



# AN-6601

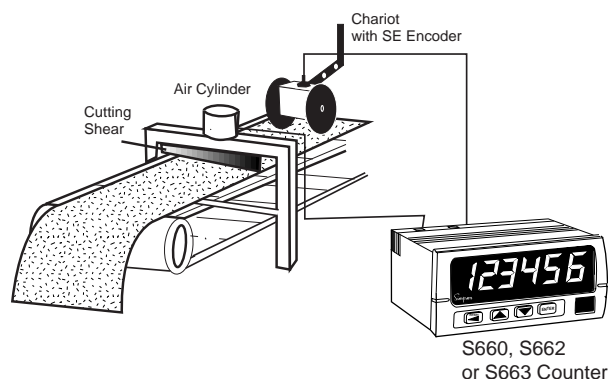
## Length Measurement

Technical Level: Intermediate

### Application Description

A Simpson Encoder and Counter are to be used to measure and cut raw material to length. A dual speed motor is used to allow selection of high speed, low speed and stop. A pneumatic shear allows the material to be cut.

Material is to be initially fed at high speed. In the final 6 inches, low speed will be used. When the desired length is reached, the motor will be temporarily stopped and the shear activated for 2 seconds. The feed and cut cycle then resumes for a new piece.



### Machine Specifications

- Motor and Control:** Motor runs in low speed when 120 VAC applied to Run-Lo terminal. Hi speed selected with 120 VAC to Run-Hi terminal. Maximum control current is 3 Amps at either terminal. Hi speed = 1725 RPM, Low speed = 430 RPM
- Shear Specifications:** The pneumatic cutting blade is activated by applying 120 VAC (0.5 Amp maximum) to a control valve.
- Mechanical:** A motor reducer and drive pulley result in 1" of linear travel for every 5 motor revolutions.
- Process:** Minimum and maximum piece length will be 12 inches and 6000 inches (500 feet) respectively. Material is a light colored textile, so skidding by measuring device is to be avoided.
- Display:** Desired display and entry of lengths is in inches with 2 decimal places (1/100 inch resolution).  
ie: The customer would like to enter 0.25 inch increments.

## Product Selection

When selecting an encoder and counter, initial computations are required to insure that maximum operation speeds will not be exceeded.

Using 12" measure wheel with non-skid rim (Simpson # **46005**) and chariot (Simpson # **46012**).

$$\text{Max. Material Speed} = \frac{\text{Max. Motor Speed}}{\text{Motor to Belt Ratio}} = \frac{1725 \text{ Rev/Min}}{5 \text{ Rev/Inch}} = 345 \text{ Inch/Min} = 5.75 \text{ Inch/Sec}$$

$$\text{Max. Encoder speed} = \frac{5.75 \text{ Inch/Sec}}{12 \text{ Inch/Rev}} = 0.4792 \text{ Rev/Sec}$$

Selecting an encoder for maximum resolution, use a 600 pulse encoder (Simpson Model **SE-600**). Now computing encoder output frequency:

$$\text{Encoder Output Freq.} = \text{Encoder (RPS)} \times \text{Encoder (PPR)} = 0.4792 \text{ Rev/Sec} \times 600 \text{ Pulses/Rev} = \mathbf{287.52 \text{ Pulses/Sec}}$$

The encoder output frequency is well below the encoder maximum frequency of 10 KHz. For added resolution, X4 Quadrature mode will be used:

$$\text{Measurement Resolution (Quad X4)} = \frac{\text{Wheel Diameter}}{\text{Encoder (PPR)} \times 4} = \frac{12 \text{ Inches}}{600 \times 4} = \mathbf{0.005 \text{ Inch}}$$

Preset Totalizer / Counter (Simpson Model **S660**) operating from 120 VAC power has the required capabilities. By adding 12V Excitation to power the encoder and Dual Relay Module, a complete counter system has been configured.

## Product Ordering Information

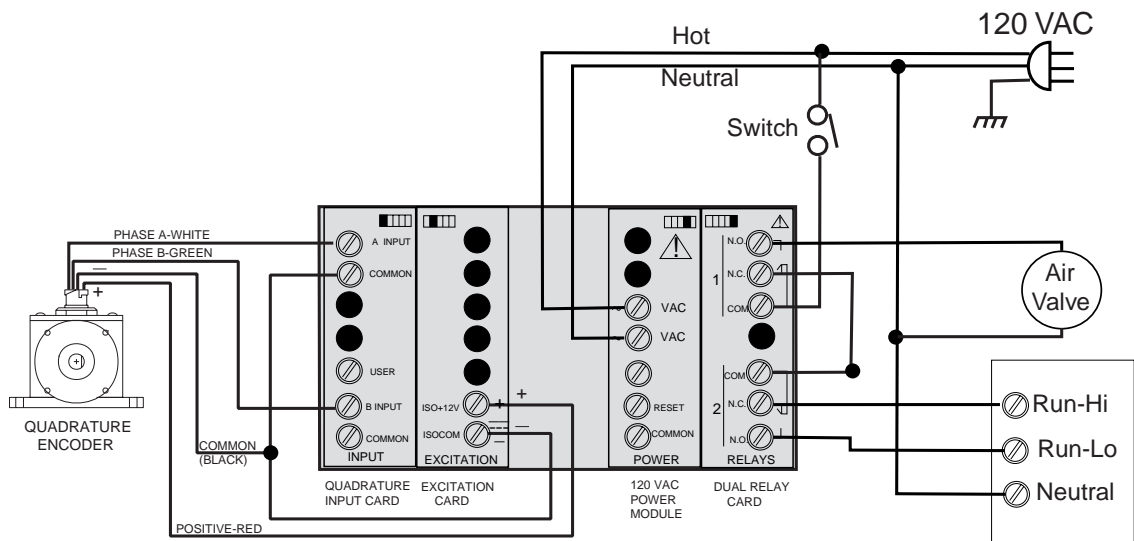
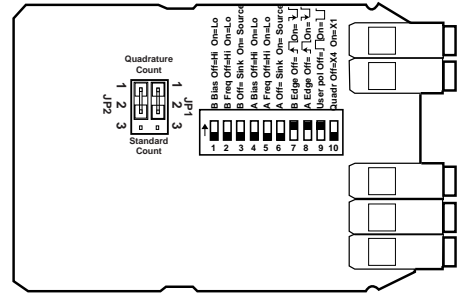
Qty	Simpson Part #	Description																																	
1	<b>46005</b>	12 inch measuring wheel with 83A durometer non-marking tire																																	
1	<b>46012</b>	Encoder Chariot																																	
1	<b>SE-600</b>	Quadrature Encoder, 600 pulses per revolution																																	
1	<b>S660-1-2-2-1-0</b>	<table border="0" style="width: 100%; text-align: center;"> <tr> <td style="border: 1px solid black; padding: 2px;">Model</td> <td>—</td> <td style="border: 1px solid black; padding: 2px;">Power</td> <td>—</td> <td style="border: 1px solid black; padding: 2px;">Input</td> <td>—</td> <td style="border: 1px solid black; padding: 2px;">Output</td> <td>—</td> <td style="border: 1px solid black; padding: 2px;">Excitation</td> <td>—</td> <td style="border: 1px solid black; padding: 2px;">Other</td> </tr> <tr> <td>↓</td> <td></td> <td>↓</td> <td></td> <td>↓</td> <td></td> <td>↓</td> <td></td> <td>↓</td> <td></td> <td>↓</td> </tr> <tr> <td><b>S660</b></td> <td></td> <td><b>120VAC=1</b> <b>240VAC=2</b></td> <td></td> <td><b>Standard=1</b> <b>Quadrature=2</b></td> <td></td> <td><b>None=0</b> <b>1 Relay=1</b> <b>2 Relay=2</b></td> <td></td> <td><b>None=0</b> <b>12 VDC=1</b></td> <td></td> <td><b>None=0</b></td> </tr> </table>	Model	—	Power	—	Input	—	Output	—	Excitation	—	Other	↓		↓		↓		↓		↓		↓	<b>S660</b>		<b>120VAC=1</b> <b>240VAC=2</b>		<b>Standard=1</b> <b>Quadrature=2</b>		<b>None=0</b> <b>1 Relay=1</b> <b>2 Relay=2</b>		<b>None=0</b> <b>12 VDC=1</b>		<b>None=0</b>
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## Hardware Setup :

Since an SE Encoder is being used, the Quadrature input card will use the default settings. The exception is that X4 quadrature mode will be used, setting Switch 10 to OFF.

Output #1 will activate the Shear. Output #2 will select the motor speed. By using the Output #1 NC contact as the Run Control Signal, the motor will not run when the shear is active.

A switch enables automatic operation in the On position. When Off, material may be loaded and adjusted manually.



## Counter Programming:

A count down sequence will be used so that the slow down point may be a fixed number (6). If a count up sequence were to be used, this slow down point would always have to be adjusted with the set material length. This method allows the machine operator to set the length by changing one value (Reset Position).

## Scaling Requirements:

Since Quad X4 mode is selected, the encoder will produce 2400 pulses for every turn of the 12" measuring wheel (600 x 4). As previously calculated, the encoder resolution is Inches / Pulses = 0.005 Inch, which also serves as our Scaling Multiplier.

$$\text{Scaling Multiplier (Inches)} = \text{Encoder Resolution} = 0.005.$$

Since the display resolution is to be to the nearest 1/100 inch, multiply by 100:

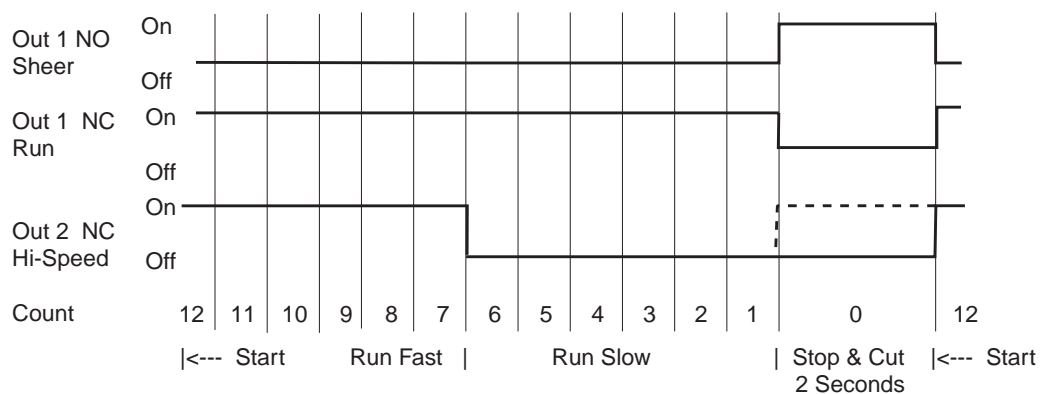
$$\text{Scaling Multiplier (1/100 Inches)} = \text{Scaling Multiplier (Inches)} \times 100 = \mathbf{0.5}$$

A Decimal Point must be placed 2 positions from the right. Use DP format "0000.00".

## Control Requirements:

1. The Cut signal (Output 1) will be fired when the count = zero for 2 seconds.
2. Output 2 will control the motor speed. The High speed motor control signal should be active when the count is above 6.00. Since the Normally Closed contact is used, Output 2 must be ON when the count is at or below 6.00.
3. The Count will be reset after the shear activation time or when a manual reset (reset button pressed) occurs.

The following diagram illustrates the behavior of a machine cycle. Note that the count may fall below zero depending on how quickly the motor stops. Since the High Speed control signal is wired in series with the Run signal, the output state indicated by the dotted line is effectively forced Off.



## S660 Programming

Category	Parameter	Selection	Comments
Input SETUP	QUAD	Quad or rQuad	Chose the quadrature mode (Quad or Reverse Quad) that will result in reverse counting when material is moved forward.
Count SETUP	PRESCAL	10	A pre-scaler is not required in this application.
Count SETUP	SCALE	00.5000	See <b>Scaling Requirements</b> discussion above.
Count SETUP	DP	0000.00	Displaying inches with 2 decimal places.
Output 1 SETUP	MODE 1	ENABLE	See <b>Control Requirements</b> discussion above. SP1 will serve as activation value.
Output 1 SETUP	DELAY 1	2.00	2 second delay time.
Output 2 SETUP	MODE2	bound	See <b>Control Requirements</b> discussion above. SP3 / SP4 serve as Low / High boundary values.
SETPnt SETUP	SP 1	0000.00	Activate shear at 0" position.
SETPnt SETUP	SP2	-----	SP2 is not used in this application.
SETPnt SETUP	SP3	0000.00	Output 2 ON between 0" (low boundary)
SETPnt SETUP	SP4	0006.00	and 6" (high boundary).
SETPnt SETUP	rStPos	00 12.00	This sets the material piece length. In this example, 12".
rESEt SETUP	ArESEt	AFtoP 1	Perform Auto-Reset after output 1 has timed out. See item 3.
rESEt SETUP	rStbtn	ENABLE	The counter's reset button is enabled in this application.

## Application Expansion

1. Use a Simpson Model S662 Batch Counter to perform the same control tasks while giving the capability to totalize number of pieces produced.
2. Use a Simpson Model S663 Counter / Rate meter to perform the same control tasks while displaying the material speed.