



## 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 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 $^{\circ}$ e $\pm$ 45 $^{\circ}$ e |
| 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)  |

\*\*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.

The device characteristics and parameters in this data sheet can and do vary in different applications and actual device performance may vary over time.  
Users 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

# 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/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

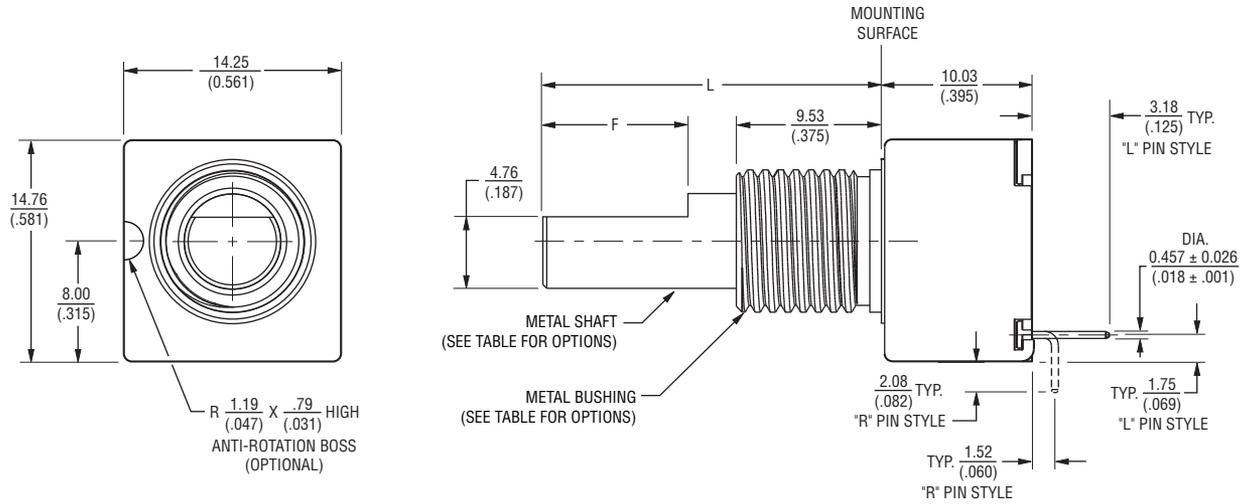
For other cable and connector options, please contact the factory.

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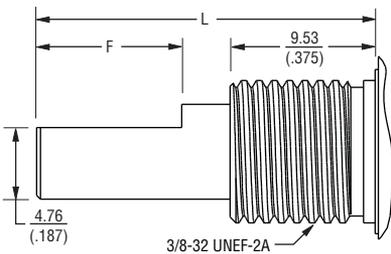


## Product Dimensions



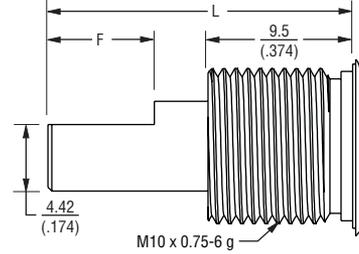
## Shaft / Flat Length Dimensions

"A" Style Bushing - Flatted Shafts



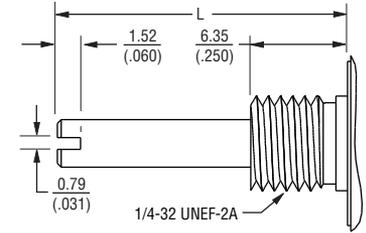
| SHAFT DIA.     | BUSHING DIA.   | SHAFT LENGTH "L" | FLAT LENGTH "F" |
|----------------|----------------|------------------|-----------------|
| 6.35<br>(.250) | 9.52<br>(.375) | 19.05<br>(.750)  | 7.94<br>(.313)  |
|                |                | 22.22<br>(.875)  | 9.52<br>(.375)  |

"R" Style Bushing - Flatted Shafts



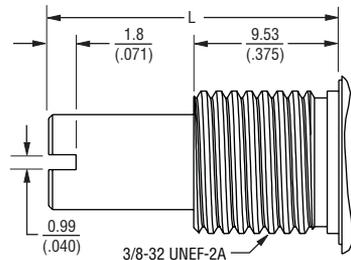
| SHAFT DIA.    | BUSHING DIA.   | SHAFT LENGTH "L" | FLAT LENGTH "F" |
|---------------|----------------|------------------|-----------------|
| 6.0<br>(.236) | 10.0<br>(.394) | 20.0<br>(.787)   | 7.0<br>(.275)   |
|               |                | 25.0<br>(.984)   | 12.0<br>(.472)  |

"C" Style Bushing - Slotted Shafts



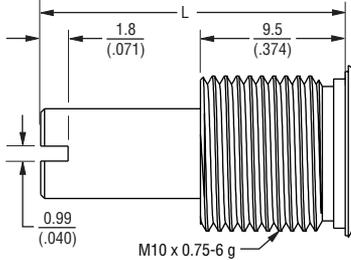
| SHAFT DIA.     | BUSHING DIA.   | SHAFT LENGTH "L" |
|----------------|----------------|------------------|
| 3.17<br>(.125) | 6.35<br>(.250) | 19.05<br>(.750)  |
|                |                | 22.22<br>(.875)  |

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

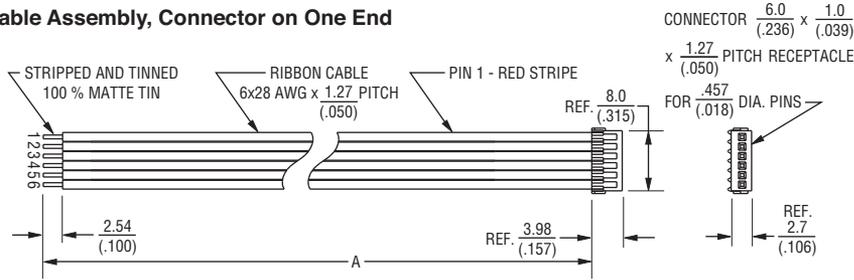
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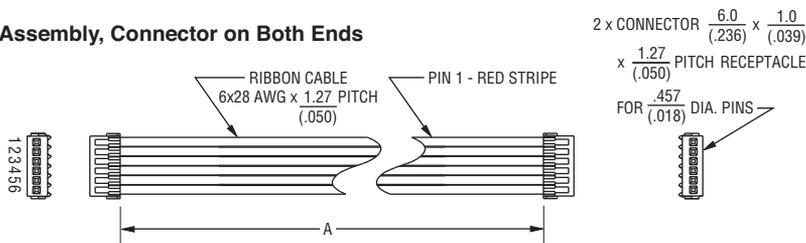
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## Cable/Connector Options

### Cable Assembly, Connector on One End



### Cable Assembly, Connector on Both Ends

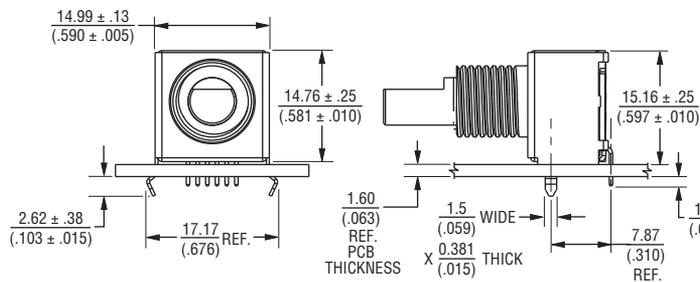


| HARDWARE NUMBER | DESCRIPTION                            | "A" DIM.                     |
|-----------------|--|------------------------------|
| H-290-4         | CABLE ASSEMBLY, CONNECTOR ON ONE END   | 152.4 ± 5.0<br>(6.0 ± .197)  |
| H-290-2         | CABLE ASSEMBLY, CONNECTOR ON ONE END   | 304.8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

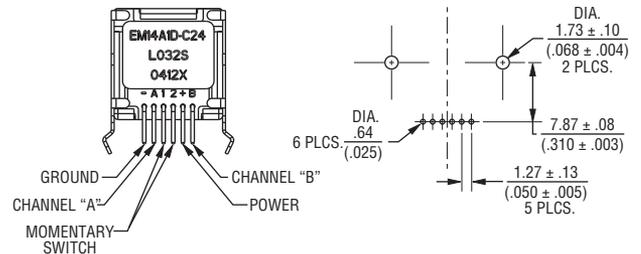
DIMENSIONS:  $\frac{\text{MM}}{\text{(INCHES)}}$

## Terminal Configurations

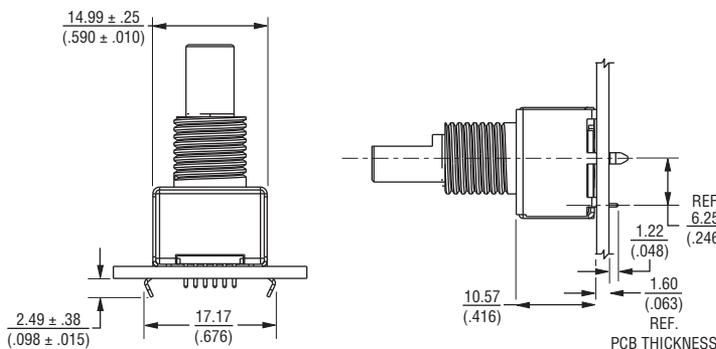
### Radial (shown with optional mounting bracket)



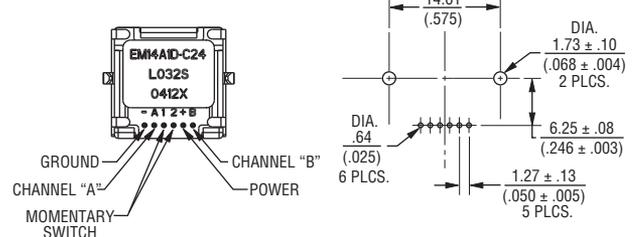
### Recommended PCB Layout



### Axial (shown with optional mounting bracket)



### Recommended PCB Layout

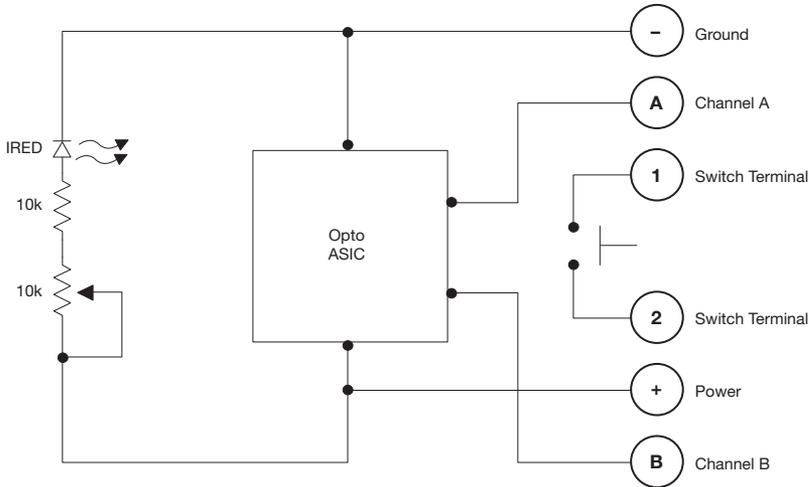


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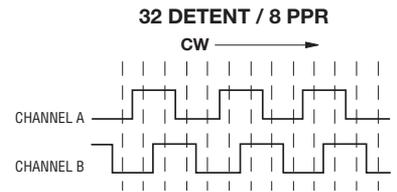
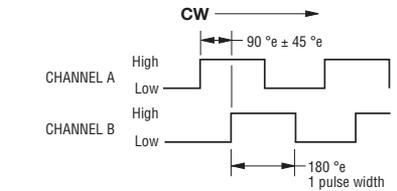
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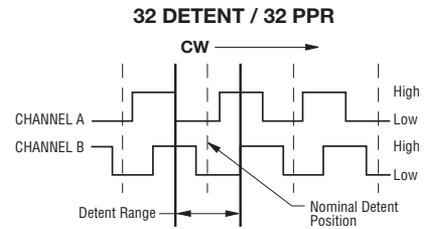
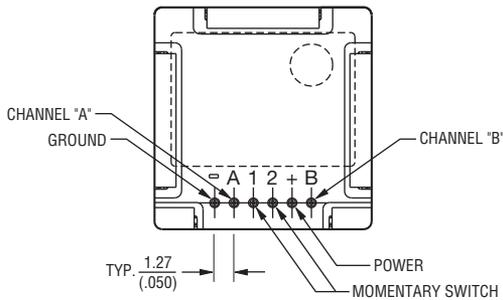
## Electrical Block Diagram



## 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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