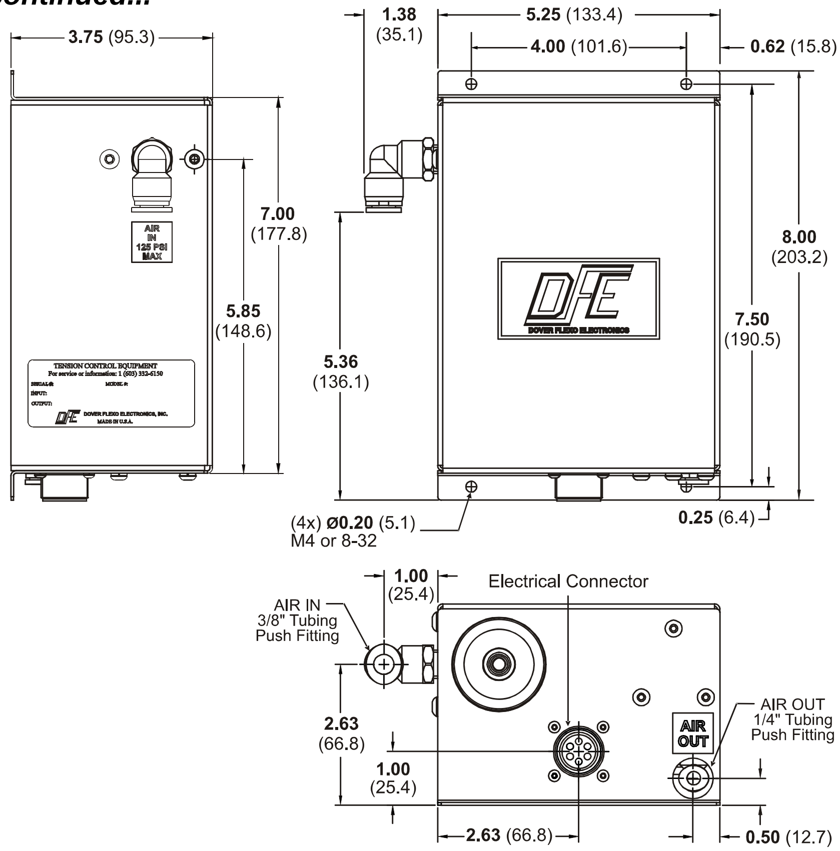


Figure 5 - **PNEUMATICS ENCLOSURE DIMENSIONS FOR VERSION P**

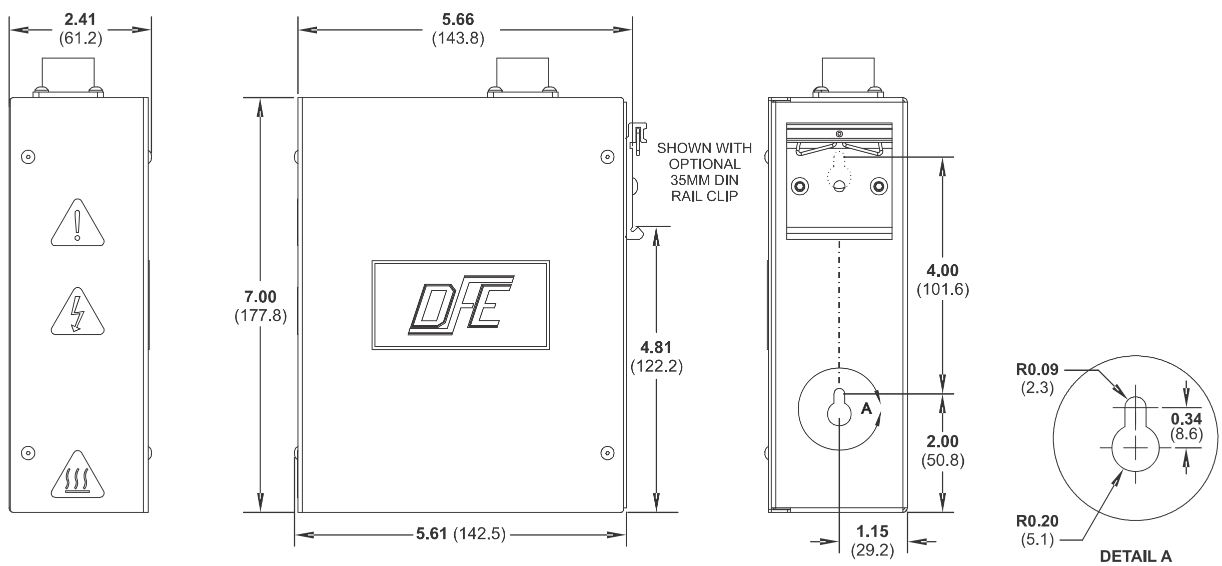


Figure 6 - **HIGH VOLTAGE OUTPUT ENCLOSURE DIMENSIONS FOR VERSION V**

2.2 SELECTION OF MOUNTING LOCATION

1. Enclosure Mount Versions

Select a mounting location on the machine frame or a wall that will provide convenient operator interaction and easy screen viewing. To ensure safety and proper operation, the SteadyWeb™ 5 must be located away from dusty or wet environments. The unit should be mounted to a secure wall or surface that can support in excess of 30 lbs. (13.6 kg). As the controller's front panel is hinged to the bottom of the enclosure, ensure that the mounting location will allow the front panel to swing open and down unobstructed. In addition, ensure there will be adequate room below the controller to allow for wire routing.

2.2 SELECTION OF MOUNTING LOCATION *continued..*

2. Panel Mount Versions

The panel mount configuration should be installed in a cabinet or enclosure that can support in excess of 15 lbs. (6.8 kg). The controller should be positioned for convenient operator interaction and easy screen viewing. To ensure safety and proper operation, the SteadyWeb™5 must be located away from dusty or wet environments. Ensure there is a minimum of 5” (12.7 cm) clearance behind the mounting panel to allow for physical fit of the controller with room for air circulation. In addition, ensure there will be adequate room below the controller's mounting location to allow for wire routing to the input/output terminal blocks.

3. Version P Only

The pneumatic enclosure is designed for mounting close to your brake or clutch. This allows for a short length of tubing between the pneumatic output and the brake or clutch. In addition to a shop air supply connection, a signal cable must be run between the pneumatic unit and the controller. Choose a location which is free from vibration and that is located away from dusty or wet environments. The pneumatic enclosure should be mounted to a secure wall or surface that can support in excess of 20 lbs. (9.1 kg). Ensure there will be adequate room around the mounting location for wire and pneumatic tube routing. Air should be clean and dry - no oil.

4. Version V Only

The High Voltage output enclosure is designed for mounting close to your electric brake or clutch. It requires a dedicated AC power feed. In addition, a signal cable must be run between the Vout module and the controller. To ensure safety and proper operation, the V-Out enclosure must be located away from dusty or wet environments. It should be mounted to a secure wall or surface that can support in excess of 12 lbs. (5.5 kg). Ensure there will be adequate room around the mounting location for wire routing.

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:** AC versions of the SteadyWeb™5 controller 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. AC Power Configuration

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 controller 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.

2. DC Enclosure Mount Configuration

For DC enclosure mount units, the length of wire inside the enclosure should be long enough to allow the front panel to open fully without putting any strain on wire, but no longer. Flexible, stranded wire should be used to allow flexing around the enclosure hinge when opening and closing the front panel. Solid wire should not be used. Be sure to route the 24VDC power supply wires through the side cable clamp as shown in **Figure 10, 24VDC Electrical Connections**.

3. AC and DC Power Configurations

Secure the power wiring to prevent inadvertent removal or strain on the input terminal. For enclosure mount units, this wiring should be secured at the power inlet of the enclosure. An external switch or circuit breaker is required for power disconnection of the SteadyWeb™5. It is recommended that this switch or circuit breaker be located near the equipment and be well labeled.

4. Version V Only

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 V-Out module using a wire with a gauge of at least 12 AWG (or a cross-sectional area of at least 2mm^2) and insulation rating of at least 600V.

Make your AC line voltage connections with wire gauge of at least 12 AWG (or a cross-sectional area of at least 2mm^2) and insulation rating of at least 600V for each conductor. Secure this wiring to prevent inadvertent removal or strain on the input terminal.

2.3 SAFETY AND EMC REQUIREMENTS *continued...*

An external switch or circuit breaker is required for power disconnection of the V-Out module. It is recommended that this switch or circuit breaker be near the equipment, and be well labeled.

It is necessary to remove the the V-Out Module cover (held in place by four M3 screws) to mount the non-DIN rail version of the output module to a supportive wall. It is also necessary to remove the cover to access and wire into the module's terminal blocks. Always remove power before removing the V-Out Module's cover. The cover should never be removed while power is supplied to the device. The V-Out module cover should always be attached and firmly tightened down when power is supplied to the unit.

⚠ WARNING:

Always keep the V-Out Module enclosure closed with the cover firmly tightened down while power is attached to the module.

5. Shielding

For maximum EMC performance, a proper transducer installation, including shielded cables must be used. The following is a list of cables available from DFE which meet this requirement:

For type C, RS, and F transducers (Use 2 cables, 1 cable per transducer): 721-0084 CN 3-conductor cable for panel mount, 721-0085 CC 3-conductor cable for enclosure mount.

For type RFA, LT, VNW, NW, and TR transducers: 721-0964 CN 6-conductor cable for panel mount, 721-0995 6-conductor cable for enclosure mount.

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: 723-2682) are required when an accessory meter is used.

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

6. Enclosure Mount Versions

Enclosure mount versions of the SteadyWeb™5 controller use a hinged enclosure. The front of the controller hinges down to allow access to the internal circuit boards and adjustments. The enclosure should always be mounted in a location that allows unobstructed opening and closing of the front panel. When the front panel is closed, an M3 screw on the top of the enclosure must be tightened down to firmly keep the panel in place and prevent unintentional opening (see **Figure 7, Enclosure Version Service Access**). The panel should be kept shut with the latch screw tight at all times when the controller is in use. Only qualified service technicians may open the enclosure and access the internal circuit boards.

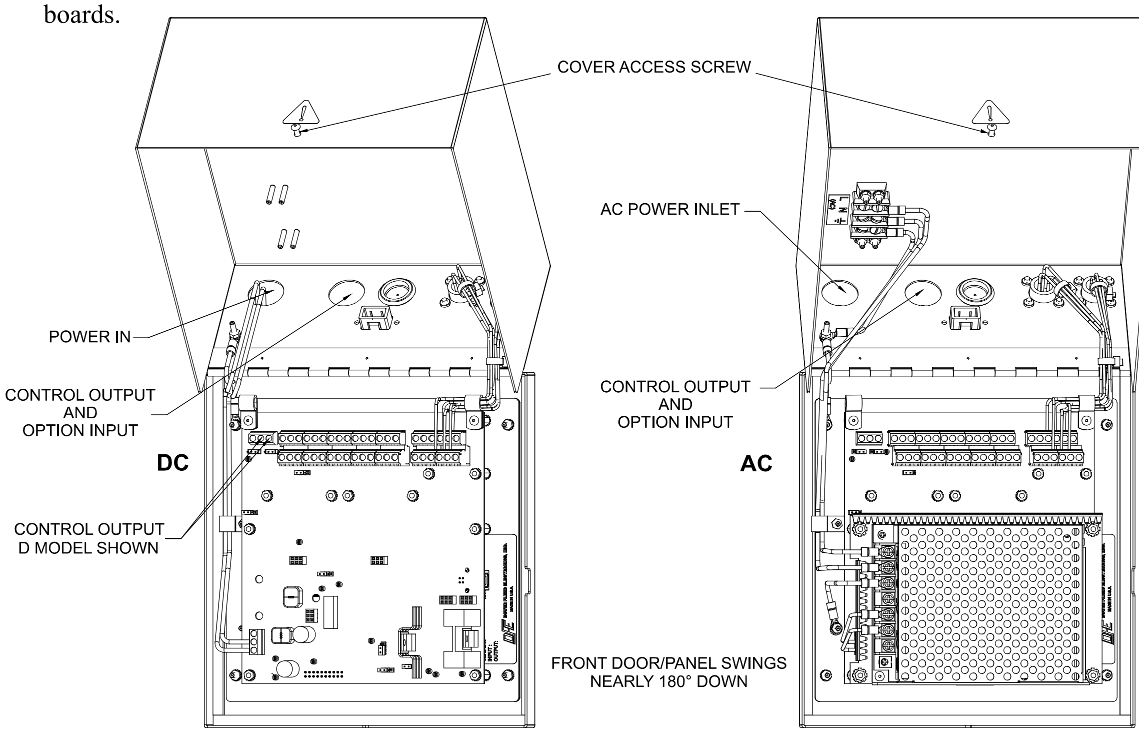


Figure 7 – **ENCLOSURE VERSION SERVICE ACCESS**

2.3 SAFETY AND EMC REQUIREMENTS *continued...*

⚠ WARNING:

Always keep the enclosure closed with the latch screw firmly tightened down during normal operation.

⚠ WARNING:

Only qualified personal may open the controller enclosure to access internal circuit boards and adjustments. When working with AC powered versions of the controller, the AC power rails will be exposed when the front panel is opened. Standard safety precautions should always be used when working around AC power rails. Unless the servicing requires power applied to the unit, power should always be removed before opening the enclosure.

7. Electrostatic Discharge Protection

The controller circuitry contains sensitive devices that are susceptible to damage from ESD (Electrostatic Discharge). The controller's power inputs, I/O terminals, push buttons, etc., have been designed to be protected from the high level of ESD present in typical industrial and web processing environments. When accessing the circuit boards directly, however, unprotected devices are exposed to direct contact. Because of this, proper ESD precautions should be followed when servicing the controller, such as wearing ground straps.

2.4 INSTALLATION INSTRUCTIONS

1. Panel Versions

For panel mount units, drill four M3 (#4) clearance (0.140" / 3.5mm) holes in a 6.75" (17.15 cm) horizontal by 6" (15.24 cm) vertical rectangle. Cut an opening centered in the holes measuring 6.25" (15.88 cm) across by 6.6" tall (16.76 cm) (see Section 2.1, Fig. 4-Panel Mount Dimensions and Views). Mount your Panel style controller in the hole using four M3 (#4) nuts and screws.

2. Enclosure Versions

For enclosure mount units, drill and tap two M4 (#8) holes 6.00" (15.24 cm) apart horizontally and 7.49" (19.02 cm) up from the desired bottom of the enclosure to match the screw hole dimensions on the back surface of the SteadyWeb™5 enclosure (see Section 2.1, Fig. 3-Enclosure Mount Dimensions and Views). The enclosure is fastened to the mounting surface you have chosen by two M4 (#8) screws. Install the screws on the mounting surface. Leave the screws loose about 6 turns. Position the keyholes in the back panel of the enclosure over the screws and slide it down until it locks in place. The cover must be open to tighten the mounting screws and secure the enclosure in place.

3. Version P Only

The pneumatic enclosure should be located in the area of your clutch or brake. Drill and tap four M3 (#4) holes in a 4" (10.16 cm) horizontal by 7.5" (19.05 cm) vertical rectangle (see Section 2.1, Fig. 5-Pneumatic Enclosure Dimensions). The enclosure is fastened to the mounting surface you have chosen by four M3 (#4) screws. The pneumatic servo is sensitive to any mounting off it's vertical axis. Mounting off vertical axis can cause error in output pressure.

4. Version V Only

The High Voltage Output module should be located in the area of your clutch or brake. If you are using the DIN Rail Clip (DRC) option, the V-out module may simply be clipped to a DIN rail. If you are using the Enclosure mount style without the DRC option, drill and tap two M4 (#8) holes 4.0" (10.16cm) apart vertically with the lower hole 2" (5.08cm) up from the desired bottom of the enclosure to match the screw hole dimensions on the back surface of the V-Out enclosure (see Section 2.1, Fig. 6-High Power Module Dimensions). The enclosure is fastened to the mounting surface you have chosen by two M4 (#8) screws. Install the screws on the mounting surface. Leave the screws loose about 6 turns. Position the keyholes in the back panel of the enclosure over the screws and slide it down until it locks in place. The cover must be open to tighten the mounting screws and secure the enclosure in place. This module is not sensitive to mounting at any angle.

2.5 TRANSDUCER VOLTAGE SELECTION

Unlike previous DFE products, the transducer excitation voltage in the SteadyWeb™5 is not normally set via a jumper or switch setting. The SteadyWeb™5 features an intelligent transducer excitation system that allows it to automatically adjust the excitation voltage in accordance with the type of connected transducers (5VDC for Standard (STD) Transducers and 10Vdc for Extended Range (XR) Transducers). The intelligent excitation system also monitors for wiring errors and/or transducer faults such as short circuit or open circuit conditions. When such faults are detected, an error message is displayed in the Run mode screen describing the detected fault.

The system works by independently monitoring the current feeding each half of the transducer bridge. For this reason, it is important when wiring transducers directly to the terminal block connections (as opposed to using the Amphenol connectors) to use all 6 transducer interface terminals, which include a separate EXC+ and EXC- terminal for each half of the transducer bridge. Incorrectly wiring both transducers to the same excitation power terminal pair will lead to false errors as the controller will see what appears to be an open condition on the unused pair of excitation power terminals and an over current condition on the other pair.

When wiring to the terminal block interface, it is also important to keep in mind that one pair of excitation power lines should have reversed polarity from the other pair. This insures that tension changes cause the signal voltages from each half of the transducer bridge to move away from each other, resulting in a differential signal (see **Figure 13, Control Board Transducer Electrical Connections and Remote Option**).

In certain situations the Auto Excitation Voltage feature may be undesirable, such as when using DFE LT transducers or other unique transducers that don't feature the normal resistance ranges of DFE Standard and Extended Range transducers. In such cases, the excitation voltage can be locked to a specific value (5V or 10V) by programming the **Excitation Voltage** setting, located in the *Setup Menu > Tension Control Setup* menu (see Section 3, User Interface Overview, for a menu navigation overview). When the **Auto** excitation setting is disabled, all excitation error messages are disabled with the exception of over-current and short-circuit error messages.

The factory default **Excitation Voltage** setting is **Auto**. When in **Auto** mode, the excitation voltage defaults to 5V except if, and only if, an XR transducer is sensed on both sides of the transducer bridge, in which case 10V excitation be activated.

During an over-current or short circuit condition, the excitation power is disabled to protect the controller and connected transducers and an error message is displayed in the Run mode screen. In this situation, the controller will periodically (around once a second) briefly enable excitation power to see if the over-current or short circuit condition has been removed and if it hasn't, shuts excitation power back down.

2.6 CONTROL OUTPUT SELECTION

The isolated control output can be configured for either +/-10V output or 4-20mA output by setting jumpers JP2 and JP3 located directly behind the control output terminal block (refer to **Figure 8, Output Jumpers**). If voltage output is required, place jumpers on pins 2 and 3 (labeled +/-10) on both JP2 and JP3. If 4-20mA output is required, place jumpers on pins 1 and 2 (labeled 4-20) on both JP2 and JP3.

NOTE: Both jumpers must be in the same position or incorrect operation will result.

When set to voltage mode, the controller is capable of producing a -10V to 10V control signal. This can be reduced to a smaller voltage range by adjusting the **Positive Output Limit** and **Negative Output Limit** settings, located in the *Setup Menu > Control Output Setup* menu (see Section 3, User Interface Overview, for a menu navigation overview). Setting **Negative Output Limit** to 0% and **Positive Output Limit** to 100% for example, will limit the output to a 0 to 10V signal. Setting both to 50% will limit the output to within -5V and 5V. When using the 4-20mA current output, the **Negative Output Limit** setting should be set to 0% and the **Positive Output Limit** should be set to 100%. The output, in both current and voltage mode, is isolated from chassis and transducer ground. This prevents ground loops and related noise issues which can be common in industrial environments.

⚠ 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.

In addition to the control output range, the control direction is also adjustable through the **Control Output** setting, also located in the *Setup Menu > Control Output Setup* menu. When set to to **Standard**, the output increases to increase tension, when set to **Reverse**, the output decreases to increase tension. **Reverse** is needed when the controller is used in an intermediate zone and the tension transducer is positioned after the drive motor, or when used in an unwind zone with a motor drive.

NOTE: Regardless of the software output limits, Emergency Stop activation will result in the output going to 0V (4mA) or 10V (20mA) based on the Output and ESTOP jumper settings (see 2.8 Emergency Stop Configuration).

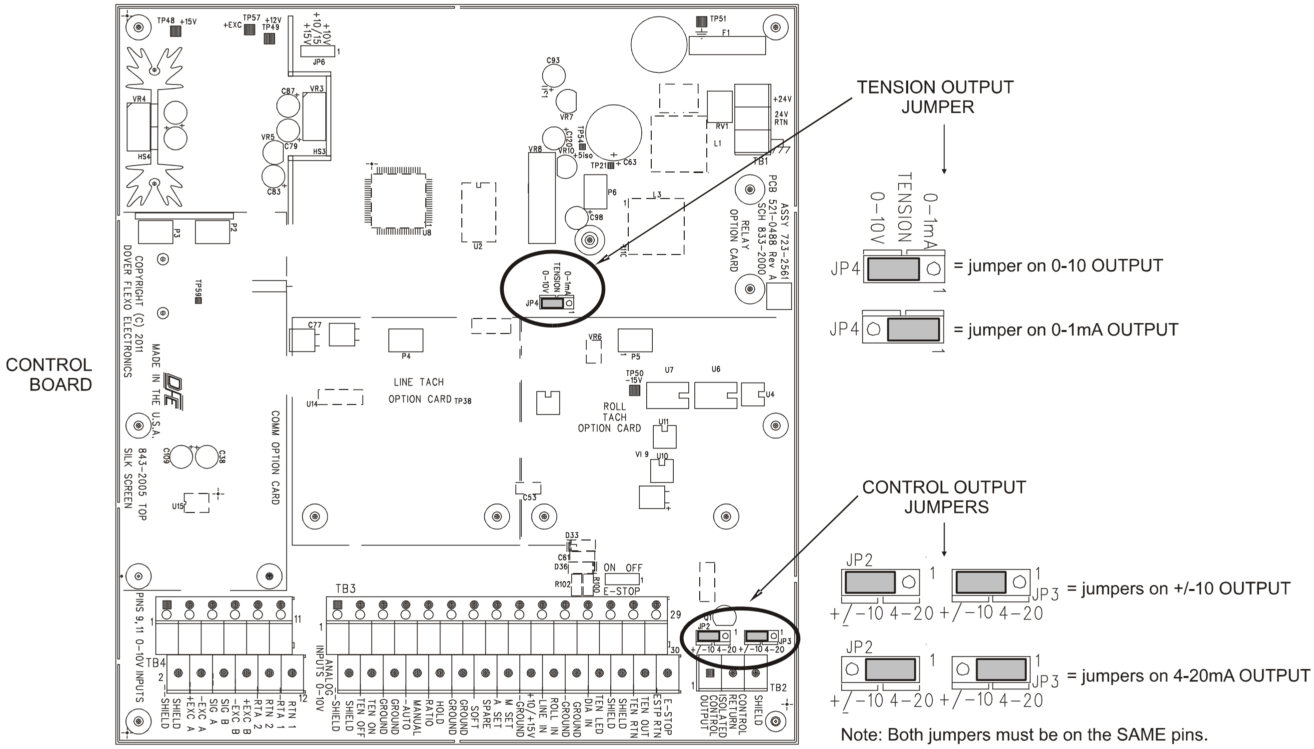


Figure 8 **- OUTPUT JUMPERS**

2.7 TENSION OUTPUT SELECTION

The tension output can be configured as a 0-10V or 0-1mA signal representing tension by setting jumper JP4 on the control board (see **Figure 8, Output Jumpers**). The 0-1mA output is designed to drive a 50 Ohm meter. If a 0-10V output is required, place the jumper on pins and 2 and 3 (labeled 0-10V) on JP4. If a 0-1mA output is required, place the jumper on pins 1 and 2 (labeled 0-1 mA) on JP4.

2.8 EMERGENCY STOP CONFIGURATION

The Emergency Stop feature is useful for stopping large rolls of material when an external normally closed switch, contact or relay is opened. The circuit requires an external switch, contact or relay to be connected to the Signals Terminal Block (TB3) terminal 30 (E-STOP) and terminal 29 (ESTP RTN) (see Section 2.11, Standard Electrical Connections). The E-STOP terminal supplies approximately 5VDC, which must be returned to the ESTP RTN terminal. If a break in the Emergency Stop circuit should occur, the Emergency Stop output circuit will activate.

The Emergency Stop circuit can be enabled or disabled with jumper JP5 (see **Figure 9, Setup Jumpers**). To Enable the Emergency Stop circuit, set the JP5 jumper to pins 2 and 3 (labeled ON). To disable the Emergency Stop circuit, set the jumper to pins 1 and 2 (OFF).

When the Emergency Stop circuit is active, the control output will produce either a zero (0V or 4mA) or full output (10V or 20mA) signal based upon jumper JP7 (see **Figure 9, Setup Jumpers**). Full output is traditionally used in braked unwind applications to stop the roll of material quickly. Minimum output is used for other applications. To set the Emergency Stop output to zero, set the jumper to pins 2 and 3 (labeled LOW) on JP7. To set the Emergency Stop output to full output, set the jumper to pins 1 and 2 (labeled HI) on JP7.

During an Emergency Stop condition a prominent E-STOP message is displayed along with the current tension reading on top of a red background on the user interface screen. The E-STOP display is active until the Emergency Stop condition is removed. The Run mode and Menu mode screens are not accessible during an E-STOP condition.

In addition to the required Emergency Stop electrical connections and jumper settings, there are two software settings related to the Emergency Stop condition. The **Tension Off by ESTOP** setting, located in the *Setup Menu > Tension Control Setup* menu allows the user to specify whether tension control will remain On during an Emergency Stop condition (to pick up control after the Emergency Stop condition is removed) or whether it will be forced Off (forcing the operator to

2.8 EMERGENCY STOP CONFIGURATION *continued...*

re-engage the tension output after an Emergency Stop condition) (see Section 3, User Interface Overview, for a menu navigation overview).

The **Output During ESTOP** setting, also located in the *Setup Menu > Tension Control Setup* menu, allows for the selection of **High** or **Low** Emergency Stop output. This setting allows the user to specify the software output level duringan Emergency Stop condition. Regardless of this setting, the hardware Emergency Stop jumper (JP7) will determine the actual output (High or Low) during an Emergency Stop condition. This setting is important if **Tension Off by ESTOP** is set to **No**, to allow a bumpless transfer out of the E-STOP condition when exiting E-STOP and returning to control mode. When **Tension Off by ESTOP** is set to **No**, this setting should always match the output specified by jumper JP7.

CONTROL BOARD

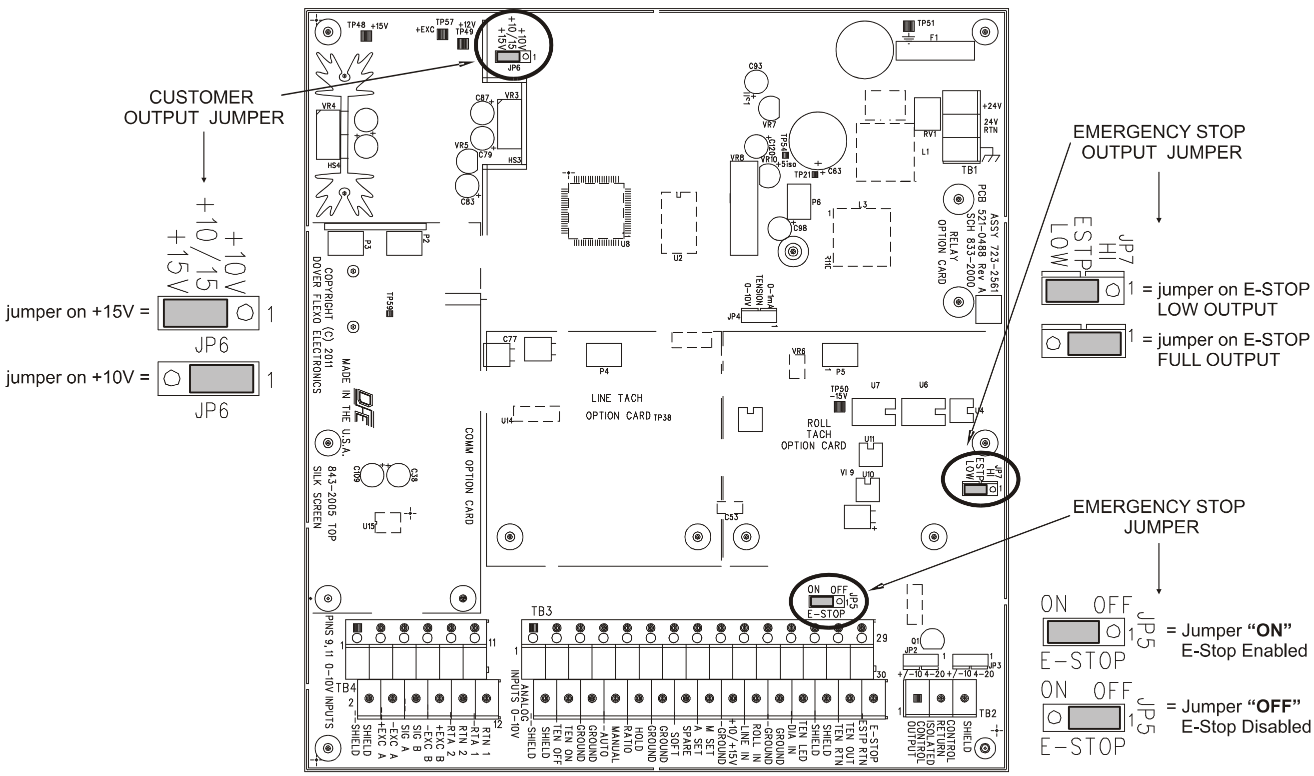


Figure 9 – **SETUP JUMPERS**

2.9 CUSTOMER +10/15V OUTPUT SELECTION

A selectable 10VDC or 15VDC rail is provided for customer use. This rail is designed to drive light loads, such as potentiometers used for external Auto or Manual setpoints, or in a roll follower setup. It should not be used for loads pulling greater than 100mA. The rail can be accessed via the Signals terminal block (TB3) terminal 18 (+10/+15V) and terminal 17 (GROUND) (see Section 2.11, Standard Electrical Connections).

The 10V or 15V selection is made by jumper JP6 (see **Figure 9, Setup Jumpers**). Placing the jumper on pins 1 and 2 (labeled +10V) sets the voltage rail to 10V. Placing the jumper on pins 2 and 3 (labeled +15V) sets the voltage rail to 15V.

2.10 POWER ELECTRICAL CONNECTIONS

Make 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. Keep all wiring away from devices emitting electromagnetic radiation.

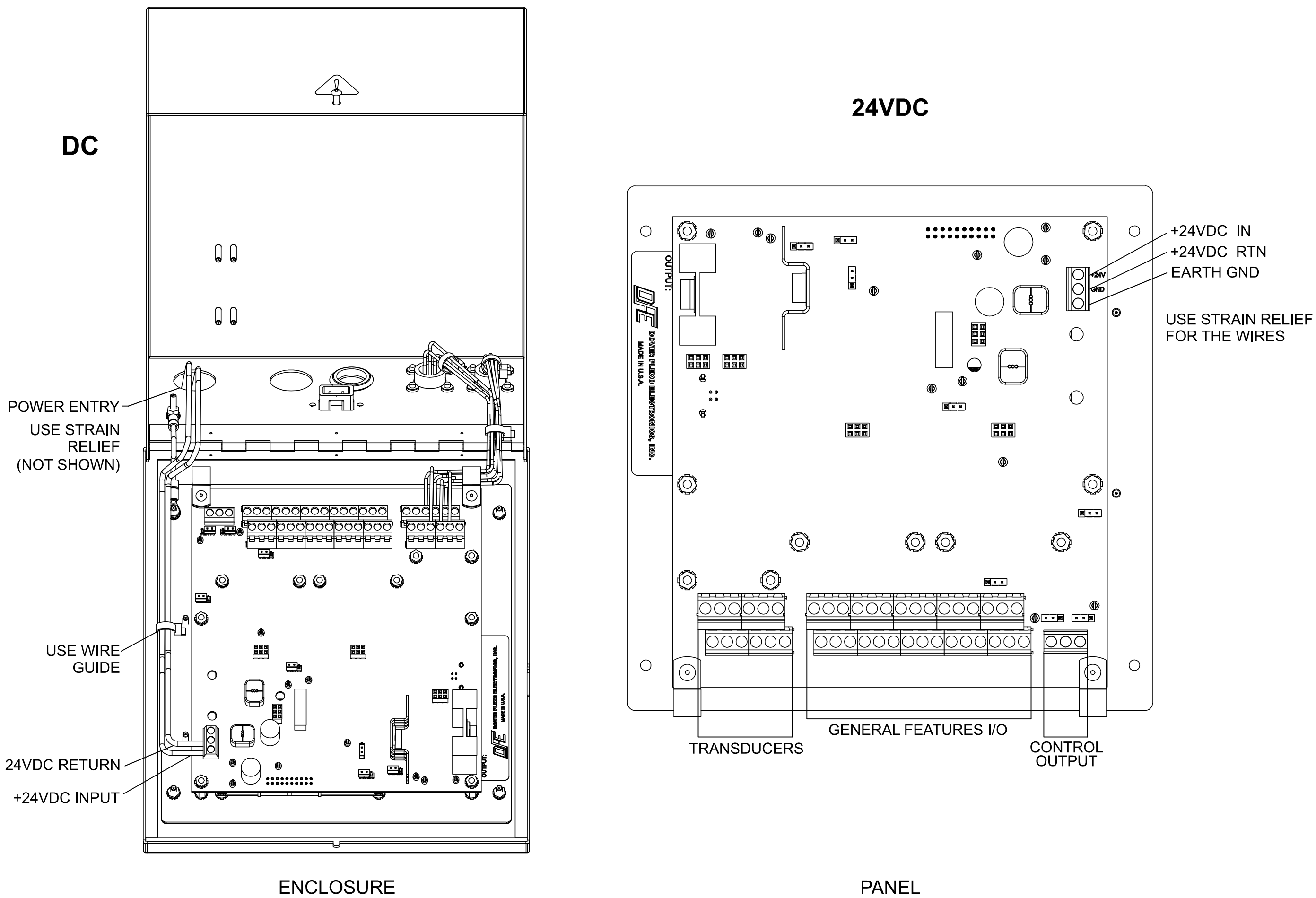


Figure 10 **– 24VDC POWER ELECTRICAL CONNECTIONS**

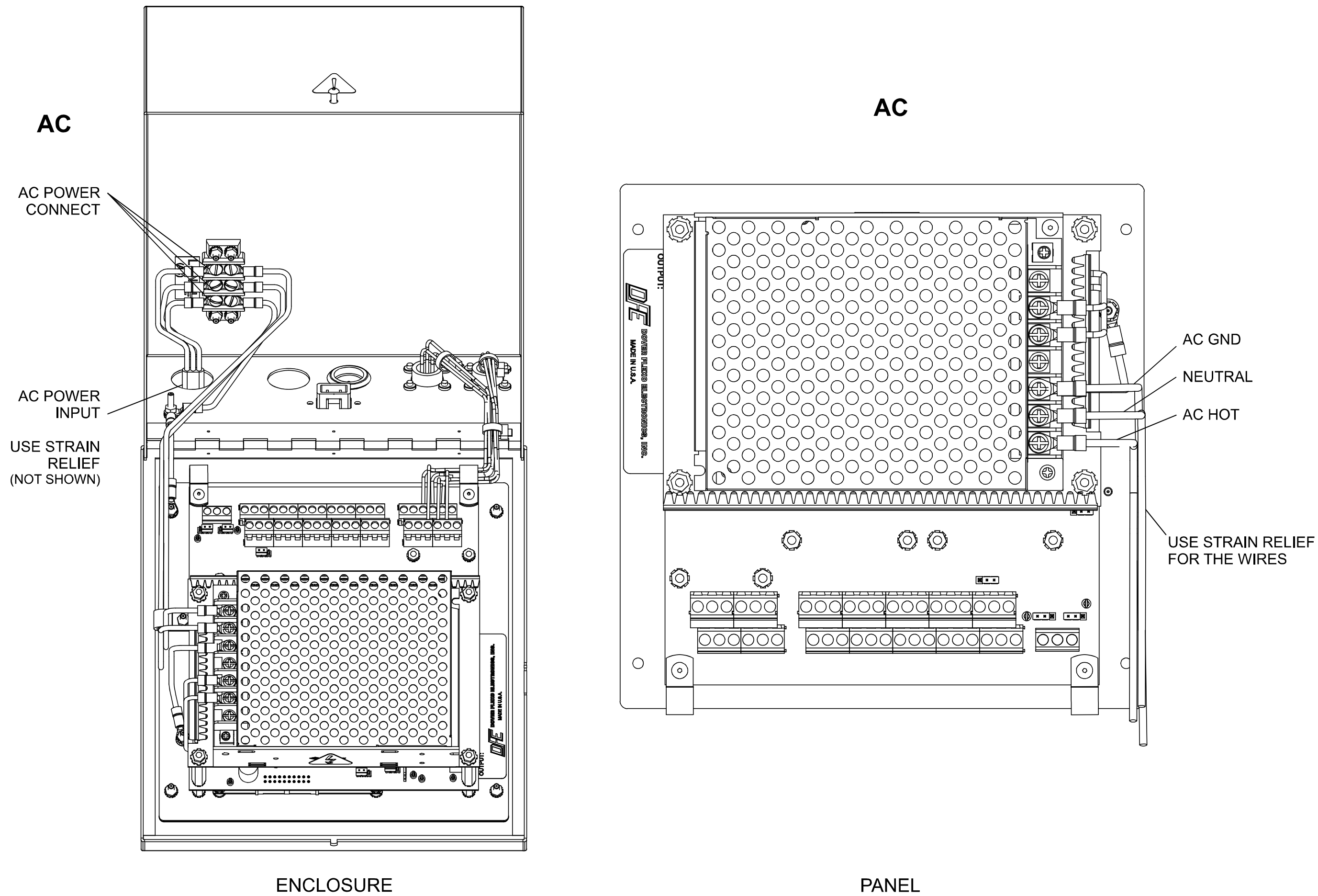


Figure 11 **– AC POWER ELECTRICAL CONNECTIONS**

2.11 STANDARD ELECTRICAL CONNECTIONS

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. Keep all wiring away from devices emitting electromagnetic radiation.
4. Connect cable shields to the closest Shield terminal on the relevant terminal block. Only connect signal cable shields on one end to avoid ground loops.

Transducer connections

Enclosure mount units are equipped with Amphenol connectors that facilitate connection with DFE transducers. Panel mount units require wiring of the transducers directly to the Transducer terminal block (TB4). The Transducer terminal block contains a 6 terminal transducer interface.

The SteadyWeb™5's intelligent excitation system monitors current feeding each half of the transducer bridge. For this reason, it is important when wiring transducers directly to the terminal block connections to use all 6 transducer interface terminals, which include a separate EXC+ and EXC- terminal for each half of the transducer bridge. Incorrectly wiring both transducers to the same excitation power terminal pair will lead to false errors as the controller will see what appears to be an open condition on the unused pair of excitation power terminals and an over current condition on the other pair.

When wiring to the terminal block interface, it is also important to keep in mind that one pair of excitation power lines should have reversed polarity from the other pair. This insures that tension changes cause the signal voltages from each half of the transducer bridge to move away from each other, resulting in a differential signal (see **Figure 13, Control Board Transducer Electrical Connections and Remote Option**).

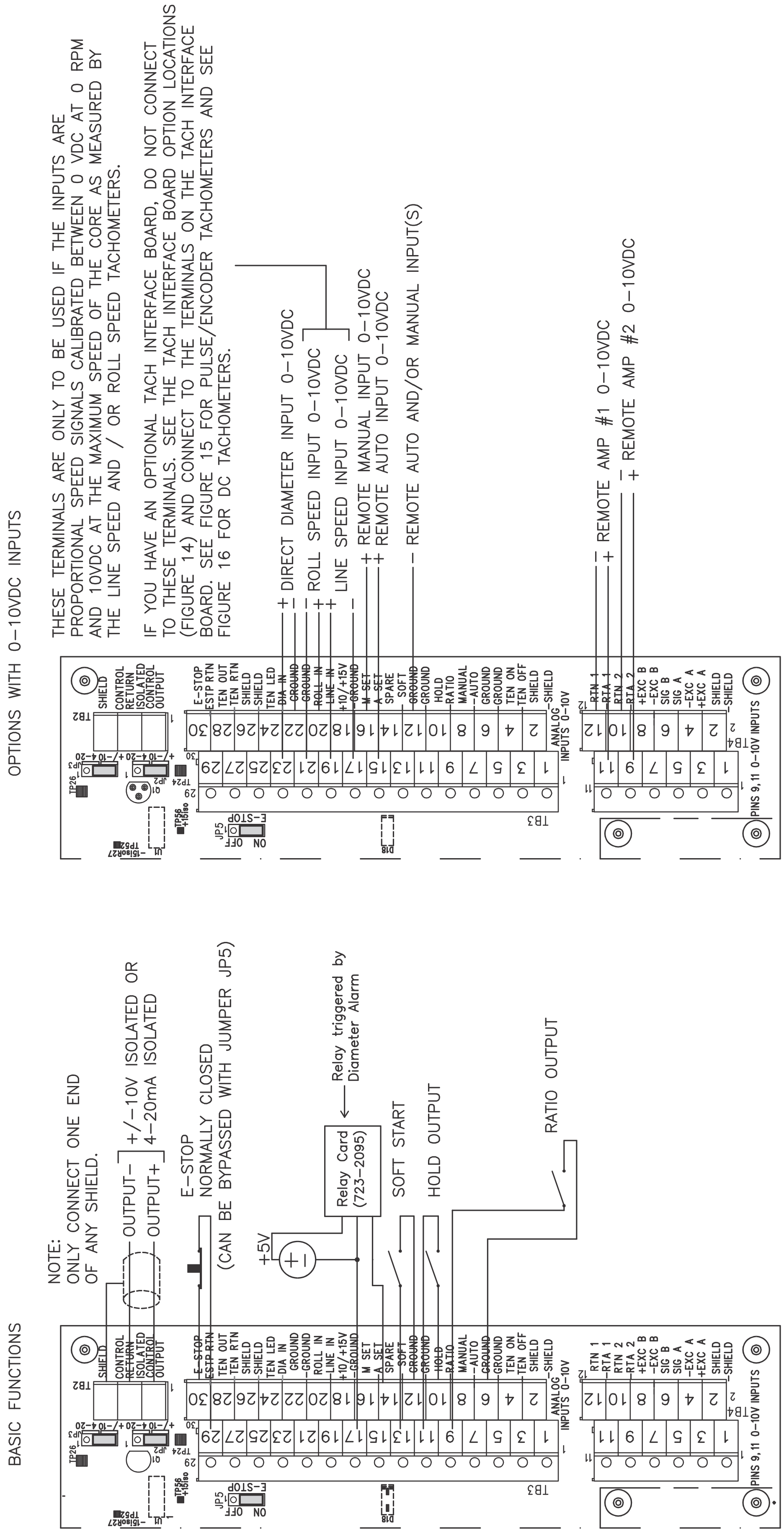


Figure 12 **- STANDARD AND 0-10VDC CONTROL BOARD ELECTRICAL CONNECTIONS**

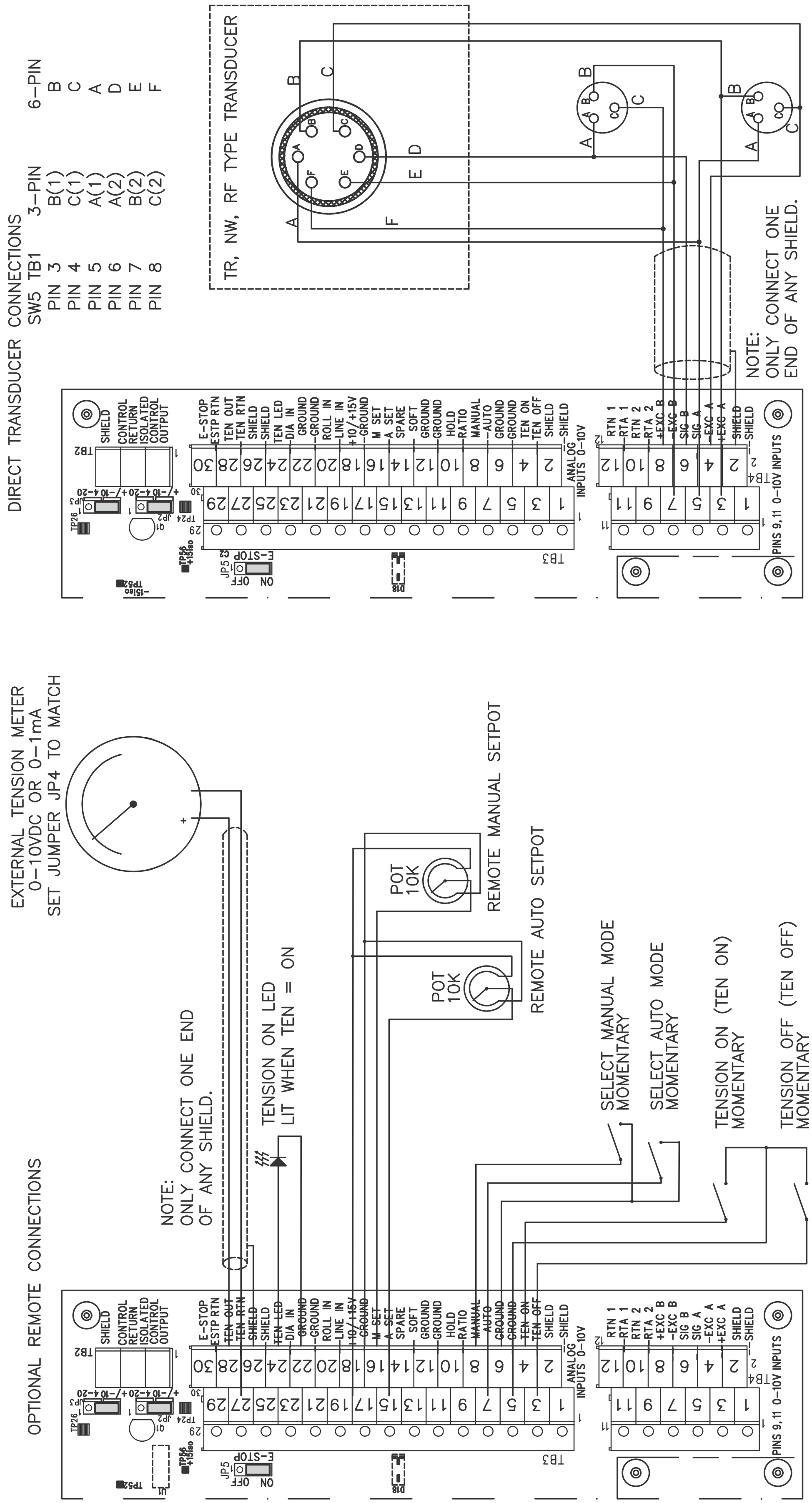


Figure 13 **- CONTROL BOARD TRANSDUCER ELECTRICAL CONNECTIONS AND REMOTE OPTION**

2.12 OPTION CARD MOUNTING LOCATIONS

The SteadyWeb™5 main control board contains plugs and mounting hole locations for option card placement, allowing for a modular assembly. There are four main option card insertion areas, as shown in **Figure 14, Option Card Mounting Locations**. The option cards include a DC Tachometer card, Pulse Tachometer card, Relay card and various communication cards. Only one communication card can be installed at a time into the COMM OPTION CARD slot. The LINE TACH OPTION CARD slot and the ROLL TACH OPTION CARD slot can be populated with either the DC or Pulse Tachometer cards. The two tachometer cards (pulse and DC) have an identical footprint, and can be populated in the LINE and ROLL slots in any combination. Option cards are installed as specified per order at the factory.

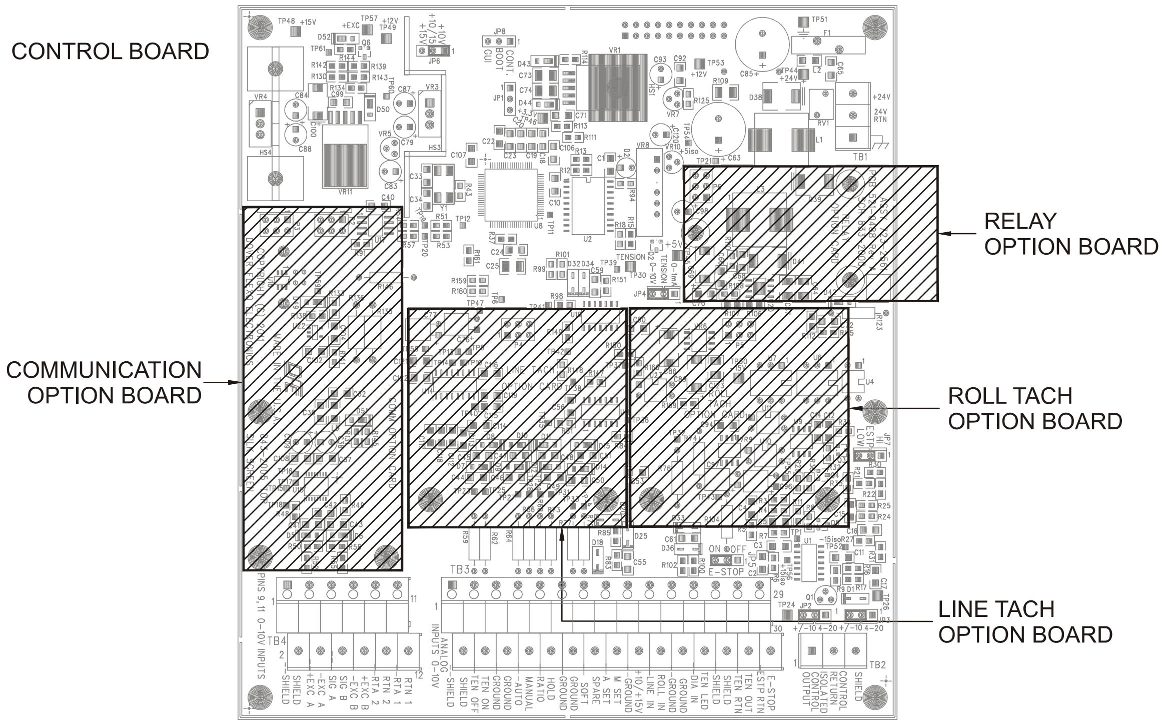


Figure 14 **- OPTION CARD MOUNTING LOCATIONS**

2.13 PULSE TACHOMETER OPTION CARD ELECTRICAL CONNECTIONS

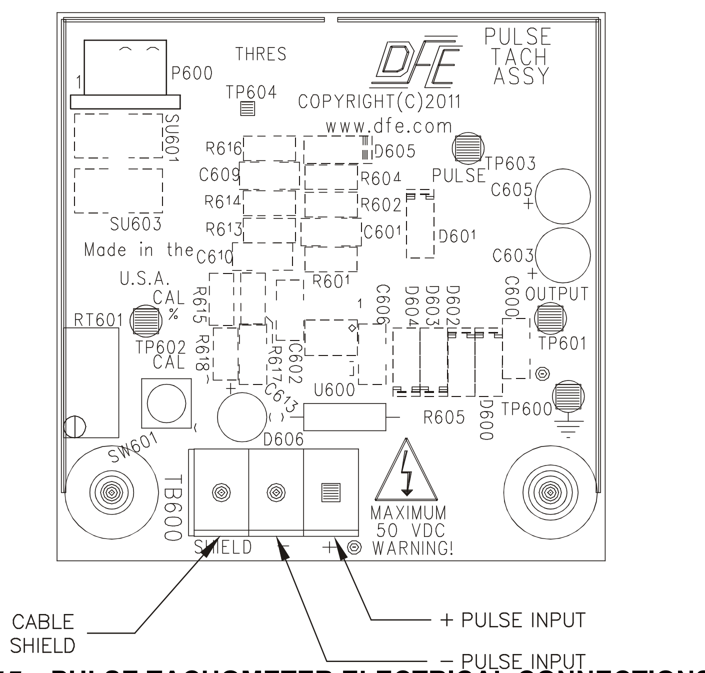


Figure 15 **– PULSE TACHOMETER ELECTRICAL CONNECTIONS**

2.14 DC TACHOMETER OPTION CARD ELECTRICAL CONNECTIONS

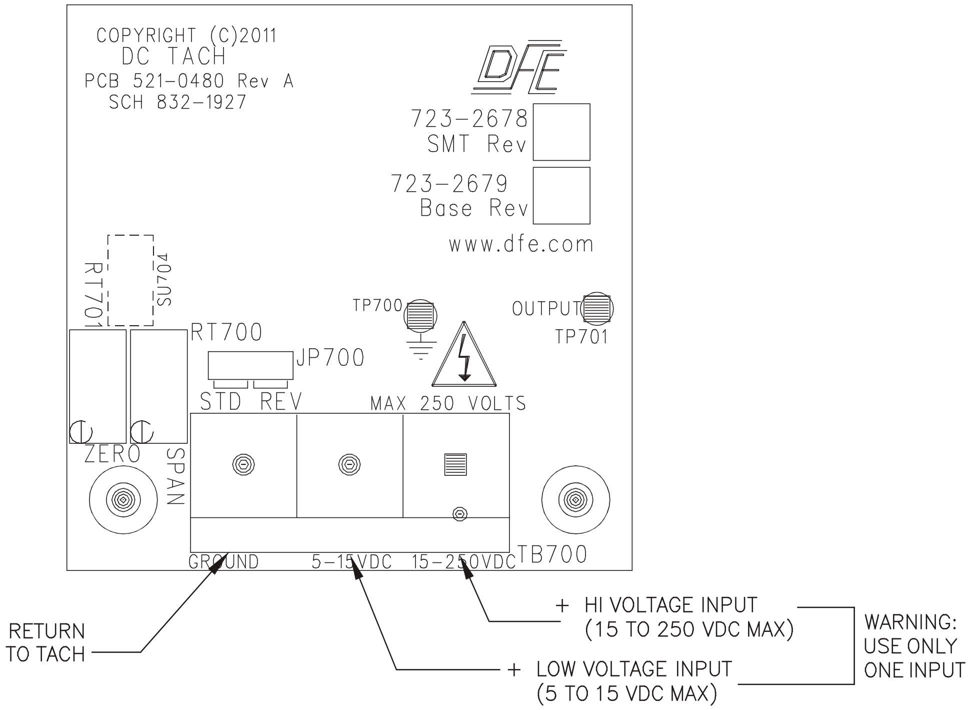


Figure 16 – **DC TACHOMETER ELECTRICAL CONNECTIONS**

2.15 RELAY OPTION CARD ELECTRICAL CONNECTIONS

To minimize electromagnetic interference and extend the life of the relay, a resistor capacitor (RC) network may be needed across the relay connections. Any arcing should be minimized. The resistor wattage and capacitor voltage ratings should be sized to handle worse case conditions of the application, including spikes caused from switching inductive loads.

Values of 0.1uF and 100 Ohms are a good starting point. If significant arcing is still occurring, the capacitance may need to be increased. Instead of individual components, monolithic components, such as Cornell Dubilier Electronic's Quenchar® line of products may be easier to use.

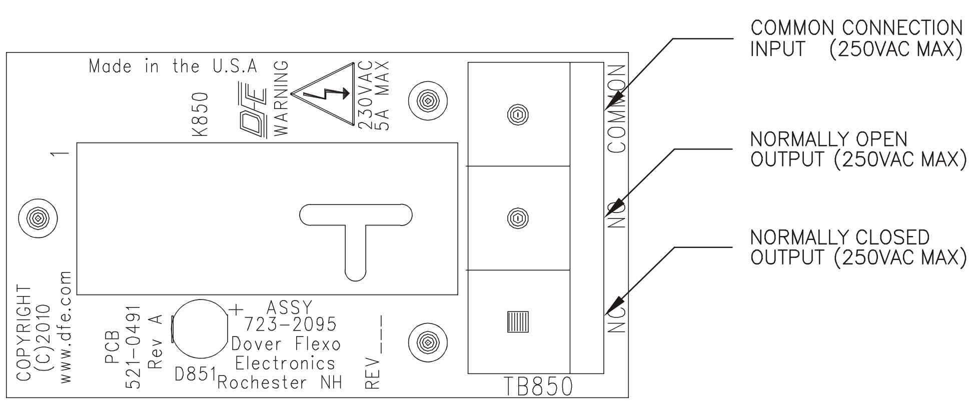


Figure 17 – **RELAY ELECTRICAL CONNECTIONS**

2.16 EXTERNAL OUTPUT MODULE CABLE CONNECTIONS

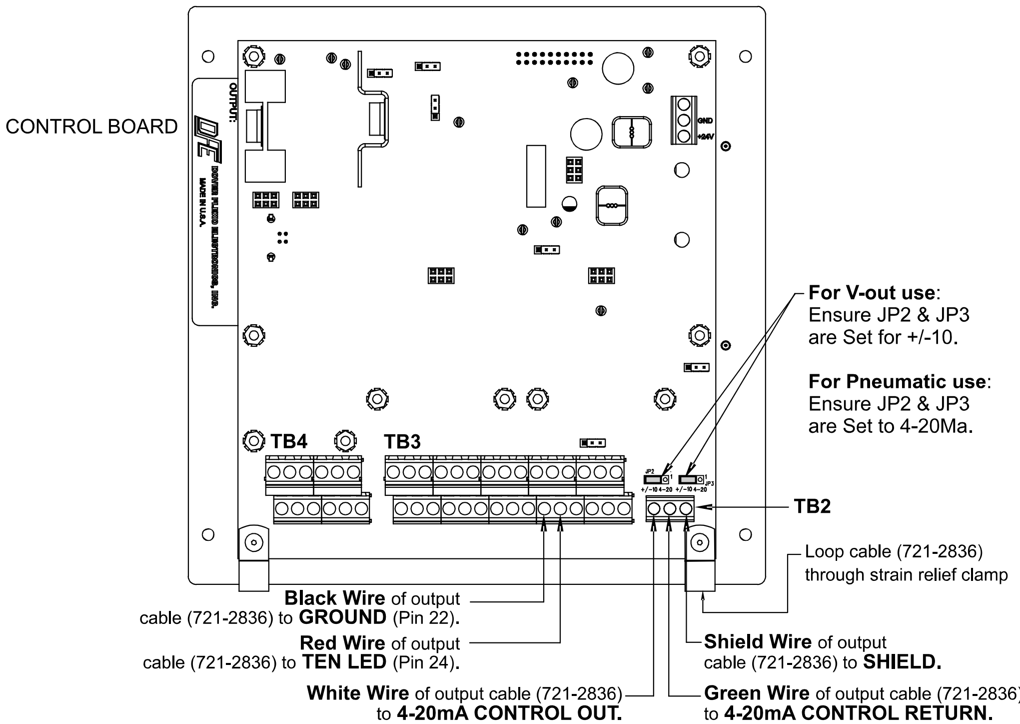


Figure 18 – **EXTERNAL OUTPUT MODULE CABLE CONNECTIONS**

2.17 HIGH VOLTAGE OUTPUT MODULE ELECTRICAL CONNECTIONS

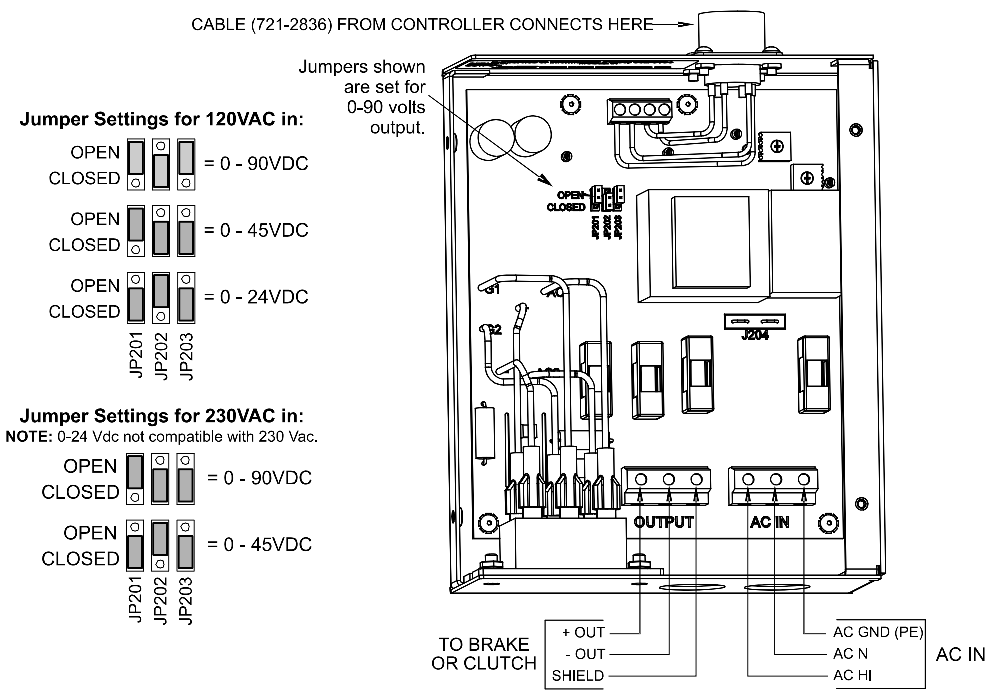


Figure 19 – **HIGH VOLTAGE OUTPUT MODULE ELECTRICAL CONNECTIONS**

2.18 COMMUNICATION OPTION CARDS ELECTRICAL CONNECTIONS

The SteadyWeb™5 controller features optional RS232, RS485 and Ethernet communication cards. Only one communication card can be populated at a time. Please refer to the specific communication card option manual for more information on wiring and configuring the card. Specific communication card manuals are shipped with the option card, or can be downloaded from the DFE website, www.dfe.com.

SECTION 3 USER INTERFACE OVERVIEW

Figure 20 – **STEADYWEB™ 5 USER INTERFACE**

3.1 MAIN INTERFACE DESCRIPTION

The SteadyWeb™5 interface consists of a high contrast color LCD (Liquid Crystal Display), multipurpose spinning knob and a mix of "Hard" (dedicated function) and "Soft" (context sensitive) push buttons. The multipurpose knob features a limitless rotation in either direction and its function is context sensitive, based on the current display. In general, the multipurpose knob is used to adjust the setpoint in in the "Run" mode display and to navigate the menu system and adjust controller settings in the "Menu" mode display. For many operations, the knob is speed sensitive, meaning turning the knob faster will cause greater, more coarse adjustments while turning the knob slower will cause smaller, more precise adjustments. The multipurpose knob drives a metal shafted optical encoder designed for long life.

The three Soft Keys underneath the display also have context sensitive functionality based on the current display, and in some situations have no function. In Run mode, the left softkey will cycle through the three run mode displays. See Section 3.3 for details on these displays. In the Menu mode displays, the function of a soft key will be displayed above the key within the Soft Key Function bar. Three dedicated functionality Hard keys perform a consistent operation regardless of display mode. The "Tension" key, to the left of the LCD, toggles the Tension On/Off state. When Tension is On, a green LED (Light Emitting Diode) above the key turns on. The "Auto/Manual" key, to the right of the LCD, toggles the Auto/Manual state of the controller. When the controller is in Auto mode, a green LED above the key turns on. The "Menu/Run" key, located in the lower left corner of the interface panel, toggles the state of the display between Menu and Run mode. More detail is given about these two display modes in the following sections.

3.2 DISPLAY MODES DESCRIPTIONS

The display has two modes of operation, **Run** mode and **Menu** mode. The current mode can be changed by pressing the **Menu / Run** key on the bottom left corner of the front panel. This key toggles between the two modes and can be pressed at any time other than when E-STOP (Emergency Stop) is activated, in which case an E-STOP warning screen overrides the current display mode.

3.3 RUN MODE DISPLAY

The **Run** mode display is used to display real time tension and related process information. This will be the active display the majority of time the controller is in use. The Run mode display is configurable, and the default Run mode view can be set to one of three display options with the **Display Mode** setting, located in the *Operator Menu > Display Configuration* menu. The available Display Mode views are **Bar Graph**, **Analog Meter**, and **Line Graph**. The three display options allow for alternate methods of displaying process information, and the best display for a given situation is subjective to the end user. The Run mode display view can also be toggled at any time from within the Run mode display by pressing the left most soft key (Display Select). Pressing this button will cycle the Run mode view from Bar Graph to Analog Meter, from Analog Meter to Line Graph, and from Line Graph back to Bar Graph. These three views are described in more detail below.

When in the Run mode display, the multipurpose knob takes on **Auto Setpoint** or **Manual Output** adjust functionality (depending upon whether the controller is in **Auto** or **Manual** mode). Turning the knob clockwise in Manual mode with Tension On will increase the output 1% per detent (or click) of the knob until Maximum Output is reached. Turning the knob counterclockwise will decrease the output 1% per detent until Minimum Output is reached. Likewise, turning the knob clockwise in Automatic mode will increase the Setpoint by 1% of the Full Range and turning the knob counterclockwise will decrease the Setpoint by 1% of the Full Range. Adjusting the Setpoints with greater than 1% resolution is achieved through the menu system with the **Manual Setpoint** and **Auto Setpoint** settings, located in the *Operator Menu*.

1. Bar Graph View

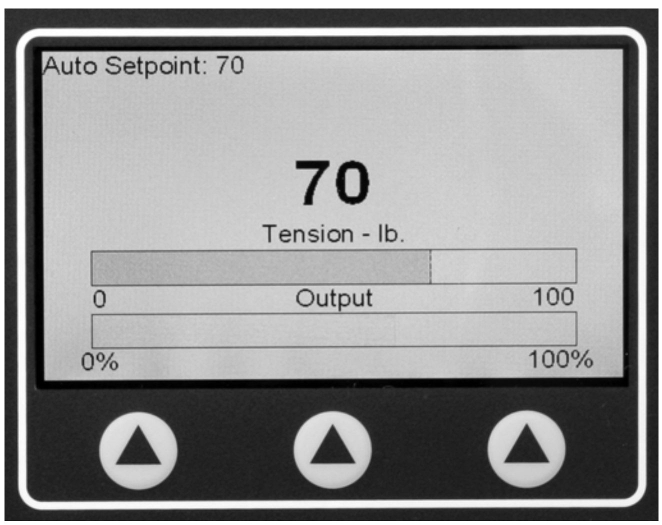


Figure 21 **– DEFAULT BAR GRAPH DISPLAY**

The **Bar Graph** display (**Figure 21**) is the default **Display Mode** view. It displays the current tension reading in large, easily viewable text in the center of the display. Below the tension readout are two bar graphs, one displaying the current tension and a second displaying the current output percentage.

Additional process information, such as line speed and roll diameter, can also be displayed as selected by the **Line Speed Display** and **Diameter Display** settings located in the *Operator Menu > Display Configuration* menu. These settings allow an **On/Off/Auto** selection for the Line Speed and Diameter options. When **Auto** is selected, the controller displays the selected variables based on the context of the controller settings (e.g. if **Taper** is activated, roll diameter information will be displayed). When active, diameter information is displayed in text form and as a circular graph on the right side of the display (**Figure 22**). When active, line speed is displayed in text form in the upper right hand corner of the display and in a split bar graph with the Output. This is beneficial in Line Speed Follow modes of control, where the output is trimmed to the Line speed signal. The setpoint is displayed in the upper left hand corner of the screen and also as a dotted line in the tension bar graph. This dotted line represents the *dynamic* setpoint while the text in the upper left hand corner represents the *programmed* setpoint. The dynamic setpoint may change based on the mode of control and the current process settings. If **Taper** is activated, for example, the dynamic setpoint will decrease as the roll diameter increases in accordance with the programmed **Taper** settings. When the TLS (Tension Limit Switch) High or Low feature is activated, a solid half line appears on the tension bar graph representing each setting. A vertical line that starts from the bottom of the bar graph and travels to the center of the bar graph is positioned at the **TLS Low** set point value (if set) and a vertical line that starts from the top of the bar graph and travels to the center of the bar graph is positioned at the **TLS High** set point value (if set) as can be seen in the rightmost screen shot in **Figure 22**.

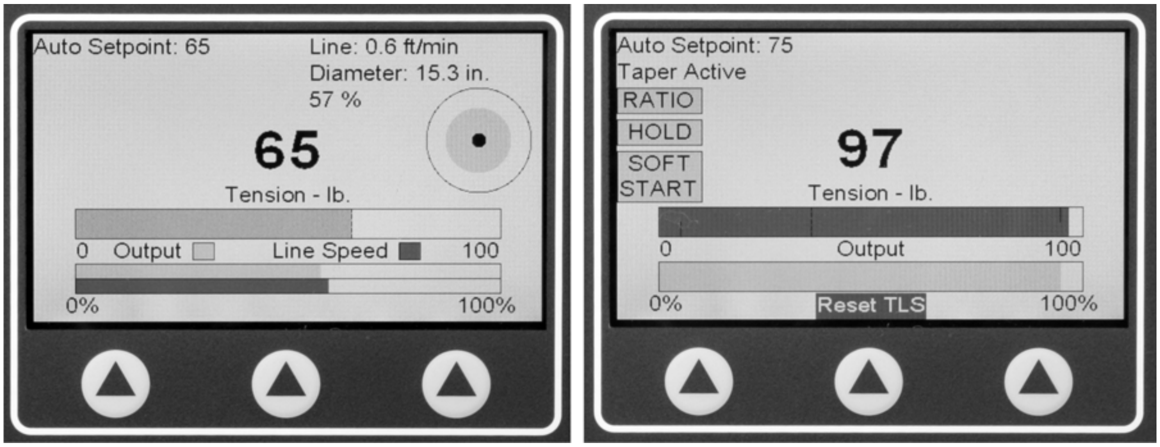


***Figure 22* – BAR GRAPH SCREENS SHOWING PROCESS INFORMATION**

Dynamic messages are displayed on the screen based upon the context of the current process parameters. If **Taper** is active, “Taper Active” is printed below the Setpoint. Status messages for the **Ratio**, **Sample and Hold**, and **Soft Start** states are displayed on the left side of the display, enclosed in clearly visible yellow boxes, when any or all are active. During a TLS (Tension Limit Switch) event, the tension bar graph turns red, and a **Reset TLS** alarm, with flashing text, is displayed over the center soft key. When the TLS alarm is set to **Latched** mode, the TLS alarm will remain active even after tension has returned to a normal range. The operator must press the center soft key to clear the alarm (see Section 7.6, Resetting TLS Alarms, for more detail).

2. Analog Meter View

The **Analog Meter** display (**Figure 23**) is an alternate Run mode display option that presents tension information in the form of a traditional analog meter. The tension is displayed in a large analog meter in the center of the display, with the meter scale based on the full range tension value. The tension and setpoint are displayed in text form in the lower left corner of the display, and the output percentage is displayed in the lower right corner. The setpoint is also displayed as a green diamond around the periphery of the analog meter scale at the setpoint. This green diamond represents the *dynamic* setpoint while the text in the lower left corner represents the *programmed* setpoint. The dynamic setpoint may change based on the mode of control and the current process settings. If **Taper** is activated, for example, the dynamic setpoint will decrease as the roll diameter increases in accordance with the programmed **Taper** settings.

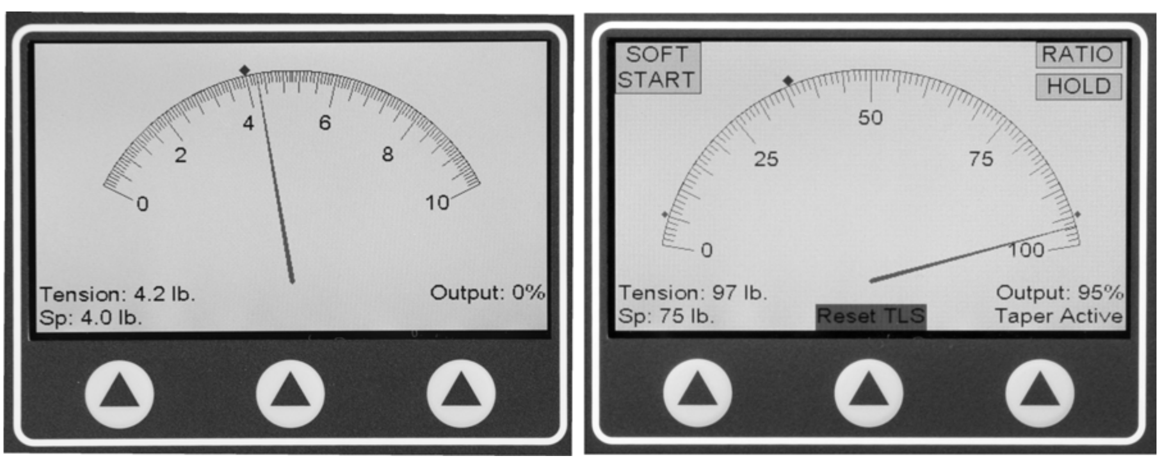


***Figure 23* – ANALOG METER DISPLAYS**

Unlike in the **Bar Graph** display, Line speed and Diameter information are not displayed in the Analog Meter display, regardless of the **Line Speed Display** or **Diameter Display** settings. When the TLS (Tension Limit Switch) High or Low settings are activated, small red diamonds appear around the periphery of the analog meter scale at the trip setpoints (**Figure 23**).

Dynamic messages are displayed on the screen based upon the context of the current process parameters. If **Taper** is active, "Taper Active" is displayed below the Output. Status messages for the **Ratio**, **Sample and Hold**, and **Soft Start** states are displayed on either side of the analog meter, enclosed in clearly visible yellow boxes, when any or all are active. During a TLS event, a **Reset TLS** alarm, with flashing text, is displayed over the center soft key. When the TLS alarm is set to **Latched** mode, the TLS alarm will remain active even after tension has returned to a normal range. The operator must press the center soft key to clear the alarm (see Section 7.6, Resetting TLS Alarms, for more detail).

3. Line Graph View

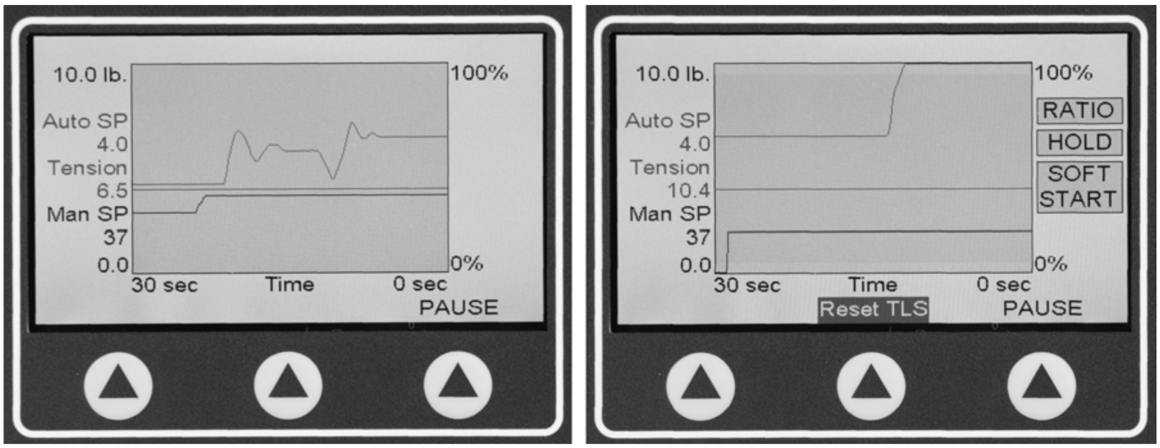


Figure 24 **- LINE GRAPH DISPLAYS**

The **Line Graph** display (**Figure 24**) is an alternate display option that presents information in the form of a real time line graph. The Setpoint, Output and measured Tension are graphed in different colors to allow visual distinction between the various signals. The signals move across the screen from right to left. The length of time required for a signal to travel completely across the graph window, and thus the speed the signals move across the screen, is determined by the **Line Graph Update Time** setting, located in the *Operator Menu > Display Configuration* menu. The available selections are 30 seconds, 60 seconds, 2 minutes, 5 minutes, 10 minutes or 30 minutes. Longer time settings allow for viewing a greater sample of data but with a loss of resolution. The Setpoint and Tension lines are referenced to the left axis, which is in units of tension. The output is referenced to the right axis, which represents the percent of full output. In addition to the line graph information, real time Setpoint, Tension and Output values are displayed in text form towards the left of the line graph window. The graphed setpoint line represents the *dynamic* setpoint while the text to the left of the graph represents the *programmed* setpoint. The dynamic setpoint may change based on the mode of control and the current process settings. If **Taper** is activated, for example, the dynamic setpoint will decrease as the roll diameter increases in accordance with the programmed **Taper** settings.

Unlike the **Bar Graph** display mode, Line speed and Diameter information are not displayed in the Line Graph display, regardless of the **Line Speed Display** or **Diameter Display** settings. When the TLS (Tension Limit Switch) High or Low settings are activated, the TLS regions are shaded yellow on the graph background.

Dynamic messages are displayed on the screen based upon the context of the current process parameters. If **Taper** is active, "Taper Active" is displayed above the line graph window. Status messages for the **Ratio**, **Sample and Hold**, and **Soft Start** states are displayed to the right of the line graph window, enclosed in clearly visible yellow boxes, when any or all are active. During a TLS event, a **Reset TLS** alarm, with flashing text, is displayed over the center soft key. When the TLS alarm is set to **Latched** mode, the TLS alarm will remain active even after tension has returned to a normal range. The operator must press the center soft key to clear the alarm (see Section 7.6, Resetting TLS Alarms, for more detail).

The Line Graph display can be paused at any time by pressing the right most soft key "PAUSE" and can then be resumed by once again pressing the right most soft key "RESUME".

This Line Graph display is also used in the **PID Tune View** displays, which allow for real time P, I and D adjustments while viewing the Line Graph display (see Section 3.5, PID Tune View, for more information).

3.4 MENU MODE DISPLAY

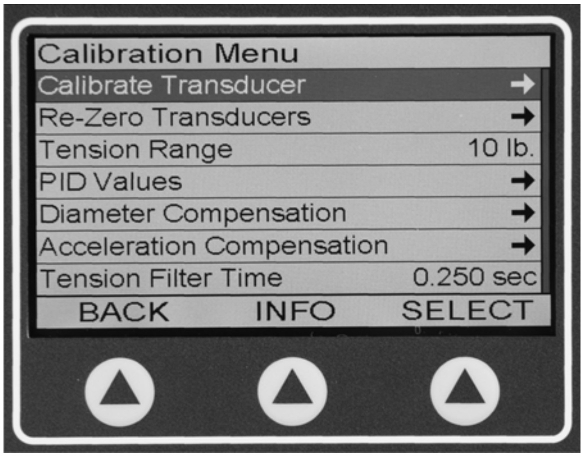


***Figure 25* – MENU MODE DISPLAY**

The **Menu** mode display is used to access and adjust the controller's settings, perform calibration and save or load Setups.

The menu system is presented as scrollable lists that the operator navigates using the three soft keys along with the multipurpose spinning knob. The soft keys' functionality varies based on the context of the current display. At all times, the function of each soft key is printed on the display immediately above the key in the Soft Key Function bar (**Figure 25, Menu Mode Display**). In some situations, certain soft keys will have no functionality and the area above them will be blank. The multipurpose knob is used to navigate through the menu hierarchy and to adjust setting values. While in Menu mode, the current menu selection is highlighted dark blue. Turning the knob clockwise moves the selection bar down and turning it counterclockwise moves it up. For menu displays that contain lists longer than physically viewable in the display, a scroll bar on the right hand side of the display shows the current position in the vertical list of menu items.

Within the menu navigation display, the three soft keys take on the function of **Back**, **Information**, and **Select**. Pressing the BACK, or left most soft key, causes the menu display to return to the previous menu or screen. Pressing the INFO, or center soft key, presents a scrollable information page about the currently highlighted menu item (**Figure 26, Example Info Page**). This allows for what is effectively an on-screen manual. Detailed information for each menu, setting and function is provided. Pressing the SELECT, or right most soft key, selects the currently highlighted menu item. This will either lead to a sub-menu, a setting adjust screen or a function screen. Sub-menu and function items are indicated by a right pointing arrow and settings typically display their currently saved value towards the right side of the menu display. While in the menu system, the current menu location is printed on the top of the display in the Menu Title Bar.

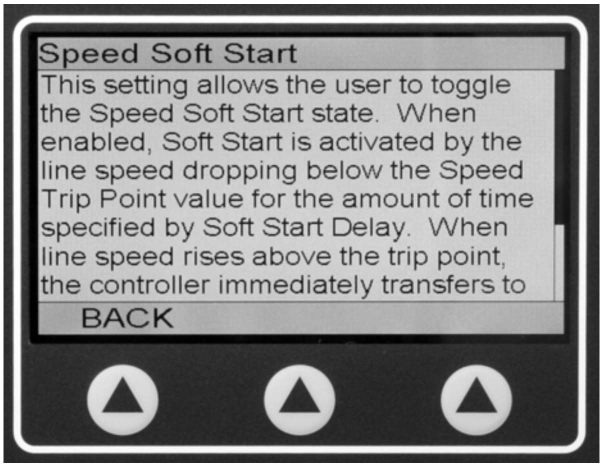


***Figure 26* – EXAMPLE of INFORMATION PAGE**

After selecting a setting through the menu system. The display will enter a Setting Adjust screen. These screens vary based on the selected setting, but all serve the same general purpose; to allow the user to adjust a given controller setting. Each Setting Adjust screen contains a Setting Title Bar that contains the name of the setting and a Soft Key Function bar displaying the function (if any) for each of the soft keys (**Figure 27, Soft Start Output Level Adjust Display**). Most Setting Adjust screens also contain the currently saved setting value, as well as the range of possible values for the particular setting.

3.4 MENU MODE DISPLAY *continued...*

The soft keys and the multipurpose knob are used to adjust and save setting values. At any time, a Setting Adjust screen may be exited by hitting the BACK, left most soft key. The adjustment of the various settings is relatively straight forward due to the descriptive and intuitive nature of each of the Setting Adjust screens. **Figure 27, Soft Start Output Level Adjust Display** and **Figure 28, Select Tension Zone Display** show some examples of Setting Adjust screens.

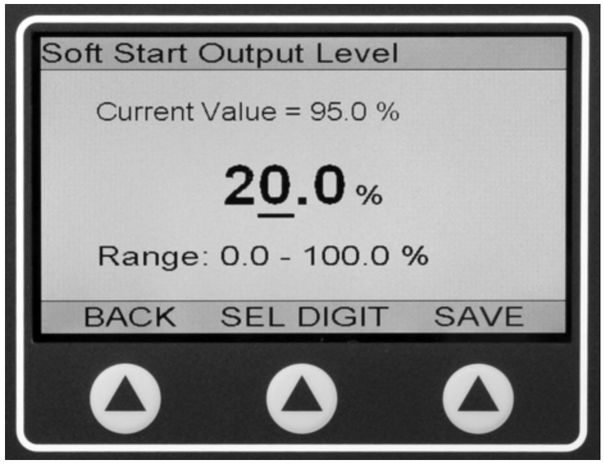


Figure 27 **- SOFT START OUTPUT LEVEL ADJUSTMENT DISPLAY**

The **Soft Start Output Level Adjust Display** (**Figure 27**), shows the currently saved value and the range of possible values. Turning the multipurpose knob allows adjustment of the new setting. Turning the knob clockwise increments the underscored digit and turning the knob counterclockwise decrements the underscored digit. The middle soft key, SEL DIGIT, selects the underscored digit position. The underscore moves left one digit every time the SEL DIGIT soft key is pressed, wrapping around to the least significant digit from the most significant digit. Using the SEL DIGIT soft key in combination with the multipurpose knob allows fast and accurate setting of a value. The multipurpose knob is also speed sensitive, meaning turning it faster will cause faster, more coarse adjustments and turning it slower will cause slower, more precise adjustments. Once the desired **Soft Start Output Level** is selected, the right most soft key, SAVE, is pressed to save the desired value to the controller's non-volatile memory. After pressing SAVE, a "Saving..." window will appear for approximately one second while the setting is stored.

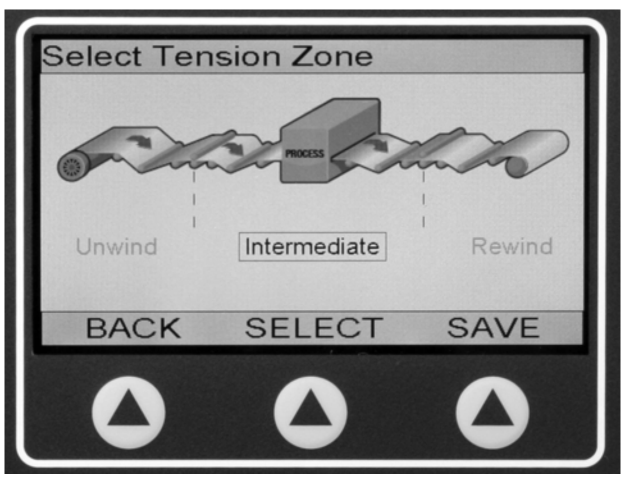


Figure 28 **- SELECT TENSION ZONE DISPLAY**

The **Select Tension Zone Display** (**Figure 28**), demonstrates another example of a Setting screen. A graphic representation of a web processing line is presented with labeled tension zones underneath. The currently selected zone is shown in a darker text, and is outlined in a blue box. Turning the multipurpose knob clockwise will move the current zone selection to the right and turning it counterclockwise will move the current zone selection to the left. Alternatively, the center soft key, SELECT, cycles the currently selected zone to the right upon each press, wrapping around from Rewind to Unwind. Once the desired zone is selected, the right most soft key, SAVE, is pressed to save the desired zone to the controller's non-volatile memory.

Other setting adjust screens are just as intuitive as those shown above. The Menu mode screens may be exited at any time by pressing the Menu / Run key.

3.5 PID TUNE VIEW

The **PID Tune View** screen (**Figure 29**) is a function screen that deserves special attention due to its usefulness and somewhat greater complexity than other function screens. The PID Tune View screen is based off of the **Line Graph Display**, described in Section 3.3, **Run Mode Display**. The display allows viewing the real time Tension, Setpoint and Output in line graph form. The PID Tune View screen adds the capability of real time Proportional, Integral and Derivative tuning adjustments. It can be accessed from the *Calibration Menu > PID Values* menu for the standard (Core) PID values, or from the *Calibration Menu > Diameter Compensation* menu for the Full Roll PID values when using Diameter Compensation (see Section 6.5, Diameter Compensation).

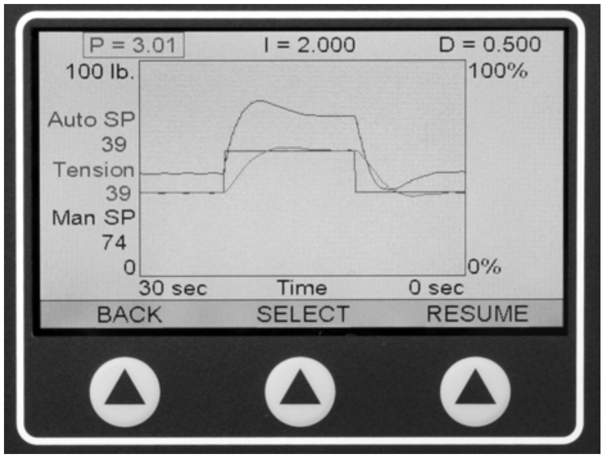


Figure 29 **- PID TUNE VIEW**

All adjustments are made with the multipurpose knob and center soft key (SELECT). Pressing the SELECT key cycles clockwise through the various adjustable parameters; the manual setpoint (Man SP), the Auto Setpoint (Auto SP), and the P, I and D terms. The currently selected parameter is highlighted within a blue rectangle. Turning the multipurpose knob clockwise will increase this value and turning it counterclockwise will decrease the value. The knob is speed sensitive, meaning turning it faster will cause faster, more coarse adjustments to the selected value and turning it slower will cause slower, more precise adjustments. All PID changes are automatically saved to the controller's non-volatile memory in the ACTIVE Setup. For a detailed description of the tuning parameters and tuning procedure, see Section 6, Tuning Adjustments.

The PID Tune View screen, like the Line Graph Display, has the ability to pause the display. This can be accomplished by pressing the right most soft key (PAUSE / RESUME).

4.1 TENSION CALIBRATION

When using the standard transducer connection (as opposed to an RTA input), tension calibration must be completed before the controller is able to display or control tension.

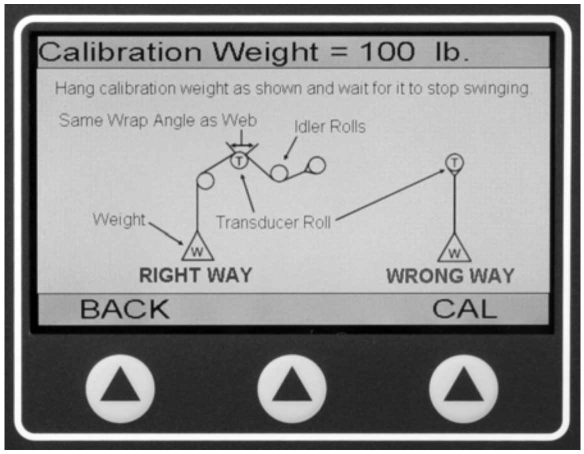
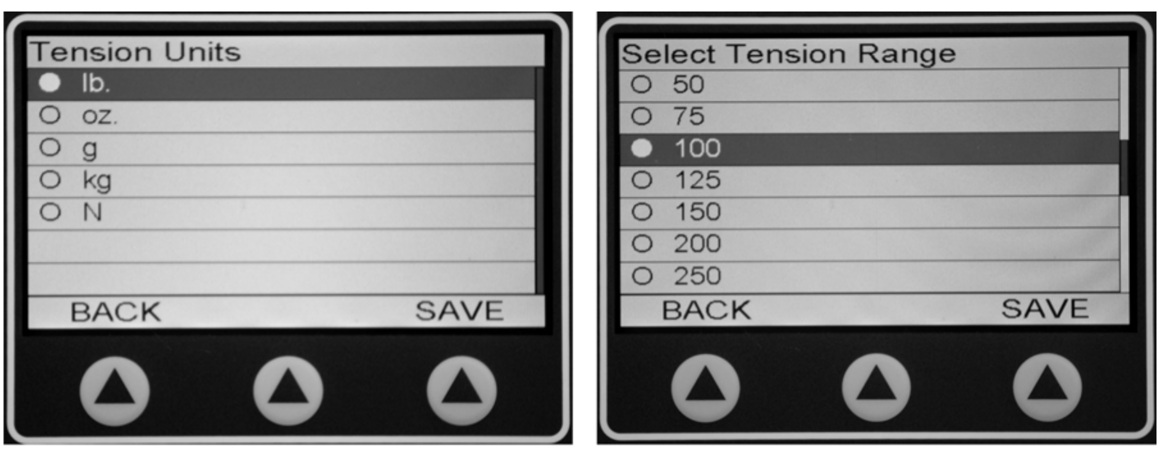


Figure 30 **- WEB PATH FOR CALIBRATION**

1. Standard Transducer Calibration

In preparation for transducer calibration, select an appropriate calibration weight. Larger weights (in reference to the full scale range) tend to give more accurate calibration, but can be unwieldy for large tension ranges. The controller requires a minimum calibration weight of 10% the full scale range. Get a length of rope, wire, or cable of appropriate length. It must NOT be extensible (stretchy). This will cause inaccurate calibration.

Before calibrating the unit, verify that the factory preset tension units are set to the values you prefer. Use the **Menu/Run** key to put the display in Menu mode. Navigate to the *Operator Menu → Display Configuration → Tension Units*. Your Tension Unit choices are lb, oz, g, kg, or N. Scroll to your choice, if it is not already selected, and press SAVE to select and store these units. BACK out to the *Main Menu Screen*. Navigate to the *Calibration Menu* and select the **Calibrate Transducer** function.



TENSION UNITS SELECTION TENSION RANGE SELECTION

Figure 31 **- SELECTION OF TENSION UNITS AND RANGE**

4.1 TENSION CALIBRATION *continued...*

The **Calibrate Transducer** function will first ask you to verify the **Tension Range** and **Units**. This is typically factory-configured, and rarely needs to be changed. If the **Tension Range** is incorrect, however, press the left most soft key (BACK) and select and adjust the **Tension Range** setting as required for your application. If the **Tension Range** value is correct, press the right most soft key (NEXT) to continue the Calibration procedure.

Next, the **Calibration Weight** value adjust screen is presented. Use the multipurpose spinning knob and the center soft key (SEL DIGIT) to adjust the **Calibration Weight** value to match the weight being used to calibrate the transducers. Press the right most soft key (SAVE) to store the **Calibration Weight** value to non-volatile memory and continue through the Calibration procedure. The “SAVING...” message screen will appear for approximately one second while the controller stores the **Calibration Weight** value. If an error message is returned, refer to Section 9.2 for error message meanings.

You will now be asked to **Zero** the transducer. Ensure nothing is hanging or pressing on the tension roll (including the calibration rope) and press the ZERO (right most) soft key. The “SAVING...” message screen will appear for approximately one second while the controller stores the Zero tension value. If an error message is returned, refer to Section 9.2 for error message meanings.

Finally, the Calibration screen is presented. The expected Calibration weight is displayed towards the top of the display. Make sure this is the correct value. If not, navigate back to the **Calibration Weight** step by pressing the left most soft key (BACK) twice, and adjust the **Calibration Weight** value as required. Otherwise, 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 (**Figure 30, Web Path for Calibration**). Be sure the rope does not pass around any driven rolls, drag bars, or anything else that can affect tension. Ideally, the rope should contact 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. Attach the weight to the free end of the rope as shown in the on screen image. The weight should not touch anything. Wait for the weight to stop swinging and press the CAL (right most) soft key. The “SAVING...” message screen will appear for approximately one second while the controller stores the tension span value. Upon successful calibration, the **Calibrate Transducer** function exits back to the the *Calibration Menu* screen. If the calibration was unsuccessful and an error message is returned, refer to Section 9.2 for error message meanings.

With the calibration weight still attached, use the **Menu/Run** key to return to the Run mode display and verify the current tension reading matches the calibration weight. Remove the weight and verify the tension reading drops to 0. If there is an error in the tension reading, repeat calibration using the above steps. If the readings are wrong the second time, refer to your transducer manual and verify that the transducers are not pre-loaded. This condition is caused by errors in mounting the transducers or roll.

2. Remote Tension Amplifier Configuration

Follow the instruction manual provided with the remote tension amplifier or indicator to calibrate the system. The 0-10V signal from the amplifier should be wired to Terminal Block 4 (TB4) on the controller board, to the RTA 1 and RTN 1 or RTA 2 and RTN 2 terminals (see Figure 12).

Use the **Menu/Run** key to put the display in Menu mode. Navigate to the *Setup Menu > Tension Control Setup* menu and adjust the **Tension Source** menu item to RTA 1 or RTA 2, based upon which pair of RTA inputs are being utilized.

Navigate to the *Calibration Menu* and adjust the **Tension Range** as required for your application. A 10V signal from the remote tension amplifier will correspond to the value specified by the **Tension Range** setting. No controller calibration is necessary when using the RTA input.

4.2 LINE/ROLL SPEED INPUT CALIBRATION

The Line Speed represents the actual speed of the web, and is useful for Line Speed Follow modes of control, as well as for tachometer ratio diameter calculation. It is usually determined by a tachometer reading an idler roll's spinning rate.

The Roll Speed represents the speed of a rotating roll, either in an Unwind or Rewind system. It again, is typically determined by a tachometer signal measuring the roll's spinning rate. The Roll Speed is used together with the Line Speed to calculate a roll's diameter (see Section, 4.5 Diameter Input Calibration, for more information).

There are three ways to feed a Line or Roll speed signal to the SteadyWeb™5 controller:

1. A 0-10V signal from an external calibrated tachometer or device where 0 Volts represents zero speed and 10 Volts represents full speed.
2. A 0-250VDC signal representing speed from an external DC Tachometer.
3. A 1-50VDC pulsed signal representing speed from an external Pulse Tachometer Encoder.

4.2 LINE/ROLL SPEED INPUT CALIBRATION *continued...*

1. 0-10V Signal

When using a 0-10V signal, no calibration is necessary. The signal should be wired directly into the control board's Signal terminal block (see Figure 12). A Line speed signal should be wired into (TB3) terminal 19 (LINE IN) and 21 (GROUND) and a Roll Speed input should be wired into (TB3) terminal 20 (ROLL IN) and 22 (GROUND) (see Section 2.11, Figure 12.

For Line speed inputs, the **Max Line Speed** setting in the *Setup Menu > Line Speed Setup* menu should be set to the line speed represented by 10V on the LINE_IN input terminal. The **Line Speed Units** setting should be set to the desired line speed display units.

2. DC Tachometer Input

Input from a DC Tachometer requires a DC Tachometer Input option card (P/N 723-2085). For a Line Speed input, this card must be installed into the LINE TACH slot on the control board (plugging into P4) and mounted properly to the two supportive mounting studs (see Section 2.12, Figure 14, Option Card Mounting Locations). For a Roll Speed input, the card must be installed into the ROLL TACH slot on the control board (plugging into P5) and mounted properly to the two supportive mounting studs (see Section 2.12, Figure 14, Option Card Mounting Locations).

For instructions on how to calibrate the DC Tachometer input option card, refer to Section 4.3, DC Tachometer Calibration.

If calibrating the Line Speed input, the **Max Line Speed** setting in the *Setup Menu > Line Speed Setup* menu should be set to the maximum Line Speed value and the **Line Speed Units** setting should be set to the desired line speed display units.

3. Pulse Tachometer Input

Input from a Pulse Tachometer requires a Pulse Tachometer input option card (P/N 723-2084). For a line speed input, this card must be installed into the LINE TACH slot on the control board (plugging into P4) and mounted properly to the two supportive mounting studs (see Section 2.12, Figure 14, Option Card Mounting Locations). For a roll speed input, the card must be installed into the ROLL TACH slot on the control board (plugging into P5) and mounted properly to the two supportive mounting studs (see Section 2.12, Figure 14, Option Card Mounting Locations).

For instruction on how to calibrate the Pulse Tachometer input option card, refer to section 4.4, Pulse Tachometer Calibration.

If calibrating the Line speed input, the **Max Line Speed** setting in the *Setup Menu > Line Speed Setup* menu should be set to the maximum Line speed value and the **Line Speed Units** setting should be set to the desired line speed display units.

4.3 DC TACHOMETER CALIBRATION

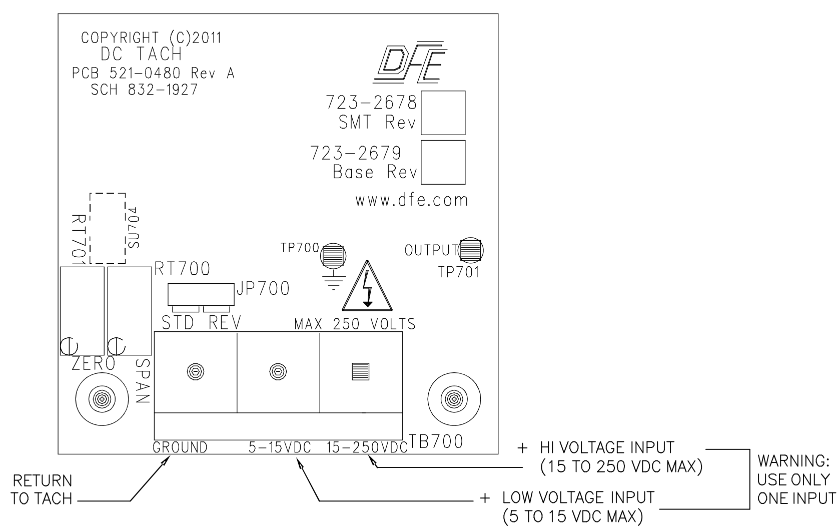


***Figure 32* - DC TACHOMETER CARD**

The optional DC Tachometer input card accepts a DC input voltage from a tachometer with a maximum output voltage between 5 and 250VDC and converts it to a 0-10VDC signal which gets passed down to the controller board. The 0-10VDC Tachometer card output signal ties into the Signal terminal block (TB3) input terminals, either terminal 19 (LINE IN) when populated in the LINE TACH OPTION CARD slot or terminal 20 (ROLL IN) when populated in the ROLL

4.3 DC TACHOMETER CALIBRATION *continued...*

TACH OPTION CARD slot. For this reason, a 0-10V signal should not be fed to both the control board's Signal terminal block (TB3) LINE IN or ROLL IN terminal and the corresponding tachometer input option card. The Line and Roll signal should only come from a single source, the TB3 terminal block OR a tachometer option card, and the terminal block input should never be used while the corresponding tachometer option card slot is populated with a tachometer card.

For DC tachometers that output a maximum output voltage between 5 and 15VDC, the positive tachometer output lead should be connected to terminal 2 of the DC Tachometer input card terminal block (TB700). Tachometers with a maximum output voltage between 15 and 250VDC should connect the positive tachometer output to terminal 3 of the DC Tachometer input card terminal block (TB700). The negative tachometer output should be connected to terminal 1 (GROUND) of the DC Tachometer input card terminal block (TB700) (see Section 2.14, Fig. 16, DC Tachometer Option Card Electrical Connections).

With the tachometer properly wired to the DC Tachometer input card and power applied to the controller, attach the positive clip lead (or probe) of a DC Voltmeter to test point TP701 (OUTPUT) and the negative clip lead (or probe) to test point TP700 (GROUND) on the DC Tachometer input card (see **Figure 32, DC Tachometer Card**).

With the machine at zero speed, the output at the Voltmeter should read 0.0V. If not, adjust the RT701 (ZERO) potentiometer until the output voltage reads 0.0V. (see **Figure 32, DC Tachometer Card**).

Run the machine at max speed, or optionally at 50% max speed and note the polarity of the output at the Voltmeter. If the polarity is negative, swap the location of jumper JP700 from STD (standard) to REV (reverse) (see **Figure 32, DC Tachometer Card**).

Use a hand tachometer to verify the machine is running correctly at maximum speed (or at 50% speed if desired).

Next, the RT700 (SPAN) potentiometer must be adjusted on the DC Tachometer input card to create the desired output at the Voltmeter (see **Figure 32, DC Tachometer Card**). When calibrating a Line Speed tachometer or a Roll tachometer at core diameter, the SPAN potentiometer should be adjusted to match the machine speed. For example, if running the machine at max speed, the SPAN potentiometer should be adjusted for a 10.0V output at the Voltmeter. If running the machine at 50% speed, the SPAN potentiometer should be adjusted for a 5.0V output

If you are calibrating a Roll tachometer and there is some material on the core, measure the roll diameter and adjust the SPAN potentiometer to produce a test point voltage of:

10 x (core diameter / actual diameter) . . . . for max speed or

5 x (core diameter / actual diameter) . . . . for 50% speed

Once calibrated, decrease and increase the machine speed and verify the DC Tachometer input card output follows machine speed changes. Stop the machine and verify the output drops down to 0.0V. If the output does not read 0.0V with the machine stopped, adjust the ZERO offset potentiometer (RT701) to bring the output to 0.0V and repeat the calibration steps for max speed as described above.

Note: If the OUTPUT and GROUND test points (TP701 and TP700) are difficult to access, the tachometer option card output signal can be read from the control board Signal terminal block (TB3) connections; terminal 19 (LINE IN) and 21 (GROUND) for the Line Speed tachometer card output and terminal 20 (ROLL IN) and 22 (GROUND) for the Roll Speed tachometer card (see Section 2.11, Standard Electrical Connections).

If calibrating the Line speed input, the **Max Line Speed** setting in the *Setup Menu > Line Speed Setup* menu should be set to the line speed represented by 10V on the tachometer option card output. The **Line Speed Units** setting should be set to the desired line speed display units.

4.4 PULSE TACHOMETER CALIBRATION

The optional Pulse Tachometer input card accepts a pulsed tachometer output signal with a peak output voltage that falls within 1 to 50V. While the peak output voltage of the tachometer is not important (as long as it is under 50V) the low voltage must come close to 0V for an accurate pulse reading. The Pulse Tachometer option card converts the pulsed signal to a 0-10V signal which gets passed down to the controller board. The Pulse Tachometer card output signal ties into the control board's Signal terminal block (TB3), either terminal 19 (LINE IN) when populated in the LINE TACH OPTION CARD slot or terminal 20 (ROLL IN) when populated in the ROLL TACH OPTION CARD slot. For this reason, a 0-10V signal should not be fed to both the Signal terminal block (TB3) LINE IN or ROLL IN terminal and the corresponding tachometer input option card. The Line and Roll signal should only come from a single source, the TB3 terminal block OR a tachometer option card, and the terminal block input should never be used while the corresponding tachometer option card slot is populated with a tachometer card.

4.4 PULSE TACHOMETER CALIBRATION *continued....*

The positive output of the pulse tachometer should connect to terminal 3 (+) of the Pulse Tachometer input card terminal block (TB600). The negative output of the pulse tachometer should connect to terminal 2 (-) of the Pulse Tachometer Input card terminal block (TB600) (see Section 2.13, Pulse Tachometer Option Card Electrical Connections).

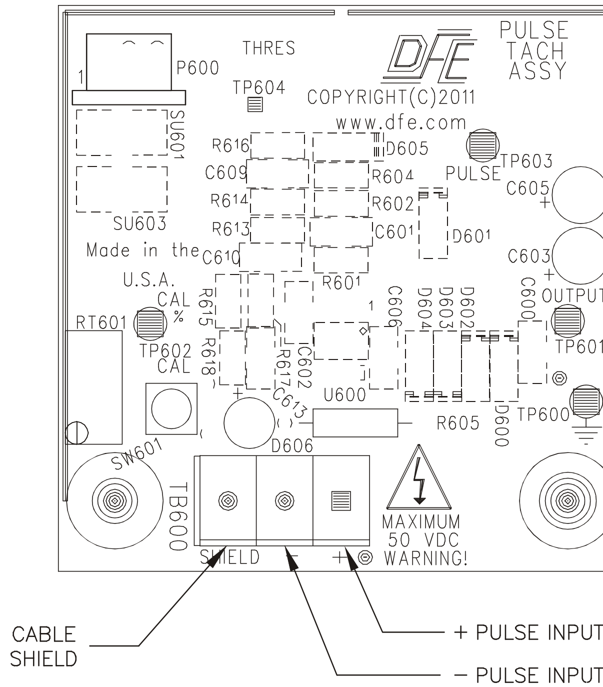


Figure 33 **- PULSE TACHOMETER CARD**

With the tachometer properly wired to the Pulse Tachometer input card and power applied to the controller, attach the positive clip lead (or probe) of a DC Voltmeter to test point TP602 (CAL) and the negative clip lead (or probe) to test point TP600 (GROUND) on the Pulse Tachometer input card (see **Figure 33, Pulse Tachometer Card**).

When calibrating a Line speed tachometer or a Roll tachometer at core diameter, the CAL potentiometer (RT601) should be adjusted to match the machine calibration speed, which is typically max speed or 50% max speed (see **Figure 33, Pulse Tachometer Card**). For example, if you are calibrating your machine at max speed, adjust the CAL voltage at the Voltmeter to 10.0V. If you are calibrating your machine at 50% speed, adjust the CAL voltage at the Voltmeter to 5.0V.

If you are calibrating a Roll tachometer and there is some material on the core, measure the roll diameter and adjust the CAL potentiometer to produce a test point voltage of:

10 x (core diameter / actual diameter) . . . . for max speed or

5 x (core diameter / actual diameter) . . . . for 50% speed

Once the CAL voltage has been adjusted, run the machine at max speed, or optionally at 50% max speed, corresponding to the CAL voltage. Use a hand tachometer to verify the the machine is running correctly at maximum speed (or at 50% speed if desired) and press the CAL push button (SW1) (see **Figure 33, Pulse Tachometer Card**). This will cause the Pulse Tachometer Input card to sample the current pulse rate and adjust the output voltage to match the voltage set by the CAL potentiometer (RT601). The Pulse Tachometer option card's LED will flash briefly at the beginning of the calibration sequence and flash again when the calibration sequence is complete. This may take a few seconds, and slower pulse rates generally take a longer period of time to calibrate than faster pulse rates. When calibration is complete, the LED will go back into run mode, flashing each time a pulse is received. Under normal operation, the LED will look to be on solid because of the high pulse frequency. If the LED is off completely and not flashing, the card is not detecting pulses from the tachometer.

NOTE: Depending on the full range frequency, the LED may flash at a slower rate then once per pulse. If the full range frequency is greater than 3,125Hz, for example, the LED will flash every 4 pulses. If the full range frequency is greater than 12.5kHz, the LED will flash every 16 pulses. Typically, however, the pulse rate will cause the LED to be flashing too fast to distinguish individual pulses and will appear to be steady on.

After the calibration sequence is complete, move the positive clip lead (or probe) of the Voltmeter to test point TP701 (OUTPUT) and verify the output of the Pulse Tachometer Input card matches the voltage that was previously set with the CAL potentiometer (RT601). Decrease and increase the machine speed and verify the Pulse Tachometer Input card output voltage follows speed changes. Stop the machine and verify the output voltage drops to 0.0V.

4.4 PULSE TACHOMETER CALIBRATION *continued....*

Note: If the OUTPUT and GROUND test points (TP601 and TP600) are difficult to access, the tachometer option card output signal can be read from the control board Signal terminal block (TB3) connections; terminal 19 (LINE IN) and 21 (GROUND) for the Line Speed tachometer card output and terminal 20 (ROLL IN) and 22 (GROUND) for the Roll Speed tachometer card (see Section 2.11, Standard Electrical Connections).

If calibrating the Line speed input, the **Max Line Speed** setting in the *Setup Menu > Line Speed Setup* menu should be set to the line speed represented by 10V on the tachometer option card output. The **Line Speed Units** setting should be set to the desired line speed display units.

4.5 DIAMETER INPUT CALIBRATION

There are two ways to feed a diameter signal to the SteadyWeb™5 controller.

1. Directly from a diameter measurement device, such as from a rider assembly or ultrasonic sensor.
2. As an internally calculated diameter based on the ratio of the Line speed to Roll speed inputs. This mode requires valid Line and Roll speed inputs, which may need to be individually calibrated (see section, 4.2 Line/Roll Speed Input Calibration).

1. Direct Diameter Input

The Diameter input is designed to take a signal from a rider assembly, ultrasonic sensor or other diameter measurement device that has an output that falls between 0 and 10VDC. The minimum voltage variation between core diameter and full roll diameter should cause at least 4V of change. When using a rider assembly, ensure the rider moves freely over the entire range of roll diameters. When using an ultrasonic sensor, ensure the ultrasonic beam is aimed perpendicular to the winding roll, not at an angle.

The diameter signal should be wired directly into the control board's Signal terminal block (TB3) terminal 23 (DIA IN) and 21 (GROUND) (see Section 2.11, Standard Electrical Connections). An available +10V or 15V power supply is available for driving light loads such as a roll follower potentiometer or ultrasonic range finder (see Section 2.9 Customer +10/15V Output Selection).

To set the diameter input type, navigate to the *Setup Menu > Diameter Setup* menu and set the **Diameter Input Type** setting to **Direct**. In the same menu, adjust the **Core Diameter**, **Max Full Roll Dia** and **Diameter Units** settings to the values required for your application.

Select the **Calibrate Rider** function to calibrate the diameter measurement device. The Calibrate Rider function will first ask you to calibrate the core diameter. Place an empty core in the machine and lower the roll follower or activate the range finder and press SAVE (the right most soft key). The “SAVING...” message screen will appear for approximately one second while the controller stores the core diameter input value.

Next, the controller will ask you to calibrate the full roll diameter. Load a roll on the machine with the maximum used diameter. Lower the roll follower or activate the range finder and press SAVE (the right most soft key). The “SAVING...” message screen will appear again for approximately one second while the controller stores the full roll diameter input value. Upon successful calibration, the **Calibrate Rider** function exits back to the the *Setup Menu > Diameter Setup* screen. If the calibration was unsuccessful and an error message is returned, refer to Section 9.2 for error message meanings.

2. Direct Diameter Input Using a DC Tachometer Card

If the Diameter input is fed from a diameter measurement device that outputs more than 10VDC, a DC Tachometer Option Card may be used to convert the voltage to a 0-10V signal (P/N 723-2085). For such a situation, the card should be installed into the ROLL TACH slot on the control board (plugging into P5) and mounted properly to the two supportive mounting studs (see Section 2.12, Figure 14, Option Card Mounting Locations). The output of the tachometer card can then be tied from the Signals terminal block (TB3) terminal 20 (ROLL IN) to the diameter input, terminal 23 (DIA IN), with a short piece of jumper wire. See Section 4.3, DC Tachometer Calibration, for instructions on calibrating the DC Tachometer.

3. Tachometer Ratio Calculation

Tachometer ratio calculation determines the roll diameter by monitoring the ratio of the Line Speed to Roll Speed inputs and taking into consideration that as diameter increases, a slower rotation is required for a given speed. For example, if the Roll input signal is half that of the Line input signal, the diameter of the Roll will be twice that of the core diameter.

To set the diameter input type, navigate to the *Setup Menu > Diameter Setup* menu and set the **Diameter Input Type** setting to **Tach Ratio Calc**. In the same menu, adjust the **Core Diameter**, **Max Full Roll Dia** and **Diameter Units** settings to the values required for your set up.

4.5 DIAMETER INPUT CALIBRATION *continued...*

To use the Tachometer Ratio Calculation feature, Line and Roll inputs must be present and calibrated if required (see section, 4.2 Line/Roll Speed Input Calibration).

4. Testing the Diameter Measurement

Ensure the **Display Mode** setting, located in the *Operator Menu > Display Configuration* menu is set to **Bar Graph**. Within the same menu, set the **Diameter Display** setting to **On**. This will display diameter information in the Run Mode screen in circular graph form, as well as text readout for both diameter percentage and the diameter value (based upon the **Core Diameter**, **Max Full Roll Dia** and **Diameter Units** settings).

The diameter displayed should agree with the actual measured diameter within at most 10%, preferably within 5%. If this is not the case, re-perform calibration as described above

4.6 SIGNAL FILTERING

The tension, diameter and line/roll inputs all feature adjustable input filtering. These are rolling average filters used to filter high frequency noise. Greater filter times allow for a cleaner signal with the drawback of added delay.

1. Tension

The tension filter action is determined by the **Tension Filter Time** setting, located in the *Calibration Menu*. Increasing the filter time can help filter high frequency noise, such as caused by machine vibration. The added delay that comes with increasing the filter time, however, can increase instability in the control loop (see Section 6, Tuning Adjustments). This setting should NOT be used to make the tension reading more readable in the Run mode display. There is a separate display tension damping filter in the *Operator Menu > Display Configuration* menu that can be used to adjust the visual, displayed tension filter without affecting the tension reading used by the control loop (see Section 7.2, Display Adjustments).

2. Diameter

The diameter filter action is determined by the **Diameter Filter Time** setting, located in the *Setup Menu > Diameter Setup* menu. Increasing the filter time can help filter high frequency diameter noise, such as caused by an out of round roll. As the diameter signal is typically a very slow changing signal, this filter time can be set reasonably high without having a negative effect on control.

3. Line / Roll

The Line and Roll Inputs share a common filter time setting. Increasing the filter time for one will do the same for the other. The only time the Roll Input is used is in conjunction with the Line Input for tachometer ratio diameter calculation, and so sharing a common filter ensures that both signals are equally filtered in such applications. It should be noted that when using tachometer ratio diameter calculation mode of diameter input, the diameter filter applies to the calculated diameter value. This means that there are essentially two separate filters involved in the diameter signal reading in such applications, the Line / Roll Filter and the Diameter Filter.

This filter can play an important role in controllers using a Line Speed Follow mode of operation, where noise in the Line Signal gets carried over into the output signal. Increasing the filter time helps reduce the impact of this noise, but also increases the delay to a fast changing Line Signal. Some experimentation may be required in setting the filter time to find optimal controller performance.

5.1 CONTROL FEEDBACK MODES

The controller features three Control Feedback Modes. The mode of use is specified by the **Control Feedback** setting, located in the *Setup Menu > Tension Control Setup* menu. The three feedback modes are **Standard Closed Loop**, **Line Speed Follow Tension Trim** and **Diameter Compensated Line Speed Follow Tension Trim**.

1. Standard Closed Loop:

Standard Closed Loop control is used for standard tension control applications. The output is adjusted to maintain tension at the operator selected setpoint. The only input required for Standard Closed Loop control is a tension signal, either directly from transducers or through one of the RTA (Remote Tension Amplifier) inputs.

2. Line Speed Follow Tension Trim:

Line Speed Follow Tension Trim mode of control is typically used in Intermediate Zone applications to prevent a lag in the output during Line Speed changes. The output is set to mirror the web speed, varying only by a small percentage to maintain tension. Line Speed Follow Tension Trim requires a Line Speed input (see Section, 4.2 Line/Roll Speed Input Calibration). In Intermediate Zone applications where the tension transducer is positioned after the drive motor the **Control Output** parameter should be set to **Reverse** (see Section 2.6 Control Output Selection).

When Line Speed Follow Tension Trim mode of control is utilized, the **Tension Trim** and **Trim Percentage Target** settings, both located in the *Setup Menu > Setup Tension* menu, control the degree of tension trim. The **Tension Trim** setting is programmed as a percentage value representing the percentage of **Output** OR **Line Speed**, as specified by the **Trim Percentage Target** setting, for which tension should be trimmed. For example, setting Tension Trim to 10% and Trim Percentage Target to Output will cause the output to match the 0-10V Line speed signal with +/- 1V of tension trim. Setting Tension Trim to 10% and Trim Percentage Target to Line Speed, on the other hand, will cause the output to match the 0-10V Line speed signal with +/-10% of that signal of tension trim. If the Line speed signal is at 1V, for example, there is +/- 0.1V of tension trim. If the Line speed signal is at 10V, there is +/- 1V of tension trim. Using the Line Speed target prevents the tension trim percentage from dominating the output contribution at low Line speeds, which can be preferable in certain applications.

3. Diameter Compensated Line Speed Follow Tension Trim:

Diameter Compensated Line Speed Follow Tension Trim control is similar to Line Speed Follow Tension Trim with the exception of being used in rewind applications. The control output is set to mirror web speed, varying only by a small percentage to maintain tension, while taking into consideration the diameter of the rewind roll. As the roll diameter increases, a single rotation will wrap more web material and so a given rotational speed will lead to faster web speed. To account for this, the controller decreases the output as the roll diameter increases to maintain the desired web speed. This mode of operation requires both a line speed and a diameter input (see Section, 4.2 Line/Roll Speed Input Calibration and Section 4.5, Diameter Input Calibration). The degree of tension trim is determined by the **Tension Trim** and **Trim Percentage Target** settings, as described above in the Line Speed Follow Tension Trim description.

5.2 UNWIND ZONE SETUP

The following series of steps are provided to setup the controller for use in an Unwind zone.

1. Set the **Tension Zone** setting to **Unwind**. This setting is located in the *Setup Menu > Setup Tension* menu.
2. Ensure the **Control Feedback** setting is set to **Closed Loop**. This setting is located in the *Setup Menu > Setup Tension* menu. See Section 5.1, Control Feedback Modes, for more information.
3. **Q**: What type of Actuator device will you be feeding?

   A: Motor Drive.

   Assuming a typical motor drive with a +/-10V input, configure the controller for voltage output with a full bipolar range (-100% to 100%) and set the **Control Output** setting to **Reverse**. See Section 2.6, Control Output Selection.

   A: Brake

   Configure the output for 0-10V or 4-20mA as required to drive your brake configuration. If ordered as a Version P, use the 4-20mA output to the pneumatics module. Ensure the **Control Output** setting is set to **Standard**. See Section 2.6, Control Output Selection.

5.2 UNWIND ZONE SETUP *continued....*

4. **Q**: Will you be using the Soft Start feature? This feature is commonly used in Unwind applications to prevent brake lock up during machine start up. See Section 5.5, Soft Start Setup, for more information.

   A: Yes. (Recommended)

   Configure Soft Start as required for your application. See Section 5.5, Soft Start Setup.

   A: No.

   Ensure the **Speed Soft Start**, **Tension Soft Start** and **Switched Soft Start** settings are set to Off. See Section 5.5, Soft Start Setup.

5. **Q**: Will you be using the TLS (Tension Limit Switch) feature? This feature is used to provide an alarm when web tension exceeds or drops below user specified levels. See Section 5.7, Tension Limit Switch Setup, for more information.

   A: Yes.

   Configure TLS as required for your application. See Section 5.7, Tension Limit Switch Setup.

   A: No.

   Ensure the **TLS Low Mode** and **TLS High Mode** settings are set to Off. See Section 5.7, Tension Limit Switch Setup.

6. If not already completed, calibrate tension as described in Section 4.1, Tension Calibration.
7. Tune the control loop as specified in Section 6, Tuning Adjustments. In applications with a large difference between core and full roll diameter, the Diameter Compensation feature may be useful. In this case, a diameter input signal is required, see Section 4.5, Diameter Input Calibration.
8. Configure the Run mode display as described in Section 7.2, Display Adjustments, to your personal preferences.
9. Once the controller is set up, tuned and operating as desired, save the Setup and tuning parameters as described in Section 7.3, Saving and Recalling Setups

5.3 INTERMEDIATE ZONE SETUP

The following series of steps are provided to setup the controller for use in an Intermediate zone.

1. Set the **Tension Zone** setting to **Intermediate**. This setting is located in the *Setup Menu > Setup Tension* menu.
2. **Q**: Is the tension measurement transducer positioned before or after the driven nip?

   A: Before.

   Assuming a typical motor drive with a +/-10V input, configure the controller for voltage output with a full bipolar range (-100% to 100%) and ensure the **Control Output** setting is set to **Standard**. See Section 2.6, Control Output Selection.

   A: After.

   Assuming a typical motor drive with a +/-10V input, configure the control for voltage output with a full bipolar range (-100% to 100%) and set the **Control Output** setting to **Reverse**. See Section 2.6, Control Output Selection.

3. **Q**: Will you be using the **Line Speed Follow Tension Trim** mode of control, as is typical in intermediate zones? See Section 5.1, Control Feedback Modes, for more information.

   A: Yes (Recommended)

   Set the **Control Feedback** setting to **Line Follow Tension**. This setting is located in the *Setup Menu > Setup Tension* menu. See Section 5.1, Control Feedback Modes, for more information. This mode of operation requires a Line speed signal, see Section 4.2 Line/Roll Speed Input Calibration.

   A: No (May cause lag in output when Line speed changes).

   Ensure the **Control Feedback** setting is set to **Closed Loop**. This setting is located in the *Setup Menu > Setup Tension* menu. See Section 5.1, Control Feedback Modes, for more information.

5.3 INTERMEDIATE ZONE SETUP continued...

4. **Q**: Will you be using the TLS (Tension Limit Switch) feature? This feature is used to provide an alarm when web tension exceeds or drops below user specified levels. See Section 5.7, Tension Limit Switch Setup, for more information.

   A: Yes.

   Configure TLS as required for your application. See Section 5.7, Tension Limit Switch Setup.

   A: No.

   Ensure the **TLS Low Mode** and **TLS High Mode** settings are set to Off. See Section 5.7, Tension Limit Switch Setup.

5. If not already completed, calibrate tension as described in Section 4.1, Tension Calibration.
6. Tune the control loop as specified in Section 6, Tuning Adjustments.
7. Configure the Run mode display as described in Section 7.2, Display Adjustments, to your personal preferences.
8. Once the controller is set up, tuned and operating as desired, save the Setup and tuning parameters as described in section 7.3, Saving and Recalling Setups.

5.4 REWIND ZONE SETUP

The following series of steps are provided to setup the controller for use in a Rewind zone.

1. Set the **Tension Zone** setting to **Rewind**. This setting is located in the *Setup Menu* > *Setup Tension* menu.
2. Assuming a typical motor drive with a +/-10V input, configure the controller for voltage output with a full bipolar range (-100% to 100%) and ensure the **Control Output** setting is set to **Standard**. See Section 2.6, Control Output Selection.
3. **Q**: Will you be using the **Diameter Compensated Line Speed Follow Tension Trim** mode of control? See Section 5.1, Control Feedback Modes, for more information.

   A: Yes

   Set the **Control Feedback** setting to **Line Follow Diam. Comp**. This setting is located in the *Setup Menu* > *Setup Tension* menu. See Section 5.1, Control Feedback Modes, for more information. This mode of operation requires Line and Roll speed signals (to provide for diameter calculation) see Section 4.2 Line/Roll Speed Input Calibration, OR a Line speed signal and a Diameter input signal, see Section 4.5 Diameter Input Calibration.

   A: No

   Ensure the **Control Feedback** setting is set to **Closed Loop**. This setting is located in the *Setup Menu* > *Setup Tension* menu. See Section 5.1, Control Feedback Modes, for more information.

4. **Q:** Will you be using the TLS (Tension Limit Switch) feature? This feature is used to provide an alarm when web tension exceeds or drops below user specified levels. See Section 5.7, Tension Limit Switch Setup, for more information.

   A: Yes.

   Configure TLS as required for your application. See Section 5.7, Tension Limit Switch Setup.

   A: No.

   Ensure the **TLS Low Mode** and **TLS High Mode** settings are set to Off. See Section 5.7, Tension Limit Switch Setup

5. If not already completed, calibrate tension as described in Section 4.1, Tension Calibration.
6. **Q**: Will you be using the Taper feature? This can be used to eliminate common roll defects and produce better quality rolls. See Section 7.5, Using Taper, for more information.

   A: Yes.

   Set the **Taper Enable** setting to On, and adjust the **Taper Percentage** setting to the desired Taper percentage, see Section 7.5, Using Taper.

   A: No.

   Ensure the **Taper Enable** setting is set to Off, see Section 7.5, Using Taper.

5.4 REWIND ZONE SETUP *continued...*

7. Tune the control loop as specified in Section 6, Tuning Adjustments. In applications with a large difference between core and full roll diameter, the Diameter Compensation feature may be useful. In this case, a diameter input signal is required, see Section 4.5, Diameter Input Calibration.
8. Configure the Run mode display as described in Section 7.2, Display Adjustments, to your personal preferences.
9. Once the controller is set up, tuned and operating as desired, save the Setup and tuning parameters as described in section 7.3, Saving and Recalling Setups.

5.5 SOFT START SETUP

Soft Start is normally used only in braked Unwind zone applications, and should be left Off when the controller is being used to control Rewind or Intermediate tension. Soft Start is used to reduce the control output to a preset (user adjustable) low level to prevent brake lockup when the machine starts. Upon exiting Soft Start, the PID loop performs a bump-less transfer back into control mode. When the display is in Run mode, a Soft Start alarm window will appear on the display whenever Soft Start is active. Soft Start is only activated when the controller is in Auto mode (not in Manual mode).

Soft Start can be actuated by any of three methods:

1. Automatically upon a loss of tension below a preset trip point (after an adjustable delay).
2. Automatically by machine speed dropping below the speed trip point (after an adjustable delay).
3. Immediately upon closure of an external contact.

It is possible to actuate Soft Start using one or more sources at a time.

1. Actuation by Low Tension

Soft Start by Tension is the standard configuration, and requires no extra external electrical connections.

To activate, navigate to the *Setup Menu > Soft Start Setup* menu and set the **Tension Soft Start** setting to **On**.

Within the same menu, set the **Tension Trip Point** setting to the desired Tension Trip point. For example, with a range of 100 lbs. and a **Tension Trip Point** setting of 10 lbs., Tension Soft Start will be activated by tension falling below 10 lbs. Avoid setting the trip point close to your operating tension. Typically, it should be set much lower than the operating tension.

Also within the *Soft Start Setup* menu, set the **Soft Start Delay** setting to the desired length of time to delay after the tension falls below the **Tension Trip Point** setting and before Soft Start is activated. This eliminates nuisance actuation if the tension drops for only a short time. This delay is only associated with entering Soft Start mode, not leaving it. Tension Soft Start mode is exited immediately upon tension climbing above the Tension Trip Point value. It should be noted that the Soft Start Delay setting is used by both **Tension Soft Start** and **Speed Soft Start**. This means that if using both Soft Start by Tension and Soft Start by Speed, the same delay time will effect the time required to enter both Soft Start modes.

Finally, set the **Soft Start Output Level** to the desired percentage of max output. It is best to set this value low, but high enough to produce enough tension to exceed the **Tension Trip Point** or the controller may become stuck in Soft Start mode. The **Soft Start Output Level** setting is used by all three Soft Start modes.

2. Actuation by Line Speed

Soft Start by Line Speed requires a valid Line Speed input signal (see Section 4.2 Line/Roll Speed Input Calibration).

To activate, navigate to the *Setup Menu > Soft Start Setup* menu and set the **Speed Soft Start** setting to **On**.

Within the same menu, set the **Speed Trip Point** setting to the desired Line Speed trip point. For example, with a range of 1,000 ft/min. and a **Speed Trip Point** setting of 100 ft/min., Speed Soft Start will be activated by Line Speed falling below 100 ft/min. Typically, this value should be set to around 10% of your maximum Line Speed.

Also within the Soft Start Setup menu, set the **Soft Start Delay** setting to the desired length of time to delay after the Line Speed falls below the **Speed Trip Point** setting and before Soft Start is activated. This eliminates nuisance actuation if the Line Speed drops for only a short time. This delay is only associated with entering Soft Start mode, not leaving it. Line Speed Soft Start mode is exited immediately upon Line Speed climbing above the Speed Trip Point value. It should be noted that the Soft Start Delay setting is used by both **Speed Soft Start** and **Tension Soft Start**. This means that if using both Soft Start by Speed and Soft Start by Tension, the same delay time will effect the time required to enter both Soft Start modes.

Finally, set the **Soft Start Output Level** to the desired percentage of max output. It is best to set this value low, but high enough to produce enough tension to produce a smooth takeoff. The **Soft Start Output Level** setting is used by all three Soft Start modes.

5.5 SOFT START SETUP *continued..*

3. Actuation by External Contact Closure

To activate, navigate to the *Setup Menu > Soft Start Setup* menu and set the **Switched Soft Start** setting to **On**.Connect an external switch or relay contact to the Signals terminal block (TB3) terminal 13 (SOFT) and terminal 11 (GROUND) (see Section 2.11, Standard Electrical Connections). The controller will enter Soft Start mode immediately upon closure of the switch and will remain in Soft Start mode as long as the contact is closed.

Finally, set the **Soft Start Output Level** to the desired percentage of max output. The **Soft Start Output Level** setting is used by all three Soft Start modes.

5.6 SAMPLE AND HOLD / RATIO SETUP

The controller features a Sample and Hold input as well as a Ratio input. Both are actuated by closure of an external switch or relay. The Ratio feature can be useful in basic unwind splicing operations to quickly adjust the output from the level produced at core to a level appropriate for a full roll.

1. Sample & Hold

For Sample & Hold functionality, wire an external switch or relay contact to the Signals terminal block (TB3) terminal 10 (HOLD) and terminal 12 (GROUND) (see Section 2.11, Standard Electrical Connections). Upon contact closure, the controller will sample the current output and hold it at that level until the contact is opened, at which time the PID control loop will perform a bump-less transfer back into control mode.

2. Sample & Hold / Ratio

For Ratio functionality, wire an external switch or relay contact to the Signals terminal block (TB3) terminal 9 (RATIO) and terminal 11 (GROUND) (see Section 2.11, Standard Electrical Connections).

The Ratio function can act upon 1 of 3 possible targets; the **Output**, the **Setpoint**, or the **Line Speed**, and its functionality differs somewhat depending on the specified target. When set to **Output**, the Ratio function will sample the current output value upon contact closure, multiply that by the **Ratio Multiplier** value and hold that multiplied value until the contact is opened and the time specified by the **Ratio Delay** setting elapses. When exiting the Ratio Output mode, the PID loop performs a bump-less transfer back into automatic mode.

When set to **Setpoint**, the Ratio function will sample the current Setpoint value, multiply that by the **Ratio Multiplier** value and hold that multiplied value until the contact is released and the time specified by the **Ratio Delay** setting elapses. During the time the Ratio Setpoint mode is active, the PID control loop will continue to adjust the output to maintain the ratioed setpoint.

The **Line Speed** setting has a somewhat different functionality. Instead of sampling and holding the current Line Speed, the Ratio function will continually update the output with the real time Line Speed value multiplied by the **Ratio Multiplier** value until the contact is released and the time specified by the **Ratio Delay** setting elapses. With **Ratio Multiplier** set to 1.0, for example, the output while Ratio Line Speed is active will be the current line speed. A valid Line speed input is required when using the Ratio Line Speed setting (see Section 4.2 Line/Roll Speed Input Calibration).

To set the target, navigate to the *Setup Menu > Ratio Setup* menu and set the **Ratio Target** setting to the desired target.

Also within the *Ratio Setup* menu, set the **Ratio Multiplier** setting to the desired ratio multiplier value.

Finally, set the **Ratio Delay** setting to the desired length of time to hold the controller in Ratio mode after the external contact is released. This feature can be used to hold the controller in Ratio mode for a specific period of time after a momentary contact closure.

When the display is in Run mode, Hold and Ratio alarm windows will appear on the screen whenever the Hold or Ratio modes are active. The Ratio function has a greater priority than the Hold function. Meaning if the Ratio function is activated after the Hold function is already active, the Ratio function will ratio the output currently held by the Hold function, overriding the Hold function. The Hold and Ratio functions are only active when the controller is in Auto mode (not in Manual mode).

5.7 TENSION LIMIT SWITCH SETUP

The TLS (Tension Limit Switch) feature is used to provide an alarm when web tension exceeds or drops below user specified levels. When a TLS condition occurs, the controller provides a visual alarm indication in the Run mode display and can also activate a Relay contact. The TLS condition can also be used to disable controller output (turn Tension Off).

There are two TLS modes, **Momentary** and **Latched**, which can be set individually for the TLS High and TLS Low alarms.

1. Momentary

In **Momentary** mode, a TLS alarm is triggered when the tension falls below the **TLS Low Setpoint** or rises above the **TLS High Setpoint** for the amount of time specified by the **TLS Delay** setting. If the tension goes back within the normal range, the TLS alarm is automatically cleared.

2. Latched

In **Latched** mode, a TLS alarm is triggered when the tension falls below the **TLS Low Setpoint** or rises above the **TLS High Setpoint** for the amount of time specified by the **TLS Delay** setting. Tension coming back into range, however, does not automatically clear the TLS alarm. The operator must manually clear the alarm by pressing the RESET TLS key on the front panel. The RESET TLS key is the center soft key in the Run mode displays. Flashing text appears above the key to clearly indicate its function during a TLS condition. Pressing the RESET TLS key before tension has come back into range will not clear the alarm. If Tension Off by TLS is activated, however, this could be a problem, as the operator may not be able to turn Tension On while TLS is active. In this situation, the operator must press and hold the RESET TLS key, then turn Tension On and wait until tension comes back into range, at which point the alarm will be cleared and the operator may release the RESET TLS key.

Low Tension Limit Switch

To enable TLS Low, navigate to the *Setup Menu > Tension Limit Switch Setup* menu and set the **TLS Low Mode** setting to the desired mode of operation, **Momentary** or **Latched**.

Also within the *Tension Limit Switch Setup* menu, set the **TLS Low Setpoint** setting to the the desired trip point.

Set the **TLS Delay** setting to the desired length of time tension must be below the **TLS Low Setpoint** for the TLS Low mode to activate. This is used to prevent nuisance tripping from tension dropping below the trip point for a brief period of time. Note that the TLS Delay setting applies to both the TLS Low and TLS High modes.

If it is desired to disable the control output during a TLS Low event, set the **Tension Off by TLS Low** setting to **Yes**.

To activate or deactivate the Relay card during a TLS condition, refer to Section 5.9, Relay Option Setup.

High Tension Limit Switch

To enable TLS High, navigate to the *Setup Menu > Tension Limit Switch Setup* menu and set the **TLS High Mode** setting to the desired mode of operation, **Momentary** or **Latched**.

Also within the *Tension Limit Switch Setup* menu, set the **TLS High Setpoint** setting to the desired trip setpoint.

Set the **TLS Delay** setting to the desired length of time tension must be above the **TLS High Setpoint** for the TLS High mode to activate. This is used to prevent nuisance tripping from tension rising above the trip point for a brief period of time. Note that the TLS Delay setting applies to both the TLS High and TLS Low modes.

If it is desired to disable the control output during a TLS High event, set the **Tension Off by TLS High** setting to **Yes**.

To activate or deactivate the Relay card during a TLS condition, refer to Section 5.9, Relay Option Setup

5.8 DIAMETER ALARM SETUP

The diameter alarm feature is used to provide an alarm when roll diameter exceeds or drops below user specified levels. When a diameter alarm condition occurs, the controller provides a visual alarm indication in the Run mode display and activates an external relay card (P/N 723-2095).

The diameter alarm is triggered when the diameter falls below the **Minimum Diameter Trip Point** or rises above the **Maximum Diameter Trip Point** for the amount of time specified by the **Diameter Alarm Delay** setting. Once the diameter alarm is triggered the operator must manually clear the alarm by pressing the RESET DA key on the front panel. The RESET DA key is the center soft key in the Run mode displays. Flashing text appears above the key to clearly indicate its function during a diameter alarm condition.

To enable the diameter alarm, navigate to the *Setup Menu > Diameter Setup* menu and set the **Diameter Alarm** setting to On.

Also within the *Diameter Setup* menu, set the **Minimum Diameter Trip Point** or **Maximum Diameter Trip Point** setting to the the desired trip point. Note that only one of the two settings will be selectable depending on the tension zone you are in. For example if you are in an unwind zone, then only the minimum diameter trip point setting is selectable.

5.8 DIAMETER ALARM SETUP *continued...*

Set the **Diameter Alarm Delay** setting to the desired length of time roll diameter must be below or above the trip point for the diameter alarm to activate. This is used to prevent nuisance tripping from diameter crossing the trip point for a brief period of time. Refer to figure 12 for the diameter alarm connection diagram.

5.9 INPUTS SETUP

The controller can be configured for remote control by interfacing external potentiometers, dry contacts, PLCs, etc., to the Signals terminal block (TB3). This allows for remote Tension On / Tension Off and Auto / Manual capability, as well as remote Auto setpoint and remote Manual setpoint input.

The Auto and Manual setpoints can be set by one of 3 methods:

1. Directly from the front panel.
2. Remotely by input from an external potentiometer.
3. Remotely by a 0-10VDC input from a PLC or other logic device.

Note that only one method of input can be specified at a time for each setpoint. That method may be different for each setpoint, however. For example, **Auto Setpoint** can be set to **Front Panel** and **Manual Setpoint** can be set to **Potentiometer**, but **Auto Setpoint** can not be adjustable from both the **Front Panel** and a **Potentiometer** simultaneously.

1. Front Panel

The default settings for both **Auto Setpoint** and **Manual Setpoint** is **Front Panel**. This allows adjustment of the setpoints from the Run mode display using the multipurpose knob.

2. Potentiometer

The **Potentiometer** input option allows an external 10k Ohm potentiometer to be used for setpoint adjustment. The potentiometer is connected to the control board's Signal terminal block (TB3).

To connect an Auto Setpoint potentiometer, the wiper should be connected to TB3 terminal 15 (A SET), and the other two power leads should be connected across terminal 18 (+10/+15V) and terminal 17 (GROUND) (see Section 2.11, Standard Electrical Connections).

To connect a Manual Setpoint potentiometer, the wiper should be connected to TB3 terminal 16 (M SET), and the other two power leads should be connected across terminal 18 (+10/+15V) and terminal 17 (GROUND) (see Section 2.11, Standard Electrical Connections).

The voltage at terminal 18 (+10/+15V) is dictated by jumper JP6, towards the top of the control board (see Section 2.9 Customer +10/15V Output Selection). For setpoint potentiometers, it is recommended to set JP6 to 10V (pins 2 and 3). The 10V potentiometer voltage rail, like all power voltage rails, can drift with time and temperature. With the setpoint setting set to **Potentiometer**, the controller monitors the 10V rail and determines the setpoint by calculating the potentiometer's wiper voltage as a percentage of the 10V rail voltage. This compensates for any voltage supply drift. The potentiometer itself, however, being a mechanical device, may experience its own drift due to temperature and vibration. This makes the use of a potentiometer less precise than that of direct front panel setpoint adjustment.

Note: While it is possible to use a common potentiometer to control both the Auto and Manual setpoints, it is strongly recommended to use two separate potentiometers in such a situation, one dedicated for each setpoint.

3. 0-10V Input

The **0-10V** Input option allows an external 0-10V signal to control the setpoint. This works very similar to the potentiometer input as described above, with the exception that the internal 10V rail drift compensation is not performed. It is assumed that the provided 0-10V signal is a precision single ended signal. Any drift in the signal will cause corresponding setpoint drift.

To connect a remote 0-10V Auto Setpoint signal, the 0-10V signal should be connected to TB3 terminal 15 (A SET) and the corresponding ground lead should be connected to terminal 11 (GROUND) (see Section 2.11, Standard Electrical Connections).

To connect a remote 0-10V Manual Setpoint signal, the 0-10V signal should be connected to TB3 terminal 16 (M SET) and the corresponding ground lead should be connected to terminal 12 (GROUND) (see Section 2.11, Standard Electrical Connections).

<u>Auto Setpoint</u>

To specify the **Auto Setpoint** source, navigate to the *Setup Menu* > *Inputs Setup* menu and set **Auto Setpoint** to the desired setting.

5.9 INPUTS SETUP *continued...*

Manual Setpoint

To specify the **Manual Setpoint** source, navigate to the *Setup Menu > Inputs Setup* menu and set **Manual Setpoint** to the desired setting.

External Tension On/Off, Auto/Manual

In addition to the front panel Tension On/Off and Auto/Manual function keys, the Tension On/Off and Auto/Manual state can be controlled by remote switches or relays by shorting the relevant input terminal to ground. There are 4 separate input terminals to control these states:

1. Tension On, TB3 Terminal 4, TEN ON
2. Tension Off, TB3 Terminal 3, TEN OFF
3. Auto Mode, TB3 Terminal 7, AUTO
4. Manual Mode, TB3 Terminal 8, MANUAL

Each terminal is activated on a falling edge (to ground). The control board inputs have built in weak pull-ups, so there is no need to connect any voltage to these terminals. A switch or relay to ground is all that is required. TB3 terminals 5 and 6 provide convenient ground connections in close location to the control inputs (see Section 2.11, Standard Electrical Connections).

In some cases, it may be desirable to use one external switch or relay to toggle the Tension or Control state (instead of using two for each). In this case the **External Tension Toggle** (for Tension On/Off) or **External Auto Manual Toggle** (for Auto/Manual mode) setting, located in the *Setup Menu > Inputs Setup* menu, can be set to On.

When **External Tension Toggle** is enabled, a single switch or relay between TB3 Terminal 4 (TEN ON) and ground is all that is required. Each falling edge (to ground) on this input terminal will cause the current Tension On/Off state to toggle.

Similarly, when **External Auto Manual Toggle** is enabled, a singled switch or relay between TB3 Terminal 7 (AUTO) and ground is all that is required. Each falling edge (to ground) on this input terminal will cause the current Auto/Manual state to toggle.

Unlike the external analog setpoint inputs, which cannot be used simultaneously with front panel setpoint input, the external Tension On/Off and Auto/Manual inputs can be used in conjunction with the front panel “hard” keys, even when using the External Toggle modes of input.

5.10 RELAY OPTION SETUP (Included in TLS option)

Use of the Relay functionality requires a Relay option card (P/N 723-2095). This card must be installed into the RELAY slot on the control board (plugging into P6) and mounted properly to the three supportive mounting studs (see Section 2.12, Figure 14, Option Card Mounting Locations). See section 2.15 Relay Option Card Electrical Connections, for relay wiring information, including the recommended use of a snubber network.

The Relay function is determined by the **Relay Function** setting, located in the *Setup Menu*. Selectable options are **Tension On**, **TLS On** and **TLS OFF**.

Tension On energizes the relay whenever the controller Tension On/Off state is On.

TLS On energizes the relay whenever the TLS High or TLS Low is active.

TLS Off energizes the relay when tension is in a valid range (TLS High and TLS Low are inactive).

5.11 COMMUNICATION OPTIONS SETUP

The controller is available with various Communication Option cards, such as RS485, RS232, or Ethernet Card. Configuration and use of the Communication Option cards is explained in its respective manual. The manual for each card will be shipped with the card, or can be downloaded from the DFE website, www.DFE.com. If a Communication Option card is not installed, all Communication related settings should be left in their default, Off, state.

5.12 TENSION ON RELAY OPTION

Used to enable a drive or other input when tension is on. See Section 5.9 for setup. Not compatible with TLS when TLS is using a relay output.

5.13 POWER ON SETTINGS

The power on Auto / Manual and Tension On / Off states can be configured with the **Power On Control Mode** and **Power On Tension Mode** settings. Both of these settings are located in the *Setup Menu > Setup Tension* menu.

5.14 ANTI-TAMPER/SECURITY LOCKOUT

The Anti-Tamper jumper (JP1) (see **Figure 33, Anti-Tamper Lockout Jumper**) can be used to limit operator access to certain menu functions and settings. When the jumper is placed between pins 1 and 2, Anti-Tamper is enabled, and only settings within the *Operator Menu* are adjustable from the front panel. All locked out menu items become shaded gray. Operators may still navigate the menu system, but attempting to access a gray (locked out) menu item will cause a message to be displayed informing the operator that the menu item is currently locked out.

When the Anti-Tamper jumper is positioned between pins 2 and 3 of JP1, full access to all menu items is restored.

CONTROL BOARD

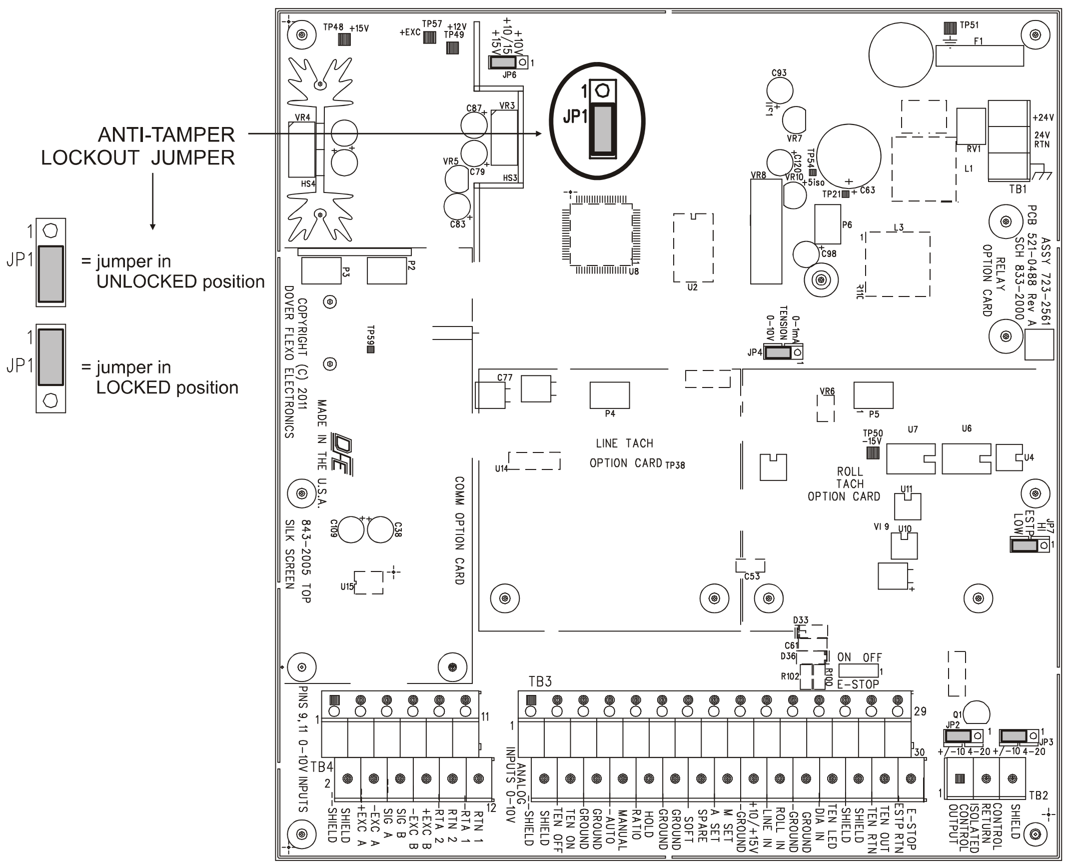


Figure 34 **– ANTI-TAMPER LOCKOUT JUMPER**

6.1 PID CONTROL TUNING

There are three tuning adjustments that set the controller's response to tension error (error referring to the difference between the set point and the actual tension measurement). The Proportional, Integral and Derivative adjustments are also more intuitively referred to as Gain, Stability and Response.

1. The Proportional, or Gain, term causes an instantaneous response proportional to the tension error, setting the sensitivity of the controller. A low setting will produce a smaller output change while a high setting will produce a larger output change for a given tension error. Increasing the Gain term increases the response of the controller, but can also lead to instability.
2. The Integral, or Stability, term remembers the error history to allow response to both the size and length of tension error. Long duration errors, for example, will lead to greater Integral response than short duration errors. This term helps the controller maintain a stable output over time. Increasing the Stability term can decrease sensitivity to fast oscillations, but setting too high may cause the controller to ignore some tension variations and decreases the reaction time of the controller. A large Stability term can also lead to setpoint overshoot when responding to large errors.
3. The Derivative, or Response, term dictates the controller's response to the rate of tension change. This works against the Gain and Stability terms to limit or prevent overshoot by decreasing the response rate for fast tension changes, effectively providing a damping effect. The Response term can be sensitive to tension noise (high frequency tension variations) and can cause instability when set too high or when significant noise is present. One way to help limit noise sensitivity is to increase the **Tension Filter Time** setting, but doing this also increases delay which can add instability to the system. Many tension systems require little or no Response and so this term should initially be kept low.

   It can help to think of the three tuning adjustments in terms of time, with Gain causing an instantaneous response to error, Stability “looking back” (or remembering) the previous error, and Response “looking ahead” to anticipate the future error based on the rate of tension change. As in most control systems, tuning involves striking a balance between response and stability. Systems tuned for more aggressive response to error may find themselves more easily overshooting the setpoint and possibly falling into oscillation, while systems tuned over conservatively may be less responsive to tension error. Some experimentation and trial and error may be necessary to find the optimal tuning values for each system and process. The SteadyWeb™5's **PID Tune View** display can greatly facilitate the tuning process by allowing the operator to visualize the response of the system and the effect PID changes have on that response (see Section 3.5, PID Tune View). Some time spent using the **PID Tune View** can lead to an intuitive feel for the impact of each of the tuning parameters.

6.2 TUNING PROCEDURE

The following steps can be used as a guide to tuning the PID values. It may take some trial and error to achieve desirable tuning. Depending on the application, some of the more advanced tuning adjustments may be necessary. These are discussed in the following sections.

1. Start off with the default P, I and D settings (1.5, 2.5 seconds and 0.5 seconds respectively). Most systems will run steadily with these initial settings.
2. Run the machine at normal operating speed with the controller in Auto mode and the tension setpoint at a typical value.
3. From within the PID Tune View screen, vary the stability (I) setting up or down as necessary to stabilize the tension. Wait after each adjustment for tension to stabilize. If the control output appears to be having large and fast fluctuations, increase the I term.
4. Accelerate the machine while watching the tension and output in the PID Tune View screen. If tension oscillates, increase the I term or decrease the P term. If tension lags excessively, reduce the I term or increase the P term.
5. From within the PID Tune View screen, make setpoint changes and watch the tension and output. If the tension overshoots the setpoint, increase the D term. Be careful not to increase the D term too rapidly, and ensure increasing the D term doesn't increase output fluctuations. The D term should typically be low. If setpoint changes cause large output fluctuations, decrease the D term.
6. Continue to adjust the P, I and D terms as necessary to ensure accurate and stable control during both machine speed and tension setpoint changes. See the following section (Section 6.3, Tuning Examples) for recommended action to address specific tuning issues.

6.3 TUNING EXAMPLES

The following figures provide some examples of the tuning parameters' effect on overall tension control. In these figures, the controller's **Ratio Target** setting is set to **Setpoint** and the **Ratio Multiplier** setting is set to **1.5**. Pulling the RATIO terminal to ground in this configuration causes the tension setpoint to instantly increase by 50%. Once the RATIO terminal is released from ground, the setpoint returns to its original value after delaying for the time specified by the **Ratio Delay** setting. This allows testing the controller's "step response." The PID Tune View's PAUSE/RESUME feature was utilized to capture the controller's response to various PID changes on a tension simulator, which was used to demonstrate the impact of PID adjustments.

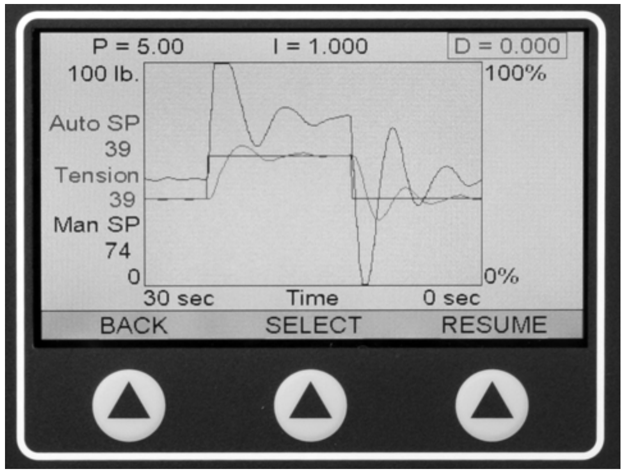
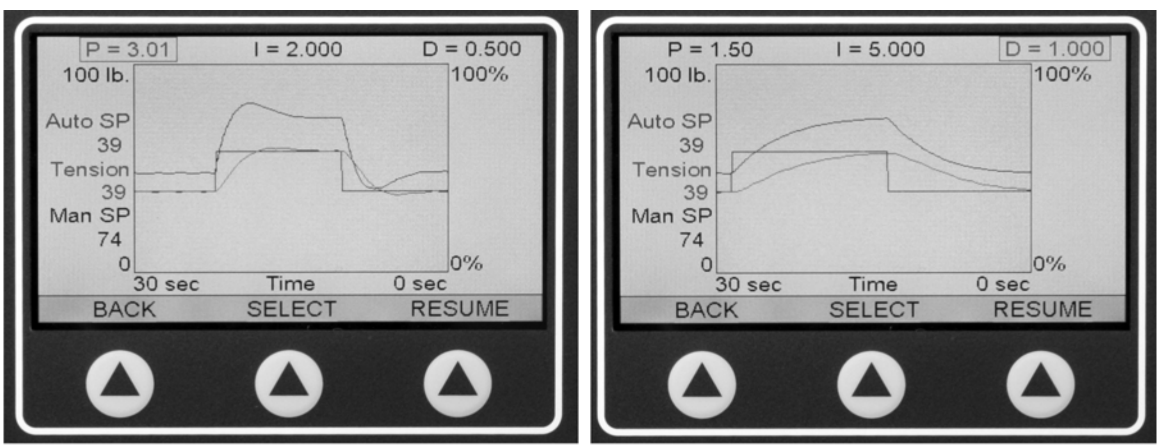


Figure 35 **– TUNING SCREEN SHOWING OVERSHOOT**

In Figure 35, the controller responds too aggressively to setpoint changes. This causes the tension to overshoot the setpoint value.

Overshooting can be addressed by increasing the I term and/or decreasing the P term. In some cases, increasing the D term can also help limit or prevent overshoot, especially with high inertia, slow response systems. The D term should not be increased too much, however, as it can lead to instability issues. The D term should always be smaller than the I term



IMPROVED RESPONSE SLOW RESPONSE

Figure 36 **– TUNING SCREENS SHOWING ADJUSTMENT RESPONSES**

In Figure 36, the Improved Response screen shows the P term was reduced and both the I and D terms were increased. This reduced the overshoot seen in the previous figure. The goal of attaining a well tuned system is to adjust the tuning parameters to achieve "critical damping." A critically damped system will respond to changes as quickly as possible without any oscillation.

In Figure 36, the Slow Response screen shows the P term was reduced further and the I and D term were increased further, causing the controller to respond sluggishly to setpoint changes.

Sluggish response can be addressed by decreasing the I term and/or increasing the P term. In certain situations, it can also be improved by decreasing the D term.

6.3 TUNING EXAMPLES *continued...*

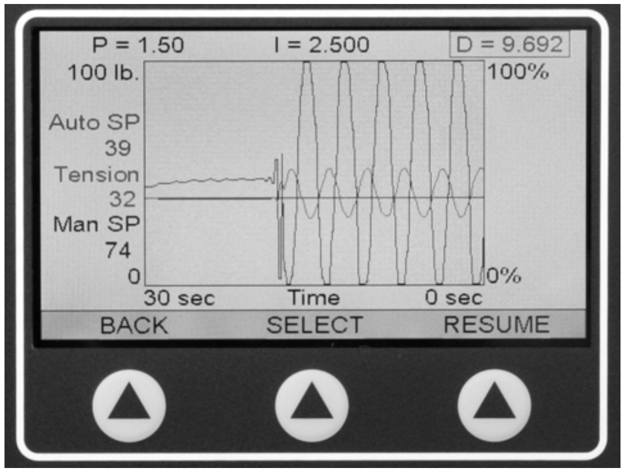
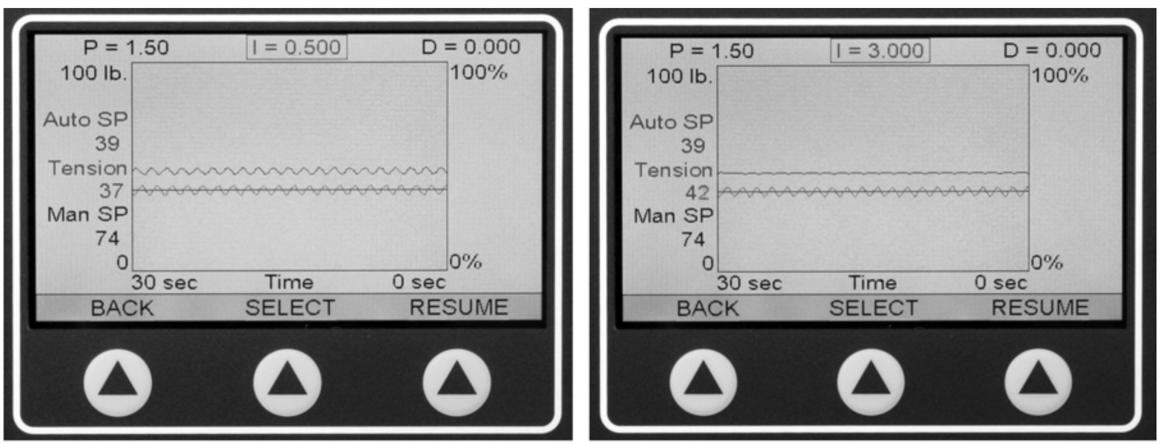


Figure 37 **– TUNING SCREEN SHOWING DERIVATIVE NOISE**

In **Figure 37, Derivative Noise**, the D term is increased until it causes instability. Here, a small wobble in the tension reading is amplified by the D term and eventually causes wild oscillations. This can be abusive to drive motors or other devices connected to the controller's output, and should be avoided. In certain cases, especially when using heavy tension reading damping in the Display mode screen, the tension may appear to be or may actually be controlled reasonably well with a highly fluctuating output. This is why it is useful to use the PID Tune View screen to monitor both the tension and the output while tuning. Large and fast output changes can be addressed by decreasing the D and P terms and increasing the I term. Increasing the **Tension Filter Time** can also aid in reducing Derivative susceptibility to tension noise.



WOBBLE COUPLED INTO OUTPUT

WOBBLE FILTERED FROM OUTPUT

Figure 38 **– SCREENS SHOWING WOBBLE**

In **Figure 38, Wobble Coupled Into Output**, there is some wobble present on the tension signal. The wobble frequency is too high to be addressed through the tension control system. To remove this tension variation would require addressing the source of the wobble. The control output, however, also has a small amount of wobble coupled into it as it tries to correct the tension wobble. In certain situations, this can actually lead to worse tension control. Increasing the I term helps to limit the output wobble, as seen in **Figure 38, Wobble Filtered from Output.**

6.4 ADVANCED TUNING ADJUSTMENTS

One of the difficulties involved with tension control is that a tension system's process variables can vary widely from one process to another, or even over the same process. Roll diameter is one such variable. A large roll has greater inertia and may require more aggressive control than a small roll. Diameter Compensation accounts for this by allowing the use of two sets of PID values, one for core diameter and a second for full roll diameter. The controller monitors roll diameter and adjusts the PID values from the core values to the full roll values as diameter increases or from full roll values to core values as diameter decreases.

6.4 ADVANCED TUNING ADJUSTMENTS *continued...*

Acceleration is another variable that can impact tension control. A system accelerating web to process speed upon start up, for example, may require more aggressive PID values then when operating at steady-state process line speed. As it is difficult to manually tune a system during an acceleration period, Acceleration Compensation uses multipliers to ratio the PID values off of the standard values during periods of acceleration.

More information about using Diameter and Acceleration compensation is provided in the following section.

6.5 DIAMETER COMPENSATION

Diameter Compensation is disabled in the intermediate zone. To use Diameter compensation, both the standard (or core) PID values and the full roll PID values must be programmed and the **Diameter Compensation Enable** setting must be enabled. These settings can be found in the *Calibration > Diameter Compensation* menu. The full roll settings can be set individually through the menu system or by using the Full Roll PID Tune View screen, which allows the user to see real time tension, output and set point information while tuning the PID values. When using the Full Roll PID Tune View screen, the system should be running as close to full roll diameter as possible and the **Diameter Compensation Enable** setting must be enabled.

The area of a circle, and therefore the mass of a roll, exhibits quadratic growth as a function of its radius. The transition from Core PID values to Full Roll PID values accounts for this by transitioning the PID terms as described in the graph below (Figure 39).

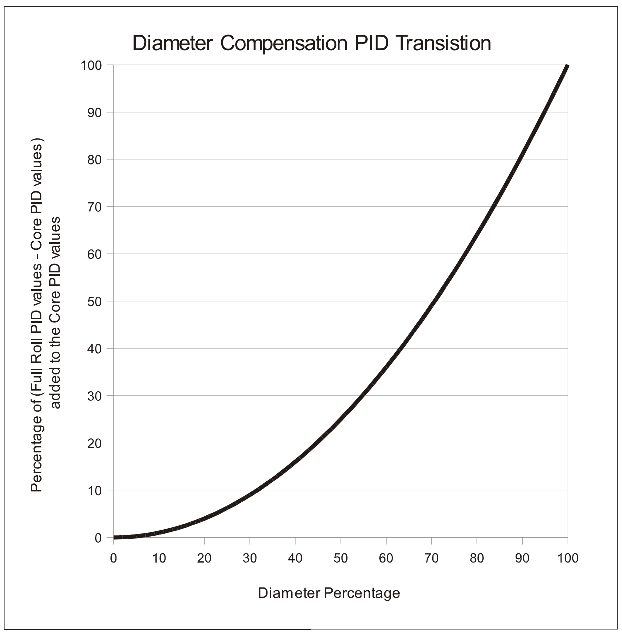


Figure 39 **– DIAMETER COMPENSATION PID TRANSITION**

6.6 ACCELERATION COMPENSATION

To use the acceleration compensation feature, the acceleration multipliers for each PID setting, as well as the **Acceleration Limit** and line **Acceleration Percentage** settings should be programmed. The **Acceleration Compensation Enable** setting must then be enabled. These settings can be found in the *Calibration Menu > Acceleration Compensation* menu. Unlike Diameter compensation, which gradually transitions the PID terms as the roll diameter changes, Acceleration Compensation is either active or inactive. When active, the standard PID terms are multiplied by the by the **Accel P Multiplier**, **Accel I Multiplier** and **Accel D Multiplier** respectively. Activation of Acceleration Compensation is dependent on both the **Acceleration Limit** and **Acceleration Percentage** settings. The Line speed must be below the value specified by the **Acceleration Limit** setting and Line acceleration must be greater than the value specified by the **Acceleration Percentage** setting. **Acceleration Percentage** is programmed as a level of percent change per second, which should be set to a level at least equal to the acceleration which occurs when the machine is starting (or when Acceleration Compensation must be activated). Some trial and error may be necessary to find PID multiplier and line speed/acceleration threshold values that work well for a given system.

7.1 BASIC OPERATION

When the controller has been properly set up and the control loop has been tuned, it should maintain constant tension while the machine is running and while speed, roll diameter, or other conditions change. However, during start up of a new roll you may want to change modes, setpoint or other settings. Usually, the only thing the operator will need to do is turn Tension On or Off, toggle between Auto and Manual modes, and change the Auto or Manual setpoint.

With tension Off, to turn Tension On and enable output, press the Tension On/Off key to the left of the LCD. The Tension On LED will turn on. With Tension On, the output will be enabled. If the controller is in Auto mode, the output will ramp up or down from 0 in order to bring tension up to the Auto Setpoint value. If the controller is in Manual mode, the output will simply go to the Manual Setpoint value. The Auto/Manual mode can be selected by pressing the Auto/Man key to the right of the LCD. When in Auto mode, the Auto LED will turn on.

While in Manual mode, the Manual setpoint (and thus the output) can be adjusted by turning the multipurpose knob while in the Run mode display. Turning the knob clockwise will increase the output and turning it counterclockwise will decrease the output. This mode has no PID or control function. Think of it as a 0-10V potentiometer feeding your drive, brake or clutch.

While in Auto mode, the Auto setpoint can be adjusted by turning the multipurpose knob. Turning the knob clockwise will increase the setpoint and turning it counterclockwise will decrease the setpoint.

7.2 DISPLAY ADJUSTMENTS

The Run mode display can be configured for the operator's preference. The three possible run mode display options are described in detail in Section 3.3, Run Mode Display. The desired mode, **Bar Graph**, **Analog Meter** or **Line Graph** can be set with the **Display Mode** setting, located in the *Operator Menu > Display Configuration* menu. This setting specifies the default Run mode display option, which is entered upon power up or after exiting the Menu mode display. The active display option can be changed at any time from within the Run mode display, however, by pressing the left most soft key (DISPLAY SELECT).

Two settings are available to adjust the tension display update, both located in the *Operator Menu > Display Configuration* menu. The **Tension Update Time** setting specifies the interval at which the display is updated with new numerical tension and process information. Longer update times may make the display more readable by preventing the digits from fluctuating quickly, with the drawback of delayed visual response to tension changes.

The **Display Tension Damping** setting, not to be confused with the **Tension Filter Time** setting located in the Calibration Menu, is used to filter the displayed tension value. This has a similar effect to the damping potentiometer for analog meter displays. Increasing the display filter time decreases visible tension fluctuations and makes the tension changes appear smoother. It is for visual purposes only, and has no effect on the control loop.

When using the **Bar Graph** display mode, real time Line speed and diameter information can optionally be displayed in addition to the tension and output information. Line speed and diameter display are configured with the **Line Speed Display** and **Diameter Display** settings, both located in the *Operator Menu > Display Configuration* menu. The default setting for each of these is **Auto**, where the control software will display the relevant information based upon the control mode. When the controller is configured for Line Speed Follow mode of control, for example, Line speed information will automatically be displayed. The settings can also optionally be manually set to On or Off, to force the display of the respective information On or Off.

When using the **Line Graph** display mode, the **Line Graph Update Time** setting allows for an operator adjustable time base. A longer time base allows more information to be shown while a shorter time base provides greater resolution. This setting applies to both the Run mode Line Graph display and the PID Tune View displays.

The **Display Brightness** setting allows the LCD backlight brightness to be adjusted as a percentage from 10-100% to account for varied lighting conditions.

7.3 SAVING AND RECALLING SETUPS

Changes made to the controller's configuration are automatically saved in the controller's permanent memory so that if power is removed, the controller will be able to operate properly when it is powered up again. Setting changes are always saved into the controller's ACTIVE Setup.

The ACTIVE Setup can be saved into additional Setup slots in the controller's permanent memory. Up to 31 different Setups (in addition to the ACTIVE Setup) can be stored and later recalled. When recalling a Setup, it is written into the ACTIVE Setup. The important fact to remember about this is that if a saved Setup is recalled into ACTIVE, and then changes are made, those changes are only made to the ACTIVE Setup. The changes must be saved back to the original Setup if desired. This provides a double buffer to the saved Setups. Setups are saved, deleted or recalled through the *Operator Menu > Store / Delete Setup* and *Operator Menu > Recall Setup* menus. In order to keep track of the last Setup loaded into or saved from the ACTIVE Setup, an asterisk appears next to the most recently saved or recalled setup in both the *Store / Delete Setup* and *Recall Setup* menus.

1. Saving a Setup

To save a Setup, navigate to the *Operator Menu > Store / Delete Setup* menu. The *Store / Delete Setup* menu contains 32 "slots" (including the ACTIVE Setup slot – 1) to store Setups. Setups may be saved to any slot other than 1, which is reserved for the ACTIVE Setup.

Use the multipurpose knob to highlight the desired slot to save the Setup. If an empty slot is chosen, you will be asked to program a name for the new Setup. If an existing Setup is chosen, you will be asked to confirm saving into the existing Setup. In this case, the name cannot be changed. If you want to overwrite an existing Setup and change its name, you must first delete the existing Setup.

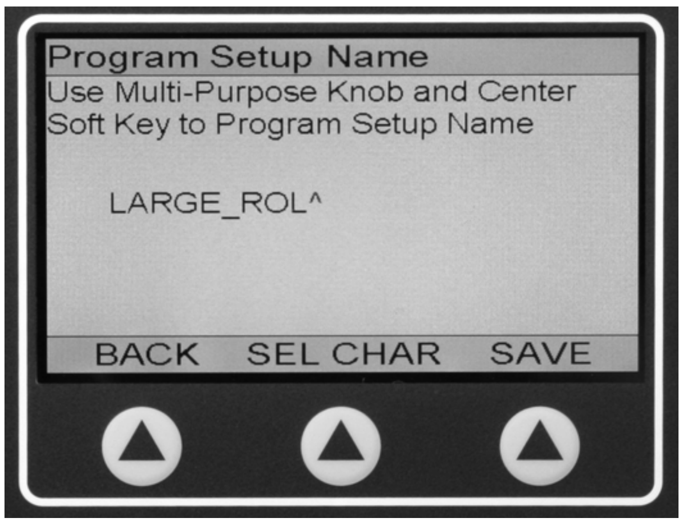


Figure 40 **– PROGRAM SETUP NAME**

After highlighting the desired slot, press the right most soft key (SAVE). For a new Setup, this will take you to the **Program Setup Name** screen (**Figure 40, Program Setup Name**) where you must enter the alphanumeric name of the Setup. Names can consist of numbers, capital letters and the underscore "_" symbol. The name is programmed using a combination of the multipurpose knob and the middle soft key (SEL CHAR). Turning the knob clockwise scrolls first through the digits 0 through 9 followed by the uppercase letters A through Z, looping back around to the digits, for the currently selected character. Pressing the middle soft key (SEL CHAR) moves the character selector over to the right, creating a new character at the end of the name, and looping back to the first character from there. A new character, which has not yet been given a value, displays the the caret '^' symbol. The name can be up to 14 characters long. The currently selected character position is highlighted red. All other characters are black.

Once the name is programmed, pressing the right most soft key (SAVE) presents a verification screen asking you to confirm your desire to save. At any time, the left most soft key (BACK) may be pressed to exit the **Program Setup Name** screen without saving. Pressing the right most "soft" key (SAVE) saves the current ACTIVE setup to the desired slot with the programmed name. The last saved or recalled asterisk now appears to the right of your newly saved Setup.

7.3 SAVING AND RECALLING SETUPS *continued...*

2. Recalling a Setup

To recall a Setup, navigate to the *Operator Menu > Recall Setup* menu. The *Recall Setup* menu contains a list of the 32 Setup slots. Not all slots may have a saved setup, and empty slots will appear blank. Trying to recall an empty slot will cause a message to appear informing you it is not possible to recall a Setup that has not been saved. It is also not possible to recall the ACTIVE Setup (slot 1) as this is always the current Setup. Recalling a Setup copies that Setup into the ACTIVE Setup. Any changes made after a Setup is recalled are made to the ACTIVE Setup. The ACTIVE Setup must be saved back to the recalled Setup if it is desired to make any changes a permanent part of that Setup. In both the *Recall Setup* and *Store / Delete Setup* menus, an asterisk appears next to the last saved or recalled Setup.

3. Deleting a Setup

To delete a Setup, navigate to the *Operator Menu > Store / Delete Setup* menu. Use the multipurpose knob to highlight the desired slot to delete and press the center soft key (Delete). Upon selection of a Setup, you will be asked for confirmation before deleting the Setup. Once deleted, the Setup is completely removed from memory and cannot be recovered. The slot can now be used to save a new Setup.

7.4 TRANSFERRING SETUPS TO PC VIA USB

The SteadyWeb5 USB interface application allows users to save setups to a PC and upload setups to a SteadyWeb5 using a USB connection. This is useful to back-up setups on a PC, or to transfer a setup from one controller to another. All SW5 parameters are transferable with the exception of calibration settings(transducer and roll diameter calibrations). This is to ensure that each controller is individually calibrated since calibration settings are typically not interchangeable..

1. Connecting the SteadyWeb5 to PC

The following steps illustrate how to connect the SteadyWeb5 to a PC. Once connected the user can begin to download and upload setups. Ensure the SW5 is in MANUAL mode to allow proper setups transfers.

1. Go to dfe.com/products/steadyweb5.html.
2. Click on the "SW5 USB Driver" to download the driver.
3. Click on the "USB Interface App" to download the user interface.
2. Run the sw5_usb_driver.exe program and follow the installation instructions.
3. Connect the Steadyweb5 to the PC using a USB cable.
4. The windows new hardware wizard will appear as follows, select "Yes, this time only" and click next

Figure 41 **– DOWNLOAD USB APP SCREEN**

5. Select “Install software automatically” and click next. If you get a warning click “continue anyway” to finish the installation.

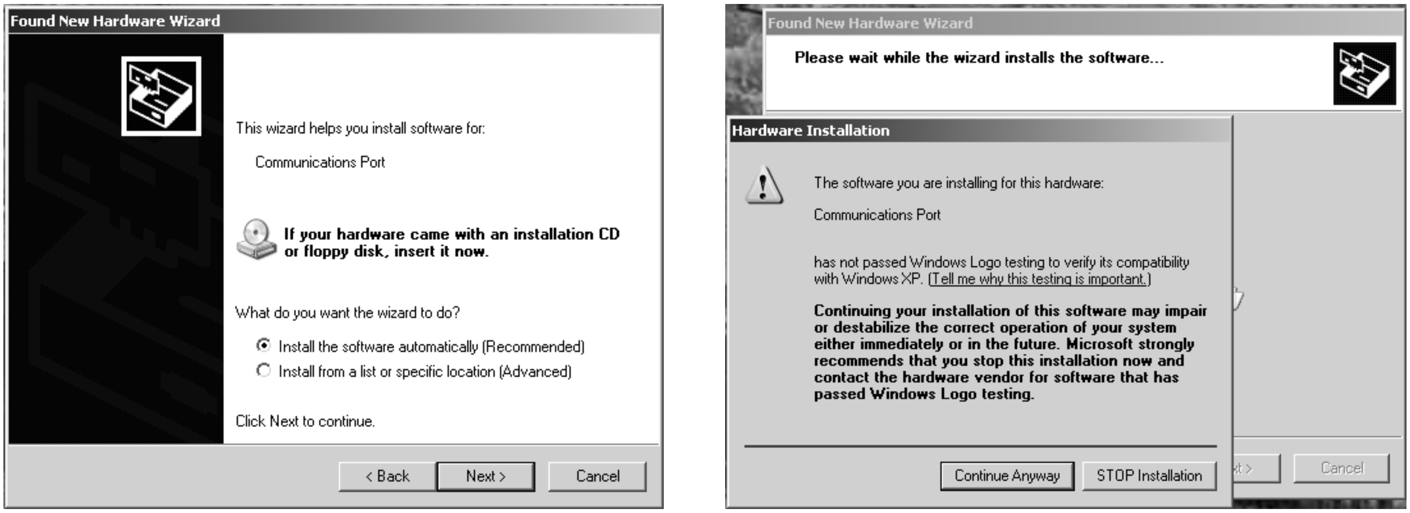


Figure 42 **– USB APP INSTALL SCREENS**

6. Once the driver is installed, click the sw5_usb_app.exe icon to launch the application.
7. Click the "settings" button to open the ***serial port settings*** dialog and choose the last com port option in the "port name" drop-down list. Click save.

Figure 43 **– USB APP PORT SELECTION SCREEN**

8. Next click "open port" to open the connection. The SteadWeb5 is now connected and can send and receive setups from the PC.

2. Downloading Setups to a PC

The SteadyWeb5 USB application will download the current setup running in the SteadyWeb5.

1. To download a setup to a PC click the "Download Setup" button. The current setup values will be downloaded into the application screen as follows

7.4 TRANSFERRING SETUPS TO PC VIA USB *continued...*

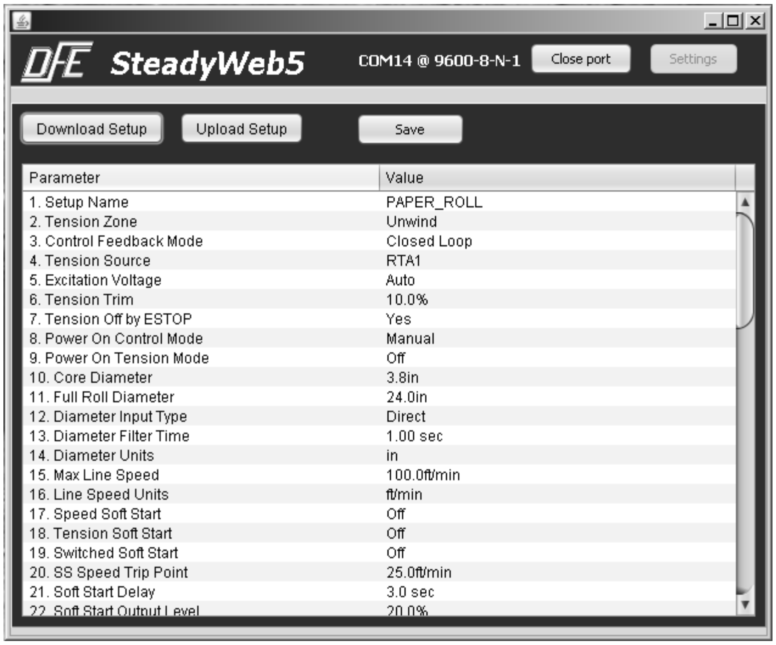


Figure 44 **– DOWNLOAD SETTINGS SCREEN**

2. To save the setup to a spreadsheet click the "save" button and enter the name and location where you want to save the file.

3. Uploading Setups to a PC

The steadyweb5 USB application will upload a saved setup to the steadyweb5 and set it as the current active setup on the steadyweb5. If a setup is uploaded to a slot location that already has a setup saved to it, it will be overridden with the new uploaded setup

1. To upload a setup to the steadyweb5 click "Upload Setup" button and choose a previously saved setup file and click "Save".

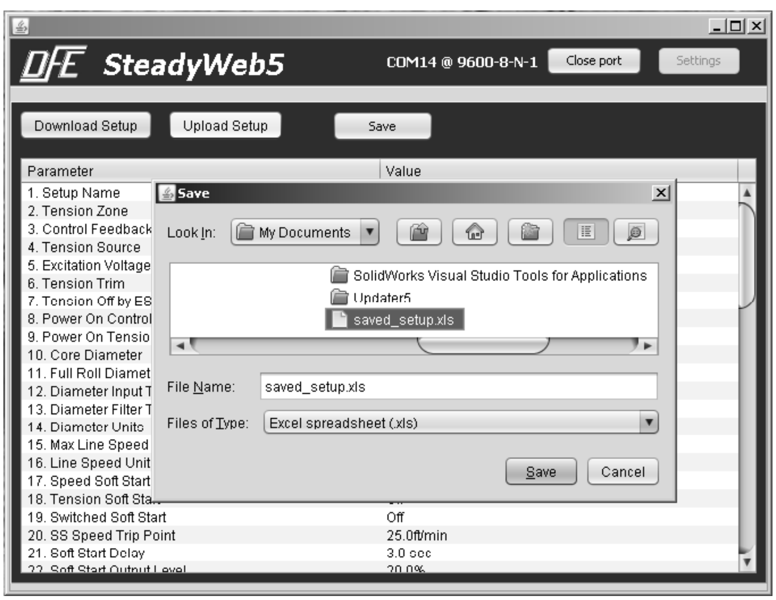


Figure 45 **– UPLOAD SETTINGS SCREEN**

2. Next, you will be prompted to enter the setup’s name and slot number that the setup will save as in the SteadyWeb5. Press “OK” to upload the settup to the SteadyWeb5

7.4 TRANSFERRING SETUPS TO PC VIA USB *continued...*

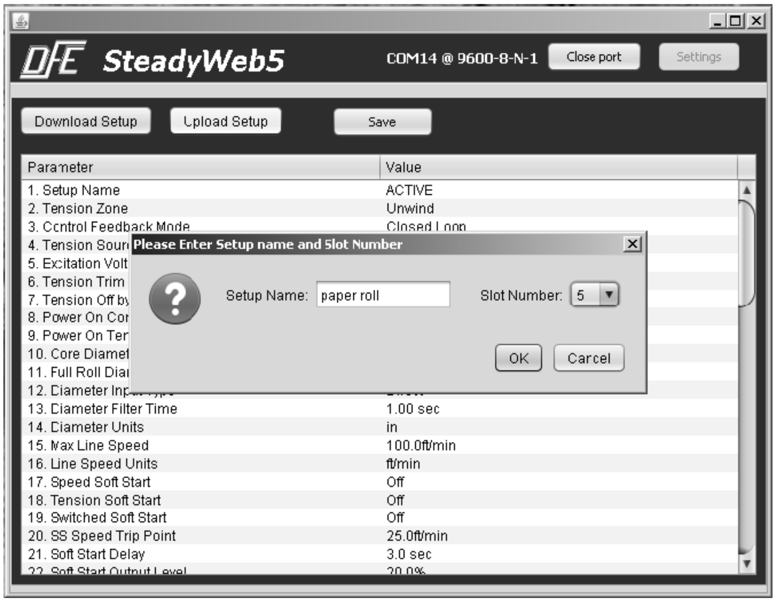


Figure 46 **– SAVING UPLOADED SETTING SCREEN**

3. This setup should now be listed in the Steadyweb5's saved setups in the Operator>Menu>Store/Delete Setup screen.

7.5 SETTING AUTO AND MANUAL SETPOINTS

The Auto and Manual setpoints can be set with the multipurpose knob from the Run mode display with 1% accuracy. The setpoints can be set with a higher degree of precision from within the menu system. Setpoint adjustments made in the Run mode display with the multipurpose knob are based upon the current control mode. When the controller is in Manual mode, the multipurpose knob controls the manual setpoint. When the controller is Auto mode, the multipurpose knob controls the Auto setpoint. If it is desired to adjust the Auto setpoint while in Manual mode, or the Manual setpoint while in Auto mode, the menu system setpoint adjustments can be used.

The *Operator Menu > Manual Setpoint* setting allows the Manual setpoint to be adjusted and saved. The *Operator Menu > Auto Setpoint* setting allows the Auto setpoint to be adjusted and saved.

7.6 USING TAPER

If your controller is used in a rewind application, it may be factory-configured for the Taper function. Taper causes the Auto setpoint to automatically decrease as the diameter increases. This helps to produce a better quality roll by eliminating telescoping, crushed cores and too tight or too loose rolls.

Taper is controlled with the **Taper Enable** and **Taper Percentage** settings, both located in the *Operator Menu > Configure Taper* menu. The **Taper Enable** setting allows for toggling the Taper function On and Off. Even though a controller may be set up for Taper, a particular job may not require it, and so this setting allows the user to turn it off while allowing its use for a later time. The **Taper Percentage** setting controls the amount of effect the Taper function has when enabled. The Taper function causes a setpoint multiplier to change from unity at core to a multiplier value of 100% minus the taper setting at full roll.

For example: With a setpoint of 50 lbs., and a **Taper Percentage** setting of 20%, the Auto setpoint will be 50 lbs. at core, decreasing linearly to (100% - 20%) x 50 lbs. = 40 lbs. at full roll.

Finding the right Taper configuration settings for a particular process may take some experimentation in adjusting both the tension setpoint and the **Taper Percentage**. See the table below for common winding defects and the corresponding corrective action.

Location	Tight/Loose	Example	Move
Core	Tight	Blocking, Crushed Core	Decrease Tension
Core	Loose	Telescope During Unwinding	Increase Tension
Outside	Tight	Baggy Lane Due to Gage Variation	Increase Taper
Outside	Loose	Out-of-Round Roll	Decrease Taper
Global	Tight	Telescope During Winding, Starring	Increase Tension and Taper

Roisum, David R. What is the Best Taper to Run on My Winder? Converting Magazine, ©November 2007.

7.7 RESETTING TLS ALARMS

When the TLS (Tension Limit Switch) alarm is activated by either a Tension High or Tension Low condition, a flashing **Reset TLS** window appears above the center soft key in the Run mode display. If the TLS alarm is configured in Momentary mode, the alarm will automatically disappear from the display when tension goes back into a valid range. If TLS is configured in Latched mode, the alarm will persist after tension has returned into a valid range until the **Reset TLS** soft key is pressed to clear the alarm. In either Momentary or Latched mode, the TLS alarm cannot be cleared until tension has returned to within a valid range.

If **Control During TLS** is set to **Off**, Tension will automatically turn off upon entering a TLS condition. If it is desired to turn tension On while tension is still not in a valid range and **Control During TLS** is set to **Off** , the operator must hold down the **Reset TLS** soft key and simultaneously press the Tension On/Off key. The operator must then continue to hold down the **Reset TLS** soft key until tension has returned to a valid range. See Section 5.7, Tension Limit Switch Setup, for more information on configuring the TLS Alarms.

Pressing the middle softkey will reset the relay no matter what the status is. The relay will remain reset only while the key is pressed if TLS is still active. If reset with tension in the desired range, it will remain reset.

7.8 RESETTING DIAMETER ALARM

When the diameter alarm is activated by either minimum or maximum diameter condition, a flashing **Reset DA** flag appears above the center soft key in the run mode display to inform the operator the diameter alarm has been triggered. The alarm can only be reset by pressing the center soft key, otherwise it will persist even after the diameter has returned into a valid range. If the diameter alarm is cleared while the diameter is still above or below the trip point, it will not trigger again until the diameter has returned to within a valid range and crosses the trip point again. See section 5.8, Diameter Alarm Setup, for more information on configuring the diameter alarm.

7.9 ZEROING TENSION

The tension transducers may be zeroed at any time while no web is on the tension roll. Tension zero may be performed without calibration using the **Set Zero Tension** function, located in the *Calibration Menu*.

Note: Do NOT use this function with web on the transducers. The current tension value will become the new zero, ruining the calibration.

SECTION 8 CARE AND MAINTENANCE

It is not necessary to perform any type of maintenance on the controller. However, you may find it worthwhile to observe whether there is buildup of dust, debris or moisture on or near the unit after a period of time. If so, you may consider moving the unit or putting the unit in an enclosure more suited to your particular environment.

Washing the exterior of the unit may be done using warm water and a mild detergent on a cloth. Disconnect power prior to cleaning. Do not spray or pressure wash the unit. Ensure the unit is dry prior to reconnecting power.

Validation of tension reading is recommended during your periodic maintenance cycle.

SECTION 9 TROUBLESHOOTING GUIDE

9.1 GENERAL TROUBLESHOOTING TIPS

Most problems are caused by incorrect installation or misapplication of the equipment, so it is important to read through the manual and follow the proper installation, calibration and configuration procedure.

If you would like assistance evaluating your installation, please call Technical Service at Phone: (603) 332-6150 Fax: (603) 332-3758 Email: techsupport@dfe.com. We offer experienced technicians whose responsibility it is to make sure you are satisfied with your DFE equipment. They will be pleased to help you.

The most common source of improper operation of tension equipment is incorrect installation of the tension transducers or using transducers of the wrong load rating. Refer to your transducer instruction manual and check the sizing and installation procedures to verify the installation. Note: Avoiding preloading the transducers is very important.

For controllers with a pneumatic output, check the following factors:

1. The output pressure should not fall below 5 psi at core diameter. If it does, the controller may be unstable. This is caused by the compressibility of air, which creates a time delay when the controller calls for a change of output pressure. At low pressures the delay becomes long.
2. The air connection between the controller and the brake or clutch should be 1/4 inch O.D. tubing, no longer than 25 feet long. Larger or longer tubing creates excessive volume which causes a time delay when output pressure changes. This can cause instability. If greater distance is unavoidable, the pneumatic enclosure should be moved closer to the brake or clutch. Use of a volume booster is an alternative. Call Technical Service at (603) 332-6150 for details.

9.2 ERROR MESSAGES

DISPLAYED ERROR	CAUSE	RESOLUTION
ERROR: EXCITATION Short or low impedance detected. Check transducer wiring.	A short circuit or low impedance condition is detected on one or both of the excitation lines. This could be caused by a miswire, a damaged (failed short) transducer strain gage or an incorrect excitation voltage setting.	• Ensure the proper excitation voltage setting. The voltage should not be set to **10V Set** when using STD transducers. • Check transducer wiring. See Appendix C: Transducer Electrical Connections and Section 2.11 Standard Electrical Connections. • Verify correct transducer resistance. ~200 Ohm per half of the transducer bridge for STD transducers, ~400 Ohm per half of the transducer bridge for XR transducers.
ERROR: EXCITATION Open Circuit. Verify transducers are connected. Check transducer wiring.	An open circuit condition is detected on one or both of the excitation lines with the **Excitation Voltage** setting set to **Auto**. This could be caused by having no transducers connected to the unit or by a miswire in the transducer connection. Other possibilities are the use of non traditional high impedance transducers (not DFE STD or XR), a damaged (failed open) transducer strain gage, or a broken wire in the cable to the transducer(s).	• Ensure transducers are connected to the controller. • Check transducer wiring. See Appendix C: Transducer Electrical Connections and Section 2.11 Standard Electrical Connections. • If using non traditional high impedance transducers (not DFE STD or XR), set the **Excitation Voltage** setting to the voltage required for the transducers (**5V Set** or **10V Set**). Do not use the **Auto** setting. *...continued next page*

DISPLAYED ERROR	CAUSE	RESOLUTION
ERROR: EXCITATION Open Circuit. Verify transducers are connected. Check transducer wiring.	*continued..*	Verify correct transducer resistance. ~200 Ohm per half of the transducer bridge for STD transducers, ~400 Ohm per half of the transducer bridge for XR transducers.
ERROR: EXCITATION Unknown transducer type. Verify STD or XR transducer Check transducer wiring.	A STD transducer is detected on one half of the bridge and an XR transducer is detected on the other. This could be caused by mismatched transducers, miswiring, or a damaged transducer strain gage.	• Verify that both transducers are the same (both STD or both XR). • Check transducer wiring. See Appendix C: Transducer Electrical Connections and Section 2.11 Standard Electrical Connections. • If using non traditional high impedance transducers (not DFE STD or XR), set the **Excitation Voltage** setting to the voltage required for the transducers (**5V Set** or **10V Set**). Do not use the **Auto** setting. • Verify correct transducer resistance. ~200 Ohm per half of the transducer bridge for STD transducers, ~400 Ohm per half of the transducer bridge for XR transducers.
ERROR: TRANSDUCER ZERO Zero out of range. Check for overloading. Check transducer wiring.	The transducer analog to digital converter zero reading is at one of the input range extremes (0 or 65535). This could be caused by overloading, a transducer miswire, or a damaged transducer strain gage.	• Ensure the transducers are not overloaded. • Check transducer wiring. See Appendix C: Transducer Electrical Connections and Section 2.11 Standard Electrical Connections. • Verify correct transducer resistance. ~200 Ohm per half of the transducer bridge for STD transducers, ~400 Ohm per half of the transducer bridge for XR transducers.
ERROR: TRANSDUCER CAL Minimum delta not met. Full range signal must exceed 15mV	The minimum calibration delta was not met during calibration, meaning the calibration reading is too close to the zero reading. The full range tension signal (from no tension to full scale tension) must exceed 15mV. This means when using a 10% (of full range) calibration weight, the signal difference between the Zero and Cal points must be at least 1.5mV or when using a 50% (of full range) calibration weight, the Zero and Cal signal difference must be at least 7.5mV. Too small of a signal could be caused by an improper transducer configuration, preloading, or a damaged transducer.	• Ensure the minimum full range tension signal is at least 15mV. If necessary, the web angle may need to be increased, a different transducer orientation or a smaller load rating may be required. • Ensure there is no transducer pre-loading when using a pair of transducers on either side of the roll, such as model C transducers. There should be axial play to allow the shaft length to expand at higher temperatures and the transducers should be mounted with proper alignment. See the transducer manual for more information.

DISPLAYED ERROR	CAUSE	RESOLUTION
ERROR: TRANSDUCER CAL Minimum delta not met. Full range signal must exceed 15mV	*continued...*	• Check transducer wiring. See Appendix C: Transducer Electrical Connections and Section 2.11 Standard Electrical Connections. It is important that each half of the transducer bridge is powered by excitation voltage of opposite polarity so that the signal voltages move away from each other when tension is applied. • Verify correct transducer resistance. ~200 Ohm per half of the transducer bridge for STD transducers, ~400 Ohm per half of the transducer bridge for XR transducers. • Monitor the plus and minus signal lines, apply pressure to the roll and verify a changing signal.
ERROR: RIDER CAL Minimum delta not met. Full range signal must exceed 4V.	The minimum diameter input calibration delta was not met. There must be at least a 4V difference between the core diameter voltage and the full roll diameter voltage.	Adjust the arm angle on a rider roll, gain on a ultrasonic sensor, or other adjustments on the diameter measurement device to achieve at least a 4V difference between core and full roll sensing.
ERROR: ZERO OFFSET Maximum delta exceeded. Verify nothing is connected to analog inputs.	The maximum zero offset has been exceeded while attempting to perform a **Zero Signal Inputs** function.	Ensure that nothing is connected to the analog inputs while performing the **Zero Signal Inputs** function.
ERROR: CALIBRATION STATUS Control prohibited until tension calibration is completed.	Tension control and display in the Run mode display is prohibited until calibration has been completed.	Perform the tension calibration procedure (see Section 4.1, Tension Calibration) when interfacing directly with the transducers, or change the **Tension Source** setting to the correct RTA (Remote Tension Amplifier) input.

9.3 DIAGNOSTIC SCREENS

The SteadyWeb™ 5's Diagnostic menu provides displays and functions to monitor, troubleshoot and fine tune the controller's performance.

1. Software/Hardware Versions

The *Diagnostic Menu > Version Menu* display shows the controller's software and hardware versions. This can be useful in communication with DFE Technical support.

2. Monitoring Controller I/O

The *Diagnostic Menu > Read Digital Inputs* display provides a real time view of the Signal terminal block (TB3) digital inputs states. This includes the Tension Off, Tension On, Auto, Manual, Ratio, Sample & Hold, Soft Start and Spare inputs. The display reads **Off** for floating inputs and **On** for inputs that are pulled to ground. This display can be used to verify the proper functionality of switches or relays connected to the terminal block.

The *Diagnostic Menu > Read Analog Inputs > Tension Input* display provides a real time view of the tension ADC (Analog to Digital Converter) count as well as the corresponding millivolt reading. This allows for transducer signal verification and/or troubleshooting.

The *Diagnostic Menu > Read Analog Inputs > Signal Inputs* display provides a real time view of the Signal terminal block (TB3) analog inputs' ADC counts as well as the corresponding voltage readings. This includes the Diameter Input, Roll Input, Line Input, Remote Manual Setpoint Input, Remote Auto Setpoint Input, Remote Tension Input 1 (RTA1) and Remote Tension Input 2 (RTA2). In addition, there is a +10V/15V external rail (provided by TB3 terminal

18) monitor ADC count and voltage provided. This allows for analog signal input verification and/or troubleshooting.

The *Diagnostic Menu > Read Analog Inputs > Excitation Sense* display provides a real time view of the transducer excitation voltage ADC count and corresponding voltage as well as the current sense count and corresponding milli-amp reading for each half of the transducer bridge. In addition, the calculated resistance of each half of the bridge is displayed with the corresponding transducer type. A value of 200 Ohms, for instance, will be displayed with "STD" for transducer and a value of 400 Ohms will be displayed with "XR" for Extended Range. For high resistances or open circuit conditions, no resistance value will be displayed and the words "Open Circuit" will be displayed. In the case of a low impedance or short circuit condition, no resistance will be displayed and the words "Short Circuit" will be displayed. This allows for transducer verification and/or troubleshooting.

3. Manual Output Control

The *Diagnostic Menu > Write Analog Outputs > Isolated Control Out* screen allows the operator to manually adjust the isolated control output voltage (or current, as dictated by the control output jumpers). Tension must be Off and the controller must be in Manual mode in order to access this screen. Once entered, turning the multipurpose knob allows manual adjustment of the control output. The output DAC (digital to analog converter) count is displayed, as well as the calculated corresponding output voltage and current value. Decreasing the DAC count (turning the knob counterclockwise) causes the output to increase, and increasing the DAC count (turning the knob clockwise) causes the output to decrease. This allows for verification and/or troubleshooting of the isolated control output.

The *Diagnostic Menu > Write Analog Outputs > Tension Out* screen allows the operator to manually adjust the tension output voltage. Tension must be Off and the controller must be in Manual mode in order to access this screen. Once entered, turning the multipurpose knob allows manual adjustment of the tension output. The output DAC count is displayed, as well as the calculated corresponding output voltage. Decreasing the DAC count (turning the knob counterclockwise) causes the output to increase, and increasing the DAC count (turning the knob clockwise) causes the output to decrease. This allows for verification and/or troubleshooting of the tension output.

4. Analog Zero Offsets

The *Diagnostic Menu > Adjust Analog Offset > Zero Signal Inputs* screen allows the operator to zero any offsets in the signal inputs (Diameter In, Roll In, Line In, Remote Manual Setpoint, Remote Auto Setpoint, Remote Tension Input 1 (RTA 1) and Remote Auto Input 2 (RTA 2)). This is done in the factory and should not have to be repeated unless the controller is reinitialized, clearing all memory. Zeroing the analog offsets will clear any small offset count that is displayed in the *Diagnostic Menu > Read Analog Inputs > Signal Inputs* display when nothing is connected to the inputs. The **Zero Signal Inputs** function is designed to account for any small offsets caused by the analog circuitry in the controller, NOT to account for offsets in external components. For this reason, all signal input connections must be removed before running the **Zero Signal Inputs** function, even if the input is reading 0V, there could be a small offset that will add inaccuracy if not removed. Tension must be Off and the controller must be in Manual mode in order to access this screen.

The *Diagnostic Menu > Adjust Analog Offset > Control Out Zero Offset* screen allows the operator to adjust the control output zero offset. This is done in the factory and should not have to be repeated unless the controller is reinitialized, clearing all memory, or if the control output is changed from voltage to current mode (or vice versa). The offset is used to account for small hardware offsets in the analog circuitry and to ensure that a zero output is represented by 0.0V or 4.0mA. From within the screen, the offset can be adjusted with the multipurpose knob and saved with the right most soft key. When performing a zero offset adjustment, a multimeter with at least 1mV (or 0.01mA in current mode) resolution should be used. Tension must be Off and the controller must be in Manual mode in order to access this screen.

The *Diagnostic Menu > Adjust Analog Offset > Tension Out Zero Offset* screen allows the operator to adjust the tension output zero offset. This is done in the factory and should not have to be repeated unless the controller is reinitialized, clearing all memory. The offset is used to account for small hardware offsets in the analog circuitry and to ensure that a zero output is represented by 0.0V. From within the screen, the offset can be adjusted with the multipurpose knob and saved with the right most soft key. When performing a zero offset adjustment, a multimeter with at least 1 mV (or 0.01mA in current mode) resolution should be used. Tension must be Off and the controller must be in Manual mode in order to access this screen.

5. Reinitializing the Controller

The *Diagnostic Menu > Reinitialize Controller* function can be used to completely clear the Controller's memory, returning it to a default state. This action should never be performed unless instructed to do so by DFE Technical Support. Reinitializing the controller will clear all saved Setups as well as the calibration values and the factory adjusted analog offset values.

SECTION 10 REPLACEMENT PARTS

⚠ **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!

Main Circuit Boards	
Control Board	723-2561
User Interface Board with Encoder	723-2812
Optional Power Supply	
AC to DC Power Supply	144-0028, 144-0006 (ALT)
AC Power Supply Option Assembly	723-2816
Optional Circuit Boards	
Pulse Tachometer Option Card Assembly	723-2084
DC Tachometer Option Card Assembly	723-2085
Relay Option Card Assembly	723-2095
Ethernet Communication Option Card Assembly	723-2670
RS485 Communication Option Card Assembly	723-2814
RS232 Communication Option Card Assembly	723-2813
Pneumatic Version	
Pneumatics Module	723-2037
Air Filter	119-0024
Servo Valve	621-2586
V-Out Version	
V-Out Module	723-2817
SCR Bridge	103-0013
Low Voltage Fuses 115VAC (125mA 250V Slow)	108-0086
Low Voltage Fuses 230VAC (63mA 250V Slow)	108-0094
Output Fuses (5A 250V Fast)	108-0003
Controller to Pneumatic/V-Out Cables	
20' Cable	721-2836
"L" Cable	721-2837
Communication Connector	
DB9 to Communication Card Cable	721-2815
Manuals	
Technical Reference Manual	801-2383
Operating Instructions	801-2396
RS232/RS485 Modbus Manual Insert	801-2385
Ethernet Option Card Manual Insert	801-2384
Quick Start Guide	801-2393

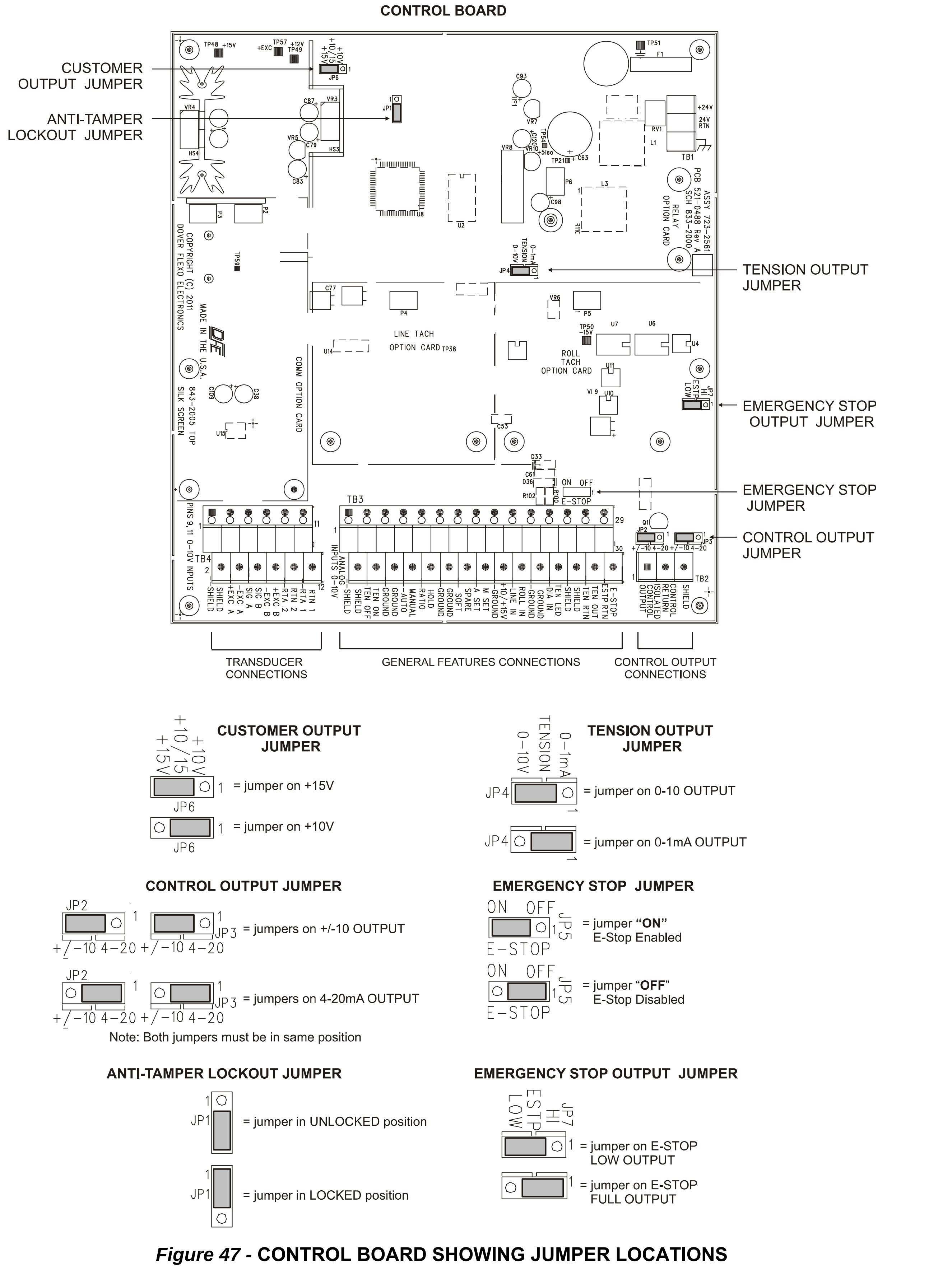


Figure 47 - **CONTROL BOARD SHOWING JUMPER LOCATIONS**

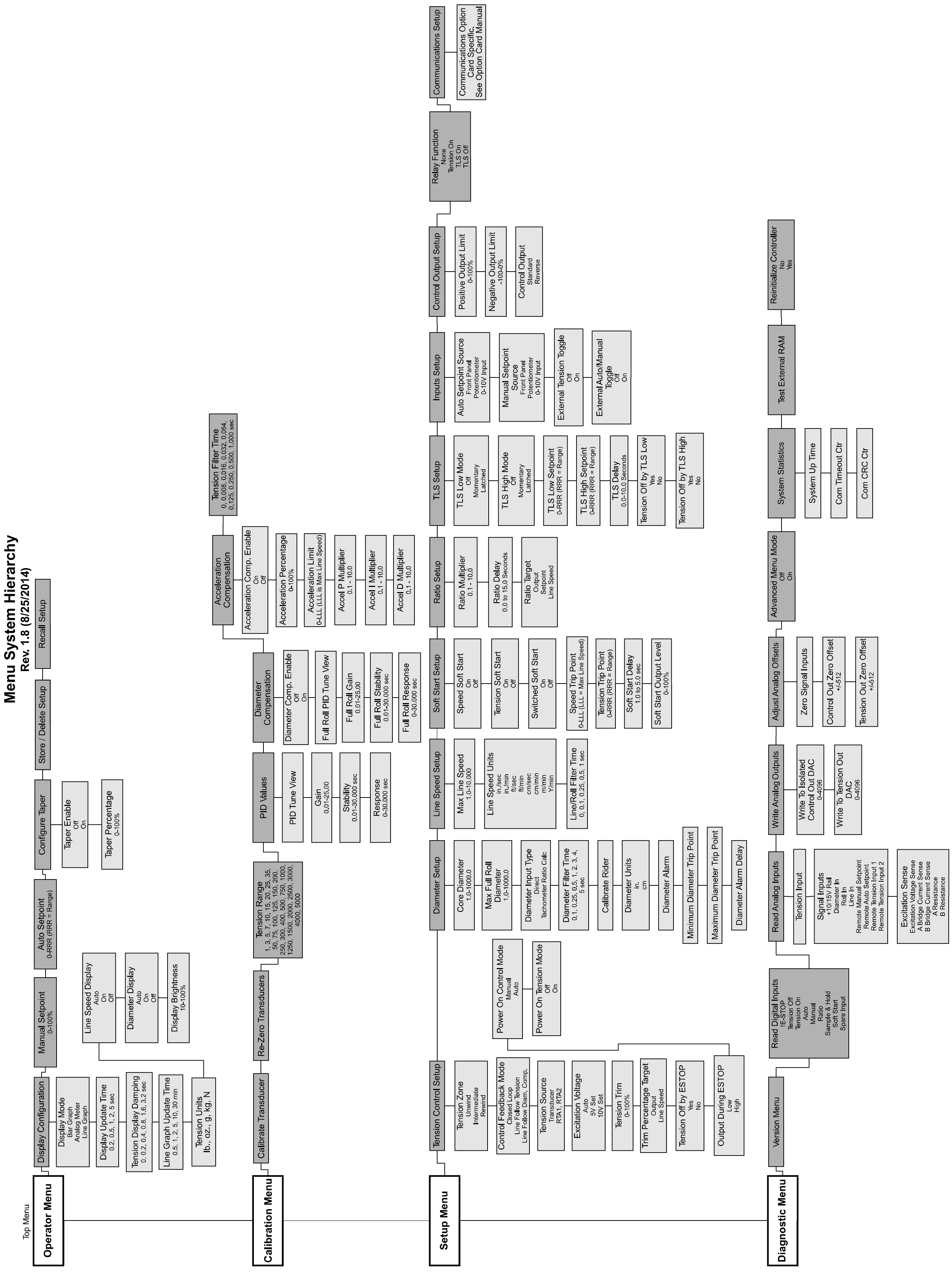


Figure 48 - **MENU HIERARCHY**

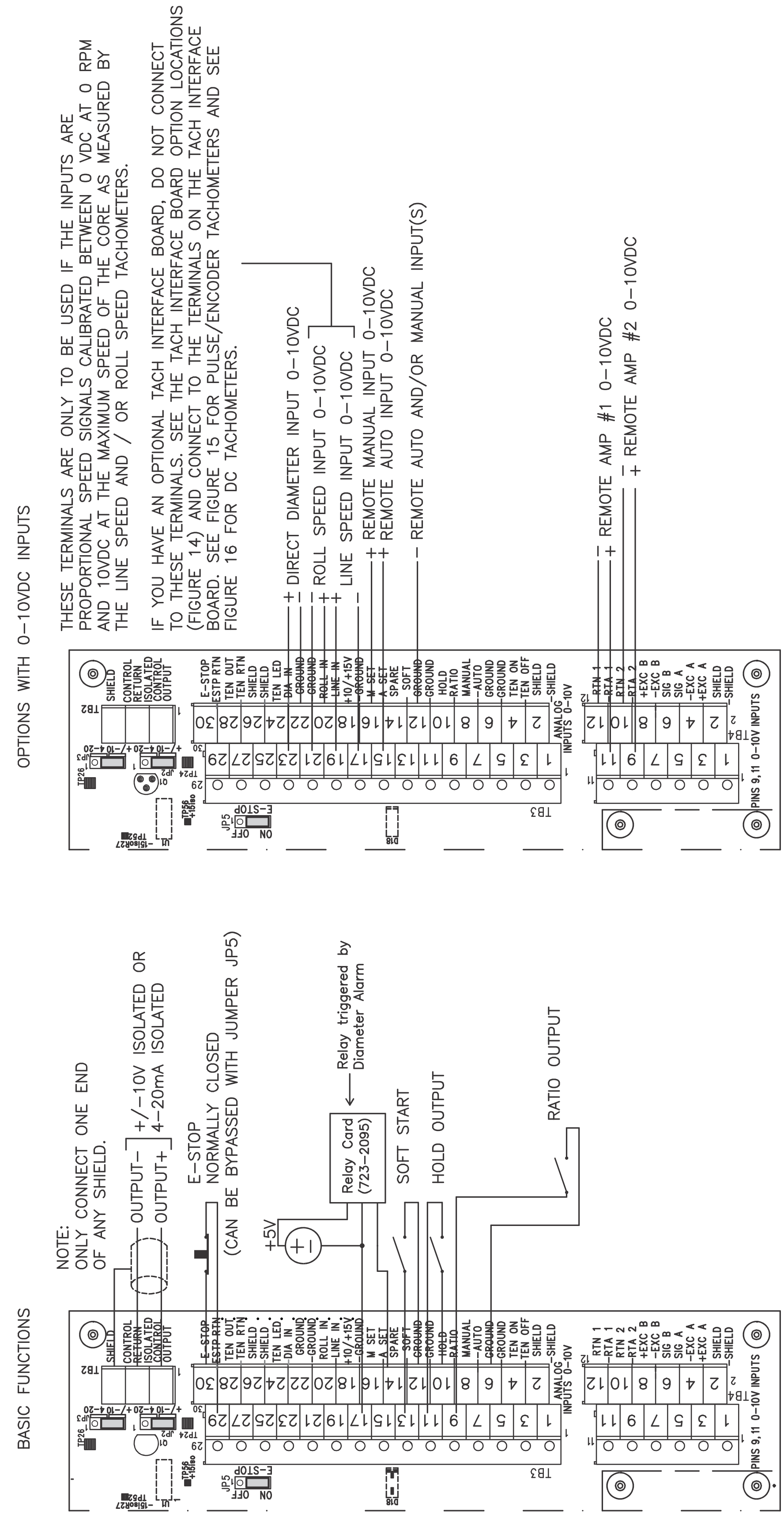


Figure 49 **- STANDARD AND 0-10VDC CONTROL BOARD ELECTRICAL CONNECTIONS**

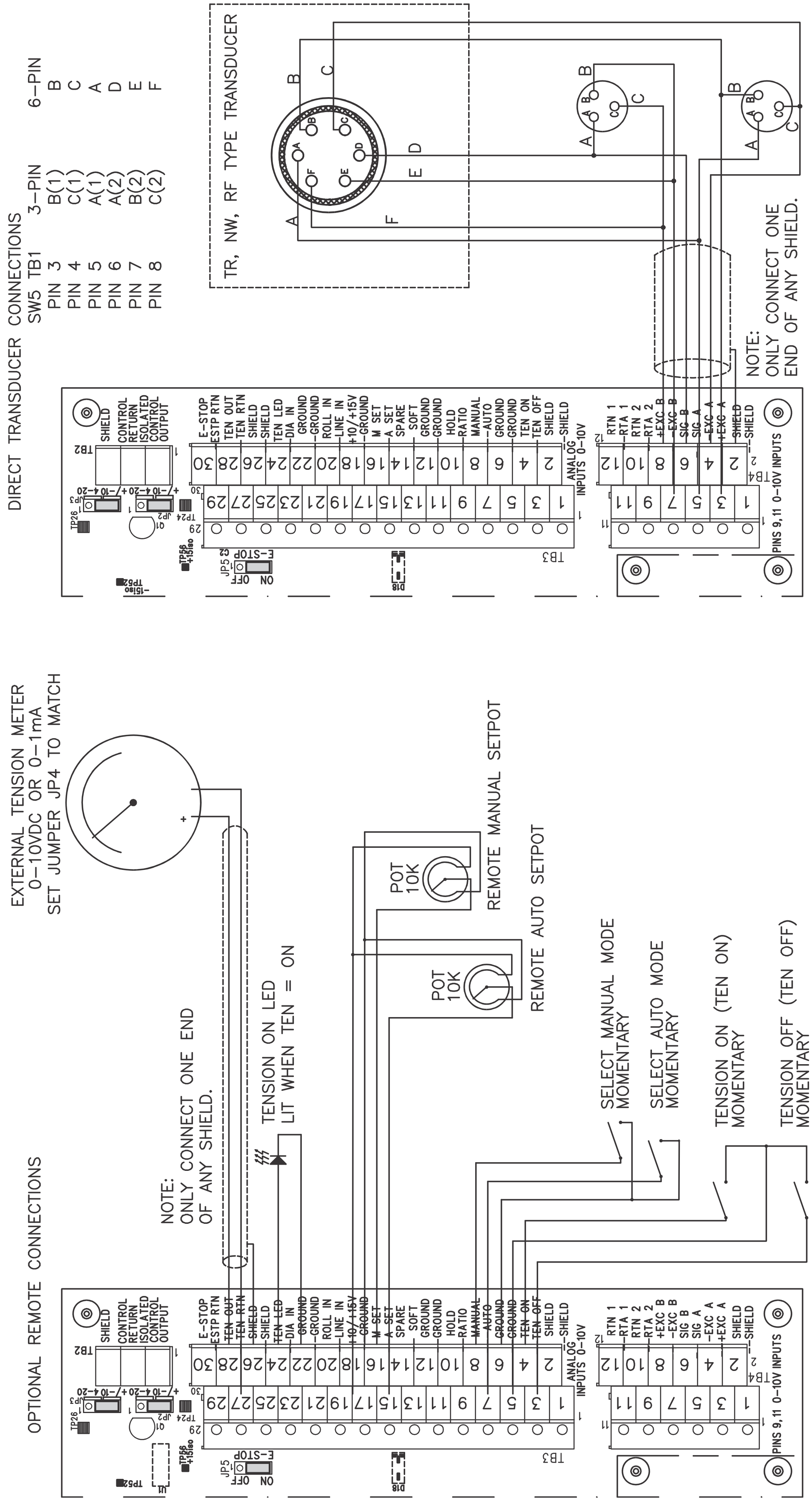


Figure 50 **- CONTROL BOARD TRANSDUCER ELECTRICAL CONNECTIONS AND REMOTE OPTION**

Appendix D: Transducer Electrical Connections

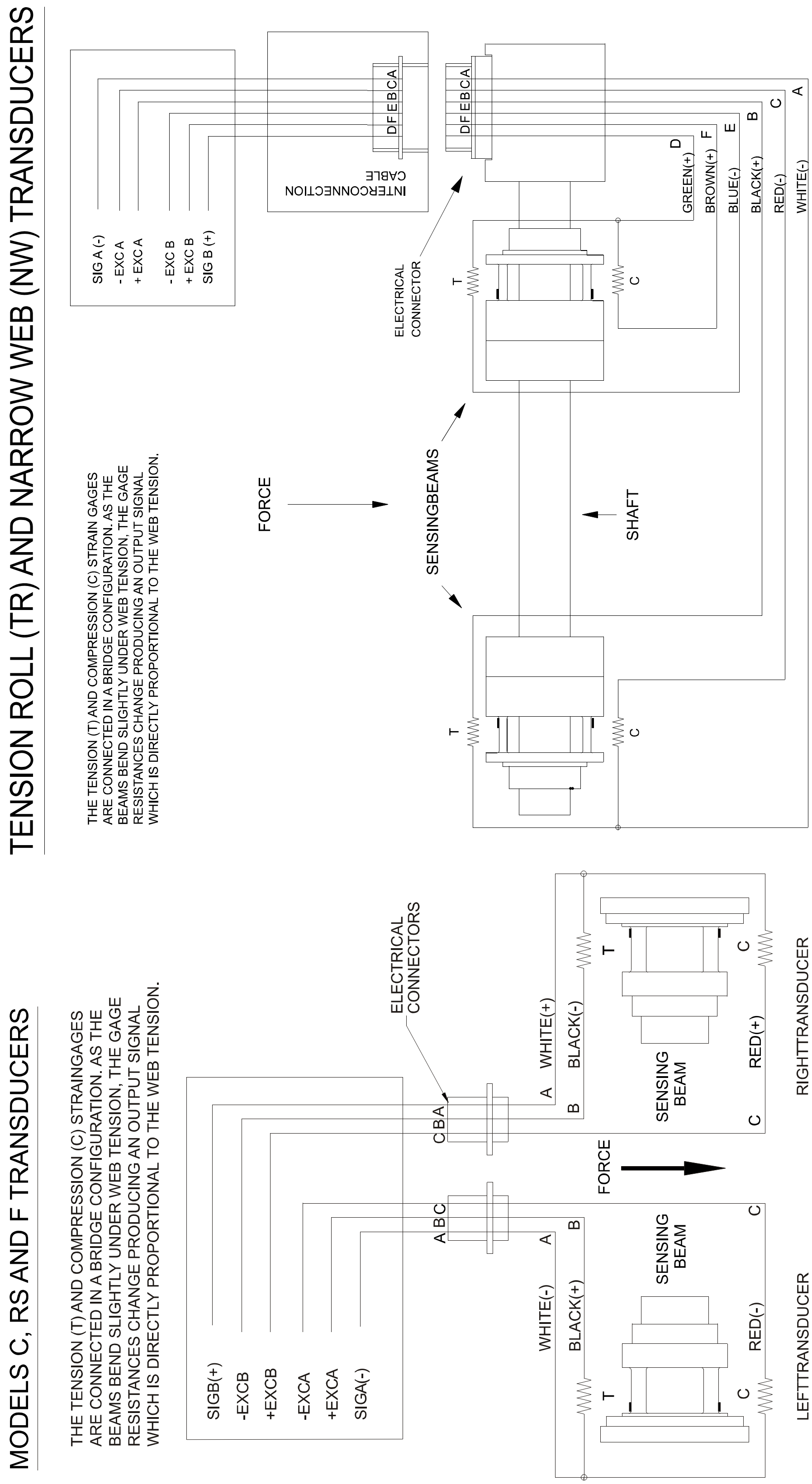


Figure 51 - **MODELS C, RS, F, TR, & NW TRANSDUCER WIRING**

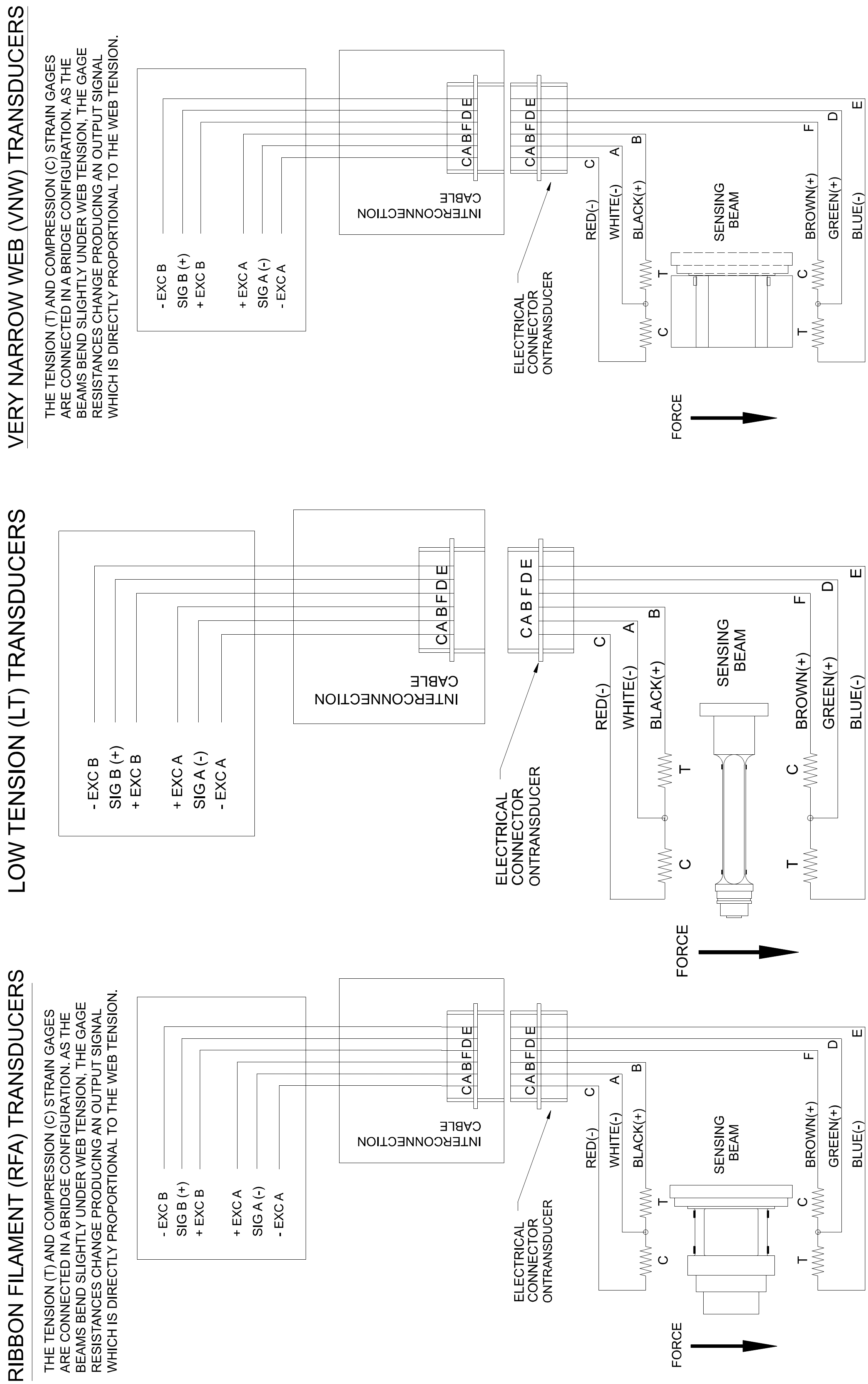


Figure 52 - **MODELS RFA, LT, & VNW TRANSDUCER WIRING**

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	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.

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.

rev.9 10/25/10

NOTES

INDEX

DOVER FLEXO ELECTRONICS, INC.

217 PICKERING ROAD
ROCHESTER, NEW HAMPSHIRE 03867-4630 U.S.A
TEL: 603-332-6150
FAX: 603-332-3758
E-mail: info@dfe.com   Internet: www.dfe.com

CANADA

MEXICO

UNITED KINGDOM

TAIWAN

KOREA

AUSTRALIA

SOUTH AFRICA

CHINA

DOC 801-2383 R4
F&C1217   PRINTED IN USA