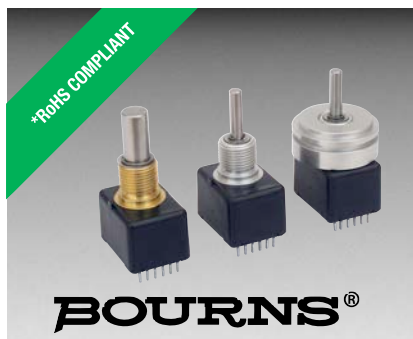




## Features

- 3.3 and 5 VDC voltage supply option
- Quadrature output
- Bushing or servo mount
- Non-contacting magnetic technology
- Small size
- CMOS and TTL compatible
- Resolution from 32-256 PPR
- Long life
- High operating speed
- Highly repeatable
- Sealed option
- Magnetic technology

## EMS22Q - Non-Contacting Incremental Encoder

### Electrical Characteristics

|                                           |                                         |
|-------------------------------------------|-----------------------------------------|
| Resolution .....                          | 32 to 256 PPR                           |
| Insulation Resistance (500 VDC) .....     | 1,000 megohms                           |
| Electrical Travel .....                   | Continuous                              |
| Supply Voltage .....                      | 5.0 VDC $\pm 10\%$ , 3.3 VDC $\pm 10\%$ |
| Supply Current .....                      | 20 mA maximum                           |
| Output Voltage                            |                                         |
| Low Output Level .....                    | Vss+0.4 V maximum                       |
| High Output Level .....                   | Vdd-0.5 V minimum                       |
| Output Current                            |                                         |
| With 4.5 VDC Supply Voltage .....         | 4 mA maximum                            |
| With 3.0 VDC Supply Voltage .....         | 2 mA maximum                            |
| Rise/Fall Time (Incremental Output) ..... | 500 ns maximum                          |
| Shaft RPM (Ball Bearing) .....            | 10,000 rpm maximum                      |
| Hysteresis .....                          | 0.7 °                                   |
| Accuracy                                  |                                         |
| Nominal .....                             | $\pm 0.7^\circ$ or better               |
| Worst Case .....                          | $\pm 1.4^\circ$                         |
| Output Transition Noise .....             | 0.12 ° RMS max.                         |

### Environmental Characteristics

|                                                        |                                       |
|--------------------------------------------------------|---------------------------------------|
| Operating Temperature Range .....                      | -40 °C to +125 °C (-40 °F to +257 °F) |
| Storage Temperature Range .....                        | -55 °C to +125 °C (-67 °F to +257 °F) |
| Humidity .....                                         | MIL-STD-202, Method 103B, Condition B |
| Vibration .....                                        | 15 G                                  |
| Shock .....                                            | 50 G                                  |
| Rotational Life                                        |                                       |
| S Bushing (@1,000 rpm) .....                           | 100,000,000 revolutions               |
| T & W Bushings (@1,000 rpm with 250 g side load) ..... | 50,000,000 revolutions                |
| IP Rating .....                                        | IP 65                                 |

### Mechanical Characteristics

|                         |                                                                                                  |
|-------------------------|--------------------------------------------------------------------------------------------------|
| Mechanical Angle .....  | 360 ° Continuous                                                                                 |
| Torque                  |                                                                                                  |
| Starting .....          | 43 $\pm 21$ g-cm (0.6 $\pm 0.3$ oz-in.)                                                          |
| Running .....           | 29 $\pm 14$ g-cm (0.4 $\pm 0.2$ oz-in.)                                                          |
| Mounting Torque .....   | 203 N-cm (18 lb.-in.)                                                                            |
| Shaft End Play .....    | 0.30 mm (0.012 ") T.I.R. maximum                                                                 |
| Shaft Radial Play ..... | 0.12 mm (0.005 ") T.I.R. maximum                                                                 |
| Weight .....            | 11 gms. (0.4 oz.)                                                                                |
| Terminals .....         | Axial, radial or ribbon cable                                                                    |
| Soldering Condition     |                                                                                                  |
| Manual Soldering .....  | 96.5Sn/3.0Ag/0.5Cu solid wire or no-clean rosin cored wire<br>370 °C (700 °F) max. for 3 seconds |
| Wave Soldering .....    | 96.5Sn/3.0Ag/0.5Cu solder with no-clean flux<br>260 °C (500 °F) max. for 10 seconds              |
| Wash processes .....    | Not recommended                                                                                  |
| Marking .....           | Manufacturer's trademark, name, part number, and date code.                                      |
| Hardware .....          | One lockwasher and one mounting nut supplied with each encoder, except on servo mount versions.  |

### Pin Configuration

| Output Type    | Pin 1 | Pin 2 | Pin 3 | Pin 4 | Pin 5 | Pin 6 |
|----------------|-------|-------|-------|-------|-------|-------|
| A/B Quadrature | A     | B     | GND   | Index | VCC*  | CS**  |

\* Can be 5 or 3.3 VDC depending on the version.

\*\* Active low chip select pin; if not used connect pin 6 to GND.



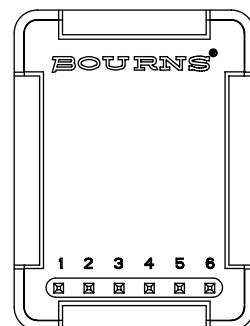
**WARNING Cancer and Reproductive Harm - [www.P65Warnings.ca.gov](http://www.P65Warnings.ca.gov)**

\*RoHS Directive 2002/95/EC Jan. 27, 2003 including annex and RoHS Recast 2011/65/EU June 8, 2011.

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## Applications

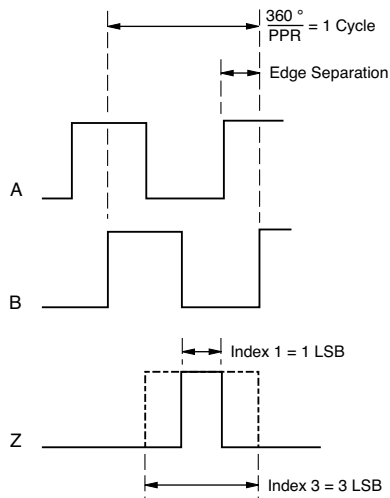
- Material handling equipment
- Brushless DC motor commutation
- Robotics
- Automotive
- Industrial automation
- Petroleum refinery
- Medical (low/medium risk)\*
- Office equipment
- Audio and broadcast equipment

## EMS22Q - Non-Contacting Incremental Encoder

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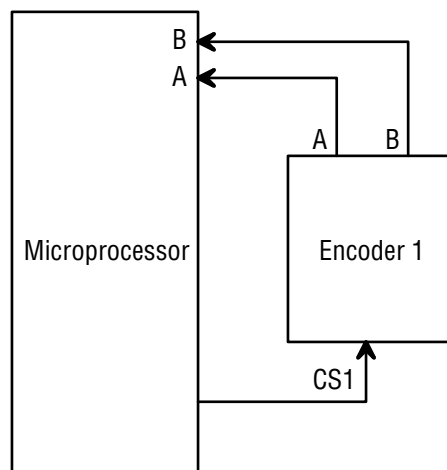
### Output Type Waveform and Variant Table

#### Quadrature Output



Minimum edge separation =  $20 \times 256 / \text{PPR}$  (no missing pulses)

| PPR | 3.3 Vcc | 5.0 Vcc | Index 1 | Index 3 |
|-----|---------|---------|---------|---------|
| 256 | X       |         | X       |         |
| 256 | X       |         |         | X       |
| 256 |         | X       | X       |         |
| 256 |         | X       |         | X       |
| 128 | X       |         | X       |         |
| 128 | X       |         |         | X       |
| 128 |         | X       | X       |         |
| 128 |         | X       |         | X       |
| 64  | X       |         | X       |         |
| 64  | X       |         |         | X       |
| 64  |         | X       | X       |         |
| 64  |         | X       |         | X       |
| 32  | X       |         | X       |         |
| 32  | X       |         |         | X       |
| 32  |         | X       | X       |         |
| 32  |         | X       |         | X       |



Chip Select Hardware Sample

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- Wire lead or cable options
- Connectors
- Non-standard resolutions
- Special shaft/bushing sizes and features
- Special performance characteristics
- PCB mounting bracket

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### Shaft Style D (Bushing T)



Technical drawing of the Bourns 3000 Series Panel Mount Potentiometer. The drawing includes front, side, and detail views with dimensions in millimeters (MM) and inches (INCHES).

**Front View Dimensions:**

- Overall Width:  $15.88 \pm .25$  (MM) /  $(.625 \pm .010)$  (INCHES)
- Overall Height:  $21.21 \pm .25$  (MM) /  $(.835 \pm .010)$  (INCHES)
- Bottom Lug Width:  $2.79 \pm .12$  (MM) /  $(.110 \pm .005)$  (INCHES)
- Bottom Lug Height:  $2.01 \pm .12$  (MM) /  $(.079 \pm .005)$  (INCHES)
- Bottom Lug Spacing:  $.51 \pm .03$  (MM) /  $(.020 \pm .001)$  (INCHES) (6 PLCS.)
- Bottom Lug Width:  $.51 \pm .03$  (MM) /  $(.020 \pm .001)$  (INCHES) (6 PLCS.)

**Side View Dimensions:**

- Overall Width:  $13.89 \pm .38$  (MM) /  $(.547 \pm .015)$  (INCHES)
- Overall Height:  $4.00 \pm .51$  (MM) /  $(.157 \pm .020)$  (INCHES)

**Detail View Dimensions:**

- Thread: 3/8-32 UNEF-2A THD
- Thread Length:  $1.57 \pm .12$  (MM) /  $(.062 \pm .005)$  (INCHES)
- Thread Diameter:  $6.342 \pm .008$  (MM) /  $(0.2497 \pm .0003)$  (INCHES)
- Thread Diameter:  $10.29 \pm .05$  (MM) /  $(.405 \pm .002)$  (INCHES)
- Thread Diameter:  $1.18 \pm 0.12$  (MM) /  $(.047 \pm .005)$  (INCHES)
- Thread Diameter:  $0.66 \pm 0.12$  (MM) /  $(.026 \pm .005)$  (INCHES)
- Thread Diameter:  $7.95 \pm .12$  (MM) /  $(.313 \pm .005)$  (INCHES)
- Thread Diameter:  $10.67 \pm .12$  (MM) /  $(.420 \pm .005)$  (INCHES)
- Thread Diameter:  $3.18 \pm .12$  (MM) /  $(.125 \pm .005)$  (INCHES)
- Thread Diameter:  $7.95 \pm .12$  (MM) /  $(.313 \pm .005)$  (INCHES)
- Thread Diameter:  $10.67 \pm .12$  (MM) /  $(.420 \pm .005)$  (INCHES)
- Thread Diameter:  $3.18 \pm .12$  (MM) /  $(.125 \pm .005)$  (INCHES)

**Panel Layout Dimensions:**

- Overall Width:  $7.94 \pm .12$  (MM) /  $(.313 \pm .005)$  (INCHES)
- Overall Height:  $7.94 \pm .12$  (MM) /  $(.313 \pm .005)$  (INCHES)

**Table 1: DIMENSION L**

| DIMENSION L      |                   |                   |
|------------------|-------------------|-------------------|
| $12.7$<br>(.500) | $15.88$<br>(.625) | $22.23$<br>(.875) |

**Table 2: DIMENSIONS**

| DIMENSIONS: | MM | INCHES |
|-------------|----|--------|
|             |    |        |

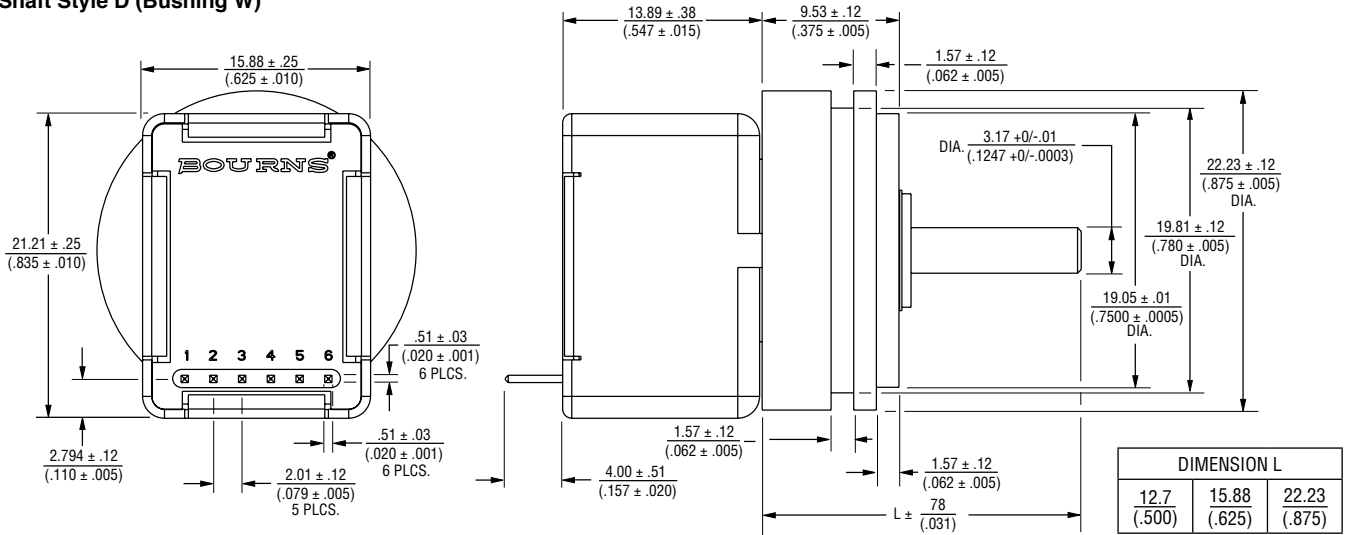
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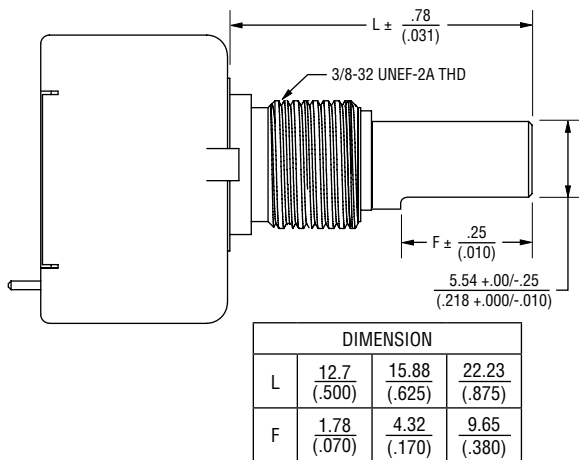
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## Product Dimensions (Continued)

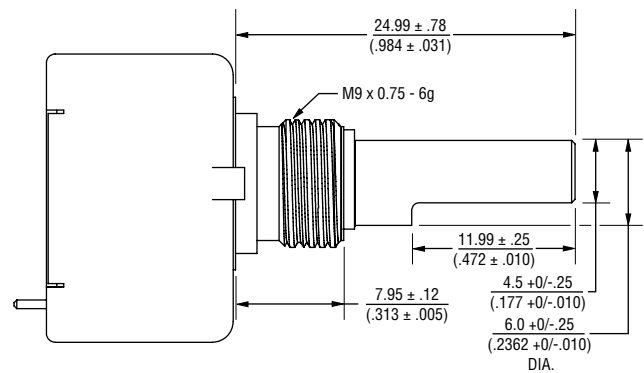
### Shaft Style D (Bushing W)



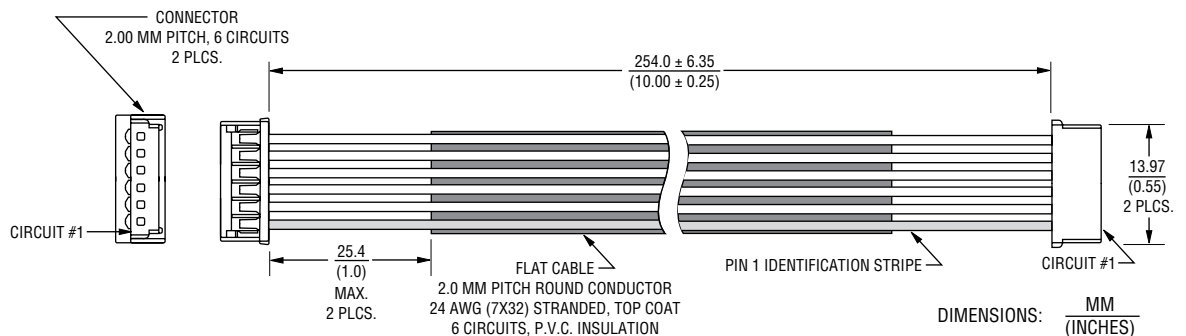
### Shaft Style C (Bushing S)



### Shaft Style M (Bushing D)



### Cable Assembly



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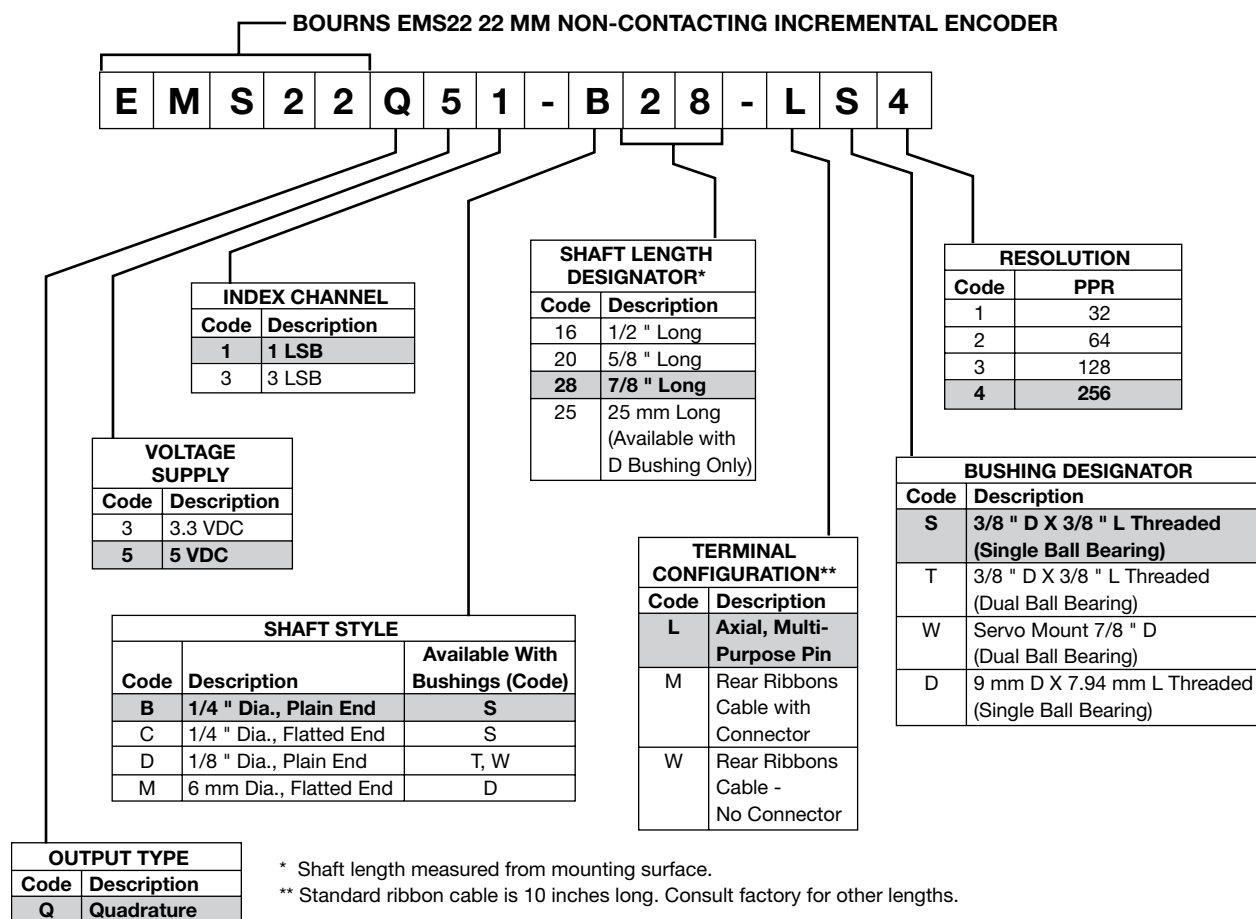
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