

# U4

## Open Loop/Diameter Based Tension Controller

### TECHNICAL MANUAL



TSC™ System Component 

## U4 Open Loop/Diameter Based Tension Controller

### Installation and Set up Instructions

Publication Date 11/27/2018  
Firmware Version 2.17

## Warning, EMC, and Safety

**Warning:** Electrical installation must be done by skilled personnel. Wiring must meet all applicable codes and standards.

Refer to the appropriate wiring and terminal descriptions for external connections.

**Note:** Double-check the accuracy of all wiring connections before applying power to the controller. Damage caused by improper wiring is not under warranty.

**EMC Requirements:** Connect the protective ground wire to the terminal marked G. Ground wires should be as short as possible. Connect the controller G terminal and enclosure to a common ground.

Use only shielded cables for all external connections. For analog signals, terminate the shield at the controller end; for digital signals, terminate the shield at both ends.

Keep signal cables away from supply cables or any wires that conduct high current. For the best noise immunity, run signal cables close to the machine frame, mounting plates, or other grounded structures.

### SAFETY INFORMATION

The following safety symbols appear in this manual.



#### Caution

Failure to follow installation and setup instructions in this manual may result in equipment damage or personal injury.



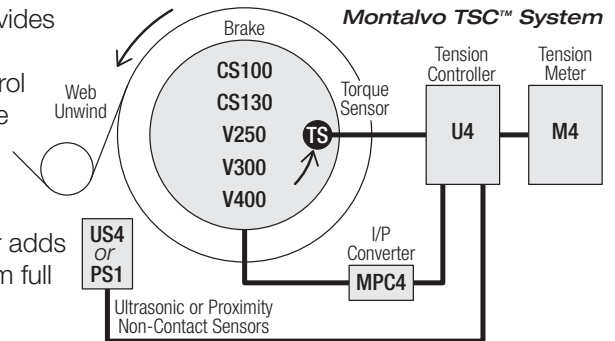
#### Electrical Hazard

Failure to follow wiring instructions in this manual may result in equipment damage, personal injury, or death.

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## 1.1 Overview

The Montalvo U4 Open Loop Controller provides precise, accurate control of web tension by varying torque based on diameter. The control outputs of 0-10VDC and 4-20mA enable the U4 to interface with a variety of torque output devices to control web tensioning brakes, clutches and motor Drives. The **TSC™ System** utilizing a TS Torque Sensor adds the ability to monitor *actual web tension* from full roll to core. Standard U4 features include:

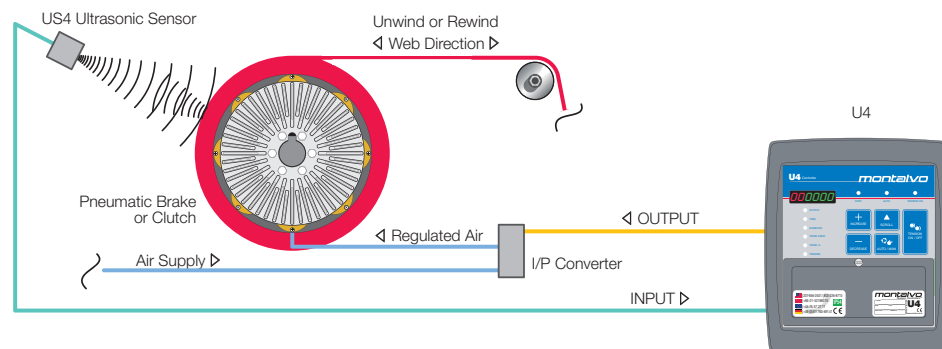


- Universal 100-240VAC (Optional 24VDC).
- Display of all Information in either English or Metric units.
- Can be used with ultrasonic or laser diameter sensors, rider arms or proximity switches.
- Programmable Soft Start, Anti-coast, and Hold values allow precise control of starting and stopping during quick Cycle applications.
- Two different alarm settings can be programmed to alert the operator or can be connected to machine controls to slowdown and stop machine.
- Set up and programming can easily be done using the keypad and display or with free software through the USB port.
- Stores and re-calls up to 9 sets of control parameters for different materials.
- Can be used with TS torque sensor to display actual calculated Web Tension. → **TS**

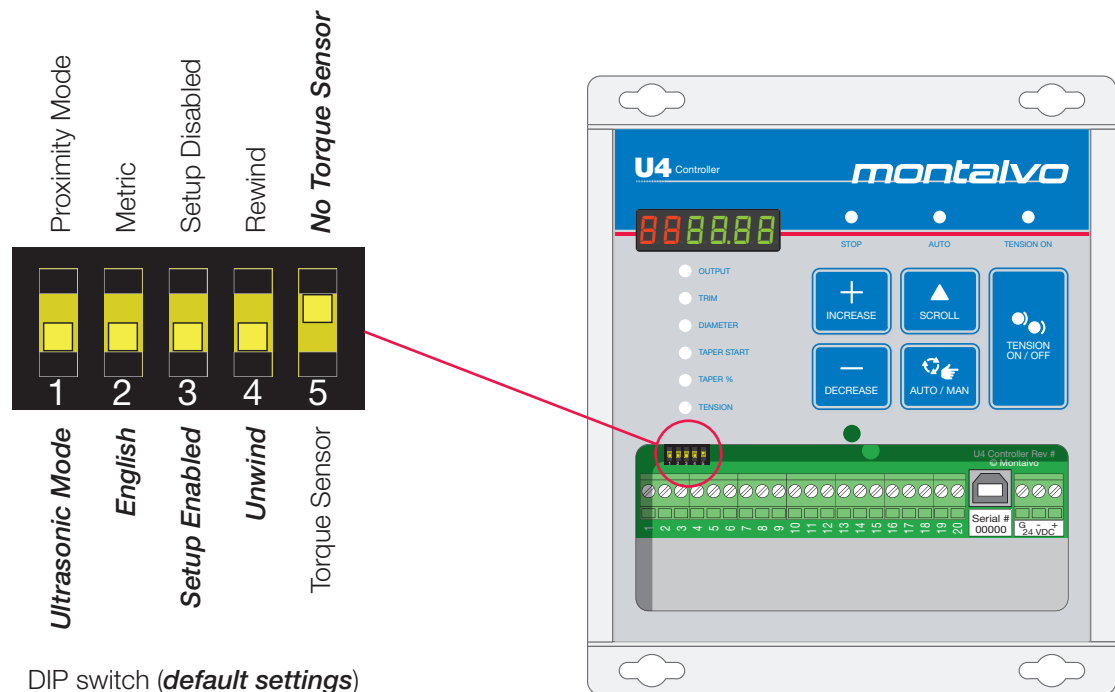
## 1.2 System Operation

In order to properly set up and program the U4, as well as take advantage of all the available features, it is important to have a basic understanding of the controller and how it fits into the tensioning system. Refer to the drawing below.

A typical pneumatic unwind system using an ultrasonic sensor is shown, however the same principles apply to most open loop tension control systems. The calibrated sensor supplies the correct diameter to the U4 which applies a proportional output to the brake. The operator sets the desired amount of tension on the web by increasing or decreasing the trim value to add to or subtract from the output proportional to the diameter. As the roll diameter decreases, the U4 reduces the output to the brake. Since the output to the brake is proportional to torque, and since Tension is equal to the Torque divided by the radius, the Tension will automatically remain the same throughout the roll.



## 2.1 DIP Switches



DIP switch (*default settings*)

**Changes to DIP switch settings require that the U4 be repowered to accept those changes.**

By making the following selections on the 5 DIP switches, the U4 will only display parameters that apply to your specific application:

Switch	Default Settings	Description
1	Ultrasonic	Select between <i>Ultrasonic Sensor</i> or <i>Proximity Switches</i> .
2	English	Select between display of <i>English</i> or <i>Metric</i> units.
3	Setup Enabled	Select between <i>Setup Enabled</i> for initial setup or <i>Setup Disabled</i> to prevent accidental changing of parameters by operator.
4	Unwind	Select between <i>Unwind</i> or <i>Rewind</i> torque device.
5	No Torque Sensor	Select between <i>Torque Sensor</i> installed or <i>No Torque Sensor</i> installed.

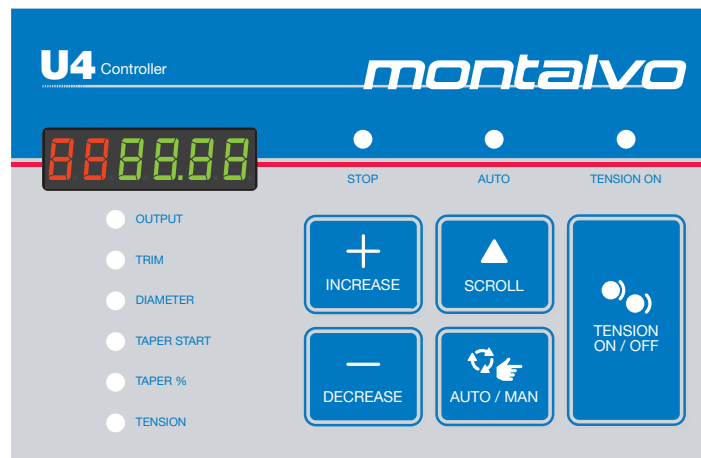
## 2.2 Keypad

### Digital Display

The first two (RED) digits are used to display Set-up Parameters when in the Set-up mode. The next four (GREEN) digits are used to display the values of the Set-up Parameters as well as the Operating Parameters.

### Operating Parameter LEDs

When Operating Parameters are displayed, corresponding LEDs below the display will light up to indicate the Parameter that is being displayed.





### Operating Mode LEDs

Mode	Description
AUTO	AUTO and TENSION ON LED lit - The output on the brake can be set using the  and  keys to set the TRIM value at full roll and will automatically decrease as the roll diameter decreases
MANUAL	Only TENSION ON LED lit - Controller output is manually controlled by using the  and  keys. If switched to Auto, this value will ramp to the calculated Auto value. When in Auto, if switched to Manual, the output will remain the same. This value can then be adjusted with the  and  keys.
TENSION ON	Output is active.
TENSION OFF	Output is set to zero


### STOP Mode Indicator LED







LED Color	Description
Red	ON during STOP time.
Yellow	ON when in HOLD mode.
Blinking Yellow	BLINKING during START time.
None	OFF during all other times.

## 2.3 Operating Parameters

Pressing the  key cycles through the modes listed below. Starting from the OUTPUT mode, pressing the  key will move in this fashion: OUTPUT / TRIM / DIAMETER / TAPER% / TAPER START / TENSION / OUTPUT.

The corresponding LED should be lit. The OUTPUT mode is the default mode. OUTPUT, DIAMETER, and TENSION modes are display values only (not adjustable).

When parameter values are modified, the new value should take effect immediately. This will allow the output to change as the TRIM value is changed in real time. This also means the main process will still run while in these modes. Pressing the  key saves the new value and moves to the next parameter.

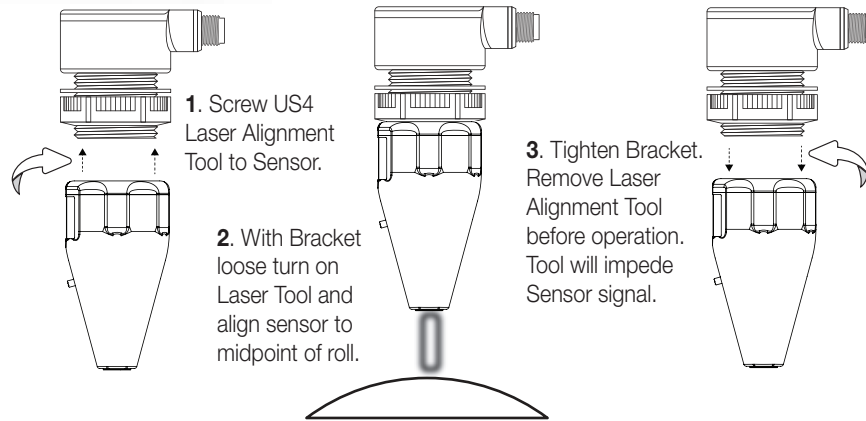
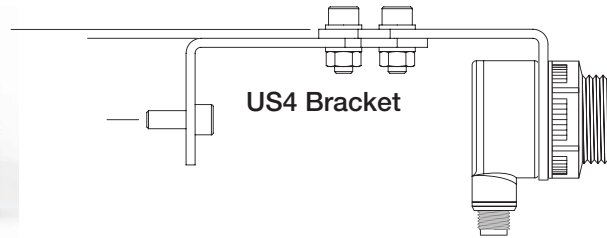
Parameter	Description
Output	Percentage of 0-10V or 4-20mA output. Display values can go from 0.0% to 100.0%. This is the default state after power up.
Trim	Displays TRIM% value (-100 to +100). In this mode, the TRIM% value can be changed by the  /  keys.
Diameter	Displays the calculated diameter in inches (0.0 – 99.9) or in mm (0 – 2500). For Display only. Cannot be changed.
Taper Start	Displays TAPER START value (0-99.9 inches or 0-2500 mm. In this mode, the TAPER START value can be changed by the  /  keys. Only displayed if rewind mode selected by dipswitch.
Taper %	Displays TAPER% value (0 – 100). In this mode, the TAPER value can be changed by the  /  keys. Only displayed if rewind mode selected by dipswitch.
Tension	Displays the calculated tension in lb (0-9999) from the torque sensor. Only displayed if torque input is selected by dipswitch.

### 3.1 Mounting

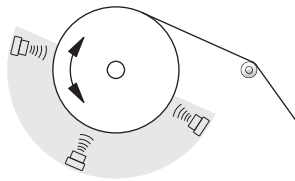
To ensure proper operations the US4 must be able to receive a DIRECT linear signal from the material back to the US4. If the direct signal is altered by any angles created through the unwind or rewind process the US4 will not receive the intended return signal.



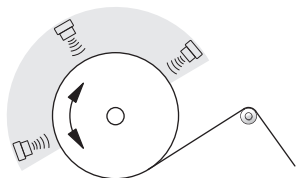
**Optional** US4 Laser Alignment Tool Part #11001498



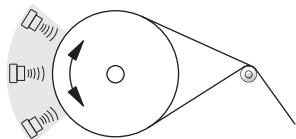
Sensor Position	Description
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...when unwinding/rewinding from top of roll  
The gray zone represents areas of correct installation angles to ensure the US4 is always receiving an accurate signal from full roll to core.



...when unwinding/rewinding from bottom of roll  
The gray zone represents areas of correct installation angles to ensure the US4 is always receiving an accurate signal from full roll to core.



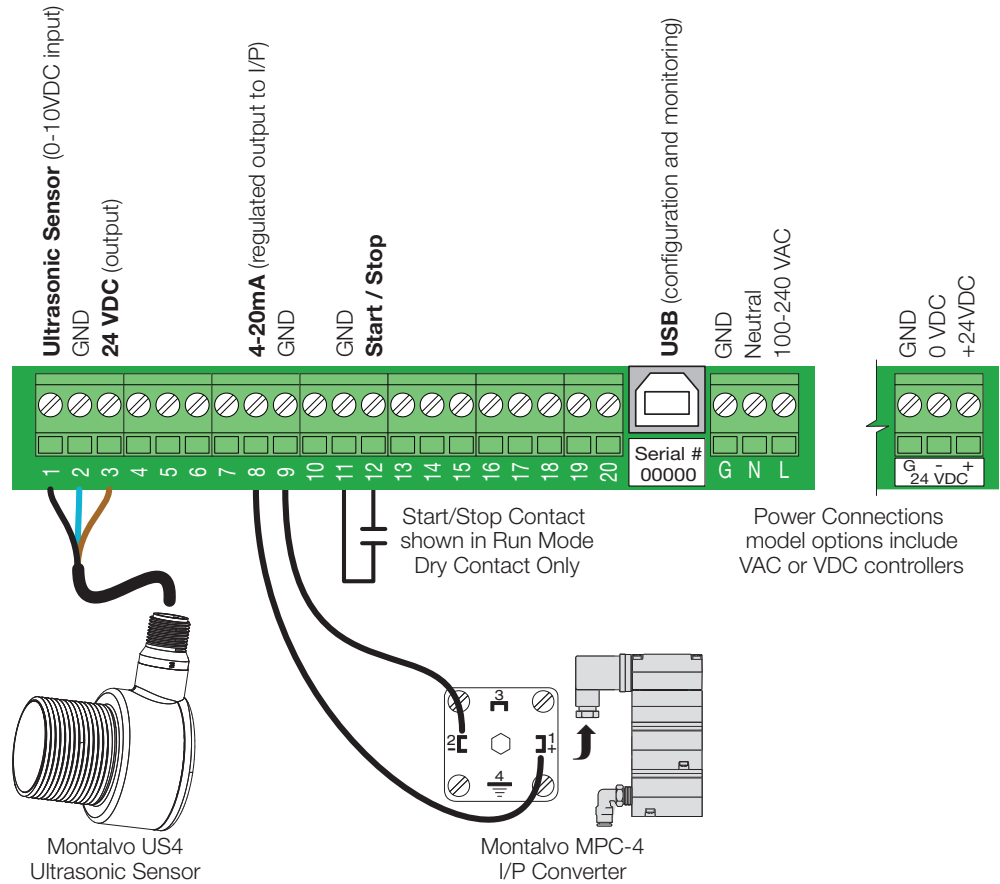
...when unwinding/rewinding from bottom or top of roll  
The gray zone represents areas of correct installation angles to ensure the US4 is always receiving an accurate signal from full roll to core.

**Notes**

- Beam direction must be perpendicular to the roll diameter and pointing directly at the core.
- The mounting position is free of any vibration that might deflect the beam pattern from the roll.
- It is free from interference of any part or surface including the web material itself.
- It is subject to as few temperature changes as possible.
- Refer to the installation instructions that were included with the sensor for specific mounting distance restrictions and calibration instructions.



## 3.2 Wiring





## 3.3 Calibration





- 1 Apply power to the U4 Controller
- 2 To set the distance for the Core and Full Roll, enter the TEACH mode (see below).
  - Set the core (maximum) distance first and the full roll (minimum) distance second.
  - Either install an empty core first and then a full roll, or utilize a sturdy, flat piece of material (ex: cardboard) as a target to set these distances.








Step	Procedure	Result
1 Enter TEACH Mode	a) Push and hold ANALOG button for > 2 seconds	Power LED: OFF Output LED: ON
2 Set CORE (max. distance)	a) Position target representing CORE distance	Signal LED: Must be ON Red or Flashing Red
	b) Push (d not hold) Analog button	Teach Accepted Power LED: OFF Output LED: Flashing Teach Not Accepted Output LED: ON
3 Set FULL ROLL (min. distance)	a) Position target representing FULL ROLL distance	Signal LED: Must be ON Red or Flashing Red
	b) Push (d not hold) Analog button	Teach Accepted Power LED: ON Output LED: ON Teach Not Accepted Power LED: OFF Output LED: Flashing



### 3.4 Set-up

#### Basics


The following parameters can only be entered or modified if the SETUP ENABLE switch is in the correct position. Ensure that both the **AUTO** LED and **TENSION** LED are illuminated. If the **TENSION** LED is not illuminated, press the  key. If the **AUTO** LED is not illuminated, press the  key.







The Set-up mode is activated by pressing the   keys together for 2 seconds. If the SETUP ENABLE switch is in the DISABLE position or the AUTO LED and TENSION LED are not illuminated, pressing the   keys together for 2 seconds will have no effect. When The Set-up mode is activated you will see this: The Red digit indicates the parameter number and the green digits indicate the value of the parameter.

Display	Description
	Press the  or  keys to set this value to the maximum full roll diameter. Press the  key when done.
	Press the  or  keys to set this value to the minimum core diameter.

**Parameters 1 and 2 are the only parameters that need to be set in order to run the machine and display accurate diameter values. By pressing the  key other optional features may be used to optimize you particular application. These features are explained below. To start running now, simply press and hold the  key for 4 seconds to exit set-up.**

#### Diameter Alarms






It is possible to enter two different diameter values. When these diameters are reached, 24 VDC will be applied to a particular terminal on the U4 board. This 24 VDC can be used to activate a 24 VDC relay that can be wired to a light or a bell or buzzer to alert the operator. This output can also be wired into a PLC or Drive to slow down and/or stop the machine at selected diameters. If this feature will not be used, simply us the  key to scroll to parameter number 5.

Display	Description
	Press the  or  keys to set the diameter value that will apply 24 VDC to terminal 18.
	Press the  or  keys to set the diameter value that will apply 24 VDC to terminal 20.

### 3.4 Setup - continued

#### *Stop / Hold / Start*

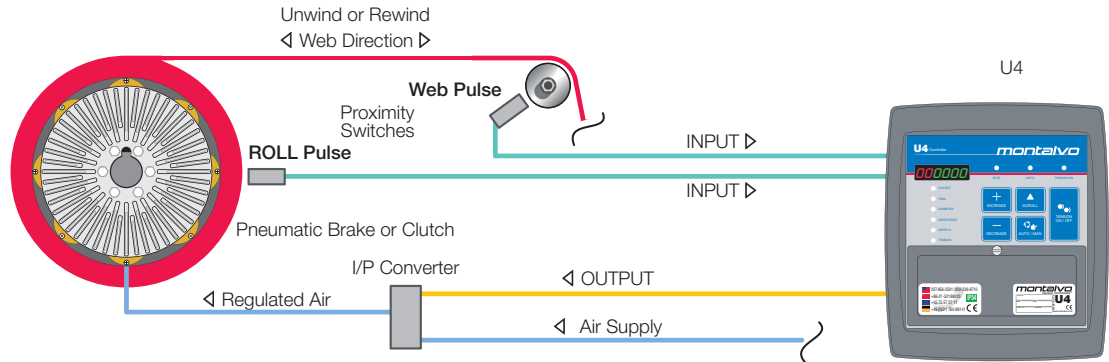
The following 5 parameters only need to be set if large rolls are being accelerated or decelerated very quickly. By connecting a dry contact between terminals 11 and 12 that opens when the machine is started and closes when the machine starts to decelerate and remains closed until the machine is restarted, the controller can be programmed to prevent the roll from coasting as well as providing a soft start function.

Display	Parameter	Description
	Anticoast %	Percent the output will instantly increase when the contact closes.
	Stop Time	Typically set to how long it takes for the machine to stop once the stop button is pushed. Output will ramp to Hold value.
	Hold %	Percent of increase or decrease of running output that will be maintained while the machine is stopped.
	Start Reduction	Percent of decrease in running output when the contact opens.
	Start Time	Ramp time from start reduction to running output.

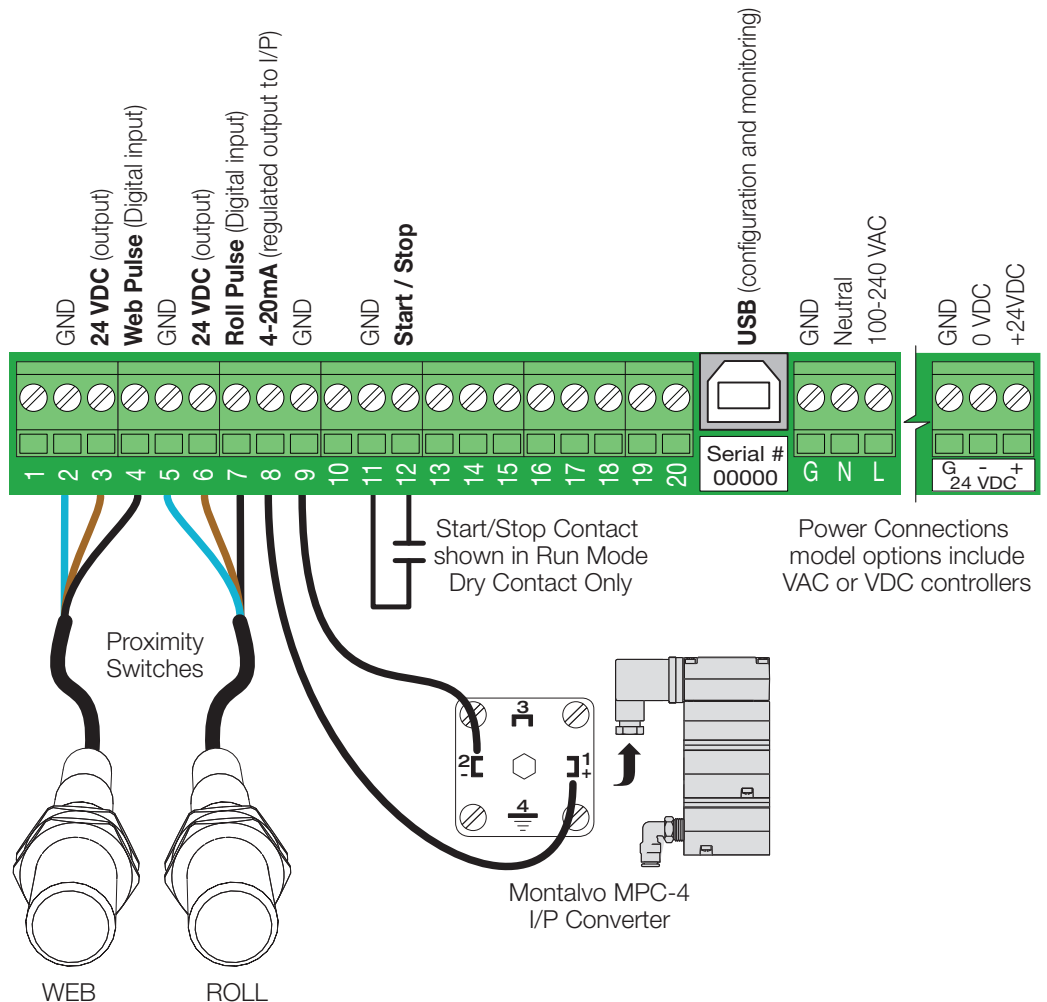
Press and hold the  key for 2 seconds to exit the Set-up mode, ready to run the machine.

## 4.1 Mounting

- 1 All Proximity switches must be PNP type.
- 2 Prox switch for Roll Pulse must pulse 1 to 4 times per revolution.
- 3 Prox switch for Web Pulse must be mounted on a roller that is rotating at Line Speed. The recommended web length per pulse is between 10 and 250 mm/pulse (0.5 to 10 inches). The shorter the distance between web pulses, the higher the resolution/accuracy of the calculation.









## 4.2 Wiring










## 4.3 Set-up


### Basic







The following parameters can only be entered or modified if the SETUP ENABLE switch is in the correct position. Insure that both the AUTO LED and TENSION LED are illuminated. If the Tension LED is not illuminated, press the  key. If the Auto LED is not illuminated, press the  key.

The Set-up mode is activated by pressing the   keys together for 2 seconds. If the SETUP ENABLE switch is in the DISABLE position or the AUTO LED and TENSION LED are not illuminated, pressing the   keys together for 2 seconds will have no effect. When the Set-up mode is activated you will see this: The Red digit indicates the parameter number and the green digits indicate the value of the parameter.

Display	Description
	Use the  /  keys to set this value to the maximum full roll diameter. Press the  key when done.
	Use the  /  keys to set this value to the to the minimum core diameter.

### Diameter Alarms

It is possible to enter two different diameter values. When these diameters are reached, 24 VDC will be applied to a particular terminal on the U4 board. This 24 VDC can be used to activate a 24 VDC relay that can be wired to a light or a bell or buzzer to alert the operator. This output can also be wired into a PLC or Drive to slow down and/or stop the machine at selected diameters. If this feature will not be used, simply us the  key to scroll to parameter number 5.






Display	Description
	Use the  /  keys to set this value to the diameter value that will apply 24 VDC to terminal 18.
	Use the  /  keys to set this value to the diameter value that will apply 24 VDC to terminal 20.

## 4.3 Set-up - continued




### Stop / Hold / Start

The following 5 parameters only need to be set if *large* rolls are being *accelerated* or *decelerated* very quickly.

By connecting a dry contact between terminals 11 and 12 that opens when the machine is started and closes when the machine starts to decelerate and remains closed until the machine is restarted, the controller can be programmed to prevent the roll from coasting as well as providing a soft start function. See **Section 6.5** for more information.

Display	Parameter	Description
	Anticoast %	Percent the output will instantly increase when the contact closes.
	Stop Time	Typically set to how long it takes for the machine to stop once the stop button is pushed. Output will ramp to Hold Value.
	Hold %	Percent of increase or decrease of running output that will be maintained while the machine is stopped.
	Start Reduction	Percent of decrease in running output when the contact opens.
	Start Time	Ramp time from start reduction to running output.

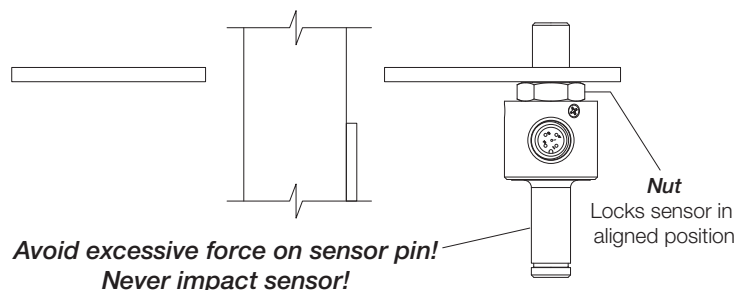
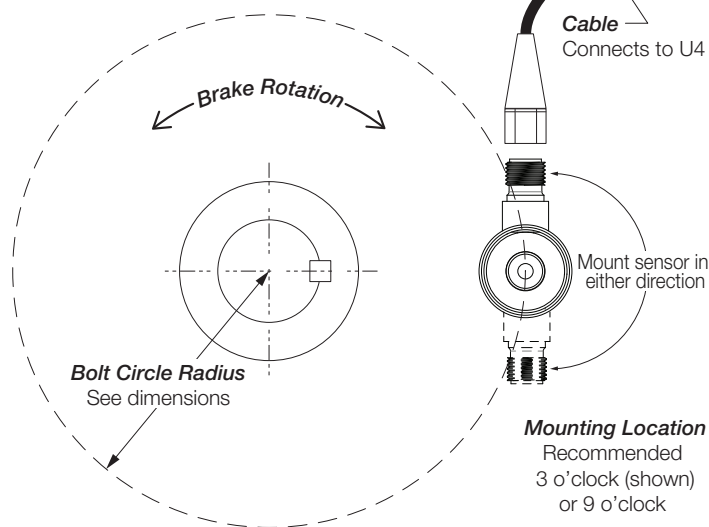
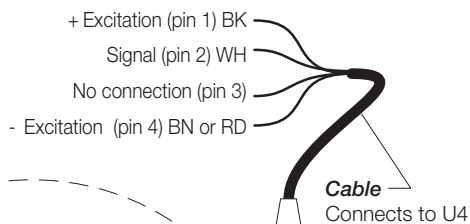
### Proximity Switch Parameters

Display	Parameter	Description
	mm/pulse or inches/pulse	Distance web travels per pulse. Depends on setting of DIP switch #2.
	Pulses per Revolution	Pulses per revolution of unwind or rewind roll.
	New Roll Diameter	Diameter that U4 will default to when tension is turned off, then on.

## 5.1 Mounting

If signal displays negative, do one of the following:

- 1- Reverse Excitation at U4 on terminals 13 and 15 or
- 2- Rotate TS 180°



### Existing brake installation

- 1A Remove brake
- 1B Remove all Anti-Rotations studs

### New brake installation

- 1C Locate, drill and tap hole for **ONE** sensor

### All installations

- 2 Mount sensor and attach sensor cable
- 3 Install/reinstall brake (see brake installation instructions)

**Make sure retaining ring is installed on TS**

- 4 Calibrate sensor

### Sensor

- **Must be mounted so that connector points directly towards or away from direction of rotation (perpendicular to shaft).**
- Can be located anywhere on bolt circle.  
*Note: It is highly recommended to located as shown in the 3 (or 9) o'clock position to enable accurate and simple calibration.*

### Align and Lock

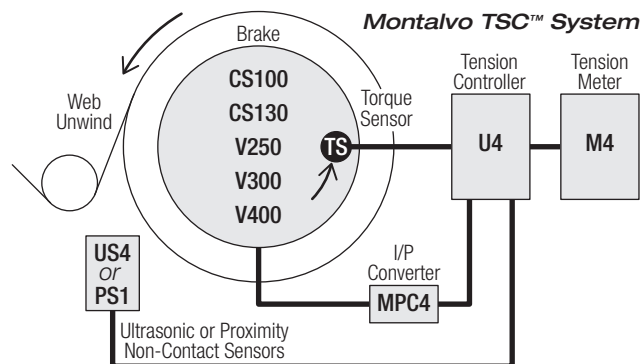
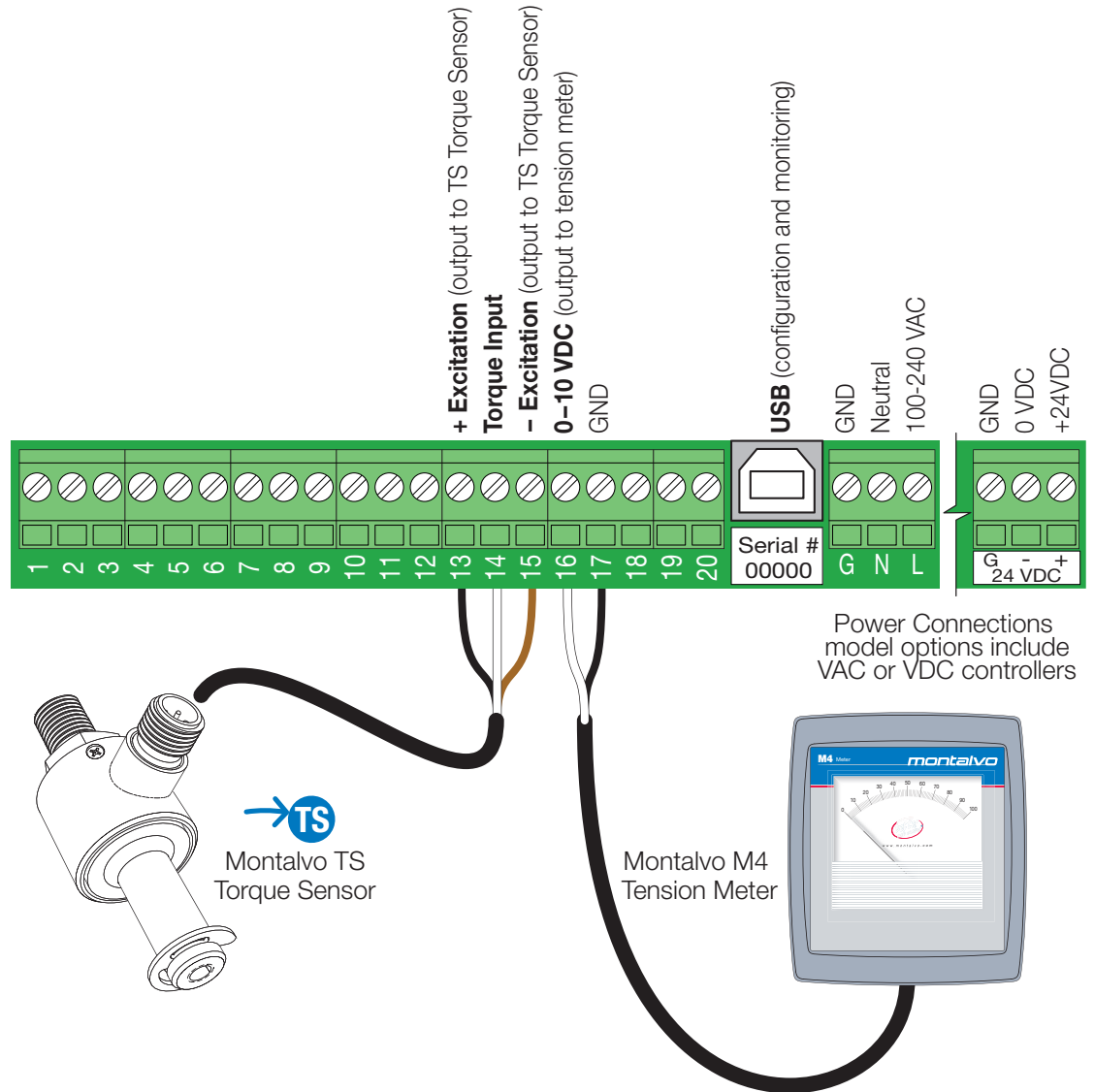
- Hand tighten nut against sensor body
- Screw sensor into tapped hole in mounting surface until nut just touches
- Loosen sensor just enough to obtain proper alignment
- Tighten nut against mounting surface to lock sensor in position

Brake Model	Bolt Circle Radius in (mm)	TS Model	TS Sensor Hole Tap Size* in (mm)	Anti-Rotation Stud Hole Tap Size in (mm)
CS100	3.0 (76)	TS1	1/2-13 or M12x1.75	1/2-13 or M12x1.75
CS130	3.25 (83)	TS1	1/2-13 or M12x1.75	1/2-13 or M12x1.75
V250	3.75 (95)	TS1	1/2-13 or M12x1.75	1/2-13 or M12x1.75
V300	5.31 (135)	TS1	1/2-13 or M12x1.75	1/2-13 or M12x1.75
<b>**V400</b>	6.38 (162)	<b>TS2</b>	<b>**3/4-10 or M20x2.5</b>	<b>**1/2-13 or M12x1.75</b>

\* The TS Torque Sensor is available in either inch or metric thread - **verify thread size if replacing an existing Anti-Rotation Stud.**













\*\* Standard V400 Anti-Rotation Studs are 1/2-13 (M12x1.75 option). Some non-standard installations may use a single 3/4-10 (M20x2.5 option) stud. An existing mounting hole (or a new hole) may need to be drilled and tapped at 3/4-10 or M20x2.5 to accept the TS2. **Check thread size carefully!**



## 5.2 Wiring


















## 5.3 Calibration When Using an Ultrasonic Sensor

- 1 Check that the torque sensor is mounted and oriented properly (see mounting instructions). Be sure that the DIP switch **SW 5** is enabled, and that DIP switch **SW1** is set to ultrasonic. The ultrasonic sensor must also be installed and calibrated prior to calibration of the torque sensor with this method. If Proximity sensors are used instead, refer to the calibration procedure for that style.
- 2 Before applying power to the controller, check that analog tension meter, if used, is set to zero. If using Montalvo M4 tension meter, mechanically adjust needle with screw at base of meter scale as needed. If no analog meter is being used, you will simply be calibrating the 0-10VDC tension output on terminal **16**.
- 3 Apply power to the controller and let it warm up for **at least 10 minutes**.
- 4 Enter setup mode by holding   keys together for 2 seconds (both Tension and Auto lights need to be illuminated to enter setup), and  to **13**.
- 5 With roll removed and no torque applied to the sensor, use a voltmeter to measure the value  /  between terminal **14** and **19** use  /  keys to **13** to match volt meter value. Hold  to exit menu.  to tension and verify that display reads **close to 0**.
- 6 Install a shaft with a roll of material onto the machine. It is permissible to use any diameter from an empty core up to a full roll. It is recommended to use a small to medium roll to simplify later steps of the procedure.
- 7 Set brake air pressure to 75 psi / 100%. The simplest way to do this is to bypass the I/P converter and put 75 psi of regulated air straight to the brake. **Note:** Prior to this step the brake must be fully installed and secured, airlines must be connected. At this point the brake should be engaged and movement of the roll of material restricted.
- 8 Wrap a rope or flat strap around the unwind roll. Rope can be tied to itself after the first wrap and then wrapped at least 2-3 full turns to provide a fixed support. Then thread the remainder of the strap around the first roller, or if there is sufficient room, it can be left hanging down provided it will not touch the ground with a weight applied. **Note:** Verify that the tension direction on the strap mimics the torque direction transmitted through the roll during normal operation.
- 9 Attach a weight of known value to the free end of the rope. For best results, the weight should be at least 25% of the TS torque sensor's full-scale value.
- 10 Enter setup mode by holding   keys together for 2 seconds and  to 15. Determine the scale you will use for tension (100% by default). Change the value to reflect this and record it for later use.
- 11 To determine the value of **14**, first compute the value of the following formula:  




$$\text{Voltage } \mathbf{14} = 10 * (\text{weight hung} / \text{meter scale value } \mathbf{15})$$
- 12 Scroll around to **14**. Place the voltmeter across terminals 16 and 17. Use the  /  keys to make the voltmeter reading match the value computed in step.
- 13 Remove weight and check that tension display returns to zero. If not, repeat steps 4 to 7. Otherwise enable the I/P converter. You have successfully calibrated the torque sensor.

## 5.4 Calibration When Using Proximity Switches

- 1 Check that the torque sensor is mounted and oriented properly (see mounting instructions). Be sure that the DIP switch **SW5** is **enabled**, and that DIP switch **SW1** is set to **proximity sensor**. The proximity sensor must also be installed and settings configured prior to calibration of the torque sensor with this method. If an ultrasonic sensor is used instead, refer to the calibration procedure for that style.
- 2 Before applying power to the controller, check that analog tension meter, if used, is set to zero. If using Montalvo M4 tension meter, mechanically adjust needle with screw at base of meter scale as needed. If no analog meter is being used, you will simply be calibrating the 0-10VDC tension output on terminal **16**.
- 3 Apply power to the controller and let it warm up for **at least 10 minutes**.
- 4 Enter setup mode by holding   keys together for 2 seconds (both tension and Auto lights need to be illuminated to enter setup) and  to **13**.
- 5 With roll removed and no torque applied to the sensor, use a voltmeter to measure the value between terminal **14** and **19** use  /  keys to **13** to match volt meter value. Hold  to exit menu.  to tension and verify that display reads **close to 0**.
- 6 Determine what size roll of material will be used for calibration. Measure the diameter of the roll.  to **12** in the setup mode and input this diameter.
- 7 Install a shaft with the selected roll of material. It is permissible to use any diameter from an empty core up to a full roll. It is recommended to use a small to medium roll to simplify later steps of the procedure.
- 8 Set brake air pressure to 75 psi / 100%. The simplest way to do this is to bypass the I/P converter and put 75 psi of regulated air straight to the brake. **Note:** Prior to this step the brake must be fully installed and secured, airlines must be connected. At this point the brake should be engaged and movement of the roll of material restricted.
- 9 Wrap a rope or flat strap around the unwind roll. Rope can be tied to itself after the first wrap and then wrapped at least 2-3 full turns to provide a fixed support. Then thread the remainder of the strap around the first roller, or if there is sufficient room, it can be left hanging down provided it will not touch the ground with a weight applied. **Note:** Verify that the tension direction on the strap mimics the torque direction transmitted through the roll during normal operation.
- 10 Attach a weight of known value to the free end of the rope. For best results, the weight should be at least 25% of the TS torque sensor's full-scale value.
- 11 Enter setup mode by holding   keys together for 2 seconds and  to **15**. Determine the scale you will use for tension (100% by default). Change the value to reflect this and record it for later use.
- 12 To determine the value of **14**, first compute the value of the following formula:  

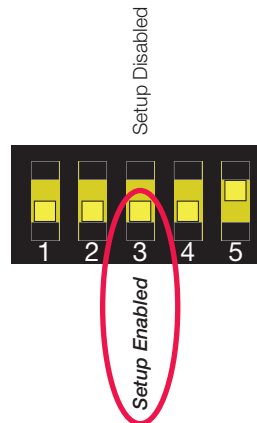
$$\text{Voltage (14)} = 10 * (\text{weight hung} / \text{meter scale value (15)})$$
- 13 Scroll around to **14**. Place the voltmeter across terminals **16** and **17**. Use the  /  keys to make the voltmeter reading match the value computed in step 12.
- 14 Remove weight and check that tension display returns to zero. If not, repeat steps 4 to 7. Otherwise enable the I/P converter. You have successfully calibrated the torque sensor.

## 5.5 Set-up








Display	Description
	mm/pulse or inches/pulse depending on setting of dipswitch #2.
	Pulses per Revolution of Unwind or Rewind Roll.
	New Roll Diameter. Diameter that U4 will default to when tension is turned off, then on.

## 6.1 Advanced Parameters


ADVANCED PARAMETERS can only be entered or modified if the SETUP ENABLE switch is in the ON position. Make sure the DIP switch is in the proper position for programming.



Turn Tension ON, and put the controller in Automatic Mode (AUTO LED and TENSION LED should be illuminated).

- The Parameter Programming mode is activated by pressing the  /  keys together for 2 seconds.
- If the SETUP ENABLE switch is in the DISABLE position or the AUTO LED and TENSION LED is not illuminated, pressing the  /  keys together for 2 seconds will have no effect.
- When this mode is activated, the Program ID (RED LEDS) will display 1, which corresponds to the MAX DIA parameter.
- Press the  or  keys to change the value. When the  key is pressed again, the Program ID increments to 2, indicating the setup for the MIN DIA. Continue down until all of the appropriate parameters have been set.

After the last Program ID, you will see S1. Continuing to  will display S2-S9 then it loops back to ID = 1. See section **6.2 Saving Different Set-ups** before proceeding.

*At any time, pressing the  key for 2 seconds will exit this mode and save the parameters displayed.*

## 6.1 Advanced Parameters - continued







Prog ID	Parameter	Range	Description
1	MAX_DIA (default = 40")	0.0-100.0" 0-2500mm	Maximum full-roll diameter.
2	MIN_DIA (default = 6")	0.0-100.0" 0-2500mm	Outside core diameter, empty roll.
3	ALARM1_DIA (default = 0")	0.0-100.0" 0-2500mm	Activate ALARM1 when roll diameter is less than entered value. Hysteresis =1% MAX_DIA.
4	ALARM2_DIA (default = 0")	0.0-100.0" 0-2500mm	Activate ALARM2 when roll diameter is less than entered value. Hysteresis =1% MAX_DIA.
5	ANTICOAST% (default = 100%)	0-500	% increase in Output when stopping (% of the value when start/stop contact closes).
6	STOP_TIME (default = 10 sec)	0-60 sec	Gradual decrease time from anti-coast increase value to HOLD value.
7	HOLD% (default = +10%)	+/- (0-100)	Increase (or decrease) in output level after machine stops (% of the value when start/start contact closes).
8	START_REDUCTION% (default = 10%)	0-100	% decrease in output when starting the machine. Reduces/eliminates tension spike at start.
9	START_TIME (default = 2 sec)	0-25 sec	Time of gradual increase to operating output level from Start Reduction level.
10	mm/pulse (default = 10mm or eq.)	1-250mm 0.20-10.00"	Proximity Switch Mode only- Distance between web pulses. Not shown if Ultrasonic Selected.
11	Pulse/rev (default = 2)	1-10	Proximity Switch mode only-Number of pulses per revolution of unwind (or rewind) roll. Not shown if Ultrasonic selected.
12	NEW_ROLL_DIA (default = 30")	0.0-100.0" 0-2500mm	For Proximity Switch Mode only, Starting roll diameter before calculation. Not shown if Ultrasonic Selected.
13	TORQUE_ZERO (default = 2.500)	2.250 – 2.750V	Zero torque reading with 5V excitation. Only if torque sensor selected.
14	TORQUE_GAIN (default = 100)	0-9999 ft-lb /100mV	Factory-calibrated gain with 5V excitation. Only if torque sensor selected.
15	TENSION_FS (def=100)	0-9999 lb 0-xxxKg	FS tension corresponding to 10V out Calculated Tension = torque / radius. Only if torque sensor selected.

## 6.2 Saving Different Set-ups

The U4 has the ability to store and recall up to nine different set-ups. These are referenced as S1 to S9. These must be saved during set-up while in the Advanced Parameter mode or by using the PC program. This can be a very useful feature when running wide array of materials on one machine. Since these set-ups can only be saved as S1 to S9, it is advisable to complete the chart provided in the back of this manual, defining the material that corresponds to the Set-up number, and post this close to the U4 for the operator's reference.



### ***Saving Procedure***

Once you have programmed the last applicable Advanced Parameter, you have two options:

- 1 You can press the  key for two seconds, which will exit the Advanced Parameter mode and save all your settings. This is advisable for applications where there is little variation in the materials that you run.
- 2 You can press the  key normally and S1 will be displayed. If you press the  key, all the parameters that that you entered will be saved under set-up S1. To save additional set-ups, continue to press the  key. When you get back to Prog ID 1, scroll down to the parameters that you want to be different than S1 and change them. Continue scrolling to the next set-up number, S2, and press the  key. When you are finished with all the set-ups that you want, hold the  key down for two seconds to exit the advanced parameter mode.

### ***Recall Procedure***

If any Set-ups have been saved, the operator needs to be able to select the appropriate set-up. Since the time to do this is when a roll is changed, and the tension is usually turned off when you change a roll, when tension is turned off the display will read whatever set-up that is active.

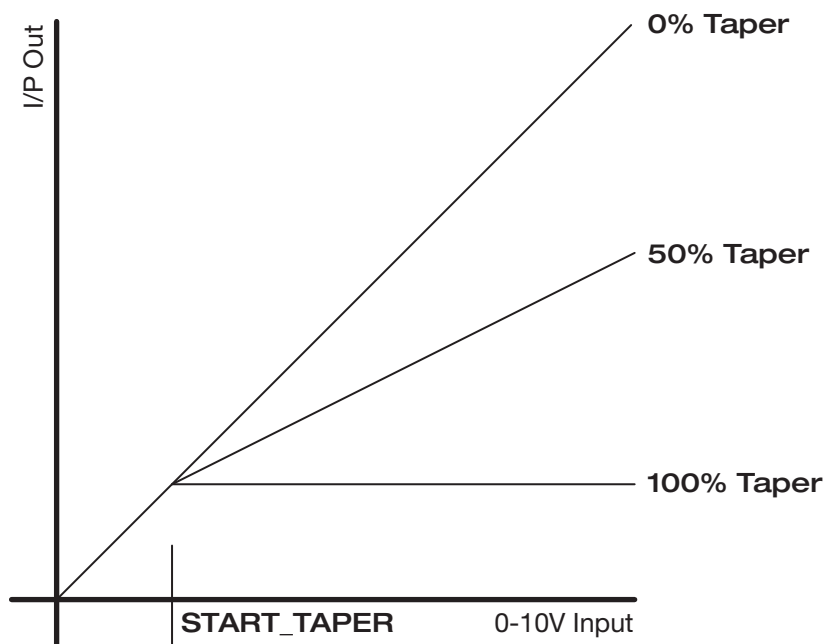
- 1 The operator can then  until the desired set-up number is displayed.
- 2 Pressing the  key will load the saved parameters and make this set-up active.

## 6.3 Ultrasonic Mode

The Ultrasonic Sensor is calibrated separately, without the involvement of the U4 Controller. If utilizing Montalvo US-1 Ultrasonic Sensor, please reference the US-1 manual for installation and calibration procedures. For all other sensors, consult owner's manual for proper installation and calibration.

It is important that with the smallest core in place, the output voltage is 0V and at the maximum roll diameter the output voltage is 10V. During setup, enter the OUTSIDE core diameter, and the MAXIMUM full roll diameter as MIN\_DIA and MAX\_DIA. Once these two Advanced Parameters are entered, the ultrasonic sensor's output voltage will automatically be converted to the correct diameter using linear interpolation.

- To generate the controller output, the ultrasonic sensor voltage is modified by two parameters: TRIM% and TAPER%. Please note that the TAPER function is only active in the Rewind Mode.
- The TRIM% can range from -100 to +100. When TRIM%=100, output = FS @MAX\_DIA; when TRIM%=0, output = ½ FS @MAX\_DIA; when TRIM%=-100, output = 0.
- Tapered Tension is controlled by 2 parameters: TAPER% and START\_TAPER. The Taper function is graphically shown below.
- The Taper function and the Trim function exists at the same time.



## 6.4 Proximity Switch Mode

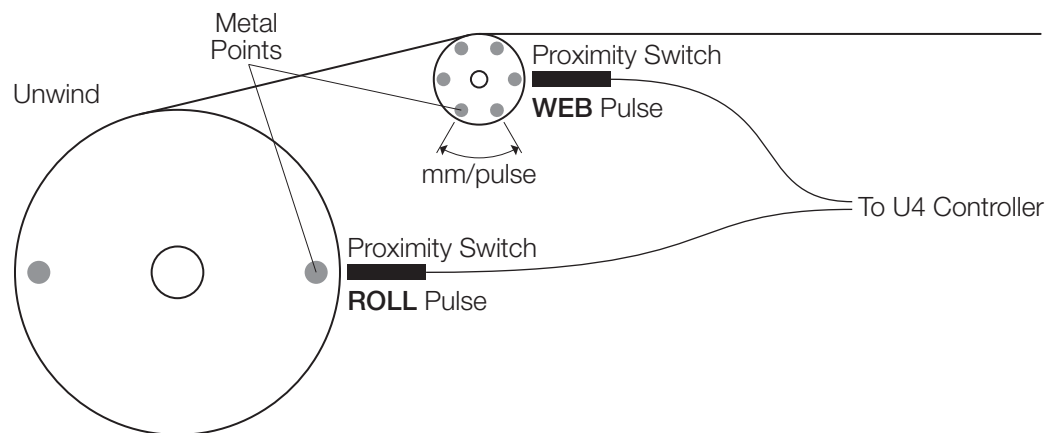
The roll diameter is calculated during machine run from the signal from 2 proximity switches; one that senses unwind (or rewind) roll revolutions, and another that senses web speed. At the start-up after roll change, the diameter of the new roll is calculated after the controller has received 2 pulses from the new roll. Prior to that, the output will default to the MAX OD level, adjusted by the current TRIM level. Once the accurate diameter calculation has been made, the output will automatically adjust to the appropriate calculated level.

### **Roll Pulse (Terminal 7)**

- A proximity switch that pulses 1 to 4 times per revolution during rotation of the roll is mounted on the unwind stand.
- The best way is to mount it at a place where you can sense a keyway, a screw, or a bored hole in the shaft; other possible sensing locations are the safety chucks, core chucks, or the brake.
- *The maximum input frequency must not exceed 80Hz.*

### **Web Pulse (Terminal 4)**

- A proximity switch is mounted to sense the web length/pulse. This is typically on a driven roll or an idler roll that turns with the line speed.
- It is not recommended that the sensor be on a roll that is geared, unless it is 1:1 with line speed.
- The recommended web length/pulse is between 10 and 250 mm/pulse. For better resolution, use a short distance between the pulses.
- *The maximum input frequency must not exceed 15KHz.*

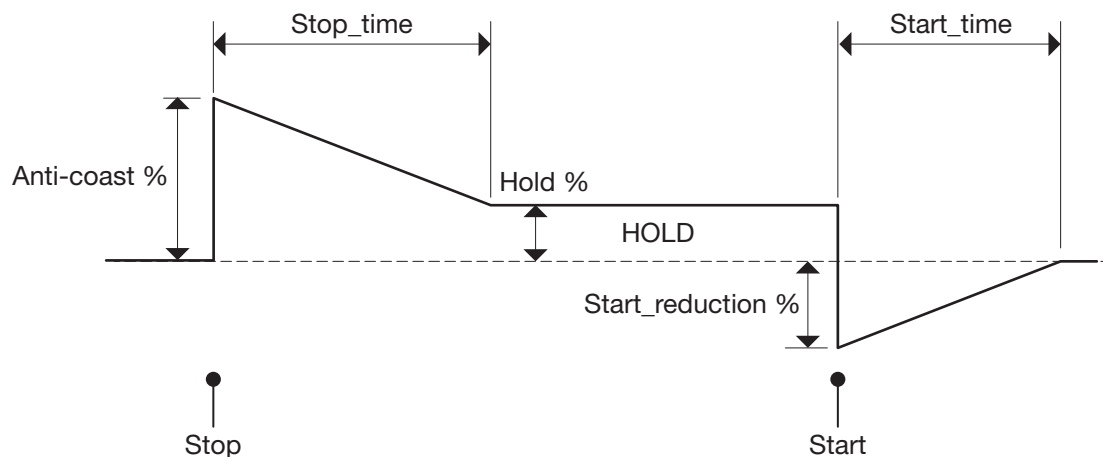


## 6.5 Start and Stop Operation

In order to implement the soft start feature, you will need to supply the U4 with a dry, voltage free, external start/stop contact which is isolated from ground and opens when the line is started and closes when the line is stopped. If the anti-coast feature, which uses the same contact, is to be implemented the contact must close as soon as the line begins to decelerate prior to stopping. If anti-coast is not required, the contact can close either when the line stops (zero speed), or a fixed time interval after the line stops. The contact should not open when the line is being jogged.

The outputs (0-10V and 4/20mA) will be modified as shown below. The various parameters are previously described in the Advanced Parameter section.

- 1 When the contact closes (meaning the machine is stopping) the output will instantly increase by the ANTI-COAST%. The percentage is based on the value just prior to stopping. For example, if the output was at 50% (0-10V was at 5V) and the \ ANTI-COAST% was 10, the voltage should increase to 5.5V. The Stop LED will turn RED.
- 2 The output then ramps down to the HOLD% value in STOP\_TIME. The percentage is based on the value just prior to stopping. While this value is usually positive, it can be a negative value, based on your particular application. When in the Hold mode, the Stop LED will be Yellow.
- 3 When starting, the output will decrease according to the START\_REDUCTION% parameter. The percentage of reduction is based on the value just prior to stopping and not the HOLD value. The Yellow Stop LED will blink.
- 4 The output will then ramp up to the calculated operating value in START\_TIME. Once the START\_TIME expires, the Stop LED will go out.
- 5 During STOP\_TIME, if the contact opens, the output will ramp to the normal calculated value in 3 seconds.
- 6 During START\_TIME, if the contact closes, a new stop sequence will be initiated (Anti-coast increase, etc. based on calculated diameter, not the output at that instance).
- 7 If START/STOP contact is closed when power is turned on, as soon as TENSION is turned on, the output should ramp to HOLD value in 3 sec. If the contact is open, the output should ramp to the calculated value in 3 seconds after TENSION is turned on.





## 6.7 Saved Parameters Log

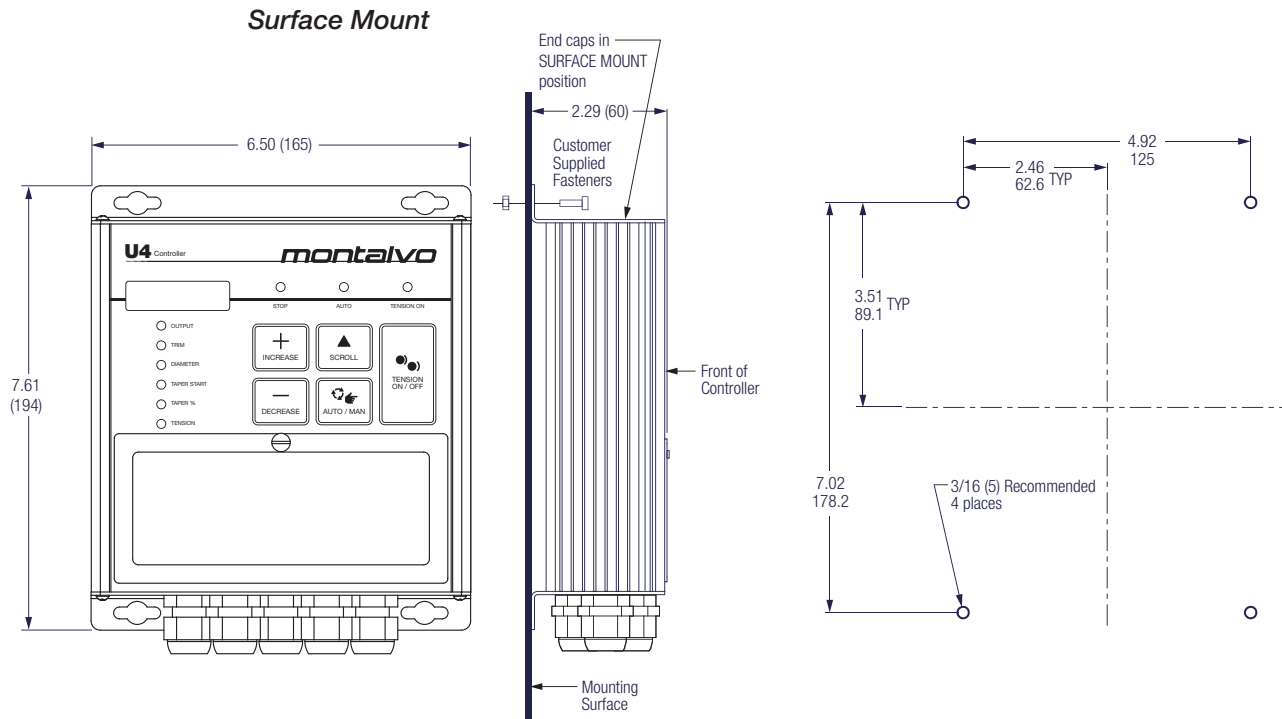
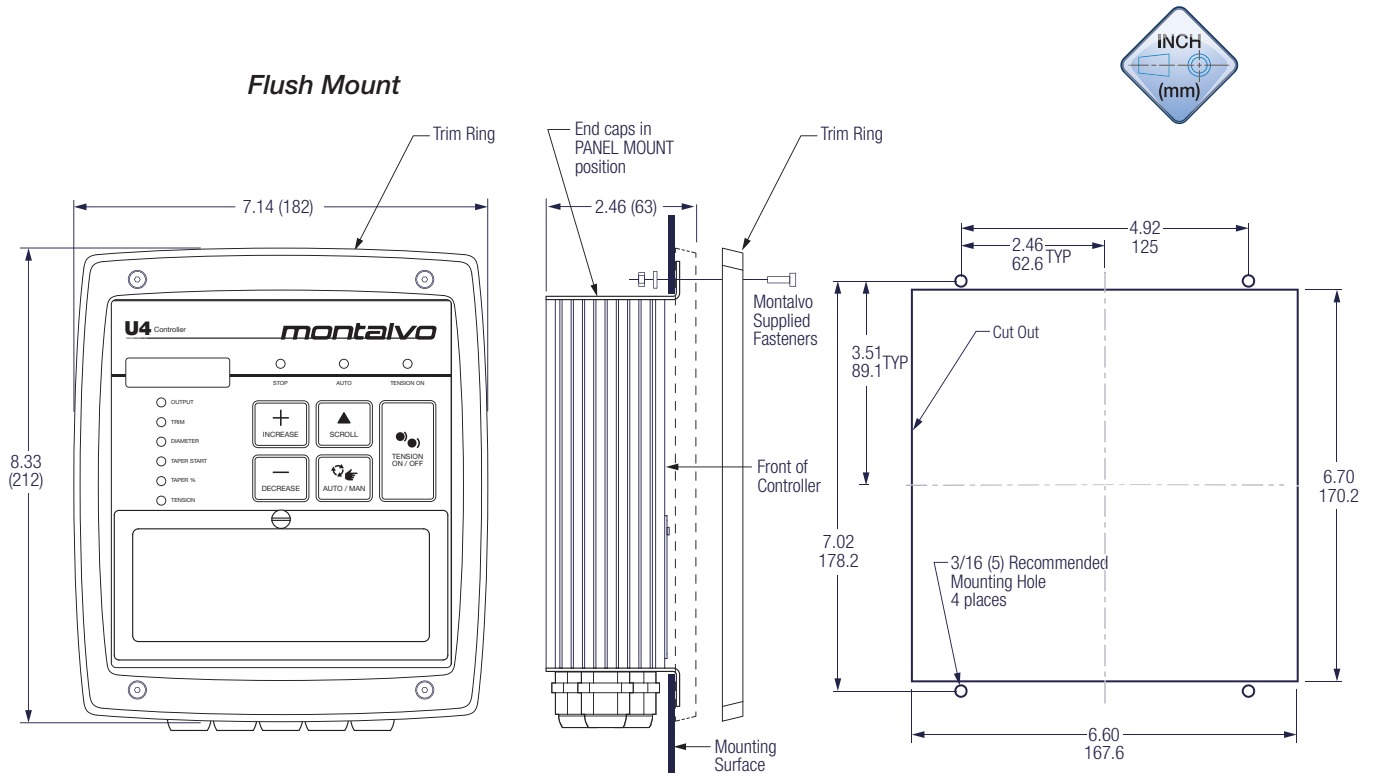
### Material Settings

Prog #	Parameter	S1	S2	S3	S4	S5	S6	S7	S8	S9
1	MAX DIA									
2	MIN DIA									
3	ALARM1_DIA									
4	ALARM2_DIA									
5	ANTICOAST%									
6	STOP_TIME									
7	HOLD%									
8	START_REDUCTION%									
9	START_TIME									
10	mm/pulse									
11	Pulse/rev									
12	NEW_ROLL_DIA									
13	TORQUE_ZERO									
14	TORQUE_GAIN									
15	TENSION_FS									

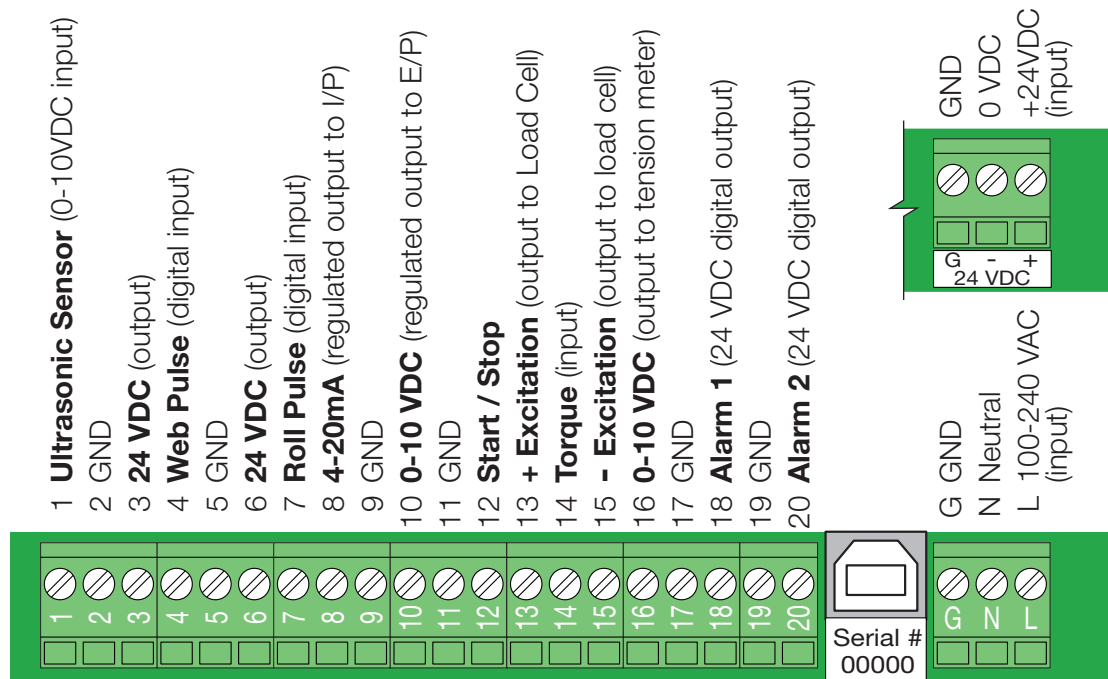
### Material Type

Material	Description
S1	
S2	
S3	
S4	
S5	
S6	
S7	
S8	
S9	







## 6.8 Controller Mounting



## 6.9 Controller Wiring



## 6.10 Quick Start

- 1 Press the  key until the Trim LED illuminates.
- 2 Press the  and  keys until both the Tension and the Auto LEDs are illuminated.
- 3 Start the machine and feel the web. If the web is too loose, press the  key until the desired Tension on the web is reached. If the web is too tight, press the  key.
- 4 Note the number in the display. This is the amount of Trim that is needed whenever you run this particular material.
- 5 If you now  until the Output LED illuminates you will see this value decrease proportionally with the changing diameter of the roll.

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