EM14 - 14 mm Rotary Optical Encoder w/Switch

**Features**
- RoHS compliant*
- HCMOS, CMOS and TTL compatible
- Compact package size
- High rotational cycle life
- Standard or high force push switch option
- Optional detent

### Electrical Characteristics
- **Electrical Output**: 2-bit quadrature code
- **Resolution**: 8 to 64 pulses per revolution (PPR)
- **Supply Voltage (VCC)**: 5.0 VDC ± 0.25 VDC maximum
- **Supply Current (ICC)**: 26 mA maximum
- **Output Voltage**
  - Low (VCE(sat)), per Channel: 800 mV maximum at I(SNK) = 25 mA
  - High (VO(HI)), per Channel: 4.0 VDC minimum if ISNK = 4.75 VDC
- **Output Current I(SNK)**, per Channel: 25 mA maximum
- **Power Dissipation**: 167 mW maximum
- **Rise/Fall Time**: 200 ns typical
- **Phase Angle (Channel A Leads Channel B, Clockwise Rotation)**: 90° ± 45°
- **Insulation Resistance @ 500 VDC**: 1,000 megohms minimum
- **Operating RPM**: 120 maximum
- **Switch Power Rating**:
  - 12 VDC / 20 mA (600 ohms minimum load)
  - 200 ohms maximum
- **Switch Contact Resistance**: 1.2 N-cm (1.7 oz.-in.) typical
- **Detent**
  - 1.06 N-cm (1.5 oz.-in.) maximum
- **Starting/Running**
  - 1.2 N-cm (1.7 oz.-in.) typical
- **Rotational Life**
  - Non-detent (@ 30 RPM): 1,000,000 cycles (2,000,000 revolutions)
  - With detent (@ 30 RPM): 100,000 cycles (200,000 revolutions)
- **Switch Actuation Force**
  - Standard: 250 gm (8.82 oz.) typical
  - High Force: 850 gm (29.98 oz.) typical
- **Switch Travel**
  - Standard: 0.04 in. typical
  - High Force: 0.025 in. typical
- **Shaft Radial Play**: 0.005 in. maximum
- **Shaft Axial Structural Strength**: 35 lbs. minimum
- **Mounting Torque**: 2.0 N-m (18 lb.-in.) maximum

### Environmental Characteristics
- **Operating Temperature Range @ 5.0 VDC**: -40 °C to +70 °C (-40 °F to +158 °F)
- **Storage Temperature Range**: -55 °C to +125 °C (-67 °F to +257 °F)
- **Vibration**: 15 G
- **Shock**: 50 G
- **Humidity**: MIL-STD-202, Method 103, Condition B
- **Flammability**: Conforms to UL 94HB
- **IP Rating**: IP 54**

### Mechanical Characteristics
- **Mechanical Angle**: 360° Continuous
- **Torque**
  - Starting/Running: 1.06 N-cm (1.5 oz.-in.) maximum
  - Detent: 1.2 N-cm (1.7 oz.-in.) typical
- **Rotational Life**
  - Non-detent (@ 30 RPM): 1,000,000 cycles (2,000,000 revolutions)
  - With detent (@ 30 RPM): 100,000 cycles (200,000 revolutions)
- **Switch Actuation Force**
  - Standard: 250 gm (8.82 oz.) typical
  - High Force: 850 gm (29.98 oz.) typical
- **Switch Travel**
  - Standard: 0.04 in. typical
  - High Force: 0.025 in. typical
- **Shaft Radial Play**: 0.005 in. maximum
- **Shaft Axial Structural Strength**: 35 lbs. minimum
- **Mounting Torque**: 2.0 N-m (18 lb.-in.) maximum

### Materials and Finishes
- **Terminals**: Sn plated PC pins
- **Soldering Condition**
  - Manual Soldering: 6.5Sn/3.0Ag/0.5Cu solid wire or no-clean resin core wire
  - Wave Soldering: 6.5Sn/3.0Ag/0.5Cu solder with no-clean flux
  - 370 °C (700 °F) max. for 3 seconds
  - 260 °C (500 °F) max. for 5 seconds
- **Wash processes**: Not recommended
- **Mounting Hardware**
  - Nut: Black anodized brass, hex (metric)/Nickel-plated brass, hex (SAE)
  - Lockwasher: Nickel-plated spring steel, internal tooth
- **Marking**: Manufacturer's symbol, model number, product code, terminal style and date code
- **Standard Packaging**: Anti-static plastic tube (25 pcs./tube)

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**WARNING** Cancer and Reproductive Harm

www.P65Warnings.ca.gov

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Part Numbering System

**MODEL NO. DESIGNATOR**
EM14 14 mm Rotary Optical Encoder

**BUSHING DESIGNATOR**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>3/8&quot; D x 3/8&quot; L Threaded</td>
</tr>
<tr>
<td>C</td>
<td>1/4&quot; D x 1/4&quot; L Threaded</td>
</tr>
<tr>
<td>R</td>
<td>10 mm D x 9.5 mm L Threaded</td>
</tr>
</tbody>
</table>

**SWITCH OPTION**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>S</td>
<td>Push Switch (Standard)</td>
</tr>
<tr>
<td>H</td>
<td>Push Switch (High Force)</td>
</tr>
<tr>
<td>N</td>
<td>No Switch</td>
</tr>
</tbody>
</table>

**RESOLUTION (Pulses Per Revolution)**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>08</td>
<td>8 PPR</td>
</tr>
<tr>
<td>16</td>
<td>16 PPR</td>
</tr>
<tr>
<td>32</td>
<td>32 PPR</td>
</tr>
<tr>
<td>64</td>
<td>64 PPR</td>
</tr>
</tbody>
</table>

**CABLE/CONNECTOR OPTION**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No Cable/Connector</td>
</tr>
<tr>
<td>1</td>
<td>6&quot; Cable with Female Connector and stripped/tinned leads</td>
</tr>
<tr>
<td>2</td>
<td>6&quot; Cable with Female Connector on both ends</td>
</tr>
<tr>
<td>3</td>
<td>12&quot; Cable with Female Connector and stripped/tinned leads</td>
</tr>
<tr>
<td>4</td>
<td>12&quot; Cable with Female Connector on both ends</td>
</tr>
<tr>
<td>5</td>
<td>3&quot; Cable with Female Connector and stripped/tinned leads</td>
</tr>
<tr>
<td>6</td>
<td>1.5&quot; Cable with Female Connector and stripped/tinned leads</td>
</tr>
<tr>
<td>7</td>
<td>2&quot; Cable with Female Connector and stripped/tinned leads</td>
</tr>
<tr>
<td>8</td>
<td>5&quot; Cable with Female Connector and stripped/tinned leads</td>
</tr>
</tbody>
</table>

**ANTI-ROTATION LUG/BRACKET OPTION**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>A/R Lug</td>
</tr>
<tr>
<td>B</td>
<td>Bracket (No hardware/no cable or connector)</td>
</tr>
<tr>
<td>D</td>
<td>None</td>
</tr>
</tbody>
</table>

**DETENT OPTION**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No Detent</td>
</tr>
<tr>
<td>1</td>
<td>32 Detents (Available for 8 or 32 PPR only)</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>R</td>
<td>Radial Multi-Purpose Pin</td>
</tr>
</tbody>
</table>

**SHAFT STYLE (See Outline Drawing for Details)**

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

<table>
<thead>
<tr>
<th>Code</th>
<th>Length (FMS)</th>
<th>Available w/ Bushing</th>
</tr>
</thead>
<tbody>
<tr>
<td>24</td>
<td>3/4&quot;</td>
<td>A, C</td>
</tr>
<tr>
<td>28</td>
<td>7/8&quot;</td>
<td>A, C</td>
</tr>
<tr>
<td>20</td>
<td>20 mm</td>
<td>R</td>
</tr>
<tr>
<td>25</td>
<td>25 mm</td>
<td>R</td>
</tr>
</tbody>
</table>

**SHAFT LENGTH DESIGNATOR**

For other cable and connector options, please contact the factory.

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**Shaft / Flat Length Dimensions**

*“A” Style Bushing - Flattened Shafts*

- SHAFT DIA: 6.35 mm (.250)
- BUSHING DIA: 9.52 mm (.375)
- SHAFT LENGTH L: 19.05 mm (.750)
- FLAT LENGTH F: 7.94 mm (.313)

*“R” Style Bushing - Flattened Shafts*

- SHAFT DIA: 6.0 mm (.236)
- BUSHING DIA: 9.5 mm (.375)
- SHAFT LENGTH L: 20.0 mm (.787)
- FLAT LENGTH F: 7.0 mm (.276)

*“C” Style Bushing - Slotted Shafts*

- SHAFT DIA: 3.17 mm (.125)
- BUSHING DIA: 6.35 mm (.250)
- SHAFT LENGTH L: 19.05 mm (.750)

*“A” Style Bushing - Slotted Shafts*

- SHAFT DIA: 8.0 mm (.315)
- BUSHING DIA: 4.76 mm (.187)
- SHAFT LENGTH L: 22.22 mm (.875)
- FLAT LENGTH F: 9.53 mm (.375)

*“R” Style Bushing - Slotted Shafts*

- SHAFT DIA: 4.0 mm (.158)
- BUSHING DIA: 1.0 mm (.039)
- SHAFT LENGTH L: 25.0 mm (.984)

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Cable/Connector Options

Cable Assembly, Connector on One End

Cable Assembly, Connector on Both Ends

Terminal Configurations

Radial (shown with optional mounting bracket)

Axial (shown with optional mounting bracket)

Recommended PCB Layout

Recommended PCB Layout

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Electrical Block Diagram

- Ground
- Channel A
- Switch Terminal
- Channel B
- Power

Quadrature Output

32 DETENT / 8 PPR

32 DETENT / 32 PPR

Terminal Diagram

1. Nominal detent position occurs when both Channel A and B are in low states.
2. Channel A leads Channel B in CW direction and lags in CCW direction.

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