CORTEX® LT V2

Instruction Manual

D14523-000

(CLT2020-000)

D14523-001

(CLT2020-024)

CAROTRON

Driven by Excellence

D.C. DRIVES, A.C. INVERTERS,
SOLID STATE STARTERS, SYSTEM INTERFACE
CIRCUITS AND ENGINEERED SYSTEMS

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1 General Description

The Cortex® LT V2 is Carotron's 2nd generation Cortex® LT controller. The device is based on a DSP (digital signal processor) controller. The following is a list of some of the configurable function blocks

- Roll Speed Calculator
- Taper Tension Calculator
- CTCW Calculator
- Diameter Calculator
- PID Loops (2)
- Timers (4)
- Summing Blocks
- Brake Letoff
- plus many more

The advanced mathematical models designed into the Cortex® LT give it many advantages over other system controls in the market place. This advanced design makes the Cortex® LT an excellent choice for a wide range of dancer, loadcell, and sensorless applications for control of Center Driven Unwinds, Center Driven Rewinds, Surface Driven Unwinds, Surface Driven Rewinds, Brake Unwinds, and speed compensation between driven nip rolls. The V2 has all of the features of the first generation controller (D12600-000) plus numerous improvements. Listed below are some of the new features:

- USB communications
- Modbus/TCP Ethernet communications
- Isolated RS422/485 communications (Com A)
- Bipolar analog inputs & outputs
- Higher rated frequency inputs & outputs
- Completely independent freq/digital outputs
- Compatible with free CaroLink software

Models are typically sold in kits that contain a USB communications cable and software. Refer to Kit CLT2020-XXX.

2 Specifications

2.1 Electrical Specifications

Input Power
- D14523-000:115VAC±10%,50/60Hz ±2Hz
- D14523-001:24VDC±10%

Internal Power Supplies
- +24V unregulated supply: 50mA
- +15V regulated supply: 100mA
- +10V regulated supply: 20mA
- +5V regulated supply (com C): 100mA

Digital Inputs (5 Total)
- Sink Mode
  Vil=+20.0 VDC max
  Vih=0.0 VDC min to +17.0 VDC max
- Source Mode
  Vil=+5.0 VDC max
  Vih=+8.0 VDC min to +30.0 VDC max

Analog Inputs (4 Total)
- 13 bit resolution (12 bit + sign)
- Voltage Range: 0 to ±10 VDC
- Input Impedance: 1MΩ

Frequency/Counter Inputs (2 Total)
- Frequency: 50kHz max, square wave
- Voltage: +15 VDC max
  Vil=0.0 VDC min to +1.1 VDC max
  Vih=+3.0 VDC min to +15.0 VDC max

Relay Outputs (2 Total)
- Form-C contacts
- 2 A @ 115 VAC
- 2 A @ 60 VDC

Analog Outputs (2 Total)
- 13 bit resolution (12 bit + sign)
- 0 to ±10 VDC max, ±20mADC max

Frequency/Digital Outputs (2 Total)
- Frequency: 10kHz max, square wave
- Open collector output
- Output voltage: 5-24VDC max
- Output current: 50mA max

Communication Ports (4 Total)
- Com A, RS485 (2/4 Wire) Terminals
- Com B, Ethernet, RJ45
- Com C, RS422/RS232, RJ12
- Com D, USB

Temperature Range (Ambient)
- Chassis: 0-55°C
- Enclosed: 0-40°C

Power Dissipation
- Less than 5 W

2.2 Physial Specifications

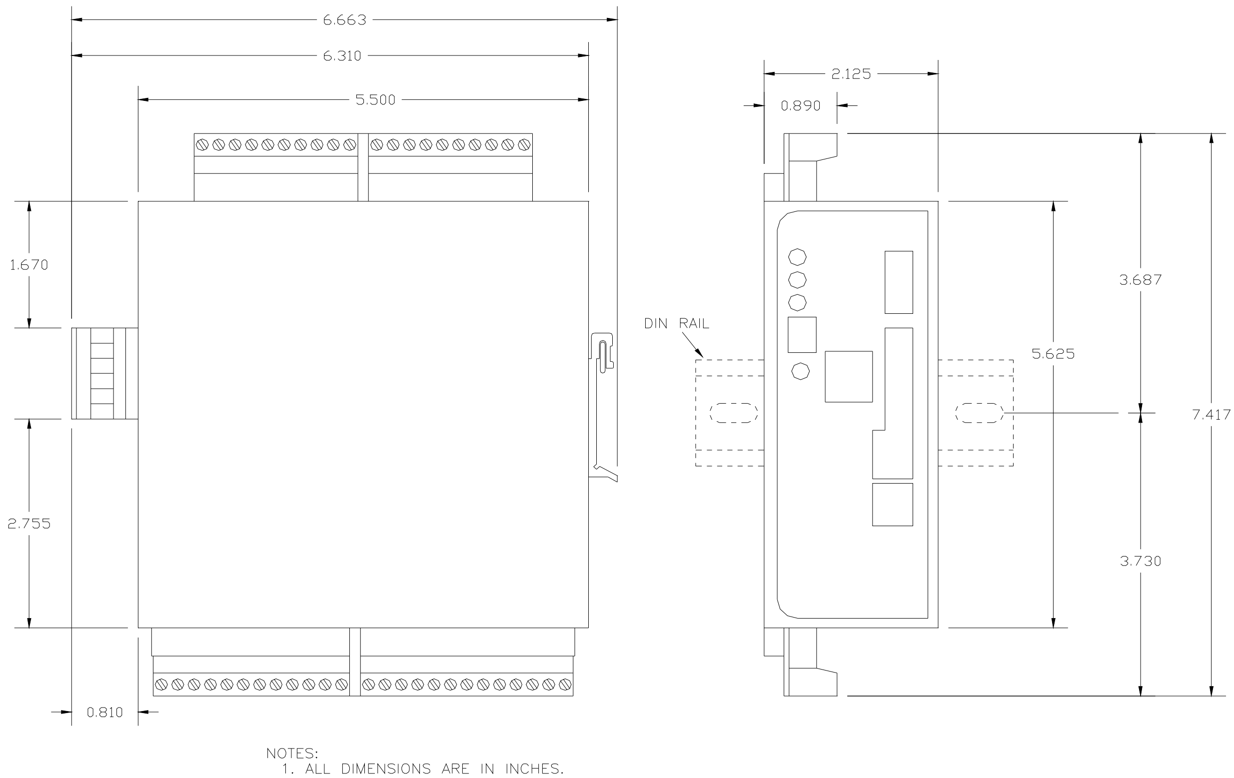


Figure 1: Physical Dimensions

3 Installation

3.1 Wiring Guidelines

To prevent electrical interference and to minimize start-up problems, adhere to the following guidelines.

Make no connections to ground other than the designated terminal strip location.

Use fully insulated and shielded cable for all signal wiring. The shield should be connected at one end only to circuit common. The other end of the shield should be clipped and insulated to prevent the possibility of accidental grounding.

Signal level wiring such as listed above should be routed separately from high level wiring such as armature, field, operator control and relay control wiring. When these two types of wire must cross, they should cross at right angles to each other.

Any relays, contactors, starters, solenoids or electro-mechanical devices located in close proximity to or on the same line supply as the Cortex® LT should have a transient suppression device such as an MOV or R-C snubber connected in parallel with its coil. The suppressor should have short leads and should be connected as close to the coil as possible.

4 Connections

4.1 Connections

Figure 2 shows connections to a Cortex® LT unit. The dashed lines represent isolation zones. The relay outputs are shown in the de-energized state.

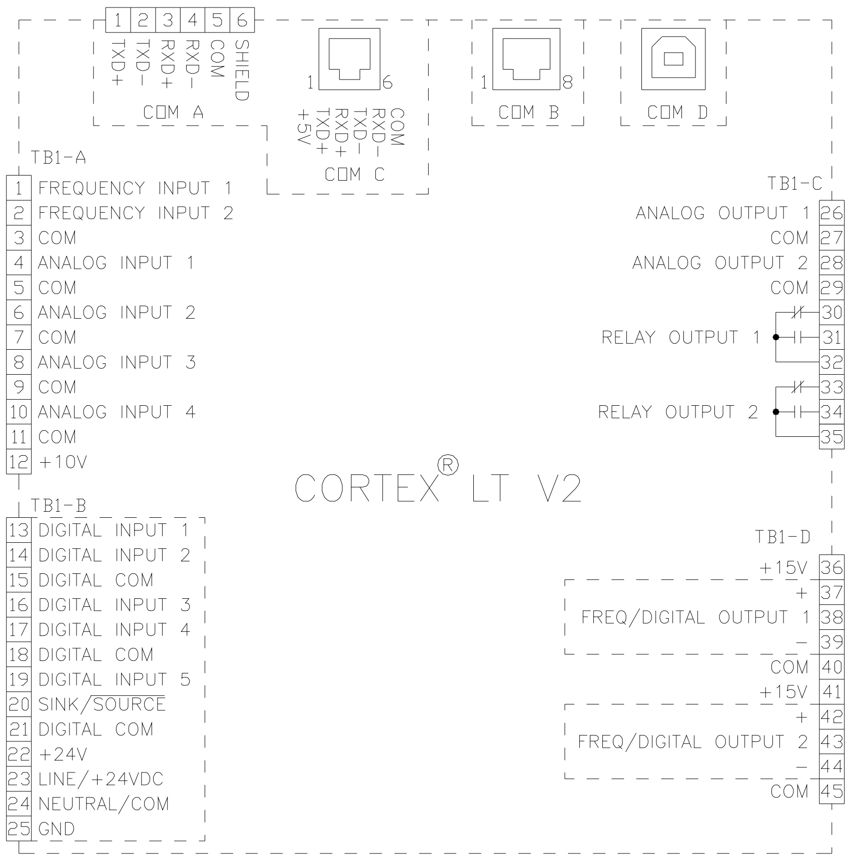


Figure 2: Connections

5 Programming

Programming and adjustment of the Cortex® LT is accomplished by using the CaroLink software. It is freely available on our website (www.carotron.com). While any of the 4 communications ports can be used to program the unit, it is recommended that the USB port be used for initial programming.

5.1 Verifying Communications (USB)

1. Ensure CaroLink software is installed on your computer.
2. Apply power to the Cortex® LT.
3. Connect a USB cable between the Cortex® LT and your computer. The first time a Cortex® LT is attached, the "Found New Hardware" message may be displayed on your computer. Windows® should automatically find and install the appropriate driver for the device.
4. Start the CaroLink software. When the software is first opened, it will prompt you to select a device. Set the **Device** field to Cortex® LT V2 and ensure USB is selected under the **Com Settings** field. Click the Auto button. This will test communications with the device. If successful, "Success" will be displayed in lower right corner and the **Model Number** and **Firmware Version** fields will be automatically set based on the connected device. If unsuccessful, confirm that the Cortex® LT driver is successfully installed. It will be listed in the Ports section of the PC's Device Manager.
5. Click OK to close the Device Selection window.

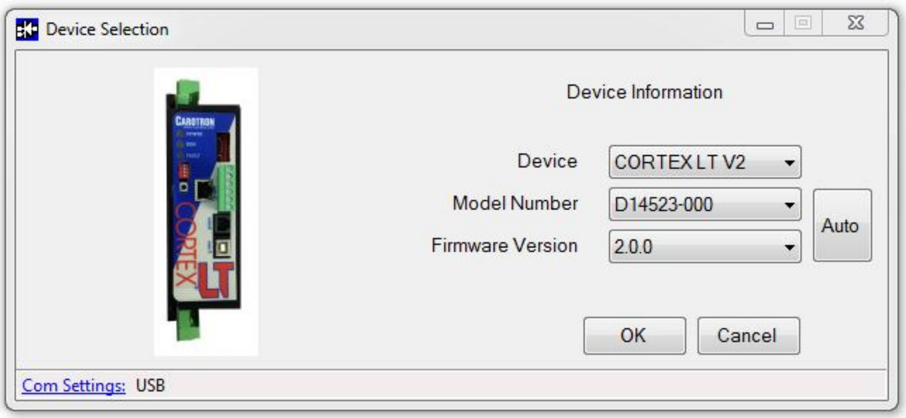


Figure 3: Device Selection

5.2 Reading Parameters from Device

After verifying communications, click the Online toolbar button (or select Online from the Tools menu). You will be then be prompted to Read, Write, or Cancel (Figure 4). Clicking Read will cause the software to go online, and read the parameters from the Cortex® LT.

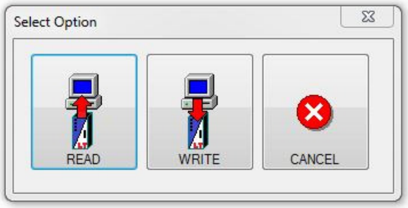


Figure 4: Read/Write/Cancel Prompt

5.3 Monitoring/Editing Parameters

Parameters can be displayed and edited by selecting the desired function block under the Cortex® LT menu. Shown below is the Analog Input 1 function block window.

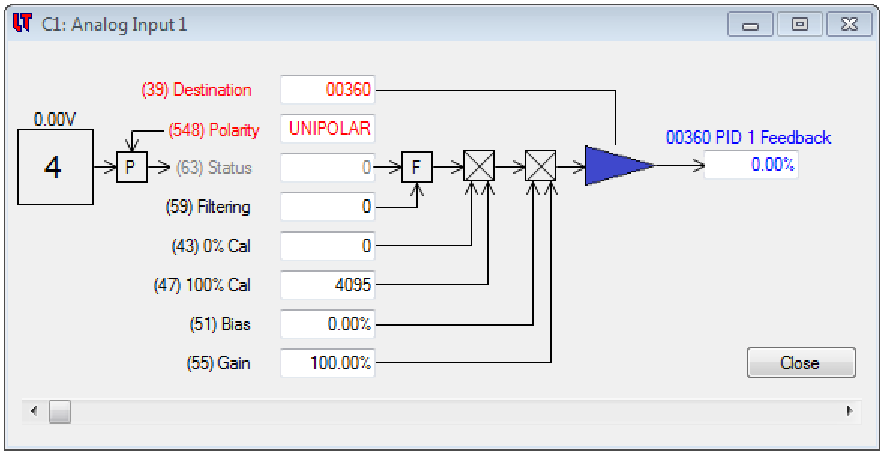


Figure 5: Analog Input 1 Window

Parameters can also be displayed and edited in a table listing by selecting Parameters from the Cortex® LT menu. A subset of the parameters can be displayed by selecting a group on the left.

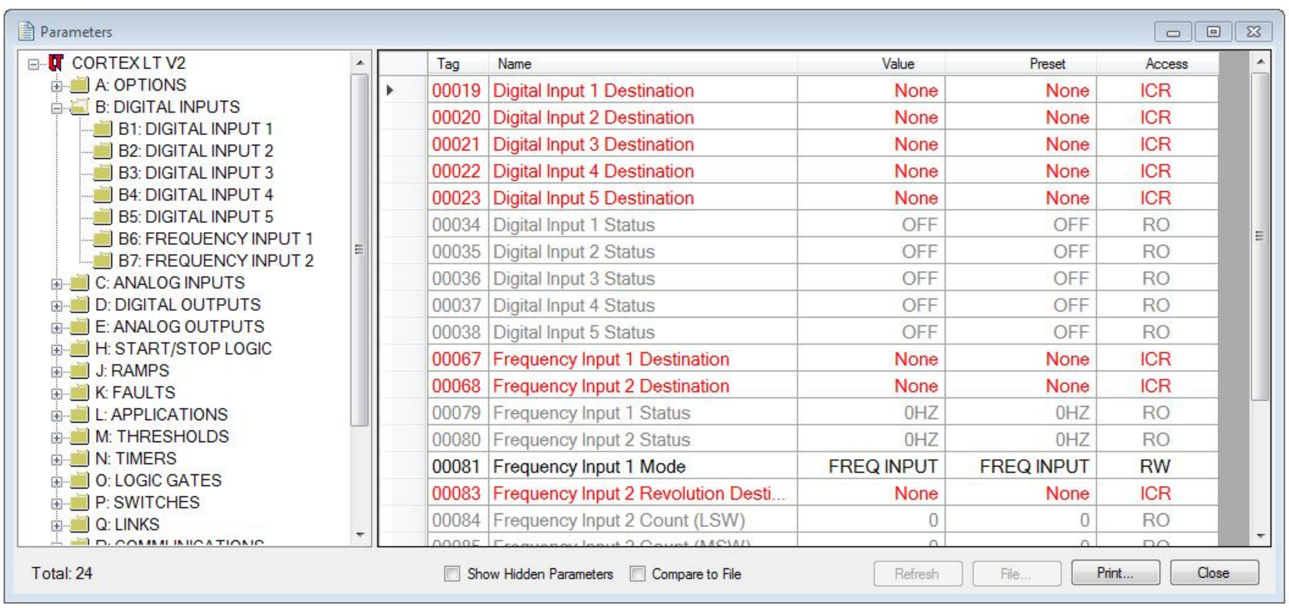


Figure 6: Parameters Window

Note: When parameters are altered, the changes must be saved. Otherwise, changes will be lost after a reset or power loss. Select Save from the Cortex® LT menu.

Parameters can also be saved to a file. This is accomplished by selecting **Save** or **Save As** from the File menu.

5.4 Writing Parameter File to Device

Parameters stored in a file can be loaded into the device in two different methods.

Method 1 (Opening file while offline)
While offline, open the desired file. Click the Online toolbar button (or select Online from the Tools menu). You will be then be prompted to Read, Write, or Cancel (Figure 4). Clicking Write will cause the software to go online and write the currently loaded parameters to the Cortex® LT.

Method 2 (Opening file while online)
While online, open the desired file. A warning will inform you that the contents of the file will be written to the Cortex® LT. Click OK to proceed. After selecting desired file, the software will write the file to the Cortex® LT.

Note that a file can only be written to the Cortex® LT if the Controller Mode is set to PROGRAM. Typically, after the parameters are written, the Controller Mode needs to be set back to the RUN mode. The parameters should then be saved in the device by selecting **Save** from the Cortex® LT menu.

5.5 Switches (SW1, SW2, & SW3)

SW1 - Reset

SW1 serves as a processor reset and can be used to perform a soft re-boot of the unit. A hard re-boot can only be achieved by cycling power. A re-boot does not reset any of the parameter settings.

SW2 - System

<u>SW2-1 (Boot Mode Enable)</u>
If this switch is on, the unit will be placed into boot mode on power up. The firmware can then be upgraded by selecting the Upgrade Firmware selection under the Tools menu in the CaroLink software. For normal operation, this switch should be in the off position.

<u>SW2-2 (LED Override)</u>
This switch determines the function of the A and B LEDs. When this switch is off, the LED outputs are controlled by their respective programming block. (Refer to pages 32 and 33). When position 2 is on, LED A will be on when the unit is in the Run mode and off when it is in the Program mode. Also, LED B will display a fault code (if any) by flashing an appropriate number of times. Refer to page 40.

<u>SW2-3 & SW2-4 (Freq Input Pull-Up Resistors)</u>
Allows enabling of a pull-up resistor for each of the frequency inputs on control board hardware revision code 1 or later (refer to parameter 547 on p. 81). *These switches are not used on earlier control board hardware revisions.

Position	Function
1	Boot Mode
2	LED Override
3	Freq Input 1 Pull-up Resistor*
4	Freq Input 2 Pull-up Resistor*

Table 1: DIP Switch SW2

SW3 - Com A

SW3 allows selection of different communications preferences for Communications Port A. Refer to page 74 for detailed information.

6 Parameters

Each parameter has a descriptive name and a tag (or number) identifier. Parameters are grouped together in blocks according to their function. The following sections contain each function block diagram and descriptions of each parameter function. Each parameter is one of three types: Read-Write (R/W), Read-Only (R/O), or Inhibit Change while Running (ICR). ICR parameters can be changed only when the unit is in the Program mode. Refer to Figure 7 for conventions that are used in the block diagrams in this manual. The CaroLink software uses color codes to identify the type of parameter (Table 2).

Note: When parameters are altered, the changes must be saved. Otherwise, changes will be lost after a reset or power loss.

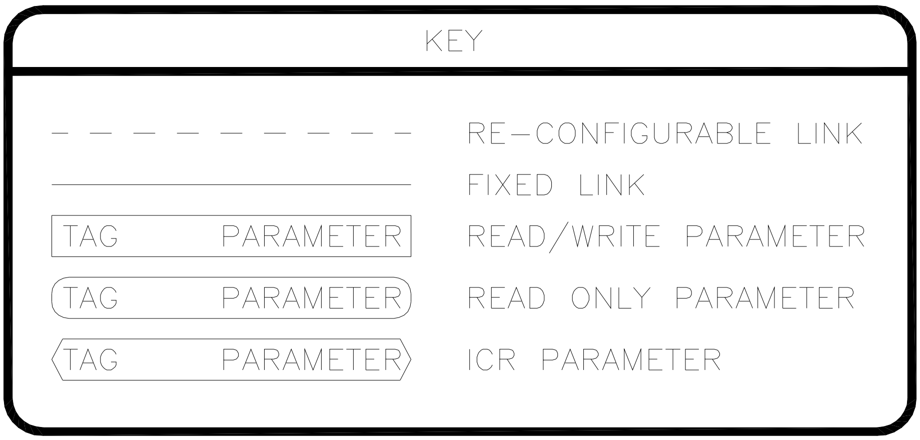


Figure 7: Software Block Diagram Key

Type	Color
R/W	Black
R/O	Gray
ICR	Red

Table 2: CaroLink Parameter Color Coding

6.1 Group A: Options

These parameters set the controller's basic operating mode.

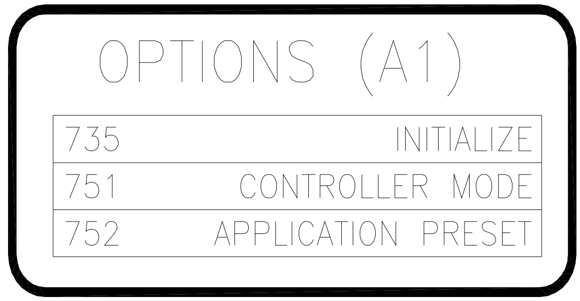


Figure 8: Options (A1) Block

A1: Options

735 Initialize (R/W, Preset: 0)

9999: Re-initializes the controller and returns all parameters to the factory default setting.
Range: 0..65535

751 Controller Mode (R/W, Preset: Program)

This parameter controls the operating mode of the controller. The mode is indicated by LED A when DIP Switch SW2-2 is in the on position.

PROGRAM

Allows modification of ICR (Inhibit Change while Running) parameters. All inputs are ignored and all outputs are disabled.

RUN

ICR parameters cannot be modified. All inputs and outputs are active.

752 Application Preset (R/W, Preset: 0)

This parameter indicates which application preset (if any) was used to configure the device. Refer to Application Builder on page 99 for additional information.
Range: 0..65535

6.2 Group B: Digital Inputs

These parameters configure the controller's physical digital inputs (digital and high speed frequency). Terminal 20 is used to select sinking or sourcing logic. Refer to Example Connections on page 101.

B1:Digital Input 1

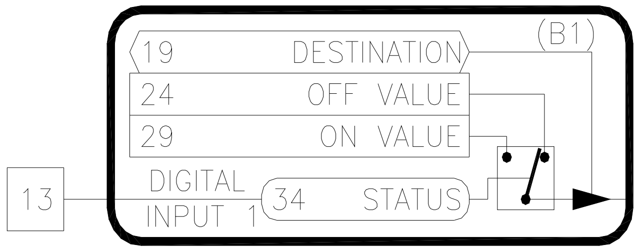


Figure 9: Digital Input 1 (B1)

19 Digital Input 1 Destination (ICR, Preset: 0)

Determines the function of the digital input. Each digital input can control (or write to) any R/W parameter in the drive. The destination parameter contains the tag of the parameter the input will control (i.e. the target parameter).

24 Digital Input 1 Off Value (RW)

This is the value written to the target parameter when the digital input's status is **OFF**. The limits and units of these parameters will change to match the limits and units of the target parameter.

29 Digital Input 1 On Value (RW)

This is the value written to the target parameter when the digital input's status is **ON.** The limits and units of these parameters will change to match the limits and units of the target parameter.

34 Digital Input 1 Status (RO)

Displays the status of the digital input. A value of **OFF** indicates the digital input is off or not activated. A value of **ON** indicates the digital input is on or active.

Example - Digital Input

Use Digital Input 1 to select between two PID Gain settings of 1.00 and 2.00:

1. Set Digital Input 1 **Destination** to **PID Prop Gain** (353).
2. Set Digital Input 1 **Open Value** to 1.00.
3. Set Digital Input 1 **Closed Value** to 2.00.

Digital Input 1 will now write the value of 1.00 to **PID Prop Gain** when the input is off. When on, it will write the value of 2.00.

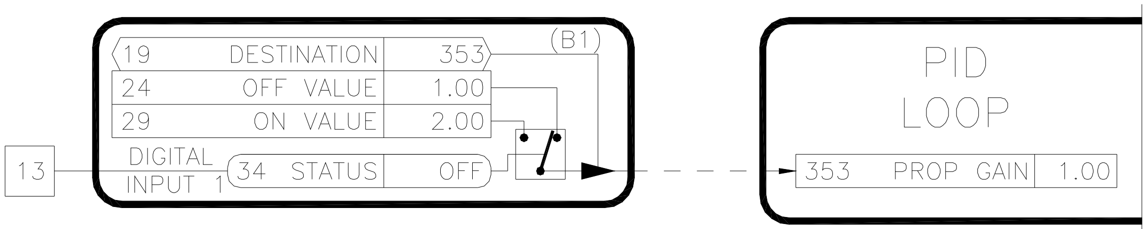


Figure 10: Digital Input Example

B2:Digital Input 2

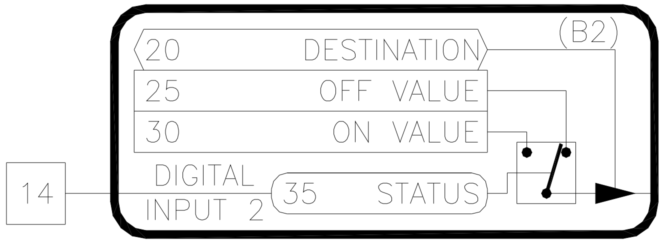


Figure 11: Digital Input 2 (B2)

20 Digital Input 2 Destination (ICR, Preset: 0)
25 Digital Input 2 Off Value (RW)
30 Digital Input 2 On Value (RW)
35 Digital Input 2 Status (RO)

Digital Input 2 is functionally equivalent to Digital Input 1. Refer to Digital Input 1.

B3:Digital Input 3

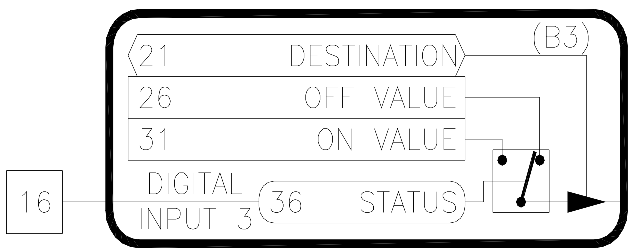


Figure 12: Digital Input 3 (B3)

21 Digital Input 3 Destination (ICR, Preset: 0)
26 Digital Input 3 Off Value (RW)
31 Digital Input 3 On Value (RW)
36 Digital Input 3 Status (RO)

Digital Input 3 is functionally equivalent to Digital Input 1. Refer to Digital Input 1.

B4:Digital Input 4

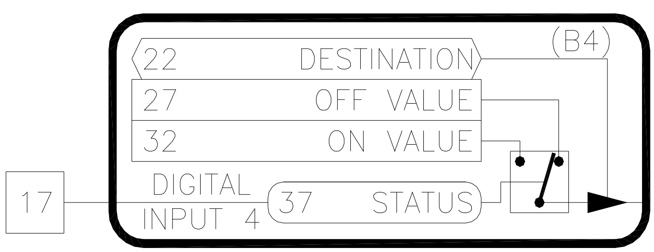


Figure 13: Digital Input 4 (B4)

22 Digital Input 4 Destination (ICR, Preset: 0)
27 Digital Input 4 Off Value (RW)
32 Digital Input 4 On Value (RW)
37 Digital Input 4 Status (RO)

Digital Input 4 is functionally equivalent to Digital Input 1. Refer to Digital Input 1.

B5:Digital Input 5

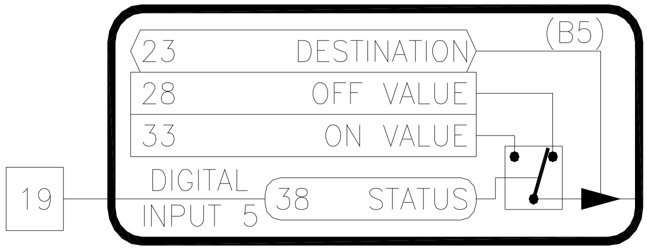


Figure 14: Digital Input 5 (B5)

23 Digital Input 5 Destination (ICR, Preset: 0)
28 Digital Input 5 Off Value (RW)
33 Digital Input 5 On Value (RW)
38 Digital Input 5 Status (RO)

Digital Input 5 is functionally equivalent to Digital Input 1. Refer to Digital Input 1.

B6:Frequency Input 1

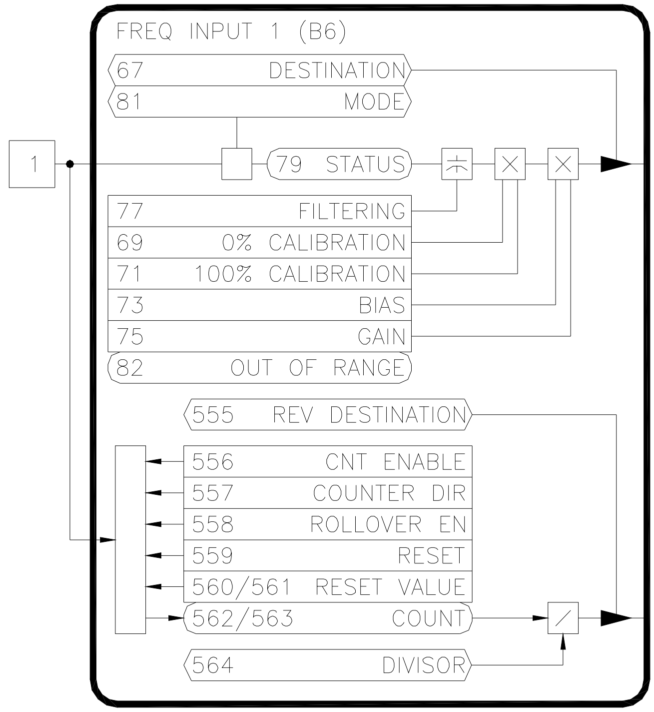


Figure 15: Freq Input 1 (B6)

67 Freq Input 1 Destination (ICR, Preset: 0)

The frequency input can control (or write to) any R/W parameter in the controller. The destination parameter contains the tag of the parameter the input will control (i.e. the target parameter).

69 Freq Input 1 0% Calibration (R/W, Preset: 0Hz)

In **FREQ INPUT** mode, this parameter defines the minimum input frequency in Hertz. An input value below this level will be ignored. Range: 0..50,000Hz

In **SONIC INPUT** mode, this parameter defines the minimum input distance in inches. An input value below this level will be ignored. Range: 6..420 inches

71 Freq Input 1 100% Calibration (R/W, Preset: 50000Hz)

In **FREQ INPUT** mode, this parameter defines the maximum input frequency in Hertz. An input value above this level will be ignored. Range: 0..50,000Hz

In **SONIC INPUT** mode, this parameter defines the maximum input distance in inches. An input value above this level will be ignored. Range: 6..420 inches

73 Freq Input 1 Bias (R/W, Preset: 0.00)

Defines the value of the target parameter when the input signal is less than or equal to the 0% Calibration. Note that the formatting of this parameter will change to match that of the target parameter. For example, if the target parameter is in percent, this parameter will be in percent. If the target parameter is Off/On, this parameter will be Off/On.

75 Freq Input 1 Gain (R/W, Preset: 100.00)

Defines the value of the target parameter when the input signal is greater than or equal to the 100% Calibration. Note that the formatting of this parameter will change to match that of the target parameter.

77 Freq Input 1 Filtering (R/W, Preset: 0)

Sets the level of digital filtering applied to the input signal. The adjustment ranges from 0 (no filtering) to 15 (heavily filtered).

79 Freq Input 1 Status (RO)

When Mode is set to **FREQ INPUT**, this parameter displays the frequency input level at terminal 1 in Hertz. When Mode is set to **SONIC INPUT**, this parameter displays the distance in inches from the sonic transducer connected to terminal 1.

81 Freq Input 1 Mode (ICR, Preset: Freq Input)

The frequency input can operate in either the **FREQ INPUT** or **SONIC INPUT** modes. In the frequency input mode, the input level is determined by the input frequency. The sonic mode is used in conjunction with Carotron's sonic transducer (P/N: C10757-000 or C11307-000) to measure distance.

82 Out of Range (RO)

Valid only when **Mode** is set to **SONIC INPUT**. Displays the status of the sonic transducer distance measurement. If the **Status** parameter is 10% less than the 0% Cal or 10% greater than the 100% Cal, this parameter will be ON indicating the target is out of range.

555 Revolution Counter Destination (ICR, Preset: 0)

The controller has a counter associated with the frequency input. This count value can control (or write to) any R/W parameter in the drive. The destination parameter contains the tag of the parameter the input will control (i.e. the target parameter).

556 Counter Enable (R/W, Preset: Disabled)
The counter is enabled when set to **ENABLED**.

557 Counter Direction (R/W, Preset: Up)
Controls the direction of the counter. When set to **UP**, each pulse on the input will cause the counter (562:563) to increase. When set to **DOWN**, each pulse on the input will cause the counter to decrease. When set to **QUAD**, both Frequency Inputs are used as a quadrature input. The phasing between the inputs determines the direction. The count is increased by a factor of 4 as both the rising and falling edges of each channel are counted. The quadrature direction can be inverted by selecting **QUAD INVERT**.

558 Rollover Enable (R/W, Preset: Disabled)
When **ENABLED**, the counter is allowed to rollover from maximum to minimum when counting up, or to rollover from minimum to maximum when counting down. If DISABLED, rollover is not allowed and the count value will stop and hold its value at the maximum or minimum.

559 Counter Reset (R/W, Preset: Off)
Resets the counter (562:563) to the Reset Value (560:561) when **ON**.

560 Reset Value Lo (R/W, Preset: 0)
561 Reset Value Hi (R/W, Preset: 0)
The 32 bit counter will be preset to the value in these two registers when **Counter Reset** is **ON**.

562 Counter Lo (RO)
563 Counter Hi (RO)
The 32 bit counter is split into two 16 bit sections (562:563). The counter has a maximum value of 4,294,967,295.

564 Divisor (ICR, Preset: 1)
The 32 bit count value is divided by this value before being written to the target parameter. Range: 0..65535

Example 1 - Frequency Input 1 (Frequency Mode)
Setup Frequency Input 1 as the Line Speed input to the Diameter Calculator Block. The max speed of the line drive is 1750 RPM with a 1024 line encoder. This gives a maximum frequency of 29866 Hz as shown below:

$$1750\frac{\text{revolutions}}{\text{minute}}\times\frac{1\,\text{minute}}{60\,\text{seconds}}\times\frac{1024\,\text{pulses}}{1\,\text{revolution}}=29866\frac{\text{pulses}}{\text{second}}=29866\,\text{Hz}$$

1. Set the **Frequency Input 1 Destination** to **Line Speed** (190).
2. Set the **Frequency Input 1 0% Calibration** to 0 Hz.
3. Set the **Frequency Input 1 100% Calibration** to 29866 Hz.
4. Set the **Frequency Input Bias** to 0.00%.
5. Set the **Frequency Input Gain** to 100.00%.

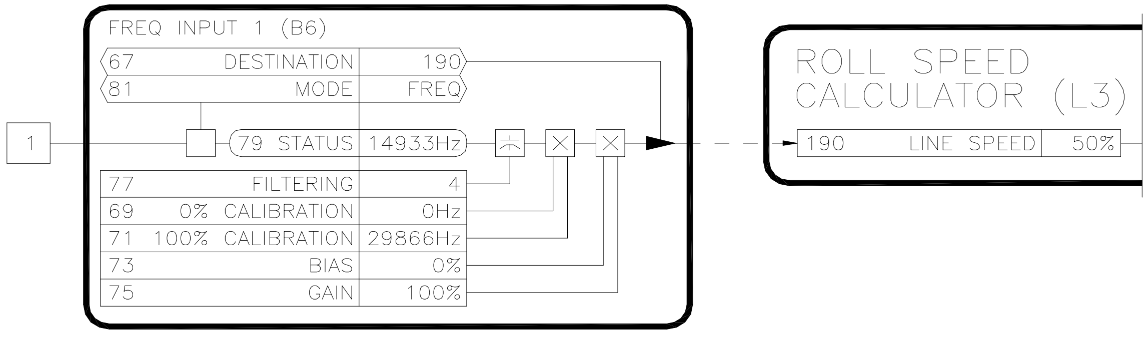


Figure 16: Freq Input Example

Example 2 - Frequency Input 1 (Sonic Mode)
Setup Frequency Input 1 in Sonic Mode to provide a diameter signal to the Diameter Calculator Block. This example also uses Frequency/Digital Output 1 to generate the required 7 Hz clock signal.

1. Connect the Sonic transducer per drawing D12656 on page 103.
2. Set the **Frequency/Digital Output 1 Mode** to Frequency.
3. Set the **Frequency/Digital Output 1 Source** to **Aux 1** (179).
4. Set **Aux 1** value to 0.14% (7 Hz = 5000 Hz x .0014).
5. Set the **Frequency Output 1 Bias** to 0.00%.
6. Set the **Frequency Output 1 Gain** to 100.00%.
7. Set the **Frequency Input 1 Mode** to Sonic.
8. Set the **Frequency Input 1 Destination** to **Ext Dia Ratio** (198).
9. Load the smallest empty core that will be used, and observe the distance reading displayed in the **Status** parameter (79).
10. Set the **Frequency Input 1 100% Calibration** to this value.
11. Load the largest diameter roll that will be used, and observe the distance reading displayed in the **Status** parameter (79).
12. Set the **Frequency Input 1 0% Calibration** to this value.
13. Set the **Frequency Input Bias** to 100.00%.
14. Set the **Frequency Input Gain** to 0.00%.

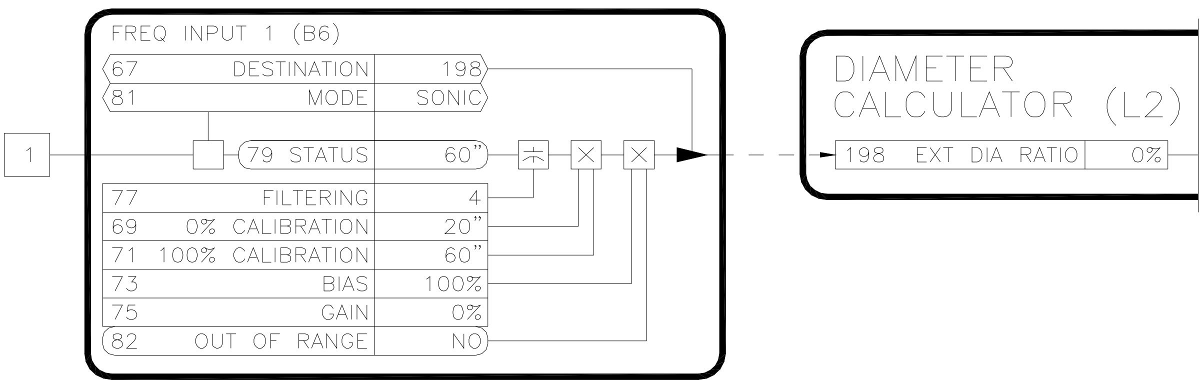


Figure 17: Sonic Input Example

B7:Frequency Input 2

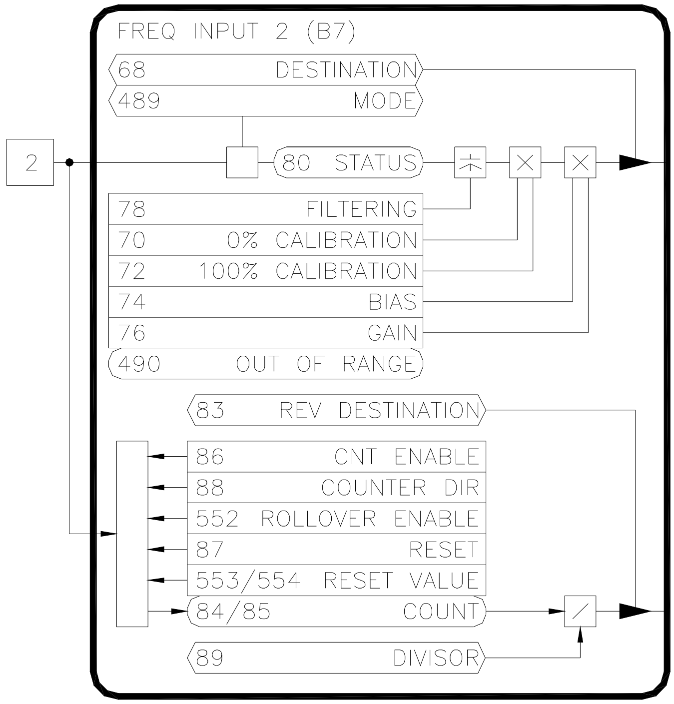


Figure 18: Freq Input 2 (B7)

<u>68 Freq Input 2 Destination (ICR, Preset: 0)</u>
<u>70 Freq Input 2 0% Calibration (R/W, Preset: 0Hz)</u>
<u>72 Freq Input 2 100% Calibration (R/W, Preset: 50000Hz)</u>
<u>74 Freq Input 2 Bias (R/W, Preset: 0.00)</u>
<u>76 Freq Input 2 Gain (R/W, Preset: 100.00)</u>
<u>78 Freq Input 2 Filtering (R/W, Preset: 0)</u>
<u>80 Freq Input 2 Status (RO)</u>
<u>83 Revolution Counter Destination (ICR, Preset: 0)</u>
<u>84 Counter Lo (RO)</u>
<u>85 Counter Hi (RO)</u>
<u>86 Counter Enable (R/W, Preset: Disabled)</u>
<u>87 Counter Reset (R/W, Preset: Off)</u>
<u>88 Counter Direction (R/W, Preset: Up)</u>
<u>89 Divisor (ICR, Preset: 1)</u>
<u>489 Freq Input 2 Mode (ICR, Preset: Freq Input)</u>
<u>490 Out of Range (RO)</u>
<u>552 Rollover Enable (R/W, Preset: Disabled)</u>
<u>553 Reset Value Lo (R/W, Preset: 0)</u>
<u>554 Reset Value Hi (R/W, Preset: 0)</u>

Frequency Input 2 is functionally equivalent to Frequency Input 1. Refer to Frequency Input 1.

6.3 Group C: Analog Inputs

These parameters configure the controller's physical analog inputs.

C1: Analog Input 1

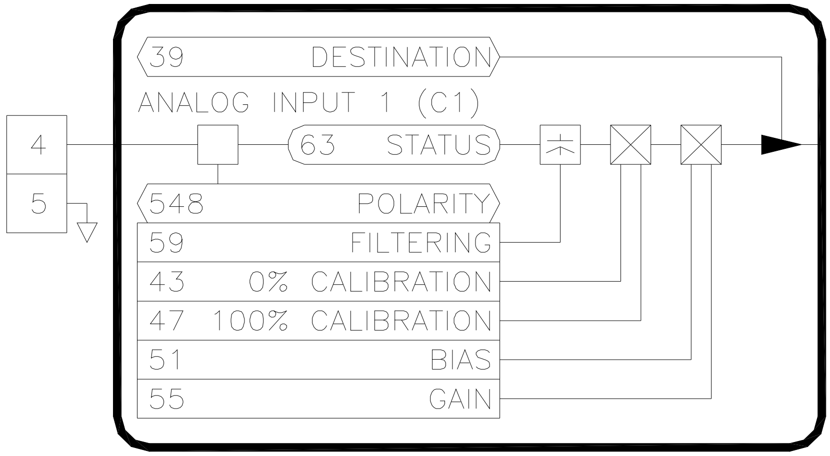


Figure 19: Analog Input 1 (C1)

<u>39 Analog Input 1 Destination (ICR, Preset: 0)</u>

Each of the analog inputs can control (or write to) any R/W parameter in the drive. The destination parameter contains the tag of the parameter the input will control (i.e. the target).

<u>43 Analog Input 1 0% Calibration (R/W, Preset: 0)</u>

Defines the minimum signal level in UNIPOLAR mode. An input value below this level will be ignored. Defines the 0V signal level in BIPOLAR mode. Range: -4095..4095

<u>47 Analog Input 1 100% Calibration (R/W, Preset: 4095)</u>

Defines the maximum positive raw signal level. An input value above this level will be ignored. In BIPOLAR mode, values below this negated value will also be ignored. Range: 0..4095

<u>51 Analog Input 1 Bias (R/W, Preset: 0.00)</u>

Defines the value of the target parameter when the input signal is at the 0% Calibration level. Note that the formatting of this parameter will change to match that of the target parameter. For example, if the target parameter is percent, this parameter will be percent. If the target parameter is Seconds, this parameter will be Seconds.

<u>55 Analog Input 1 Gain (R/W, Preset: 100.00)</u>

Defines the value of the target parameter when the input signal is at the 100% Calibration level. Note that the formatting of this parameter will change to match that of the target parameter.

<u>63 Analog Input 1 Status (RO)</u>

Displays the raw analog to digital conversion value. Table 3 below lists the typical status values for common input levels. Negative values are only valid in BIPOLAR mode.

Input	Status
+10V	4095
+7.5V	3071
+5V	2047
+2.5V	511
0V	0
-2.5V	-512
-5V	-1024
-7.5V	-1536
-10V	-4095

Table 3: Analog Input Status Readings

548 Analog Input 1 Polarity (ICR, Preset: Unipolar)

Configures the type of analog input signal used, either UNIPOLAR or BIPOLAR. In UNIPOLAR mode, negative values are ignored.

59 Analog Input 1 Filtering (R/W, Preset: 0)

Sets the level of digital filtering applied to the input signal. The adjustment ranges from 0 (no filtering) to 15 (heavily filtered). Range: 0..15

Example - Analog Input

Setup **Analog Input 1** to control the **PID Feedback** parameter. Define the 1-9V input to produce 0.00%-100.00% setpoint.

1. Set **Analog Input 1 Destination** to **PID Feedback** (360).
2. Set **Analog Input 1 0% Calibration** to 409.

$$0\%\ \mathrm{Cal} = \frac{\text{Minimum Input Voltage}}{10\mathrm{V}} \times 4095 = \frac{1\mathrm{V}}{10\mathrm{V}} \times 4095 = 409$$

3. Set **Analog Input 1 100% Calibration** to 3686.

$$100\%\ \mathrm{Cal} = \frac{\text{Maximum Input Voltage}}{10\mathrm{V}} \times 4095 = \frac{9\mathrm{V}}{10\mathrm{V}} \times 4095 = 3686$$

4. Set **Analog Input 1 Bias** to 0.00%.
5. Set **Analog Input 1 Gain** to 100.00%.

When any voltage signal below 1V is applied, **PID Feedback** equates to 0.00%. As the voltage increases to 9V, **PID Feedback** increases linearly to 100.00%. The value will remain at 100.00% for all voltages over 9V.

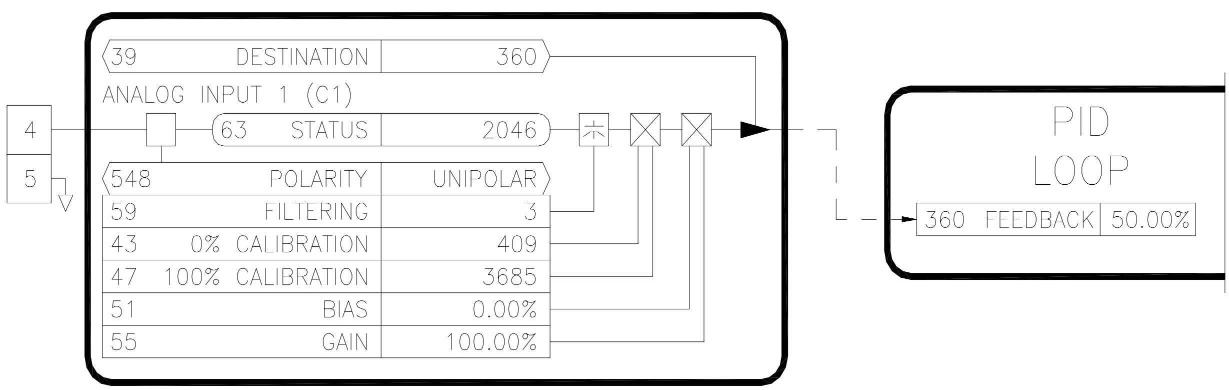


Figure 20: Analog Input Example

C2: Analog Input 2

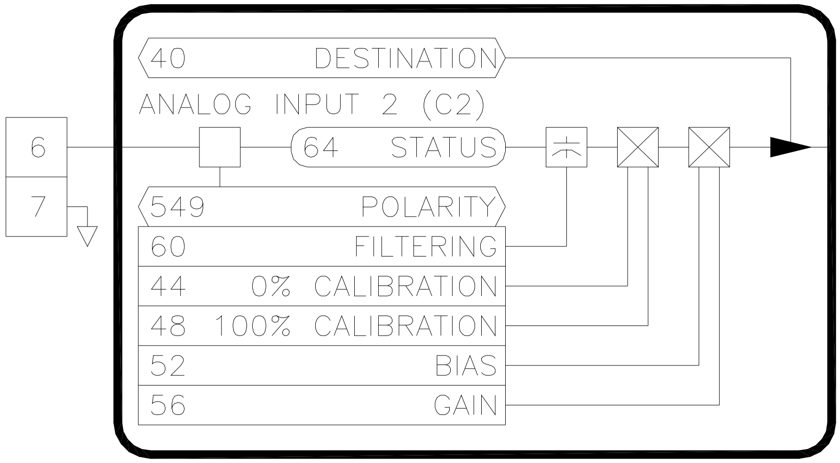


Figure 21: Analog Input 2 (C2)

40 Analog Input 2 Destination (ICR, Preset: 0)
44 Analog Input 2 0% Calibration (R/W, Preset: 0)
48 Analog Input 2 100% Calibration (R/W, Preset: 4095)
52 Analog Input 2 Bias (R/W, Preset: 0.00)
56 Analog Input 2 Gain (R/W, Preset: 100.00)
64 Analog Input 2 Status (RO)
60 Analog Input 2 Filtering (R/W, Preset: 0)
549 Analog Input 2 Polarity (ICR, Preset: Unipolar)

Analog Input 2 is functionally equivalent to Analog Input 1. Refer to Analog Input 1.

C3: Analog Input 3

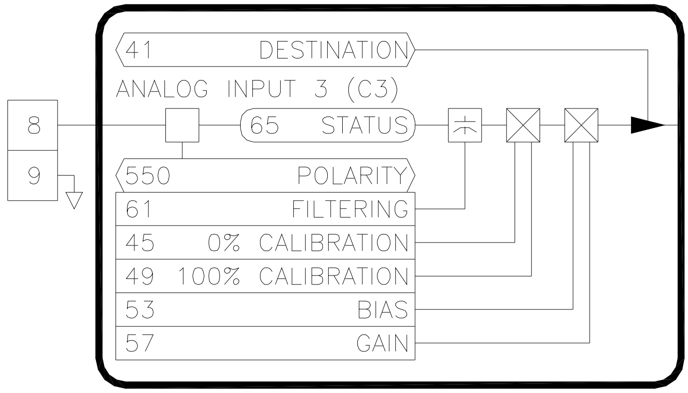


Figure 22: Analog Input 3 (C3)

<u>40 Analog Input 3 Destination (ICR, Preset: 0)</u>
<u>44 Analog Input 3 0% Calibration (R/W, Preset: 0)</u>
<u>48 Analog Input 3 100% Calibration (R/W, Preset: 4095)</u>
<u>52 Analog Input 3 Bias (R/W, Preset: 0.00)</u>
<u>56 Analog Input 3 Gain (R/W, Preset: 100.00)</u>
<u>64 Analog Input 3 Status (RO)</u>
<u>60 Analog Input 3 Filtering (R/W, Preset: 0)</u>
<u>549 Analog Input 3 Polarity (ICR, Preset: Unipolar)</u>

Analog Input 3 is functionally equivalent to Analog Input 1. Refer to Analog Input 1.

C4: Analog Input 4

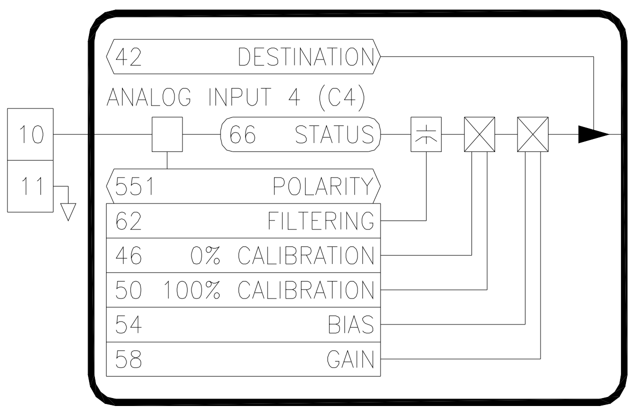


Figure 23: Analog Input 4 (C4)

<u>41 Analog Input 4 Destination (ICR, Preset: 0)</u>
<u>45 Analog Input 4 0% Calibration (R/W, Preset: 0)</u>
<u>49 Analog Input 4 100% Calibration (R/W, Preset: 4095)</u>
<u>53 Analog Input 4 Bias (R/W, Preset: 0.00)</u>
<u>57 Analog Input 4 Gain (R/W, Preset: 100.00)</u>
<u>61 Analog Input 4 Filtering (R/W, Preset: 0)</u>
<u>65 Analog Input 4 Status (RO)</u>
<u>550 Analog Input 4 Polarity (ICR, Preset: Unipolar)</u>

Analog Input 4 is functionally equivalent to Analog Input 1. Refer to Analog Input 1.

6.4 Group D: Digital Outputs

These parameters configure the drive's physical digital outputs (relay & frequency/digital).

D1: Relay Output 1

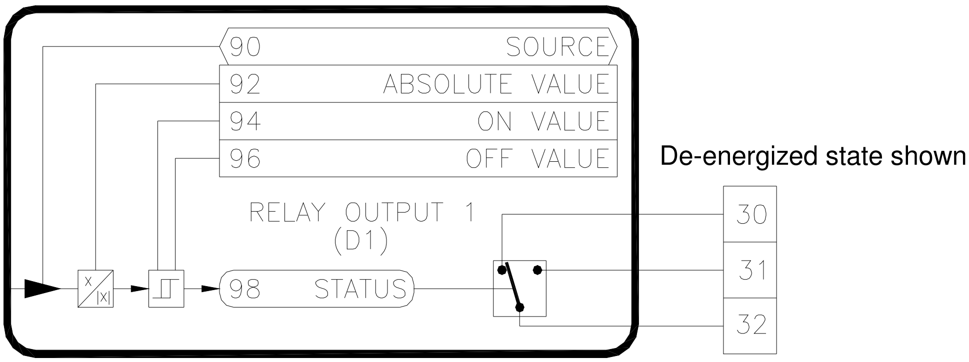


Figure 24: Relay Output 1 (D1)

<u>90 Relay Output 1 Source (ICR, Preset:0)</u>

The function of the relay output is configured by this parameter. The output can be controlled by any parameter in the device. The source parameter contains the tag of the parameter that will control the relay output. The source parameter's value is compared to the **On Value** and **Off Value** parameters (94 & 96) to determine if the relay should be ON (energized) or OFF (de-energized).

<u>92 Relay Output 1 Absolute Value (R/W, Preset: Off)</u>

When ON, the absolute value of the source parameter's value is taken before it is compared to the **On Value** and **Off Value**.

<u>94 Relay Output 1 On Value (R/W, Preset: On)</u>

The relay will energize (turn on) when the source parameter's value is greater than or equal to this value. The limits and units of this parameter will change to match the limits and units of the source parameter.

<u>96 Relay Output 1 Off Value (R/W, Preset: Off)</u>

The relay will de-energize (turn off) when the source parameter's value is less than or equal to this value. The limits and units of this parameter will change to match the limits and units of the source parameter.

<u>98 Relay Output 1 Status (RO)</u>

Displays the status of the relay output, ON or OFF.

NOTE! The logic of the relay output can be reversed by swapping the values of **On Value** and **Off Value.**

Example - Relay Output

Setup Relay Output 1 to signal when the Line Speed is above 5% with a hysteresis of 3%.

1. Set **Relay Output 1** Source to **Line Speed** (190).
2. Set **Relay Output 1 On Threshold** to 5.00%.
3. Set **Relay Output 1 Off Threshold** to 2.00 %.

Relay Output 1 will energize when the line speed equals or exceeds 5.00% and will de-energize when the speed equals or falls below 2.00%. A hysteresis level was used to prevent the relay from 'chattering' (continually energizing and de-energizing) when the drive runs at 5.00% speed.

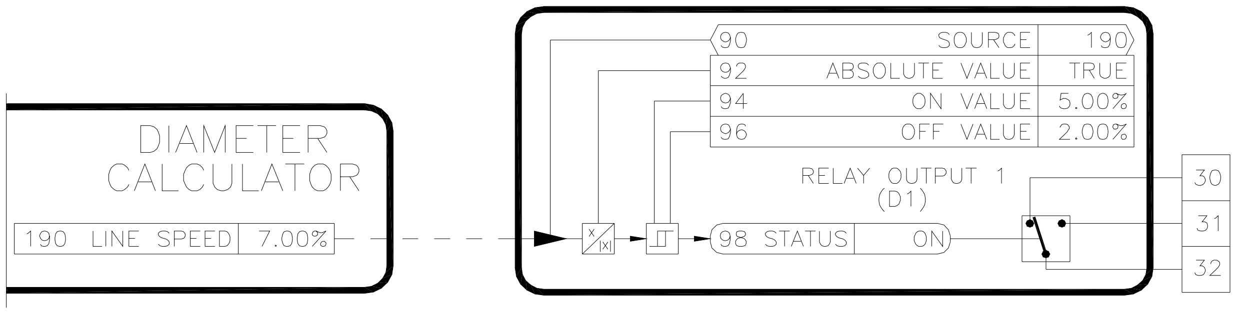


Figure 25: Relay Output Example

D2: Relay Output 2

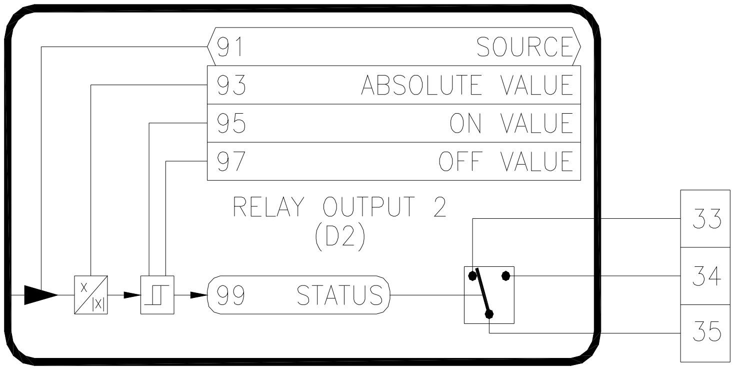


Figure 26: Relay Output 2 (D2)

90 Relay Output 2 Source (ICR, Preset:0)
92 Relay Output 2 Absolute Value (R/W, Preset: Off)
94 Relay Output 2 On Value (R/W, Preset: On)
96 Relay Output 2 Off Value (R/W, Preset: Off)
98 Relay Output 2 Status (RO)

Relay Output 2 is functionally equivalent to Relay Output 1. Refer to Relay Output 1.

D3: Frequency/Digital Output 1

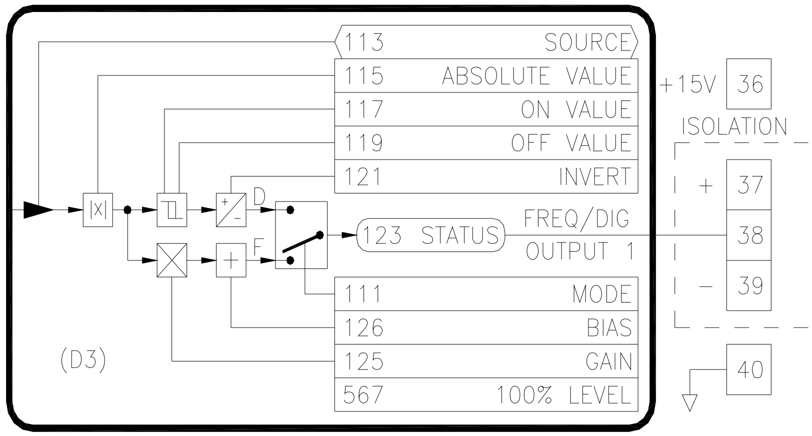


Figure 27: Freq/Digital Output 1 (D3)

111 Freq/Digital Output 1 Mode (ICR, Preset: Freq Out)

The open collector output can function in either a high speed frequency or digital mode. In FREQ OUT mode, the output is a pulse train. The frequency level of the output is based on the source parameter's value. In DIGITAL OUT mode, the output is driven either on or off (similar to a relay output).

113 Freq/Digital Output 1 Source (ICR, Preset: 0)

The function of this output is configured by this parameter. The output can be controlled by most parameters in the drive. The source parameter contains the tag of the parameter that will control the relay output.

115 Digital Output 1 Absolute Value (R/W, Preset: Off)

When ON, the absolute value of the source parameter's value is taken before being used by the Frequency or Digital Output.

117 Digital Output 1 On Value (R/W, Preset: 0.01)

Used only in the DIGITAL OUT mode. The output will turn on (sink current) when the source parameter's value is greater than or equal to this value. The limits and units of this parameter will change to match the limits and units of the source parameter.

119 Digital Output 1 Off Value (R/W, Preset: 0.00)

Used only in the DIGITAL OUT mode. The output will turn off when the source parameter's value is less than or equal to this value. The limits and units of this parameter will change to match the limits and units of the source parameter.

121 Digital Output 1 Invert (R/W, Preset: Off)

Used only in the DIGITAL OUT mode. This parameter allows the output to be inverted.

123 Output 1 Status (RO)

In the FREQ OUT mode, this parameter displays the frequency output level in Hz. In DIGITAL OUT mode, this parameter displays the status of the output, either ON or OFF.

125 Freq Output 1 Gain (R/W, Preset: 100.00%)

Used only in the FREQ OUT mode. This adjustment is used to scale the output level of the pulse train. A Gain of 100% with a source parameter value of 100% will yield a frequency output level equal to **100% Level** parameter.
Range: 0..300%

126 Freq Output 1 Bias (R/W, Preset: 0.00%)

Used only in the FREQ OUT mode. This adjustment is used to set a minimum frequency output level. The percentage adjustment is based on the **100% Level** parameter.
Range: 0..300%

567 Freq Output 1 100% Level (R/W, Preset: 5000Hz)

Used only in the **FREQ OUT** mode. This parameter defines the nominal 100% output level.
Range: 0..10000Hz

Example - Frequency Output

Setup Frequency Output 1 to output the Sum 1 parameter. A full-scale level of 1800 Hz should be output when Sum 1 is at 100%.

1. Set the **Frequency/Digital Output 1 Mode** to Frequency.
2. Set the **Frequency/Digital Output 1 Source** to **Sum 1** (233).
3. Set the **Frequency Output 1 Bias** to 0.00%.
4. Set the **Frequency Output 1 Gain** to 36.00%.

$$\text{Gain} = \frac{\text{Maximum Output in Hertz}}{5000\ \text{Hz}} \times 100\% - \text{Bias} = \frac{1800\ \text{Hz}}{5000\ \text{Hz}} \times 100\% - 0\% = 36.00\%$$

Frequency Output 1 will give a 1800 Hz full-scale signal when **Sum 1** equals 100%. If a 5000 Hz full-scale signal were required, the **Gain** should be set to 100% in Step 4.

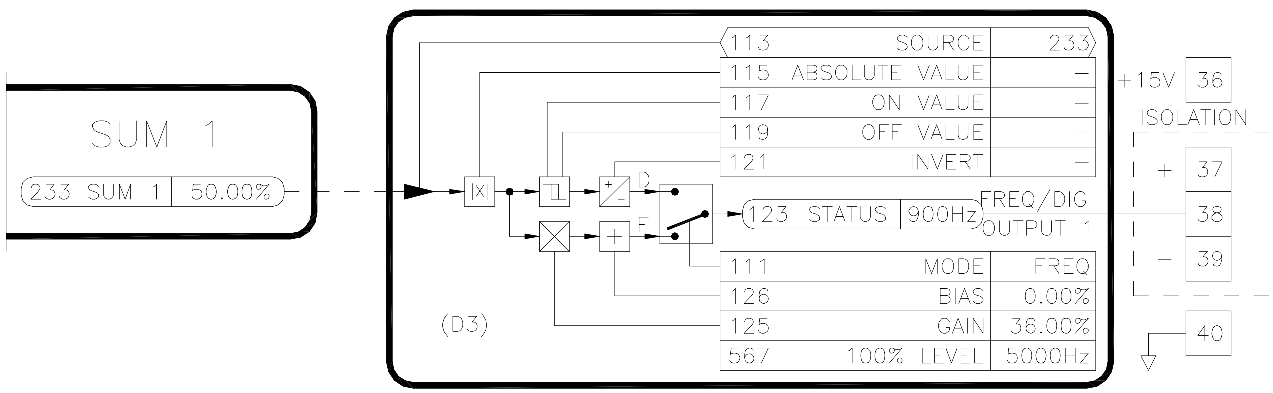


Figure 28: Frequency Output Example

Example - Digital Output

Setup Digital Output 1 to indicate when the diameter is above 40 inches.

1. Set the **Frequency/Digital Output 1 Mode** to Digital.
2. Set the **Frequency/Digital Output 1 Source** to **Diameter** (202).
3. Set the **Digital Output On Threshold** to 40.00 inches.
4. Set the **Digital Output Off Threshold** to 39.00 inches.
5. Set the **Digital Output Invert** to OFF.

The Digital Output will be on when the diameter is at or above 40 inches. The output will be off when the diameter is at or below 39 inches.

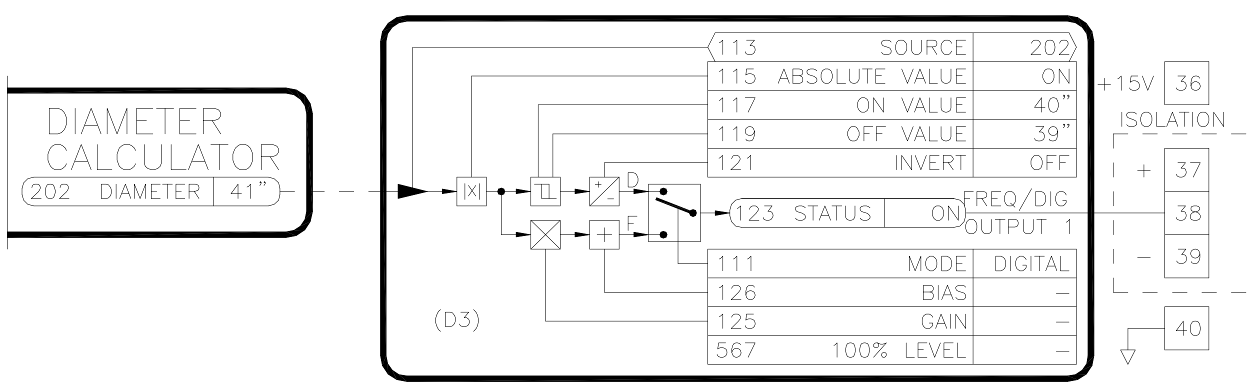


Figure 29: Digital Output Example

D4: Frequency/Digital Output 2

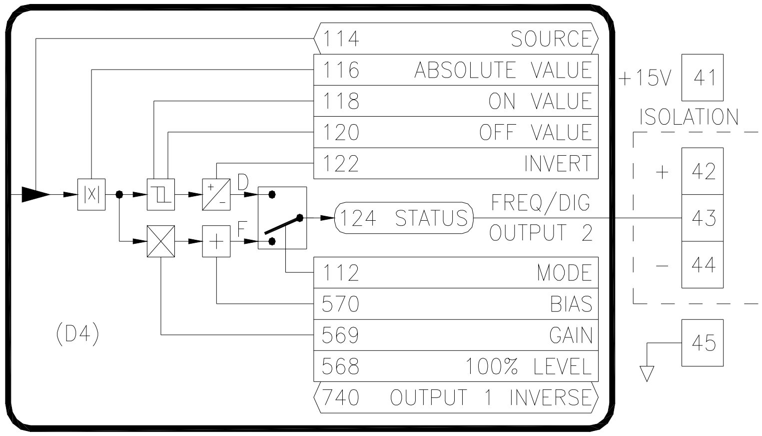


Figure 30: Freq/Digital Output 2 (D4)

112 Freq/Digital Output 2 Mode (ICR, Preset: Freq Out)
114 Freq/Digital Output 2 Source (ICR, Preset: 0)
116 Digital Output 2 Absolute Value (R/W, Preset: Off)
118 Digital Output 2 On Value (R/W, Preset: 0.01)
120 Digital Output 2 Off Value (R/W, Preset: 0.00)
122 Digital Output 2 Invert (R/W, Preset: 0.00)
124 Freq/ Digital Output 2 Status (RO)
569 Freq Output 2 Gain (R/W, Preset: 100.00%)
570 Freq Output 2 Bias (R/W, Preset: 0.00%)
568 Freq Output 2 100% Level (R/W, Preset: 5000Hz)

Except for the parameter below, Freq/Digital Output 2 is functionally equivalent to Freq/Digital Output 1. Refer to Freq/Digital Output 1.

740 Freq Output 2 Inverse (R/W, Preset: On)

Due to hardware limitations on the first generation Cortex® LT units (Model D12600-XXX), when in the **Freq Out** mode, Output 2's frequency was an inverted waveform of Output 1. This was primarily used as a Inverse Clock when using dual Sonic Transducers. The V2 units do not have this limitation and Freq Output 2 is completely independent. This parameter is provided for backwards compatibility with the first generation Cortex® LTs. Set this parameter to ON when using dual Sonic Transducers. This synchronizes output 2 with output 1 to prevent sonic interference from the transducers. When Off, the output will operate independently.

D5: LED Output A

The LED Output A block has 5 configurable sources. Each source can be configured to monitor a different parameter. If/when any of these monitored parameters becomes On or True, the LED will turn on. By default, if none of the 5 source parameters are defined (or if DIP switch SW2-2 is on), LED A will be on when the controller is in the Run mode and off otherwise.

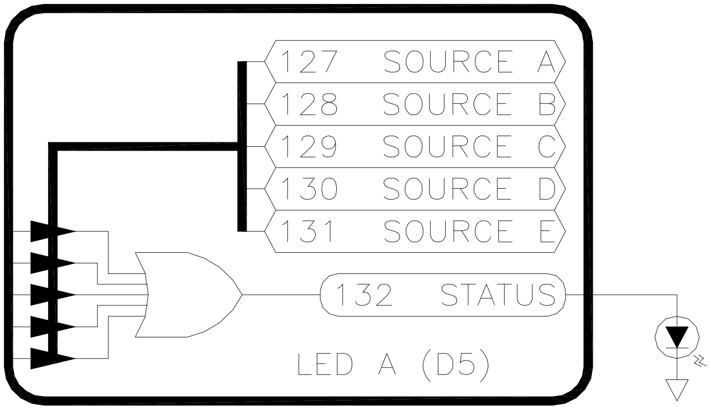


Figure 31: LED Output A (D5)

127 LED Output A Source A (ICR, Preset: 0)
128 LED Output A Source B (ICR, Preset: 0)
129 LED Output A Source C (ICR, Preset: 0)
130 LED Output A Source D (ICR, Preset: 0)
131 LED Output A Source E (ICR, Preset: 0)

The function of the LED is defined by these parameters.

132 LED Output A Status (RO)

Displays the status of the LED output, either **ON** or **OFF**.

D6: LED Output B

The LED Output B block has 5 configurable sources. Each source can be configured to monitor a different parameter. If/when any of these monitored parameters becomes On or True, the LED will turn on.

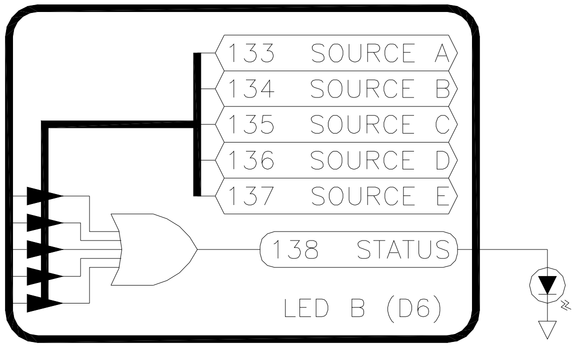


Figure 32: LED Output B (D5)

133 LED Output B Source A (ICR, Preset: 0)
134 LED Output B Source B (ICR, Preset: 0)
135 LED Output B Source C (ICR, Preset: 0)
136 LED Output B Source D (ICR, Preset: 0)
137 LED Output B Source E (ICR, Preset: 0)

The function of the LED is defined by these parameters.

138 LED Output A Status (RO)

Displays the status of the LED output, either **ON** or **OFF**.

6.5 Group E: Analog Outputs

These parameters configure the drive's physical analog outputs.

E1: Analog Output 1

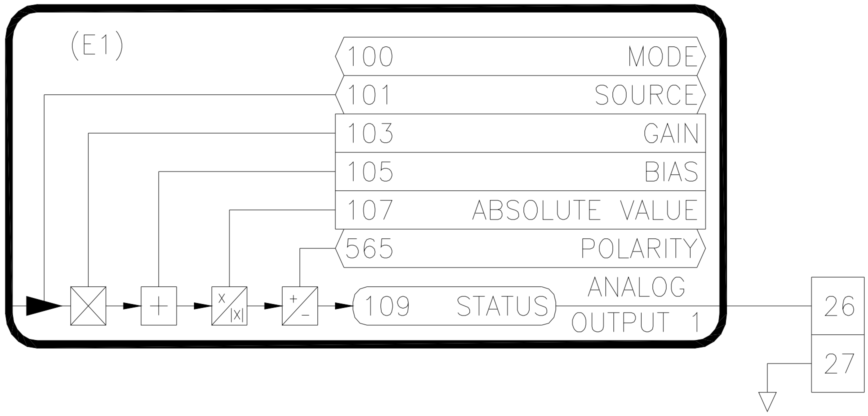


Figure 33: Analog Output 1 (E1)

100 Analog Output Mode (ICR, Preset: Unipolar)

This parameter is included for backwards compatibility with the first generation (Models D12600-XXX). Analog Outputs 1 & 2 on first generation units could only produce unipolar outputs. When set to BIPOLAR, this parameter provided a method so both analog outputs could be used to produce a single bipolar analog output. A unique wiring scheme was also used. The V2 hardware allows for bipolar analog outputs, thus this parameter is often not used (i.e. set to **UNIPOLAR**). It is typically only used when replacing a legacy unit that required a bipolar output. When set to **BIPOLAR**, the Analog Output 2 status value is overridden and controlled by Analog Output 1.

101 Analog Output 1 Source (ICR, Preset: 0)

The function of this output is configured by this parameter. The output can be controlled by any parameter in the drive. The source parameter contains the tag of the parameter that will control the analog output level.

103 Analog Output 1 Gain (R/W, Preset: 100.00%)

This adjustment is used to scale the output level. A gain of 100% with a source parameter value of 100% will yield maximum output level of 10V. Range: -300..300%

105 Analog Output 1 Bias (R/W, Preset: 0.00%)

This adjustment is used to set a minimum output level. The percentage adjustment is based on the maximum output level (10V). Range: -300..300%

107 Analog Output 1 Absolute Value (R/W, Preset: Off)

When ON, the absolute value is taken after the Bias and Gain have been applied to the source parameter's value. This effectively makes the output unipolar (positive only).

109 Analog Output 1 Status (RO)

Displays the raw digital to analog output level. Refer to Table 4 for typical values.

Status	Voltage
4095	+10V
2047	+5V
0	0V
-2047	-5V
-4095	-10V

Table 4: Analog Output Status

565 Analog Output 1 Polarity (R/W, Preset: Unipolar)

When set to **UNIPOLAR**, the output can only produce positive outputs. Any negative values will be limited to zero volts. When set to **BIPOLAR**, the output can range positive and negative. The setting is defaulted to **UNIPOLAR** to mimic the first generation Cortex® LT units.

Example - Analog Output

Setup Analog Output 1 to output the **PID Output** signal. Scale the analog output so that a 100.00% value from the **PID Output** gives 5V.

1. Set **Analog Output 1 Source** to **PID Output** (369).
2. Set **Analog Output 1 Bias** to 0.00%.
3. Set **Analog Output 1 Gain** to 50.00%.

$$\text{Gain} = \frac{\text{Desired Full Scale Voltage}}{10\text{V}} \times 100\% - \text{Bias} = \frac{5\text{V}}{10\text{V}} \times 100\% - 0\% = 50\%$$

4. Set **Analog Output 1 Absolute Value** to OFF.

Analog Output 1 will give a 5V full-scale version of **PID Output**. If a 10V full-scale signal were required, the **Analog Output 1 Gain** should be set to 100% in Step 3.

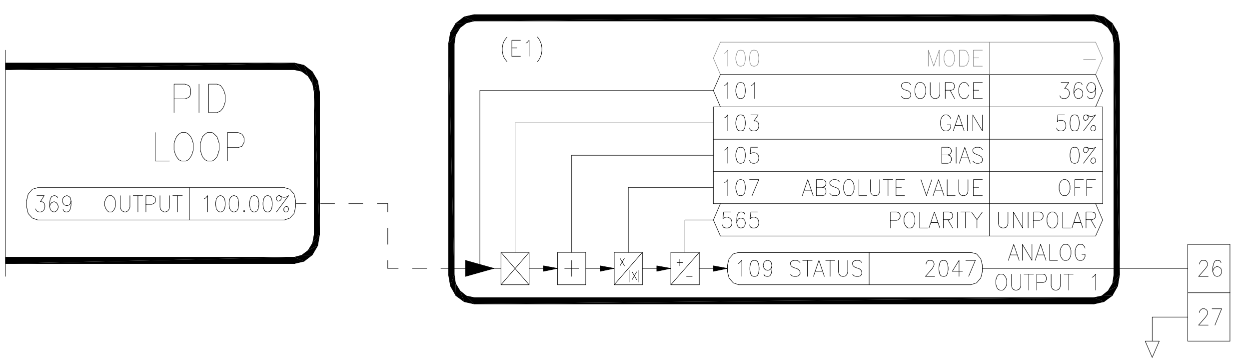


Figure 34: Analog Output Example

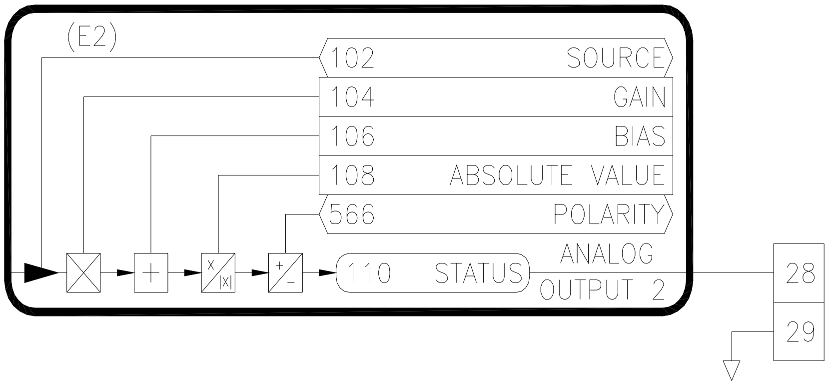


Figure 35: Analog Output 2 (E2)

102 Analog Output 2 Source (ICR, Preset: 0)
104 Analog Output 1 Gain (R/W, Preset: 100.00%)
106 Analog Output 1 Bias (R/W, Preset: 0.00%)
108 Analog Output 1 Absolute Value (R/W, Preset: Off)
110 Analog Output 1 Status (RO)
566 Analog Output 1 Polarity (R/W, Preset: Unipolar)

Analog Output 2 is functionally equivalent to Analog Output 1 (with the exception of the Mode parameter). Refer to Analog Output 1.

6.6 Group H: Start/Stop Logic

These parameters configure the Start/Stop Logic block. It is typically used in applications that need zero speed logic to keep items in the run mode while ramping to stop.

H1: Start/Stop Logic

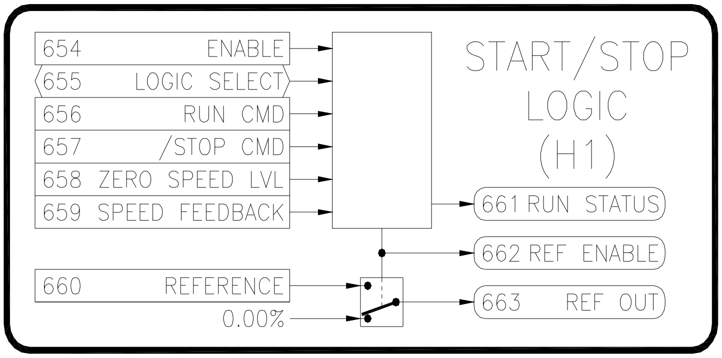


Figure 36: Start/Stop Logic (H1)

<u>654 Enable (R/W, Preset: Disabled)</u>
This parameter must be set to ENABLED for the block to function. When DISABLED, the Run Status is Off and the reference is disabled.

<u>655 Logic Select (ICR, Preset: Maintained)</u>
When set to MOMENTARY, the logic block emulates a 3 wire (momentary) run logic. The interface acts like it has two momentary pushbutton inputs (run and stop). When set to MAINTAINED, the logic block emulates 2 wire (maintained) run logic. The interface uses only a single input for a run command (i.e. the /Stop Command is not used).

<u>656 Run Command (R/W, Preset: Off)</u>
In the MAINTAINED logic mode, this input alone determines run/stop command. When ON, a run command is issued. When OFF, a stop command is issued. In the MOMENTARY logic mode, a run command is issued when this value momentarily is ON.

<u>657 /Stop Command (R/W, Preset: Off)</u>
Only used in the MOMENTARY logic mode. A stop command is issued when this parameter has a value of OFF.

<u>658 Zero Speed Level (R/W, Preset: 2.00%)</u>
When a stop command is received, the Ref Enable will immediately be disabled. Only after the Speed Feedback drops below this level does the Run Status transition from ON to OFF.

<u>659 Speed Feedback (R/W, Preset: 0.00%)</u>
After a stop command has been received, the Run Status will transition from ON to OFF once this value drops below the Zero Speed Level.

<u>660 Reference (R/W, Preset: 0.00%)</u>
The block's input reference.

<u>661 Run Status (R/O)</u>
Displays the status of the block. An ON value indicates a run command has been received. Even after a stop command is issued, the value will remain ON until the Speed Feedback drops below the Zero Speed Level.

<u>662 Ref Enable (R/O)</u>
Ref Enable will be ON when a valid run command is received. Ref Enable will be OFF when a stop command is received.

<u>663 Reference Out (R/O)</u>
Displays the selected reference. When Ref Enable is ON, this parameter is equal to Reference. When Ref Enable is OFF, this parameter is equal to 0%.

6.7 Group J: Ramps

The Ramp blocks control the rate at which a reference changes.

J1: Ramp 1

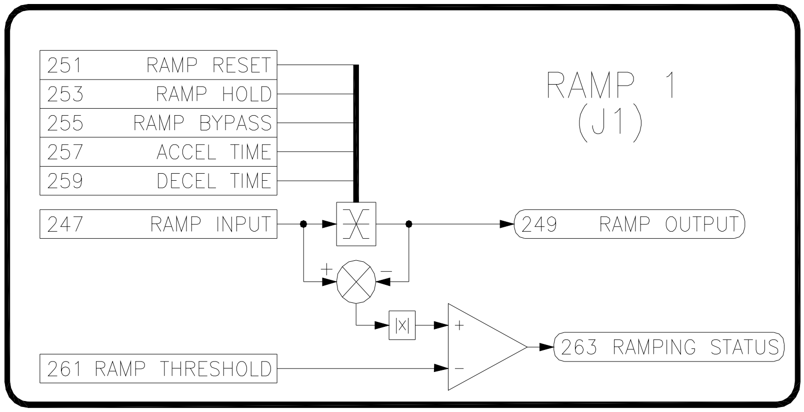


Figure 37: Ramp 1 (J1)

247 Ramp Input (R/W, Preset: 0.00%)
Input signal to the Ramp block.

249 Ramp Output (R/O)
Ramped output signal.

251 Ramp Reset (R/W, Preset: Off)
Ramp Reset resets the **Ramp Output** to 0.00% when ON.

253 Ramp Hold (R/W, Preset: Off)
The **Ramp Output** is held at its current value while **Ramp Hold** is ON. When the hold is released, the **Ramp Output** will continue to ramp up or down from its current value. The **Ramp Reset** parameter overrides this setting.

255 Ramp Bypass (R/W, Preset: Off)
Ramp Bypass disables the Accel/Decel rates and simply passes the **Ramp Input** through to the **Ramp Output**. The **Ramp Reset** parameter overrides this setting.

257 Accel Time (R/W, Preset: 10.0Secs)
The accel adjustment controls the amount of time that it takes for the **Ramp Output** to increase from 0% to 100%.

259 Decel Time (R/W, Preset: 10.0Secs)
The decel adjustment controls the amount of time that it takes for the **Ramp Output** to decrease from 100% to 0%.

261 Ramp Thresold (R/W, Preset: 1.00%)
Ramp Threshold adjusts the level at which the **Ramping Status** parameter is active.

263 Ramping Status (R/O)
The **Ramping Status** parameter signals when **Ramp Output** is changing.

J2: Ramp 2

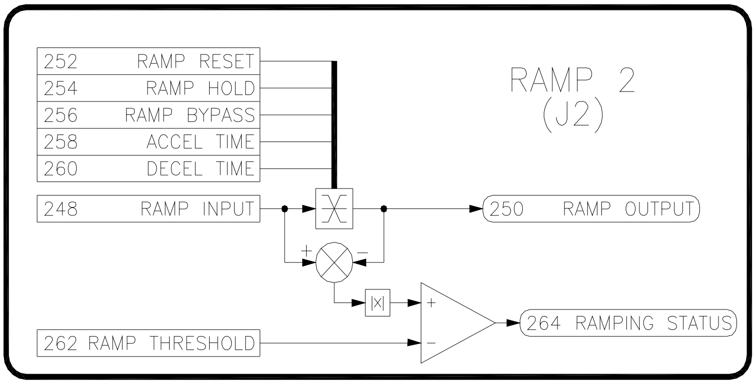


Figure 38: Ramp 2 (J2)

248 Ramp Input (R/W, Preset: 0.00%)
250 Ramp Output (R/O)
252 Ramp Reset (R/W, Preset: Off)
254 Ramp Hold (R/W, Preset: Off)
256 Ramp Bypass (R/W, Preset: Off)
258 Accel Time (R/W, Preset: 10.0Secs)
260 Decel Time (R/W, Preset: 10.0Secs)
262 Ramp Thresold (R/W, Preset: 1.00%)
264 Ramping Status (R/O)

Ramp 2 is functionally equivalent to Ramp 1. Refer to Ramp 1.

6.8 Group K: Faults

K1: Faults

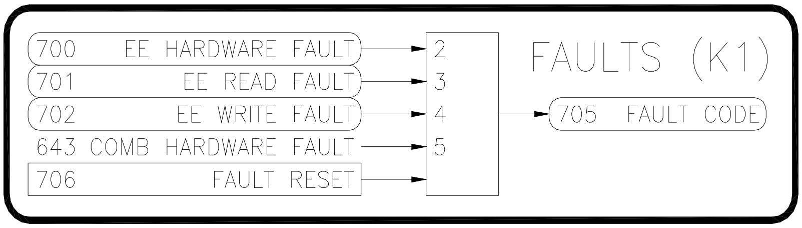


Figure 39: Faults (K1)

700 EEPROM Hardware Fault (R/O)
When ON, indicates a hardware EEPROM fault.

701 EEPROM Read Fault (R/O)
When ON, indicates an EEPROM Read fault.

702 EEPROM Write Fault (R/O)
When ON, indicates an EEPROM Write fault.

705 Fault Code (R/O)
The fault block continually monitors the inputs. If/when an input becomes ON, a unique code for that fault is stored in this parameter. LED B will also flash the corresponding numeric code (if DIP Switch SW2-2 is on).

Fault	Code
Reserved	1
EE Hardware Fault	2
EE Read Fault	3
EE Write Fault	4
COM B Hardware Fault	5

Table 5: Fault Codes

706 Fault Reset (R/W, Preset: Off)
Allows clearing of a fault condition. Setting the value of ON will clear any existing fault code stored in Fault Code.

6.9 Group L: Applications

The Application block contains blocks/calculators that are commonly used in applications (like winding and unwinding). The Roll Speed calculator is typically used in velocity (speed) control configurations while the CTCW calculator is typically used in torque control configurations.

L1: Length Calculator

This block can be used to provide batching functions to a system. The calculator determines the length of material by referencing the revolutions (via Freq Input 1 or 2) of a line speed encoder signal. This pulse count along with the length per revolution allows the calculator to provide precise length calculations.

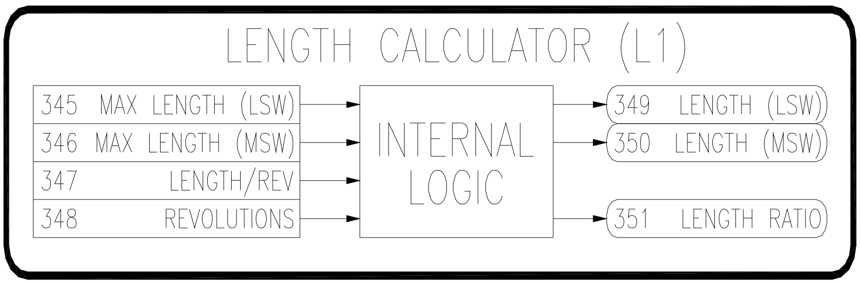


Figure 40: Length Calculator (L1)

345,346 Max Length (R/W, Preset: 0.00")

The desired maximum length in inches. This value is a 32 bit integer and is broken into a least significant word and most significant word.

347 Length Per Revolution (R/W, Preset: 0.01")

The length (in inches) of material that is accumulated for each **Revolution**.

348 Revolutions (R/W, Preset: 0)

The number of revolutions. Typically, the Revolution counter of Frequency Input 1 or 2 is linked to this parameter when used.

349,350 Length (R/O)

The accumulated length in inches. This value is a 32 bit integer and is broken into a least significant word and most significant word. This value is the product of the **Length Per Revolution** and **Revolutions**.

351 Length Ratio (R/O)

Displays the ratio of **Length** to **Max Length**. Typically this value is used to activate one of more relay outputs.

L2: Diameter Calculator

Diameter compensation is essential for stable and accurate tension control of winders and unwinders. The diameter calculator provides a number of methods of calculating the diameter.

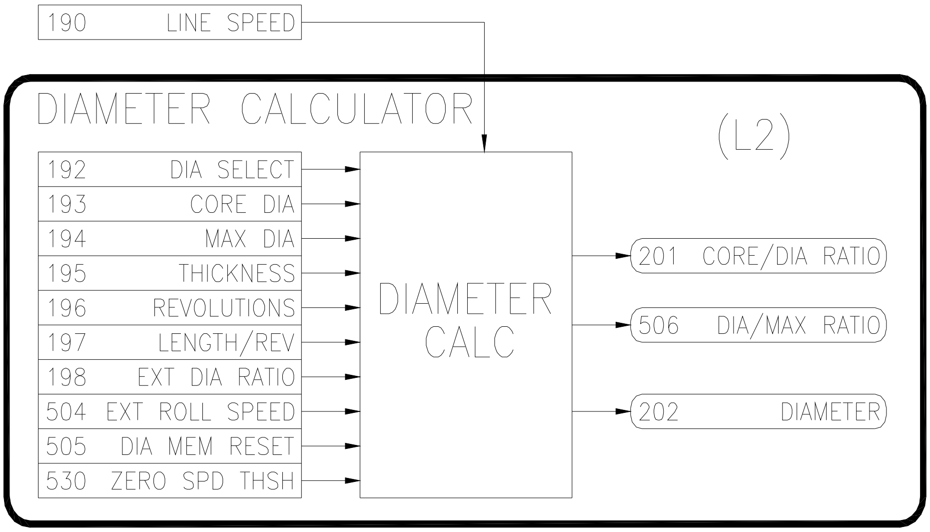


Figure 41: Diameter Calculator (L2)

192 Diameter Select (R/W, Preset: None)

Determines which method is used to calculate the diameter.

NONE

The diameter calculator is disabled, and the **Diameter** is equal to the **Core Diameter**.

EXTERNAL DIAMETER

An external diameter signal is provided. This signal could come from an ultrasonic measuring unit like the SONICTRAC®, a laser, or from a mechanical measuring device such as a rider arm and pot.

ROLL REVOLUTIONS

The diameter is calculated by the **Material Thickness** and the **Revolutions** of the takeup or letoff roll. The revolution count can be easily obtained by from an pulse type encoder mounted on the takeup or letoff drive or roll.

LINE REVOLUTIONS

The diameter is calculated by the number of line speed **Revolutions**, **Length Per Revolution**, and **Material Thickness**. The revolution count can be easily obtained by from an pulse type encoder mounted on the line drive.

LINE/ROLL SPEED

The diameter is calculated by dividing Line Speed signal by the **External Roll Speed** signal.

193 Core Diameter (R/W, Preset: 1.00")

The outside diameter of an empty core in inches. If multiple size cores are used, enter the smallest size.

194 Max Diameter (R/W, Preset: 10.00")

The maximum roll diameter in inches.

195 Material Thickness (R/W, Preset: 0.001")

Used to calculate the diameter when the ROLL REVOLUTIONS or LINE REVOLUTIONS method is selected by **Diameter Select**.

196 Revolutions (R/W, Preset: 0)

The number of revolutions of the takeup/letoff roll or the line speed roll. Used to calculate the

Diameter when the ROLL REVOLUTIONS or LINE REVOLUTIONS method is selected by **Diameter Select**. Typically, the Revolution counter of Frequency Input 1 or 2 is linked to this parameter when used.

<u>197 Length Per Revolution (R/W, Preset: 0.01")</u>

The length in inches of material per one revolution of a line roller. Used to calculate the **Diameter** when the LINE REVOLUTIONS method is selected by **Diameter Select**.

<u>198 External Diameter Ratio (R/W, Preset: 0.00%)</u>

Ratio that is proportional to the diameter of the takeup or letoff roll. Used to calculate the **Diameter** when the *EXTERNAL DIAMETER* method is selected by **Diameter Select**. Typically, an analog input is linked to this parameter to provide the diameter information. The signal should be scaled via the **Gain** and **Bias** of the input so that this value reads 0.00% at **Core Diameter** and 100.00% at **Maximum Diameter**.

<u>201 Core/Diameter Ratio (R/O)</u>

The ratio obtained by dividing the **Core Diameter** by the calculated **Diameter**. This value is used along with the **Line Speed** to calculate the **Roll Speed** in the Roll Speed Calculator block (L3).

<u>202 Diameter (R/O)</u>

The calculated diameter in inches.

<u>504 External Roll Speed (R/W, Preset: 0.00%)</u>

Signal used to calculate **Diameter** along with the **Line Speed**. This parameter is only used when **Diameter Select** is set to *LINE/ROLL SPEED.*

<u>505 Diameter Memory Reset (R/W, Preset: On)</u>

A diameter memory function is provided to maintain speed based diameter levels during stop (when the **Line Speed** and **Ext Roll Speed** signals are at 0.00%). The memory function only allows the **Diameter** signal to increase in value. When **Diameter Memory Reset** is ON (default), the memory circuit is reset to the **Core Diameter** value and **Diameter** is based upon the current **Line Speed** and **Roll Speed** calculations. The diameter memory function can only be used when **Diameter Select** is set to the *LINE/ROLL SPEED*.

<u>506 Diameter/Max Ratio (R/O)</u>

The ratio obtained by dividing the **Diameter** by the **Max Diameter**. This value is used along with **Tension Demand** to calculate **Diameter Torque** in the CTCW calculator (L5).

<u>530 Zero Speed Threshold (R/W, Preset: 5.00%)</u>

This adjust the point where the Cortex® LT considers the line speed to be zero. Also affects the Brake Letoff calculator (L5).

L3: Roll Speed Calculator

A problem encountered in center driven takeup and letoff applications is the nonlinear relationship between the diameter of a roll and the motor speed required to maintain constant surface speed of the roll during diameter increase or decrease. A plot of this relationship shows a hyperbolic curve (Figure 42).

When the line speed and roll diameter values are known, the required roll speed can be calculated. The rate of material take-up or pay-out from a center driven winder or unwinder would be held constant during roll diameter changes. The line speed signal typically comes from a tachometer or encoder on the line drive. The diameter information can be obtained through a number of different methods described below in the Diameter Select parameter selection.

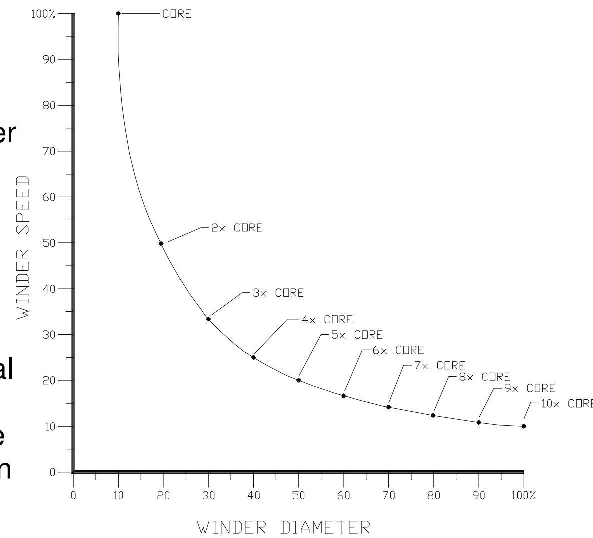


Figure 42: Winder Speed vs. Diameter Curve

The scaled line speed is divided by the scaled diameter signal to generate the center drive speed reference. Depending on required system response, a dancer or other device may be required for limited transient compensation between the center winder/unwinder and other driven parts of a line.

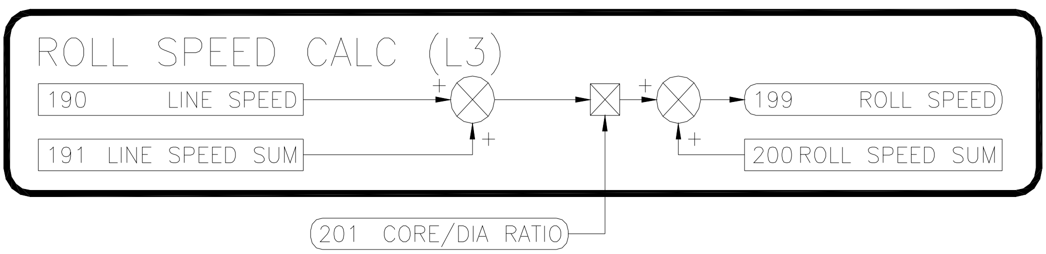


Figure 43: Roll Speed Calculator (L3)

<u>190 Line Speed (R/W, Preset: 0.00%)</u>

This signal is used along with the **Core/Diameter Ratio** (L2) to calculate the takeup or letoff **Roll Speed**. Range: -327.68..327.67%

<u>191 Line Speed Sum (R/W, Preset: 0.00%)</u>

This parameter provides a place to sum a signal with the **Line Speed** before it is multiplied by the **Core/Diameter Ratio**. A typical use would be to sum in the output of the PID block. Range: -327.68..327.67%

<u>199 Roll Speed Sum (R/O)</u>

The calculated takeup or letoff roll speed.

<u>200 Roll Speed Sum (R/W, Preset: 0.00%)</u>

This parameter provides a place to sum a signal after the **Line Speed** has been multiplied by the **Core/Diameter Ratio**. A typical use would be to sum in the output of the PID block. Range: -327.68..327.67%

L4: Taper Tension Calculator

In some cases, decreasing tension (taper tension) is desirable to prevent telescoping and/or wrinkling of inner layers of material. The tension calculator can be configured to provide tapering tension starting at any point in the roll. **Tension Demand** will decrease by a percentage of the **Tension Setpoint** from the **Taper Diameter** setting to the **Max Diameter**.

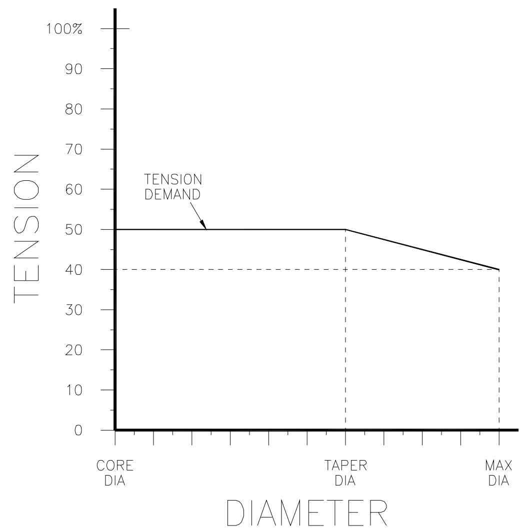


Figure 44: Tension vs. Diameter

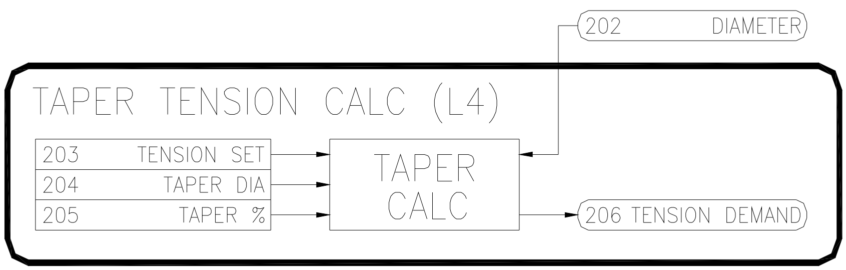


Figure 45: Taper Tension Calculator Block (L4)

203 Tension Setpoint (R/W, Preset: 0.00%)
The desired tension setpoint.

204 Taper Diameter (R/W, Preset: 200.00")
The diameter level (in inches) at which tapering begins.

205 Taper Percentage (R/W, Preset: 0.00%)
The desired percentage of the **Tension Setpoint** that the **Tension Demand** signal will be tapered when **Diameter** is at the **Max Diameter**. Refer to Figure 44. In this example, the **Tension Setpoint**=50.00% and the **Taper Percentage**=20.00%. Thus, at **Max Diameter**, the **Tension Demand** signal has decreased by 10.00% (20.00% of the **Tension Setpoint**).

206 Tension Demand (R/O)
The tapered tension demand output. In a dancer position system, this value would be output to control the tension on an air-loaded dancer. In a loadcell system, this value would be used as the setpoint for the PID. When the calculated **Diameter** is less than the **Taper Diameter**, the **Tension Demand** will be equal to the **Tension Setpoint**. In a CTCW system, this value is used to determine the amount of **Diameter Torque**.

L5: Torque (CTCW) Calculator

The CTCW block allows the Cortex® LT to provide constant or taper tension control without external tension sensors. The CTCW block provides a torque reference output that is composed of diameter torque, inertia torque, friction torque, static friction torque, and pulse torque. Diameter torque is supplied to compensate for the increase in roll diameter. Inertia torque is supplied when the line is accelerating. Friction torque must also be supplied to overcome the mechanics in the drive train. A momentary pulse of torque (pulse torque) can be supplied to help 'break away' the mechanics of the system.

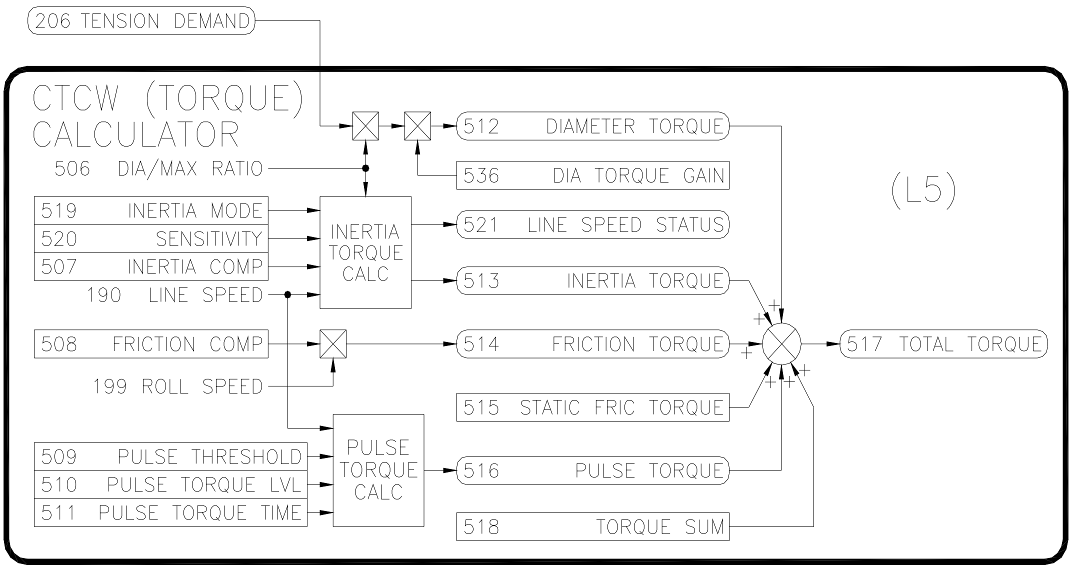


Figure 46: CTCW Calculator Block (L5)

507 Intertia Compensation (R/W, Preset: 0.00%)

Additional torque is required by the winder drive when the line is accelerating. This parameter is used in conjunction with **Line Speed** to control the amount of additional **Inertia Torque**.

508 Friction Compensation (R/W, Preset: 0.00%)

Torque is required to overcome the dynamic friction in the mechanics of the drive train. Friction loading typically increases with speed. The amount of **Friction Torque** is controlled by **Friction Compensation.**

509 Pulse Threshold (R/W, Preset: 0.00%)

The level that the **Line Speed** signal must exceed before the **Pulse Torque Level** is applied to **Pulse Torque**. After the pulse torque has been applied, the **Line Speed** signal must return to 0.00% and again exceed the threshold for pulse torque to be re-applied.

510 Pulse Level (R/W, Preset: 0.00%)

When the mechanics of a system are oversized for the desired level of tension, the friction of the system while stopped many need to be overcome with additional starting torque. This additional torque is only needed momentarily to 'break away' the mechanics of the system. This parameters sets the level of torque to be momentarily applied.

511 Pulse Time (R/W, Preset: 0.0 Secs)

The amount of time that the pulse torque signal is applied.

512 Diameter Torque (R/O)

Displays the calculated torque based on the **Diameter**. In order to provide constant tension, the winder torque must increase proportionally to the diameter.

513 Inertia Torque (R/O)

The amount of additional torque reference supplied when the line is accelerating.

514 Friction Torque (R/O)

The amount of torque reference supplied to compensate for frictional loading.

515 Static Friction Torque (R/W, Preset: 0.00%)

Torque is required to overcome the static friction in the mechanics of the drive train. This parameter sums with all the other torque signals to produce the **Total Torque** signal.

516 Pulse Torque (R/O)

When the **Line Speed** exceeds the **Pulse Torque Threshold**, the **Pulse Torque** signal will be equal to the **Pulse Torque Level** signal for the amount of time specified by **Pulse Torque Time**. After the time has expired, **Pulse Torque** will reset to zero.

517 Total Torque (R/O)

The sum of the **Inertia Torque**, **Friction Torque**, **Static Friction Torque**, **Pulse Torque**, **Diameter Torque,** and **Torque Sum** parameters. The **Friction Torque, Static Friction Torque, Diameter Torque,** and **Torque Sum** levels are first summed and limited to 100%. The **Inertia Torque** & **Pulse Torque** are then summed and the total is limited to 150%. This parameter is typically output through an analog output to a motor drive configured as a torque regulator.

518 Torque Sum (R/O)

This parameter provides an auxiliary summing point before the **Total Torque** is calculated. A typical use would be to sum in a correction signal from the output of a PID block when loadcells are used with the CTCW Calculator.

519 Inertia Mode (R/W, Preset: Accel)

Controls the type of inertia compensating torque supplied. Typically, winders (takeups) need accelerating compensation and unwinders (letoffs) need decelerating compensation.

520 Inertia Sensitivity (R/W, Preset: 5)

The Inertia Torque calculator monitors the Line Speed parameter to provide an Inertia Torque output level. This level depends upon how fast the line speed is changing. This derivative calculation is made by examining the Line Speed at a set interval and determining the amount of change. This parameter adjusts the amount of time between samples. With fast line acceleration/deceleration rates of a few seconds, the sampling time can be set at 1 or 2. With slower rates, the time between samples typically would need to be increased. Refer to the following table for recommended initial values depending upon the line accel/decel rates. Note that these values may need to be adjusted to obtain steady levels of **Inertia Torque** depending upon the amount of electrical noise present on the signal.

Line Accel/Decel Times (secs)	Typical Inertia Sensitivity Values
1-3	1
4-7	2
8-11	3
12-13	4
14-20	5
21-26	6
27 or higher	7

Table 6: Inertia Sensitivity Values

521 Line Speed Status (R/O)

Indicates whether Line Speed is accelerating, decelerating, or steady.

536 Diameter Torque Gain (R/W, Preset: 100.00%)

This parameter provides a gain adjustment for the **Diameter Torque**. Typically, the maximum amount of torque that the motor (and gearing) can provide is greater than the actual amount of torque required to provide the desired tension level at the maximum diameter. This trim adjustment provides a means to scale the **Diameter Torque** level so that a **Tension Demand** level of 100% provides only the required torque level to achieve 100% tension.

L6: PID Loop 1

The Cortex® LT provides 2 PID Loops for system integration with dancer potentiometers, loadcells, etc…

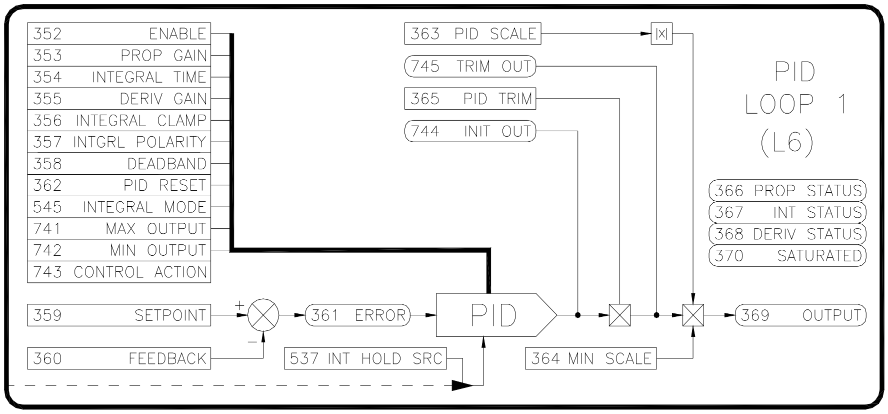


Figure 47: PID Loop 1 (L6)

352 Enable (R/W, Preset: Disabled)

This parameter must be set to ENABLED for the PID block to function. When DISABLED, all of the PID parameters are held at their previous value.

353 Proportional Gain (R/W, Preset: 5.00)

The **Proportional Gain** scales the output based upon the **Error**. Increasing the gain improves the loop response but can also increase overshoot.

354 Integral Time (R/W, Preset: 10.000 Secs)

The **Integral Time** adjustment eliminates steady-state error. Decreasing the integral time improves loop response. However, setting it too low can cause oscillation. The adjustment is in seconds and corresponds to the amount of time that the **PID Output** signal would take to integrate from 0.00% to 100%.

355 Derivative Gain (R/W, Preset: 0.00%)

With derivative action, the controller output is proportional to the rate of change of the error. The **Derivative Gain** output is based upon the predicted **Error** by analyzing the previous error levels. Increasing the **Derivative Gain** can help reduce overshoot.

356 Integral Clamp (R/W, Preset: Off)

When **Integral Clamp** is ON, the integral signal is clamped to zero in the PID loop, yielding proportional and derivative control only.

357 Integral Polarity (R/W, Preset: Unipolar)

The **Integral Polarity** parameter controls whether the integral portion of the controller is UNIPOLAR (positive only) or BIPOLAR (positive and negative).

358 Deadband (R/W, Preset: 0.00%)

The **Deadband** adjustment is used to provide a window of tolerance in the error signal that the integral circuit will ignore. This is commonly used to ignore small dancer movements.

359 Setpoint (R/W, Preset: 0.00%)

The desired position on dancer systems or the desired tension in loadcell control systems.

360 Feedback (R/W, Preset: 0.00%)

The dancer feedback signal or loadcell feedback signal. This signal will typically come from one of the Analog Inputs.

361 Error (R/O)
The difference between the desired **Setpoint** and the actual **Feedback**.

362 PID Reset (R/W, Preset: Off)
When ON, resets the **PID Output** to zero.

363 PID Scale (R/W, Preset: 100.00%)
The **PID Scale** adjustment provides for a method to scale the **PID Output** via an external signal. This signal is typically a line speed signal from an Analog Input.

364 Min Scale (R/W, Preset: 10.00%)
The **Min Scale** adjustment provides for a minimum level of scaling even when the PID Scale parameter is at zero.

365 PID Trim (R/W, Preset: 100.00%)
The **PID Trim** adjustment controls the amount of correction that the **PID Output** can provide.

366 Proportional Status (R/O)
The individual proportional component of the **PID Output**.

367 Integral Status (R/O)
The individual integral component of the **PID Output**.

368 Derivative Status (R/O)
The individual integral component of the **PID Output**.

369 PID Output (R/O, Preset: 0.00%)
The output of the PID loop after being modified by the **PID Trim** and **PID Scale** parameters.

370 PID Saturated (R/O)
When the **Initial Output** saturates at the **Max Output** or **Min Output** levels, this value turns ON. This may indicate that the **PID Trim** parameter may need to be increased. This parameter is provided for aid in setup and tuning.

537 PID Integrator Hold Source (R/W, Preset: None)
This parameter is designed to keep the integration from going negative. It will monitor another parameter and if the monitored parameter is less than or equal to zero and moving more negative, the integrator goes into a hold mode. When the monitored parameter is greater than zero or less than zero but moving toward positive, the integrator behaves normally. This is an optional parameter. This parameter is disables when set to 0 (None).

545 Integral Mode (ICR, Preset: Linear)
The Integral portion has two modes of operation. In the LINEAR mode, the rate of change of the integral value is not dependent on the amount of error. This mode is useful and typically more stable in dancer/loadcell systems. In the CLASSICAL mode, the rate of change of the integral is dependent on the amount of error (the greater the error, the faster the integration).

741 Max Output (R/W, Preset: 100.00%)
Defines the upper limit for the initial PID output. Range: 0..+100%

742 Min Output (R/W, Preset: -100.00%)
Defines the lower limit for the initial PID output. Range: -100..0%

743 Control Action (R/W, Preset: Err=Sp-Fb)
Determines how the error is calculated. The error is the difference between the Setpoint and Feedback parameters. This effectively determines the direction of correction that the PID loop provides. Available options are ERR=SP-FB or ERR=FB-SP.

744 Initial Output (R/O)
The initial output of the PID loop. This value is the sum of the **Prop Status**, **Integral Status**, & **Deriv Status** parameters. Parameters L1.10 and L1.11 also limit this value.

745 Trim Output (R/O)
The result of the **Initial Output** scaled by the **PID Trim**.

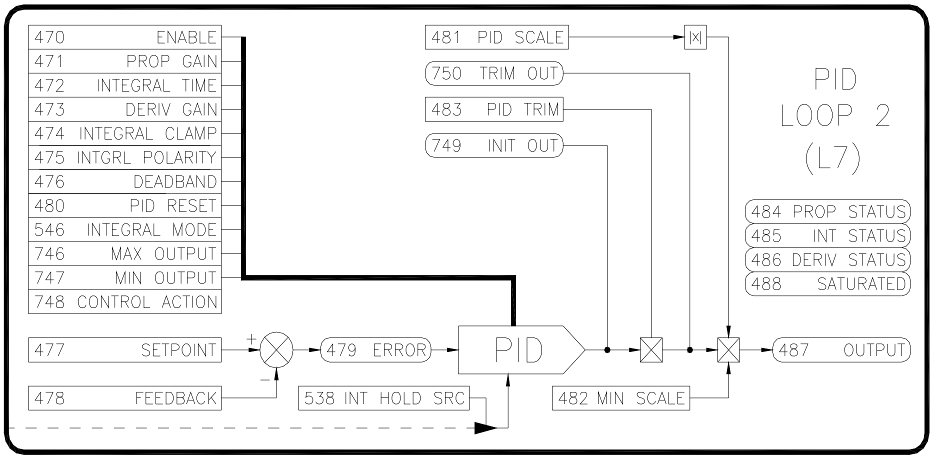


Figure 48: PID Loop 2 (L7)

470 Enable (R/W, Preset: Disabled)
471 Proportional Gain (R/W, Preset: 5.00)
472 Integral Time (R/W, Preset: 10.000 Secs)
473 Derivative Gain (R/W, Preset: 0.00%)
474 Integral Clamp (R/W, Preset: Off)
475 Integral Polarity (R/W, Preset: Unipolar)
476 Deadband (R/W, Preset: 0.00%)
477 Setpoint (R/W, Preset: 0.00%)
478 Feedback (R/W, Preset: 0.00%)
479 Error (R/O)
480 PID Reset (R/W, Preset: Off)
481 PID Scale (R/W, Preset: 100.00%)
482 Min Scale (R/W, Preset: 10.00%)
483 PID Trim (R/W, Preset: 100.00%)
484 Proportional Status (R/O)
485 Integral Status (R/O)
486 Derivative Status (R/O)
487 PID Output (R/O, Preset: 0.00%)
488 PID Saturated (R/O)
538 PID Integrator Hold Source (R/W, Preset: None)
546 Integral Mode (ICR, Preset: Linear)
746 Max Output (R/W, Preset: 100.00%)
747 Min Output (R/W, Preset: -100.00%)
748 Control Action (R/W, Preset: Err=Sp-Fb)
749 Initial Output (R/O)
750 Trim Output (R/O)

PID Loop 2 is functionally equivalent to PID Loop 1. Refer to PID Loop 1.

L8: Turret Logic

The Turret Logic Block is provided to allow a single Cortex® LT to control both rolls of a dual turret winder (in velocity mode).

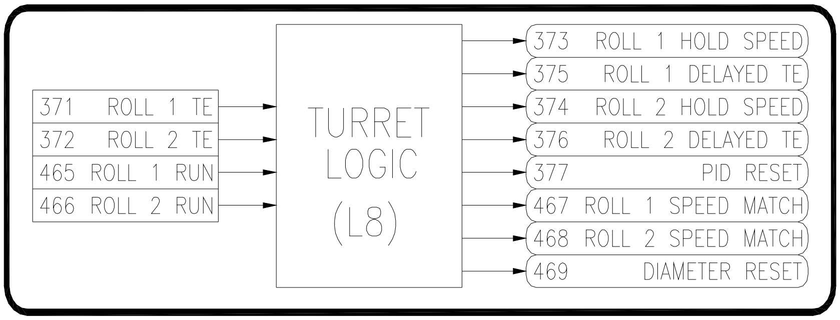


Figure 49: Turret Winder Logic (L8)

371 Roll 1 Tension Enable (R/W, Preset: Disabled)

Input that typically is linked from one of the digital inputs. This input is used to enable the diameter based tension output on roll 1.

372 Roll 2 Tension Enable (R/W, Preset: Disabled)

Input that typically is linked from one of the digital inputs. This input is used to enable the diameter based tension output on roll 2.

373 Roll 1 Hold Speed (R/O)

Output that typically is linked to the **Ramp Hold** parameter in the Accel/Decel 1 block. This output is used to temporarily hold the roll 1 speed constant during the splice and switch over to roll 2.

374 Roll 2 Hold Speed (R/O)

Output that typically is linked to the **Ramp Hold** parameter in the Accel/Decel 2 block. This output is used to temporarily hold the roll 2 speed constant during the splice and switch over to roll 1.

375 Roll 1 Delayed Tension Enable (R/O)

Output that is typically linked to the **Reference Select 1 (MSB)** parameter. This output is used to enable the diameter based tension output in roll 1. This signal is delayed to allow the PID to be reset momentarily before becoming active with the new roll.

376 Roll 2 Delayed Tension Enable (R/O)

Output that is typically linked to the **Reference Select 2 (MSB)** parameter. This output is used to enable the diameter based tension output in roll 2. This signal is delayed to allow the PID to be reset momentarily before becoming active with the new roll.

377 PID Reset (R/O)

Output that is typically linked to the **PID Reset** parameter of the PID block. This output turns ON momentarily to provide automatic reset of the PID loop when switching over from a full roll to an empty core.

465 Roll 1 Run (R/W, Preset: Off)

Input that typically is linked from one of the digital inputs. This input is used to enable the output on roll 1.

466 Roll 2 Run (R/W, Preset: Off)

Input that typically is linked from one of the digital inputs. This input is used to enable the output on roll 2.

467 Roll 1 Speed Match (R/O)

Output that is typically linked to the **Reference Select 1 (LSB)** parameter. This output is used to enable the speed match reference output for roll 1.

<u>468 Roll 2 Speed Match (R/O)</u>

Output that is typically linked to the **Reference Select 2 (LSB)** parameter. This output is used to enable the speed match reference output for roll 1.

<u>469 Diameter Reset (R/O)</u>

Output that is typically linked to the **Count Reset** parameter of Frequency input 1 or 2. This output is used only if the diameter is calculated by counting Line Speed revolutions or Roll Speed revolutions. This output turns ON momentarily to provide automatic reset of the diameter when switching over from a full roll to an empty core.

<u>Turret Winder Operating Sequence</u>

Initially, all of the Run and Tension Enable contacts are open and empty cores are loaded onto both winders. Material is loaded into the machine for Roll 1. Close the Roll 1 Run and Roll 1 Tension Enable contacts. The line drive can be activated and ramped up to speed.

As Roll 1 nears maximum diameter, the Roll 2 Run contact is closed, causing Roll 2 to speed match with the line. When the splice and change over is made, the Roll 2 Tension Enable contact must be closed.

Roll 1 will hold its present speed until both the Roll 1 Run and Roll 1 Tension Enable contacts are opened. Once opened, Roll 1 will ramp down to zero speed and the roll can be replaced with an empty core.

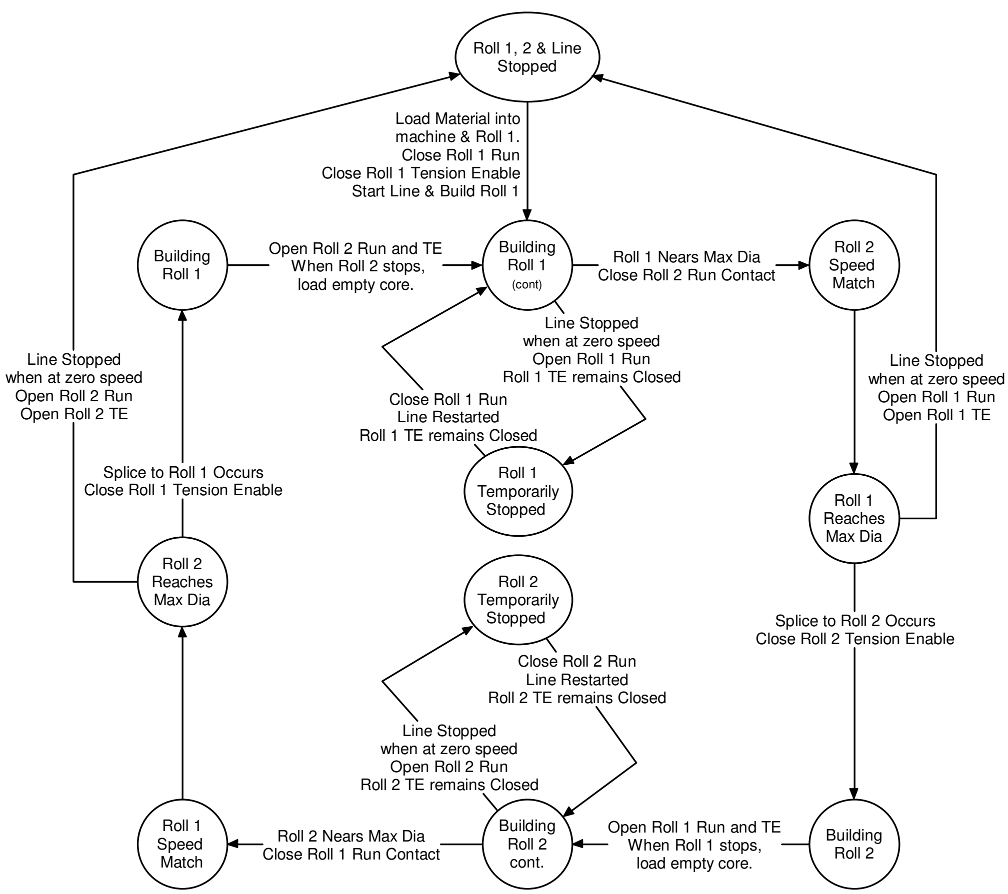


Figure 50: Turret Logic Operating Sequence

As Roll 2 nears maximum diameter, the Roll 1 Run contact is closed, causing Roll 1 to speed match with the line. When the splice and change over is made, the Roll 1 Tension Enable contact must be closed.

Roll 2 will hold its present speed until both the Roll 2 Run and Roll 2 Tension Enable contacts are opened. Once opened, Roll 2 will ramp down to zero speed and the roll can be replaced with an empty core.

The above cycle may repeat until the machine needs to be stopped.

Stopping and re-starting a partially built roll (Roll 1 described)
To temporarily stop the winder when Roll 1 is active (winding), stop the line drive. After it ramps to zero speed, open the Roll 1 Run contact but keep the Roll 1 Tension Enable contact closed. This will prevent the diameter from being reset. When ready to restart, simply close the Roll 1 Run contact and then restart the line drive.

Stopping a completely built roll (Roll 1 described)
To stop the cycle when Roll 1 is active (winding), stop the line drive. After it ramps to zero speed, open all of the Run and Tension Enable contacts for both rolls.

L9: Brake Letoff Logic

The Cortex® LT provides a logic block to implement control of a undriven brake letoff. This logic block serves as a control block for many of the other function blocks. All of the following assumes that the Cortex® LT is configured as a Brake Letoff controller (refer to the Application Builder Wizard in the CaroLink software).

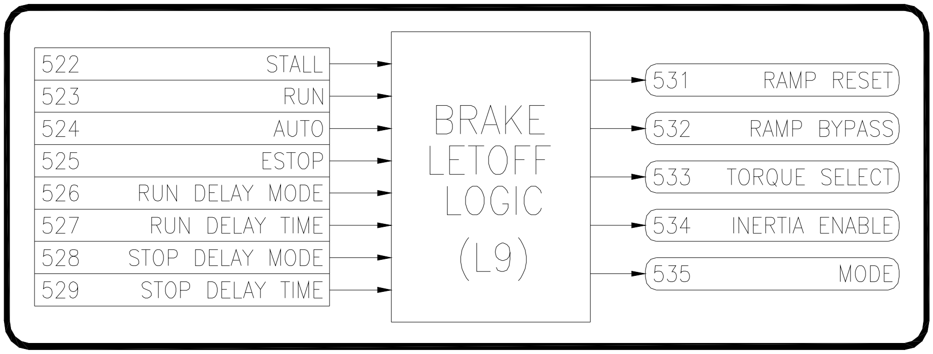


Figure 51: Brake Letoff Logic (L9)

Tension is controlled by the LT by providing a braking torque signal through varying levels of roll diameter and line speeds. Two basic modes of operation are provided: manual and auto. In manual mode, the level of output torque from the Cortex® LT is simply controlled by the Manual Torque setting. In Auto mode, the output torque is compensated by the change in diameter in order to provide constant tension. Additionally, loadcells may also be used in this mode to provide for closed loop tension control. The operating sequence is detailed below. Refer to Figure 52.

When the Stall input is closed, the output torque ramps to the Stall Torque level. This mode is used to prevent the letoff from unrolling while the line is stopped. When the Run input is closed and the line begins accelerating up to speed, the braking torque ramps to the Initial Run Torque level. This is typically a very low torque level, allowing the line to accelerate the letoff up to speed. The output torque is held at the Initial Run Torque level until the Run Delay Mode conditions are met (timer expires and/or line at speed). If the Auto Input is open (manual mode), the output torque ramps to the Manual Torque level. If the Auto Input is closed (auto mode), the output torque ramps to a torque level based upon the diameter and the Tension Setpoint. This torque level will be adjusted to maintain the desired tension as the diameter of the letoff decreases. When the Run Input is opened and the line begins decelerating, the braking torque will continue to be output as in the Run mode. Once the Stop Delay Mode conditions are met (timer expires and/or line at zero speed), the output torque ramps to the Stall Torque level. When the Stall Input is opened, the torque signal is immediately clamped to zero. An Emergency Stop Input is also provided. When this input is opened, the output torque immediately transitions to an adjustable E-Stop Torque level allowing the letoff to be quickly stopped.

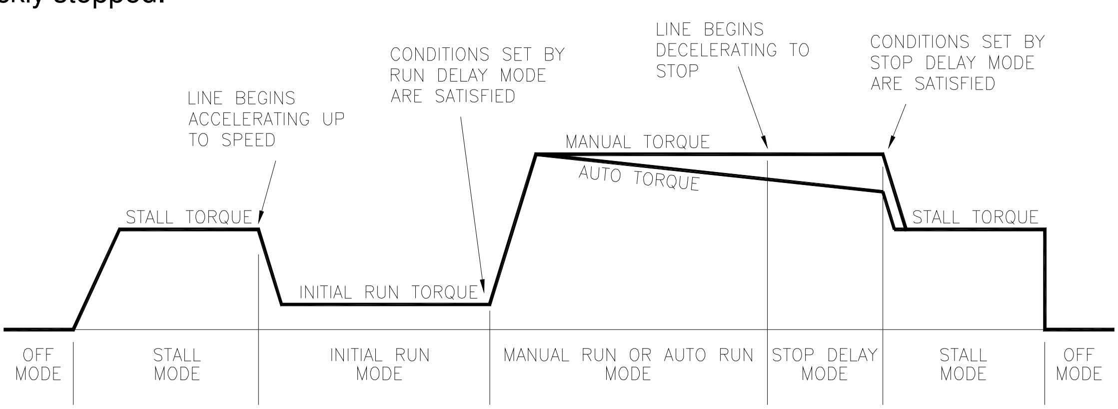


Figure 52: Brake Letoff Operational Profile

522 Stall (R/W, Preset: Off)

Input that typically is linked from digital input 1. A value of ON selects the Stall mode, while OFF selects the Off mode.

523 Run (R/W, Preset: Off)

Input that typically is linked from digital input 2. When Run becomes ON, the unit exits the Stall mode and enters the Initial Run mode. When Run becomes OFF, the unit exits the Manual or Auto Run mode and enters the Stop Delay mode.

524 Auto (R/W, Preset: Off)

Input that may be linked from digital input 3. A value of ON selects the auto mode of operation, and the torque output will be compensated for changes in diameter and line speed. A value of OFF selects the manual mode of operation, and a constant level of torque is output.

525 Emergency Stop (R/W, Preset: Off)

Input that is typically linked from digital input 4. A value of ON overrides all other modes and causes the Emergency Stop torque level to be selected. When the Emergency Stop mode is entered, the Stall and Run inputs must be de-activated to return to the Off mode.

526 Run Delay Mode (R/W, Preset: Timer)

Determines the conditions that must be met before the unit exits the Initial Run mode and enters the Manual Run or Auto Run mode.

TIMER

The Run mode is entered when the time specified by **Run Delay Time** has elapsed.

SPEED

The Run mode is entered when the **Line Speed Status** transistions from accelerating to steady (i.e. when Line Speed finishes accelerating).

EITHER

The Run mode is entered when either of the above conditions are met.

BOTH

The Run mode is entered when both of the above conditions are met.

527 Run Delay Time (R/W, Preset: 5.0 Secs)

The length of time the unit remains in the Initial Run mode before entering the Manual or Auto Run mode. This parameter is used when **Run Delay Mode** is set to Timer, Either, or Both.

528 Stop Delay Mode (R/W, Preset: Timer)

Determines the conditions that must be met before the unit exits the Stop Delay mode and enters the Stall mode.

TIMER

The unit exits the Stop Delay mode when the time specified by **Stop Delay Time** has elapsed.

SPEED

The unit exits the Stop Delay mode when Line Speed falls below the **Zero Speed Threshold**.

EITHER

The unit exits the Stop Delay mode when either of the above conditions are met.

BOTH

The unit exits the Stop Delay mode when both of the above conditions are met.

529 Stop Delay Time (R/W, Preset: 5.0 Secs)

The length of time the unit remains in the Initial Run mode before entering the Manual or Auto Run mode. This parameter is used when **Run Delay Mode** is set to Timer, Either, or Both.

530 Zero Speed Threshold (R/O)

The threshold that **Line Speed** must fall below before the unit exits the Stop Delay mode. This parameter is used when **Stop Delay Mode** is set to Speed, Either, or Both.

531 Ramp Reset (R/O)

Output that is typically linked to the **Ramp Reset** parameter of the Accel/Decel 2 block. This output is ON only in the Off mode in order to clamp the output to zero.

532 Ramp Bypass (R/O)

Output that is typically linked to the **Ramp Bypass** parameter of the Accel/Decel 2 block. This output is ON only in the Auto Run mode.

533 Torque Select (R/O)

Output that is typically linked to the **Reference Select (LSB)** parameter of Reference Select 1 block. The Torque Select value is used to select between the Stall, Initial Run, Manual, & Diameter Torque levels.

534 Inertia Compensation Enable (R/O)

Output that is typically linked to the **Coil** parameter of the Logic Switch 1. This output is ON only in the Auto Run mode.

535 Mode (R/O)

Displays the mode of the Brake Letoff Logic block.

ESTOP
OFF
STALL
INITIAL RUN
INITIAL AUTO RUN
MANUAL RUN
AUTO RUN
STOP DELAY

6.10 Group M: Thresholds

The threshold blocks compare an input value to two threshold levels. Depending upon the comparison, one of two values are sent to the output.

M1: Threshold 1

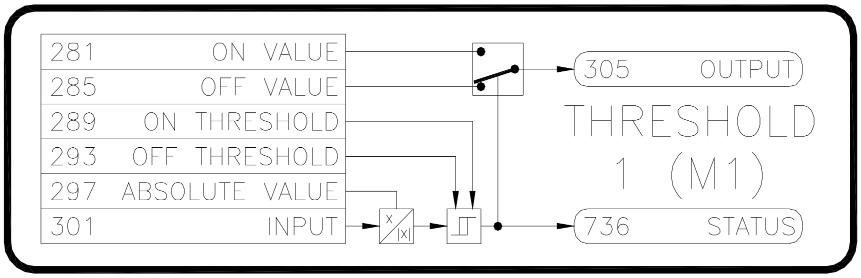


Figure 53: Threshold 1 (M1)

281 On Value (R/W, Preset: 0.01%)
The value sent to the **Output** when **Status** is ON.

285 Off Value (R/W, Preset: 0.00%)
The value sent to the **Output** when **Status** is OFF.

289 On Threshold (R/W, Preset: 0.00%)
When the **Input** signal equals or exceeds this level, **Status** becomes ON.

293 Off Threshold (R/W, Preset: 0.01%)
When the Input signal equals or falls below this level, **Status** becomes OFF.

297 Absolute Value (R/W, Preset: Off)
When ON, the absolute value of the input is taken before comparing to the **On Threshold** and the **Off Threshold**.

301 Input (R/W, Preset: 0.00%)
The value of the internal parameter that serves as the control for the switch. An input or internal link must be used to connect the desired parameter to this input.

305 Output (R/O)
Contains either the **On Value** or **Off Value** depending on the value of **Status**.

736 Status (R/O)
This value is determined by the comparison of the **Input** to the **On Threshold** and **Off Threshold**.

M2: Threshold 2

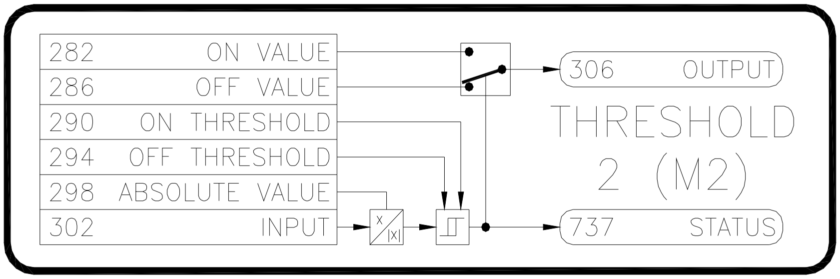


Figure 54: Threshold 2 (M2)

282 On Value (R/W, Preset: 0.01%)
286 Off Value (R/W, Preset: 0.00%)
290 On Threshold (R/W, Preset: 0.00%)
294 Off Threshold (R/W, Preset: 0.01%)
298 Absolute Value (R/W, Preset: Off)
302 Input (R/W, Preset: 0.00%)
306 Output (R/O)
737 Status (R/O)

Threshold 2 is functionally equivalent to Threshold 1. Refer to Threshold 1.

M3: Threshold 3

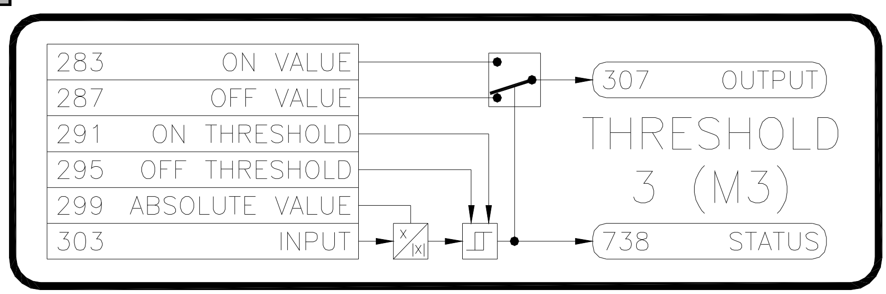


Figure 55: Threshold 3 (M3)

283 On Value (R/W, Preset: 0.01%)
287 Off Value (R/W, Preset: 0.00%)
291 On Threshold (R/W, Preset: 0.00%)
299 Absolute Value (R/W, Preset: Off)
295 Off Threshold (R/W, Preset: 0.01%)
303 Input (R/W, Preset: 0.00%)
307 Output (R/O)
738 Status (R/O)

Threshold 3 is functionally equivalent to Threshold 1. Refer to Threshold 1.

M4: Threshold 4

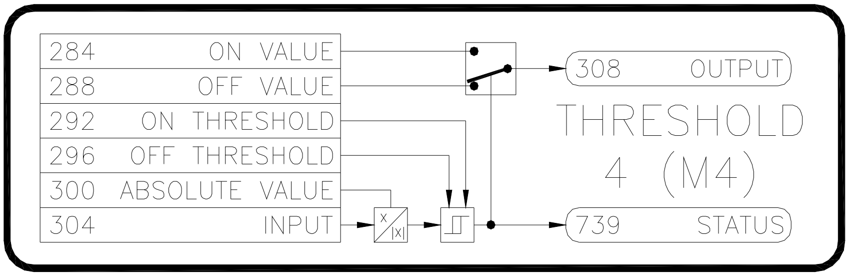


Figure 56: Threshold 4 (M4)

283 On Value (R/W, Preset: 0.01%)
287 Off Value (R/W, Preset: 0.00%)
291 On Threshold (R/W, Preset: 0.00%)
295 Off Threshold (R/W, Preset: 0.01%)
299 Absolute Value (R/W, Preset: Off)
303 Input (R/W, Preset: 0.00%)
307 Output (R/O)
738 Status (R/O)

Threshold 4 is functionally equivalent to Threshold 1. Refer to Threshold 1.

Example - Thresholds

Setup the Threshold 1 block to monitor the Diameter and change the PID Proportional Gain parameter. The Proportional Gain should be 1.00 below 5.00 inches and 2.00 above.

1. Set **Internal Link 9 Source** to **Diameter** (202).
2. Set **Internal Link 9 Destination** to **Threshold 1 Input** (301).
3. Set **Threshold 1 On Value** to 5.00%.
4. Set **Threshold 1 Off Value** to 4.00%.
5. Set **On Value** to 1.00%.
6. Set **Off Value** to 2.00%.
7. Set **Internal Link 10 Source** to **Threshold 1 Output** (305).
8. Set **Internal Link 10 Destination** to **PID Prop Gain** (353).

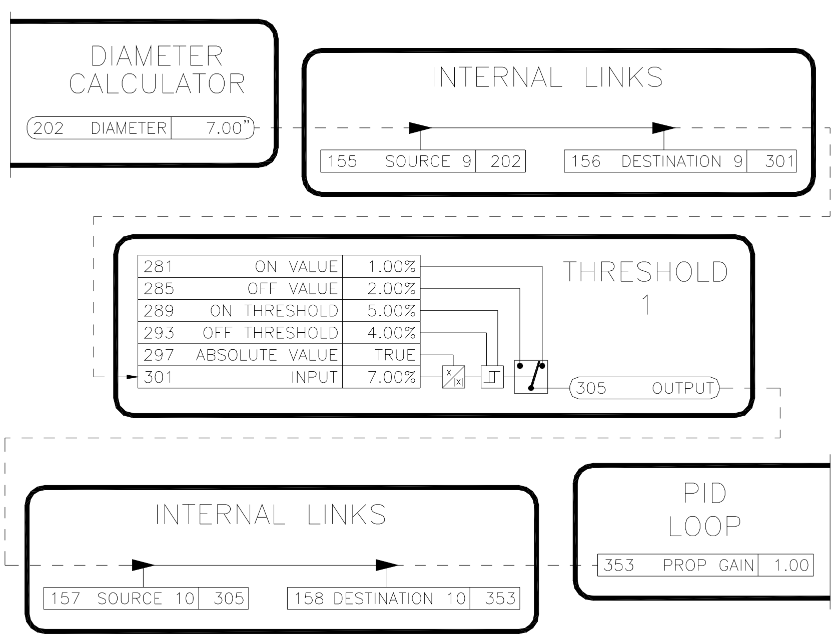


Figure 57: Threshold Example

6.11 Group N: Timers

Each of the four timers can operate in one of seven modes. Depending upon the mode and the input, one of two values are sent to the output.

N1: Timer 1

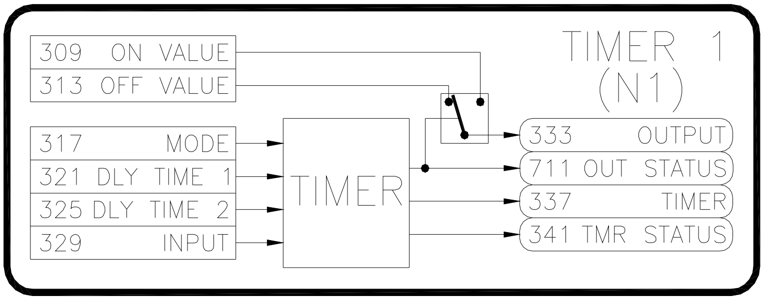


Figure 58: Timer 1 (N1)

309 On Value (R/W, Preset: 0.01%)

Output is equal to this value when **Output Status** is ON.

313 Off Value (R/W, Preset: 0.00%)

Output is equal to this value when **Output Status** is OFF.

317 Mode (R/W, Preset: On Delay)

Sets the timer function. Refer to Figure 59.

ON DELAY

When **Input** turns ON, the **Output** switches from **Value B** to **Value A** after a pause of **Delay Time 1**. **Output** switches back to **Value B** when Input turns OFF.

OFF DELAY

When **Input** turns ON, the **Output** immediately switches from **Value B** to **Value A**. When Input turns OFF, the **Output** switches from **Value A** to **Value B** after a pause of **Delay Time 1**.

ONE SHOT

When **Input** turns ON, the **Output** immediately switches from **Value B** to **Value A**. After a pause of **Delay Time 1**, the **Output** switches back to **Value B**. The timer ignores any successive state changes on the input while timing.

RETRIGGERABLE ONE SHOT

Performs the same as the One Shot described above, except that successive state changes on the Input reset the timing.

SINGLE CYCLE

When **Input** turns ON, the **Output** switches from **Value B** to **Value A** after a pause of **Delay Time 1**. The **Output** switches back to **Value B** after a pause of **Delay Time 1**.

REPEAT CYCLE

When **Input** turns ON, the **Output** immediately switches from **Value B** to **Value A**. After a pause of **Delay Time 1**, the **Output** switches back to **Value B**. After a pause of **Delay Time 2**, the **Output** switches back to **Value A.** The cycle repeats until **Input** turns OFF.

DELAYED START REPEAT CYCLE

Performs the same as above, except when the Input initially turns ON a pause of **Delay Time 2** is executed before the **Output** switches from **Value B** to **Value A**.

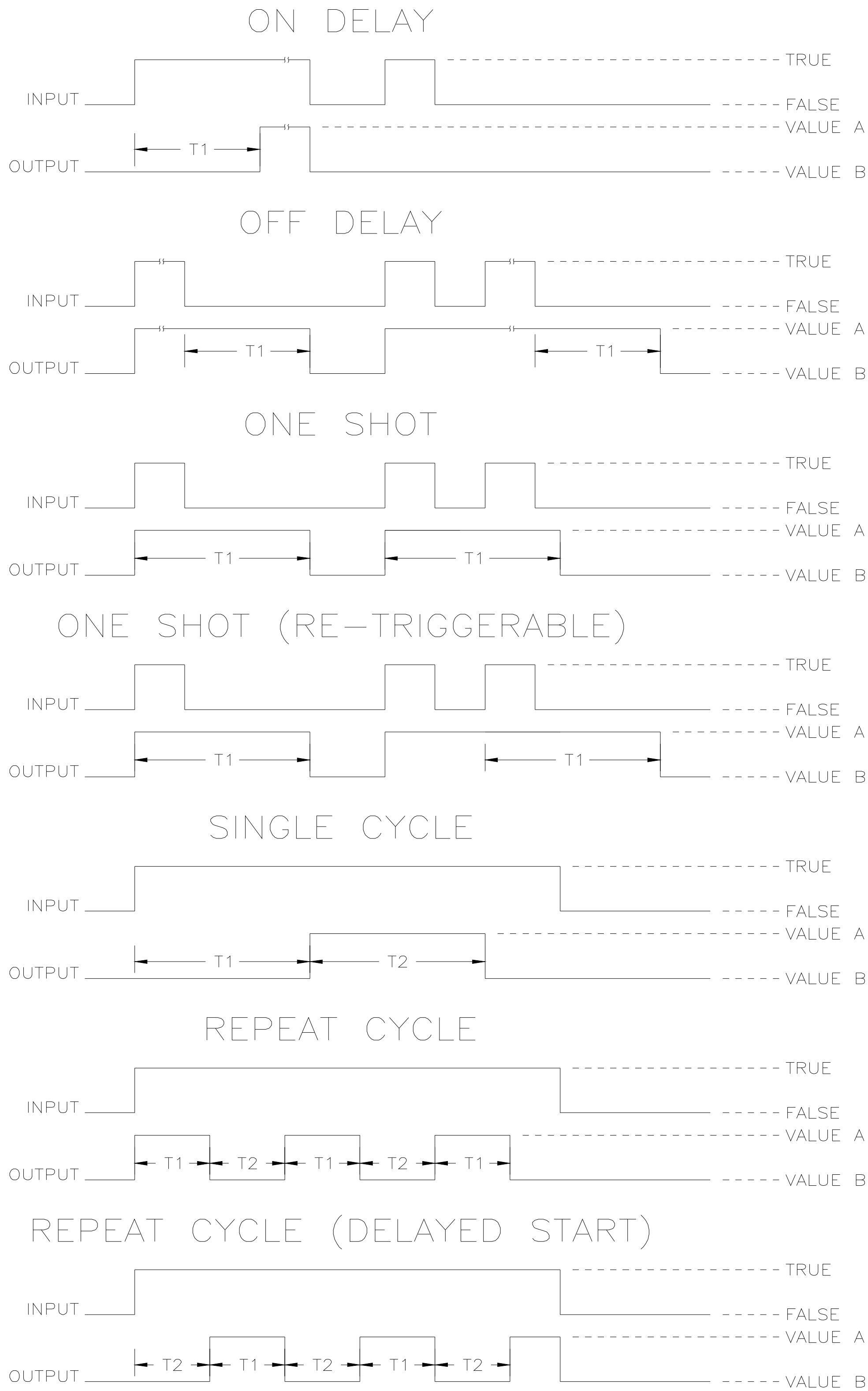


Figure 59: Timer Functions

<u>321 Delay Time 1 (R/W, Preset: 0.1Secs)</u>
Adjustable time delay from 0 to 300.0 seconds.

<u>325 Delay Time 2 (R/W, Preset: 0.1Secs)</u>
Adjustable time delay from 0 to 300.0 seconds.

<u>329 Input (R/W, Preset: Off)</u>
This parameter serves as the trigger/control signal to the timer.

<u>333 Output (R/O)</u>
This parameter is equal to **On Value** or **Off Value**, depending upon the state of **Output Status**.

<u>337 Timer Value (R/O)</u>
The value of the Timer in seconds.

<u>341 Timer Status (R/O)</u>
ON indicates the timer is running. OFF indicates the timer is stopped.

<u>711 Output Status (R/O)</u>
The value of this parameter is controlled by the timer logic. It depends upon the **Input** and the **Mode**.

N2: Timer 2

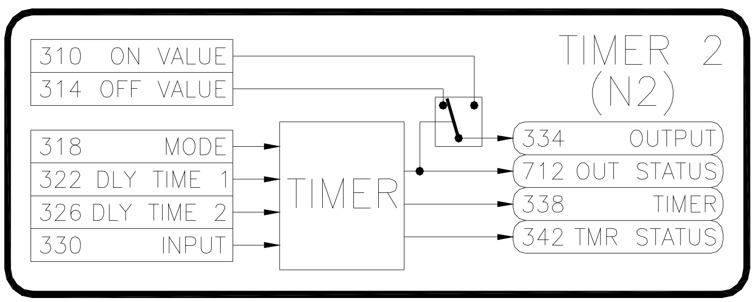


Figure 60: Timer 2 (N2)

<u>310 On Value (R/W, Preset: 0.01%)</u>
<u>314 Off Value (R/W, Preset: 0.00%)</u>
<u>318 Mode (R/W, Preset: On Delay)</u>
<u>322 Delay Time 1 (R/W, Preset: 0.1Secs)</u>
<u>326 Delay Time 2 (R/W, Preset: 0.1Secs)</u>
<u>330 Input (R/W, Preset: Off)</u>
<u>334 Output (R/O)</u>
<u>338 Timer (R/O)</u>
<u>342 Timer Status (R/O)</u>
<u>712 Output Status (R/O)</u>
Timer 2 is functionally equivalent to Timer 1. Refer to Timer 1.

N3: Timer 3

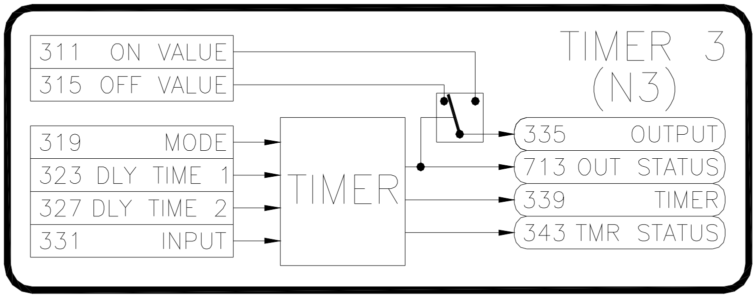


Figure 61: Timer 3 (N3)

<u>311 On Value (R/W, Preset: 0.01%)</u>
<u>315 Off Value (R/W, Preset: 0.00%)</u>
<u>319 Mode (R/W, Preset: On Delay)</u>
<u>323 Delay Time 1 (R/W, Preset: 0.1Secs)</u>
<u>327 Delay Time 2 (R/W, Preset: 0.1Secs)</u>
<u>331 Input (R/W, Preset: Off)</u>
<u>335 Output (R/O)</u>
<u>339 Timer (R/O)</u>
<u>343 Timer Status (R/O)</u>
<u>713 Output Status (R/O)</u>

Timer 3 is functionally equivalent to Timer 1. Refer to Timer 1.

N4: Timer 4

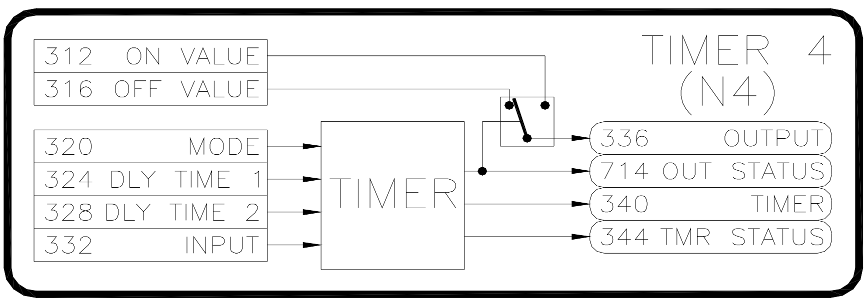


Figure 62: Timer 4 (N4)

<u>312 On Value (R/W, Preset: 0.01%)</u>
<u>316 Off Value (R/W, Preset: 0.00%)</u>
<u>320 Mode (R/W, Preset: On Delay)</u>
<u>324 Delay Time 1 (R/W, Preset: 0.1Secs)</u>
<u>328 Delay Time 2 (R/W, Preset: 0.1Secs)</u>
<u>332 Input (R/W, Preset: Off)</u>
<u>336 Output (R/O)</u>
<u>340 Timer (R/O)</u>
<u>344 Timer Status (R/O)</u>
<u>714 Output Status (R/O)</u>

Timer 4 is functionally equivalent to Timer 1. Refer to Timer 1.

6.12 Group O: Logic Gates

These blocks provide logic, arithmetic, & comparison functions.

O1: Logic Gate 1

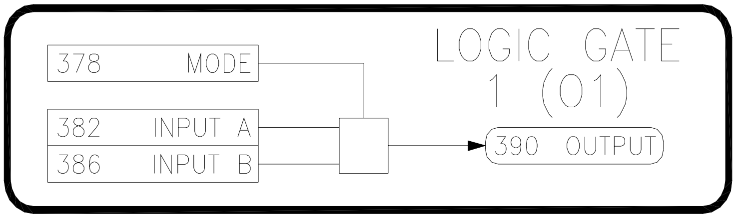


Figure 63: Logic Gate 1 (O1)

<u>378 Mode (R/W, Preset: -A)</u>

Sets the logic gate function.

A AND B
: **Output** is ON if both **Input A** and **Input B** are ON. Otherwise, **Output** is OFF.

A NAND B
: Inverted output of AND.

A OR B
: **Output** is ON if either **Input A** or **Input B** is ON. Otherwise, **Output** is OFF.

A NOR B
: Inverted output of OR.

A XOR B (Exclusive Or)
: **Output** is ON if either **Input A** or **Input B** is ON, but not both.

A XNOR B (Exclusive Nor)
: Inverted output of Exclusive Or.

NOT A (Logical Inversion)
: **Output** is ON if **Input A** is OFF. **Output** is OFF otherwise.

A>B?
: **Output** is ON if **Input A** > **Input B**.

A>=B?
: **Output** is ON if **Input A** >= **Input B**.

A<B?
: **Output** is ON if **Input A** < **Input B**.

A<=B?
: **Output** is ON if **Input A** <= **Input B**.

A EQUALS B?
: **Output** is ON if **Input A** equals **Input B**.

A NOT EQUAL B?
: **Output** is ON if **Input A** and **Input B** are not equal.

|A| (Absolute Value)
: **Output** is equal to the absolute value of **Input A**.

-|A| (Negative Absolute Value)
: **Output** is equal to the negative absolute value of **Input A**.

-A (Sign Invert)
: **Output** is equal to **Input A** with opposite polarity.

A+B
: **Output** is equal to **Input A** + **Input B.**

A-B

Output is equal to **Input A - Input B.**

*A*B*

Output is equal to **Input A** times **Input B.**

FILTER

Output is equal to **Input A.** **Input B** controls the filter gain. The higher the gain, the more filtering that is applied.

SR FLIP FLOP (Set-Reset)

Input A functions as the Set and **Input B** functions as the Reset. Refer to Table 7 below for Output states.

Set (Input A)	Reset (Input B)	Output
Off	Off	No Change
Off	On	Off
On	Off	On
On	On	Off

Table 7: Set Reset Truth Table

POSITIVE EDGE LATCH

The value in **Input A** is latched into **Output** when **Input B** transitions from OFF to ON.

NEGATIVE EDGE LATCH

The value in **Input A** is latched into **Output** when **Input B** transitions from ON to OFF.

A/B

Output is equal to **Input A** divided by **Input B.**

382 Input A (R/W, Preset: 0.00%)

Input to the logic gate. Note that the decimal places and units may change depending upon the **Mode**.

386 Input B (R/W, Preset: 0.00%)

Input to the logic gate. Note that the decimal places and units may change depending upon the **Mode**.

390 Output (R/O)

Output of the logic gate. Note that the decimal places and units may change depending upon the **Mode**. Its value depends upon the **Mode**, **Input A**, & **Input B** parameters.

O2: Logic Gate 2

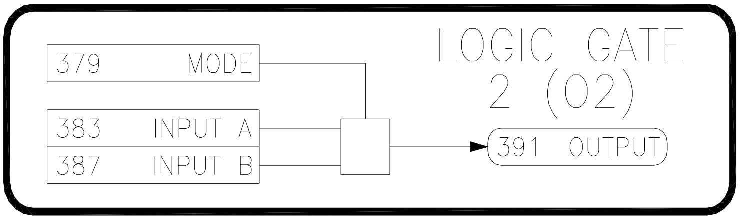


Figure 64: Logic Gate 2 (O2)

379 Mode (R/W, Preset: -A)
383 Input A (R/W, Preset: 0.00%)
387 Input B (R/W, Preset: 0.00%)
391 Output (R/O)
Logic Gate 2 is functionally equivalent to Logic Gate 1. Refer to Logic Gate 1.

O3: Logic Gate 3

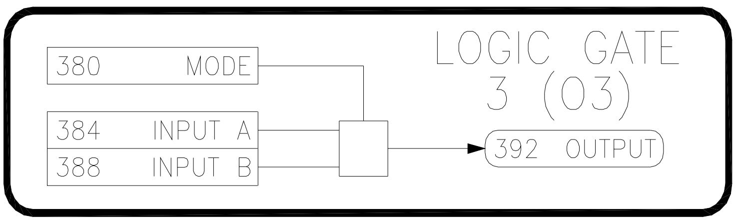


Figure 65: Logic Gate 3 (O3)

380 Mode (R/W, Preset: -A)
384 Input A (R/W, Preset: 0.00%)
388 Input B (R/W, Preset: 0.00%)
392 Output (R/O)
Logic Gate 3 is functionally equivalent to Logic Gate 1. Refer to Logic Gate 1.

O4: Logic Gate 4

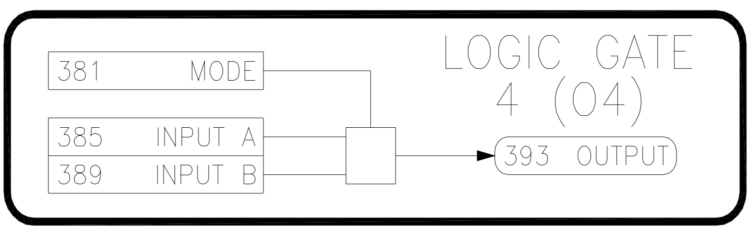


Figure 66: Logic Gate 4 (O4)

381 Mode (R/W, Preset: -A)
385 Input A (R/W, Preset: 0.00%)
389 Input B (R/W, Preset: 0.00%)
393 Output (R/O)
Logic Gate 4 is functionally equivalent to Logic Gate 1. Refer to Logic Gate 1.

6.13 Group P: Switches

The Cortex® LT provides four internal 2 pole switches and two 4 pole switches.

P1: Switch 1

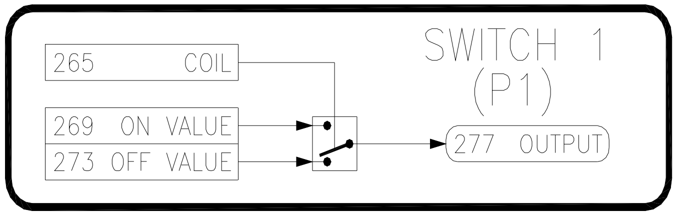


Figure 67: Switch 1 (P1)

265 Coil (R/W, Preset: Off)
This value controls the switch, ON or OFF.

269 On Value (R/W, Preset: 0.00%)
The **Output** will have this value when Coil is ON.

273 Off Value (R/W, Preset: 0.00%)
The **Output** will have this value when Coil is OFF.

277 Output (R/O)
The output of the switch. It will be equal to **On Value** or **Off Value** depending upon value of **Coil**.

P2: Switch 2

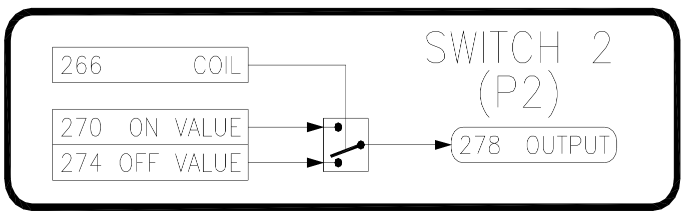


Figure 68: Switch 2 (P2)

266 Coil (R/W, Preset: Off)
270 On Value (R/W, Preset: 0.00%)
274 Off Value (R/W, Preset: 0.00%)
278 Output (R/O)
Switch 2 is functionally equivalent to Switch 1. Refer to Switch 1.

P3: Switch 3

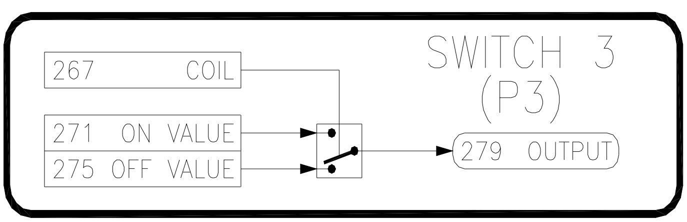


Figure 69: Switch 3 (P3)

267 Coil (R/W, Preset: Off)
271 On Value (R/W, Preset: 0.00%)
275 Off Value (R/W, Preset: 0.00%)
279 Output (R/O)
Switch 3 is functionally equivalent to Switch 1. Refer to Switch 1.

P4: Switch 4

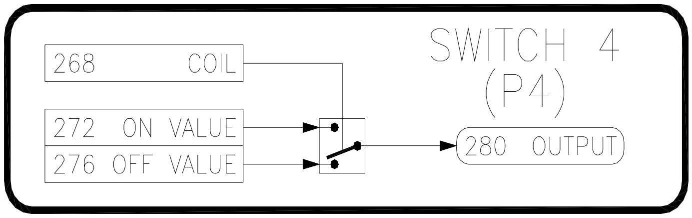


Figure 70: Switch 4 (P4)

268 Coil (R/W, Preset: Off)
272 On Value (R/W, Preset: 0.00%)
276 Off Value (R/W, Preset: 0.00%)
280 Output (R/O)

Switch 4 is functionally equivalent to Switch 1. Refer to Switch 1.

P5: Switch 5

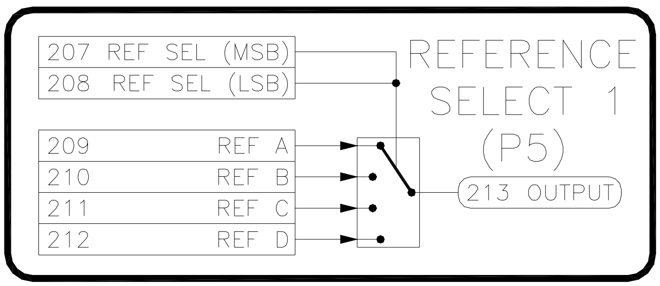


Figure 71: Switch 5 (P5)

207 Reference Select (MSB) (R/W, Preset: Off)
208 Reference Select (LSB) (R/W, Preset: Off)

The 4 pole switch is controlled by the Most Significant Bit and Least Significant Bit parameters

MSB	LSB	Selected Reference
Off	Off	REF A
Off	On	REF B
On	Off	REF C
On	On	REF D

Table 8: Reference Selection

209 Reference A (R/W, Preset: 0.00%)
210 Reference B (R/W, Preset: 0.00%)
211 Reference C (R/W, Preset: 0.00%)
212 Reference D (R/W, Preset: 0.00%)

These are the inputs to the 4 pole switch.

213 Output (R/O)

The output of the 4 pole switch. Its value will be equal to one of the Reference A-D values depending upon the Reference Select values.

P6: Switch 6

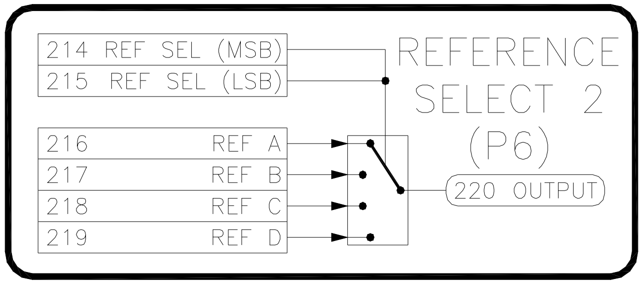


Figure 72: Switch 6 (P6)

214 Reference Select (MSB) (R/W, Preset: Off)
215 Reference Select (LSB) (R/W, Preset: Off)
216 Reference A (R/W, Preset: 0.00%)
217 Reference B (R/W, Preset: 0.00%)
218 Reference C (R/W, Preset: 0.00%)
219 Reference D (R/W, Preset: 0.00%)
220 Output (R/O)

Switch 6 is functionally equivalent to Switch 5. Refer to Switch 5.

6.14 Group Q: Links

The internal links can be used to connect or link parameters together. The source parameter selects the parameter from which data will be retrieved. The destination parameter selects the parameter to which the data will be written. In other words, the value of the parameter identified by Source will be written to the parameter identified by Destination. The drive provides 30 links that are separated into 3 groups for custom configuration. Each link has a source and a destination.

Q1: Internal Links Group 1

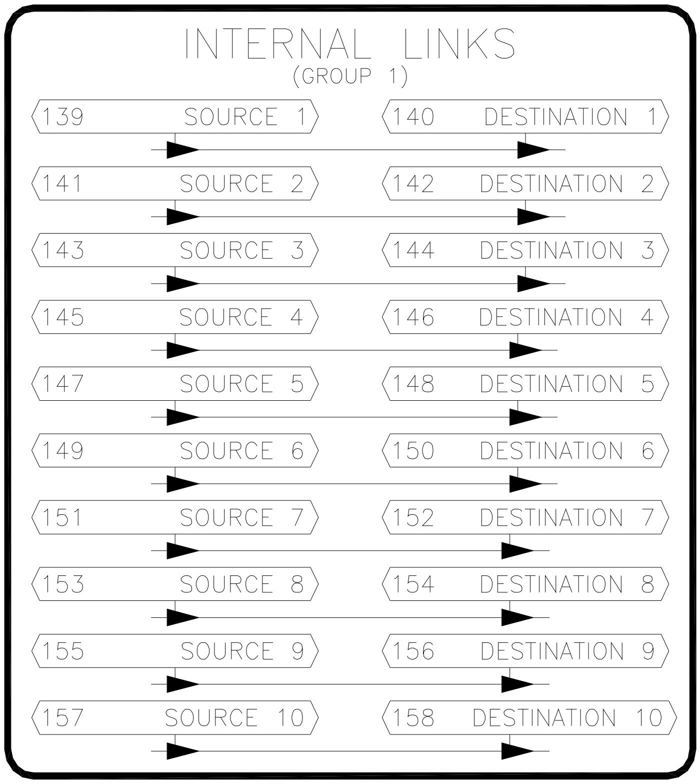


Figure 73: Internal Links Group 1 (Q1)

139 Internal Link 1 Source (ICR, Preset: 0)
Defines the source parameter via its tag. ICR parameters cannot be selected as sources.

140 Internal Link 1 Destination (ICR, Preset: 0)
Defines the destination or target parameter via its tag. Only Read/Write parameters can be selected as Destinations (i.e. Read/Only and ICR parameters are prohibited).

141-158 (ICR, Preset: 0)
These parameters are functionally equivalent to the ones listed above.

Note: When two parameters with different numbers of decimal places are linked together the following occurs: The source parameter value is reformatted into an integer without any decimal places. The number of decimal places of the destination parameter is then applied to the resulting integer. For example, if a source parameter has a value of 12.34% (2 decimals) and it is linked to an accel/decel time parameter (1 decimal), 12.34% is converted to an integer value of 1234, and then reformatted with 1 decimal place, 123.4. Therefore, the destination will contain the value 123.4 seconds.

Example - Internal Link

Setup an internal link from **Accel Time 1** to **Decel Time 1**. Whenever the **Accel Time 1** parameter is changed, the **Decel Time 1** parameter is also changed to the same value.

1. Set **Internal Link 5 Source** to **Accel Time 1** (257).
2. Set **Internal Link 5 Destination** to **Decel Time 1** (259).

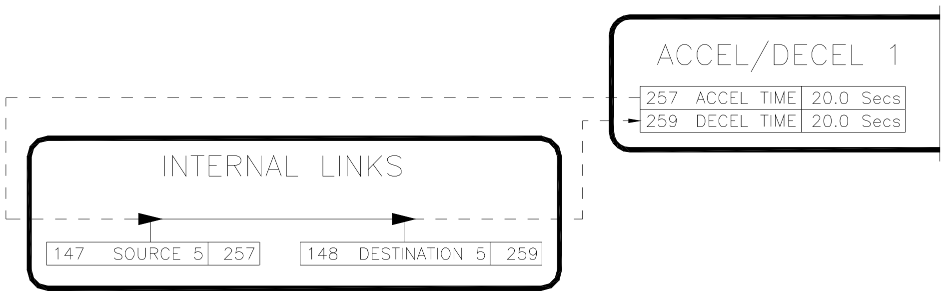


Figure 74: Internal Link Example

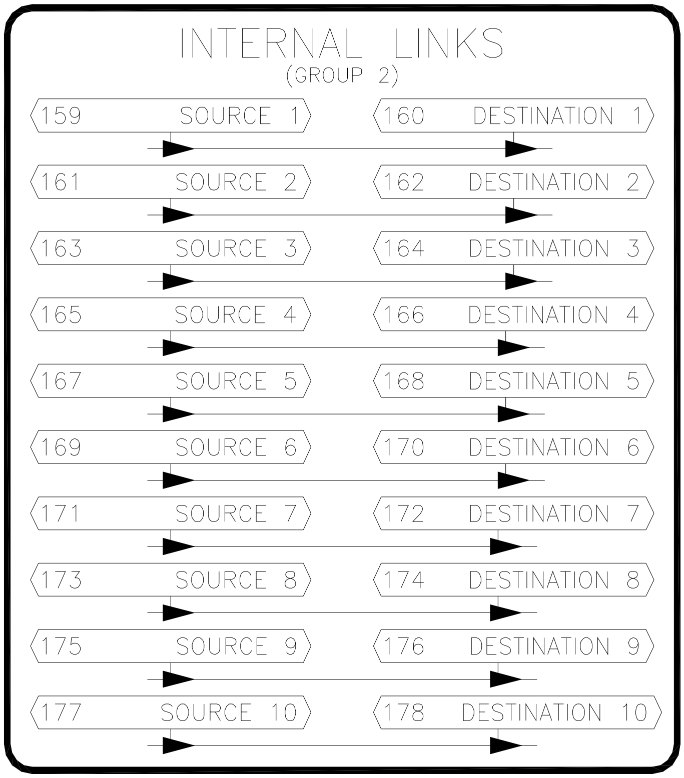


Figure 75: Internal Links Group 2 (Q2)

159-178 (ICR, Preset: 0)

The Internal Links Group 2 (Q2) is functionally equivalent to Group 1 (Q1). Refer to Group 1.

Q3: Internal Link Group 3

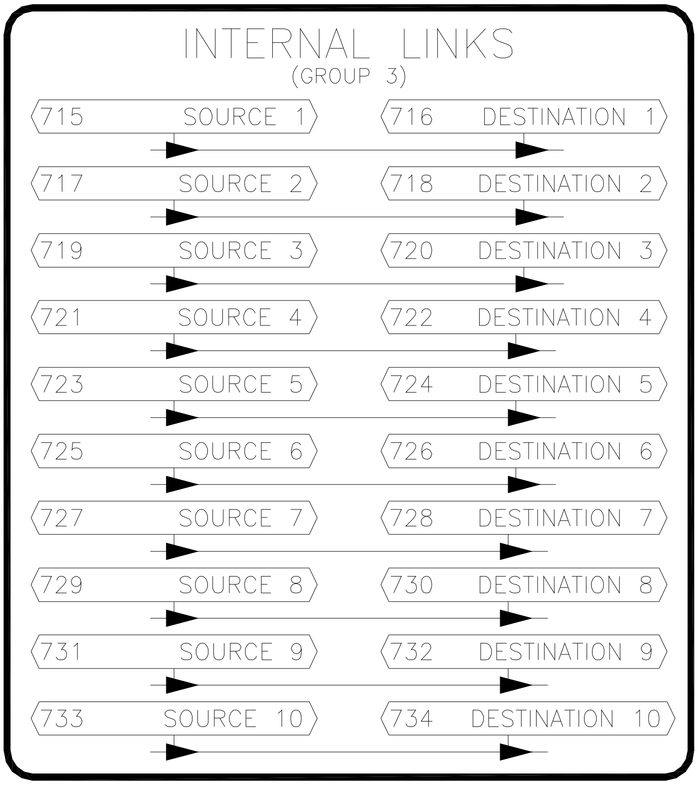


Figure 76: Internal Links Group 3 (Q3)

715-734 (ICR, Preset: 0)

The Internal Links Group 3 (Q3) is functionally equivalent to Group 1 (Q1). Refer to Group 1.

6.15 Group R: Communications

The Cortex® LT V2 provides 4 integrated communications channels.

R1: Com A (RS422/485 Terminals)

Com A is an RS422/485 communications channel that uses the Modbus® RTU protocol. Via DIP switches, it can be configured as either 2 wire or 4 wire modes. DIP switch SW3 should be set in one of the three following configurations: RS422, RS485 (4 wire), or RS485 (2 wire). Positions 1-3 should be set according to the descriptions below.

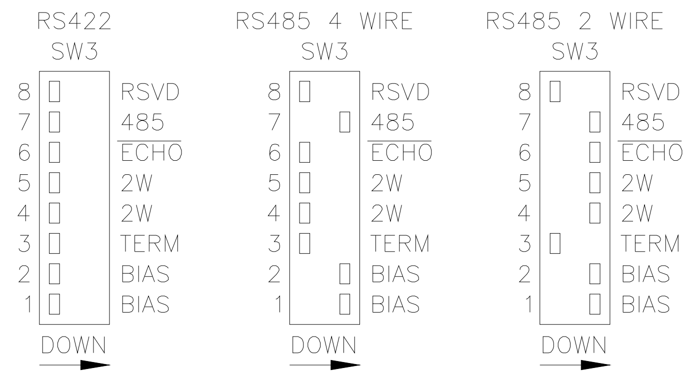


Figure 77: DIP Switch SW3

Fail-Safe Biasing (Positions 1 & 2)
Failsafe biasing is required to bias the communication lines to a known state when no devices are communicating (i.e., driving the bus). Fail-safe biasing should be active in **ONLY** one unit in the network. Placing positions 1 & 2 in the closed (down) position activates the Fail-Safe biasing. In some cases, the network master may provide this biasing, and therefore would not need to be activated on the Cortex® LT units. (Refer to master documentation.)

Terminator (Position 3)
Terminating resistors are required at each end of a daisy chained RS-485 network in order to provide clean, error free signal transmissions. If the Cortex® LT is at one end of the daisy chained network, activate the terminating resistor by placing position 3 in the closed position (down).

2-Wire (Positions 4 & 5)
RS-485 networks can operate in either a 2-Wire or 4-Wire configuration. In 4-Wire mode, the transmit and receive signals use separate twisted wire pairs. Positions 4 & 5 should set in the open (up) position. In 2-Wire mode, the transmit and receive signals share the same twisted wire pair. If a 2-Wire network is used, place positions 4 & 5 in the closed (down) position. This provides an internal connection from TXD+ to RXD+ and from TXD- to RXD-, and eliminates the need to add jumpers externally to the drive between these points. An RS-422 network should always use the 4 wire selection.

$\overline{\text{Echo}}$ (Position 6)
On RS-485 2 wire networks, the echo selection should be disabled by placing position 6 in the closed (down) position. It should be open (up) in all other cases.

485 (Position 7)
Position 7 should be open (up) for RS-422 networks and closed (down) for RS-485 networks.

458 Modbus Network Address (R/W, Preset: 1)
Sets the Modbus® network address of the drive. Changes to this value only take affect after the **Apply** parameter is set to ON or power is cycled on unit. Range: 1..247

459 Legacy Status (R/O)
Reserved. Not used on V2 units.

460 Baud Rate (R/W, Preset: 38400)
Sets the communication speed. Available rates are 2400, 4800, 9600, 19200, 38400, 57600, 76800, & 115200. Changes to this value only take affect after the **Apply** parameter is set to ON or power is cycled on unit.

461 Legacy Firmware Major (R/O)
462 Legacy Firmware Minor (R/O)
463 Legacy Firmware Rev (R/O)
464 Legacy Firmware Sub Rev (R/O)
Reserved. Not used on V2 units.

581 Parity (R/W, Preset: 0)
Sets the parity. Available selections are NONE, ODD, & EVEN. Changes to this value only take affect after the **Apply** parameter is set to ON or power is cycled on unit.

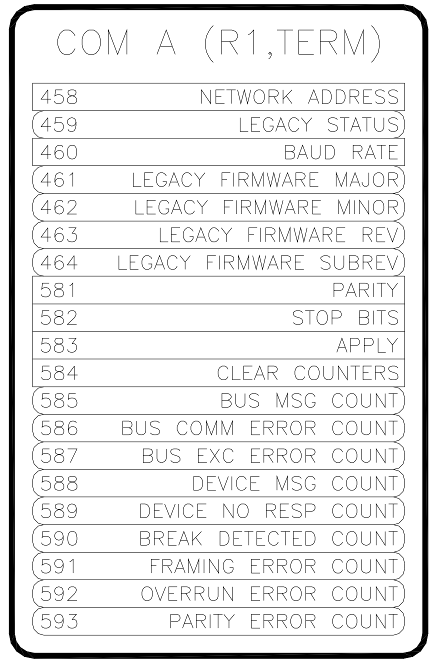


Figure 78: Com A (R1)

582 Stop Bits (R/W, Preset: 0)
Sets the number of stop bits. Available selections are 1 STOP BIT & 2 STOP BITS. Changes to this value only take affect after the **Apply** parameter is set to ON or power is cycled on unit.

583 Apply (R/W, Preset: Off)
Changes to parameters 458, 460, 581, & 582 do not take affect until they are applied by setting this parameter to ON. Note that the value automatically returns to OFF. The changes can also be applied by cycling power on the unit (after saving of course).

584 Clear Counters (R/W, Preset: Off)
Resets counter values in parameters 585-593 to zero when set to ON. Value automatically returns to OFF.

585 Bus Messages Counter (RO)
The total number of bus messages detected. This includes messages that are not addressed to the controller.

586 Bus Com Errors Counter (RO)
The total number of bus messages that have errors.

587 Exceptions Counter (RO)
The total number of Modbus® Exception errors.

588 Device Message Counter (RO)
The total number of messages that were addressed to the controller.

589 Device No Responses Counter (RO)
The total number of times the controller did not respond to a message due to an error.

590 Break Detected Counter (RO)

The total number of times the controller detected a serial break condition.

591 Framing Errors Counter (RO)

The total number of times the controller detected a framing error.

592 Overrun Errors Counter (RO)

The total number of times a buffer overrun error occurred.

593 Parity Errors Counter (RO)

The total number of times a parity error was detected.

R2: Com B (Ethernet)

Com B is an Ethernet communications channel that uses the Modbus® TCP/IP protocol.

539 Legacy Status (R/O)
540 Legacy Baud Rate (R/W)
541 Legacy Firmware Major (R/O)
542 Legacy Firmware Minor (R/O)
543 Legacy Firmware Revision (R/O)
544 Legacy Firmware Sub Revision (R/O)

Reserved. Not used on V2 units.

607 Enable (R/W, Preset: Enabled)

Enables/Disables the Ethernet port.

608 Static IP Address 1 (R/W, Preset: 192)
609 Static IP Address 2 (R/W, Preset: 168)
610 Static IP Address 3 (R/W, Preset: 0)
611 Static IP Address 4 (R/W, Preset: 181)

These 4 parameters define the IP address of the unit when **IP Address Mode** is set to STATIC. Changes to these values only take affect after the **Apply** parameter is set to ON or power is cycled on unit.

612 Static Subnet 1 (R/W, Preset: 255)
613 Static Subnet 2 (R/W, Preset: 255)
614 Static Subnet 3 (R/W, Preset: 255)
615 Static Subnet 4 (R/W, Preset: 0)

These 4 parameters define the subnet address of the unit when **IP Address Mode** is set to STATIC. Changes to these values only take affect after the **Apply** parameter is set to ON or power is cycled on unit.

616 Static Gateway Address 1 (R/W, Preset: 192)
617 Static Gateway Address 2 (R/W, Preset: 168)
618 Static Gateway Address 3 (R/W, Preset: 0)
619 Static Gateway Address 4 (R/W, Preset: 1)

These 4 parameters define the IP gateway address of the unit when **IP Address Mode** is set to STATIC. Changes to these values only take affect after the **Apply** parameter is set to ON or power is cycled on unit.

620 IP Address Mode (R/W, Preset: Static)

Determines how the device obtains the IP parameters. When set to STATIC, parameters 608-619 are used. When set to DHCP (Dynamic Host Control Protocol), a DHCP server on the network will automatically assign the unit IP values.

COM B (R2, RJ45)	
539	LEGACY STATUS
540	LEGACY BAUD RATE
541	LEGACY FIRMWARE MAJOR
542	LEGACY FIRMWARE MINOR
543	LEGACY FIRMWARE REVISION
544	LEGACY FIRMWARE SUBREV
607	COM B ENABLE
608	STATIC IP ADDRESS 1
609	STATIC IP ADDRESS 2
610	STATIC IP ADDRESS 3
611	STATIC IP ADDRESS 4
612	STATIC SUBNET 1
613	STATIC SUBNET 2
614	STATIC SUBNET 3
615	STATIC SUBNET 4
616	STATIC GATEWAY 1
617	STATIC GATEWAY 2
618	STATIC GATEWAY 3
619	STATIC GATEWAY 4
620	IP ADDRESS MODE
621	MODBUS TCP PORT
622	HTTP PORT
623	MAC 1
624	MAC 2
625	MAC 3
626	MAC 4
627	MAC 5
628	MAC 6
629	DHCP STATUS
630	LINK STATUS
631	IP ADDRESS 1
632	IP ADDRESS 2
633	IP ADDRESS 3
634	IP ADDRESS 4
635	SUBNET 1
636	SUBNET 2
637	SUBNET 3
638	SUBNET 4
639	GATEWAY 1
640	GATEWAY 2
641	GATEWAY 3
642	GATEWAY 4
643	HARDWARE FAULT
644	CHIP VERSION
645	SOCKET 0 STATUS
646	SOCKET 1 STATUS
647	SOCKET 2 STATUS
648	SOCKET 3 STATUS
649	SOCKET 4 STATUS
650	SOCKET 5 STATUS
651	SOCKET 6 STATUS
652	SOCKET 7 STATUS
653	APPLY

Figure 79: Com B (R2)

621 Modbus TCP Port (R/W, Preset: 502)

This defines the port to use for the Modbus TCP server. Changes to this value only takes affect after the **Apply** parameter is set to ON or power is cycled on unit.

622 HTTP Port (R/W, Preset: 80)

This defines the port to use for the basic web server. Changes to this value only takes affect after the **Apply** parameter is set to ON or power is cycled on unit.

623 MAC Address 1 (R/O)
624 MAC Address 2 (R/O)
625 MAC Address 3 (R/O)
626 MAC Address 4 (R/O)
627 MAC Address 5 (R/O)
628 MAC Address 6 (R/O)

Displays the MAC (Media Access Control) Address of the unit.

629 DHCP Status (R/O)

Valid only when IP Address Mode is set to DHCP. Displays the status of the DHCP assignment. Values are FAILED, RUNNING, ASSIGNED, CHANGED, LEASED, STOPPED.

630 Link Status (R/O)

Displays the link status of the Ethernet port, ON or OFF.

631 IP Address 1 (R/O)
632 IP Address 2 (R/O)
633 IP Address 3 (R/O)
634 IP Address 4 (R/O)

Displays the unit's IP address.

635 Subnet 1 (R/O)
636 Subnet 2 (R/O)
637 Subnet 3 (R/O)
638 Subnet 4 (R/O)

Displays the unit's subnet address.

639 Gateway Address 1 (R/O)
640 Gateway Address 2 (R/O)
641 Gateway Address 3 (R/O)
642 Gateway Address 4 (R/O)

Displays the unit's gateway address.

643 Ethernet Hardware Fault (R/O)

When ON, indicates a problem with the Ethernet hardware.

644 Chip Version (R/O)

Displays the Ethernet hardware chip version.

645 Socket 0 Status (R/O)
646 Socket 1 Status (R/O)
647 Socket 2 Status (R/O)
648 Socket 3 Status (R/O)
649 Socket 4 Status (R/O)
650 Socket 5 Status (R/O)
651 Socket 6 Status (R/O)
652 Socket 7 Status (R/O)

Displays the status of the 8 sockets. Valid states are CLOSED, INIT, LISTEN, SYN-SENT,SYN-RCVD, ESTABLISHED, FIN-WAIT, CLOSING, TIME-WAIT, CLOSE-WAIT, LAST-ACK, UPD, and MACRAW.

653 Apply (R/W, Preset: Off)

Changes to any Com B parameters do not take affect until they are applied by setting this parameter to ON. Note that the value automatically returns to OFF. The changes can also be applied by cycling power on the unit (after saving of course).

R3: Com C (RS422/232)

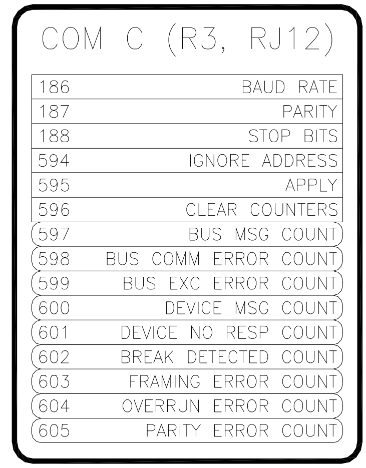


Figure 80: Com C (R3)

Com C is an RS422/232 serial communications channel that uses the Modbus® RTU protocol. It is mainly used for backwards compatibility with first generation hardware.

186 Baud Rate (R/W, Preset: 38400)

Sets the communication speed. Available rates are 2400, 4800, 9600, 19200, 38400, 57600, 76800, & 115200. Changes to this value only take affect after the **Apply** parameter is set to ON or power is cycled on unit.

187 Parity (R/W, Preset: 0)

Sets the parity. Available selections are NONE, ODD, & EVEN. Changes to this value only take affect after the **Apply** parameter is set to ON or power is cycled on unit.

188 Stop Bits (R/W, Preset: 0)

Sets the number of stop bits. Available selections are 1 STOP BIT & 2 STOP BITS. Changes to this value only take affect after the **Apply** parameter is set to ON or power is cycled on unit.

594 Ignore Address (R/W, Preset: Off)

When set to ON, the Com C port uses the **Modbus Network Address** defined in Com A. When set to OFF, the unit will respond to any address in the Modbus packet.

595 Apply (R/W, Preset: Off)

Changes to parameters 186, 187, 188, & 594 do not take affect until they are applied by setting this parameter to ON. Note that the value automatically returns to OFF. The changes can also be applied by cycling power on the unit (after saving of course).

596 Clear Counters (R/W, Preset: Off)

Resets counter values in parameters 597-605 to zero when set to ON. Value automatically returns to OFF.

597 Bus Messages Counter (RO)

The total number of bus messages detected. This includes messages that are not addressed to the controller.

598 Bus Com Errors Counter (RO)

The total number of bus messages that have errors.

599 Exceptions Counter (RO)

The total number of Modbus® Exception errors.

600 Device Message Counter (RO)

The total number of messages that were addressed to the controller.

601 Device No Responses Counter (RO)

The total number of times the controller did not respond to a message due to an error.

602 Break Detected Counter (RO)

The total number of times the controller detected a serial break condition.

603 Framing Errors Counter (RO)

The total number of times the controller detected a framing error.

604 Overrun Errors Counter (RO)

The total number of times a buffer overrun error occurred.

605 Parity Errors Counter (RO)

The total number of times a parity error was detected.

R4: Com D (USB)

Com D is a USB serial communications channel that uses the Modbus® RTU protocol.

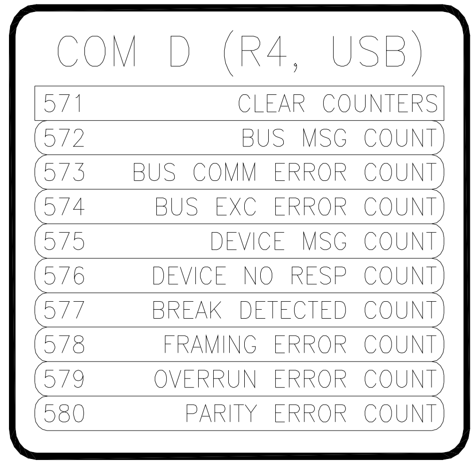


Figure 81: Com D (R4)

571 Clear Counters (R/W, Preset: Off)
Resets counter values in parameters 572-580 to zero when set to ON. Value automatically returns to OFF.

572 Bus Messages Counter (RO)
The total number of bus messages detected. This includes messages that are not addressed to the controller.

573 Bus Com Errors Counter (RO)
The total number of bus messages that have errors.

574 Exceptions Counter (RO)
The total number of Modbus® Exception errors.

575 Device Message Counter (RO)
The total number of messages that were addressed to the controller.

576 Device No Responses Counter (RO)
The total number of times the controller did not respond to a message due to an error.

577 Break Detected Counter (RO)
The total number of times the controller detected a serial break condition.

578 Framing Errors Counter (RO)
The total number of times the controller detected a framing error.

579 Overrun Errors Counter (RO)
The total number of times a buffer overrun error occurred.

580 Parity Errors Counter (RO)
The total number of times a parity error was detected.

6.16 Group T: System

The System group contains system level parameters.

T1: System

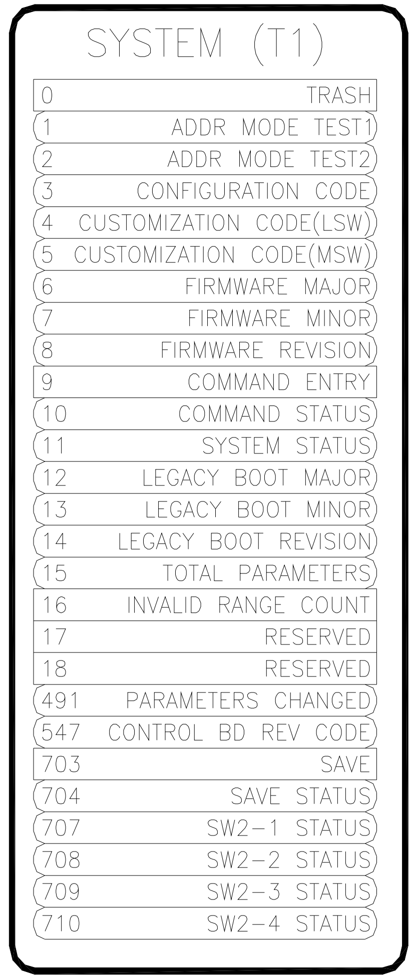


Figure 82: System (T1)

1 Addressing Mode Test 1 (R/O)
This parameter has a fixed value of 21845 decimal (5555 hex).

2 Addressing Mode Test 2 (R/O)
This parameter has a fixed value of 43690 decimal (AAAA hex).

3 Configuration Code (R/O)
Reserved. Not used on V2 units

4 Customization Code LSW (R/O)
5 Customization Code MSW (R/O)
Displays a unique code on units that contain custom firmware.

6 Firmware Major (R/O)
7 Firmware Minor (R/O)
8 Firmware Revision (R/O)
These parameters display the firmware version of the unit.

9 Command Entry (R/W, Preset: 0)
10 Command Status (R/O)
11 System Status (R/O)
12 Legacy Boot Major (R/O)
13 Legacy Boot Minor (R/O)
14 Legacy Boot Revision (R/O)
These parameters are included for backwards compatibility with first generation hardware units.

15 Total Parameters (R/O)
Displays the total number of parameters in the unit.

16 Invalid Range Count (R/O)
Reserved. Not used on V2 units

491 Parameters Changed (R/O)
A value of YES indicates that parameters have been changed via communications but have not been saved.

547 Control Board Revision Code (R/O)
Displays a unique code based on the control board installed in unit.

703 Save (R/W, Preset: Off)
Setting value to ON saves all parameters to internal memory. The value will automatically return to OFF.

704 Save Status (R/O)
Displays the status of the above save command. A value of 0 indicates the save was successful. A value of 4 indicates the save was unsuccessful.

707 DIP Switch SW2-1 Status (R/O)
708 DIP Switch SW2-2 Status (R/O)
709 DIP Switch SW2-3 Status (R/O)
710 DIP Switch SW2-4 Status (R/O)
Displays the status of the SW2 DIP switch positions. Refer to Table 1 on page 12 for more info. Note that switches 3 & 4 are reserved (i.e. status is no longer displayed) on Control Board Hardware Revision Codes 1 or greater (see parameter 547 above).

U1: Auxiliary

The Cortex® LT provides 7 auxiliary parameters for general use. One specific function the auxiliary parameters are often used for is to tie an input directly to an output. They are formatted as signed 16 bit integers (with an assumed 2 decimal places).

179 Auxiliary 1 (RW, Preset: 0.00%)
180 Auxiliary 2 (RW, Preset: 0.00%)
181 Auxiliary 3 (RW, Preset: 0.00%)
182 Auxiliary 4 (RW, Preset: 0.00%)
183 Auxiliary 5 (RW, Preset: 0.00%)
184 Auxiliary 6 (RW, Preset: 0.00%)
185 Auxiliary 7 (RW, Preset: 0.00%)
Range: -327.68%..327.67%

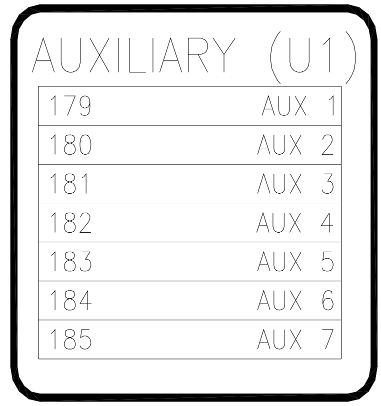


Figure 83: Auxiliary (U1)

Example - Auxiliary Parameters

A frequency to voltage conversion is needed. The Cortex® LT can perform the conversion using its frequency input and an analog output. Setup the Cortex® LT to convert a 0 to 4000 Hz signal to a voltage signal of 0 to 7.5VDC.

1. Set the **Frequency Input 1 Destination** to **Auxiliary 1** (179),
2. Set the **Frequency Input 1 Min Calibration** to 0 Hz.
3. Set the **Frequency Input 1 Max Calibration** to 4000 Hz.
4. The **Frequency Input 1 Bias** and **Gain** parameters should be set the factory presets of 0.00% and 100.00%.
5. Set **Analog Output 1 Source** to **Auxiliary 1** (179).
6. Set **Analog output 1 Bias** to 0.00%.
7. Set **Analog Output 1 Gain** to 75.00% (7.5VDC/10.0VDC=75%).

   Analog Output 1 should now give the desired voltage levels.

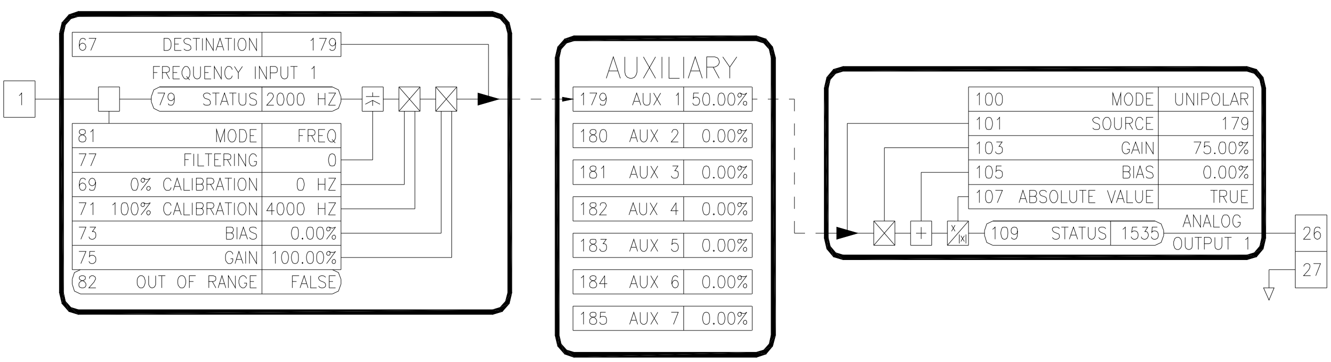


Figure 84: Auxiliary Block Example

U2: General

The Cortex® LT also provides an additional 12 general parameters. They are similar to the auxiliary parameters but are formatted as unsigned 16 bit integers.

492 General 1 (RW, Preset: 0)
493 General 2 (RW, Preset: 0)
494 General 3 (RW, Preset: 0)
495 General 4 (RW, Preset: 0)
496 General 5 (RW, Preset: 0)
497 General 6 (RW, Preset: 0)
498 General 7 (RW, Preset: 0)
499 General 8 (RW, Preset: 0)
500 General 9 (RW, Preset: 0)
501 General 10 (RW, Preset: 0)
502 General 11 (RW, Preset: 0)
503 General 12 (RW, Preset: 0)
Range: 0..65535

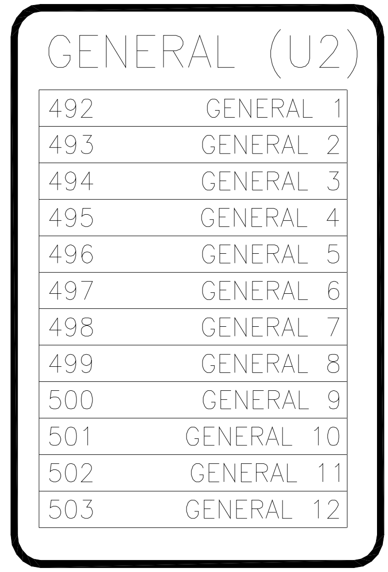


Figure 85: General (U2)

6.18 Group Y: Sum

Y1: Sum 1

The Sum 1 block sums together 4 inputs (designated A-D). Each input has an associated multiplier (Ratio) and sign inversion parameters that are applied to the inputs before being summed.

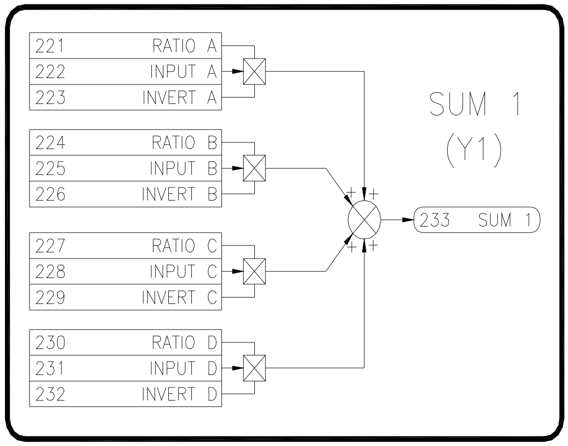


Figure 86: Sum 1 (Y1)

<u>221 Ratio A (RW, Preset: 100.00%)</u>
This is a multiplier for the Input A value. Range: -32.768..327.67%

<u>222 Input A (RW, Preset: 0.00%)</u>
The Input A value. Range: -32.768..327.67%

<u>223 Invert A (RW, Preset: Off)</u>
When ON, the value of Input A is inverted before being summed.

<u>224 Ratio B (RW, Preset: 100.00%)</u>
<u>225 Input B (RW, Preset: 0.00%)</u>
<u>226 Invert B (RW, Preset: Off)</u>
<u>227 Ratio C (RW, Preset: 100.00%)</u>
<u>228 Input C (RW, Preset: 0.00%)</u>
<u>229 Invert C (RW, Preset: Off)</u>
<u>230 Ratio D (RW, Preset: 100.00%)</u>
<u>231 Input D (RW, Preset: 0.00%)</u>
<u>232 Invert D (RW, Preset: Off)</u>
The B-D parameters are similar in function to the A parameters.

<u>233 Sum 1 (RO)</u>
This value contains the sum of the A-D values (after the ratio and inversion values have been applied). The sum has a valid range of -32.768..327.67%

Y2: Sum 2

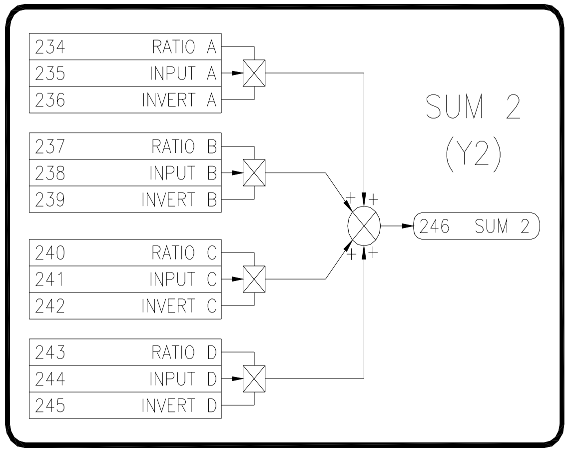


Figure 87: Sum 2 (Y2)

234 Ratio A (RW, Preset: 100.00%)
235 Input A (RW, Preset: 0.00%)
236 Invert A (RW, Preset: Off)
237 Ratio B (RW, Preset: 100.00%)
238 Input B (RW, Preset: 0.00%)
239 Invert B (RW, Preset: Off)
240 Ratio C (RW, Preset: 100.00%)
241 Input C (RW, Preset: 0.00%)
242 Invert C (RW, Preset: Off)
243 Ratio D (RW, Preset: 100.00%)
244 Input D (RW, Preset: 0.00%)
245 Invert D (RW, Preset: Off)
246 Sum 2 (RO)

The Sum 2 block is functionally equivalent to Sum 1. Refer to Sum 1.

6.19 Group Z: Processing Order

Z1: Procesing Order

The Cortex® LT provides great flexibility in allowing the block interconnects (links) to be reconfigured. It is therefore essential that the processor executes the blocks in a specific order to minimize the time that it takes for signals to propagate through the device. Normally, the settings in the Processing Order block are set automatically by the Application Builder. Changes to these settings may only be required if the Cortex® LT is configured manually.

The Processing Order block provides the means to control not only the order, but also which blocks do and do not execute. The order of items in the left column determine the execution order. Blocks in the right column are not executed.

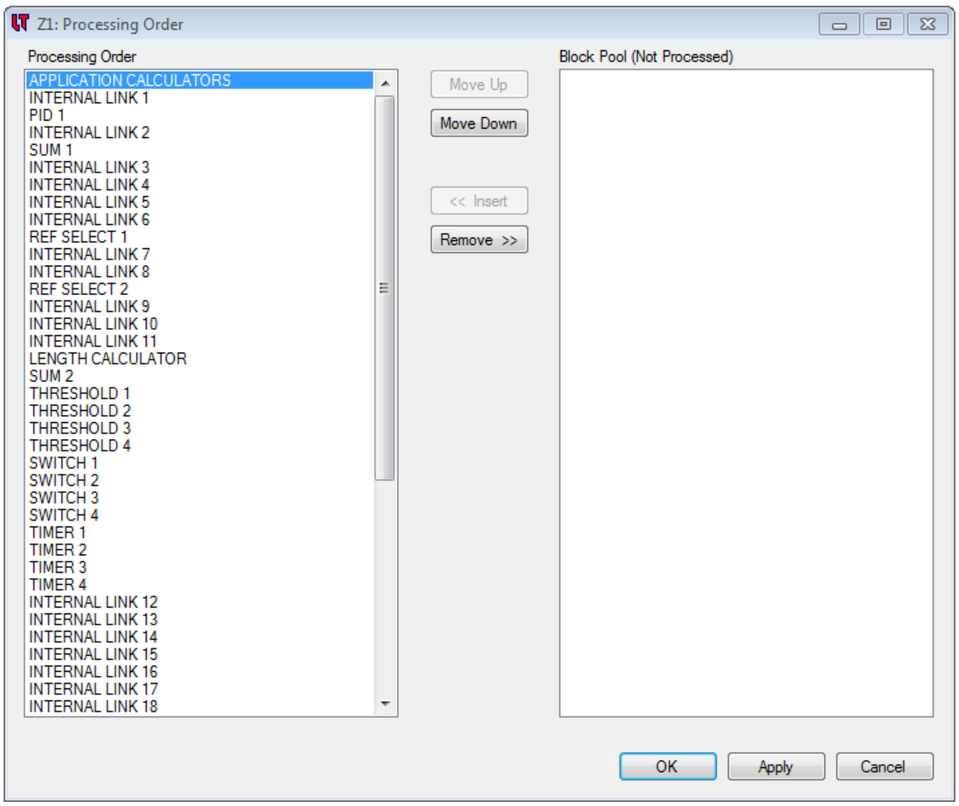


Figure 88: Processing Order (Z1)

6.26 Parameter Table

The following table lists all the Cortex® LT parameters and their properties. In the Access colunm, ICR stands for ***I**nhibit **C**hange while **R**unning* and identifies the parameters that cannot be modified while the unit is in the Run mode. Furthermore, RO indicates ***R**ead-**O**nly* parameters and RW indicates Read/Write.

Table 9: Parameters

Tag	Parameter Name	Access	Range	Preset	Block
0	None	RW	-32768..32767	0	T1
1	Addressing Mode Test 1	RO	0..65535	21845	T1
2	Addressing Mode Test 2	RO	0..65535	43690	T1
3	Configuration (Model) Code	RO	0..65535	-	T1
4	Customization Code (LSW)	RO	0..65535	-	T1
5	Customization Code (MSW)	RO	0..65535	-	T1
6	Firmware Version Major	RO	0..255	-	T1
7	Firmware Version Minor	RO	0..255	-	T1
8	Firmware Version Revision	RO	0..255	-	T1
9	Command Entry	RW	0..65535	0	T1
10	Command Status	RO	0..3	0	T1
11	System Status Register	RO	0..65535	0	T1
12	Legacy Boot Firmware Version Major	RO	0..65535	0	T1
13	Legacy Boot Firmware Version Minor	RO	0..65535	0	T1
14	Legacy Boot Firmware Version Revision	RO	0..65535	0	T1
15	Total Parameters	RO	0..65535	751	T1
16	Invalid Range Count	RO	0..65535	0	T1
17	Reserved 17	RO	0..65535	0	T1
18	Reserved 18	RO	0..65535	0	T1
19	Digital Input 1 Destination	ICR	0..751	0	B1
20	Digital Input 2 Destination	ICR	0..751	0	B2
21	Digital Input 3 Destination	ICR	0..751	0	B3
22	Digital Input 4 Destination	ICR	0..751	0	B4
23	Digital Input 5 Destination	ICR	0..751	0	B5
24	Digital Input 1 Off Value	RW	Varies By Destination	0.00%	B1
25	Digital Input 2 Off Value	RW	Varies By Destination	0.00%	B2
26	Digital Input 3 Off Value	RW	Varies By Destination	0.00%	B3
27	Digital Input 4 Off Value	RW	Varies By Destination	0.00%	B4
28	Digital Input 5 Off Value	RW	Varies By Destination	0.00%	B5
29	Digital Input 1 On Value	RW	Varies By Destination	1.00%	B1
30	Digital Input 2 On Value	RW	Varies By Destination	1.00%	B2
31	Digital Input 3 On Value	RW	Varies By Destination	1.00%	B3
32	Digital Input 4 On Value	RW	Varies By Destination	1.00%	B4
33	Digital Input 5 On Value	RW	Varies By Destination	1.00%	B5
34	Digital Input 1 Status	RO	Off..On	Off	B1
35	Digital Input 2 Status	RO	Off..On	Off	B2
36	Digital Input 3 Status	RO	Off..On	Off	B3
37	Digital Input 4 Status	RO	Off..On	Off	B4
38	Digital Input 5 Status	RO	Off..On	Off	B5
39	Analog Input 1 Destination	ICR	0..751	0	C1
40	Analog Input 2 Destination	ICR	0..751	0	C2
41	Analog Input 3 Destination	ICR	0..751	0	C3
42	Analog Input 4 Destination	ICR	0..751	0	C4
43	Analog Input 1 0% Calibration	RW	-4095..4095	0	C1
44	Analog Input 2 0% Calibration	RW	-4095..4095	0	C2
45	Analog Input 3 0% Calibration	RW	-4095..4095	0	C3
46	Analog Input 4 0% Calibration	RW	-4095..4095	0	C4
47	Analog Input 1 100% Calibration	RW	0..4095	4092	C1
48	Analog Input 2 100% Calibration	RW	0..4095	4092	C2
49	Analog Input 3 100% Calibration	RW	0..4095	4092	C3
50	Analog Input 4 100% Calibration	RW	0..4095	4092	C4
51	Analog Input 1 Bias	RW	Varies By Destination	0.00%	C1
52	Analog Input 2 Bias	RW	Varies By Destination	0.00%	C2

Tag	Parameter Name	Access	Range	Preset	Block
53	Analog Input 3 Bias	RW	Varies By Destination	0.00%	C3
54	Analog Input 4 Bias	RW	Varies By Destination	0.00%	C4
55	Analog Input 1 Gain	RW	Varies By Destination	100.00%	C1
56	Analog Input 2 Gain	RW	Varies By Destination	100.00%	C2
57	Analog Input 3 Gain	RW	Varies By Destination	100.00%	C3
58	Analog Input 4 Gain	RW	Varies By Destination	100.00%	C4
59	Analog Input 1 Filtering	RW	0..15	0	C1
60	Analog Input 2 Filtering	RW	0..15	0	C2
61	Analog Input 3 Filtering	RW	0..15	0	C3
62	Analog Input 4 Filtering	RW	0..15	0	C4
63	Analog Input 1 Status	RO	-4095..4095	0	C1
64	Analog Input 2 Status	RO	-4095..4095	0	C2
65	Analog Input 3 Status	RO	-4095..4095	0	C3
66	Analog Input 4 Status	RO	-4095..4095	0	C4
67	Frequency Input 1 Destination	ICR	0..751	0	B6
68	Frequency Input 2 Destination	ICR	0..751	0	B7
69	Frequency Input 1 0% Calibration	RW	0..50000Hz	0Hz	B6
70	Frequency Input 2 0% Calibration	RW	0..50000 Hz	0Hz	B7
71	Frequency Input 1 100% Calibration	RW	0..50000 Hz	42000Hz	B6
72	Frequency Input 2 100% Calibration	RW	0..50000 Hz	42000Hz	B7
73	Frequency Input 1 Bias	RW	Varies By Destination	0.00%	B6
74	Frequency Input 2 Bias	RW	Varies By Destination	0.00%	B7
75	Frequency Input 1 Gain	RW	Varies By Destination	100.00%	B6
76	Frequency Input 2 Gain	RW	Varies By Destination	100.00%	B7
77	Frequency Input 1 Filtering	RW	0..15	0	B6
78	Frequency Input 2 Filtering	RW	0..15	0	B7
79	Frequency Input 1 Status	RO	0..50000Hz	0Hz	B6
80	Frequency Input 2 Status	RO	0..50000Hz	0Hz	B7
81	Frequency Input 1 Mode	RW	Freq..Sonic	Freq	B6
82	Frequency Input 1 Out Of Range	RO	No..Yes	No	B6
83	Frequency Input 2 Revolution Destination	ICR	0..751	0	B7
84	Frequency Input 2 Count (LSW)	RO	0..65535	0	B7
85	Frequency Input 2 Count (MSW)	RO	0..65535	0	B7
86	Frequency Input 2 Count Enable	RW	Disabled..Enabled	Disabled	B7
87	Frequency Input 2 Reset	RW	Off, Reset, Preset	0	B7
88	Frequency Input 2 Direction	RW	Down..Up	Up	B7
89	Frequency Input 2 Divisor	RW	1..65535	1	B7
90	Relay Output 1 Source	ICR	0..751	0	D1
91	Relay Output 2 Source	ICR	0..751	0	D2
92	Relay Output 1 Absolute Value	RW	Off..On	On	D1
93	Relay Output 2 Absolute Value	RW	Off..On	On	D2
94	Relay Output 1 On Value	RW	Varies By Source	0.01%	D1
95	Relay Output 2 On Value	RW	Varies By Source	0.01%	D2
96	Relay Output 1 Off Value	RW	Varies By Source	0.00%	D1
97	Relay Output 2 Off Value	RW	Varies By Source	0.00%	D2
98	Relay Output 1 Status	RO	Off..On	Off	D1
99	Relay Output 2 Status	RO	Off..On	Off	D2
100	Legacy Analog Output Mode	RW	Unipolar..Bipolar	Unipolar	E1
101	Analog Output 1 Source	ICR	0..751	0	E1
102	Analog Output 2 Source	ICR	0..751	0	E2
103	Analog Output 1 Gain	RW	-327.68..327.67%	100.00%	E1
104	Analog Output 2 Gain	RW	-327.68..327.67%	100.00%	E2
105	Analog Output 1 Bias	RW	-327.68..327.67%	0.00%	E1
106	Analog Output 2 Bias	RW	-327.68..327.67%	0.00%	E2
107	Analog Output 1 Absolute Value	RW	Off..On	Off	E1
108	Analog Output 2 Absolute Value	RW	Off..On	Off	E2
109	Analog Output 1 Status	RO	-4095..4095	0	E1
110	Analog Output 2 Status	RO	-4095..4095	0	E2
111	Freq/Digital Output 1 Mode	ICR	Freq..Digital	Freq	D3
112	Freq/Digital Output 2 Mode	ICR	Freq..Digital	Digital	D4
113	Freq/Digital Output 1 Source	ICR	0..751	0	D3
114	Freq/Digital Output 2 Source	ICR	0..751	0	D4
115	Freq/Digital Output 1 Absolute Value	RW	Off..On	On	D3
116	Freq/Digital Output 2 Absolute Value	RW	Off..On	On	D4

Tag	Parameter Name	Access	Range	Preset	Block
117	Freq/Digital Output 1 On Value	RW	Varies By Source	1.00%	D3
118	Freq/Digital Output 2 On Value	RW	Varies By Destination	1.00%	D4
119	Freq/Digital Output 1 Off Value	RW	Varies By Destination	0.00%	D3
120	Freq/Digital Output 2 Off Value	RW	Varies By Destination	0.00%	D4
121	Freq/Digital Output 1 Invert	RW	Off..On	Off	D3
122	Freq/Digital Output 2 Invert	RW	Off..On	Off	D4
123	Freq/Digital Output 1 Status	RO	0..65535Hz/Off..On	0Hz	D3
124	Freq/Digital Output 2 Status	RO	0..65535Hz/Off..On	0Hz	D4
125	Freq/Digital Output 1 Gain	RW	-327.68..327.67%	100.00%	D3
126	Freq/Digital Output 1 Bias	RW	-327.68..327.67%	0.00%	D3
127	LED A Source A	ICR	0..751	0	D5
128	LED A Source B	ICR	0..751	0	D5
129	LED A Source C	ICR	0..751	0	D5
130	LED A Source D	ICR	0..751	0	D5
131	LED A Source E	ICR	0..751	0	D5
132	LED A Status	RO	Off..On	Off	D5
133	LED B Source A	ICR	0..751	0	D6
134	LED B Source B	ICR	0..751	0	D6
135	LED B Source C	ICR	0..751	0	D6
136	LED B Source D	ICR	0..751	0	D6
137	LED B Source E	ICR	0..751	0	D6
138	LED B Status	RO	Off..On	Off	D6
139	Internal Link 1 Source	ICR	0..751	0	Q1
140	Internal Link 1 Destination	ICR	0..751	0	Q1
141	Internal Link 2 Source	ICR	0..751	0	Q1
142	Internal Link 2 Destination	ICR	0..751	0	Q1
143	Internal Link 3 Source	ICR	0..751	0	Q1
144	Internal Link 3 Destination	ICR	0..751	0	Q1
145	Internal Link 4 Source	ICR	0..751	0	Q1
146	Internal Link 4 Destination	ICR	0..751	0	Q1
147	Internal Link 5 Source	ICR	0..751	0	Q1
148	Internal Link 5 Destination	ICR	0..751	0	Q1
149	Internal Link 6 Source	ICR	0..751	0	Q1
150	Internal Link 6 Destination	ICR	0..751	0	Q1
151	Internal Link 7 Source	ICR	0..751	0	Q1
152	Internal Link 7 Destination	ICR	0..751	0	Q1
153	Internal Link 8 Source	ICR	0..751	0	Q1
154	Internal Link 8 Destination	ICR	0..751	0	Q1
155	Internal Link 9 Source	ICR	0..751	0	Q1
156	Internal Link 9 Destination	ICR	0..751	0	Q1
157	Internal Link 10 Source	ICR	0..751	0	Q1
158	Internal Link 10 Destination	ICR	0..751	0	Q1
159	Internal Link 11 Source	ICR	0..751	0	Q2
160	Internal Link 11 Destination	ICR	0..751	0	Q2
161	Internal Link 12 Source	ICR	0..751	0	Q2
162	Internal Link 12 Destination	ICR	0..751	0	Q2
163	Internal Link 13 Source	ICR	0..751	0	Q2
164	Internal Link 13 Destination	ICR	0..751	0	Q2
165	Internal Link 14 Source	ICR	0..751	0	Q2
166	Internal Link 14 Destination	ICR	0..751	0	Q2
167	Internal Link 15 Source	ICR	0..751	0	Q2
168	Internal Link 15 Destination	ICR	0..751	0	Q2
169	Internal Link 16 Source	ICR	0..751	0	Q2
170	Internal Link 16 Destination	ICR	0..751	0	Q2
171	Internal Link 17 Source	ICR	0..751	0	Q2
172	Internal Link 17 Destination	ICR	0..751	0	Q2
173	Internal Link 18 Source	ICR	0..751	0	Q2
174	Internal Link 18 Destination	ICR	0..751	0	Q2
175	Internal Link 19 Source	ICR	0..751	0	Q2
176	Internal Link 19 Destination	ICR	0..751	0	Q2
177	Internal Link 20 Source	ICR	0..751	0	Q2
178	Internal Link 20 Destination	ICR	0..751	0	Q2
179	Aux 1 Param	RW	-327.68..327.67%	0.00%	U1
180	Aux 2 Param	RW	-327.68..327.67%	0.00%	U1

Tag	Parameter Name	Access	Range	Preset	Block
181	Aux 3 Param	RW	-327.68..327.67%	0.00%	U1
182	Aux 4 Param	RW	-327.68..327.67%	0.00%	U1
183	Aux 5 Param	RW	-327.68..327.67%	0.00%	U1
184	Aux 6 Param	RW	-327.68..327.67%	0.00%	U1
185	Aux 7 Param	RW	-327.68..327.67%	0.00%	U1
186	Com C Baud Rate	RW	2400, 4800, 9600, 19.2k, 38.4k, 57.6k, 76.8k, 115.2k	38400	R3
187	Com C Parity	RW	None, Odd, Even	0	R3
188	Com C Stop Bits	RW	1..2	2	R3
189	Addressing Mode	RW	0..1	1	R0
190	Line Speed	RW	-327.68..327.67%	100.00%	L3
191	Line Speed Sum	RW	-327.68..327.67%	0.00%	L3
192	Diameter Select	RW	0..4		L2
193	Core Diameter	RW	0.01..655.35"	1.00"	L2
194	Max Diameter	RW	0.01..655.35"	10.00"	L2
195	Material Thickness	RW	0.001..20.000"	0.001"	L2
196	Revolutions	RW	0..65535	0	L2
197	Length/Revolution	RW	1..20000	0.01"	L2
198	External Diameter Ratio	RW	0..10000	0.00%	L2
199	Roll Speed	RO	-327.68..327.67%	0.00%	L3
200	Roll Speed Sum	RW	-327.68..327.67%	0.00%	L3
201	Core/Diameter Ratio	RO	0..100.00%	0.00%	L2
202	Diameter	RO	0.01..655.35"	0.00"	L2
203	Tension Setpoint	RW	0..100.00%	0.00%	L4
204	Taper Diameter	RW	0.01..200.00"	200.00"	L4
205	Taper Percentage	RW	0..100.00%	0.00%	L4
206	Tension Demand	RO	0..100.00%	0.00%	L4
207	Reference Select 1 (MSB)	RW	0..1	0	P5
208	Reference Select 1 (LSB)	RW	0..3	0	P5
209	Reference Select 1 Reference A	RW	-327.68..327.67%	0.00%	P5
210	Reference Select 1 Reference B	RW	-327.68..327.67%	0.00%	P5
211	Reference Select 1 Reference C	RW	-327.68..327.67%	0.00%	P5
212	Reference Select 1 Reference D	RW	-327.68..327.67%	0.00%	P5
213	Reference Select 1 Output	RO	-327.68..327.67%	0.00%	P5
214	Reference Select 2 (MSB)	RW	0..1	0	P6
215	Reference Select 2 (LSB)	RW	0..3	0	P6
216	Reference Select 2 Reference A	RW	-327.68..327.67%	0.00%	P6
217	Reference Select 2 Reference B	RW	-327.68..327.67%	0.00%	P6
218	Reference Select 2 Reference C	RW	-327.68..327.67%	0.00%	P6
219	Reference Select 2 Reference D	RW	-327.68..327.67%	0.00%	P6
220	Reference Select 2 Output	RO	-327.68..327.67%	0.00%	P6
221	Sum 1 Multiplier A	RW	-327.68..327.67%	100.00%	Y1
222	Sum 1 Input A	RW	-327.68..327.67%	0.00%	Y1
223	Sum 1 Invert A	RW	Off..On	Off	Y1
224	Sum 1 Multiplier B	RW	-327.68..327.67%	100.00%	Y1
225	Sum 1 Input B	RW	-327.68..327.67%	0.00%	Y1
226	Sum 1 Invert B	RW	Off..On	Off	Y1
227	Sum 1 Multiplier C	RW	-327.68..327.67%	100.00%	Y1
228	Sum 1 Input C	RW	-327.68..327.67%	0.00%	Y1
229	Sum 1 Invert C	RW	Off..On	Off	Y1
230	Sum 1 Multiplier D	RW	-327.68..327.67%	100.00%	Y1
231	Sum 1 Input D	RW	-327.68..327.67%	0.00%	Y1
232	Sum 1 Invert D	RW	Off..On	Off	Y1
233	Sum 1 Output	RO	-327.68..327.67%	0%	Y1
234	Sum 2 Multiplier A	RW	-327.68..327.67%	100.00%	Y2
235	Sum 2 Input A	RW	-327.68..327.67%	0.00%	Y2
236	Sum 2 Invert A	RW	Off..On	Off	Y2
237	Sum 2 Multiplier B	RW	-327.68..327.67%	100.00%	Y2
238	Sum 2 Input B	RW	-327.68..327.67%	0.00%	Y2
239	Sum 2 Invert B	RW	Off..On	Off	Y2
240	Sum 2 Multiplier C	RW	-327.68..327.67%	100.00%	Y2
241	Sum 2 Input C	RW	-327.68..327.67%	0.00%	Y2
242	Sum 2 Invert C	RW	Off..On	Off	Y2
243	Sum 2 Multiplier D	RW	-327.68..327.67%	100.00%	Y2

Tag	Parameter Name	Access	Range	Preset	Block
244	Sum 2 Input D	RW	-327.68..327.67%	0.00%	Y2
245	Sum 2 Invert D	RW	Off..On	Off	Y2
246	Sum 2 Output	RO	-327.68..327.67%	0.00%	Y2
247	Accel/Decel 1 Ramp Input	RW	-327.68..327.67%	0.00%	J1
248	Accel/Decel 2 Ramp Input	RW	-327.68..327.67%	0.00%	J2
249	Accel/Decel 1 Ramp Output	RO	-327.68..327.67%	0.00%	J1
250	Accel/Decel 2 Ramp Output	RO	-327.68..327.67%	0.00%	J2
251	Accel/Decel 1 Ramp Reset	RW	Off..On	Off	J1
252	Accel/Decel 2 Ramp Reset	RW	Off..On	Off	J2
253	Accel/Decel 1 Ramp Hold	RW	Off..On	Off	J1
254	Accel/Decel 2 Ramp Hold	RW	Off..On	Off	J2
255	Accel/Decel 1 Ramp Bypass	RW	Off..On	Off	J1
256	Accel/Decel 2 Ramp Bypass	RW	Off..On	Off	J2
257	Accel/Decel 1 Accel Time	RW	0.1..600.0 Secs	10.0 Secs	J1
258	Accel/Decel 2 Accel Time	RW	0.1..600.0 Secs	10.0 Secs	J2
259	Accel/Decel 1 Decel Time	RW	0.1..600.0 Secs	10.0 Secs	J1
260	Accel/Decel 2 Decel Time	RW	0.1..600.0 Secs	10.0 Secs	J2
261	Accel/Decel 1 Ramp Threshold	RW	0..100.00%	100.00%	J1
262	Accel/Decel 2 Ramp Threshold	RW	0..100.00%	100.00%	J2
263	Accel/Decel 1 Ramping Status	RO	Off..On	Off	J1
264	Accel/Decel 2 Ramping Status	RO	Off..On	Off	J2
265	Logic Switch 1 Coil	RW	Off..On	Off	P1
266	Logic Switch 2 Coil	RW	Off..On	Off	P2
267	Logic Switch 3 Coil	RW	Off..On	Off	P3
268	Logic Switch 4 Coil	RW	Off..On	Off	P4
269	Logic Switch 1 On Value	RW	-327.68..327.67%	0.00%	P1
270	Logic Switch 2 On Value	RW	-327.68..327.67%	0.00%	P2
271	Logic Switch 3 On Value	RW	-327.68..327.67%	0.00%	P3
272	Logic Switch 4 On Value	RW	-327.68..327.67%	0.00%	P4
273	Logic Switch 1 Off Value	RW	-327.68..327.67%	0.00%	P1
274	Logic Switch 2 Off Value	RW	-327.68..327.67%	0.00%	P2
275	Logic Switch 3 Off Value	RW	-327.68..327.67%	0.00%	P3
276	Logic Switch 4 Off Value	RW	-327.68..327.67%	0.00%	P4
277	Logic Switch 1 Output	RO	-327.68..327.67%	0.00%	P1
278	Logic Switch 2 Output	RO	-327.68..327.67%	0.00%	P2
279	Logic Switch 3 Output	RO	-327.68..327.67%	0.00%	P3
280	Logic Switch 4 Output	RO	-327.68..327.67%	0.00%	P4
281	Threshold 1 On Value	RW	-327.68..327.67%	0.01%	M1
282	Threshold 2 On Value	RW	-327.68..327.67%	0.01%	M2
283	Threshold 3 On Value	RW	-327.68..327.67%	0.01%	M3
284	Threshold 4 On Value	RW	-327.68..327.67%	0.01%	M4
285	Threshold 1 Off Value	RW	-327.68..327.67%	0.00%	M1
286	Threshold 2 Off Value	RW	-327.68..327.67%	0.00%	M2
287	Threshold 3 Off Value	RW	-327.68..327.67%	0.00%	M3
288	Threshold 4 Off Value	RW	-327.68..327.67%	0.00%	M4
289	Threshold 1 On Level	RW	-327.68..327.67%	0.01%	M1
290	Threshold 2 On Level	RW	-327.68..327.67%	0.01%	M2
291	Threshold 3 On Level	RW	-327.68..327.67%	0.01%	M3
292	Threshold 4 On Level	RW	-327.68..327.67%	0.01%	M4
293	Threshold 1 Off Level	RW	-327.68..327.67%	0.00%	M1
294	Threshold 2 Off Level	RW	-327.68..327.67%	0.00%	M2
295	Threshold 3 Off Level	RW	-327.68..327.67%	0.00%	M3
296	Threshold 4 Off Level	RW	-327.68..327.67%	0.00%	M4
297	Threshold 1 Absolute Value	RW	Off..On	Off	M1
298	Threshold 2 Absolute Value	RW	Off..On	Off	M2
299	Threshold 3 Absolute Value	RW	Off..On	Off	M3
300	Threshold 4 Absolute Value	RW	Off..On	Off	M4
301	Threshold 1 Input	RW	-327.68..327.67%	0.00%	M1
302	Threshold 2 Input	RW	-327.68..327.67%	0.00%	M2
303	Threshold 3 Input	RW	-327.68..327.67%	0.00%	M3
304	Threshold 4 Input	RW	-327.68..327.67%	0.00%	M4
305	Threshold 1 Output	RO	-327.68..327.67%	0.00%	M1
306	Threshold 2 Output	RO	-327.68..327.67%	0.00%	M2
307	Threshold 3 Output	RO	-327.68..327.67%	0.00%	M3

Tag	Parameter Name	Access	Range	Preset	Block
308	Threshold 4 Output	RO	-327.68..327.67%	0.00%	M4
309	Timer 1 On Value	RW	-327.68..327.67%	1.00%	N1
310	Timer 2 On Value	RW	-327.68..327.67%	1.00%	N2
311	Timer 3 On Value	RW	-327.68..327.67%	1.00%	N3
312	Timer 4 On Value	RW	-327.68..327.67%	1.00%	N4
313	Timer 1 Off Value	RW	-327.68..327.67%	0.00%	N1
314	Timer 2 Off Value	RW	-327.68..327.67%	0.00%	N2
315	Timer 3 Off Value	RW	-327.68..327.67%	0.00%	N3
316	Timer 4 Off Value	RW	-327.68..327.67%	0.00%	N4
317	Timer 1 Mode	ICR	On Delay, Off Delay, One Shot, One Shot Retrig, Single Cycle, Repeat Cycle, Repeat (Delayed)	On Delay	N1
318	Timer 2 Mode	ICR		On Delay	N2
319	Timer 3 Mode	ICR		On Delay	N3
320	Timer 4 Mode	ICR		On Delay	N4
321	Timer 1 Delay Time 1	RW	0..300.0 Secs	0.1 Secs	N1
322	Timer 2 Delay Time 1	RW	0..300.0 Secs	0.1 Secs	N2
323	Timer 3 Delay Time 1	RW	0..300.0 Secs	0.1 Secs	N3
324	Timer 4 Delay Time 1	RW	0..300.0 Secs	0.1 Secs	N4
325	Timer 1 Delay Time 2	RW	0..300.0 Secs	0.1 Secs	N1
326	Timer 2 Delay Time 2	RW	0..300.0 Secs	0.1 Secs	N2
327	Timer 3 Delay Time 2	RW	0..300.0 Secs	0.1 Secs	N3
328	Timer 4 Delay Time 2	RW	0..300.0 Secs	0.1 Secs	N4
329	Timer 1 Input	RW	Off..On	Off	N1
330	Timer 2 Input	RW	Off..On	Off	N2
331	Timer 3 Input	RW	Off..On	Off	N3
332	Timer 4 Input	RW	Off..On	Off	N4
333	Timer 1 Output	RO	-327.68..327.67%	0.00%	N1
334	Timer 2 Output	RO	-327.68..327.67%	0.00%	N2
335	Timer 3 Output	RO	-327.68..327.67%	0.00%	N3
336	Timer 4 Output	RO	-327.68..327.67%	0.00%	N4
337	Timer 1 Value	RO	0..300.0 Secs	0.0 Secs	N1
338	Timer 2 Value	RO	0..300.0 Secs	0.0 Secs	N2
339	Timer 3 Value	RO	0..300.0 Secs	0.0 Secs	N3
340	Timer 4 Value	RO	0..300.0 Secs	0.0 Secs	N4
341	Timer 1 Status	RO	Off..On	Off	N1
342	Timer 2 Status	RO	Off..On	Off	N2
343	Timer 3 Status	RO	Off..On	Off	N3
344	Timer 4 Status	RO	Off..On	Off	N4
345	Max Length (LSW)	RW	0..42,949,672.96"	0.00"	L1
346	Max Length (MSW)	RW			L1
347	Length/Revolution	RW	1..200.00"	0.01"	L1
348	Revolutions	RW	0..65535	1	L1
349	Length (LSW)	RO	0..42,949,672.96"	0.00"	L1
350	Length (MSW)	RO			L1
351	Length Ratio	RO	0..100.00%	0.00%	L1
352	PID 1 Enable	RW	Disabled..Enabled	Disabled	L6
353	PID 1 Proportional Gain	RW	0..100.00	5.00	L6
354	PID 1 Integral Time	RW	0.010..65.535 Secs	10.000 Secs	L6
355	PID 1 Derivative Gain	RW	0..10.00	0.00	L6
356	PID 1 Integral Clamp	RW	Off..On	Off	L6
357	PID 1 Integral Polarity	RW	Unipolar..Bipolar	Unipolar	L6
358	PID 1 Deadband	RW	0..30.00%	0.00%	L6
359	PID 1 Setpoint	RW	-100.00..100.00%	0.00%	L6
360	PID 1 Feedback	RW	-150.00..150.00%	0.00%	L6
361	PID 1 Error	RO	-250.00..250.00%	0.00%	L6
362	PID 1 Reset	RW	Off..On	Off	L6
363	PID 1 Scale	RW	-100.00..100.00%	100.00%	L6
364	PID 1 Min Scale	RW	0..100.00%	10.00%	L6
365	PID 1 Trim	RW	-100.00..100.00%	100.00%	L6
366	PID 1 Proportional Status	RO	-100.00..100.00%	0.00%	L6
367	PID 1 Integral Status	RO	-100.00..100.00%	0.00%	L6
368	PID 1 Derivative Status	RO	-100.00..100.00%	0.00%	L6
369	PID 1 Output	RO	-100.00..100.00%	0.00%	L6
370	PID 1 Integral Saturation Status	RO	No..Yes	No	L6
371	Turret Roll 1 Tension Enable	RW	Disabled..Enabled	Disabled	L8

Tag	Parameter Name	Access	Range	Preset	Block
372	Turret Roll 2 Tension Enable	RW	Disabled..Enabled	Disabled	L8
373	Turret Roll 1 Hold Speed	RO	Off..On	Off	L8
374	Turret Roll 2 Hold Speed	RO	Off..On	Off	L8
375	Turret Roll 1 Delayed Tension Enable	RO	Disabled..Enabled	Disabled	L8
376	Turret Roll 2 Delayed Tension Enable	RO	Disabled..Enabled	Disabled	L8
377	Turret PID Reset	RO	0..1	Disabled	L8
378	Logic Gate 1 Mode	ICR	AND, NAND, OR, NOR, XOR, XNOR, INVERT (logical), GT, GEQ, LT, LEQ, EQ, NEQ, ABS, NEG ABS, INVERT (sign), ADD, SUBTRACT, MULTIPLY, FILTER, SRFF, POS LATCH, NEG LATCH, DIVIDE	INVERT (sign)	O1
379	Logic Gate 2 Mode	ICR		INVERT (sign)	O2
380	Logic Gate 3 Mode	ICR		INVERT (sign)	O3
381	Logic Gate 4 Mode	ICR		INVERT (sign)	O4
382	Logic Gate 1 Input A	RW	-327.68..327.67%	0.00%	O1
383	Logic Gate 2 Input A	RW	-327.68..327.67%	0.00%	O2
384	Logic Gate 3 Input A	RW	-327.68..327.67%	0.00%	O3
385	Logic Gate 4 Input A	RW	-327.68..327.67%	0.00%	O4
386	Logic Gate 1 Input B	RW	-327.68..327.67%	0.00%	O1
387	Logic Gate 2 Input B	RW	-327.68..327.67%	0.00%	O2
388	Logic Gate 3 Input B	RW	-327.68..327.67%	0.00%	O3
389	Logic Gate 4 Input B	RW	-327.68..327.67%	0.00%	O4
390	Logic Gate 1 Output	RO	-327.68..327.67%	0.00%	O1
391	Logic Gate 2 Output	RO	-327.68..327.67%	0.00%	O2
392	Logic Gate 3 Output	RO	-327.68..327.67%	0.00%	O3
393	Logic Gate 4 Output	RO	-327.68..327.67%	0.00%	O4
394	Block 1	ICR		App. Calculators	Z1
395	Block 2	ICR		Internal Link 1	Z1
396	Block 3	ICR		PID1	Z1
397	Block 4	ICR		Internal Link 2	Z1
398	Block 5	ICR		Sum1	Z1
399	Block 6	ICR		Internal Link 3	Z1
400	Block 7	ICR		Internal Link 4	Z1
401	Block 8	ICR		Internal Link 5	Z1
402	Block 9	ICR		Internal Link 6	Z1
403	Block 10	ICR		Ref Select1	Z1
404	Block 11	ICR		Internal Link 7	Z1
405	Block 12	ICR		Internal Link 8	Z1
406	Block 13	ICR		Ref Select2	Z1
407	Block 14	ICR		Internal Link 9	Z1
408	Block 15	ICR		Internal Link 10	Z1
409	Block 16	ICR		Internal Link 11	Z1
410	Block 17	ICR		Length Calculator	Z1
411	Block 18	ICR		Sum2	Z1
412	Block 19	ICR		Threshold 1	Z1
413	Block 20	ICR		Threshold 2	Z1
414	Block 21	ICR		Threshold 3	Z1
415	Block 22	ICR		Threshold 4	Z1
416	Block 23	ICR		Logic Switch 1	Z1
417	Block 24	ICR		Logic Switch 2	Z1
418	Block 25	ICR		Logic Switch 3	Z1
419	Block 26	ICR		Logic Switch 4	Z1
420	Block 27	ICR		Timer 1	Z1
421	Block 28	ICR		Timer 2	Z1
422	Block 29	ICR		Timer 3	Z1
423	Block 30	ICR		Timer 4	Z1
424	Block 31	ICR		Internal Link 12	Z1
425	Block 32	ICR		Internal Link 13	Z1
426	Block 33	ICR		Internal Link 14	Z1
427	Block 34	ICR		Internal Link 15	Z1
428	Block 35	ICR		Internal Link 16	Z1
429	Block 36	ICR		Internal Link 17	Z1
430	Block 37	ICR		Internal Link 18	Z1
431	Block 38	ICR		Internal Link 19	Z1
432	Block 39	ICR		Internal Link 20	Z1
433	Block 40	ICR		Turret Logic	Z1

Tag	Parameter Name	Access	Range	Preset	Block
434	Block 41	ICR		Logic Gate 1	Z1
435	Block 42	ICR		Logic Gate 2	Z1
436	Block 43	ICR		Logic Gate 3	Z1
437	Block 44	ICR		Logic Gate 4	Z1
438	Block 45	ICR		PID2	Z1
439	Block 46	ICR		Brake Letoff	Z1
440	Block 47	ICR		Start-Stop Logic	Z1
441	Block 48	ICR		Internal Link 21	Z1
442	Block 49	ICR		Internal Link 22	Z1
443	Block 50	ICR		Internal Link 23	Z1
444	Block 51	ICR		Internal Link 24	Z1
445	Block 52	ICR		Internal Link 25	Z1
446	Block 53	ICR		Internal Link 26	Z1
447	Block 54	ICR		Internal Link 27	Z1
448	Block 55	ICR		Internal Link 28	Z1
449	Block 56	ICR		Internal Link 29	Z1
450	Block 57	ICR		Internal Link 30	Z1
451 - 457	Reserved	ICR		-	Z1
458	Network Address	RW	1..255	1	R1
459	Legacy Com A Status	RO	Disabled..Enabled	Enabled	R1
460	Com A Baud Rate	RW	2400, 4800, 9600, 19.2k, 38.4k, 57.6k, 76.8k, 115.2k	38400	R1
461	Legacy Com A Firmware Major	RO	0..255	0	R1
462	Legacy Com A Firmware Minor	RO	0..255	0	R1
463	Legacy Com A Firmware Revision	RO	0..255	0	R1
464	Legacy Com A Firmware Sub Rev	RO	0..255	0	R1
465	Turret Roll 1 Run	RW	Off..On	Off	L8
466	Turret Roll 2 Run	RW	Off..On	Off	L8
467	Turret Roll 1 Speed Match	RO	Off..On	Off	L8
468	Turret Roll 2 Speed Match	RO	Off..On	Off	L8
469	Turret Diameter Reset	RO	Off..On	Off	L8
470	PID 2 Enable	RW	Disabled..Enabled	Disabled	L7
471	PID 2 Proportional Gain	RW	0..100.00	5.00	L7
472	PID 2 Integral Time	RW	0.010..65.535 Secs	10.000 Secs	L7
473	PID 2 Derivative Gain	RW	0..10.00	0.00	L7
474	PID 2 Integral Clamp	RW	Off..On	Off	L7
475	PID 2 Integral Polarity	RW	Unipolar..Bipolar	Unipolar	L7
476	PID 2 Deadband	RW	0..30.00%	0.00%	L7
477	PID 2 Setpoint	RW	-100.00..100.00%	0.00%	L7
478	PID 2 Feedback	RW	-150.00..150.00%	0.00%	L7
479	PID 2 Error	RO	-250.00..250.00%	0.00%	L7
480	PID 2 Reset	RW	Off..On	Off	L7
481	PID 2 Scale	RW	-100.00..100.00%	100.00%	L7
482	PID 2 Min Scale	RW	0..100.00%	10.00%	L7
483	PID 2 Trim	RW	-100.00..100.00%	100.00%	L7
484	PID 2 Proportional Status	RO	-100.00..100.00%	0.00%	L7
485	PID 2 Integral Status	RO	-100.00..100.00%	0.00%	L7
486	PID 2 Derivative Status	RO	-100.00..100.00%	0.00%	L7
487	PID 2 Output	RO	-100.00..100.00%	0.00%	L7
488	PID 2 Integral Saturation Status	RO	No..Yes	No	L7
489	Frequency Input 2 Term 2 Mode	RW	Freq..Sonic	Freq	B7
490	Frequency Input 2 Term 2 Out Of Range	RO	No..Yes	No	B7
491	Parameters Changed	RO	No..Yes	No	T1
492	General Param 1	RW	0..65535	0	U2
493	General Param 2	RW	0..65535	0	U2
494	General Param 3	RW	0..65535	0	U2
495	General Param 4	RW	0..65535	0	U2
496	General Param 5	RW	0..65535	0	U2
497	General Param 6	RW	0..65535	0	U2
498	General Param 7	RW	0..65535	0	U2
499	General Param 8	RW	0..65535	0	U2
500	General Param 9	RW	0..65535	0	U2

Tag	Parameter Name	Access	Range	Preset	Block
501	General Param 10	RW	0..65535	0	U2
502	General Param 11	RW	0..65535	0	U2
503	General Param 12	RW	0..65535	0	U2
504	External Roll Speed	RW	0..150.00%	0.00%	L2
505	Diameter Memory Reset	RW	Off..On	On	L2
506	Diameter/Max Ratio	RO	0..100.00%	0.00%	L2
507	Inertia Compensation	RW	0..100.00%	0.00%	L5
508	Friction Compensation	RW	0..100.00%	0.00%	L5
509	Pulse Threshold	RW	0..100.00%	0.00%	L5
510	Pulse Torque Level	RW	0..100.00%	0.00%	L5
511	Pulse Torque Time	RW	0..10.0Secs	0.0 Secs	L5
512	Diameter Torque	RO	0..100.00%	0.00%	L5
513	Inertia Torque	RO	0..100.00%	0.00%	L5
514	Friction Torque	RO	0..100.00%	0.00%	L5
515	Static Friction Torque	RW	0..100.00%	0.00%	L5
516	Pulse Torque	RO	0..100.00%	0.00%	L5
517	Total Torque	RO	0..100.00%	0.00%	L5
518	Torque Sum	RW	-100.00..100.00%	0.00%	L5
519	Inertia Mode	RW	Accel..Decel	Accel	L5
520	Inertia Sensitivity	RW	1..10	1	L5
521	Line Speed Status	RO	Decelerating, Steady, Accelerating	Steady	L5
522	Stall	RW	Off..On	Off	L9
523	Run	RW	Off..On	Off	L9
524	Auto	RW	Off..On	Off	L9
525	Emergency Stop	RW	Off..On	Off	L9
526	Run Delay Mode	RW	Timer, Speed, Either, Both	Timer	L9
527	Run Delay Time	RW	0..300.0 Secs	5.0 Secs	L9
528	Stop Delay Mode	RW	Timer, Speed, Either, Both	Timer	L9
529	Stop Delay Time	RW	0..300.0 Secs	5.0 Secs	L9
530	Zero Speed Threshold	RW	0..100.00%	5.00%	L2
531	Ramp Reset	RO	Off..On	On	L9
532	Ramp Bypass	RO	Off..On	Off	L9
533	Torque Select	RO	0..3	0	L9
534	Inertia Enable	RO	Disabled..Enabled	Disabled	L9
535	Brake Mode	RO	E-Stop, Off, Stall, Init Run, Init Run Auto, Man Run, Auto Run, Stop Delay	E-Stop	L9
536	Diameter Torque Gain	RW	0..655.35%	100.00%	L5
537	PID 1 Integrator Hold Source	RW	0..751	0	L6
538	PID 2 Integrator Hold Source	RW	0..751	0	L7
539	Legacy Com B Status	RO	Disabled..Enabled	Disabled	R2
540	Legacy Com B Baud Rate	RW			R2
541	Legacy Com B Firmware Version Major	RO	0..255	0	R2
524	Legacy Com B Firmware Version Minor	RO	0..255	0	R2
543	Legacy Com B Firmware Version Revision	RO	0..255	0	R2
544	Legacy Com B Firmware Version SubRev	RO	0..255	0	R2
545	PID 1 Integration Mode	ICR	Linear..Classical	Linear	L6
546	PID 2 Integration Mode	ICR	Linear..Classical	Linear	L7
547	Control Board Revision Code	RO	0..65535	0	T1
548	Analog Input 1 Polarity	ICR	Unipolar..Bipolar	Unipolar	C1
549	Analog Input 2 Polarity	ICR	Unipolar..Bipolar	Unipolar	C2
550	Analog Input 3 Polarity	ICR	Unipolar..Bipolar	Unipolar	C3
551	Analog Input 4 Polarity	ICR	Unipolar..Bipolar	Unipolar	C4
552	Frequency Input 2 Rollover Enable	RW	Disabled..Enabled	Enabled	B7
553	Frequency Input 2 Reset Value (LSW)	RW	0..65535	0	B7
554	Frequency Input 2 Reset Value (MSW)	RW	0..65535	0	B7
555	Frequency Input 1 Revolution Destination	ICR	0..751	0	B6
556	Frequency Input 1 Count Enable	RW	Disabled..Enabled	Disabled	B6
557	Frequency Input 1 Count Direction	RW	Down..Up	Up	B6
558	Frequency Input 1 Rollover Enable	RW	Disabled..Enabled	Enabled	B6
559	Frequency Input 1 Count Reset	RW	Off, Reset, Preset	Off	B6
560	Frequency Input 1 Reset Value (LSW)	RW	0..65535	0	B6
561	Frequency Input 1 Reset Value (MSW)	RW	0..65535	0	B6
562	Frequency Input 1 Count (LSW)	RO	0..65535	0	B6

Tag	Parameter Name	Access	Range	Preset	Block
563	Frequency Input 1 Count (MSW)	RO	0..65535	0	B6
564	Frequency Input 1 Divisor	RW	1..65535	1	B6
565	Analog Output 1 Polarity	ICR	Unipolar..Bipolar	Unipolar	E1
566	Analog Output 2 Polarity	ICR	Unipolar..Bipolar	Unipolar	E2
567	Freq/Digital Output 1 100% Level	RW	0..10000Hz	5000Hz	D3
568	Freq/Digital Output 2 100% Level	RW	0..10000Hz	5000Hz	D4
569	Freq/Digital Output 2 Gain	RW	-327.68..327.67%	100.00%	D4
570	Freq/Digital Output 2 Bias	RW	-327.68..327.67%	100.00%	D4
571	Com D Clear Counters	RW	Off..On	Off	R4
572	Com D Bus Message Count	RO	0..65535	0	R4
573	Com D Bus Com Error Count	RO	0..65535	0	R4
574	Com D Bus Exception Error Count	RO	0..65535	0	R4
575	Com D Bus Device Message Count	RO	0..65535	0	R4
576	Com D Bus Device No Response Count	RO	0..65535	0	R4
577	Com D Bus Break Detected Count	RO	0..65535	0	R4
578	Com D Bus Framing Error Count	RO	0..65535	0	R4
579	Com D Bus Overrun Error Count	RO	0..65535	0	R4
580	Com D Bus Parity Error Count	RO	0..65535	0	R4
581	Com A Parity	RW	None, Odd, Even	None	R1
582	Com A Stop Bits	RW	1..2	2	R1
583	Com A Apply	RW	Off..On	Off	R1
584	Com A Clear Counters	RW	Off..On	Off	R1
585	Com A Bus Message Count	RO	0..65535	0	R1
586	Com A Bus Com Error Count	RO	0..65535	0	R1
587	Com A Bus Exception Error Count	RO	0..65535	0	R1
588	Com A Device Message Count	RO	0..65535	0	R1
589	Com A Device No Response Count	RO	0..65535	0	R1
590	Com A Break Detected Count	RO	0..65535	0	R1
591	Com A Framing Error Count	RO	0..65535	0	R1
592	Com A Overrun Error Count	RO	0..65535	0	R1
593	Com A Parity Error Count	RO	0..65535	0	R1
594	Com C Ignore Address	RW	Off..On	Off	R3
595	Com C Apply	RW	Off..On	Off	R3
596	Com C Clear Counters	RW	Off..On	Off	R3
597	Com C Bus Message Count	RO	0..65535	0	R3
598	Com C Bus Com Error Count	RO	0..65535	0	R3
599	Com C Bus Exception Error Count	RO	0..65535	0	R3
600	Com C Device Message Count	RO	0..65535	0	R3
601	Com C Device No Response Count	RO	0..65535	0	R3
602	Com C Break Detected Count	RO	0..65535	0	R3
603	Com C Framing Error Count	RO	0..65535	0	R3
604	Com C Overrun Error Count	RO	0..65535	0	R3
605	Com C Parity Error Count	RO	0..65535	0	R3
606	Port ID	RO	0=USB, 1=422, 2=485, 3=ETH	-	R
607	Com B Enable	RW	Disabled..Enabled	Enabled	R2
608	Static IP Address 1	RW	0..255	192	R2
609	Static IP Address 2	RW	0..255	168	R2
610	Static IP Address 3	RW	0..255	0	R2
611	Static IP Address 4	RW	0..255	181	R2
612	Static Subnet 1	RW	0..255	255	R2
613	Static Subnet 2	RW	0..255	255	R2
614	Static Subnet 3	RW	0..255	255	R2
615	Static Subnet 4	RW	0..255	0	R2
616	Static Gateway 1	RW	0..255	192	R2
617	Static Gateway 2	RW	0..255	168	R2
618	Static Gateway 3	RW	0..255	0	R2
619	Static Gateway 4	RW	0..255	1	R2
620	IP Address Mode	RW	Static..DHCP	DHCP	R2
621	Modbus TCP Port	RW	0..65535	502	R2
622	HTTP Port	RW	0..65535	80	R2
623	MAC 1	RO	0..255	0	R2
624	MAC 2	RO	0..255	0	R2
625	MAC 3	RO	0..255	0	R2
626	MAC 4	RO	0..255	0	R2

Tag	Parameter Name	Access	Range	Preset	Block
627	MAC 5	RO	0..255	0	R2
628	MAC 6	RO	0..255	0	R2
629	DHCP Status	RO	0..255	0	R2
630	Link Status	RO	Off..On	Off	R2
631	IP Address 1	RO	0..255	0	R2
632	IP Address 2	RO	0..255	0	R2
633	IP Address 3	RO	0..255	0	R2
634	IP Address 4	RO	0..255	0	R2
635	Subnet 1	RO	0..255	0	R2
636	Subnet 2	RO	0..255	0	R2
637	Subnet 3	RO	0..255	0	R2
638	Subnet 4	RO	0..255	0	R2
639	Gateway 1	RO	0..255	0	R2
640	Gateway 2	RO	0..255	0	R2
641	Gateway 3	RO	0..255	0	R2
642	Gateway 4	RO	0..255	0	R2
643	Ethernet Hardware Fault	RO	Off..On	Off	R2
644	Chip Version	RO	0..255	0	R2
645	Socket 0 Status	RO	0..65535	0	R2
646	Socket 1 Status	RO	0..65535	0	R2
647	Socket 2 Status	RO	0..65535	0	R2
648	Socket 3 Status	RO	0..65535	0	R2
649	Socket 4 Status	RO	0..65535	0	R2
650	Socket 5 Status	RO	0..65535	0	R2
651	Socket 6 Status	RO	0..65535	0	R2
652	Socket 7 Status	RO	0..65535	0	R2
653	Com B Apply	RW	Off..On	Off	R2
654	Start/Stop Logic Enable	RW	Disabled..Enabled	Disabled	H1
655	Logic Select	ICR	Momentary..Maintained	Maintained	H1
656	Run Command	RW	Off..On	Off	H1
657	Stop Command	RW	Off..On	Off	H1
658	Zero Speed Level	RW	0..327.67%	2.00%	H1
659	Speed Feedback	RW	-327.68..327.67%	0.00%	H1
660	Reference	RW	-327.68..327.67%	0.00%	H1
661	Run Status	RO	Off..On	Off	H1
662	Reference Enable	RO	Disabled..Enabled	Disabled	H1
663	Reference Output	RO	-327.68..327.67%	0.00%	H1
664 - 699	Reserved	-	-	-	-
700	EEPROM Hardware Fault	RO	Off..On	Off	K1
701	EEPROM Read Fault	RO	Off..On	Off	K1
702	EEPROM Write Fault	RO	Off..On	Off	K1
703	Save	RW	Off..On	Off	T1
704	Save Status	RO	0..65535	0	T1
705	Fault Code	RO	0..65535	0	K1
706	Fault Reset	RW	Off..On	Off	K1
707	SW2-1 Status	RO	Off..On	Off	T1
708	SW2-2 Status	RO	Off..On	Off	T1
709	SW2-3 Status	RO	Off..On	Off	T1
710	SW2-4 Status	RO	Off..On	Off	T1
711	Timer 1 Switch Status	RO	Off..On	Off	N1
712	Timer 2 Switch Status	RO	Off..On	Off	N2
713	Timer 3 Switch Status	RO	Off..On	Off	N3
714	Timer 4 Switch Status	RO	Off..On	Off	N4
715	Internal Link 21 Source	ICR	0..751	0	Q3
716	Internal Link 21 Destination	ICR	0..751	0	Q3
717	Internal Link 22 Source	ICR	0..751	0	Q3
718	Internal Link 22 Destination	ICR	0..751	0	Q3
719	Internal Link 23 Source	ICR	0..751	0	Q3
720	Internal Link 23 Destination	ICR	0..751	0	Q3
721	Internal Link 24 Source	ICR	0..751	0	Q3
722	Internal Link 24 Destination	ICR	0..751	0	Q3
723	Internal Link 25 Source	ICR	0..751	0	Q3

Tag	Parameter Name	Access	Range	Preset	Block
724	Internal Link 25 Destination	ICR	0..751	0	Q3
725	Internal Link 26 Source	ICR	0..751	0	Q3
726	Internal Link 26 Destination	ICR	0..751	0	Q3
727	Internal Link 27 Source	ICR	0..751	0	Q3
728	Internal Link 27 Destination	ICR	0..751	0	Q3
729	Internal Link 28 Source	ICR	0..751	0	Q3
730	Internal Link 28 Destination	ICR	0..751	0	Q3
731	Internal Link 29 Source	ICR	0..751	0	Q3
732	Internal Link 29 Destination	ICR	0..751	0	Q3
733	Internal Link 30 Source	ICR	0..751	0	Q3
734	Internal Link 30 Destination	ICR	0..751	0	Q3
735	Initialize	RW	0..65535	0	A1
736	Threshold 1 Status	RO	Off..On	Off	M1
737	Threshold 2 Status	RO	Off..On	Off	M2
738	Threshold 3 Status	RO	Off..On	Off	M3
739	Threshold 4 Status	RO	Off..On	Off	M4
740	Freq/Digital Output 2 Inverse Clock	ICR	Off..On	Off	D4
741	PID1 Max Output	RW	0..100.00%	100.00%	L6
742	PID1 Min Output	RW	-100.00..0.00%	-100.00%	L6
743	PID1 Control Action	ICR	ERR=SP-FB, ERR=FB-SP	ERR=SP-FB	L6
744	PID1 Initial Output	RO	-327.68..327.67%	0.00%	L6
745	PID1 Trim Output	RO	-327.68..327.67%	0.00%	L6
746	PID2 Max Output	RW	0..100.00%	100.00%	L7
747	PID2 Min Output	RW	-100.00..0.00%	-100.00%	L7
748	PID2 Control Action	ICR	ERR=SP-FB, ERR=FB-SP	ERR=SP-FB	L7
749	PID2 Initial Output	RO	-327.68..327.67%	100.00%	L7
750	PID2 Trim Output	RO	-327.68..327.67%	-100.00%	L7
751	Controller Mode	RW	Program..Run	Program	A1
752	Application Preset	RW	0..65535	0	A1

7 Application Builder

7.1 Application Builder

The purpose of the Application Builder is to allow configuration of the Cortex® LT by answering a series of questions and making choices based on these answers. This will allow the first-time user to set up the LT for sophisticated applications. The unit can then be used as it is or manually customized further.

Some of the applications the Builder can handle are:

- Basic PID Control
- Center Winder, both Velocity and Torque modes
- Center Unwinder, both Driven and Brake modes
- Velocity controlled Surface Drive
- Level Control
- Turret Winder in Velocity mode

On some screens, the Application Builder will allow you to step back to change a previous selection. If the “Back” button is enabled, then this is the case. If the Back button is disabled, and you realize you have made a selection on a previous screen incorrectly, you must cancel the Application Builder and start over.

When the builder has collected all of the information, it will display a summary of the results. Within this summary, is an Application Preset. This value determines which of the pre-defined application templates that will be used. Refer to the corresponding page of D14566 (Application Presets) starting on page 106. For example, Application Preset 4 is on page 4 of D14566. Also, please refer to Table 10 and Table 11 below. The Application Preset can be determined by the type of diameter compensation and the type of sensor.

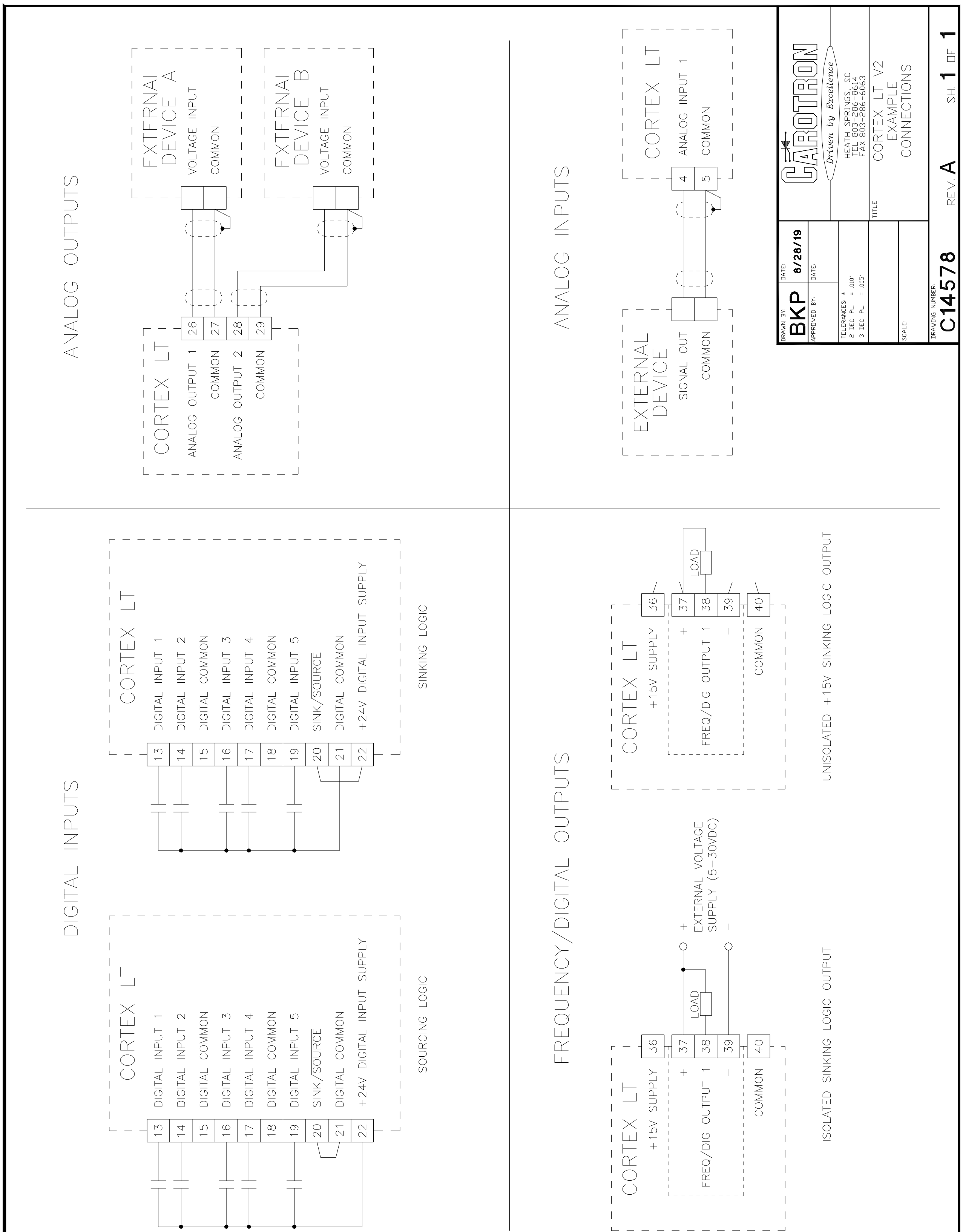
Diameter Method	Sensor		
	None	Dancer	Loadcell
None	-	1	2
External	3	4	5
Roll Revolutions	6	7	8
Line Revolutions	9	10	11
Line/Roll Speed	-	-	-

Table 10: Application Presets (Velocity Mode)

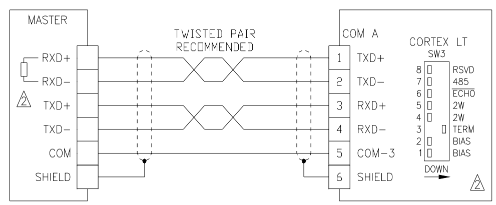
Diameter Method	Sensor		
	None	Dancer	Loadcell
None	-	-	12
External	13	-	14
Roll Revolutions	15	-	16
Line Revolutions	17	-	18
Line/Roll Speed	19	-	20

Table 11: Application Presets (Torque Mode)

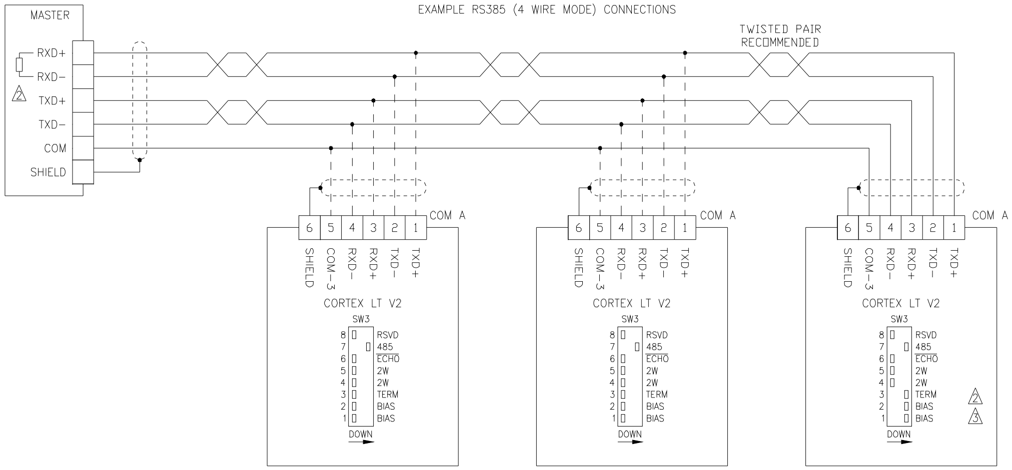
The settings and choices you make as you go through the Application Builder are held until you complete the process and click “Finish”. If you are online, this is when the settings are transferred to the Cortex® LT. If you are offline, the parameter file may be saved just as you would any other parameter file, then downloaded to a Cortex® LT later.


ANALOG OUTPUTS
EXTERNAL DEVICE A
VOLTAGE INPUT
COMMON
EXTERNAL DEVICE B
VOLTAGE INPUT
COMMON
CORTEX LT
ANALOG OUTPUT 1
COMMON
ANALOG OUTPUT 2
COMMON
ANALOG INPUTS
CORTEX LT
ANALOG INPUT 1
COMMON
EXTERNAL DEVICE
SIGNAL OUT
COMMON
DIGITAL INPUTS
CORTEX LT
DIGITAL INPUT 1
DIGITAL INPUT 2
DIGITAL COMMON
DIGITAL INPUT 3
DIGITAL INPUT 4
DIGITAL COMMON
DIGITAL INPUT 5
SINK/SOURCE
DIGITAL COMMON
+24V DIGITAL INPUT SUPPLY
SOURCING LOGIC
SINKING LOGIC
FREQUENCY/DIGITAL OUTPUTS
CORTEX LT
+15V SUPPLY
FREQ/DIG OUTPUT 1
COMMON
LOAD
EXTERNAL VOLTAGE SUPPLY (5-30VDC)
ISOLATED SINKING LOGIC OUTPUT
UNISOLATED +15V SINKING LOGIC OUTPUT
CAROTRON
Driven by Excellence
HEATH SPRINGS, SC
TEL 803-286-8614
FAX 803-286-6063
TITLE: CORTEX LT V2 EXAMPLE CONNECTIONS
DRAWN BY: BKP
DATE: 8/28/19
APPROVED BY:
DATE:
SCALE:
DRAWING NUMBER: C14578
REV. A
SH. 1 OF 1

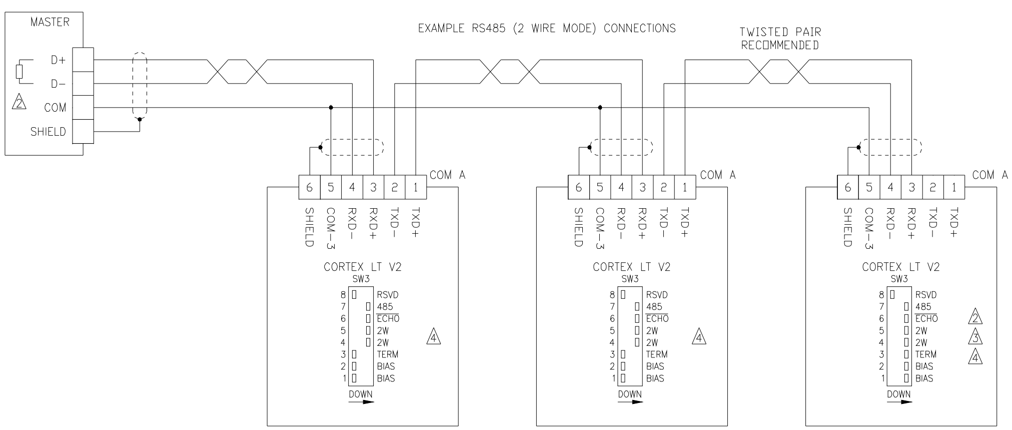
EXAMPLE RS422 CONNECTIONS



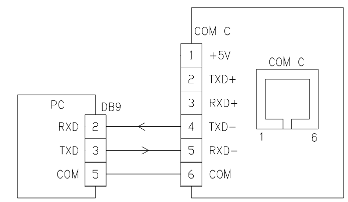
EXAMPLE RS385 (4 WIRE MODE) CONNECTIONS



EXAMPLE RS485 (2 WIRE MODE) CONNECTIONS



EXAMPLE PC TO COM C CONNECTIONS



NOTES:

1. MAXIMUM TOTAL NETWORK LENGTH: 4000 FEET.

2. DEVICE AT END OF NETWORK SHOULD HAVE ITS TERMINATING RESISTOR SWITCHED IN (POSITION 3) WHEN OPERATING AT BAUD RATES ABOVE 9600.

3. IN 4 WIRE MODE, FAIL-SAFE BIASING MAY BE REQUIRED ON EACH PAIR OF COMMUNICATION LINES. WHEN CLOSED, POSITIONS 1 & 2 ON THE CORTEX LT PROVIDE BIASING ON THE (LT) RXD LINE PAIR. EXTERNAL BIASING ON THE OTHER PAIR MAY BE REQUIRED. REFER TO MASTER DOCUMENTATION FOR MORE INFORMATION.

   IN 2 WIRE MODE, FAIL-SAFE BIASING MAY BE REQUIRED BY AT LEAST ONE DEVICE ON THE NETWORK. IF MASTER DOES NOT PROVIDE BIASING, CLOSE POSITIONS 1 & 2 ON DIP SWITCH 2 ON ONLY ONE CORTEX LT UNIT.

4. IN 2 WIRE MODE, CLOSE POSITIONS 4 & 5. THIS INTERNALLY CONNECTS TXD+ TO RXD+ AND TXD− TO RXD−.

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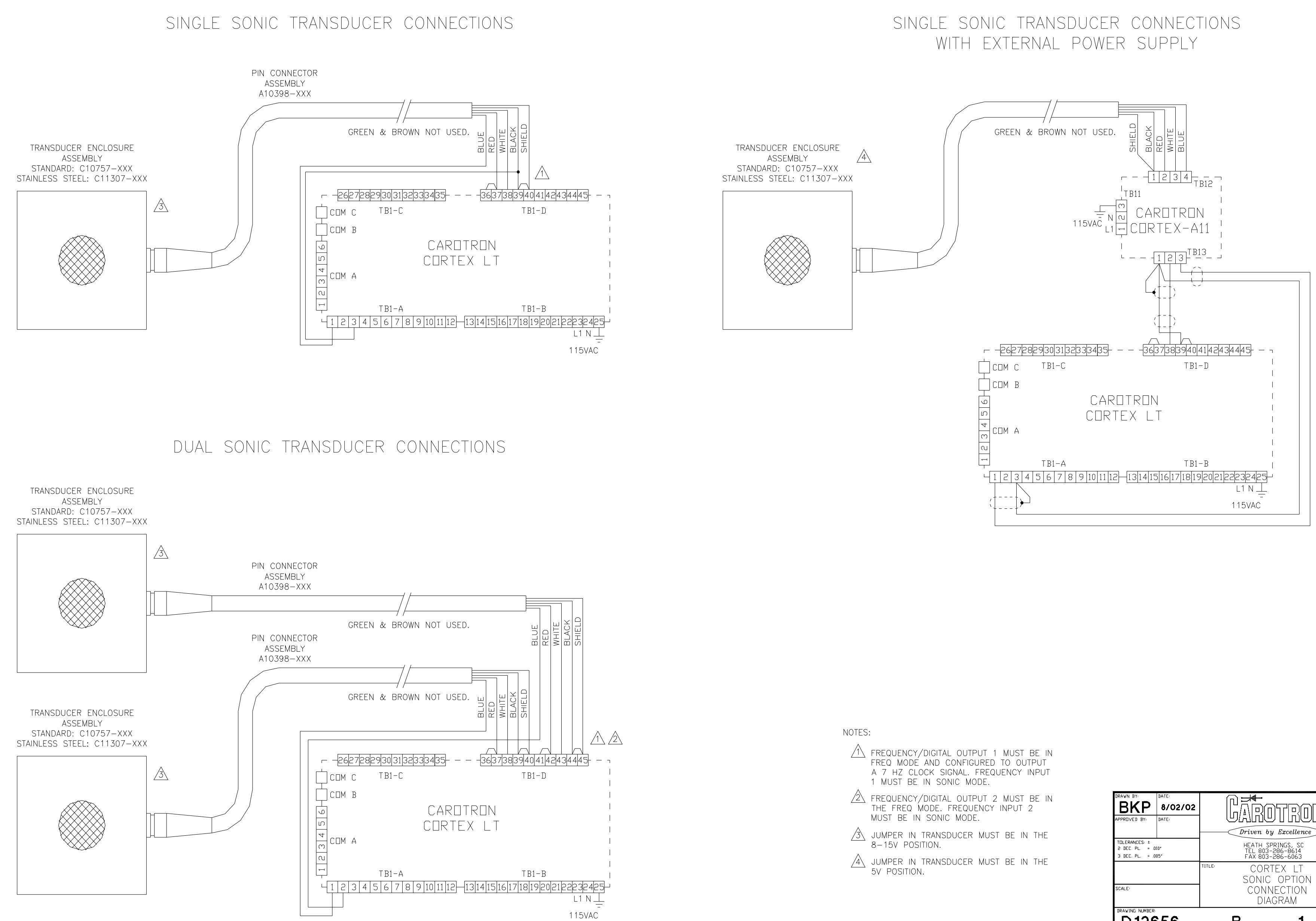
APPROVED BY:	DATE:	Driven by Excellence HEATH SPRINGS, SC TEL 803-286-8614 FAX 803-286-6063
TOLERANCES ± 2 DEC PL. = .010" 3 DEC PL. = .005"		TITLE: CORTEX LT V2 MODBUS NETWORK CONNECTIONS
SCALE:		
DRAWING NUMBER: D14579	REV. A	SH. 1 OF 1



NOTES:

1. FREQUENCY/DIGITAL OUTPUT 1 MUST BE IN FREQ MODE AND CONFIGURED TO OUTPUT A 7 HZ CLOCK SIGNAL. FREQUENCY INPUT 1 MUST BE IN SONIC MODE.
2. FREQUENCY/DIGITAL OUTPUT 2 MUST BE IN THE FREQ MODE. FREQUENCY INPUT 2 MUST BE IN SONIC MODE.
3. JUMPER IN TRANSDUCER MUST BE IN THE 8-15V POSITION.
4. JUMPER IN TRANSDUCER MUST BE IN THE 5V POSITION.

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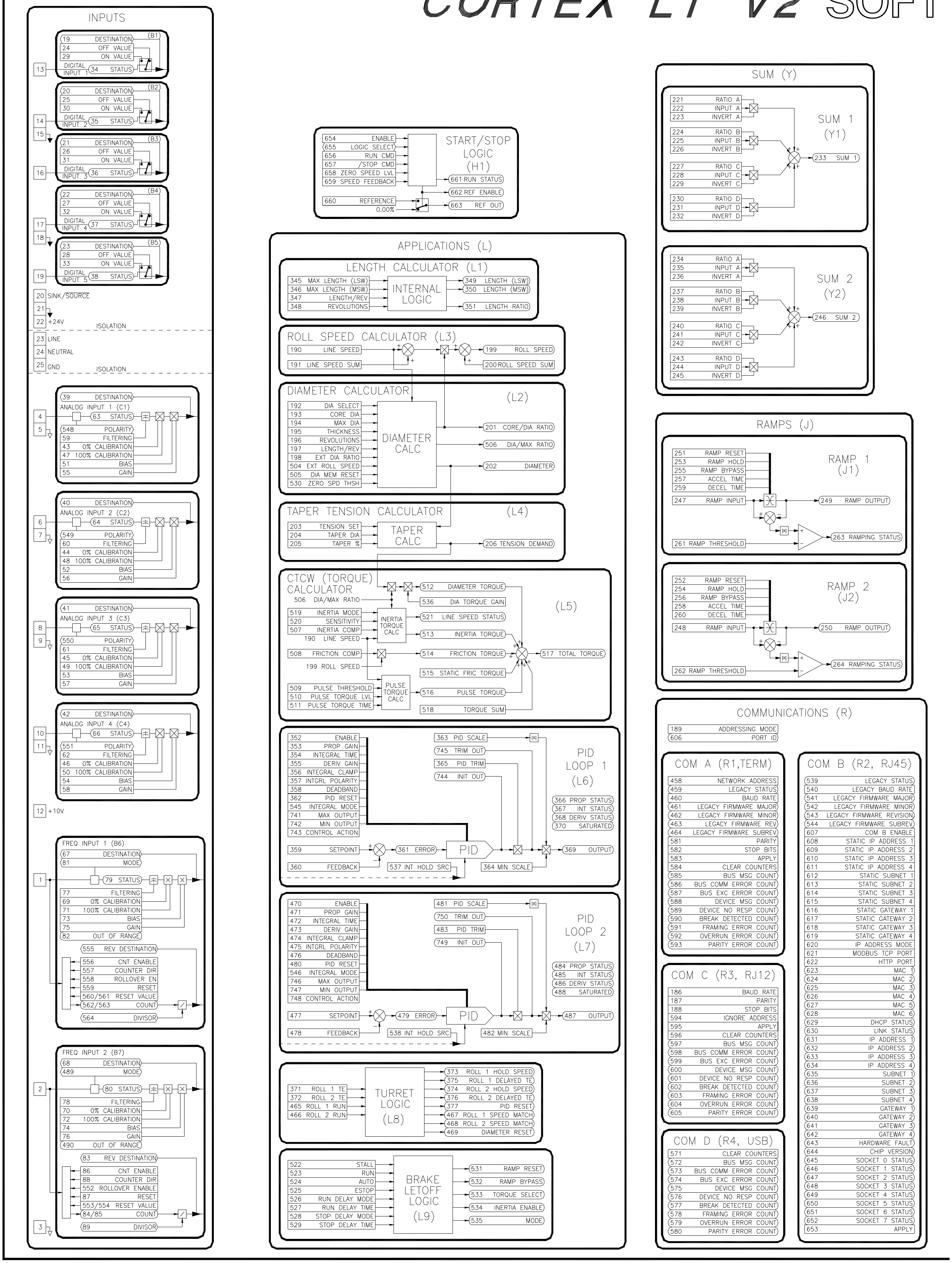
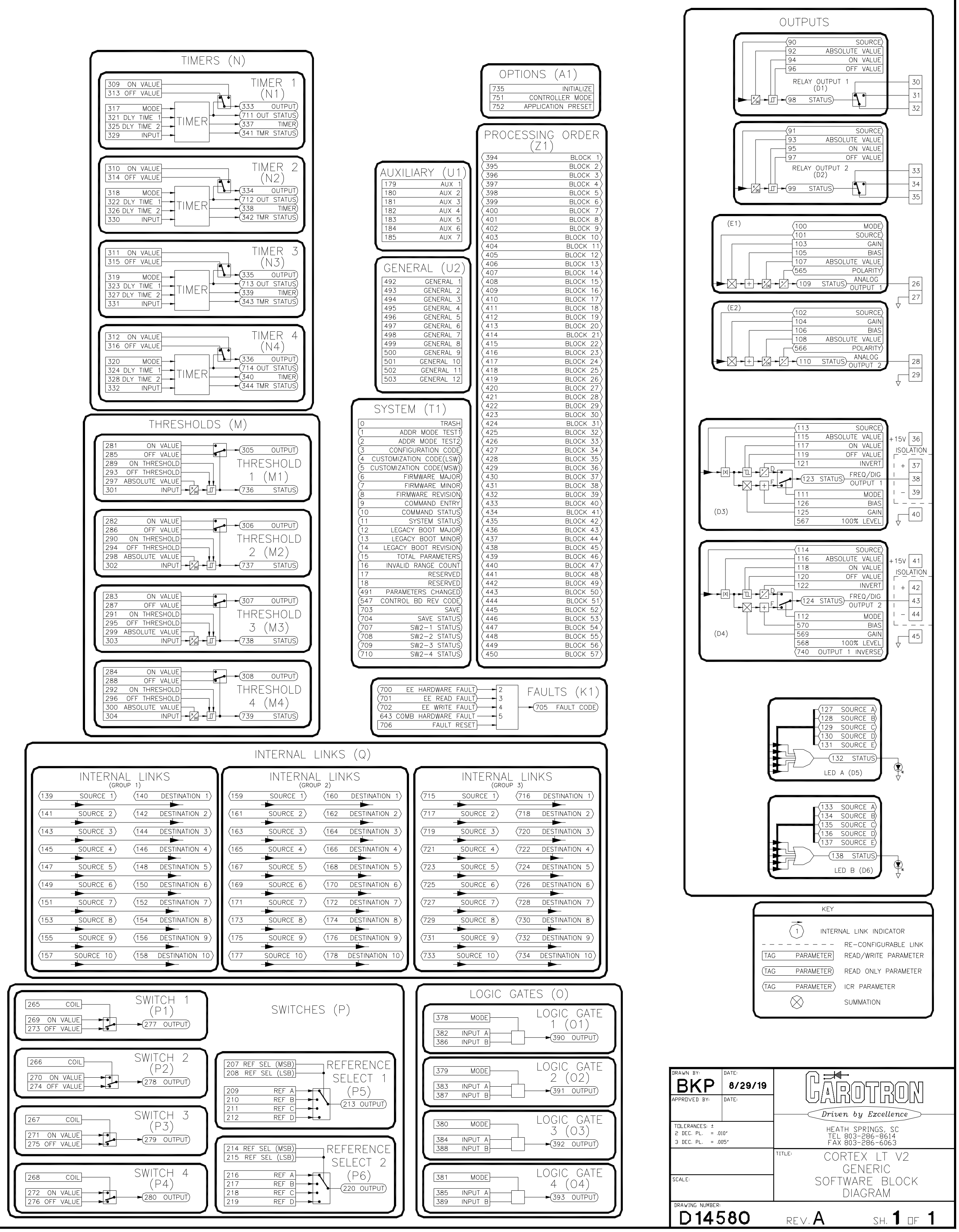
APPROVED BY:	DATE:
TOLERANCES: ± 2 DEC. PL. = .010" 3 DEC. PL. = .005"	CAROTRON Driven by Excellence HEATH SPRINGS, SC TEL 803-286-8614 FAX 803-286-6063
SCALE:	TITLE: CORTEX LT SONIC OPTION CONNECTION DIAGRAM
DRAWING NUMBER: D12656	REV. B SH. 1 OF 1

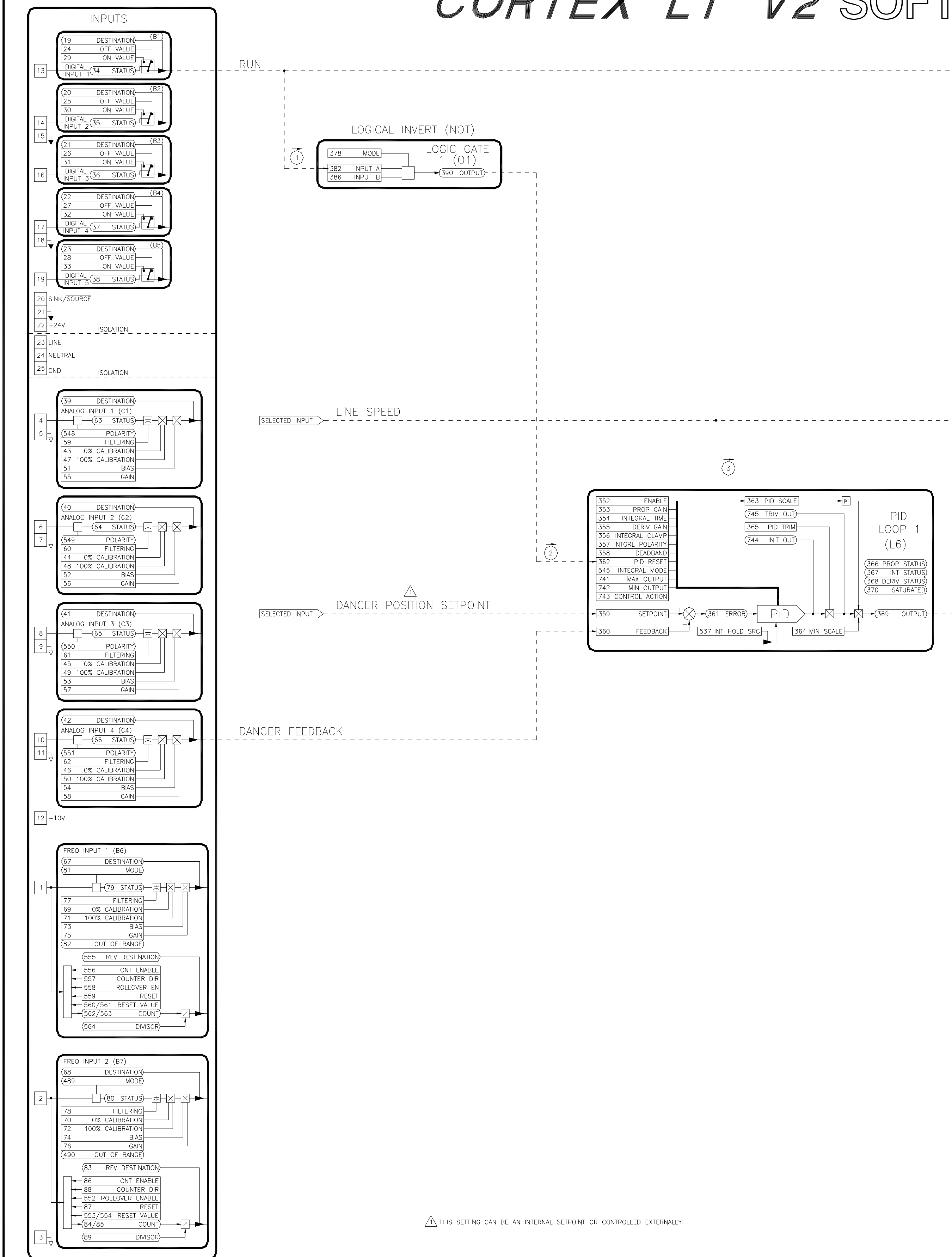
CORTEX LT V2 SOFT



WARE BLOCK DIAGRAM

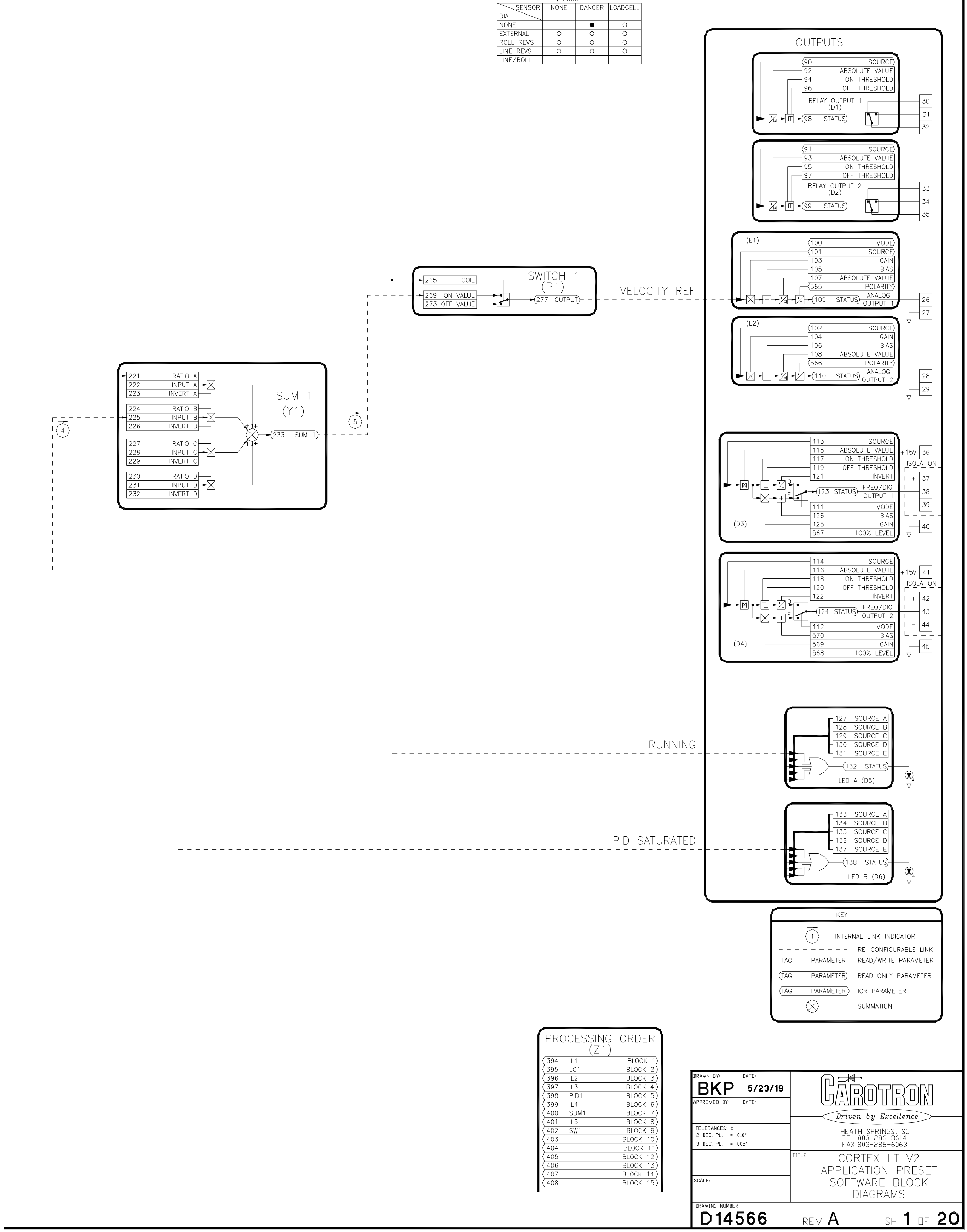


CORTEX LT V2 SOFT

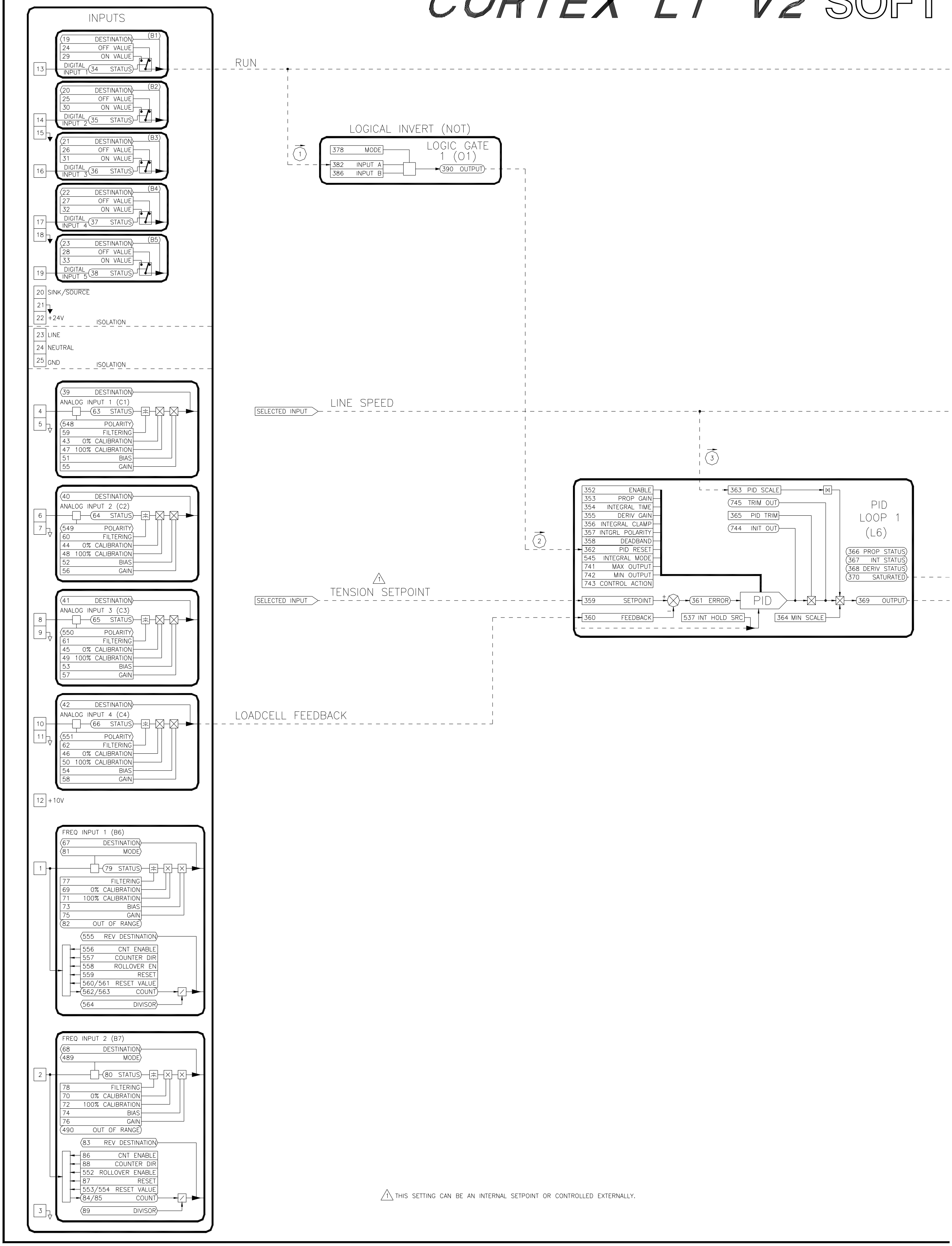


WARE BLOCK DIAGRAM

VELOCITY SENSOR / DIA	NONE	DANCER	LOADCELL
NONE		●	○
EXTERNAL	○	○	○
ROLL REVS	○	○	○
LINE REVS	○	○	○
LINE/ROLL			

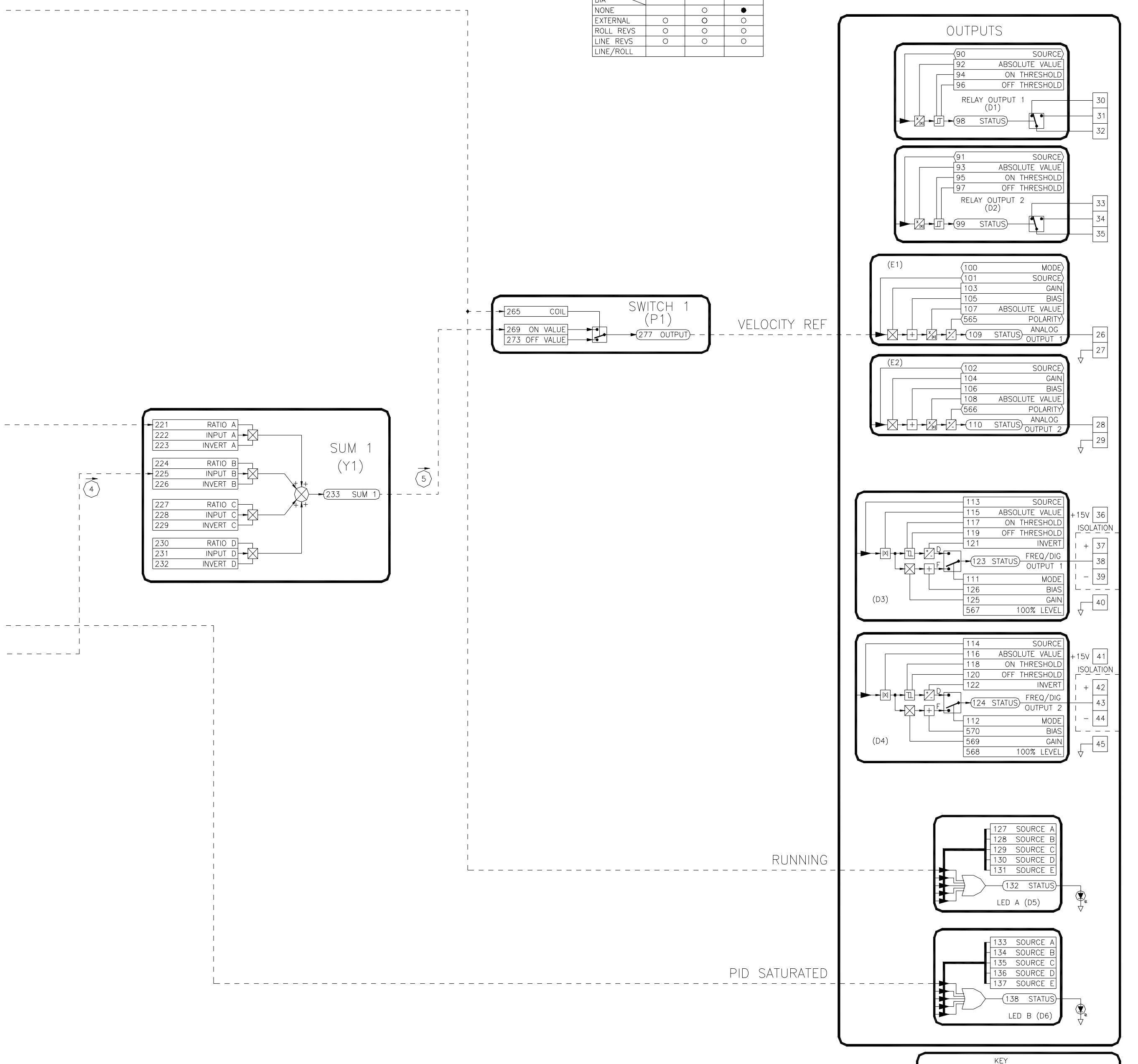


CORTEX LT V2 SOFT



WARE BLOCK DIAGRAM

SENSOR / DIA	VELOCITY NONE	DANCER	LOADCELL
NONE		○	●
EXTERNAL	○	○	○
ROLL REVS	○	○	○
LINE REVS	○	○	○
LINE/ROLL			



KEY

(1)	INTERNAL LINK INDICATOR
- - - - - - -	RE-CONFIGURABLE LINK
TAG PARAMETER	READ/WRITE PARAMETER
(TAG PARAMETER)	READ ONLY PARAMETER
(TAG PARAMETER)	ICR PARAMETER
⊗	SUMMATION

PROCESSING ORDER (Z1)

394	IL1	BLOCK 1
395	LG1	BLOCK 2
396	IL2	BLOCK 3
397	IL3	BLOCK 4
398	PID1	BLOCK 5
399	IL4	BLOCK 6
400	SUM1	BLOCK 7
401	IL5	BLOCK 8
402	SW1	BLOCK 9
403		BLOCK 10
404		BLOCK 11
405		BLOCK 12
406		BLOCK 13
407		BLOCK 14
408		BLOCK 15

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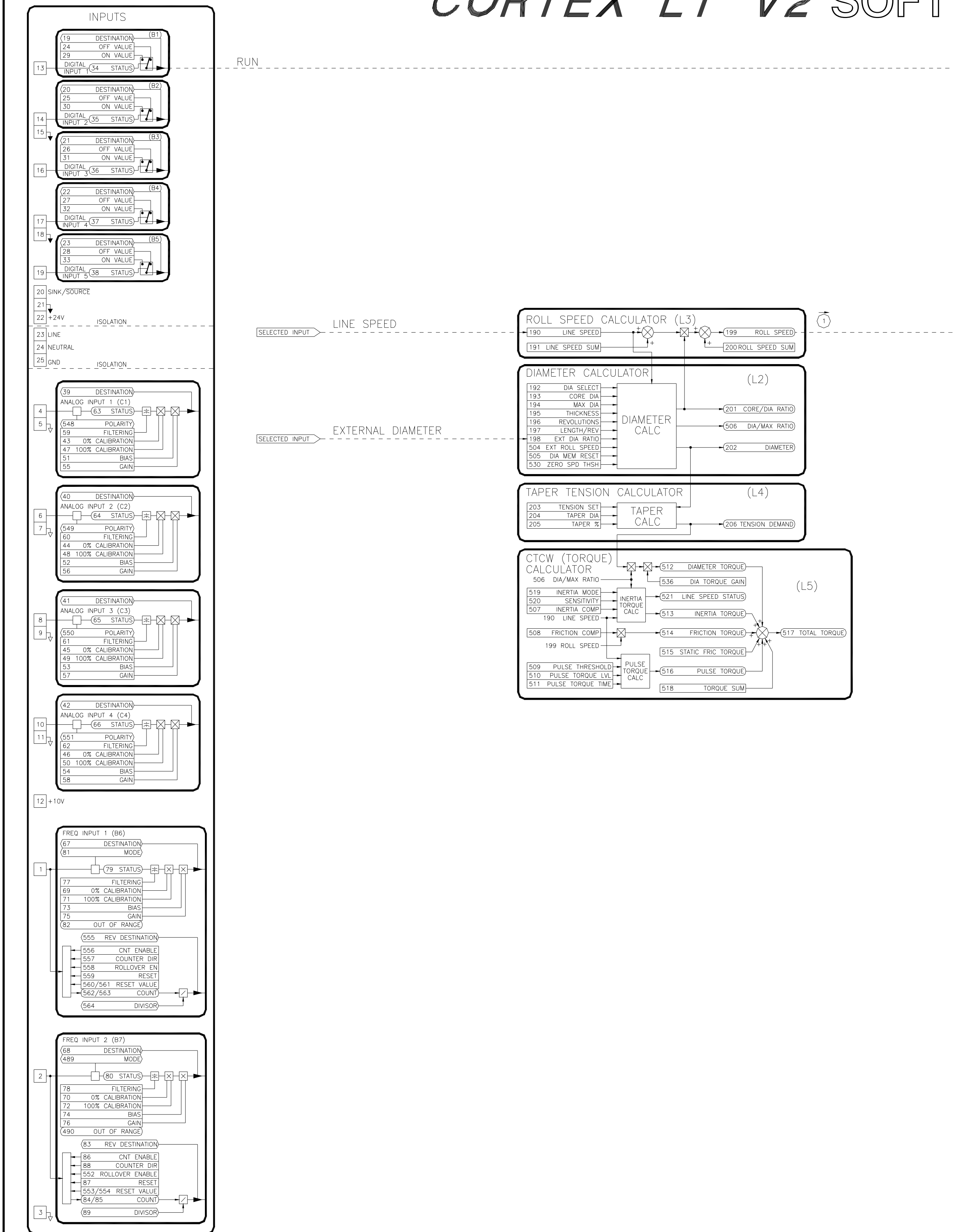
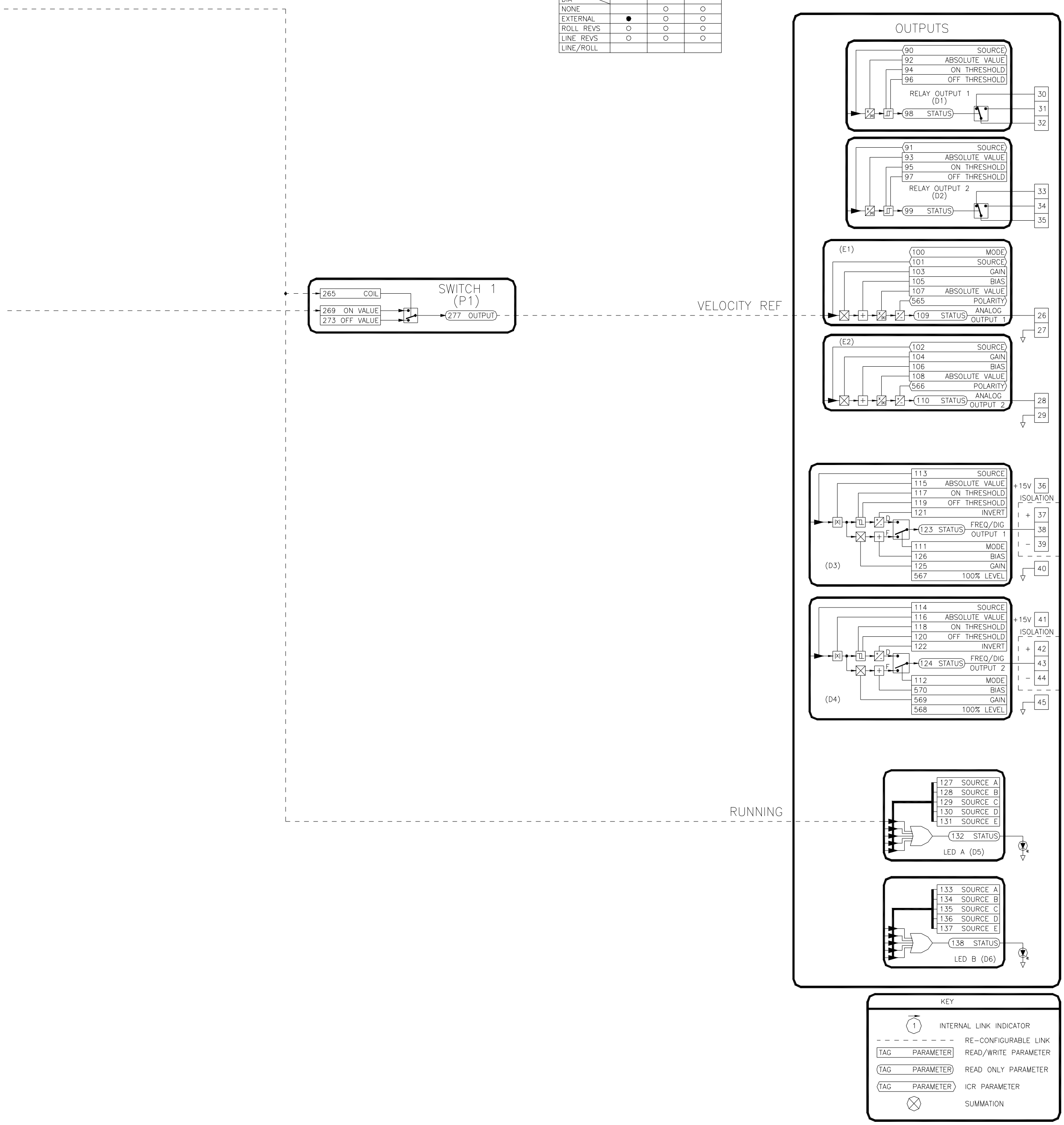
APPROVED BY:	DATE:	
TOLERANCES: ± 2 DEC. PL. = .010" 3 DEC. PL. = .005"		TITLE: CORTEX LT V2 APPLICATION PRESET SOFTWARE BLOCK DIAGRAMS
SCALE:		
DRAWING NUMBER: D14566	REV. A	SH. 2 OF 20

CORTEX LT V2 SOFT



WARE BLOCK DIAGRAM

VELOCITY			
SENSOR / DIA	NONE	DANCER	LOADCELL
NONE		○	○
EXTERNAL	●	○	○
ROLL REVS	○	○	○
LINE REVS	○	○	○
LINE/ROLL			



PROCESSING ORDER (Z1)

394	APP CALCS	BLOCK 1
395	IL1	BLOCK 2
396	SWI1	BLOCK 3
397		BLOCK 4
398		BLOCK 5
399		BLOCK 6
400		BLOCK 7
401		BLOCK 8
402		BLOCK 9
403		BLOCK 10
404		BLOCK 11
405		BLOCK 12
406		BLOCK 13
407		BLOCK 14
408		BLOCK 15

DRAWN BY: BKP DATE: 5/23/19
APPROVED BY: DATE:
TOLERANCES: ±
2 DEC PL. = .010"
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SCALE:

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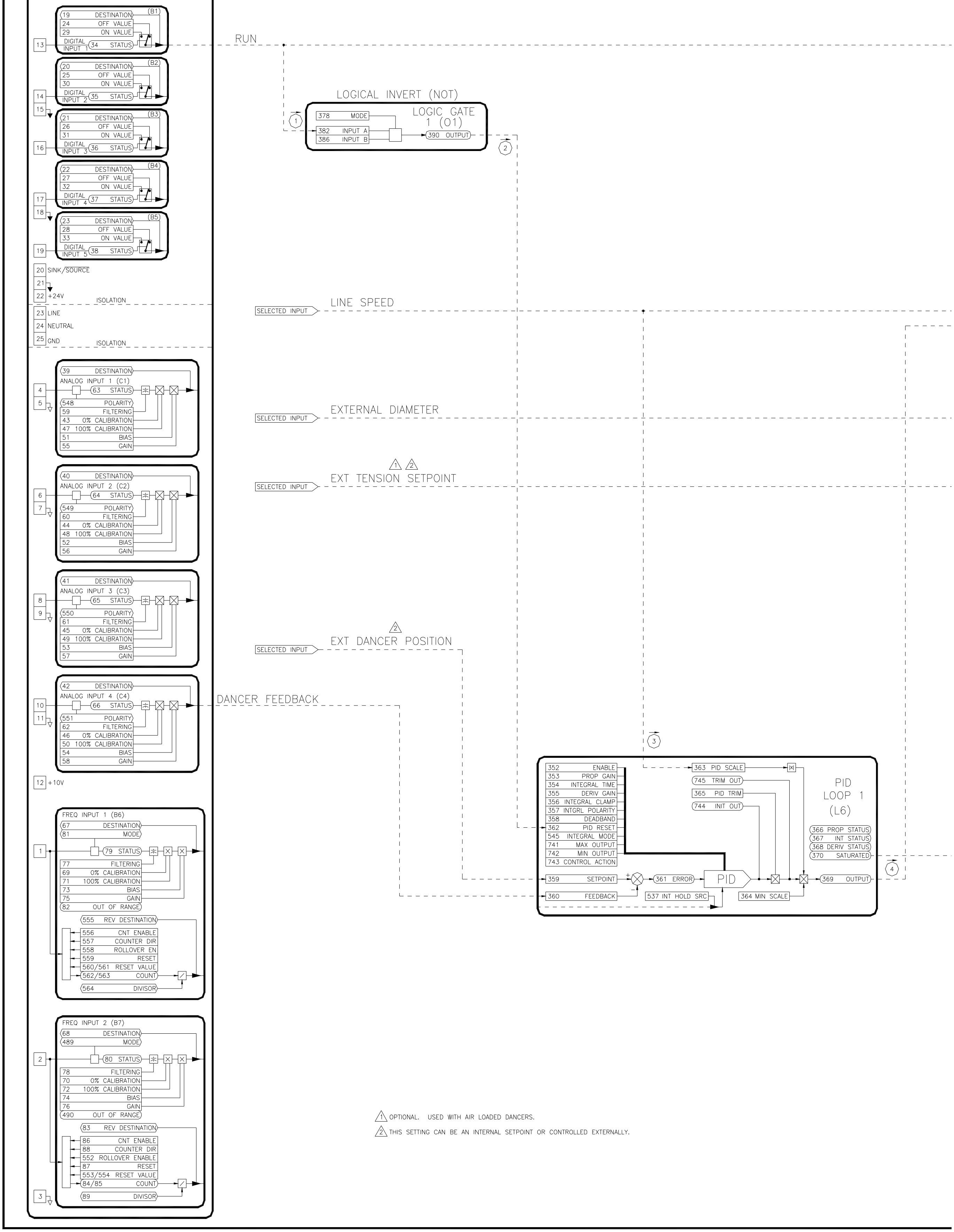
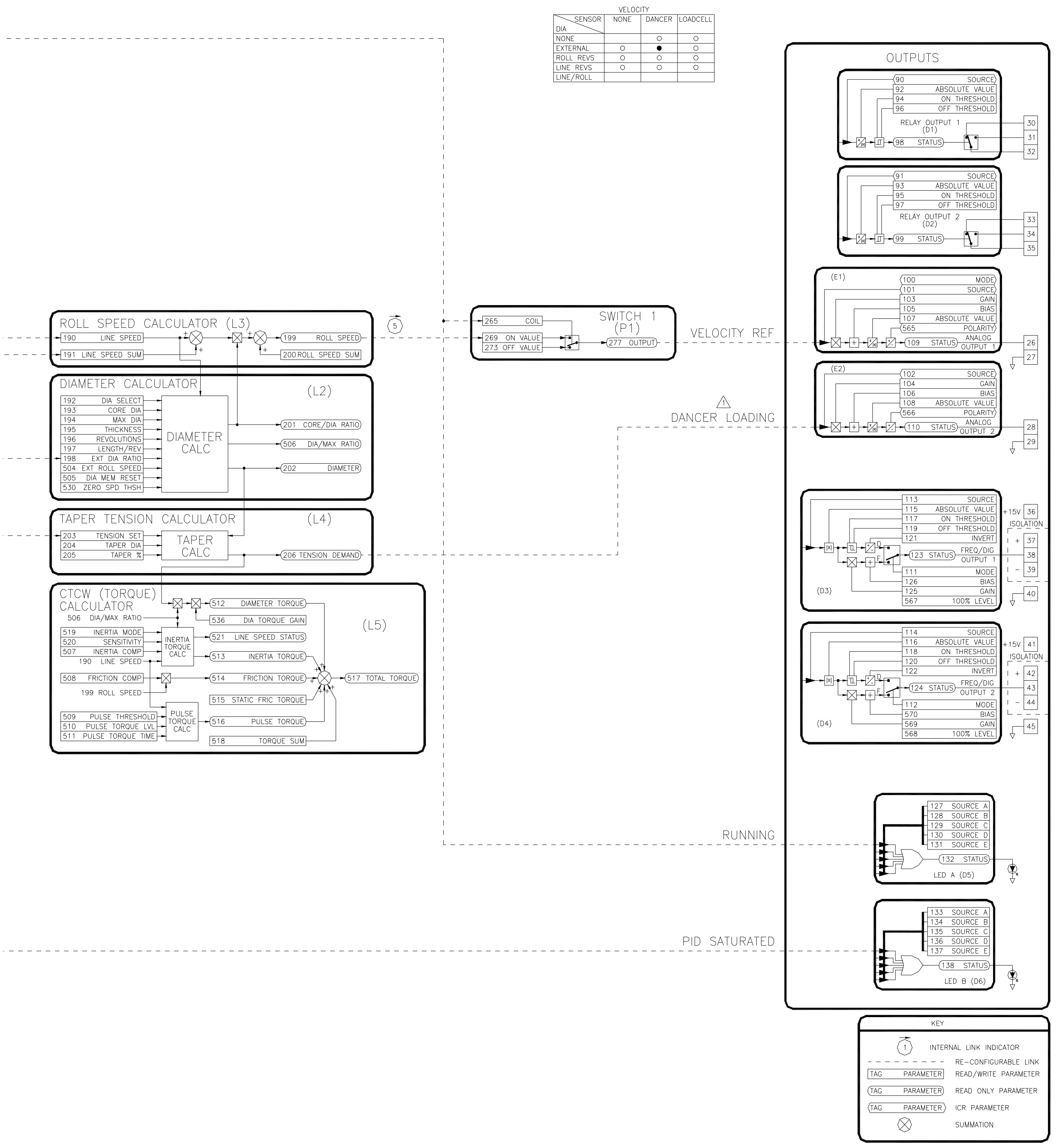
TITLE: CORTEX LT V2 APPLICATION PRESET SOFTWARE BLOCK DIAGRAMS

DRAWING NUMBER: D14566 REV. A SH. 3 OF 20

CORTEX LT V2 SOFT



WARE BLOCK DIAGRAM



PROCESSING ORDER (Z1)

394	IL1	BLOCK 1
395	LG1	BLOCK 2
396	IL2	BLOCK 3
397	IL3	BLOCK 4
398	PID1	BLOCK 5
399	IL4	BLOCK 6
400	APP CALCS	BLOCK 7
401	IL5	BLOCK 8
402	SWI1	BLOCK 9
403		BLOCK 10
404		BLOCK 11
405		BLOCK 12
406		BLOCK 13
407		BLOCK 14
408		BLOCK 15

DRAWN BY: BKP DATE: 5/23/19
APPROVED BY: DATE:
TOLERANCES: ±
2 DEC. PL. = .010"
3 DEC. PL. = .005"
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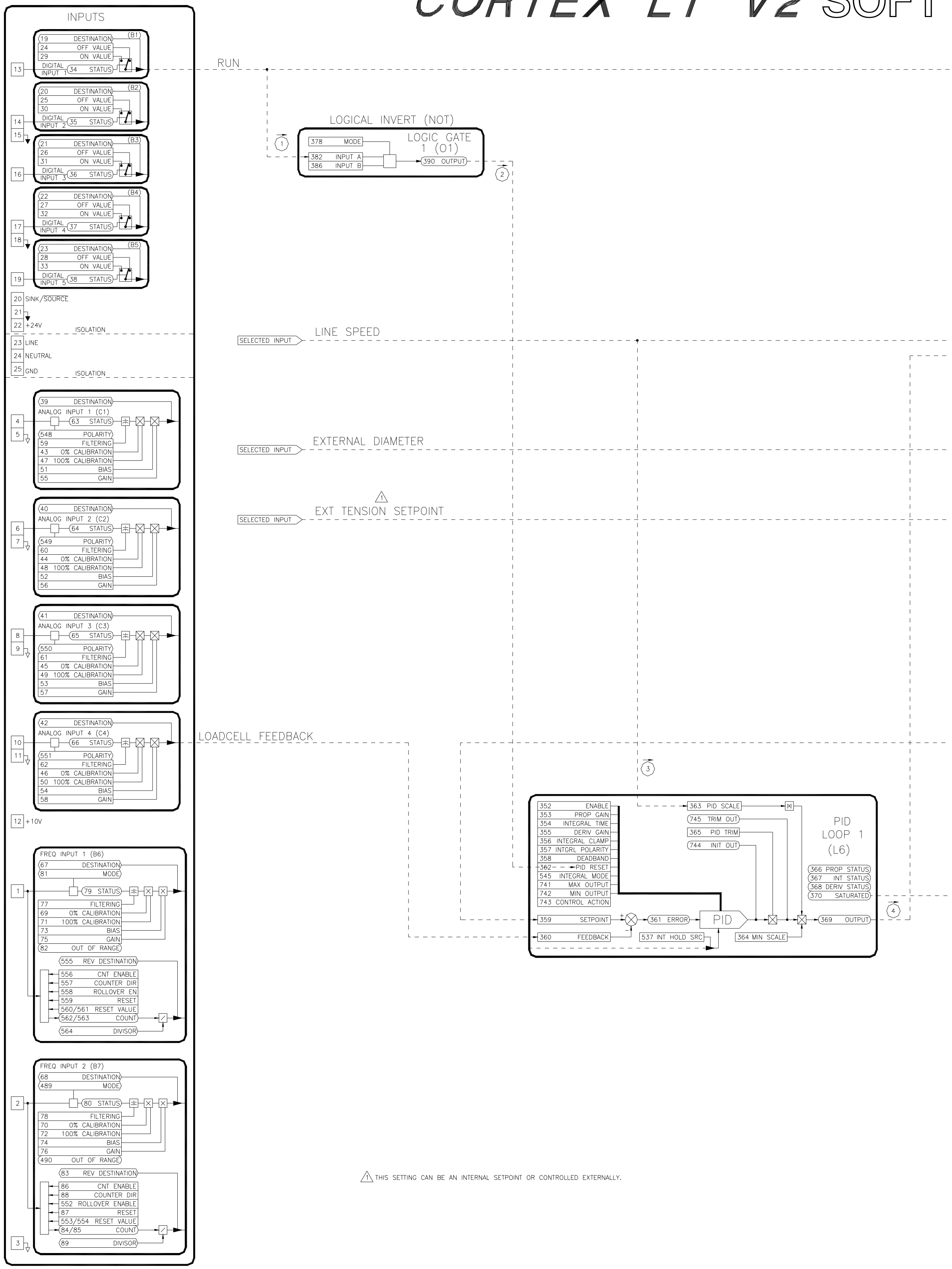
TITLE: CORTEX LT V2 APPLICATION PRESET SOFTWARE BLOCK DIAGRAMS

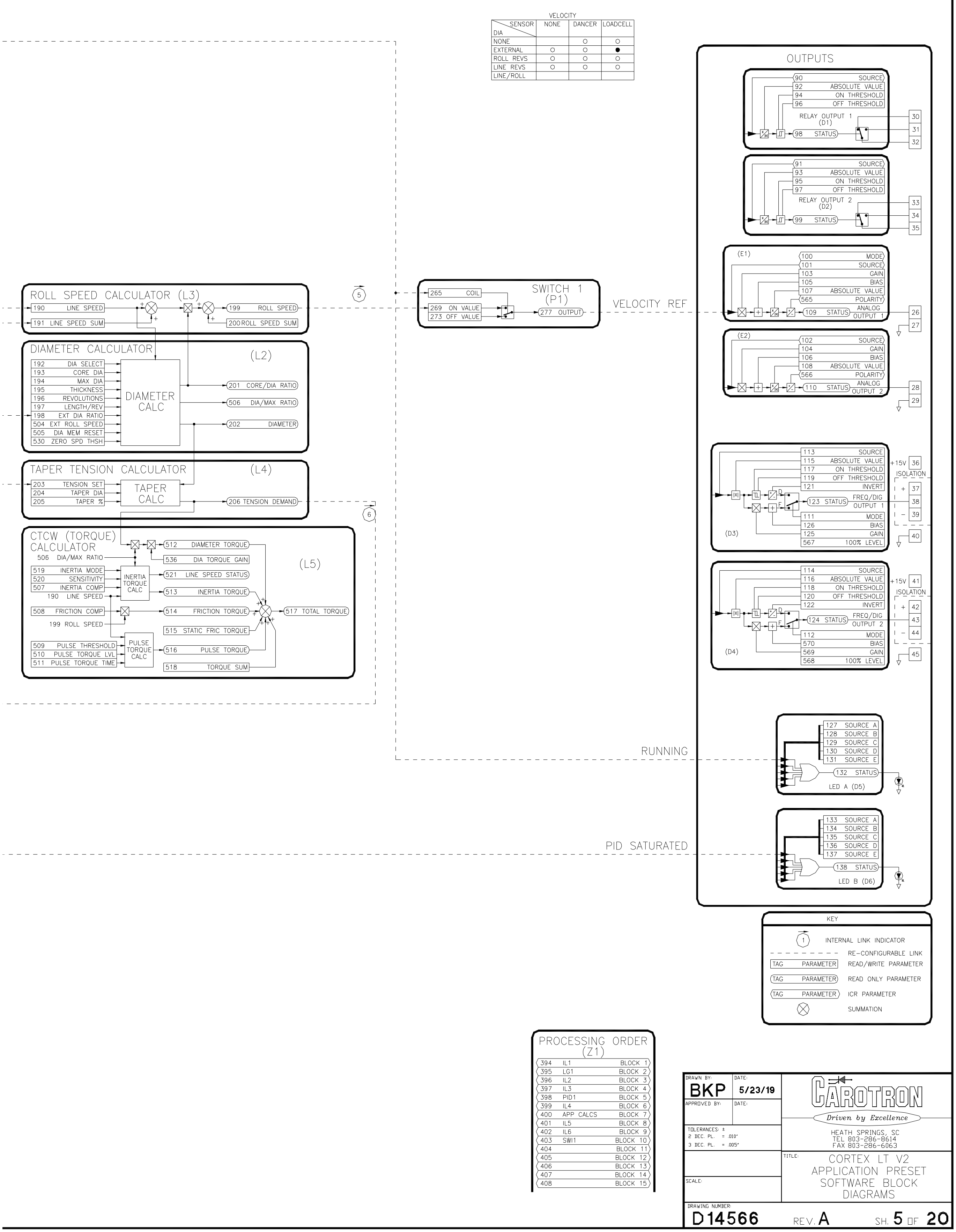
DRAWING NUMBER: D14566 REV. A SH. 4 OF 20

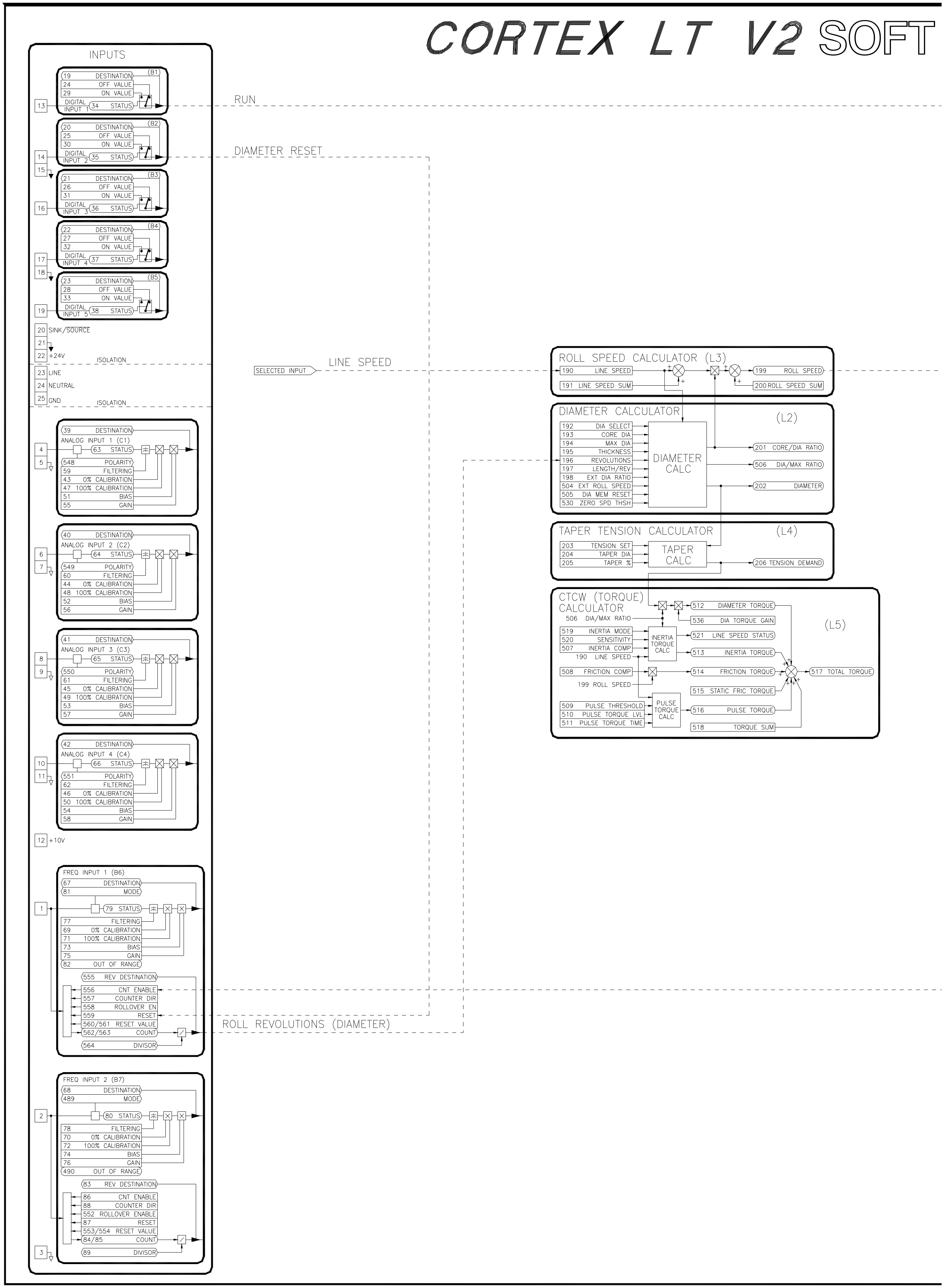
CORTEX LT V2 SOFT



⚠ THIS SETTING CAN BE AN INTERNAL SETPOINT OR CONTROLLED EXTERNALLY.

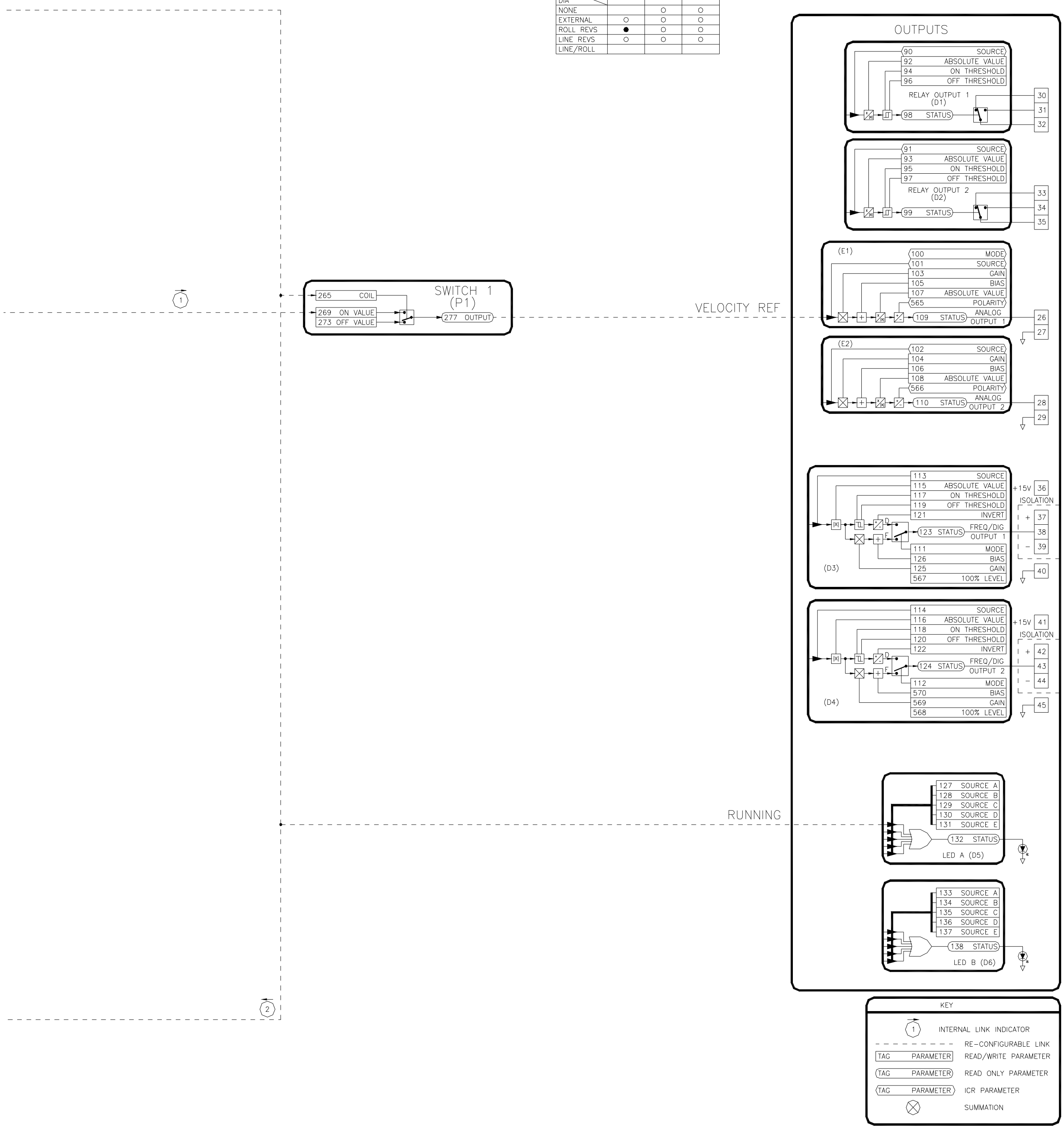
WARE BLOCK DIAGRAM




CORTEX LT V2 SOFT
INPUTS
DIGITAL INPUT 1
RUN
DIAMETER RESET
DIGITAL INPUT 2
DIGITAL INPUT 3
DIGITAL INPUT 4
DIGITAL INPUT 5
SINK/SOURCE
+24V
ISOLATION
LINE
NEUTRAL
GND
SELECTED INPUT
LINE SPEED
ANALOG INPUT 1 (C1)
ANALOG INPUT 2 (C2)
ANALOG INPUT 3 (C3)
ANALOG INPUT 4 (C4)
+10V
FREQ INPUT 1 (B6)
FREQ INPUT 2 (B7)
ROLL REVOLUTIONS (DIAMETER)
ROLL SPEED CALCULATOR (L3)
190 LINE SPEED
191 LINE SPEED SUM
199 ROLL SPEED
200 ROLL SPEED SUM
DIAMETER CALCULATOR (L2)
192 DIA SELECT
193 CORE DIA
194 MAX DIA
195 THICKNESS
196 REVOLUTIONS
197 LENGTH/REV
198 EXT DIA RATIO
504 EXT ROLL SPEED
505 DIA MEM RESET
530 ZERO SPD THSH
DIAMETER CALC
201 CORE/DIA RATIO
506 DIA/MAX RATIO
202 DIAMETER
TAPER TENSION CALCULATOR (L4)
203 TENSION SET
204 TAPER DIA
205 TAPER %
TAPER CALC
206 TENSION DEMAND
CTCW (TORQUE) CALCULATOR (L5)
506 DIA/MAX RATIO
519 INERTIA MODE
520 SENSITIVITY
507 INERTIA COMP
190 LINE SPEED
INERTIA TORQUE CALC
508 FRICTION COMP
199 ROLL SPEED
509 PULSE THRESHOLD
510 PULSE TORQUE LVL
511 PULSE TORQUE TIME
PULSE TORQUE CALC
512 DIAMETER TORQUE
536 DIA TORQUE GAIN
521 LINE SPEED STATUS
513 INERTIA TORQUE
514 FRICTION TORQUE
515 STATIC FRIC TORQUE
516 PULSE TORQUE
518 TORQUE SUM
517 TOTAL TORQUE

WARE BLOCK DIAGRAM

SENSOR / DIA	VELOCITY NONE	DANCER	LOADCELL
NONE		○	○
EXTERNAL	○	○	○
ROLL REVS	●	○	○
LINE REVS	○	○	○
LINE/ROLL			

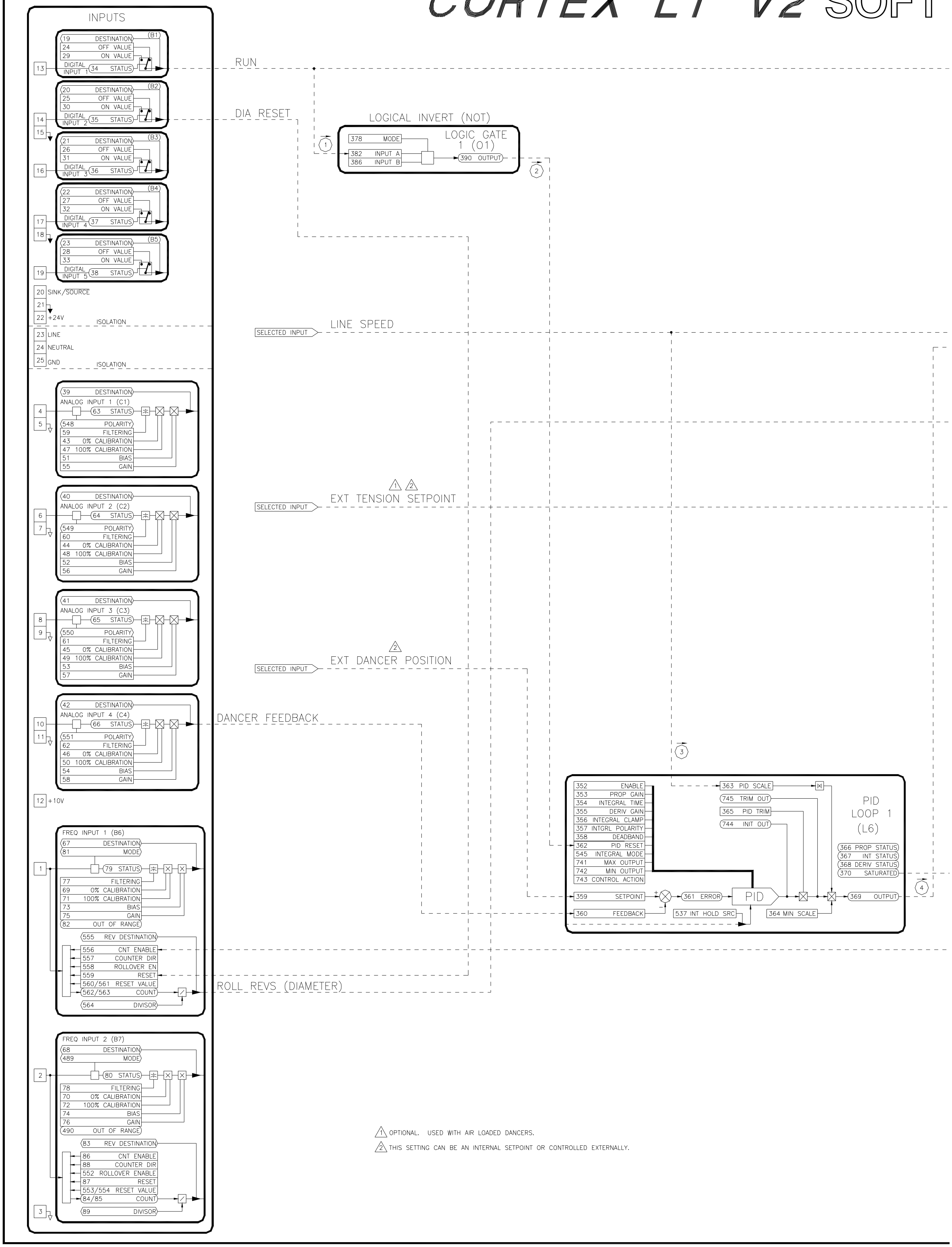


PROCESSING ORDER (Z1)

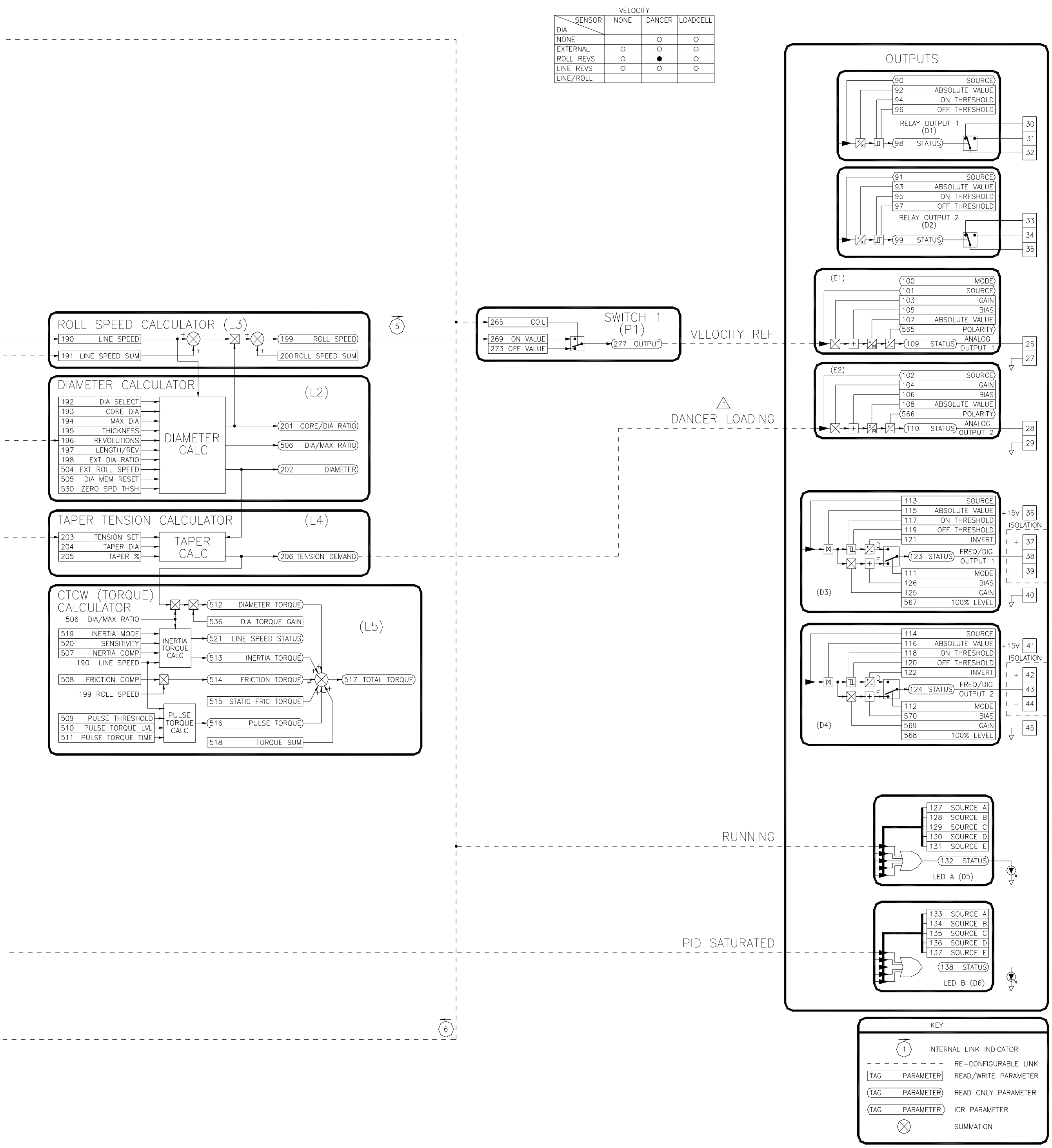
394	APP CALCS	BLOCK 1
395	IL1	BLOCK 2
396	IL2	BLOCK 3
397		BLOCK 4
398		BLOCK 5
399		BLOCK 6
400		BLOCK 7
401		BLOCK 8
402		BLOCK 9
403		BLOCK 10
404		BLOCK 11
405		BLOCK 12
406		BLOCK 13
407		BLOCK 14
408		BLOCK 15

DRAWN BY: BKP	DATE: 5/23/19
APPROVED BY:	DATE:
TOLERANCES: ± 2 DEC. PL. = .010" 3 DEC. PL. = .005"	CAROTRON — Driven by Excellence — HEATH SPRINGS, SC TEL 803-286-8614 FAX 803-286-6063
SCALE:	TITLE: CORTEX LT V2 APPLICATION PRESET SOFTWARE BLOCK DIAGRAMS
DRAWING NUMBER: D14566	REV. A SH. 6 OF 20

CORTEX LT V2 SOFT



WARE BLOCK DIAGRAM



PROCESSING ORDER (Z1)

394	IL1	BLOCK 1
395	LG1	BLOCK 2
396	IL2	BLOCK 3
397	IL3	BLOCK 4
398	PID1	BLOCK 5
399	IL4	BLOCK 6
400	APP CALCS	BLOCK 7
401	IL5	BLOCK 8
402	SWI1	BLOCK 9
403	IL6	BLOCK 10
404		BLOCK 11
405		BLOCK 12
406		BLOCK 13
407		BLOCK 14
408		BLOCK 15

DRAWN BY: BKP DATE: 5/23/19
APPROVED BY: DATE:
TOLERANCES: ±
2 DEC PL. = .010"
3 DEC PL. = .005"
SCALE:

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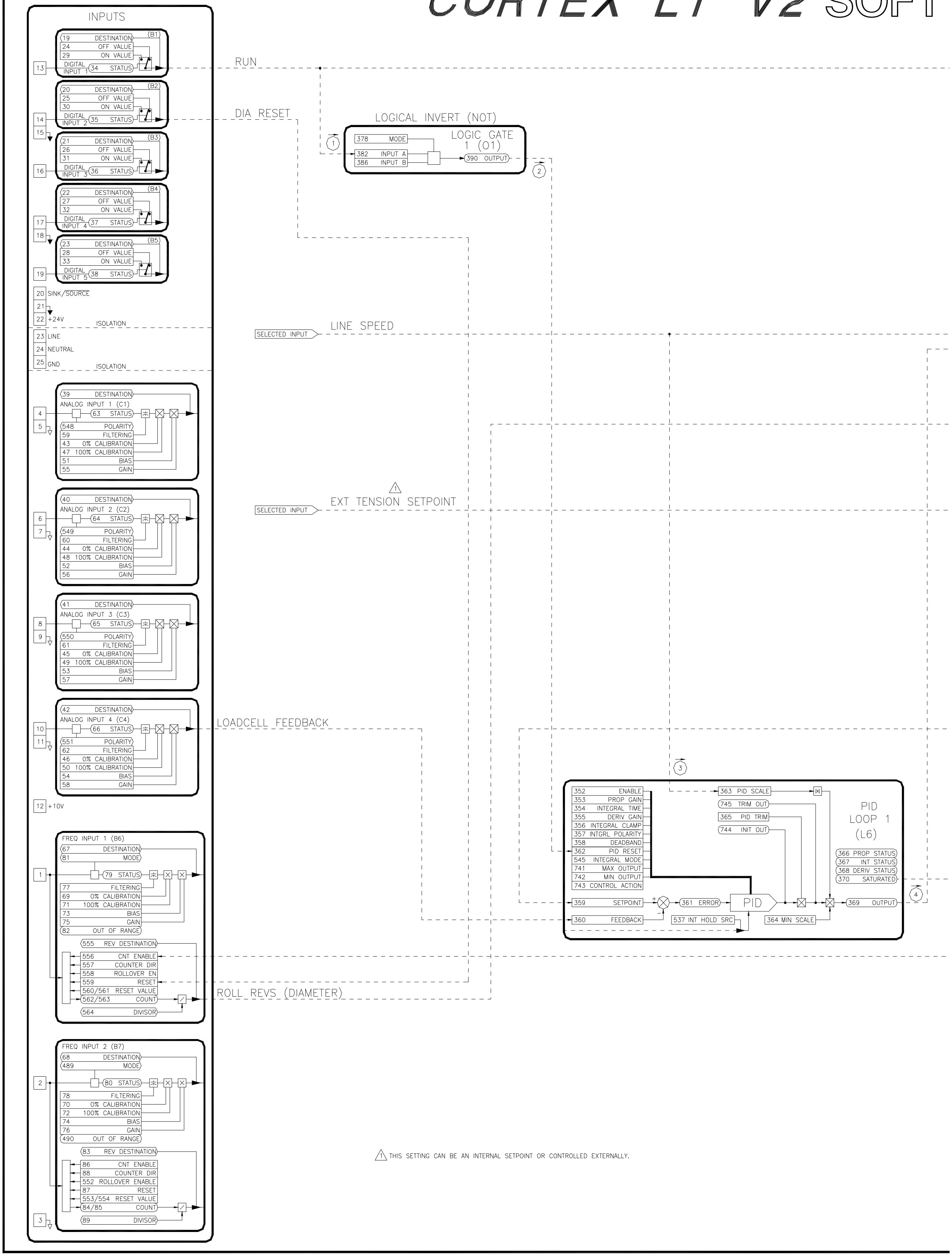
TITLE: CORTEX LT V2 APPLICATION PRESET SOFTWARE BLOCK DIAGRAMS

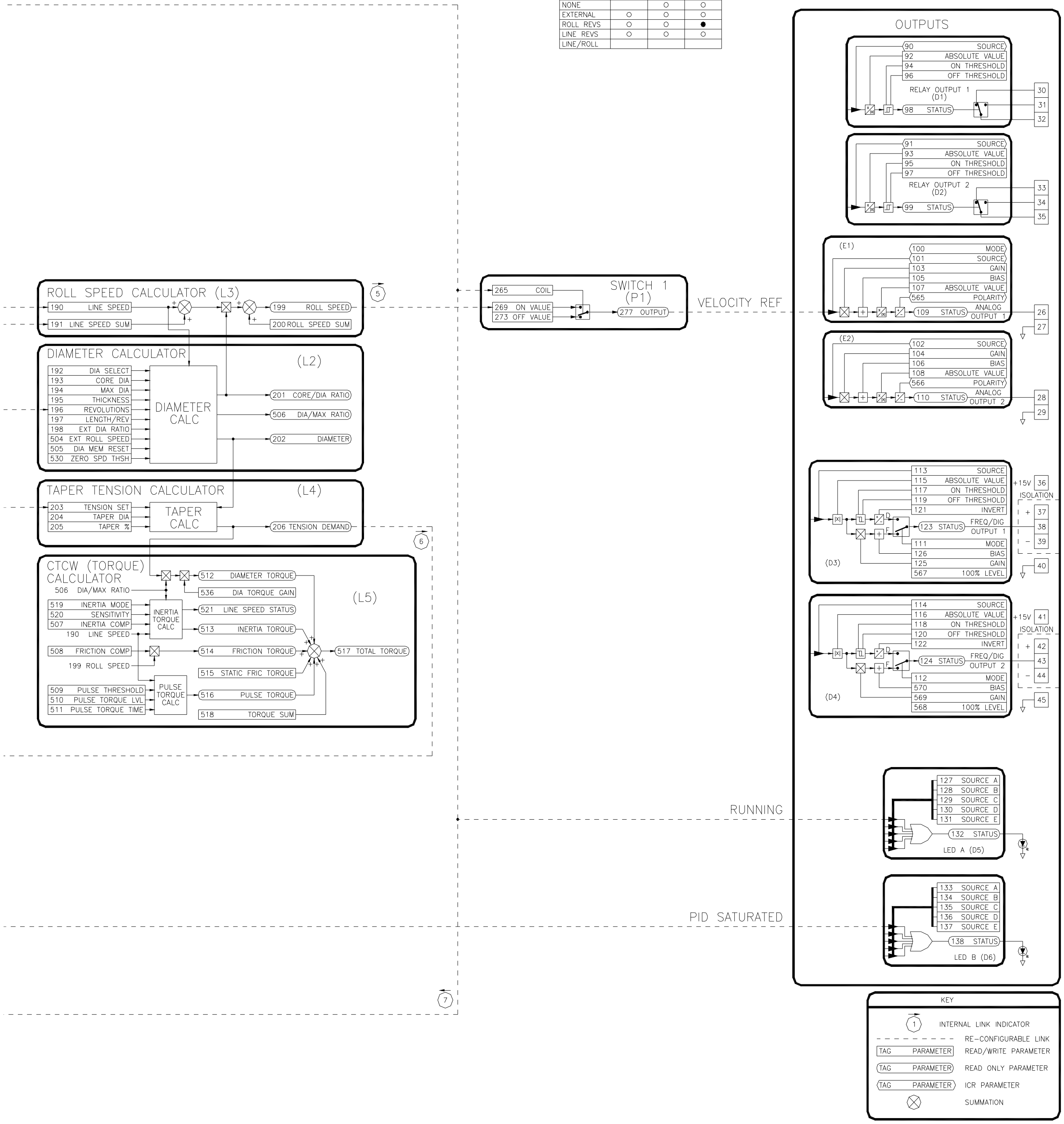
DRAWING NUMBER: D14566 REV. A SH. 7 OF 20

CORTEX LT V2 SOFT



WARE BLOCK DIAGRAM

SENSOR / DIA	VELOCITY NONE	VELOCITY DANCER	VELOCITY LOADCELL
NONE		○	○
EXTERNAL	○	○	○
ROLL REVS	○	○	●
LINE REVS	○	○	○
LINE/ROLL			



PROCESSING ORDER (Z1)

394	IL1	BLOCK 1
395	LG1	BLOCK 2
396	IL2	BLOCK 3
397	IL3	BLOCK 4
398	PID1	BLOCK 5
399	IL4	BLOCK 6
400	APP CALCS	BLOCK 7
401	IL5	BLOCK 8
402	IL6	BLOCK 9
403	SWI1	BLOCK 10
404	IL7	BLOCK 11
405		BLOCK 12
406		BLOCK 13
407		BLOCK 14
408		BLOCK 15

DRAWN BY: BKP DATE: 5/23/19
APPROVED BY: DATE:
TOLERANCES: ±
2 DEC. PL. = .010"
3 DEC. PL. = .005"
SCALE:

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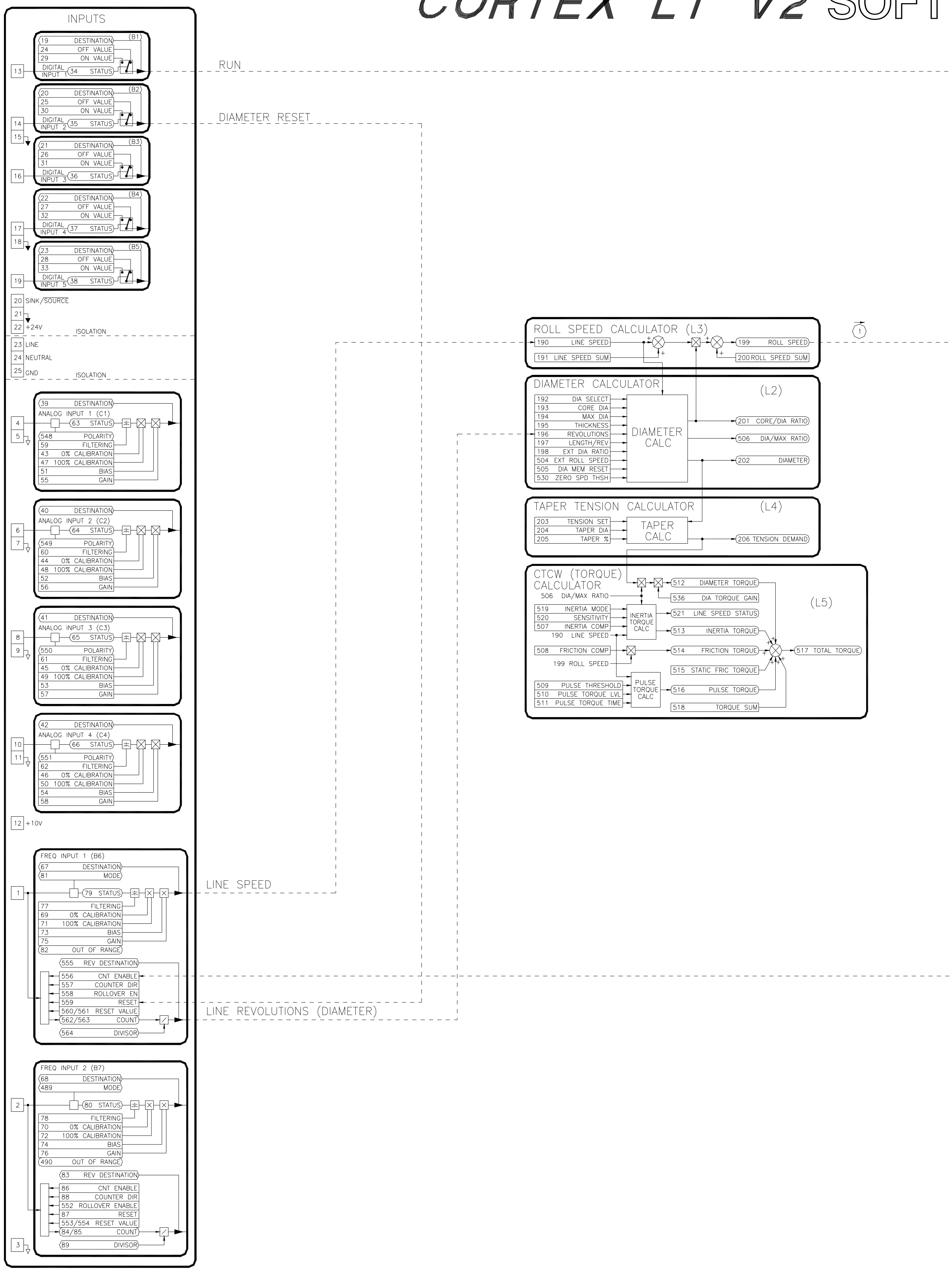
TITLE: CORTEX LT V2 APPLICATION PRESET SOFTWARE BLOCK DIAGRAMS

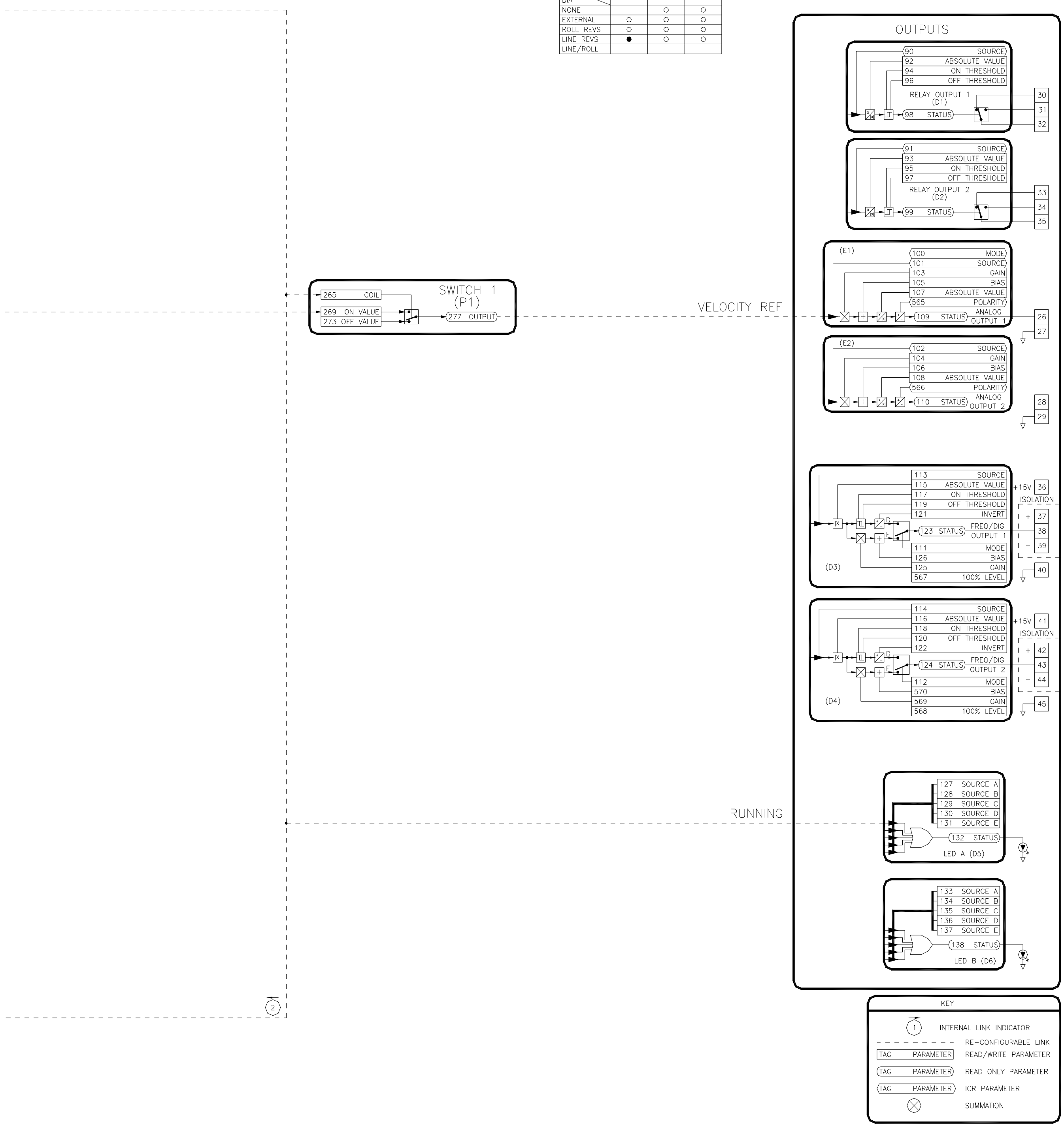
DRAWING NUMBER: D14566 REV. A SH. 8 OF 20

CORTEX LT V2 SOFT



WARE BLOCK DIAGRAM

VELOCITY SENSOR / DIA	NONE	DANCER	LOADCELL
NONE		O	O
EXTERNAL	O	O	O
ROLL REVS	O	O	O
LINE REVS	●	O	O
LINE/ROLL			

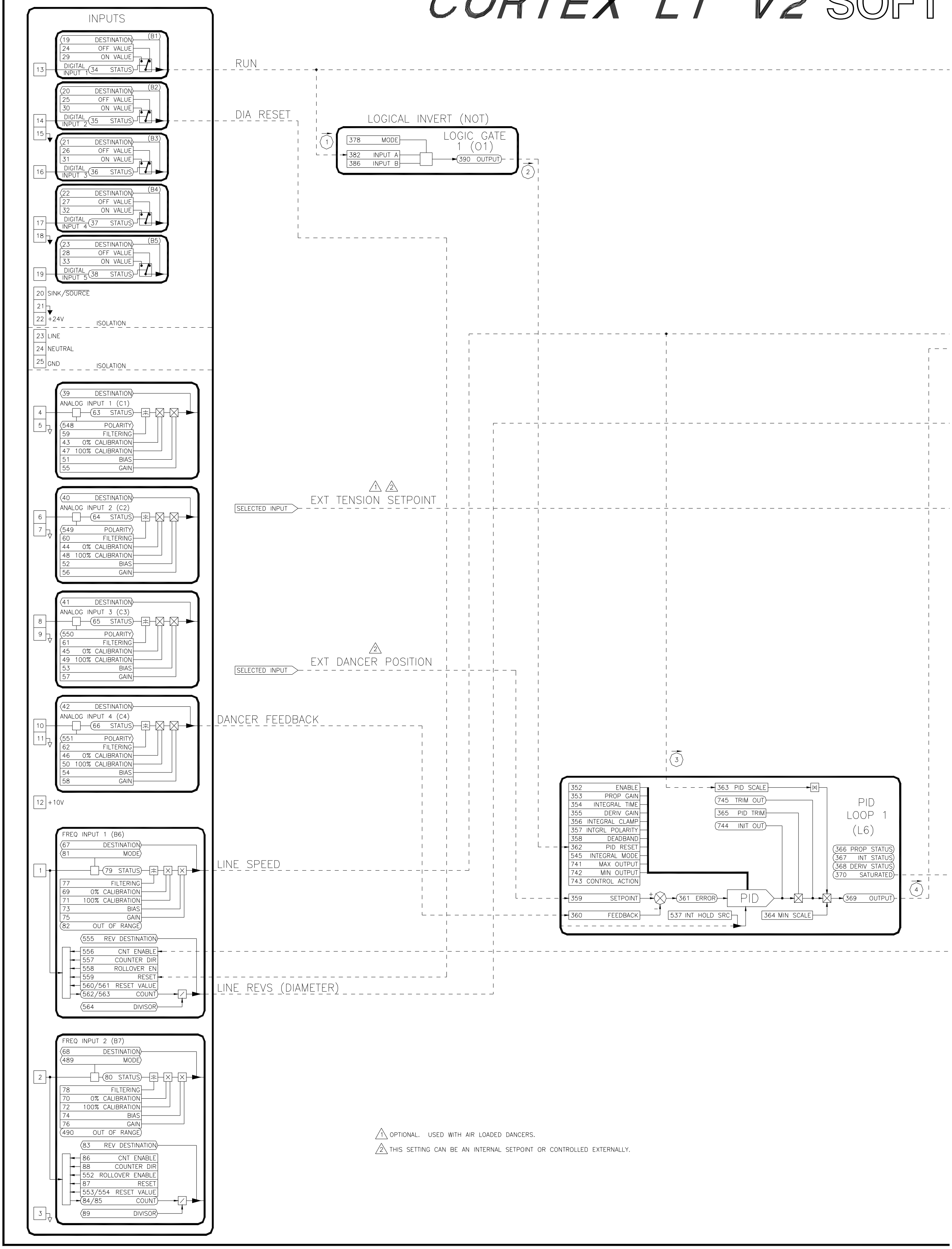


PROCESSING ORDER (Z1)

394	APP CALCS	BLOCK 1
395	IL1	BLOCK 2
396	IL2	BLOCK 3
397	SWI1	BLOCK 4
398		BLOCK 5
399		BLOCK 6
400		BLOCK 7
401		BLOCK 8
402		BLOCK 9
403		BLOCK 10
404		BLOCK 11
405		BLOCK 12
406		BLOCK 13
407		BLOCK 14
408		BLOCK 15

DRAWN BY: BKP	DATE: 5/23/19
APPROVED BY:	DATE:
TOLERANCES: ± 2 DEC. PL. = .010" 3 DEC. PL. = .005"	CAROTRON Driven by Excellence HEATH SPRINGS, SC TEL 803-286-8614 FAX 803-286-6063
SCALE:	TITLE: CORTEX LT V2 APPLICATION PRESET SOFTWARE BLOCK DIAGRAMS
DRAWING NUMBER: D14566	REV. A SH. 9 OF 20

CORTEX LT V2 SOFT

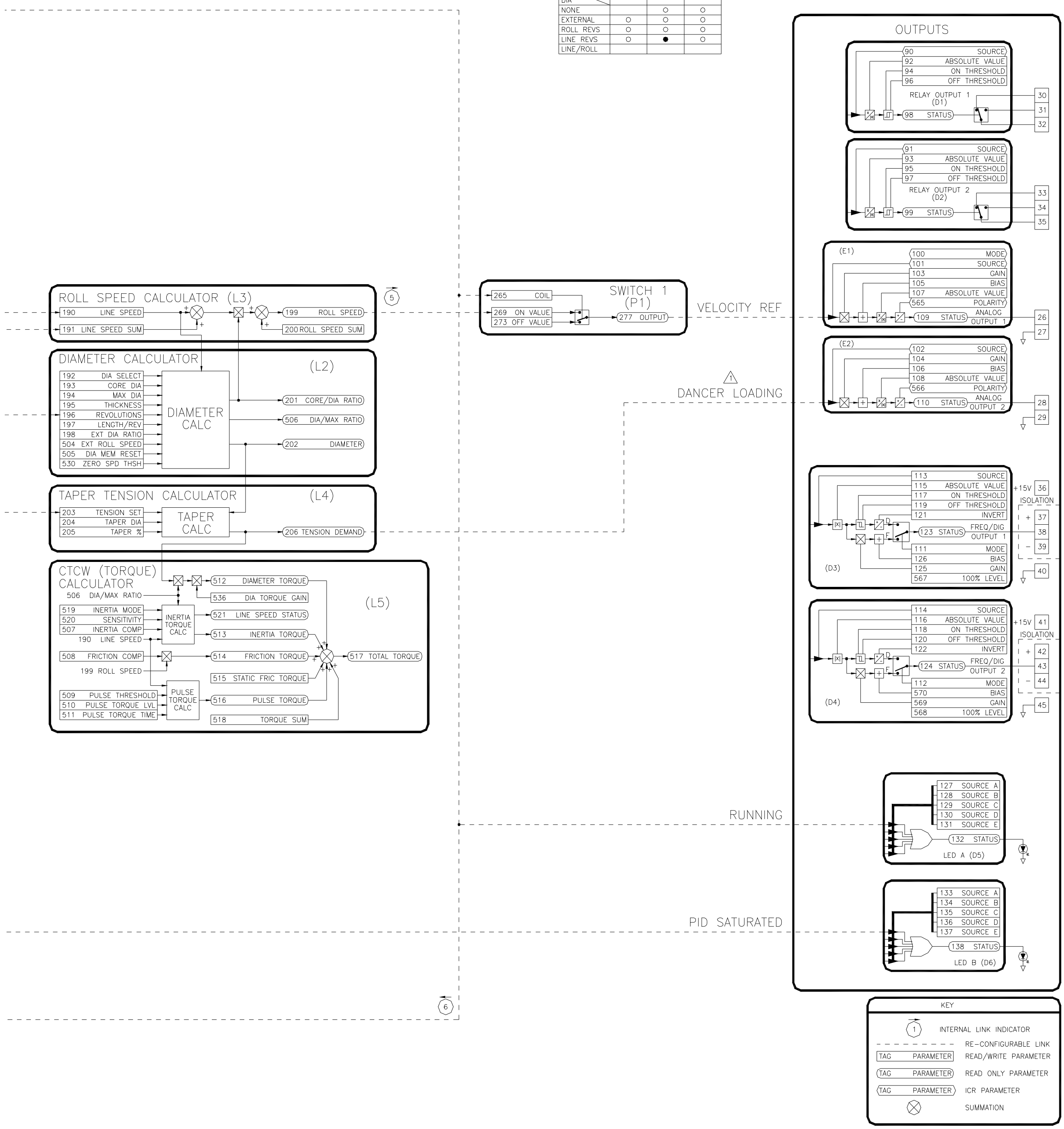


1 OPTIONAL. USED WITH AIR LOADED DANCERS.

2 THIS SETTING CAN BE AN INTERNAL SETPOINT OR CONTROLLED EXTERNALLY.

WARE BLOCK DIAGRAM

SENSOR \ DIA	VELOCITY NONE	DANCER	LOADCELL
NONE		○	○
EXTERNAL	○	○	○
ROLL REVS	○	○	○
LINE REVS	○	●	○
LINE/ROLL			

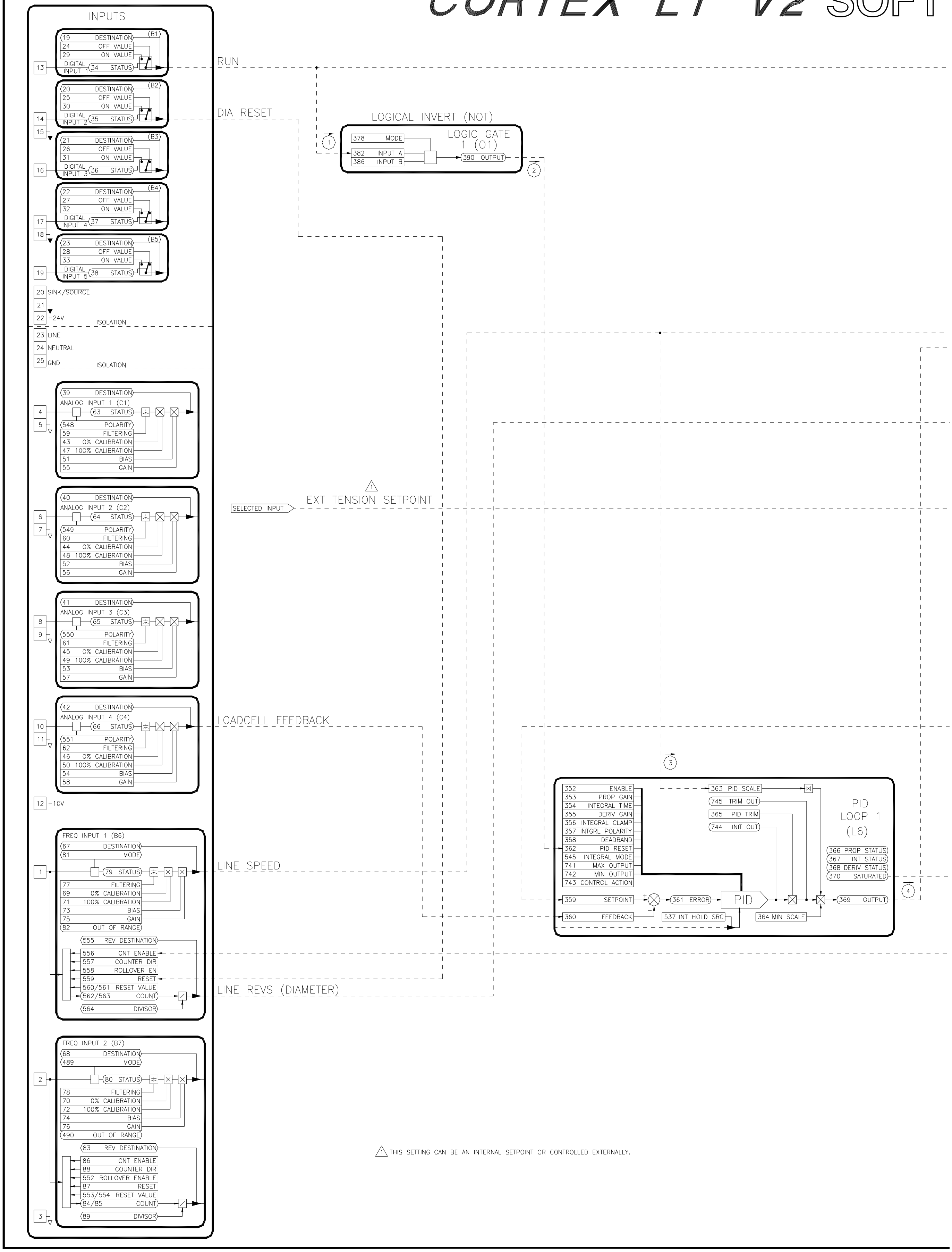


PROCESSING ORDER (Z1)

394	IL1	BLOCK 1
395	LG1	BLOCK 2
396	IL2	BLOCK 3
397	IL3	BLOCK 4
398	PID1	BLOCK 5
399	IL4	BLOCK 6
400	APP CALCS	BLOCK 7
401	IL5	BLOCK 8
402	SWI1	BLOCK 9
403	IL6	BLOCK 10
404		BLOCK 11
405		BLOCK 12
406		BLOCK 13
407		BLOCK 14
408		BLOCK 15

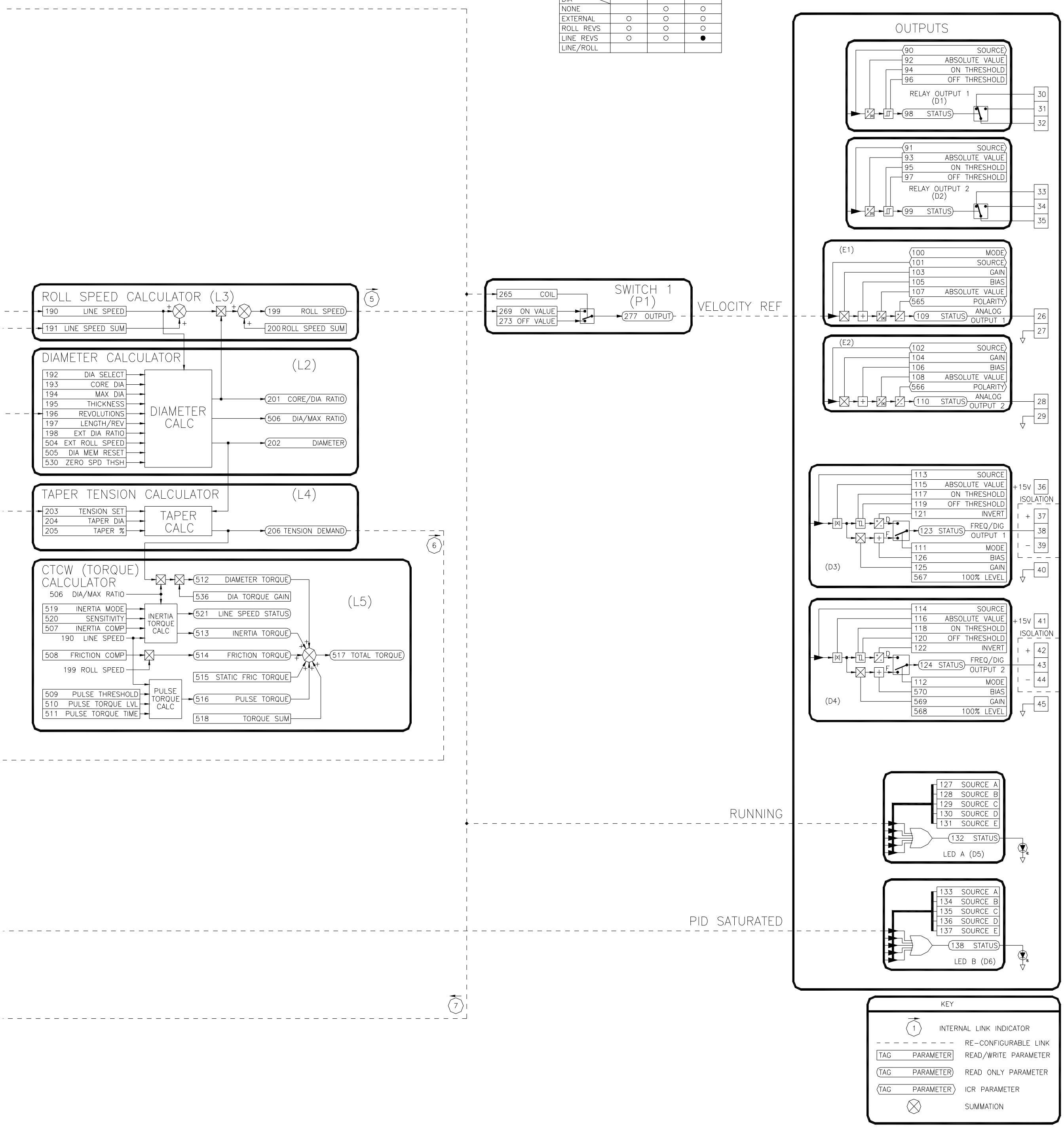
DRAWN BY: BKP	DATE: 5/23/19	CAROTRON Driven by Excellence
APPROVED BY:	DATE:	HEATH SPRINGS, SC TEL 803-286-8614 FAX 803-286-6063
TOLERANCES: ± 2 DEC. PL. = .010" 3 DEC. PL. = .005"		TITLE: CORTEX LT V2 APPLICATION PRESET SOFTWARE BLOCK DIAGRAMS
SCALE:		
DRAWING NUMBER: D14566	REV. A	SH. 10 OF 20

CORTEX LT V2 SOFT



WARE BLOCK DIAGRAM

VELOCITY: SENSOR / DIA	NONE	DANCER	LOADCELL
NONE		O	O
EXTERNAL	O	O	O
ROLL REVS	O	O	O
LINE REVS	O	O	●
LINE/ROLL			



PROCESSING ORDER (Z1)

394	IL1	BLOCK 1
395	LG1	BLOCK 2
396	IL2	BLOCK 3
397	IL3	BLOCK 4
398	PID1	BLOCK 5
399	IL4	BLOCK 6
400	APP CALCS	BLOCK 7
401	IL5	BLOCK 8
402	SWI1	BLOCK 9
403	IL6	BLOCK 10
404	IL7	BLOCK 11
405		BLOCK 12
406		BLOCK 13
407		BLOCK 14
408		BLOCK 15

DRAWN BY: BKP DATE: 5/23/19
APPROVED BY: DATE:
TOLERANCES: ±
2 DEC. PL. = .010"
3 DEC. PL. = .005"
SCALE:

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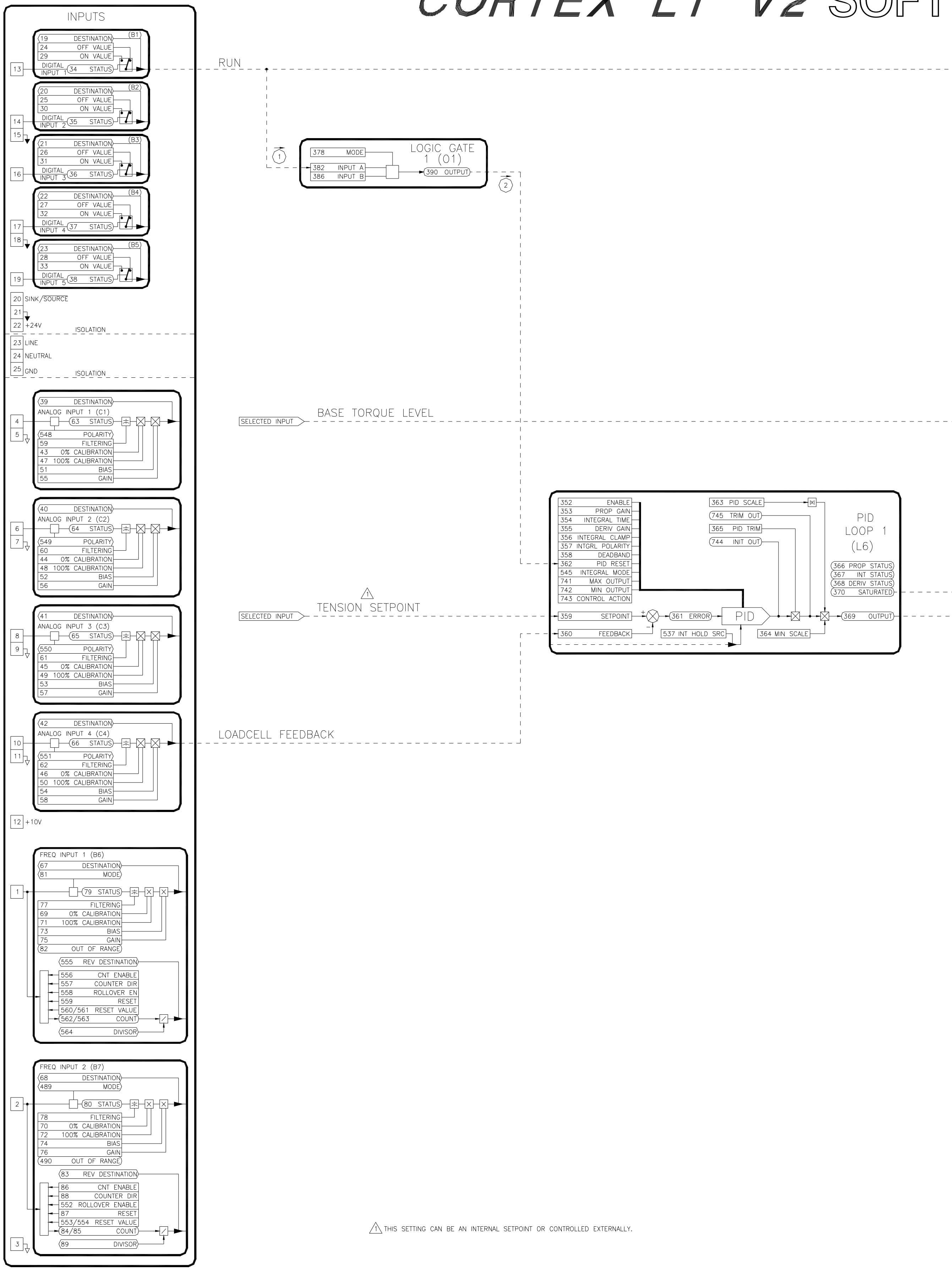
TITLE: CORTEX LT V2 APPLICATION PRESET SOFTWARE BLOCK DIAGRAMS

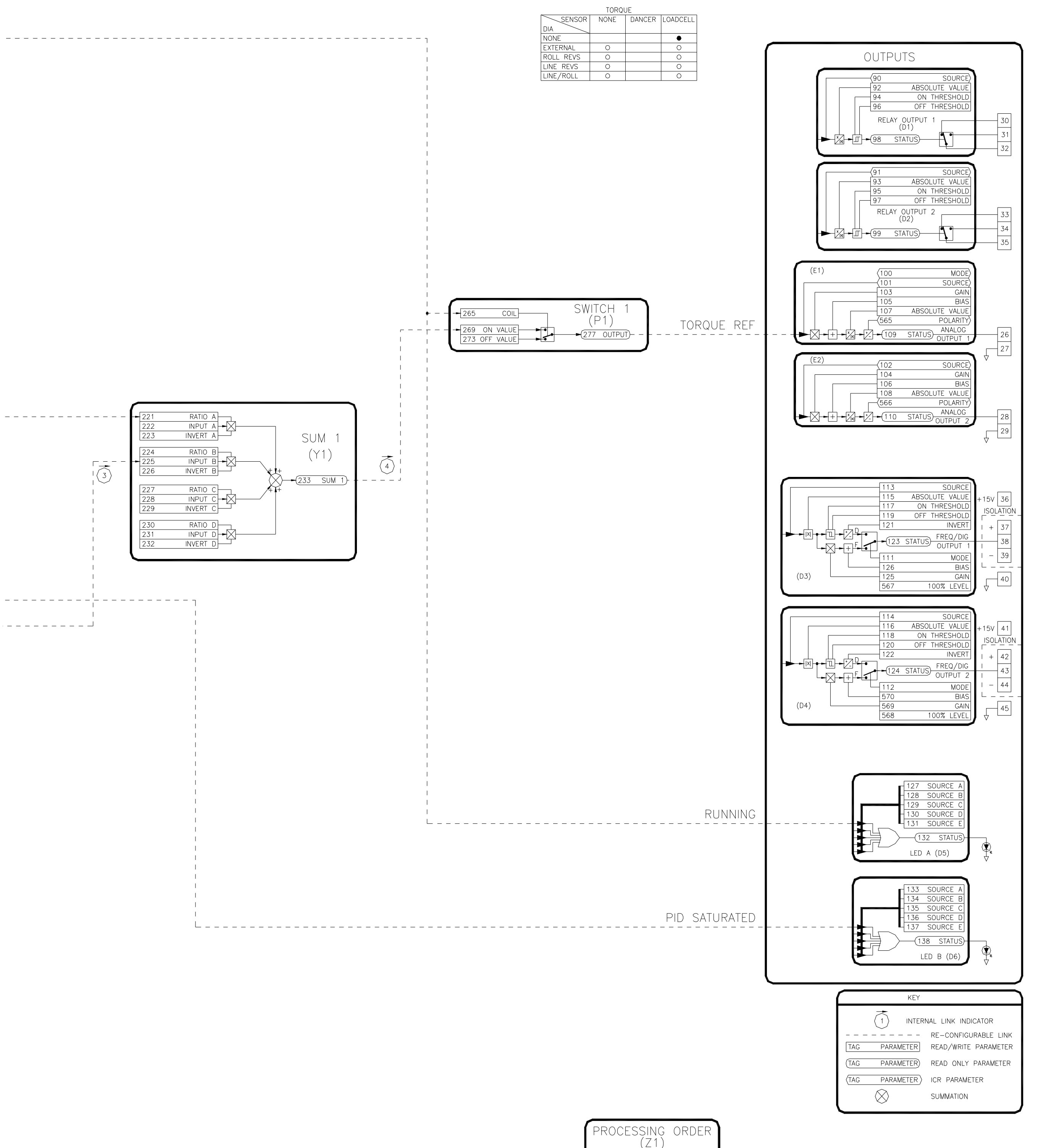
DRAWING NUMBER: D14566 REV. A SH. 11 OF 20

CORTEX LT V2 SOFT



⚠ THIS SETTING CAN BE AN INTERNAL SETPOINT OR CONTROLLED EXTERNALLY.

WARE BLOCK DIAGRAM



PROCESSING ORDER (Z1)

394	IL1	BLOCK 1
395	LG1	BLOCK 2
396	IL2	BLOCK 3
397	PID1	BLOCK 4
398	IL3	BLOCK 5
399	SUM1	BLOCK 6
400	IL4	BLOCK 7
401	SW1	BLOCK 8
402		BLOCK 9
403		BLOCK 10
404		BLOCK 11
405		BLOCK 12
406		BLOCK 13
407		BLOCK 14
408		BLOCK 15

DRAWN BY: BKP	DATE: 5/23/19
APPROVED BY:	DATE:
TOLERANCES: ± 2 DEC. PL. = .010" 3 DEC. PL. = .005"	
SCALE:	

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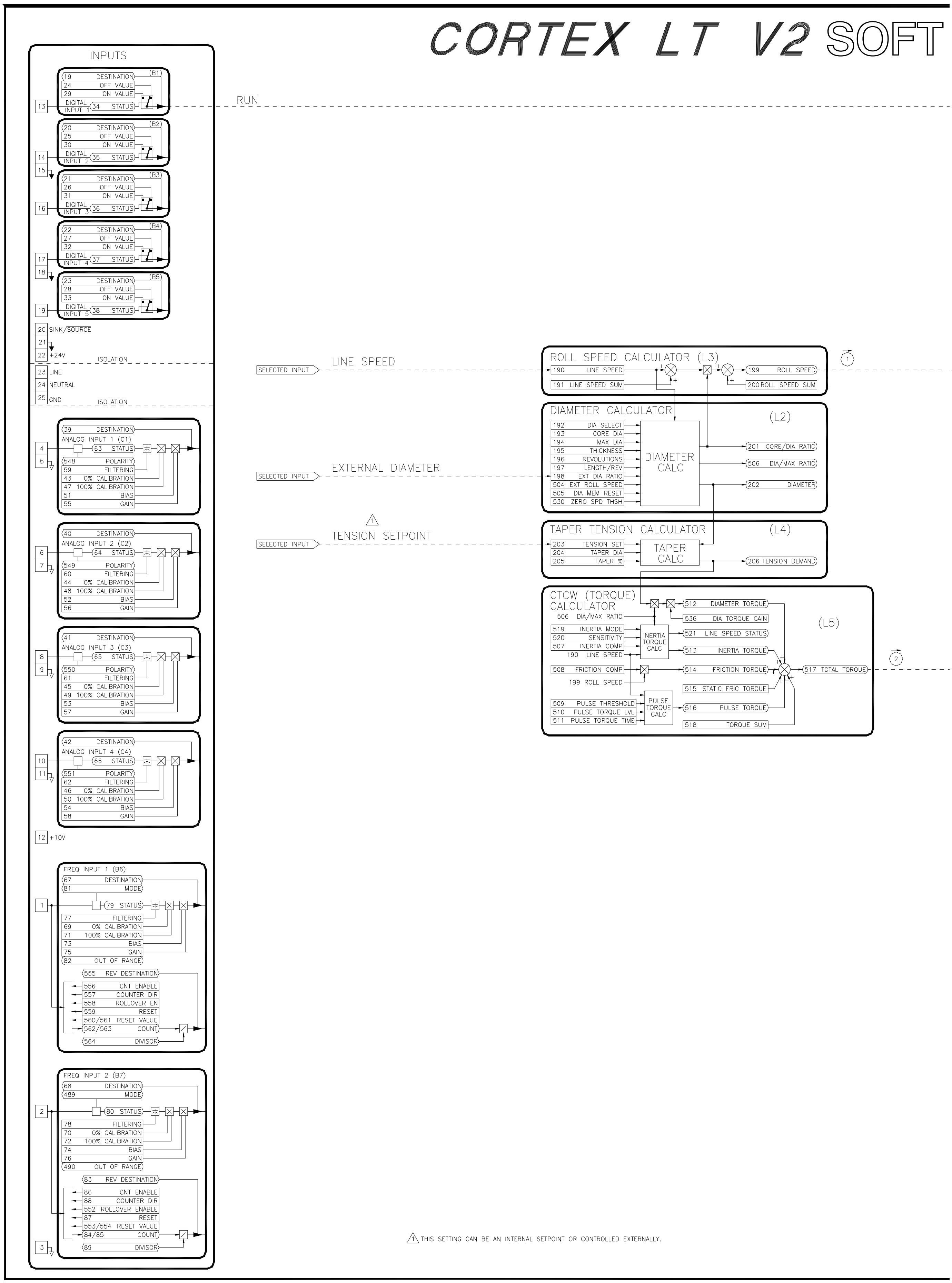
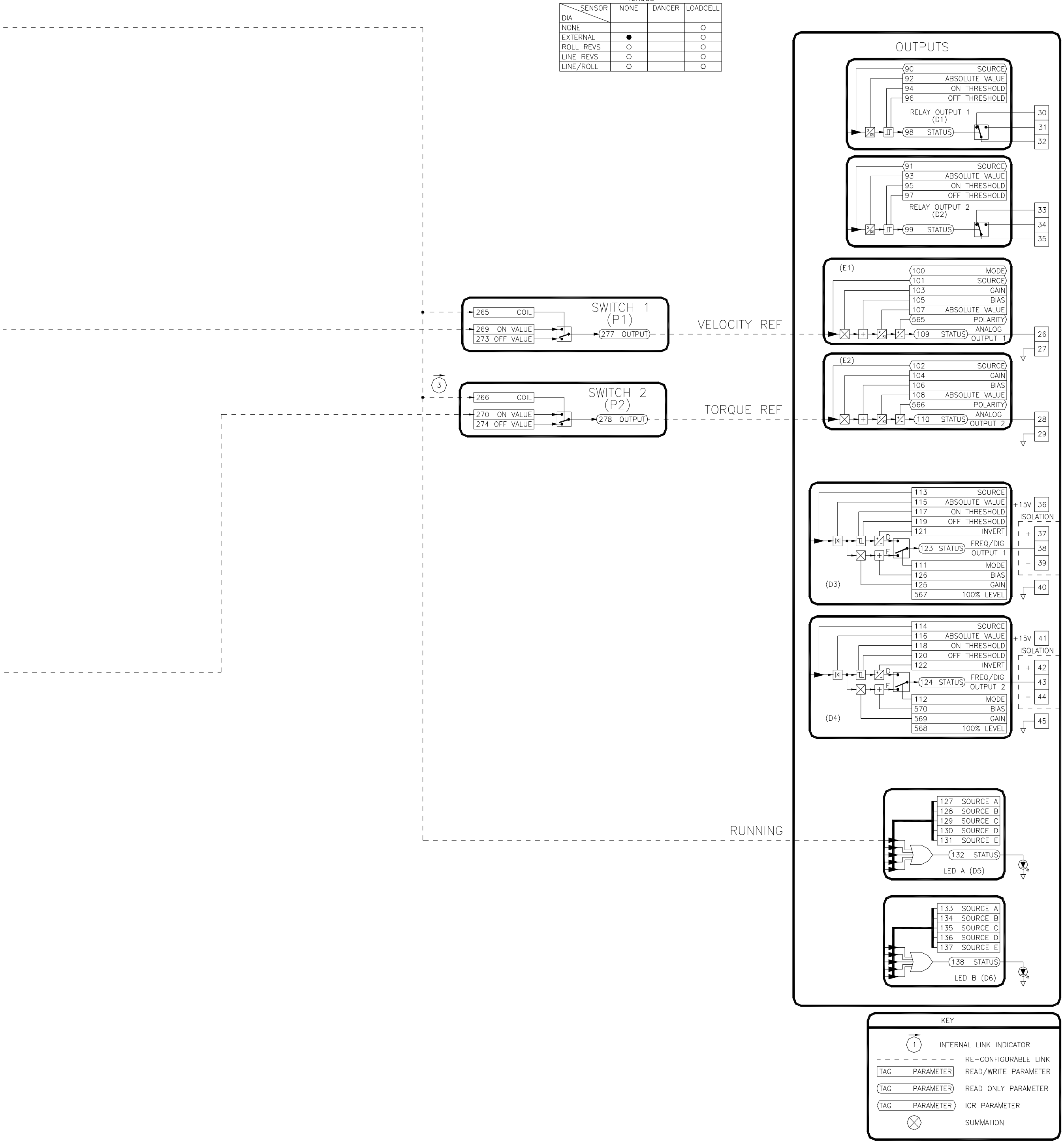
TITLE: CORTEX LT V2 APPLICATION PRESET SOFTWARE BLOCK DIAGRAMS

DRAWING NUMBER: D14566 REV. A SH. 12 OF 20


CORTEX LT V2 SOFT
INPUTS
19 DESTINATION
24 OFF VALUE
29 ON VALUE
DIGITAL INPUT 1 34 STATUS
(B1)
20 DESTINATION
25 OFF VALUE
30 ON VALUE
DIGITAL INPUT 2 35 STATUS
(B2)
21 DESTINATION
26 OFF VALUE
31 ON VALUE
DIGITAL INPUT 3 36 STATUS
(B3)
22 DESTINATION
27 OFF VALUE
32 ON VALUE
DIGITAL INPUT 4 37 STATUS
(B4)
23 DESTINATION
28 OFF VALUE
33 ON VALUE
DIGITAL INPUT 5 38 STATUS
(B5)
13
14
15
16
17
18
19
20 SINK/SOURCE
21
22 +24V
ISOLATION
23 LINE
24 NEUTRAL
25 GND
ISOLATION
RUN
39 DESTINATION
ANALOG INPUT 1 (C1)
63 STATUS
548 POLARITY
59 FILTERING
43 0% CALIBRATION
47 100% CALIBRATION
51 BIAS
55 GAIN
4
5
40 DESTINATION
ANALOG INPUT 2 (C2)
64 STATUS
549 POLARITY
60 FILTERING
44 0% CALIBRATION
48 100% CALIBRATION
52 BIAS
56 GAIN
6
7
41 DESTINATION
ANALOG INPUT 3 (C3)
65 STATUS
550 POLARITY
61 FILTERING
45 0% CALIBRATION
49 100% CALIBRATION
53 BIAS
57 GAIN
8
9
42 DESTINATION
ANALOG INPUT 4 (C4)
66 STATUS
551 POLARITY
62 FILTERING
46 0% CALIBRATION
50 100% CALIBRATION
54 BIAS
58 GAIN
10
11
12 +10V
FREQ INPUT 1 (B6)
67 DESTINATION
81 MODE
79 STATUS
77 FILTERING
69 0% CALIBRATION
71 100% CALIBRATION
73 BIAS
75 GAIN
82 OUT OF RANGE
555 REV DESTINATION
556 CNT ENABLE
557 COUNTER DIR
558 ROLLOVER EN
559 RESET
560/561 RESET VALUE
562/563 COUNT
564 DIVISOR
1
FREQ INPUT 2 (B7)
68 DESTINATION
489 MODE
80 STATUS
78 FILTERING
70 0% CALIBRATION
72 100% CALIBRATION
74 BIAS
76 GAIN
490 OUT OF RANGE
83 REV DESTINATION
86 CNT ENABLE
88 COUNTER DIR
552 ROLLOVER ENABLE
87 RESET
553/554 RESET VALUE
84/85 COUNT
89 DIVISOR
2
3
SELECTED INPUT
LINE SPEED
SELECTED INPUT
EXTERNAL DIAMETER
SELECTED INPUT
TENSION SETPOINT
ROLL SPEED CALCULATOR (L3)
190 LINE SPEED
191 LINE SPEED SUM
199 ROLL SPEED
200 ROLL SPEED SUM
1
DIAMETER CALCULATOR
(L2)
192 DIA SELECT
193 CORE DIA
194 MAX DIA
195 THICKNESS
196 REVOLUTIONS
197 LENGTH/REV
198 EXT DIA RATIO
504 EXT ROLL SPEED
505 DIA MEM RESET
530 ZERO SPD THSH
DIAMETER CALC
201 CORE/DIA RATIO
506 DIA/MAX RATIO
202 DIAMETER
TAPER TENSION CALCULATOR
(L4)
203 TENSION SET
204 TAPER DIA
205 TAPER %
TAPER CALC
206 TENSION DEMAND
CTCW (TORQUE) CALCULATOR
506 DIA/MAX RATIO
519 INERTIA MODE
520 SENSITIVITY
507 INERTIA COMP
190 LINE SPEED
INERTIA TORQUE CALC
508 FRICTION COMP
199 ROLL SPEED
509 PULSE THRESHOLD
510 PULSE TORQUE LVL
511 PULSE TORQUE TIME
PULSE TORQUE CALC
512 DIAMETER TORQUE
536 DIA TORQUE GAIN
521 LINE SPEED STATUS
513 INERTIA TORQUE
514 FRICTION TORQUE
515 STATIC FRIC TORQUE
516 PULSE TORQUE
518 TORQUE SUM
(L5)
517 TOTAL TORQUE
2
THIS SETTING CAN BE AN INTERNAL SETPOINT OR CONTROLLED EXTERNALLY.

WARE BLOCK DIAGRAM

SENSOR / DIA	TORQUE: NONE	DANCER	LOADCELL
NONE			○
EXTERNAL	●		○
ROLL REVS	○		○
LINE REVS	○		○
LINE/ROLL	○		○



PROCESSING ORDER (Z1)

394	APP CALCS	BLOCK 1
395	IL1	BLOCK 2
396	IL2	BLOCK 3
397	SWI1	BLOCK 4
398	IL3	BLOCK 5
399	SWI2	BLOCK 6
400		BLOCK 7
401		BLOCK 8
402		BLOCK 9
403		BLOCK 10
404		BLOCK 11
405		BLOCK 12
406		BLOCK 13
407		BLOCK 14
408		BLOCK 15

DRAWN BY: BKP
DATE: 5/23/19
APPROVED BY:
DATE:
TOLERANCES: ±
2 DEC PL. = .010"
3 DEC PL. = .005"
SCALE:

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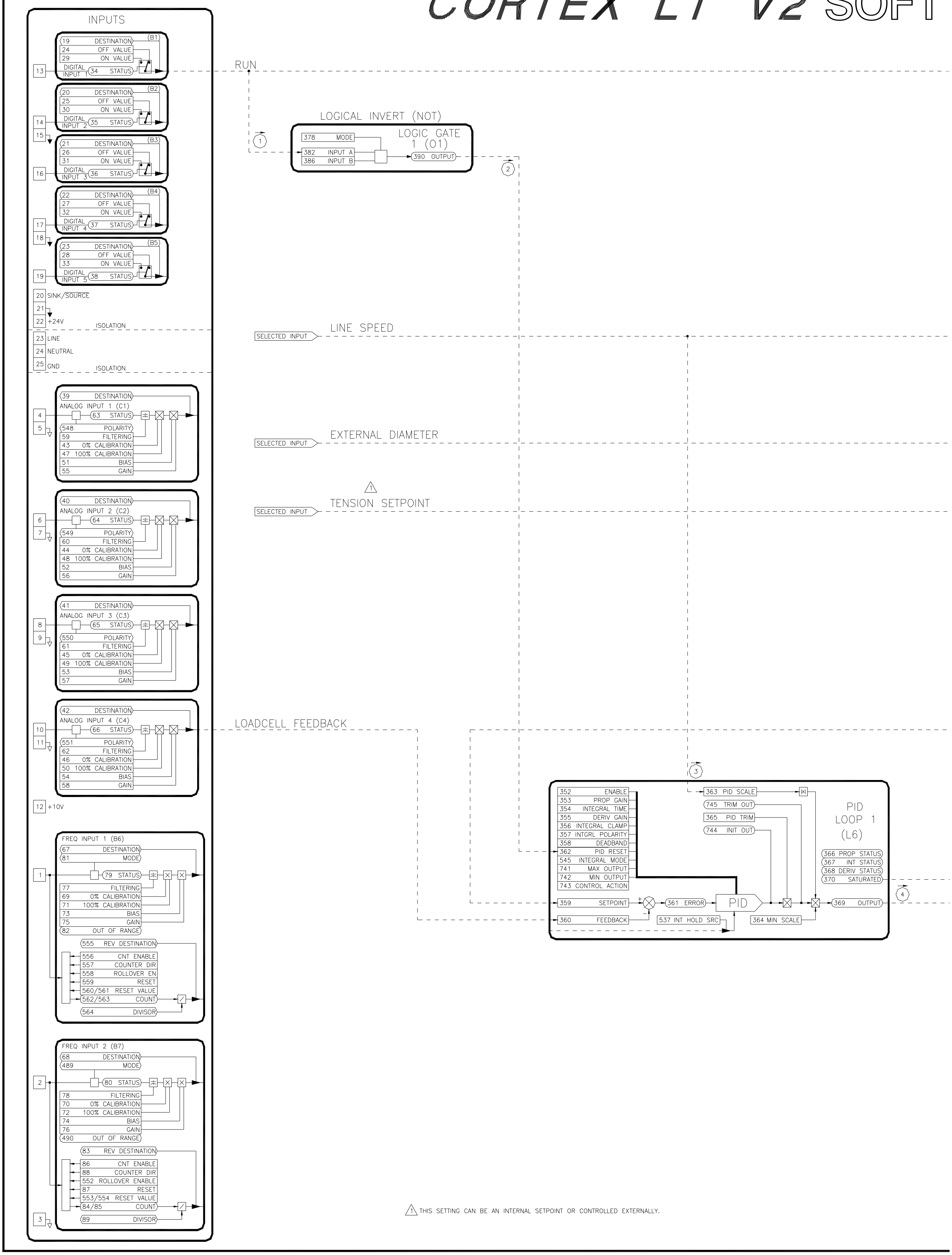
TITLE: CORTEX LT V2 APPLICATION PRESET SOFTWARE BLOCK DIAGRAMS

DRAWING NUMBER: D14566 REV. A SH. 13 OF 20

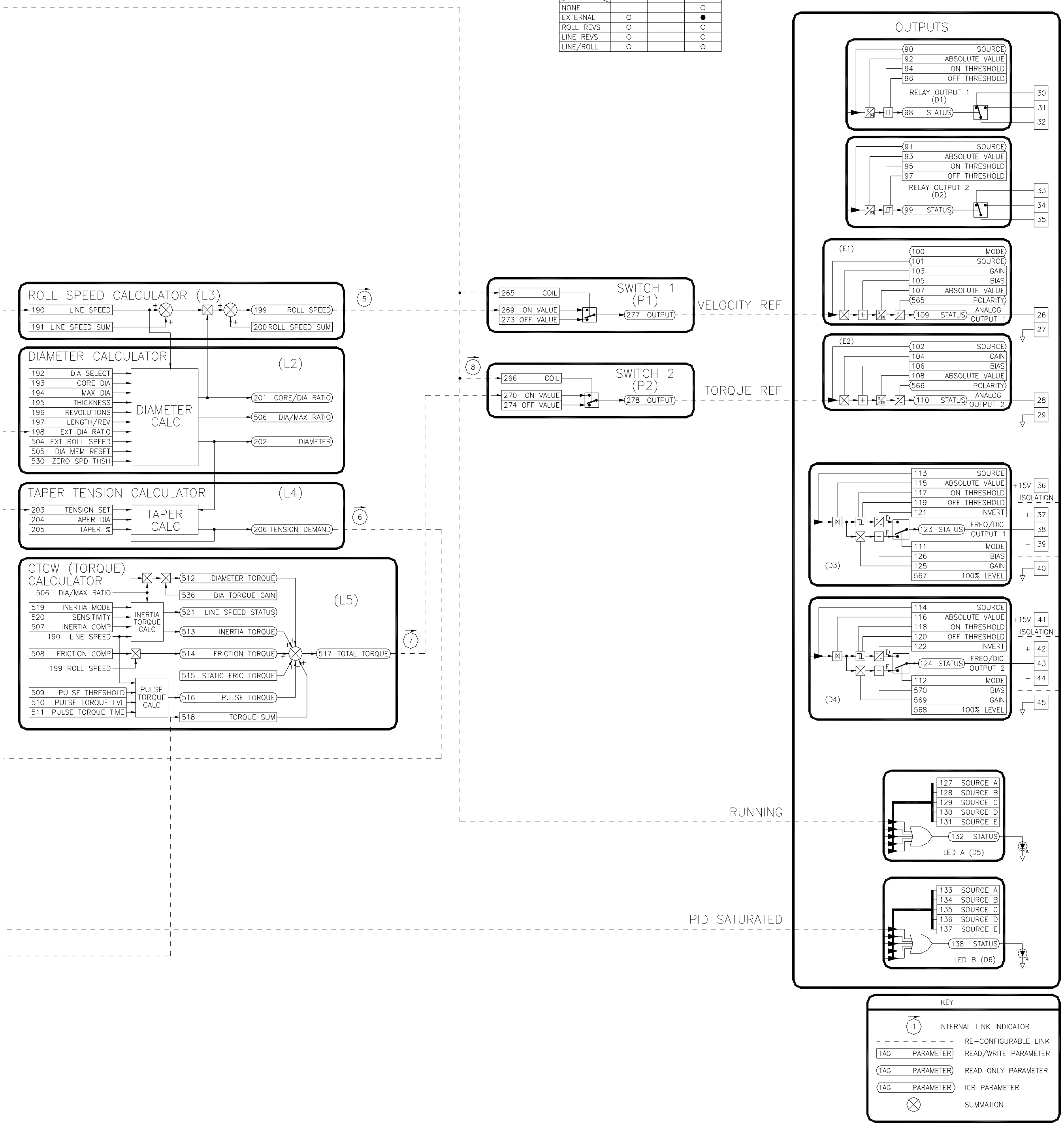
CORTEX LT V2 SOFT



THIS SETTING CAN BE AN INTERNAL SETPOINT OR CONTROLLED EXTERNALLY.

WARE BLOCK DIAGRAM

TORQUE SENSOR / DIA	NONE	DANCER	LOADCELL
NONE			○
EXTERNAL	○		●
ROLL REVS	○		○
LINE REVS	○		○
LINE/ROLL	○		○



PROCESSING ORDER (Z1)

394	IL1	BLOCK 1
395	LG1	BLOCK 2
396	IL2	BLOCK 3
397	IL3	BLOCK 4
398	PID1	BLOCK 5
399	IL4	BLOCK 6
400	APP CALCS	BLOCK 7
401	IL5	BLOCK 8
402	IL6	BLOCK 9
403	IL7	BLOCK 10
404	SWI1	BLOCK 11
405	IL8	BLOCK 12
406	SWI2	BLOCK 13
407		BLOCK 14
408		BLOCK 15

DRAWN BY: BKP DATE: 5/23/19

APPROVED BY: DATE:

TOLERANCES: ±
2 DEC. PL. = .010"
3 DEC. PL. = .005"

SCALE:

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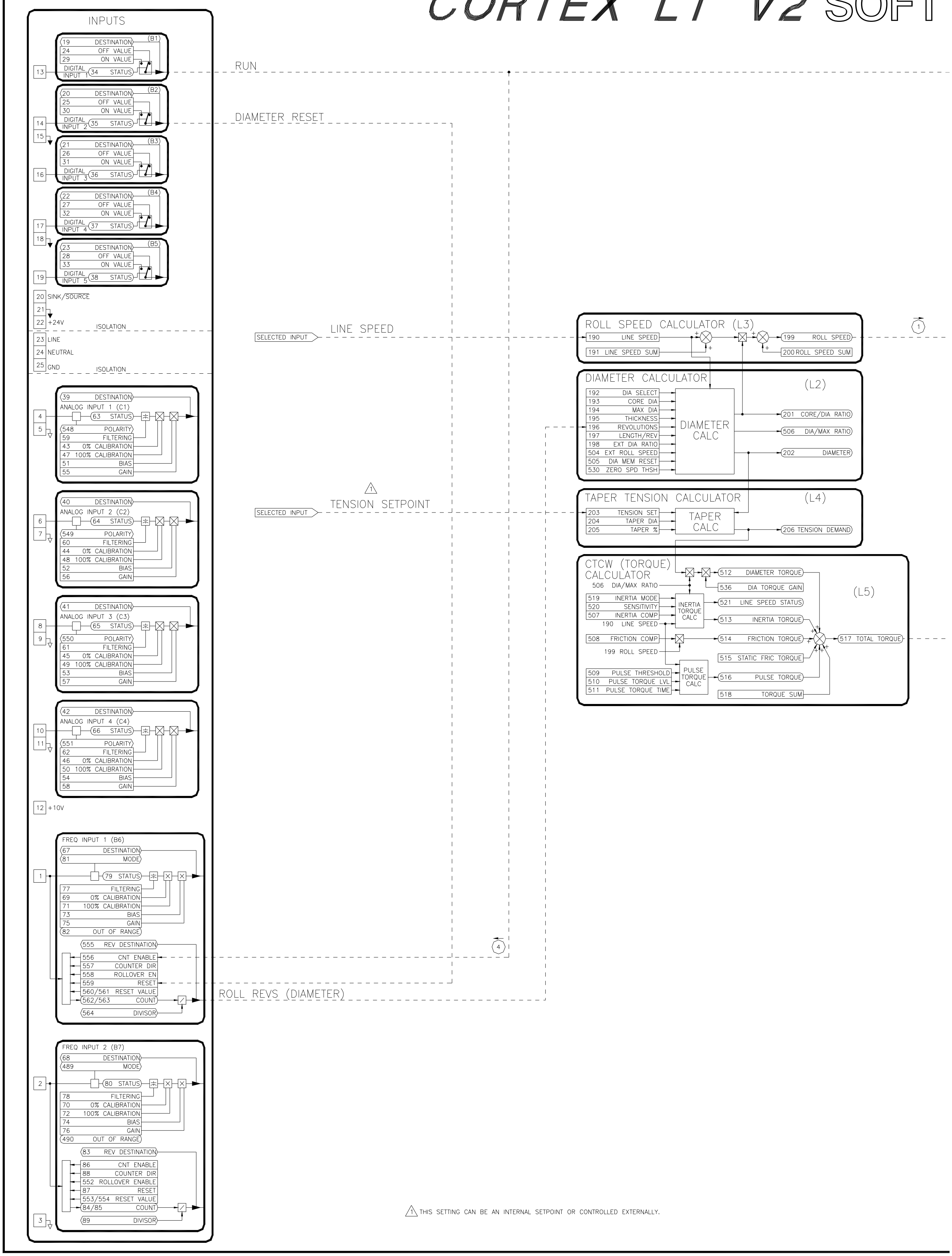
TITLE: CORTEX LT V2 APPLICATION PRESET SOFTWARE BLOCK DIAGRAMS

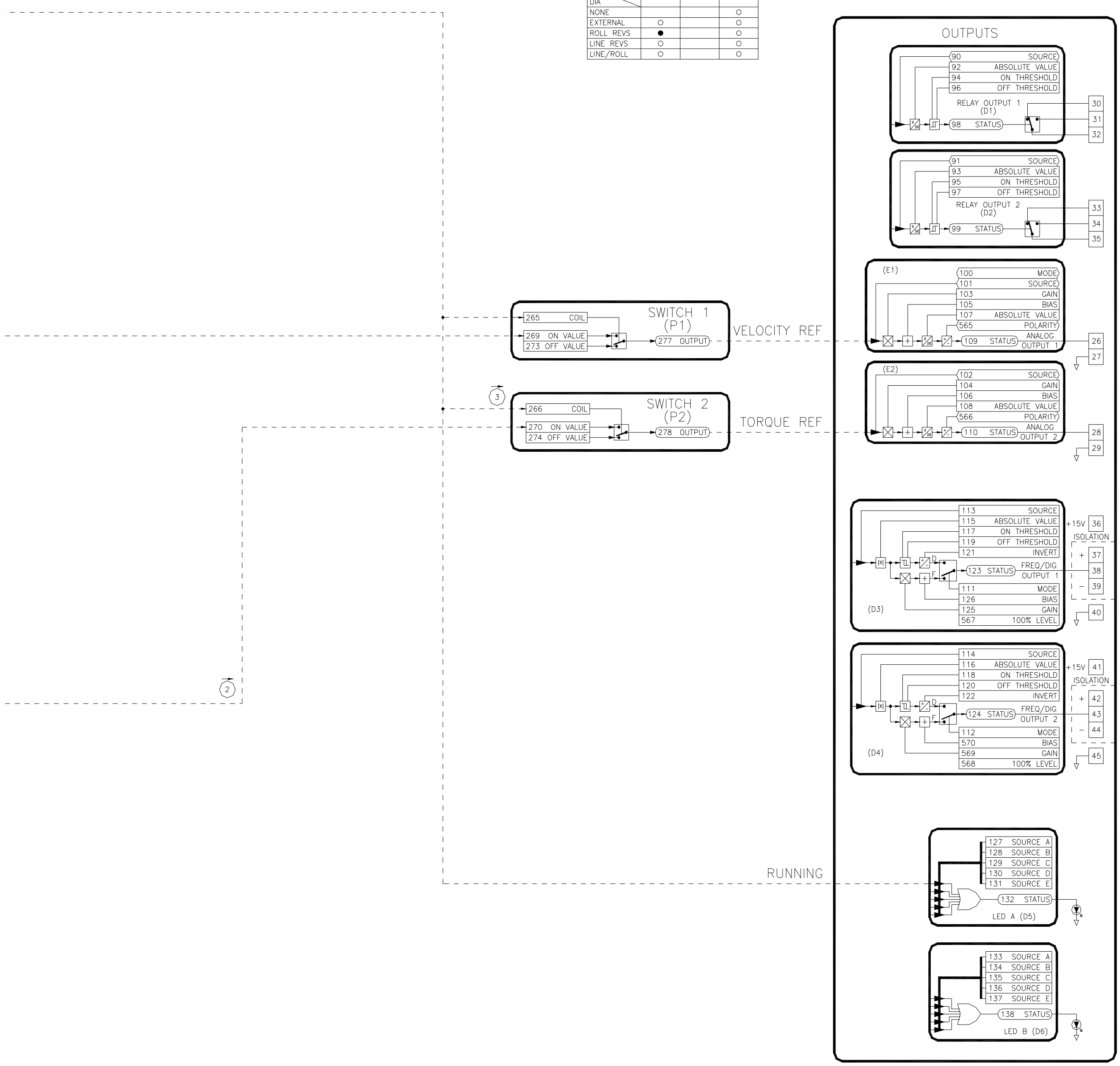
DRAWING NUMBER: D14566 REV. A SH. 14 OF 20

CORTEX LT V2 SOFT



WARE BLOCK DIAGRAM

TORQUE SENSOR / DIA	NONE	DANCER	LOADCELL
NONE			○
EXTERNAL	○		○
ROLL REVS	●		○
LINE REVS	○		○
LINE/ROLL	○		○



KEY	
1	INTERNAL LINK INDICATOR
- - - - - - - -	RE-CONFIGURABLE LINK
TAG PARAMETER	READ/WRITE PARAMETER
TAG PARAMETER	READ ONLY PARAMETER
TAG PARAMETER	ICR PARAMETER
⊗	SUMMATION

PROCESSING ORDER (Z1)

394	APP CALCS	BLOCK 1
395	IL1	BLOCK 2
396	IL2	BLOCK 3
397	SWI1	BLOCK 4
398	IL3	BLOCK 5
399	SWI2	BLOCK 6
400	IL4	BLOCK 7
401		BLOCK 8
402		BLOCK 9
403		BLOCK 10
404		BLOCK 11
405		BLOCK 12
406		BLOCK 13
407		BLOCK 14
408		BLOCK 15

DRAWN BY: BKP DATE: 5/23/19
APPROVED BY: DATE:
TOLERANCES: ± 2 DEC. PL. = .010" 3 DEC. PL. = .005"
SCALE:

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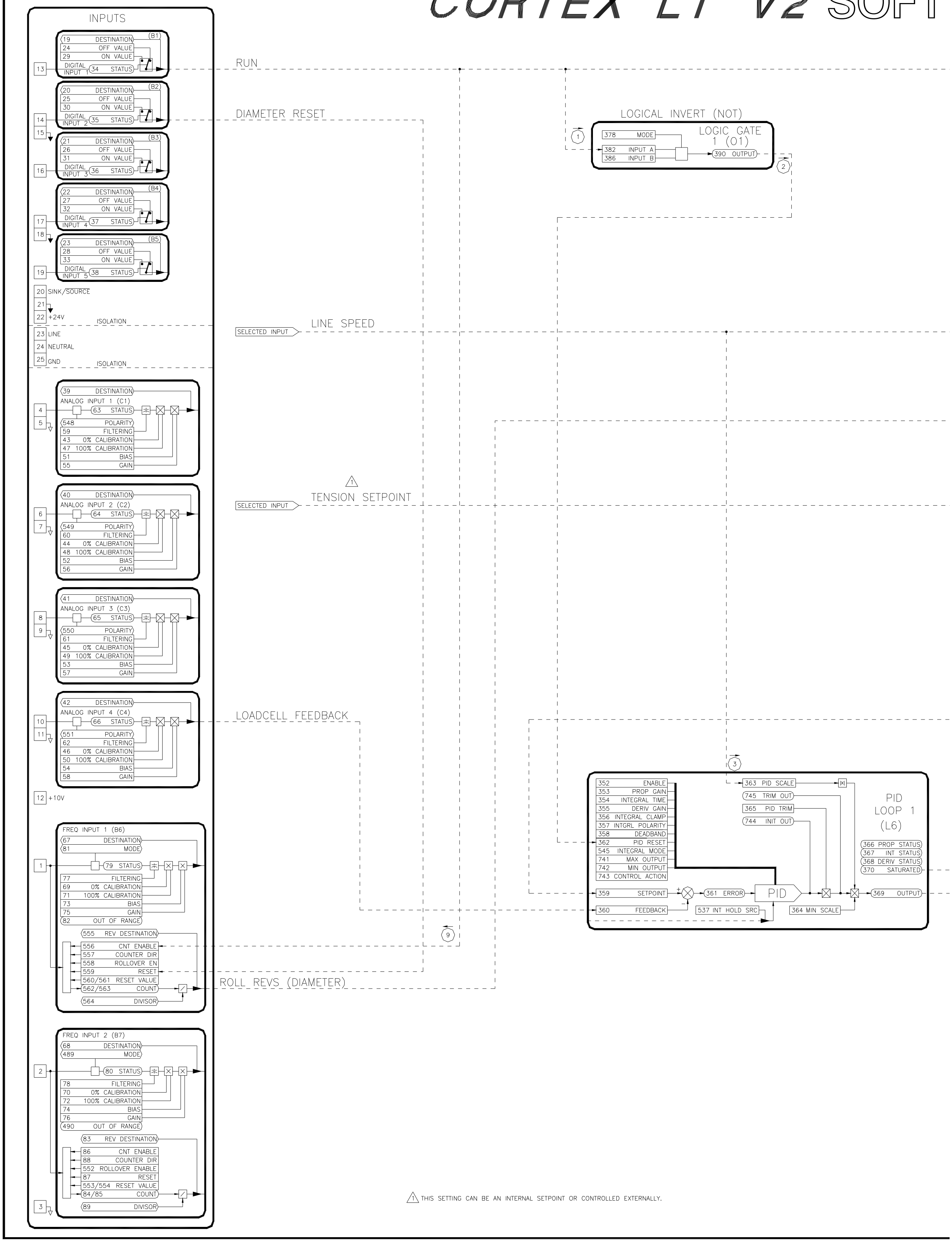
TITLE: CORTEX LT V2 APPLICATION PRESET SOFTWARE BLOCK DIAGRAMS

DRAWING NUMBER: D14566 REV. A SH. 15 OF 20

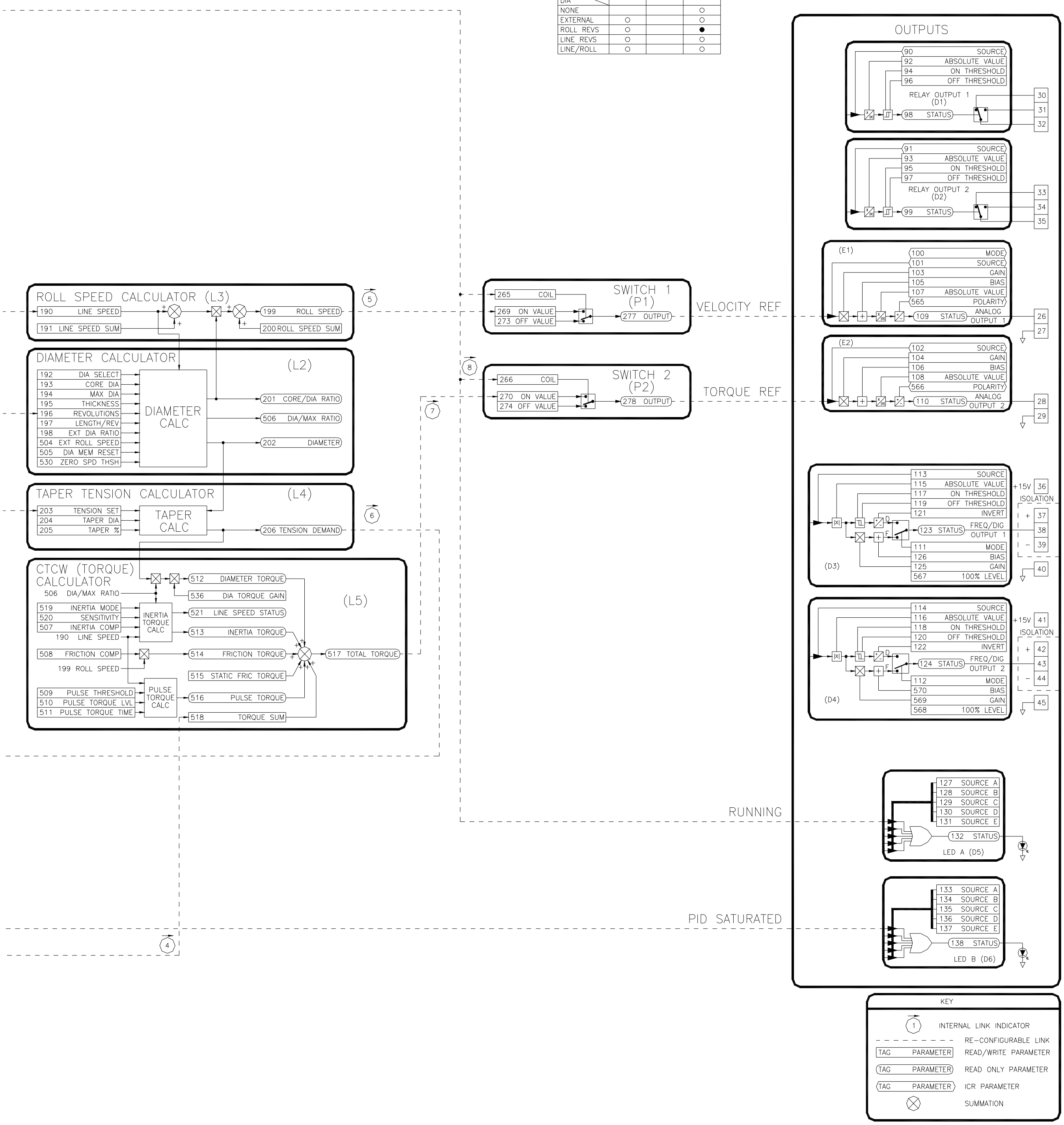
CORTEX LT V2 SOFT



WARE BLOCK DIAGRAM

TORQUE

SENSOR / DIA	NONE	DANCER	LOADCELL
NONE			○
EXTERNAL	○		○
ROLL REVS	○		●
LINE REVS	○		○
LINE/ROLL	○		○



PROCESSING ORDER (Z1)

394	IL1	BLOCK 1
395	LG1	BLOCK 2
396	IL2	BLOCK 3
397	IL3	BLOCK 4
398	PID1	BLOCK 5
399	IL4	BLOCK 6
400	APP CALCS	BLOCK 7
401	IL5	BLOCK 8
402	IL6	BLOCK 9
403	IL7	BLOCK 10
404	SWI1	BLOCK 11
405	IL8	BLOCK 12
406	SWI2	BLOCK 13
407	IL9	BLOCK 14
408		BLOCK 15

DRAWN BY: BKP DATE: 5/23/19
APPROVED BY: DATE:
TOLERANCES: ±
2 DEC. PL. = .010"
3 DEC. PL. = .005"
SCALE:

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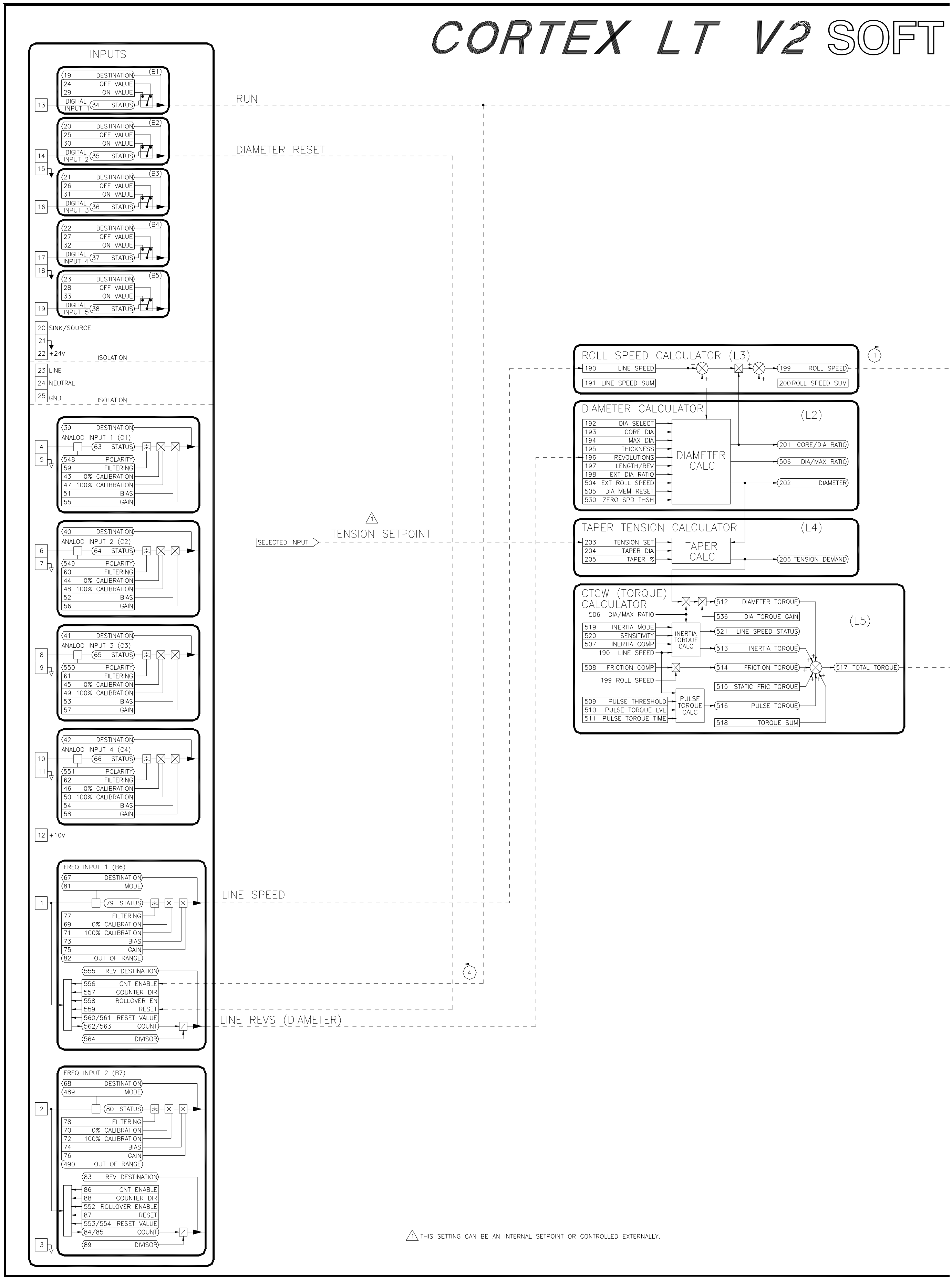
TITLE: CORTEX LT V2 APPLICATION PRESET SOFTWARE BLOCK DIAGRAMS

DRAWING NUMBER: D14566 REV. A SH. 16 OF 20

CORTEX LT V2 SOFT

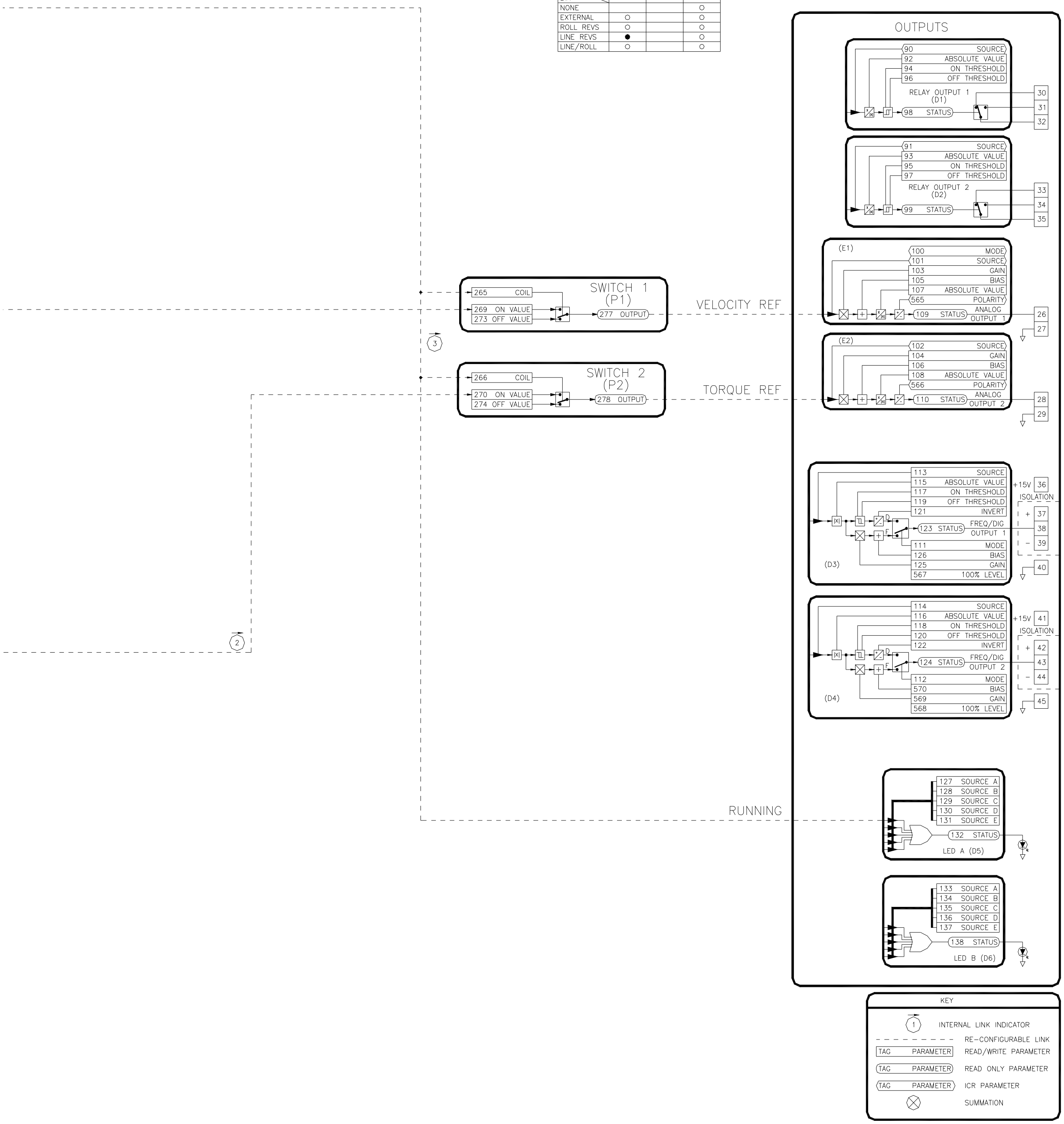


THIS SETTING CAN BE AN INTERNAL SETPOINT OR CONTROLLED EXTERNALLY.

WARE BLOCK DIAGRAM

TORQUE

SENSOR / DIA	NONE	DANCER	LOADCELL
NONE			○
EXTERNAL	○		○
ROLL REVS	○		○
LINE REVS	●		○
LINE/ROLL	○		○

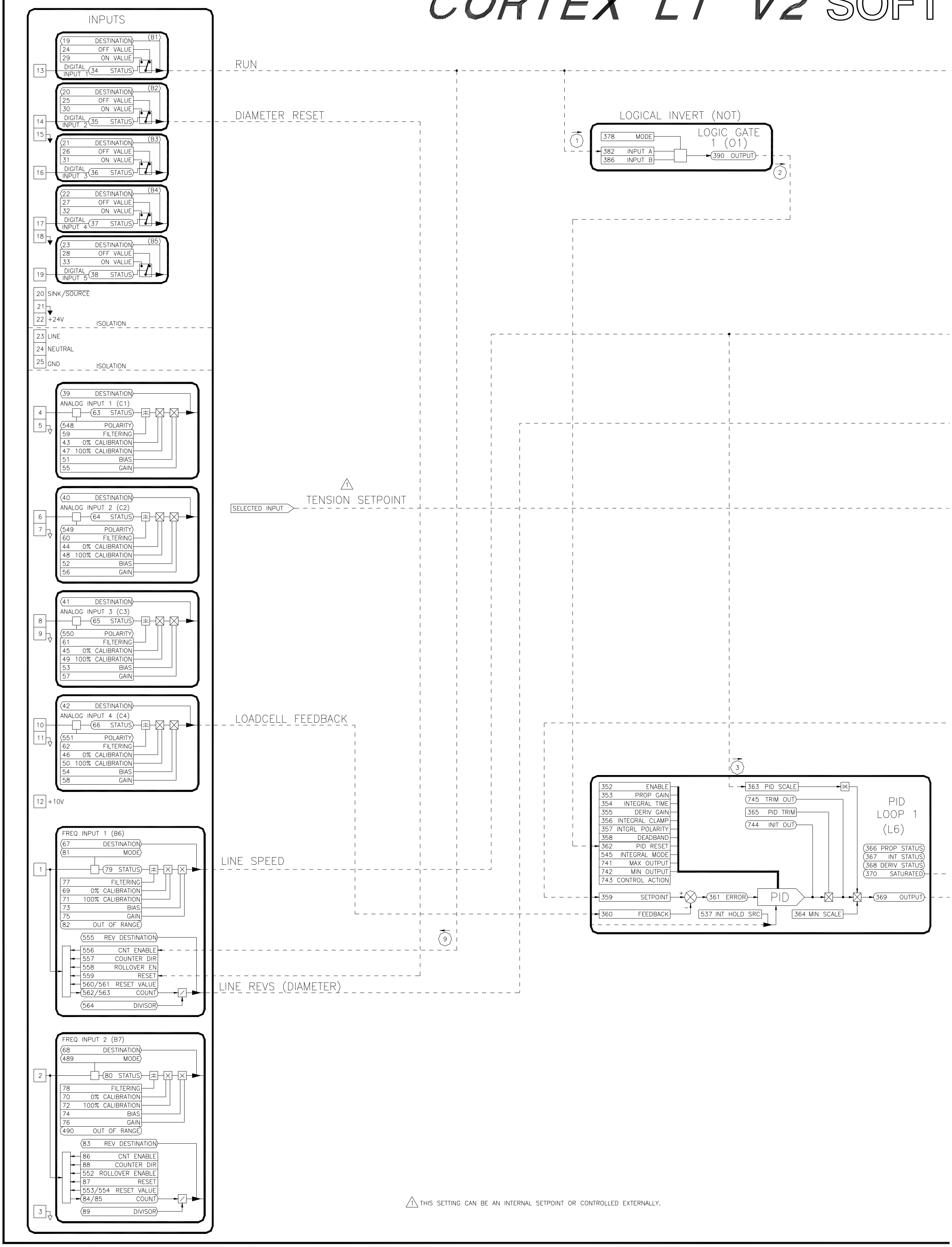


PROCESSING ORDER (Z1)

394	APP CALCS	BLOCK 1
395	IL1	BLOCK 2
396	IL2	BLOCK 3
397	SWI1	BLOCK 4
398	IL3	BLOCK 5
399	SWI2	BLOCK 6
400	IL4	BLOCK 7
401		BLOCK 8
402		BLOCK 9
403		BLOCK 10
404		BLOCK 11
405		BLOCK 12
406		BLOCK 13
407		BLOCK 14
408		BLOCK 15

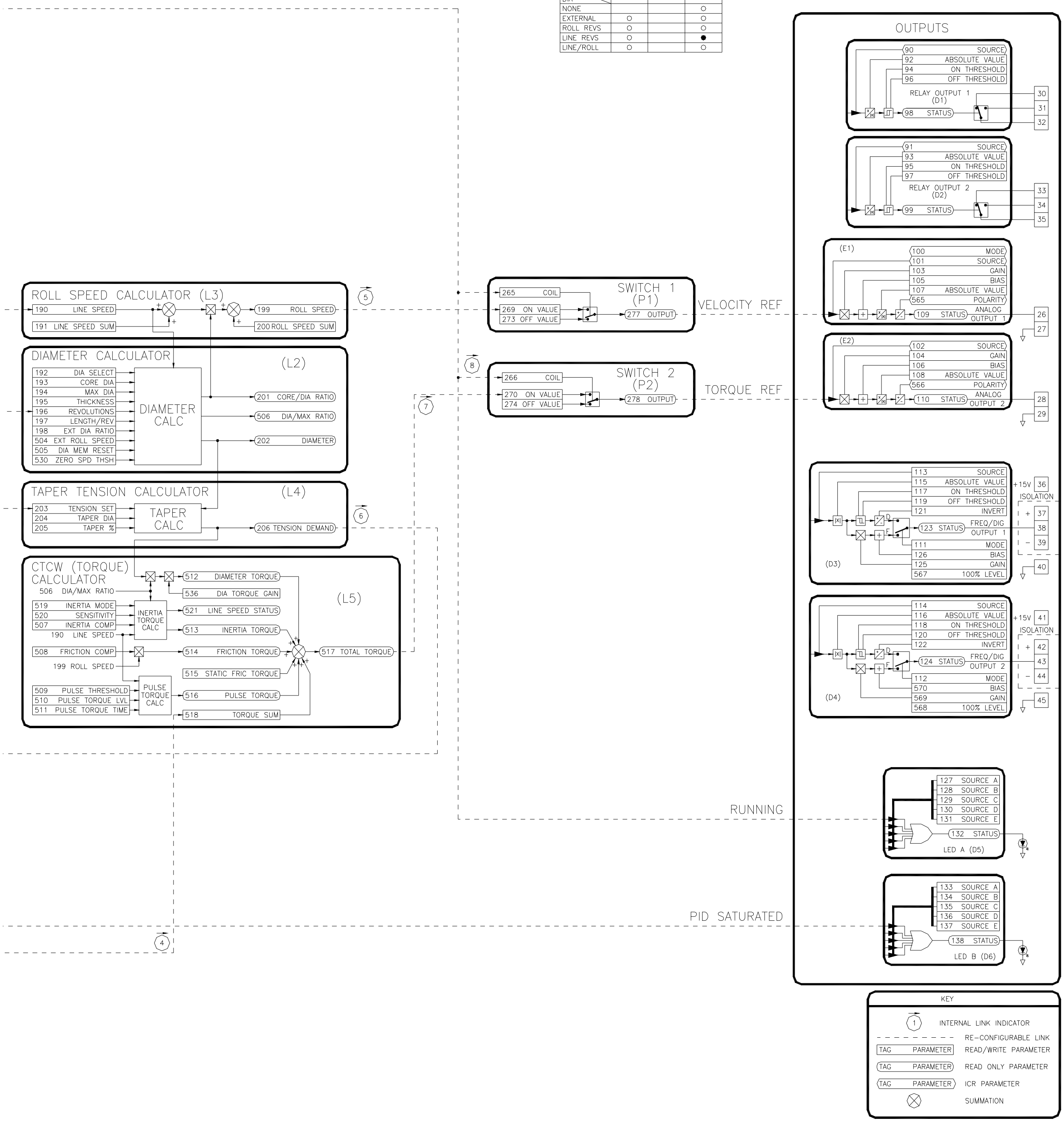
DRAWN BY: BKP	DATE: 5/23/19	CAROTRON — Driven by Excellence — HEATH SPRINGS, SC TEL 803-286-8614 FAX 803-286-6063
APPROVED BY:	DATE:	
TOLERANCES: ± 2 DEC. PL. ± .010" 3 DEC. PL. ± .005"		
		TITLE: CORTEX LT V2 APPLICATION PRESET SOFTWARE BLOCK DIAGRAMS
SCALE:		
DRAWING NUMBER: D14566	REV. A	SH. 17 OF 20

CORTEX LT V2 SOFT



WARE BLOCK DIAGRAM

SENSOR / DIA (TORQUE)	NONE	DANCER	LOADCELL
NONE			○
EXTERNAL	○		○
ROLL REVS	○		○
LINE REVS	○		●
LINE/ROLL	○		○

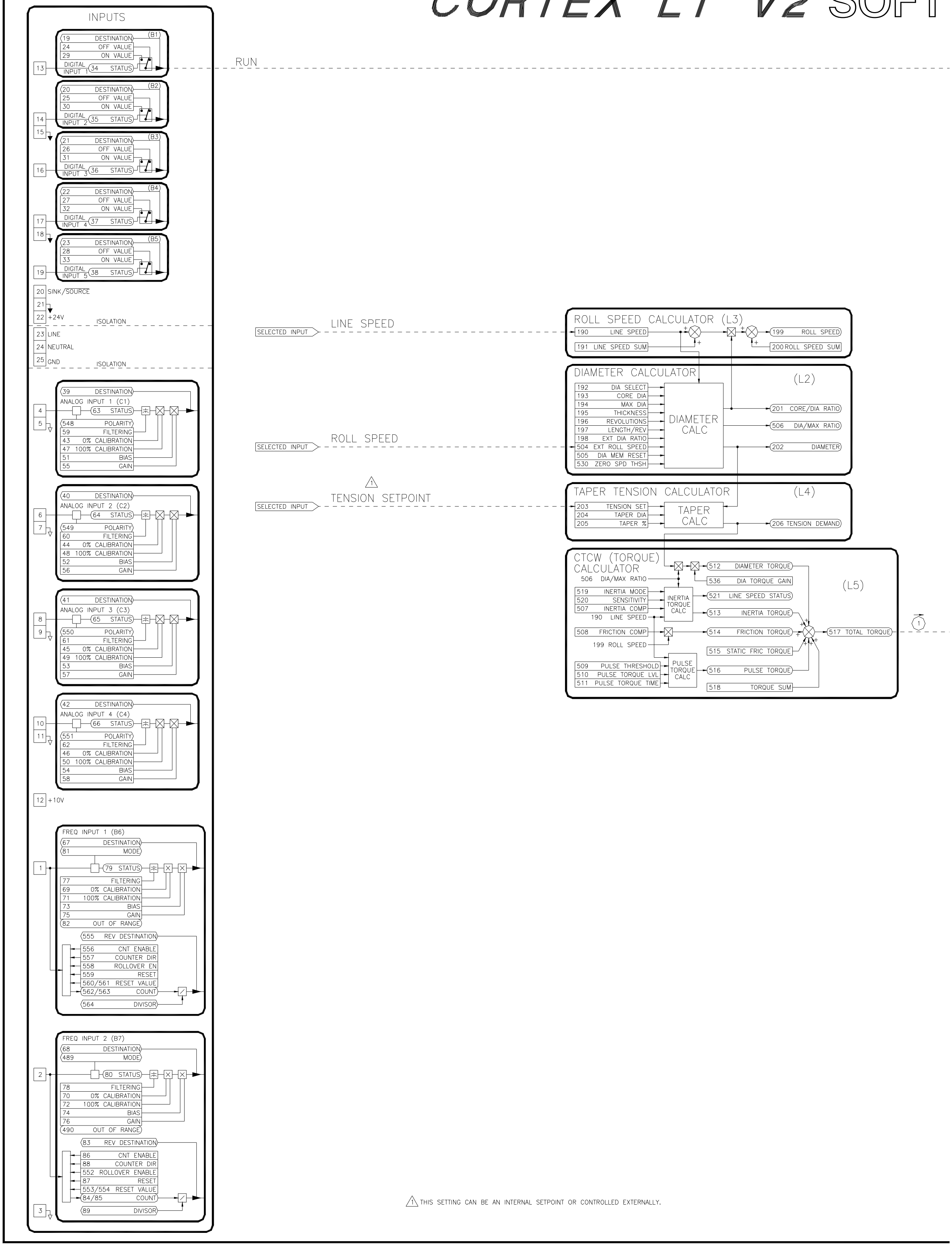


PROCESSING ORDER (Z1)

394	IL1	BLOCK 1
395	LG1	BLOCK 2
396	IL2	BLOCK 3
397	IL3	BLOCK 4
398	PID1	BLOCK 5
399	IL4	BLOCK 6
400	APP CALCS	BLOCK 7
401	IL5	BLOCK 8
402	IL6	BLOCK 9
403	IL7	BLOCK 10
404	SWI1	BLOCK 11
405	IL8	BLOCK 12
406	SWI2	BLOCK 13
407	IL9	BLOCK 14
408		BLOCK 15

DRAWN BY: BKP	DATE: 5/23/19	CAROTRON — Driven by Excellence
APPROVED BY:	DATE:	
TOLERANCES: ± 2 DEC. PL. = .010" 3 DEC. PL. = .005"		HEATH SPRINGS, SC TEL 803-286-8614 FAX 803-286-6063
SCALE:		TITLE: CORTEX LT V2 APPLICATION PRESET SOFTWARE BLOCK DIAGRAMS
DRAWING NUMBER: D14566	REV. A	SH. 18 OF 20

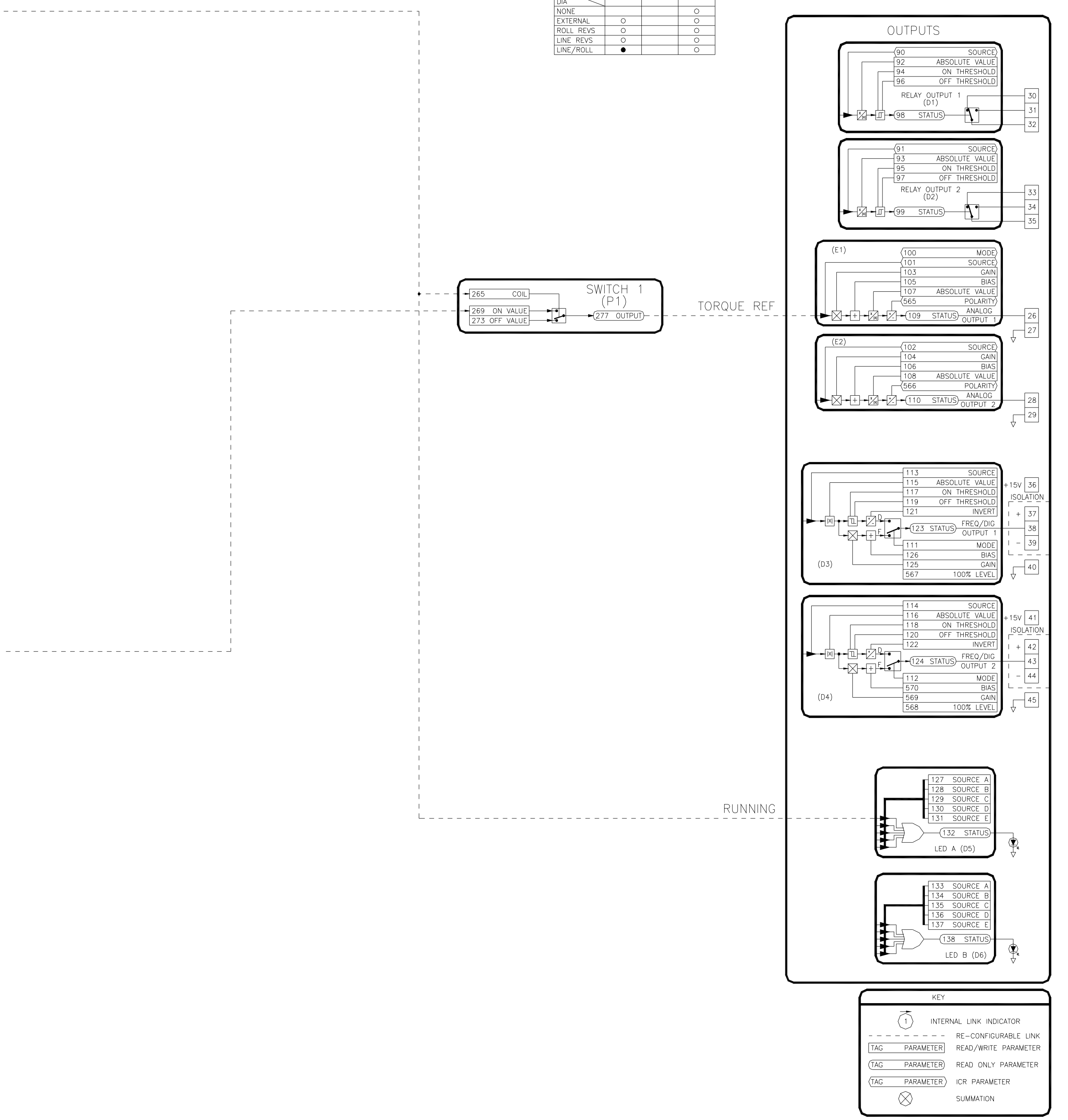
CORTEX LT V2 SOFT



WARE BLOCK DIAGRAM

TORQUE

SENSOR / DIA	NONE	DANCER	LOADCELL
NONE			○
EXTERNAL	○		○
ROLL REVS	○		○
LINE REVS	○		○
LINE/ROLL	●		○



PROCESSING ORDER (Z1)

394	APP CALCS	BLOCK 1
395	IL1	BLOCK 2
396	SWI1	BLOCK 3
397		BLOCK 4
398		BLOCK 5
399		BLOCK 6
400		BLOCK 7
401		BLOCK 8
402		BLOCK 9
403		BLOCK 10
404		BLOCK 11
405		BLOCK 12
406		BLOCK 13
407		BLOCK 14
408		BLOCK 15

DRAWN BY: BKP DATE: 5/23/19
APPROVED BY: DATE:
TOLERANCES: ±
2 DEC. PL. = .010"
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SCALE:

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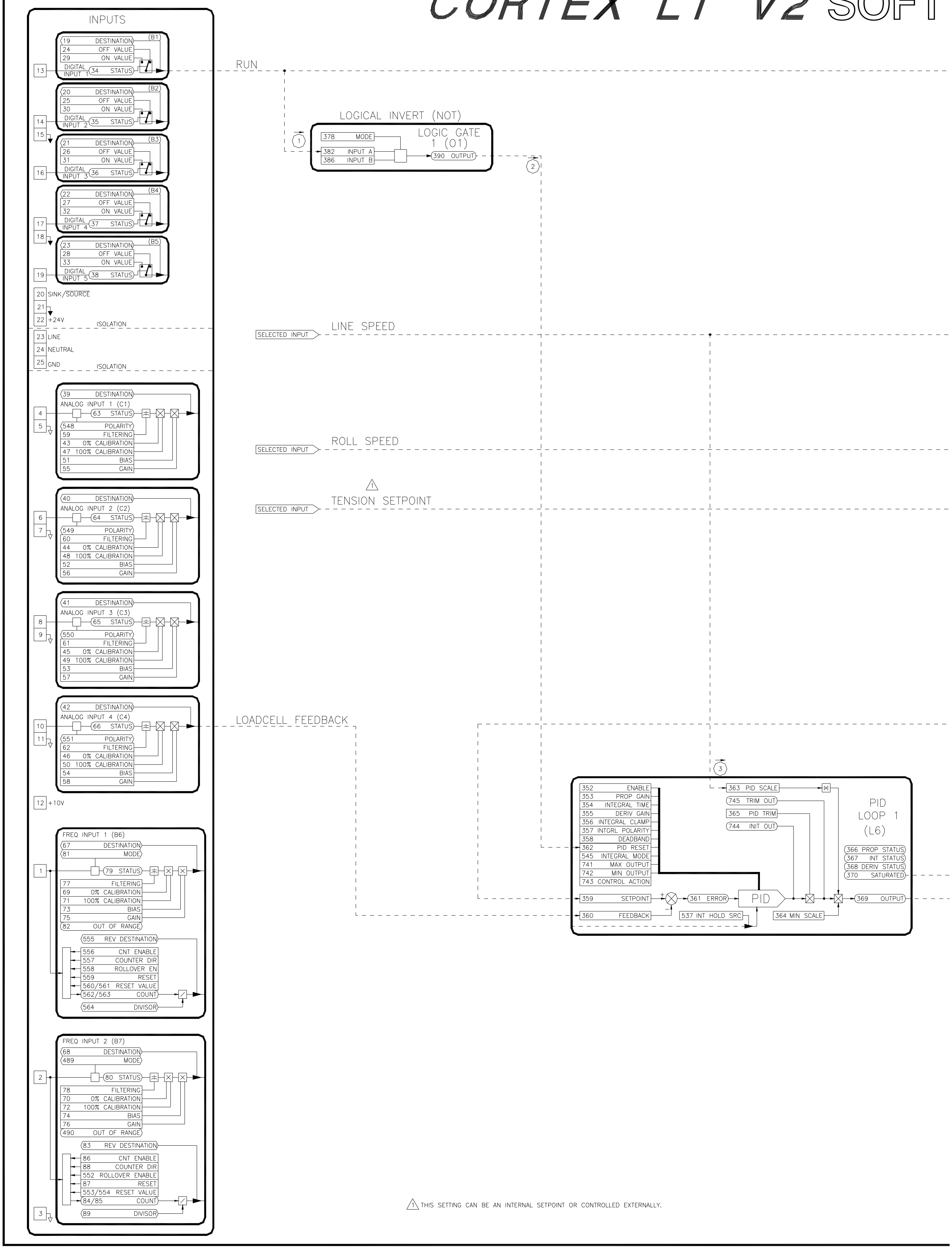
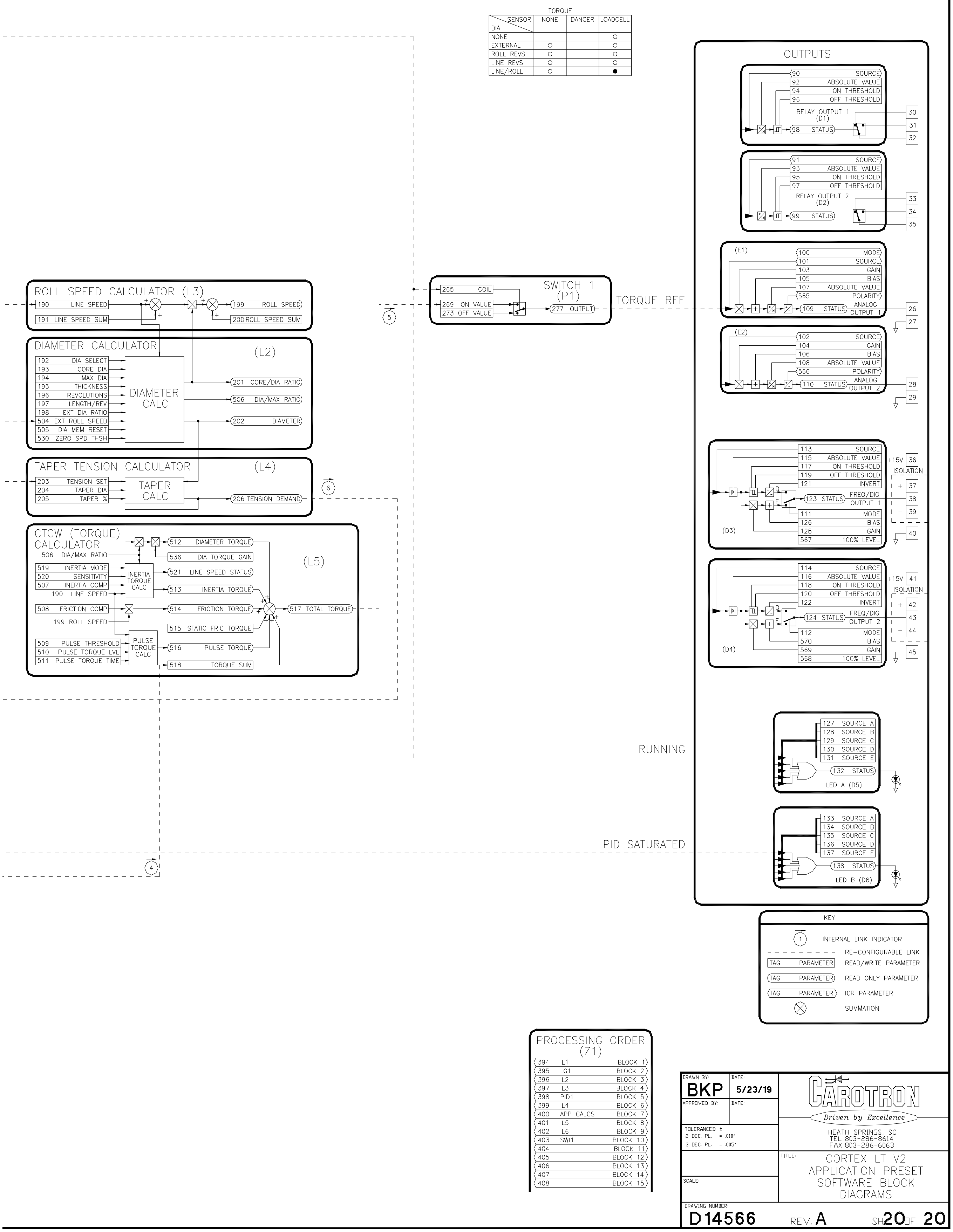
TITLE: CORTEX LT V2 APPLICATION PRESET SOFTWARE BLOCK DIAGRAMS

DRAWING NUMBER: D14566 REV. A SH. 19 OF 20

CORTEX LT V2 SOFT



WARE BLOCK DIAGRAM



9 Appendix

9.1 Modbus® Protocol

The Cortex® LT supports a subset of the Modbus® RTU communications protocol. This section describes the Cortex® LT's implementation of the protocol. For a complete detailed specification of the entire Modbus® protocol, please refer to http://www.modbus.org.

In the Cortex® LT, functions 1,2,3,4,5,6,8,15, & 16 are supported. The message format or frame varies depending upon which function code is used. Each frame is started by the slave address and ends with a CRC-16 error checking code. If the slave addresses do not match or the CRC-16 code is invalid, the slave ignores the message and no response is returned. The Cortex® LT acts as a slave (server) to a single master (client). Bus contentions are avoided since the Modbus master initiates all communications. Slave devices only place data on the bus in response to a master's request. Each slave device on the bus must have a unique network address.

Frames consist of 8 bit data bytes. Parity can set for None, Odd, or Even. Frames are separated on the bus by a silent period in which no data transmissions occur. This silent period thus signals devices on the bus when a frame has ended and can now begin to examine the frame data. Bytes within a frame must therefore be sent in a continuous stream to avoid silent periods.

The Modbus® protocol uses two general types of data: bits and registers. Registers are composed of 16 bits. Some slave devices further divide each of these data types depending upon its method of access (read-write or read-only). The Cortex® LT makes no distinction between read-write and read-only with respect to the command. For example, any register can be read by using Function Code 3 or 4, and any bit can be read using Function Codes 1 or 2. Attempts to write a value to a read-only parameter are ignored.

Since all of the Cortex® LT's parameters are implemented internally as 16 bit registers, each parameter can be accessed by using a bit or a register command. Thus, a register can be read or written to by a bit command. In these cases, any non-zero value is interpreted as True/On (1) and zero is interpreted as False/Off (0).

In the following, hexadecimal number are represented with an 'h' suffix and binary numbers with a 'b' suffix. Decimal data is shown with no suffix.

Code	Function	Data Type	Access	Data Type Code
1 (01h)	Read Bits	bit	(read-write)	0x
2 (02h)	Read Bits	bit	(read-only)	1x
3 (03h)	Read Multiple Registers	16 bit register	(read-write)	4x
4 (04h)	Read Multiple Registers	16 bit register	(read-only)	3x
5 (05h)	Write Single Bit	bit	(read-write)	0x
6 (06h)	Write Single Register	16 bit register	(read-write)	4x
8 (08h)	Diagnostics (Loopback)	-	-	-
15 (0Fh)	Write Multiple Bits	bit	(read-write)	0x
16 (10h)	Write Multiple Registers	16 bit register	(read-write)	4x

Table 12: Supported Modbus® Functions

Function Code 1 (01h) Read Bits
In this example, Function Code 1 is used to read the status of the 5 digital inputs (i.e. parameters 34-38). Digital Inputs 1, 2, & 4 are on.

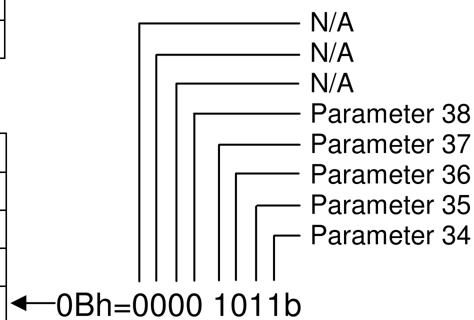
Master Command

Description		Data
Slave Address		01h
Function Code		01h
Starting Address	Upper	00h
	Lower	21h
Quantity	Upper	00h
	Lower	05h
CRC-16	Lower	ACh
	Upper	03h

34-1=0021h

Normal Slave Response

Description		Data
Slave Address		01h
Function Code		01h
Byte Count		01h
Data		0Bh
CRC-16	Lower	10h
	Upper	4Fh



Error Slave Response

Description		Data
Slave Address		01h
Function Code		81h
Error Code		02h
CRC-16	Lower	C1h
	Upper	91h

Function Code 2 (02h) Read Bits
In this example, Function Code 2 is used to read the status of the 5 digital inputs (i.e. parameters 34-38). Digital Inputs 2, 3, & 5 are on.

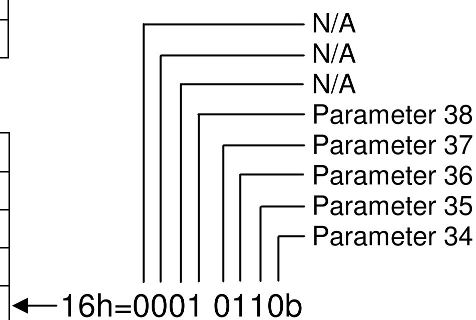
Master Command

Description		Data
Slave Address		01h
Function Code		02h
Starting Address	Upper	00h
	Lower	21h
Quantity	Upper	00h
	Lower	05h
CRC-16	Lower	E8h
	Upper	03h

34-1=0021h

Normal Slave Response

Description		Data
Slave Address		01h
Function Code		02h
Byte Count		01h
Data		16h
CRC-16	Lower	20h
	Upper	46h



Error Slave Response

Description		Data
Slave Address		01h
Function Code		82h
Error Code		03h
CRC-16	Lower	00h
	Upper	A1h

Function Code 3 (03h) Read Multiple Registers
In this example, Function Code 3 is used to read the status of the Analog Inputs 1 & 2 (i.e. parameters 63-64).

Master Command

Description		**Data**	
Slave Address		01h	
Function Code		03h	
Starting Address	Upper	00h	63-1=003Eh
	Lower	3Eh	
Quantity	Upper	00h	
	Lower	02h	
CRC-16	Lower	A5h	
	Upper	C7h	

Normal Slave Response

Description		**Data**	
Slave Address		01h	
Function Code		03h	
Byte Count		04h	
Register Data	Upper	04h	0414h=1044
	Lower	14h	
Register Data	Upper	08h	08A1h=2209
	Lower	A1h	
CRC-16	Lower	7Dh	
	Upper	7Fh	

Error Slave Response

Description		**Data**
Slave Address		01h
Function Code		83h
Error Code		02h
CRC-16	Lower	C0h
	Upper	F1h

Function Code 4 (04h) Read Multiple Registers

In this example, Function Code 4 is used to read the value of Line Speed (i.e. parameter 190). When read, the value of Line Speed was 56.47%.

Master Command

Description		Data	
Slave Address		01h	
Function Code		04h	
Starting Address	Upper	00h	190-1=00BDh
	Lower	BDh	
Quantity	Upper	00h	
	Lower	01h	
CRC-16	Lower	A1h	
	Upper	EEh	

Normal Slave Response

Description		Data	
Slave Address		01h	
Function Code		04h	
Byte Count		02h	
Register Data	Upper	16h	160Fh=5647
	Lower	0Fh	
CRC-16	Lower	F7h	
	Upper	54h	

Error Slave Response

Description		Data
Slave Address		01h
Function Code		84h
Error Code		03h
CRC-16	Lower	03h
	Upper	01h

Function Code 5 (05h) Write Single Bit
In this example, Function Code 5 is used to write a value of 1 to PID Loop 1 Enable (i.e. parameter 352).

Master Command

Description		**Data**
Slave Address		01h
Function Code		05h
Address	Upper	01h
	Lower	5Fh
Data	Upper	FFh
	Lower	00h
CRC-16	Lower	BDh
	Upper	D4h

352-1=015Fh

FF00h is used to turn bit on. 0000h would be used to turn bit off.

Normal Slave Response

Description		**Data**
Slave Address		01h
Function Code		05h
Address	Upper	01h
	Lower	5Fh
Register Data	Upper	FFh
	Lower	00h
CRC-16	Lower	BDh
	Upper	D4h

Error Slave Response

Description		**Data**
Slave Address		01h
Function Code		85h
Error Code		02h
CRC-16	Lower	C3h
	Upper	51h

Function Code 6 (06h) Write Single Register

In this example, Function Code 6 is used to write a value of 34.56% to Tension Setpoint (i.e. parameter 203).

Master Command

Description		Data	
Slave Address		01h	
Function Code		06h	
Address	Upper	00h	203-1=00CAh
	Lower	CAh	
Data	Upper	0Dh	3456=0D80h
	Lower	80h	
CRC-16	Lower	ACh	
	Upper	C4h	

Normal Slave Response

Description		Data
Slave Address		01h
Function Code		06h
Address	Upper	00h
	Lower	CAh
Register Data	Upper	0Dh
	Lower	80h
CRC-16	Lower	ACh
	Upper	C4h

Error Slave Response

Description		Data
Slave Address		01h
Function Code		86h
Error Code		02h
CRC-16	Lower	C3h
	Upper	A1h

Function Code 8 (08h) Diagnostics, Echo Data

In this example, Function Code 8 (Diagnostics) with Sub Code 0 (Echo Data) is used to test communications with a slave device. The slave should echo back the received data.

Master Command

Description		**Data**
Slave Address		01h
Function Code		08h
Sub Code	Upper	00h
	Lower	00h
Data	Upper	AAh
	Lower	55h
CRC-16	Lower	5Dh
	Upper	94h

Normal Slave Response

Description		**Data**
Slave Address		01h
Function Code		08h
Sub Code	Upper	00h
	Lower	00h
Data	Upper	AAh
	Lower	55h
CRC-16	Lower	5Eh
	Upper	94h

Error Slave Response

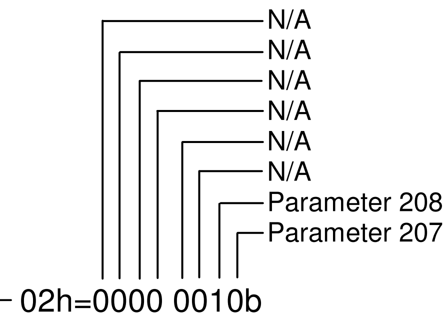
Description		**Data**
Slave Address		01h
Function Code		88h
Error Code		01h
CRC-16	Lower	87h
	Upper	C0h

Function Code 15 (0Fh) Write Multiple Bits
In this example, Function Code 15 is used to write a value of 1 to Ref Select 1 MSB and a value of 0 to Ref Select 1 LSB (i.e. parameters 207 & 208).

Master Command

Description		Data
Slave Address		01h
Function Code		0Fh
Start Address	Upper	00h
	Lower	CEh
Num Bits	Upper	00h
	Lower	02h
Byte Count		01h
Data		02h
CRC-16	Lower	36h
	Upper	86h

207-1=00CEh



Normal Slave Response

Description		Data
Slave Address		01h
Function Code		0Fh
Start Address	Upper	00h
	Lower	CEh
Num Bits	Upper	00h
	Lower	02h
CRC-16	Lower	B5h
	Upper	F5h

Error Slave Response

Description		Data
Slave Address		01h
Function Code		8Fh
Error Code		02h
CRC-16	Lower	C5h
	Upper	F1h

Function Code 16 (10h) Write Multiple Registers
In this example, Function Code 16 is used to write the values 10.5s and 20.6s to the Decel Times (i.e. parameters 259 & 260) of Accel/Decel Block 1 and 2.

Master Command

Description		Data	
Slave Address		01h	
Function Code		10h	
Start Address	Upper	01h	259-1=0102h
	Lower	02h	
Register Count	Upper	00h	
	Lower	02h	
Byte Count		04h	
Regiser Data	Upper	00h	105=0069h
	Lower	69h	
Regiser Data	Upper	00h	206=00CEh
	Lower	CEh	
CRC-16	Lower	2Eh	
	Upper	6Eh	

Normal Slave Response

Description		Data
Slave Address		01h
Function Code		10h
Start Address	Upper	01h
	Lower	02h
Register Count	Upper	00h
	Lower	02h
CRC-16	Lower	E1h
	Upper	F4h

Error Slave Response

Description		Data
Slave Address		01h
Function Code		90h
Error Code		02h
CRC-16	Lower	CDh
	Upper	C1h

9.3 CRC-16 Calculations

CRC stands for Cyclical Redundancy Check and is a 16 bit value appended to all Modbus® frames. When a device (either master or slave) places data on the bus, the CRC value is appended to the message. The receiving device also calculates a CRC value as it receives the message. The receiver compares its calculated value to the one received. A transmission error has occurred if the values do not match.

Please note that when the CRC value is appended to a message, the low byte is appended first followed by the upper byte. This is different from all other Modbus® data fields where the upper byte is sent first followed by the lower byte.

Below is some example C code to generate a CRC-16 value. The method used below provides for fast generation of the CRC value by using lookup tables that contain precalculated CRC values. Please refer to the Modbus® specification (available at http://www.modbus.org) for more details.

```
// The function returns the CRC value. Note that this function internally swaps the high and low CRC bytes.
// Thus, the resulting value can be appended directly to the Modbus message. Msg is a pointer to the
// message that CRC is to be calculated from. DataLen is the quantity of bytes in the message
unsigned int CRC16 (unsigned char *Msg, unsigned char DataLen)
        {
        unsigned char CRCHi = 0xFF;           // Initialize high byte of CRC
        unsigned char CRCLo = 0xFF;           // Initialize low byte of CRC
        unsigned char Index;                  // index into CRC lookup table
        while (DataLen--)                     // pass through message buffer
                {
                Index = CRCLo ^ *Msg++;       //calculate the CRC
                CRCLo = CRCHi ^ CRCHi[Index} ;
                CRCHi = CRCLo[Index] ;
                }
        return (CRCHi << 8 | CRCLo) ;
        }
```

High-Order Byte Table

```
// Table of CRC values for high–order byte
static unsigned char CRCHi[] = {
        0x00,0xC1,0x81,0x40,0x01,0xC0,0x80,0x41,0x01,0xC0,0x80,0x41,0x00,0xC1,0x81,0x40,
        0x01,0xC0,0x80,0x41,0x00,0xC1,0x81,0x40,0x00,0xC1,0x81,0x40,0x01,0xC0,0x80,0x41,
        0x01,0xC0,0x80,0x41,0x00,0xC1,0x81,0x40,0x00,0xC1,0x81,0x40,0x01,0xC0,0x80,0x41,
        0x00,0xC1,0x81,0x40,0x01,0xC0,0x80,0x41,0x01,0xC0,0x80,0x41,0x00,0xC1,0x81,0x40,
        0x01,0xC0,0x80,0x41,0x00,0xC1,0x81,0x40,0x00,0xC1,0x81,0x40,0x01,0xC0,0x80,0x41,
        0x00,0xC1,0x81,0x40,0x01,0xC0,0x80,0x41,0x01,0xC0,0x80,0x41,0x00,0xC1,0x81,0x40,
        0x00,0xC1,0x81,0x40,0x01,0xC0,0x80,0x41,0x01,0xC0,0x80,0x41,0x00,0xC1,0x81,0x40,
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        0x01,0xC0,0x80,0x41,0x00,0xC1,0x81,0x40,0x00,0xC1,0x81,0x40,0x01,0xC0,0x80,0x41,
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        0x01,0xC0,0x80,0x41,0x00,0xC1,0x81,0x40,0x00,0xC1,0x81,0x40,0x01,0xC0,0x80,0x41,
        0x00,0xC1,0x81,0x40,0x01,0xC0,0x80,0x41,0x01,0xC0,0x80,0x41,0x00,0xC1,0x81,0x40
        } ;
```

Low-Order Byte Table

// Table of CRC values for low–order byte

static char CRCLo[] = {

```
0x00,0xC0,0xC1,0x01,0xC3,0x03,0x02,0xC2,0xC6,0x06,0x07,0xC7,0x05,0xC5,0xC4,0x04,
0xCC,0x0C,0x0D,0xCD,0x0F,0xCF,0xCE,0x0E,0x0A,0xCA,0xCB,0x0B,0xC9,0x09,0x08,0xC8,
0xD8,0x18,0x19,0xD9,0x1B,0xDB,0xDA,0x1A,0x1E,0xDE,0xDF,0x1F,0xDD,0x1D,0x1C,0xDC,
0x14,0xD4,0xD5,0x15,0xD7,0x17,0x16,0xD6,0xD2,0x12,0x13,0xD3,0x11,0xD1,0xD0,0x10,
0xF0,0x30,0x31,0xF1,0x33,0xF3,0xF2,0x32,0x36,0xF6,0xF7,0x37,0xF5,0x35,0x34,0xF4,
0x3C,0xFC,0xFD,0x3D,0xFF,0x3F,0x3E,0xFE,0xFA,0x3A,0x3B,0xFB,0x39,0xF9,0xF8,0x38,
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0x78,0xB8,0xB9,0x79,0xBB,0x7B,0x7A,0xBA,0xBE,0x7E,0x7F,0xBF,0x7D,0xBD,0xBC,0x7C,
0xB4,0x74,0x75,0xB5,0x77,0xB7,0xB6,0x76,0x72,0xB2,0xB3,0x73,0xB1,0x71,0x70,0xB0,
0x50,0x90,0x91,0x51,0x93,0x53,0x52,0x92,0x96,0x56,0x57,0x97,0x55,0x95,0x94,0x54,
0x9C,0x5C,0x5D,0x9D,0x5F,0x9F,0x9E,0x5E,0x5A,0x9A,0x9B,0x5B,0x99,0x59,0x58,0x98,
0x88,0x48,0x49,0x89,0x4B,0x8B,0x8A,0x4A,0x4E,0x8E,0x8F,0x4F,0x8D,0x4D,0x4C,0x8C,
0x44,0x84,0x85,0x45,0x87,0x47,0x46,0x86,0x82,0x42,0x43,0x83,0x41,0x81,0x80,0x40
};
```

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Standard Terms & Conditions of Sale

1. General
The Standard Terms and Conditions of Sale of Carotron, Inc. (hereinafter called "Company") are set forth as follows in order to give the Company and the Purchaser a clear understanding thereof. No additional or different terms and conditions of sale by the Company shall be binding upon the Company unless they are expressly consented to by the Company in writing. The acceptance by the Company of any order of the Purchaser is expressly conditioned upon the Purchaser's agreement to said Standard Terms and Conditions. The acceptance or acknowledgement, written, oral, by conduct or otherwise, by the Company of the Purchaser's order shall not constitute written consent by the Company to addition to or change in said Standard Terms and Conditions.

2. Prices
Prices, discounts, allowances, services and commissions are subject to change without notice. Prices shown on any Company published price list and other published literature issued by the Company are not offers to sell and are subject to express confirmation by written quotation and acknowledgement. All orders of the Purchaser are subject to acceptance, which shall not be effective unless made in writing by an authorized Company representative at its office in Heath Springs, S.C. The Company may refuse to accept any order for any reason whatsoever without incurring any liability to the Purchaser. The Company reserves the right to correct clerical and stenographic errors at any time.

3. Shipping dates
Quotation of a shipping date by the Company is based on conditions at the date upon which the quotation is made. Any such shipping date is subject to change occasioned by agreements entered into previous to the Company's acceptance of the Purchaser's order, governmental priorities, strikes, riots, fires, the elements, explosion, war, embargoes, epidemics, quarantines, acts of God, labor troubles, delays of vendors or of transportation, inability to obtain raw materials, containers or transportation or manufacturing facilities or any other cause beyond the reasonable control of the Company. In no event shall the Company be liable for consequential damages for failure to meet any shipping date resulting from any of the above causes or any other cause.

In the event of any delay in the Purchaser's accepting shipment of products or parts in accordance with scheduled shipping dates, which delay has been requested by the Purchaser, or any such delay which has been caused by lack of shipping instructions, the Company shall store all products and parts involved at the Purchaser's risk and expense and shall invoice the Purchaser for the full contract price of such products and parts on the date scheduled for shipment or on the date on which the same is ready for delivery, whichever occurs later.

4. Warranty
The Company warrants to the Purchaser that products manufactured or parts repaired by the Company, will be free, under normal use and maintenance, from defects in material and workmanship for a period of one (1) year after the shipment date from the Company's factory to the Purchaser. The Company makes no warranty concerning products manufactured by other parties.

As the Purchaser's sole and exclusive remedy under said warranty in regard to such products and parts, including but not limited to remedy for consequential damages, the Company will at its option, repair or replace without charge any product manufactured or part repaired by it, which is found to the Company's satisfaction to be so defective; provided, however, that (a) the product or part involved is returned to the Company at the location designated by the Company, transportation charges prepaid by the Purchaser; or (b) at the Company's option the product or part will be repaired or replaced in the Purchaser's plant; and also provided that Cc) the Company is notified of the defect within one (1) year after the shipment date from the Company's factory of the product or part so involved.

The Company warrants to the Purchaser that any system engineered by it and started up under the supervision of an authorized Company representative will, if properly installed, operated and maintained, perform in compliance with such system's written specifications for a period of one (1) year from the date of shipment of such system.

As the Purchaser's sole and exclusive remedy under said warrant in regard to such systems, including but not limited to remedy for consequential damages, the Company will, at its option, cause, without charges any such system to so perform, which system is found to the Company's satisfaction to have failed to so perform, or refund to the Purchaser the purchase price paid by the Purchaser to the Company in regard thereto; provided, however, that (a) Company and its representatives are permitted to inspect and work upon the system involved during reasonable hours, and (b) the Company is notified of the failure within one (1) year after date of shipment of the system so involved.

The warranties hereunder of the Company specifically exclude and do not apply to the following:

a. Products and parts damaged or abused in shipment without fault of the Company.

b. Defects and failures due to operation, either intentional or otherwise, (l) above or beyond rated capacities, (2) in connection with equipment not recommended by the Company, or (3) in an otherwise improper manner.

c. Defects and failures due to misapplication, abuse, improper installation or abnormal conditions of temperature, humidity, abrasives, dirt or corrosive matter.

d. Products, parts and systems which have been in any way tampered with or altered by any party other than an authorized Company representative.

e. Products, parts and systems designed by the Purchaser.

f. Any party other than the Purchaser.

The Company makes no other warranties or representation, expressed or implied, of merchantability and of fitness for a particular purpose, in regard to products manufactured, parts repaired and systems engineered by it.

5. Terms of payment
Standard terms of payment are net thirty (30) days from date of the Company invoice. For invoice purposed, delivery shall be deemed to be complete at the time the products, parts and systems are shipped from the Company and shall not be conditioned upon the start up thereof. Amounts past due are subject to a service charge of 1.5% per month or fraction thereof.

6. Order cancellation
Any cancellation by the Purchaser of any order or contract between the Company and the Purchaser must be made in writing and receive written approval of an authorized Company representative at its office in Heath Springs, S.C. In the event of any cancellation of an order by either party, the Purchaser shall pay to the Company the reasonable costs, expenses, damages and loss of profit of the Company incurred there by, including but not limited to engineering expenses and expenses caused by commitments to the suppliers of the Company's subcontractors, as determined by the Company.

7. Changes
The Purchaser may, from time to time, but only with the written consent of an authorized Company representative, make a change in specifications to products, parts or systems covered by a purchase order accepted by the company. In the event of any such changes, the Company shall be entitled to revise its price and delivery schedule under such order.

8. Returned material
If the Purchaser desires to return any product or part, written authorization thereof must first be obtained from the Company which will advise the Purchaser of the credit to be allowed and restocking charges to be paid in regard to such return. No product or part shall be returned to the Company without a "RETURNTAG" attached thereon which has been issued by the Company.

9. Packing
Published prices and quotations include the Company's standard packing for domestic shipment. Additional expenses for special packing or overseas shipments shall be paid by the Purchaser. If the Purchaser does not specify packing or accepts parts unpacked, no allowance will be made to the Purchaser in lieu of packing.

10. Standard transportation policy
Unless expressly provided in writing to the contrary, products, parts and systems are sold f.o.b. first point of shipment. Partial shipments shall be permitted, and the Company may invoice each shipment separately. Claims for non-delivery of products, parts and systems, and for damages thereto must be filed with the carrier by the Purchaser. The Company's responsibility therefor shall cease when the carrier signs for and accepts the shipment.

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