



## Features

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

## Additional Information

Click these links for more information:



# 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 maximum                          |
| Rise/Fall Time .....  | 200 ns typical**                       |
| Power Dissipation .....   | 167 mW maximum                         |
| Pulse Width (per Channel) .....                                   | 180 $\mu$ s typical                    |
| Phase Angle (Channel A Leads Channel B, Clockwise Rotation) ..... | 90 $\mu$ s $\pm$ 45 $\mu$ s            |
| Insulation Resistance @ 500 VDC .....                             | 1,000 megohms minimum                  |
| Operating RPM .....   | 120 maximum                            |
| Switch Power Rating .....   | 12 VDC / 20 mA (600 ohms minimum load) |
| Switch Contact Resistance .....                                   | 200 ohms maximum                       |

## Environmental Characteristics

|   |   |
|---|---|
| Operating Temperature Range @ 5.0 VDC ..... | -40 $^{\circ}$ C to +70 $^{\circ}$ C (-40 $^{\circ}$ F to +158 $^{\circ}$ F)  |
| Storage Temperature Range .....             | -55 $^{\circ}$ C to +125 $^{\circ}$ C (-67 $^{\circ}$ F to +257 $^{\circ}$ 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 $^{\circ}$ 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 $^{\circ}$ C (700 $^{\circ}$ F) max. for 3 seconds |
| Wave Soldering .....     | 96.5Sn/3.0Ag/0.5Cu solder with no-clean flux<br>260 $^{\circ}$ C (500 $^{\circ}$ 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)  |

\*\*See schematic note page 5.

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



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

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\*RoHS Directive 2015/863, Mar 31, 2015 and Annex.

## Additional Features

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

# EM14 – 14 mm Rotary Optical Encoder w/Switch

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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/BRAKET 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                   |
| 25                      | 25 mm        | R                   |

| 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 and stripped/tinned leads   |
| 2                      | 6 " Cable with Female Connector on both ends                |
| 3                      | 12 " Cable with Female Connector and stripped/tinned leads  |
| 4                      | 12 " Cable with Female Connector on both ends               |
| 5                      | 3 " Cable with Female Connector and stripped/tinned leads   |
| 6                      | 1.5 " Cable with Female Connector and stripped/tinned leads |
| 7                      | 2 " Cable with Female Connector and stripped/tinned leads   |
| 8                      | 5 " Cable with Female Connector and stripped/tinned leads   |

Connector options 1~8 are currently available, but not recommended for new designs. See [Product Obsolescence Memo](#).

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

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

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## Product Dimensions



## Shaft / Flat Length Dimensions

"A" Style Bushing - Flatted Shafts



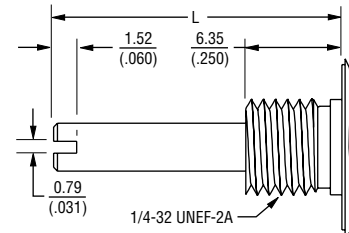
| SHAFT DIA.     | BUSHING DIA.   | SHAFT LENGTH "L" | FLAT LENGTH "F" |
|----------------|----------------|------------------|-----------------|
| 6.35<br>(.250) | 9.52<br>(.375) | 19.05<br>(.750)  | 7.94<br>(.313)  |
|                |                | 22.22<br>(.875)  | 9.52<br>(.375)  |

"R" Style Bushing - Flatted Shafts



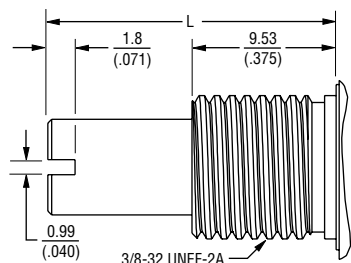
| SHAFT DIA.    | BUSHING DIA.   | SHAFT LENGTH "L" | FLAT LENGTH "F" |
|---------------|----------------|------------------|-----------------|
| 6.0<br>(.236) | 10.0<br>(.394) | 20.0<br>(.787)   | 7.0<br>(.275)   |
|               |                | 25.0<br>(.984)   | 12.0<br>(.472)  |

"C" Style Bushing - Slotted Shafts



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

"A" Style Bushing - Slotted Shafts



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

"R" Style Bushing - Slotted Shafts



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

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

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# EM14 – 14 mm Rotary Optical Encoder w/Switch

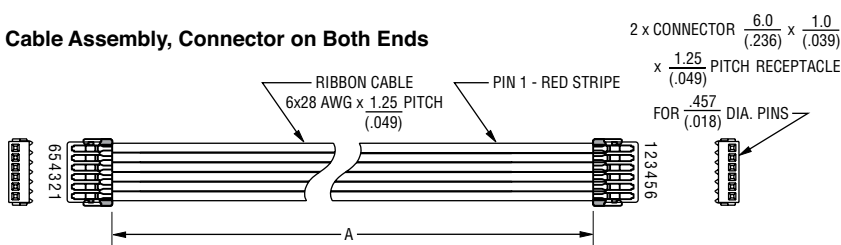
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## Cable/Connector Options

### Cable Assembly, Connector on One End



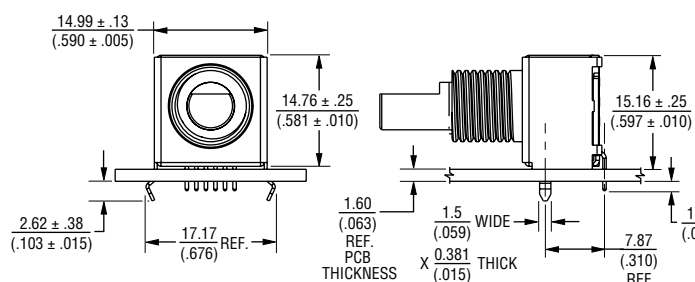
### Cable Assembly, Connector on Both Ends



| HDW. NO. | DESCRIPTION                                | "A" DIM.                     |
|----------|--|------------------------------|
| H-290-1  | CABLE ASSEMBLY, CONNECTOR ON BOTH ENDS     | 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-290-3  | CABLE ASSEMBLY, CONNECTOR ON BOTH ENDS     | 304.8 ± 5.0<br>(12.0 ± .197) |
| H-290-4  | CABLE ASSEMBLY, CONNECTOR ON ONE END       | 152.4 ± 5.0<br>(6.0 ± .197)  |
| H-290-5  | RIBBON CABLE, 28 AWG, CONNECTOR ON ONE END | 76.2 ± 5.0<br>(3.0 ± .197)   |
| H-290-6  | RIBBON CABLE, 28 AWG, CONNECTOR ON ONE END | 38.1 ± 5.0<br>(1.5 ± .197)   |
| H-290-7  | RIBBON CABLE, 28 AWG, CONNECTOR ON ONE END | 50.8 ± 5.0<br>(2.0 ± .197)   |
| H-290-8  | RIBBON CABLE, 28 AWG, CONNECTOR ON ONE END | 127 ± 5.0<br>(5.0 ± .197)    |

## Terminal Configurations

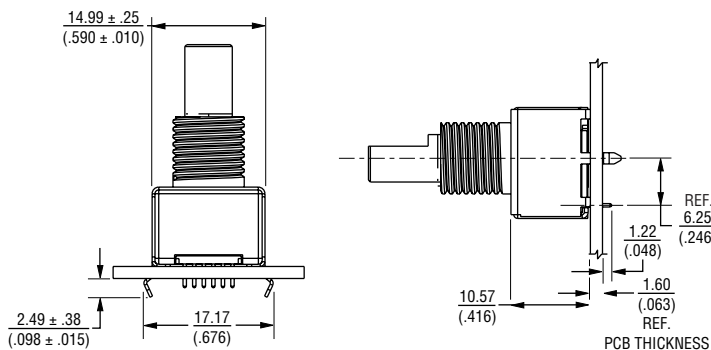
### Radial (shown with optional mounting bracket)



### Recommended PCB Layout



### Axial (shown with optional mounting bracket)



### Recommended PCB Layout



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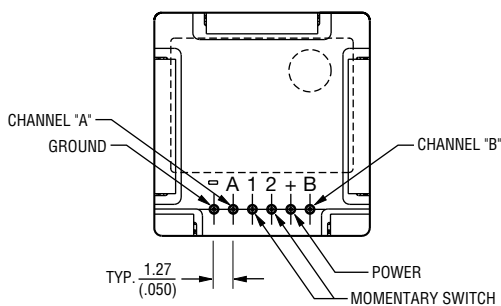


## 14 mm Optical Encoder Electrical Diagram

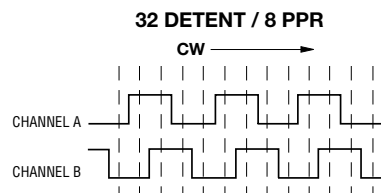
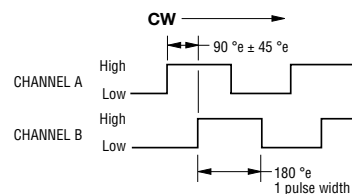


\*External pull-up resistors (1K ohms) and filter caps (22 nF) recommended for proper operation. Utilization of a filter circuit will yield a typical rise time of 50 microseconds. See schematic.

## Terminal Diagram



## Quadrature Output



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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