Danaher MOTION
Engineered Systems Center

OWNER'S INSTALLATION AND OPERATING MANUAL

SV3000 AC FLUX VECTOR

Application Software

CTCW (Constant Tension Centerwind)
FOR SV3000
Firmware Version : 804-376.034

Detailed changes to software programs are introduced frequently. Please ensure this manual refers to the software version you are using.

Danaher MOTION
ENGINEERED SYSTEMS CENTER
13500-J SOUTHPOINT BLVD. , CHARLOTTE,N.C. 28273
PHONE: (704)-588-5693; FAX: (704)-588-5695

For your safety and for proper operation, please take time to carefully read all instructions before installing and operating this unit.

LIM #SV3992-4 2/2000

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I. Introduction To Constant Tension Centerwind (CTCW)

Prequalifications:

The SV3000 CTCW was designed for and performs well on applications which meet the following criteria:

- Line speeds less than 2000 ft/min
- Build-up Ratios less than 10:1
- Tension range (w/combined build-up) less than 20:1
- Tension resolution 1-3% (machine dependent)
- Overall gear reduction less than 20:1 with 85% or greater efficiency
- Line speed acceleration or deceleration greater than 15 seconds (0-max speed).
- Reflected inertia at motor shaft not greater than 15 times the motor rotor inertia.
- Minimum tension requirement 10% greater than frictional torque requirement (machine dependent)

Applications that do not fall into the above ranges may still be possible and should be reviewed by Danaher Motion Engineered Systems Center.

A. Theory:

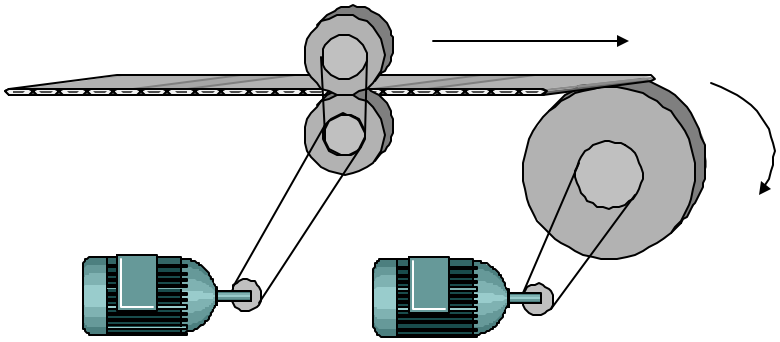
Constant Tension Center-Wind is **a winding method where the tension in the web is maintained at a fixed value from empty core to a full roll (or in the case of unwinding from full roll to empty core).** If the line speed signal is held constant, the winding horsepower is also constant. The torque required to turn the winder roll at the center shaft must increase as the size of the package increases to maintain the constant tension. In other words, as the roll radius (r) increases due to build-up, the required winder torque must increase as well. The speed of rotation at the center of the roll (the shaft) must decrease as the roll radius increases to keep the surface speed constant from core to full roll. Winding a package with constant tension involves:

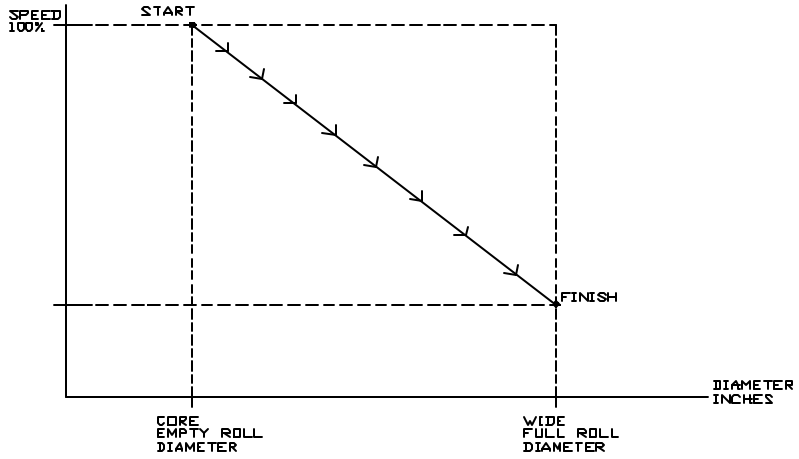
- Compensating for diameter as the roll grows (rewind) or pays off (unwind)
- Compensating for roll inertia when accelerating or decelerating
- Providing Constant HP

Some methods of winding (or unwinding) use sensors such as loadcells or dancers as a feedback device for tension. CTCW for the SV3000 can provide constant tension regulation **without** the use of a tension feedback device.

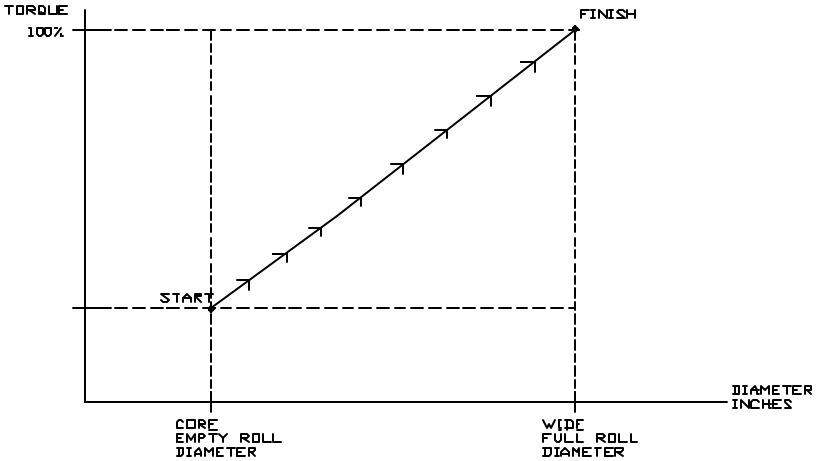
The relationships of speed, torque, and roll diameter are shown below:

WIND PROCESS



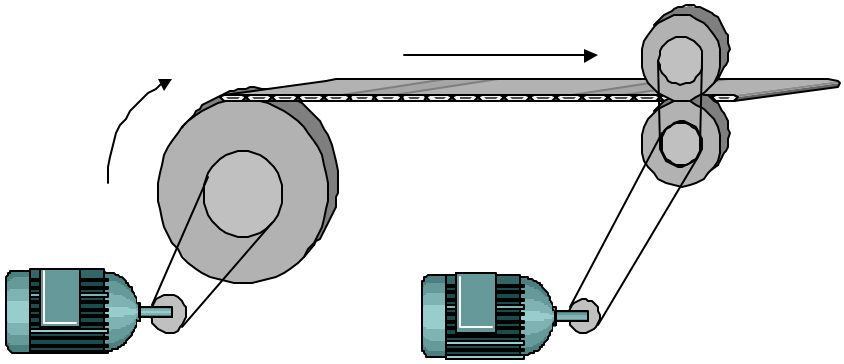


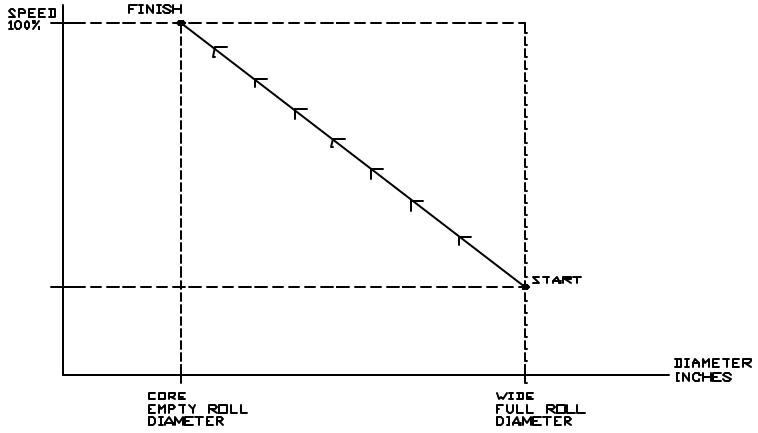
SPEED VS. DIAMETER



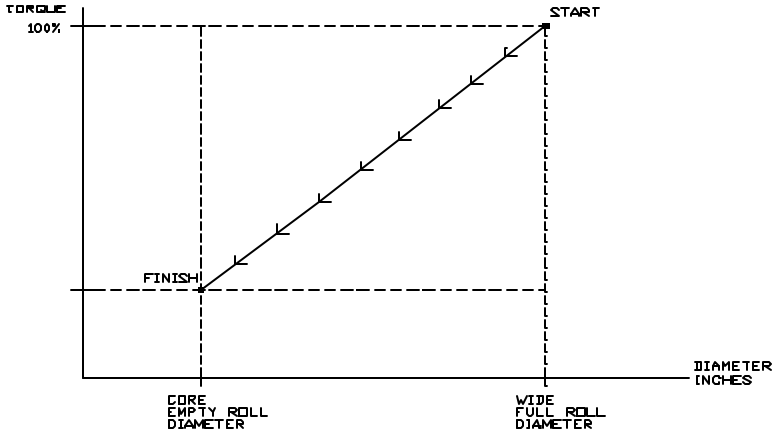
TORQUE VS. DIAMETER

UNWIND PROCESS





SPEED VS. DIAMETER



TORQUE VS. DIAMETER

Note the following relationships:
Unwind T↓ RPM↑ HP = Constant
Wind T↑RPM ↓ HP = Constant
HP = TxRPM/5252

To set a linear relationship from core to full roll, parameters are provided to set the starting (initial) diameter and the maximum diameter.
In normal CTCW operation, the drive operates in Torque With Speed Over-ride mode. In this mode, a tension reference (i.e. tension pot) sets the amount of tension required. There are two modes of tension control:

- Open loop tension control
- Closed-loop

The mode of operation is automatically selected based on the following criteria:

The mode of operation is "OPEN LOOP" if **ANY** of the following are **FALSE**:

1. Line Speed is above the MIN SPD (P101) in FPM.
2. Line Speed is above (P401/50) where P401 = Max. Line Speed (FPM).
3. Line Speed is above 10 FPM.
4. The winder drive is NOT in Speed Override (P534 Mode = Speed or Torq).

The mode of operation is "CLOSED LOOP" if **ALL** of the following are **TRUE**:

1. Line Speed is above the MIN SPD (P101) in FPM.
2. Line Speed is above (P401/50) where P401 = Max. Line Speed (FPM).
3. Line Speed is above 10 FPM.
4. The winder drive is NOT in Speed Override (P534 Mode = Speed or Torq).

Please refer to the MODES OF OPERATION flowchart for graphical details.

B. Important Concepts and Definitions

1. Open-Loop

In Open-Loop tension control the tension reference is divided by the build-up-ratio and then multiplied by the current diameter. In this way, as the diameter grows the amount of tension demanded increases (rewind). Unwind works conversely in relationship.

2. Closed-Loop

In Closed-Loop tension control the tension reference is still used to set tension. However, the CTCW operates as a closed-loop (constant) HP regulator in this mode of operation.

3. **Speed Mode**

P200 (Run Mode)= Speed sets the drive to regulate speed (as in a standard drive). In this mode of operation P000 sets the speed setpoint. Note that this is useful during commission of the drive or for troubleshooting purposes. Essentially, this mode of operation turns the CTCW off.

4. **Torque With Speed Override**

In normal operation of the CTCW software the drive receives an analog signal (0-10VDC) for line speed and an analog signal (0-10VDC) Tension Ref./Pot to control the tension setpoint. When the drive senses the load the drive operates in torque mode. If the drive becomes unloaded (as in a web breaks) the drive switches to speed mode and the winder roll continues to run at the current line speed (as determined by the analog Line Speed signal). P534 (a read-only) displays the current mode of operation (torque mode or speed override).

5. **Inertia**

Inertia is a measure of a body's resistance to changes in velocity.
The resistance can act upon the body whether the body is in motion or at rest.
The velocity can be rotational or linear.

6. **Moment Of Inertia**

The moment of inertia is the product of the weight (W) of an object and the square of the radius of gyration (K^2).
The radius of gyration for a solid rotating body is as follows:

$$k^2 = \frac{r^2}{2}$$

The radius of gyration for a hollow rotating body is as follows:

$$k^2 = \frac{r_1^2 + r_2^2}{2}$$

Where r = radius
R1= inside diameter
R2 = outside diameter

The System Gain when measured/calculated by the tune test simply measures the inertia of the given load at the time of tuning. This will be important when setting up the inertia compensation.

7. **Inertia Compensation**

The System Gain Calculation during the tune test measures Inertia and calculates a gain for compensation based on the load at the time of the tune test. The System Gain Empty measures Inertia Comp for an empty beam (smallest core).

The System Gain Narrow measures Inertia Comp for a narrow beam (full roll). This is normally considered a "light" set.
The System Gain Wide measures Inertia Comp for a wide beam (full roll). This is normally considered a "heavy" set.

8. **Adaptive Gain Control**
The inertia compensation calculation uses adaptive gain control based on the changing inertia compensation requirements from empty roll diameter to the full roll (narrow or wide) diameter using the system gains mentioned above under **Inertia Compensation.** This is important for applications where the weight and diameter of the roll changes dramatically in a short period of time (where line speeds are extremely fast and the material builds onto the roll at a rapid rate).

9. **Line Speed**:
The line speed is the rate at which the processed web moves through the machine. The preferred units are FPM (feet per minute). Usually the line speed is adjustable from 0 to Max. Line Speed but is held constant at some % of Max. Line Speed for good production (note this implies non-incremental motion applications !).

10. **Roll Speed**
Roll speed is the rate of rotation when winding the web at a given line speed. Winders are usually designed so that at maximum line speed and minimum roll diameter (core) the winder motor must operate at rated (motor nameplate) speed.
RPMr = FPM x 12 (in) x $1/\pi$ x 1/ Dr where
RPMr = roll speed
FPM = line speed
Dr = roll diameter in inches

11. **Build-Up-Ratio**
The build up ratio of a winder is the ratio of the full roll diameter to the empty core

$$\text{Build Up Ratio} = \frac{\text{Diameter (Full Roll)}}{\text{Diameter (Empty Core)}}$$

diameter. The number is dimensionless.

Ex. The Diameter @ Full Roll = 36 in. and the Diameter @ Empty Core = 6 in.

$$\text{Build Up Ratio} = \frac{36\text{ in.}}{6\text{ in.}} = 6 \qquad (6\text{ to }1)$$

12. **Tension**

Web tension is a measure of net force in the moving web. The preferred unit of tension is pounds (lbs). Sometimes tension is expressed in PLI (pounds per linear inch). The net tension is obtained by multiplying the PLI times the web width (inches). The tension can be expressed as

F = tension (lbs)

13. **Torque**

Torque is the action of twisting force having the tendency to cause rotation about some point. Unlike work which only occurs during movement, torque may exist even when no rotation or movement is occurring. Torque is the product of a force (lbs) times the length of the lever arm (ft).

$$T = \text{Force (lbs)} \times \text{Distance (ft)}$$

14. **Horsepower**

Horsepower is a measurement of work.

$$HP = \frac{\text{Torque(ft} \bullet \text{lbs)} \times \text{RPM}}{5252}$$

Or

$$HP = \frac{\text{Force} \times \text{FPM}}{33000}$$

where FPM is Feet Per Minute

15. **Gear Ratio**

The gear-in ratio is a ratio of motor rpm to roll rpm (**measured at the center of the roll**):

$$\text{Gear Ratio} = \frac{\text{Motor Speed (rpm)}}{\text{Roll Speed (rpm)}}$$

$$\text{Roll Speed} = \left(\frac{\text{Line Speed} \left(\frac{\text{ft}}{\text{min}}\right)}{\pi \times \text{Core Diameter (in)}} \right) \times 12 \left(\frac{\text{in}}{\text{ft}} \right)$$

Therefore the gear-in-ratio is:

$$\text{G.R.} = \frac{(\text{Max Motor Speed (rpm)}) \text{ x } \pi \text{ x } (\text{Core Diameter (in)})}{\text{Max Line Speed (ft/min) x 12 (in/ft)}}$$

The gear ratio is determined by the machine builder. The gear ratio is usually based on an empty roll (core) rotating with the motor running at maximum (or rated rpm). In the case where the gear ratio is unknown, place the smallest core you will ever use in the machine and run the beam at a known speed (keypad mode). Using a digital hand-tach, check the roll speed (rpm) of the empty core **at the center of the roll** and use the formula above to calculate the gear ratio.

16. **Stall Tension**

Stall Tension is the reduction of tension demand on the web when the winding process stops during a run. This reduction of tension is desirable (in most cases) when the line has stopped and full tension on the material between the feedrolls and the winder roll is not necessary.

17. **Taper**

Taper is the (gradual) reduction or increase of tension demand as the diameter grows or depletes. This may be desirable for some winding packages.

18. **Web Break**

Web Break is a fault condition sensed (calculated) by the winder drive based on if the drive suddenly becomes unloaded (the web has broken). CTCW for the SV3000 has two web break faults that can be enabled/disabled based on the HW Mask setting in the 600 Menu. ***Warning !*** If the web breaks are disabled, make sure that any safety issues regarding a web break are addressed in your system.

19. **Static Friction**

Static Friction is the inherent resistance in the mechanics of the machine that resists motion. The power (torque) required to overcome this resistance is sometimes referred to break-away torque. CTCW for the SV3000 provides compensation for machine friction by adding a settable amount of tension demand to the tension setpoint. In this way, the tension pot controls only the material tension demand and not the additional torque required to set the machine into motion.

20. **Viscous Friction**

Viscous Friction is the inherent resistance in the mechanics of the machine that resists motion while the machine is in motion. This is typically called “the flywheel effect” due to the fact that the ends of a roll work like flywheels or fans and cause drag due to the movement of air during operation. CTCW for the SV3000 provides compensation for machine friction by adding a settable amount of tension demand to the tension setpoint. In this way, the tension pot controls only the material tension demand and not the additional torque required to due to the flywheel effect during runtime.

21. **Diameter Calculation**

The following formula states that if the line speed (FPM), the Winder Motor Speed (RPM) and the Gear Ratio is known, then the current diameter of a given package can be calculated.

$$\text{Diameter (in.)} = \left(\text{LineSpeed (FPM)}\right) \times \left(\frac{12\text{in}}{1\text{ft}}\right) \times \left(\frac{1}{\pi}\right) \times \left(\frac{1}{\text{Winder Motor Speed (RPM)}}\right) \times \left(GearRatio\right)$$

22. **Diameter Freeze/Thaw**

The CTCW software calculates the diameter of the package based on the diameter calculation above. During run-time the diameter is constantly being calculated. However, when the machine is stopped the line speed goes to zero and the diameter calculator presumably would also go to zero unless a mechanism is in place to remember or "freeze" the current diameter of the package. This is important on the restart of a significantly grown (winding) or depleted (unwinding) package. Since the amount of inertia compensation used during acceleration and deceleration is based on the size of the package, the current diameter must be known. CTCW For SV3000 will "freeze" the current calculated diameter if the winder drive is stopped or the line speed falls below 10FPM/Min Line Speed.

On restart (re-enable) and the line speed rises above the 10FPM/Min Line Speed, the current diameter then "thaws" and the calculator picks up where it left off and calculates the diameter based on the run-time line speed and winder speed values.

23. **Diameter Reset (Preset)**

The diameter reset provides a starting point for the software to calculate the diameter. On a rewind application the diameter reset function sets the current diameter to the core diameter value. On an unwind application the diameter reset function sets the current diameter to the full roll diameter value.

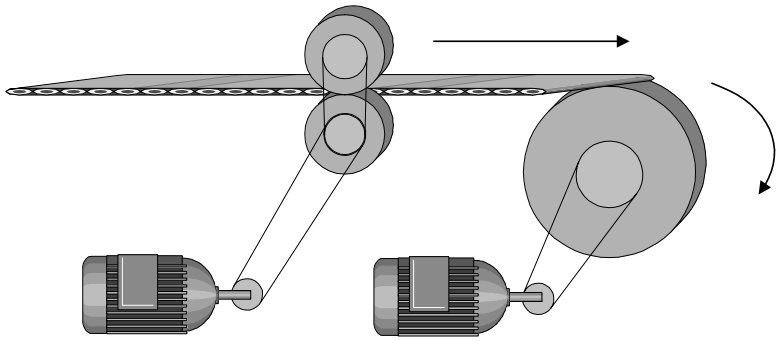
When the diameter is reset to core/full roll (depending on wind/unwind) P015 or P527 (CDIA, Current Diameter) will reset to the initial diameter programmed in P016 (I DIA S) or P017 (I DIA B).

24. **Over/Under**

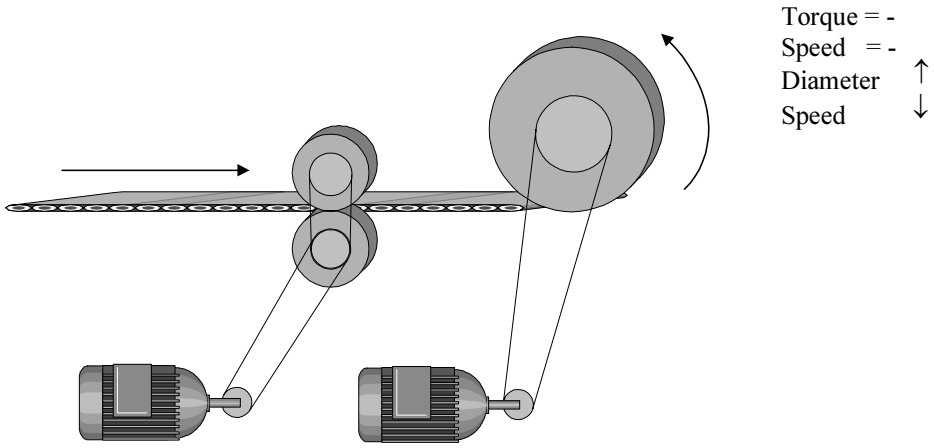
In some winding applications it is required to be able to wind the material over top of the beam and then for the next roll wind the material under the bottom of the beam. CTCW for the SV3000 provides a digital input to select which mode the drive operates in. The following diagrams show each case for winding and unwinding.

WIND PROCESS

Over

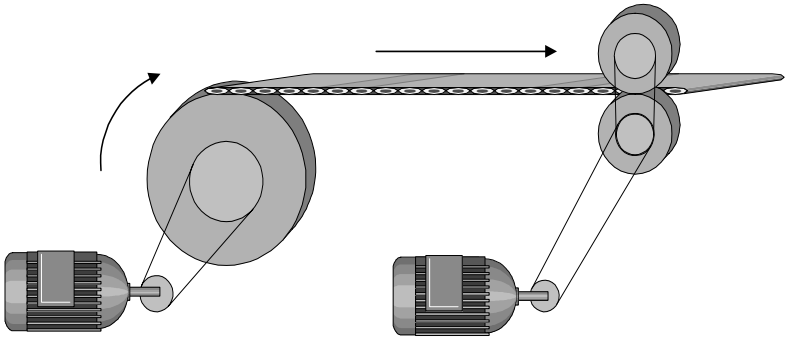


Under



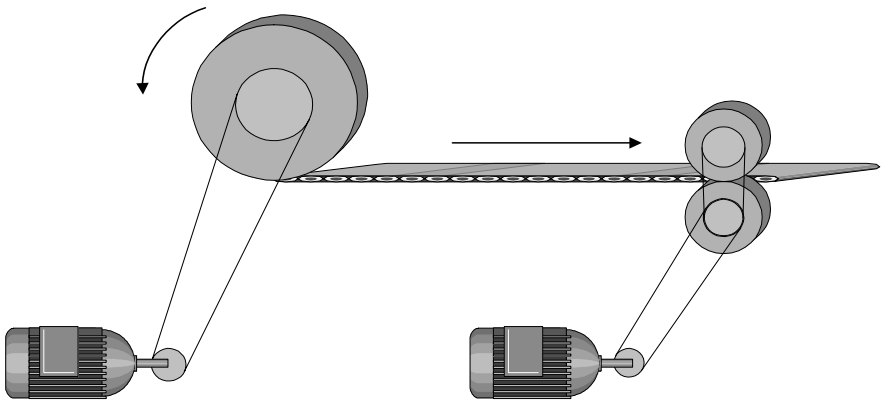
UNWIND PROCESS

OVER



Torque = +
Speed = +
Diameter ↓
Speed ↑

UNDER



Torque = -
Speed = -
Diameter ↓
Speed ↑

C. Description Of Operation: Open Loop Control

In most cases and in our experience in using this software, open loop control is sufficient and provides adequate tension control.

1. Tension Reference and Scaling

The CTCW for SV3000 software allows the user to scale everything based on real-world units (i.e. FPM, inches, etc.). For example, the final tension reference sourcing from the tension pot or 0-10VDC signal at the User Vin (TB2-3) appears as a final tension reference in P528 as tension in pounds. Because the software requires real-world units to perform its calculations, proper scaling is important. Referring to the Tension Reference flow diagram provide in this manual, reading from left to right, note that the Tension Reference is an analog input using TB2-3, UVIN. Parameter P406 can be set to OFF or P TENS. In most cases, P406 will be set to P TENS. Next the UVIN input is scaled based on P407, P408, and P409. The default values are 100%, 0%, and SCALE respectively which sets the relationship that 0-10VDC input = 0%-100% Demand. Next P014, PER TENS, scales the tension reference by dividing by the build-up-ratio. This is a key concept because in open-loop operation the tension reference is divided by the build-up-ratio and then multiplied back times the current diameter. In this way, the tension is at a minimum at core and grows with diameter to a maximum at full roll. P014 should be set to a value of 1/BUR x 100% in edit mode.

Note that in normal viewing mode the value of P014 reads Volts In/10VDCx UVIN Scaling/BUR since the analog input controls P014. Finally, Parameter P123, P TENS, converts the tension reference to lbs. This is based on knowing:

1. The gear-ratio
2. The winder motor's HP
3. The number of FT*LBS/HP of the motor (based on number of poles)
4. The beam's (or spool's) core radius

The tension reference in pounds equals P014 (normal viewing mode)/100% x P123.

2. Taper Calculation

Still referring to the Tension Reference flow diagram, note that the CTCW for SV3000 software provides the user with a taper setting. The taper calculation is a function of the tension reference, the current diameter, the maximum diameter expected and the taper setting. Note that the taper calculation equals:

Tension Reference (lbs) x CDIA (P527) / MXDIA (P104) x TAPER (P018) /100%.
Internally, the result is multiplied by a x (–1). This affects the taper contribution to the final tension reference in the following way:

If Taper is 0.0 then the taper calculation has no contribution to the final tension reference.
If Taper is a positive number (i.e. 50%) then as the diameter grows the more the taper calculation subtracts from the tension reference. This is due to the fact that the taper percent is a positive number but the software internally multiplies the calculation's result by a x (–1).
If Taper is a negative number (i.e. –50%) then as the diameter grows the more the taper calculation adds to the tension reference. This is due to the fact that the taper percent in this case is a negative number but the software internally multiplies the calculation's result by a x (–1). (i.e. - x - = +).
Worse case scenario when the diameter is at full roll and the taper is set to 100% then the tension reference is zero. If, in this case, the taper was set to –100%, then the tension reference is twice the tension value.

In summary,
Post Taper Calculation Tension Reference = Tension Reference (LBS) – (-1x Taper Calculation)

If the Taper is a **positive** value:

Post Taper Calculation Tension Reference =
Tension Reference (LBS) - | Taper Calculation |

If the Taper is a **negative** value:

Post Taper Calculation Tension Reference =
Tension Reference (LBS) + | Taper Calculation |

3. **Stall Percent**

After the Taper Calculation, the CTCW for SV3000 software provides a stall function where the tension demand (reference) can be reduced when the drive receives a go-to-stall command (TB1-18) AND the line speed is below the Stall Speed Threshold (P102) set by the user. Referring to the Tension Reference flow diagram, in run mode, there is no stall reduction and the final tension reference (P528, TENS) is 1:1 with the Post Taper Calculation Tension Reference. In stall mode, the Post Taper Calculation is multiplied by (100%- P103) where P103 is the Stall Percent. This means that the value of P103, STA PER is the user setable Tension Percent REDUCTION desired when the winder drive goes into stall mode. For example, if P103, STA PER is set to 40% then the Final Tension Reference (P528 , TENS) will equal 60% of what the Post Taper Calculation Tension Reference is run mode. Stall Mode selection is based on two events occurring:

1. P526, L SPD (Line Speed) must fall below the threshold set in P102, STA SPD (Stall Speed)
2. TB1-18 (Stall Select) must be made to logic common (TB1-11).

Note that both conditions must be true before the winder drive switches from run to stall.

Note that both conditions must be true before the winder drive switches from run to stall.

4. **Drive Enable**

Referring to the Tension Reference flow diagram, note that when the drive is given a run command (drive enable, TB1-23) and the stop input (TB1-22) is made to logic common (TB1-21), then P528, TENS (Final Tension Reference) equals the Post Stall Tension Tension Reference. If the stop input (TB1-22) is broken and/or no run command is given then P528, TENS (Final Tension Reference) is clamped to zero.

5. **Open Loop Control**

Open Loop Control in a nutshell is simply dividing the tension reference by the build-up-ratio and then multiplying the result by the calculated diameter of the package. In unwind mode, since you start at full roll, the tension demand is 1:1 with the tension reference. As the package shrinks and winds toward the empty core, the diameter decreases and at core the tension demand is 1:1/BUR with the tension reference. In wind mode, the opposite occurs.
Referring to the Open Loop Control flow diagram provided with this manual, reading from left to right, the final tension reference (previously covered) appears in P528, TENS. Recall that the tension reference at this point has already been divided by the build-up-ratio. The final tension reference is then multiplied by the current diameter of the package (P527, CDIA in inches).

6. **Line Speed**

Line speed is monitored via a 0-10VDC analog input (TB2-2, LVIN) where 0-10VDC = 0 – 100% Line Speed. Parameter P401, M SPD, scales the line speed analog input and serves to convert the line speed to real-world units (FPM). TB1-19 selects whether the software operates in wind or unwind mode. If wind is selected (TB1-19 opened) then the Scaled Line Speed Read-Only (P526) is a positive number. If unwind is selected (TB1-19 closed), then the Scaled Line Speed Read-Only (P526) is a negative number.

7. **Winder Speed**

The winder drive's speed feedback can be read in P500 (Winder Speed Feedback) in RPM.

8. **Diameter Calculation**

The diameter is calculated is based on the following formula:

$$\text{Diameter (in.)} = \left(\text{LineSpeed (FPM)}\right) \times \left(\frac{12\text{in}}{1\text{ft}}\right) \times \left(\frac{1}{\pi}\right) \times \left(\frac{1}{\text{Winder Motor Speed (RPM)}}\right) \times \left(GearRatio\right)$$

9. **Diameter Slew**

Because the diameter calculation is real-time (sampling both line speed and winder speed), in order to keep stability in the system it may be required to limit how fast the current diameter (P527, CDIA) can change. Limiting how fast the current diameter can change keeps the tension on the material smooth and prevents large swings in tension demand particularly in transitions (accelerating or decelerating). P105, CH DIA sets the limit on how fast the diameter can change.

10. **Diameter Limits**

P106, DIA CLIP (Diameter Clipping), prevents the current diameter from decreasing in wind mode and increasing in unwind mode. For more detail see the parameter definitions.

11. **Diameter Freeze/Thaw**

Often when winding or unwinding the process must stop for some period of time (the line speed signal goes to zero). It is important to note that the diameter calculation also goes to zero since the calculation uses line speed to calculate the current diameter. In order to restart the process with the proper torque, there must be a way to “remember” the diameter of the package at the time the process was stopped. CTCW for SV3000 provides a freeze/thaw function that resolves these issues.

12. **Diameter Reset**

Since the diameter is calculated over time, when the roll is changed out with a new roll, the process must start all over again. Therefore, there must be a way to reinitialize the diameter calculation so the software knows the initial size of the package when the process begins. Referring to the Open Loop Control flow diagram provided with this manual, note the table that triggers the Diameter Reset Function.

There are two settings for initializing the diameter when beginning a wind or unwind. P016 sets the Initial Diameter Small (in inches). This value would typically be used on a wind application where the initial diameter is small (at core) and begins to grow from that point. P017 sets the Initial Diameter Big (in inches). This value would typically be used on an unwind application where the initial diameter is big (full roll) and begins to pay off from that point. Using these two parameter settings, CTCW for SV3000 provides three ways to reset the diameter. If P419, User In (UIN) is programmed for I DIA B, when the TB1-14 goes high (close to common), the diameter is reset to the value (in inches) in P017. When TB1-19 goes high (close to common), the diameter is reset (initialized) to the value in P017. Note that the User In (UIN) is not used in this case. If P419, User In (UIN) is set to OFF and TB1-20 goes high (close to common), the diameter is reset (initialized) to the value (in inches) in P016 if TB1-19 is open (Wind selected) or P017 if TB1-19 is closed (Unwind selected). The diameter reset selection is summarized in the following table.

Function	Input	UIN: P419 Set To:	Core Reset To:
Reset Diameter (Big)	TB1-14	I DIA B	P017 I DIA B
Rev/Unwind	TB1-19	DON'T CARE	P017 I DIA B
Reset Diameter (Small)	TB1-20	OFF	P016 I DIA S (If TB1-19 is open) or P017 I DIA B (If TB1-19 is closed)

13. **Inertia Compensation**

Inertia Compensation and its contribution to the tension (torque) demand is shown on the Open Loop Control flow diagram provided with this manual. There is also a separate flow diagram which shows the Inertia Compensation calculation. The Open Loop Control flow diagram shows that Inertia Compensation can be enabled or disabled via P107, ACCEL COMP. If P107 is set to Disable then no inertia compensation is added or subtracted to/from the tension (torque) demand. If P107 is set to Enabled, then the Inertia Compensation Calculation adds or subtracts to/from the tension (torque) demand. P119, INER TORQ, Inertia Torque Limit, sets a percent value that limits/clamps how much inertia compensation gets added or subtracted to/from the tension (torque) demand. For more details refer to the Inertia Compensation flow diagram and the section covered later in this manual on the Inertia Compensation Calculation.

Note that the line speed signal is sampled by the inertia compensation to determine whether the line is accelerating, decelerating, or at speed (steady state).
the inertia compensation can add (accel), subtract (decel), or remain zero (steady state) as needed to adjust the tension demand in order to maintain constant tension on the material during these transitions. The inertia comp gains are measured based on measuring the system gain (see tune test) with the drive under load for: 1) Empty roll 2) Full roll (Narrow and/or Wide).

14. **Mechanical Friction Compensation**

P114 sets the Static Friction compensation. P115 sets the Viscous Friction compensation.

15. **Torque Slew (Dampening)**

P124, P DAMP, sets a slew rate (limit) as to how fast the tension (torque) demand can change. This dampening is intended to provide smoother operation when at slow speed on high inertia loads.

16. **Tension Torque Limit**

P118, TENS TORQ, Tension Torque Limit sets a limit/clamp on the final torque demand to the winder drive's current loop.

17. **Wind/Unwind**

If TB1-19 (Wind/Unwind Select) is open to logic common (TB1-11) then the winder drive operates in Wind Mode and the final torque demand is positive. If TB1-19 is closed to logic common (TB1-11), then the winder drive is in Unwind Mode and the final torque demand is negative (multiplied times a x (–1)).

18. **Over/Under**

If TB1-16 is open to logic common (TB1-11) then the winder drive operates in Over Mode and the internal rotation direction selection is positive (forward direction). If TB1-16 is closed to logic common (TB1-11) then the winder drive operates in Under Mode and internal rotation direction is negative (reverse direction).

19. **Inertia Compensation Calculation**

Referring to the Inertia Compensation flow diagram provided in this manual, there are 3 settings that affect the adaptive gain calculation:

1. Empty Roll
2. Narrow Roll
3. Wide Roll

20. **Empty Roll**

Two parameters are used to set the empty roll inertia compensation. P113 (DIA E) is set by the user and should be set to a value that represents the diameter of the empty roll (in inches). P112 (SYS GAIN E) is a value that the user sets based on the system gain calculation when the System Gain part of the tune test is ran with an empty roll on the winder (beam).

21. **Narrow Roll**

Two parameters are used to set the narrow roll inertia compensation. P111 (DIA N) is set by the user and should be set to a value that represents the diameter of a full roll of material (in inches) where the web width is narrow. P110 (SYS GAIN N) is a value that the user sets based on the system gain calculation when the System Gain part of the tune test is ran with a full roll of material on the winder (beam) where the web width is narrow.

22.**Wide Roll**

Two parameters are used to set the wide roll inertia compensation. P109 (DIA W) is set by the user and should be set to a value that represents the diameter of a full roll of material (in inches) where the web width is wide. P108 (SYS GAIN W) is a value that the user sets based on the system gain calculation when the System Gain part of the tune test is ran with a full roll of material on the winder (beam) where the web width is wide.

23. **Narrow/Wide Roll Select**

The digital input (TB1-17) selects whether the adaptive gain calculation is based on a wide or narrow roll. If TB1-17 is open to logic common (TB1-11) then narrow roll is selected. If TB1-17 is closed to logic common (TB1-11) then wide roll is selected. Applications where “light” sets and “heavy” sets are ran on the same machine, this input allows the software to apply the correct inertia compensation where one set may have significant inertial differences from another set.

23. **Narrow/Wide Roll Select**

The digital input (TB1-17) selects whether the adaptive gain calculation is based on a wide or narrow roll. If TB1-17 is open to logic common (TB1-11) then narrow roll is selected. If TB1-17 is closed to logic common (TB1-11) then wide roll is selected. Applications where “light” sets and “heavy” sets are ran on the same machine, this input allows the software to apply the correct inertia compensation where one set may have significant inertial differences from another set.

24. **Current Diameter, Current Gain, and Adaptive Gain Calculation**

P527, CDIA (Current Diameter), affects the adaptive gain calculation where the roll’s diameter and therefore inertia (weight and speed) changes in a short period in time. If the application is at low line speeds (<1000 FPM) and the diameter doesn’t grow/payoff in a rapid period of time, the current gain (based on the adaptive gain calculation) will change very little from core to full roll. The current gain can be read as a read-only in P532, CGAIN (Current Gain).

25. **Line Speed, Sampling, and Inertia Comp**

As aforementioned, the line speed (P526, L SPD) is sampled by the software to determine whether the line is:

- At Speed
- Accelerating
- Decelerating

If the line is At Speed then the inertia compensation is multiplied by 0.
If the line is Accelerating then the inertia compensation is multiplied by a x (+1) and the inertia compensation is ADDED to the tension reference (see the Inertia Compensation and Open Loop Control flow diagrams for more detail).
If the line is Decelerating then the inertia compensation is multiplied by a x (–1) and the inertia compensation is SUBTRACTED from the tension reference (see the Inertia Compensation and Open Loop Control flow diagrams for more detail).

Basically, if the line is at speed then there is no need for inertia compensation to be added or subtracted from the tension reference. This is steady state. If the line is accelerating the load then more torque is required and inertia compensation is added to the tension reference. If the line is decelerating then it is necessary to subtract torque from driving the load to help the load stop (or when changing from a higher speed to a lower speed).

26. **Inertia Compensation Enable/Disable**

If P107 is set to Enabled, then the Inertia Compensation Calculation adds or subtracts to/from the tension (torque) demand. If P107 is set to Disabled then no inertia compensation is added or subtracted to/from the tension reference.

27. **Inertia Compensation Limit**
P119, INER TORQ, Inertia Torque Limit, sets a percent value that limits/clamps how much inertia compensation gets added or subtracted to/from the tension (torque) demand and limits it as a percentage.

28. **Web Break Detection**
Referring to the Web Break 1 and 2 flow diagram provided with this manual, CTCW for SV3000 provides two drive trips for stopping the drive when a break in the web is detected. Both Web Break Trips are as a default disabled at the factory.

29. **Web Break 1**:
The threshold that determines a Web Break 1 condition is settable by the user. P116, TL ACC TRIP LEVEL, sets the threshold of acceleration that is considered a web break condition. The Line Accel Readout (P117, LACC R) is monitored by the software which stores the fastest acceleration that has occurred during a process run (from empty core to full roll). The Web Break 1 trip is based on if the Line Accel Readout (P117) is ever greater than the accel time set by the user in P116. Web Break 1 can be disabled by subtracting a value of 1024 to the hardware mask set in parameter P614. ***Warning !*** If the Web Break 1 Trip is disabled, be sure that measures are taken to ensure personnel safety in the event a web break occurs.

30. **Web Break 2**:
Web Break 2 is based on the software monitoring a change in line speed and a change in winder speed greater than 12%. If the line speed hasn't changed and the winder speed increases by more than 12% then the software sees the winder as becoming instantaneously unloaded (as when the web breaks) and a Web Break 2 is triggered. Web Break 2 can be disabled by subtracting a value of 2048 to the hardware mask set in P614. Web Break 2 can be disabled by subtracting a value of 1024 to the hardware mask set in parameter P614. ***Warning !*** If the Web Break 2 Trip is disabled, be sure that measures are taken to ensure personnel safety in the event a web break occurs.

D. Description Of Operation: Closed Loop Control

It is advisable to attempt to apply the CTCW for SV3000 software in the open loop control mode of operation and monitoring the process results before attempting Closed Loop Control. In most cases, Open Loop Control is sufficient and provides adequate tension control.

Referring to the Closed Loop Control flow diagram provided with this manual, Closed Loop Control operation works basically as a horsepower regulator. In the theory section of this manual it was shown that center winding (or unwinding) is a constant horsepower process. Closed Loop Control calculates the HP Demand from the Line Speed in FPM and the Tension Reference in LBS. By taking the Feedforward Final Tension (Torque) Demand and using it as feedback and using the Winder Speed Feedback the Feedback HP can be calculated.

HP Demand is calculated by:

$$HP = \frac{Force \times FPM}{33000}$$

Feedback HP is calculated by:

$$HP = \frac{Torque(ft \bullet lbs) \times RPM}{5252}$$

where FPM is Feet Per Minute

By comparing the HP Demand from the Feedback HP an error value is calculated. Error HP is calculated by:

E HP (P531) = D HP (P529) – F HP (P530)

1. **Error Compensation**

PKp (P121) is the Proportional Gain in the Error Compensation Calculation.
PKp (P122) is the Integral Gain in the Error Compensation Calculation.
The Error Compensation is a feedforward compensator.

2. **Tension Torque Limit**

P118, Tension Torque Output Limit, is user settable and serves as a clamp as to limit the amount of torque demand that can be sent to the drive's torque loop. The value is set as a percentage from 0% to 100%.

3. **Inertia and Mechanical Friction Compensation**

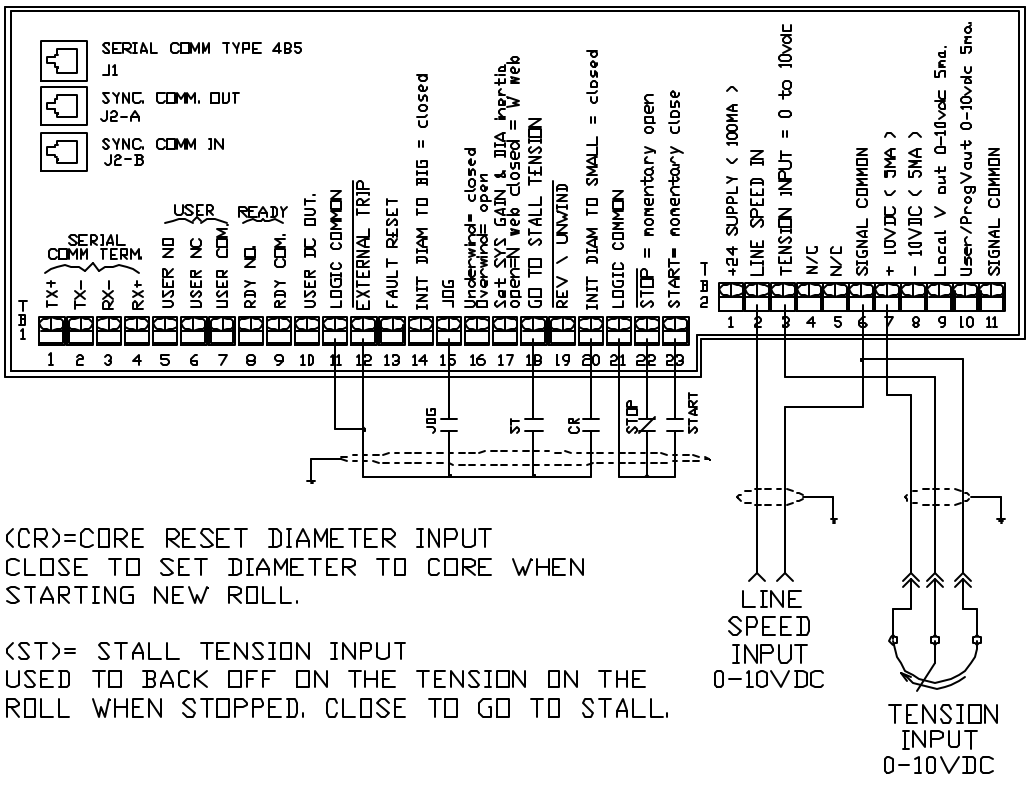
Note that the inertia and mechanical friction compensation shown in the Closed Loop Control flow diagram work in the same manner as previously discussed in Open Loop Control. It is necessary to set the parameters for these compensators as described in the set-up procedures provided in this manual. An interesting point is that these compensators appear in both the feedforward and feedback sections of the closed loop control flow diagram. The idea is to add inertia and mechanical friction compensation to the feedforward demand but not to use them to develop the error signal. That is, only regulate based on the two HP equations and not on the compensations.

II. Quick-Start : Procedure For CTCW Set-Up

Wiring w/ Diagram:

The following diagram depicts typical SV3000 connections for the CTCW software. This software connection diagram does not cover all applications. For additional information regarding hookup or programming of the drive refer to the setup procedure and the parameter descriptions. A flow diagram is provided for ease of programming.

TYPICAL
SV3000 CONNECTIONS WITH CTCW SOFTWARE



(CR)=CORE RESET DIAMETER INPUT
CLOSE TO SET DIAMETER TO CORE WHEN STARTING NEW ROLL.

(ST)= STALL TENSION INPUT
USED TO BACK OFF ON THE TENSION ON THE ROLL WHEN STOPPED. CLOSE TO GO TO STALL.

Terminal connections:

Line Speed Input :

An analog 0 to 10v line speed signal is required for line speed indication. This input (typically the + of a two wire signal) is wired to TB2-2 (LVIN).

Tension Reference :

Typically the tension setpoint is adjusted via a tension pot or a 0-10VDC tension signal. Wire the wiper of the pot or the + signal wire to TB2-3.

Over/Under :

The default setting is Over (TB1-16 open). To select Under, close TB1-16 to common.

Wind/Unwind :

The default setting is Wind (TB1-19 open). To select Unwind, close TB1-19 to common.

Diameter Reset :

There are two settings for initializing the diameter when beginning a wind or unwind. P016 sets the Initial Diameter Small (in inches). This value would typically be used on a wind application where the initial diameter is small (at core) and begins to grow from that point. P017 sets the Initial Diameter Big (in inches). This value would typically be used on an unwind application where the initial diameter is big (full roll) and begins to pay off from that point. Using these two parameter settings, CTCW for SV3000 provides three ways to reset the diameter. If P419, User In (UIN) is programmed for I DIA B, when the TB1-14 closes to common) the diameter is reset to the value (in inches) in P017. When TB1-19 closes to common the diameter is reset (initialized) to the value in P017. Note that the User In (UIN) is not used in this case. If P419, User In (UIN) is set to OFF and TB1-20 closes to common the diameter is reset (initialized) to the value (in inches) in P016 if TB1-19 is open (Wind selected) or P017 if TB1-19 is closed (Unwind selected). The diameter reset selection is summarized in the following table.

Function	Input	UIN: P419 Set To:	Core Reset To:
Reset Diameter (Big)	TB1-14	I DIA B	P017 I DIA B
Rev/Unwind	TB1-19	DON'T CARE	P017 I DIA B
Reset Diameter (Small)	TB1-20	OFF	P016 I DIA S (If TB1-19 is open) or P017 I DIA B (If TB1-19 is closed)

Jog

The winder can be jogged by closing stop, TB1-22, and jog, TB1-15 to common (TB1-11). TB1-19 will cause the winder to jog reverse.

Stall

When TB1-18 is closed to common and the line speed (P526, L SPD) falls below the threshold set in P102 (STA SPD, Stall Speed), the tension reference is reduced by the percentage set in P103 (STA PER, Stall Percentage).

Inertia Comp

CTCW for SV3000 provides for selection between two gain and diameter settings for adaptive gain control. The two selections are narrow and wide where:

Narrow = a narrow web where the number of ends (yarn) or thickness and width of the material (plastic, steel, etc.) is narrow and thin. This usually represents a “light” set. The full roll diameter is typically smaller than a heavy set.

Wide = a wide web where the number of ends (yarn) or thickness and width of the material (plastic, steel, etc.) is wide and thick. This usually represents a “heavy” set. The full roll diameter is typically larger than a light set.

The selection between a narrow (“light”) set and a wide (“heavy”) set is set by TB1-17. If TB1-17 is open the narrow system gain and full roll diameter is selected. The narrow system gain is set by P110 (SYS GAIN N) and the narrow full roll diameter is set by P111 (DIA N). If TB1-17 is closed then the wide system gain and wide full roll diameter is selected. The wide system gain is set by P108 (SYS GAIN W) and wide full roll diameter is set by P109 (DIA W).

B. Programming Setup Procedure

1) Tune Drive To The Motor. Note that on initial start-up it is **HIGHLY RECOMMENDED** to first run the drive in speed mode (P200=Speed) and set the speed of the drive via Keypad (P202 = Keypad, P008 = Setpoint Speed). This will prove that the drive can regulate speed and that the motor can rotate freely in the correct direction. Attempting to run the drive in Torque Regulation with Speed Override can complicate matters in the beginning.

2) Acquire The Following Information:
   a) Maximum Line Speed (Feet Per Minute)
   b) Total Gear Ratio between the Motor Shaft and the Center Driving Shaft of The Beam
   c) Maximum Winder Motor Speed (RPM) Required To Achieve Maximum Line Speed (FPM)
   d) Minimum Empty Core Diameter (Inches). Note: This should be the smallest core ever expected to be used on the machine !
   e) Maximum Full Roll Diameter (Inches)
   f) Number of Motor Poles. Note: This can be found on the motor nameplate.
   g) Winder Motor Horsepower. Note: This can be found on the motor nameplate.

The following table is provided for customer use. Feel free to use it to chart your application's data. These values will be required later to calculate drive adjustments.

ITEM	VALUE	UNITS
MAX. LINE SPEED		FPM
TOTAL GEAR RATIO		-
MAX. WINDER MOTOR SPEED		RPM
MIN. CORE DIAMETER		IN
MAX. FULL ROLL DIAMETER		IN
NUMBER OF MOTOR POLES		–
WINDER MOTOR HORSEPOWER		HP

STEP 2

Tension Reference Scaling

Parameters involved:

Percentage Tension, Pr014	Max Tension, P123
User VIN, Pr406	User Vin Hi, Pr407
User Vin Lo, Pr408	User Vin Mode, Pr409
User Vin Mode, Pr409	

Refer to the Tension Reference Flow Diagram for this portion of the setup procedure.

1) Set P406 (UVIN) Equal To “PTENS”. This enables an analog signal (0 – 10 VDC) to control the tension setpoint.

2) For most applications the default settings for Pr407, Pr408, and Pr409 are adequate. (Default Values are: Pr407=100%, Pr408=0%, Pr409=SCALE) This scales the analog input for 0-100% proportionally.

3) Calculate the Build-Up-Ratio. Recall that,

$$BUR = \frac{FullRollDiameter}{EmptyCoreDiameter}$$

(i.e. 6” core and 36” full roll, the BUR = 36/6 = 6. This means that there is a 6:1 “6 to 1” build-up.

4) Use the BUR calculated in step 2 to calculate the percent tension scaling,

$$P014(PERTENS) = \left[\frac{1}{BUR}\right] \times 100\%$$

when in edit mode.

Using the example in step 2,

$$P014(PERTENS) = \left[\frac{1}{6}\right] \times 100\% = 16.6(\%)$$

Note: Edit mode displays the maximum scaling of P014. Consequentially, in Normal Viewing Mode, P014 is controlled by the UVIN analog input. In Normal Viewing Mode, P014 displays:

$$\left[\frac{\text{Volts In (UVIN)}}{\text{10 VDC}}\right]\times\left[\frac{\text{UVIN Scaling}}{100\%}\right]\times\left[\frac{1}{\text{BUR}}\right]\times 100\%$$

Or

$$\left[\frac{\text{Volts In (UVIN)}}{\text{10VDC}}\right]\times\left[\frac{\text{UVIN Scaling}}{\text{BUR}}\right]$$

Where UVIN Scaling is based on P407, P408, and P409.

1) Calculate the maximum torque (FT*LBS) that the motor can produce. This can be calculated based on the HP of the motor and the foot*pounds of torque per unit of HP. The ft*lbs per HP is based on the number of poles the motor has.
   Note: RPM = 120x Hz/Poles and T/HP = 5252/RPM.

$$\text{Motor Torque}_{\text{Max}} = [HP]\times\left[\frac{FT\bullet LBS}{HP}\right]$$

Ex. A 4-pole, 15HP,1800 base speed motor yields 3 FT*LBS of torque per HP.

$$\text{Motor Torque}_{\text{Max}} = [\,15\text{HP}\,]\times\left[3\left(\frac{\text{FT}\bullet\text{LBS}}{\text{HP}}\right)\right] = 45\,\text{FT}\bullet\text{LBS}$$

Number Of Poles	Base Speed	FT*LBS/ HP
2	3600	1.5
4	1800	3
6	1200	4.5
8	900	6

2) The Tension Scaling in P123 (P TENS) converts the tension reference to real-world units of force actually pulling on the material (LBS) .

   The Torque applied to the centerwinding shaft is equal to the maximum motor torque calculated (in step 5) times the Total Gear Ratio between the motor shaft and the center driving shaft of the beam.

   $$\text{Torque (at the centerwinding shaft)} = \text{Motor Torque}_{\text{Max}} \times \text{Gear Ratio}$$

   Using the example,
   Torque (at the centerwinding shaft) = 45FT*LBS x 6 = 270 FT*LBS

Since Torque = Force(LBS) * Distance(FT),

$$\text{Tension (Force)} = \frac{\text{Torque}}{\text{Distance}}$$

The distance in FT is calculated from the torque arm in inches. Since the torque arm is the radius (½ the diameter), if the diameter (in inches) is known, the distance is equal to:

$$\text{Distance(radius in ft)} = \text{Diameter Of Roll (in)} \times \left[\frac{1\text{FT}}{12\text{in}}\right] \times \left[\frac{1}{2}\right] = \frac{\text{Diameter Of Roll (in)}}{24(\text{ft/in})}$$

Using the example,

$$\text{Diameter Of Roll (ft)} = 6\text{in} \times \frac{1\text{FT}}{12\text{ in}} = 0.5\,\text{FT}$$

Since the torque arm is the radius,

$$\text{Core Radius (FT)} = \frac{\text{Core Diameter (FT)}}{2} = \frac{0.5\,\text{FT}}{2} = 0.25\,\text{FT}$$

Recall,

$$\text{P123 (P TENS)} = \text{Tension (Force)} = \frac{\text{Torque}}{\text{Distance}}$$

Therefore (using the example),

P123 (P TENS) should be set to:

$$\text{P123 (PTENS)} = \frac{270\,\text{FT} \bullet \text{LBS}}{0.25\,\text{FT}} = 1080\,\text{LBS}$$

In summary,

$$\boxed{\text{P123} = \frac{\text{HP} \times \left(\frac{\text{FT} \bullet \text{LBS}}{\text{HP}}\right) \times \text{G.R}}{\text{CoreRadius(FT)}}}$$

Note that this scales the tension reference for the maximum tension (torque) *available* at core. Note this is not necessarily the *required* tension (torque).

Taper

Parameters Involved:	
Percent Tension, Pr014	Taper, Pr018
Maximum Diameter, Pr104	Current Diameter, Pr527

1) During commissioning taper may be desired. Initially set the Taper (P018) to 0 % (no taper).
2) Set parameter Pr104 to the maximum diameter of the largest package the machine will ever see.
3) Pr014 (Percent Tension) was previously set and Pr527 (Current Diameter) is a read-only. This is just a reminder that when Pr018 is used to set a taper value other than zero that these parameters play a part in the taper calculation.

Stall

Parameters Involved:	
Stall Speed, Pr102	Stall Percentage , Pr103
Line Speed, Pr526	
Digital Inputs Involved:	
TB1-18 Stall Select	

1) To set the Stall Percent, Set P103 to the % of tension **reduction** required when the system switches to stall tension. Ex. If 40% tension reduction is required during stall, set P103 to 40. In this example the tension output will equal 60 % of the tension demand during stall.
2) If the line speed (Pr526) falls below the speed level set by P102 (STA SPD) and the digital input TB1-18 (Stall Select) goes high, the CTCW software will switch from run to stall mode. Set P102 equal to a desired line speed in FPM. In General, P102 can be set to 5 FPM or some other low value.

Speed Scaling

Parameters Involved:	
M SPD, Pr401	Max RPM, Pr007
Limit RPM, Pr307	

1) Enter the maximum line speed expected in FPM into P401 (M SPD).
2) Enter the max motor RPM (Pr007 & Pr307). The maximum motor RPM and the Limit RPM used to limit the motor speed to a value that yields the Max FPM material speed.

Diameter Reset and Scaling

Parameters involved:	
Initial Diameter Small, Pr016	Initial Diameter Big, Pr017
Gear Ratio, Pr100	Maximum Diameter, Pr104

1) Set Pr016 (Initial Diameter Small) to the smallest core diameter that will ever be used on the machine.
2) Set Pr017 (Initial Diameter Big) to the largest full roll diameter that will ever be used on the machine. Note that the maximum diameter in Pr104 serves as a limit (or clamp) on Pr017.
3) Set Pr100 to a value that equals the **TOTAL** gear ratio between the motor shaft and the center of the driven roll. This is used for internal scaling in the diameter calculation.

Inertia Compensation

Parameters involved:

Inertia compensation enable, Pr107
Full diameter wide, Pr109
Full diameter narrow, Pr111
Empty core diameter, Pr113
System gain wide, Pr108
System gain narrow, Pr110
System gain core, Pr112

Because the inertia compensation at full diameter is different for different material widths, the CTCW for SV3000 has two different inertia compensation settings which are externally selectable from the terminal strip. The empty core inertia compensation is the same for either selection. It is important to note that the following procedure sets the relationship of inertia compensation gain to the current diameter calculated by the software. Note that the relationship is non-linear.

1) Enter all diameters in inches.
   a) If you run different diameter cores, enter the smallest you will ever run in parameter Pr113.
   b) Enter the largest diameter you will ever run in parameter Pr104

2) Inertia Comp Adjustments:

a) Empty Core Inertia Comp

To set the empty core inertia compensation settings, you will need to re-run the “Calculate System Gain” part of the tune test (Pr600) with the smallest empty core beam (roll) that will ever be used installed on the machine. Start the tune test. When initializing the tune test, don’t change any of the motor information. The information should already be set for the motor (see Step 1). Once the tune test has initialized, the test will allow you to choose to press the “edit” key to perform the test. To skip the test, press the single down arrow key. Skip all test until you reach the “system gain” test. Perform the “system gain” test and then enter the value from Pr602 to parameter Pr112.

b) Full Core Inertia Comp

i) Wide Inertia Comp

Perform the system gain test as described above in the empty core inertia comp section. This time perform the test with a full roll that represents your widest and largest diameter to be used on the machine. Enter the "system gain" from P602 into P108 (SYS GAIN W).

ii) Narrow Inertia Comp

If there is a big difference in widths to be run, perform the full diameter test again with a roll of narrow material and enter the values in Pr110 & Pr111. The decision to implement the narrow width inertia compensation may be a judgement call because there are too many variables to calculate the break point. The drive defaults to the SYS GAIN N and DIA N unless a momentary closure to common is made between terminal TB1-17 and TB1-11.

Machine Friction Compensation

Parameters involved Run Mode, P200 Static friction, Pr114 Viscous friction, Pr115

Warning ! This test requires the machine (and/or motor) to be set into motion.

Procedure

The purpose of static and viscous friction compensation is to remove anything other than material tension from the tension set-point. Setting the friction values will require the machine to be run with an empty core installed.

Static Friction Compensation Setup:

Set parameter Pr101, min FPM speed to some value above the max FPM speed (P401). For example, if P401=300FPM, then set P101=350FPM. This ensures that the CTCW control always operates in Open Loop mode (see Modes Of Operation flowchart for details). Set the Run Mode (P200) to Torq to enable the CTCW software. Turn the tension pot down to "0". Start the winder with the line speed at "0" and adjust Pr 114 until the core just starts to roll.

Viscous Friction Compensation Setup

Set the line speed up to full speed and adjust Pr115 until the core is within 10% of full surface speed.

Note: Line speed ramp and winder drive must start at the same time otherwise the winder will be clamped to a slow speed.

Hand Taching The Core's Surface Speed

Parameters involved Limit RPM, Pr303

Now that the CTCW drive has been setup statically, it is important to make sure that the surface speed of your roll AT CORE can make speed under all circumstances. It has been our experience that a minimum of 5% overspeed on the winder's core to the nip rolls (line speed) is required (10% is recommended). In this step, it is important to use the **smallest** core that will ever be used on the machine. Start the line without any material in the machine. Bring the line up gradually (typically we will check the nip rolls surface speed then the winder's core surface speed at 25% line speed, 50% line speed, 75% line speed, and finally at 100% line speed). Pr303 in the CTCW drive adjusts the top speed of the winder motor. In order to raise or lower the winder's surface speed increment or decrement Pr303's value. Adjust until at full line speed the winder's surface speed is 10% higher than the nip roll's surface speed. The machine should be ready to run at this point. Thread up the machine and run at a slow line speed at first. Start and stop the line and check that the material between the nip rolls and winder holds tension. After checking this, run up to higher line speeds. Start and stop from the higher line speeds and check that the material between the nip rolls and winder holds tension. If the material gets too tight or too loose in either case, there could be a mechanical problem (loose belts, slippage,etc.) or the inertia compensation must be adjusted (this is rarely required).

Web Break Setup

Parameters involved	
Trip line acceleration, Pr116	Line acceleration readout, Pr117
Hardware mask, Pr614	

Refer to the Web Break flowchart for this procedure.

The software has two web break functions.

- **Web Break 1** senses a break when the reel accelerates quickly. This feature can be disabled by setting Pr116 to “0”. To set Web Break 1, start with Pr116 set at zero and watch Pr117 while you start and stop the line (with a web threaded through the machine). Then set Pr116 to a value slightly below the value you see in Pr117. This alarm can also be disabled by subtracting 1024 from the value in the Hardware Mask (Pr614).

- **Web Break 2** sets a speed limit based on diameter. If the winder is winding (not unwinding) the unit will trip if the reel speed has a 12% increase in speed with out a change in line speed. To disable this alarm, subtract 2048 from the value in the Hardware Mask (Pr614).

<u>Troubleshooting/Symptoms/Tips</u>

- Scaling is very important for the tension setting and the inertia comp function. Symptoms of incorrect scaling are web tension changing during acceleration or deceleration and drive exceeding current limit at full diameter.

- The diameter change rate is the speed the diameter calculation steps the diameter value in the drive. If it is set too small, the digital diameter value will fall behind the actual diameter growth. If it is set too large, the diameter miscalculates when the line is stopped and the inertia compensation over reacts.

- Select No DB in tune test.

- Don’t enable Catch A Spinning Load (P205=DIS).

- Measure I Field and Slip with only the motor (if there is a sensitivity issue).

CTCW WIND / UNWIND APPLICATIONS SOFTWARE

Main Parameter Menu Summary (P0xx)

Parameter Name	Default Value	Parameter Number	Value Range Min / Max	Units	Info	Run Edit
LANGUAGE:	English	**P000**	ENGL,SPAN FREN,GERM.	-----	Display language	Yes
ENG SCALE:	1800	**P001**	100…….9999	(ENG)	value at base HZ	No
ENG DEC POINT:	0	**P002**	0……3		Decimal places from right	Yes
ENG CHAR 1:	R	**P003**	94 different characters Including 0-9 / A-Z + - < > = / % ( ) plus others		First character on far left	Yes
ENG CHAR 2:	P	**P004**	94 different characters Including 0-9 / A-Z + - < > = / % ( ) plus others		Middle character	Yes
ENG CHAR 3:	M	**P005**	94 different characters Including 0-9 / A-Z + - < > = / % ( ) plus others		Third character on Right	Yes
MIN:	0 RPM	**P006**	-2*base…MAX –1	(ENG)	Minimum Speed	Yes
MAX:	1800 RPM	**P007**	MIN+1 ….2*base	(ENG)	Maximum Speed	Yes
SETPT:	0 RPM	**P008**	MIN……MAX	(ENG)	Speed of Drive	Yes
ACCEL:	3.0	**P009**	0.1……3200	Seconds	Acceleration	Yes
DECEL:	3.0	**P010**	0.1……3200	Seconds	Deceleration	Yes
JOG:	100RPM	**P011**	MIN……MAX	(ENG)	Jog Speed	Yes
JOG ACCEL:	3.0	**P012**	0.1……999	Seconds	Jog Acceleration	Yes
JOG DECEL:	3.0	**P013**	0.1……999	Seconds	Jog Deceleration	Yes
PER TENS:	75.0	**P014**	0.1……..100%	(%)	Tension Set-point	Yes
CDIA:	3.00	**P015**	0.25……200.00	inch	Current Diameter	Yes
I DIA S:	3.00	**P016**	0.50…….200.0	inch	Initial Dia. Small	Yes
I DIA B:	3.00	**P017**	0.50…….200.0	inch	Initial Dia. Big	Yes
TAPER:	0.0	**P018**	-100.0……100.0	(%)	Taper tension	Yes
SECURITY:	OFF	**P019**	OFF,ON	------	Security state	Yes
DEFLT MENU:	NO	**P020**	NO,YES	------	Default this parameter menu	Yes

CTCW WIND / UNWIND APPLICATIONS SOFTWARE

Main Parameter Menu Descriptions (P0xx)

LANGUAGE **Parameter (P000) Language**
This parameter sets the language viewed on the display to English, French, Spanish or German.

ENG SCALE **Parameter (P001) Engineering Scale**
This parameter sets the scale or numerical readout that is displayed when the drive is at base motor speed. In conjunction with parameters P002, P003, P004, and P005 the readout can be programmed to any user value that is desired for example (**180** Yards per Minute) would be represented as (**180.0** YPM).

ENG DEC POINT Parameter (P002) Engineering Decimal Point
This parameter determines the decimal point location for the (P001) parameter. 0 = no decimal points. 1 = one decimal point from the right. 2 = two decimal points from the right. 3 = three decimal points from the right.

ENG CHAR 1 **Parameter (P003) Engineering Character 1**
Sets the first or left character in the engineering display. There are 94 different characters available.

ENG CHAR 2 **Parameter (P004) Engineering Character 2**
Sets the second or middle character in the engineering display. There are 94 different characters available.

ENG CHAR 3 **Parameter (P005) Engineering Character 3**
Sets the last or right character in the engineering display. There are 94 different characters available.

MIN **Parameter (P006) Minimum Speed**
Sets the minimum speed the drive can run. This parameter can be set from –2X base speed of the motor to Max speed –1.

MAX **Parameter (P007) Maximum Speed**
Sets the maximum speed of the drive. The range of adjustment is from MIN +1 to 2X base speed of the motor.

SETPT **Parameter (P008) Set-point Speed**
This parameter is the set-point speed of the drive when the drive is in keypad mode. Range is from “MIN” to “MAX”.

ACCEL **Parameter (P009) Acceleration Rate**
Sets the amount of time the drive takes to accelerate in seconds to base speed as set in parameter (P301). Range is 0.1 seconds to 3200 seconds.

DECEL **Parameter (P010) Deceleration Rate**
Sets the amount of time the drive takes to decelerate in seconds from base speed as set in parameter (P301) to zero speed. Range is 0.1 seconds to 3200 seconds.

JOG **Parameter (P011) Jog Speed**
Sets the speed of the drive in jog mode. The range of speed is between “MIN to “MAX”.

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Main Parameter Menu Descriptions cont. (P0xx)

JOG ACCEL **Parameter (P012) Jog Acceleration**

Sets the acceleration rate that the drive takes to accelerate the motor to base speed. Normally jog speeds are set relatively low so since the jog accel rate is based on motor base speed a setting of 3 seconds in this parameter with a jog speed of 100 with a 1800 rpm base speed motor the accel time to 100RPM would be 0.17 seconds.

JOG DECEL **Parameter (P013) Jog Deceleration**

Sets the deceleration rate that the drive takes to decelerate the motor to base speed. Normally jog speeds are set relatively low so since the jog decel rate is based on motor base speed a setting of 3 seconds in this parameter with a jog speed of 100 with a 1800 rpm base speed motor the decel time from 100RPM would be 0.17 seconds.

PER TENS **Parameter (P014) Percentage Tension**

Sets the tension as a percentage of the pounds of tension set in parameter " P TENS (P123). The requested set tension is calculated as follows:

Tension = "PER TENS" (P014) * "P TENS" (P123) / 100 (Tension = lbs.)

CDIA **Parameter (P015, P016, P017) Current Diameter & Initializing Diameter**
I DIA S
I DIA B

CDIA is the current diameter that the drive has calculated. CDIA must be initialized when starting a new roll. To initialize the CDIA stop the line and Check the setting of parameter (P419) it should be set ="OFF" then provide a closure between TB1-20 & TB1-11. This closure will set the CDIA to the value programmed into the "I DIA S" parameter if the drive is running forward or winding. The CDIA will be set to the value of I DIA B if the drive is running reverse or unwinding. The reverse input at terminal TB1-19 sets the CDIA to the Value of I DIA B when closed to common. If parameter (P419) is set =" I DIA B" then the CDIA is programmed to the value in parameter " I DIA BIG (P017).When the Terminal TB1-14 is taken to TB1-11 common. It is not recommended that the diameter be initialized while the drive is running or product damage could occur.

TAPER **Parameter (P018) Taper Tension**

Taper trims the tension on the material as the roll diameter changes. The value programmed into this parameter can increase or decrease the tension as diameter changes for unwind or rewind applications. The Taper value is a percentage of the set tension. When 0.0 is the value set "TAPER" has no effect.
Note: when "TAPER = -100 then the requested tension is twice the tension when the material is at The "MAX DIA" value for winding.
Note: when "TAPER = 100 then the requested tension is zero when the material is at The "MAX DIA" value for winding.

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Main Parameter Menu Descriptions cont. (P0xx)

SECURITY **Parameter (P019) Security**

This parameter is used to restrict the access of the programmable parameters by unauthorized personnel. Default for this parameter is “OFF” which provides unrestricted access. When the parameter is set to “ON” you will be prompted for a three digit security code. The security code you enter allows for menu lockout. For EX: If A security code of 101 is entered then all parameters above and including parameter 100 will require a security code to allow editing. 300 will require a security code to allow editing. The first digit of the security code indicates what parameter menu and above is locked. The next two digits are the code number you want for your code between 1 and 99.

DEFLT MENU **Parameter (P020) Default this menu**

This parameter when set to “yes” puts the parameters of menu P0xx to the factory default values.

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Preset Parameter Menu Summary (P1xx)

Parameter Name	Default Value	Parameter Number	Value Range Min / Max	Units	Info	Run Edit
G Ratio:	6.00	**P100**	0.01……200.0	---------	Gear Ratio	Yes
MIN SPD:	30	**P101**	0……..5000	FPM	Minimum Speed	Yes
STA SPD:	30	**P102**	0……..5000	FPM	Stall Speed threshold	Yes
STA PER:	0	**P103**	0……100.0	%	Stall Percent	Yes
MX DIA:	52.00	**P104**	0.25….200.00	inch	Maximun Diameter	Yes
CH DIA :	0.10	**P105**	0.02……10.00	inch	Change Diameter (Slew) / Rev	Yes
DIA CLIP:	ENA	**P106**	ENA,AUTO,DIS	-----	Diameter clipped	Yes
ACCEL COMP:	D	**P107**	D,E	-----	Accel Inertia Comp Enable	Yes
SYSGAIN W:	0	**P108**	0.00…999.99	-----	System Gain Wide Coil	Yes
DIA W:	50.0	**P109**	0.2……200.0	inch	Wide Coil Diameter	Yes
SYSGAIN N:	0	**P110**	0.00…999.99	-----	System Gain Narrow Coil	Yes
DIA N:	40.0	**P111**	0.2……200.0	inch	Narrow Coil Diameter	Yes
SYSGAIN E:	0	**P112**	0.00…999.99	-----	System Gain Empty	Yes
DIA E:	2.0	**P113**	0.2……200.0	inch	Empty Mandrel Diameter	Yes
STA FRIC:	0	**P114**	0.0……..50.0	%	Static Friction	Yes
VIS FRIC:	0	**P115**	0.0……..50.0	%	Viscous Friction	Yes
TL ACC:	3.0	**P116**	0……..200.0	Sec.	Trip Line Accel	Yes
LACC R:	999.9	**P117**	0……..999.9	Sec.	Line Acceleration Readout	Yes
TENS TORQ:	100	**P118**	0……..100	%	Tension Torque Limit	Yes
INER TORQ:	100	**P119**	0……..100	%	Inertia Torque Limit	Yes
P KEY:	1	**P120**	1……..1000	-----	Power Key Rate	Yes

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Preset Parameter Menu Summary cont.(P1xx)

Parameter Name	Default Value	Parameter Number	Value Range Min / Max	Units	Info	Run Edit
P KP:	100.00	**P121**	0….65535.0	-----	Power KP	Yes
P KI:	100.00	**P122**	0….65535.0	-----	Power Ki	Yes
P TENS:	1000	**P123**	1…..100000	lbs	Max Tension	Yes
P DAMP:	NO	**P124**	0…..100000	-----	Open Loop Dampening	Yes
DEFLT MENU:	NO	**P125**	NO,YES	-----	Default This Menu	NO

CTCW WIND / UNWIND APPLICATIONS SOFTWARE

Preset Parameter Menu Descriptions (P1xx)

G RATIO **Parameter (P100) Gear Ratio**

Gear ratio between the motor and the wind / unwind roll.
It is best to know the exact gear ratio but if this is not known then enter the approximate value, after all other correct values for other parameters have been entered run the machine with material at a speed of 10ft/min or faster. Monitor the parameter (P527) until parameter is steady write down the value then stop the machine and measure the actual roll diameter. Use the following formula to determine the correct gear ratio and properly program parameter P100 G Ratio.

$$\textbf{(P100) G RATIO} = \text{old (P100) G RATIO X} \left\{ \frac{\text{actual measured diameter}}{\text{CDIA (P527) value}} \right\}$$

Repeat the procedure to double check the “G RATIO” value.

MIN SPD **Parameter (P101) Minimum Speed**

The absolute value of line speed must be above this value before the drive switches from open loop torque mode to closed loop torque mode. The following conditions also must be met before closed loop torque mode is entered.

Absolute value of line speed > “ MIN SPD”, “Accel Dec” input is open, absolute value of line speed > “M SPD” (P401) /50, absolute value of line speed > 10feet per minute, the drive has not gone into speed override.

STA SPD **Parameter (P102) Stall speed**

Sets the speed at which the stall tension is applied . When the line speed is below the value set in (P102) then the tension is reduced to the value set in parameter (P103) “STA PER”.

STA PER **Parameter (P103) Stall Percentage**

This parameter sets the tension that is applied when the line speed signal is below the value set in parameter (P102). The tension is set then the requested tension is reduced by the following formula:

$$\text{Tension} = \text{requested tension X } \frac{\text{“STA PER” (P103)}}{100}$$

MX DIA **Parameter (P104) Maximum Diameter**

Sets the maximum diameter used by the taper tension calculation. If the actual diameter is greater than the “ MX DIA” parameter then the diameter for taper is limited to the “MX DIA” setting. The tension is calculated as follows:

Requested tension = (P104) – ((P104) X (“TAPER”/100) X “MX DIA”)

Preset Parameter Menu Descriptions (P1xx) cont.

CH DIA **Parameter (P105) Change in Diameter Limit**
Sets the maximum amount the diameter is allowed to change per revolution of the roll. The "CH DIA" value must be set large enough to allow the diameter to change fast to accommodate diameter changes at core sizes. The diameter changes occur most rapidly around core diameters. The value set in this parameter should also not be set any larger than is needed to prevent oscillations that can cause the material to go slack, then get tight, then loose. A normal setting for example would be 0.10".

DIA CLIP **Parameter (P106) Diameter Clipping**
This parameter has three settings: "ENA" prevents the diameter calculator (P015) from decreasing the diameter value when winding and prevents the diameter value from increasing when unwinding. "AUTO" allows the diameter to change until the value stabilizes and then holds the diameter in one direction like "ENA". "DIS" disables the lock. **CAUTION** – Disabling the diameter clamp may disable the speed over ride function and allow the winder motor to accelerate to max speed in the condition of a web brake.

ACCEL COMP **Parameter (P107) Accel/Decel Compensation**
This parameter is used to either enable or disable the line Accel/Decel inertia compensation. Line acceleration/ deceleration compensation adds power or subtracts power from the roll as required to accelerate/ decelerate and compensate for the inertia of the material on the roll.

SYSGAIN W **Parameter (P108) System Gain Wide web**
This parameter is the gain value that the drive tuned when using the auto-tune parameter (P600) for the widest web that the machine will run. If there is only one web width used on the machine then set this parameter the same as parameter (P110). See parameter (P600) for auto-tuning the SV3000 drive with this software. When terminal TB1-17 is closed to common SYSGAIN W & DIA W is used.

DIA W **Parameter (P109) Diameter of the Wide web**
This parameter is set to the value for the diameter of the wide web when the "SYSGAIN W" (P108) was tuned.

SYSGAIN N **Parameter (P110) System Gain Narrow web**
This parameter is the gain value that the drive tuned when using the auto-tune parameter (P600) for the narrowest web that the machine will run. If there is only one web width used on the machine then set this parameter the same as parameter (P108). See parameter (P600) for auto-tuning the SV3000 drive with this software. If TB-17 is open then SYSGAIN N & DIA N is used.

DIA N **Parameter (P111) Diameter of the Narrow web**
This parameter is set to the value for the diameter of the narrow web when the "SYSGAIN W" (P108) was tuned.

SYSGAIN E **Parameter (P112) System Gain Empty**
This value is programmed to the gain the drive initially tuned with just a core on the winder/ unwinder. The minimum load value.

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Preset Parameter Menu Descriptions (P1xx) cont.

DIA E **Parameter (P113) Diameter Empty**
This value is programmed to the core diameter of the roll when the "SYSGAIN E was programmed.

STA FRIC **Parameter (P114) Static Friction**
This parameter sets the static friction of the system. Static friction is the amount of motor power it takes to move the motor gear train and the empty roll. The value set in this parameter is a value that represents % of motor torque and has a range of 0 to 50% full motor torque.

VIS FRIC **Parameter (P115) Viscous Friction**
This parameter controls the amount of power in percentage of motor torque that is required to compensate for viscous friction. Viscous friction is associated with bearing friction as it increases with speed. Viscous is also associated with friction of a large roll as weight increases and windage of a roll as speed increase. Friction in a gear box based on the viscosity of oil lubricants in the gear box and friction associated with increase of speed. All these factors combined require a small compensation as speed of the roll increases. The range of compensation is 0 to 50% motor torque.

TL ACC **Parameter (P116) Trip Level Accel**
This parameter set the level of speed that if the acceleration rate is less than the value programmed the drive trips on a web break. The value should be programmed to zero for starters then once a roll is run under normal operating conditions set to a value slightly less than the value shown in parameter (P117).

LACC R **Parameter (P117) Line Acceleration Readout**
This parameter should be set to 999.9 initially then when the machine is run it will constantly monitor and store the most rapid acceleration rate attained during the run of the roll. This value should be slightly decreased and programmed into parameter (P116).

TENS TORQ **Parameter (P118) Tension Torque Limit**
Sets the constant demand limit for tension torque does not affect the inertia comp. The value set in this parameter limits the output torque of the drive. The range of this parameter is 0 to 100%.

INER TORQ **Parameter (P119) Inertia Torque Limit**
This parameter sets the torque limit of the inertia compensation circuit.
The range of adjustment is 0 to 100% torque.

P KEY **Parameter (P120) Power Key Rate**
This parameter is used with parameters(P121 through P125) to allow the changes with the double up and down arrow keys to change the parameter values by the amount programmed. The range off adjustment is 0 to 1000.

P KP **Parameter (P121) Power KP**
This parameter is set by the auto-tune sequence but is affectivity the Proportional gain. The range of adjustment is 0 to 65535.00.

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Preset Parameter Menu Descriptions (P1xx) cont.

P KP **Parameter (P122) Power KI**
This parameter is set by the auto-tune sequence but is affectivity the Integral gain. The range of adjustment is 0 to 65535.00.

P TENS **Parameter (P123) Max Tension**
This parameter sets the Maximum tension in lbs. That can be requested from the drive. The range of adjustment for this parameter is 1 to 100000 lbs.
P123 (P TENS) = G.R. x HP x (FT*LBS/HP) / Core Radius (FT)

P DAMP **Parameter (P124) Proportional Dampening**
This parameter adjusts the open loop mode dampening to allow for if necessary on high inertia loads a smother less oscillatory slow speed operation. The range of adjustment is 0 to 100000.

DEFLT MENU **Parameter (P125) Default This Menu**
This parameter will set all the parameters in the 100 menu to there default values.

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Setup Parameter Menu Summary (P2xx)

Parameter Name	Default Value	Parameter Number	Value Range Min / Max	Units	Info	Run Edit
RUN MODE	SPEED	**P200**	SPEED/TORQUE	---	Controls the run mode	Yes
STOP MODE	DECEL	**P201**	DECEL,COAST DCINJ,DCHOLD	----	Controls the stopping mode	Yes
KPAD ENABLE	ENA	**P202**	ENA,DIS,DAL	----	Enable, Disable, Disable all	Yes
ON DEL	0.10	**P203**	0.1……99.99	Sec	Motor on Delay	No
AD DEL	0	**P204**	0.1……99.99	Sec	Added motor on delay	Yes
SPINNING MOTOR	D	**P205**	Hold, Disable, Enable	--	Catch a spinning motor	No
S RAMP	0	**P206**	0…….100	%	S Ramp Percent	Yes
S RAMP M	Position	**P207**	Position,Always	-------	S Ramp Mode	Yes
F R MODE	NO REV	**P208**	NO REV,ALWAYS STOPPED,JOG	----	Controls drive Rev mode	Yes
INJBRAKE TIME	2	**P209**	1……..99	Sec	DC injection brake time	Yes
INJBRAKE I	30%	**P210**	0……100	%	DC injection brake current	Yes
RUN ENABLE	STOP	**P211**	STOP,COAST	----	Coast or Stop	Yes
START INIT	ON	**P212**	ON	----	Terminal over keypad	Yes
SET USER DEFLT	N	**P213**	NO, Yes	----	Sets user default parameters	No
DEFLT MENU	NO	**P214**	NO, Yes	----	Default this menu to factory	No
DEFLT ALL FACT	N	**P215**	NO, Yes	----	Default all menus to factory	No
DEFAULT ALL USER	N	**P216**	NO, Yes	----	Default all menus to user	No

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Setup Parameter Menu Descriptions (P2xx) cont.

RUN MODE **Parameter (P200) Run mode of drive**
Selects the basic operational mode of the drive. In Speed Mode the speed of the drive is controlled by keypad or by analog input. In torque mode the CTCW software controls the torque of the drive. The run mode has to be set for torque mode for the CTCW software to work.

STOP MODE **Parameter (P201) Stopping mode of the drive**
Selects the stopping mode of the drive. When set to coast the drive coasts to rest when stopped. When in decel the drive follows the decel ramp(P010) to zero when stopped. When in DC INJ the drive applies a dc current to stop the motor which is set by (P207 & P208). When in DC HOLD the drive ramp to a low speed then a DC voltage is applied to the motor to hold the motor for the time set in (P207). This parameter is set to coast mode for most CTCW applications.

KPAD ENABLE Parameter (P202) Keypad enable
When the keypad is disabled, the Run Fwd, Run Rev and jog keys are non-functional. Keypad enabled is the factory default state. DAL (disable all) disables the Jog,RunFwd,Run Rev and stop keys. Digital inputs or serial commands must be used to control the drive.

ON DEL **Parameter (P203) Drive on delay**
This parameter is set by the auto-tune procedure and indicates the time it takes for the drive to rotate the motor once a start command is given. This delay is necessary to allow the field flux in the motor to build up to produce torque before starting.

ADD DELAY **Parameter (P204) Additional delay**
This parameter allows for additional time to be added to the ON DELAY before the drive moves. This parameter is useful to allow multi-drive applications to start at the same time. The on-delay is viewed on all drives and the time of the longest on-delay is matched by increasing the value of the Add-Delay on the other drives so that the total on-delay and add-delay time equals the longest on-delay time. This allows all drives to flux up and start at the same time. Different size drives and motors have different on-delay times.

SPINNING MOTOR **Parameter (P205) Catch a Spinning Motor**
This parameter when enabled allows the drive to start into a motor that is already rotating . When disabled the drive when started will bring the motor to zero speed first then start rotating the motor. When this parameter is enabled the drive when started determines the frequency of the motor rotation and matches the output frequency then turns on and then accelerates the motor to requested speed.

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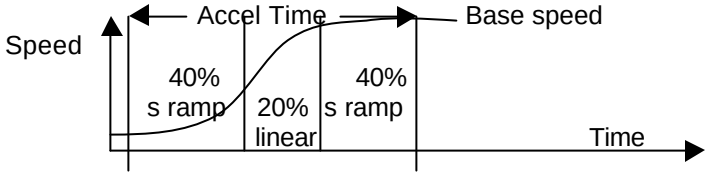
Setup Parameter Menu Descriptions (P2xx) cont.

S RAMP **Parameter (P206) Smoothing Ramp**

This parameter sets the amount of smoothing that is applied at the beginning and at the end of a linear acceleration or deceleration ramp. This parameter does provide a great deal of jerk reduction and is benificial for sensitive materials.



S RAMP M **Parameter (P207) S Ramp Mode**

When set to “Position” the s ramp algorithm allows the drive to decelerate in the middle of accelerating immediately when the drive is commanded to. This setting will produce a jerk as the drive follows the linear part of the deceleration ramp down. When set to “Always” and the drive is requested to decelerate in the middle of accelerating the drive will continue to accelerate by applying the s ramp portion of the ramp to prevent jerking then start to decelerate. The for mentioned situations also apply to when the drive is decelerating and is commanded to accelerate.

FR MODE **Parameter (P208) Forward Reverse Mode**

When set to “NO REV” the drive will not reverse even when commanded to by the keyboard or by the terminal strip input. When set to “ALWAYS” the drive will always reverse when commanded. When set to “STOPPED” the drive will only reverse direction after it is first stopped. If a direction change is requested and the drive is not stopped the drive will remember the reverse command and once it is stopped will then automatically start back up in the opposite direction. When set to “JOG” the drive will only reverse when jogging. The drive will not run in reverse but if running and a reverse command is given the drive will remember the command a reverse when next commanded to jog.

INJBRAKE TIME **Parameter (P209) Injection Brake Time**

The length of time that DC current is applied to the motor when “STOP MODE” (P201) is set for “ DC INJ” or “ DC HOLD”. The DC current will stop after this time delay, when a fault occurs, or when the drive is restarted.

INJ BRAKE I **Parameter (P210) Injection Brake Current**

The level of DC current applied to the motor when the “ STOP MODE” (P201) is DC INJ or DC HOLD. The largest value that can be entered is 100% which corresponds to the current value of “ I LIMIT” (P304).

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Setup Parameter Menu Descriptions (P2xx) cont.

RUN ENABLE Parameter (P211) Run Enable

This parameter determines the function of the start stop input terminals. When set to " STOP" TB1-22 is closed and TB1-23 is Momentarily closed the drive starts. When TB1-22 is momentarily opened the drive stops according to " STOP MODE" (P201). If the (P211) parameter is set for "stop" then WhenTB1-22 is opened then the drive coasts to a stop regardless of the setting of "STOP MODE" (P201) parameter. The start input TB1-23 must be maintained closed to start and keep the drive running. When the start input is opened the drive will stop according to the "STOP MODE" (P201) setting. Regardless of the setting of parameter (P211) if the stop input TB1-22 is open the drive cannot be started serially or by the keypad.

START INIT Parameter (P212) Start Initiate

This parameter sets the operation and state of the digital inputs for the drive. The reverse, Jog, remote and user inputs are edge sensitive. When the "START INIT" parameter is set to "ON" which is the case for most applications the inputs to the drive are initialized to the levels seen when the drive is started. This allows the keypad or serial communications to also control the drive inputs.
Notes: When the "START INIT" = "OFF and "RUN ENABLE"= "COAST": this combination of settings is not recommended. When the run enable is set to coast, the "START INIT" should be set to "ON". When "START INIT" is set to "OFF" and "RUN ENABLE"= "STOP" and the drive is started the inputs are initialized to the last state selected not the level of the inputs. This can be useful when some of the inputs are controlled by the keypad or serially and others are controlled by the inputs to the terminal strip.

SET USER DEFLT Parameter (P213) Set User Default

This parameter allows the customer to capture the drives current parameter Settings and place them into the e-prom as user parameter set. To set the current parameter values change this parameter to "Y(es)". After the user defaults are set the parameter will revert back to "NO".

DEFLT MENU Parameter (P214) Default Menu

Enables the loading of factory default parameters for this menu only.
To set the factory parameter values for this menu change this parameter to "Y(es)". After the factory defaults are set the parameter will revert back to "NO".

DEFLT ALL FACT Parameter (P215) Default all factory

This parameter defaults all drive parameters back to the initial factory settings. Once the drive has been defaulted to factory settings the drive will have to be reprogrammed. To set the factory parameter values change this parameter to "Y(es)". After the factory defaults are set the parameter will revert back to "NO".

DEFLT ALL USER Parameter (P216) Default all user

This parameter sets all the drive parameters back to the saved user parameter values. To set the user parameter values change this parameter to "Y(es)". After the user defaults are set the parameter will revert back to "NO".

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Drive Parameter Menu Summary (P3xx)

Parameter Name	Default Value	Parameter Number	Value Range Min / Max	Units	Info	Run Edit
MTR HP:	Drive rated	**P300**	0….999.9	HP	Motor HP	Yes
MTR RPM:	1780	**P301**	0…..7200	RPM	Motor rated speed	Yes
MTR AMPS:	Motor rated	**P302**	20%..83%	A	Motor Full load Amps	NO
I FIELD:	0.27*(P302)	**P303**	0.00…MTR Amps	A	Motor mag. Current or I field	Yes
I LIMIT:	(P302)*1.5	**P304**	(P303).. Int. limit	A	Max drive current limit	Yes
MOTOR VOLTS:	Rated	**P305**	10…..999	Vrms	Motor nameplate voltage	NO
BASE FREQ:	60Hz	**P306**	10….120	HZ	Motor base spd. Frequency	NO
LIMIT RPM:	1800	**P307**	1….7200	RPM	Motor limit RPM	Yes
IXT AMPS:	105%	**P308**	10….105	%	Timed over-current point	Yes
MAX F TORQ:	100	**P309**	0……100	%	Max FwdTorque100=(P304)	Yes
MAX R TORQ:	100	**P310**	0……100	%	Max RevTorque100=(P304)	Yes
MAX F BRAKE:	100	**P311**	0……100	%	Max Fwd Brk Tq100=(P304)	Yes
MAX R BRAKE:	100	**P312**	0……100	%	Max Rev Brk Tq100=(P304)	Yes
NUM POLES:	4	**P313**	2,4,6,..18	-----	Number of motor poles	NO
SERIAL BAUD:	96	**P314**	96,48,24,12,192	------	Baud rate X 100	Yes
SERIAL ADDR:	1	**P315**	0…….99	-----	Serial address for coms.	Yes
BITS PAR:	8 NONE	**P316**	7 or 8 none,even,odd		Bits of data + Parity	Yes
MDROP MODE:	D	**P317**	D,E,MD,ME	-----	Multi-drop enable mode	Yes
CHECK SUM:	E	**P318**	EN CHK,DIS CHK	--	Check sum enable/disable	Yes
DEFLT MENU	NO	**P319**	NO,YES	-----	Default this menu to factory	NO

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Drive Parameter Menu Descriptions (P3xx)

MTR HP **Parameter (P300) Motor Horse Power**
This parameter displays the motor horse power of the drive and is normally preset by the drives rating. If the rating does not show the correct value then enter in the correct value.

MTR RPM **Parameter (P301) Motor RPM**
This parameter sets the correct motor base speed. It is important to set this parameter correctly. This parameter will be set when the drive's auto-tune procedure is run. The nameplate base speed of the motor is what should be present in this parameter.

MTR AMPS **Parameter (P302) Motor Amps**
This parameter sets the rated full load of the motor as indicated by the FLA name-plated on the motor. This parameter will be set when the drive's auto-tune procedure is run.

I FIELD **Parameter (P303) Field Current**
This parameter is the amount of current the motor takes from the drive to produce a magnetic field on the stator of the motor allowing the motor to produce torque. The value is normally between 27% to 50% of the motors full load amps and is set by the drive's auto-tune procedure. This parameter should only be allowed to be set when tuning the drive with the motor uncoupled. See the auto tune flow diagram procedure.

I LIMIT **Parameter (P304) I (Current) Limit**
This parameter sets the maximum current that the drive can produce rms. This value is normally set to 1.5 times the full load motor current set in parameter (P302).

MOTOR VOLTS Parameter (P305) Motor Volts
This parameter is set to the motor nameplate voltage . This parameter is set when the auto-tune procedure is performed.

BASE FREQ **Parameter (P306) Motor Base Frequency**
This parameter is set to the frequency of the motor that produces the motor's base speed. This parameter is set when the auto-tune procedure is performed.

LIMIT RPM **Parameter (P307) Motor Limit RPM**
This parameter is set to the speed of the motor that the customer needs it to run. With the SV3000 the top speed of the motor is limited to 2 times the base speed of the motor. For Example: Motor base speed is 1800 then this parameter can be set as high as 3600.

IXT AMPS **Parameter (P308) IXT (current over Time) Amps**
This parameter sets the value in percent that the drive starts to consider itself overloaded. The drive emulates a motor thermal overload in respect to the greater the load over full load the faster the drive times out then trips. This setting is a percentage value based on parameter (P302). For Example: (P302)= 10 AMPS and (P308)= 105% then the overload level is set to 10.5amps.

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Drive Parameter Menu Descriptions (P3xx) cont.

MAX F TORQ **Parameter (P309) Max Forward Motor Torque**

This parameter sets the output motor torque limit in the forward direction the current being generated by the drive to accelerate or keep the motor running in the forward direction. This torque is based on "I LIMIT" Parameter (P304) 100% = the value in P304. This parameter allows for custom settings to limit torque below the I Limit parameter P304. This may be beneficial if torque needs to be limited in one or more quadrants of motor operation.

MAX R TORQ **Parameter (P310) Max Reverse Motor Torque**

This parameter sets the output motor torque limit in the reverse direction the current being generated by the drive to accelerate or keep the motor running in the reverse direction. This torque is based on "I LIMIT" Parameter (P304) 100% = the value in P304. This parameter allows for custom settings to limit torque below the I Limit parameter P304. This may be beneficial if torque needs to be limited in one or more quadrants of motor operation.

MAX F BRAKE **Parameter (P311) Max Forward Braking Motor Torque**

This parameter sets the output motor torque limit the braking torque in the forward direction. The current is being generated by the motor back into the drive. This parameter controls the amount of current the drive is allowed to absorb. The torque is based on "I LIMIT" Parameter (P304) 100% = the value in P304. This parameter allows for custom settings to limit torque below the I Limit parameter P304. This may be beneficial if torque needs to be limited in one or more quadrants of motor operation. This can also be beneficial to reduce the setting of this parameter if OVR trips are experienced when the drive is not fitted with an external braking package.

MAX R BRAKE **Parameter (P312) Max Reverse Braking Motor Torque**

This parameter sets the output motor torque limit the braking torque in the reverse direction. The current is being generated by the motor back into the drive. This parameter controls the amount of current the drive is allowed to absorb. The torque is based on "I LIMIT" Parameter (P304) 100% = the value in P304. This parameter allows for custom settings to limit torque below the I Limit parameter P304. This may be beneficial if torque needs to be limited in one or more quadrants of motor operation. This can also be beneficial to reduce the setting of this parameter if OVR trips are experienced when the drive is not fitted with an external braking package.

NUM POLES **Parameter (P313) Number of Motor Poles**

This parameter should be set to the correct number of poles in the AC motor. For Example: Motor is 1800 RPM base speed Number of poles = 4, : Motor is 1200 RPM base speed Number of poles = 6,etc. This parameter is set by the auto-tune procedure.

SERIAL BAUD **Parameter (P314) Serial Baud Rate**

This parameter sets the drive serial communication baud rate. The settings are 1200,2400,4800,9600 and19,200 bits per second. This has to be set to match the host computer settings. This is for the Serial comm. J1 only.

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Setup Parameter Menu Descriptions (P3xx) cont.

SERIAL ADDR **Parameter (P315) Serial Address**

This parameter sets the serial address of the individual drive. The drive address is defaulted to 1. If more than one drive is multi-dropped to a host computer each drive must have a unique serial address. This parameter must be selected to match host computer.

BITS PAR **Parameter (P316) Number of Bits and Parity**

Sets the number of data bits and the parity of the computer for the SV3000's J1 communications port. This parameter must be selected to match host computer. Settings are 8 NONE, 8 EVEN, 8 ODD, 7 ODD, 7 EVEN.

MDROP MODE **Parameter (P317) Multi-drop Mode Communications**

The parameter settings are E, D, ME, MD. The ME and MD settings are the monitor mode and are for factory use only. The settings available to the user are the settings of E or D. When set to "E" multiple SV3000 can be connected together to communicate to a host computer. The SV3000 will tri-state its transmitter when it is not transmitting. When set to "D" only one SV3000drive is allowed to communicate with the host computer.

CHECK SUM **Parameter (P318) Check Sum**

Enables or disables the check sum of the write command to the J1 SV3000 serial communications port. The ability to disable the checksum is only provided to ease the development of communications software. In the final system, the checksum must be enabled to provide protection against communication errors.

DEFLT MENU **Parameter (P319) Default this Menu**

Enables the loading of factory default parameters for this menu only.
To set the factory parameter values for this menu change this parameter to "Y(es)". After the factory defaults are set the parameter will revert back to "NO".

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Terminal Parameter Menu Summary (P4xx)

Parameter Name	Default Value	Parameter Number	Value Range Min / Max	Units	Info	Run Edit
Spare:	Disable	**P400**	Enable,Disable	------	Spare not used	Yes
M SPD:	360	**P401**	0…5000	FPM	Max Line Speed	Yes
L OFFSET:	Nominal	**P402**	Done,Z SET,P SET,M SET,INVERSE,NOMINAL			Yes
L OFRSETV:	0	**P403**	-40000..40000	DAC	Local offset	Yes
L POS X:	32767	**P404**	0…80000	DAC	Local Positive gain	Yes
L NEG X:	32767	**P405**	0…80000	DAC	Local Negative gain	Yes
USER VIN:	OFF	**P406**	OFF, P TENS	-----`	User vin for tension	Yes
UVIN HI:	100%	**P407**	-100…100	%	User vin HI %	Yes
UVIN LO:	0%	**P408**	-100…100	%	User vin Low %	Yes
UVIN MODE:	SCALE	**P409**	SCALE,TRIM	-----	User VIN mode	Yes
UVIN OS:	DONE	**P410**	DONE,Z SET,P SET,NOMINAL		Set Offset +Gain	Yes
UVIN OV:	0	**P411**	-40000..40000	DAC	User VIN Offset	Yes
UVIN PX:	32767	**P412**	0……80000	DAC	UVIN Positive Gain	Yes
LOCAL VOUT:	SPEED	**P413**	SPEED,TORQ,PTR		Local voltage out	Yes
LVOUT HI:	100	**P414**	-999999..8388607	%	Local voltage out hi scale	Yes
LVOUT LO:	0	**P415**	-8388607..8388607	%	Local voltage out low scale	Yes
USER VOUT:	P503	**P416**	P500---P512	-----	User Voltage output source	Yes
UVOUT HI:	100	**P417**	-999999..8388607	----	User voltage out Hi scale	Yes
UVOUT LO:	0	**P418**	-8388607..8388607	---	User voltage out Low scale	Yes
UIN:	NONE	**P419**	OFF, I DIA BIG	---	User digital input	Yes
USER RELAY:	P500	**P420**	P500---P514	-----	User Relay Source	Yes
UR SET:	1750	**P421**	0…..999999	-----	User relay set level	Yes
UR CLR:	1700	**P422**	0…..999999	-----	User relay clear level	Yes

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Terminal Parameter Menu Summary (P4xx) cont.

Parameter Name	Default Value	Parameter Number	Value Range Min / Max	Units	Info	Run Edit
USER OUT: P500		**P423**	P500….P514	-----	open collector output source	Yes
UO SET:	1750	**P424**	0…….999999	-----	open collector output set	Yes
UO CLR:	1700	**P425**	0…….999999	-----	open collector output clear	Yes
DEFLT MENU:	NO	**P426**	NO,YES	-----	Default this menu to factory	NO
LVOUT PTR:	17000	**P427**	0…..8388607	-----	L DAC Probe ptr	Yes
UVOUT PTR:	17000	**P428**	0…..8388607	-----	U DAC Probe ptr	Yes

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Setup Parameter Menu Descriptions (P4xx)

SPARE **Parameter (P400) Spare**
This parameter is currently not used

M SPD **Parameter (P401) Max Line Speed**
This parameter sets the Max line speed that the line is running when the SV3000 drive is operating at its maximum speed. By setting this parameter to the drives max speed the scaling is being performed for the CTCW software in feet per minute.

L OFFSET **Parameter (P402) Local Offset**
This parameter allows the user to calibrate the Local Input voltage At TB2-2 to accommodate analog input signals that are not 0 - ± 10VDC. The user can specify the zero, maximum, and minimum points of the input signal, and the drive will automatically calculate the correct offset and gain. To use this feature refer to the following procedure. When set to "NOMINAL" the drive is scaled for a 0 – 10VDC analog voltage input.
SET INPUT SIGNAL to MIN INPUT set parameter to "Z SET" the drive learns the min input value. When the drive is done the parameter will reset itself to "DONE
SET INPUT SIGNAL to MAX INPUT set parameter to "P SET" the drive learns the min input value. When the drive is done the parameter will reset itself to "DONE

It is not recommended that this parameter be set to "M SET" because this input with the CTCW software has been changed to receive a 0 to ± 10 VDC but then the software absolute values the input so the SV3000 only detects a positive value from 0 to 10VDC.

When the parameter is set to "INVERSE" the Maximum input becomes the zero speed demand and the minimum input becomes the Maximum speed demand. This should only be done if a normal 0 to 10vdc input signal is being used or the "Z SET" and "P SET" has already been done.

L OFFSETV **Parameter (P403) Local offset Voltage**
This parameter is automatically set when the "L OFFSET" is run for "Z SET" but with this parameter "Z SET" can be set manually. The analog input is based on 10VDC equals a value of 32767 so setting the value to 6553 would offset the input voltage to 2VDC before the drive will respond.

L POS X **Parameter (P404) Local Positive X**
This parameter is automatically set when the "L OFFSET" is run for "P SET" but with this parameter "PSET" can be set manually. The analog input is based on 10VDC equals a value of 32767.

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Setup Parameter Menu Descriptions (P4xx) cont.

L NEG X **Parameter (P405) Local Negative X**

It is recommended that this parameter not be adjusted due to this input has an absolute value calculator and will not recognize a negative offset . This is a modification associated with the CTCW software.

USER VIN **Parameter (P406) User V In**

This parameter controls the input on TB2-3, when set to “OFF” turns the input off. This parameter when set to “P TENS” allows the input to control a set-point tension in percent for the CTCW software. This parameter should be set for “P TENS” in most applications.

UVIN HI **Parameter (P407) User V In Hi**

This parameter scales the input so that when 10VDC is input how much affect it has on the drive tension. For Example: 10VDC input and UVIN HI =(50) then the tension range would be 0-10VDC input would = 0-50% tension. 10VDC input and UVIN HI =(100) then the tension range would be 0-10VDC input would = 0-100% tension.

UVIN LO **Parameter (P408) User V In Low**

This parameter scales the input so that when 0VDC is input how much offset is present on tension. For Example: 10VDC input and UVIN LO =(50) then the tension at 0VDC input would = 50% tension and increase from there. 0VDC input and UVIN LO =(0) then the tension would be 0VDC input would = 0% tension and increase from there.

UVIN MODE **Parameter (P409) User V IN Mode**

This parameter sets the mode of operation for the “USER VIN” TB2-3 terminal. In both modes the input voltage is scaled according to the “UVIN HI” (P407) and “UVIN LO” (P408). When (P409) is set to “SCALE” the value set in parameter (P123) “P TENS” is multiplied by the setting of “UVIN LO”(P408) when zero volts is input to the terminal strip and multiplied by “UVIN HI” (P407) when 10vdc is input to the terminal strip. This produces a linear range of adjustment between LO and HI for the 0 to 10VDC input signal.

When this parameter is set for “TRIM” then the value in (P123) “P TENS” is added to by the value set in (P407) “UVIN HI” and the “P TENS” value is subtracted from by setting the “UVIN LO” (P408) to a negative value.

EXAMPLE:

“TRIM MODE” “P TENS” (P123)=50 lbs. and “UVIN LO”= -10%, “UVIN HI”=10% then when the User VIN Voltage (TB2-3) changes from 0 to 10VDC the value of torque set-point will change from 45lbs. to 55lbs. This parameter should be set for “SCALE” for most applications.

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Setup Parameter Menu Descriptions (P4xx) cont.

UVIN OS **Parameter (P410) User V IN Offset and scaling**
This parameter allows the user to calibrate the Local Input voltage At TB2-3 to accommodate analog input signals that are not 0 - ± 10VDC. The user can specify the zero, maximum, and minimum points of the input signal, and the drive will automatically calculate the correct offset and gain. To use this feature refer to the following procedure. SET INPUT SIGNAL to MIN INPUT set parameter to "Z SET" the drive learns the min input value. When the drive is done the parameter will reset itself to "DONE". SET INPUT SIGNAL to MAX INPUT set parameter to "P SET" the drive learns the min input value. When the drive is done the parameter will reset itself to "DONE".
When set to "NOMINAL" the drive is scaled for a 0 – 10VDC analog voltage input.

UVIN OV **Parameter (P411) User VIN manual Offset Voltage**
This parameter is used to manually offset the zero volt input (TB2-3) based on a maximum value of 32767 equaling 10VDC. This value is automatically set when the "UVIN OS" routine is run with the value Z SET. It can also be set manually.

UVIN PX **Parameter (P412) User VIN manual Positive Gain**
This parameter is used to manually set the positive gain of input (TB2-3) based on a maximum value of 32767 equaling 10VDC. This value is automatically set when the "UVIN OS" routine is run with the value P SET. It can also be set manually.

LOCAL V OUT **Parameter (P413) Local Voltage Output**
This parameter selects the signal reflected in the "LOCAL V OUT" output terminal (TB2-9). This parameter can be set to any value in the status menu P5XX menu between P500 and P512. This allows for 0 to 10VDC output for Speed, Motor Torque, Speed Error, Watts Etc. Normally the LV OUT HI and LV OUT LO are set equal to LV OUT HI = 100 and LV OUT LO = 0

LVOUT HI **Parameter (P414) Local Voltage Out Hi Scaling**
If the "LOCAL V OUT" is set to a "SPEED" value output then the scaling is the value of Max (P007) when (P414)=100% the output voltage will be 10VDC when the RPM value of the drive is at Max (P007) RPM speed. If the " LOCAL V OUT" is set to a "TORQUE" value output the scaling is when this parameter is set to 100 a 10VDC output is equal to 200% current.

LVOUT LO **Parameter (P415) Local Voltage Out Low Scaling**
If the "LOCAL V OUT" is set to a "SPEED" value output then the scaling is the value of (P007) when (P414)=0% the output voltage will be 0VDC when the RPM value of the drive is at zero speed. If the " LOCAL V OUT" is set to a "TORQUE" value output the scaling is when this parameter is set to 0 a 0VDC output is equal to 0% current.

USER V OUT **Parameter (P416) User Voltage Output**
This parameter selects the signal reflected in the "USER V OUT" output terminal (TB2-10). This parameter can be set to any value in the status menu P5XX menu between P500 to P512 and P526 to P531. This allows for 0 to 10VDC output for Speed, Motor Torque, Speed Error, Watts Etc. Normally the UV OUT HI and UV OUT LO are set equal to UV OUT HI = 100 and UV OUT LO = 0

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Setup Parameter Menu Descriptions (P4xx) cont.

UVOUT HI **Parameter (P417) User Voltage Out Hi Scaling**

If the "UVOUT HI" is set to a "SPEED" value output then the scaling is the value of Max (P007) when (P414)=100% the output voltage will be 10VDC when the RPM value of the drive is at Max (P007) RPM speed. If the " UVOUT HI" is set to a "TORQUE" value output the scaling is when this parameter is set to 100 a 10VDC output is equal to 200% current.

UVOUT LO **Parameter (P418) User Voltage Out Low Scaling**

If the "UVOUT LO" is set to a "SPEED" value output then the scaling is the value of (P007) when (P414)=0% the output voltage will be 0VDC when the RPM value of the drive is at zero speed. If the " UVOUT LO" is set to a "TORQUE" value output the scaling is when this parameter is set to 0 a 0VDC output is equal to 0% current.

UIN **Parameter (P419) User Digital Input**

This parameter specifies the action taken when the terminal TB1-14 is tied to drive common TB1-11. The drive must have received a stop command and be below a speed of 10 feet a minute. When set to "OFF" this terminal input is not functional, but if the input to TB1-19 is closed to common momentarily then the drive is reversed and the starting diameter is set to " I DIA BIG "(P017) this is used for unwinding if no connection is made to TB1-19 then the drive is in wind mode.

When set to " I DIA B" This input when tied to common set the "C DIA" (P115) to the value programmed in parameter "I DIA B" (P017). This input is useful when different full roll or core diameters are used.

USER RELAY **Parameter (P420) User Relay**
UR SET **Parameter (P421) User Relay Set Toggle Point**
UR CLR **Parameter (P422) User Relay Clear Point**

These parameters control the function of the user relay output at terminals (TB1-5, TB1-6, TB1-7). The "USER RELAY" parameter can be set to monitor parameters from P500---P514 in the status menu. The "UR SET" and "UR CLR" parameters function like a level detector. Once a level is set in (P421) and exceeded the status of the form-c relay contacts change state. When the value goes below the value set in (P422) the relay resets back to it's normal state as shown on the terminal strip diagram.

USER OUT` **Parameter (P423) User Open collector digital output**
UO SET **Parameter (P424) User output Set Toggle Point**
UO CLR **Parameter (P425) User output Clear Point**

These parameters control the function of the user digital output at terminal (TB1-10). The "USER OUT" parameter can be set to monitor parameters from P500---P514 in the status menu. The "UO SET" and "UO CLR" parameters function like a level detector. Once a level is set in (P424) and exceeded the status of the output changes state from high to low. When the value goes below the value set in (P425) the output resets back to it's normal state which is high.

DEFLT MENU **Parameter (P426) Default this Menu**

Enables the loading of factory default parameters for this menu only.

To set the factory parameter values for this menu change this parameter to "Y(es)". After the factory defaults are set the parameter will revert back to "NO"

Setup Parameter Menu Descriptions (P4xx) cont.

LVOUT PTR **Parameter (P427)**
LVOUT PTR **Parameter (P428)**
These parameters are for factory use only. The default value is 17000 for both parameters and should remain at this value.

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Status Parameter Menu Summary (P5xx)

Parameter Name	Parameter Number	Units	Info
SPEED	**P500**	ENG	Read only for speed
SET SP	**P501**	ENG	Read only for set speed
SPEED ERR	**P502**	%	Read only for speed error
MOTORTORQ	**P503**	%	Read only for motor torque
MOTOR I	**P504**	A	Read only for motor current
MOTOR HZ	**P505**	HZ	Read only for motor frequency
MOTOR V	**P506**	Vrms	Read only for motor voltage
RMOTORTOR	**P507**	%	Read only for requested motor torq
IN WATTS	**P508**	W	Read only for input power watts
INPUT PF	**P509**	-----	Read only for input power factor
BUSS VOLTS	**P510**	VDC	Read only for DC Buss voltage
IXT ACCUM	**P511**	%	Read only for timed overcurrent trip
DB ACCUM	**P512**	%	Read only for DB overload trip
TOTAL KWH	**P513**	KW-H	Read only for est. Kilowatt Hours
HOURS RUN	**P514**	H	Read only for hours run
INS	**P515**	-----	Read only term inputs TB1-12,--,23
LAST FAULT	**P516**	-----	Read only for last drive fault
FAULT 2	**P517**	-----	Read only for fault before last fault
FAULT 3	**P518**	-----	Read only for fault before fault 2
FLT VOLTS	**P519**	VDC	Read only Volt. output at last fault
FLT FREQ	**P520**	HZ	Read only Freq. output at last fault
F MODE	**P521**	-----	Read only mode status at last fault
FLT CUR	**P522**	A	Read only amp output at last fault

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Status Parameter Menu Summary (P5xx)

Parameter Name	Parameter Number	Units	Info
FLT TIME	**P523**	H	Read only for time of last fault
SW	**P524**	-----	Read only for software and revision
DRIVE SIZE	**P525**	HP	Read only drive size
L SPD	**P526**	FPM	Read only for line speed
CDIA	**P527**	inch	Read only for calculated diameter
TEN	**P528**	LBS	Read only for Tension
D HP	**P529**	HP	Read only demand HP
F HP	**P530**	HP	Read only feedback HP
E HP	**P531**	HP	Read only error HP
CGAIN	**P532**	-----	Read only calculated gain
CONTROL	**P533**	------	Read only Open, closed mode
MODE	**P534**	------	Read only Torque, speed override

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Status Parameter Menu Descriptions (P5xx)

SPEED **Parameter (P500) read only**
Speed of the motor (in the engineering units specified by parameters P003,P005. With encoder feedback the drive shows the speed of the motor whether the drive is started or stopped. If the re is no encoder feedback the drive displays the speed of the motor when the drive is started only.

SET SP **Parameter (P501) read only**
Displays the requested or set speed of the motor in engineering units as set by parameters P003—P005.

SPEED ERR **Parameter (P502) read only**
Displays the error in speed between set speed and feedback speed.

MOTOR TORQ **Parameter (P503) read only**
Displays the output motor torque as a percentage. 100%= the value set in P302

MOTOR I **Parameter (P504) read only**
Displays the output motor current in Amps RMS

MOTOR HZ **Parameter (P505) read only**
Displays the output motor speed in Hertz

MOTOR V **Parameter (P506) read only**
Displays the output motor voltage

RMOTORTOR **Parameter (P507) read only**
Displays the requested motor torque in percent. 100%=the value set in P302

IN WATTS **Parameter (P508) read only**
Displays the estimated input power in watts

INPUT PF **Parameter (P509) read only**
Displays the estimated input power factor

BUSS VOLTS **Parameter (P510) read only**
Displays the DC buss voltage

IXT ACCUM **Parameter (P511) read only**
Displays a value of the percentage of time used before the drive will trip due to operation above 100% full load current. When the value of this parameter reaches 100 the drive will trip

DB ACCUM **Parameter (P512) read only**
Displays a value of the dynamic braking overload accumulator when the value reaches 100% and Dynamic braking is being used the drive will trip

CTCW WIND / UNWIND APPLICATIONS SOFTWARE

Status Parameter Menu Descriptions (P5xx) cont.

TOTAL KWH **Parameter (P513) read only**
Displays a value of estimated power consumption in Kilowatt-hours, since initial installation or since the last time all memory was defaulted to user or factory defaults. The display will roll over to zero at 999,999 hours.

HOURS RUN **Parameter (P514) read only**
Displays the number of hours the drive has run since its initial installation. The counter will roll over to zero at 999,999 hours and cannot be reset

INS **Parameter (P515) read only**
Displays the status of the digital inputs on TB1. Each digit in the display from left to right corresponds to terminals TB1-12 to TB1-23 a Zero (0) = open and a one (1) = closed.

LAST FAULT **Parameter (P516) read only**
Displays the last fault that has occurred. Refer to the faultfinding section for further explanations

FAULT 2 **Parameter (P517) read only**
Displays the fault before the last fault that occurred

FAULT 3 **Parameter (P518) read only**
Displays the fault before the fault 2 that occurred

FLT VOLTS **Parameter (P519) read only**
Displays the buss voltage at the time that the last fault occurred

FLT FREQ **Parameter (P520) read only**
Displays the motor speed in hertz at the time the last fault occurred

F MODE **Parameter (P521) read only**
Displays what the operational mode of the drive was at the time when the last fault occurred. For ex: (“accel fwd”, “running”, “decel fwd”, etc)

FLT CUR **Parameter (P522) read only**
Displays the motor RMS current in amps at the time the last fault occurred

FLT TIME **Parameter (P523) read only**
The time of occurrence of the last fault trip, expressed in terms of hours run (P514).

SW **Parameter (P524) read only**
Displays software program and revision number

DRIVE SIZE **Parameter (P525) read only**
Displays the drives horsepower rating

L SPD **Parameter (P526) read only**
Displays the current line speed in FPM feet per minute

CTCW WIND / UNWIND APPLICATIONS SOFTWARE

Status Parameter Menu Descriptions (P5xx) cont.

CDIA **Parameter (P527) read only**
Displays the current calculated diameter of the roll.

TEN **Parameter (P528) read only**
Displays the current tension

D HP **Parameter (P529) read only**
Displays the demand horsepower which is based on the line speed and the tension. If either the tension or line speed change this value will change. Zero will be displayed at zero speed.

F HP **Parameter (P530) read only**
Displays the feedback horsepower which is based on the line speed and the tension. If either the tension or line speed change this value will change. Zero will be displayed at zero speed.

E HP **Parameter (P531) read only**
Displays the difference between the requested demand HP and the feedback HP. This is the error HP and in theory should be zero

CGAIN **Parameter (P532) read only**
Displays the current gain value of the drive while in operation

CONTROL **Parameter (P533) read only**
Displays the drives current mode of operation either open loop or closed loop operation.

MODE **Parameter (P534) read only**
Displays whether the drive is in torque mode or in speed override

CTCW WIND / UNWIND APPLICATIONS SOFTWARE

TUNE Parameter Menu Summary (P6xx)

Parameter Name	Default Value	Parameter Number	Value Range Min / Max	Units	Info	Run Edit
AC TUNE:	D	**P600**	Disable, Enable		Enable AC tune test	No
SYS WN:	10	**P601**	1…...200	-----	System Bandwidth	Yes
SYS GAIN:	0.000	**P602**	0.000…999.000	----	System Gain	Yes
CAR FREQ:	6.5 kHz	**P603**	6.5	----	Carrier frequency kHz	Yes
MOTOR PPR:	1024	**P604**	0….9999	PPR	Pulses per Rev. of encoder	No
STATOR R:	0.000	**P605**	0.000…32.000	OHM	Stator resistance in ohms	Yes
SLIP FREQ:	0.000	**P606**	0.000…32.767	HZ	Slip frequency in Hertz	Yes
LEAKAGE:	0.0000	**P607**	0.0000..99999.000		HENRIES leakage in henries	Yes
kA CMD:	0.000	**P608**	0.000..99999.000		Ka (PID Tuning)	Yes
KV CMD:	0.000	**P609**	0.000..99999.000		KV (PID Tuning)	Yes
KP FBK:	0.000	**P610**	0.000..99999.000		Kp (PID Tuning)	Yes
KD FBK:	0.000	**P611**	0.000..99999.000		Kd (PID Tuning)	Yes
INVERT:	PGN MTN 0	**P612**	PGN MTN 0, PGN MTI 1, PGI MTN 2, PGI MTI 3			No
SET T:	0.500	**P613**	0…..10.00	S	Settle Time	Yes
H MASK:	895	**P614**	0…..1023	-----	Hardware fault mask	Yes
S MASK:	64751	**P615**	0…..65535	-----	Software fault mask	Yes
IN VOLTS:	230,460,575	**P616**	50…..635	-----	Incoming voltage	Yes
I KP:	400	**P617**	0…10000	------	current loop proportional gain	Yes
I FDFWD:	1.000	**P618**	0….5.000	-----	Current loop Feed forward	Yes
I R FDFWD:	1.000	**P619**	0….5.000	-----	Current loop IR feed fwd comp.	Yes
UPID SPEED:	FAST	**P620**	FAST, MED	-----	Velocity loop execution freq.	No

CTCW WIND / UNWIND APPLICATIONS SOFTWARE

TUNE Parameter Menu Summary (P6xx) cont.

Parameter Name	Default Value	Parameter Number	Value Range Min / Max	Units	Info	Run Edit
V P Hz:	Disable	**P621**	Disable, Enable	-----	Volts per Hertz Mode	Yes
Boost:	0	**P622**	0…..100	%	V per Hz boost	Yes
DB Watts:	0	**P623**	0…..50000	Watts	Watt rating of db	Yes
DB RES:	0	**P624**	0….600.00	OHM	DB resistance in ohms	Yes
DB T CON:	25	**P625**	1…..60	Sec.	DB resistance time const.	Yes
DB PER:	0	**P626**	0….50000	%	actual DB watts dissipated	Yes
VR TL:	0	**P627**	0…32768	(ENG)	Vel error toler	Yes
VR:	0	**P628**	0…32768	(ENG)	Max Vel Error	Yes
LOWPASS FREQ:	50	**P629**	0…..9999	HZ	Low pass torque HZ	Yes
NOTCH FREQ:	0	**P630**	0…..9999	HZ	Notch torque frequency	Yes
OPEN LOOP:	D	**P631**	Disable,enable	-----	Open loop test	N0

CTCW WIND / UNWIND APPLICATIONS SOFTWARE

TUNE Parameter Menu Descriptions (P6xx)

ACTUNE **Parameter (P600) AC Auto-tune**
This parameter enables the AC tune test which after initial motor data is entered will auto tune the drive and set up the motor map parameters automatically. This auto-tune can be run with the motor coupled or uncoupled.

SYS WN **Parameter (P601) System Natural frequency gain**
This parameter adjusts the tightness of the motor response. Normal values for this parameter range from 2-60, with higher values representing increased response. This parameter is much like current loop gain. This parameter is not adjusted by the Auto-tune procedure.

SYS GAIN **Parameter (P602) System Gain**
This parameter adjusts the velocity loop gain. The auto-tune procedure sets this parameter. Higher values will result in greater response but to high a value can result in instability. Normal values range from 20-200.

CAR FREQ **Parameter (P603) Carrier frequency**
This parameter displays the PWM carrier frequency. This frequency is 6.5KHZ and cannot be changed.

MOTOR PPR **Parameter (P604) Motor Encoder Pulse per revolution**
This parameter displays the number of counts of the encoder per revolution for one channel. This parameter is set up by the auto-tune procedure but also may be edited from the key pad. If no encoder is used then this parameter must be set to (0). The power must be turned off and back on for any changes to be recognized when editing this parameter.

STATOR R **Parameter (P605) Motor stator resistance**
This parameter displays the stator resistance in ohms of the motor. This parameter is set by the auto-tune procedure. Editing of this parameter is permitted from the keypad but only if the stator resistance in known or provided on the nameplate of the motor, it is advised to let the auto-tune procedure set the value.

SLIP FREQ **Parameter (P606) Motor slip frequency**
This parameter is set by the auto-tune procedure. This parameter can be set manually from the keypad, if changed manually then the auto-tune should be performed again to allow the drive to reset the system gain for the new slip value.

LEAKAGE **Parameter (P607) Motor leakage**
This parameter is set by the auto-tune procedure and displays the motor leakage inductance, do not change this value.

KA CMD **Parameter (P608) Derivative (velocity) gain**
This parameter sets the derivative velocity gain of the drive. This parameter is set by the auto-tune procedure. This parameter changes every time parameter (601) or (602) is changed.

CTCW WIND / UNWIND APPLICATIONS SOFTWARE

TUNE Parameter Menu Descriptions (P6xx) cont.

KV CMD **Parameter (P609) Proportional (velocity) gain**
This parameter sets the proportional velocity gain of the drive. This parameter is set by the auto-tune procedure. This parameter changes every time parameter (601) or (602) is changed.

KP FBK **Parameter (P610) Proportional (velocity) feedback gain**
This parameter sets the proportional velocity feedback gain of the drive. This parameter is set by the auto-tune procedure. This parameter changes every time parameter (601) or (602) is changed.

KD FBK **Parameter (P611) Derivative (velocity) feedback gain**
This parameter sets the derivative velocity feedback gain of the drive. This parameter is set by the auto-tune procedure. This parameter changes every time parameter (601) or (602) is changed.

INVERT **Parameter (612) Invert motor or encoder phasing**
His parameter is used to invert the motor or encoder phasing to allow the motor to run or run in the correct direction without making wiring changes. The following describes the settings of this parameter:
PGN MTN 0 = Pulse generator not inverted / Motor not inverted
PGN MTI 1 = Pulse generator not inverted / Motor inverted
PGI MTN 2 = Pulse generator inverted / Motor not inverted
PGI MTI 3 = Pulse generator inverted / Motor inverted

SET T **Parameter (P613) set time delay**
This parameter when the parameter (P201) stop mode is set to decel and the drive is in slave mode will set the time that the drive waits after reaching stop before it is turned off. After jogging, or running in master mode and is stopped the drive waits set t time before switching to slave mode.

H MASK **Parameter (P614) Hardware mask Default 3967 = all faults enabled**
S MASK **Parameter (P615) Software mask Default 65535 = all faults enabled**
These two parameters are used to allow for the disabling of certain faults. Some faults are not maskable. By subtracting the values listed below for hardware and software faults from the default values listed above the faults can be disabled.

Hardware faults:
Peak I Limit (POC) =(1)
Heatsink Temp (HSOT) = (4)
Ext. fault trip (EXT) = (32)
Web break 1 (WB1) = (1024)
Ambient Overtemp (AOT) = (2)
Logic Ps Fault (PSF) = (16)
PG card fault (PGC) = (256)
Web break 2 (WB2) = (2048)

Software faults:
IXT current trip (IXTT) = (2)
Motor runaway (RUN) = (8)
Motor not wired (NOMO) = (16)
I Loop loss (ILL) = (32)
Excessive DB (EXDB) = (256)
FBK marker fault (MOMA) = (512)
HW fault (LEM) = (1024)
No speed select (ZERO) = (2048)
UART receive (SERR) = (16384)
FWD REV (DIR) = (32768)

CTCW WIND / UNWIND APPLICATIONS SOFTWARE

TUNE Parameter Menu Descriptions (P6xx) cont.

IN VOLTS **Parameter (P616) Incoming voltage**
This parameter sets the incoming voltage for 230, 460 or 575 the range of voltage is 50 – 635 volts. This parameter does not affect drive operation it is used for other calculations.

I KP **Parameter (P617) Current loop proportional gain**
This parameter is set up by the auto-tune procedure. It is automatically recalculated when the values of parameters P601 & P602 are changed.

I FDFWD **Parameters (P618) current loop feed forward**
This parameter is set up by the auto-tune procedure. It is automatically recalculated when the values of parameters P601 & P602 are changed. This parameter is the current feed forward parameter an is much like derivative gain for the current loop.

I R FDFWD **Parameter (P619) current loop Internal resistance feed forward**
This parameter is adjusted by the auto-tune procedure. This parameter should not be changed once calculated by the auto-tune procedure.

UPID SPEED **Parameter (P620) UPID frequency**
This parameter is normally set for fast and sets the velocity loop execution frequency. A setting of fast is used for encoder feedback and operates at 1085 HZ. A setting of medium is used for non encoder applications and operates at 543 HZ.

V P HZ **Parameter (P621) Volts per Hertz mode**
This parameter when enabled places the drive in volts per hertz mode. Normally the best motor performance is achieved when this parameter is set to disable and the drive is in the flux vector mode. The drive must have this parameter set at " Disable" for the CTCW software to work.

BOOST **Parameter (P622) Boost for volts per HZ mode**
This parameter increases the drive output voltage in volts per hertz mode to increase the low speed torque.

DB WATTS **Parameter (P623) Dynamic Brake resistor watts**
This parameter is set for the continuous watts for the db resistor divided by 10 so a 3000 watt resistor would have a value of 300 entered into this parameter. There is a 0 displayed at the far right of the display which is the units and should be disregarded.

DB RES **Parameter (P624) Dynamic brake resistor ohms**
This parameter is set to the brake resistors overall resistance in ohms.

DB T CON **Parameter (P625) Dynamic brake res. Time constant**
This parameter is used to predict how long the resistor will take to heat up under steady load. The proper DB T CON is rarely known due to many factors such as load , air flow and resistor construction. This value is normally set at 25 seconds and should provide some protection against overheating yet be long enough to avoid nuisance trips.

CTCW WIND / UNWIND APPLICATIONS SOFTWARE

TUNE Parameter Menu Descriptions (P6xx) cont.

DB PER **Parameter (P626) DB percentage of watts**
This parameter displays the DB resistors current dissipated watts as updated and averaged every 0.5 seconds. DB PER will typically exceed the 100% value when decelerating.

VR TL **Parameter (P627) Velocity Error Tolerance**
This parameter adjust the max velocity error tolerance. This parameter should be set to zero.

VR **Parameter (P628) Max Velocity Error**
This parameter monitors the max velocity error. This parameter is used for other applications and is not useful for the CTCW software.

LOWPASS FREQ Parameter (P629) Low pass torque hertz
This parameter sets the low pass frequency for torque to minimize machine resonance if they exist. This parameter should not be adjusted it is set by the auto-tune procedure.

NOTCH FREQ **Parameter (P630) Notch torque frequency**
This is used to set a notch frequency that the drive will not produce to minimize machine resonance if they exist. Normally set to zero.

OPEN LOOP **Parameter (P631) Open loop test**
This parameter is used only for testing purposes and should not be enabled.

APPLICATION EXAMPLE

Criteria	Units	Application Data
Wind or Unwind	-	Wind
Maximum Line Speed	FPM	455 FPM
Minimum Line Speed	FPM	25 FPM
Core Minimum Diameter	Inches	3 in
Full Roll Diameter	Inches	30 in
Full Roll Weight (Maximum)	Pounds	1000 lbs
Web Width (Maximum)	Inches	48 in
Web Width (Minimum)	Inches	48 in
Web Tension (Maximum)	Pounds	100 lbs
Web Tension (Minimum)	Pounds	50 lbs
Web Material Description (extensible?)	-	25 lb paper, Not extensible
Web Material Thickness	Inches	1/10000 of an inch
Taper Tension For Entire Roll	Percent	5%
Line Acceleration From 0-Full Speed	Seconds	20 seconds
Estimated Mechanical Losses	Percent	10%
Total Gear-In Ratio From Motor To Final Drive	-	3:1 Reduction
Type Of Reduction (ex. Belt, Helical Gearbox, etc.)	-	Timing Belt
Motor Base Speed and Number Of Poles	RPM	1800 RPM, 4 Poles
Motor Top Speed	RPM	3600 RPM
Motor HP	HP	7.5 HP

Parameter 123 (P Tens) = (HP x (FT*LB/HP) x Gear Ratio)/ (CoreRadius (FT))

Parameter 123 (P Tens) = ((7.5 HP x 3 FT*LB/HP) x 3)/(0.125 FT)

Parameter 123= 540 FT*LBS Torque

To scale the tension input (i.e. pot):

Parameter 014 = (core diameter (inches)/(full roll diameter (inches)) x 100%

Parameter 014 = (3 inches / 30inches) x 100% = 10 %

APPLICATION EXAMPLE (Continued)

Parameter #	Value	Parameter #	Value	Parameter #	Value
P001	1800	P113	3	P419	OFF
P006	0	P114	10	P601	DIS
P007	1800	P115	0	P604	1024
P009	0.1	P116	0	ALL OTHER 600 MENU PARAMETERS ARE SET WHEN THE AUTO-TUNE PROCEDURE IS PERFORMED.	
P010	0.1	P117	999.9		
P015	3	P118	100		
P016	3	P119	100		
P017	3	P123	540		
P018	5	P200	Torque		
P100	3.0	P201	Coast		
P101	0	P208	No Rev		
P102	10	P212	ON		
P103	50.0	P300	7.5		
P104	30	P301	1800		
P105	0,10	P302	10.7		
P106	ENA	P303	4.28		
P107	E	P304	16.05		
P108	AUTO-TUNED	P305	460		
P109	30.0	P306	60		
P110	AUTO-TUNED	P307	1800		
P111	30.0	P308	105		
P112	AUTO-TUNED	P401	455		
		P406	PTENS		
		P407	100		
		P408	0		

PARAMETER SETTINGS

Parameter #	Parameter Value	Date Value Recorded	Parameter #	Parameter Value	Date Value Recorded
P000			P104		
P001			P105		
P002			P106		
P003			P107		
P004			P108		
P005			P109		
P006			P110		
P007			P111		
P008			P112		
P009			P113		
P010			P114		
P011			P115		
P012			P116		
P013			P117		
P014			P118		
P015			P119		
P016			P120		
P017			P121		
P018			P122		
P020			P123		
P100			P124		
P101			P125		
P102					
P103					

PARAMETER SETTINGS

Parameter #	Parameter Value	Date Value Recorded	Parameter #	Parameter Value	Date Value Recorded
P200			P307		
P201			P308		
P202			P309		
P203			P310		
P204			P311		
P205			P312		
P206			P313		
P207			P314		
P208			P315		
P209			P316		
P210			P317		
P211			P318		
P212			P319		
P213			P400		
P214			P401		
P215			P402		
P216			P403		
P300			P404		
P301			P405		
P302			P406		
P303			P407		
P304			P408		
P305			P409		
P306			P410		
			P411		

PARAMETER SETTINGS

Parameter #	Parameter Value	Date Value Recorded	Parameter #	Parameter Value	Date Value Recorded
P412			P607		
P413			P608		
P414			P609		
P415			P610		
P416			P611		
P417			P612		
P418			P613		
P419			P614		
P420			P615		
P421			P616		
P422			P617		
P423			P618		
P424			P619		
P425			P620		
P426			P621		
P427			P622		
P428			P623		
P600			P624		
P601			P625		
P602			P626		
P603			P627		
P604			P628		
P605			P629		
P606			P630		
			P631		

CTCW Application Data Sheet

The SV3000 CTCW software was designed for, and performs very well as a standard package on applications which meet the following criteria.

- Line speed less than 2000 ft/min.
- Build-up range less than 10:1.
- Tension range (w/combined build-up) less than 20:1.
- Tension resolution 1-3% (machine dependent).
- Overall gear reduction less than 20:1 with 85% or greater efficiency.
- Line speed acceleration or decel greater than 15 seconds (0- max speed).
- Reflected Inertia at motor shaft not greater than 15X motor rotor inertia.
- Minimum tension requirement 10% greater than frictional torque requirement (Machine dependent).

Applications that do not fall into the above ranges may still be possible and should be reviewed at the address and phone number listed on the back cover.

1) Wind or unwind _____

2) Maximum line speed in feet per minute _____

3) Minimum line speed in feet per minute _____

4) Core minimum diameter in inches _____

5) Full roll diameter in inches _____

6) Full roll weight, maximum in pounds _____

7) Web width maximum in inches _____

8) Web width minimum in inches _____

9) Web tension maximum in pounds (PLI) _____

10) Web tension minimum in pounds (PLI) _____

11) Web material description, is web material extensible. _____

12) Web material thickness, in inches or mils. _____

13) Taper tension, in percent for entire roll. _____

14) Line acceleration in seconds from 0-full speed _____

15) Estimated mech losses in machine, percent _____

16) Total gear-in ratio from motor to final drive _____

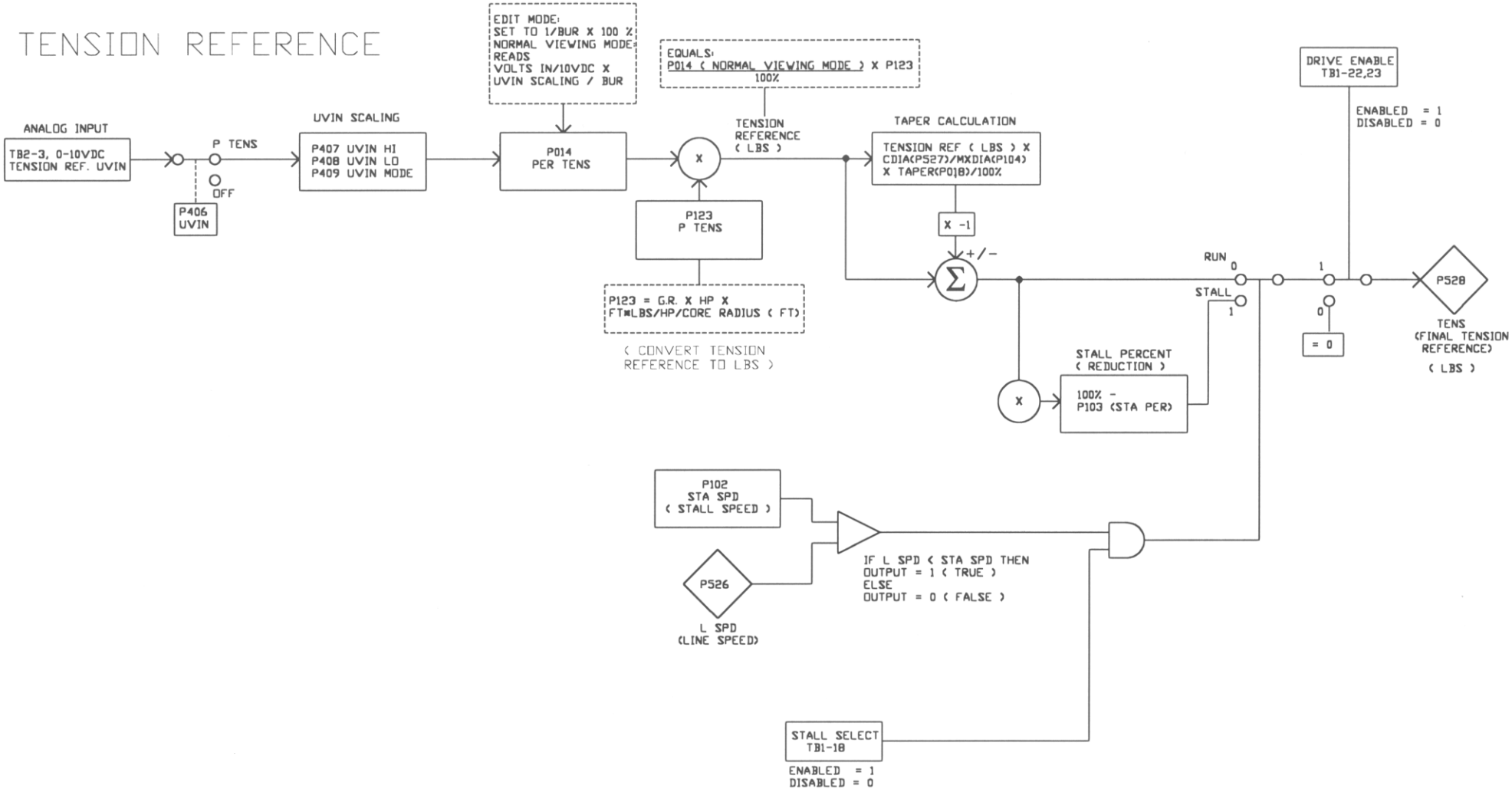
17) Type of reduction (ex.: belt, helical gearbox etc.) _____

18) Motor base speed in RPM or motor poles _____

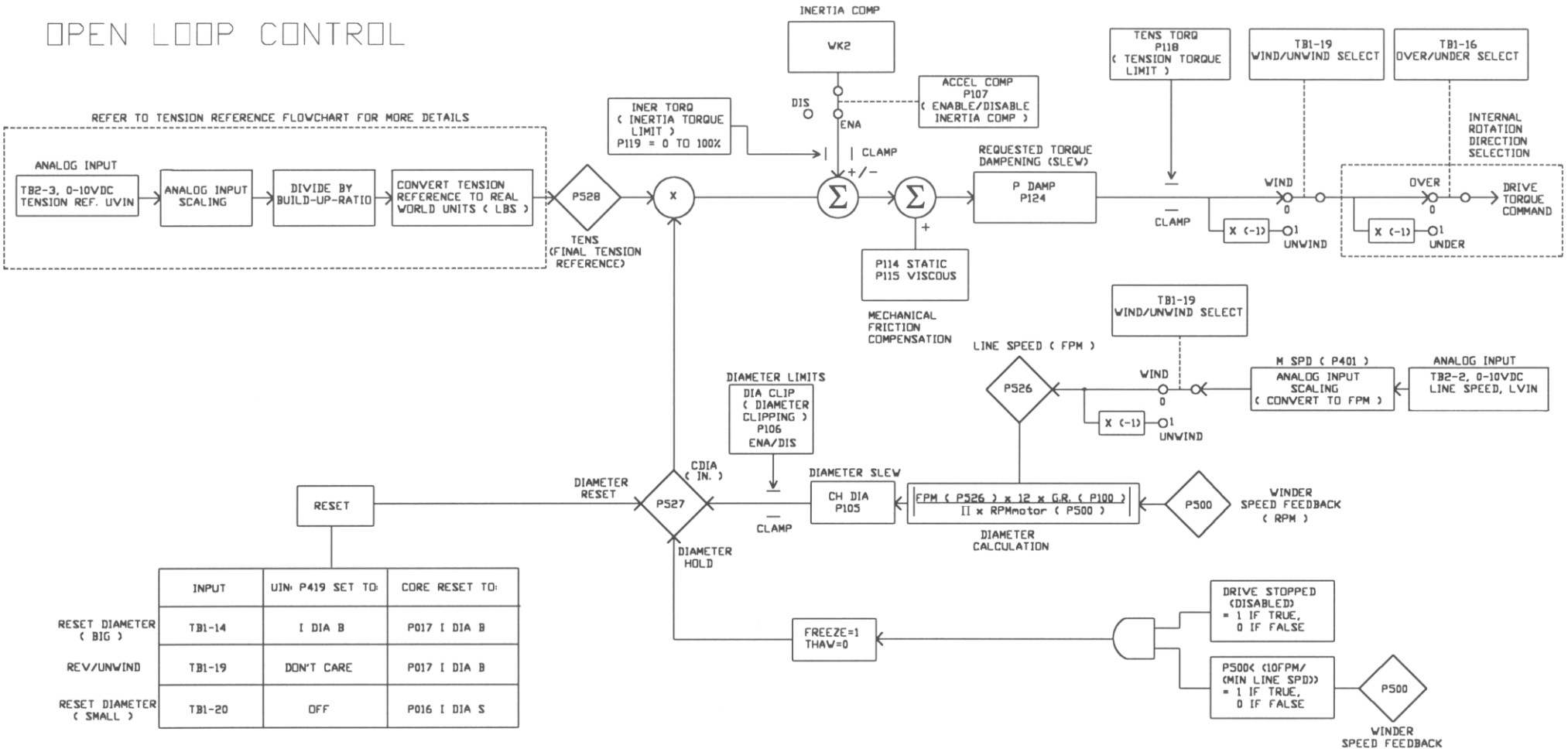
19) Motor top speed in RPM _____

20) Motor HP _____

TENSION REFERENCE

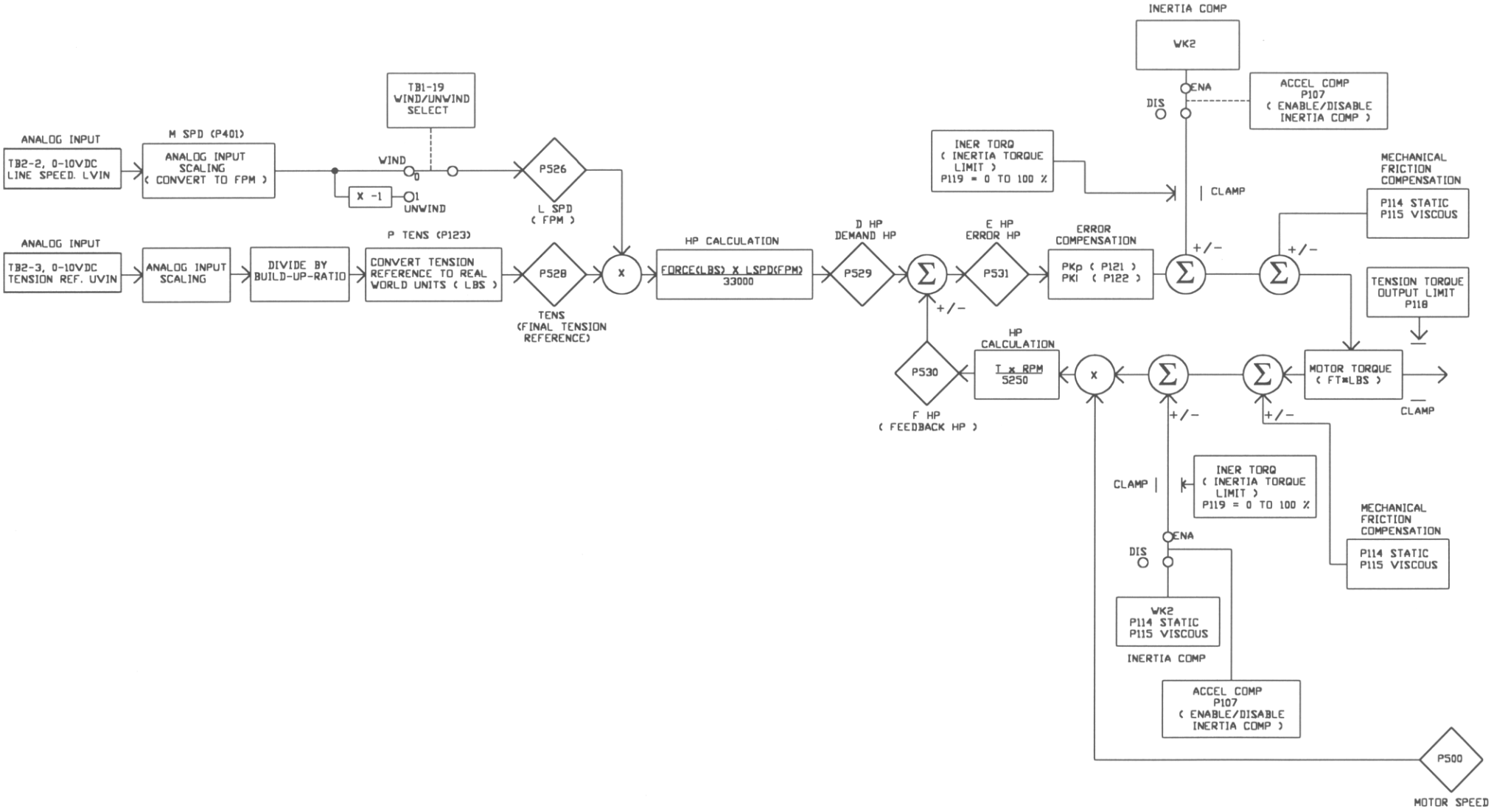


OPEN LOOP CONTROL

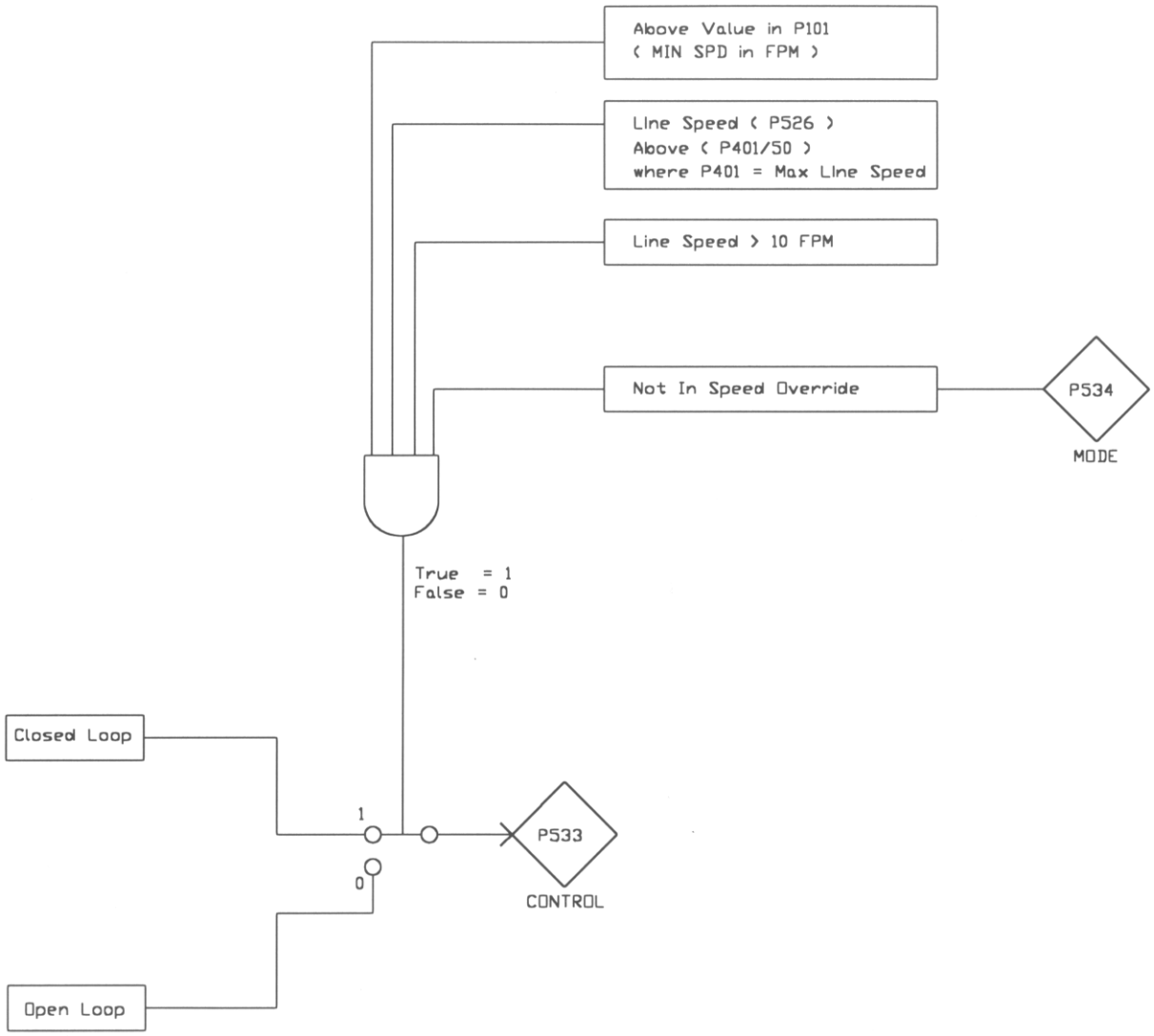


	INPUT	UIN: P419 SET TO:	CORE RESET TO:
RESET DIAMETER (BIG)	TB1-14	I DIA B	P017 I DIA B
REV/UNWIND	TB1-19	DON'T CARE	P017 I DIA B
RESET DIAMETER (SMALL)	TB1-20	OFF	P016 I DIA S

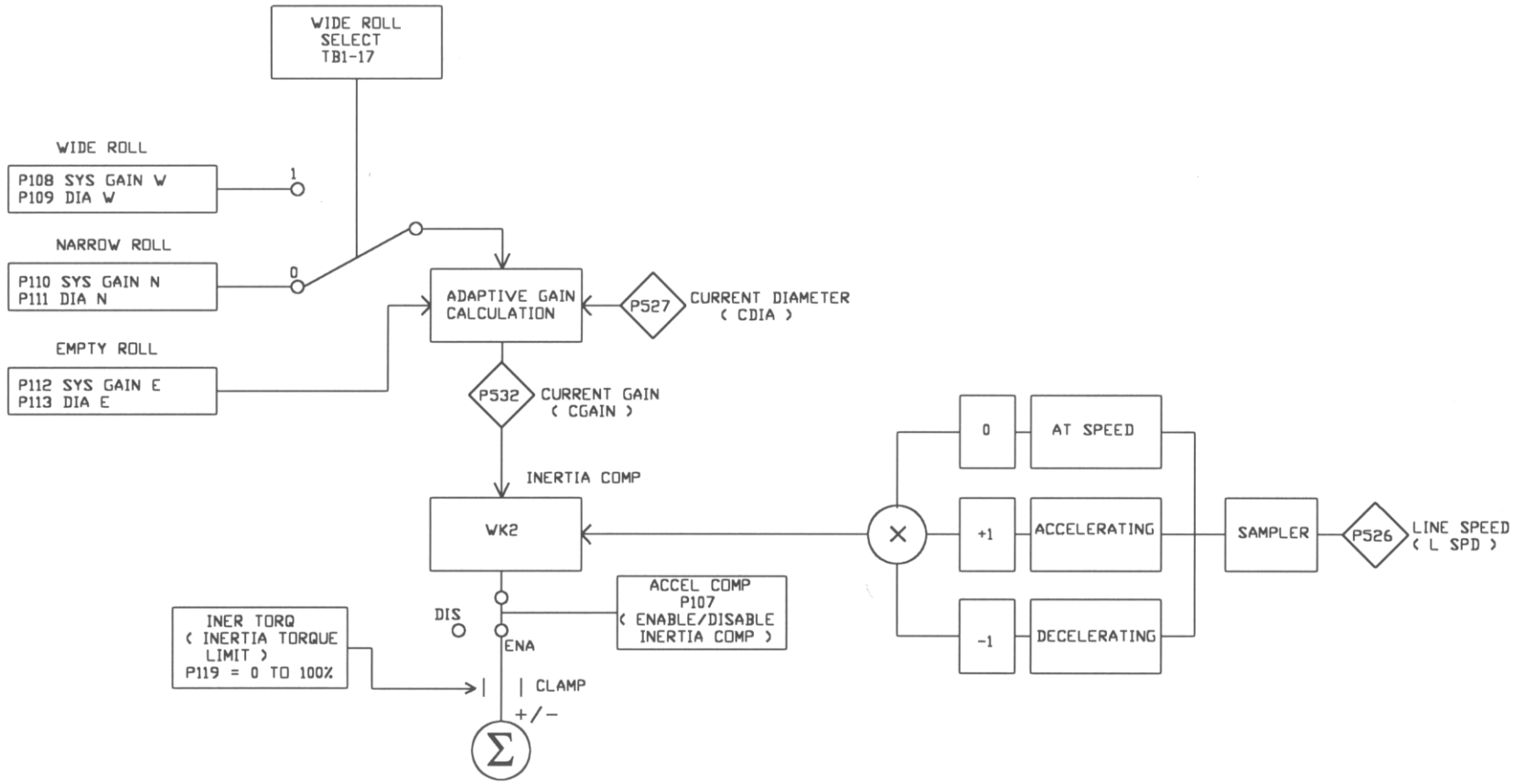
CLOSED LOOP CONTROL



MODES OF OPERATION

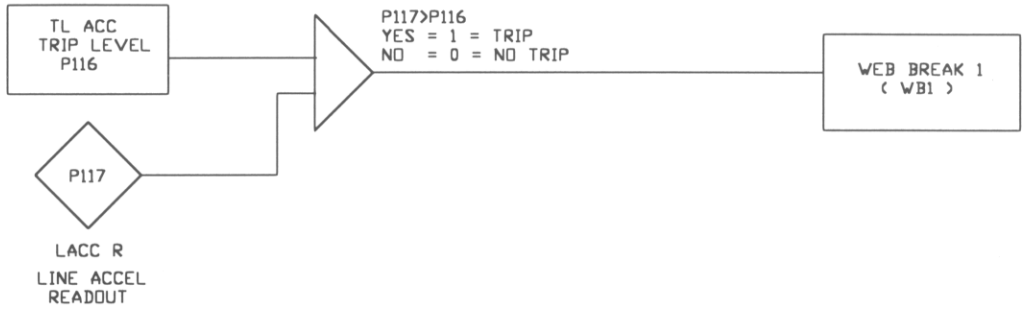


INERTIA COMPENSATION CALCULATION

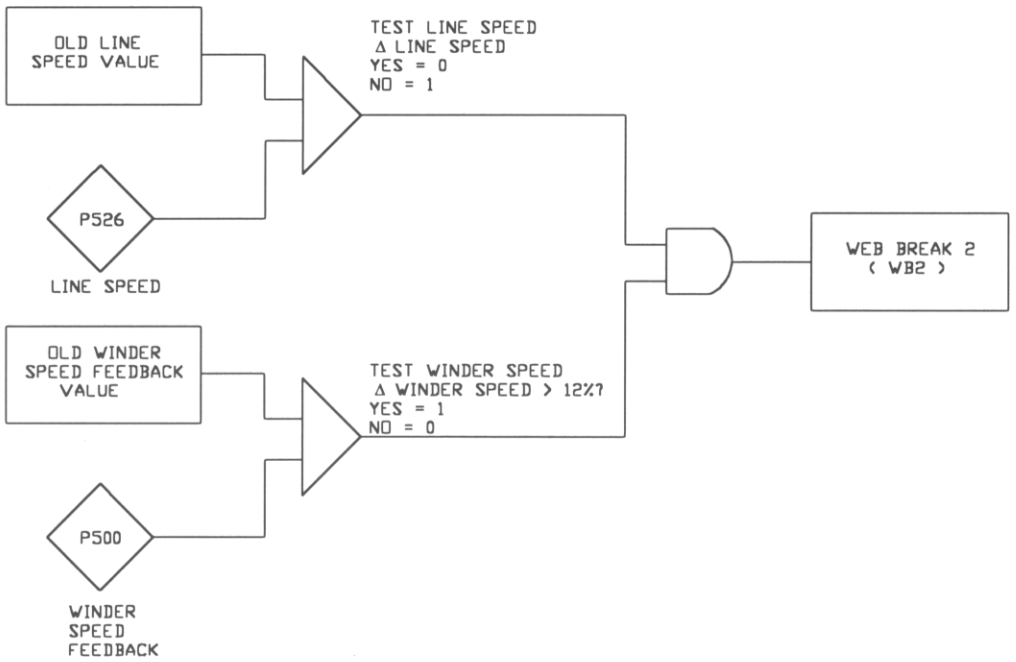


WEB BREAK 1 & 2

WEB BREAK 1
(WB1)



WEB BREAK 2
(WB2)



Distribution Coast to Coast and International

Danaher Motion Engineered Systems Center Adjustable Speed Drive products are available worldwide through an extensive authorized distributor network. These distributors offer literature, technical assistance and a wide range of models off the shelf for fastest possible delivery and service.

In Addition, Danaher Motion Engineered Systems Center located in Charlotte, NC can integrate any Danaher Motion product into engineered systems. Coordination with PC or PLC based control and Man-Machine Interfaces can be provided as solutions to complex process control issues.

In U.S.A. and Canada
Danaher Motion Engineered Systems Center

Customer Service: (704) 588-5693 x 275
Product Application: (704) 588-5693 x 205, 202
Product Literature Request: (704) 588-5693 x 275
Fax: (704) 588-5695
Web Site: http://www.superiorelectric.com
13500-J South Point Blvd.
Charlotte, NC 28273

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