**Simpson S66x Counter Series Application Note**

# AN-6604

## Position Measurement

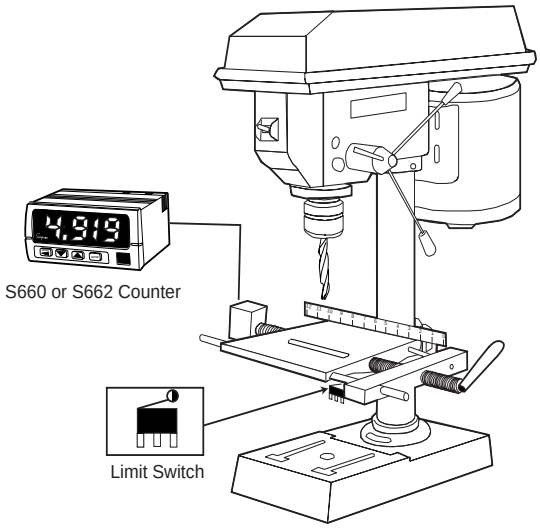
**Technical Level: Intermediate**

## Application Description

A Simpson Encoder and Counter are to provide digital position indication of a drill press table. The position of the table is adjusted by a hand crank.

To prevent fixture damage, the Counter is to allow drill operation only if the table is located within the legal drilling area.

A limit switch will also be employed to perform a homing / zeroing capability.




### *Machine Specifications*

Motor Control: Operation of the drill motor is controlled via a latching control relay. The relay coil is operated by 120 VAC and draws less than 1 Amp. The existing run / stop buttons (normally open / normally closed respectively) are to remain.

Mechanical: An anti-backlash worm gear produces 1 inch of linear travel for every 12 crankshaft revolutions. The total travel of the table is from 0 to 13.0 inches. Through observation, it has been found that the fastest operator can move the table at 0.5 inches per second.

Limit Switch: A plunger type limit switch will be attached such that it will actuate near the 0.5 inch position ±0.25". The mechanical 0" stop will prevent the switch from overtravel.

Process: To prevent drilling into the fixture, operation must limited to positions between 1" and 12".

Display: Desired display of position is in inches with 3 decimal places (1/1000 inch resolution).

# Product Selection

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

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

The encoder maximum frequency is 10 KHz. Selecting an encoder for maximum resolution:
Maximum Allowed Pulse Rate = 0.5 inch/sec x 12 turns/inch x (**Encoder Pulses/turn**) = 10,000 Pulses/Sec

Solving for (**Encoder Pulses/turn**) = $\frac{10{,}000 \text{ Pulses/Sec}}{0.5 \text{ inch/sec} \times 12 \text{ turns/inch}}$ = **1666.66 Pulses/turn**

Using a 600 pulse encoder (Simpson # **SE-600**) with X1 Quadrature mode:

Maximum Pulse Rate = 0.5 in/sec x 12 turns/inch x 600 Pulses/turn = 3,600 Pulses/Sec

**Encoder Resolution** = 12 turns/inch x 600 Pulses/turn = **7,200 Pulses/inch**

## Product Ordering information

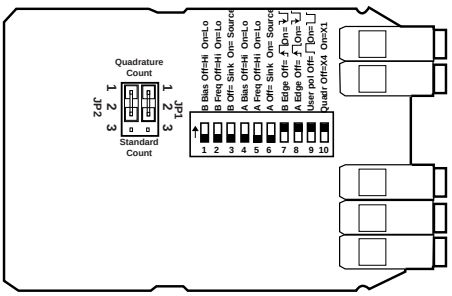
| Qty | Simpson Part # | Description |
|---|---|---|
| 1 | **SE-600** | Quadrature Encoder, 600 pulses per revolution |
| 1 | **S660-1-2-1-1-0** | Model — Power — Input — Output — Excitation — Other<br>**S660** / **120VAC=1** 240VAC=2 / Standard=1 **Quadrature=2** / None=0 **1 Relay=1** 2 Relay=2 / None=0 **12 VDC=1** / **None=0** |

## Hardware Setup :

Since an SE Encoder is being used, the Quadrature input card will use the default settings. Note that X1 Quadrature mode will be used, setting Switch 10 to ON.

Output Relay #1 Normally Open contact will enable drill operation.

The limit switch is connected to the Reset and Common terminals located at the Power Supply card.



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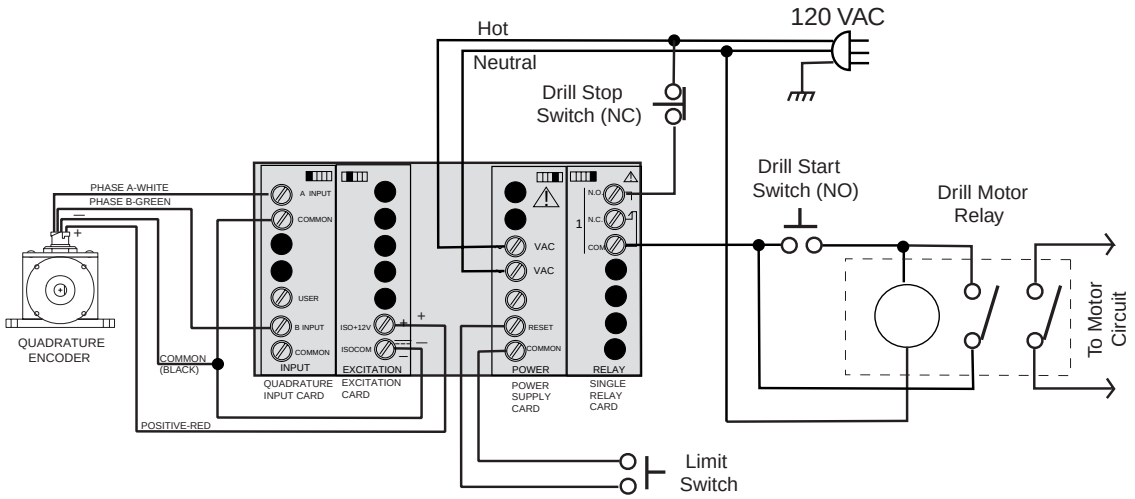


## Counter Programming:

As computed during the selection process, the encoder will produce 7,200 counts for 1" of linear travel. Scaling counts to inches requires the inverse of pulses/inch:

Scaling = 7,200 count/inch = 0.000138888 inch/count

To produce a display in thousandths of inches, multiply by 1000:

**Scaling** (1/1000 inch) = 0.000138888 x 1000 = **0.138888**

Since the scaling factor has significant figures below 4 places to the right of the decimal, this can be rounded to **0.1389**.

A boundary control operation on output #1 will perform the motor enable function.

The Reset function of the S660 operates as an 'asynchronous' reset. This means that the count is overrided with the RstPos value whenever the switch is active, thus counting is essentially disabled when the table is at or below the switch position. Homing of the fixture now occurs 'automatically' anytime the table is moved to the minimum end of travel.

Since the switch is at a fixed position, the RstPos value must be adjusted to compensate.

Adjustment procedure (to be perfomed if the switch and/or fixture is replaced or removed):

1. Position the table to a point at or below the switch activation point (when counting stops).

2. Position the table to a known position (perhaps using a reference block).

3. Adjust the RstPos value in the counter by the error displayed.
   Example: Target position = 2.000", Reading = 2.018", Current RstPos = 0.387"
   Error = 2.000" - 2.018" = - 0.018"
   New RstPos = 0.387 + (-0.018) = 0.369

**S660 Programming**

| Category | Parameter | Selection | Comments |
|---|---|---|---|
| inPut SEtuP | A CHAn | 9uAd or r9uAd | Choose the quadrature mode (Quad or Reverse Quad) that will result in correct direction of count. |
| Count SEtuP | PrESCL | 1.0 | A pre-scaler is not used in this application. |
| Count SEtuP | SCALE | 00.1389 | See scaling discussion above. |
| Count SEtuP | dP | 000.000 | Displaying inches with 3 decimal places. |
| oPut 1 SEtuP | MModE 1 | bound | Output will be active if within limit boundaries SP1 and SP2. |
| SEtPnt SEtuP | SP 1 | 00 1.000 | Minimum operate position at 1inch. |
| SEtPnt SEtuP | SP2 | 0 12.000 | Maximum operate position at 12 inches. |
| SEtPnt SEtuP | rStPoS | 000.369 | This sets references the limit switch. See also adjustment procedure. |
| rESEt SEtuP | ArESEt | di SAbLE | Auto-Reset must be disabled for this application. |
| rESEt SEtuP | rStbtn | di SAbLE | Prevent an accidental reset. |

## Application Expansion

1. Use a Simpson Model S662 to perform this application while adding the capability to display the position in millimeters (Count2) as well as inches (Count1).

2. Use a second Simpson Model S660 Counter to perform control of a 2nd independent axis for a two dimensional drill table.