



## Features

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



## EM14 - 14 mm Rotary Optical Encoder w/Switch

### Electrical Characteristics

|  |  |
|--|--|
| Electrical Output.....   | 2-bit quadrature code                  |
| Resolution.....  | 8 to 64 pulses per revolution (PPR)    |
| Supply Voltage (VCC).....  | 5.0 VDC $\pm$ 0.25 VDC                 |
| Supply Current (ICC).....  | 26 mA maximum                          |
| Output Voltage   |  |
| Low (VCE(sat)), per Channel.....                                 | 800 mV maximum at I(SINK) = 25 mA      |
| High (VO(HI)), per Channel.....                                  | 4.0 VDC minimum @ VCC = 4.75 VDC       |
| Output Current I(SINK), per Channel.....                         | 25 mA minimum                          |
| Rise/Fall Time.....  | 200 ns typical                         |
| Power Dissipation.....   | 167 mW maximum                         |
| Pulse Width (per Channel).....                                   | 180 °e typical                         |
| Phase Angle (Channel A Leads Channel B, Clockwise Rotation)..... | 90 °e $\pm$ 45 °e                      |
| Insulation Resistance @ 500 VDC.....                             | 1,000 megohms minimum                  |
| Operating RPM.....   | 120 maximum                            |
| Switch Power Rating.....   | 12 VDC / 20 mA (600 ohms maximum load) |
| Switch Contact Resistance.....                                   | 200 ohms 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 Life.....                     | 100,000 cycles                           |
| 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.....   | 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 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)  |

\*\*When device is mounted by normal mounting means.

\*RoHS Directive 2002/95/EC Jan. 27, 2003 including annex and RoHS Recast 2011/65/EU June 8, 2011.  
Specifications are subject to change without notice.  
Customers should verify actual device performance in their specific applications.

## Additional Features

- Splashproof shaft seal
- Recommended for human/machine interface applications (HMI)
- Cable/connector option
- Optional bracket

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## Part Numbering System

**E M 1 4 A 0 D - C 2 4 - L 0 3 2 S**

| MODEL NO. DESIGNATOR |                              |
|----------------------|------------------------------|
| EM14                 | 14 mm Rotary Optical Encoder |

| BUSHING DESIGNATOR |                             |
|--------------------|-----------------------------|
| Code               | Description                 |
| A                  | 3/8 " D x 3/8 " L Threaded  |
| C                  | 1/4 " D x 1/4 " L Threaded  |
| R                  | 10 mm D x 9.5 mm L Threaded |

| DETENT OPTION |   |
|---------------|---|
| Code          | Description                                 |
| 0             | No Detent                                   |
| 1             | 32 Detents (Available for 8 or 32 PPR only) |

| ANTI-ROTATION LUG/BACKET OPTION |   |
|---------------------------------|---|
| Code                            | Description                                 |
| A                               | A/R Lug                                     |
| B                               | Bracket (No hardware/no cable or connector) |
| D                               | None  |

| SHAFT STYLE (See Outline Drawing for Details) |                        |                      |
|---|------------------------|----------------------|
| Code  | Description            | Available w/ Bushing |
| B   | 1/4 " Dia. Slotted End | A                    |
| C   | 1/4 " Dia. Flatted End | A                    |
| E   | 1/8 " Dia. Slotted End | C                    |
| R   | 6 mm Dia. Slotted End  | R                    |
| M   | 6 mm Dia. Flatted End  | R                    |

| SHAFT LENGTH DESIGNATOR |              |                     |
|-------------------------|--------------|---------------------|
| Code                    | Length (FMS) | Available w/Bushing |
| 24                      | 3/4 "        | A, C                |
| 28                      | 7/8 "        | A, C                |
| 20                      | 20 mm        | R, U                |
| 25                      | 25 mm        | R, U                |

| SWITCH OPTION |                          |
|---------------|--------------------------|
| Code          | Description              |
| S             | Push Switch (Standard)   |
| H             | Push Switch (High Force) |
| N             | No Switch                |

| RESOLUTION (Pulses Per Revolution) |             |
|------------------------------------|-------------|
| Code                               | Description |
| 08                                 | 8 PPR       |
| 16                                 | 16 PPR      |
| 32                                 | 32 PPR      |
| 64                                 | 64 PPR      |

| CABLE/CONNECTOR OPTION |  |
|------------------------|--|
| Code                   | Description  |
| 0                      | No Cable/Connector   |
| 1                      | 6 " Cable with Female Connector (0.050 "/1.27 mm pitch centers in-line) and stripped/tinned leads  |
| 2                      | 6 " Cable with Female Connector (0.050 "/1.27 mm pitch centers in-line) on both ends               |
| 3                      | 12 " Cable with Female Connector (0.050 "/1.27 mm pitch centers in-line) and stripped/tinned leads |
| 4                      | 12 " Cable with Female Connector (0.050 "/1.27 mm pitch centers in-line) on both ends              |

| TERMINAL CONFIGURATION |                          |
|------------------------|--------------------------|
| Code                   | Description              |
| L                      | Axial Multi-Purpose Pin  |
| R                      | Radial Multi-Purpose Pin |

### Cable and Connector Options:

- H-290-4 = 6 " Cable with Female Connector (0.050 "/1.27 mm pitch centers in-line) and stripped/tinned leads
- H-290-1 = 6 " Cable with Female Connector (0.050 "/1.27 mm pitch centers in-line) on both ends
- H-290-2 = 12 " Cable with Female Connector (0.050 "/1.27 mm pitch centers in-line) and stripped/tinned leads
- H-290-3 = 12 " Cable with Female Connector (0.050 "/1.27 mm pitch centers in-line) on both ends

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

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## Product Dimensions



## Shaft / Flat Length Dimensions

"A" Style Bushing - Flatted Shafts



| SHAFT DIA.  | BUSHING DIA. | SHAFT LENGTH "L" | FLAT LENGTH "F" |
|-------------|--------------|------------------|-----------------|
| 6.35 (.250) | 9.52 (.375)  | 19.05 (.750)     | 7.94 (.313)     |
|             |              | 22.22 (.875)     | 9.52 (.375)     |

"R" Style Bushing - Flatted Shafts



| SHAFT DIA. | BUSHING DIA. | SHAFT LENGTH "L" | FLAT LENGTH "F" |
|------------|--------------|------------------|-----------------|
| 6.0 (.236) | 10.0 (.394)  | 20.0 (.787)      | 7.0 (.275)      |
|            |              | 25.0 (.984)      | 12.0 (.472)     |

"C" Style Bushing - Slotted Shafts



| SHAFT DIA.  | BUSHING DIA. | SHAFT LENGTH "L" |
|-------------|--------------|------------------|
| 3.17 (.125) | 6.35 (.250)  | 19.05 (.750)     |
|             |              | 22.22 (.875)     |

"A" Style Bushing - Slotted Shafts



| SHAFT DIA.  | BUSHING DIA. | SHAFT LENGTH "L" |
|-------------|--------------|------------------|
| 6.35 (.250) | 9.52 (.375)  | 19.05 (.750)     |
|             |              | 22.22 (.875)     |

"R" Style Bushing - Slotted Shafts



| SHAFT DIA. | BUSHING DIA. | SHAFT LENGTH "L" |
|------------|--------------|------------------|
| 6.0 (.236) | 10.0 (.394)  | 20.0 (.787)      |
|            |              | 25.0 (.984)      |

DIMENSIONS:  $\frac{\text{MM}}{\text{(INCHES)}}$

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## Cable/Connector Options

### Cable Assembly, Connector on One End



### Cable Assembly, Connector on Both Ends



| HARDWARE NUMBER | DESCRIPTION                            | "A" DIM.                     |
|-----------------|--|------------------------------|
| H-290-4         | CABLE ASSEMBLY, CONNECTOR ON ONE END   | 152.4 ± 5.0<br>(6.0 ± .197)  |
| H-290-2         | CABLE ASSEMBLY, CONNECTOR ON ONE END   | 304.8 ± 5.0<br>(12.0 ± .197) |
| H-290-1         | CABLE ASSEMBLY, CONNECTOR ON BOTH ENDS | 152.4 ± 5.0<br>(6.0 ± .197)  |
| H-290-3         | CABLE ASSEMBLY, CONNECTOR ON BOTH ENDS | 304.8 ± 5.0<br>(12.0 ± .197) |

DIMENSIONS:  $\frac{\text{MM}}{\text{(INCHES)}}$

## Terminal Configurations

### Radial (shown with optional mounting bracket)



### Recommended PCB Layout



### Axial (shown with optional mounting bracket)



### Recommended PCB Layout



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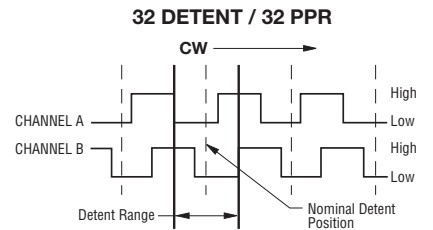
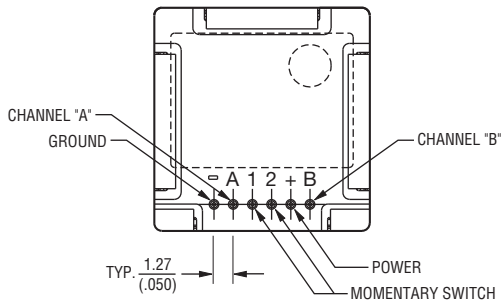
## Electrical Block Diagram



## Quadrature Output



## 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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