User Guide
Unidrive®
Digital AC Drives

UD70 Software
Dual Mode
Winder Program

Kit Part Numbers UD70-DMW
UD73-DMW
UD74-DMW
UD75-DMW
UD77-DMW

CONTROL TECHNIQUES

This document describes the parameters and operation of the Dual Mode Winder Program for use with Unidrive® drives fitted with a UD70 coprocessor option.

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HOW TO USE THIS MANUAL

This manual is intended as a reference to the user of the Control Techniques Dual Mode Winder program. It presents a basic overview of the winding process, instructions for setup of a winder program in a Unidrive, a full list of the parameters involved in setting up a winder program, winder program examples, a glossary, information on multi-spindle applications, and an index.

Unidrive parameters have number designations that consist of the menu number and the specific parameter number (for example, 19.21 is menu 19, parameter 21). Unisoft software separates parameters and their values with a colon. Throughout this manual, parameters are designated by a "#" symbol and they are separated from their value by a "=" symbol.

WINDER SYSTEMS PRINCIPLE OF OPERATION

Winder programs enable the drive to control the winding or unwinding of various materials (metal wire, paper, plastic film, etc.). Winding programs must permit feedback from devices (dancers, loadcells, potentiometers, sensors, etc.) and precisely measure and control diameter, torque and speed.

The Dual Mode Winder Program for Unidrive® UD70 can operate in either speed (velocity) or torque (tension) mode, or a combination of the two, to meet the needs of single or multi-turret (multi-spindle) applications. Torque mode is generally preferred for metal or paper; speed mode is generally preferred for thinner media, such as plastics. In torque mode, the material tension is held constant as the roll diameter increases/decreases during the winding/unwinding of the material. This is sometimes referred to as Constant Tension Center Winding (CTCW). This term applies solely to the tension being held in torque mode. In speed mode, the roll velocity is adjusted to keep the tension constant.

Applications that require continuous winding through multi-turret setups will use both speed and torque memory modes to accomplish the winding process. See Appendix D for more information.

The Dual Mode Winder program controls the power output of the AC motor in open loop, closed loop, or servo control. Open loop control is typically found in applications when no feedback is available. This allows operation with relatively low demand winding applications, in speed or torque mode, with induction motors only. Closed loop control is the most popular motor mode for winding applications, having feedback for better control of the drive speed and torque in speed and torque modes. Servo control is used for very thin films or high response applications in speed and torque modes when the use of a high response servo motor would be beneficial.

This Dual Mode Software can be used with CT Net or with an external PLC, which determines the final control of the overall system. The Dual Mode Software reacts to the logic and data inputs from this external control. In a full CT Net system using SYPT, the PLC can be eliminated by writing a winder sequence control program and by using CT Net I/O for the customer's controlling inputs.

MODES OF OPERATION

Speed Mode

This winder method uses a line speed reference and the winder spindle speed to calculate the roll diameter. A prediction of winder spindle speed can be calculated, if the diameter is known. To compensate for any material or machine variation, a signal (from a loadcell or dancer) is used to trim the spindle speed, with the use of a PID trim function. This method provides excellent material control over large speed ranges, high dynamic tension ranges and large build up ratios.

In the Dual Mode Winder, the torque requirements are the responsibility of the drive's speed control loop. If the speed reference changes and the roll inertia is high, there would be a natural tendency for an initial speed error. However, the drive's high gain speed loop will resolve this by increasing its internal current reference. Therefore, many of these torque-requiring compensations (which can be difficult to predict or determine) are handled automatically.

Dancer and Loadcell program options allow the use of these feedback devices. Dancers provide inherent material storage, when the material itself has no stretch properties, and so provide better tension control of low or no stretch materials. Loadcells are commonly used with materials that stretch, and so require no additional storage to buffer tension variations. See the example figures in Appendix C for examples of how dancers and loadcells function.

General Proportional and Integral and Derivative Control (PID)

The speed winder must have closed loop tension or position control to function. This allows the precise spindle speed to be determined. Diameter calculation alone is positive feedback and thus can not be used alone to control a winder in the speed mode.

With loadcell feedback enabled, the PID feedback is strip tension. As a result, the tension reference is the operator's desired tension setpoint, plus any taper tension desired. In loadcell systems, only the proportional and integral gains are used and the derivative gain is set to zero, in the PID.

With dancer feedback enabled, the PID feedback is position, with the reference being the desired position. The actual, resulting strip tension is controlled by the physical force or weight applied to the dancer. In some cases this is an air loading cylinder which is controlled by an electrical air valve. The winder program can supply an output Digital to Analog converter (D/A) signal to control this valve by routing the tension setpoint signal out to the D/A output of the drive. This dancer loading is the only means to control tension in a dancer-controlled system.

With dancer feedback enabled, derivative is especially good for non-stretch materials, such as paper. With extensible films, derivative is not used, because it tends to cause dancer oscillation. When derivative is not used the proportional gain needs to be lower, as with loadcells.

Torque Mode

This winder method applies a decrease or increase of spindle torque, proportional to the diameter. The tension reference is a constant setpoint input. To obtain truly constant material tension, compensation must be made to the motor torque reference to take account of the effect of system friction, of system and roll inertia, and of machine losses. The machine losses are comprised of all the various current requiring sub-components of the winding problem, such as: Viscous Losses-Windage and Dynamic Friction; Static Friction; Breakaway Torque; Inertia Compensation for Accelerating & Decelerating Torque; and Tension Reference.

In basic terms, Tension is the intended variable to be controlled by adjusting motor torque.

$$\textbf{Strip Tension} = \frac{\textbf{Spindle Torque}}{\textbf{Diameter}}$$

In a winder/unwinder, the diameter is always changing. The torque must keep in step with the changing diameter, in order to maintain a constant tension. However, a certain amount of torque must be added to compensate for the torque required to accelerate a large roll vs. a small roll. Also, a certain amount of torque must be added to provide the torque required to overcome the frictional and viscous losses, etc. which can vary over the speed range. Tension can be very difficult to control, especially if the torque requirements to compensate for these factors is an appreciable part of the torque required to control tension. Therefore, for fine tension control on delicate material CTCW may have a difficult time resolving the required torque. CTCW however, is best for applications where there is substantial strip tension and where a trim device is not available. CTCW can perform without the need for a feedback device such as a loadcell or dancer. The CTCW program can also, however, optionally accommodate these trim devices which will allow it to control tension much more accurately, when needed.

WINDER BLOCK

The external control inputs listed in figure 1 are typically excited by a PLC that is also performing other winder logic functions, especially on multi-turret winders. In many processes where the material to be wound is manufactured in the process line itself, such as cast or blown plastic films, productivity would be limited without the ability to run continuously. In other processes, such as printing or laminating, the adjustments of coating and curing, should be repeated as little as possible for greatest product yields. In any process where goods are wound and where set-up is laborious, one-time setup for a particular product has advantages. In these processes, the use of the Turret Unwinder and Rewinder allows these operations to be continuous.

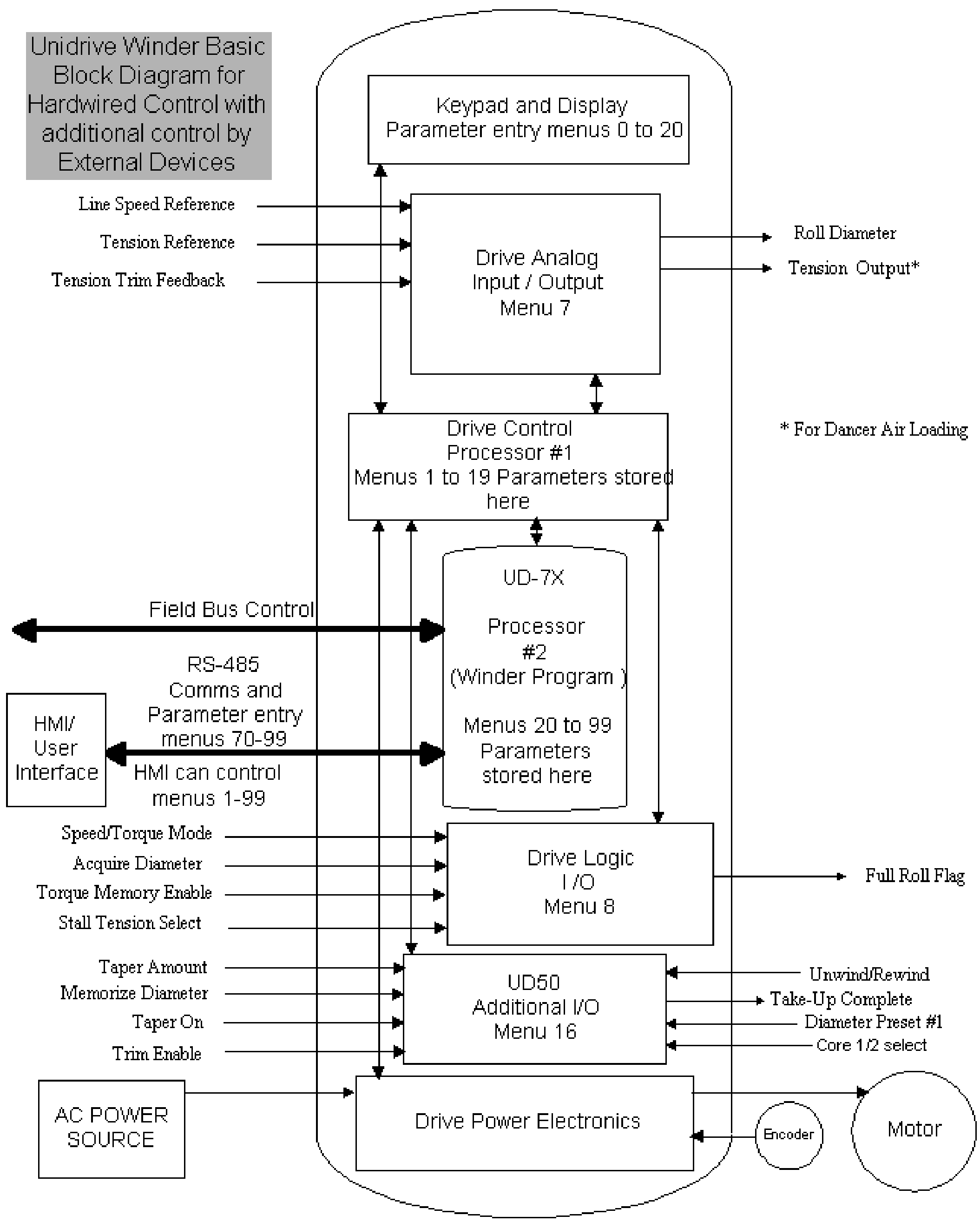


Figure 1. Basic Winder Block Diagram

INSTALLATION

⚠WARNING

Variable speed drives may be hazardous if misused. This drive and associated motor contain hazardous voltages and rotating mechanical parts. The voltages present in the drive are capable of inflicting a severe electric shock and may be lethal. The stop function of the drive does not remove dangerous voltages from the drive or driven machine.

AC supplies to the drive must be discontinued at least 15 minutes before any cover is removed or servicing work is performed.

If this is the first time the drive has been operated, ensure that no damage or safety hazard could arise from the motor starting unexpectedly.

The motor must be fixed down and the shaft guarded against inadvertent contact.

Do not change parameter values without careful consideration; wrong values may cause damage or a safety hazard.

When it is necessary to make measurements with the power turned on, do not touch any electrical connection points. Remove all jewelry from wrists and fingers. Make sure test equipment is in good, safe operating condition.

Carefully follow the warnings, cautions and instructions in this User Guide and in the *Unidrive User Guide* (P/N 0460-0021).

Only qualified personnel familiar with this type of equipment and the information supplied with it should be permitted to install, operate, troubleshoot or repair the apparatus. A qualified person must be previously trained in the following procedures:

- Energizing, de-energizing, grounding, and tagging circuits and equipment in accordance with established safety practices.
- Using protective equipment, such as rubber gloves, hard hat, safety glasses or face shields, flash clothing, etc., in accordance with established safety practices.
- Rendering first aid.

Installation of the equipment must be done in accordance with the National Electrical Code and any other state or local codes. Proper grounding, conductor sizing, and short circuit protection must be installed for safe operation.

Please install the Unidrive drive according to the instructions in the *Unidrive and Unidrive LV User Guide* (P/N 0460-0021) and *Installation Guide MD29/UD70* (P/N 0400-0030).

Unpacking

Before proceding to the actual installation, check the contents of the kit to make certain that all items have been included. If anything is damaged or missing, please contact your Control Techniques sales source.

To install the Dual Mode Winder system without fieldbus described in this manual, you will need the UD70-DMW kit that includes the following items:

- UD70 Large Option Module with Dual Mode Winder software loaded
- UD50 Second Option Module
- CD-ROM with set-up examples

Please refer to *UD70 Large Option Module User Guide* (P/N 0447-0017).

If you wish to use Profibus DP, you will need an UD73-DMW kit that includes the following items:

- UD73 Large Option module with Dual Mode Winder software loaded
- UD50 Second Option Module
- CD-ROM with set-up examples

For more information, please refer to *Profibus DP User Guide* (P/N 0447-0022).

If you wish to use Interbus-S, you will need an UD74-DMW kit that includes the following items:

- UD74 Large Option module with Dual Mode Winder software loaded
- UD50 Second Option Module
- CD-ROM with set-up examples

If you wish to use CT Net, you will need an UD75-DMW kit that includes the following items:

- UD75 Large Option module with Dual Mode Winder software loaded
- UD50 Second Option Module
- CD-ROM with set-up examples

For more information, please refer to *CTNet User Guide* (P/N 0447-0009).

If you wish to use DeviceNet, you will need an UD77-DMW kit that includes the following items:

- UD77 Large Option module with Dual Mode Winder software loaded
- UD50 Second Option Module
- CD-ROM with set-up examples

For more information, please refer to *DeviceNet UD77/MD25 User Guide* (P/N 0447-0034)

The following items are available from Control Techniques as options:

- Cables
- Unisoft software (if wish to use software interface rather than the keypad on front of Unidrive)
- CTKP Keypad
- CTIU Interface panel
- CT Browser software (if wish to use software interface rather than the keypad on front of Unidrive)

Once the mechanical installation of the Unidrive is complete, the coprocessor module (UD70) or the Large Option module (UD73, UD74 OR UD77) and UD50 Second Option Module, if applicable, must be plugged in. Then, the I/O wiring must be completed. To determine wiring, determine parameter assignments and use the example programs in Appendix C as a guide.

Setting Up Parameters

You will need to set up the basic drive parameters before setting up the Dual Mode Winder Program specific parameters. For more information on the basic Unidrive® parameters, refer to *Unidrive and Unidrive LV User Guide* (P/N 0460-0021). Parameters can be set either with Unisoft software and a RS485 converter or with the keypad on the front of the Unidrive drive. If using Unisoft software, be sure to read all parameters from the drive, select the motor mode (open loop, closed loop or servo), and set the motor rated current in #5.07, before setting the parameters in this chapter. Menu 70 parameters should be set through a CTIU Interface panel.

A full list of the parameters discussed in this chapter can be found in Appendix A.

Before commencing setup, make sure all the necessary calculations have been made. Most of the information for the parameters should have been calculated already. If any have not, then you should calculate them before inputting the parameters. Inertia Compensation and PID related values will need to be calculated.

Operational Mode

Parameter #19.33 determines whether the program will run in speed or torque mode. Select 0 for torque mode or 1 for speed mode. This important parameter will determine which of the parameters from the following two sections will be necessary. For more information on these two modes, please read the "Modes of Operation" chapter.

Menu 70 Parameters

Menu 70 parameters can be accessed through a CTKP Keypad, CTIU Interface panel or CTNet Browser software. To establish or change these parameters in CT Browser software, open the software and establish a connection to the drive. These parameters can be set while the drive is online. Open the CT Browser window and type the parameter number and the desired value: for example, #70.39=500.

Bit parameters in menus 70-73 are described herein with the third numeric position. For example, #70.58.0 in the text, which is equivalent to _P58%.0, is the least significant bit in the word #70.58. Up to 32 'bit' parameters can be stored in one of these menu 70 words. For example, to set the second bit high, enter 4 into a menu 70 parameter, because the second bit has a weight of x^2. Similarly, to set the third bit high, enter 8 into a menu 70 parameter, because the third bit has a weight of x^3.

If Using a UD73, UD74 or UD77 Large Option Module

NOTE: Three parameters in the original winder block (#18.31, #18.32 & #18.33) conflict with parameters used by the fieldbus modules (Profibus-DP, DeviceNet or Interbus-S). Profibus-DP, DeviceNet and Interbus-S already use the same parameters for application I/O into the drive. This program will auto detect these modules and re-assign the three parameters to new locations (three new input parameters to the program and three new steered output parameters for the dislocated ones).

Parameter #70.83, if defaulted to zero, will allow auto-detection of a UD73, UD74 OR UD77 module. If set to 1, no program change will occur. If set to 2, the re-direction of the 3 parameters will occur whether or not a UD73, UD74 OR UD77 module is installed.

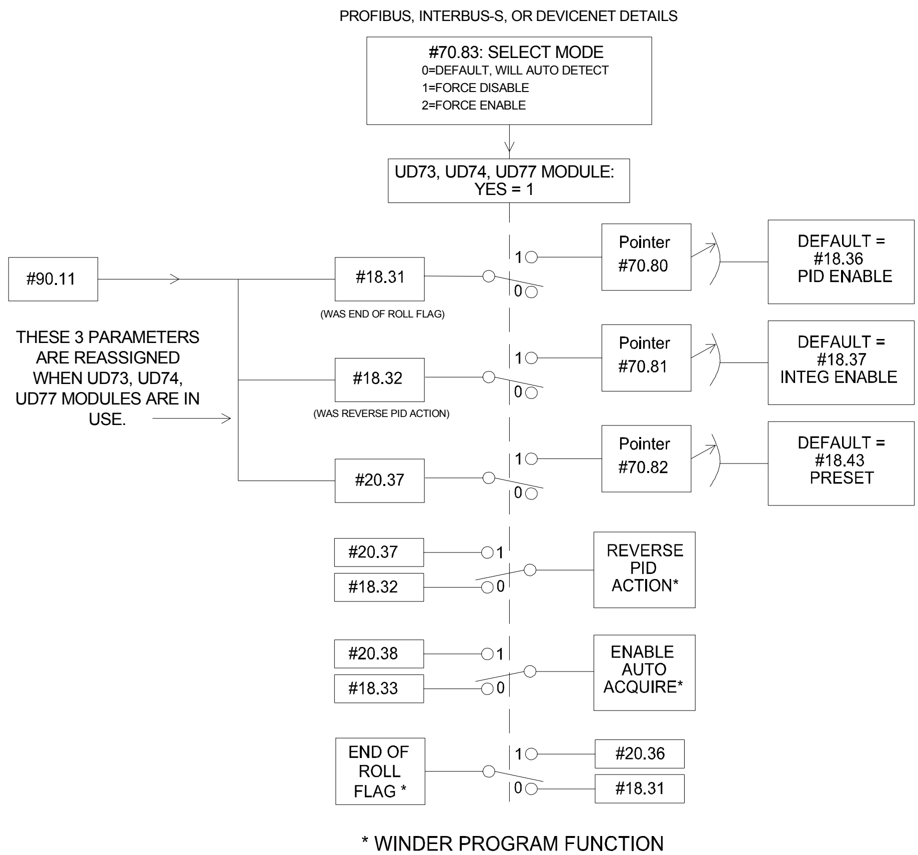


Figure 2. UD73, UD74 OR UD77 module Parameter Changes

Startup of Speed Winders

Survey the installation. The following items are needed for proper operation:

1. Tension feedback or position feedback device. This can be from a drive's analog input or via CTNet. The destination parameter is #18.12 for an analog input. The scaled range should be +/- 10000 for dancers or 0-10000 for loadcells.

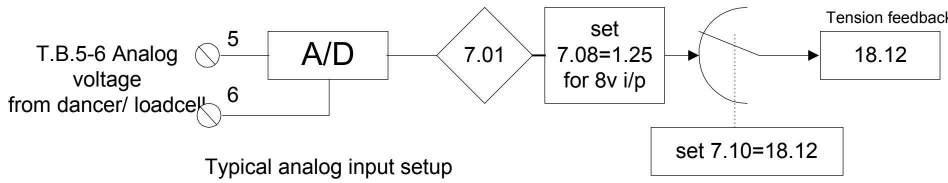
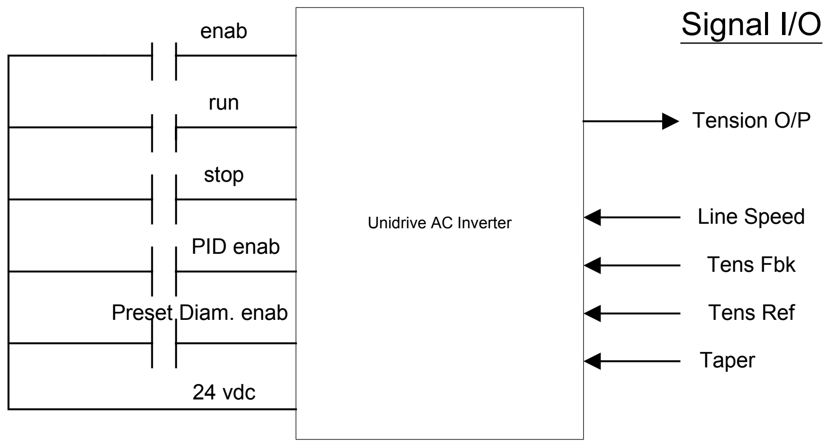


Figure 3. Typical Analog Input Setup

2. Speed reference from an adjacent line section. Speed winders need to develop tension against an adjacent line section with an isolating speed controlled nip. The speed of this adjacent section is needed as a reference for the winder. The destination is #18.11, for analog inputs, or #73.00, for CTNet sourced references. The range should be 0-10000 for an analog input or 0-1,000,000 when CTNet is used.

Note: Be sure to save your menu 70 data before resetting an UD70 or drive, as this will erase your changes if they have not been "flashed". Flashing is done by first setting #0.00=200, if not already done, and then #17.19=1. The Unidrive® will trip during this process if the DPL watchdog is enabled. You will notice that the parameter #17.19 will go back to 0 when the flash process is done.

3. Control relay logic input to appropriate drive terminals to control drive start, PID enable #18.36, integrator enable #18.37 (turret winders only), and presetting of start diameters #18.34.



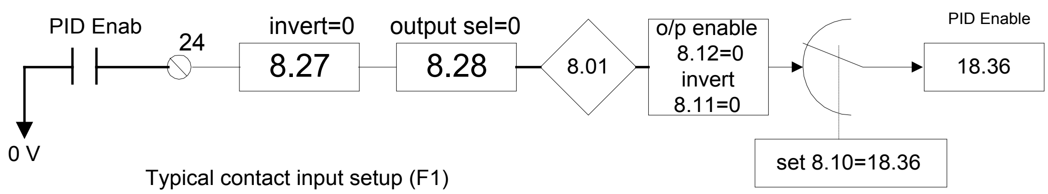


Figure 4. Typical I/O Setup for Speed Mode

4. CTKP Keypad, CTIU Interface panel or CT Browser software for setting menu 70 parameters, because these cannot be adjusted with the drive keypad.
5. Fully checked out basic Drive/Motor combination that can hold a stable jog speed with the largest roll of material to be used. This implies that the drive needs to be a good speed controller before it can be a speed winder. With large roll buildups, historically, speed stability over the buildup range was acquired by using multispeed motors. This option was preferred with buildups of greater than 10:1. With AC motors, this is done by using an extended frequency range, which has a similar effect to weakening the field in a DC motor. An 8 pole motor may have a base speed of 875 RPM, but if built for higher speeds, may be run at higher than base speed by increasing the inverter frequency, while holding the output voltage constant above base speed.

Calculated/Known Parameters

Sizes and Thicknesses

Smallest core size in #18.13 X 1000 ex. 3 inches=3000
Nominal full roll size in #18.15 X 100 ex. 36 inches=3600

Rewind/Unwind

Parameter #19.49 should be set to 0 for rewind function and 1 for unwind function. For Speed mode, unwind function is necessary for Web Break function.

Tracking Filter Rate

The fastest diameter rate of change needs to be determined for the diameter tracking filter. Enter a number into #20.40. The formula for #20.40 is max web thickness X max line speed in FPM X 12. For example, 0.01 inch material and 2500 FPM line: = 300 into #20.40.

The units are $inches^2$/minute, and relate to the amount of time it would take to build a full roll at full speed and the number of counts needed at the 5 millisecond scan rate of the clock task in the UD70. The program uses #20.40 in calculations to set up the size of the counter needed to keep track of the diameter.

Web Thickness

If the material being wound is not a full width web (wire, for instance) the effective web thickness is the number of wraps per layer divided into the wire O.D. With 0.25 inch O.D. wire on a 3 foot mandrel, there may be 144 wraps of wire per layer on a traversing type winder. The effective web thickness in this case would be 0.25 inch divided by 144, which equals 0.001736 inch, to be used in the above calculation.

In the case of traverse winding flat strip, the effective web thickness is the number of strips per traversed layer divided by the actual strip thickness.

The program puts a minimum limit on #20.40 in the case of very thin materials or low line speeds. The user can't set the parameter below a minimum value. This normally causes no problems; simply enter the lowest allowable value.

If a wide material thickness range is to be used, (greater than 8:1), it may be good to change this parameter as a function of material change so that the rate is fairly close to optimum, for each material used. If the rate is too slow (number too low), the PID error (#19.08) will appear to go off in one direction, instead of oscillating around zero.

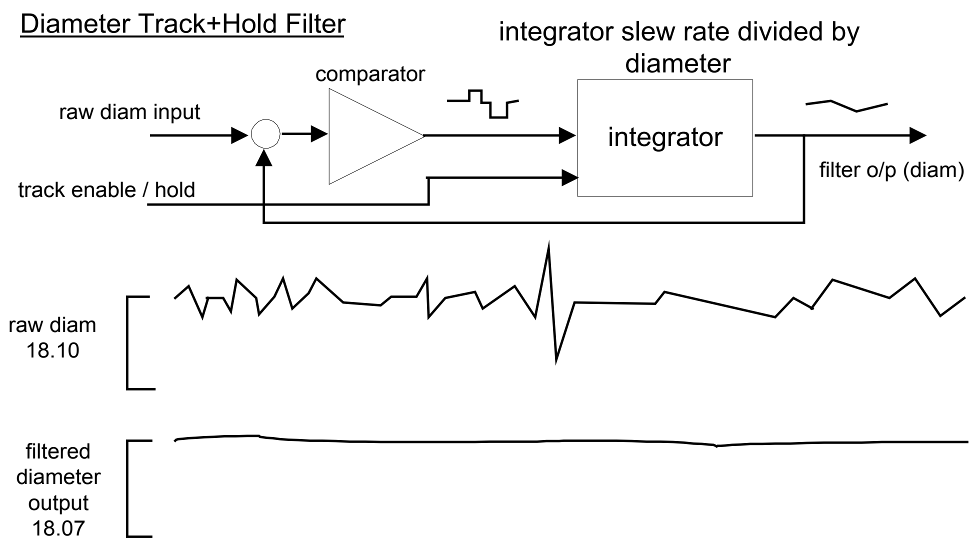


Figure 5. Diameter Track

Minimum Speed Detectors

Below a certain speed, diameter calculation becomes inaccurate because:

$$\text{Diameter} = \frac{\text{Line Speed}}{\text{Spindle Speed}}$$

As core speed approaches 0 the result of the program's calculation approaches infinity, a number that is difficult for even the best computers to deal with. As a result, you will need to set the following two parameters.

- #18.24 sets the minimum calculation speed for the line speed component of the diameter calculation, and is the numerator of the equation. The value is % x 100, and should be set just below minimum operating speed for the line.

- #18.23 sets the minimum calculation point for the denominator of the diameter equation (the spindle speed), and should be set about 3% or 30, to prevent a divide by zero situation, or an erroneous diameter value at extremely low speeds.

Ramp Function

Parameter #19.46 sets up the ramp function. There is always a ramp on start, at the #2.11 rate, but the ramp on stop is programmable. #19.46=0 yields a fast ramp to zero speed where a regenerative or DB stop is desired. #19.46=1 results in a controlled ramp stop at the #2.11 rate. For ramp stop, the drive parameter #6.01 must also be set to a 1.

The Regen brake provides a stop without a ramp. The Regen brake is activated by turning the drive off.

Line Speed Input

The Dual Mode Software needs to know the rate at which material is flowing on to or off of the roll. This enables the program to predict the speed needed at the winder spindle. This is a result of the program using line speed and spindle speed to calculate the relative diameter. Also the line speed is the speed reference for the winder program allowing it to set the correct spindle speed, based on the diameter.

The line speed via analog input should be routed to #18.11. See the cautionary note under speed matching. If a UD73, UD74 OR UD77 module is used, the speed reference is routed directly to #73.00 which is the sectional controller DPL's speed reference destination from an upstream/ downstream section.

Precision Reference

With Unidrives in closed loop mode, the standard drive speed resolution of 0 to +/-1 RPM is not fine enough for winder duty. Select the precision reference path with #1.14=5. This enables the drive's own internal precision reference system, which has a bipolar range of 0 to +/- the value in #1.06. The winder program speed demand will then come through the precision reference system into #1.49. The bipolar reference select #1.10=1 normally should be set on. This will allow speed control down to 0.01 RPM increments.

Tension Taper Control

Tension demand is modified by the taper setpoint. A negative value of -10000, or 100%, will cause the tension demand to drop off as a function of roll diameter to the fullest degree. Hyperbolic taper (#18.40=0) causes tension to drop as the inverse of diameter, so for each doubling of diameter, the tension drops 1/2 again as much, which results in constant torque at the spindle shaft, when 100% taper is used. This reduces problems with slippery or coated stock, because you don't put any additional twist (torque) on the spindle as the roll size increases. An increase in spindle torque can cause the inner wraps of the roll to distort or "telescope". 100% taper is the unique case in which torque remains constant, with less taper, the torque will rise linearly, as shown in the graph below.

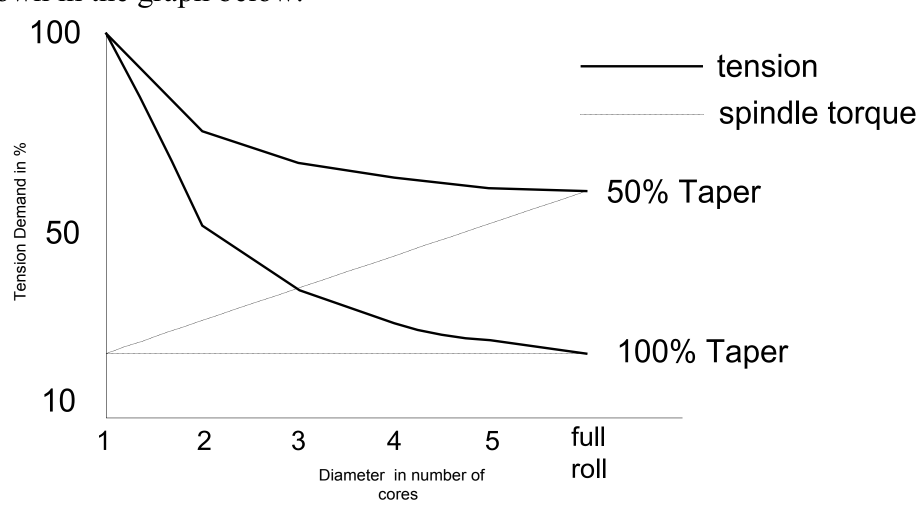


Figure 6. Hyperbolic Taper

With linear taper (#18.40=1), the tension drops an equal amount for each diameter increase, so with 100% taper the tension would actually go to zero at full roll. Hence values above 50% are seldom seen. Linear taper is used with paper and board stock.

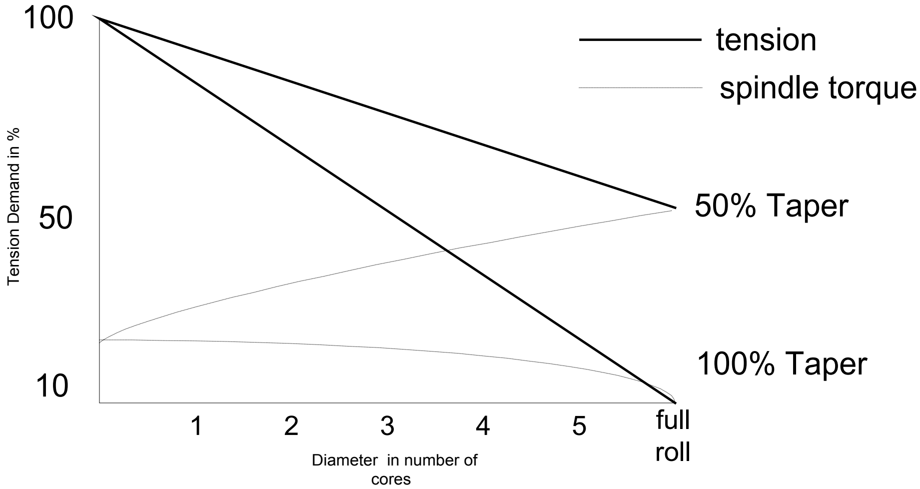


Figure 7. Linear Taper

Taper On/Off

#18.39=0 removes the effect of taper with a slow transition back to full (core) tension. This is sometimes used at roll change time to get a better roll transfer and cut.
#18.42=0 removes the effect of taper but effects a sharp transition back to full (core) tension, instead of a slow transition.
#18.39 and #18.42 are then set back to “1” for normal operation.

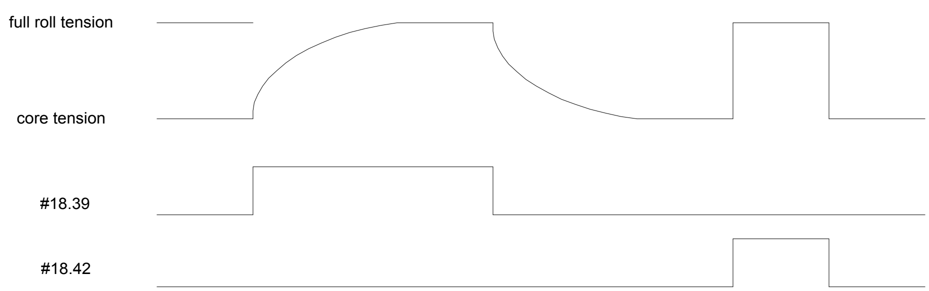


Figure 8. Taper On/Off

Tension Reference

#20.42 is the desired tension demand input. Typically, a drive internal Analog to Digital (A/D) would be assigned to this parameter, because tension demand may come from an operator potentiometer. CT Net can also address this input via #70.31, if the reference comes from a digital source, such as a PLC. A value of 10000 via analog, or 10000 via CT Net, will produce 100% tension demand to the following places:
a) the tension PID reference input in loadcell mode or,
b) an analog output via #19.07 for a dancer air-loading transducer valve, because dancer tension is controlled by physical force on the roll.

Diameter Memory

Logic is provided to switch between diameter memory hold and diameter memory track. Diameter Memory keeps the value from the last scan (200 scans/sec). Memory hold enables the current diameter or a starting preset value to be held when the line is stopped. When running above the min speeds and with the required enables, the diameter memory will begin to follow the raw calculated diameter. This keeps the memory updated with the true running diameter. The enables are:

1. run, not jog , #1.13 (read only, automatically set by drive)
2. ref on , #1.11 (read only, set by drive condition)
3. PID enable, #18.36 (user input to program)
4. integrator enabled, #18.37 (user input to program)

If integrator is not needed in PID, the integral gain (#18.20) should be set to zero, but the integrator enable bit is still needed to enable diameter tracking.

Diameter Acquire (speed mode only)

A special feature of the Dual Mode Winder is Diameter Acquire (#18.38). This bit parameter causes the diameter memory to track at a much faster (adjustable) rate. This allows an unknown roll diameter to be determined (acquired) as the roll is coming up to speed. Because this allows the raw diameter to go directly to memory, some instability in tension can occur if left on too long. Acquire is intended as a momentary pulse when needed by the external winder logic. If left on for more than 10 seconds, it will ‘time out’ internally.

Acquire is intended for use at startup to determine an unknown roll size while the line initially accelerates. At low line speeds, the PID has sufficient gain to maintain control even if there is a significant diameter error, but the acquire process has to occur before full speed is reached.

The rate of acquisition is adjusted with #18.16, which then multiplies the normal tracking rate by its value. Thus if #18.16=10 the diameter memory will slow 10 times faster than normal, when the acquire bit #18.38, is on (=1).

Acquire only works effectively in dancer mode, because the motion of the dancer is used as a correction of the line speed input, to acquire the true diameter. The function is not locked out in loadcell mode, and may be used to acquire an approximate diameter, if desired.

Inertia Compensation

Inertia compensation is available in speed mode. In this case the compensation is fed to the current demand offset input to the current loop. In torque winder mode this same compensation is added to the master torque reference and fed into #4.08. This can’t be done in speed mode, so the inertia compensation is added in as a torque offset to the torque demand from the speed loop via #4.09. This offset input is enabled by the program.

To find the Machine Inertia Compensation (#19.15) and Material Inertia Compensation (#19.14), perform the following calculations.

To calculate #19.15:

$$\#19.15 = \frac{\text{Machine Inertia} * \text{Line Speed} * \text{Nameplate RPM} * \text{Buildup ratio}}{316.8 * \text{Motor HP} * \#20.27 * \text{GBR} * \text{Full Roll Diameter}}$$

To calculate #19.14:

$$\#19.14 = \frac{\text{Full Roll Weight} * \text{Full Roll Diam} * \text{Nameplate RPM} * \text{Max Line Speed}}{36496 * \text{Motor HP} * \#20.27 * \{(\text{Buildup Ratio}^{\wedge} 3) - 1\} * \text{GBR}}$$

GBR is GearBox Ratio
Machine Inertia is the metal core inertia value divided by the GBR squared plus actual rotor inertia.
Motor HP is the 100% motor rating. Drive HP rating cancels out in the equations, provided drive nameplate data is set up correctly. Nameplate RPM is the lower value on a multi-speed motor nameplate.
Use the following units: Full Roll weight in Lbs. minus core weight, Line Speed in FPM, Machine Inertia in LB FT^2 , Full Roll Diameter in inches.
Buildup ratio is (#18.15 * 10) / #18.13 or, full roll diam / min core diam. For example, if full roll diameter=36" and core diameter=3.5" then the Buildup Ratio=10.28.
#20.27 is value as entered.

Inertia compensation is not needed in speed mode, in most cases. It is used for difficult applications, where the drive speed loop cannot fully compensate the effects of inertia. Two examples are a very large roll paper winder in speed mode using only loadcell feedback, or a servo winder where very high accelerations are used.

Coiler mode (#19.47=0) allows full positive and negative torque so that the inertia compensation in torque mode can be fully effective at controlling tension.

The scaling is the same for both speed and torque modes. Inertia compensation is not available in open loop, speed mode. If this compensation is enabled while in speed mode, a "3" will display in #4.11 while winding, indicating that the current loop offset is enabled.

Web Break

In the speed mode, web break is detected in two ways:

a) by comparing the raw diameter to the filtered diameter. If a large divergence occurs in these values, and if **DriveTrip upon Web Break** for speed mode is enabled (#19.48=0), a drive trip will occur.
An excess divergence occurs if:
Memorized-50% >**Raw Diameter**>Memorized+30%

b) Web break can also be detected if slack web sensing is enabled. Enter a value in #18.29, if a dancer is used. This is the dancer level below which the web is considered to have lost tension. The slack web information will then be used by the web break function. If loadcell feedback is used, then #18.30 is the slack tension level for loadcell mode. A non-zero value in either of these parameters enables slack web sensing.

Setting #19.48=1 will disable drive trip out due to web break, when in speed mode. The drive trip code displayed is "trip81". The web break signal is always sent to two status parameters, (#70.51 (word), and #19.31(bit)), regardless of #19.48.

Torque Memory

This is available in speed mode, to enable PID control to be transferred to another spindle, without losing tension on the present spindle. This is required in multi-turret type winders where continuous winding is done with more than one drive controller. In effect the present winder spindle becomes a torque winder, allowing feedback to be transferred to another spindle. This happens when a roll transfer is about to occur and both spindle drives are up and running, waiting for the knife cut signal.

An external controller, such as a PLC, would determine when, during a roll transfer cycle, torque memory should go on. To memorize the present winding torque, set #19.41=1. To put drive into memorized torque control mode, set #19.37=1. These inputs would typically be a part of the above mentioned PLC program. Because #19.37 is an enable, you can leave #19.37=1 and only use logic control of 19.41. In this case, 1 logic input to #19.41 will both memorize the torque and put the drive into torque mode, saving the need for an extra logic input.

Speed override of the drive's torque mode using the presently calculated winder speed is inherent in this mode so that if the web breaks during a transfer, the speed will be limited to 10% above the winder speed occurring just before memorization occurred.

Proportional, Integral and Derivative (PID)

The PID output limit by default is set to zero, so you need to put a value into #18.25 to get any PID trim at all. 10000 is the normal value entered. The limit then will be 10000 for the integrator and 10000 for the proportional trim, for a total limit of 20000 + or -.

PID gain settings for dancer and loadcell (Speed Mode Only)

proportional, #18.19 = 30 as a start value
integral, #18.20 = 20 as an initial value
derivative #18.21=0 for loadcell, 100 for dancer
derivative filter #18.22=30
overall gain #18.18= 500 or 5% for loadcell, 1000 or 10% for dancer

The PID Enable (#18.36) determines whether the winder system will use closed loop feedback devices. This parameter is only available in speed mode.

Jog

In either winder mode, the program tests the jog parameter of the drive. If the normal jog function in the drive is activated (causing #1.13 to be =1) the winder program suspends activity and, if in torque mode, temporarily switches the drive back to speed mode, while the jogging continues. When the drive is put back into normal run mode, #1.13=0, the normal winder program control resumes. Additionally, the jog reference #1.05 can be written to by the program with the desired surface speed. The actual jog reference is the value in #19.16, when #19.35=1, for surface jog speed control. If #19.35 =0, the jog speed is directly entered into #1.05 by the user.

Calibrated Parameters

The following parameters require test runs to establish the values. These calibration test runs should be done after initial parameters have been set. See the "Diagnostics" chapter.

Tension Device Feedback

The speed winder must have its trim loop closed using tension or position feedback in order to properly perform. This allows the precise winder speed to be determined. Diameter calculation is positive feedback, and thus, can not normally be used alone to control a winder in the speed mode, except when it is in Speed Match operation (at the beginning of a roll transfer when the winder must be held at an exact speed and the PID is disabled).

Loadcells or dancers should have some excess feedback range. 10000 should represent full feedback, but it should be possible for the feedback to go beyond this. If the feedback reaches a limit at a value similar to the reference's maximum value, you might get into a situation where the feedback can't quite overcome the reference, at which point the PID will lose all control. It would be good if the feedback can be about 10% greater than any reference possible. This can be done by scaling the analog input for the feedback so that the normal 100% feedback level is only about 80 to 90% of the possible input voltage. The scaling for the Unidrive® drive inputs are in menu 7. In the case of feedback via CTNet, the scaling would be done in the source drive.

Loadcell Feedback

This must be calibrated prior to startup. Normally a rope or scrap piece of material is threaded through the normal passline and tied to an anchor point. Weights or a fish scale are attached to the other end to calibrate the feedback. A 0 to 8 Volt span, from zero to full load would represent a good setup. This is then routed into the program by A/D input on the drive. The destination parameter is #18.12, which can be set up with one of the drive's input steering parameters for the A/D converters. Normally the feedback device is adjusted for approximately 0 to +8 Volts input swing so as to get a 0 to +10000 parameter range. This allows some feedback overrange.

With loadcell feedback enabled (#18.44=0) the PID feedback is strip tension, so the reference is the operator's desired tension setpoint, plus any taper tension desired. In this case only the proportional and integral gains are used. The derivative gain is set to zero in loadcell systems.

Typical settings are 1 to 3 % proportional gain (#18.19=10 to 30) and an integral time of 3 to 10 seconds (#18.20=20 to 6).

Dancer Feedback

This must be calibrated prior to startup by moving the dancer through its range and adjusting the potentiometer or linear sensor for a continuously changing voltage from one extreme to the other with no tendency for the feedback to jump through zero to a new value. Ideally, a +/- 10 Volt swing would be obtained, but is not necessary, because the program has a dancer position setpoint input available. The dancer position setpoint (#18.17) allows the null or running position of the dancer to be set precisely. The feedback is then sent to the Dual Mode Software by drive A/D input. The destination parameter is #18.12, which can be set up with one of the drive's input steering parameters for the A/D converters. 0 to +/-10000 is the preferred parameter value range.

With a dancer, the web tension is controlled by the amount of weight or force applied to the dancer roll. The drive maintains enough torque to hold against this physical upsetting force in order to hold the dancer at the desired position. So the dancer is actually a position feedback, not tension feedback.

With dancer feedback enabled (#18.44=1) the PID feedback is position, with the reference being the desired position (#18.17). The actual strip tension that results is controlled by the physical force or weight applied to the dancer. In some cases this is an air loading cylinder which is controlled by an electrical air valve. The Dual Mode Software can supply an output D/A signal to control this valve by routing the tension setpoint signal (#19.07) out to the D/A output of the drive.

Typical settings for dancer feedback are 5% proportional (#18.19=50), 3 second integral (#18.20=20), and derivative = 20 to 100 gain (#18.21=20 to 100).

Derivative is especially good with non-stretch materials, such as paper. With extensible films, derivative is not used, because it tends to set up an oscillation with the dancer.
When derivative is not used the proportional gain needs to be lower, as with loadcells, typically 1-3 %.

Drive Stability

With speed winders, it's important that the drive be a good speed controller. With a large roll diameter change, this can be a concern. Quite commonly, at large roll sizes, speed control is at its poorest. Therefore, you should load a large roll and check the basic speed stability under this condition. The goal is an overdamped speed loop, as opposed to underdamped (speed overshoot). Typically, this requires a fairly low number in the speed loop integral gain (#3.11) and as high a value in the speed loop proportional gain (#3.10) as possible. With too high an integral gain setting, the two integrators, speed loop and PID, will fight each other. The result will be difficulty attaining full roll tension stability, even with very low PID gains.

Diameter Control

Both the speed and torque winder modes use diameter information to control tension. The Dual Mode Winder uses the same diameter control system for both modes. A Track and hold memory and filter is used to store the diameter information. From an initial power up situation or roll change, it's necessary to preset the memory with the correct diameter. This is done with the diameter preset functions of the Dual Mode Software. The last running diameter is saved in non volatile memory via parameter #19.01, and so diameter is normally saved during power interruptions.

The minimum roll diameter is entered into #18.13. This parameter must always correlate to the full speed calibration of the motor and thus is never used as a mid-roll preset. Once the smallest spindle is speed matched, this parameter is not changed. (see "Speed Calibration" section). In order to use another core size or to preset the diameter to a mid- or full-roll value, the second through the seventh presets can be used, #20.48, #18.14 and #70.53-55.

Normally the presets are fixed values, but if you want to vary the starting diameter, you can use an analog input and a potentiometer or ultrasound device to bring in a variable diameter. You can also use CT Net to bring in diameter changes. If using an analog input, you need to use either #20.48 or #18.14 as the destination. With CT Net you can also use #70.53-55 as auxiliary presets.

Parameter #18.45 defines the analog presets as starting (core) values or, mid/full roll values. #18.35 selects which core size will be used. This sets up the tension taper curve to work correctly, and the starting speed match value that will occur upon initial start after preset, with turret winders.

Speed Matching (speed mode operation or torque mode setup)

It's necessary to track in the speed of the winder/unwinder drive to the up or downstream nip roll. Disable PID control (#18.36=0), and preset the diameter memory (#18.34=1) to the smallest core size (#18.13 in the case of a rewinder). If the drive is an unwinder, select the smallest core value, core 1, and then reset the program by putting 1070 into any menu zero parameter, and hitting reset, which resets the program and sets the diameter to the selected core value. Check #20.41; it should show the desired diameter.

The line speed reference to the nip roll and winder are brought up together to any desired speed, preferably between 50 to 100%. When the drive is finally running, it is tracked in to the line by adjusting core speed with a hand tach, to match the line speed. The hand tach is used to check the speed match between the nip roll and the empty core. Speed match is adjusted with the speed scaling parameter in the UD70, which for encoder feedback is #19.12 (#19.11 in open loop). For example, if 1811 RPM is needed at core, set #19.12 to 1811, if in closed loop vector mode, and at full line speed. #1.06, the max drive speed, needs to be a little higher than the value in #19.12 to allow a little "headroom".

Note: #19.11 and #19.12 only update after a winder program reset.

Speed Match Boost/Cut

The spindle speed described above can be trimmed above or below true speed match, to compensate for effects occurring at the time of roll transfers or splices. (#20.45=boost amount, 1000=10% trim) (#18.47=1 to enable boost when PID is disabled (#18.36=0)). This compensation cuts out as soon as the PID is re-enabled.

Dancer Motion Compensation (speed mode only)

The raw diameter is the result of dividing roll surface speed by spindle speed. The result is relative diameter. Here the line speed is used to represent surface speed and this is true when the dancer is not moving. If you sense dancer motion and add that to the line speed, you have true surface speed information. #19.26 >0, enables this compensation. Normally this compensation is only used if you want to use the acquire function (#18.38) to accurately determine roll size when starting up, because dancer motion at low speeds is a significant part of surface speed. All you have to do is to tell the program how much material can be stored in your dancer in a given period of time. The formula is:

#19.26 = (DANCER STORAGE IN INCHES/MAX LINE FPM)X2500
(based on 10000 counts=full line speed & 20000 counts= full dancer travel)

This is based on scaling the dancer feedback to have a full travel swing of +/- 10000 counts into #18.12.

Initial Run Test

When all logic and signal inputs have been set up, do a speed test of the winder. See the “Diagnostics” chapter.

Startup of Torque Winders

Survey the installation. The following items are required:

1. Tension setpoint device (potentiometer or CTNet variable). The destination is #20.42 or #70.36.
2. Speed reference from an adjacent line section. Torque winders need to work with an isolating speed controlled nip. The speed of this adjacent section is needed as a reference for the winder. The destination is #18.11 for analog inputs, or #73.00, for CTNet sourced references. The range should be 0-10000 for an analog input or 0-1,000,000 when CTNet is used.

Note: Be sure to save your menu 70 data before doing an UD70 or drive reset as this will erase your changes if they have not been "flashed". Flashing is done by first setting #0.00 to 200, if not already done, and then #17.19 to 1. The Unidrive® will trip during this process if the DPL watchdog is enabled. You will notice that the parameter #17.19 will go back to 0 when the flash process is done.

3. Control relay logic input to appropriate drive parameters to control start, and presetting of start diameters, PID enable #18.36, integrator enable #18.37 (turret winders only), and presetting of start diameters #18.34.

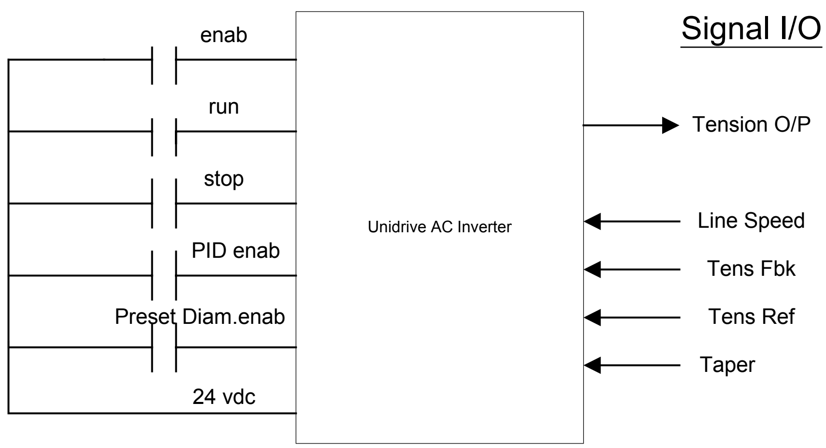


Figure 9. Typical Contact Setup for Torque Mode

4. CTKP Keypad, CTIU Interface Panel or CT Browser software capable of setting menu 70 parameters, because these cannot be adjusted with the drive keypad.

5. Fully checked out basic Drive/Motor combination that can hold a stable jog speed with the largest roll of material to be used. This implies that the drive needs to be a good speed controller before it can be a torque winder. This will allow jogging for roll offloading etc.

NOTE: Torque Mode requires that Speed Matching calibration be done before the winder system can run in Torque Mode. So, set #19.33 to Speed mode, set up the basic Unidrive and Dual Mode Winder parameters, send the parameters and program, and then run the calibration (see the section on "Speed Matching"). When the calibration is complete, switch #19.33 to Torque mode and complete setup and testing.

Calculated/Known Parameters

Sizes and Thicknesses

Smallest core size X 1000 into 18.13	ex. 3 inches=3000
Nominal full roll size X 100 into 18.15	ex. 36 inches=3600

Rewind/Unwind

Parameter #19.49 should be set to 0 for rewind function and 1 for unwind function. For Torque mode, unwind function is necessary for Web Break function and Torque sensor.

Tracking Filter Rate

The formula for #20.40 is max web thickness X max line speed in FPM X 12
For example, 0.01 inch material and 2500 FPM line: = 300 into #20.40.

The units are inches^2/minute, and relate to the amount of time it would take to build a full roll at full speed and the number of counts needed at the 5 millisecond scan rate of the clock task in the UD70. The results of these calculations cause #20.40 to set up the size of the counter needed to keep track of the diameter properly.

If the material being wound is not a full width web (wire, for instance) the effective web thickness is the number of wraps per layer divided into the wire O.D. With .25 inch O.D. wire on a 3 foot mandrel, there may be 144 wraps of wire per layer on a traversing type winder. The effective web thickness in this case would be .25 inch divided by 144, which equals .001736 inch, to be used in the above calculation.

In the case of traverse winding flat strip, the effective web thickness is the number of strips per traversed layer divided by the actual strip thickness.

The program puts a minimum limit on #20.40 in the case of very thin materials or low line speeds. The parameter can't be set below a minimum value. This normally causes no problems; simply enter the lowest allowable value.

Web Thickness

The fastest diameter rate of change needs to be determined for the diameter tracking filter. This is done by entering a number into #20.40 which is web thickness times 12 times the maximum line speed in FPM.

If a wide material thickness range is to be used, (greater than 8:1), it may be good to change this parameter as a function of material change so that the rate is fairly close to optimum.

Minimum Speed Detectors

Below a certain speed, diameter calculation becomes inaccurate because:

$$\text{Diameter} = \frac{\text{Line Speed}}{\text{Spindle Speed}}$$

As core speed approaches 0 the result of the program's calculation approaches infinity, a number that is difficult for even the best computers to deal with. As a result, you will need to set these two parameters.

a) #18.24 sets the minimum calculation speed for the line speed component of the diameter calculation, and is the numerator of the equation. The value is % x 100, and should be set just below minimum operating speed for the line.

b) #18.23 sets the minimum calculation point for the denominator of the diameter equation (the spindle speed), and should be set about 3% or 30, to prevent a divide by zero situation, or an erroneous diameter value at extremely low speeds.

Inertia Compensation

In torque winder mode this compensation is added to the master torque reference and fed into #4.08.
To find the Machine Inertia Compensation (#19.15) and Material Inertia Compensation (#19.14), perform the following calculations.

To calculate 19.15:

$$\#19.15 = \frac{\text{Machine Inertia} * \text{Line Speed} * \text{Nameplate RPM} * \text{Buildup ratio}}{316.8 * \text{Motor HP} * \#20.27 * \text{GBR} * \text{Full Roll Diam}}$$

To calculate 19.14:

$$\#19.14 = \frac{\text{Full Roll Weight} * \text{Full Roll Diam} * \text{Nameplate RPM} * \text{Max Line Speed}}{36496 * \text{Motor HP} * \#20.27 * \{(\text{Buildup Ratio} \wedge 3) - 1\} * \text{GBR}}$$

GBR is GearBox Ratio
Machine Inertia is the metal core inertia value divided by the GBR squared plus actual armature inertia.
Motor HP is the 100% motor rating. Drive HP rating cancels out in the equations, provided drive nameplate data is set up correctly. Nameplate RPM is the lower value on a multi-speed motor nameplate.
Use the following units: Full Roll weight in Lbs. minus core weight, Line Speed in FPM, Machine Inertia in LB FT^2 , Full Roll Diameter in inches.
Buildup ratio is (#18.15 * 10) / #18.13 or, full roll diam / min core diam. For example, if full roll diameter=36" and core diameter=3.5" then the Buildup Ratio=#10.28.
#20.27 is value as entered.

PID Gain Settings (if PID enabled for CTCW mode)

proportional, #20.31 = 30 as a start value
integral, #20.32 = 20 as an initial value.
derivative #20.33=0 for loadcell, 100 for dancer.
derivative filter #18.22 set for 30.
overall gain #20.35= 1000 or 10% total trim.

Web Break

In torque mode, web break is detected by comparing raw diameter to the diameter memory. If the unit is designated (#19.49=0) as a winder, the web break will be signaled, by a flagout to the user on a PLC and perhaps by a trip, if the raw diameter regresses back to less than 80% of the memorized value. This diameter regression happens because a broken web tends to change speed, which causes an immediate change in the raw diameter. If the raw diameter drops to 80% of its prior value, it means the speed of the roll must have suddenly increased 20% (the speed is limited to 125% of normal speed due to the speed override function). If defined as an unwind drive (#19.49=1), a web break will be signaled if the raw diameter regresses to greater than 120% of memorized. This means the roll has begun to slow down and is headed in the other direction. Additionally, in torque mode only, web break is signaled if the speed feedback (#3.02) exceeds the value in overspeed trip (#1.06).

The drive will trip if #19.34=0. #19.34=1 will disable the drive trip out function upon web break. The customer web break bit is always functional, #70.51, irrespective of #19.34.

Ramp Function

Parameter #19.46 sets up the ramp function. There is always a ramp on start, at the #2.11 rate, but the ramp on stop is programmable. #19.46=0 yields a fast ramp to zero speed where a regenerative or DB stop is desired. #19.46=1 results in a controlled ramp stop at the #2.11 rate. For ramp stop, the drive parameter #6.01 must also be set to a 1.

The Regen brake provides a stop without a ramp. The Regen brake is activated by turning the drive off.

Line Speed Input

The Dual Mode Software needs to know the rate at which material is flowing onto or off of the roll. The diameter can then be calculated. This is a result of the program using line speed and spindle speed to calculate the relative diameter. This enables the program to predict the speed needed at the winder spindle, for the speed override function.

The line speed via analog input should be routed to #18.11. If a UD73, UD74 OR UD77 module is used, the speed reference is routed directly to #73.00, which is the sectional controller DPL's speed reference destination from an upstream/downstream section, when this program is used in a large system.

Diameter Memory

Logic is provided to switch between diameter memory hold and diameter memory track. Diameter Memory keeps the value from the last scan (200 scans/sec). Memory hold enables the current diameter or a starting preset value to be held when the line is stopped. When running above the min speeds and with the required enables, the diameter memory will begin to follow the raw calculated diameter. This keeps the memory updated with the true running diameter.

The enables are:
1. run, not jog , #1.13 (read only, automatically set by drive)
2. ref on , #1.11 (read only, set by drive condition).

Precision Reference

With Unidrives, select the precision reference path with #1.14=5. This enables the drive's own internal precision reference system, which has a bipolar range of 0 to +/- the value in #1.06. The standard closed-loop drive speed resolution of 0 to +/-1 RPM is not fine enough for winder duty.

The winder program speed demand will then come through the precision reference system into #1.49. The bipolar reference select #1.10=1 normally should be set on.

Tension Reference

#20.42 is the desired tension demand input. Typically, a drive internal A/D would be assigned to this parameter, because tension demand may come from an operator potentiometer. CT Net can also address this input via #70.36, if the reference comes from a digital source, such as a PLC. A value of 10000 here, in the analog case, or 10000 via CT Net, will produce 100% tension demand to the tension demand to the following locations:

- to the tension PID reference input in loadcell mode,
- to an analog output via #19.07 for a dancer air-loading transducer valve, because dancer tension is controlled by physical force on the roll,
- the tension demand, which is multiplied by 2/3 and sent to the torque input of the drive #4.08, because 667=100% torque demand.

Taper

The tension demand, mentioned above, is modified by the taper setpoint. A negative value of 10000, or 100%, will cause the tension demand to drop of as a function of roll diameter to the fullest degree. Hyperbolic taper, #18.40=0, causes tension to drop as the inverse of diameter, so for each doubling of diameter, the tension drops 1/2 again as much, which results in constant torque at the spindle shaft. This reduces problems with slippery or coated stock, because you don't put any additional twist on the spindle as the roll size increases.

Linear taper causes the tension to drop an equal amount for each diameter increase, so with 100% taper the tension would actually go to zero at full roll. Hence values above 50% are seldom seen. Linear taper is used with paper and board stock.

Jog

In either winder mode, the program tests the jog parameter of the drive. If the normal jog function in the drive is activated, causing #1.13 to be =1, the winder program suspends activity and, if in torque mode, temporarily switches the drive back to speed mode, while the jogging continues. When the drive is put back into normal run mode, #1.13=0, the normal winder program control resumes. Additionally, the jog reference #1.05 can be written to by the program with the desired surface speed. The actual jog reference is the value in #19.16, when #19.35 is 1, for surface jog speed control. If #19.35 =0, the jog speed is directly entered into #1.05 by the user.

Calibrated Parameters

Speed Matching Calibration

The raw diameter needs to be calibrated in Speed mode. The drive is temporarily put in Speed mode and calibrated as described in the "Speed Matching" section, then the drive can be returned to Torque mode. The diameter calculations will then be accurate, for use of the roll diameter sensor, inertia compensation circuit, etc. This also implies that the winder can be switched between torque and speed mode at any point, even mid roll and continue normally. In order to do so, you would have to have a strip tension feedback device.

The line speed reference to the nip roll and winder are brought up together to any desired speed, preferably between 50 to 100%. A hand tach is used to check the speed match between the nip roll and the empty core. Speed match is adjusted with the speed scaling parameter in the UD70, which for encoder feedback is #19.12 (#19.11 in open loop). It should be noted that changes to #19.11/19.12 only go in after UD70 reset, so the procedure is to determine the speed match error percentage with a calculator, and change the parameter by this amount.

Example:

Speed of spindle is 10% below upstream nip:
Increase #19.12 (or #19.11) by 10% and reset UD70 by entering 1070 in any menu 0 parameter and hitting the red reset button.

Initial Run Test (torque mode)

When all logic and signal inputs have been set up, do a test of the winder. See the “Diagnostics” chapter.

DIAGNOSTICS

Parameter Calibration

Some of the parameters require test runs to establish the values. These calibration test runs should be done after initial parameters have been set and the binary file has been sent to the drive. The instructions for these tests is in the appropriate parameter's description in the "Setting Up Parameters" chapter. These calibration tests should be done before the Initial Run Tests described below.

Initial Run Test (speed mode)

Set #18.32 (with a UD73, UD74 OR UD77 module #20.37) to a 0 for a rewind or 1 for an unwind. This sets up the PID action for the correct result, as described below.

When all logic and signal inputs have been set up, it's good to do a speed test of the winder. Prepare to run the winder and line without material. Temporarily disable web break (#19.34=1). Bring up the line speed to 50%, and observe the effect of the loadcell or dancer. Increasing tension on the feedback device should cause the winder speed to gradually slow down, and the diameter display in #20.41 to increase. Reducing tension feedback should cause the winder speed to slowly increase and the diameter display to go down. This indicates that the basic functionality is present, and the winder won't start by throwing material on the floor. An Unwinder would behave in the opposite manner, decreasing speed with an increase in tension feedback. If the winder remains on long enough, the diameter will reach one of the extremes, either full roll or the selected core diameter.

Zero tension feedback, the null point, on the dancer, is where the PID error is zero (#19.08). This will be where the dancer will normally operate. Adjust dancer position (#18.17) to adjust this point.

Zero tension feedback on a loadcell happens when nothing is touching the loadcell roll. Typically, a tare adjustment is available on the loadcell amplifier to null this out. Then if sufficient force is put upon the roll, a null will occur at the PID error point (#19.08). This is the force level at which the winder will operate. To adjust, the tension, simply change the operator's tension adjustment, as this is the PID reference.

When these tests have been run, re-enable web break (#19.48=0)

Initial Run Test (torque mode)

When all logic and signal inputs have been set up, it's good to do a test of the winder. Prepare to run the winder and line without material. Temporarily disable web break (#19.34=1). Bring up the line speed to 50%, and observe the effect of the operator's tension adjustment. With zero tension the winder should just sit there. If breakaway boost is used, you will see a little spindle motion at the initial start, but that will dissipate quickly. Increasing tension should cause the spindle to accelerate to the speed override point which is 25% above speed match for the diameter at which you are operating. As an example, if you are at core diameter, the spindle should run up to a speed so that if you hand-tached the core, the surface speed at the core would be 25% above the upstream nip surface speed. This indicates the speed tracking is correct. This would not work at top speed, because the 25% speed overhead is lost as you approach top line speed, however at 50% line speed the above statement should be true.

The inertia compensation can be checked also. If a line speed change is made and the winder tension setting is zero, you should see the spindle start to move whenever a positive line speed acceleration occurs, and the winder should develop negative torque and slow down whenever there is a line speed deceleration. With the diameter set to the minimum or core value, the machine inertia compensation #19.15 directly controls this effect. With the diameter set to full roll the material inertia compensation #19.14 directly controls the winder's response to line speed changes. If the inertia compensation is at the correct value, the winder will accelerate to approximately the correct core or full roll *surface* speed. The numeric values needed are determined in the calculations above or by experimentation. The overall response of the inertia circuit is set by #20.27. This value multiplies all the above effects directly. The value will depend on basic machine size but a good starting value is 10. If the above adjustments come in with very low values, #20.27 can be lowered so the settings can be raised to a more workable range. For example, if the material inertia compensation #19.14 looks good at a value of 3, lowering #20.27 by a factor of ten will cause the material compensation to be 30 to get the same result. This will give you more steps of adjustability than you have with a value of 3.

Friction or static compensation (#20.25) will cause the spindle to hold speed after the tension demand is reset to zero, when at low spindle speeds (unloaded, no web).

Viscous compensation (#20.26), will cause the spindle to hold speed after the tension demand is reset to zero, when at high spindle speeds (unloaded, no web). Notice that just a little too much viscous compensation will cause the spindle to run away.

When these tests have been run, re-enable web break (#19.34=0).

Error Handling

During startup of this program Drive tripouts due to errors may occur. The error codes display in three locations: the diagnostic register for program problems (#19.06), the drive display (will show tr + the code number), and the user trip parameter (#10.38). The following codes may appear in the register (#19.06):

81	Web break detected
82	blank
83	Wrong Drive type detected
84	Drive Overspeed in torque mode.
85	Core or full roll diams not set up.
86	CTNet problem, where CTNet communications have been enabled
87	Diam buildup range exceeds 30

Drive trip display example:

For Web break:	Drive Display:
trip 81	line1
trip 83	line 2

If no error codes are present, the program may have failed due to a math error, such as divide by zero. This can happen if one of the key setup parameters has not been entered. Another possibility is that the parameters in menu 70 were not memorized before a drive reset. A reset causes menu 70 parameters to return to their last memorized value. If the program has stopped due to an internal (math) error, the line number in the program where the error occurred will show in parameter #17.03. Please check parameter #17.03 and note this useful information when contacting Control Techniques support staff.

‡ Bit parameters are described herein with the 3rd numeric position. ex: #70.58.0 which is equivalent to _P58%.0 is the least significant bit in the word #70.58 . Up to 32 bit parameters can be stored in one of these menu 70 words, bits 0 through 31.

Regen Brake

The Regen Stop can bring a large roll to a controlled stop. It provides a stop without a ramp. The Regen brake is activated by turning the drive off.

Final Startup Evaluation

At the completion of a winder startup, the following items should be tested and meet the user's expectations.

1. Operation with thinnest material to be used
2. Flying transfer/splice location at full speed and good stability while the turret is being indexed. The material should be inspected at the cutting point.
3. Operation with stretchiest material to be used. Verify the tension is within tolerances and that the web has no problems.
4. Accel/decel and start/stop coordination. Verify the emergency stop capability.
5. Tension taper range scaling. Inspect the roll quality.
6. Tension setpoint scaling. Verify the pounds per linear inch (PLI) requirement is within tolerances.

APPENDIX A: PARAMETER TABLE AND DESCRIPTIONS

Parameters in Numerical Order

Read Status

RO=Read Only
RW/R=Read Write/Reads when Program Reset
RW/S= Read Write/Reads when Stopped
RW/A= Read Write/Reads Anytime

Parameter Type

SU=Parameter determined on Setup
DN=Parameter determined Dynamically (operational)

♦ ♦ Affected by use of UD73, UD74 OR UD77 module

Para-meter	Read Status	Para meter Type	Para-meter Data Flow	Para-meter Multi-plier or Type	Default Value	Winder Mode	Winder Function	Parameter Descriptions
1.05	RO	DN	I/P	1		All	Drive Reference	Inch, or jog ref to drive (RO if #19.35 jog spd control enabled) Hz, or RPM
1.11	RO	DN	O/P	Bit		All	Drive status	Drive Reference is on
1.13	RO	DN	O/P	Bit		All	Drive status	Inch or jog mode selected=1
1.18	RO	DN	O/P	1		All	Drive Reference	Precision ref input to drive from program, high digits, for vector mode.
1.19	RO	DN	O/P	1		All	Drive Reference	Precision ref input to drive from program, low digits, for vector mode.
1.27	RO	DN	O/P	1		All	Drive Reference	Speed ref to drive from winder prog in open loop drive mode, in HZ
2.01	RO	DN	O/P	1		All	feedback	Speed feedback , hz, in open loop mode, for Diameter calculation.
2.02	RO	DN	I/P	Bit		All	Drive status	Enable Drive ramps = 1 (set by prog for some jog modes) (in closed loop Drive only, sets ramps off for winding)
2.11	S	SU	I/P	10		All	Rate	Winder accel / (decel) rate. (amp-clamp-ramp) , seconds.
3.02	RO	DN	O/P	1		All	feedback	Speed feedback in vector mode, rpm, for Diameter calculation.
4.02	RO	DN	O/P	1		All	Drive status	Drive active (torque producing) current %
4.03	RO	DN	O/P	1		All	Drive Reference	Running torque demand from speed loop. %
4.08	RO	DN	I/P	1		All	Drive Reference	Drive Torque ref, %. (RO if torq modes or torque mem active)
4.09	A	SU	I/P	1		All	Drive Reference	Drive Torque loop offset input, %. Controlled by winder program.
4.11	RO	DN	I/P	Word		All	Drive Mode	Torque mode control for drive. Range= 0-4 Controlled by winder program.
5.06	A	SU	I/P	1	60	All	Drive setup	Motor rated freq
10.02	RO	DN	O/P	Bit		All	Drive status	inverter active, drive running
10.04	RO	DN	O/P	Bit		All	Drive status	speed at or below min
10.05	RO	DN	O/P	Bit		All	Drive status	speed below set
10.06	RO	DN	O/P	Bit		All	Drive status	speed at set
10.07	RO	DN	O/P	Bit		All	Drive status	speed above set
10.09	RO	DN	O/P	Bit		All	Drive status	Drive cur lim status
10.20	RO	DN	O/P	Word		All	Drive status	last drive trip code
10.38	RO	DN	O/P	Word		All	Drive status	Current drive trip code.
11.29	RO	SU	O/P	Word		All	Drive status	Drive Software version
11.31	RO	SU	O/P	Word		All	Drive status	Drive type 0=op loop, 1=cl loop, 2=servo
12.04	RO	DN	I/P	1		All	Threshold	Slack takeup level, %. (see 19.23) This threshold level in drive menu 12, is set by the winder program to sense a specific slack takeup completed level.

Para-meter	Read Status	Para meter Type	Para-meter Data Flow	Para-meter Multi-plier or Type	Default Value	Winder Mode	Winder Function	Parameter Descriptions
17.11	R	SU	I/P	0.001	5	All	Time Constant	Processor 2 scan time in milliseconds. (default=5 in vector mode, 7 in servo mode) This is the basic scan time for the winder program.
18.01			O/P	Word		All		Non volatile. Saved upon power-down. Unassigned
18.03	RO	DN	O/P			All	Winder Status	Winder Prog ID number (Program Catalog No.)
18.04	RO	DN	O/P			All	Winder Status	Winder Prog Revision level ex. 207 in display=version 2.0.7
18.05	RO	DN	O/P	100		All	Speed Reference	LINE SPEED INPUT RECEIVED This parameter output represents the line speed coming in from either an analog input or the Ctnet and is the winder's main line speed reference. %
18.06	RO	DN	O/P			All	Winder Status	Buddy node's ID. This is part of a Ctnet loss detection scheme used by older systems.
18.07	RO	DN	O/P	100		All	Diameter	Filtered diameter, %, 10000= FULL ROLL
18.08	RO	DN	O/P	100		All	PID	PID tension integrator out, (TENSINTEG%)
18.09	RO	DN	O/P	100		All	PID	PID tension differentiator out
18.10	RO	DN	O/P	100		All	Diameter	Diameter, prior to filtering. %, 10000=FULL ROLL (the calculated diameter) Should be equal to 18.07 in steady state operation. This value "jumps around" normally
18.11	A	DN	I/P	100		All	Speed Reference	LINE SPEED REF INPUT #1 , % CAN ALSO USE 73.00, SEE 70.52
18.12	A	DN	I/P	100		Speed	Dancer/ Loadcell	DANCER OR LOADCELL FEEDBACK +/- 10000=100% trim
18.13	S	SU	I/P	1000	0	All	Diameter Setpoint	Diameter PRESET 1. This is the smallest roll size ex: 3.5"=3500. This preset calibrates the drive speed match and thus should not be used as a mid-roll or unwind preset. Use instead the aux preset or preset 2.
18.14	S	SU	I/P	100	0	All	Diameter Setpoint	Diameter PRESET 2 Taper tension is based on the correct core Diameter being used. If only one core preset is used, this preset can also be used as a mid-roll or unwind preset. See text.
18.15	S	SU	I/P	100	0	All	Diameter Setpoint	Full Roll Diameter X100, for setup. (ACTUAL WORKING SIZE MAY EXCEED THIS BY 20% MAX)
18.16	S	SU	I/P		0	Speed	Acquire	ACQUIRE RATE (this value multiplies the normal diameter tracking rate 20.40 by the value in 18.16)
18.17	A	SU	I/P	100	0	Speed	Dancer	Dancer position reference. (+/- 10000) Dancer position, %.
18.18	A	SU	I/P	100	0	Speed	PID	PID percent L.C./Danc. OVERALL TRIM GAIN, speed mode, (%X100) 0 to 25(%)
18.19	A	SU	I/P	10	0	Speed	PID	PID proportional gain(x10), 0 to 32000
18.20	A	SU	I/P		0	Speed	PID	PID INTEGRATOR rate (t=64/#18.20, sec). 0 to disable, (HIGHER GAIN VALUE MAKES THE INTEGRATOR FASTER) Time=64/GAIN IN SEC.
18.21	A	SU	I/P	1	0	Speed	PID	PID differential gain (X1)
18.22	A	SU	I/P	1	30	Speed	PID	PID differential term filter time constant (T.C.= # * TICK TIME)
18.23	A	SU	I/P	100	1	All	Threshold	Speed threshold in %. This is a zero speed sensing switch for spindle speed.
18.24	A	SU	I/P	100	1	All	Threshold	Speed threshold in % This is a zero speed sensing switch for line speed.
18.25	R	SU	I/P	10	0	Speed	PID	PID LIMIT % , speed mode, 10000 =nom , 0-12000 range
18.29	R	SU	I/P	100	0	Speed	Web break	Slack web level for Dancer in feedback counts. % Used by web break function, when in speed mode. Also inhibits diameter tracking (19.44).
18.30	R	SU	I/P	100	0	Speed	Web break	Slack web level for Loadcell in feedback counts. % Used by web break function, when in speed mode. Also inhibits diameter tracking (19.44).
18.31	RO	DN	O/P	Bit		All	Winder Status	Diameter FLAG, when at MIN diam. see #20.24,20.36
18.32	S	SU	I/P	Bit		Speed	PID	Reverse PID Action=1 (defines drive as rewind/unwind in speed mode)also reverses speed boost, and min Diameter sensing direction. (20.37 used instead, for Fieldbusses)
18.33	R	SU	I/P	Bit		Speed	Acquire	AUTO ACQUIRE of Diameter after power-up reset, 1 = enable. (**see 20.38) When enabled, this func acquires current roll diameter after first drive startup, after power up. Normally not needed, since the diameter is saved when power is off.

Para-meter	Read Status	Para meter Type	Para-meter Data Flow	Para-meter Multi-plier or Type	Default Value	Winder Mode	Winder Function	Parameter Descriptions
18.34	S	DN	I/P	Bit		All	Enable	PRESET THE Diameter , 1=yes This sets the working diameter to the selected diameter preset (18.13, 18.14, or 20.48). Drive must be off to function. Additional presets are available via 19.32, 70.53, and 70.54
18.35	S	DN	I/P	Bit		All	Diameter	SELECT PRESET 2 =1 (THE LARGER CORE)
18.36	A	DN	I/P	Bit		Speed	PID enab	PID Enable bit for speed mode. Setting this to 0 enables speed matching at core or full roll.
18.37	A	DN	I/P	Bit		All	PID enab	Integrator and diameter tracking enab bit in both modes. This allows for winder speed matching at core for transfers, with proportional trim only, in spd mode.
18.38	A	DN	I/P	Bit		Speed	Acquire	ACQUIRE new diameter. Externally controlled. (speeds up the diameter tracking, so as to rapidly update the diameter memory with a new or unknown roll size.)
18.39	A	DN	I/P	Bit		All	Enable	TAPER ON/OFF. 1=OFF (RAMPED TRANSITION)
18.40	S	SU	I/P	Bit		All	Enable	TAPHYPLIN% 1=LINEAR TAPER , 0=HYPERBOLIC
18.41	R	SU	I/P	Bit		All	Dancer/ Loadcell	INVERT DANCER/LOADCELL FEEDBACK 1=INVERT
18.42	A	DN	I/P	Bit		All	Enable	TAPER ON/OFF (FAST TRANSITION) 1=OFF
18.43	A	DN	I/P	Bit		All	Tension Reference	Index boost enab (also 70.33.01 via CTnet) see 20.46
18.44	R	SU	I/P	Bit		All	Dancer/ Loadcell	Dancer Feedback=1, Loadcell Feedback=0 (mode selection)
18.45	S	DN	I/P	Bit		All	Enable	UNWIND or MIDROLL PRESET =1, 0=REWIND or CORE PRESET This enables a mid or full roll diameter preset, using preset 2 or 3 depending on the setting of #18.49. If 0, the preset is a core preset, to the selected core size.
18.46	A	SU	I/P	Bit		Speed	Enable	SPEED BOOST/CUT SIGNAL INVERT =1
18.47	A	DN	I/P	Bit		Speed	Enable	SPEED BOOST/CUT WHEN PID DISABLED,1 TO ENAB (SEE#20.45 for val)
18.49	S	DN	I/P	Bit		All	Enable	Diameter preset selection command used to set Diameter to #20.48, 1 to enable (unwind or mid-roll mode). This allows two unwind/rewind core sizes, using the std presets (1 and 2), (for correct taper operation.) 18.49= 0 to cause preset command to set Diameter to preset #2 value.(unwind or mid-roll mode) w/ 18.45 enabled), when only 1 core size is used. (preset 1). 18.49= 0 also frees up #20.48 to be used for other purposes. (#18.45 must be a 1 to enable these functions.)
19.01	S	DN	O/P	100		All	reference	Non volatile storage of roll diameter. Normalized to 10000=full roll.
19.03	RO	DN	O/P	Word		All	Winder Status	Location in prog background task where processor last visited prior to errors.
19.04	RO	DN	O/P	Word		All	Winder Status	Location in clock task where prog has stopped due to errors.
19.05	RO	DN	O/P	Word		All	Winder Status	Failsafe register contents holding info regarding loss of CTNet comms
19.06	RO	DN	O/P	Word		All	Winder Status	DIAGNOSTIC FAULT REGISTER The number stored here, if any, indicates what was the cause of the last winder program error. Example: 81=WEB BREAK. The complete error list is in the text.
19.07	RO	DN	O/P	100			reference	TENSION REF OUTPUT 10000 =MAX W/O TAPER.
19.08	RO	DN	O/P	100		All	PID	PID TENSION ERROR (TENSERR%)
19.09	RO	DN	O/P	100		All	PID	PI OUTPUT (TRIM) % This value is multiplied by the overall gain setting for the final trim signal.
19.11	R	SU	I/P	100	6000	All	Speed Scaling	Setup speed, for Open loop drive. Sets nominal max freq (at core) (HZ X100) for speed matching.
19.12	R	SU	I/P	1	1750	All	Speed Scaling	Setup speed, in Vector mode. Sets up nominal max speed at core. (rpm X1), for speed matching.
19.13	R	SU	I/P	1000	10000	Speed	Time Constant	Torque memory filter TC. milliseconds (max 10sec) Use 3000 or 3 sec for a good running average of the motor torque. Torque mem is used in turret winders.
19.14	A	SU	I/P	1	0	All	Inertia	INERTIA COMP (WK^2) of FULL ROLL (MATERIAL) Affects response at full roll.
19.15	A	SU	I/P	1	0	All	Inertia	INERTIA COMP (WK^2) of MACHINE (Spindle plus motor). Affects response at core diam.
19.16	S	SU	I/P	100	0	All	Speed Setpoint	Jog speed setpoint for Winder,% (see 70.39) when jog at surface speed is enabled (19.35).
19.20	R	SU	I/P	1	0	Speed	Acquire	Auto Acquire Time Period (sec) (see 18.33)
19.21	R	SU	I/P	1	0	All	Time	Stall Tension activation Time Delay. (SEC)

Para-meter	Read Status	Para meter Type	Para-meter Data Flow	Para-meter Multi-plier or Type	Default Value	Winder Mode	Winder Function	Parameter Descriptions
							Constant	
19.22	A	SU	I/P	100	0	All	Tension Reference	STALL TENSION % OR LEVEL (SEE #19.40). 0-10000=0-100%, 0 TO DISABLE
19.23	A	DN	I/P	1			Tension Reference	SLACK TAKEUP TENSION XFER LEVEL (%) (0-100% , x1) (this sets up a comparator existing in Mentor / Quantum /Unidrive, with tension threshold for external use in systems, where it is desired to sense that slack has been taken up.
19.24	R	SU	I/P	1	3	Speed	Acquire	Acquire timer off delay, seconds, for external acquire control input. This prevents acq from remaining on continuously due to user input
19.26	R	SU	I/P		0	Speed	Dancer	DANCER STORAGE IN INCHES/MAX LINE FPM) X 2500 (based on 10000 counts=full line spd & 20000 counts= full dancer travel)
19.27	S	SU	I/P	0.05	1	Speed	Time Constant	Filter time const for tension and taper refs, in speed mode, SEC X .05 (see 20.29)
19.29	R	SU	I/P	100	0	All	Threshold	Speed threshold of Line Speed, at which STALL TENS is enabled, % Also, this threshold is used for the end of roll flag, to detect that the line is moving.
19.31	RO	DN	O/P	Bit		All	Web break	Web Break Flag. always active, even if Drive trips are disabled.
19.32	S	DN	I/P	Bit		All	Diameter	Preset enable bit for Diameter value entered in #20.48 This preset is used for mid-roll values. To preset to core, use 18.34
19.33	S	DN	I/P	Bit		All	Enable	WINDER MODE: (CTCW) TORQUE =0, 1=SPEED WINDER MODE WITH PID
19.34	A	SU	I/P	Bit	0	Torque	Web break	Web break local drive trip disab in CTCW mode, 1 to disable drive trip except if overspeed trip. This does not disable user web break flags.
19.35	R	SU	I/P	Bit		All	Enable	jog speed divided by diam, for const surf spd ,1 to enable
19.36	R	SU	I/P	Bit		All	Enable	jog with ramp enabled=1. 0=step jog.
19.37	A	DN	I/P	Bit		Speed	Enable	Torque memory mode activate. 1 to put drive in torque mode, while speedwinding. (19.41) (Closed Loop Drive)
19.38	S	DN	I/P	Bit	0	Torque	PID enab	PID enable for CTCW mode. 0=open loop tension control. This is an optional enable for PID control in the Torque mode, which is optional and rarely used. The PID in torque mode trims the drive's torque level up to 10 % if needed to improve tension control, but requires the use of a loadcell or dancer.
19.39	A	DN	I/P	Bit		All	Enable	Stall Tension Activate , Setting this parameter to 1 enables Stall Tension.
19.40	R	SU	I/P	Bit		All	Enable	Stall Tension control in % of set value, or Fixed Level. Stall Value=1, Stall % of set=0
19.41	A	DN	I/P	Bit		Speed	Enable	Torque Memorize: 1 To memorize present filtered drive torque level (19.37) (Closed loop drive)
19.42	S	DN	I/P	Bit		All	Diameter	Direct diameter input enable using 20.44 X100, 1 to enab
19.43	A	DN	I/P	Bit	0	Torque	Inertia	Breakaway torque pulse in CTCW mode. 1 to generate pulse from external input. Bit input is trigger for a 1-shot function.(see 20.20,21) works anytime drive is on. If bit is left on, pulse will occur whenever drive is started.
19.44	R	SU	I/P	Bit		Speed	Dancer/ Loadcell	Diameter Tracking inhibit if web with DANCER OR LOADCELL is slack in speed mode, 18.29, and 18.30 are the slack levels, depending on feedback device. See web break details.
19.45	R	SU	I/P	Bit		All	Enable	CT net watchdog, 1=hard disable (self enabling after receipt of 1st packet)
19.46	R	SU	I/P			All	Drive Mode	For Ramp Stop, use parameter 6.01="rp", in drive. For quick stop, set 6.01 to "norp", or "coast". Drive's stop function overrides any winder program control of speed, so 19.46 function is not used, except in Mentor ver of this prog.
19.47	S	SU	I/P	Bit		Torque	Enable	Coiler Mode select. 0=coiler torq control w/ spd override, 1=std torq w/ spd override. Applies to both winder modes. Program selects drive mode based on this input, and the winder mode. Coiler mode differs from normal speed override mode in that negative torque demand causes the speed override level to go to zero, so that full negative torque is available for inertia comp during line decel.
19.48	A	SU	I/P	Bit	0	Speed	Web break	Web break local drive trip disab in speed mode. 1 to disable. Web break utilizes slack web detection parameters 18.30 or 18.29). This does not disable user web break flags.
19.49	S	SU	I/P	Bit		Torque	Enable	Rewinder=0, 1=Unwinder (for CTCW mode only). Needed for web break function and torque sense for winding.
20.01		SU				All	Ctnet	CTnet setup parameters #20.01-20.12

Para-meter	Read Status	Para meter Type	Para-meter Data Flow	Para-meter Multi-plier or Type	Default Value	Winder Mode	Winder Function	Parameter Descriptions
20.20	A	DN	I/P	1		Torque	Inertia	BREAKAWAY PULSE AMPLITUDE %, CTCW (in drive % current units 1-100%) This gives the machine a starting current boost to get the roll moving, by overcoming static friction.
20.21	A	DN	I/P	10		Torque	Inertia	BREAKAWAY PULSE DURATION, CTCW (sec X 10) Length of starting boost time.
20.22	RO	DN	O/P	100		Speed	Dancer / Loadcell	Tension Feedback filtered o/p for MMI usage. % This output is filtered so an MMI bargraph display will present a steady reading in the presence of tension vibrations.
20.23	R	SU	I/P	0.005	1	Speed	Dancer / Loadcell	Tension feedback filter o/p filter T.C. sec X .005 , for MMI for 20.22
20.24	R	SU	I/P	10	0	All	Diameter Setpoint	END OF ROLL FLAG SETPOINT. Diameter X 10. Ex. 3.1"=31. Flag 18.31goes on when roll diameter drops below this point, as the roll is unwound. In the case of a winder, the flag goes off when above this diameter.
20.25	A	SU	I/P	100	0	Torque	Inertia	Friction or Static Loss Comp (0-2500 = 0-25% torque) CTCW
20.26	A	SU	I/P	1	0	Torque	Inertia	Viscous Loss Comp (% F.L. TORQ X 100 at full spd) CTCW, 0 to 10%
20.27	A	SU	I/P	1	0	All	Inertia	WK^2 COMP overall gain , (typ=10) See inertia comp setup text.
20.28	A	SU	I/P	0.005	30	All	Inertia	WK^2 line spd differentiator post filter time constant. T.C.=sec X .005 This is the final filter for the inertia comp signal derived from line speed. The filtering smooths the torque signal that will be produced. See also the pre-filter, 70.90 The value here should be 3 times the value in 70.90 The default value produces minimal output filtering.
20.29	S	SU	I/P	0.005	1	Torque	Time Constant	Filter time const for tension ref in ctcw mode , sec X 200. This causes any operator tension changes to have a ramp effect. Also causes initial startup tension to ramp up smoothly
20.30	R	SU	I/P	100	300	All	Web break	Speed level threshold, of spindle, above which web break can be detected, in % X 100 ex. 100=1%, both modes.
20.31	S	SU	I/P	10	0	Torque	PID	Proportional gain for CTCW PID
20.32	S	SU	I/P		0	Torque	PID	integrator gain CTCW PID
20.33	S	SU	I/P	1	0	Torque	PID	derivative gain CTCW PID
20.34	R	SU	I/P	100	0	Torque	PID	PID limit in CTCW mode in % 10000=nominal value
20.35	S	SU	I/P	100	0	Torque	PID	PID OVERALL TRIM GAIN, in CTCW mode, in percent. (%X100) 0 to 10(%), max
20.36	A	DN	O/P	Bit		All	Winder Status	Diameter Flag** when fieldbus in use. (see 18.31)
20.37	S	SU	I/P	Bit		All	PID	Reverse PID action here** when Fieldbus in use (see 18.32)
20.38	R	SU	I/P	Bit		Speed	Acquire	Auto Acquire Enable is here when fieldbus in use. (**see 18.33 for info)
20.40	S	SU	I/P		40	All	Rate	TRACK FILTER RATE (MAX WEB THICKNESS * MAX LINE SPEED IN FPM * 12) Prog limits the min value of 20.40 during initialization. See text.
20.41	A	DN	O/P	100		All	Diameter	ROLLSIZE IN INCHES X 100 This is the value held in diameter memory, and is the working value, used for winder control.
20.42	A	DN	I/P	100		All	Tension Reference	Tension reference, common to all winder modes, 10000=100%, It is summed with Ctnet refs 70.31 or 70.36 depending upon winder mode
20.43	A	DN	I/P	100		All	Tension Reference	Taper Tension Setpoint (0-+/-10000 = 0-+/-100%) for both winder modes. Adds with any value entered into 70.32, from Ctnet.
20.44	A	DN	I/P	100		All	Diameter Setpoint	DIRECT diameter INPUT (X100). Used where diameter information is determined externally, as with an ultrasound system. In this case, the internal diameter calculation is not used.
20.45	A	DN	I/P	100	0	Speed	Speed Setpoint	SPEED MATCH BOOST/CUT for WINDER,% (+/-1000=+/-10%) (see #18.32,& #18.46) 1000 limit. This is used to assist in proper splicing operations on Turret winders. See text.
20.46	A	DN	I/P	100		All	Tension Reference	Index Boost added to tension or torque ref. in both wind modes. %, Adds a boost value to the operating tension, when needed during transfers. See 70.33
20.48	S	DN	I/P	100		All	Diameter Setpoint	Aux unwind diameter preset value. Used when 2 core presets are used, and an unwind or mid-roll preset is needed. see 19.32
The following parameters can only be set or changed with a CTKP Keypad, CTIU Interface Panel or CT Browser software.								
70.31	A	DN	I/P	100		Speed	Tension Reference	Tension Ref (% Tension) for speed mode via Ctnet

Para-meter	Read Status	Parameter Type	Para-meter Data Flow	Para-meter Multi-plier or Type	Default Value	Winder Mode	Winder Function	Parameter Descriptions
70.32	A	DN	I/P	100		All	Tension Reference	Taper Ref from Ctnet (%). Adds with 20.43
70.33	A	DN	I/P	Contrl Word bit		All	Tension Reference	Index Boost=1 using Bit 0 of word. Enables boost torque. (see 20.46)
70.36	A	DN	I/P	100		Torque	Tension Reference	Tension Ref, %, (for CTCW mode) (% Armature torque, or % to 4.08) via Ctnet
70.37	A	SU	I/P	10	0	Speed	PID	Proportional gain for extensible mat'l, speed mode
70.38	A	SU	I/P		0	Speed	PID	Integrator Gain for extensible mat'l, speed mode
70.39	R	SU	I/P	100	0	All	Speed Setpoint	Jog Speed for Winder, via Ctnet. %, If #19.35 enab. Adds with val in #19.16 Sends result to drive #1.05.
70.40	S	DN	I/P	100		All	Diameter Setpoint	Preset Diameter input, Manual. (70.54). Used for operator input of unwind roll size via MMI or Ctnet.
70.42	A	DN	I/P	100		Torque	Tension Reference	Lay-on Roll Tension Ref (% tension or torque) (used for index tens ref)CTCW
70.50	A	SU	I/P	Bit		Speed	PID	Extensible Web=1 (select 2nd set of speed mode pid gains)
70.51	RO	DN	O/P	Bit		All	Web break	Web Break or overspeed detected=1. (web break detection in speed mode requires slack web sensing to be enabled. For external use. This bit is not disabled by 19.34 or19.48, being set .
70.52	R	SU	I/P	Bit	0	All	Speed reference	Select Line Spd Ref #2. Select=1 using Bit 0. (73.00 vs 18.11)
70.53	S	DN	I/P	Bit		All	Diameter	Preset Diameter to Full Roll value in 18.15 This directly sets diameter to full roll.
70.54	S	DN	I/P	Bit		All	Diameter	Preset enable bit for Manual Diameter Value located in 70.40 Used for operator input of unwind roll size via MMI or Ctnet.
70.59	S	SU	I/P	Contrl Word bit		Speed	Inertia	Inertia comp in speed mode, Bit 0=1 to enable. Used only on difficult loads.
70.59	S	SU	I/P	Contrl Word bit		Speed	Inertia	Add PID trim to line speed derivative signal. Optionally used as part of inertia comp in speed mode. Bit 1= enable
70.80	R	SU	I/P	word	1836	All	Pointer	Pointer for 18.31 bit o/p** (w/ Fieldbus)
70.81	R	SU	I/P	word	1837	All	Pointer	Pointer for 18.32 bit o/p** (w/ Fieldbus)
70.82	R	SU	I/P	word	1834	All	Pointer	Pointer for 18.33 bit o/p** (w/ Fieldbus)
70.83	R	SU	I/P	Contrl Word	0	All	Enable	Control for 3 pointers used by Fieldbusses for redirect of 18.31-33. 0 (Default)=autodetect devicenet,profi, or interbus,1=man disab pointers,2=force pointers on. See text.
70.90	A	SU	I/P	0.005	90	All	Inertia	WK^2 line spd differentiator pre-filter Time Const. Sec X .005 This is the filter for the line speed signal going in to the inertia comp block. See also the output filter, 20.28. The value here should be 1/3 the value in 20.28. This filter cleans any noise on the line speed signal, and greatly enhances the ability of the output filter to smooth the inertia comp signal. The default value is good for >100 hp machines
70.92	A	SU	I/P	1	0	All	Limit	Speed lim in neg direction (used only in Mentor program version)
70.93	A	DN	I/P	Contrl Word		All	Control Word	Control word for PLC control of winder. See text
70.94	S	SU	I/P	Contrl Word		All	Control Word	Control word mask for winder control word. See text
70.95	RO	DN	O/P	Contrl Word		All	Winder Status	Status Word for winder
70.95	RO	DN	O/P	Contrl Word		All	Control Word	Winder Status Word see text.
73.00	RO	DN	I/P	10000		All	Speed reference	CTNET derived Line Speed Reference #2 , (+/-%) see 70.52
73.01	RO	DN	O/P	word		All	Ctnet	Handshake id from buddy for failsafe. Reserved for comms loss functions in systems.
73.04	RO	DN	O/P	word		All	Ctnet	ID from Speed Ref source (73.04), reserved for control purposes, in sectional control system programs.
73.07	RO	DN	O/P	100		All	Winder Status	Line speed derivative signal o/p for testing of inertia comp setup.

Parameter Descriptions

The following descriptions present more information about the Dual Mode Winder Program-specific parameters (menus 18,19 & 20), listed by Parameter Group.

Read Status

RO=Read Only
RW/R=Read Write/Reads when Program Reset
RW/S= Read Write/Reads when Stopped
RW/A= Read Write/Reads Anytime

Mode

TM=Torque Mode Only
SM=Speed Mode Only
All=Both Modes

Acquire

#18.16 ACQUIRE RATE RW/S SM

Default: 0 Data Flow Direction: Input

This value multiplies the normal diameter tracking rate #20.40 by #18.16.

#18.33 ENABLE AUTO ACQUIRE RW/R SM

Data Flow Direction: Input

When enabled, this func acquires current roll diameter after first drive startup, after power up. Normally not needed, since the diameter is saved when power is off. When a UD73, UD74 OR UD77 module is used, this parameter switches to #20.38.

#18.38 ACQUIRE NEW DIAMETER RATE RW/A SM

Data Flow Direction: Input

1= Speeds up the diameter tracking
0= Uses normal (filtered) diameter calculating method (see #18.07)

Externally controlled. (speeds up the diameter tracking, so as to rapidly update the diameter memory with a new or unknown roll size.). Speed mode only

---

#19.20 AUTO ACQUIRE TIME PERIOD RW/R SM

Default: 0 Data Flow Direction: Input

19.20 is the time period in which diameter tracking is accelerated, automatically on the first drive startup, so as to rapidly acquire an incoming diameter, when the winder is started up for the first time and diameter of material is as of yet unknown.

#19.24 ACQUIRE TIMER PERIOD RW/R SM

Default: 3 Data Flow Direction: Input

This is the timeout period for an external acquire input request. This prevents acq from remaining on continuously due to user input.

#20.38 ENABLE AUTO ACQUIRE RW/R SM

Data Flow Direction: Input

When UD73, UD74 OR UD77 module used, #18.33 is re-located here.

Diameter

#18.07 FILTERED DIAMETER RO All

10000= FULL ROLL Data Flow Direction: Output

This is the result of the diameter calculation after filtering. (DIAM%)

#18.10 RAW DIAMETER RO All

Data Flow Direction: Output

10000=FULL ROLL

This is the diameter prior to filtering. (RWDIAM%)

#18.13 DIAMETER PRESET #1 RW/S All

Multiplier: DIGITS X 1000 (x.xxx)

Default: 0 Data Flow Direction: Input

This is the smallest roll size, example: 3.5"=3500. This preset calibrates the drive speed match and thus should not be used as a mid-roll or unwind preset. Use instead the aux preset or preset 2.

#18.14 DIAMETER PRESET #2 RW/S All

Multiplier: DIGITS X 100

Default: 0 Data Flow Direction: Input

Taper tension is based on the correct core diameter. If only one core preset is used, this preset can also be used as a mid-roll or unwind preset. See “Setting Up Parameters” section.

#18.15 FULL ROLL DIAMETER RW/S All

Multiplier: FULL ROLL DIAMETERx 100

Default: 0 Data Flow Direction: Input

This is the largest expected roll size (used for scaling purposes). This is also the diameter where the taper setpoint will be reached.

ACTUAL WORKING SIZE MAY EXCEED THIS BY 20% MAX.

#19.32 PRESET DIAMETER TO AUXILIARY VALUE RW/S All

Data Flow Direction: Input

Preset diameter to auxiliary value in #20.48

#19.42 DIRECT DIAMETER INPUT RW/S All

Data Flow Direction: Input

1=enable

This allows direct diameter input using 20.44 X100.

#20.24 END OF ROLL FLAG SETPOINT RW/R All

Multiplier: Diameter in Inches X 10

Default: 0 Data Flow Direction: Input

Flag #18.31 goes on below this diameter and line direction

#20.26 VISCOUS LOSS COMPENSATION RW/A All

Data Flow Direction: Input

(% F.L. Torque X 100 at full speed) in Torque Mode, 0 to 10%

#20.41 ROLL SIZE RW/A All

Multiplier: Inches X 100 Data Flow Direction: Output

This is the value held in diameter memory, and is the working value, used for winder control.

#20.44 DIRECT DIAMETER INPUT RW/A All

Multiplier: X 100 Data Flow Direction: Input

Used where diameter information is determined externally, as with an ultrasound system.

#20.48 AUXILIARY UNWIND PRESET VALUE RW/S All

Multiplier: X 100 Data Flow Direction: Input

1 = to allow 2 core presets in the unwind mode, used when 2 core presets are used, and an unwind or mid-roll preset is needed. See 19.32.

Drive Mode

#19.46 RAMP STOP STYLE RW/R All

Data Flow Direction: Input

1=Ramp stop

0=Coast stop or DB stop.

Use parameter 6.01="rp", in drive. For quick stop, set #6.01 to "norp", or "coast". Drive's stop function overrides any winder program control of speed, so #19.46 function is not used.

Drive Reference

#19.07 TENSION REFERENCE OUTPUT RO

Multiplier: X 100 Data Flow Direction: Output

10000=maximum without taper.

This signal is available to drive a dancer air-loading valve.

Enable

#18.34 PRESET THE DIAMETER RW/S All

Data Flow Direction: Input

1=yes

This parameter when enabled, causes the diameter memory to be set to the selected core or unwind diameter value.

#18.39 TAPER ON/OFF RW/A All

Data Flow Direction: Input

1=Taper Off (RAMPED TRANSITION)

0=Taper On

Removes taper and applies full core tension in anticipation of a new roll transfer, when used in turret winders. This allows air pressure to begin building up in the dancer air loading cylinders.

#18.40 TAPER STYLE RW/S All

Data Flow Direction: Input

1 = Linear Taper

0= Hyperbolic Taper

When using taper, this parameter selects whether taper should occur in a Linear or Hyperbolic fashion.

#18.42 TAPER ON/OFF (stepped/fast transition) RW/A All

Data Flow Direction: Input

1=OFF

0=ON

This causes a rapid transition to the core tension value, by eliminating taper. See parameter #18.39.

#18.45 PRESET STYLE RW/S All

Data Flow Direction: Input

1=UNWIND or Midroll

0=REWIND or Core

This enables a mid or full roll diameter preset, using preset 2 or 3 depending on the setting of #18.49. If 0, the preset is a core preset, to the selected core size.

#18.46 SPEED BOOST/CUT SIGNAL INVERT RW/A SM

Data Flow Direction: Input

INVERT=1

#18.47 SPEED BOOST/CUT WHEN PID DISABLED RW/A SM

Data Flow Direction: Input

1 = Enable

See #20.45 for value.

#18.49 SET DIAMETER TO AUXILIARY UNWIND VALUE RW/S All

Data Flow Direction: Input

This preset command to set diameter to #20.48.1 = enable (with 18.45 enabled). This allows two unwind/rewind core sizes, using the standard presets (1 and 2), for correct taper operation. #18.49= 0 to cause preset command to set Diameter to preset #2 value.(unwind or mid-roll mode) w/ 18.45 enabled), when only 1 core size is used. (preset 1). #18.49= 0 also frees up #20.48 to be used for other purposes. (#18.45 must be 1 to enable these functions.)

#19.33 WINDER MODE RW/S All

Data Flow Direction: Input

0=TORQUE WINDER (CTCW)

1=SPEED WINDER MODE WITH PID

#19.34 DISABLE WEB BREAK LOCAL DRIVE TRIP RW/A TM

Default: 0 Data Flow Direction: Input

This disables the web break local drive trip in CTCW mode. 1=disable, except if overspeed trip.

#19.35 JOG SPEED AUTO TRACK ENABLE RW/R All

Data Flow Direction: Input

1=Enable

0=Disable

By setting this control bit the jog speed setting is divided by diameter so that the jog occurs at constant surface speed.

#19.36 JOG ACCEL/DECEL RAMP RW/R All

Data Flow Direction: Input

1=Ramped

0=Stepped

This is the ramp select bit for jog. This makes it possible for jog to be ramped or stepped.

#19.37 TORQUE MEMORY ENABLE RW/A SM

Data Flow Direction: Input

1=put drive in torque mode

This activates torque memory mode. (See 19.41)

#19.39 STALL TENSION SELECT RW/A All

Data Flow Direction: Input

1= Select Stall Tension Amount

0=De-Select Stall Tension -Use Normal Tension Reference

#19.40 STALL TENSION STYLE RW/R All

Data Flow Direction: Input

1= to select a fixed value for stall tension

0= to select stall tension as a % of set tension value.

(SEE #19.22,19.39,19.21).

#19.41 TORQUE MEMORIZE ENABLE RW/A SM

Data Flow Direction: Input

1=Enable Torque Memory Feature

0=Disable Torque Memory Feature

To memorize present filtered drive torque level (closed loop drive).

#19.45 CT NET MODULE WATCHDOG RW/R All

Data Flow Direction: Input

1=hard disable (self enabling after receipt of 1st packet)

This watches for UD75 CT Net module.

#19.47 COILER MODE SELECT RW/S TM

Data Flow Direction: Input

0=coiler torq control w/ speed override

1=standard torque w/ speed override.

Applies to both winder modes. Program selects drive mode based on this input, and the winder mode. Coiler mode differs from normal speed override mode in that negative torque demand causes the speed override level to go to zero, so that full negative torque is available for inertia comp during line decel.

#19.48 DISABLE WEB BREAK LOCAL DRIVE TRIP RW/A SM

Default: 0 Data Flow Direction: Input

1=disable

This disables the web break local drive trip in Speed mode. This utilizes slack web detection parameters #18.30 or #18.29.

#19.49 REWINDER/UNWINDER IN TORQUE MODE RW/S TM

Data Flow Direction: Input

0=Rewinder

1=Unwinder

Torque mode only. Needed for web break function and torque sense for winding.

Feedback

#18.12 DANCER or LOADCELL FEEDBACK AMOUNT RW/A SM

Range:_ 0 to +/-10000=100% trim

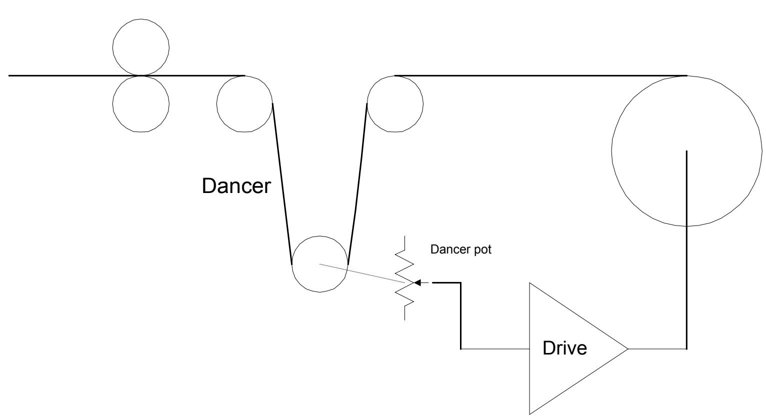
Multiplier: x 100 Data Flow Direction: Input

#18.17 DANCER POSITION REFERENCE RW/A SM

Range: +/- 1000 Multiplier: X 100

Default: 0 Data Flow Direction: Input

This is the position reference for a dancer PID loop. The previous computation allows a 0-255 parameter to cover the range +/- 1000



Example: If one had a dancer pot that was supplied with a unipolar supply (say 0 to +10v) and the desired home position for the dancer developed +4 Volts on the pot wiper, you would set the Dancer Position Reference as follows:

$$\#18.17 = \frac{\text{Dancer Output @Home Position}}{\text{Max Dancer Output}} \times 255 = \frac{4 \times 255}{10} = 102$$

#18.29 SLACK WEB LEVEL FOR DANCER RW/R SM

Multiplier: X 100

Default: 0 Data Flow Direction: Input

Used by Web break function. Also inhibits diameter tracking.reak function. In Feedback Counts.

#18.30 SLACK WEB LEVEL FOR LOADCELL RW/R SM

Multiplier: X 100

Default: 0 Data Flow Direction: Input

In Feedback Counts, %.

#18.41 FEEDBACK INVERTER RW/R All

Data Flow Direction: Input

1=Invert dancer/loadcell feedback

0=No Inversion

This reverses the polarity of the trim feedback.

#18.44 FEEDBACK TYPE RW/R All

Data Flow Direction: Input

1=Dancer

0= Loadcell

This bit characterizes the reference and feedback for the PID to operate as either a **Dancer Position** or **Loadcell Tension** loop.

#19.26 DANCER STORAGE RW/R SM

Default: 0 Data Flow Direction: Input

In Inches/Max Line FPM x 2500

Based on 10000 counts=full speed & 20000 counts=full dancer travel

This sets up the motion compensation for the dancer.

#19.44 ENABLE TRACKING INHIBIT RW/R SM

Data Flow Direction: Input

1=ENABLE

Tracking inhibit if dancer or loadcell is slack in Speed mode 18.29, and 18.30 are the slack levels.

Inertia

#19.14 MATERIAL INERTIA COMPENSATION RW/A SM

Default: 0 Data Flow Direction: Input

Affects response at full roll.WR^2. See "Setting Up Parameters" chapter.

#19.15 MACHINE INERTIA COMPENSATION RW/A SM

Default: 0 Data Flow Direction: Input

Affects response at core diameter (spindle plus motor). WR^2

#19.43 BREAKAWAY TORQUE PULSE RW/A SM

Default: 0 Data Flow Direction: Input

1=to generate pulse.

From external input. Bit input is trigger for a 1-shot function.(see 20.20,21) works anytime drive is on. If bit is left on, pulse will occur whenever drive is started.For Torque mode.

#20.20 BREAKAWAY PULSE AMPLITUDE RW/A SM

Data Flow Direction: Input

Torque Mode only. (in drive % current units 1-100%)

#20.21 BREAKAWAY PULSE DURATION RW/A TM

Data Flow Direction: Input

Multiplier: second X 10

#20.25 FRICTION OR STATIC LOSS COMPENSATION RW/A TM

Multiplier: X 100 Data Flow Direction: Input

Default: 0

(0-2500 = 0-25% torque) Torque Mode only.

#20.27 COMPENSATION OVERALL GAIN RW/A TM

Default: 0 Data Flow Direction: Input

Torque mode only. Typically the value for this is 10. WR^2

#20.28 TERM FILTER TIME CONSTANT RW/A TM

Multiplier: X .005 Data Flow Direction: Input

Default: 30

T.C.=sec X .005 Torque Mode (typically=30) WR^2

#18.08 PID TENSION INTEGRATOR OUTPUT RO All
Multiplier: X 100 Data Flow Direction: Output
This is the integrator's contribution to the PID Loop output.

#18.09 PID TENSION DIFFERENTIATOR OUTPUT RO All
Multiplier: X 100 Data Flow Direction: Output
This is the differentiator's contribution to the PID Loop output.

#18.18 PID PERCENT OVERALL TRIM GAIN RW/A SM
Multiplier: % X 100 Data Flow Direction: Input
Default: 0
Loadcell/Dancer, % OVERALL TRIM GAIN, 0 to 25%
This is the final overall gain multiplier of the PI trim. Speed Mode.

#18.19 PID PROPORTIONAL GAIN RW/A SM
Range: 0 to 32000 Multiplier: GAIN x 10
Default: 0 Data Flow Direction: Input
This sets the proportional gain of the PID trim controller.

#18.20 PID INTEGRATOR RATE RW/A SM
Default: 0 Data Flow Direction: Input
Rate is (time=64 / #18.20 Gain), in seconds.
0= disable the integrator
This sets the rate of integration for the PID trim controller.
HIGHER GAIN VALUES MAKES THE INTEGRATOR FASTER.

#18.21 PID DIFFERENTIAL GAIN RW/A SM
Multiplier: X 1 Data Flow Direction: Input
Default: 0
This sets the Differential gain of the PID trim controller. A starting value for dancer feedback would be 10.

#18.22 PID DIFFERENTIAL FILTER TIME CONSTANT RW/A SM
Default: 30 Data Flow Direction: Input
(Time Constant= #18.21X Tick Time)
Analog noise can be amplified by a differential term. This filter will prevent this erroneous occurrence.

#18.25 PID LIMIT RW/R SM
Range: 0-12000 Multiplier: X 10
Default: 0 Data Flow Direction: Input
10000 =Nominal
The limits to the proportional and integral values are set here. This prevents the integrator from "*winding up*" to an excessively large value when operational problems occur.

#18.32 REVERSE PID ACTION RW/S SM
Data Flow Direction: Input
1=Reverse Enable
This defines drive as rewind/unwind in speed mode. It also reverses speed boost, and minimum diameter sensing direction. When a UD73, UD74 OR UD77 module is used, this parameter switches to #20.37.

#18.36 PID TRIM ENABLE RW/A SM
Data Flow Direction: Input

1=Enable PID Loop
0=Disable PID Loop
This enables speed matching at core or full roll.

#18.37 PID INTEGRATOR ENABLE RW/A All

Data Flow Direction: Input

1=Enable Integrator
0=Disable Integrator

Integrator and diameter tracking enable bit in both modes. This allows for winder speed matching at core for transfers, with proportional trim only, in speed mode

---

#19.08 TENSION/POSITION ERROR RO All

Multiplier: X 100 Data Flow Direction: Output

This is the difference between the PID reference and feedback before conditioning.

#19.09 PROPORTIONAL/INTEGRAL OUTPUT (TRIM) RO All

Multiplier: X 100 Data Flow Direction: Output

This value is multiplied by the overall gain setting for the final trim signal.

#19.38 PID ENABLE FOR CTCW MODE RW/S TM

Default: 0 Data Flow Direction: Input

0=open loop control, disable
1=closed loop control, enable

This is an optional enable for PID control in the Torque mode, which is optional and rarely used. The PID in torque mode trims the drive's torque level up to 10 % if needed to improve tension control, but requires the use of a loadcell or dancer.

#20.31 PID PROPORTIONAL GAIN RW/S TM

Default: 0 Data Flow Direction: Input

For Torque Mode only.

#20.32 INTEGRATOR RATE RW/S TM

Multiplier: X 10 Data Flow Direction: Input

Default: 0

For Torque Mode only.

#20.33 PID DERIVATIVE GAIN RW/S TM

Default: 0 Data Flow Direction: Input

For Torque Mode only.

#20.34 PID LIMIT RW/R TM

Multiplier: X 100 Data Flow Direction: Input

Default: 0

In %, 10000=nominal

#20.35 PID % OVERALL TRIM GAIN RW/S TM

Multiplier: %X100 Data Flow Direction: Input

Default: 0

0 to 10(%) maximum

For Torque mode.

#20.37 REVERSE PID ACTION RW/S All

Data Flow Direction: Input

When UD73, UD74 OR UD77 module used, #18.32 is re-located here.

Rate

#20.40 TRACK FILTER RATE RW/S All

Default: 40 Data Flow Direction: Input

(Enter MAX WEB THICKNESS INCHES * MAX LINE SPEED IN FPM * 12)

This sets the basic tracking rate of the diameter filter. The maximum web thickness should be used to calculate this rate. Program limits the minimum value during initialization so that internal counter ranges do not become excessive. The smaller the number is, the slower the tracking speed becomes.

Select

#18.35 CORE PRESET SELECT RW/S All

Data Flow Direction: Input

1 = Select Preset 2 (The Larger Core)

0 = Select Preset 1

This selects the minimum operational diameter for the winder or unwinder.

Tension

#19.22 STALL TENSION AMOUNT RW/A All

Range: 0-10000, 0-100% Multiplier: X 100

Default: 0 Data Flow Direction: Input

0=Disable

This defines the Stall Tension and is set as a % of Run Tension or as a fixed amount or Level. See #19.40.

#20.42 TENSION REFERENCE RW/A All

Data Flow Direction: Input

1000=100%

This is common tension reference. 10000=100%, summed with #70.31 or #70.36 dependent on mode.

#20.43 TENSION TAPER AMOUNT RW/A All

(0-+/-10000 = 0-+/-100%) for both modes

0-+/-10000 = 0-+/-100% for both winder modes. Adds with any value entered into #70.32.

#20.46 INDEX BOOST RW/A All

Range:+/-10000=+/-100%

Multiplier: X 100 Data Flow Direction: Input

This is added to tension or torque reference in both wind modes

---

Threshold

#18.23 MINIMUM WINDER SPEED RW/A All

Multiplier: Speed threshold % X 10 Data Flow Direction: Input

Default: 1

Minimum speed threshold for Zero speed switch for winder spindle.

#18.24 MINIMUM LINE SPEED RW/A All

Multiplier: Speed threshold % X100 Data Flow Direction: Input

Default: 1

Minimum speed threshold for Zero speed switch for line speed

#19.23 SLACK TAKE-UP TENSION TRANSFER LEVEL (%) RW/A

Range: 0-100% Data Flow Direction: Input

Multiplier: X 1

This programs a drive threshold comparator with a percentage of the tension setpoint level, which can then be compared to the loadcell feedback and sense when slack take-up has been accomplished.

#19.29 MIN. SPEED FOR STALL TENSION AND DIRECTION ENABLING RW/R All

Multiplier: % x 100

Default: 0

Speed threshold of line for stall tension and direction enabling, %.

#20.30 MINIMUM SPEED LEVEL FOR WEB BREAK DETECT RW/R All

Multiplier: X 100 Data Flow Direction: Input

Default: 300

This is the speed level threshold of the spindle for web break detect in % X 100
ex. 100=1%, both modes.

Time Constant

#19.13 TORQUE MEMORY FILTER TIME CONSTANT RW/R SM

Multiplier: Seconds X 1000

Default: 10000 Data Flow Direction: Input

(maximum 10 sec)

#19.27 TENSION AND TAPER REF. FILTER TIME CONSTANT RW/S SM

Default: 1 Data Flow Direction: Input

In seconds, Sec X .05 (#20.29)

Tension and taper setpoints are passed through a filter so that rapid setpoint changes are ramped to prevent a sudden step change of reference.

Velocity

#18.05 LINE SPEED INPUT RECEIVED RO All

Data Flow Direction: Output

This parameter output represents the line speed coming in from either an analog input or the CTNet and is the winder's main line speed reference.

#18.11 LINE SPEED REFERENCE INPUT #1 RW/A All

Range: 0 to +/-10000 Data Flow Direction: Input

Multiplier: X 100

Can also use #70.52.

#19.11 NOMINAL MAXIMUM FREQUENCY RW/R All

Multiplier: HZ X 100 Data Flow Direction: Input

Default: 6000

This is the nominal maximum frequency at core. Speed Mode only, Open loop.

#19.12 NOMINAL MAXIMUM SPEED RW/R All

Default: 1750 Data Flow Direction: Input

Speed Mode only, (RPM X 1)

This is the nominal maximum speed at core.

#20.45 SPEED MATCH BOOST/CUT for WINDER RW/A SM

Multiplier: X 100 Data Flow Direction: Input

Default: 0

% (+/-1000=+/-10%)

(See #18.32,& #18.46 invert polarity). 1000 limit. This is used to assist in proper splicing operations on Turret winders. See “Setting Up Parameters” section.

Winder Status

#18.03 PROGRAM ID RO All

Data Flow Direction: Output

Identifies the program. Program catalog number.

#18.04 PROGRAM REVISION RO All

Data Flow Direction: Output

Identifies the revision of the winder program. Should be 2.0.7.

#18.06 BUDDY NODE ENABLED RO All

Data Flow Direction: Output

The system node that checks communications via CT Net, should the network fail.

#18.31 DIAMETER FLAG RO All

Data Flow Direction: Output

Trips when at minimum diameter. See #20.24 & #20.36.

#19.06 DIAGNOSTIC FAULT REGISTER RO All

Data Flow Direction: Output

81=WEB BREAK
82=error
83=wrong drive mode
84=overspeed
86=CTNet error

The number stored here, if any, indicates what was the cause of the last winder program error. Example: 81=WEB BREAK. More information is in the "Diagnotics" chapter.

#20.36 DIAMETER FLAG RW/A All

Data Flow Direction: Output

This is the re-location for #18.31, when UD73, UD74 OR UD77 module used.

Appendix B: Winder Program Flow Drawings

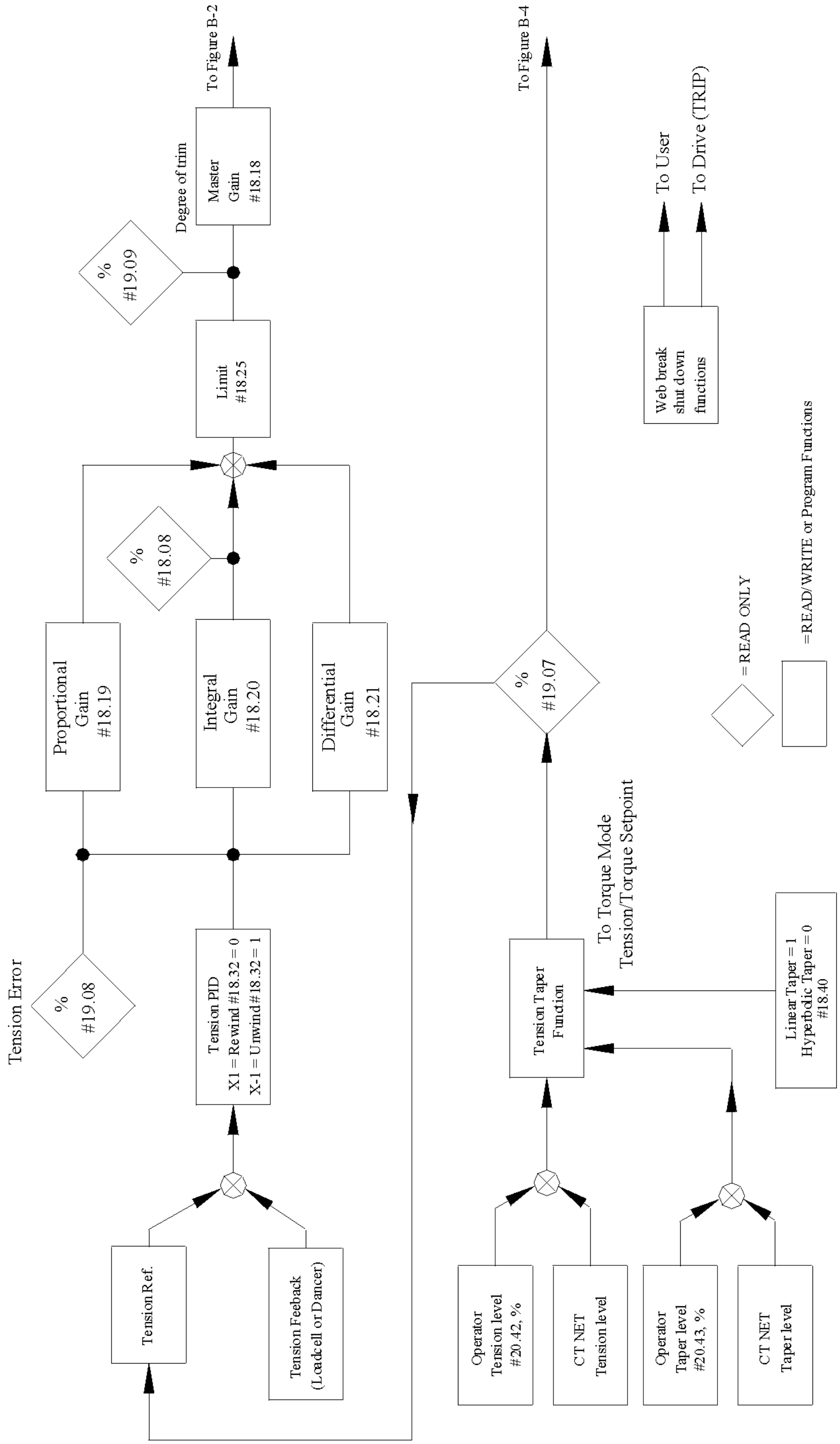


Figure B-1. Tension PID

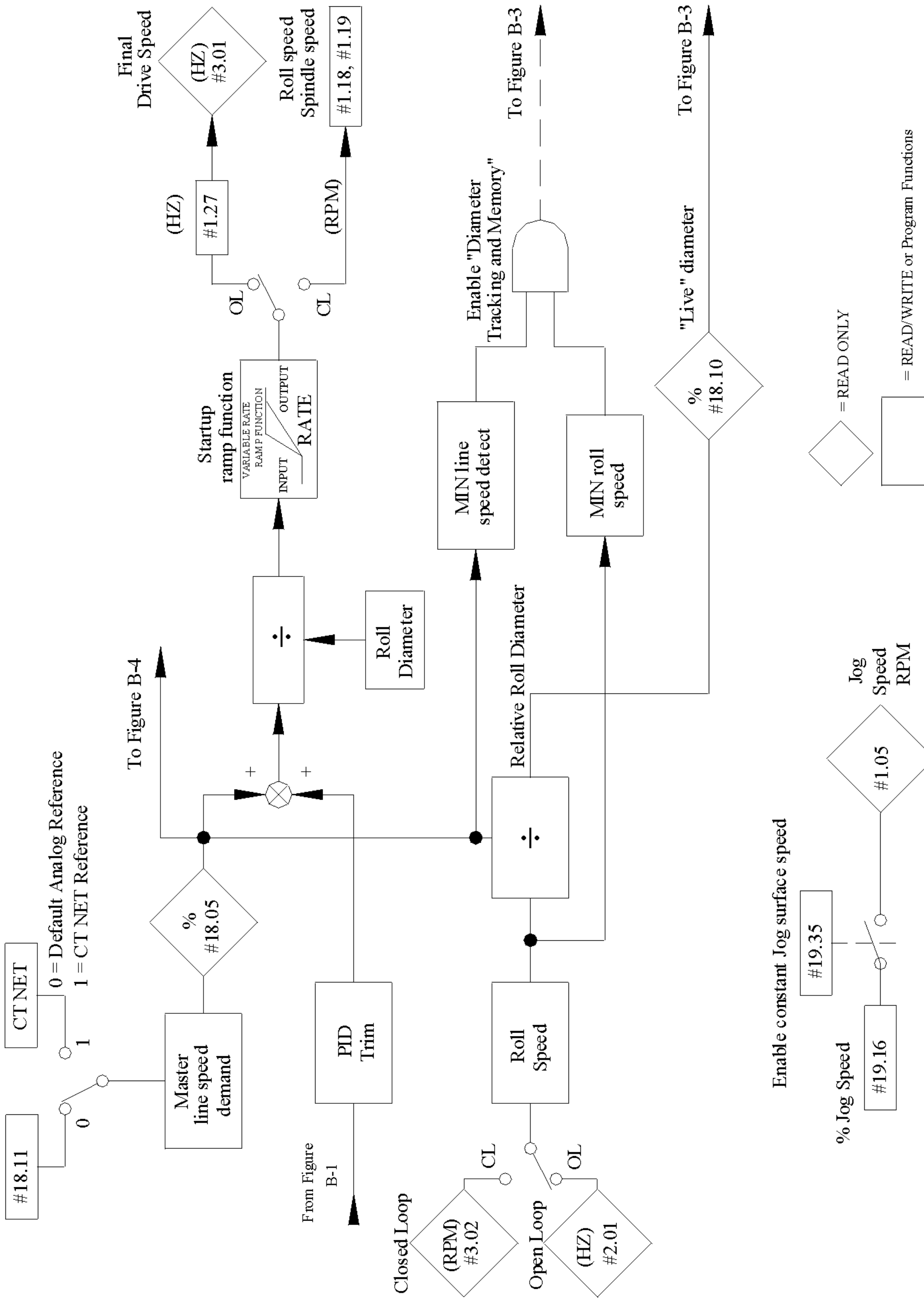


Figure B-2. Line Speed

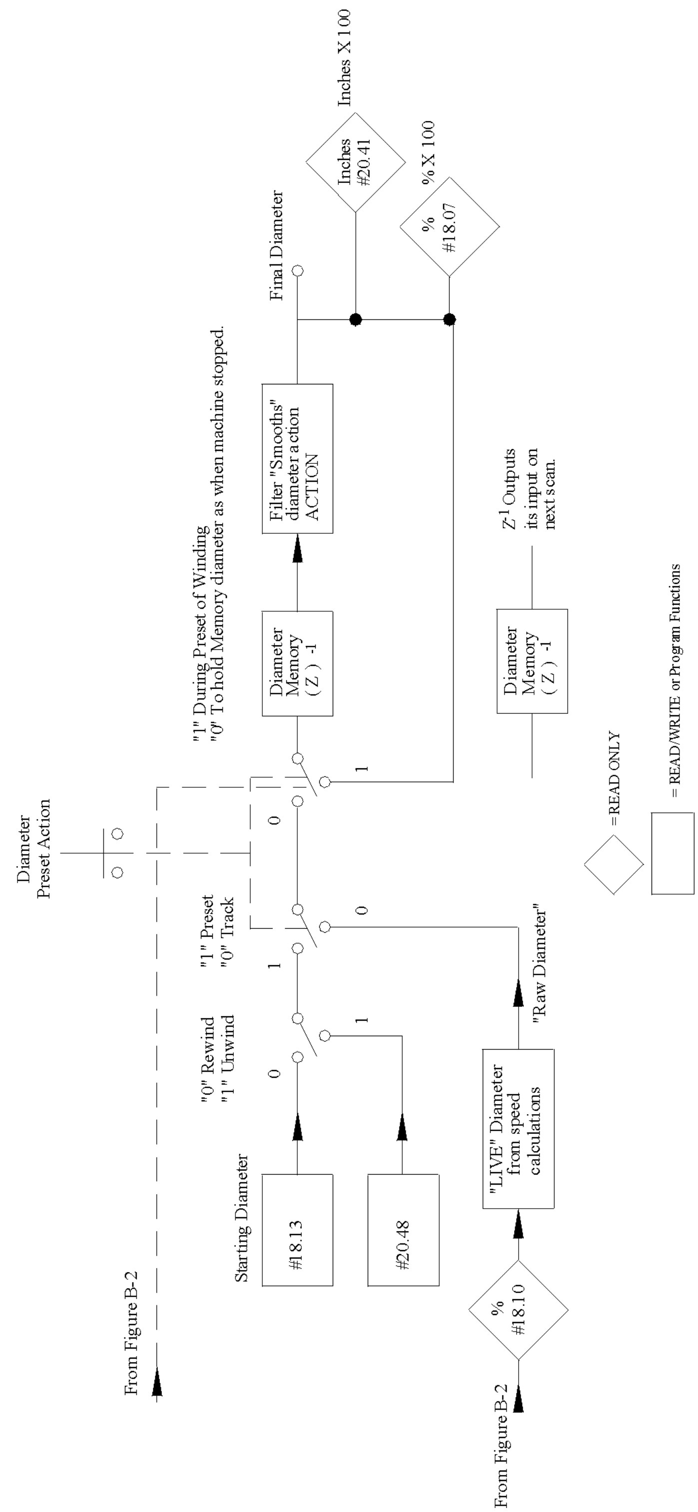


Figure B-3. Diameter Control

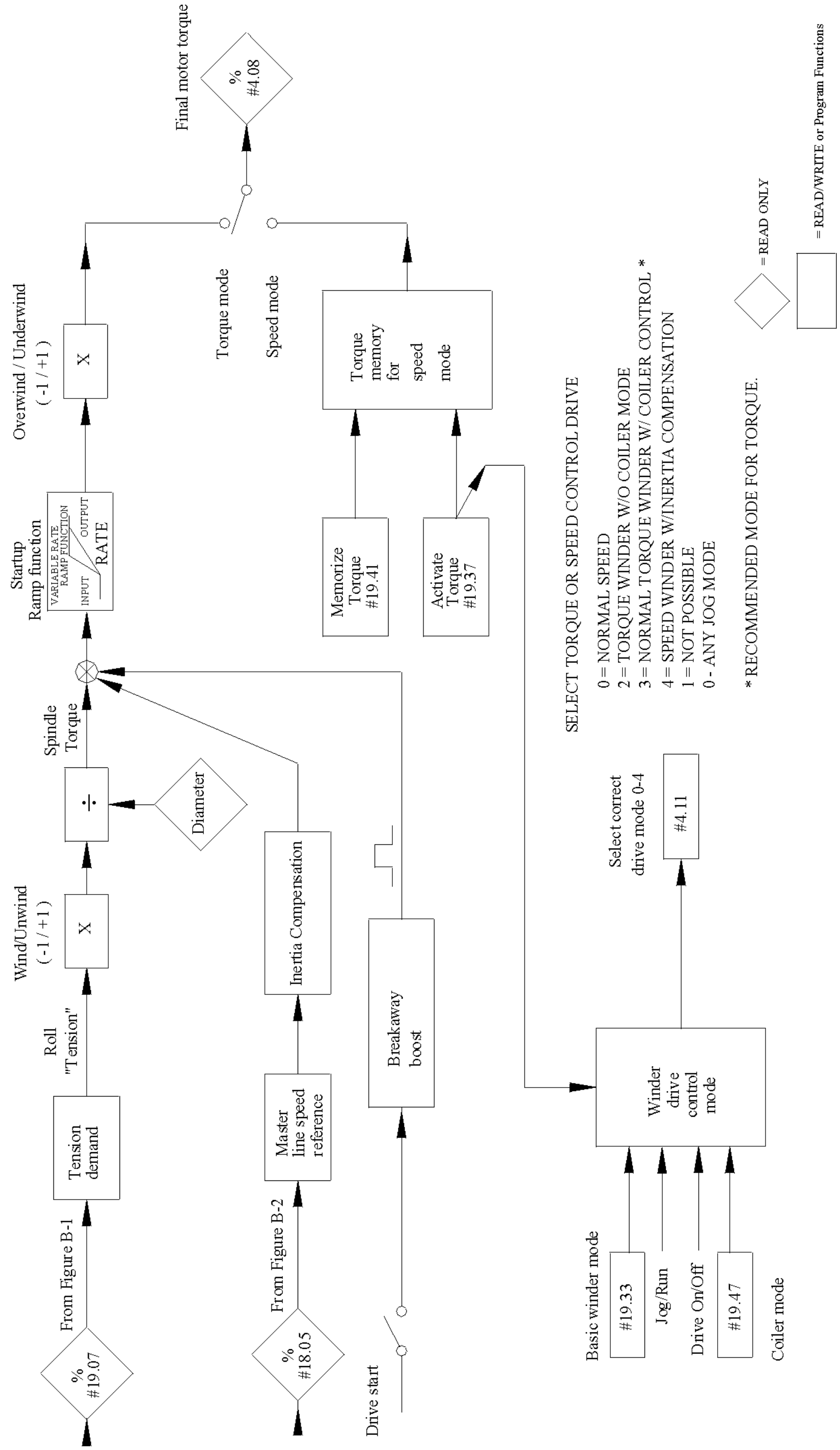


Figure B-4. Torque Modes

APPENDIX C: WINDER APPLICATION EXAMPLES

1. Single Spindle Rewinder in Speed Mode

The following is a basic Winder application example for a Single Spindle Rewinder using the UD70 Speed Basic Winder Program. The basic system information necessary as acquired during the Sales Application process results in the following Specification Data.

Machine:	Single Spindle Rewind
Cores:	4.5" and a 6"
Full Roll:	Max 50 "
Line Speed:	1300 FPM
Material:	Paper (copy machine grade) 8mils thick
Web width:	50"
Tension:	1.2PLI to 5PLI (*this info plays a role in the HP sizing*)
Feedback :	Dancer 0 to +/-10v + v = dancer being pulled by winder
Storage:	Approximately 4'
Drive:	Unidrive® in Closed Loop (Vector) Mode with encoder 1024PPR
Motor:	25HP Vector with gear-in such that 1300FPM=1710RPM
Line Ref:	via DC Tach from an upstream nip (+10v = Full Speed)

Operator Devices:

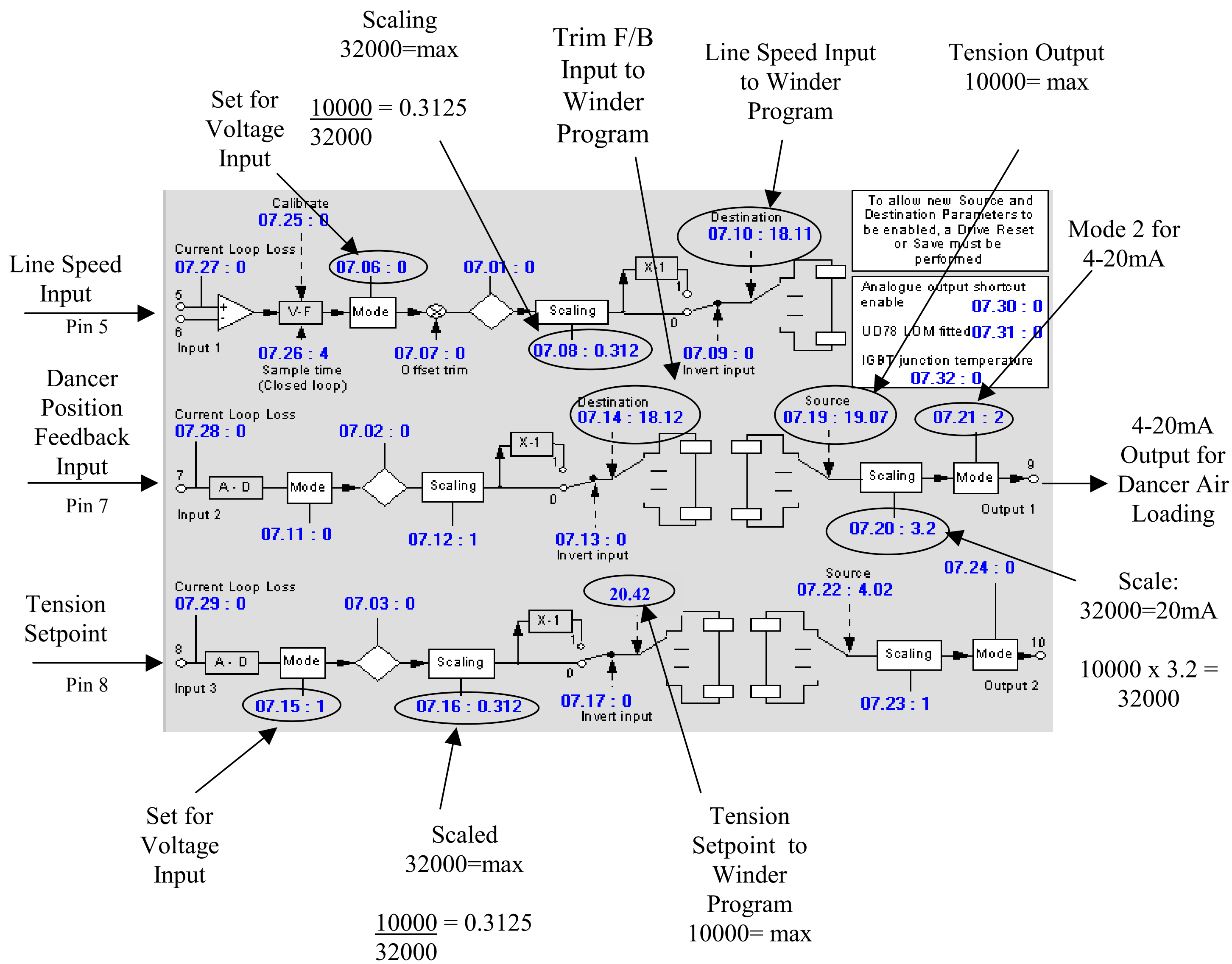
- Jog Rewinder
- Potentiometer for Tension Setpoint- 100%
- Potentiometer for Taper Tension – Linear 0 to 25%
- Tension On Switch

- Output for Roll at Max Diameter for auto stop function
- Dancer needs 4-20mA signal for tension set
- Must have web break detection

The I/O Assignments show the pertinent UniSoft software screens with Unidrive® I/O assignments and the rationale behind the scaling and associated interaction with Dual Mode Winder Application program. Additional I/O was required, and so the UD50 was employed.

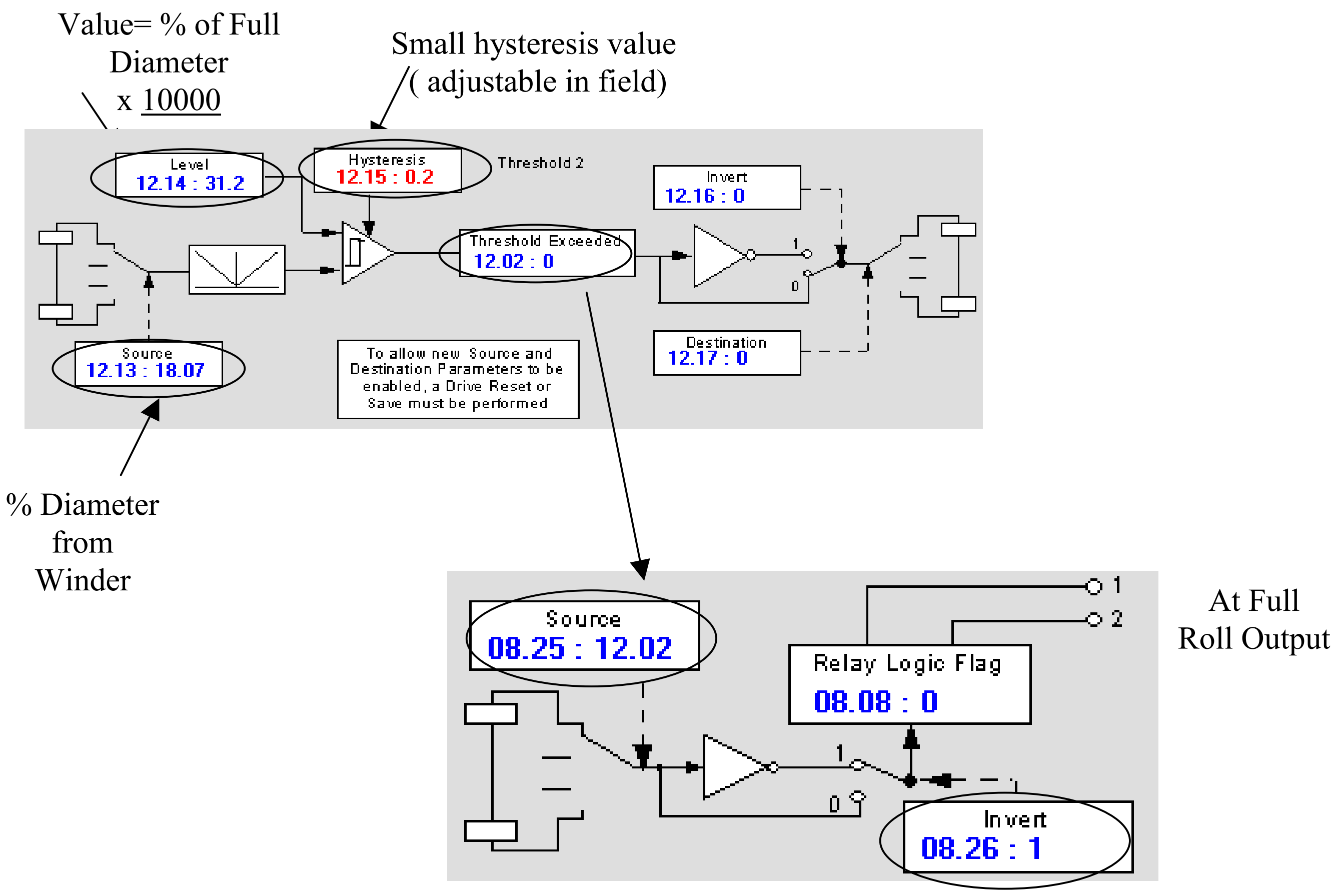
Winder I/O Assignments

Analog I/O (Menu 7) Mapping and Scaling

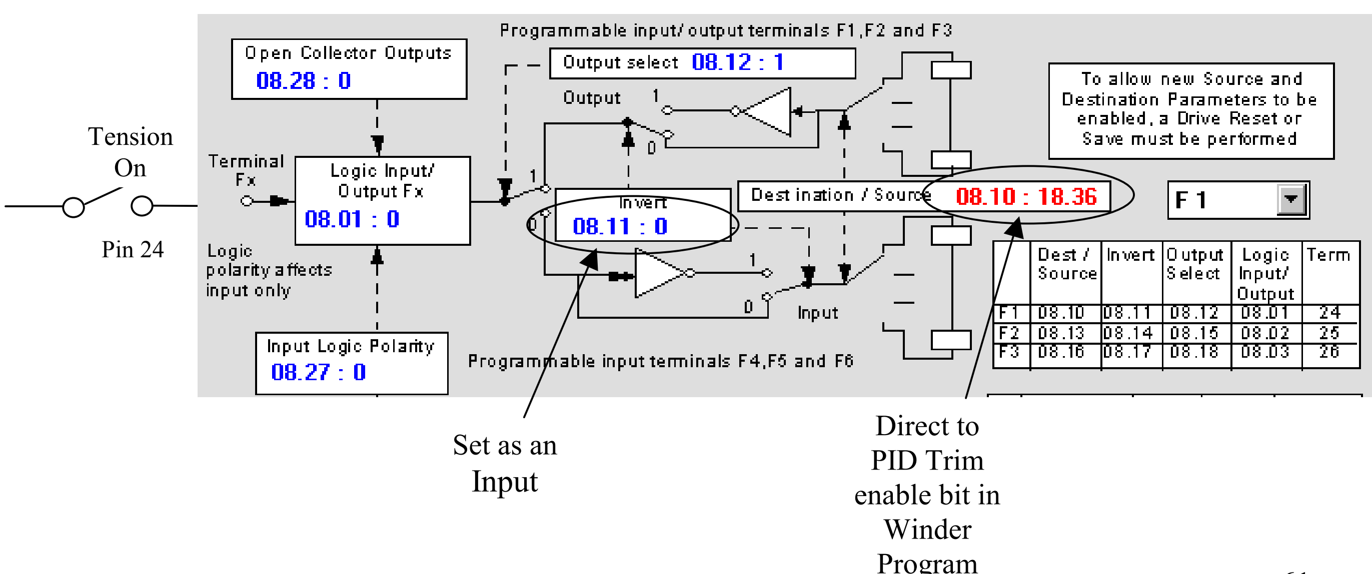


Winder I/O Assignments

Full Roll Output



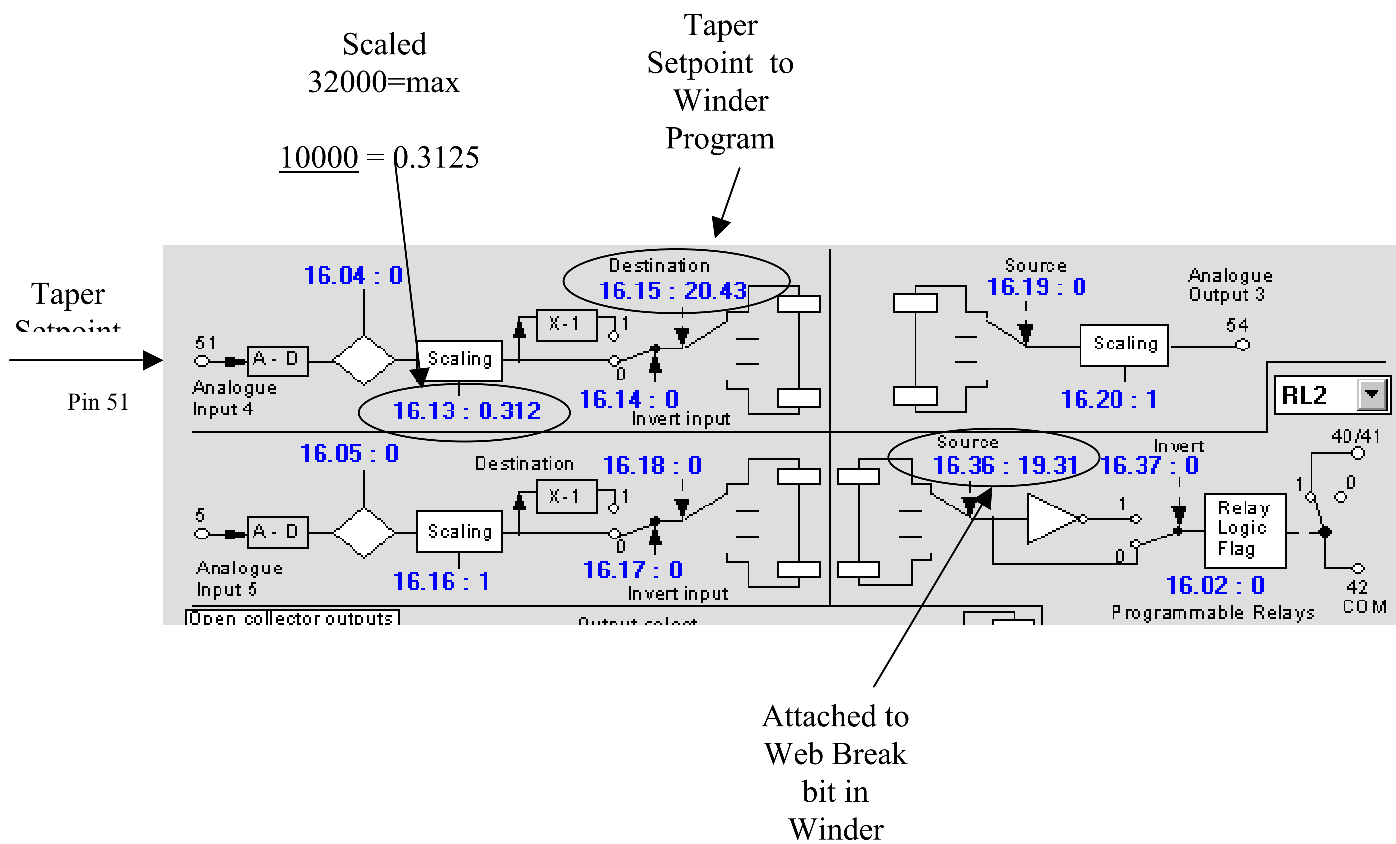
Tension "On" Input



	Dest / Source	Invert	Output Select	Logic Input/ Output	Term
F1	08.10	08.11	08.12	08.01	24
F2	08.13	08.14	08.15	08.02	25
F3	08.16	08.17	08.18	08.03	26

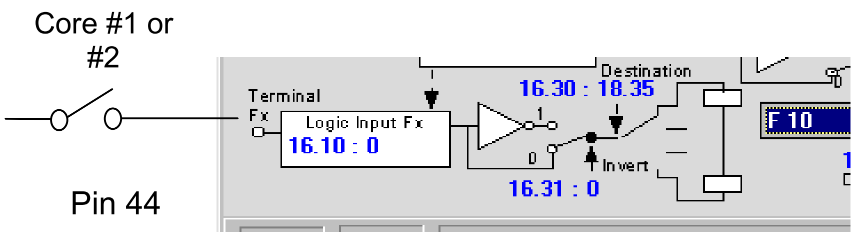
UD50 SOM Extended I/O Assignments

Taper Setpoint & Web Break



UD50 SOM Digital I/O Assignments

Core Selection Input Assignment



Programmable Relays COM

	Source	Invert	Log flag	Term
RL2	16.36	16.37	16.02	40
RL3	16.38	16.39	16.03	41

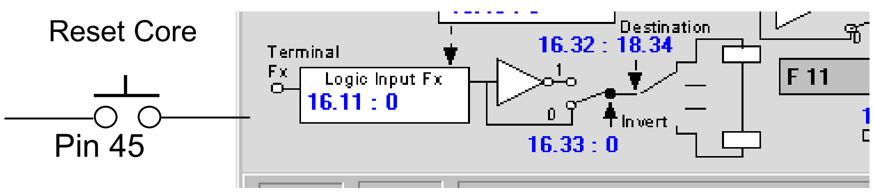
Programmable output /input terminals F7, F8 and F9

	Dest/ Srce	Invert	O/put Sel	Logic IP/O P	Term
F7	16.21	16.22	16.23	16.07	48
F8	16.24	16.25	16.26	16.08	49
F9	16.27	16.28	16.29	16.09	50

Programmable input terminals F10, F11 and F12

	Dest	Invert	Logic IP	Term
F10	16.30	16.31	16.10	44
F11	16.32	16.33	16.11	45
F12	16.34	16.35	16.12	46

Core Preset Input Assignment



Unidrive Pinout Summary

Winder Function	Unidrive Pin #	Unidrive Function
At Full Roll	1	Dry Relay Contact
At Full Roll	2	Dry Relay Contact
	3	
	4	+10v
Line Speed Input	5	Analog Input 0-10v
Line Speed Input	6	Differential to pin 5
Dancer Pot	7	Analog Input 0-10v
Tension Setpoint	8	Analog Input 0-10v
4-20mA Air Valve	9	Analog Output
	10	
Analog Common	11	Analog Common
	12	
	13	
	14	
	15	
	16	
	17	
	18	
	19	
	20	
	21	
	22	
	23	
Dancer Trim Enable	24	Input F1
External Fault Reset	25	Input F2
Winder Jog	26	Input F3
Reset Diameter	27	Input F4
Overwind/Underwind	28	Input F5
Stop Circuit	29	Input F6
Drive Enable/ESR	30	E-Stop Reset
Contact Common	31	
	32	
	33	
	34	
	35	
	36	
	37	
	38	
	39	

UD50 SOM Pinout Summary

Winder Function	UD50 Pin #	UD50 Function
Web Break	40	Relay 3
	41	Relay 4
Web Break	42	Relay Common
	43	Ov (Digital)
	44	Input F10
	45	Input F11
	46	Input F12
	47	Ov (Digital)
4.5"/6" Core Select	48	Digital In/Out F7
	49	Digital In/Out F8
	50	Digital In/Out F9
Tension Taper Setpoint	51	SOM Analog Input #4
	52	SOM Analog Input #5
	53	Ov (Analog)
	54	Analog Output #3
	55	Control Earth

Preliminary Setup

After the Unidrive wiring is complete, set up the key parameters for the application. Follow the parameters listed in the table below. Enter Values in Bold only. Italics values are calculated

Example **Single Spindle Rewind**

Parameter	Value	Actual	Units	Notes
		1300	FPM	Maximum Line Speed
		8.0	mils	Web Thickness
				UD70 Parameters
1.06	*1744.2*		RPM	Maximum RPM Drive Limit
1.14	5			Selects Precision Speed Reference in Unidrive
3.10	2000			Drive Proportional Gain (1000-5000) typically
3.11	20			Drive Integral Gain set low (10-100) typically
18.12	adjust			This is the Dancer Feedback to the PID loop.
18.13	*4500*	**4.50**	Inches	Core #1
18.14	*600*	**6.00**	Inches	Core #2
18.15	*5000*	**50.0**	Inches	Max Diameter of Full Roll
18.18	*1000*	**10%**		Overall PID Gain
18.20	20			Integrator Gain 20~ = 3 seconds
18.21	100			Derivative Gain (w/ Dancer F/B)
18.22	30			Derivative Output Filter Amount
18.24	300	**3%**	*39 FPM*	Sets Minimum **Line** Speed Threshold
18.23	30	**3%**	*39 FPM*	Sets Minimum **Spindle** Speed Threshold
18.25	10000	**100%**		PID Limit
18.37	1			Integrator Enable when PID Enabled
18.40	*1*	**0 or 1**	*Linear*	Taper Type 1= Linear 0 = hyperbolic
	2			
19.12	*1710*	**1710**	RPM	Desired Full Core Speed
19.33	1	**1**		Mode Torque=0 Speed=1
19.48	*1*		*Yes*	Web Break Detection->Drive Trip 0=Off 1=On
20.40	*125*			Tracking Filter Amount
				UD50 Parameters
16.13	0.312			Scaling for a-d #4, taper input
16.15	20.43			Taper input setup

16.21	18.35			Core #1 / #2 logic setup
16.24	18.34			Diam preset logic input setup
16.36	19.31			Web break output logic setup

Parameters in this Example Described

Place Tracking Filter Rate into #20.40 In this example:,
Material Thickness = 8 mils or 0.008 inches
Max Line Speed =1300 FPM line

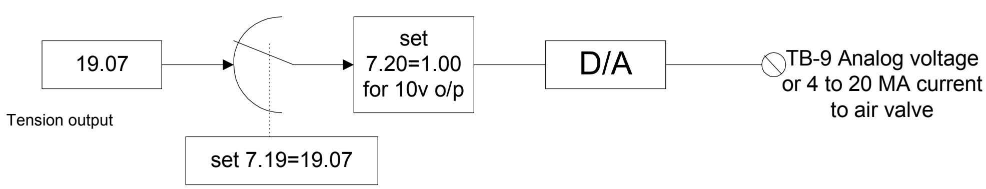
#20.40 = 0.008 x 1300 * 12 = 124.8 or 125

For this example, Dancer PID gain settings:

Proportional	#18.19 = 30 as a start value
Integral	#18.20 = 20 as an initial value.
Derivative	#18.21= 50
Derivative filter	#18.22 set for 30.
Overall gain	#18.18= 100 or 10%

Dancer Position Feedback

With dancer feedback enabled #18.44=1, the PID feedback is position, with the reference being the desired position (#18.17). The actual strip tension that results is controlled by the physical force or weight applied to the dancer. In some cases this is an air loading cylinder which is controlled by an electrical air valve. The Dual Mode Software can supply an output D/A signal to control this valve by routing the tension setpoint signal #19.07 out to a D/A output of the drive.



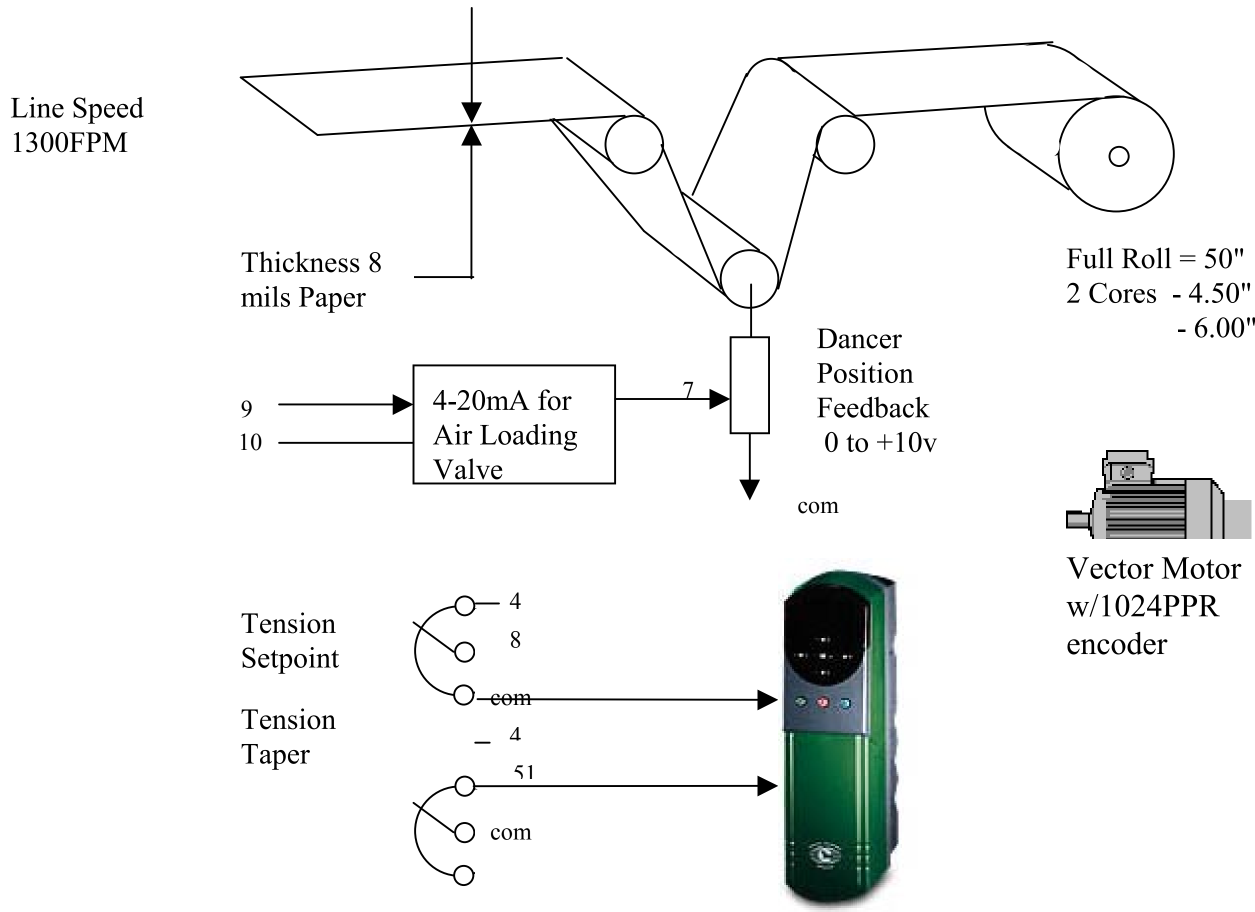
Dancer PID Stability

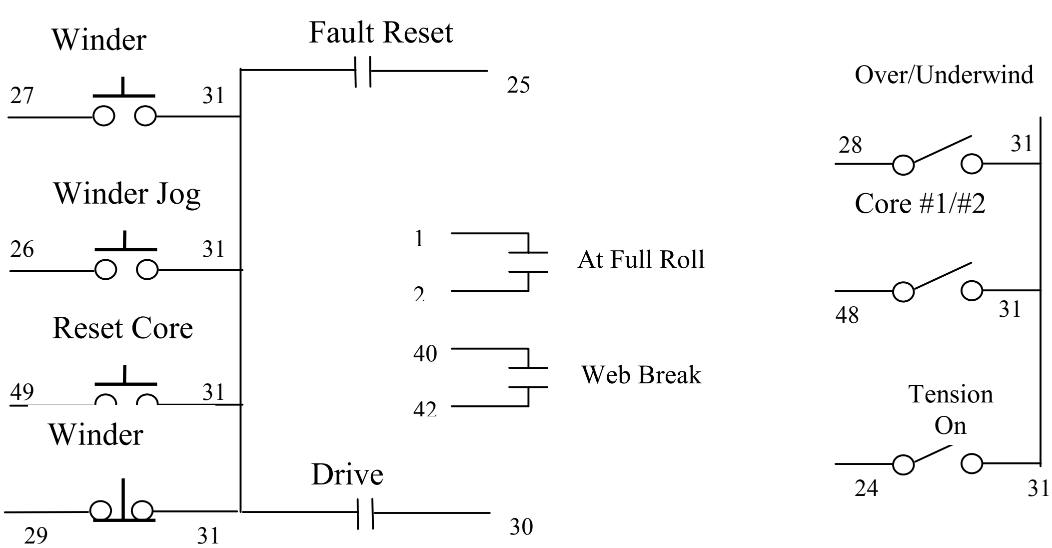
Typical starting value for dancer feedback are:

	3% Proportional	#18.19=30	
	3 sec Integral	#18.20=20	
and	Derivative Gain	#18.21=50	20 to 100 gain

Derivative is especially good with non stretch materials such as paper. With extensible films, derivative is not used, because it tends to set up an oscillation with the dancer. When derivative is not used the proportional gain needs to be lower, as with loadcells- typically 1-3 %.

The PID output limit by default is set to zero, so you need to put a value into #18.25 to get any PID trim at all. 10000 is the normal value entered. The limit then will be 10000 for the integrator and 10000 for the proportional trim for a total limit of 20000, plus or minus.


Line Speed
1300FPM
Thickness 8
mils Paper
Full Roll = 50"
2 Cores - 4.50"
- 6.00"
9
10
4-20mA for
Air Loading
Valve
7
Dancer
Position
Feedback
0 to +10v
com
Vector Motor
w/1024PPR
encoder
Tension
Setpoint
4
8
com
Tension
Taper
4
51
com


Winder
27
31
Fault Reset
25
Winder Jog
26
31
Reset Core
49
31
Winder
29
31
Drive
30
1
2
At Full Roll
40
42
Web Break
Over/Underwind
28
31
Core #1/#2
48
31
Tension
On
24
31

2. Single Spindle Unwind in Speed Mode

The following is a basic application example for a Single Spindle Unwind using the UD70 Dual Mode Winder Program. The basic system information necessary as acquired during the Sales Application process results in the following Specifications Data. Taper although rarely used with unwinds, is shown in this example.

Machine: Single Spindle Unwind
Cores: 4.5” and a 6”
Full Roll: Max 50 “
Line Speed: 1300 FPM
Material: Paper (copy machine grade) 8mils thick
Web width: 50”
Tension: 1.2PLI to 5PLI (*this info plays a role in the HP sizing*)
Feedback : Dancer 0 to +/-10v + v = decreasing dancer storage
Storage: Approximately 4’
Diameter measurement: Ultrasound roll sensor for starting diameter.
Drive: Unidrive® in Closed Loop (Vector) Mode encoder 1024PPR
Motor: 25HP Vector with gear-in such that 1300FPM=1710RPM
Line Speed Ref: via DC Tach from a downstream nip (+10v = Full Speed)

Operator Devices:

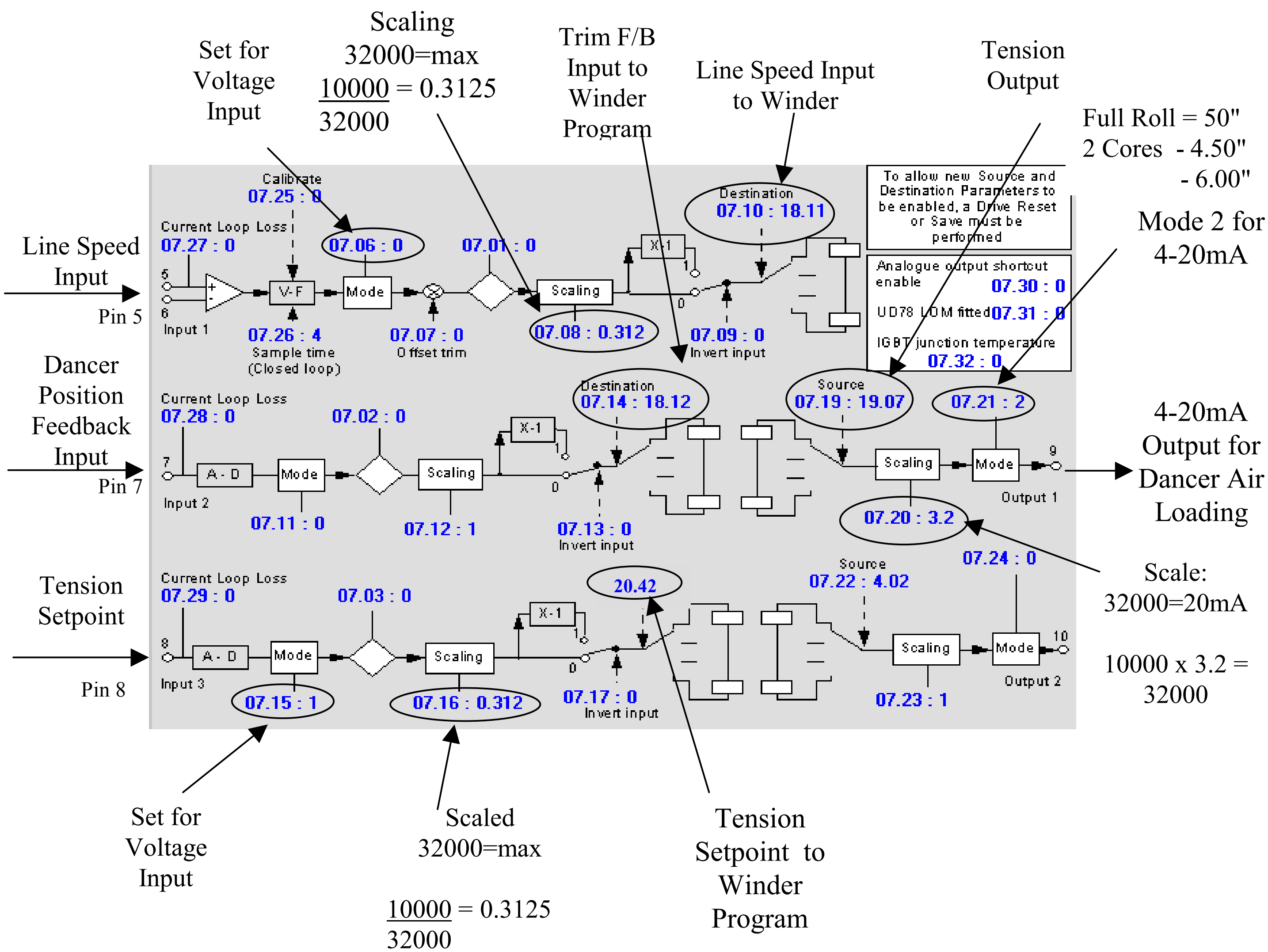
- Jog Unwind
- Potentiometer for Tension Setpoint- 100%
- Potentiometer for Taper Tension – Linear 0 to 25%
- Tension On Switch
- Diameter acquire or preset.

- Output for Roll at Min Diameter for auto stop function
- Dancer needs 4-20mA signal for tension set
- Must have web break detection

The I/O Assignments show the pertinent UniSoft software screens with Unidrive® I/O assignments and the rationale behind the scaling and associated interaction with Dual Mode Winder Application program. Additional I/O was required, and so the UD50 was employed.

Winder I/O Assignments

Analog I/O (Menu 7) Mapping and Scaling

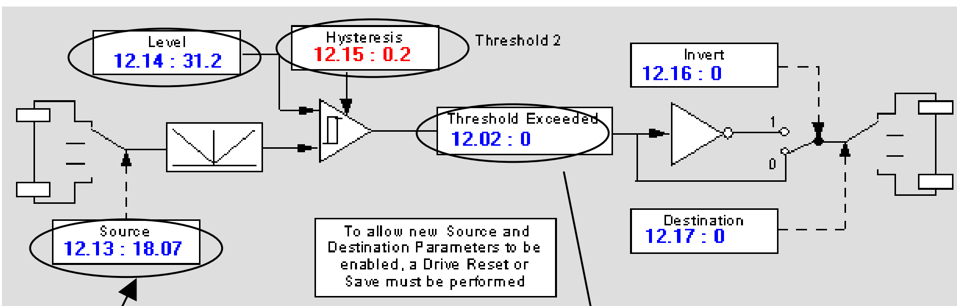


Winder I/O Assignments

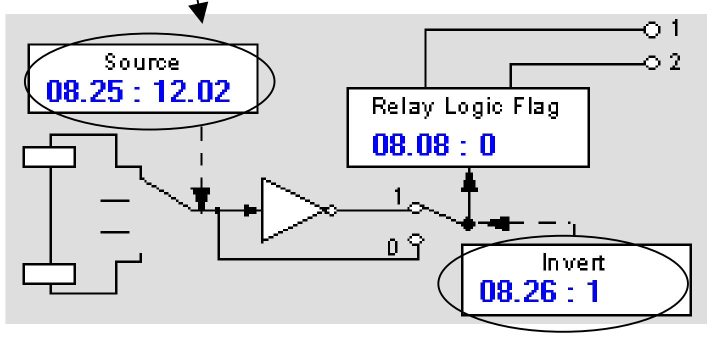
END of Roll Output

Value= % of Full Diameter
x 10000
32000

Small hysteresis value
(adjustable in field)



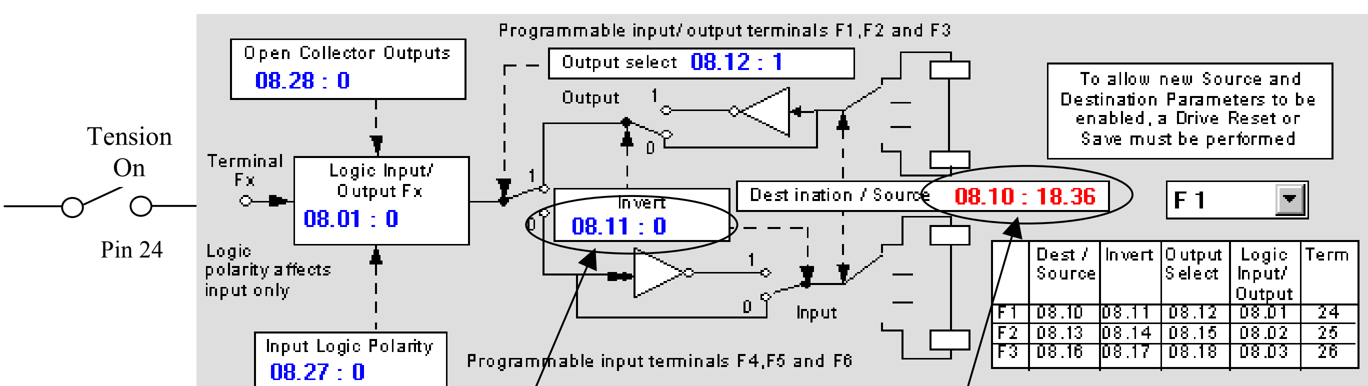
% Diameter
from Winder
Program



At Roll end
Output

The PID enable can be on at all times in a single spindle unwinder, except if speed match is desired, as when used in a turret configuration. Therefore, this input may not be needed. The PID will then enable whenever the drive is in a run mode.

Tension "On" Input



Set as an
Input

Direct to PID Trim
enable bit in
Winder Program

UD50 SOM Extended I/O Assignments

Taper Setpoint & Web Break

Scaled
32000=max

Taper Setpoint to Winder Program 10000= max

$\frac{10000}{32000} = 0.3125$

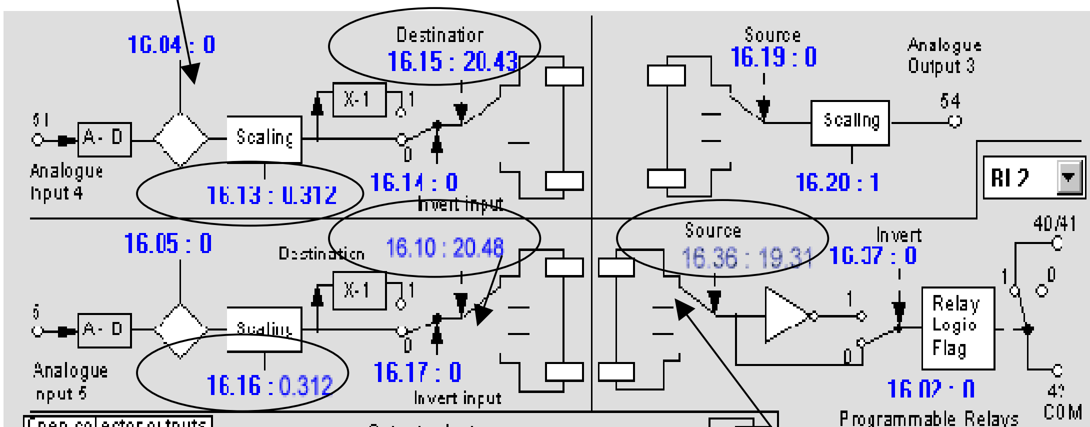
Taper Setpoint

Pin 51

Ultrasound Diameter signal

Pin 52

Web Break Contact

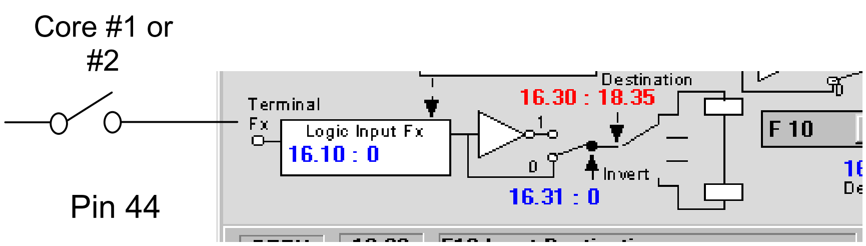


Aux Preset input

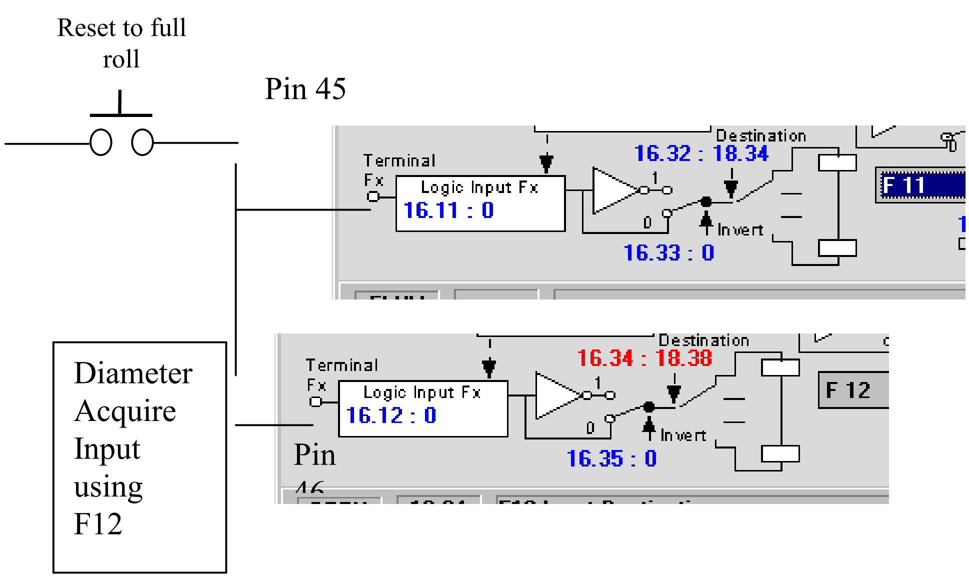
Attached to Web Break bit in Winder Program

UD50 SOM Digital I/O Assignments

Core Selection Input Assignment



Diameter Preset or Acquire Input Assignment



Unidrive Pinout Summary

Winder Function	Unidrive Pin #	Unidrive Function
At Roll end	1	Dry Relay Contact
At Roll end	2	Dry Relay Contact
	3	
	4	+10v
Line Speed Input	5	Analog Input 0-10v
Line Speed Input	6	Differential to pin 5
Dancer Pot	7	Analog Input 0-10v
Tension Setpoint	8	Analog Input 0-10v
4-20mA Air Valve	9	Analog Output
	10	
Analog Common	11	Analog Common
	12	
	13	
	14	
	15	
	16	
	17	
	18	
	19	
	20	
	21	
	22	
	23	
Dancer Trim Enable	24	Input F1
External Fault Reset	25	Input F2
Winder Jog	26	Input F3
Reset Diameter	27	Input F4
Overwind/Underwind	28	Input F5
Stop Circuit	29	Input F6
Drive Enable/ESR	30	E-Stop Reset
Contact Common	31	
	32	
	33	
	34	
	35	
	36	
	37	
	38	
	39	

UD50 SOM Pinout Summary

Winder Function	UD50 Pin #	UD50 Function
Web Break	40	Relay 3
	41	Relay 4
Web Break	42	Relay Common
	43	Ov (Digital)
Acquire unknown diameter	44	Input F10
	45	Input F11
	46	Input F12
	47	Ov (Digital)
4.5”/6” Core Select	48	Digital In/Out F7
Preset to Ultrasonic diameter	49	Digital In/Out F8
	50	Digital In/Out F9
Tension Taper Setpoint	51	SOM Analog Input #4
	52	SOM Analog Input #5
	53	Ov (Analog)
	54	Analog Output #3
	55	Control Earth

Preliminary Setup

After the Unidrive wiring is complete, set up the key parameters for the application. Follow the parameters listed in the tables below. Enter Values in Bold only. Italics values are calculated.

Example **Single Spindle Unwind**

Parameter	Value	Actual	Units	Notes
		1300	FPM	Maximum Line Speed
		8.0	mils	Web Thickness
		UD70 Parameters		
1.06	*1744.2*		RPM	Maximum RPM Drive Limit
1.14	5			Selects Precision Speed Reference in Unidrive
3.10	2000			Drive Proportional Gain (1000-5000) typically
3.11	20			Drive Integral Gain set low (10-100) typically
18.12	adjust			This is the Dancer Feedback to the PID loop.
18.13	*4500*	**4.50**	Inches	Core #1
18.14	*600*	**6.00**	Inches	Core #2
18.15	*5000*	**50.0**	Inches	Max Diameter of Full Roll
18.18	*1000*	**10%**		Overall PID Gain
18.20	20			Integrator Gain 20~ = 3 seconds
18.21	100			Derivative Gain (w/ Dancer F/B)
18.22	30			Derivative Output Filter Amount
18.24	300	**3%**	*39 FPM*	Sets Minimum **Line** Speed Threshold
18.23	300	**3%**	*51.3 RPM*	Sets Minimum **Spindle** Speed Threshold
18.25	10000	**100%**		PID Limit
18.32	1	**1**		Reverse PID action (unwind=1)
18.37	1			Integrator Enable when PID Enabled
18.40	*1*	**0 or 1**	*Linear*	Taper Type 1= Linear 0 = hyperbolic
	2			
18.45	1	1	bit	Diameter Preset type 1=unwind, 0= rewind
18.49	1	1	bit	Aux. preset . 1=select
19.12	*1710*	**1710**	RPM	Desired Full Core Speed
19.24	10	10		Diam acquire timer , sec.
19.33	1	**1**		Mode Torque=0 Speed=1
19.48	*1*		*Yes*	Web Break Detection->Drive Trip 0=Off 1=On
20.40	*125*			Tracking Filter Amount
		UD50 Parameters		
16.16	0.312			Scaling for a-d #5, Ultrasound input
16.13	0.312			Scaling for a-d #4, taper input
16.15	20.43			Taper input setup

16.21	18.35			Core #1 / #2 logic setup
16.30	18.38			Acquire logic input setup
16.24	18.34			Diam preset logic input setup
16.36	19.31			Web break output logic setup
16.10	20.48			Ultrasound diameter input

Parameters in Example Described

Place Tracking Filter Rate into #20.40
In this example, Material Thickness = 8 mils or 0.008 inches
Max Line Speed =1300 FPM line

#20.40 = 0.008 x 1300 * 12 = 124.8 or 125

Jog

In either winder mode, the program tests the jog parameter of the drive, and if the normal jog function in the drive is activated, causing #1.13 to be =1, the winder program suspends activity and, if in torque mode, temporarily switches the drive back to speed mode , while the jogging continues. When the drive is put back into normal run mode, #1.13=0, the normal winder program control resumes. Additionally, the jog reference #1.05 can be written to by the program with the desired surface speed. The actual jog reference is the value in #19.16, when #19.35 is =1, for surface jog speed control. If #19.35 =0, the jog speed is directly entered into #1.05 by the user.

Diameter Presets

When #18.45 = 1, the program is set up for unwind type presets. When preset is activated, (#18.34=1), the diameter memory is set to a full roll value as set by the value in #20.48. This is different from a re-winder preset where the diameter is reset to one of the core diameter values. In the case of unwinds, the core diameter information is only used to calibrate the diameter to speed scaling of the machine, and taper tension functions.

For this example, Dancer PID gain settings.

Proportional	#18.19 = 30 as a start value
Integral	#18.20 = 20 as an initial value.
Derivative	#18.21= 50
Derivative filter	#18.22 set for 30.
Overall gain	#18.18= 100 or 10%

Speed Matching

It's necessary to track in the speed of the winder drive to the upstream nip roll. This is done by disabling PID control (#18.36=0), and presetting the diameter memory (toggle #18.34=1) to the smallest core size (#18.13). The smallest core value, always core #1, should be selected prior to the reset. Check #20.41, it should show the desired diameter.

The line speed reference to the nip roll and winder are brought up together to any desired speed, preferably between 50 to 100%. A hand tach is used to check the speed match between the nip roll and the empty core. Speed match is adjusted with the speed scaling parameter in the UD70, which for encoder feedback is #19.12 (#19.11 in open loop).

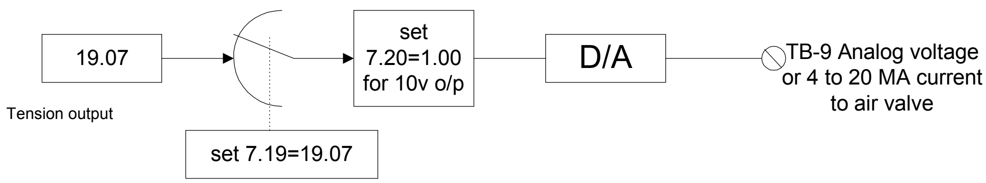
The speech match parameter only updates after program reset. The best method is to change the parameter value by the amount of the speed match error. This will reduce the number of adjustments needed.

Example:

If 1811 RPM is needed at core and at full line speed, set #19.12 to 1811, if in vector mode. Parameter #1.06, the max drive speed, needs to be a little higher than the value in #19.12, to allow a little "headroom", because the drive will never operate above this speed limit.

Dancer Position Feedback

With dancer feedback enabled #18.44=1, the PID feedback is position, with the reference being the desired position (#18.17). The actual strip tension that results is controlled by the physical force or weight applied to the dancer. In some cases this is an air loading cylinder which is controlled by an electrical air valve. The Dual Mode Software can supply an output D/A signal to control this valve by routing the tension setpoint signal #19.07 out to a D/A output of the drive.



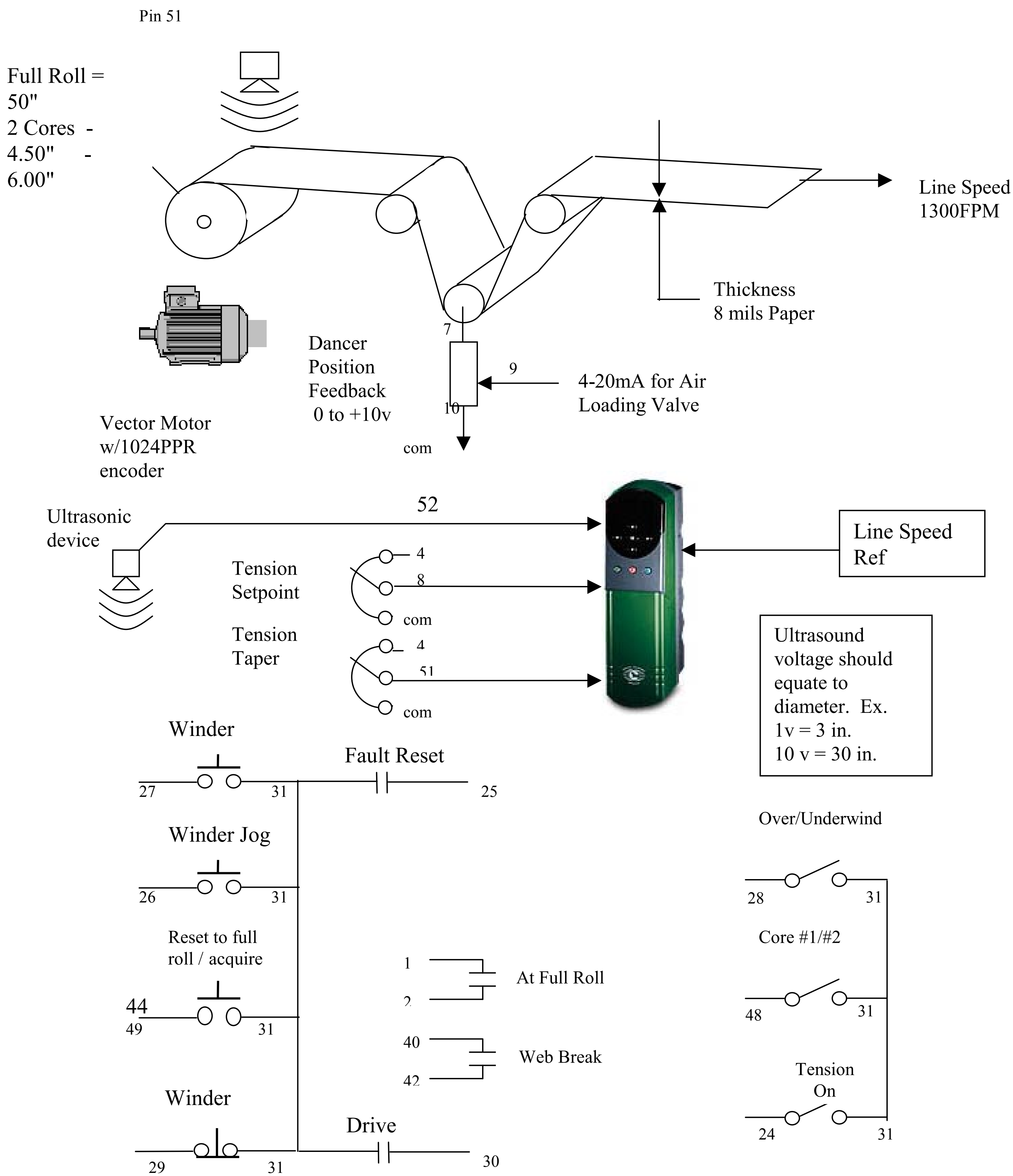
Dancer PID Stability

Typical starting values for dancer feedback are:

	3% Proportional	#18.19=30	
	3 sec Integral	#18.20=20	
and	Derivative Gain	#18.21=50	20 to 100 gain

Derivative is especially good with non-stretch materials such as paper. With extensible films, derivative is not used, because it tends to set up an oscillation with the dancer. When derivative is not used the proportional gain needs to be lower, as with loadcells, typically 1-3 %.

The PID output limit by default is set to zero, so you need to put a value into #18.25 to get any PID trim at all. 10000 is the normal value entered. The limit then will be 10000 for the integrator and 10000 for the proportional trim for a total limit of 20000, plus or minus.



Pin 51
Full Roll =
50"
2 Cores -
4.50" -
6.00"
Line Speed
1300FPM
Thickness
8 mils Paper
Dancer
Position
Feedback
0 to +10v
7
9
10
com
4-20mA for Air
Loading Valve
Vector Motor
w/1024PPR
encoder
Ultrasonic
device
52
Line Speed
Ref
Tension
Setpoint
4
8
com
Tension
Taper
4
51
com
Ultrasound
voltage should
equate to
diameter. Ex.
1v = 3 in.
10 v = 30 in.
Winder
27
31
Fault Reset
25
Over/Underwind
Winder Jog
26
31
28
31
Reset to full
roll / acquire
Core #1/#2
1
2
At Full Roll
44
49
31
48
31
40
42
Web Break
Tension
On
Winder
Drive
24
31
29
31
30

3. Single Spindle Rewinder for Loadcell in Speed Mode

The following is a basic Winder application example for a Single Spindle Rewinder using the UD70 Speed Basic Winder Program. The basic system information necessary as acquired during the Sales Application process results in the following Specification Data.

<u>Machine</u>: Single Spindle Rewind with Loadcell, speed controlled
<u>Cores</u>: 4.5" and a 6"
<u>Full Roll</u>: Max 50 "
<u>Line Speed</u>: 1300 FPM
<u>Material</u>: Paper (copy machine grade) 8mils thick
<u>Web width</u>: 50"
<u>Tension</u>: 1.2PLI to 5PLI (*this info plays a role in the HP sizing*)
<u>Feedback</u> : Loadcell 0 to +/-10v + v = Loadcell being pulled by winder
<u>Storage</u>: Approximately 4'

<u>Drive</u>: Unidrive in Closed Loop (Vector) Mode encoder 1024PPR
<u>Motor</u>: 25HP Vector with gear-in such that 1300FPM=1710RPM
<u>Line Ref</u>: via DC Tach from an upstream nip (+10v = Full Speed)

<u>Operator Devices:</u>

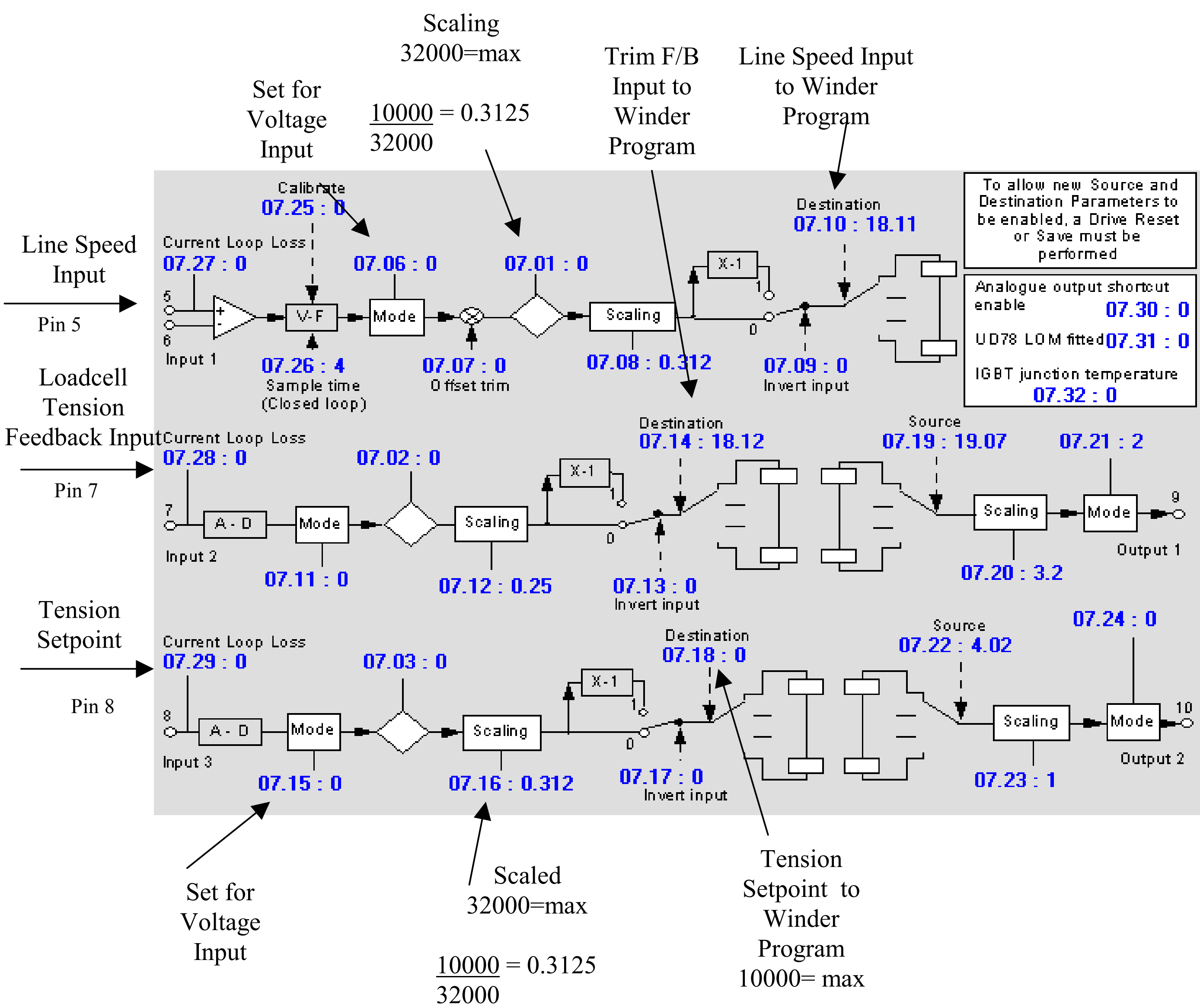
- Jog Rewinder
- Pot for Tension Setpoint- 100%
- Pot for Taper Tension – Linear 0 to 25%
- Tension On Switch

- Output for Roll at Max Diameter for auto stop function
- Must have web break detection

The I/O Assignments show the pertinent UniSoft software screens with Unidrive I/O assignments and the rationale behind the scaling and associated interaction with Dual Mode Winder Application program. Additional I/O was required, and so the UD50 was employed.

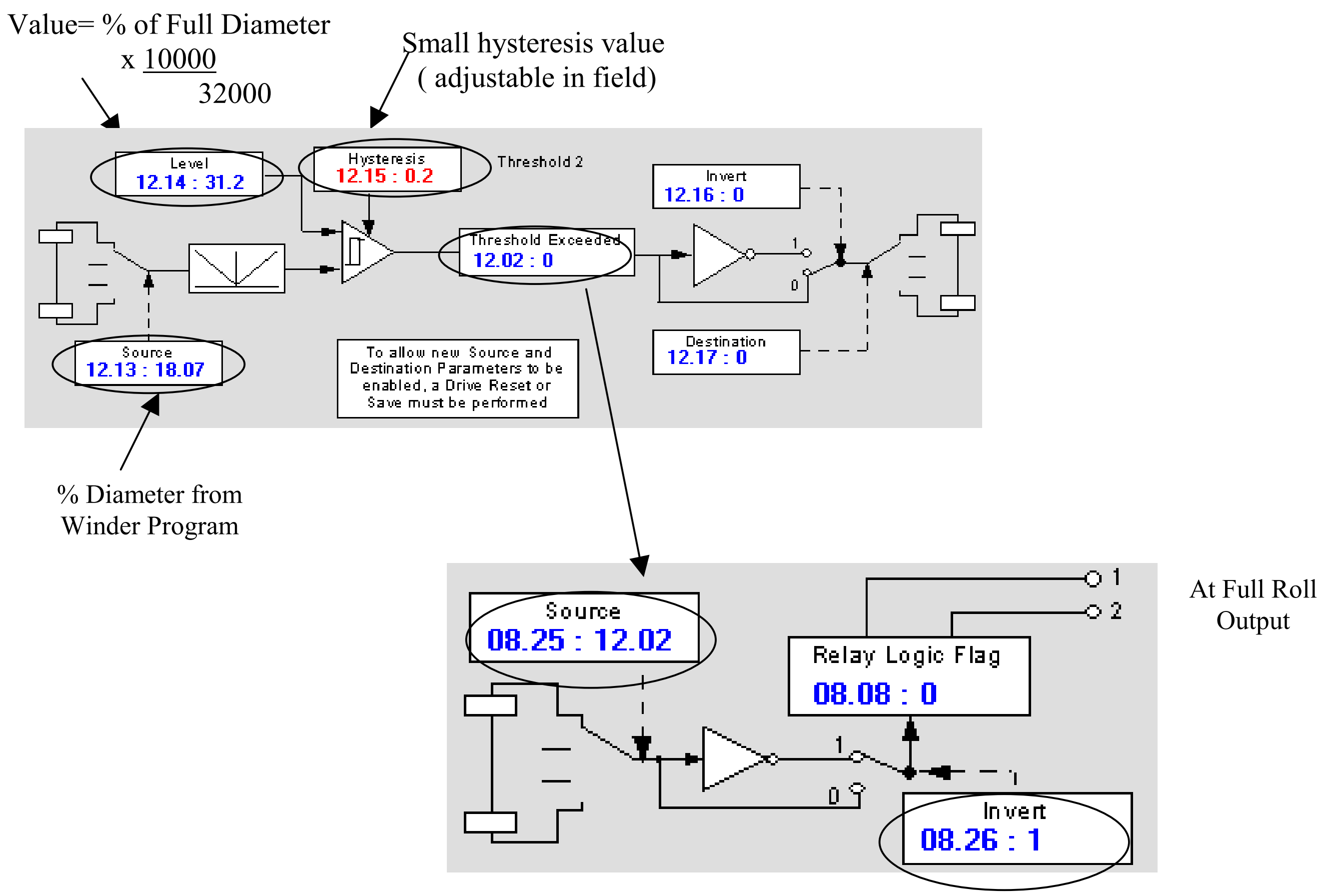
Winder I/O Assignments

Analog I/O (Menu 7) Mapping and Scaling

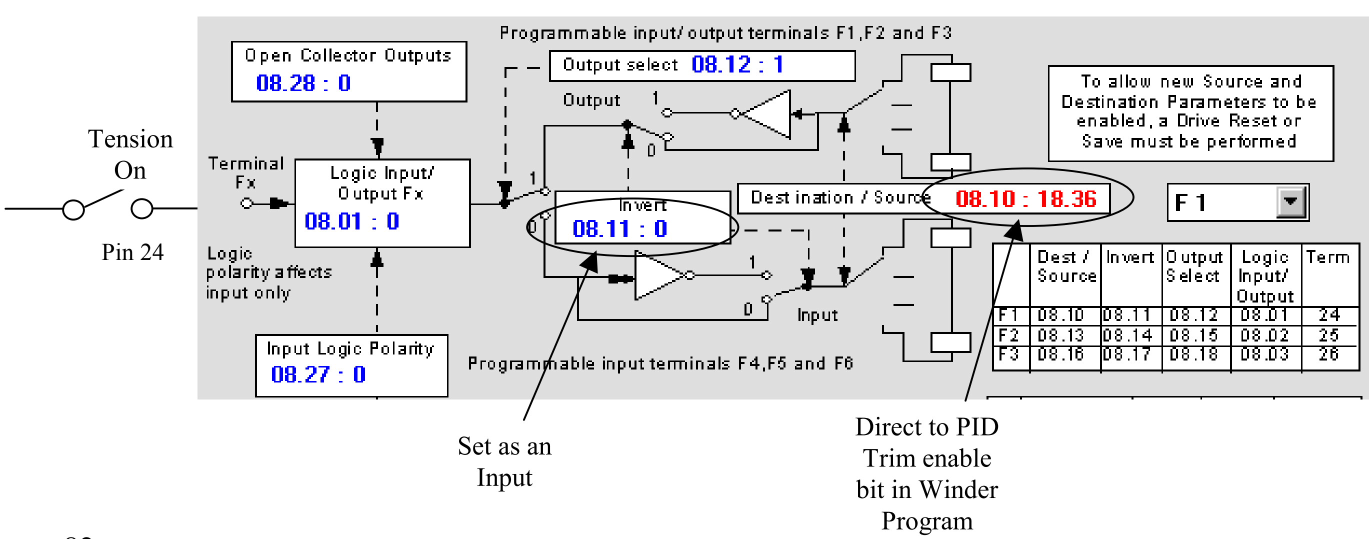


Winder I/O Assignments

Full Roll Output

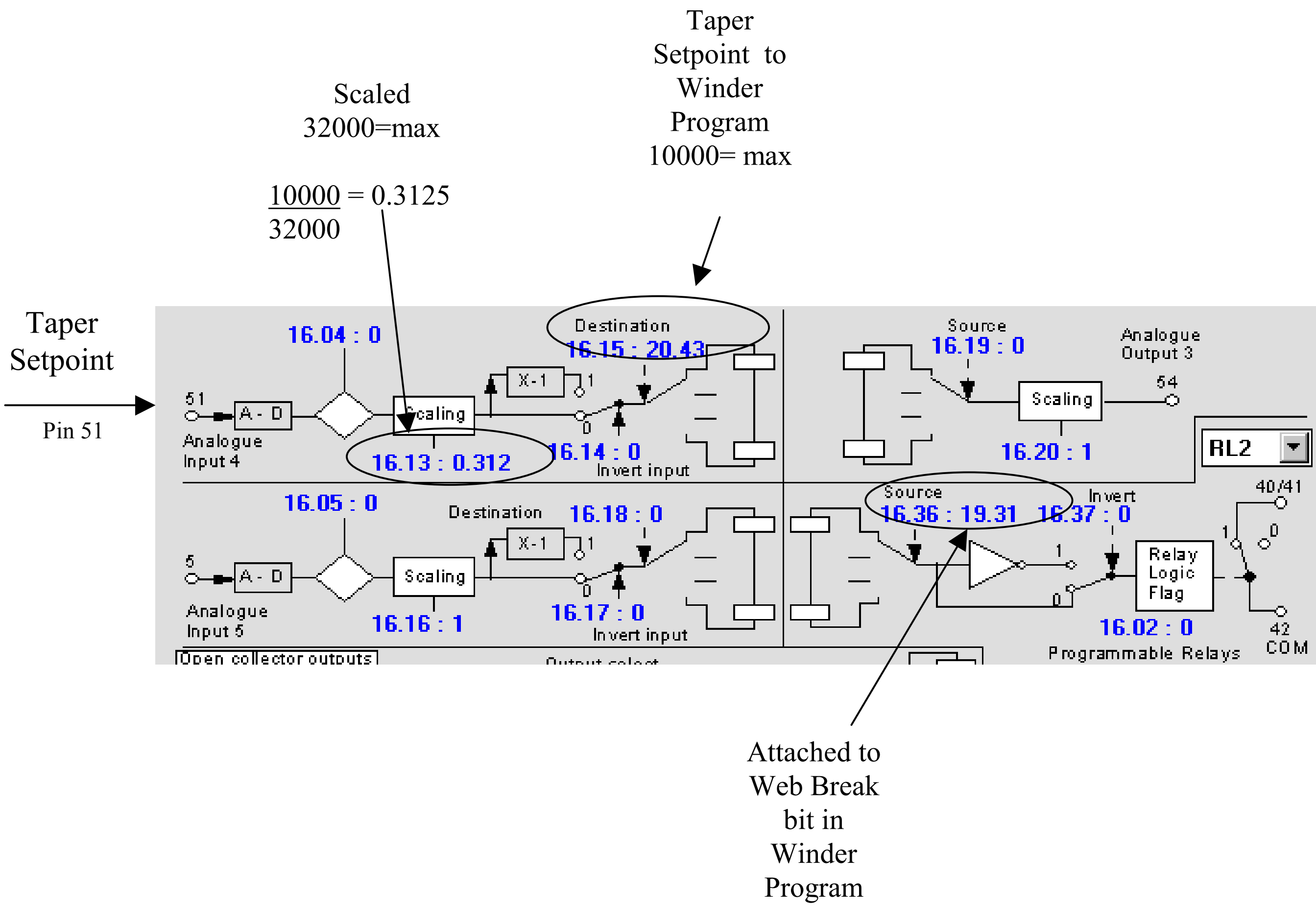


Tension "On" Input



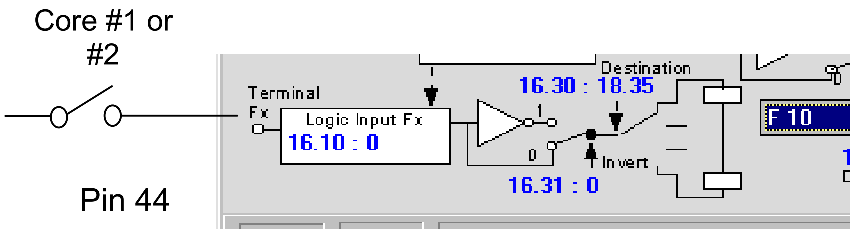
UD50 SOM Extended I/O Assignments

Taper Setpoint & Web Break



UD50 SOM Digital I/O Assignments

Core Selection Input Assignment



Programmable Relays

	Source	Invert	Log flag	Term
RL2	16.36	16.37	16.02	40
RL3	16.38	16.39	16.03	41

COM

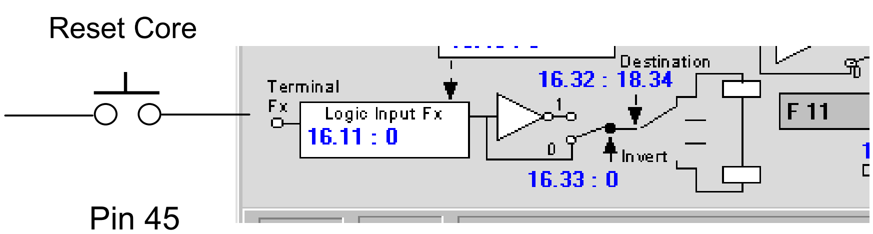
Programmable output /input terminals F7, F8 and F9

	Dest/ Srce	Invert	O/put Sel	Logic IP/O P	Term
F7	16.21	16.22	16.23	16.07	48
F8	16.24	16.25	16.26	16.08	49
F9	16.27	16.28	16.29	16.09	50

Programmable input terminals F10, F11 and F12

	Dest	Invert	Logic IP	Term
F10	16.30	16.31	16.10	44
F11	16.32	16.33	16.11	45
F12	16.34	16.35	16.12	46

Core Preset Input Assignment



Unidrive Pinout Summary

Winder Function	Unidrive Pin #	Unidrive Function
At Full Roll	1	Dry Relay Contact
At Full Roll	2	Dry Relay Contact
	3	
	4	+10v
Line Speed Input	5	Analog Input 0-10v
Line Speed Input	6	Differential to pin 5
Loadcell	7	Analog Input 0-10v
Tension Setpoint	8	Analog Input 0-10v
	9	Analog Output
	10	
Analog Common	11	Analog Common
	12	
	13	
	14	
	15	
	16	
	17	
	18	
	19	
	20	
	21	
	22	
	23	
Loadcell Trim Enable	24	Input F1
External Fault Reset	25	Input F2
Winder Jog	26	Input F3
Reset Diameter	27	Input F4
Overwind/Underwind	28	Input F5
Stop Circuit	29	Input F6
Drive Enable/ESR	30	E-Stop Reset
Contact Common	31	
	32	
	33	
	34	
	35	
	36	
	37	
	38	
	39	

UD50 SOM Pinout Summary

Winder Function	UD50 Pin #	UD50 Function
Web Break	40	Relay 3
	41	Relay 4
Web Break	42	Relay Common
	43	Ov (Digital)
	44	Input F10
	45	Input F11
	46	Input F12
	47	Ov (Digital)
4.5"/6" Core Select	48	Digital In/Out F7
	49	Digital In/Out F8
	50	Digital In/Out F9
Tension Taper Setpoint	51	SOM Analog Input #4
	52	SOM Analog Input #5
	53	Ov (Analog)
	54	Analog Output #3
	55	Control Earth

Preliminary Setup

After the Unidrive wiring is complete, set up the key parameters for the application. Use the parameters from the following table. Enter Values in Bold only. Italics values are calculated

Example **Single Spindle Rewind**

Parameter	Value	Actual	Units	Notes
		1300	FPM	Maximum Line Speed
		8.0	mils	Web Thickness

UD70 Parameters				
1.06	*1744.2*		RPM	Maximum RPM Drive Limit
1.14	5			Selects Precision Speed Reference in Unidrive
3.10	2000			Drive Proportional Gain (1000-5000) typically
3.11	20			Drive Integral Gain set low (10-100) typically
18.12	scale			This is the Loadcell Feedback to the PID loop.
18.13	*4500*	**4.50**	Inches	Core #1
18.14	*600*	**6.00**	Inches	Core #2
18.15	*5000*	**50.0**	Inches	Max Diameter of Full Roll
18.18	*1000*	**10%**		Overall PID Gain
18.20	20	20		Integrator Gain 20~ = 3 seconds
18.21	0	0		Derivative Gain (w/ Loadcell F/B)
18.22	0	0		Derivative Output Filter Amount
18.24	300	**3%**	*39 FPM*	Sets Minimum **Line** Speed Threshold
18.23	30	**3%**	*39 FPM*	Sets Minimum **Spindle** Speed Threshold
18.25	10000	**100%**		PID Limit
18.37	1			Integrator Enable when PID Enabled
18.40	*1*	**0 or 1**	*Linear*	Taper Type 1= Linear 0 = hyperbolic
	2			
19.12	*1710*	**1710**	RPM	Desired Full Core Speed
19.33	1	**1**		Mode Torque=0 Speed=1
19.48	*1*		*Yes*	Web Break Detection->Drive Trip 0=Off 1=On
20.40	*125*			Tracking Filter Amount
UD50 Parameters				
16.13	0.312			Scaling for a-d #4, taper input
16.15	20.43			Taper input setup
16.21	18.35			Core #1 / #2 logic setup

16.24	18.34			Diam preset logic input setup
16.36	19.31			Web break output logic setup

Parameters in Example Described

Smallest core size in 18.13 x 1000 ex. 4.5 inches=4500
Nominal full roll size in 18.15 x 100 ex. 6 inches=600

Place Tracking Filter Rate into @20.40 The formula for #20.40 is:
#20.40 = Max Web Thickness x Max Line Speed in fpm x 12

Example:
Material Thickness = 8 mils or 0.008 inches
Max Line Speed =1300 FPM line

#20.40 = 0.008 x 1300 * 12 = 124.8 or 125

The units are inches^2/minute, and relate to the amount of time it would take to build a full roll at full speed and the number of counts needed at the 5 millisecond scan rate of the clock task in the UD70. The results of these calculations cause #20.40 to set up the size of the counter needed to keep track of the diameter.

Loadcell PID gain settings

Proportional	#18.19 = 30 as a start value
Integral	#18.20 = 20 as an initial value.
Derivative	#18.21= 50
Derivative filter	#18.22 set for 30.
Overall gain	#18.18= 100 or 10%

The standard drive speed resolution of 0 to +/-1 RPM is not fine enough for winder duty. Select the precision reference path by setting #1.14=5. This enables the drive's own internal precision reference system, which has a bipolar range of 0 to +/- the value in #1.06. The winder program speed demand will then come through the precision reference system into #1.49. The bipolar reference select #1.10=1 normally should be set on.

Speed Matching

It's necessary to track in the speed of the winder drive to the upstream nip roll. This is done by disabling PID control (#18.36=0), and presetting the diameter memory (toggle #18.34=1) to the smallest core size (#18.13). The smallest core value, always core #1, should be selected prior to the reset. Check #20.41; it should show the desired diameter.

The line speed reference to the nip roll and winder are brought up together to any desired speed, preferably between 50 to 100%. A hand tach is used to check the speed match between the nip roll and the empty core. Speed match is adjusted with the speed scaling parameter in the UD70, which for encoder feedback is #19.12 (#19.11 in open loop).

Example:

If 1811 RPM is needed at core and at full line speed, set #19.12 to 1811, if in speed mode. Parameter #1.06, the max drive speed, needs to be a little higher than the value in #19.12, to allow a little “headroom”.

Loadcell Feedback

This must be calibrated prior to startup. Normally a rope or scrap piece of material is threaded through the normal passline and tied to an anchor point. Weights or a fish scale are attached to the other end to calibrate the feedback. A 0 to 8 volt span, from zero to full load would represent a good setup. This is then routed into the program via an A/D input on the drive. The destination parameter is #18.12 , which can be set up with one of the drive’s input steering parameters for the A/D converters. Normally the feedback device is adjusted for approximately 0 to +8 Volts input swing so as to get a 0 to +10000 parameter range. This allows some feedback overrange as discussed below.

Tension/Loadcell Feedback

With loadcell feedback enabled, #18.44=0, the PID feedback is strip tension, so the reference is the operator’s desired tension setpoint plus any taper tension desired. In this case only the proportional and integral gains are used. The derivative gain is set to zero in loadcell systems. Typical settings are 1 to 3 % proportional gain #18.19=10 to 30, and an integral time of 3 to 10 seconds #18.20=20 to 6.

Loadcell PID Stability

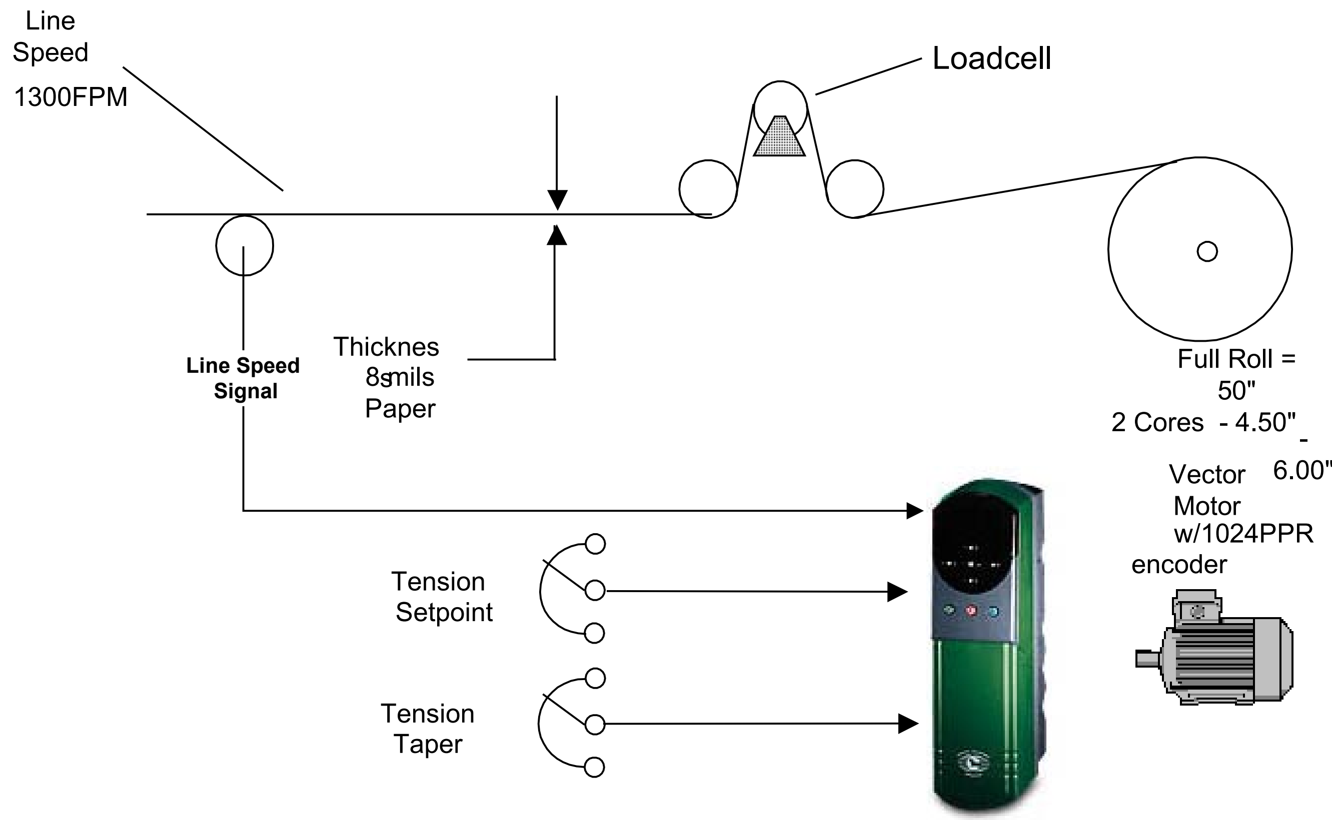
Typical starting values for Loadcell feedback are:

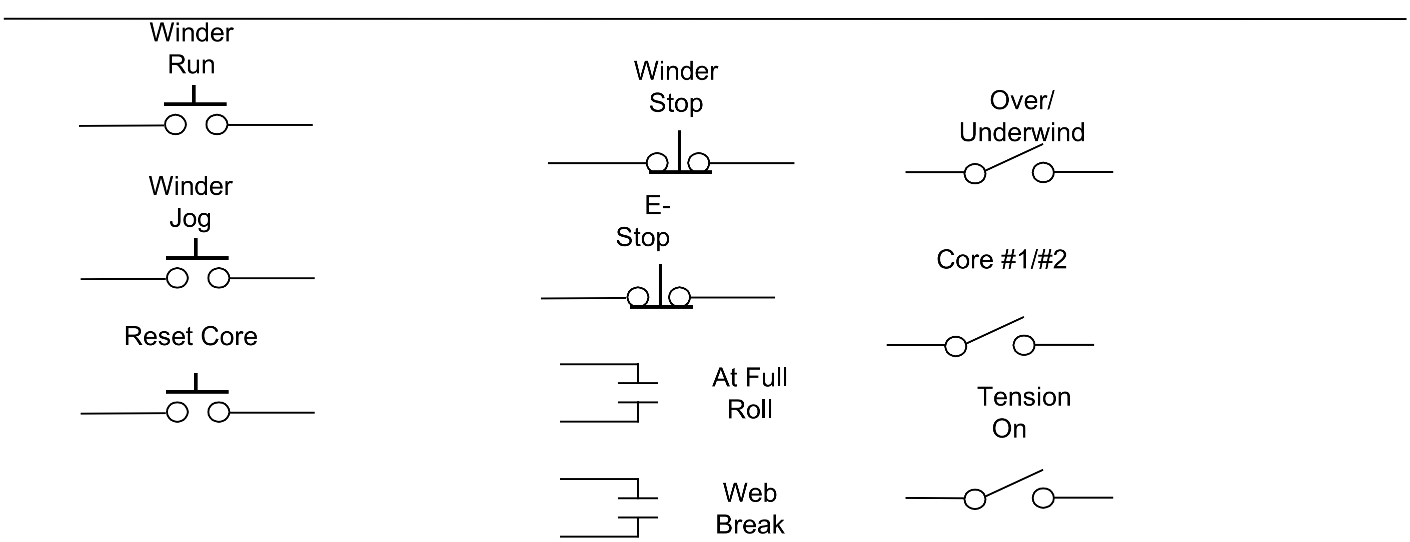
3% Proportional #18.19=30
3 sec Integral #18.20=20
and Derivative Gain #18.21=50 20 to 100 gain

Derivative is especially good with non-stretch materials such as paper. With extensible films, derivative is not used, because it tends to set up an oscillation with the Loadcell. When derivative is not used the proportional gain needs to be lower, as with loadcells- typically 1-3 %.

The PID output limit by default is set to zero, so you need to put a value into #18.25 to get any PID trim at all. 10000 is the normal value entered. The limit then will be 10000 for the integrator and 10000 for the proportional trim for a total limit of 20000, plus or minus.

•


Line
Speed
1300FPM
Loadcell
Line Speed
Signal
Thicknes
8 mils
Paper
Full Roll =
50"
2 Cores - 4.50" - 6.00"
Vector
Motor
w/1024PPR
encoder
Tension
Setpoint
Tension
Taper


Winder
Run
Winder
Jog
Reset Core
Winder
Stop
E-
Stop
At Full
Roll
Web
Break
Over/
Underwind
Core #1/#2
Tension
On

4. Single Spindle Rewinder in Torque Mode

The following is a basic Winder application example for a Single Spindle Rewinder using the UD70 Speed Basic Winder Program operating in the Constant Tension Center Wind (CTCW) torque mode. The basic system information necessary as acquired during the Sales Application process results in the following Specification Data.

Machine:	Single Spindle Rewind
Cores:	4.5" and a 6"
Full Roll:	Max 50 "
Line Speed:	1300 FPM
Material:	Paper (copy machine grade) 8 mils
Web width:	50"
Tension:	1.2PLI to 5PLI (*this info play a role in the HP sizing*)
Feedback :	none
Drive:	Unidrive® in Closed Loop (Vector) Mode with encoder 1024PPR
Motor:	25HP Vector with gear-in such that 1300FPM=1710RPM
Line Ref:	via DC Tach from an upstream nip (+10v = Full Speed)

Operator Devices:

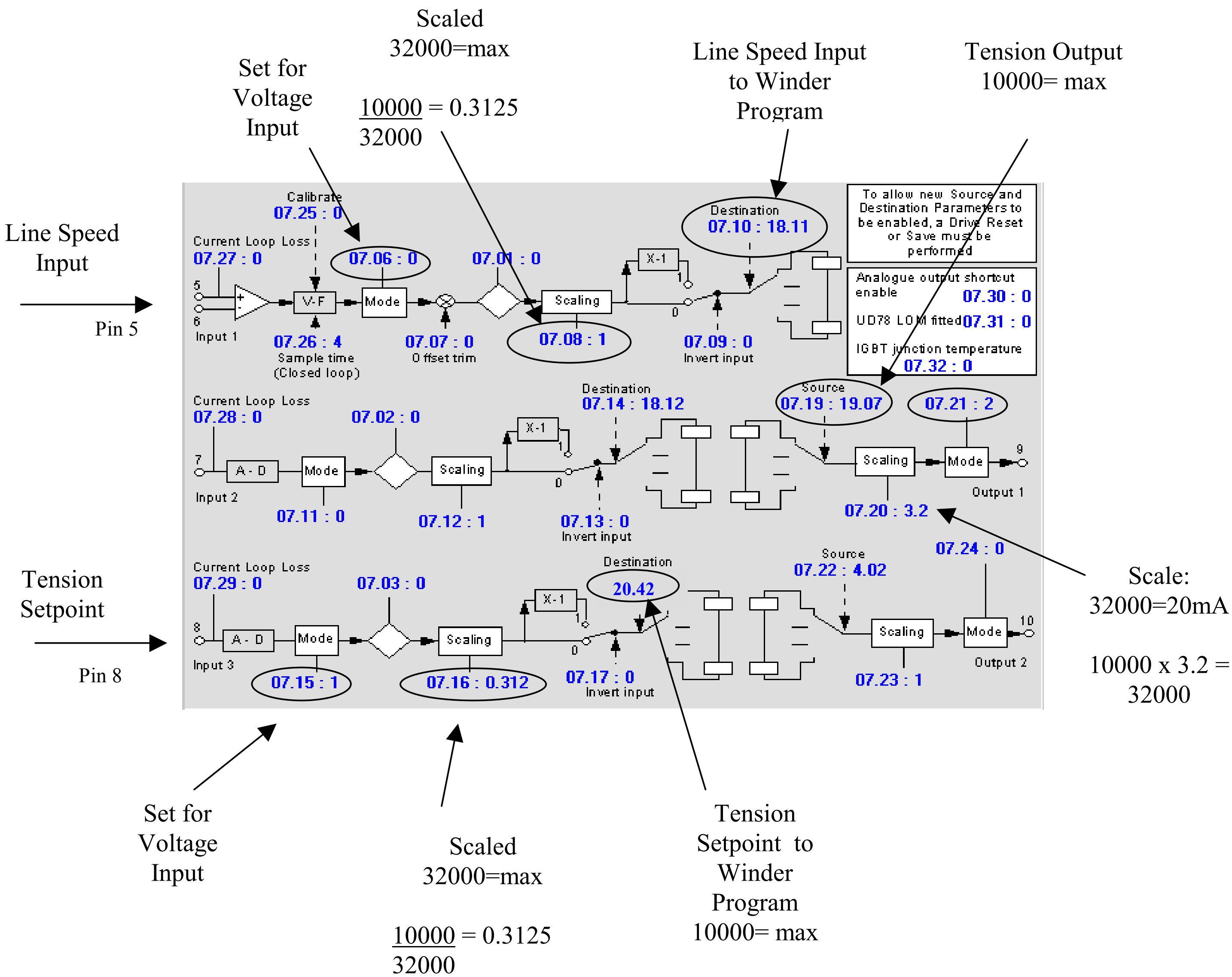
- Jog Rewinder
- Potentiometer for Tension Setpoint- 100%
- Potentiometer for Taper Tension – Linear   0 to 25%
- Tension On Switch
- Analog Output for Tension Meter

- Output for Roll at Max Diameter for auto stop function
- Must have web break detection

The I/O Assignments show the pertinent UniSoft software screens with Unidrive® I/O assignments and the rationale behind the scaling and associated interaction with Dual Mode Winder Application program operating in the CTCW mode. Additional I/O was required, and so the UD50 was employed.

Winder I/O Assignments

Analog I/O (Menu 7) Mapping and Scaling

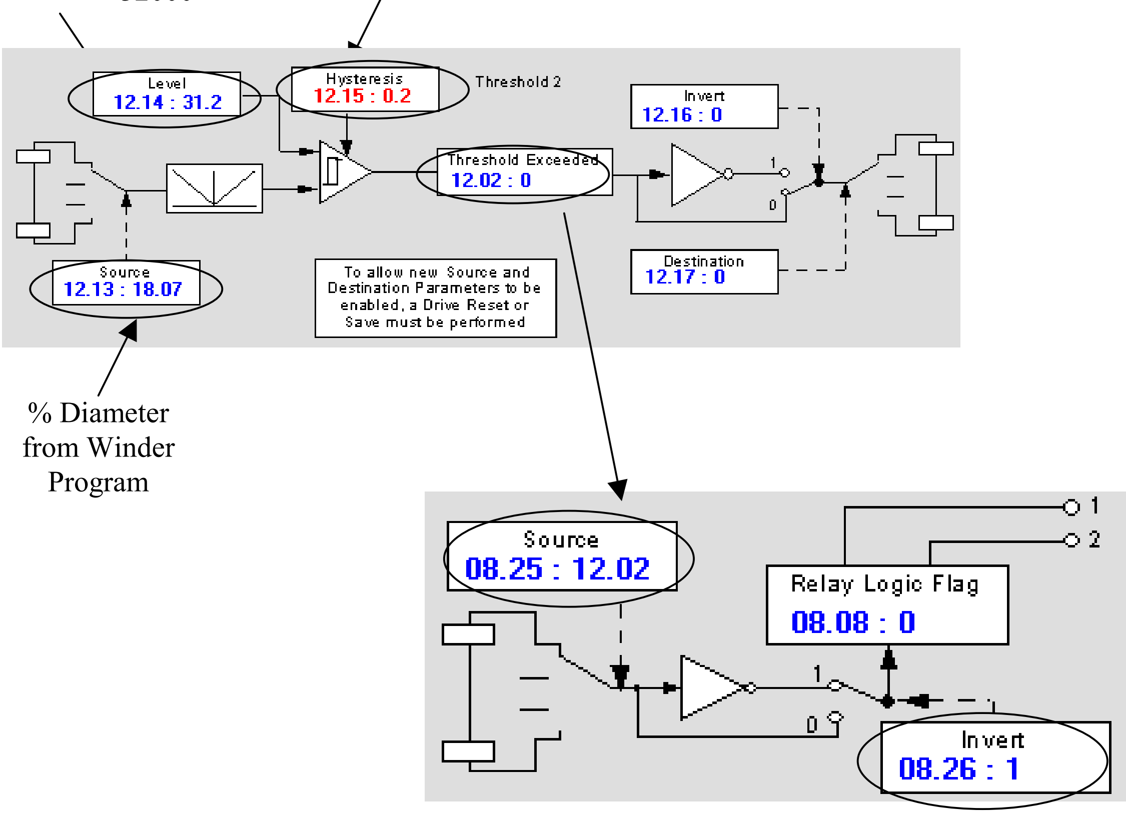


Winder I/O Assignments

Full Roll Output

Value= % of Full Diameter x $\frac{10000}{32000}$

Small hysteresis value (adjustable in field)

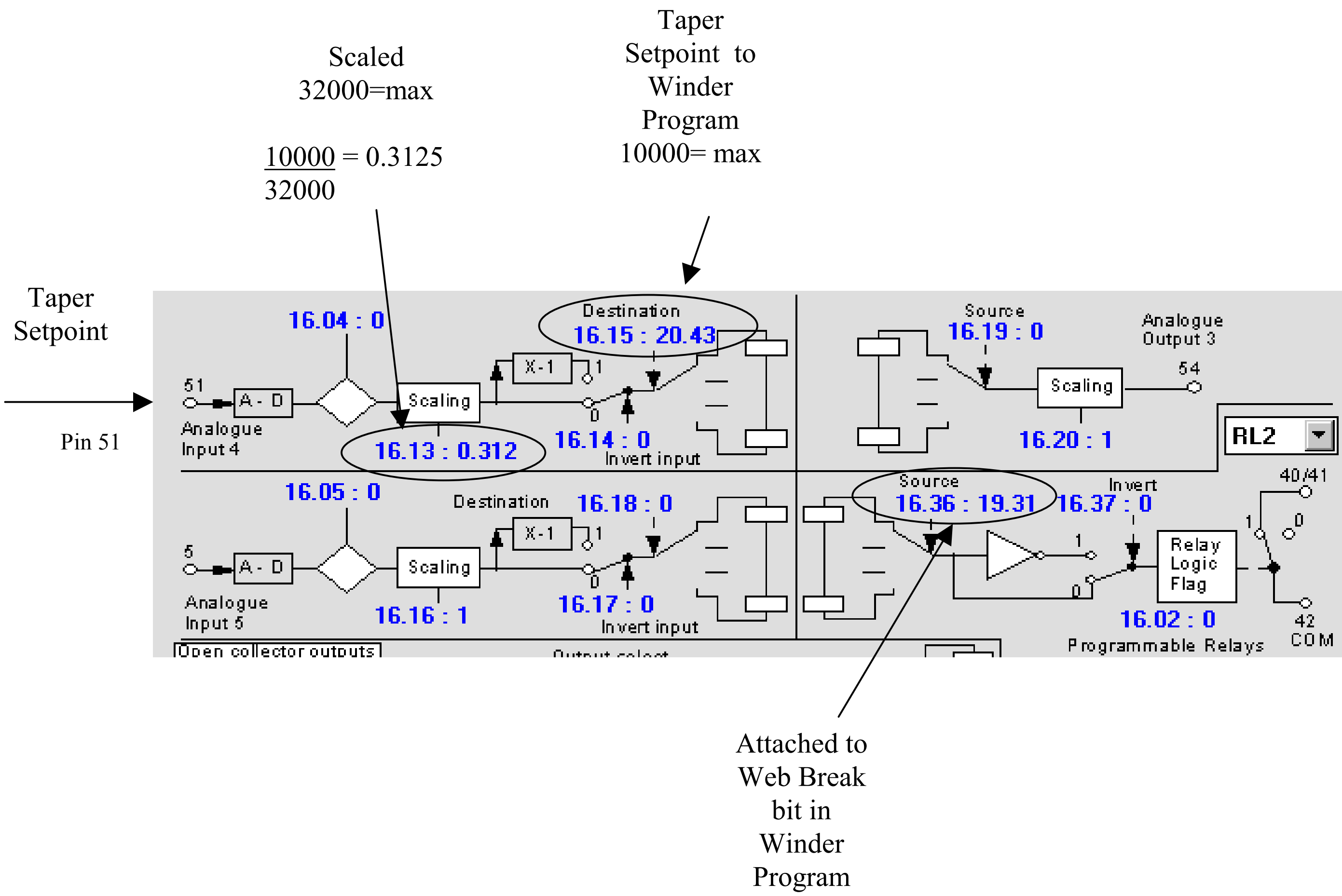


% Diameter from Winder Program

At Full Roll Output

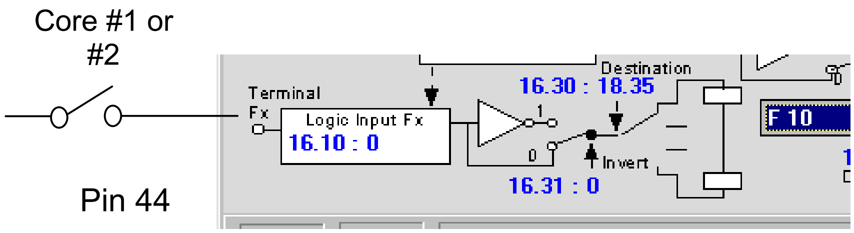
UD50 SOM Extended I/O Assignments

Taper Setpoint & Web Break



UD50 SOM Digital I/O Assignments

Core Selection Input Assignment



Programmable Relays COM

	Source	Invert	Log flag	Term
RL2	16.36	16.37	16.02	40
RL3	16.38	16.39	16.03	41

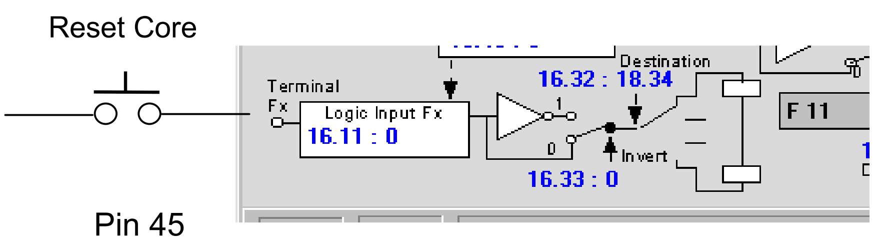
Programmable output /input terminals F7, F8 and F9

	Dest/ Srce	Invert	O/put Sel	Logic IP/O P	Term
F7	16.21	16.22	16.23	16.07	48
F8	16.24	16.25	16.26	16.08	49
F9	16.27	16.28	16.29	16.09	50

Programmable input terminals F10, F11 and F12

	Dest	Invert	Logic IP	Term
F10	16.30	16.31	16.10	44
F11	16.32	16.33	16.11	45
F12	16.34	16.35	16.12	46

Core Preset Input Assignment



Unidrive Pinout Summary

Winder Function	Unidrive Pin #	Unidrive Function
At Full Roll	1	Dry Relay Contact
At Full Roll	2	Dry Relay Contact
	3	
	4	+10v
Line Speed Input	5	Analog Input 1 0-10v diff hi
Line Speed Input	6	Analog Input 1 0-10v diff lo
	7	Analog Input 2 0-10v single input
Tension Setpoint	8	Analog Input 3 0-10v single input
Tension Output	9	Analog Output 1
	10	Analog Output 2 (spare)
Analog Common	11	Analog Common
	12	
	13	
	14	
	15	
	16	
	17	
	18	
	19	
	20	
	21	
	22	
	23	
	24	Input F1
External Fault Reset	25	Input F2
Winder Jog	26	Input F3
Winder Run	27	Input F4
Overwind/Underwind (fwd/rev)	28	Input F5
Stop Circuit / permissives	29	Input F6
Drive Enable/ESR	30	E-Stop Reset
Contact Common	31	Logic Common
	32	
	33	
	34	
	35	
	36	
	37	
	38	
	39	

UD50 SOM Pinout Summary

Winder Function	UD50 Pin #	UD50 Function
Web Break	40	Relay 3
	41	Relay 4
Web Break	42	Relay Common
	43	Ov (Digital)
	44	Input F10
	45	Input F11
	46	Input F12
	47	Ov (Digital)
4.5"/6" Core Select	48	Digital In/Out F7
Diameter reset to core	49	Digital In/Out F8
	50	Digital In/Out F9
Tension Taper Setpoint	51	SOM Analog Input #4
	52	SOM Analog Input #5
	53	Ov (Analog)
	54	Analog Output #3
	55	Control Earth

Preliminary Setup

After the Unidrive wiring is complete, set up the key parameters for the application. Follow the parameters listed in the table below. Enter Values in BOLD only. Italic values are calculated.

Example **Single Spindle Rewind**

Parameter	Value	Actual	Units	Notes
		1300	FPM	Maximum Line Speed
		8.0	mils	Web Thickness
UD70 Parameters				
1.05				Winder jog speed (rpm) (if const speed jog)
1.06	*1744.2*		RPM	Maximum RPM Drive Limit
1.14	5			Selects Precision Speed Reference in Unidrive
3.10	2000			Drive Proportional Gain (1000-5000) typically
3.11	20			Drive Integral Gain set low (10-100) typically
18.13	*4500*	**4.50**	Inches	Core #1
18.14	*600*	**6.00**	Inches	Core #2
18.15	*5000*	**50.0**	Inches	Max Diameter of Full Roll
18.24	300	**3%**	*39 FPM*	Sets Minimum Line Speed Threshold
18.23	30	**3%**	*39 FPM*	Sets Minimum Spindle Speed Threshold
18.40	*1*	**0 or 1**	*Linear*	Taper Type 1= Linear 0 = hyperbolic
19.12	*1710*	**1710**	RPM	Desired Full Core Speed
19.33	0	**0**		Mode Torque=0 Speed=1
19.34	*1*		*Yes*	Web Break Detection->Drive Trip 0=Off 1=On
20.27	**10**			Compensation Overall Gain
20.40	*125*			Tracking Filter Amount
UD50 Parameters				
16.13	0.312			Scaling for a-d #4, taper input
16.15	20.43			Taper input setup
16.21	18.35			Core #1 / #2 logic setup
16.24	18.34			Diam preset logic input setup
16.36	19.31			Web break output logic setup

Parameters in Example Described

Sizes and Thicknesses

Smallest core size in 18.13 x 1000 ex. 4.5 inches=4500
Nominal Full roll size in 18.15 x 100 ex. 6 inches=600

Place Tracking Filter Rate into #20.40 In this example:,
Material Thickness = 8 mils or 0.008 inches
Max Line Speed =1300 FPM line

#20.40 = 0.008 x 1300 * 12 = 124.8 or 125

Speed Matching

It's necessary to track in the speed of the winder drive to the upstream nip roll. This is done by disabling PID control (#18.36=0, #19.38=0), and presetting the diameter memory (toggle #18.34=1) to the smallest core size (#18.13). The smallest core value, always core #1, should be selected prior to the reset. Check #20.41, it should show the desired diameter. As described in the start-up guide, the system is temporarily put in speed wind mode, (#19.33=1), for the speed matching setup. Speed match is needed to correctly calibrate the roll diameter sensor.

The line speed reference to the nip roll and winder are brought up together to any desired speed, preferably between 50 to 100%. A hand tach is used to check the speed match between the nip roll and the empty core. Speed match is adjusted with the speed scaling parameter in the UD70, which for encoder feedback is #19.12 (#19.11 in open loop). It should be noted that changes to #19.11/19.12 only go in after UD70 reset, so the procedure is to determine the speed match error percentage with a calculator, and change the parameter by this amount.

Example:

Speed of spindle is 10% below upstream nip:
Increase #19.12 (or #19.11) by 10% and reset ud70 by entering 1070 in parameter menu 0 and hitting the red reset button.

Example:

If 1811 RPM is needed at core and at full line speed, set #19.12 to 1811, if in vector mode. Parameter #1.06, the max drive speed, needs to be a little higher than the value in #19.12, to allow a little "headroom".

Inertia Compensation

To calculate #19.15:

$$\#19.15 = \frac{\text{Machine Inertia} * \text{Line Speed} * \text{Nameplate RPM} * \text{Buildup ratio}}{316.8 * \text{Motor HP} * \#20.27 * \text{GBR} * \text{Full Roll Diam}}$$

To calculate #19.14:

$$\#19.14 = \frac{\text{Full Roll Weight} * \text{Full Roll Diam} * \text{Nameplate RPM} * \text{Max Line Speed}}{36496 * \text{Motor HP} * \#20.27 * \{(\text{Buildup Ratio} \hat{\ } 3) - 1\} * \text{GBR}}$$

GBR is GearBox Ratio
Machine Inertia is the metal core inertia value divided by the GBR squared plus actual armature inertia.
Motor HP is the 100% motor rating. Drive HP rating cancels out in the equations, provided drive nameplate data is set up correctly. Nameplate RPM is the lower value on a multi-speed motor nameplate.
Use the following units: Full Roll weight in Lbs. minus core weight, Line Speed in FPM, Machine Inertia in LB FT^2 , Full Roll Diameter in inches.
Buildup ratio is (#18.15 * 10) / #18.13 or, full roll diam / min core diam. For example, if full roll diameter=6" and core diameter=4.5" then the Buildup Ratio=1.33.
For example, if full roll diameter=48" and core diameter=4" then the Buildup Ratio=12.

#20.27 is value as entered.
In this example, #19.15=98 and #19.14=22.

Web break in CTCW mode

If DriveTrip upon Web Break for CTCW mode is enabled with (#19.34=0), a drive trip will occur.

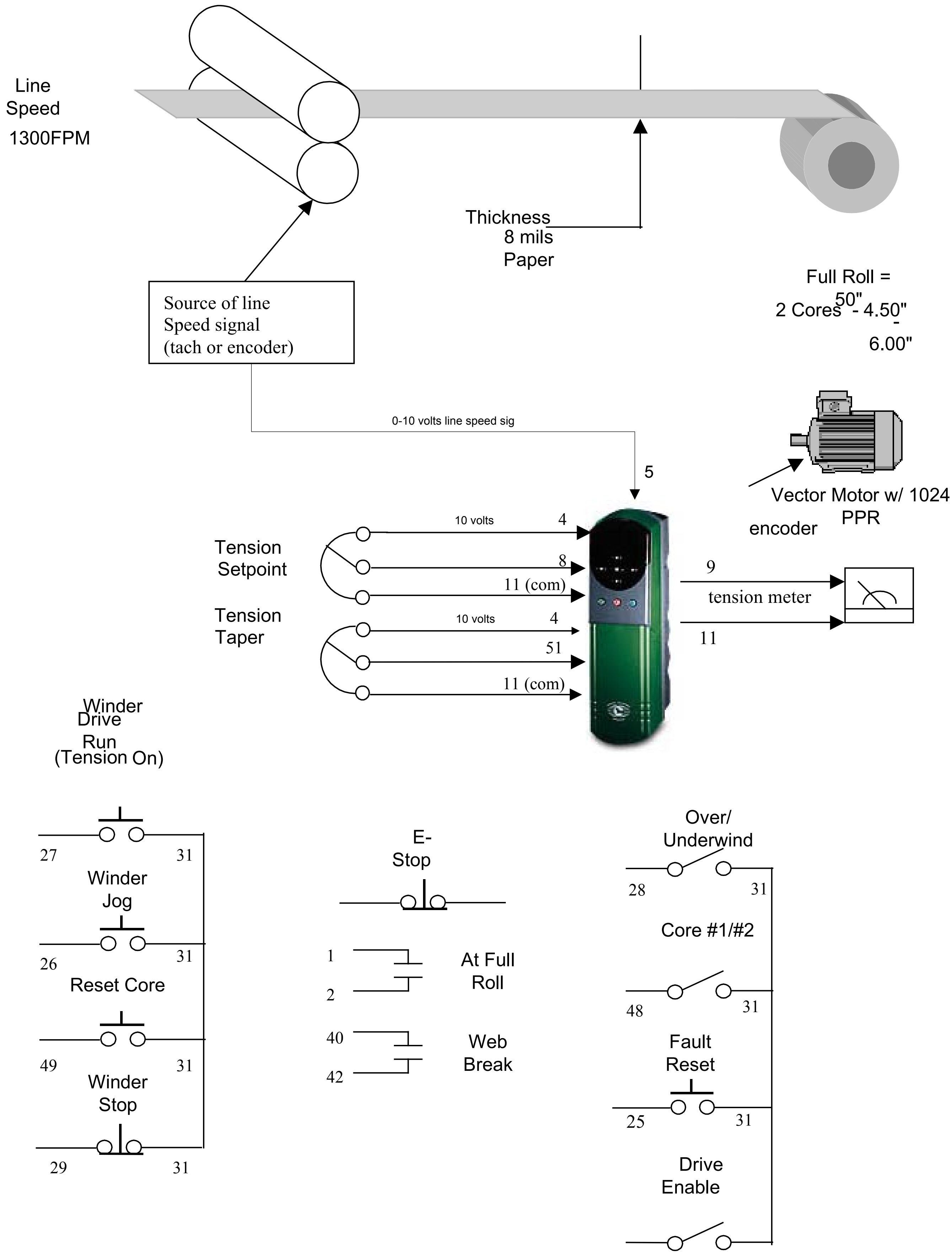
In torque mode, web break is detected by comparing raw diameter to the diameter memory.
If the unit is designated (#19.49=0) as a winder, the web break will be signaled if the raw diameter regresses back to less than 80% of the memorized value. This happens because a broken web tends to change speed which causes an immediate change in the raw diameter. If the raw diameter drops to 80% of its prior value, it means the speed of the roll must have suddenly increased 20%. If defined as an unwind drive (#19.49=1), a web break will be signaled if the raw diameter regresses to greater than 120% of memorized. This means the roll has begun to slow down and is headed in the other direction.

Additionally, in torque mode only, web break is signaled if the speed feedback #3.02 exceeds the value in #1.06 (overspeed trip).

•The program needs to know whether the unit is an unwinder or a rewinder by the setting of #19.49.0=rewind. This sets up the web break function for proper operation, (and sets the correct torque polarity for the spindle).

The drive will trip on web break if #19.34 is 0. A logic 1 will disable the drive trip out function upon web break. The customer web break bit is always functional, (#70.51 and #19.31 outputs), regardless of #19.34's setting.

¤ *the speed is limited to 125% of normal winding speed due to the speed override function.*



Line
Speed
1300FPM
Thickness
8 mils
Paper
Full Roll =
50"
2 Cores - 4.50"
-
6.00"
Source of line
Speed signal
(tach or encoder)
0-10 volts line speed sig
5
Vector Motor w/ 1024
PPR
encoder
Tension
Setpoint
10 volts
4
8
11 (com)
Tension
Taper
10 volts
4
51
11 (com)
9
tension meter
11
Winder
Drive
Run
(Tension On)
27
31
Winder
Jog
26
31
Reset Core
49
31
Winder
Stop
29
31
E-
Stop
1
2
At Full
Roll
40
42
Web
Break
Over/
Underwind
28
31
Core #1/#2
48
31
Fault
Reset
25
31
Drive
Enable

APPENDIX D: MULTI-TURRET WINDING

To allow continuous winding applications, a multi-turret flying splice winder can be created using this program installed in each winder drive. Dual or triple turret winders are the most common multi-turret setups.

CTNet communication or the CTIU Interface handles the start/stop and control coordination.

In the case of a dual-turret winder, the PLC would provide control for jogging and starting each drive in normal control. Typically, the first drive to be started is given PID control and integrator enable. This allows the drive to hold tension and wind material.
When the roll is nearly fully wound, the second drive to be started is given a speed reference but no PID or integrator enables. This causes its core to track in speed match with the incoming nip. When roll transfer occurs, the second drive has its PID enabled. After a short delay, the integrator is enabled, and normal winding continues on the second drive. Enabling the PID without the integrator on the second drive allows some proportional trim to get through, while holding off the diameter tracking action, so that the diameter stays at the preset value. This gives good control with j-arm type winders, because no buildup occurs on the new core until after the cut. However, the web is already in contact with the new core, so you need a little bit of proportional trim.

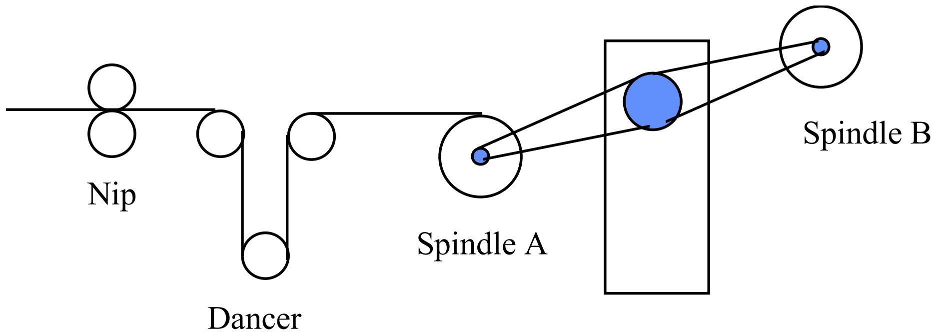
If the oncoming core is in control of the PID, the offgoing drive is put into current memory so it can hold its winding tension without the need for PID control (so only one feedback device is on the material and only one PID can be enabled at once). The first drive is then stopped and the roll unloaded. After the first roll is unloaded, the first drive is restarted without PID enables. It follows in speed match waiting for the next transfer. This alternating sequence allows material to be wound continuously.

The block diagram shown below lists the input and outputs to the Dual Mode Winder Program. All physical I/O comes through the drive's I/O terminal strips via the drives A/D and D/A Converters, and digital I/O structures. Not all of the inputs require a connection; only those inputs required for the particular application need to be considered. For instance, the Taper input would only be used if this variable needs to be an operator-adjustable value. I/O can also come through the various communication devices: UD73, UD74 or UD77.

Turret Wind/Unwind Sequence of Operation

Rewind Sequence

The following information is intended to help describe how one might interface a PLC or other form of logic sequencer to the Dual Mode Winder program. The Turret Rewind sequence of operation described below is only an example, and some facets of the operation may vary depending on the winder machine construction or operation.



To start out, an operator typically threads the material through the machine and through the final set of nips. The nips are necessary in a winding operation to isolate the tension producing section (winder) from the upstream operations such as coating, laminating or other process area. A regenerative drive is typically used on the nip roll drives so that the winder cannot overhaul the material and pull it through the machine.

The operator applies tape or other adhesive to a cardboard or similar core so that the material can be wrapped around the core and not slip. The operator would then jog the taped core to wrap the core.

Diameter Preset

Typically the machine winds materials onto a core of known diameter. The winder needs to know that a new core is ready and needs to know its diameter. Sometimes this preset would be accomplished by the machine chuck closure command. Since this closure command would indicate that a new core is present, this may be a logical time to inform the winder electronics. An alternate method could simply use a core preset button or buttons. Or if the user has different core sizes, a range of core sizes could be part of a selector switch or the core size could be communicated by a computer system.

Tension On

After the core has been wrapped, the operator can depress a "Tension On" or Spindle Start push-button. This would typically turn the winder drive on and apply either full tension or a stall tension reference and enable the trim loop. In the example diagram above, this would cause the dancer to seek and maintain "home" position with the selected tension. Keep in mind that with a dancer loop, the winder would be regulating dancer position. The winder electronics can provide a tension reference signal for an air loading device that is actually applying the force to develop web tension. If the feedback device happened to be a loadcell, then the PID trim loop would be actually regulating the set tension by using the actual tension measurement as provided by the loadcell.

Line Run

When the operator and material is ready to run, the operator would then depress Line Run which would start the line accelerating toward the line speed setpoint (and apply the full tension reference if it was in stall tension). The initial diameter preset gave the winder program its original core value. The diameter calculator is inhibited during the very beginning of line speed acceleration because:

$$\text{Diameter} = \frac{\text{Line Speed}}{\text{Core Speed}}$$

So when core speed is something near 0, the result would approach infinity. Therefore, this calculation is held off until the Line Speed is above 3-5%. During this time the dancer gain will have enough range to make any adjustments. Above this low speed the diameter calculator is released and diameter tracking begins to keep the dancer trim range requirement as small as possible.

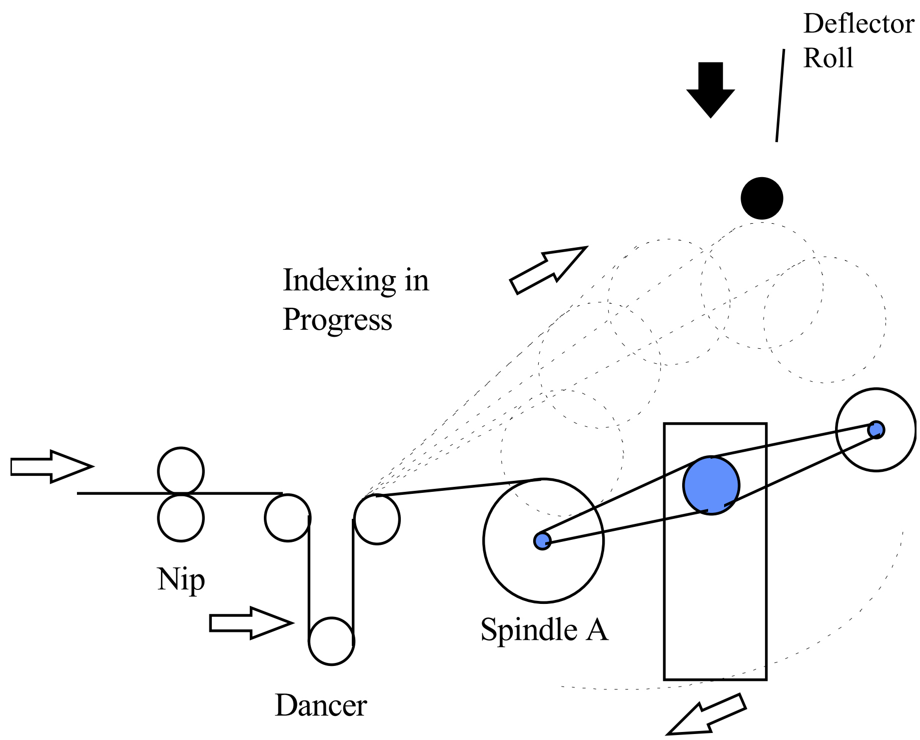
Roll Build-Up

During this phase of the process, the operator would be placing a new core on Spindle B getting ready for the eventual transfer. The roll would be building up with a constant tension unless Taper Tension was selected. This tapering tension is typically selected as either linear or hyperbolic in nature. Taper could begin immediately when the diameter calculator is released or could be kicked when the roll diameter reaches some specific point. Tapering tension tends to prevent roll “telescoping” and is a variable for different product types, roll sizes and tensions. The taper amount can be an operator adjustment via a potentiometer or via some recipe selection communicated to the winder control.

Index Turret

As the roll approaches its full diameter, the winder turret is indexed so that the empty core is put in a position to accept the oncoming material. The point in time to index can be selected by :

a) the operator
b) the machine, which could be told it is time to index automatically from a full roll diameter threshold detector
c) the machine, which could be told it is time to index automatically from a length counter on the material.

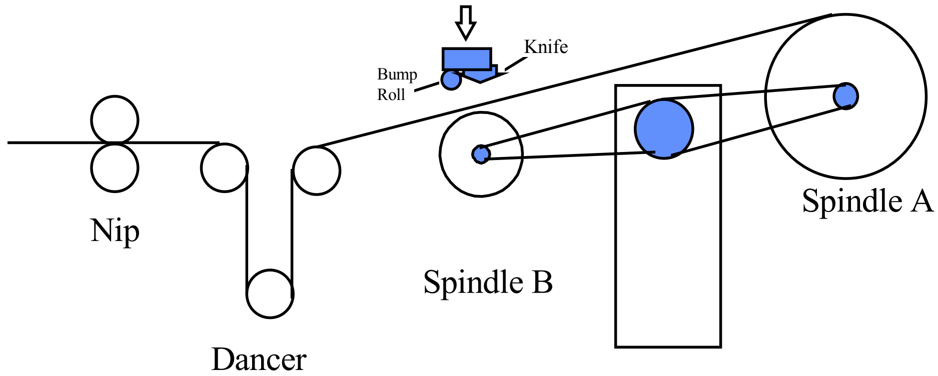


The indexing process distorts the torque requirement for the winding process slightly as the building roll is rotated around the rear. To minimize these effects which can show up on the roll, Torque Memory is often utilized.

Torque Memory

This feature allows the last running average of current reference to be used as the torque command during this index rotation. This makes any indexing distortion invisible. Sometimes a boost amount is added to this Memorized Torque to compensate for the torque requirements (due to the added length of material between the building roll and the dancer), compensation for the new wrap angles and additional torque requirements of the deflector roll (if used). So, the current reference is memorized just prior to the index process. Usually as the turret passes through 90° or approaches contact of the deflector roll, this would result in a command that takes Spindle A drive from the Speed Regulator Mode to the Torque Mode using the memorized torque reference value (with perhaps a boost amount added).

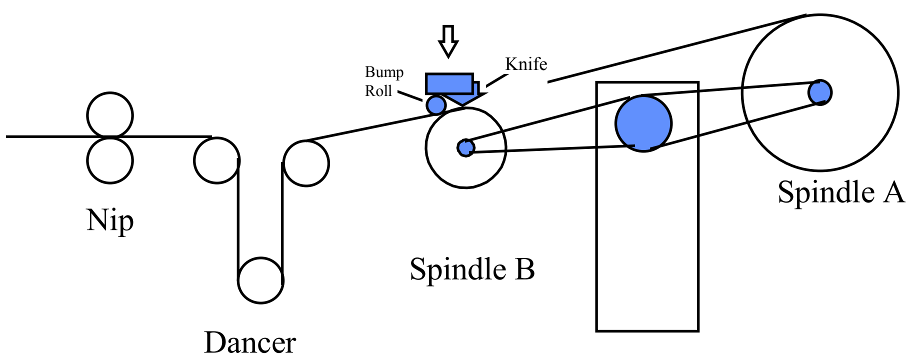
Speed Match



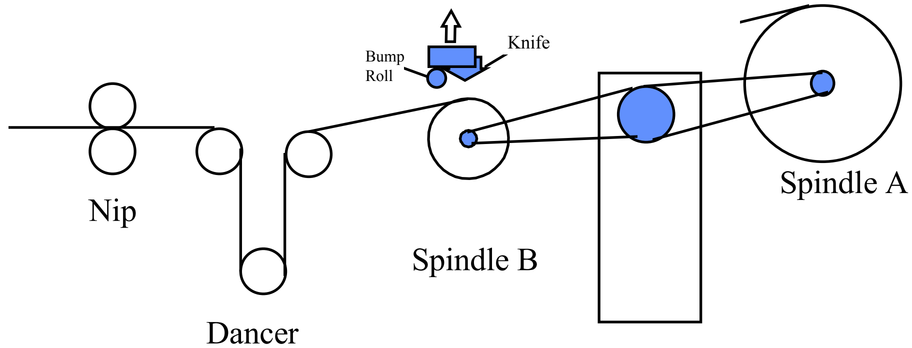
When the index is complete and the empty core is in the transfer position, Spindle B is turned on and the diameter is preset to that core setting. The winder control will provide Spindle B drive with a speed reference to match the surface speeds of the two rolls. When Spindle B drive has reached this speed target, a drive output will indicate to the PLC logic that the knife can now be fired.

Transfer

The knife is fired, which is sometimes referred to as a "*bump and cut*". A roller slightly ahead of the knife presses the material onto the empty core to put it in contact with the adhesive on the core roll and the serrated knife blade right behind it cuts the web and retracts. Spindle A is thrown back into the Speed mode with a zero speed target and ramps the full roll down to zero speed using a controlled regenerative stop. Sometimes dynamic braking is used, but this can be a rather heavy shock on the high full roll inertia and cause slippage on the core.



Meanwhile after about 1 second of material winds on Roll B, Spindle B winder is placed in the Tension Mode (Trim Loop enabled-integrator still held off). A short time delay later the integrator is released and diameter tracking begins and the whole process repeats.



Unwind Sequence

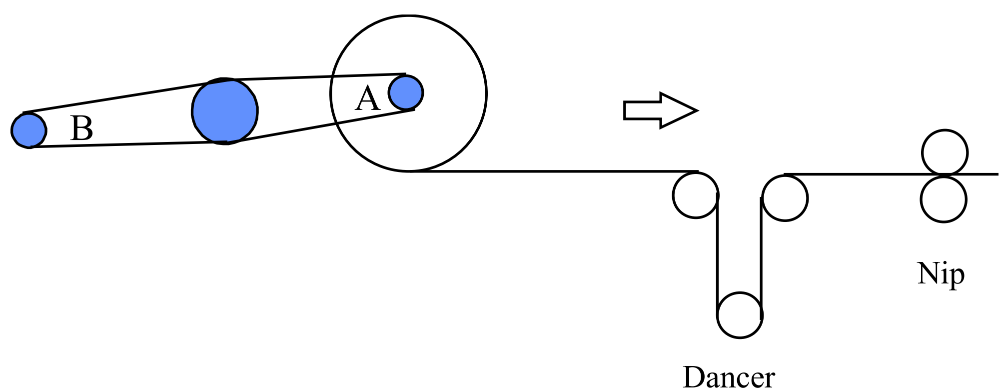
The following information is intended to help describe how one might interface a PLC or other form of logic sequencer to the Dual Mode Winder program. The Turret Unwind sequence of operation described below is only an example, and some facets of the operation may vary depending on the unwinder machine construction or how the OEM typically operates its machinery. In general, unwinding is a little more difficult than winding, having a few more considerations to handle.

To start out, an operator typically threads the material through the first set of nips. The nips are necessary in an unwinding operation to isolate the tension producing section (unwinder) from the downstream operations, such as coating, laminating or other process area. A regenerative drive is used on the unwinder because it is always trying "hold-back" while regulating tension/position.

The machine is threaded using Unwind Jog. It is desirable that this Unwind Jog speed be a variable as a function of the Full Roll Diameter so that the material jog speed is consistent, regardless of the roll diameter. Therefore, the initial diameter of the starting roll must be entered into the electronics. This can be accomplished through a number of means:

1. The operator enters the diameter via an Operator Interface Unit, Keypad/Display, or HMI CRT/ SCADA System
2. Diameter is measured via Ultrasonic Sensor & Preset Prior to Jog

Spindle On



After the machine is threaded through the tension feedback area and nips are closed, the unwinder can be placed in the tension mode. The operator can depress a "Tension On" or Spindle Start push-button. This will typically turn the unwinder drive on and apply either full tension or a stall tension reference and enable the trim loop. In the example diagram above, this would cause the dancer to seek and maintain "home" position with the selected tension. Keep in mind that with a dancer loop, the unwinder would be regulating dancer position. The unwinder electronics can provide a tension reference signal for an air loading device that is actually applying the force to develop web tension. Further jogging would be under tension control.

Line Run

When the material is ready to run, the operator would then depress Line Run which would start the line accelerating toward the line speed setpoint (and apply the full tension reference if it was in stall tension). The initial diameter preset gave the unwinder program its original full roll value. The diameter calculator is inhibited during the very beginning of line speed acceleration because:

$$\text{Diameter} = \frac{\text{Line Speed}}{\text{Core Speed}}$$

So when core speed is something near 0, the result would approach infinity. Therefore, this calculation is held off until the Line Speed is above 3-5%. During this time the dancer gain will have enough range to make any adjustments. Above this low speed the diameter calculator is released and diameter tracking begins to keep the dancer trim range requirement as small as possible.

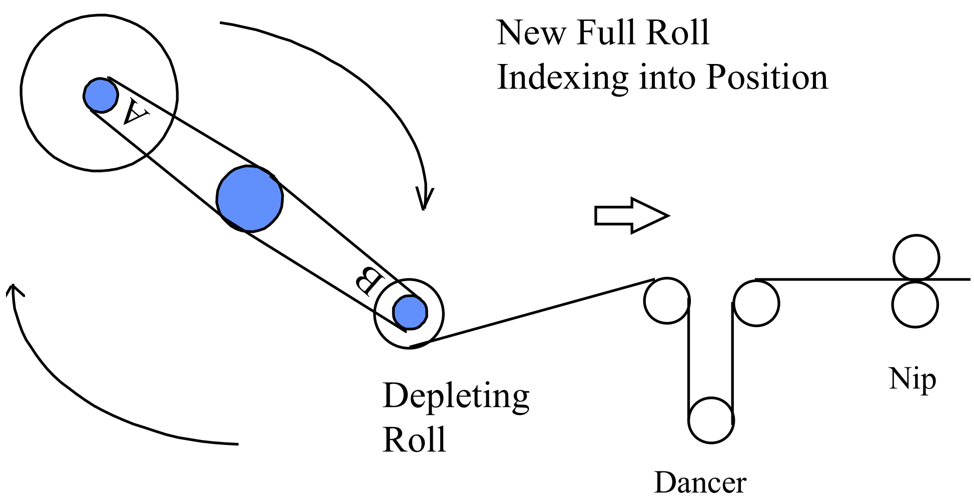
Roll Depletion

During this phase of the process, the operator would be placing on a new full roll on Spindle B getting ready for the eventual transfer. The roll in process would be unwinding with a constant tension, unless Taper Tension was selected which is rare on unwinding processes.

Index Turret

As the roll unwinds, the unwinder turret is indexed so that the full roll is put into a position to "*pass the baton*" so to speak. The point in time to index can be selected:

a) manually by the operator
b) automatically from a "roll almost empty" diameter threshold detector
c) automatically from a length counter on the material
d) or through some time calculation based on line speed setting, etc.



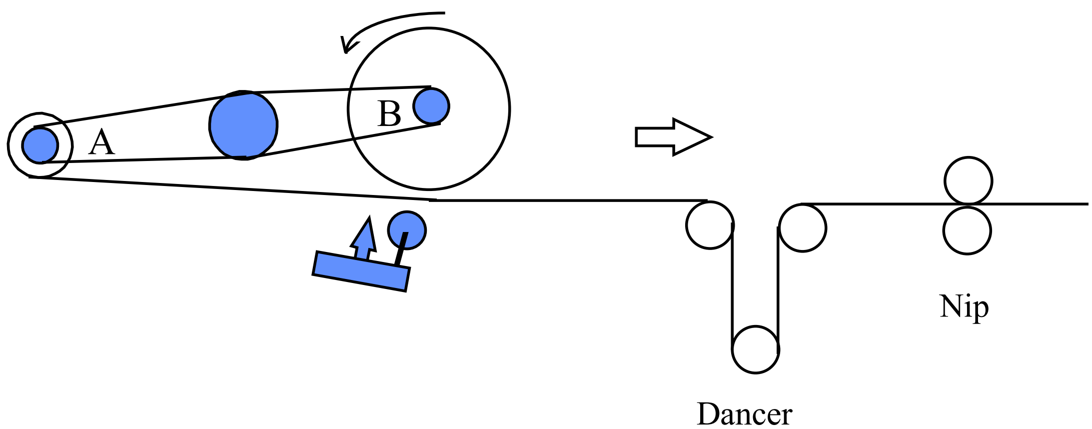
Acquire Diameter

Because any full roll placed on the machine could be a different diameter, the electronics must acquire this new full roll diameter. This could be accomplished in a number of ways:

1. The operator measures and enters the diameter via an Operator Interface Unit (Keypad/Display or MMI CRT/ SCADA System
2. The diameter is measured via an Ultrasonic Sensor
3. A lay-on roll equipped with a tachometer is placed against the full roll while rotating to pre-calculate full roll diameter. (The Dual Mode Winder program does not currently support this method.)

Speed Match

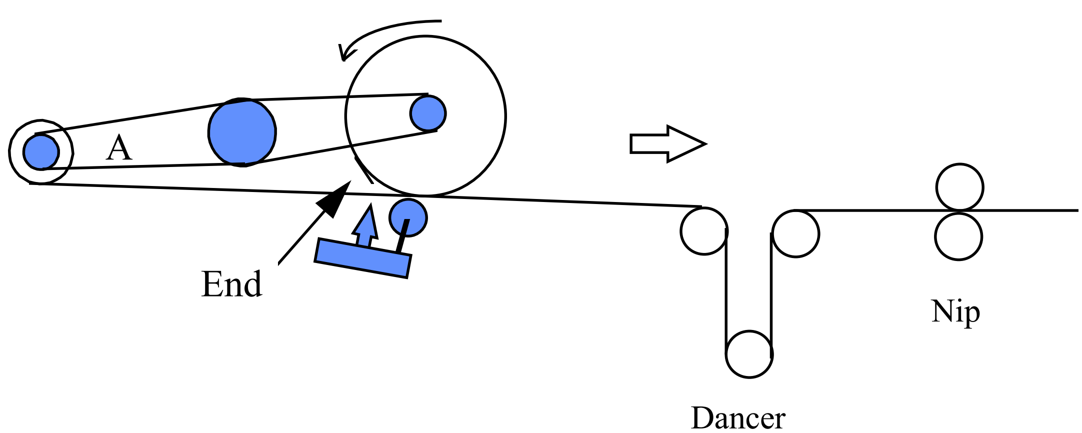
Full Roll in Position & Speed Matched



Once the full roll diameter is known, the winder control will provide Spindle B drive with a speed reference to match the surface speeds of the two rolls. When the index is complete and the full roll is in the transfer position, the knife mechanism can be moved into position. When Spindle B drive has reached this speed target, a drive output will indicate to the PLC logic that transfer is ready.

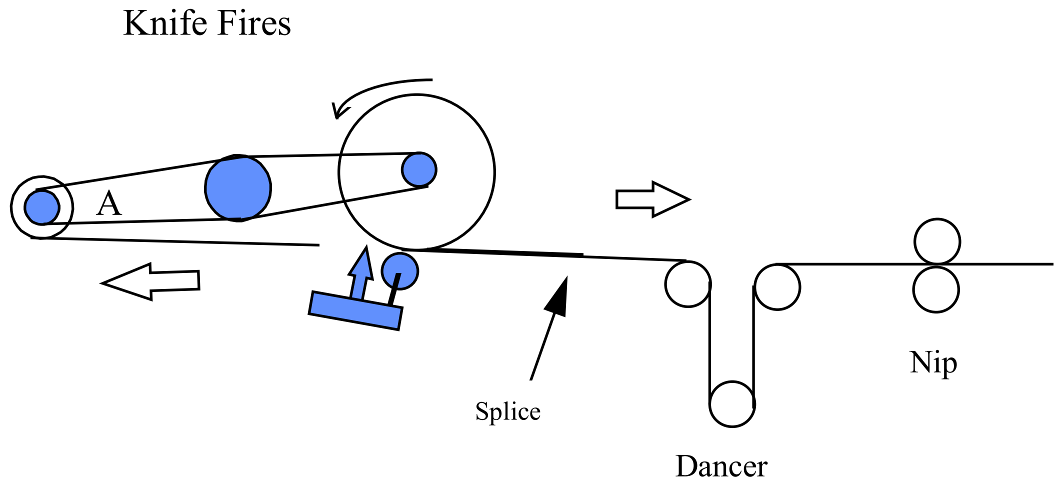
Torque Memory

Bump Roll Engaged Ready for Tack



During the transfer process, a roll is pressed against the new full roll to insure that the web makes good contact to the adhesive. Spindle A would be taken from the Speed Regulator Mode and placed in the Torque Mode using the average current reference memorized just prior to this action.

Transfer



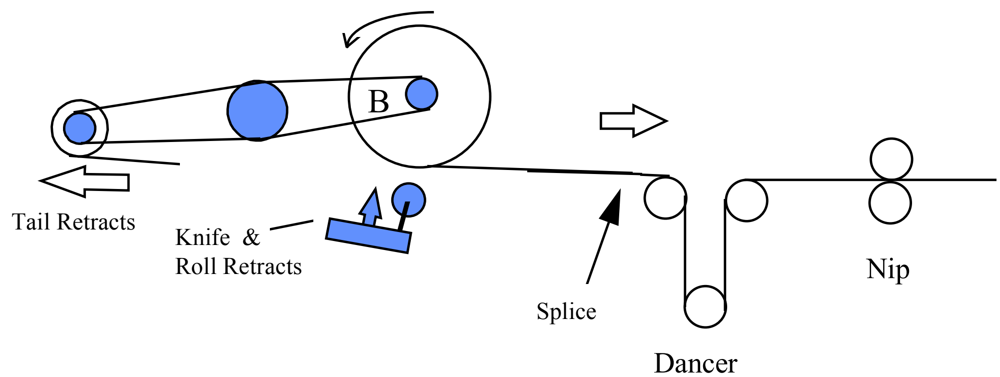
The serrated knife blade is then fired. This "flying splice" consists of a double thickness where the old web is spliced to the new full roll. Spindle A is thrown back into the Speed mode with a zero speed target and ramps the empty roll rapidly down to zero speed using a controlled regenerative stop.

Transfer Complete

The empty roll (still has some material on it) is often quickly reversed to pull the tail out of the machine area and stopped.

Meanwhile after about 1 second of material winds from Roll B, Spindle B winder is placed into the Tension Mode (Trim Loop enabled-integrator still held off). A short time delay later the integrator is released and diameter tracking begins and the whole process repeats.

Transfer Complete



Dual Spindle Rewinder in Speed Mode Example

The following is a basic Winder application example for a Dual Spindle Rewinder using the UD70 Speed Basic Winder Program. The basic system information necessary as acquired during the Sales Application process results in the following Specification Data.

Machine: Dual Spindle Rewind
Cores: 4.5" and a 6"
Full Roll Diam. Max 50 "
Max Line Speed: 1300 FPM
Material: Paper (copy machine grade) 8mils thick
Web width: 50"
Tension: 1.2PLI to 5PLI (*this info plays a role in the HP sizing*)
Feedback : Dancer 0 to +/-10v + v = dancer being pulled by winder
Storage: Approximately 4'
Full Roll Weight: 4000 lbs
Machine Inertia: 25 ft•lb^2
Nameplate RPM: 1725

Drive: Unidrive in Closed Loop (Vector) Mode with encoder 1024PPR
Motor: 25HP Vector with gear-in such that 1300FPM=1710RPM
Line Ref: via DC Tach from an upstream nip (+10v = Full Speed)

Operator Devices:

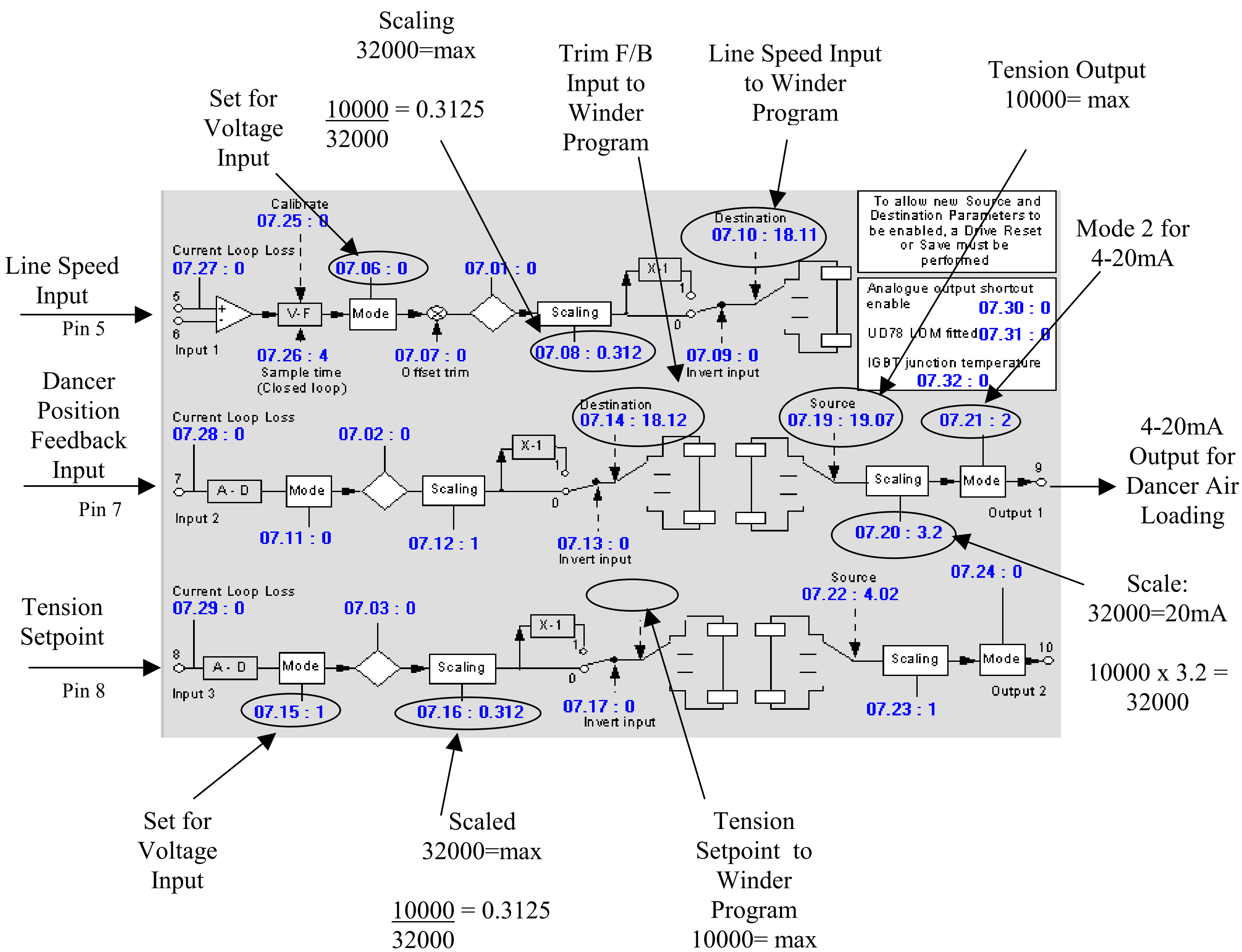
- Jog Rewinder
- Pot for Tension Setpoint- 100%
- Pot for Taper Tension – Linear 0 to 25%
- Tension On Switch

- Output for Roll at Max Diameter for auto stop function
- Dancer needs 4-20mA signal for tension set
- Must have web break detection

The I/O Assignments show the pertinent UniSoft software screens with Unidrive I/O assignments and the rationale behind the scaling and associated interaction with Dual Mode Winder Application program. Additional I/O was required, and so the UD50 was employed.

Winder I/O Assignments

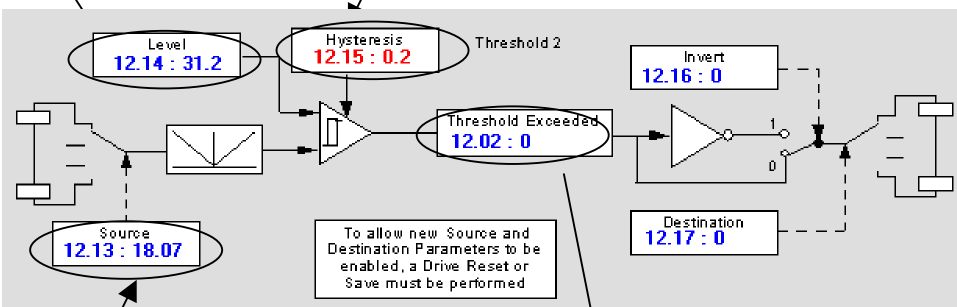
Analog I/O (Menu 7) Mapping and Scaling



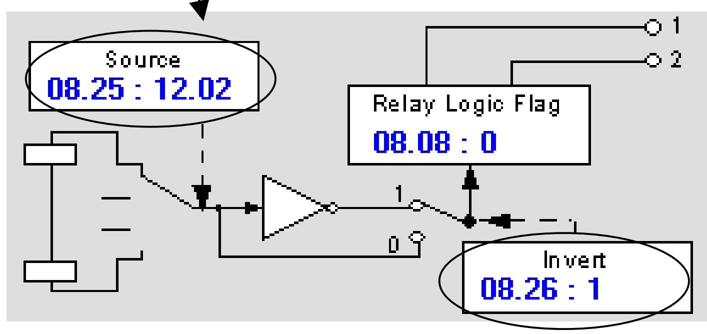
Full Roll Output

Value= % of Full Diameter x 10000 / 32000

Small hysteresis value (adjustable in field)

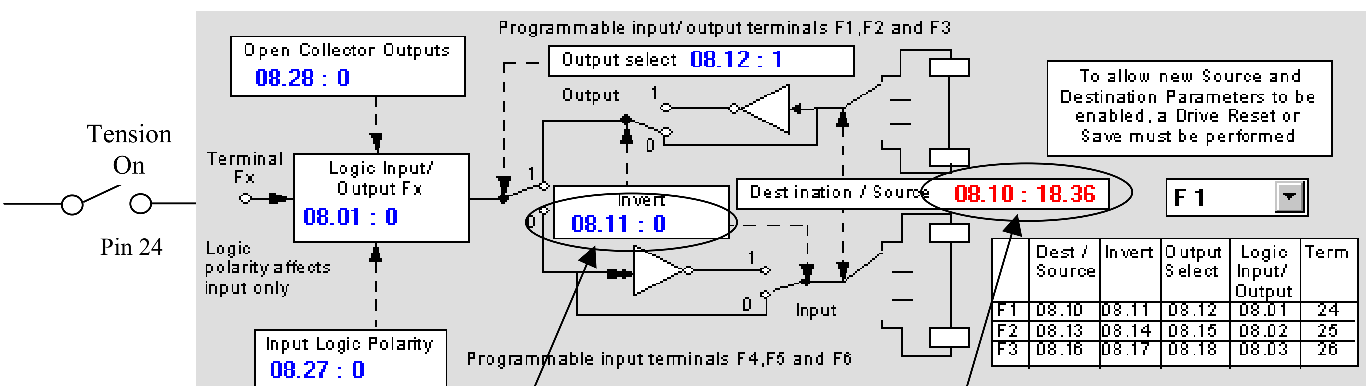


% Diameter from Winder Program



At Full Roll Output

Tension "On" Input



Dest / Source	Invert	Output Select	Logic Input/ Output	Term
F1 08.10	08.11	08.12	08.01	24
F2 08.13	08.14	08.15	08.02	25
F3 08.16	08.17	08.18	08.03	26

Set as an Input

Direct to PID Trim enable bit in Winder Program

UD50 SOM Extended I/O Assignments

Taper Setpoint & Web Break

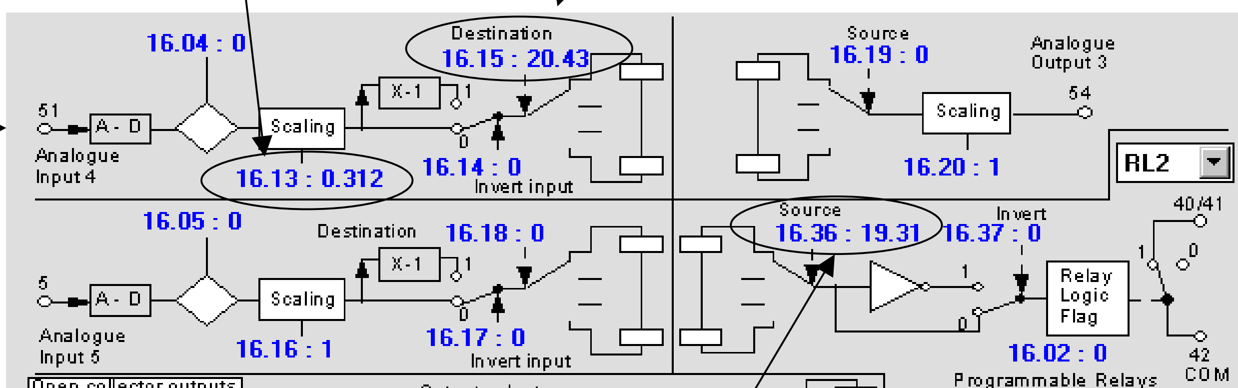
Taper
Setpoint to
Winder
Program
10000= max

Scaled
32000=max

$\frac{10000}{32000} = 0.3125$

Taper
Setpoint

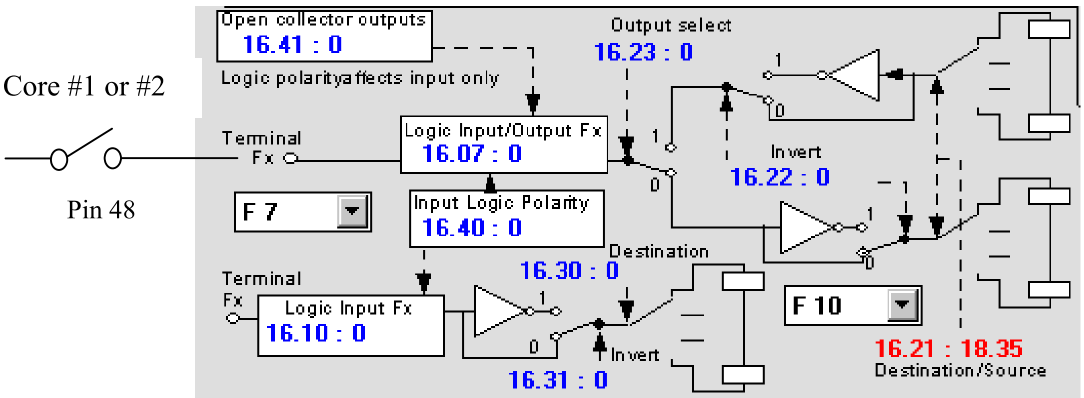
Pin 51



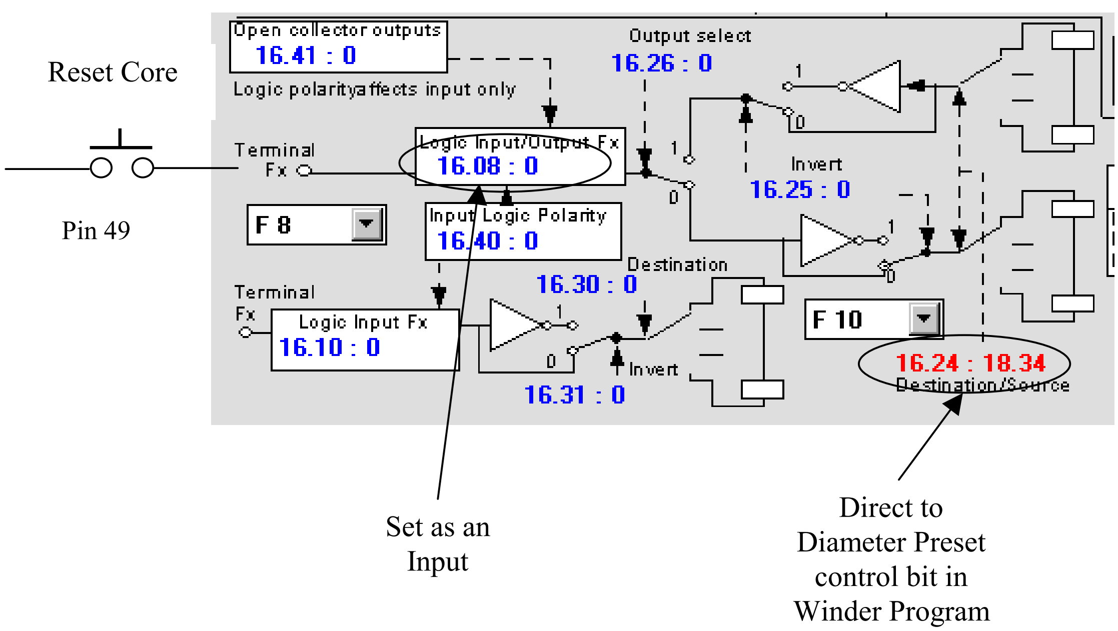
Attached to
Web Break
bit in
Winder
Program

UD50 SOM Digital I/O Assignments

Core Selection Input Assignment

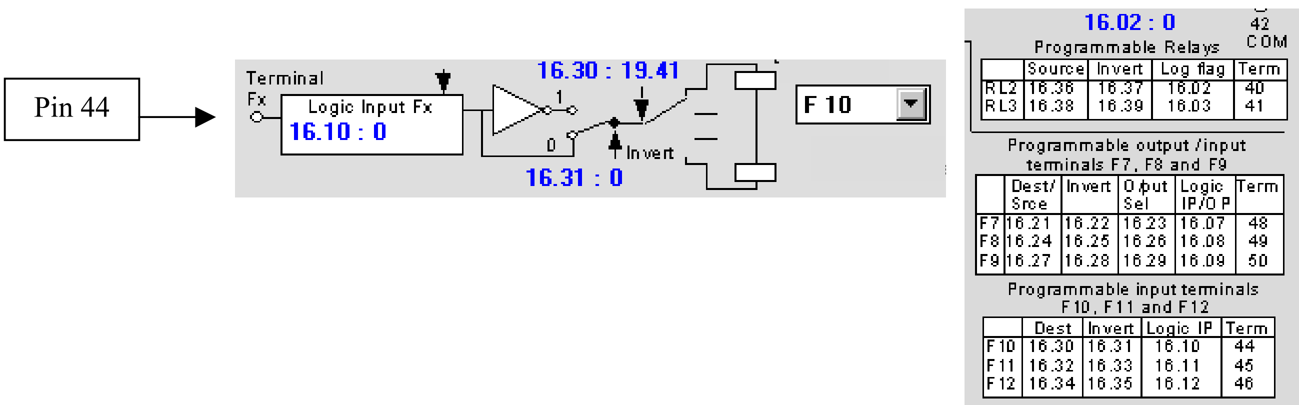


Core Preset Input Assignment

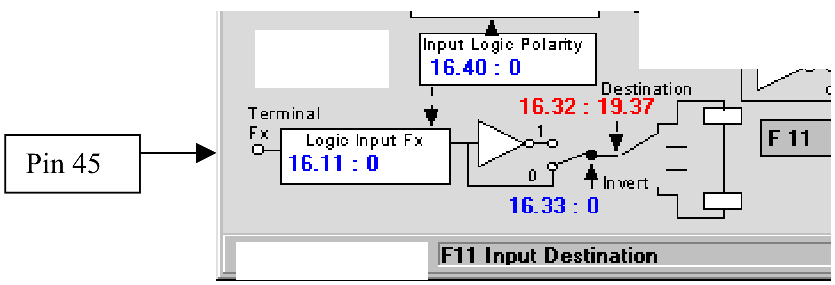


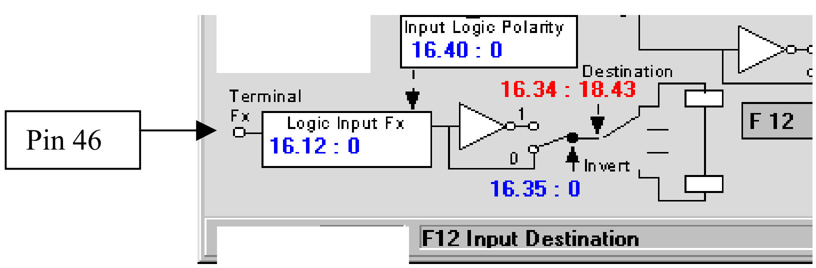
UD50 SOM Digital I/O Assignments

Logic input to memorize spindle torque via terminal 44



Logic input via terminal 45 to put Drive into Torque Memory Mode





Logic input to boost torque during transfer

Unidrive Pinout Summary

Winder Function	Unidrive Pin #	Unidrive Function
At Full Roll	1	Dry Relay Contact
At Full Roll	2	Dry Relay Contact
	3	
	4	+10v
Line Speed Input	5	Analog Input 0-10v
Line Speed Input	6	Differential to pin 5
Dancer Pot	7	Analog Input 0-10v
Tension Setpoint	8	Analog Input 0-10v
4-20mA Air Valve	9	Analog Output
	10	
Analog Common	11	Analog Common
	12	
	13	
	14	
	15	
	16	
	17	
	18	
	19	
	20	
	21	
	22	
	23	
Dancer Trim Enable	24	Input F1
External Fault Reset	25	Input F2
Winder Jog	26	Input F3
Reset Diameter	27	Input F4
Overwind/Underwind	28	Input F5
Stop Circuit	29	Input F6
Drive Enable/ESR	30	E-Stop Reset
Contact Common	31	
	32	
	33	
	34	
	35	
	36	
	37	
	38	
	39	

UD50 SOM Pinout Summary

Winder Function	UD50 Pin #	UD50 Function
Web Break	40	Relay 3
	41	Relay 4
Web Break	42	Relay Common
	43	Ov (Digital)
Memorize Torque	44	Input F10
Go to Torque Memory	45	Input F11
Boost spindle torque	46	Input F12
	47	Ov (Digital)
4.5"/6" Core Select	48	Digital In/Out F7
	49	Digital In/Out F8
	50	Digital In/Out F9
Tension Taper Setpoint	51	SOM Analog Input #4
	52	SOM Analog Input #5
	53	Ov (Analog)
	54	Analog Output #3
	55	Control Earth

Preliminary Setup

After the Unidrive wiring is complete, set up the key parameters for the application. Follow the values listed in the table below. Enter Values in Bold only. Italics values are calculated.

Example 1 **Dual Spindle Rewind**

Parameter	Value	Actual	Units	Notes
		1300	FPM	Maximum Line Speed
		8.0	mils	Web Thickness
UD70 Parameters				
1.06	*1744.2*		RPM	Maximum RPM Drive Limit
1.14	5			Selects Precision Speed Reference in Unidrive
3.10	2000			Drive Proportional Gain (1000-5000) typically
3.11	20			Drive Integral Gain set low (10-100) typically
18.12	adjust			This is the Dancer Feedback to the PID loop.
18.13	*4500*	**4.50**	Inches	Core #1
18.14	*600*	**6.00**	Inches	Core #2
18.15	*5000*	**50.0**	Inches	Max Diameter of Full Roll
18.18	*1000*	**10%**		Overall PID Gain
18.20	20			Integrator Gain 20~ = 3 seconds
18.21	100			Derivative Gain (w/ Dancer F/B)
18.22	30			Derivative Output Filter Amount
18.24	300	**3%**	*39 FPM*	Sets Minimum **Line** Speed Threshold
18.23	30	**3%**	*39 FPM*	Sets Minimum **Spindle** Speed Threshold
18.25	10000	**100%**		PID Limit
18.37	1			Integrator Enable when PID Enabled
18.40	*1*	**0 or 1**	*Linear*	Taper Type 1= Linear 0 = hyperbolic
	2			
19.12	*1710*	**1710**	RPM	Desired Full Core Speed
19.33	1	**1**		Mode Torque=0 Speed=1
19.48	*1*		*Yes*	Web Break Detection->Drive Trip 0=Off 1=On
20.40	*125*			Tracking Filter Amount
20.46				Turret Index torque boost level in % X 100
UD50 Parameters				
16.13	0.312			Scaling for a-d #4, taper input
16.15	20.43			Taper input setup
16.21	18.35			Core #1 / #2 logic setup

16.24	18.34			Diam preset logic input setup
16.36	19.31			Web break output logic setup

Parameters in Example Described

Smallest core size in 18.13 x 1000 ex. 4.5 inches=4500
Nominal full roll size in 18.15 x 100 ex. 6 inches=600

Place Tracking Filter Rate into #20.40. The formula for 20.40 is:
20.40 = Max Web Thickness x Max Line Speed in fpm x 12

Example: Material Thickness = 8 mils or 0.008 inches
Max Line Speed =1300 FPM line

#20.40 = 0.008 x 1300 * 12 = 124.8 or 125

The units are inches^2/minute, and relate to the amount of time it would take to build a full roll at full speed and the number of counts needed at the 5 millisecond scan rate of the clock task in the UD70. The results of these calculations cause #20.40 to set up the size of the counter needed to keep track of the diameter.
Dancer PID Gain Settings

Proportional	#18.19 = 30 as a start value
Integral	#18.20 = 20 as an initial value.
Derivative	#18.21= 50
Derivative filter	#18.22 set for 30.
Overall gain	#18.18= 100 or 10%

The standard drive speed resolution of 0 to +/-1 RPM is not fine enough for winder duty. Select the precision reference path by setting #1.14=5. This enables the drive's own internal precision reference system, which has a bipolar range of 0 to +/- the value in #1.06. The winder program speed demand will then come through the precision reference system into #1.49. The bipolar reference select #1.10=1 normally should be set on.

Speed Matching

It's necessary to track in the speed of the winder drive to the upstream nip roll. This is done by disabling PID control (#18.36=0), and presetting the diameter memory (toggle #18.34=1) to the smallest core size (#18.13) . The smallest core value, always core #1, should be selected prior to the reset. Check #20.41, it should show the desired diameter.

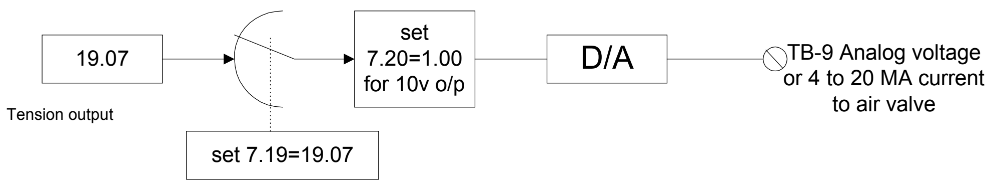
The line speed reference to the nip roll and winder are brought up together to any desired speed, preferably between 50 to 100%. A hand tach is used to check the speed match between the nip roll and the empty core. Speed match is adjusted with the speed scaling parameter in the UD70, which for encoder feedback is #19.12 (#19.11 in open loop).

Example:

If 1811 RPM is needed at core and at full line speed, set #19.12 to 1811, if in vector mode. Parameter #1.06, the max drive speed, needs to be a little higher than the value in #19.12, to allow a little "headroom".

Dancer Position Feedback

With dancer feedback enabled #18.44=1, the PID feedback is position, with the reference being the desired position (#18.17). The actual strip tension that results is controlled by the physical force or weight applied to the dancer. In some cases this is an air loading cylinder which is controlled by an electrical air valve. The Dual Mode Software can supply an output D/A signal to control this valve by routing the tension setpoint signal #19.07 out to a D/A output of the drive.



Dancer PID Stability
Typical starting value for dancer feedback are:

3% Proportional #18.19=30
3 sec Integral #18.20=20
and Derivative Gain #18.21=50 20 to 100 gain

Derivative is especially good with non-stretch materials such as paper. With extensible films, derivative is not used, because it tends to set up an oscillation with the dancer. When derivative is not used the proportional gain needs to be lower, as with loadcells, typically 1-3%.

The PID output limit by default is set to zero, so you need to put a value into #18.25 to get any PID trim at all. 10000 is the normal value entered. The limit then will be 10000 for the integrator and 10000 for the proportional trim for a total limit of 20000, plus or minus.

Turret Index Torque Boost

When the winder turret is indexed, or at the end of the index process, some winder tension or torque boost may be desired, to assist in obtaining a proper transfer to the fresh core. This is the purpose of the function. Boost is available both during normal speed winding, or during torque memory.

Spindle Control Logic

Commonly, the second processor in each winder drive is dedicated to the winder signal process function. This allows each program to be identical. The control of the spindle start stop and indexing functions are then done in another place. Typically this is a PLC which is wired or networked to the drives. Another possibility is to use a third drive in SYPT, for the spindle indexing and control functions. A good choice for this would be the drive that is used to index the spindle.

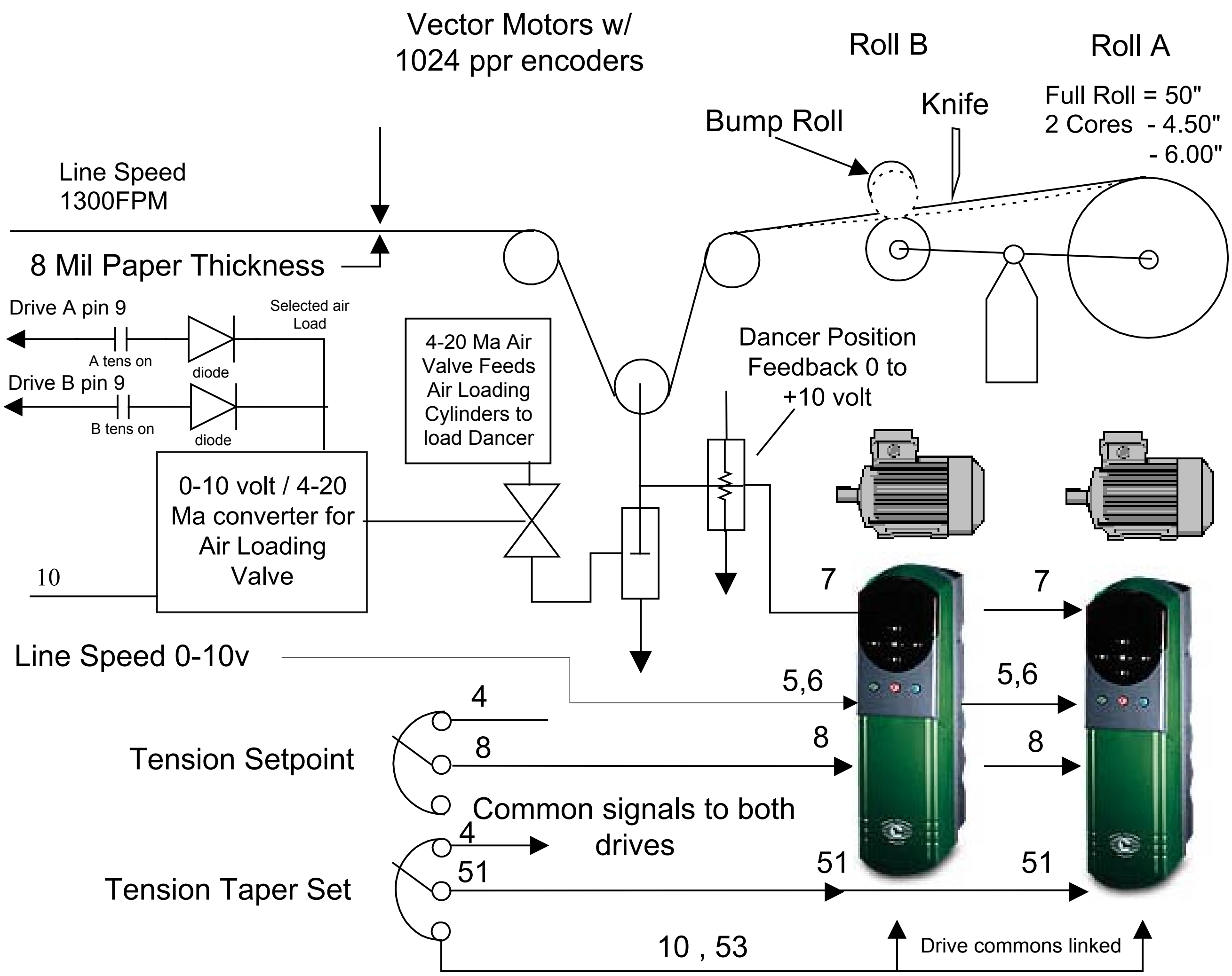
Memorizing Torque

Terminal 44 of the UD50 signals the program to memorize the average torque needed at the current diameter to maintain the present strip tension. This torque level is collected, so it can be used when the drive is switched to torque control mode during the roll transfer and cut process. By switching the off-going drive to torque mode, the dancer PID control can be switched off, so the dancer can be used to control the oncoming roll.

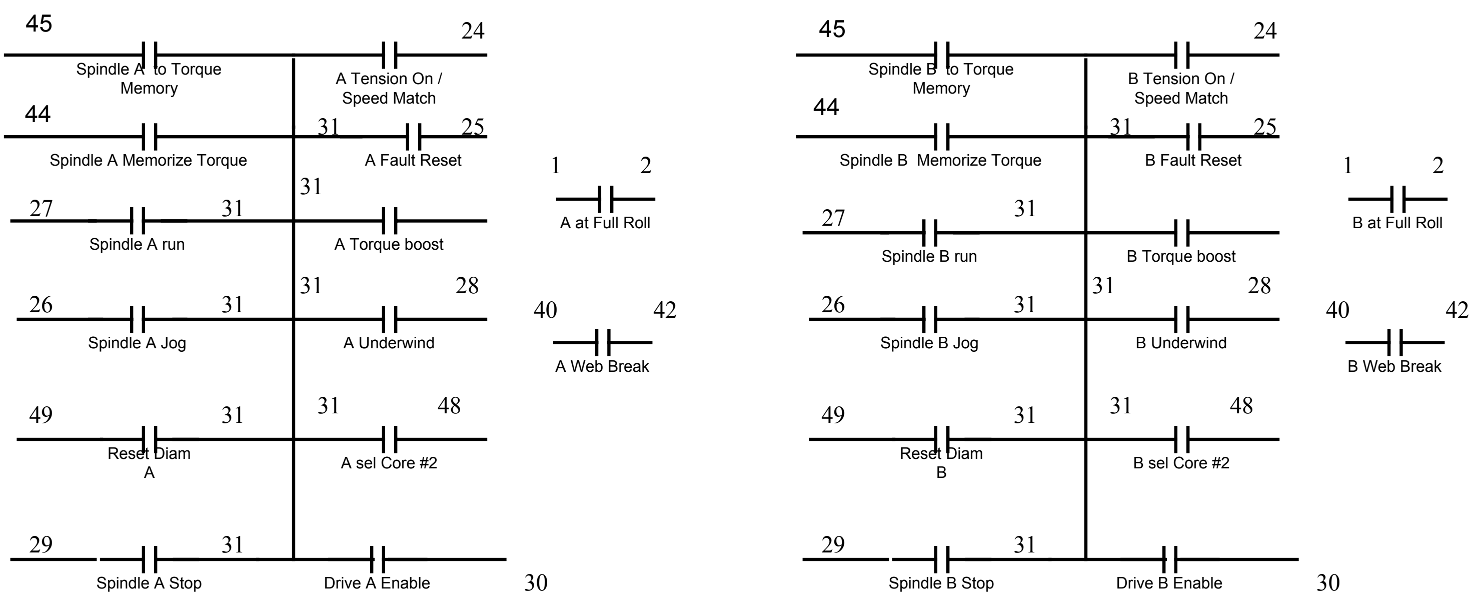
Torque Memory

Terminal 45 of the UD50 signals the winder program to actually switch the drive from speed mode to torque mode. The drive torque level, #4.08, is loaded with the memorized torque and operates at that level. So the off-going spindle becomes an open loop torque winder for the duration of the cut and transfer process.

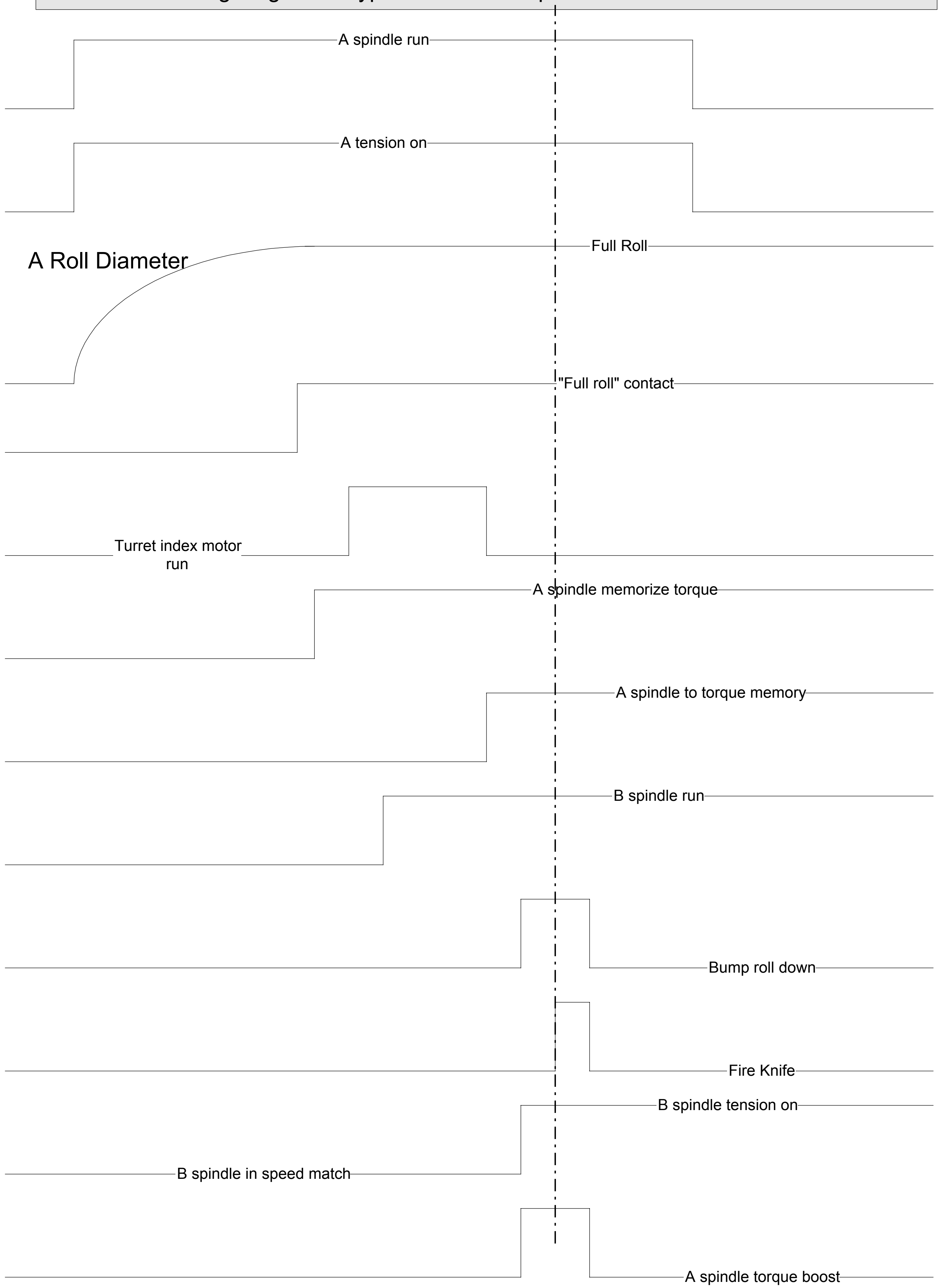
Dual Turret Example using Unidrives



Control logic functions required for each spindle:

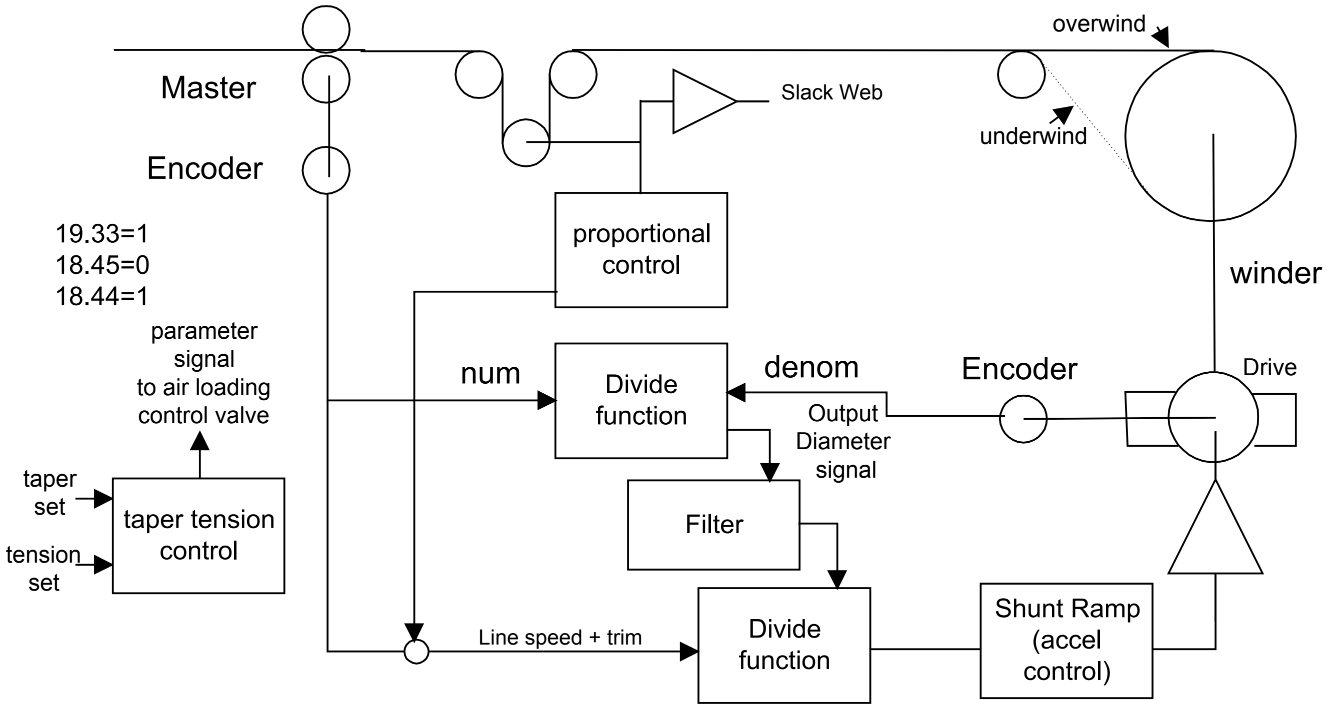


Timing diagram of typical transfer sequence to new roll with cut.

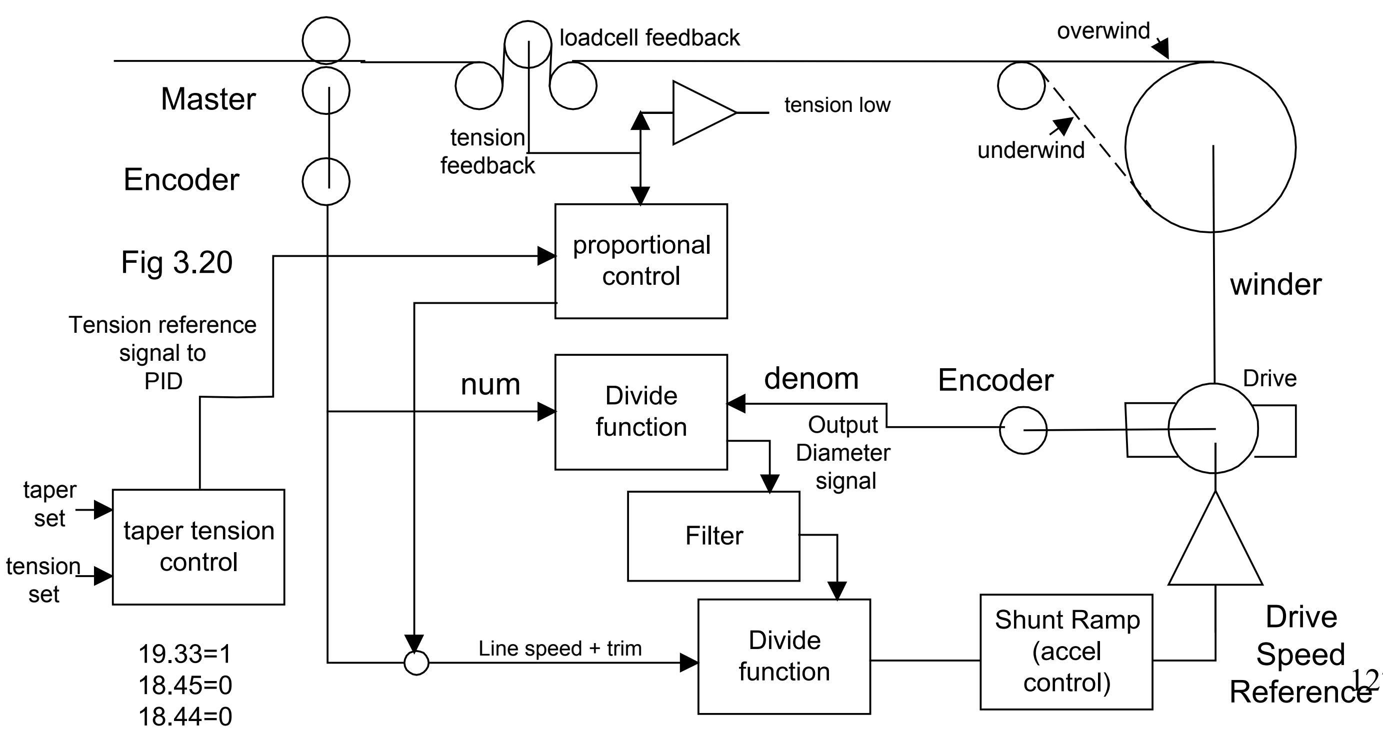


APPENDIX E: COMMON CONFIGURATIONS

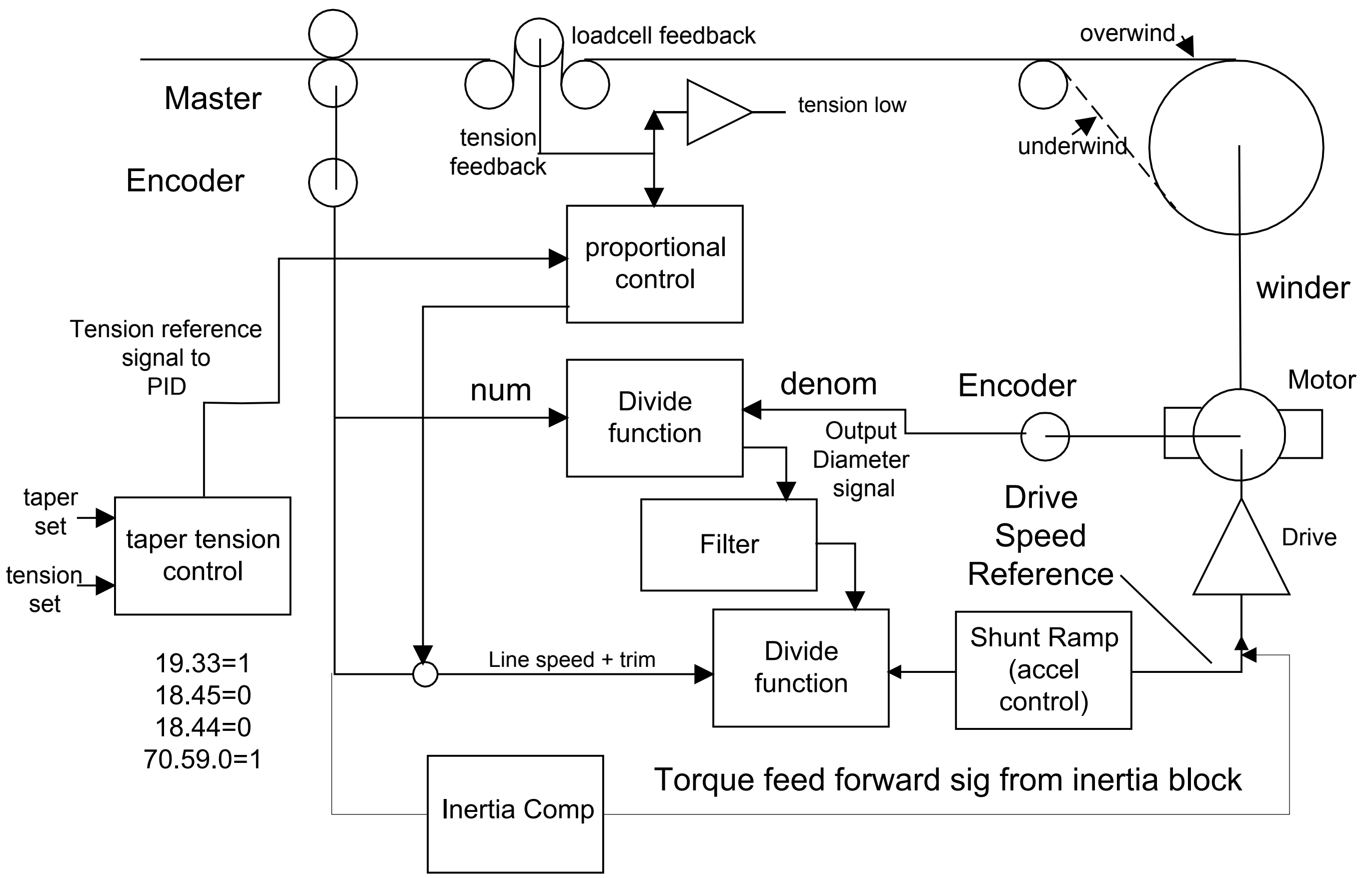
1. Complete single spindle dancer winder in speed mode



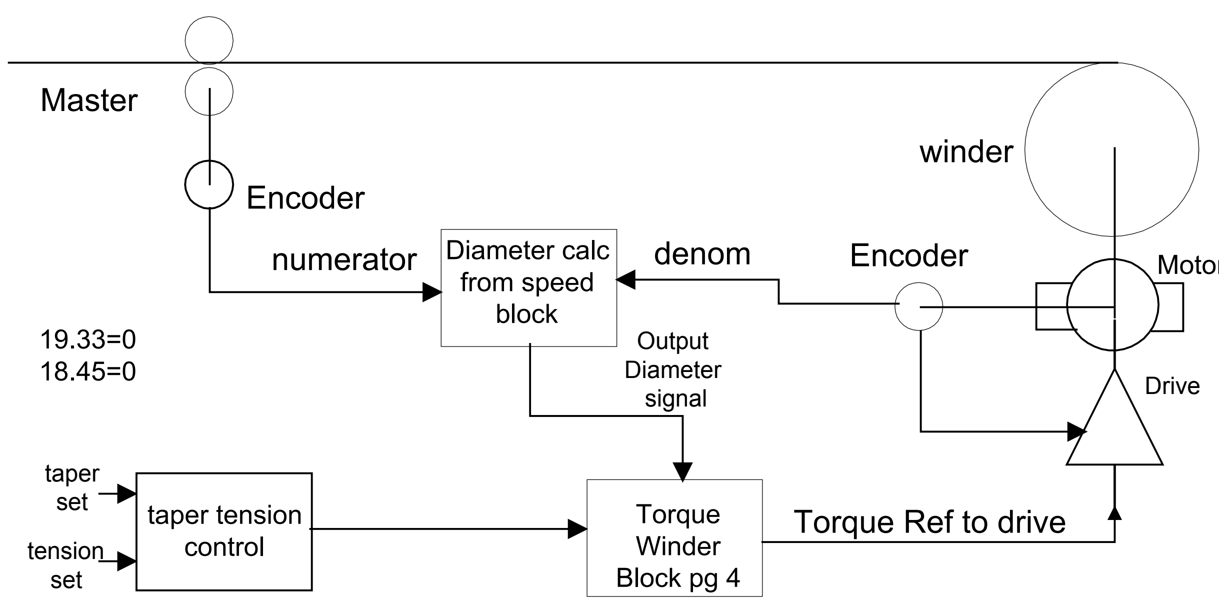
2. Complete single spindle loadcell winder in speed mode



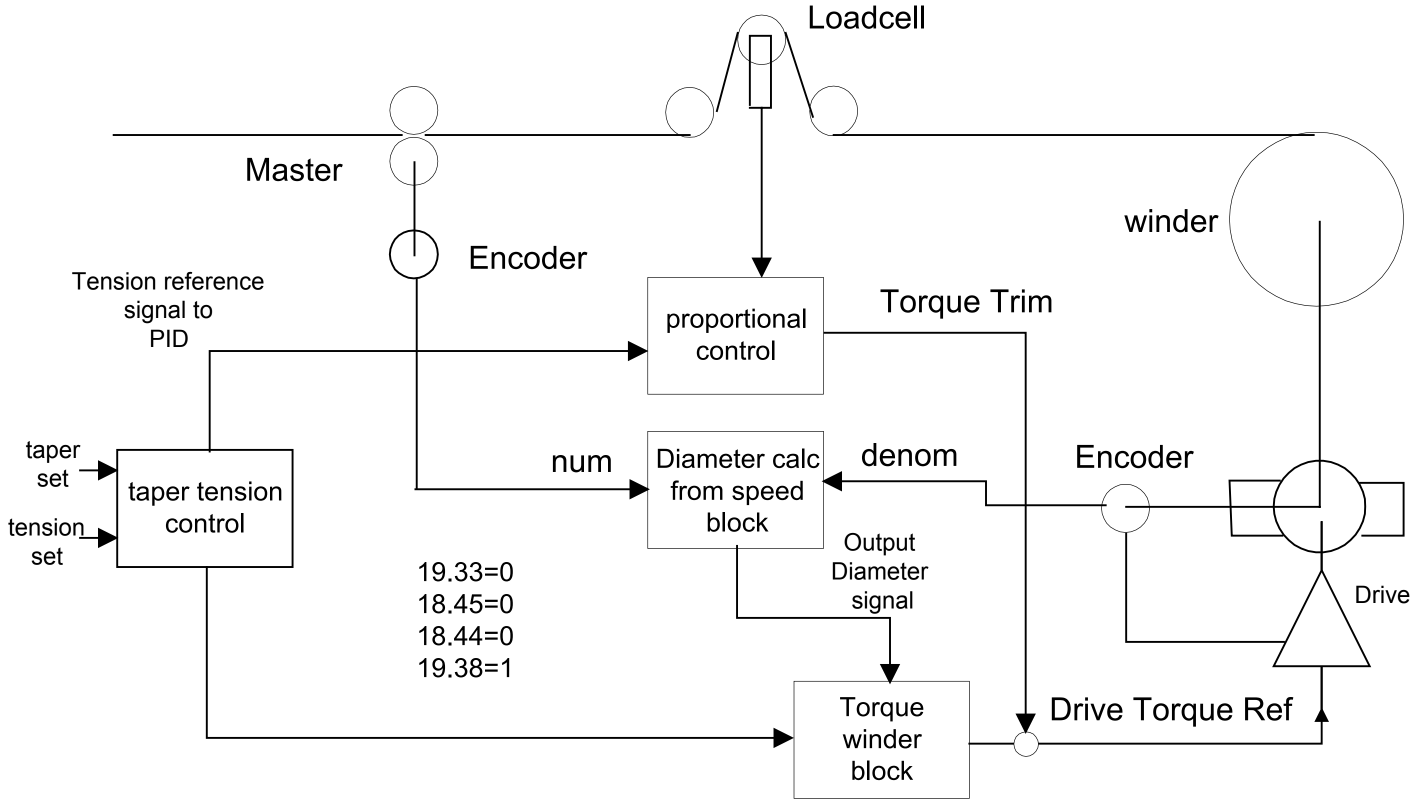
3. Loadcell winder in speed mode with inertia comp feed forward



4. Basic Torque Controlled Winder (CTCW)



5. Torque Controlled winder with PID trim



APPENDIX F: GLOSSARY

Closed Loop Control

Control System which sends information to the motor and receives feedback from sensing equipment.

Core

The empty spool.

CT Browser

CT Browser Software from Control Techniques, for drive setup and configuration, offers a choice of CTNet or RS-485 networks. It has the ability to view and modify any parameter, save and restor to files, compare parameters on different drives, gang save/restore of all drives. It has a real-time oscilloscope function, a transient recorder that will write to disk, and a transient playback system that works like a VCR.

CTCW

Constant Tension Center Winding program. Tension control in torque mode.

CTIU

The CTIU Interface panel from Control Techniques uses a back-lit LCD display and navigation keys to display a variety of menus, submenus, alarms, fault conditions, and other critical information. The CTIU supports a range of capabilities, including multiple font sizes, real-time trends and graphs, scheduling and background programs. It communicates via 2 or 4 wire RS-232/485.

CTKP

The CTKP Keypad Interface from Control Techniques has five navigation keys for viewing and modifying drive data. The keypad is designed for hand-held or panel mounting.

Dancer

A sensing arm for tension of material. The material is wound around the dancer and moves between the rolls and around the main dancer which rotates as the material passes by.

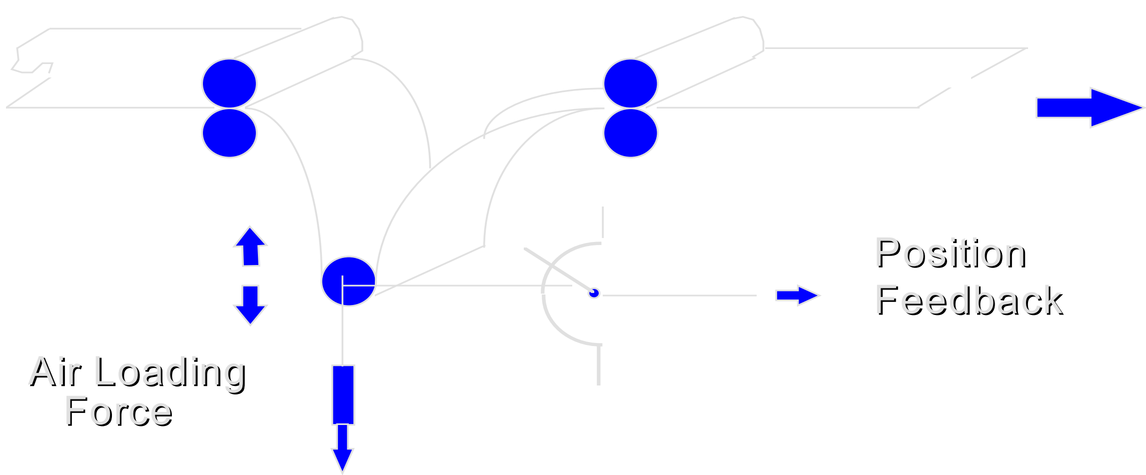


Figure E-1. Typical Dancer Arrangement

Full Roll

The diameter of the spool and wound material.

Index

The act of moving the core to a new position, as in a multi-turret winder.

Loadcell

A device to sense material tension. The loadcell roll deflects very slightly in its mounting blocks as the material passes by and pulls back or forward as the tension of the material changes.

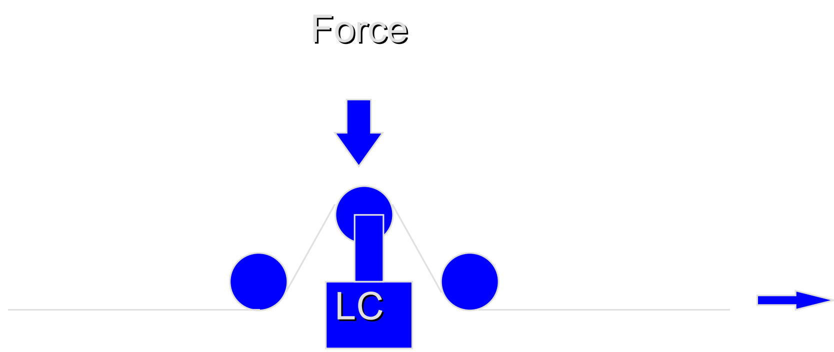


Figure E-2. Loadcell

Nip

Two rollers positioned vertically to control movement of a strip of material.

Open Loop Control

Control system which sends information to the motor, with no feedback. In the Dual Mode Winder program, the parameter to be calculated (tension) is pre-calculated so that no tension feedback device is necessary.

PLC

Programmable Logic Controller

PID Trim

PID controller that only affects the controlled variable slightly.

Servo Control

Control system which sends information to a high response servo motor and receives feedback from sensing equipment.

Speed Mode

A control system where velocity is the controlled element

SYPT

Control Techniques product that allows block system programming, as well as DPL and multi-drive programming. Conforms to IEC 1131.

Taper

A process for reducing material tension as the roll increases in size.

Torque Mode

A control system where tension is the controlled element.

Turret

A mechanical device for holding a several rolls of material, especially where continuous winding is desired.

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WARRANTY

Control Techniques Drives warrants to the buyer who purchased for use and not for resale that the equipment described in this manual is sold in accordance with CT's published warranty statement (document #GEN-030) and CT's published terms and conditions (document #GEN-031). Copies of these documents may be obtained from any Drive Center or Sales Office listed below.

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2617 Interstate Street
Charlotte, NC 28208
Ph: 704-393-3366
Fax: 704-393-0900

CLEVELAND
6892 West Snowville Road
Brecksville, OH 44141
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Fax: 440-717-0133

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Lincoln, RI 02865
Ph: 401-333-3331
Fax: 401-333-6330

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Ph: 630-893-5249
Fax: 630-893-4156

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Fax: 905-475-4694

MINNEAPOLIS
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Eden Prairie, MN 55344
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