EMS22P - Non-Contacting PWM Encoder

**Features**
- 3.3 and 5 VDC voltage supply option
- PWM Absolute Position
- Bushing or servo mount
- Non-contacting magnetic technology
- Small size
- CMOS and TTL compatible
- Resolution: 1024 states
- Resolution: 1024 states
- Long life
- High operating speed
- Highly repeatable
- Sealed option
- Magnetic technology

**Electrical Characteristics**
- Resolution: 1024 states
- Insulation Resistance (500 VDC): 1000 megohms
- Electrical Travel: Continuous
- Supply Voltage: 5.0 VDC ±10 %, 3.3 VDC ±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
- Linearity: ±0.5 %
- Accuracy
  - Nominal: ±0.7 ° or better
  - Worst Case: ±1.4 °
- 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)
- 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 ±21 g-cm (0.6 ±0.3 oz-in.)
  - Running: 29 ±14 g-cm (0.4 ±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
  - Wave Soldering: 96.5Sn3.0Ag/0.5Cu solder with no-clean flux
- Wash processes: Not recommended
- Marking: Manufacturer’s trademark, name, part number, and date code.

**Pin Configuration**

<table>
<thead>
<tr>
<th>Output Type</th>
<th>Pin 1</th>
<th>Pin 2</th>
<th>Pin 3</th>
<th>Pin 4</th>
<th>Pin 5</th>
<th>Pin 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>PWM</td>
<td>PWM Signal</td>
<td>GND</td>
<td>GND</td>
<td>GND</td>
<td>VCC*</td>
<td>CS**</td>
</tr>
</tbody>
</table>

* 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

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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

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**EMS22P - Non-Contacting PWM Encoder**

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**Output Type Waveform and Variant Table**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Type</th>
<th>Unit</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>PWM frequency</td>
<td>IPWM</td>
<td>0.9756</td>
<td>KHz</td>
<td>Signal period: 1025 μs</td>
</tr>
<tr>
<td>MIN pulse with</td>
<td>PWMIN</td>
<td>1</td>
<td>μS</td>
<td>Position 0 Angle 0 °</td>
</tr>
<tr>
<td>MAX pulse with</td>
<td>PWMAX</td>
<td>1024</td>
<td>μS</td>
<td>Position 1023 Angle 359.65 °</td>
</tr>
</tbody>
</table>

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**Analog output using an external low pass filter**

**Recommended Filter**

![Simple Passive 2nd Order Low Pass Filter](image)

R1, R2 $\geq 4.7$ K ohms  
C1, C2 $\geq 1$ μF / 6 V

R1 should be $\geq 4.7$ K ohms to avoid loading of the PWM output. Larger values of R and C will provide better filtering and less ripple, but will also slow down the response time.

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Consult factory for options not shown, including:

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

**EMS22P - Non-Contacting PWM Encoder**

**Product Dimensions**

**Shaft Style D (Bushing T)**

**Shaft Style B (Bushing S)**

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**EMS22P - Non-Contacting PWM Encoder**

### Product Dimensions (Continued)

#### Shaft Style D (Bushing W)

<table>
<thead>
<tr>
<th>DIMENSION</th>
<th>MM</th>
<th>INCHES</th>
</tr>
</thead>
<tbody>
<tr>
<td>$L$</td>
<td>$21.21$ ± $0.25$</td>
<td>$(0.835$ ± $0.010)$</td>
</tr>
<tr>
<td>$F$</td>
<td>$21.21$ ± $0.25$</td>
<td>$(0.835$ ± $0.010)$</td>
</tr>
</tbody>
</table>

#### Shaft Style C (Bushing S)

<table>
<thead>
<tr>
<th>CONNECTOR</th>
<th>3/8-32 UNEF-2A THD</th>
</tr>
</thead>
<tbody>
<tr>
<td>DIMENSION</td>
<td>$L$ = $78$ (3.071)</td>
</tr>
<tr>
<td>$F$</td>
<td>$25$ (0.984)</td>
</tr>
</tbody>
</table>

#### Shaft Style M (Bushing D)

| CONNECTOR | 9.53 ± 0.12 (0.375 ± 0.005) |
| DIMENSION | $L$ = $78$ (3.071) |

### Cable Assembly

- **CONNECTOR**: 2.00 MM PITCH, 6 CIRCUITS
- **2 PLCS.**
- **FLAT CABLE**: 2.0 MM PITCH ROUND CONDUCTOR
- **24 AWG (7X32) STRANDED, TOP COAT**
- **6 CIRCUITS, P.V.C. INSULATION**
- **PIN 1 IDENTIFICATION STRIPE**
- **CIRCUIT #1**: 19.0 ± 0.079 (0.7500 ± 0.005) 2 PLCS.
- **FLAT CABLE**: 2.0 MM PITCH ROUND CONDUCTOR
- **24 AWG (7X32) STRANDED, TOP COAT**
- **6 CIRCUITS, P.V.C. INSULATION**
- **PIN 1 IDENTIFICATION STRIPE**
- **CIRCUIT #1**: 13.21 (0.52) 2 PLCS.

**DIMENSIONS:**

- **CIRCUIT #1**: 19.0 ± 0.079 (0.7500 ± 0.005) 2 PLCS.
- **FLAT CABLE**: 2.0 MM PITCH ROUND CONDUCTOR
- **24 AWG (7X32) STRANDED, TOP COAT**
- **6 CIRCUITS, P.V.C. INSULATION**
- **PIN 1 IDENTIFICATION STRIPE**
- **CIRCUIT #1**: 13.21 (0.52) 2 PLCS.

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### EMS22P - Non-Contacting PWM Encoder

#### How To Order

- **BOURNS EMS22 22 MM NON-CONTACTING PWM ENCODER**

<table>
<thead>
<tr>
<th>EMS22P50-B28-LS6</th>
</tr>
</thead>
</table>

### Shaft Length Designator

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>16</td>
<td>1/2&quot; Long</td>
</tr>
<tr>
<td>20</td>
<td>5/8&quot; Long</td>
</tr>
<tr>
<td>28</td>
<td>7/8&quot; Long</td>
</tr>
<tr>
<td>25</td>
<td>25 mm Long (Available with D Bushing Only)</td>
</tr>
</tbody>
</table>

### Voltage Supply

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>3.3 VDC</td>
</tr>
<tr>
<td>5</td>
<td>5 VDC</td>
</tr>
</tbody>
</table>

### Terminal Configuration**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>L</td>
<td>Axial, Multi-Purpose Pin</td>
</tr>
<tr>
<td>M</td>
<td>Rear Ribbons Cable with Connector</td>
</tr>
<tr>
<td>W</td>
<td>Rear Ribbons Cable - No Connector</td>
</tr>
</tbody>
</table>

### Shaft Style

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>1/4&quot; Dia., Plain End</td>
</tr>
<tr>
<td>C</td>
<td>1/4&quot; Dia., Flatted End</td>
</tr>
<tr>
<td>D</td>
<td>1/8&quot; Dia., Plain End</td>
</tr>
<tr>
<td>M</td>
<td>6 mm Dia., Flatted End</td>
</tr>
</tbody>
</table>

### Bushing Designator

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>S</td>
<td>3/8&quot; D X 3/8&quot; L Threaded (Single Ball Bearing)</td>
</tr>
<tr>
<td>T</td>
<td>3/8&quot; D X 3/8&quot; L Threaded (Dual Ball Bearing)</td>
</tr>
<tr>
<td>W</td>
<td>Servo Mount 7/8&quot; D (Dual Ball Bearing)</td>
</tr>
<tr>
<td>D</td>
<td>9 mm D X 7.94 mm L Threaded (Single Ball Bearing)</td>
</tr>
</tbody>
</table>

### Index Channel

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No Index</td>
</tr>
</tbody>
</table>

### Resolution

<table>
<thead>
<tr>
<th>Code</th>
<th>States</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>1024</td>
</tr>
</tbody>
</table>

### Output Type

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>P</td>
<td>CW PWM</td>
</tr>
<tr>
<td>R</td>
<td>CCW PWM</td>
</tr>
<tr>
<td>Notes</td>
<td></td>
</tr>
</tbody>
</table>

* Shaft length measured from mounting surface.
** Standard ribbon cable is 10 inches long. Consult factory for other lengths.

Note 1: (P) t on increases from 1 to 1025 with CW rotation of the shaft.
Note 2: (R) t on increases from 1 to 1025 with CCW rotation of the shaft.

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