Conic Systems, Inc.

INSTRUCTION MANUAL
FOR
DATATRAN
C2889
DANCER ROLL
POSITION REGULATOR

FOR TECHNICAL OR SALES ASSISTANCE
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GENERAL DESCRIPTION:

This dancer roll position regulator is designed to maintain a process dancer roll at a preset position. During operation the dancer position is indicated by the signal supplied from a potentiometer or any other suitable position sensing transducer. The dancer position signal is compared to the command position signal by the regulator. Any error existing between the two signals is amplified and applied to the process drive system in a manner that will tend to cause it's response to reduce the error to zero. The dancer position regulator provides all of the features required to implement a complete high performance, closed loop, control system. The module includes the following functions and features.

- Position transducer power supply section, providing regulated positive and negative DC output voltages.
- Bipolar output amplifier with independently adjustable positive and negative maximum output voltage clamps.
- Models are available with a wide range of input voltages or 4 to 20 ma. current signals.
- Multiple turn potentiometers to adjust the system gain, response and stability functions.
- Operation with either a board mounted or external position command potentiometer. A jumper mounted on the circuit board selects the mode of operation.
- Auxiliary bias or position command input signal channel that is summed with the dancer feedback position signal.
- Two adjustable solid state end of travel limits that may be used to provide web break protection or automatic slack takeup.
- Panel or plastic track mounting with plug in terminal blocks for all external connections.

The dancer position regulator is supplied as a single, industrial grade circuit board assembly. The circuit board is solder masked and conformal coated. Plug in terminal blocks are included for external wiring, thus reducing the amount of downtime for replacement or service to a minimum. All of the external connections to the terminal blocks as well as the adjustment controls are clearly marked.

INSTALLATION INSTRUCTIONS:

Once the circuit board assembly has been removed from the shipping container, inspect the unit to determine if any of the components have been or damaged during shipment and storage. In the event that any items are damaged, missing or should loose parts be discovered, they must be repaired or replaced before proceeding with the installation.

In the event that the equipment is not to be used for a period of time it should be stored in the shipping carton. The storage area should be dry and protected. Severe humidity or temperature, vibration and dirt are adverse conditions that can be injurious to the equipment and must be avoided.

The location selected for mounting the equipment should be of the same nature as that selected for storage. The temperature should be such that the ambient does not rise above 55 degrees C. Note, that 55 degrees C. is the maximum ambient surrounding the devices on the circuit board when it is operating at maximum load with the maximum rated input voltage applied. Due to the voltage regulator heat dissipation in this condition, it may be necessary to force some cooling air through the equipment if the plant temperature approaches 55 degrees C. In the event that forced air cooling is required, always install a good filter in the inlet stream ahead of the controller.

All of the electrical connections to the dancer position regulator module must be made in strict conformance with the connection diagrams in this manual, as well as all applicable electrical codes. Should conflicts occur between the connection diagrams and the local electrical code, Datatran's engineering department should be consulted prior to proceeding with the installation.

If possible, the system common (0 volt line) should be connected to the plant earth ground point. This will provide the highest immunity to any electrical noise as well as the maximum safety for the operator. The dancer position regulator assembly system common terminal is clearly marked on the board connection drawings included in this manual. If the system design allows, this point should be run directly to the plant earth ground with a wire no smaller then that used to connect the power line to the equipment. Connections to the dancer position regulator should be in conduit separate from all other plant wiring for optimum performance and reliable operation in the high electrical noise environment typical in most industrial operations. This is particularly true for external command and feedback signal input lines.

Where shielded cable is called for on the connection diagram, unless specifically noted, expose the shield on the controller end only. If this cable is spliced at any point along its run be sure that the shield splice is covered and not grounded at any point along the run. The user should note that the shield is connected to the dancer position regulators common, *this may or may not be at earth ground potential.* Shielded cable should be in separate signal conduits only. They should not be run parallel to non signal conduits. If any signal conduits must cross non signal wires they should do so at an angle between 45 and 90 degrees.

All of the external connections to the dancer position regulator should be clearly marked and installed in conduit where possible. The importance of proper wire routing during the installation period can not be overstated; all of the time spent on this operation is well worth it and will eliminate a number of potential problems and the associated expense that will occur to eliminate improper connections during the startup and operation of the equipment.

! ! ! ! ! WARNING ! ! ! ! !

The dancer position regulator assembly is transformer isolated from the AC power line (AC line powered models only). The regulator assembly does not provide any additional signal isolation. It is extremely important that the entire dancer controlled drive system have a single common or earth ground connection.

Multiple grounds or common connections that differ in electrical potential may cause high current flows resulting in fire and/or permanent damage to the dancer position regulator as well as other devices connected to the system.

For the maximum immunity to electrical noise as well as to provide the best operator safety, the entire dancer controller drive system should operate with its common (0 volt) potential connected directly to the plant earth ground point.

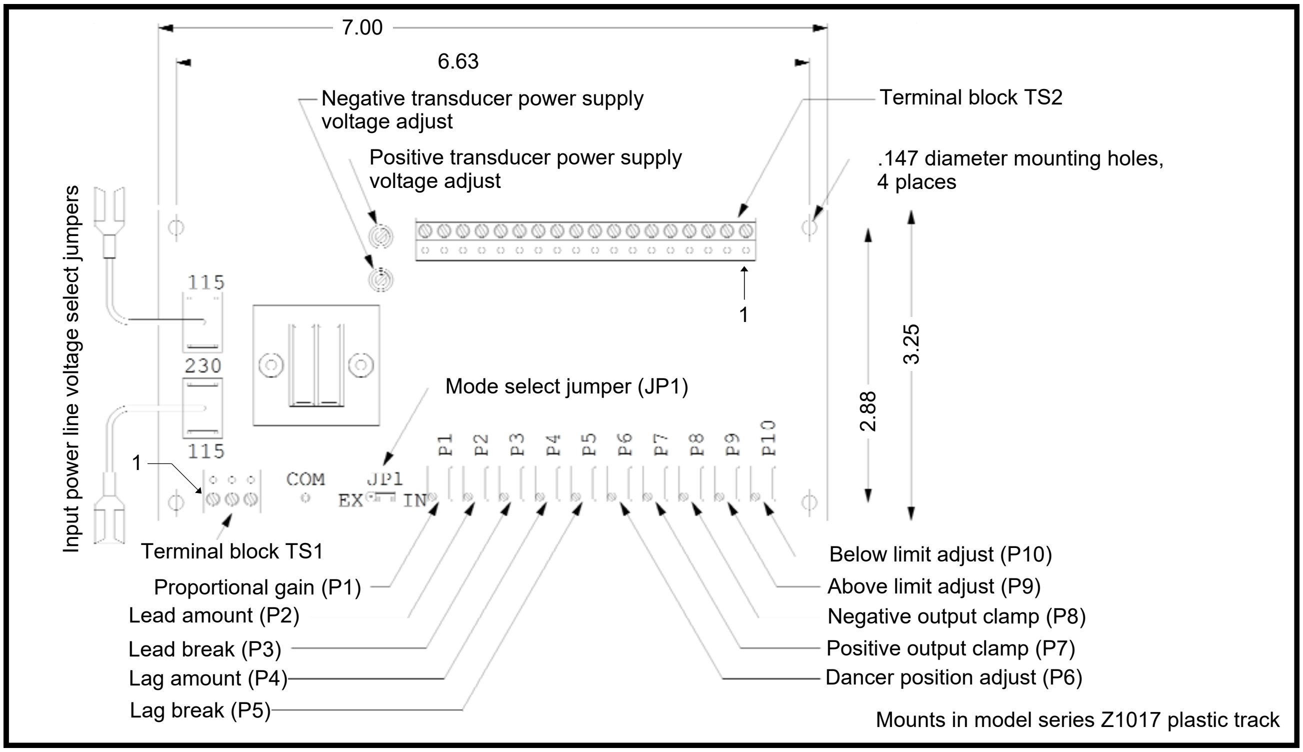
In the event that the system must operate without the system common at earth ground potential the user should be aware that any shield connections may be at the operating system common potential. For some drive systems this potential may be equal to the power line input voltage. For operator safety all ungrounded equipment should be clearly marked as such.

IF POSSIBLE, GROUND THE SYSTEM COMMON (0 VOLT) CONNECTION!

Prior to attempting to startup and operate the dancer position regulator, the user should take the time to verify the mechanical operation of the dancer roll assembly. Loose or binding bearings, bushings, chains , gears or other mechanical components can make the dancer position regulator tuning process difficult. Excess friction or clearances in the dancer roll assembly are detrimental to the operation and in extreme cases may cause the dancer to continually oscillate or cease to function.

Any dancer position control system that oscillates or fails to provide a smooth controlled output at all times is not properly installed or tuned. Any oscillation is dangerous and is capable of causing injury to product, equipment and operating personnel. The entire dancer position control system must be stable and predictable under all operating conditions.

OUTLINE DIMENSIONS AND COMPONENT LOCATIONS:



EXTERNAL WIRING REQUIREMENTS:

All external wiring shall be located in conduit or raceways. All shielded wiring must be located in it's own separate signal conduit. In general, all shielded wire should have the shield exposed and connected on one end only, as shown on the interconnection drawings. All of the wiring connections to the dancer roll position regulator circuit board can be made with 20 AWG or larger. All command input and feedback wiring should be twisted and shielded.

All external non-shielded wires should be of stranded copper with thermoplastic (PVC) insulation, rated for 600 volts and 90 degrees C. minimum. All external, multiconductor shielded cables should be of stranded copper with a foil shield and thermoplastic (PVC) insulation, rated for a minimum of 300 volts at 80 degrees C. The wire and cable ratings listed are the minimum. The user is expected to show a bit of common sense in the selection of the external interconnection wires, the voltage rating, current capacity and operating temperature must be suitable for the specific application. ***All wires must be selected and installed as specified in the local electrical and fire codes.***

POWER LINE FUSE REQUIREMENTS:

All of the signal outputs will withstand a direct short circuit to the system common or the transducer power supply outputs. The transducer power supply voltage regulators are both short circuit and thermally protected.

All 115 volt or 230 volt AC power line input models (suffix AAA =111 or 231) should be protected by a fast blowing fuse in series with the power line connections to terminal numbers 1 and 2, on TS1. Both fuses are specified at 250 volts. In the event that terminal number 2 on TS1 is connected to the system earth ground, the user *should not install* a fuse in series with this connection The maximum fuse size for 115 volt AC power line operation is 1/2 amp. The maximum fuse size for 230 volt AC power line operation is 1/4 amp. All external fuses should be equal to the Littelfuse series 312 (type 3AG, at 250 volts).

All models that are supplied for operation with a bipolar DC power supply input should be protected by fast blowing fuses in series with the power line connections to terminal numbers 1 and 3, on TS1. Fuses should be no larger then .5 amp. These fuses should be equal to a Littelfuse part number 312.500 (type 3AG, rated 1/2 amp at 250 volts).

Do not install fuses in any conductor that is connected to the system earth ground.

The user should note that on DC powered models, a blown fuse in one of the input power line connections may cause the dancer position regulator output signal line to assume a maximum positive or negative value.

USER ADJUSTMENTS:

The devices listed below are multiple turn potentiometers, located on the circuit board. These are the controls that are normally adjusted by the user to obtain the response required for a specific installation. The location of these controls is marked on the circuit board as well as the installation drawing on page number 3 of this manual.

PROPORTIONAL GAIN (P1): Adjusts the magnitude of the primary output signal for a given amount of steady state error signal. Clockwise rotation increases the output signal gain.

LEAD AMOUNT (P2): Adjusts the amount of the derivative or brake signal that is summed with the error signal for a specific rate of change for the dancer position signal. Clockwise rotation increases the amount of applied derivative signal. With this control set fully c'clockwise, the derivative signal is inhibited.

LEAD BREAK (P3): Adjusts the high frequency cutoff point for the derivative signal to reduce the effect of noise on the output signal. Clockwise rotation will decrease the cutoff frequency. With this control set fully clockwise the lead amount signal will be greatly reduced.

LAG AMOUNT: (P4): Adjusts the amount of the integral signal or the rate that the output signal will change for a given rate change in the dancer position error signal. Clockwise rotation increases the amount of integral signal and slows the output signal rate of change. With this control set fully c'clockwise the integral signal is inhibited.

LAG BREAK (P5): Adjusts the high frequency cutoff point for the integral signal to reduce the effect of noise on the output signal. Clockwise rotation will decrease the cutoff frequency. With this control set fully clockwise the lag amount signal will be greatly reduced.

Since the lag signal is 180 degrees out of phase with the lead signal, this control can also be used to reduce the high frequency noise generated by the lead network signal.

POSITION ADJUST (P6): Adjusts the dancer operating position in the steady state condition. This is the dancer position command signal. It can be set over the entire dancer travel range. Clockwise rotation will move the dancer position towards the positive transducer supply voltage position.

POSITIVE OUTPUT CLAMP (P7): Sets the magnitude of the maximum positive output voltage from the signal output amplifier. Clockwise rotation will increase the output.

NEGATIVE OUTPUT CLAMP (P8): Set the magnitude of the maximum negative output voltage from the signal output amplifier. Clockwise rotation will increase the output.

ABOVE LIMIT ADJUST (P9): Adjusts the dancer position where the above output will turn on. This output will remain on as long as the dancer position transducer signal is more positive than the set point. Clockwise rotation will make the trip point more positive.

BELOW LIMIT ADJUST (P10): Adjusts the dancer position where the below output will turn on. This output will remain on as long as the dancer position transducer signal is more negative than the set point. Clockwise rotation will make the trip point more negative.

SUPPLEMENTARY ADJUSTMENTS:

The devices listed below are single turn potentiometers that are located on the circuit board. They are preset and sealed at the factory prior to shipment. They do not normally require additional adjustment by the user. The function of these devices is included for reference only. The location of these devices is marked on the installation drawing on page number 3 of this manual.

POSITIVE TRANSDUCER SUPPLY: Adjusts the magnitude of the positive output voltage for the transducer power supply.

NEGATIVE TRANSDUCER SUPPLY: Adjusts the magnitude of the negative output voltage for the transducer power supply.

DANCER POSITION COMMAND SIGNAL MODE SELECT JUMPER (JP1):

This is a three (3) position pin header located on the circuit board. It should be positioned by the user, prior to installation, to set the mode of operation required for a specific application. The location of this jumper is marked on the circuit board as well as the installation drawing on page number 3 of this manual.

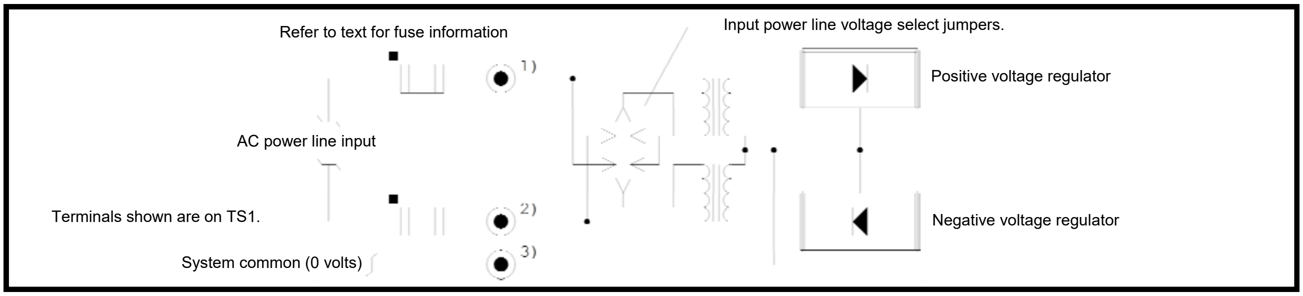
With the jumper placed in the "I" position, the dancer position regulator will use the internal "POSITION ADJUST" potentiometer for the dancer position command signal. With this jumper placed in the "E" position the dancer position command signal must be derived from a external voltage source and applied to terminal number 13 on TS2.

INPUT POWER LINE VOLTAGE SELECT JUMPERS:

All dancer position regulators with suffix AAA = 111 are designed to operate from *either 115 or 230 volt AC power lines*. Prior to applying power to any of these models the user must position the voltage select jumpers for the proper line voltage. The location of these jumpers is marked on the circuit board as well as the installation drawing on page number 2 of this manual.

For 115 volt AC power line operation, connect the two wires with the female connectors to the adjacent male tab marked "115" For 230 volt AC power line operation, connect the two wires with the female connector to the adjacent male tabs marked "230".

EXTERNAL POWER SUPPLY CONNECTIONS, AC INPUT MODELS



The external fuse shown in series with the connection to terminal number 2 on TS1 should *not be installed* if this line is connected to the system earth ground.

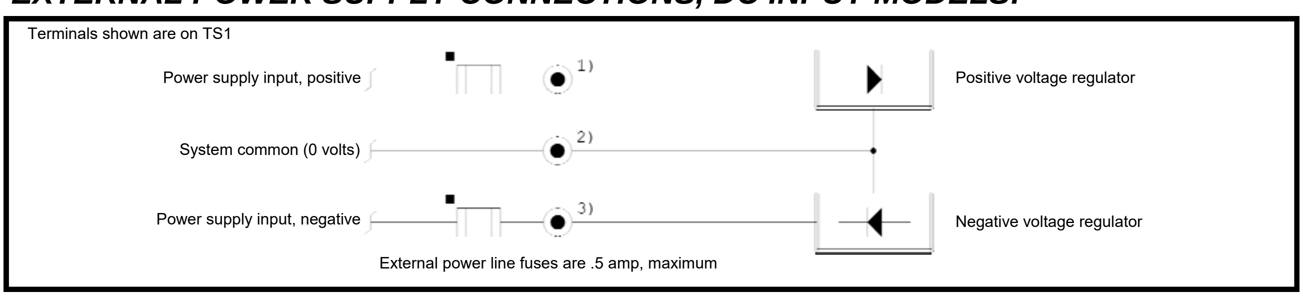
Note that regulator assemblies with suffix AAA = 111 will operate from both 115 and 230 volt AC power lines. ***The line voltage select jumpers must be placed in the correct position prior to applying AC power to these models.*** Regulators with suffix AAA = 231 operate on 230 volts AC only. No line voltage selection is required for these models.

The external fuses shall be rated at .5 amps for 115 volt AC input models and .3 amps for 230 volt AC input models. All fuses should withstand 250 volts rms.

! ! ! ! ! CAUTION ! ! ! ! !

Improper connection of the input power line voltage selection jumpers may cause irreparable damage to the dancer roll position regulator circuit board assembly.

EXTERNAL POWER SUPPLY CONNECTIONS, DC INPUT MODELS:



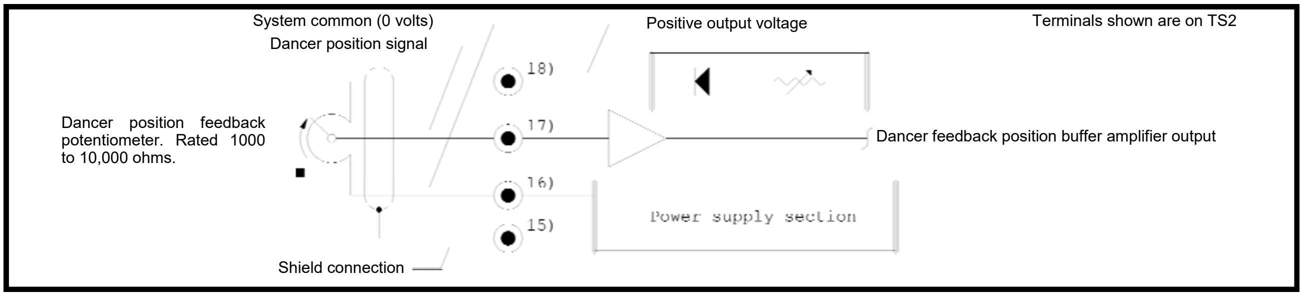
The fuses shown in the connections to terminal numbers 1 and 3 on TS1 are not required if the user's external power supply includes the necessary short circuit protection devices.

Do not install fuses in any conductor that is connected to the system earth ground.

The external fuses should be rated at .5 amps for all DC voltage powered models.

The minimum input voltage for controllers with suffix AAA = 180 is plus and minus 18 volts DC. The minimum input voltage with suffix AAA = 150 is plus and minus 15 volts DC. The maximum input voltage to all DC powered controllers is plus and minus 30 volts DC.

DANCER ROLL POSITION FEEDBACK POTENTIOMETER CONNECTIONS:

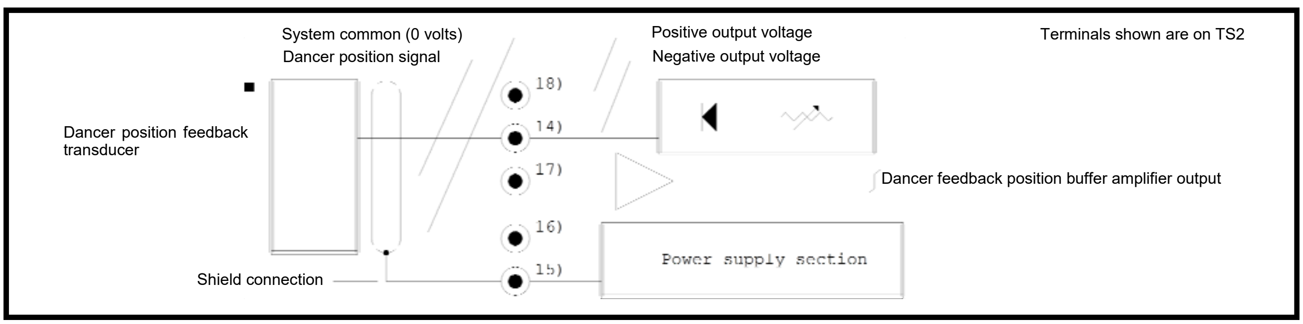


The figure above shows the connections between the dancer position regulator board and the position feedback potentiometer. The dancer roll position feedback potentiometer must be connected to the dancer roll assembly so that full travel of the dancer does cause the potentiometer to exceed its mechanical or electrical rotation limits. The feedback potentiometer value is not critical, however optimum operation will be obtained with potentiometers rated between 1000 and 10,000 ohms. All potentiometers should be rated for a minimum of 1/2 watt and have a linear taper.

Rotation of the potentiometer in the direction shown by the arrow (towards the positive transducer power supply output) will cause the output signal from the dancer position regulator to decrease from it's maximum positive value.

Datatran's model series C2699, heavy duty, geared potentiometer is ideal for use as the dancer feedback position transducer. This industrial rated device is available with a choice of over 700 internal gear ratios. This wide selection of gear ratios will allow the user to obtain full potentiometer travel with input shaft rotations of less than 1 to more than 45 revolutions. Interested user's are invited to contact Datatran's sale department for specific model information and pricing.

DANCER ROLL POSITION FEEDBACK TRANSDUCER CONNECTIONS:

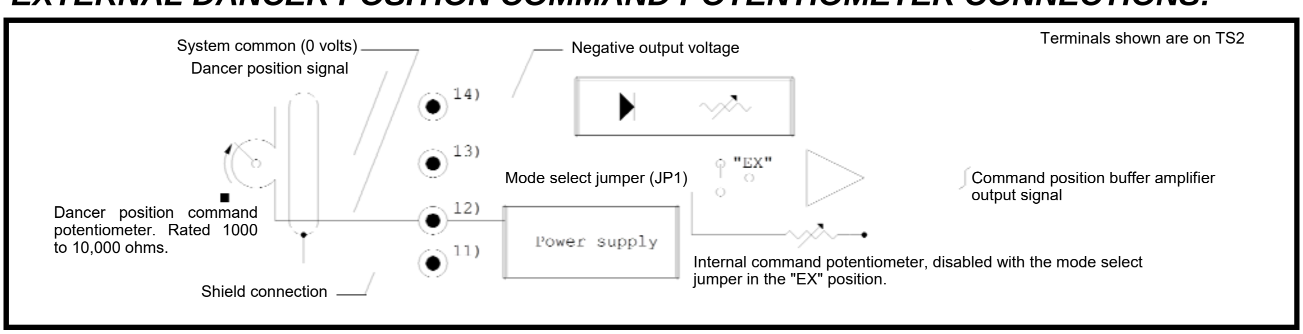


The figure above shows the connections between the dancer position regulator and a external dancer roll position feedback transducer. The dancer roll position feedback transducer must be connected to the dancer roll assembly so that full travel or loading of the dancer roll does not cause the output from the transducer to exceed the rated input signal to the dancer position regulator.

The example above shows the use of the internal bipolar power supply for the external transducer assembly. *Transducers that are externally powered must share the same common (0 volt) potential as the dancer position regulator.*

A positive going output signal from the external transducer will cause the output signal from the dancer position regulator to decrease from it's maximum positive value.

EXTERNAL DANCER POSITION COMMAND POTENTIOMETER CONNECTIONS:

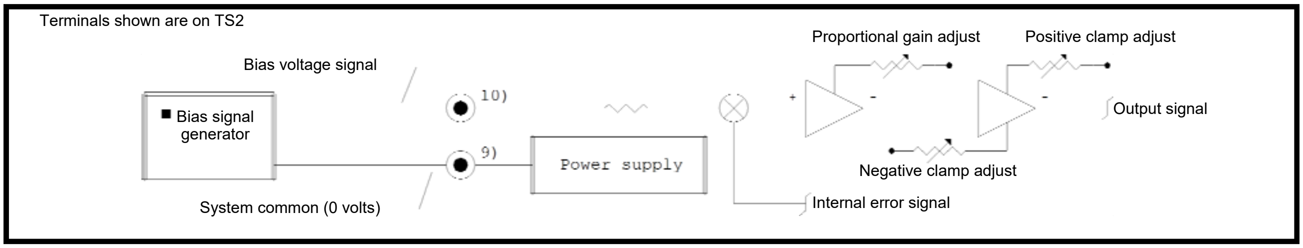


EXTERNAL DANCER POSITION COMMAND POTENTIOMETER CONNECTIONS, CON'T:

The figure on the preceding page shows the connections between the dancer position regulator board and a user supplied external position command potentiometer. When a external command potentiometer is used to set the steady state dancer operating position the mode select jumper, on the circuit board, must be placed in the "E" position. The external position command potentiometer value is not critical, however optimum operation will be obtained with potentiometers rated between 1000 and 10,000 ohms. All potentiometers should be rated for a minimum of 1/2 watt and have a linear taper.

Rotation of the command potentiometer in the direction shown by the arrow will cause the system to adjust the dancer roll steady state operating position so that the feedback potentiometer wiper is moved towards the positive transducer power supply output.

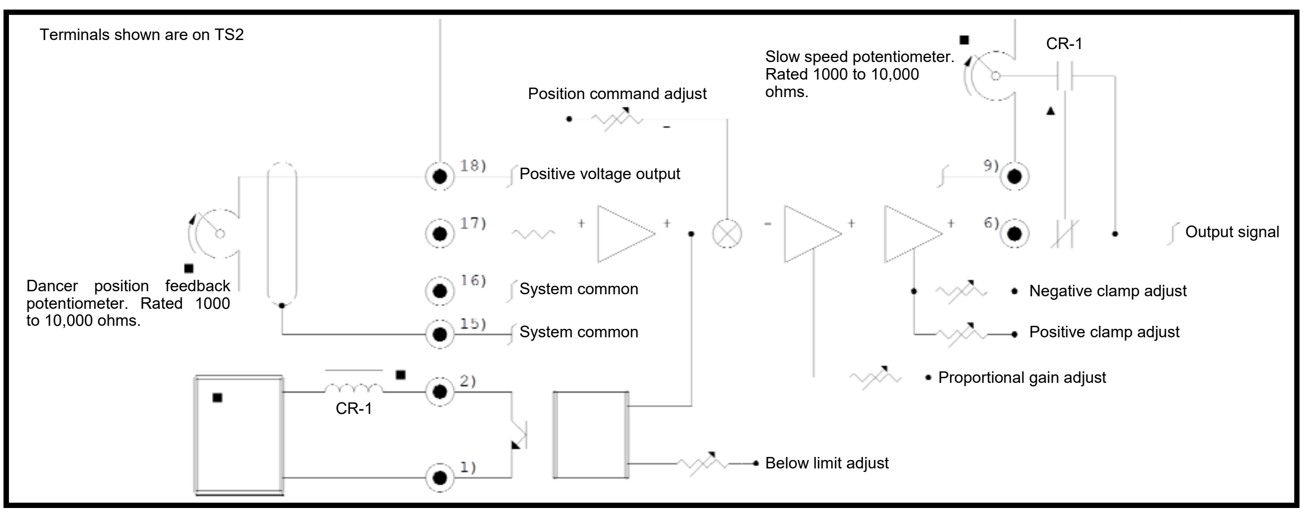
EXTERNAL BIAS SIGNAL CONNECTIONS:



Any voltage signal at the bias input terminal is summed with the other input signals. The result of the summing action is directed to the output signal amplifier. Signals applied to the bias input are multiplied by the proportional gain setting and may require that the dancer command position signal be modified. This input can be used to provide a line speed, friction bias or dither signal to the output from the dancer position regulator. In the event that this input is not used, it should be connected to one of the system common (0 volt) terminals.

AC dither signals applied to the bias input are generally well above the cutoff frequency for the lag network. However, very low dither frequencies (below 15 hz.) are subject to modification by the lag network setting such that clockwise rotation of the "LAG AMOUNT" and c'clockwise rotation of the "LAG BREAK" adjustments will reduce the amount of dither signal on the output.

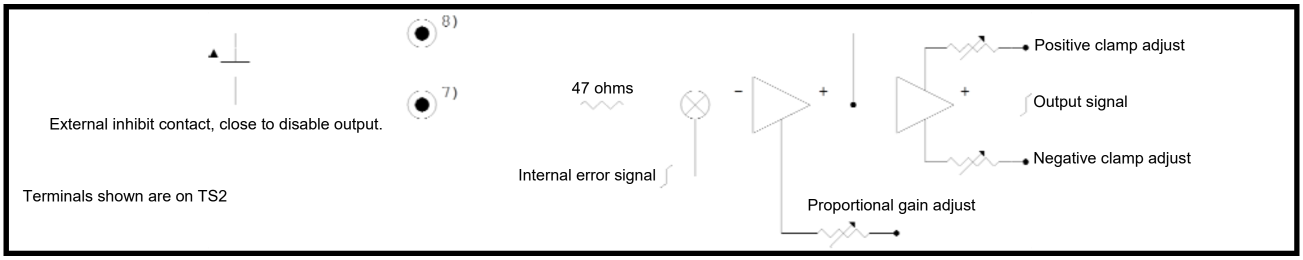
SLACK WEB PROTECTION CIRCUIT CONNECTIONS:



In many applications, a slack web condition will cause the output from the dancer position regulator to command the system drive to operate at maximum speed. The drive will continue to operate at maximum speed until the slack is removed from the system at which time the dancer is forced back into the regulation range. Unfortunately, the speed at which the dancer will move into the regulation range will usually be extremely high. This violent movement along with the sudden application of tension to the web may combine to break the web before the drive system will respond or alternately force the drive into violent oscillation.

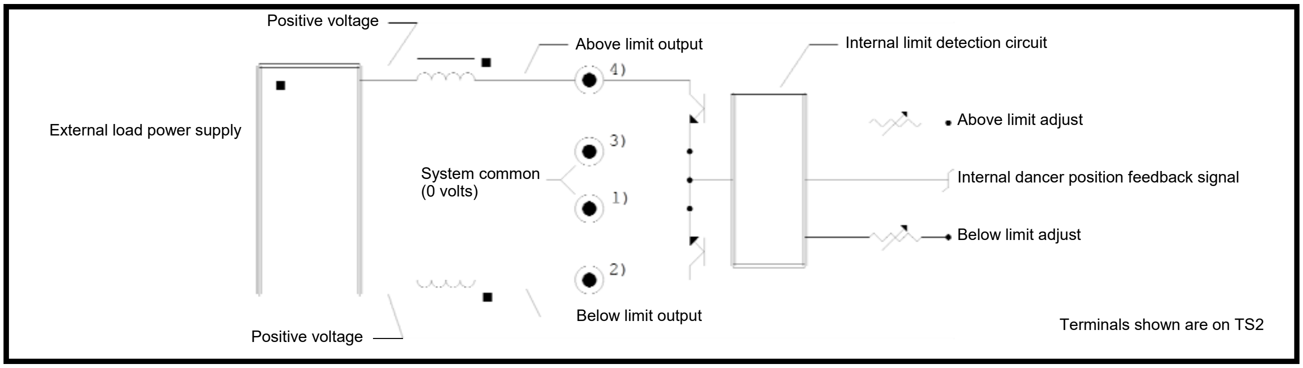
Drive runaway due to a slack or broken web can be prevented by forcing the system to operate at low speed any time the dancer position is beyond the normal range of operation in the direction that will cause the regulator output to command maximum drive speed. A circuit to accomplish this, using the bias signal input and one of the limit outputs is shown above.

EXTERNAL INHIBIT CONTACT CONNECTIONS:



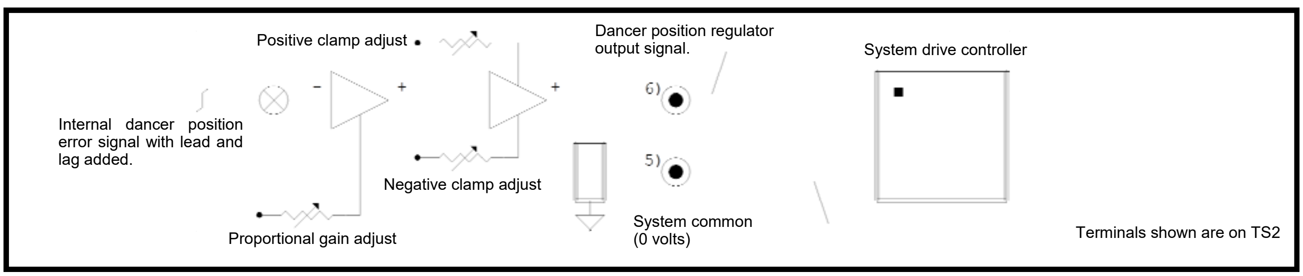
The external inhibit contact is used to force the output signal from the dancer position regulator to zero. When the inhibit contact is closed the output of the dancer position regulator will be clamped to a value of less than .050 volts. The current flow through the inhibit contact is internally limited to a maximum of 10 ma., accordingly this contact should be rated for low level or dry circuit switching operation.

EXTERNAL LIMIT OUTPUT CONNECTIONS:



The dancer position regulator contains two current sinking digital limit outputs. These are open collector type NPN transistors. During normal operation, both of these outputs will be in the off or blocking condition. One output will turn on when the dancer position signal, as indicated by the dancer position feedback device is less than the "BELOW" limit setpoint. The second limit will be on at any time the dancer position signal is greater than the "ABOVE" limit setpoint. These limits can be used to indicate that the dancer position has moved outside its normal operating range.

EXTERNAL SYSTEM DRIVE OUTPUT COMMAND SIGNAL CONNECTIONS:



The output signal from the dancer position regulator will swing between the positive and negative clamp settings.

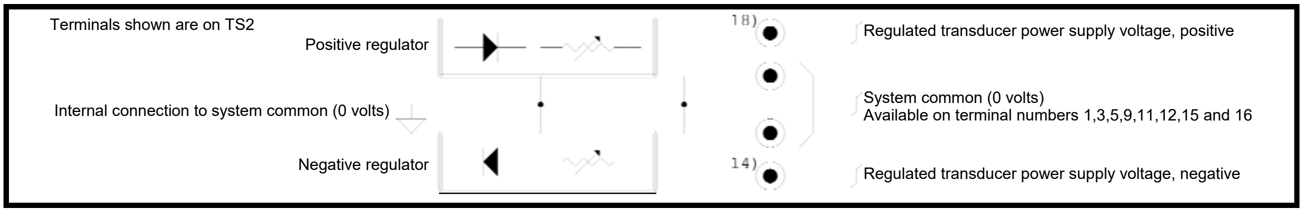
For optimum electrical noise immunity, the connections between the dancer position regulator and the system drive controller should be made with shielded cable. In most applications, the shield should be exposed and connected at the *drive controller end of the run only.*

The dancer position regulator includes an isolation transformer for the power line input on AC operated devices only. *This is the only signal isolation provided*. DC powered controllers are connected directly to the input power supply lines with no isolation.

! ! ! ! ! WARNING ! ! ! ! !

It is the responsibility of the user to ensure that the dancer position regulator output signal is referenced to the same common point (0 volts) as the system drive controller. All installations must have a single common reference point.

EXTERNAL TRANSDUCER POWER SUPPLY CONNECTIONS:



The connections shown above are included for user's who plan to use the dancer position regulators internal power supplies to drive external feedback or command transducers in addition to or in place of the normal position command and feedback potentiometers.

The transducer power supply output current is limited by the regulators ability to dissipate heat as well as the maximum power rating for the transformer on AC line powered models. The maximum output current at all ambient temperatures can be determined from the formula given below:

$$\text{Maximum current (amps)} = \frac{125 - \text{Ambient temperature (degrees C)}}{30.2 * (\text{Supply voltage} - \text{Transducer}}$$

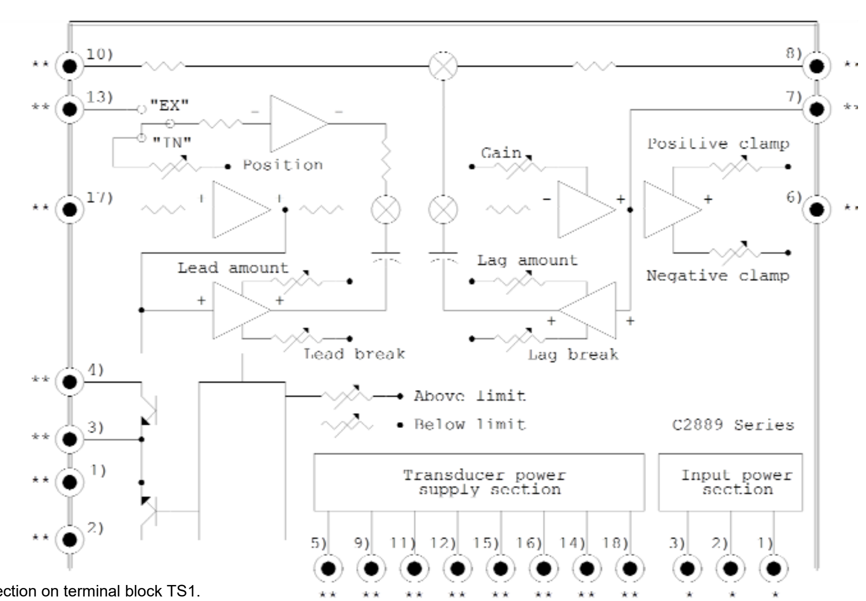
In order to prevent possible damage to the voltage regulators or transformer secondary windings, the maximum current drawn from either output must not exceed .100 amps (100 ma.) under any load or temperature condition.

When using the formula above to calculate the maximum current that can be delivered by the transducer power supply, the supply voltage value inserted for all AC line powered models is 30 volts. For DC powered models, use the maximum applied input power line voltage.

Note: the formula above calculates the absolute maximum output current. The prudent user will limit the output current to lessor values to obtain maximum reliability from the equipment. This is of particular importance when the equipment is operated at high ambient temperatures.

The minimum differential voltage between the power supply inputs and the transducer outputs must be equal to 2.5 volts or greater. Failure to provide this voltage differential may cause poor voltage regulation, reduced current capability and excessive ripple on the transducer power supply output lines.

FUNCTIONAL DIAGRAM



* Denotes connection on terminal block TS1.

** Denotes connection on terminal block TS2.

The functional drawing in the figure above illustrates the signal flow and polarity as well as the interconnections between the signal processing modules supplied on the dancer position regulator circuit board assembly.

The user should carefully examine the logic, signal flow and polarities shown on the functional diagram prior

FUNCTIONAL DIAGRAM, CON'T:

to installation. *Incorrect external wiring connections may damage the dancer roll position regulator or produce unpredictable results when the regulator is applied on a specific system*. User's with questions are encouraged to contact Datatran's technical support department. Our engineers will be pleased to help you select the correct configuration for you application. They can be reached by phone or FAX from 8:00 AM to 5:00 EST or EDT on Monday through Friday.

The terminal blocks for power and signal wiring connections are located on opposite sides of the circuit board to provide the maximum immunity to any induced electrical noise. The terminal blocks plug in to mating pins on the circuit board. In the event that the circuit board assembly must be replaced for any reason this plug in construction eliminates the need to disconnect the external wiring thus reducing the board replacement time to the absolute minimum. The function of each terminal is given in the tables below.

! ! ! ! ! WARNING ! ! ! ! !

The input power line voltage select jumpers are not shown on the functional diagram on the previous page. All dual voltage AC line powered models must have these power line select jumpers set for the correct AC power line voltage prior to applying power to the dancer roll position regulator circuit board assembly.

EXTERNAL TERMINAL BLOCK CONNECTIONS:

Two terminal blocks are provided for the external user connections to the dancer roll position regulator board. The terminals for power and signal wiring connections are separated in order to provide the maximum immunity to any induced electrical noise. The terminal blocks are removable to simplify any required maintenance and plug in to mating pins on the circuit board.

The terminal numbers on each block are numbered from 1, starting from the left most terminal when the block is viewed from the *wire entry side*. Terminal block locations as well as position number 1 for each block are shown in the figure on page 3. The function of each terminal is given in the tables below.

CONNECTIONS TO TERMINAL BLOCK TS1 (*), AC POWERED CONTROLLERS ONLY:	
TS1-1	Power line input, hot connection.
TS1-2	Power line input, neutral connection.
TS1-3	System common (0 volts), connect to the system earth ground, if possible.

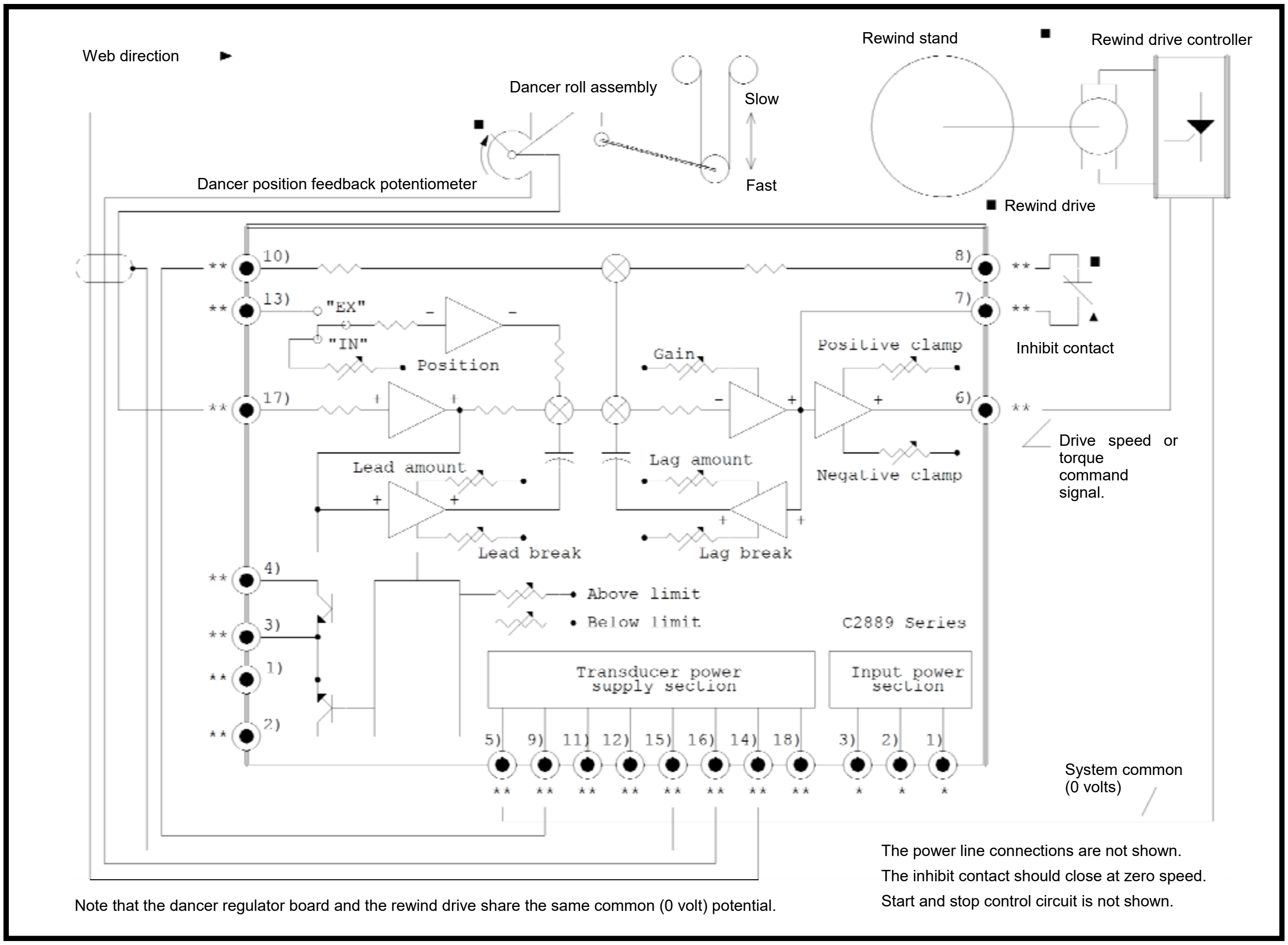
CONNECTIONS TO TERMINAL BLOCK TS1 (*), DC POWERED CONTROLLERS ONLY:	
TS1-1	Power supply input, positive dc voltage.
TS1-2	System common (0 volts), connect to the system earth ground, if possible.
TS1-3	Power supply input, negative dc voltage.

CONNECTIONS TO TERMINAL BLOCK TS2 (**), ALL CONTROLLER MODELS:	
TS2-1	System common (0 volt) connection.
TS2-2	Below limit output signal. Output transistor open collector connection.
TS2-3	System common (0 volt) connection.
TS2-4	Above limit output signal. Output transistor open collector connection.
TS2-5	System common (0 volt) connection.
TS2-6	Dancer position regulator voltage output signal.
TS2-7	Signal output inhibit contact. Connect TS2-7 to TS2-8 to disable the output signal.
TS2-8	Signal output inhibit contact.
TS2-9	System common (0 volt) connection.

EXTERNAL TERMINAL BLOCK CONNECTIONS, CON'T:

CONNECTIONS TO TERMINAL BLOCK TS2 (**), ALL CONTROLLER MODELS:	
TS2-10	External bias or dither voltage signal input.
TS2-11	System common (0 volt) connection.
TS2-12	System common (0 volt) connection.
TS2-13	External dancer position command voltage input signal.
TS2-14	Transducer power supply, negative voltage output.
TS2-15	System common (0 volt) connection.
TS2-16	System common (0 volt) connection.
TS2-17	External dancer feedback position voltage input signal.
TS2-18	System common (0 volt) connection.

APPLICATION EXAMPLE:



! ! ! ! ! WARNING ! ! ! ! !

It is the responsibility of the user to ensure that the dancer position regulator output signal is referenced to the same common point (0 volts) as the system drive controller. All installations must have a single common reference point.

Improper wiring connections or any potential difference in the common potentials may cause high currents to flow through the system, thus causing irreparable damage to both the dancer position regulator and the connected drive controller.

APPLICATION EXAMPLE, CON'T:

! ! ! ! ! CAUTION ! ! ! ! !

The dancer position regulator described in this instruction manual is designed to be applied by experienced user's in closed loop applications.

Although each individual component in a system may function perfectly by itself, once they are interconnected, closed loop operations can be sometimes difficult or in extreme cases, impossible to stabilize.

The type of external load, its location, the process control element gain as well as the system time constants, friction, inertia and electrical noise all contribute to the stability considerations in any closed loop application.

Due to the numerous external factors acting upon the dancer roll position regulator, Datatran is not able to guarantee that satisfactory operation can be obtained in all closed loop applications.

The application shown on the previous page illustrates the use of the dancer position regulator to control the speed of a center bar driven rewind stand. The web tension is maintained constant by the dancer roll assembly loading device (not shown). As the material is taken up by the winder, the drive motor speed will decrease and it's torque (for constant tension) will increase. The rewind drive motor will vary it's speed and torque in response to a positive going output signal from the dancer position regulator. When correctly tuned, the dancer position will remain nearly constant over the entire range of operation. The tuning process for this application is described in the steps below.

The user should note that the dancer position regulator does not contain a forward integral gain block, accordingly some movement of the dancer steady state position is to be expected as the batch diameter increases.

DANCER POSITION REGULATOR LOOP TUNING PROCESS:

The tuning instructions below are written specifically for the rewind application illustrated on the previous page. However, the information contained is such that the experienced user should not have a problem applying the tuning process to similar dancer position control loops.

! ! ! ! ! WARNING ! ! ! ! !

The calibration instructions in this section are for use by qualified service personnel only. Line voltage will exist on the equipment at any time the power line is connected. To avoid possible injury or death do not attempt to calibrate or service this equipment unless you have been properly trained to do so.

1) Verify the installation for correct assembly and wiring. The mechanical portions of the dancer roll assembly must operate smoothly. A dancer roll assembly containing parts with excessive ware or parts that bind as the roll moves may be difficult or impossible to stabilize.
2) With no input power applied, first turn all of the potentiometers, except the "PROPORTIONAL GAIN", the "POSITIVE OUTPUT CLAMP" and the "NEGATIVE OUTPUT CLAMP" c'clockwise twenty five (25) turns. Next, turn the "POSITIVE OUTPUT CLAMP", the "NEGATIVE OUTPUT CLAMP" and the "PROPORTIONAL GAIN" controls clockwise twenty five (25) turns. Finally, turn the "LEAD AMOUNT", the "LAG AMOUNT" and the "LAG BREAK" controls back clockwise approximately twelve (12) turns.
3) Remove the wire connected to terminal number 6 on TS2. This will disable the output signal to the drive controller.
4) Disconnect the mechanical link between the dancer feedback position potentiometer and the dancer roll assembly. Set and secure the dancer roll at it's center position.

DANCER POSITION REGULATOR LOOP TUNING PROCESS, CON'T:

5) Connect a DC voltmeter between the test pin marked "COM" on the circuit board and terminal number 18 on TS2, the transducer positive voltage output.

6) Apply the input power to the dancer position regulator board. If the optional inhibit contact is wired between terminal numbers 7 and 8 on TS2 it must be in the open position.

7) Measure and note the positive transducer power supply voltage reading on the meter. Move the voltmeter connection from terminal number 18 to terminal number 17 on TS2.

8) Rotate the dancer feedback position potentiometer shaft until the voltage on the meter reads 1/2 of the value obtained in step number 6, above. Both the dancer position feedback potentiometer and the dancer roll assembly are now in their center positions.

9) Without moving either the dancer position feedback potentiometer shaft or the dancer roll assembly, mechanically couple the two together. Leave the dancer roll assembly in the center position.

10) Move the voltmeter connection from terminal number 17 to terminal number 6 on TS2. Adjust the dancer position command potentiometer (either the board mounted or external device) until the voltmeter reads less than .05 volts DC.

11) Move the dancer roll assembly to the position where the drive motor should operate at maximum speed. In the rewind example shown, this will be the lower position. The voltmeter should be reading a positive output voltage. The magnitude of the output voltage should be greater than the maximum rated input voltage signal for the drive controller.

    If the voltage reading on the meter is negative with the dancer in the maximum speed position, reverse the connections to terminal numbers 16 and 18 on TS2. The voltmeter should than indicate a positive value.

12) Adjust the "POSITIVE OUTPUT CLAMP" control until the voltmeter reading is equal to the maximum rated drive controller input signal voltage. At this point, turn the "POSITIVE OUTPUT CLAMP" control back clockwise about one turn.

13) Adjust the "PROPORTIONAL GAIN" control c'clockwise until the voltmeter reading starts to decrease. At this point, turn the "PROPORTIONAL GAIN" control back clockwise until the voltmeter reading is the same as the drive controller maximum rated input signal voltage.

14) Move the dancer roll assembly to it's minimum speed position. In the rewind example shown, this will be the raised position. The voltmeter should be reading a negative voltage.

15) Adjust the "NEGATIVE OUTPUT CLAMP" control until the voltmeter reads zero volts.

16) Move the dancer roll over it's entire range of travel. The dancer position feedback potentiometer must not reach it's mechanical or electrical endpoints as the dancer roll assembly is moved between the mechanical limits. In the event that the potentiometer end points are reached, *the ratio between the dancer roll and the potentiometer must be modified* before proceeding with the loop tuning process.

17) If the digital limit outputs are not going to be used proceed to step number 20, below.

18) Move the dancer roll assembly to the position where the "BELOW" limit output should turn on. Adjust the "BELOW LIMIT" control until the load connected to the BELOW limit output energizes. Move the dancer roll assembly to it's minimum speed position. The "BELOW" limit output should remain energized.

19) Move the dancer roll assembly to the position where the "ABOVE" limit output should turn on. Adjust the "ABOVE LIMIT" control until the load connected to the "ABOVE" limit output energizes. Move the dancer roll assembly to it's maximum speed position. The "ABOVE" limit output should remain energized.

20) Remove the input power from the dancer position regulator board. Reconnect the wire to terminal number 6 on TS2 to the drive controller. Disconnect the voltmeter.

21) Thread the equipment and securely fasten the web to the rewind core. The prudent user will install a light web at this point under the assumption that the drive may become unstable during the turning process. The web should break rather than damage the dancer roll assembly or other process equipment.

    Should the web break or slack accumulate in the dancer roll assembly at any time when the drive controller is in the run mode, the rewind drive motor will immediately accelerate and run at it's maximum speed. The user should be prepared to manually stop the drive should this occur.

22) Apply tension to the web with the dancer roll loading system. The amount of dancer roll tension should be great enough to force the dancer roll assembly towards it's maximum speed position with a zero signal applied to the rewind drive controller. ***Remove all of the slack from the web prior to energizing***

the rewind drive. The web must contact the dancer roll assembly any time the rewind drive controller is in the run mode.

Because the dancer position regulator will be unable to control the rewind drive motor at any time a slack or broken web condition exists. It is strongly recommended that the limit outputs be used to override the dancer position regulator drive signal should either of these conditions occur.

23) Do ***not start the process main drive at this point.*** Apply power to the dancer position regulator, open the inhibit contact and set the rewind drive controller to it's run mode. The rewind drive motor should run and smoothly move the dancer close to the center position.

24) Turn the "PROPORTIONAL GAIN" control clockwise approximately one turn. Stop the rewind drive and force the dancer toward it's maximum speed position and release it. Start the rewind drive, again the rewind drive motor should run and return the dancer close to it's center position. Repeat this step until the dancer roll starts to oscillate or display large overshoots around the center position. Stop the rewind drive.

    As the "PROPORTIONAL GAIN" setting is increased the rewind drive motor should move the dancer roll closer to the mechanical center as defined when the dancer roll was connected to the dancer feedback position potentiometer.

25) Turn the "LEAD AMOUNT" control clockwise approximately one turn. Force the dancer toward it's maximum speed position and release it. Start the rewind drive, the rewind drive motor should run and return the dancer close to it's center position. Stop the rewind drive. Repeat this step, increasing the "LEAD AMOUNT" each time until the dancer roll returns to the center position in a continuous smooth move with no oscillation and a minimum of overshoot. In the event that the oscillation can not be removed with the "LEAD AMOUNT" control, the "PROPORTIONAL GAIN" control setting must be reduced (turned c'clockwise) until stable operation is reestablished.

    Note, the "LAG AMOUNT" control can also be used to dampen the drive oscillation. However this control will tend to slow down the response and should be used as a last resort. The preferred method to obtain stable operation at this point is to reduce the "PROPORTIONAL GAIN" control setting.

    A "LEAD AMOUNT" setting that is too high will cause the dancer roll to move towards it's center position in a series of steps as opposed to one smooth transition. You may be able to smooth this out by increasing the "LEAD BREAK" setting (clockwise rotation). If this does not work, the "LEAD AMOUNT" and "PROPORTIONAL GAIN" settings should be reduced until a smooth transition is obtained.

26) Once the dancer roll assembly is adjusted for stable static operation, as described above. Start the main process drive and set it to run at about 50% of it's maximum speed. The rewind should take up the web being delivered with the dancer roll close to it's center position. The dancer roll will move closer to the mechanical center position as the rewind batch diameter goes from the core size to it's maximum diameter.

    The amount of dancer movement during the winding process depends upon the system gain setting and the total speed range required from the rewind drive. Very low gain settings may require that the center position be moved slightly by adjusting the "DANCER POSITION" command potentiometer.

    Small high speed oscillation of the dancer roll assembly when the process is running can be dampened by increasing (turning clockwise) the "LEAD BREAK" or "LAG AMOUNT" controls. If the oscillation is caused by a out of round or eccentric batch the "LAG AMOUNT" should be increased, otherwise increase the "LEAD BREAK" setting.

    You should note that too much "LEAD BREAK" may cancel the stability condition obtained with the "LEAD AMOUNT" control. If this happens, reduce the "PROPORTIONAL GAIN" amount to regain system stability.

27) Once stable operation is obtained at 50% processing speed, reduce the process speed to it's lowest value. The dancer roll should remain stable and close to it's center point.

28) Increase the process speed to it's maximum value , the dancer roll should remain stable and close to it's center position.

29) Start and stop the process and vary the processing speed over it's entire range. ***The dancer must be stable over the entire range of operation.*** Remember, a slack or broken web condition at any time will cause the dancer position regulator to loose control of the loop and the rewind drive will immediately accelerate and run at its top speed until the dancer is returned to it's working range.

    The dancer roll assembly can always be stabilized by reducing the "PROPORTIONAL GAIN" setting.

DANCER POSITION REGULATOR LOOP TUNING PROCESS, CON'T:

However, the lower the gain setting, the more the dancer roll will move as the line speed and batch diameter change. In extreme cases, the dancer roll travel may have to be increased to handle this displacement without having the dancer contact it's mechanical limits.

For those applications where the user should be notified or other action taken if the dancer roll should reach the mechanical stops, Datatran's model series C2699 Heavy duty, geared potentiometer assemblies can be supplied with internal end og travel limit switches. These limit switches are open collector transistor outputs that can be used to operate external alarms or annunciators as required.

THE DANCER LOOP MUST BE STABLE UNDER ALL CONDITIONS!

Any process that oscillates or rings in an uncontrolled manner is not only not working, it may damage the equipment or cause injury to personnel.. If you are forced to choose between accuracy and stability, always set the process for stable operation.

30) Once the dancer roll stability and movement range have been verified over the entire range of operation you have produced a working dancer position control loop. The tuning process is complete.

The dancer position regulator loop tuning process described above will produce a working system in most applications. However, the loop is most likely not perfectly tuned in the classic sense. Experienced user's may wish to perform additional fine tuning in an attempt to further optimize the response of the system. Should you decide to attempt this, you should bear in mind the following loop tuning relationships.

- Increasing the loops proportional gain setting will decrease the stability of the system while reducing it's response time. The higher the gain setting, the less the dancer movement during the winding process. Proportional gain alone will always cause the system to cycle around the setpoint.
- Increasing the lead amount (derivative) will tend to reduce overshoot and ringing due to a step disturbance, however too much lead action will lengthen the time required for the process to stabilize. The lead action is only effective with dynamic signals.
- Increasing the lead amount will add high frequency noise to the regulator output. The lead break control acts as a filter and will remove some of this noise, however if the lead break control is set too high the lead amount setting will be canceled.
- Increasing the lag amount will slow down (integrate) the regulator's output signal and cause the drive to react in a damped and sluggish manner. Too much lag amount will cause the system to become unstable. The lag amount also works to cancel the effects of the lead amount adjustment.
- Increasing the lag break will reduce the lag amount at high frequencies. Too much lag break will tend to cancel the lag amount setting.
- In general, dancer roll loop tuning should be approached as a black art as opposed to an exact science. What works for one application may be totally wrong for the next. Always make small adjustments to one setting at a time and allow the loop to respond before proceeding with the next. Feel free to experiment, experience is the best teacher.

SPECIFICATIONS:

DC INPUT POWER SUPPLY REQUIREMENTS:	+/- 15 VDC minimum with suffix AAA = 150
	+/- 18 VDC minimum with suffix AAA = 180

The maximum power supply voltage for all dc powered models is +/- 30 volts dc. The power supply must deliver a minimum of 40 ma., plus the transducer power supply current.

SPECIFICATIONS, CON'T:

AC INPUT POWER SUPPLY REQUIREMENTS: 205 to 250 VAC with suffix AAA = 231

105 to 130 VAC or 205 to 250 VAC with suffix AAA = 111

All ac line powered models will operate with line frequencies from 47 to 62 Hz.

AC INPUT POWER REQUIREMENT: 6 VA maximum with maximum transducer current.

TRANSDUCER POWER SUPPLY VOLTAGE +/- 5.0 volts dc with suffix BBB = 050

+/- 6.8 volts dc with suffix BBB = 068 +/- 10.0 volts dc with suffix BBB = 100

+/- 12.0 volts dc with suffix BBB = 120 +/- 15.0 volts dc with suffix BBB = 150

TRANSDUCER POWER SUPPLY CURRENT: +/- 100 ma., maximum.

Refer to the transducer power supply connection section for thermal limit notes and calculation.

TRANSDUCER POWER SUPPLY REGULATION: Line regulation = .8% maximum.

Load regulation = .5% maximum.

Thermal regulation = .07% per watt, maximum.

Line regulation is with the input power supply varied over the limits specified in the power supply requirement section, above.

Load regulation is with the transducer power supply output currents from 15 to 100 ma.

RATED INPUT VOLTAGE SIGNALS : +/- 5.0 volts dc with suffix CCC = 050

+/- 6.8 volts dc with suffix CCC = 068

+/- 10.0 volts dc with suffix BBB = 100

+/- 12.0 volts dc with suffix CCC = 120

All voltage inputs will withstand up to 300% of the rated voltage without damage.

RATED INPUT CURRENT SIGNAL: + 4 to + 20 ma. with suffix CCC = 420

The current input will withstand up to 60 ma. without damage. Current input is not available for the bias or external position command input signals. Current input models are shipped with the external position command voltage signal rated for the transducer power supply value.

INPUT SIGNAL IMPEDANCE: All voltage input terminals are 100K ohms, except terminal number 10on terminal block TS2. The current signal line input has as impedance of 250 ohms, except terminal number 10 on terminal block TS2. The 250 ohm impedance will require a compliance voltage of 5 volts at 20 ma. input current. The input impedance at terminal number 10 on TS2 is always 10K ohms.

RATED OUTPUT VOLTAGE SIGNAL: +/- 10 volts dc maximum, all models.

RATED OUTPUT CURRENT: +/- 5 ma. with all suffix CCC versions

The output currents are specified with the input power supply set to +/- 10 volts dc.

OUTPUT VOLTAGE STABILITY AND DRIFT: Better than 1% at unity gain.

DIGITAL LIMIT OUTPUT TYPE: Open collector, type NPN transistor.

The emitters for both limit output transistors are connected internally to the system common (0 volts).

SPECIFICATIONS, CON'T:

RATED LIMIT SINK CURRENT (ON STATE):	500 ma., maximum for all models.
LIMIT VOLTAGE DROP (ON STATE):	1 volt maximum at 500 ma. load current.
RATED LIMIT BLOCKING VOLTAGE (OFF STATE):	60 volts dc , maximum.
LIMIT LEAKAGE CURRENT (OFF STATE):	5 ma. maximum at 60 volts dc.
PROPORTIONAL GAIN ADJUSTMENT RANGE:	1% to 26% per 1% input volts.
LAG AMOUNT ADJUSTMENT RANGE:	0% to 67% per 1% input volts.
LAG AMOUNT ADJUSTMENT RANGE:	0% to 67% per 1% input volts.
LEAD AND LAG BREAK FREQUENCY RESPONSE:	Essentially flat above 12 Hz.
OUTPUT VOLTAGE CLAMP ADJUSTMENT RANGE:	0 to plus and minus 12 volts dc.
ABOVE AND BELOW LIMIT ADJUSTMENT RANGE:	0% to 110% of rated input voltage range.
DANCER POSITION ADJUSTMENT RANGE:	0% to 100% of rated input voltage range.
TRANSDUCER POWER SUPPLY ADJUSTMENT RANGE:	+/- 10% of nominal, minimum.

ADJUSTMENT POTENTIOMETERS: All are twenty five (25) turns, nominal. Totally enclosed and sealed against dirt and other contaminates per MIL-STD-202. Method 103.

OPERATING TEMPERATURE: - 20 degrees to + 55 degrees C.

Extended temperature range operation is available, contact Datatran's Sales Department for availability and price.

PART NUMBER IDENTIFICATION:

All dancer roll position regulator circuit board assemblies utilize the same basic model series identifier number. This number is modified with a suffix to indicate a particular combination of options. The format for the complete part number is illustrated in the example below:

Option identifier suffix groups

Model series identifier

C2889-AAA-BBB-CCC-DD

PART NUMBER SUFFIX GROUP EXPLANATION	
SUFFIX	**DESCRIPTION**
AAA	Minimum power supply voltage
BBB	Rated transducer power supply voltage
CCC	Maximum input signal voltage or current
DD	Factory installed option identifier

Parts shipped from the factory will have the correct alphanumeric option identifier in place of the suffix letters indicated in the table above. Refer to the C2889 model series selection sheet for a complete listing of all available models.

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