nexen®

WEB CONTROL PRODUCTS

User Manual

Digital Dancer Position Controller
RSD100 & RSD100P

FORM NO. L-21107-G-1105

In accordance with Nexen's established policy of constant product improvement, the specifications contained in this manual are subject to change without notice. Technical data listed in this manual are based on the latest information available at the time of printing and are also subject to change without notice.

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www.nexengroup.com

DANGER

Read this manual carefully before installation and operation.

Follow Nexen's instructions and integrate this unit into your system with care.

This unit should be installed, operated and maintained by qualified personnel ONLY.

Improper installation can damage your system or cause injury or death.

Comply with all applicable codes.

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ISO 9001 Certified

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INTRODUCTION

The Nexen RSD100 is a microprocessor based position controller designed to minimize dancer arm movement during tension disturbances and then return the arm to its running position. The RSD100 features two different control choices: First, using the analog output and a Nexen current or voltage to pressure transducer such as the EN40 or EN50 to control a Nexen pneumatic brake or clutch (Refer to Figure 1.); Second, using the analog output as a tension trim signal for an unwind or rewind motor drive. The RSD100 is housed in a dust tight and drip proof enclosure enabling it to be mounted near the brake or clutch. All set up parameters are passed to the controller via RS232 connection that makes remote control and adjustment possible.

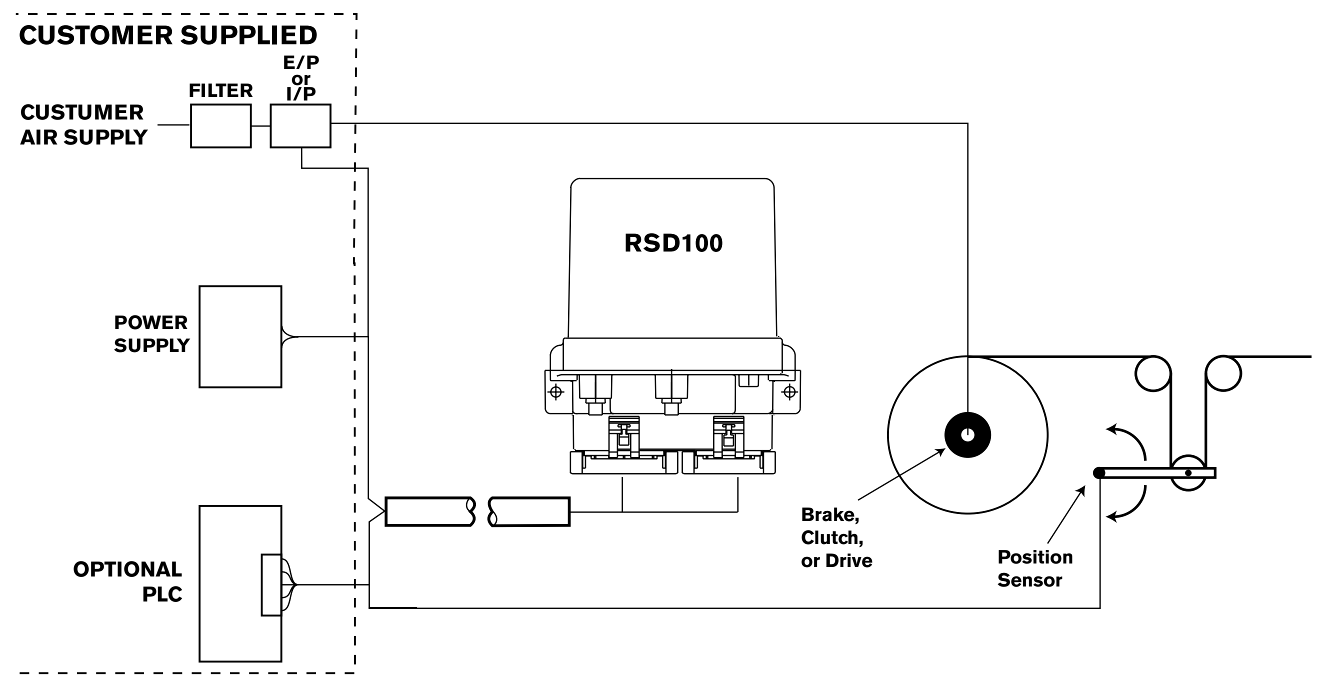


Figure 1 Using External E/P or I/P

RSD100 Overview

Adaptation is the key to high performance dancer control. As a roll changes from maximum to minimum diameter, a dancer control must adapt to the corresponding changes in speed, inertia and torque. In addition, many web machines run wide tension ranges from heavy weight paper to light weight poly, which require very different tension settings. Being able to adapt for the effects of tension setpoint changes is important when high performance dancer control is desired. High performance dancer control allows faster machine accelerations and decelerations which means higher production rates on many machines.

RSD100 Application Chart

From simple slitting machines to high performance flexographic printing machines, the RSD100 has the versatility and performance to get the job done. Use the RSD100 application chart to determine the appropriate hardware, and signals for the application. The chart is divided into two general application types:

Constant Tension Setpoint Machines (tension setting is not changed more than +/- 20%).

Variable Tension Setpoint Machines (tension setting is changed more than +/- 20%).

Start from the left and follow the chart across to your application.

Application Chart Key

Symbol	Meaning	Description
●	Must Have	This item is needed for the system to function.
NN	Not Needed	System performance will not be enhanced with this item.
HP	High Performance	The system's performance can be enhanced with this item. Acceleration/deceleration times may be limited without this item.
(grey)	Not Applicable	This item cannot be used with the present configuration.

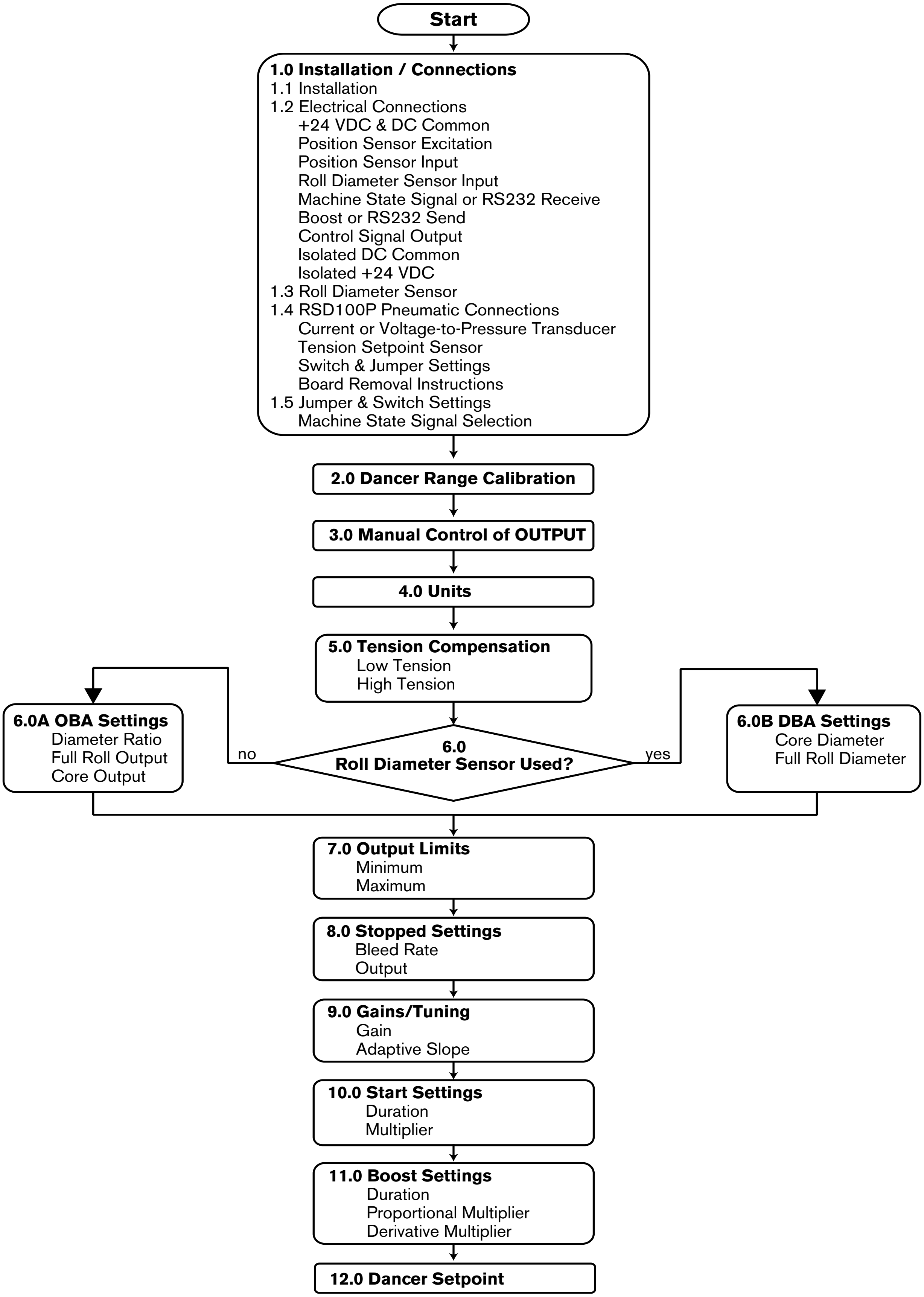
RSD100 Application Chart

			Torque Device	RSD100	RSD100P	Dancer Position Sensor	24 VDC Power	Roll Diameter Sensor	I/P or E/P	Instrument Quality Air	Multi-Piston Brake (Manual Selection)	Multi-Piston Brake (Automatic Selection)*	Machine State Signal	Boost Signal	Dancer Air Pressure Signal
				Hardware									Signals		
Constant Tension Sepoint Machines	No Flying Splices &/or Extensible Webs		Brake/Clutch	●	NN	●	●	NN	●	●	NN	NN	●	NN	NN
			Drive	●	NN	●	●	NN					●	NN	NN
	Flying Splices &/or Extensible Webs		Brake/Clutch	●	NN	●	●	HP	●	●	NN	NN	●	HP	NN
			Drive	●	NN	●	●	HP					●	HP	NN
Variable Tension Setpoint Machines	No Flying Splices No Extensible Webs		Brake/Clutch	●	HP	●	●	HP	●	●	HP	HP	●	NN	●
			Drive	●	HP	●	●	HP					●	NN	●
		Non-pneumatic Dancer	Brake/Clutch	●		●	●	HP	●	●		HP	●	HP	
			Drive	●		●	●	HP					●	HP	
	Extensible Webs &/or Flying Splices		Brake/Clutch		●	●	●	HP	●	●	●	HP	●	HP	●
			Drive		●	●	●	HP					●	HP	●
		Non-pneumatic Dancer	Brake/Clutch	●		●	●	HP	●	●		●	●	HP	
			Drive	●		●	●	HP					●	●	

* A manually switched multipiston brake can be used, but the automatically switched braking system will provide automated operation with higher performance dancer control. Consult Nexen for availability of this system.

RSD100 Setup

The following flowchart outlines the RSD100 setup.



1.0 INSTALLATION / CONNECTIONS

1.1 Installation

The RSD100 can be located near the pneumatic brake or clutch being controlled and can be mounted horizontally or vertically. Provide enough clearance around the RSD100 to allow removal of the cover and the hold down screws.

NOTE: For best performance and reliability, locate the current or voltage to pressure converter near the brake or clutch. Use a regulated clean air supply and a filter of 20 microns or less.

CAUTION

Mount the RSD100 in a shock and vibration free area with an ambient temperature of less than 140°F [60°C] and more than 32°F [0°C].

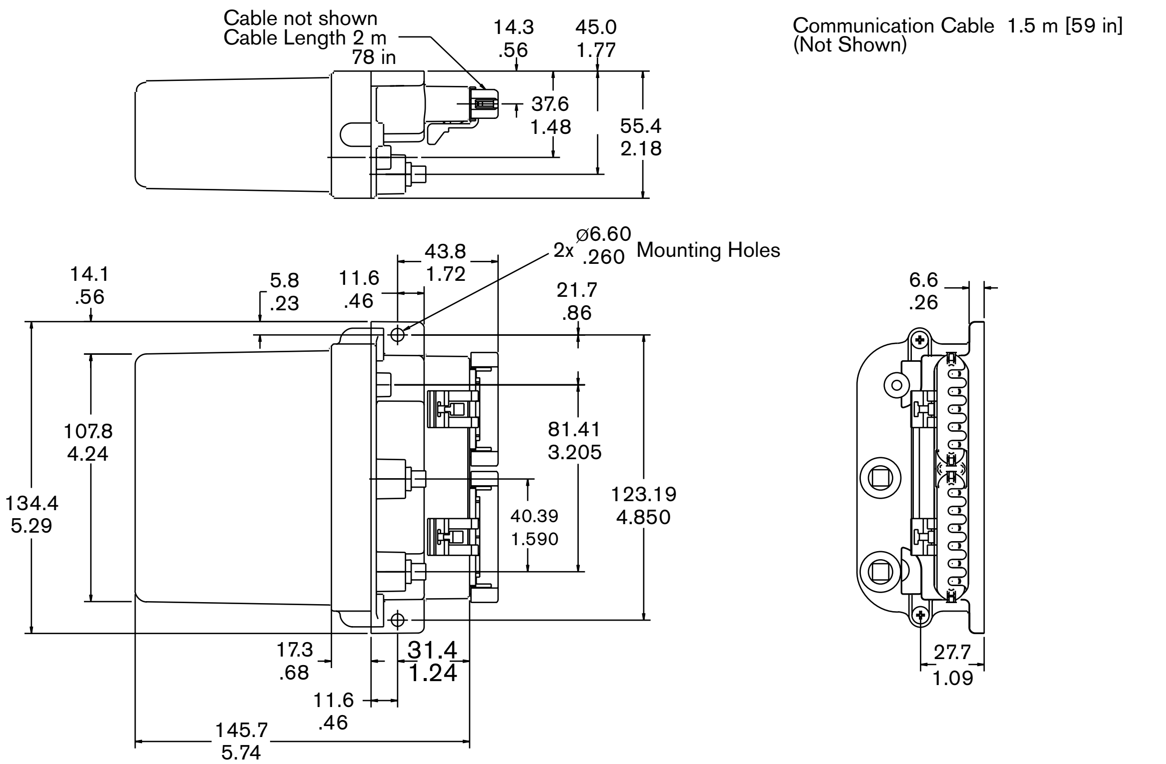


Figure 2

1.2 Electrical Connections

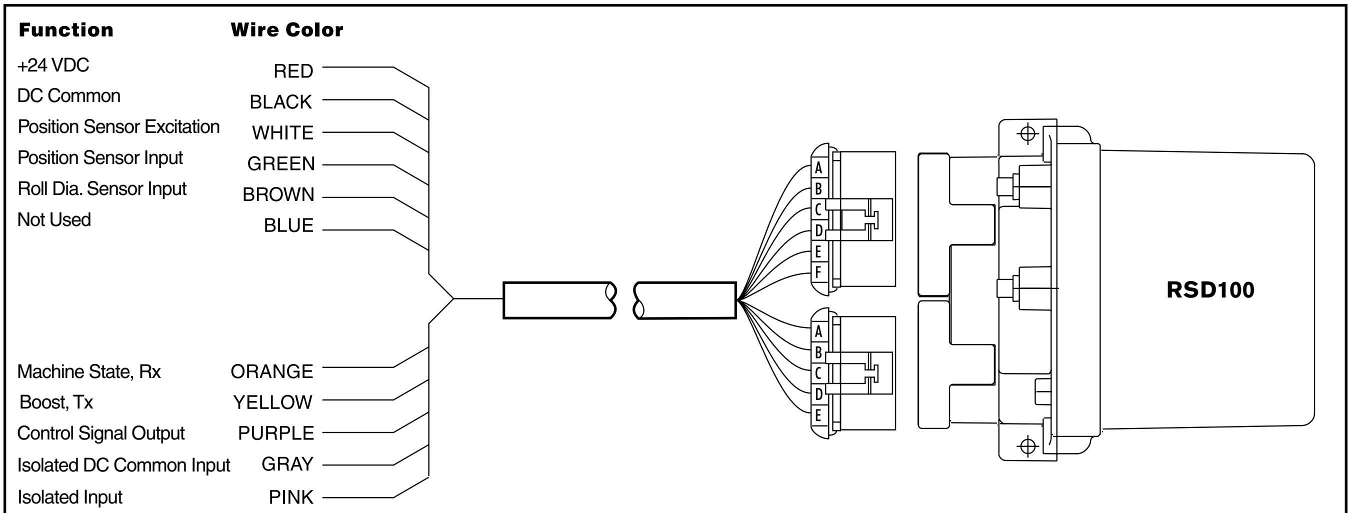


Figure 3 **RSD100 Electrical Connections**

+24 VDC & DC Common: The RSD100 requires 24 VDC to operate (Refer to the ***SPECIFICATIONS*** section for current rating.).

Position Sensor Excitation: This output provides +12 VDC as an excitation voltage for dancer arm position sensors such as Nexen's DPS 30 or DPS 60 and mechanical potentiometers (Refer to the ***SPECIFICATIONS*** section for current rating.).

Position Sensor Input: The position sensor input is a 0–10 or 0–12 VDC signal that is provided from the dancer arm position sensor. The choice of voltage range is selected by Jumper W3 (Refer to Figure 8). For best results the voltage range should match the dancer arm swing (i.e.: a 30° dancer arm swing should produce nearly a 0–10 VDC or 0–12 VDC position signal).

Roll Diameter Sensor Input: This input accepts a 0 – 10 VDC signal that represents roll diameters from maximum full roll to core (refer to Section 6.0B).

Machine State Signal or RS232 Receive: This input has two functions: first, to accept a Machine State Signal; and second, to act as the receive line for RS232 communications. The function is chosen by Jumper W5 (Refer to Figure 8).

As a Machine State input, this signal uses Isolated DC Common as a return. When 12-24 VDC is applied, the controller will respond according to how this input was setup (refer to Machine State Signal selection in Section 1.5). This feature tells the RSD100 controller when the machine starts and stops. A yellow indicator, I6, on the controller's printed circuit board will be on when 12-24 VDC is present at this input.

As the receive line (Rx) for RS232 communications, this input, the next input (Tx), and DC Common are all that is needed to communicate with the RSD100 (Refer to Figure 5.). Communications setup broadcast and command parameters can be sent back and forth between the controller and other devices such as a PLC or computer by using RS232 . When using this input as the receive line for RS232 communications, the Machine State Signal command has to be sent via this communications link.

Boost or RS232 Send: This input has two functions: first, to accept the Boost signal; and second, to act as the send line for RS232 communications. The function is chosen by jumper W6 (Refer to Figure 8).

As the Boost input, this signal uses the Isolated DC Common as a return. When 12-24 VDC is applied momentarily, the controller will respond by applying Boost Multipliers to the controller gains (refer to Section 11). This feature is used to increase the responsiveness of the RSD100 during events such as machine acceleration and deceleration. Otherwise, when no signal is present, the controller will operate normally. A yellow indicator, I5, on the controller's circuit board will be on when 12-24 VDC is present at this input.

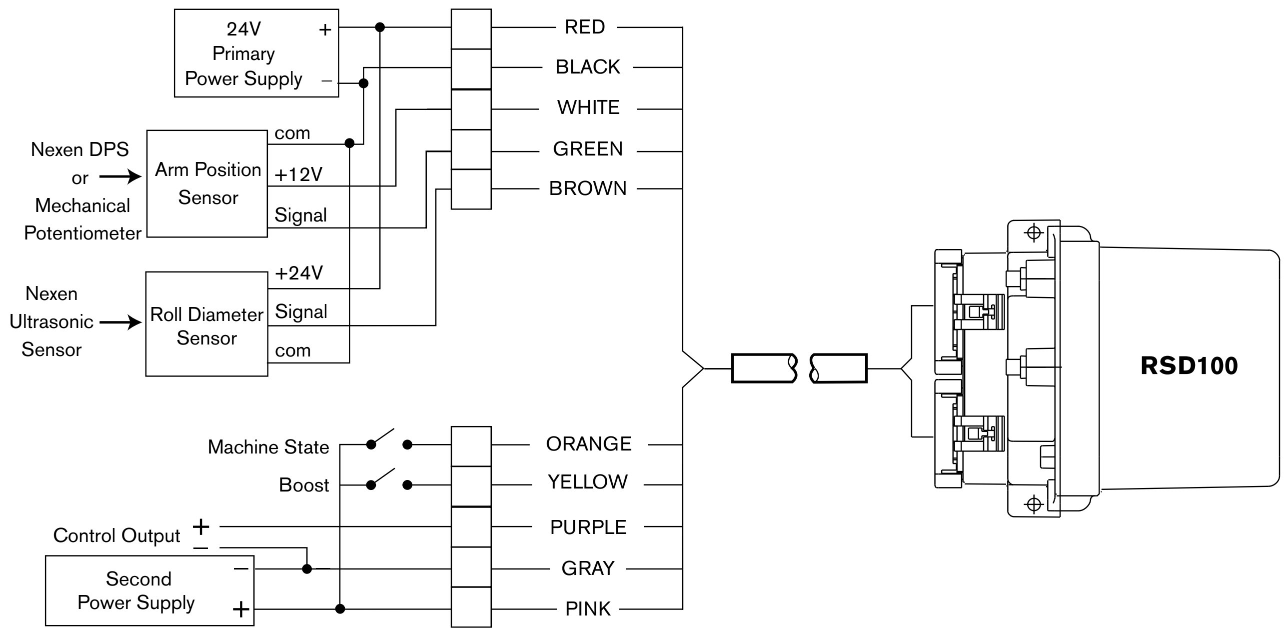
As the send line (Tx) for RS232 communications, this input, the previous input (Rx), and DC common are all that is needed to communicate with the RSD100 (Refer to Figure 5.). Communications setup broadcast and command parameters can be sent back and forth between the controller and other devices such as a PLC or computer by using RS232. When using this input as the send line for RS232 communications, the Boost command has to be sent via this communications link.

Control Signal Output: This output signal can be used as an input to a current or voltage-to-pressure transducer or as a trim signal to a motor drive. The output is chosen by jumper W7 (Refer to Figure 8). The output can be set to 0–10 VDC or 4–20 mA. Both ranges are already calibrated and ready for use.

Isolated DC Common Input: In cases where isolated Machine State and Boost inputs or Analog Signal Output is desired, this input is the return line for the isolated power supply (supplied by user). If isolation is not needed, this input must be connected to DC Common input.

Isolated +24 VDC Input: In cases where isolated Machine State and Boost inputs or Analog Signal Output is desired, this input is the supply line for the isolated 15-24 VDC power supply (supplied by user). If isolation is not needed, this input must be connected to the +24 VDC input.

External Electrical Connections
Isolated Output



External Electrical Connections
Non-Isolated Output

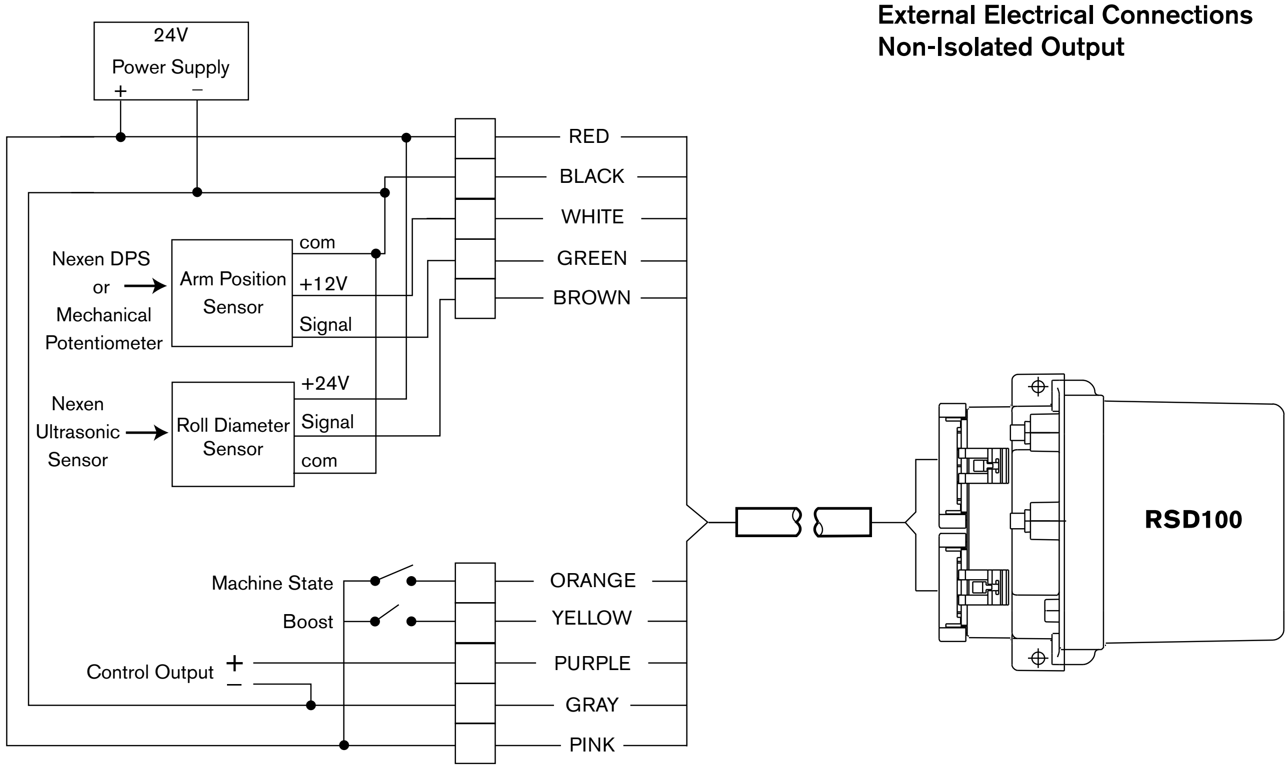


Figure 4

RS232 Connections

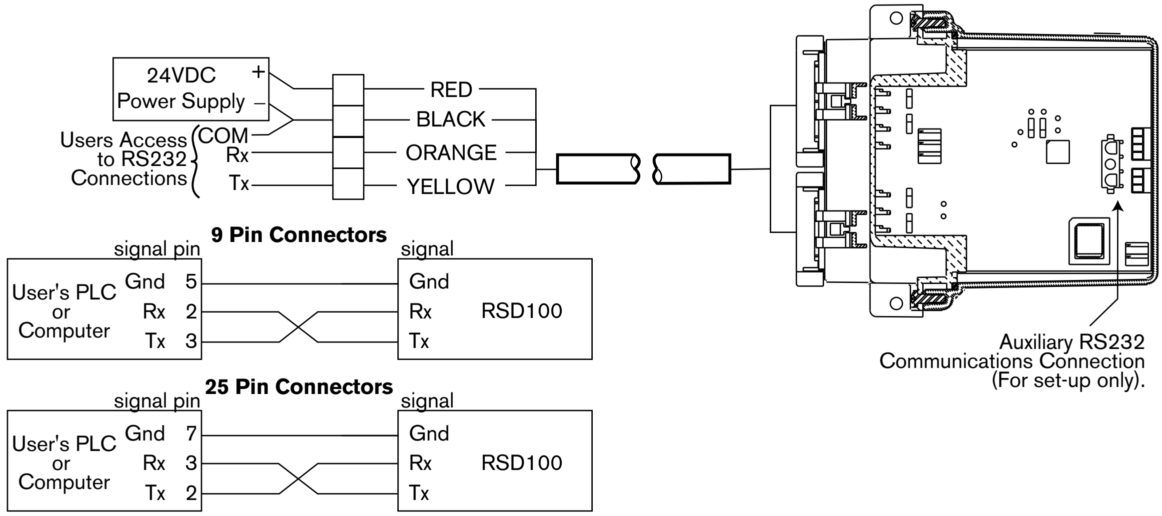


Figure 5

Minimum Connections Necessary For Pneumatic Brake or Clutch Application:

The RSD100 must have at least the following connected to it for a pneumatic brake or clutch application: a 24 VDC Power Supply, Dancer Arm Position Sensor, Current- or Voltage-to-Pressure Transducer, and a dry circuit contact or switch (Refer to Figure 4).

24 VDC Power Supply: Provides the power for operation (Refer to SPECIFICATIONS for details).

Dancer Arm Position Sensor: Provides an analog signal that tracks dancer arm movement.

Current- or Voltage-to-Pressure Transducer: (ex. Nexen's EN50 or EN40) Converts the appropriate control output (i.e. 4-20 mA or 0-10 VDC) into air pressure for use with a pneumatic brake or clutch.

Machine State Signal: Provides a machine state signal (ie: start, stop) to the RSD100.

Minimum Connections Necessary For Motor Drive Application:

The RSD100 must have at least the following connected to it for a motor drive applications: a 24 VDC Power Supply, Dancer Arm Position Sensor, optional second power supply, and a dry circuit contact or switch (Refer to Figure 4).

24 VDC Power Supply: Provides the power for operation (Refer SPECIFICATIONS for details).

Dancer Arm Position Sensor: Provides an analog signal that tracks dancer arm movement.

Optional Power Supply: Used when isolated inputs or output is required. Most commonly used to prevent the mixing of power supply commons together when connecting the analog output to a motor drive (Refer to SPECIFICATIONS for details).

Machine State Signal: Provides a machine state signal (ie: start, stop) to the RSD100.

1.3 Roll Diameter Sensor

An Ultrasonic Sensor can measure the change in roll radius by bouncing sound waves off the material, enabling the RSD100 to calculate roll diameter. For calibrations to be accurate, the sensor must be installed perpendicular to the axis of the wind or unwind shaft. Also, the Ultrasonic Sensor must be mounted at least four inches [100 mm] away from the maximum diameter roll.

Adjustment of the Ultrasonic Sensor

Nexen's Ultrasonic Sensor is factory adjusted for a 4 to 40 inch range and typically does not require re-adjustment prior to use. If a shorter range is desired, then re-adjustment may be performed by connecting a voltmeter to the sensor's output and turning P1 for the near point adjustment and P2 for the far point adjustment. (See figure 6) Adjust P1 and P2 until the output voltage covers as much of the 0 to 10 VDC range as possible over the desired distance.

NOTE: The indicator on the end of the Ultrasonic Sensor provides an indication of signal strength. The indicator will light GREEN when the target is out of range, and it fades to RED as a target moves into range, depending on how much reflected signal it receives from the target.

An Ultrasonic Sensor (See Figure 6) must be calibrated to measure a minimum core diameter and a maximum roll diameter that will be placed on the machine. Refer to the 6.0B Diameter Based Adaptation Settings section for a description of this procedure.

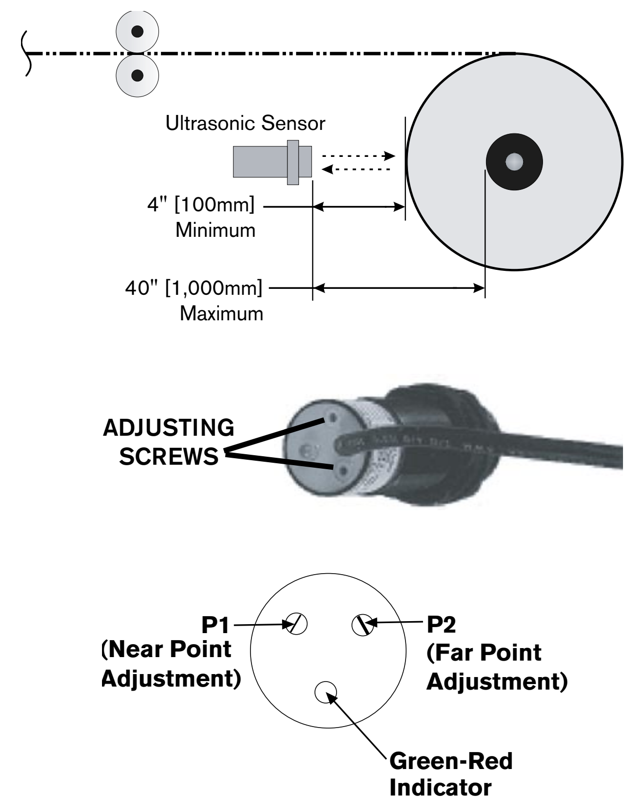


Figure 6 - Ultrasonic Sensor

1.4 RDS100P Pneumatic Connections

Nexen developed the RSD100P for applications that would benefit from tension setpoint compensation (as determined by the RSD100 Applications Chart). The RSD100P features an integral pressure sensor that connects to the air supply pressure of the dancer arm loading cylinder. As the tension setpoint changes via the air pressure of the loading cylinder, the RSD100P measures this change and adjusts its performance accordingly. The RSD100P pressure sensor's calibration procedure is listed in the Tension Compensation portion of Section 5.

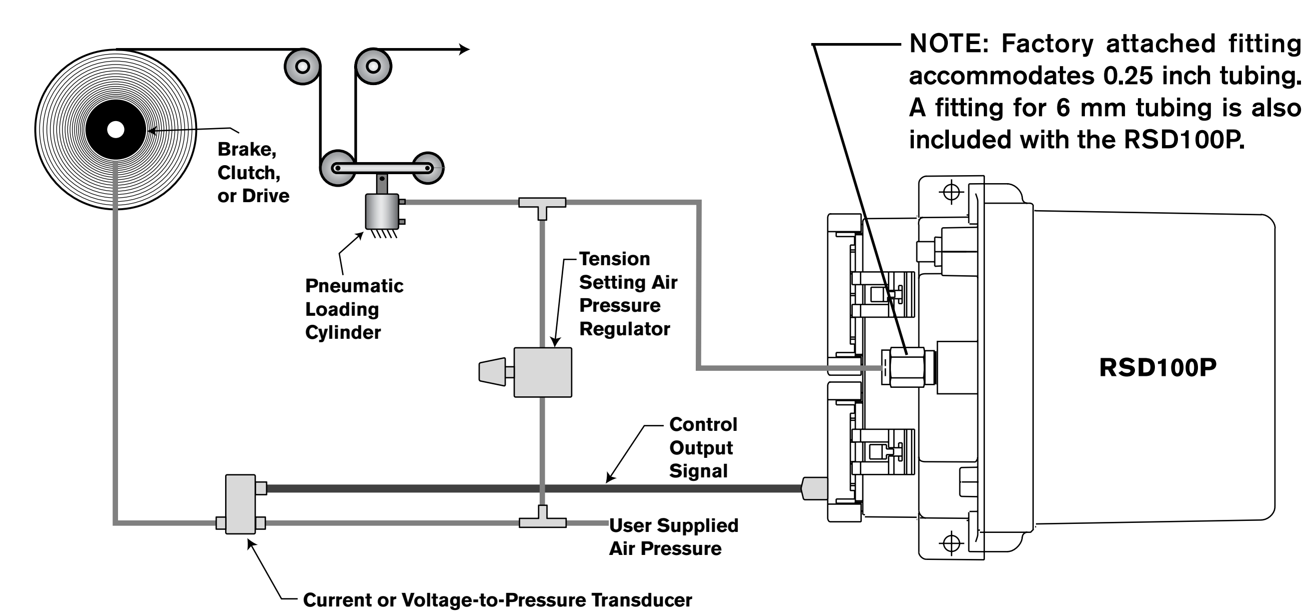


Figure 7

1.5 Jumper & Switch Settings

Make the appropriate Jumper and Switch Settings shown below for your application. The RSD100 printed circuit-board can be removed to facilitate access to all jumpers and switches.

Board Removal Instructions:

1. Remove power from RSD100.
2. Disconnect the Power and Signal Cable Connectors from the RSD100 base.
3. Move the printed circuit board side-to-side while pulling to remove board.

Jumper and Switch Settings: (Refer to Figure 8.)

Jumper W1	NORM, if controller action is backwards, then select REV
Jumper W2	Position 1
Jumper W3	10 V or 12 V, depends on maximum output voltage of sensor, use 10 V for Nexen's DPS 30 or DPS 60 sensor, and 12V for mechanical potentiometer.
Jumper W4	10 V, for Nexen's Roll Diameter Sensor
Jumper W5	Dig. In 1, if using this input for Machine State Signal Rx, if using this input for RS232 communication
Jumper W6	Dig. In 2, if using this input for Boost Signal Tx, if using this input for RS232 communication
Jumper W7	V Out, for 0 – 10 VDC analog output I Out, for 4 – 20 mA analog output
Rotary Switch	Refer to Table 2

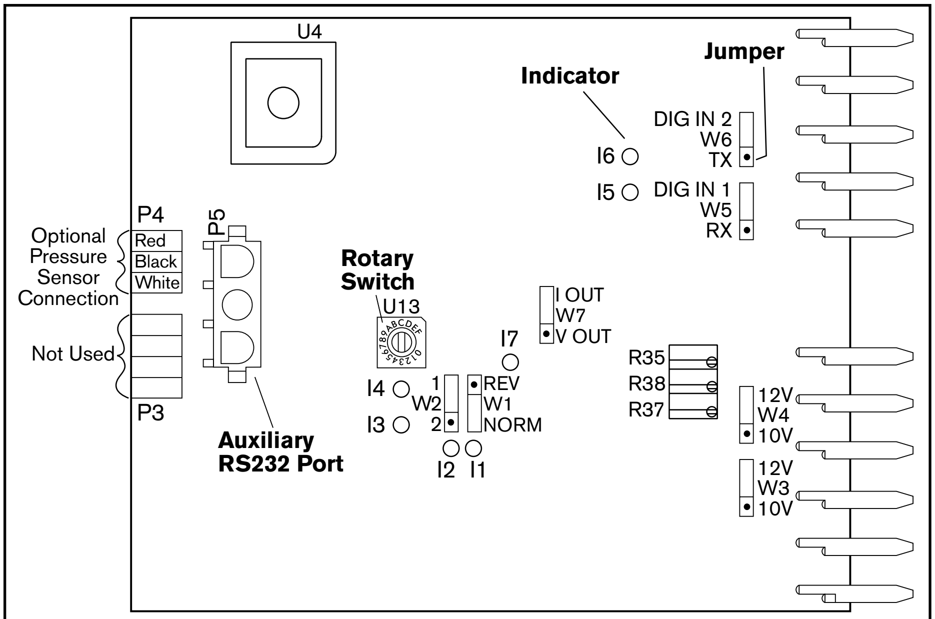


Figure 8

Table 1

Designation	Color	Function
I1	Green	"ON when +5 VDC is present
I2	Green	"ON" when +12 VDC is present
I3	Red	"ON" when increasing air pressure
I4	Red	"ON" when decreasing air pressure
I5	Yellow	"ON" when voltage is applied to Boost Input
I6	Yellow	"ON" when voltage is applied to Machine State Input
I7	Yellow	"ON" when in manual control

After completing all jumper and switch settings: replace printed circuit board, reconnect connectors and apply 24 VDC power. Next, check that both green Indicators, I1 and I2, are on. If not, refer to the TROUBLESHOOTING section. Otherwise, connect the RSD Communications Software cable to the Auxiliary RS232 Port and a computer. Refer to the RSD Communications Software Installation and Connection Manual for instructions how to use the program.

Machine State Signal Selection

The RSD100 needs to know what the machine is doing (i.e. starting, running and stopping). This is accomplished through the Machine State signal input to the RSD100. Because many machines operate differently, the RSD100 was designed to accommodate many different types of machine state signals. The following figure and descriptions detail the many variations of machine state signals that the RSD100 accepts. After choosing the best one for the application, the rotary switch on the RSD100 printed circuit board has to be set per Table 2.

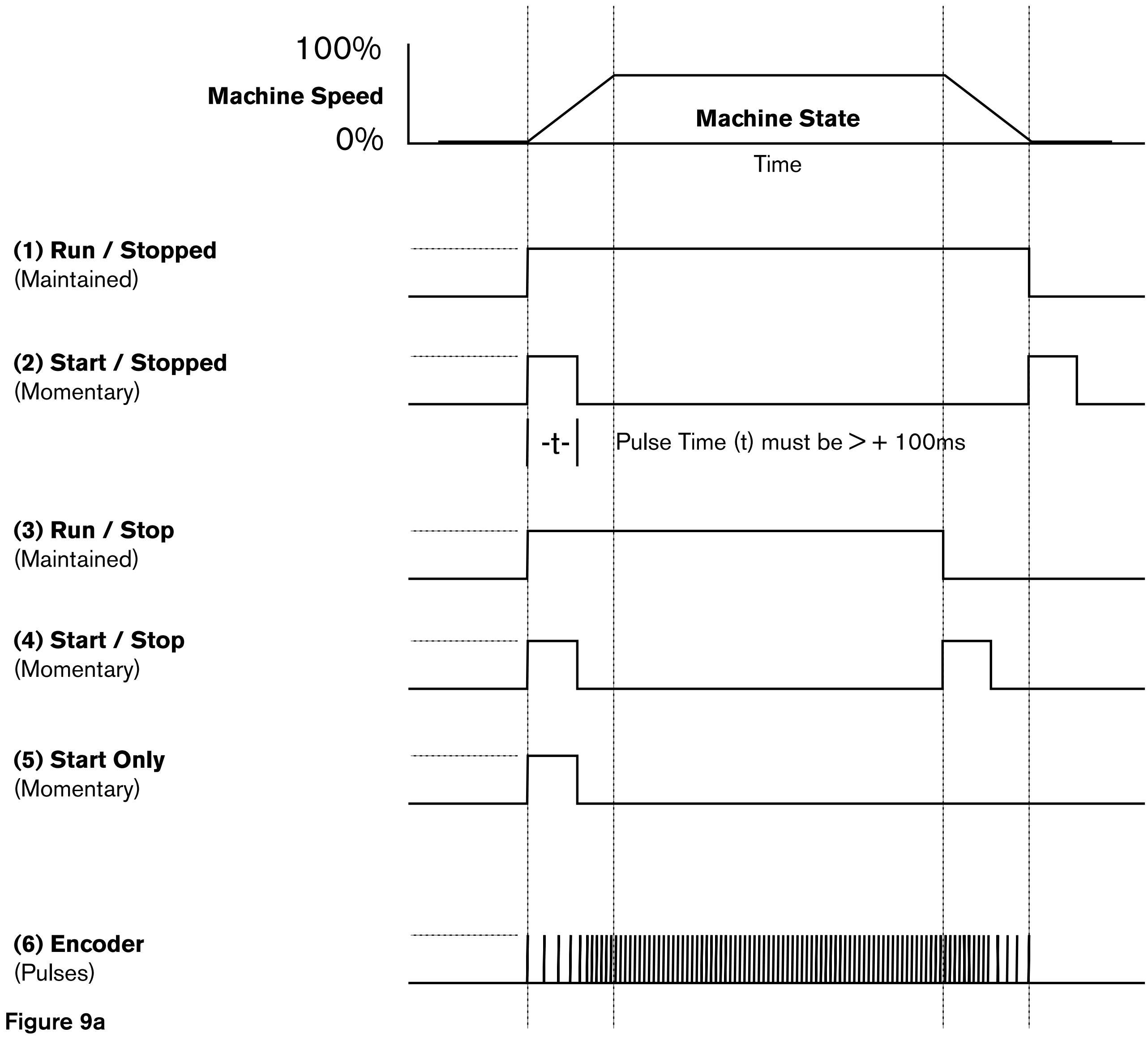


Figure 9a

Machine State Signal Controller Descriptions

1. **Run / Stopped Signal (Maintained)**
   When the Run/Stopped signal is low, the RSD100 OUTPUT will hold at the STOPPED OUTPUT %. When the Run/Stopped signal transitions from low to high the RSD100 will begin controlling and the RSD100 PROPORTIONAL gain value will be multiplied by the PROPORTIONAL MULTIPLIER. The duration of the PROPORTIONAL MULTIPLIER is set with the START DURATION parameter. After the machine state signal goes low, the OUTPUT will change to the STOPPED OUTPUT % at the rate set by the STOPPED BLEED RATE.
2. **Start / Stopped (Momentary)**
   Before the Start/Stopped pulse, the RSD100 OUTPUT will hold at the STOPPED OUTPUT %. When the Start pulse is detected, the RSD100 will begin controlling and the RSD100 PROPORTIONAL gain will be multiplied by the PROPORTIONAL MULTIPLIER. The duration of the PROPORTIONAL MULTIPLIER is set with the START DURATION parameter. When the stopped pulse is detected again, the OUTPUT will change to the STOPPED OUTPUT % at the rate set by the STOPPED BLEED RATE.

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3. **Run / Stop (Maintained)**
   When the Run/Stop signal is low, the RSD100 OUTPUT will hold at the STOPPED OUTPUT %. When the Run/Stop signal transitions from low to high, the RSD100 will begin controlling and the RSD100 PROPORTIONAL gain will be multiplied by the PROPORTIONAL MULTIPLIER. The duration of the PROPORTIONAL MULTIPLIER is set with the START DURATION parameter. When the Run/Stop signal goes low again, the RSD100 will continue controlling for the duration of the START DURATION. After the START DURATION time has elapsed, the OUTPUT will change to the STOPPED OUTPUT % at the rate set by the STOPPED BLEED RATE. For this type of operation, the machine acceleration and deceleration rates should be the same. The START DURATION should be > or = to the acceleration/deceleration time.
4. **Start/Stop (Momentary)**
   Before the Start/Stop pulse, the RSD100 OUTPUT will hold at the STOPPED OUTPUT %. The first time the Start/Stop pulse transitions from low to high, the RSD100 will begin controlling and the RSD100 PROPORTIONAL gain will be multiplied by the PROPORTIONAL MULTIPLIER. The duration of the PROPORTIONAL MULTIPLIER is set with the START DURATION parameter. The second time the Stop pulse transitions from low to high, the RSD100 will continue controlling for the duration of the START DURATION. After the START DURATION time has elapsed, the OUTPUT will change to the STOPPED OUTPUT % at the rate set by the STOPPED BLEED RATE. For this type of operation, the machine acceleration and deceleration rates should be the same. The START DURATION should be > or = to the acceleration/deceleration time.
5. **Start Only (Momentary)**
   Before the Start Only pulse, the RSD100 OUTPUT will be either at 100% or 0% depending on the position of the dancer arm. When the Start Only pulse transitions from low to high, the RSD100 will transition through a stop (STOPPED BLEED RATE can be set fast) and then begin controlling and the RSD100 PROPORTIONAL gain will be multiplied by the PROPORTIONAL MULTIPLIER. The duration of the PROPORTIONAL MULTIPLIER is set with the START DURATION parameter.
6. **Encoder (Pulses)**
   For those applications where a Start / Stop signal is not available, an encoder driven from the machine's drive line can be used to sense machine motion. Before the first Encoder pulse is detected, the RSD100 OUTPUT will hold at the STOPPED OUTPUT %. When the first Encoder pulse is detected, the RSD100 will begin controlling and the RSD100 PROPORTIONAL gain will be multiplied by the PROPORTIONAL MULTIPLIER. The duration of the PROPORTIONAL MULTIPLIER is set with the START DURATION parameter. When the machine stops and the Encoder pulse is not present for more than 5 seconds, the OUTPUT will change to the STOPPED OUTPUT % at the rate set by the STOPPED BLEED RATE. Minimum and maximum encoder pulse voltage levels are defined in the SPECIFICATIONS section.

Table 2

Rotary Switch Position	Machine State Signal
0	Not Used
1	Run / Stopped (Maintained)
2	Start / Stopped (Momentary)
3	Run / Stop (Maintained)
4	Start / Stop (Momentary)
5	Start Only (Momentary)
6	Encoder (Pulses)

Determine which signal type your machine uses and set the Rotary Selection Switch (See Figure 9a).

1.6 RS232 SERIAL COMMUNICATIONS, RSD100 TO A PC

In order to setup the RSD100, a serial cable and the RSD100 Communications Software are required. A custom RS-232 serial cable is provided with the RSD100 Dancer Controller. The RSD100 Communications Software is available free by download from Nexen's web site, www.nexengroup.com, or by purchase from Nexen.

Downloading the Software from the Nexen Web Site

1. Enter the RSD100 Communications Software product number (see PART NUMBER section) in the product number search window and press Go .
2. Under Resources, select Software.
3. Next select the appropriate software product.

Instructions for installing the software as well as the Download Software link can be found under Resources. Instructions for using the RSD100 Communications Software can be accessed in the Help menu.

Getting Started with the Communications Software
After completing all jumper and switch settings:

1. Replace printed circuit board and reconnect connectors.
2. Connect the RSD Communications cable from the PC to the Auxiliary RS232 Port (see Figure 9b).
3. Apply 24 VDC power.
4. Check that the green Indicators, I1 and I2 are on. If not, refer to the TROUBLESHOOTING section.

NOTE: The remaining steps involve configuring the RSD100 via the RSD100 Communications Software.

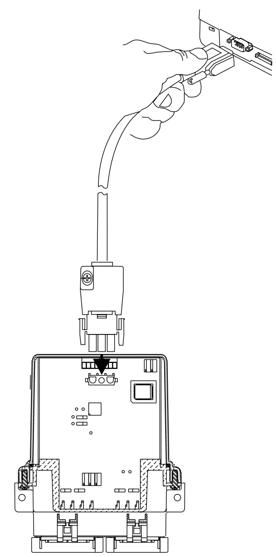


Figure 9b

2.0 DANCER RANGE CALIBRATION

The DANCER RANGE calibration must be done before the RSD100 can operate. Open DANCER RANGE through the Sensor Calibration Window. A set of dialog boxes will step through the calibration procedure. Calibration involves holding the dancer in the maximum and minimum storage positions. This completes the Dancer Range Calibration. The dancer position can be monitored on the Diagnostics screen (Refer to Figure 18).

3.0 MANUAL OPERATION OF RSD100 OUTPUT

To achieve a stable dancer arm before the RSD100 is tuned, the RSD100 OUTPUT may have to be controlled manually. Manual control of the RSD100 OUTPUT can be achieved by pressing the SWITCH TO MANUAL CONTROL button on the Diagnostics Screen (Refer to Figure 18). The increase buttons increase the RSD100 OUTPUT to the brake, clutch or drive. Conversely, the decrease buttons decrease the RSD100 OUTPUT to the brake, clutch, or drive. The 10% buttons increase/decrease the output by 10% steps. The 1% buttons increase/decrease the output by 1% steps. Manual operation provides enough output resolution to provide stability for a quick measurement or reading.

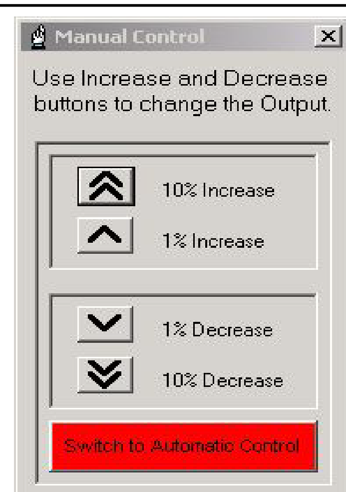


Figure 10

4.0 UNITS

For the units of measurement, select English (psi and lb-force) or Metric (kPa and N-force). Refer to Figure 12.

5.0 TENSION COMPENSATION (RSD100P only)

If the machine's tension setpoint varies more than +/- 20%, RSD100 performance can be improved with Tension Compensation. Improved performance will allow for faster machine accelerations & decelerations. Tension Compensation can be skipped if: the machine's tension setpoint does not vary by more than ±20%, higher performance is not necessary, or Tension Compensation is not chosen.

NOTE: Tension Compensation works with a minimum Dancer Air Pressure of 1.5 psi (10.3 kPa). If Dancer Air Pressure is not connected or is below the minimum allowed, the Tension Compensation will be disregarded. The Dancer Air Pressure and Total Web Tension displays in the Diagnostics Window will be 0 (Refer to Figure 18).

Setting up tension compensation involves calibrating the RSD100P to convert dancer air pressure into total tension. Consequently, total web tension must be physically measured (or calculated) at low and high tension once during the setup process. After tension compensation is setup, the RSD100P will also display machine tension on the Diagnostics screen.

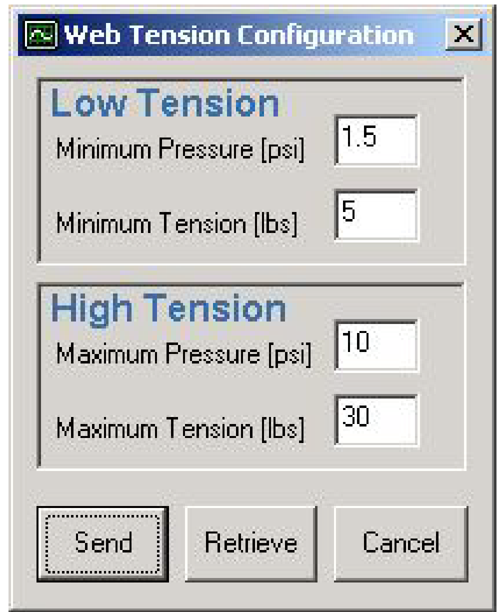


Figure 11

Low Tension

Machine with integrated Tension Measurement: Setup the web machine with the minimum tension and run the machine at 20% of maximum speed and adjust the output of the RSD100P manually until the dancer is stable. Read the web tension and dancer loading pressure. Enter these values in the Low Tension fields of the Web Tension Configuration window.

Machine without integrated Tension Measurement: Set the dancer pressure to the minimum. With a spring or electronic scale, measure the dancer force. Use the following formula to calculate total tension.

Total Tension = Force Measurement / (2 x Number of dancer rollers)

High Tension

Repeat the Low Tension procedure except use maximum tension. Press the SEND button to store the Web Tension Setup values in the RSD100P.

6.0 OUTPUT BASED ADAPTATION & DIAMETER BASED ADAPTATION

If a diameter sensor has been installed and calibrated, use the DBA Setup (Section 6.0B) of this manual. If no diameter sensor will be used for the application, OBA Setup (Section 6.0A) must be completed.

NOTE: Press SEND anytime a setting on the Setup screen is changed. The SEND button will send all of the setup values to the RSD100. Press the RETRIEVE button to read the SETUP values that are already stored in the RSD100.

6.0A Output Based Adaptation (OBA) Settings

The OBA setup parameters are visible in the lower left of the SETUP screen when OBA is selected. They are not accessible if DBA has been selected.

The RSD100 must be run in manual mode to determine the OBA Settings. A full roll will be needed. Run the machine at 20% of full speed with normal operating tension (minimum tension for variable tension machines). Manually adjust the output of the RSD100 to achieve stable operation at full roll and core (Refer to Manual Operation of RSD100 Output). Record and enter these output values into the OBA Settings window.

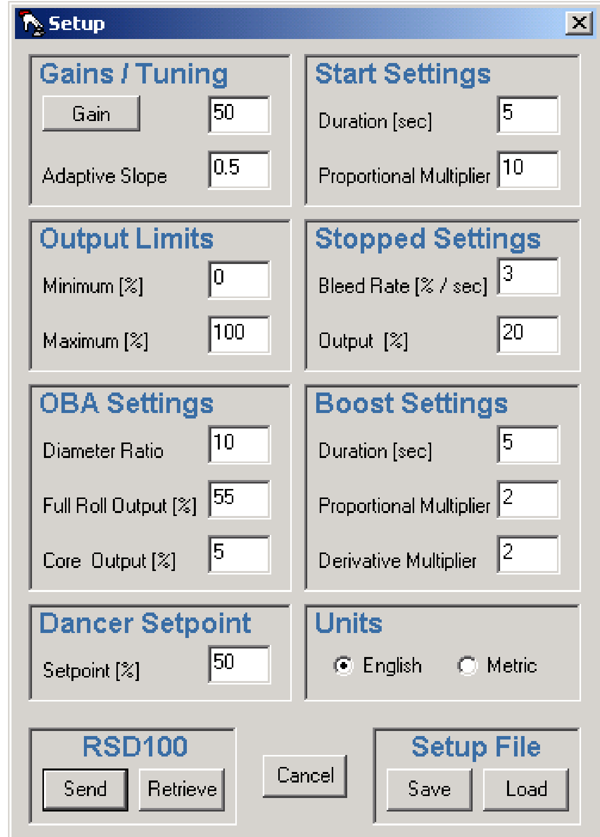


Figure 12

Diameter Ratio

1. Measure the Full Roll Diameter and Core Diameter.
2. Calculate the Diameter Ratio. DIAMETER RATIO = Full Roll Diameter / Core Roll Diameter.
3. Round this number off to an integer and enter it in the DIAMETER RATIO field of the OBA settings window.

Full Roll Output [%]

1. Open the Diagnostics and Setup windows.
2. Place RSD100 in manual mode (Refer to Manual Operation of RSD100 Output).
3. Adjust the tension on the machine for the minimum operating tension. For constant tension machines, run the machine at normal operating tension.
4. Start the machine with a full roll and run machine at 20% of maximum speed.
5. Manually adjust the OUTPUT of the RSD100 until the dancer arm is stable in the middle of its travel.
6. Round this number to an integer and enter it in the FULL ROLL OUTPUT field.

Core Output [%]

The procedure for determining the CORE OUTPUT is the same as the FULL ROLL OUTPUT [%] procedure, except it is done at core. However, if the roll is not at core and the machine needs to run until core, then CORE OUTPUT [%] can be approximated using the following steps:

1. CORE OUTPUT = FULL ROLL OUTPUT / DIAMETER RATIO (Temporary Value)
2. Set Gain = 50 with Proportional (P)= 40, Integral (I)= 10 and Derivative (D)= 50.
3. Place the RSD100 in Automatic operation and slowly take the machine to normal running speed. **Note: The control is not tuned yet for optimum performance. If the dancer arm hits an end-of-travel limit, reduce the Proportional and Derivative gains or decrease the machine acceleration / deceleration times.**
4. Run the machine to near core and then slow machine down to 20% of maximum speed.
5. When at core, record the RSD100 OUTPUT. Round this number to an integer and input this value in the CORE OUTPUT field in Setup.

Skip to Section 7.0

6.0B Diameter Based Adaptation (DBA) Settings

Overview

If a diameter sensor is installed and Diameter Based Adaptation (DBA) has been selected, then the diameter sensor must be calibrated. Select the "Sensor Configuration" icon on the tool bar and then select Roll Diameter.

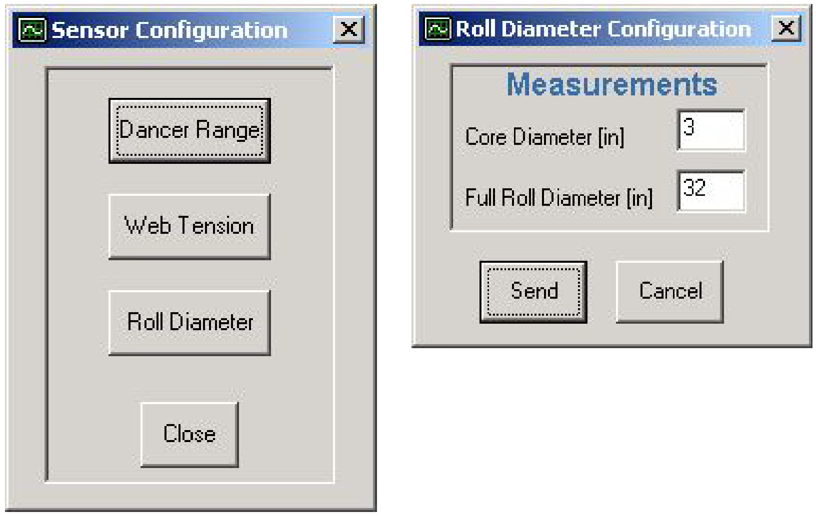


Figure 13

CALIBRATE THE DIAMETER SENSOR AS FOLLOWS:

Core Diameter

Measure the empty core diameter and enter this value in the CORE DIAMETER field.

Full Roll Diameter

Measure a full roll diameter and enter this value in the FULL ROLL DIAMETER field.

A dialog box will now appear prompting you to place an empty core on the shaft. Press OK when the core is being measured by the diameter sensor. Next you will be prompted to place a full roll of maximum size on the machine. Once the diameter sensor is measuring the full roll press "OK". This completes the Roll Diameter Calibration. The roll diameter can be monitored on the Diagnostics screen (Refer to Figure 18).

7.0 OUTPUT LIMITS

The MINIMUM and MAXIMUM OUTPUT settings override all other settings and allow the RSD100 OUTPUT to be limited. Generally the MINIMUM and MAXIMUM will be set at 0 and 100% respectively. However, in some applications these values may need to be adjusted.

Example One: Air supply pressure exceeds the maximum air pressure rating of a brake or clutch. For instance, an I/P transducer can supply 125 psi to a brake rated for 80 psi. The MAXIMUM OUTPUT % should be set as follows:

MAXIMUM OUTPUT % = (maximum brake pressure / supply air pressure) * 100 = (80 / 125)*100 = 64%

Example Two: A pneumatic brake or clutch that is spring disengaged; In this case the MINIMUM OUTPUT % would be set high enough to overcome the spring and allow the friction facing to just contact the rotor.

8.0 STOPPED SETTINGS

Unwind Applications

Without any brake pressure, the force on the dancer arm can spin the roll. In addition, out-of-round rolls can rotate by themselves until their heavy side is at the lowest point. Consequently, in most unwind applications it is important to provide some brake pressure while the machine is stopped to prevent the roll from turning. The RSD100 not only allows for a configurable STOPPED OUTPUT%, it will ramp to this value after a machine stop thereby minimizing dancer arm disturbances.

Winding Applications

Without any output, the force on the dancer arm or an out-of-round roll could cause the roll to spin backwards and spill web onto the floor. With the RSD100 there are two ways to prevent this from happening. First, leave the RSD100 in run mode even while the machine is stopped in order for the arm position to be maintained. Or, use the Stopped Output feature to provide a minimal level of output to keep tension on the web.

STOPPED BLEED RATE

STOPPED BLEED RATE controls the rate at which the output is ramped to the STOPPED OUTPUT value after the machine stops (machine state signal is low). If this value is increased, the RSD100 OUTPUT will ramp faster to the STOPPED OUTPUT value. Set this value so the dancer arm does not move quickly to the maximum web loop position after a machine stop. If STOPPED BLEED RATE is set too fast, the force on the dancer arm will spin the roll and slacken the web. If STOPPED BLEED RATE is set too slow, the ramp may not finish before another machine start occurs.

STOPPED OUTPUT

Set STOPPED OUTPUT to the maximum OUTPUT % level the web can handle during a start at core and minimum tension (on variable tension machines). If STOPPED OUTPUT is set too high, when the machine accelerates from a stop at core, the dancer web loop will be consumed very quickly and cause a tension spike when the dancer arm hits an end-of-travel stop.

NOTE: Use the PROPORTIONAL MULTIPLIER (START SETTINGS section) to bring the output up quickly for full roll starts. Setting the STOPPED OUTPUT too high can cause excessive tension in the web and the dancer arm to hit an end-of-travel stop during starts near core.

9.0 GAINS / TUNING

The RSD100 uses a P (Proportional), I (Integral), and D (Derivative) control algorithm. This PID algorithm adjusts the control output to obtain the desired response of a dancer arm. The Proportional term corrects for the difference between the arm's position and the position setpoint. Hence, the larger the difference, the larger the response from the Proportional term. Next, the Integral term corrects for longer-term position errors and its response increases with time whenever there is a position error. Last, the Derivative term corrects for fast changing position errors and the faster the arm moves the larger the Derivative response.

Basic Tuning

Most applications only require adjustment of GAIN and ADAPTIVE SLOPE to tune the RSD100. For extreme applications, the RSD100 offers advanced tuning parameters (See Advanced Tuning).

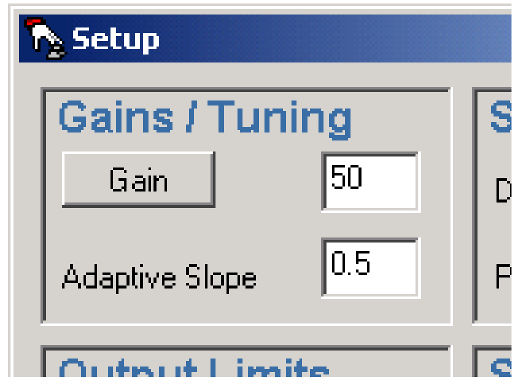
Gain

The GAIN value adjusts the P, I and D gains simultaneously. The ratio between P, I and D is set to a factory default of 4:1:5 (P:I:D), which is the optimum ratio for most dancer systems. Adjustment of these ratios should not be necessary, however the ratios can be adjusted by clicking the GAIN button and entering new values in the Advanced Setup window (Refer to Figure 14).

Adaptive Slope

The ADAPTIVE SLOPE range is from 0.1 to 1.0. A slope of 1 means that the gains will change in direct proportion to the change in diameter for DBA or output for OBA. An ADAPTIVE SLOPE of 0.5 will cause the slope of the gains to be 50% of the diameter (DBA) / output (OBA) slope. The default ADAPTIVE SLOPE is 0.5.

continued...



(See Figure 12 for entire Setup Window.)

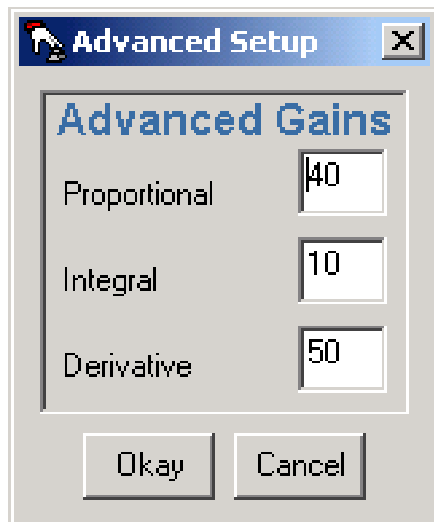


Figure 14

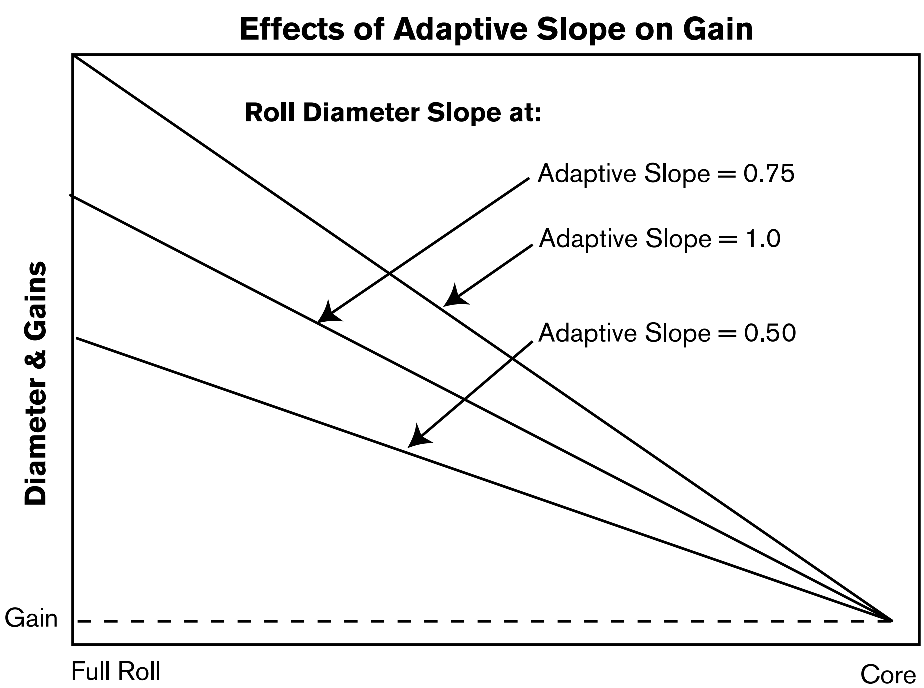


Figure 15

Advanced Tuning

For most applications the Basic Tuning Parameters will be sufficient to tune the RSD100. The advanced Tuning Parameters are for applications with unique requirements such as extremely fast accelerations/decelerations where it is desirable to change the individual terms of the PID algorithm. System Integrators appreciate these parameters as they provide the flexibility to customize the control system similar to that of hardware based control boards

Note: Adjusting individual PID values from their factory default settings should be done only by personnel experience in the operation of PID controlled closed loop systems.

Select GAIN from the TUNING pane of the SETUP window.

Proportional

This parameter corrects for arm position errors and is generally adjusted as follows:

- If dancer arm slowly moves towards its setpoint, increase PROPORTIONAL.
- If the dancer arm excessively oscillates around the setpoint position after a tension disturbance, decrease PROPORTIONAL.

Integral

This parameter corrects for long term position errors and is generally adjusted as follows:

- If the Dancer arm slowly oscillates around the setpoint position, decrease INTEGRAL.
- If the dancer arm settles into a position other than the setpoint position, increase INTEGRAL.

Derivative

This parameter corrects for fast changing position errors and is generally adjusted as follows:

- If the dancer arm oscillates from one end-of-travel limit to the other, decrease DERIVATIVE.
- If the dancer arm drastically overshoots the position setpoint after a tension disturbance, increase DERIVATIVE.

NOTE: In most dancer arm controller applications, the two most important parameters are Proportional and Derivative. In order to simplify the tuning process the INTEGRAL term can be set to zero, thus leaving only PROPORTIONAL and DERIVATIVE to be adjusted. If needed, INTEGRAL can be adjusted after the other parameters are set.

10.0 START SETTINGS

The Start Settings are used to help the RSD100 output get from the STOPPED OUTPUT to an operating level quickly. When the Start Signal transitions from low to high, the PROPORTIONAL MULTIPLIER will be applied to proportional gain for the duration of START DURATION. The Start Settings will help the RSD100 most during full roll starts where the output must climb quickly to a high output level from the STOPPED OUTPUT level.

Duration

The DURATION controls how long the PROPORTIONAL GAIN MULTIPLIER will be applied after the machine state signal goes high (Refer to Figure16).

Proportional Multiplier

The PROPORTIONAL MULTIPLIER increases the RSD PROPORTIONAL term during the START DURATION. At full roll and core, try several machine starts from 0 to 100% speed and adjust the DURATION and MULTIPLIER until the RSD100's performance is satisfactory. If the PROPORTIONAL MULTIPLIER is set to 1, the RSD100 will not apply any Start Boost.

NOTE: To help with full roll starts, use the proportional multiplier to achieve a high output quickly.

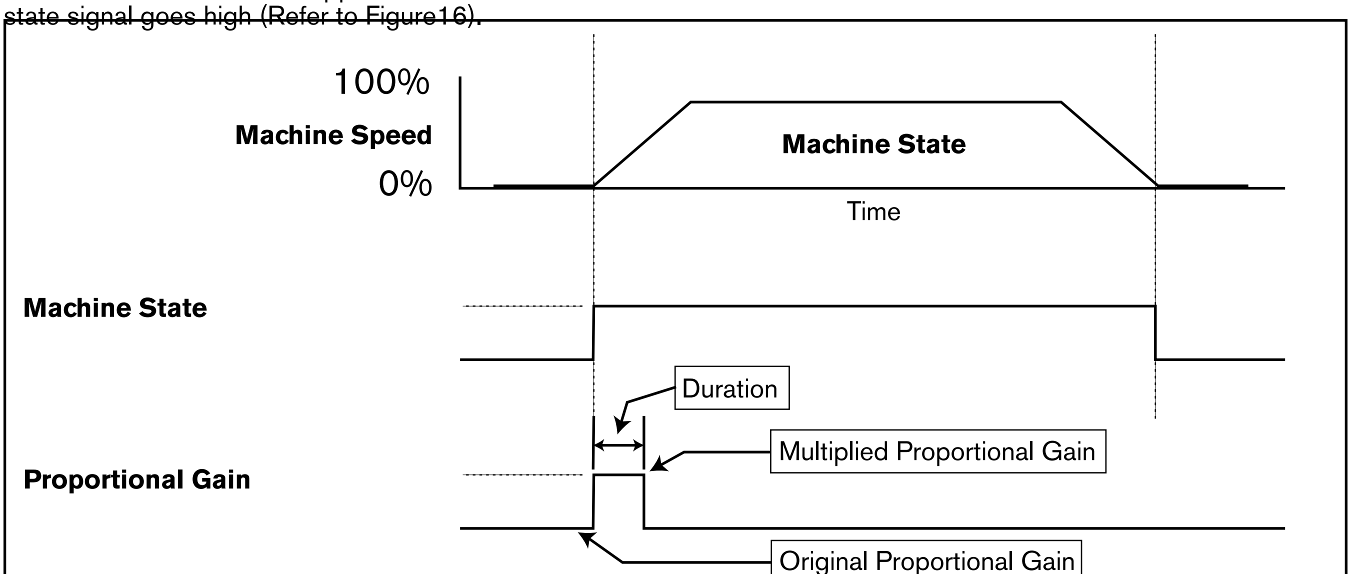


Figure 16

11.0 BOOST (OPTIONAL SIGNAL)

The BOOST signal is used to tailor the performance of the RSD100 during infrequent events such as speed changes, flying splices, and rapid stops. When the BOOST signal transitions from low to high, the PROPORTIONAL and DERIVATIVE MULTIPLIERs will be applied to the proportional and derivative gains. The gains will be boosted for the duration of BOOST DURATION once the signal transitions from high to low.

Duration

Time in seconds that the PROPORTIONAL and/or DERIVATIVE MULTIPLIER will be applied after BOOST INPUT goes from high to low (Refer to Figure 17).

Proportional Multiplier

If Proportional boost is desired, enter a PROPORTIONAL MULTIPLER.

Derivative Multiplier

If Derivative boost is desired, enter a DERIVATIVE MULTIPLIER.

12.0 DANCER SETPOINT (%)

The RSD100 will maintain the dancer arm position at the Dancer SETPOINT value when the machine is running. For most applications, the Dancer SETPOINT should be set to 50%. However, the Dancer SETPOINT can be offset from 50% to provide more or less web storage depending on the acceleration and deceleration requirements of the machine.

NOTE: If you have trouble with the dancer loop hitting the maximum storage stop at the end of a full roll accelerations, set your dancer SETPOINT for less storage. This will give the dancer more potential storage for acceleration changes. Configuring the BOOST signal will also help with this situation.

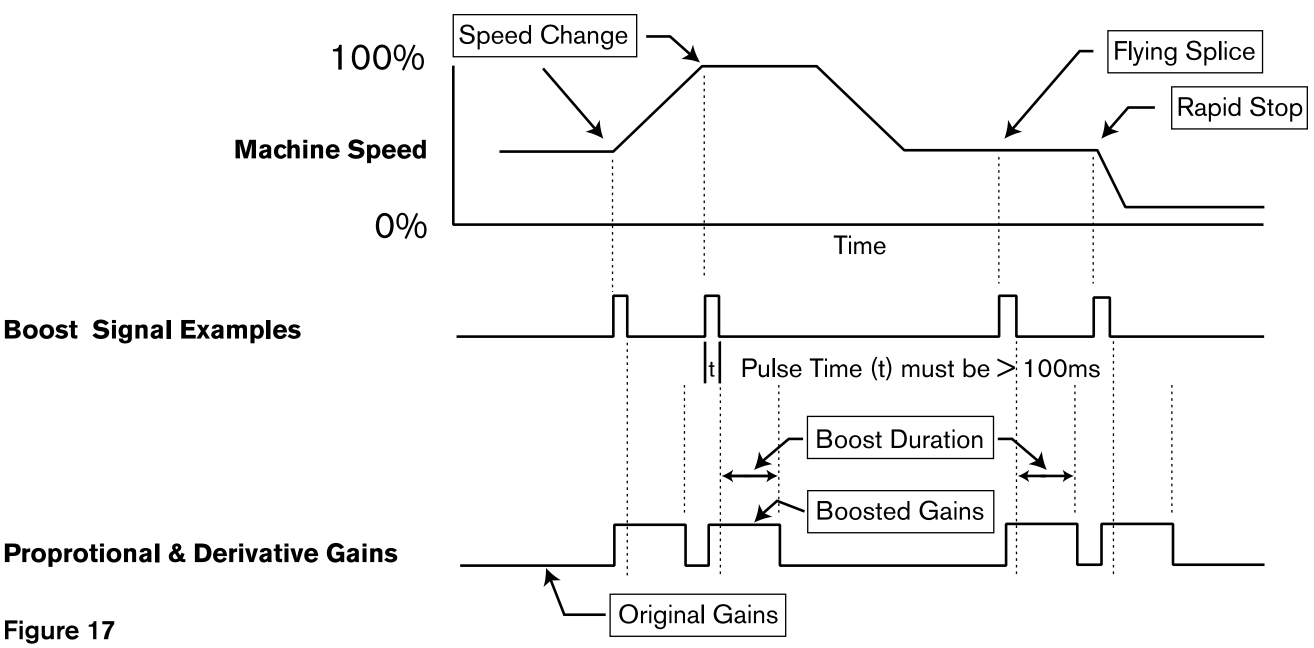


Figure 17

WEB JOGGING

During job changes, it is common to jog a new web through the machine. This is often accomplished by the operator pressing the JOG button on the machine's operator panel. As long as the button is depressed the web slowly advances through the machine. Once the operator lets go of the JOG button, the web stops moving. This can be repeated many times over a short period of time. During instances such as this, the RSD100 would perform better if left in the RUN mode continuously. Otherwise, it will go through a START-RUN-STOP sequence every time the web is jogged. The BOOST signal can be used as a START mode while the RSD100 is running.

DIAGNOSTICS

The Diagnostics window displays real-time operating information from the RSD100. This can be used throughout the setup procedure to verify results from sensors and Setup parameter settings.

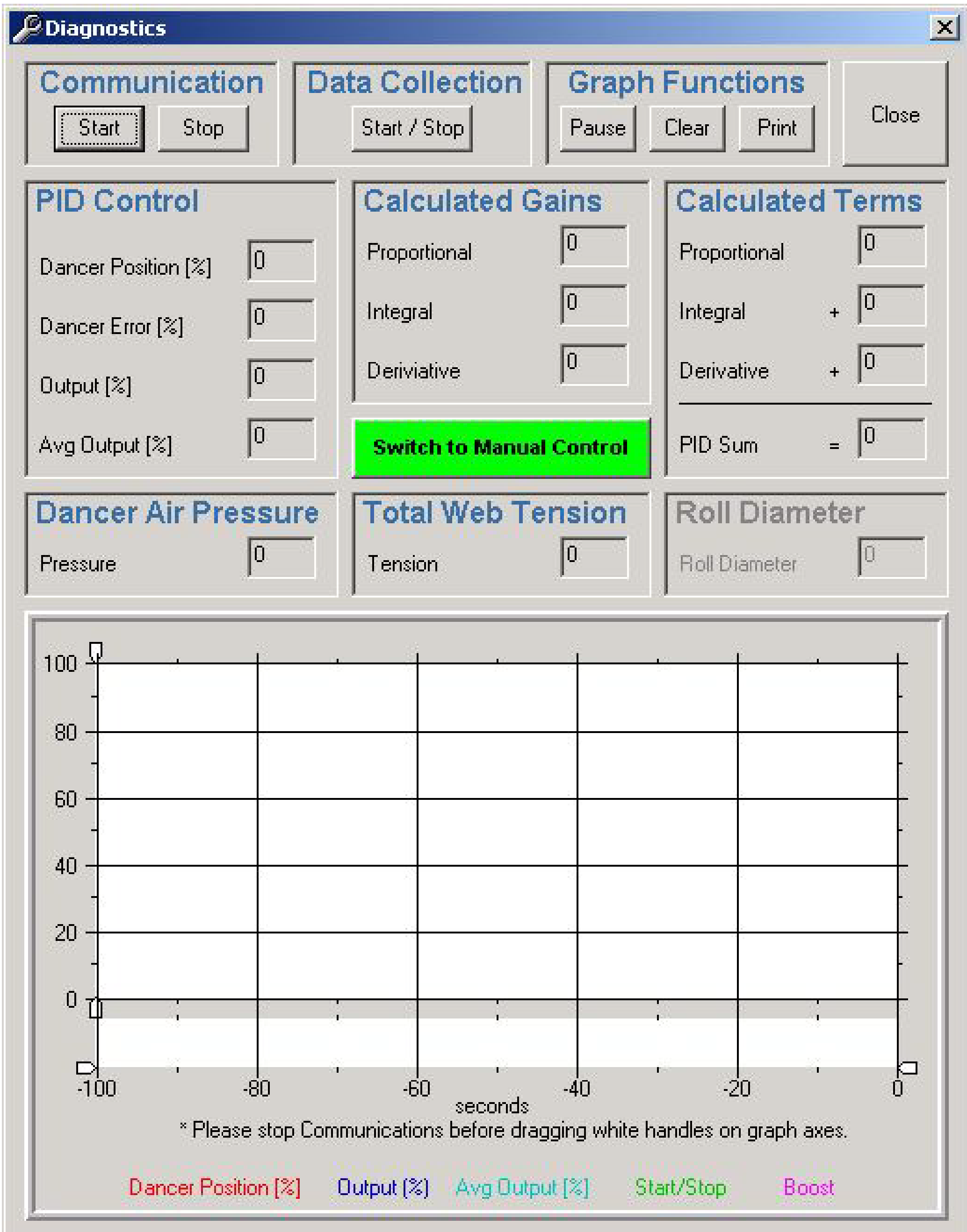


Figure 18

PART NUMBERS

Dancer Controller	(RSD100)	964520
Dancer Controller	(RSD100P)	964522
Dancer Position Sensors	(DPS30) (DPS60)	964510 964511
Communication Software (Download)		964521
Power Supply		964509
Roll Diameter Sensor		912127

SPECIFICATIONS

Power Supply		+24 VDC @ 500 mA
Isolated Power Supply		15-24 VDC @ 150 mA
Operating Ambient Temperature		0° C [32° F] to 60° C [140° F]
Inputs	Digital	12-24 VDC @ 24 mA Maximum
	Dancer Arm Position	0-12 VDC Maximum @ 1 mA
	Dancer Arm Pressure	1.5 - 100 PSI [10.3 - 689 kPa]
Outputs	Control (Analog)	0-10 VDC or 4-20 mA
	Position Sensor Excitation Voltage	+ 12 VDC @ 100 mA
Enclosure		Nylon with O-ring Seal
Cables	Power	20 AWG Conductors, 2 m [78 in] long
	Communications	Serial, RS232 1.5 m [59 in] long
Air Supply	Pre-Filter	5 Micron
	Final Filter	.1 Micron
Certification		ETL & CE

SERVICE INSTRUCTIONS

Nexen does not recommend customer servicing of this product. Contact Nexen for replacement parts or repair.

TROUBLESHOOTING

Problem	Possible Cause	Quick Test	Corrective Action
Green LEDs are not lit.	No power to RSD100 board	Place the positive lead of Volt Meter on RED wire and Negative Lead on BLACK wire. Should meausre +24VDC.	If proper voltage is not measured: check wire connections and/or replace power supply.
Connection failed error when CONNECT icon is pressed, or PC is not communicating with RSD100.	RSD100 not powered up	Green LEDs, I1 and I2, on board should be lit.	Apply proper power to RSD100.
	Cable not connected	Ensure cable is connected from PCs RS232 port to P5 on the RSD100 board.	Connect cable properly.
	Faulty RS232 cable	Test continuity of cable (See Figure 5).	Replace cable if faulty.
Bad Port number error is reported when CONNECT icon is pressed.	Wrong serial port is selected.	None	Select Communications Setup and switch to another port. **NOTE: DB9 serial ports are now COMM3 on some PCs with USB ports.**
Digital Inputs not responding.	Improper jumper selection.	Check Jumpers W5 and W6 (Refer to Jumper & Switch Settings).	Set jumpers properly and test again.
	Input signals to RSD100 not being toggled.	Toggle the inputs and check for proper voltage changes (Refer to SPECIFICATIONS Section)	Setup signal properly and test again. Yellow LEDs, I5 and/or I6, should light when input is high.
RSD100 output does not move when the machine is started.	Machine State Signal is not setup correctly.	The green trend line on the Diagnostics screen should show the MACHINE STATE signal true when the machine is running.	Check the setup and make sure rotary switch selection is correct for the type of machine state signal used.
	RSD100 is in MANUAL mode.	Check SWITCH TO MANUAL button on the Diagnostics screen.	Press the SWITCH TO MANUAL BUTTON and then SWITCH TO AUTOMATIC when the manual operations window appears.
RSD100 output changes, but the dancer arm does not move.	No air pressure to brake.	Use RSD100 setup screen to set Stopped Output to 100% and test if roll can be rolled by hand.	Troubleshoot pneumatic air circuit and check the I/P pressure output.
	Output limits are not set correctly.	Use RSD100 Setup screen to check the Maximum and Minimum Output Limits.	Set Maximum and Minimum Output LImits according to output range required (Refer to OUTPUT LIMITS section).
	Tension is set too high on machine.	Reduce the dancer pressure/weight test again.	If you have a multi-piston brake, make sure there are enough brake pistons engaged.
	No air pressure in roll core.	Core shaft should turn when the machine runs.	Apply proper air pressure to core and test again.
	Dancer Setpoint set improperly.	Use RSD100 Setup screen to check the DANCER SETPOINT %	Start with a DANCER SETPOINT of 50% (See the INSTALLATION section.)
Brake Clutch, or Drive does the opposite of what it should.	Controller action is backwards.	The brake output goes to minimum when the dancer arm storage is at the maximum or vise versa.	Change Jumper W1 setting (Refer to Jumper and Switch settings).
When machine speed is constant, dancer arm cycles continuously above and below setpoint or between maximum and minimum limit.	OBA settings are incorrect.	Output (%), from the Diagnostics window, is out of the OBA Settings Output (%) range.	Refer to OBA Settings section.
	RSD100 PID gains are set too high.	Reduce P, I and D by 1/2 and see if arm stops cycling.	Refer to the GAINS/TUNING section.
	Tension compensation not setup correctly (variable tension machines only).	Measure tension on machine and see if it is close to the tension displayed on the RSD100 Diagnostics screen.	Refer to TENSION COMPENSATION section.
After machine has stopped, web becomes slack.	STOPPED OUTPUT % is set too low.	STOPPED OUTPUT % should be set to something greater than 0%.	Refer to STOPPED SETTINGS section.
RSD100 output goes to zero % output during acceleration (brake applications only).	Machine acceleration is too fast.	None	For a dancer control to work properly, the machine acceleration should be set so that some braking is needed during acceleration. When the output to the brake is 0% the RSD100 has no control over the dancer position.
At the end of an acceleration run, the dancer hits the maximum storage stop.	PID DERVIATIVE gain or BOOST DERIVATIVE MULTIPLIER is not tuned properly.	**No Boost Signal:** Increase DERIVATIVE gain **Boost Signal:** Increase BOOST DERIVATIVE MULTIPLIER.	Refer to the GAINS/TUNING and BOOST sections.

Communications Protocol

RS232 Communications can be used to broadcast arm position and output percentage from the RSD100 to a device such as a PLC or computer. At the same time, the PLC or computer would control the Machine State and Boost signals to the RSD100.

Serial Communication is achieved with RS232 through a null modem cable. Data Transmission for each byte follows the format “9600, N, 8, 1” (9600 Baud, No Parity, 8 data bits, 1 stop bit) with no handshaking. Data is transmitted in 8 bit binary format, meaning that a number 0 to 255 is considered 1 byte and a number 0 to 65535 or -32676 to +32676 is considered two bytes. If a data item is two bytes long, the MSB is sent/received first and the LSB second.

Data is sent and received in Message Packets that are comprised of bytes of information (Refer to Table 2). The Checksum can be used as an error-checking tool to confirm the data sent on one end is the same as the data received on the other end. Use the Start byte to designate the beginning of a new message packet as well as the Stop byte to designate that the entire packet was sent/received. The Packet Size is the number of bytes in the packet, excluding the start and stop bytes.

- For commands sent from a PLC/Computer to the RSD100, refer to Table 4.
- For commands and/or data sent from the RSD100 to a PLC/Computer, refer to Table 5.

The Functional Test command can be used to confirm the communications are working properly.

1. From a PLC/Computer, send a Functional Test message packet (See Table 4).
2. If functioning properly, the RSD100 will immediately send a Functional Test packet back to the PLC/Computer (See Table 5).

The Machine State command operates like the Run/Stopped (Maintained) signal (Refer to Machine State Signal). The Rotary Mode Switch needs to be in the ‘1’ position.

Table 3 Message Packet Protocol

Byte Number	Description
1	**Start Byte**, value equal to 1
2	**Packet Size**, excluding Start & Stop
3	**Command ID**, identifies the function
4 -?	**Data,** variable length (if any)
? + 1	**Checksum**, the two-digit remainder of the division of the summation of the Data bytes and Command ID with 100 [i.e. (Data + Command ID) MOD 100].
? + 2	**Stop Byte**, value equal to 0

Table 4 Message Packets for PLC/Computer to RSD

Command ID	Function	Example
8	Start Broadcasting Data	1, 3, 8, 8, 0
9	Stop Broadcasting Data	1, 3, 9, 9, 0
14	Boost	1, 3, 14, 14, 0
15	Machine State - Run (Date = 1)	1, 4, 15, 1, 16, 0
15	Machine State-Stopped (Data = 2)	1, 4, 15, 2, 17, 0
16	Functional Test	1, 3, 16, 16, 0

Table 5 Message Packets for RSD to PLC/Computer

<table>
<tr><th>Command ID</th><th colspan="2">Function</th><th>Example</th></tr>
<tr><td rowspan="4">8</td><td colspan="2">Receive Broadcast Data</td><td rowspan="4">1,7,8, Data, Checksum, 0</td></tr>
<tr><td>Data</td><td>Range</td></tr>
<tr><td>Arm Position</td><td>0 - 1000</td></tr>
<tr><td>Output</td><td>0 - 1000</td></tr>
<tr><td>16</td><td colspan="2">Functional Test</td><td>1, 3, 16, 16, 0</td></tr>
</table>

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