Danaher MOTION
Engineered Systems Center

OWNER'S INSTALLATION AND OPERATING MANUAL

ZPD

Zero Position Dancer

Stand-Alone Option Board
Or use with Q7000 DC Drive

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

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

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PID Control

Introduction:

PID Control has often been considered mysterious. Tuning PID controllers for proper system operation can be difficult and frustrating to those new to PID control. There are a considerable number of application variables to be concerned with. For example: the speed of the material being controlled, the tension or pressure needed or how much elasticity the material has, etc. The following offers a simplified explanation of PID control, adjustment considerations, and application examples.

P.I.D. (Proportional, Integral, Differential) provides three types of control in one. The input to any PID control is usually from a single source such as a dancer potentiometer, load cell, hall effect, proximity, flow or pressure transducer. The signal from the sensor is fed into the PID controller. The input from the sensor is compared with a setpoint that is normally adjusted to the value to be maintained during the process. If the input goes above or below the setpoint value there is error generated (i.e. the dancer arm goes above or below the set position). The error is then acted upon by the three separately tunable parameters which are Pgain, Igain, and Dgain which work to eliminate the error and return the transducer to its setpoint level. The PID parameters actually increase or decrease the input signal based on time and then are added together to form one composite output signal. The output signal then will partially or completely control the speed of the motor (i.e. line speed with trim, full dancer control). To view the simplified PID flow diagram refer to Fig. 1 below.

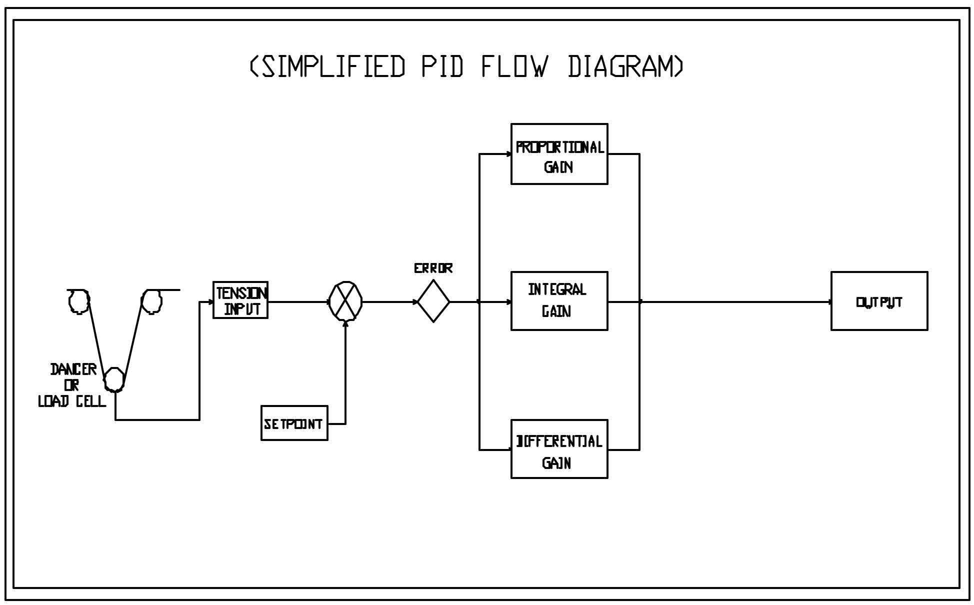


Fig. 1

The control strategy of PID is to compensate for any error by providing 3 adjustments which provide different reaction times to the error.

The first adjustment is **Proportional (P gain)** ***which provides a medium time response.*** The proportional gain adjustment allows the input to be multiplied or divided. Proportional gain is normally used to compensate for speed changes during acceleration and deceleration. It is also largely responsible for starting and stopping performance.

The Proportional gain, if set too low, will result in large swings in input signal (i.e. large dancer arm swing) before the motor will change speed (or respond). If the Proportional gain is set too high then just a small amount of input signal change (i.e. small dancer arm swing) will cause a large change in motor speed.

The best way to adjust the Proportional gain is to first place the Dgain and Igain at zero. Then change the input signal to its maximum (i.e. raise or lower the dancer arm to full up or down) and adjust the Pgain until the motor runs the desired speed. Make sure the motor does not exceed the maximum RPM speed rating found on the motor nameplate. *This adjustment procedure assumes that the drive running the motor has already been set up to run the motor properly.*

The second adjustment is **Differential (D gain)** ***which provides a fast time response.*** The differential gain adjustment allows the input to be amplified or attenuated for surge conditions. Differential gain is normally used to compensate for quick disturbances (i.e. momentary jams or snags) in the material or pressure being controlled. The Differential gain can also aid in the starting and stopping of materials on unwind or windup rolls. The Differential gain is useful when controlling high inertia loads (i.e. heavy rolls or big flywheels). The differential acts like an anticipation response which will pulse the motor with short energy bursts to get it going faster or slower as needed.

The Differential gain, if set too low, will result in less than optimum starting and stopping performance. It can also create increased oscillations if a jam or other quick disturbances are present when running production. Differential gain is needed in every application but the gain level is application specific.

If the Differential gain is set too high it will result erratic system response (i.e. the dancer quivers or the dancer, once it begins to move, it eventually oscillates out of control). The output signal, when viewed in the parameters of the drive, appears to be very unstable and fluctuates rapidly up and down.

The best way to adjust Differential gain is to set the Pgain as described previously and leave the I gain set to zero. Then increase the Dgain setting and create a disturbance such as starting and stopping the material. Continue to adjust the gain up or down until minimum overshoot is experienced. *Note: It is best to make an adjustment to the D gain slowly. If the system becomes unstable, stop the machine. Making no further adjustment, restart the machine. Do this at least once because the adjusting the Dgain too rapidly may create a disturbance that would never happen under normal operating conditions. When the machine is stopped it cancels the disturbance created by the adjustment. The adjustment made may be fine other than the fact that it was made too quickly.*

The third adjustment is **Integral (I gain)** ***which provides a slow time response.*** The Integral gain adjustment allows the input to be offset by adding or subtracting to the input slowly over time which compensates for small signal deviations. The Integral gain adjustment is normally used to compensate for diameter changes or stability of material by averaging. The larger the Integral gain, the less the averaging effect and the greater the offsetting effect.

The Integral gain, if set too low, results in tension or pressure deviations that deviate away from setpoint slightly over long periods of time (i.e. the dancer will slowly begin to rise or lower over time as the roll diameter changes on a windup roll).

The Integral gain, if set too high, results in constant slow oscillations in motor speed commonly referred to as hunting. If Integral gain is set extremely high, oscillations will normally start small and increase in size until there is no control of tension and the material is damaged.

Integral gain is the most difficult of the three responses to set . Integral gain should be set last and while some Integral gain is needed in every application, the setting of the Integral gain is very application specific. The Integral gain setting, for example, on a large heavy flywheel would normally be very low because the flywheel itself has built in Integral gain due to its inertia. If high Integral gains were used on this device, oscillations would occur and speed stability of the flywheel probably would not be realized. Applications with extremely light loads normally need medium to high settings for Integral gain.

The best way to set the Integral gain is to set the P and D gains as described previously. Use a low setting at first then adjust the Integral gain up very slowly until the material shows oscillations that are slight but slow in nature . Then, stop and restart the machine from standstill. If oscillations are still present then reduce the setting. The rule of thumb is to use as little Integral gain as possible to run the application.

Additional Application Notes:

The PID gains are summed together into a single output signal and interact with each other at the output. The most difficult thing to remember is that PID not only controls the motor’s speed but controls a closed loop system as well. The tension sensor, motor controller, motor, gear box, and material, as well as other mechanical devices all have response characteristics that the PID must compensate for.

The Adjustment of the Proportional, Differential, and Integral gains can be a challenge for anyone depending on the application.

The higher the speed of the material and the lighter the tension or pressure to be maintained, the more difficult PID is to adjust. Speeds in the range of 1-500 ft/min are normally easy to adjust. Speeds above 1000 ft/min are normally harder to adjust. Tensions that are below 0.25 pounds per linear inch are harder to adjust than tensions at 1 pound per linear inch.

ZERO POSITION DANCER LOGIC CARD P/N WA37192-00,01

1. GENERAL DESCRIPTION

The Zero Position Dancer (ZPD) option was designed to provide an interface between a dancer arm potentiometer and a motor speed control. The end result is a tension control system which may be used for many rewinds, unwinds, or other applications.

The operation of the ZPD card provides control of the system by maintaining the dancer's steady-state position about a fixed reference point, thus, with correct dancer design, maintaining tension within a given tolerance range.

2. SPECIFICATIONS

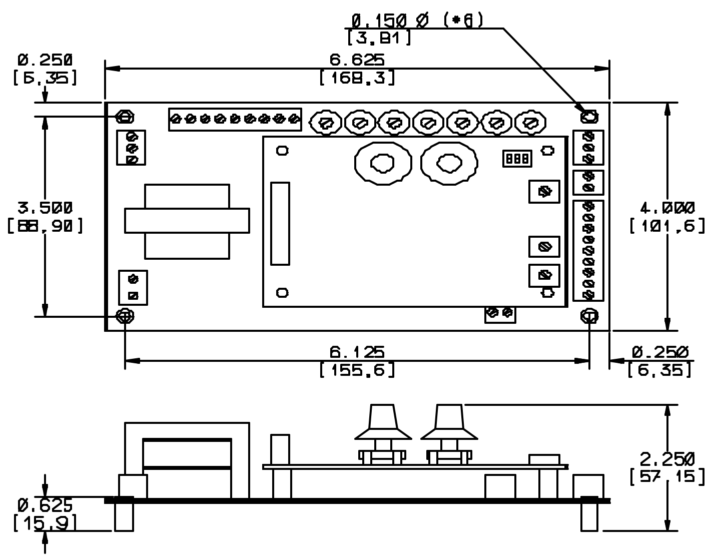
-Power Supply Requirements 115/230 VAC, single phase.

-Dancer Pot (Pivot Point Sensor) 1k OHM min., 20k OHM max., 2 watt.

-Output Voltage 0 - 10 VDC

-Note : Circuit Board Common NOT Isolated

-Mechanical Dimensions



3. INSTALLATION

The Zero Position Dancer Card can be installed as an option on the Q7000 motor speed control or as a stand-alone unit which can be interfaced with any motor speed control. The stand-alone card may be mounted with captive standoffs and four screws (#8-32 x 1-1/4"). Shielded cable is required for connections to the dancer pot and remote dancer position pot is applicable. Connection to 115 V or 230 V AC, single phase, is required.

4. SETUP AND CONFIGURATION

4. SETUP AND CONFIGURATION

BASIC ZPD BOARD SETUPS - There are two basic dancer control setups which may be used with the SECO ZPD option board.

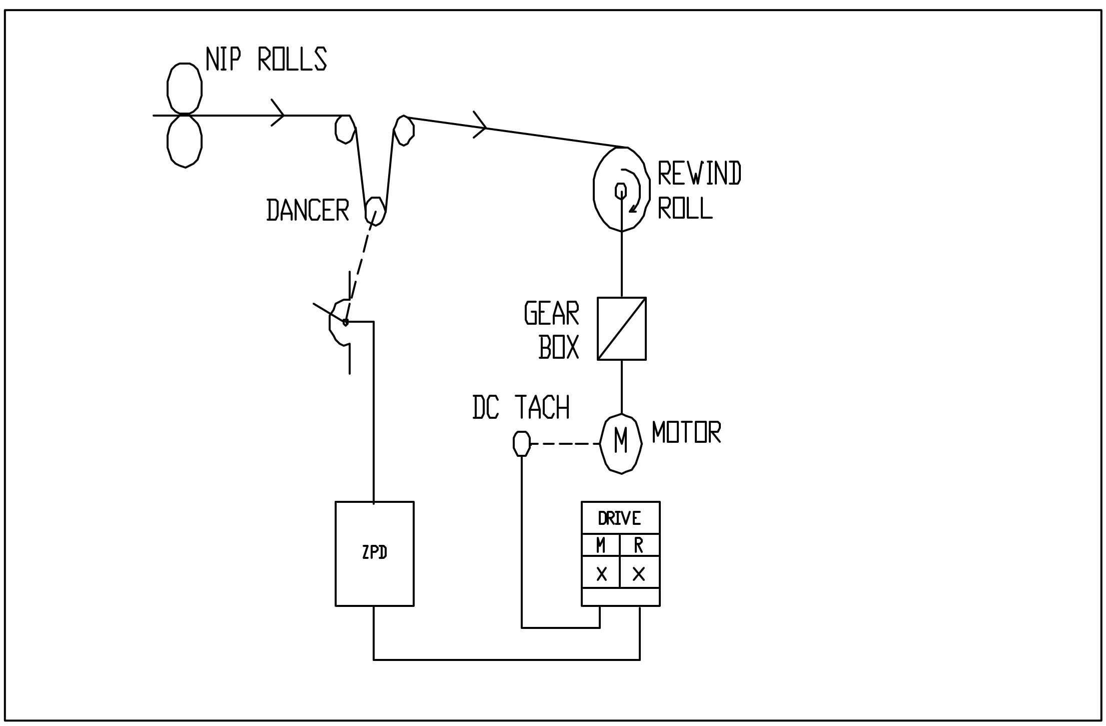
> **Full Dancer (Full Range Control) -** The Dancer pot has FULL control over the output speed of the 2 drive. Most commonly used on Rewinds or Unwinds where the roll diameter changes.

> **Dancer Trim (Zero Position Dancer Control) -** The Dancer pot Adds or Subtracts from a Line Speed signal which the drive is set up to follow. Most commonly used where the diameter of the driven roll is constant.

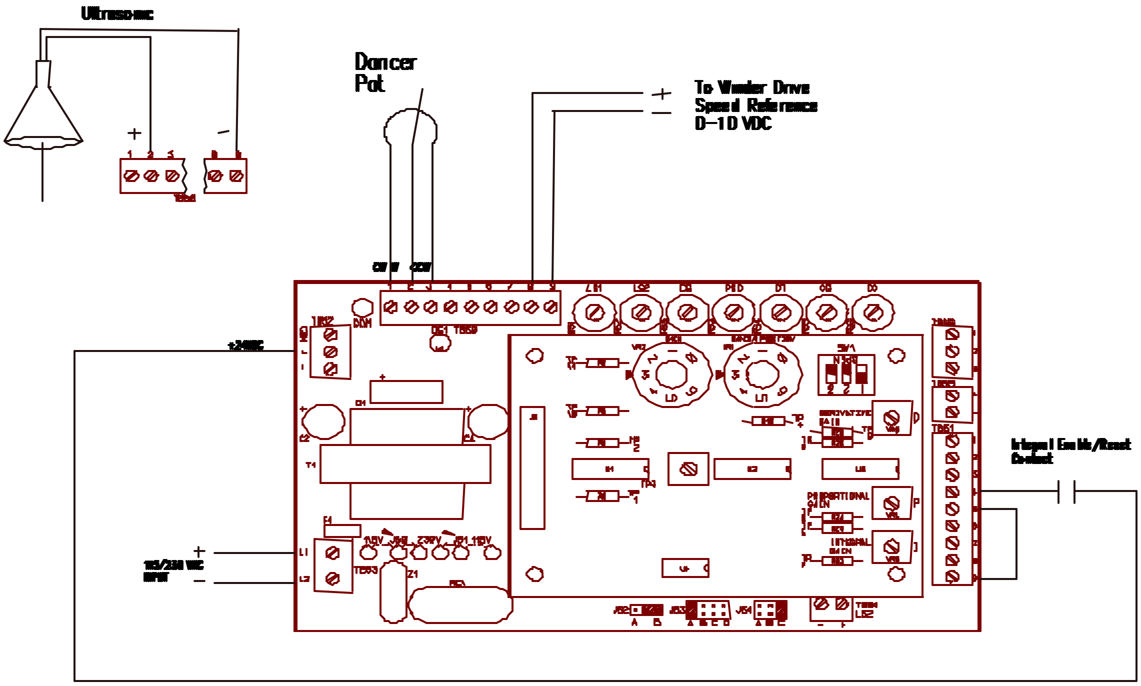
The ZPD board allows several types of line speed input - 0-10 VDC, 4-20 mA, 0-90 VDC or 0-180 VDC. The last two generally come from DC motor armature voltage on other drives.

SETTING UP THE BOARD FOR YOUR APPLICATION

<u>Full Dancer Control On A Rewind</u>



Wiring Diagram



Connection Diagram For A Rewind With Full Dancer Control

Set-Up Procedure

1) Connect a dancer pot from 1 to 5 K? to TB50 terminals 1, 2, and 3. Terminal Block TB50 is shown in the diagram above where pins 1, 2, and 3 represent the dancer pot's clockwise, wiper, and counterclockwise connection respectively. Note that connections are shown for an ultrasonic (photo) sensor when a dancer pot isn't used.

2) With no AC power applied to the ZPD board, set the jumpers on the bottom board (green) to the following positions: J52 = B, J53 = A, J54 = C. Set the two adjustable dials (VR1, Dancer Position and VR2, System Gain) on the top (red) board so that both read a value of 3 at the 9 o'clock position.

3) Apply AC power. (**Note : Do NOT enable the integrator via the relay (K2) on TB51.** The integrator will be enabled later in the set-up procedure.

4) Without coupling the dancer pot to the dancer arm, adjust the shaft of the dancer pot until your voltmeter (with the + lead on TB50-2 and the - lead on TB50-9) reads 0.00 VDC.

5) On a rewind with Full Dancer Control, the zero setpoint is typically set where the dancer arm is in the Full-Up position. (In this case, the winder would be taking up more material than the infeed is supplying. The Full-Up position would be the worse-case scenario where the winder motor would stop altogether.) With the voltmeter still reading 0.00 VDC and the dancer in the Full-Up position, couple the dancer pot to the dancer arm.

6) Have someone to continue to hold the dancer arm in the Full-Up position.

7) At this point the desired result is with 0.00 VDC input from the dancer pot to provide 0.00 VDC output from the ZPD card. With the voltmeter + lead on TB50-8 and the - lead on TB50-9, eliminate any offset remaining by adjusting the “PS0” (Offset) pot until the voltmeter reads 0.00 VDC. Note that typical readings are 0.100 to 0.200 VDC before adjusting the “PS0” pot.

8) Make a final check with the dancer in the Full-Up position. Place the + lead of the voltmeter on TB50-2 and the - lead on TB50-9. The voltmeter should read 0.00 VDC. Remove the + lead of the voltmeter and place it on TB50-8 (leave the - lead on TB50-9). The voltmeter should read 0.00 VDC. We have now verified that with 0.00 VDC input from the dancer pot, the ZPD board output is 0.00 (the desired result).

9) Now have someone to place the dancer arm in the Full-Down position. (In this case, the infeed is supplying more material than the winder is taking up. This is worst-case scenario where the motor should run at the required full speed, typically motor nameplate.)

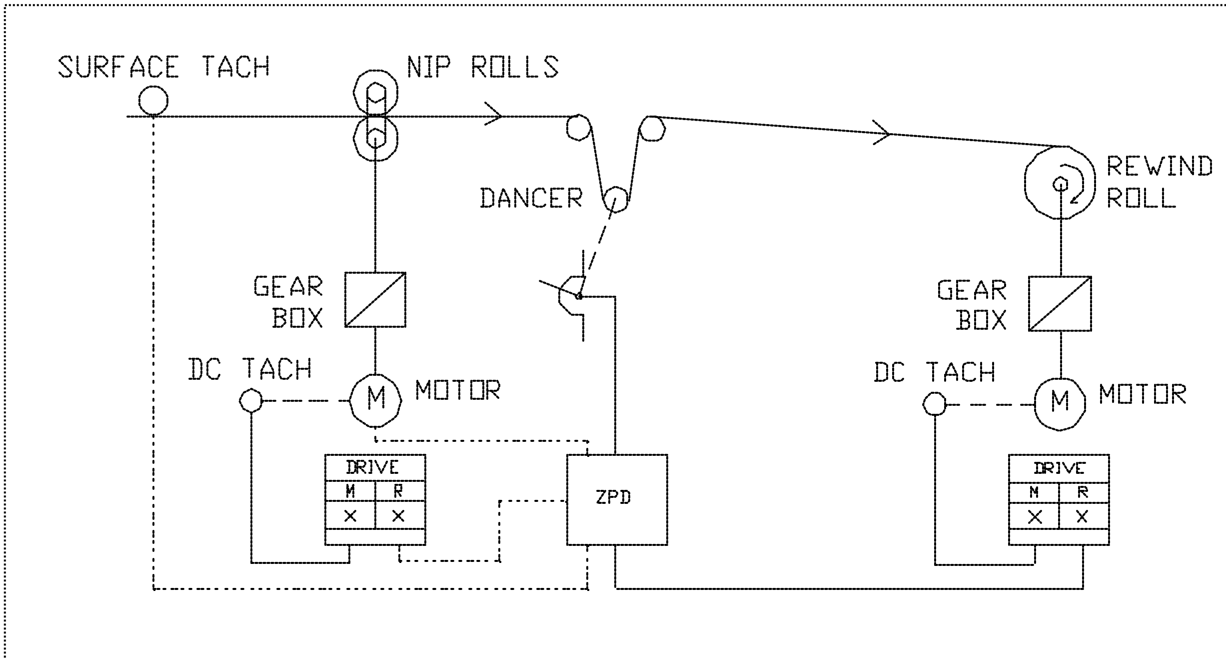
10) Place the + lead of the voltmeter on TB50-2 and the - lead on TB50-9. Make sure the “DT” (Dancer Trim) pot is set to its full clockwise position. Adjust the “DS” (Dancer Sensitivity) pot until the meter reads approximately 3.00 VDC.

11) Move the + lead of the voltmeter to TB50-8 and leave the - lead on TB50-9. Adjust the P Gain pot until the voltmeter reads 10 VDC (full speed reference on most drives). Note most drives have a maximum speed adjustment or parameter. If you need to reduce the maximum motor speed, you can always adjust this later.

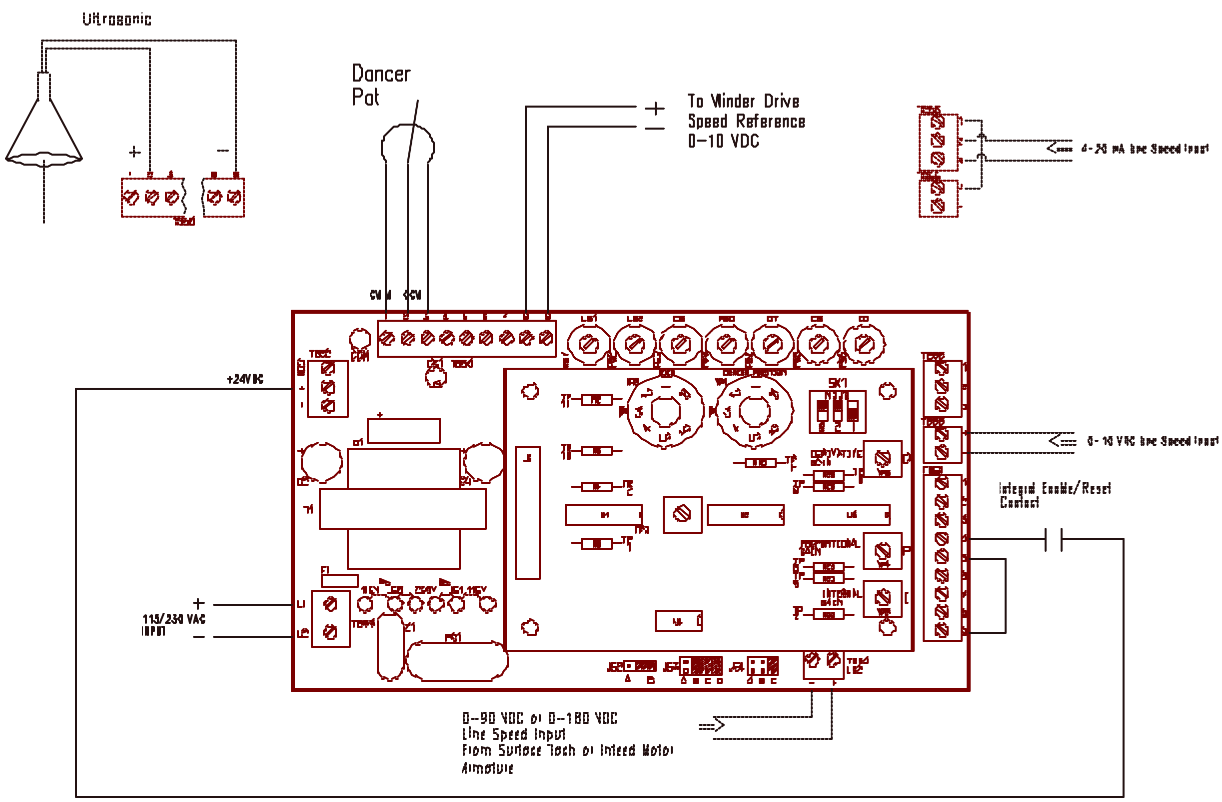
12) Have someone to raise the dancer arm to the Full-Up position. The voltmeter should read 0.00 VDC. Now lower the dancer arm to the Full-Down position. The voltmeter should read 10.00 VDC. We have verified that with full dancer travel, the output of the ZPD board provides 0-10 VDC or 0 to max speed.

13) Thread the machine and run slowly. First adjust the D gain and later the I gain. Note the I gain will have to be enabled via the relay on TB51. Usually it is desirable to enable and disable the Integral relay when the winder drive is given a run or stop command. This will prevent the integrator from integrating while the winder is stopped.

Line Speed With Dancer Trim On A Rewind



Wiring Diagram



Connection Diagram For Line Speed With Dancer Trim

Set-Up Procedure

1) Connect a dancer pot from 1 to 5 K? to TB50 terminals 1, 2, and 3. Terminal Block TB50 is shown in the diagram above where pins 1, 2, and 3 represent the dancer pot's clockwise, wiper, and counterclockwise connection respectively. Note also that connections are shown where an ultrasonic (photo) sensor is used instead of a dancer pot.

2) Make the line speed signal connections appropriate to your application :

If the line speed signal is :

0-10 VDC, connect the + and - wires of the line speed signal to terminals TB55-1 (+), and TB55-2 (-). TB55 is labeled LS1 (line speed 1). Move Jumper J53 to "B".

4-20 mA, connect the + and - terminals TB56-3 (+) and TB56-2 (-). Place a jumper between terminal TB56-1 and TB55-1. Move jumper J53 to "B". Note for a current input the ZPD board converts the 4-20 mA signal to 0-10 VDC. The output of the current to voltage converter is sent to the LS1 (line speed 1) input. See the calibration procedure for a 4-20 mA line speed signal in the Additional Options and Features section of the manual.

0-90 VDC or 0-180 VDC, connect to terminals TB54-2 (+), and TB54-1 (-). Set jumper J53 to "C" if a 0-90 VDC line speed signal is used or set J53 to "D" if a 0-180 VDC is used. TB54 is labeled LS2. Typically in this case, the line speed signal is provided by either a surface tachometer or by the armature of the infeed motor.

3) With no AC power applied to the ZPD board, set the jumpers on the bottom board (green) to the following positions : J52 = B, J53 = B, C, or D (input dependent), J54 = C. Set the two adjustable dials (VR1, Dancer Position and VR2, System Gain) on the top board (red) so that the dial value reads 3 at the 9 o'clock position.

4) Apply AC power. (**Note : Do NOT enable the integrator via the relay (K2) on TB51.)** The integrator will be enabled later in the set-up procedure.

5) Without coupling the dancer pot to the dancer arm, adjust the shaft of the dancer pot until your voltmeter (with the + lead on TB50-2 and the - lead on TB50-9) reads 0.00 VDC.

6) On a Rewind With Line Speed Trim, the zero setpoint is typically set where the dancer arm is in the mid-stroke position (parallel to the floor). In this position there is no trim. With the voltmeter still reading 0.00 VDC and the dancer arm in the mid-stroke position, couple the dancer pot to the dancer arm.

7) Have someone to continue to hold the dancer arm in the mid-stroke position. At mid-stroke, the desired result is 0.00 VDC input from the dancer pot and 0.00 VDC output from the ZPD board. With the voltmeter + lead on TB50-8 and the - lead on TB50-9, eliminate any offset remaining by adjusting the "PSO" (Offset) pot until the voltmeter reads 0.00 VDC. Note that typical readings are 0.100 to 0.200 VDC before adjusting the "PSO" (Offset) pot.

8) Make a final check with the dancer at the mid-stroke position. Place the + lead of the voltmeter on TB50-2 and the - lead on TB50-9. The voltmeter should read 0.00 VDC. Remove the + lead and place it on TB50-8 with the - lead still on TB50-9. The voltmeter should read 0.00 VDC. We have now verified that with the dancer at mid-stroke, we have 0.00 VDC input from the dancer pot and 0.00 VDC output from the ZPD board.

9) Now have someone place the dancer in the Full-Down position. (In this case, the infeed would be delivering more material than the winder is taking up. This is worst-case scenario where the motor should run at full required speed, typically nameplate.)

10) At this point, place the + lead of the voltmeter on TB50-2 and the - lead on TB50-9. Adjust the “DS” (Dancer Sensitivity) pot until the voltmeter reads 3.00 VDC. Note that if the voltmeter reads negative voltage at Full Down, the dancer pot is probably wired backwards.

11) Place the + lead of the voltmeter on TB50-8 and the - on TB50-9. Make sure the “DT” (Dancer Trim) pot is set to its full clockwise position. Adjust the P Gain pot until the voltmeter reads 10 VDC. Next, adjust the “DT” pot for the amount of trim desired (i.e. for a 10% trim, the voltmeter should read 1.00 VDC, for a 20% trim, the voltmeter should read 2.00 VDC.

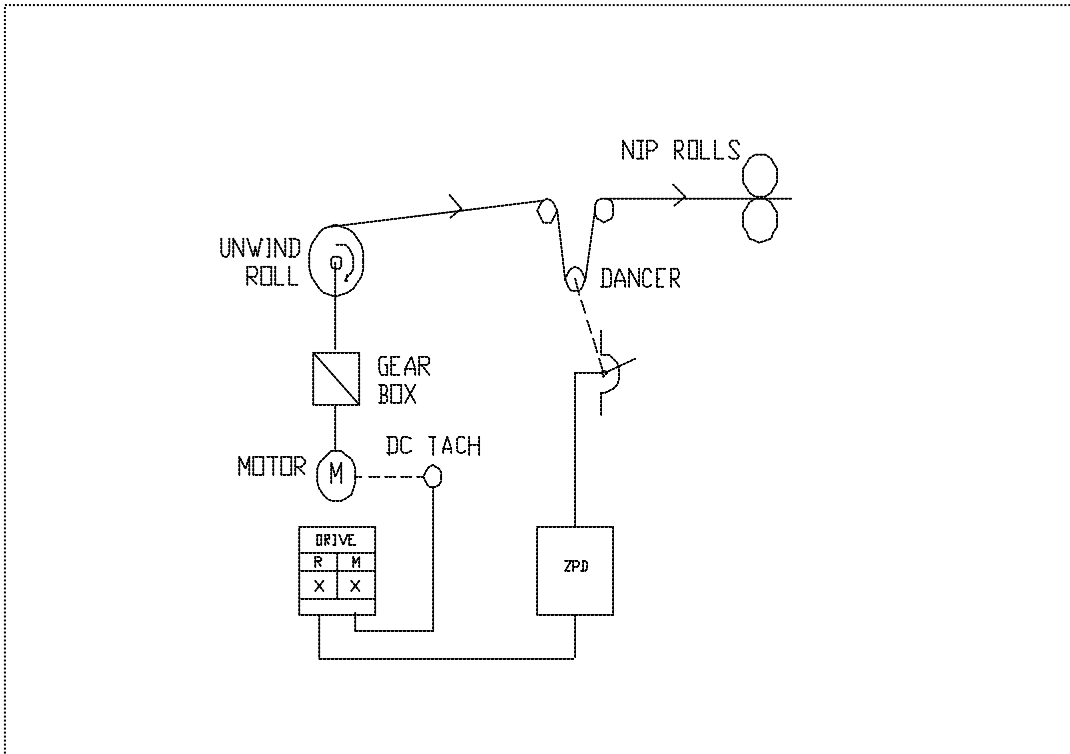
12) Input maximum line speed signal to the ZPD board (typically 90 VDC, 180 VDC, 10 VDC, or 4-20 mA depending on the type of line speed signal used).

13) Adjust the LS1 or LS2 pot depending on the input used until the voltmeter reads 10 VDC (the + lead of the voltmeter on TB50-8 and the - on TB50-9).

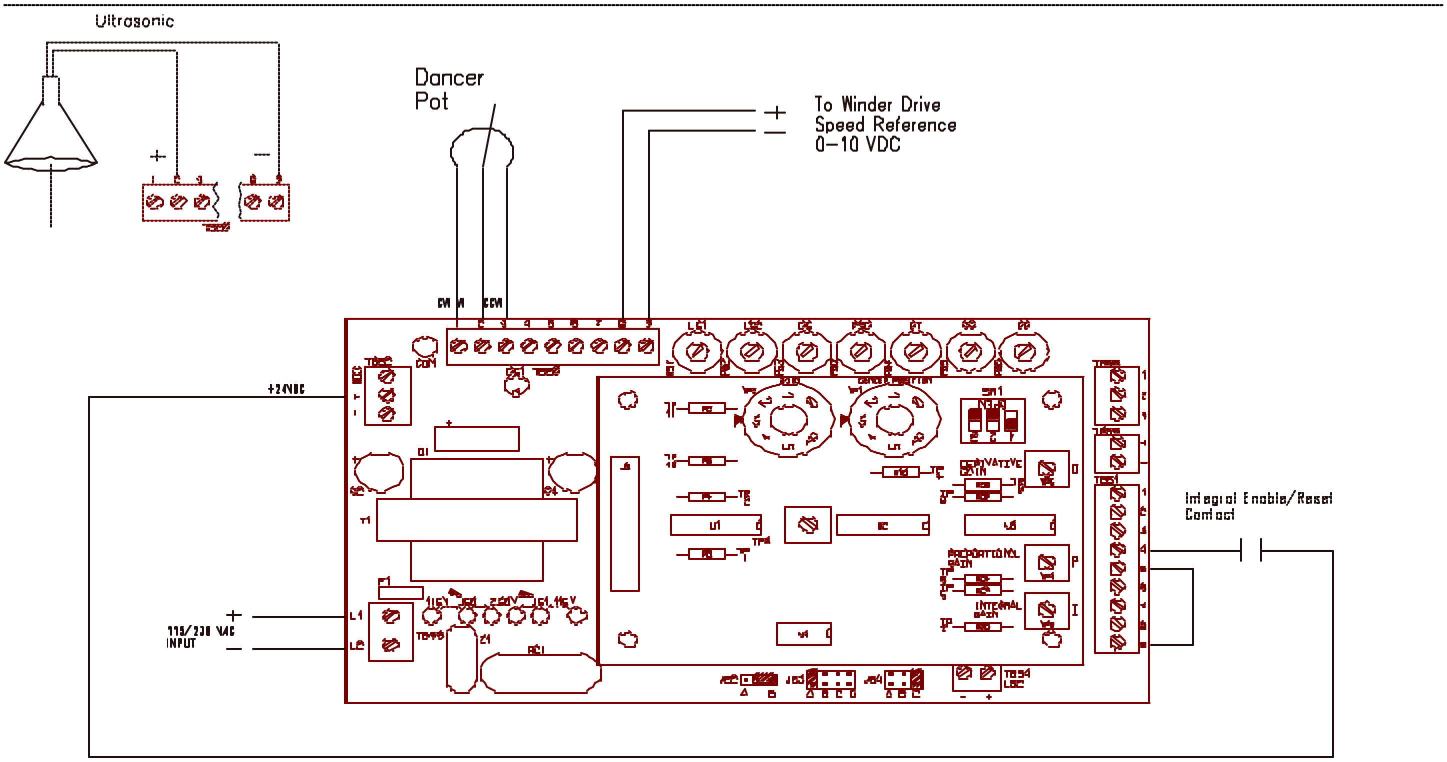
14) Have someone raise the dancer arm to the midstroke position. At this point there is no trim and the winder motor runs at the set speed (i.e. running at 90 % or 9VDC out in our example). Raising the dancer arm to the Full-Up position should yield X% less than set speed (i.e. running at 80% or 8 VDC output in our example). Lowering the dancer arm to the Full-Down position should yield X% more than set speed (i.e. running at 100% or 10 VDC output). Note the concept here is that the line speed input to the card has to be reduced by the percentage we want to trim. Suppose for a moment we set the ZPD board up so that with 10 VDC line speed in, the ZPD board outputs 10 VDC. Since 10 VDC is maximum out, the dancer could only trim down and from midstroke to the Full-Down position (+% trim) would have no effect on motor speed.

15) Thread the machine and run slowly. First adjust the D gain and later the I gain. Note the I gain will have to be enabled via the relay on TB51 (-4 and -5). Usually it is desirable to disable the Integral relay when the winder drive is given a run or stop command. This will prevent the integrator from integrating while the winder is stopped.

Full Dancer Control On An Unwind



Wiring Diagram



Connection Diagram For Full Dancer Control

Set-Up Procedure

1) Connect a dancer pot from 1 to 5 K? to TB50 terminals 1, 2, and 3. Terminal Block TB50 is shown in the diagram above where pins 1, 2, and 3 represent the dancer pot's clockwise, wiper, and counterclockwise connection respectively. Note that connections are shown for an ultrasonic (photo) sensor when a dancer pot isn't used.

2) With no AC power applied to the ZPD board, set the jumpers on the bottom board (green) to the following positions: J52 = B, J53 = A, J54 = C. Set the two adjustable dials (VR1, Dancer Position and VR2, System Gain) on the top (red) board so that both read a value of 3 at the 9 o'clock position.

3) Apply AC power. (**<u>Note : Do NOT enable the integrator via the relay (K2) on TB51.</u>** The integrator will be enabled later in the set-up procedure.

4) Without coupling the dancer pot to the dancer arm, adjust the shaft of the dancer pot until your voltmeter (with the + lead on TB50-2 and the - lead on TB50-9) reads 0.00 VDC.

5) On a Unwind with Full Dancer Control, the zero setpoint is typically set where the dancer arm is in the Full-Down position. (In this case, the winder would be delivering more material than the nip rolls are taking up. The Full-Down position would be the worse-case scenario where the winder motor would stop altogether.) With the voltmeter still reading 0.00 VDC and the dancer in the Full-Down position, couple the dancer pot to the dancer arm.

6) Have someone to continue to hold the dancer arm in the Full-Down position.

7) At this point the desired result is with 0.00 VDC input from the dancer pot to provide 0.00 VDC output from the ZPD card. With the voltmeter + lead on TB50-8 and the - lead on TB50-9, eliminate any offset remaining by adjusting the "PS0" (Offset) pot until the voltmeter reads 0.00 VDC. Note that typical readings are 0.100 to 0.200 VDC before adjusting the "PS0" pot.

8) Make a final check with the dancer in the Full-Down position. Place the + lead of the voltmeter on TB50-2 and the - lead on TB50-9. The voltmeter should read 0.00 VDC. Remove the + lead of the voltmeter and place it on TB50-8 (leave the - lead on TB50-9). The voltmeter should read 0.00 VDC. We have now verified that with 0.00 VDC input from the dancer pot, the ZPD board output is 0.00 (the desired result).

9) Now have someone to place the dancer arm in the Full-Up position. (In this case, the nip rolls are taking up more material than the winder is delivering. This is worst-case scenario where the motor should run at the required full speed, typically motor nameplate.)

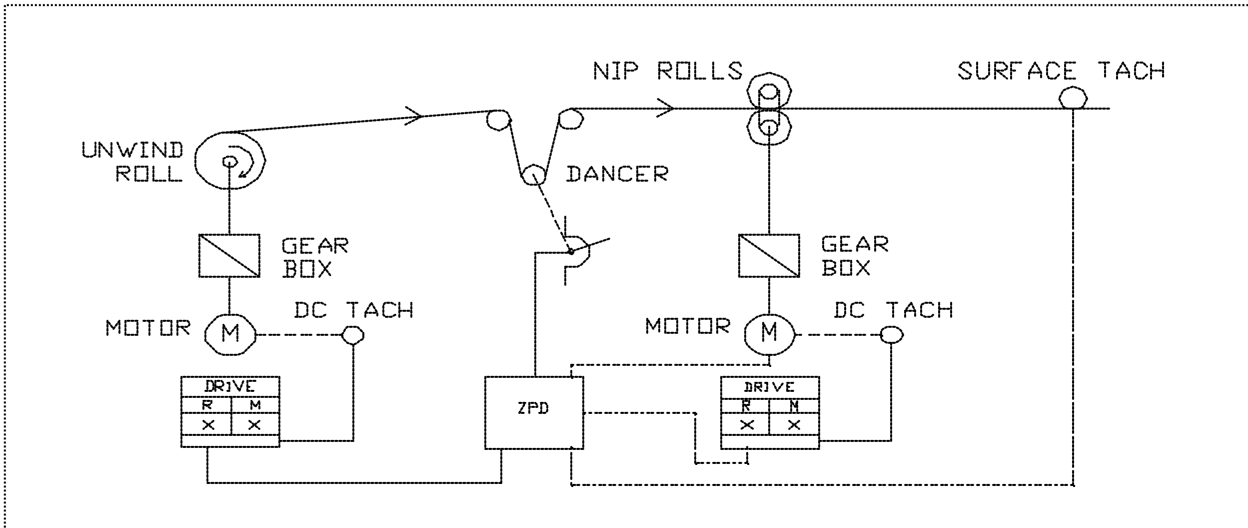
10) Place the + lead of the voltmeter on TB50-2 and the - lead on TB50-9. Make sure the "DT" (Dancer Trim) pot is set to its full clockwise position. Adjust the "DS" (Dancer Sensitivity) pot until the meter reads approximately 3.00 VDC.

11) Move the + lead of the voltmeter to TB50-8 and leave the - lead on TB50-9. Adjust the P Gain pot until the voltmeter reads 10 VDC (full speed reference on most drives). Note most drives have a maximum speed adjustment or parameter. If you need to reduce the maximum motor speed, you can always adjust this later.

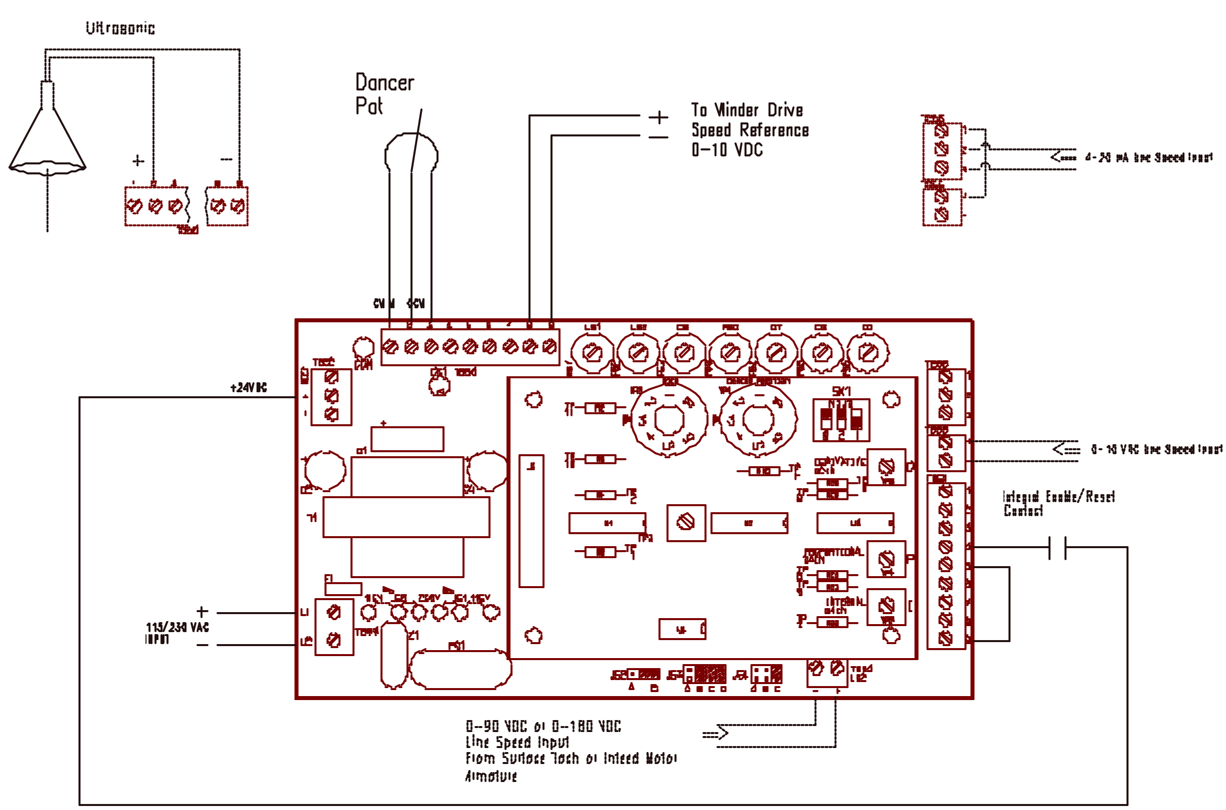
12) Have someone to lower the dancer arm to the Full-Down position. The voltmeter should read 0.00 VDC. Now raise the dancer arm to the Full-Up position. The voltmeter should read 10.00 VDC. We have verified that with full dancer travel, the output of the ZPD board provides 0-10 VDC or 0 to max speed.

13) Thread the machine and run slowly. First adjust the D gain and later the I gain. Note the I gain will have to be enabled via the relay on TB51. Usually it is desirable to enable and disable the Integral relay when the winder drive is given a run or stop command. This will prevent the integrator from integrating while the winder is stopped.

Line Speed With Dancer Trim On An Unwind



Wiring Diagram



Connection Diagram For Line Speed With Dancer Trim

Set-Up Procedure

1) Connect a dancer pot from 1 to 5 K? to TB50 terminals 1, 2, and 3. Terminal Block TB50 is shown in the diagram above where pins 1, 2, and 3 represent the dancer pot's clockwise, wiper, and counterclockwise connection respectively. Note also that connections are shown where an ultrasonic (photo) sensor is used instead of a dancer pot.

2) Make the line speed signal connections appropriate to your application :

If the line speed signal is :

0-10 VDC, connect the + and - wires of the line speed signal to terminals TB55-1 (+), and TB55-2 (-). TB55 is labeled LS1 (line speed 1). Move Jumper J53 to "B".

4-20 mA, connect the + and - terminals TB56-3 (+) and TB56-2 (-). Place a jumper between terminal TB56-1 and TB55-1. Move jumper J53 to "B". Note for a current input the ZPD board converts the 4-20 mA signal to 0-10 VDC. The output of the current to voltage converter is sent to the LS1 (line speed 1) input. See the calibration procedure for a 4-20 mA line speed signal in the Additional Options and Features section of the manual.

0-90 VDC or 0-180 VDC, connect to terminals TB54-2 (+), and TB54-1 (-). Set jumper J53 to "C" if a 0-90 VDC line speed signal is used or set J53 to "D" if a 0-180 VDC line speed signal is used. TB54 is labeled LS2. Typically in this case, the line speed signal is provided by either a surface tachometer or by the armature of the outfeed motor (nips).

3) With no AC power applied to the ZPD board, set the jumpers on the bottom board (green) to the following positions : J52 = B, J53 = B,C, or D (input dependent), J54 = C. Set the two adjustable pots (VR1, Dancer Position and VR2, System Gain) on the top board (red) so that the dial value reads 3 at the 9 o'clock position.

4) Apply AC power. (**Note : Do NOT enable the integrator via the relay (K2) on TB51.)** The integrator will be enabled later in the set-up procedure.

5) Without coupling the dancer pot to the dancer arm, adjust the shaft of the dancer pot until your voltmeter (with the + lead on TB50-2 and the - lead on TB50-9) reads 0.00 VDC.

6) On an Unwind With Line Speed Trim, the zero setpoint is typically set where the dancer arm is in the mid-stroke position (parallel to the floor). In this position there is no trim. With the voltmeter still reading 0.00 VDC and the dancer arm in the mid-stroke position, couple the dancer pot to the dancer arm.

7) Have someone to continue to hold the dancer arm in the mid-stroke position. At mid-stroke, the desired result is 0.00 VDC input from the dancer pot and 0.00 VDC output from the ZPD board. With the voltmeter + lead on TB50-8 and the - lead on TB50-9, eliminate any offset remaining by adjusting the "PSO" (Offset) pot until the voltmeter reads 0.00 VDC. Note that typical readings are 0.100 to 0.200 VDC before adjusting the "PSO" (Offset) pot.

8) Make a final check with the dancer at the mid-stroke position. Place the + lead of the voltmeter on TB50-2 and the - lead on TB50-9. The voltmeter shold read 0.00 VDC. Remove the + lead and place it on TB50-8 with the - lead still on TB50-9. The voltmeter should read 0.00 VDC. We have now verified that with the dancer at mid-stroke, we have 0.00 VDC input from the dancer pot and 0.00 VDC output from the ZPD board.

9) Now have someone place the dancer in the Full-Up position. (In this case, the winder would be delivering more material than the nip rolls are taking up. This is worst-case scenario where the motor should run at full required speed, typically nameplate.)

10) At this point, place the + lead of the voltmeter on TB50-2 and the - lead on TB50-9. Adjust the “DS” (Dancer Sensitivity) pot until the voltmeter reads 3.00 VDC. Note that if the voltmeter reads negative voltage at Full Up, the dancer pot is probably wired backwards.

11) Place the + lead of the voltmeter on TB50-8 and the - on TB50-9. Make sure the “DT” (Dancer Trim) pot is set to its full clockwise position. Adjust the P Gain pot until the voltmeter reads 10 VDC. Next, adjust the “DT” pot for the amount of trim desired (i.e. for a 10% trim, the voltmeter should read 1.00 VDC, for a 20% trim, the voltmeter should read 2.00 VDC.

12) Input maximum line speed signal to the ZPD board (typically 90 VDC, 180 VDC, 10 VDC, or 4-20 mA depending on the type of line speed signal used).

13) Adjust the LS1 or LS2 pot depending on the input used until the voltmeter reads 10 VDC (the + lead of the voltmeter on TB50-8 and the - on TB50-9).

14) Have someone lower the dancer arm to the midstroke position. At this point there is no trim and the winder motor runs at the set speed (i.e. running at 90 % or 9VDC out in our example). Lowering the dancer arm to the Full-Down position should yield X% less than set speed (i.e. running at 80% or 8 VDC output in our example). Raising the dancer arm to the Full-Up position should yield X% more than set speed (i.e. running at 100% or 10 VDC output). Note the concept here is that the line speed input to the card has to be reduced by the percentage we want to trim. Suppose for a moment we set the ZPD board up so that with 10 VDC line speed in, the ZPD board outputs 10 VDC. Since 10 VDC is maximum out, the dancer could only trim down and from midstroke to the Full-Up position (+% trim) would have no effect on motor speed.

15) Thread the machine and run slowly. First adjust the D gain and later the I gain. Note the I gain will have to be enabled via the relay on TB51 (-4 and -5). Usually it is desirable to disable the Integral relay when the winder drive is given a run or stop command. This will prevent the integrator from integrating while the winder is stopped.

Additional Options and Features

AUTO/MANUAL Input : JOG or THREAD-UP Speeds

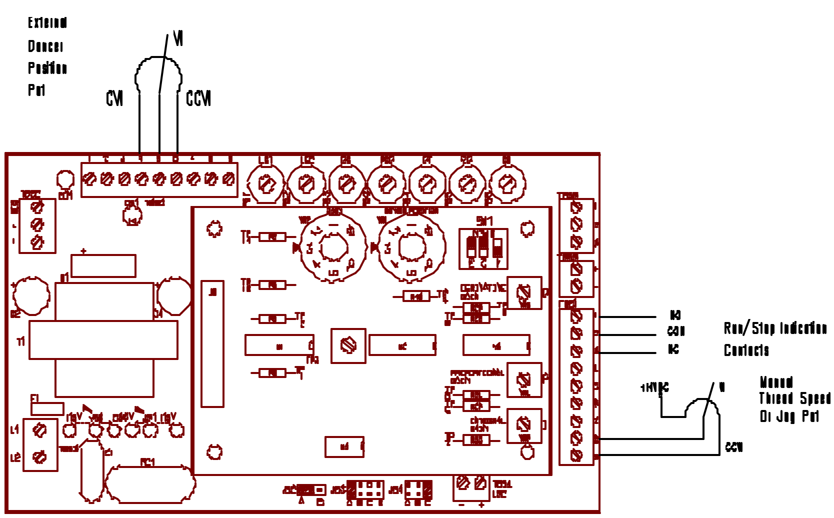
Many applications call for a mode of operation where the ZPD (PID) correction signal is disabled. An example of this would be while JOGGING or THREAD-UP. The mode where the ZPD output is disabled (or ignored) is called Manual Mode. The mode where the ZPD output controls the winder is called Auto Mode (this is the default). To switch to Manual Mode, apply 24 VDC to terminals TB51-6 (+), and 7 (-). This toggles an on-board relay and redirects the reference from the output of the PID loop to terminals TB51-8 and TB51-9 (the Manual Input). TB51 can be used to wire in a JOG or THREAD SPEED pot as shown in the diagram below. NOTE: While MANUAL MODE is selected, the INTEGRAL function will be disabled.

Integral Enable/Reset and Start/Stop Indication

Certain applications require stopping during operation, for example, to change a roll on an unwind, etc. Normally it is desirable to DISABLE the integrator on the ZPD board during these stops. Otherwise, it will continue integrating and can produce sluggish operation. A typical symptom of the integrator NOT being disabled while stopped and then restarting is the winder motor doesn't turn or begins to turn slowly and increases in speed over time (typically the dancer slowly travels to the Full-Up or Full-Down position). To disable the integrator, remove the 24 VDC from terminals TB51-4 and -5, which is normally applied there while running. The wiring for the Integral Enable/Reset is shown in each of the Set-Up Wiring Diagrams. Note that when 24 VDC is applied to terminal TB51-4 and -5, form "C" relay contacts on terminals TB51-1, 2, and 3 change state. These may be used, for example, to disable the drive being used while stopped. These contacts are shown below in the diagram.

Optional External Dancer Position Pot

Sometimes after setting the ZPD Zero Position Dancer Card up for operation, it is desirable to provide a means for the operator to adjust the zero position or where the dancer "rides" during operation. The ZPD board provides an input where an External Dancer Position Pot can be wired. TB50-4, TB50-5, and TB50-6 are the clockwise, wiper, and counterclockwise pin connections. See the diagram below for details.



Calibrating the ZPD Card For a 4-20 mA Line Speed Input

For a **4-20 mA** signal, wire the + signal-in to TB56-2 and the - signal-in to TB56-3. Place the + lead of your voltmeter on TB56-1 and the - lead on TB56-3. Input 4 mA into the ZPD board and adjust the "CO" (Current Offset) pot until the meter reads 0.00 VDC. Input 20 mA into the ZPD board and adjust the "CG" (Current Gain) pot until the meter reads 10.00 VDC. Input 4 mA again into the ZPD board. Eliminate any residual voltage by adjusting the "CO" pot until the meter reads 0.00 VDC. Input 20 mA into the ZPD board. Adjust the "CG" pot until the meter reads 10.00. Repeat until 4-20 mA input yields a linear 0-10 on your meter.

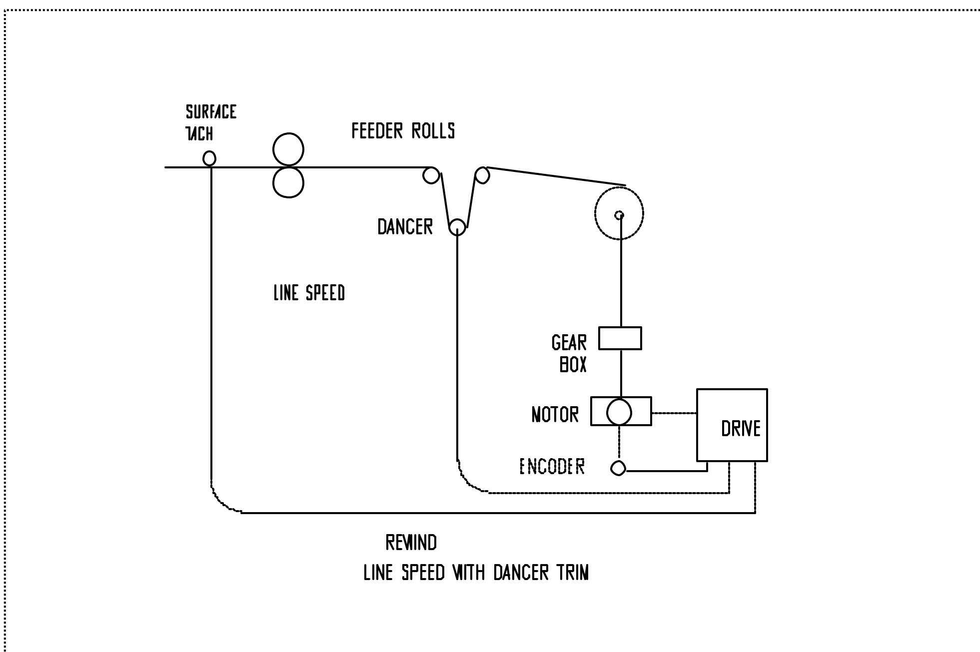
Set-Up For Applications Where The Dancer Trim % Must Vary With Line Speed

Most applications fall in the 4 categories previously described in the Set-Up section of the manual. However, there are cases where the dancer trim % must change in proportion to the amount of line speed signal. If the line speed signal is LS1 , then the J54 jumper can be placed in the "B" position. If the line speed signal is LS2, then the J54 jumper can be placed in the "A" position.

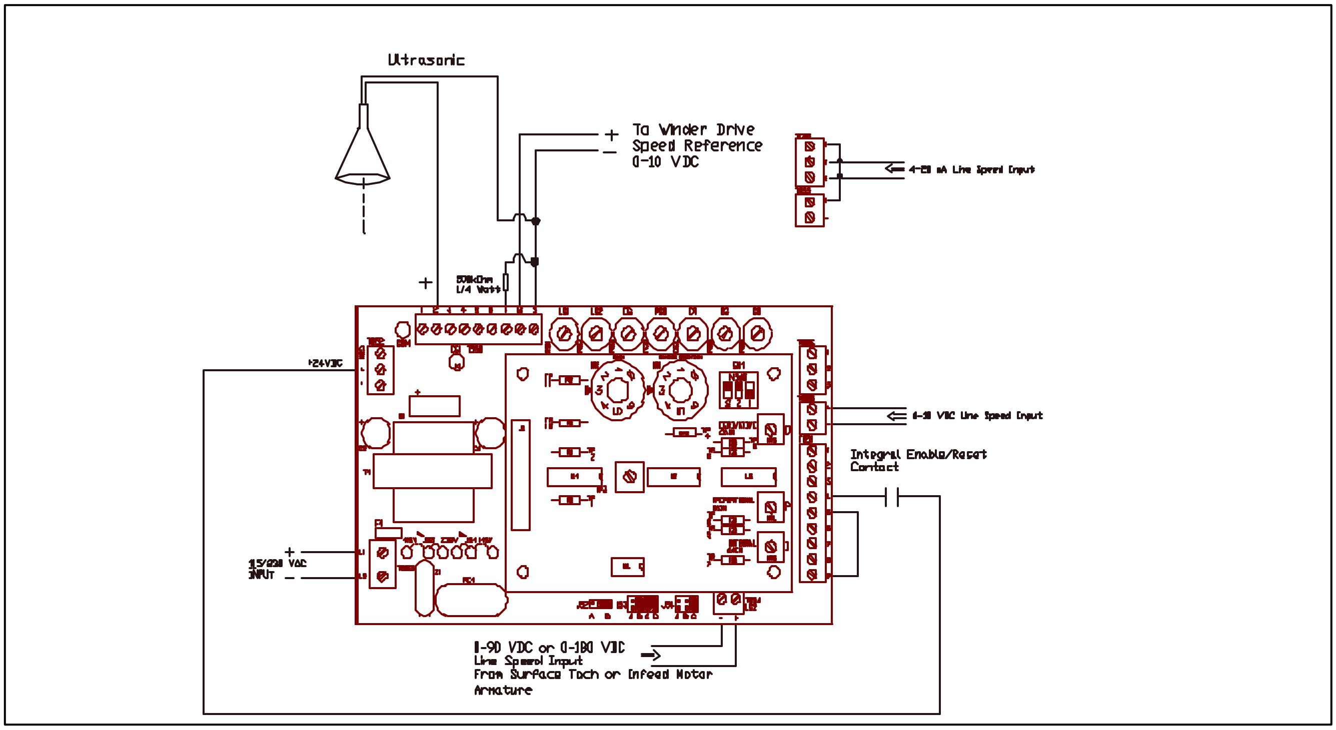
Set-Up Procedure For An Unipolar Ultrasonic "Dancer" Input

The ZPD Zero Position Dancer Card is designed to be used in an application where the dancer input is bipolar. Once the integrator is charged, it will not integrate towards zero until the dancer input goes negative. However in the case where an unipolar ultrasonic is used, the input never goes negative. A special set-up is required in this case.

Line Speed With Dancer Trim On A Rewind



Wiring Diagram



Please note in the wiring diagram that a 500 k? ¼ Watt resistor has been place between terminal TB50 pins 7 and 9. This will resolve the problem with the integrator's inability to integrate to zero.
This is mandatory when using an unipolar dancer input signal.

Set-Up Procedure

1. Connect the + and – signal wires of the ultrasonic to TB50 terminals 2 (+) and 9 (-).

2. Make the line speed signal connections appropriate to your application :

   If the line speed signal is :

   <u>0-10 VDC</u>, connect the + and - wires of the line speed signal to terminals TB55-1 (+), and TB55-2 (-). TB55 is labeled LS1 (line speed 1). Move Jumper J53 to "B".

4-20 mA, connect the + and - terminals TB56-3 (+) and TB56-2 (-). Place a jumper between terminal TB56-1 and TB55-1. Move jumper J53 to "B". Note for a current input the ZPD board converts the 4-20 mA signal to 0-10 VDC. The output of the current to voltage converter is sent to the LS1 (line speed 1) input. See the calibration procedure for a 4-20 mA line speed signal in the Additional Options and Features section of the manual.

0-90 VDC or 0-180 VDC, connect to terminals TB54-2 (+), and TB54-1 (-). Set J53 to “C” if the line speed signal is0-90 VDC or "D" if the line speed signal 0-180 VDC. TB54 is labeled LS2. Typically in this case, the line speed signal is provided by either a surface tachometer or by the armature of the infeed motor.

3. With no AC power applied to the ZPD board, set the jumpers on the bottom board (green) to the following positions : J52 = B, J53 = B,C, or D (Input Dependent), J54 = C. Set the two adjustable pots (VR1, Dancer Position and VR2, System Gain) on the top board (red) so that the dial value reads 3 at the 9 o’clock position.

4. Apply AC power. (**Note : Do NOT enable the integrator via the relay (K2) on TB51.)** The integrator will be enabled later in the set-up procedure.

5. On a Rewind With Line Speed Trim, the “zero” setpoint is typically set where the

loop of the material is in the mid-stroke position (parallel to the floor). In this position there is no trim. Based on how the machine is designed and what type of operation is desired, determine a percent (%) trim desired. Sometimes this has to be a ball-park figure. (i.e. 20 % trim). To determine what the expected output voltage of the ZPD card is when the sonic is at the mid-stroke position use the following formula :

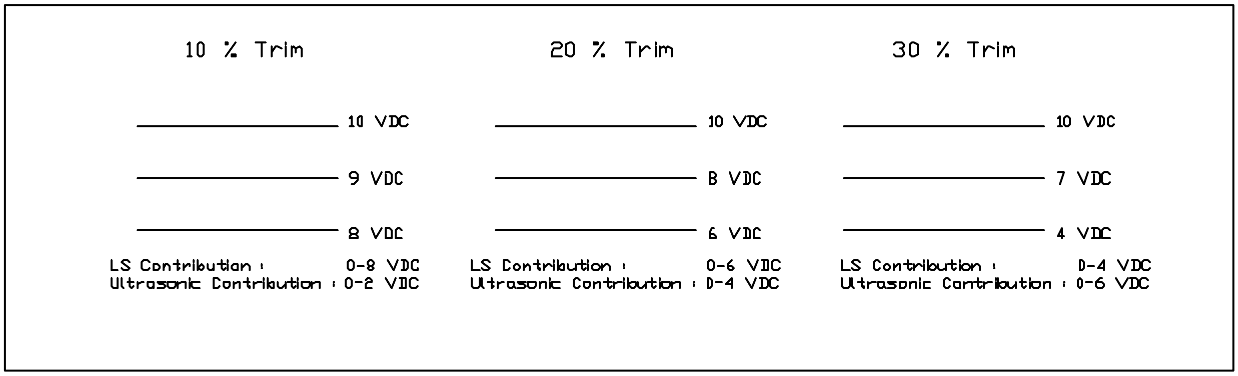
$$(100 - \% \text{ trim })/10$$

For example : With a 20 % trim, the output of the ZPD card will be 8 VDC (assuming full line speed signal input).

In this example, the line speed input should contribute 60 % of the output voltage and the ultrasonic should contribute 20 %. Remember the sonic ,at mid-stroke, will provide 2 VDC input. This means the line speed signal should provide 6 VDC.

ZPD output voltage = Scaled Line Speed Signal + Scaled Ultrasonic Input

Examples :



6. Calibrate the ultrasonic for 0 – 10 VDC from full up to full down per the ultrasonic manual. Using a piece of paper or reflector plate, hold the object in the mid-stroke position or where the material's loop is expected to "ride" in the steady-state condition. This should be 5VDC input at mid-stroke. With no line speed input, the output of the ZPD card should read the appropriate value as discussed above (2 VDC in the example). With the voltmeter + lead on TB50-8 and the - lead on TB50-9, adjust the "DT" pot until the output reads the value. Any offset can be eliminated by adjusting the "PSO" (Offset).

7. With 0 VDC input from the ultrasonic (the + lead can be simply temporarily removed), apply the full line speed voltage (10 VDC, 90 VDC, or 180 VDC depending on the type of input). Using a voltmeter, place the + lead on TB50-8 and the lead on TB50-9. Adjust the LS1 (0-10 VDC line speed input) or LS2 pot (90 VDC or 180 VDC line speed signal input) until the meter reads the appropriate voltage as discussed above. Stop the line speed drive and make sure there is no line speed input to the ZPD card.

8. Again, place the piece of paper or the reflector plate in the mid-stroke position. Apply full line speed signal and check the output voltage of the ZPD care (TB50 pins 8 and 9). The output voltage should read the appropriate voltage (2 V + 6V = 8 V in the example).

9. Now place the piece of paper or the reflector plate in the full down position. In this case, the infeed would be delivering more material than the winder is taking up. This is worst-case scenario where the motor should run at full required speed, typically nameplate. At this point, place the + lead of the voltmeter on TB50-8 and the lead on TB50-9. With no line speed input, the voltmeter should read the maximum value (4 V + 6 V = 10 V in the example).

10. Raise the piece of paper or the reflector plate slowly. From the full down position toward the full up position continue to raise the paper or plate. The output of the ZPD card should approach the appropriate value (6 V in the example).

11. Thread the machine and run slowly. First adjust the D gain and later the I gain. Note the I gain will have to be enabled via the relay on TB51 (-4 and -5). Usually it is desirable to disable the Integral relay when the winder drive is given a run or stop command. This will prevent the integrator from integrating while the winder is stopped.

APPENDIX

Typical effect of adjustments:

Proportional - CW increases responsiveness
VR-4 CCW decreases responsiveness
Gain too high, causes instability
Gain too low, causes excessive dancer movement

Derivative - CW provides more damping
VR-5 CCW provides less damping
3 ranges (time constants)
1 & 6 closed minimum damping range
2 & 5 closed medium damping range
3 & 4 closed high damping range
Too much damping causes jerky and erratic operation.
Too little damping causes overshooting and oscillatory behavior.

Integral - Provides compensation for build down/build up ratio
VR-6 CW provides shorter time constant (more)
CCW provides longer time constant (less)
Too much integral can cause hunting (slow oscillations).
Too little integral can cause excessive dancer droop.

Main Gain - CW increases gain
VR-2 CCW decreases gain
Too much gain can cause unstable operation (too responsive).
Too little gain can cause sluggish operation and droop.

Dancer Position - Electrically adjust zero position on dancer.
VR-1

PROGRAMMING JUMPERS/SWITCHES/ADJUSTMENT POTS

JUMPERS	FUNCTION	POSITION
J50, J51	Input Voltage Select - 115/230	*
J52	**Bi-Directional Output**	**A**
	Uni-Directional Output	B
J53	**Full Dancer Control**	**A**
	Dancer Trim with Line Speed 1	B
	Dancer Trim with Line Speed 2 (0-90V)	C
	Dancer Trim with Line Speed 2 (0-180V)	D
J54	Dancer Pot Reference is Line Speed 2	A
	Dancer Pot Reference is Line Speed 1	B
	Dancer Pot Reference is Fixed Reference	**C**

SWITCH	FUNCTION	POSITION
SW1	**Minimum Damping**	**1 ON**
	Medium Damping	2 ON
	Maximum Damping	3 ON

POT	FUNCTION
R50	Summing Amp Offset Adjust (Factory Set - Do not adjust)
LS1	Line Speed 1 Trim
LS2	Line Speed 2 Trim
DS	Dancer Sensitivity
DT	Dancer Trim Percentage
CG	Gain for 4-20 mA signal
CO	Offset for 4-20 mA signal
VR1	Dancer Position Adjust - Internal
VR2	Main System Gain
VR4	Proportional Gain
VR5	Derivative Gain
VR6	Integral Gain

THIS DIAGRAM FOR STAND ALONE APPLICATIONS ONLY.
SEE CONNECTION DIAGRAM FOR Q7000 ON LAST PAGE (Pg.11).

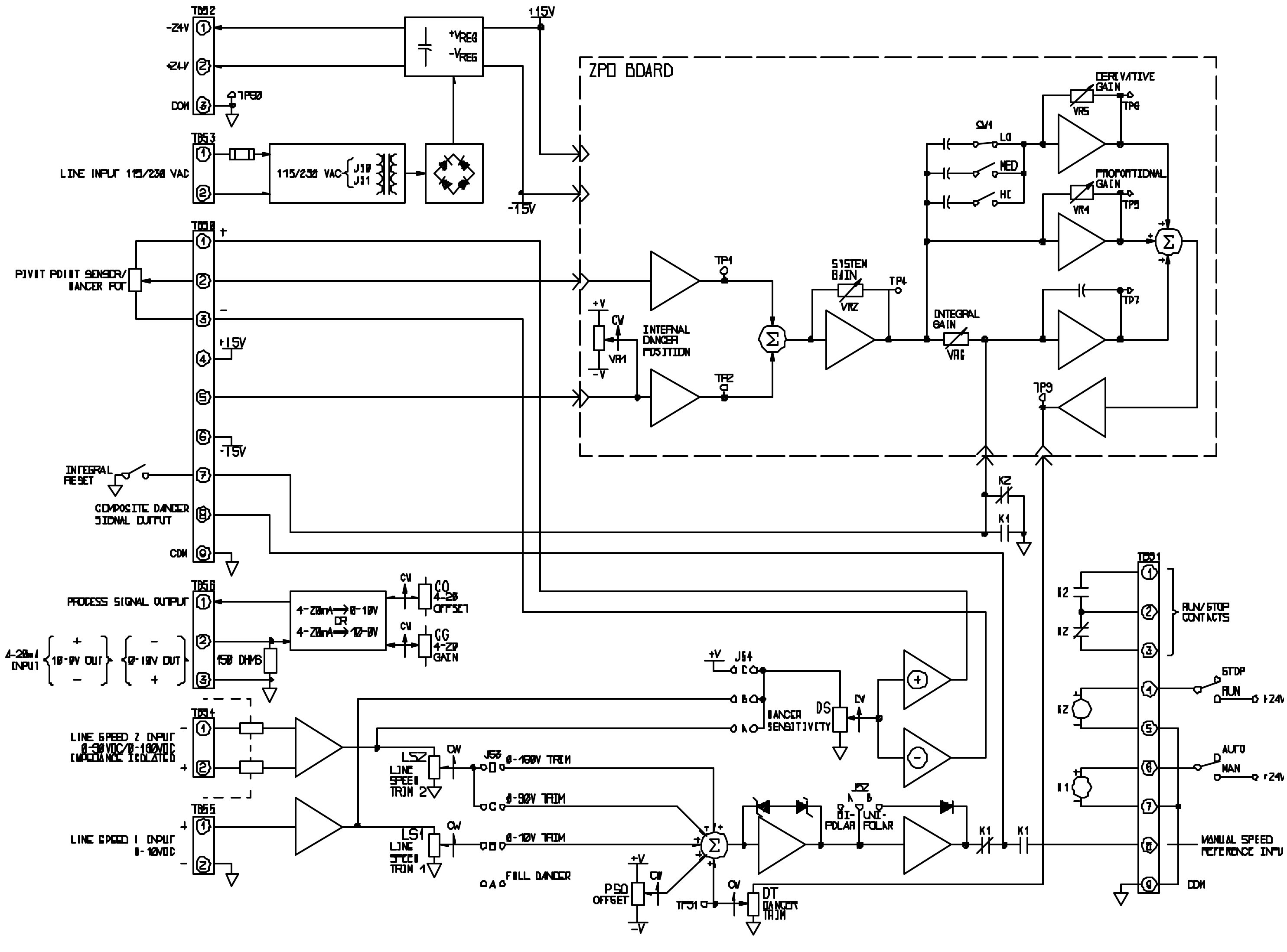
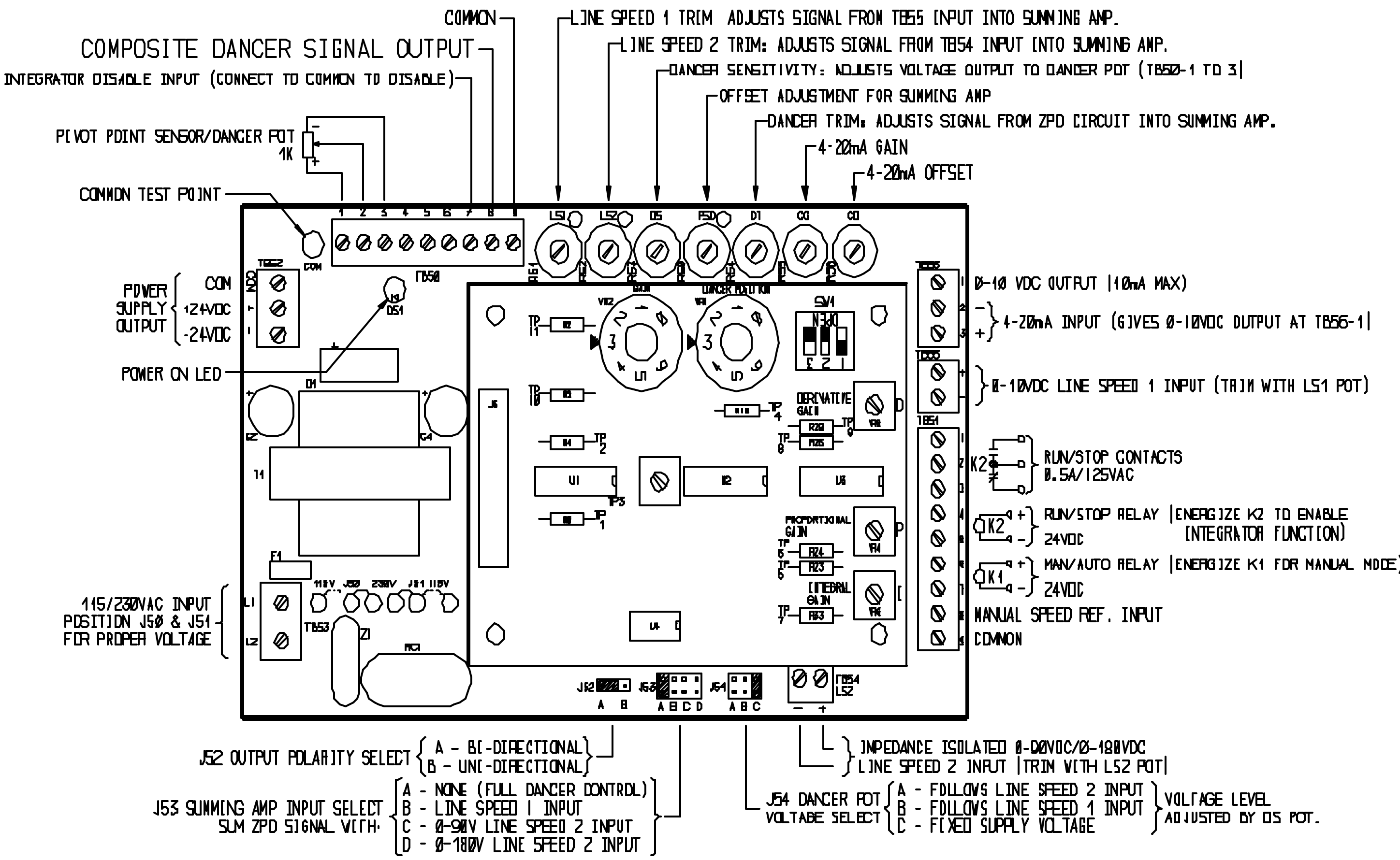
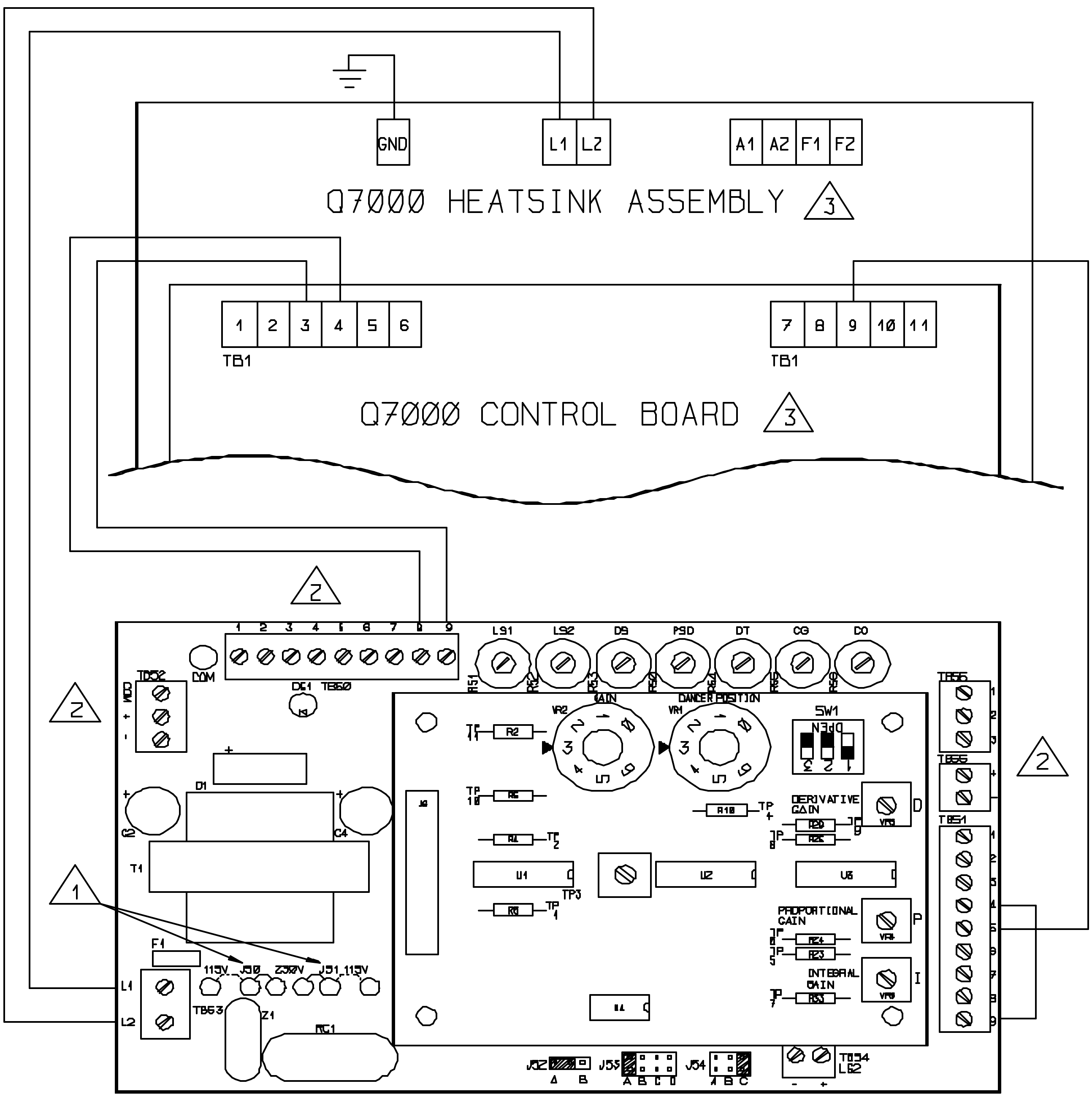


Figure 2 - Block Diagram


COMMON
COMPOSITE DANCER SIGNAL OUTPUT
INTEGRATOR DISABLE INPUT (CONNECT TO COMMON TO DISABLE)
PIVOT POINT SENSOR/DANCER POT 1K
COMMON TEST POINT
LINE SPEED 1 TRIM ADJUSTS SIGNAL FROM TB55 INPUT INTO SUMMING AMP.
LINE SPEED 2 TRIM: ADJUSTS SIGNAL FROM TB54 INPUT INTO SUMMING AMP.
DANCER SENSITIVITY: ADJUSTS VOLTAGE OUTPUT TO DANCER POT (TB50-1 TO 3)
OFFSET ADJUSTMENT FOR SUMMING AMP
DANCER TRIM: ADJUSTS SIGNAL FROM ZPD CIRCUIT INTO SUMMING AMP.
4-20mA GAIN
4-20mA OFFSET
POWER SUPPLY OUTPUT
COM
+24VDC
-24VDC
POWER ON LED
0-10 VDC OUTPUT (10mA MAX)
4-20mA INPUT (GIVES 0-10VDC OUTPUT AT TB56-1)
0-10VDC LINE SPEED 1 INPUT (TRIM WITH LS1 POT)
RUN/STOP CONTACTS 0.5A/125VAC
RUN/STOP RELAY (ENERGIZE K2 TO ENABLE INTEGRATOR FUNCTION) 24VDC
MAN/AUTO RELAY (ENERGIZE K1 FOR MANUAL MODE) 24VDC
MANUAL SPEED REF. INPUT
COMMON
115/230VAC INPUT POSITION J50 & J51 FOR PROPER VOLTAGE
DERIVATIVE GAIN
PROPORTIONAL GAIN
INTEGRAL GAIN
J52 OUTPUT POLARITY SELECT
A - BI-DIRECTIONAL
B - UNI-DIRECTIONAL
J53 SUMMING AMP INPUT SELECT SUM ZPD SIGNAL WITH:
A - NONE (FULL DANCER CONTROL)
B - LINE SPEED 1 INPUT
C - 0-90V LINE SPEED 2 INPUT
D - 0-180V LINE SPEED 2 INPUT
IMPEDANCE ISOLATED 0-90VDC/0-180VDC LINE SPEED 2 INPUT (TRIM WITH LS2 POT)
J54 DANCER POT VOLTAGE SELECT
A - FOLLOWS LINE SPEED 2 INPUT
B - FOLLOWS LINE SPEED 1 INPUT
C - FIXED SUPPLY VOLTAGE
VOLTAGE LEVEL ADJUSTED BY DS POT.



POSITION JUMPERS J50 & J51 TO MATCH Q7000 LINE VOLTAGE.

REFERENCE FIGURE 3 FOR ADDITIONAL ZPD CONNECTION INFORMATION

REFERENCE Q7000 MANUAL |P-851| FIGURE 2 2 FOR ADDITIONAL Q7000 CONNECTION INFORMATION DISREGARD FIGURE 6 1

Figure 4 - ZPD/Q7000 Connection Diagram

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