Features

- 3.3 and 5 VDC voltage supply option
- Quadrature, absolute, PWM and direction/step output options
- Bushing or servo mount
- Non-contacting magnetic technology
- Small size
- CMOS and TTL compatible

Resolution from 32-512 PPR and 1024 states
- Long life
- High operating speed
- Highly repeatable
- Sealed option

EMS22 - Non-Contacting Rotary Magnetic Encoder

Electrical Characteristics

Resolution................................................................. 32 to 512 PPR and 1024 states
Insulation Resistance (500 VDC).................................. 1,000 megohms
Electrical Travel.......................................................... Continuous
Supply Voltage......................................................... 5.0 VDC ±10 %, 3.3 VDC ±10 %
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................................................................. ±0.35 %
Accuracy
Nominal..................................................................... ±0.5 ° 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)
Humidity...................................................................... MIL-STD-202, Method 103B, Condition B
Vibration...................................................................... 15 G
Shock.......................................................................... 50 G
Rotational Life
S Bushing (91,000 rpm)............................................ 100,000,000 revolutions
T & W Bushings (91,000 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......................................................... 0.03 mm (0.012 ”) 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......................................................... 96.5Sn/3.0Ag/0.5Cu solder with no-clean flux

Wash processes................................................................ 370 °C (700 °F) max. for 3 seconds
360 °C (675 °F) max. for 10 seconds
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

<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>A/B Quadrature</td>
<td>A</td>
<td>B</td>
<td>GND</td>
<td>Index</td>
<td>VCC*</td>
<td>CS**</td>
</tr>
<tr>
<td>Direction/Step</td>
<td>Pulse</td>
<td>Direction</td>
<td>GND</td>
<td>Index</td>
<td>VCC*</td>
<td>CS**</td>
</tr>
<tr>
<td>PWM</td>
<td>PWM Signal</td>
<td>GND</td>
<td>GND</td>
<td>GND</td>
<td>VCC*</td>
<td>CS**</td>
</tr>
<tr>
<td>Absolute</td>
<td>Digital Input</td>
<td>Clock</td>
<td>GND</td>
<td>Digital Output</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.

Applications
- Material handling equipment
- Brushless DC motor commutation
- Robotics
- Automotive
- Industrial automation
- Petroleum refinery
- Medical
- Office equipment
- Audio and broadcast equipment

EMS22 - Non-Contacting Rotary Magnetic Encoder

Output Type Waveforms and Variant Tables

Quadrature Output

<table>
<thead>
<tr>
<th>PPR</th>
<th>3.3 Vcc</th>
<th>5.0 Vcc</th>
<th>Index 1</th>
<th>Index 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>256</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>256</td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>128</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>128</td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>64</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>64</td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>32</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>32</td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

Absolute Output

<table>
<thead>
<tr>
<th>Data Content</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>D9:D0</td>
<td>Absolute angular position data</td>
</tr>
<tr>
<td>S1</td>
<td>End of offset compensation algorithm</td>
</tr>
<tr>
<td>S2</td>
<td>Cordic overflow indicating an error in cordic part</td>
</tr>
<tr>
<td>S3</td>
<td>Linearity alarm</td>
</tr>
<tr>
<td>S4</td>
<td>Increase in magnitude</td>
</tr>
<tr>
<td>S5</td>
<td>Decrease in magnitude</td>
</tr>
<tr>
<td>P1</td>
<td>Even parity for detecting bits 1-15 transmission error</td>
</tr>
</tbody>
</table>
### PWM Output

<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>fPWM</td>
<td>0.9756 KHz</td>
<td>Signal period: 1025 µs</td>
<td></td>
</tr>
<tr>
<td>MIN pulse with</td>
<td>PWMIN</td>
<td>1 µs</td>
<td></td>
<td>Position 0 Angle 0 °</td>
</tr>
<tr>
<td>MAX pulse with</td>
<td>PWMAX</td>
<td>1024 µs</td>
<td></td>
<td>Position 1023 Angle 359.65 °</td>
</tr>
</tbody>
</table>

Analog output using an external low pass filter

Direction/Step Output

<table>
<thead>
<tr>
<th>PPR</th>
<th>3.3 Vcc</th>
<th>5.0 Vcc</th>
<th>Index 1</th>
<th>Index 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>512</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>512</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>256</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>256</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>128</td>
<td>X</td>
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<tr>
<td>64</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>64</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Consult factory for options not shown, including:
- Wire lead or cable options
- Connectors
- Non-standard resolutions

EMS22 - Non-Contacting Rotary Magnetic Encoder

Shaft Style D (Bushing T)

Shaft Style B (Bushing S)

Shaft Style D (Bushing W)

Dimensions: MM (INCHES)

Specifications are subject to change without notice.
Customers should verify actual device performance in their specific applications.
# EMS22 - Non-Contacting Rotary Magnetic Encoder

## How To Order

**BOURNS EMS22 22 MM NON-CONTACTING ROTARY MAGNETIC ENCODER**

<table>
<thead>
<tr>
<th>EMS22 S51 - B28 - LQ3</th>
</tr>
</thead>
</table>

### Specifications

- **Index Channel**
  - **Code**: 0, 1, 2
  - **Description**: No Index, 1 Pulse, 3 Pulses
  - **Available With Output Types (Code)**: A, P

- **Voltage Supply**
  - **Code**: 3, 5
  - **Description**: 3.3 VDC, 5 VDC

- **Shaft Length Designator**
  - **Code**: 16, 20, 25
  - **Description**: 1/2" Long, 5/8" Long, 7/8" Long
  - **Available With Output Types (Code)**: Q, D
  - **PPR/States*****: 32, 64, 128

- **Terminal Configuration**
  - **Code**: L, M, W
  - **Description**: Axial, Multi-Purpose Pin, Rear Ribbons Cable with Connector, Rear Ribbons Cable - No Connector

- **Bushing Designator**
  - **Code**: S, T, W, D
  - **Description**: 3/8" D X 3/8" L Threaded (Single Ball Bearing), 3/8" D X 3/8" L Threaded (Dual Ball Bearing), Servo Mount 7/8" D (Dual Ball Bearing), 9 mm D X 7.94 mm L Threaded (Single Ball Bearing)

### Notes

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