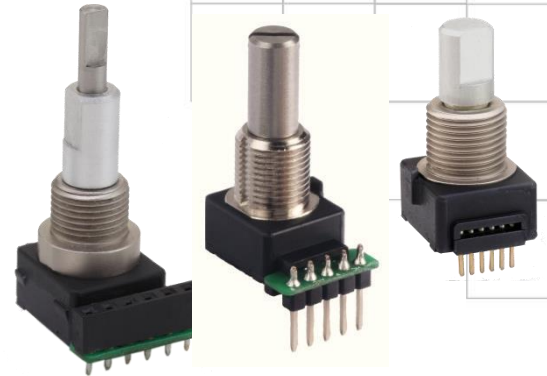




# Series 291

## Precision, Long-life 12mm Optical Encoder

- Available with 4, 6, 8, 24,32, 64 Pulses per Revolution
- Optional Momentary Switch
- Multiple options for terminations, resolution, cable lengths, and operating voltage



### Description

The 291 Series allows versatility in design applications by providing highly reliable, precise digital output and long rotational life with our non-contacting design. This product provides flexibility in resolution, power consumption, and operating temperatures. The options of Schmitt trigger, detents, momentary switch, shaft & bushing length, dual shaft, termination styles, torque, operating voltage, and IP ratings provide flexibility to meet your exacting design requirements.

### Ordering Information

| Series | Termination | Bushing Length | Shaft Length | Shaft Trim | Output Combination | Operating Voltage | Switch | Schmitt Trigger & Locating Lug |
|--------|-------------|----------------|--------------|------------|--------------------|-------------------|--------|--------------------------------|
| 291    | V1          | 0              | 22           | F          | 832                | A                 | B      | A                              |

| Code | Termination  |
|------|--|
| V1   | .050" pitch pins<br>Rear facing<br>.132" length(not for 64 PPR)          |
| P1   | .10" pitch pins<br>Rear facing<br>.236" length                           |
| *C4  | 4" ribbon cable<br>With .050" pitch connector terminals (not for 64 PPR) |
| *C5  | 5" ribbon cable<br>With .050" pitch connector terminals (not for 64 PPR) |
| *C6  | 6" ribbon cable<br>With .050" pitch connector terminals (not for 64 PPR) |

| Code                          | Shaft Length "L"   |
|-------------------------------|--|
| <b>Single shaft structure</b> |  |
| 22                            | .687"  |
| 24                            | .875"  |
| <b>Dual shaft structure</b>   |  |
| DD                            | Outer shaft: .685"<br>Inner shaft: 1.059"<br>(Not available with locating lug, 32 and 64 PPR, see page 8 for additional details) |

| Code | Spec.   |
|------|---------|
| F    | Flat    |
| S    | Slotted |

| Code | Spec.                    |
|------|--------------------------|
| A    | None                     |
| B    | Momentary (not for 64 P) |

| Code  | Spec.  |
|-------|--|
| BLANK | Without Schmitt trigger, With locating lug (not for 32, 64 PPR)    |
| A     | Without Schmitt trigger, Without locating lug (not for 32, 64 PPR) |
| S     | With Schmitt trigger, Without locating lug                         |
| B     | With Schmitt trigger, With locating lug                            |

| Code | Spec.                 |
|------|-----------------------|
| A    | 5.0V                  |
| B    | 3.3V (not for 64 PPR) |

| Code | Bushing Length "B"                                     |
|------|--|
| 0    | .312" For single shaft construction                    |
| D    | .256" For dual shaft construction (not for 32, 64 PPR) |

| Output | Combination  |
|--------|--|
| 832    | 8 PPR, 32 Detents  |
| 624    | 6 PPR, 24 Detents  |
| 416    | 4 PPR, 16 Detents  |
| 800    | 8 PPR, No Detents  |
| 600    | 6 PPR, No Detents  |
| 400    | 4 PPR, No Detents  |
| X00    | 24 PPR, No Detents (only available with Schmitt trigger) |
| X24    | 24 PPR, 24 Detents (only available with Schmitt trigger) |
| Y00    | 32 PPR, No Detents (only available with Schmitt trigger) |
| Z00    | 64 PPR, No Detents (only available with Schmitt trigger) |

Note: \* Cable connector for C4, C5, C6 is AMP P/N 215083-6 or Equivalent

## Electrical Specifications

| Encoder Function              |   |       |         |       |                          |
|-------------------------------|---|-------|---------|-------|--------------------------|
| Parameter                     | Conditions & Remarks  | Min   | Nominal | Max   | Unit                     |
| Voltage (4, 6, 8, 24, 32 PPR) |   | 4.75  | 5.0     | 5.25  | VDC                      |
|                               |   | 3.175 | 3.3     | 3.425 |                          |
| Voltage (64 PPR)              |   | 4.5   | 5.0     | 5.5   | VDC                      |
| Output Code                   | 2-Bit Quadrature<br>Channel A leads<br>Channel B by 90°<br>during clockwise<br>rotation |       |         |       |                          |
| Sink Current                  | 5.0 VDC   | 2.0mA |         |       |                          |
|                               | 3.3 VDC   | 1.0mA |         |       |                          |
| Power Consumption             | 5.0 VDC   |       |         | 150   | mW                       |
|                               | 3.3 VDC   |       |         | 80    | mW                       |
| Resolution                    | 4, 6, 8, 24, 32, 64   |       |         |       | Pulses per<br>Revolution |

## Mechanical and Environmental

|   |  |                  |                 |                |               |
|---|--|------------------|-----------------|----------------|---------------|
| Manual Soldering  | Maximum temperature of 350°C for 5 seconds   |                  |                 |                |               |
| RoHS  | Lead-Free. Fully compliant to RoHS Directive |                  |                 |                |               |
| Shock :   | Per MIL-STD-883F ( 100G's)                   |                  |                 |                |               |
| Vibration :   | Per MIL-STD-883F ( 15G's)                    |                  |                 |                |               |
| IP Rating (4, 6, 8, 24, 32 PPR):                              | IP 50  |                  |                 |                |               |
| IP Rating (64 PPR):   | IP 40  |                  |                 |                |               |
| Packaging :   | Standard anti-static tray packaging          |                  |                 |                |               |
| Operating Temperature:  | -40°C to +85°C                               |                  |                 |                |               |
| Storage Temperature:  | -55°C to +100°C                              |                  |                 |                |               |
| Storage Temperature:<br>(32, 64 PPR)                          | -40°C to +100°C                              |                  |                 |                |               |
| Rotational Life   | No detent @ 30 RPM                           | 3 Million Cycles |                 |                |               |
|   | With detent @ 30 RPM                         | 1 Million Cycles |                 |                |               |
| Push-Pull Strength of Shaft<br>(4,6,8,24, 32 PPR)<br>(64 PPR) | 10 seconds                                   | 20 kg            |                 |                |               |
|   | 10 seconds                                   | 13.6 kg          |                 |                |               |
| Terminal Pull-out Strength                                    | 10 seconds                                   | 6 kg             |                 |                |               |
| Rotational Torque   | (4, 6, 8, 24 PPR)                            | Running          | 10 to 30 gf-cm  |                |               |
|   |  | (32 PPR)         | Running         |                | 30 gf-cm Max. |
|   | (64 PPR)                                     | Running          |                 | 100 gf-cm Max. |               |
| Rotational Torque   | 24 Detents                                   |                  | 90 to 190 gf-cm |                |               |
|   | 16, 32 Detents                               |                  | 50 to 150 gf-cm |                |               |
| Detent Options  | 0, 16, 24, 32                                |                  |                 |                |               |

**Optional Momentary Switch Function:**

| Parameter                 | Conditions & Remarks                     | Min.      | Nominal | Max  | Unit       |
|---------------------------|--|-----------|---------|------|------------|
| Switch contact resistance |  |           |         | 10   | ohms       |
| Switch rating             | 5 VDC @10 mA                             |           |         |      |            |
| Switch travel             |  | 0.25      | 0.5     | 0.75 | mm         |
| Actuation Force           |  | 400       | 510     | 620  | grams      |
| Switch Life               | Standard                                 | 1 Million |         |      | Actuations |
| Switch Life               | Consult CTS for custom life requirements |           |         |      |            |

**Mechanical Specifications**

Figure 1 – 291V1... – Without Schmitt Trigger, With Left Locating Lug, .050” Pitch Pins Facing Rear

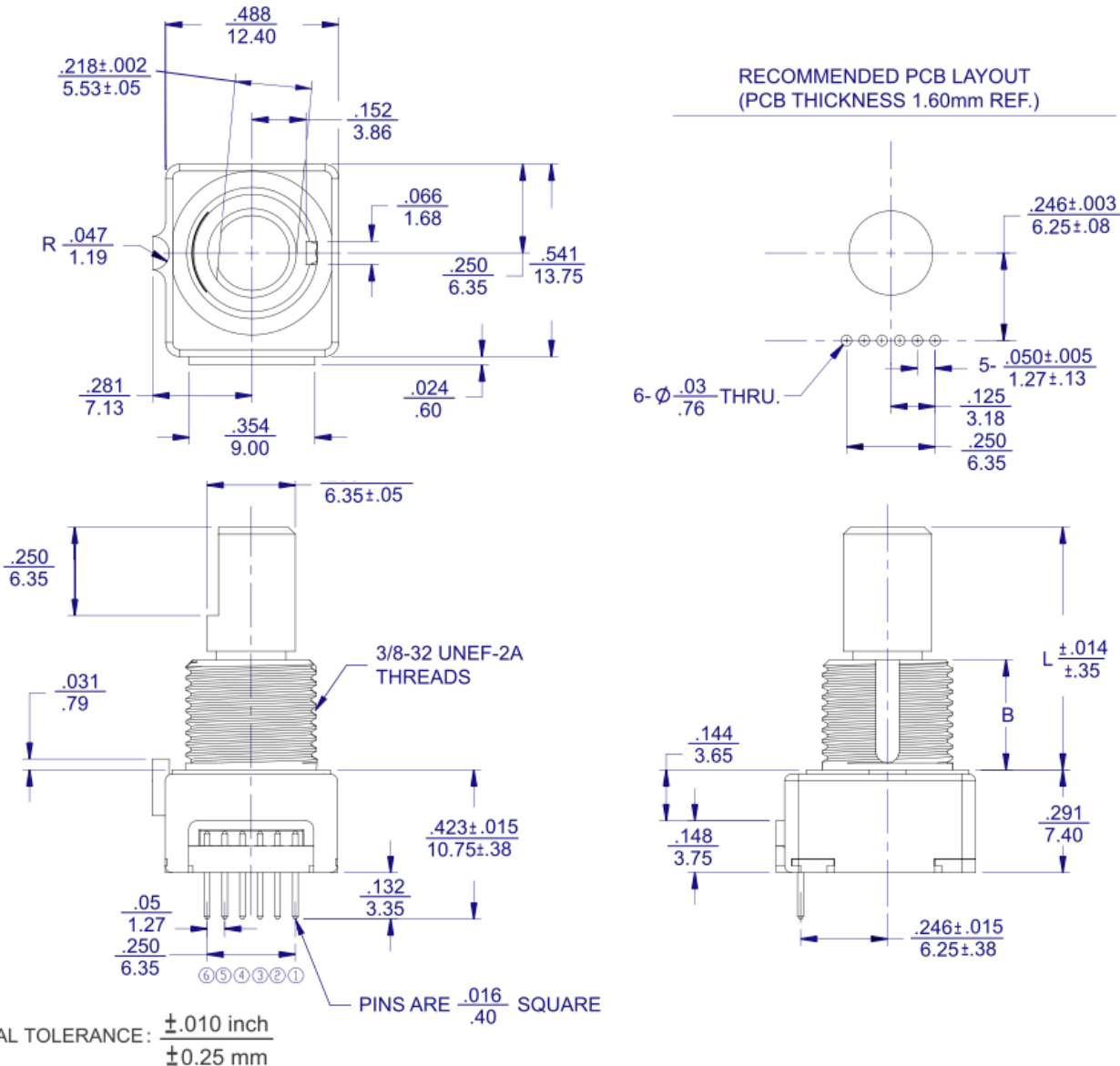
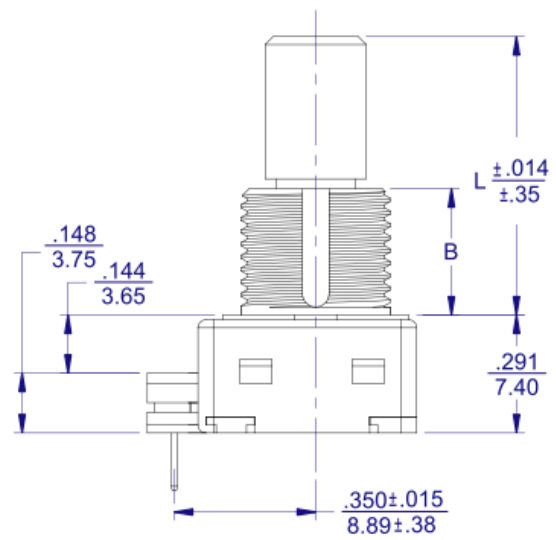
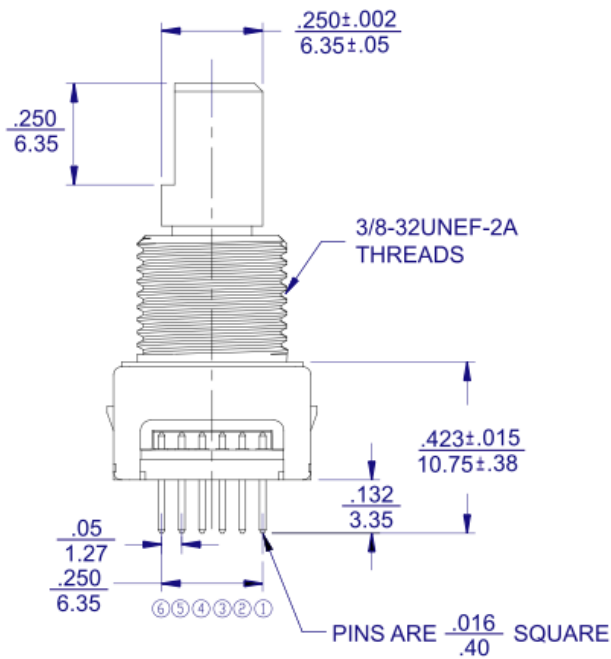
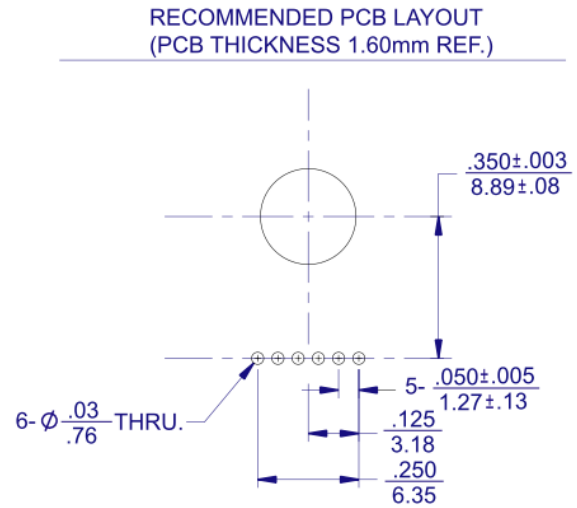
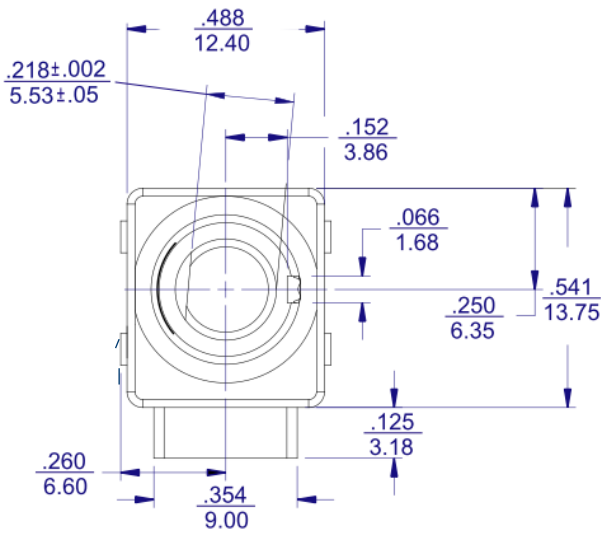
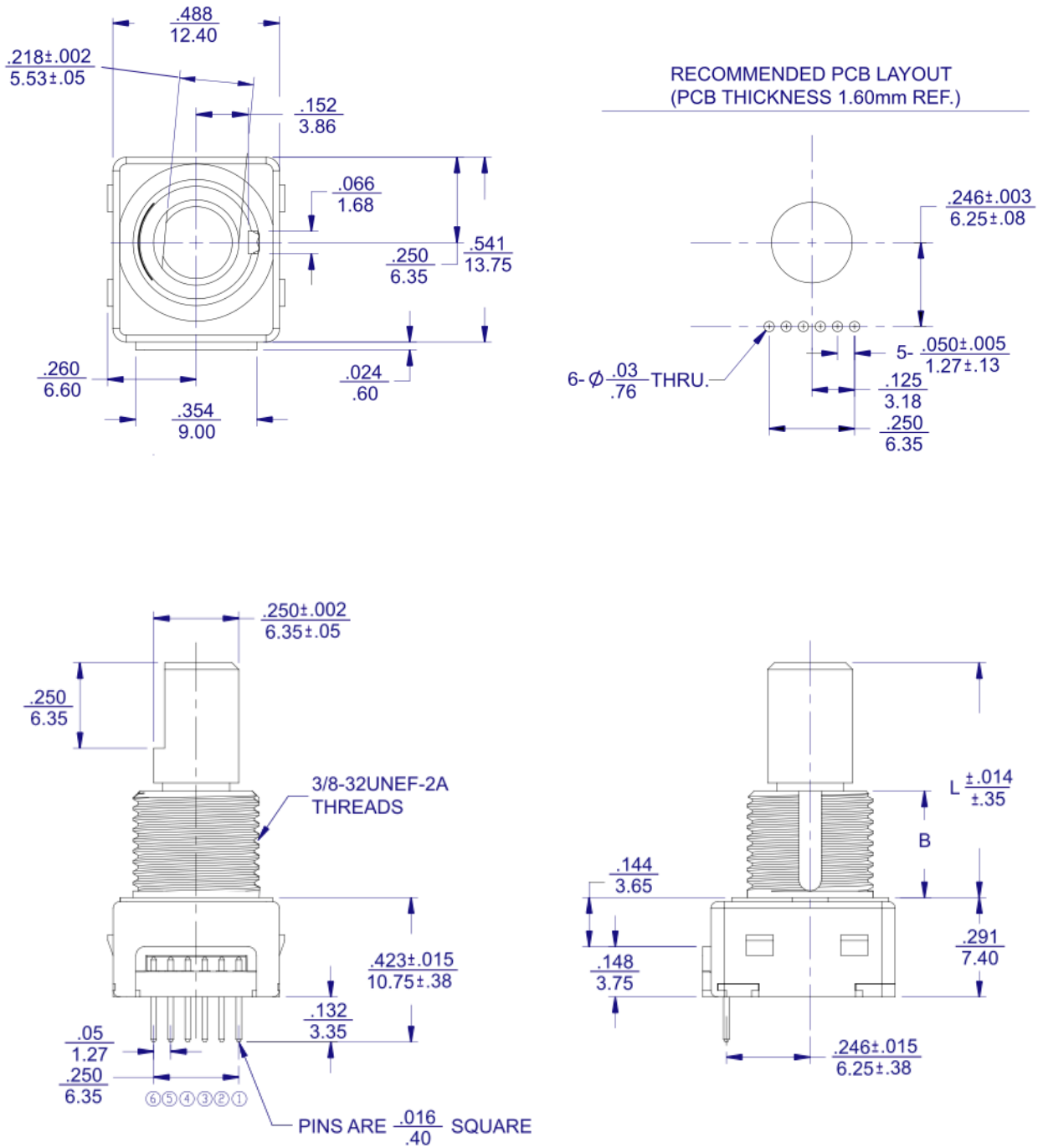


Figure 2 – 291V1...S – With Schmitt Trigger, Without Locating Lug, .050" Pitch Pins Facing Rear



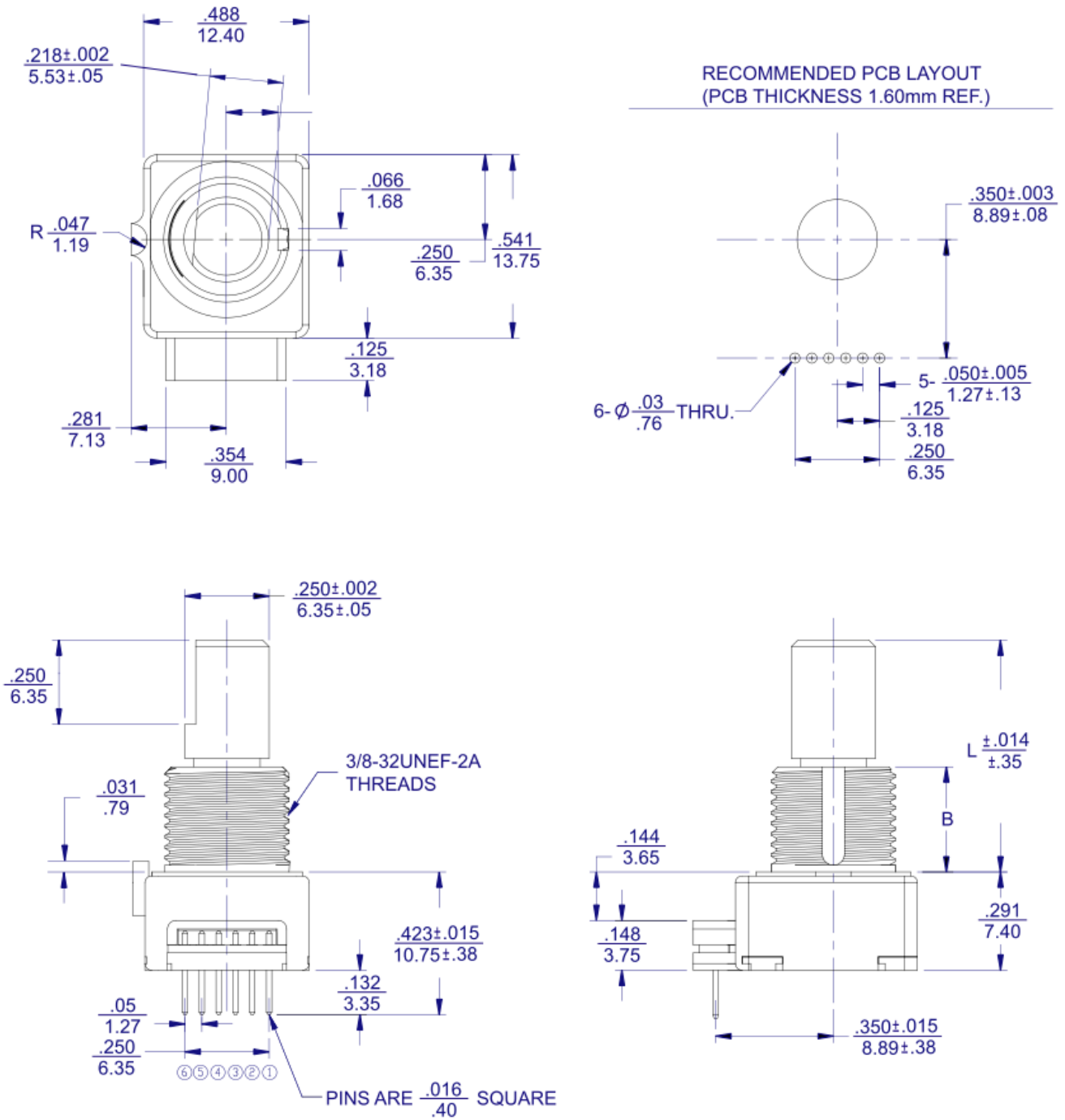
GENERAL TOLERANCE:  $\pm .010$  inch  
 $\pm 0.25$  mm

Figure 3 – 291V1...A – Without Schmitt Trigger, Without Locating Lug, .050" Pitch Pins Facing Rear



GENERAL TOLERANCE:  $\pm .010$  inch  
 $\pm 0.25$  mm

Figure 4 – 291V1...B – With Schmitt Trigger, With Locating Lug, .050" Pitch Pins Facing Rear



GENERAL TOLERANCE:  $\pm$  .010 inch  
 $\pm$  0.25 mm

Figure 5 – 291P1...A – Without Schmitt Trigger, Without Locating Lug, .100" Pitch Pins Facing Rear  
291P1...S – With Schmitt Trigger, Without Locating Lug, .100" Pitch Pins Facing Rear

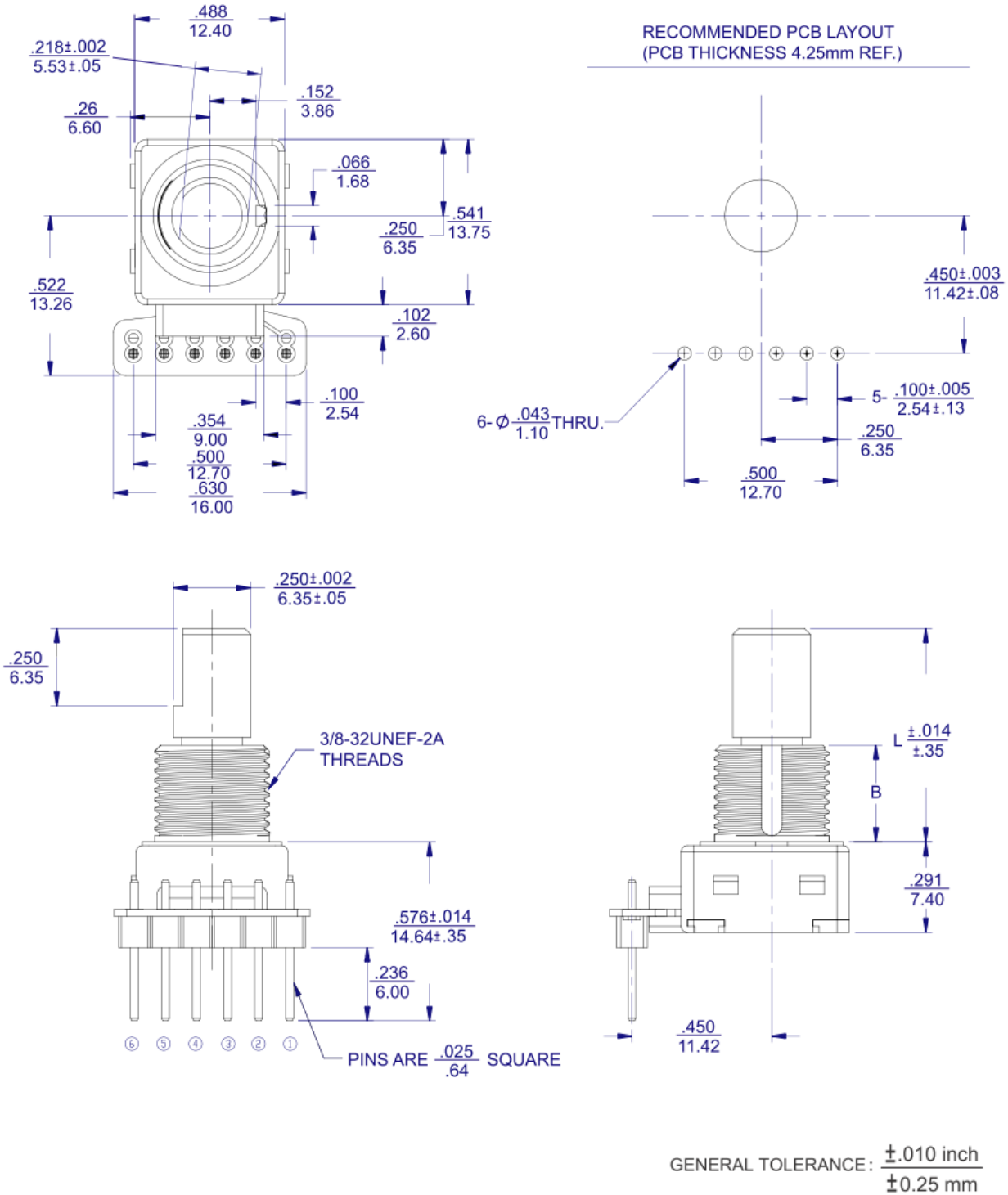
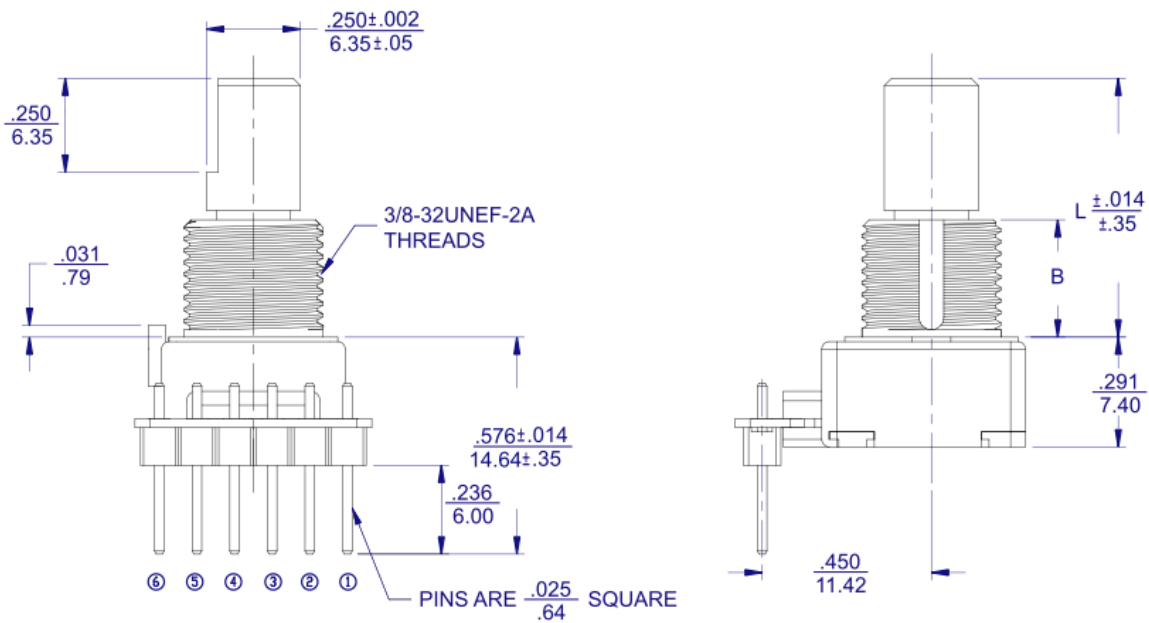
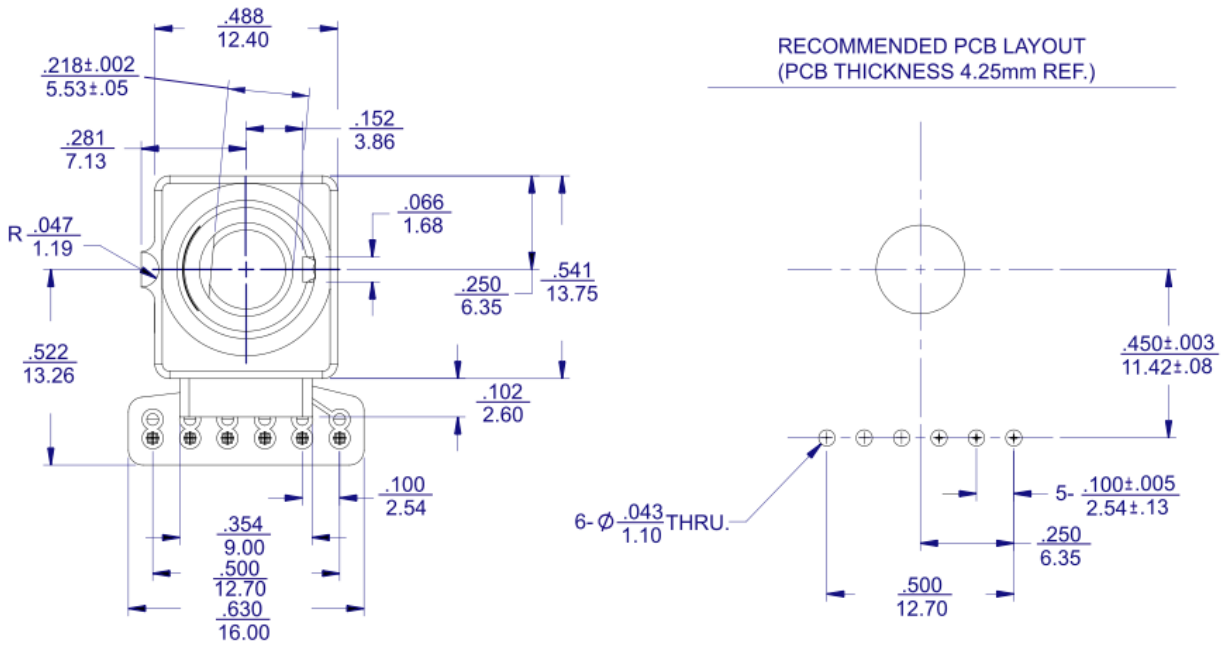


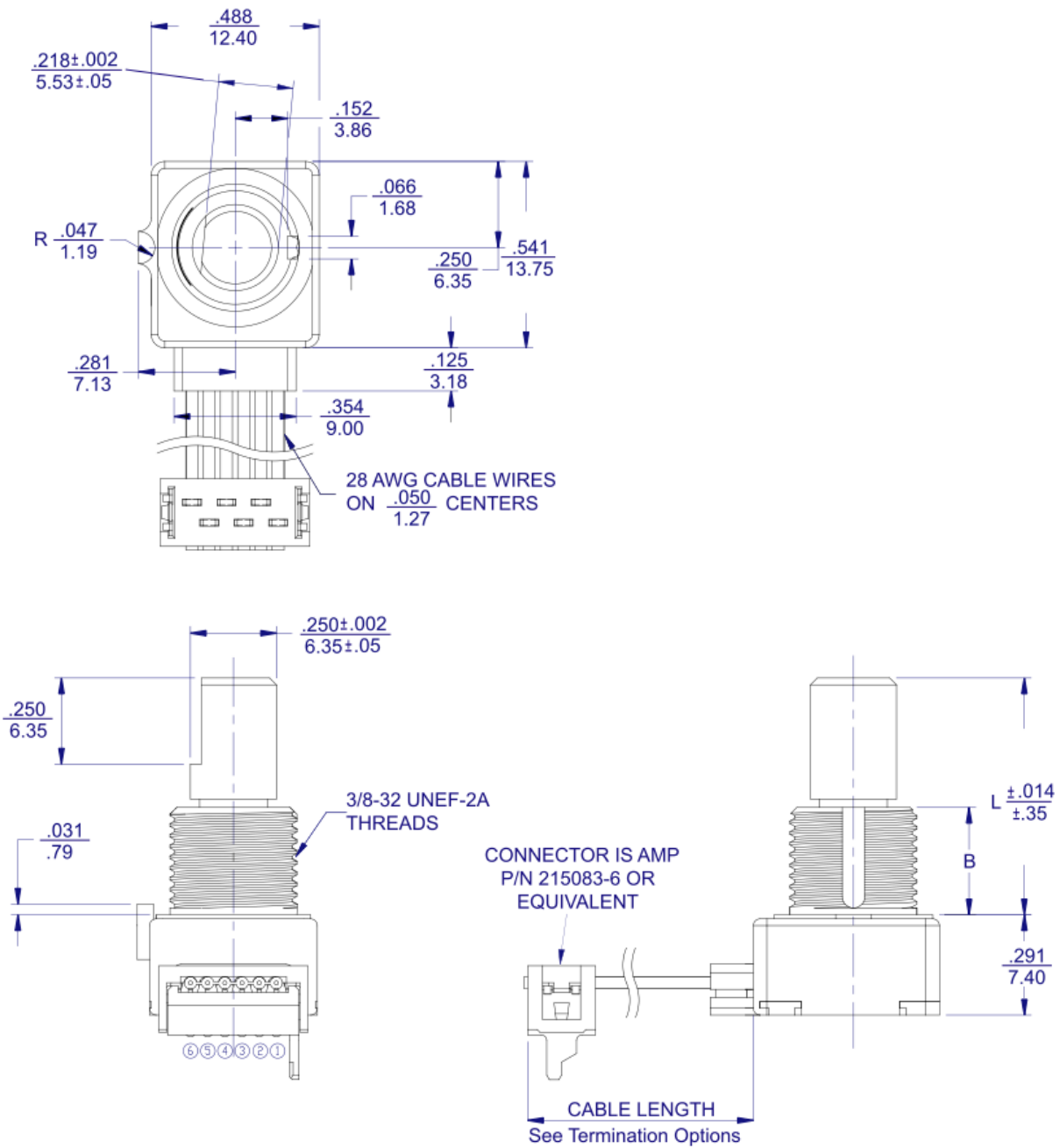
Figure 6 –291P1... – Without Schmitt Trigger, With Locating Lug, .100" Pitch Pins Facing Rear  
291P1...B – With Schmitt Trigger, With Locating Lug, .100" Pitch Pins Facing Rear



GENERAL TOLERANCE:  $\pm .010$  inch  
 $\pm 0.25$  mm



Figure 7 –291C... – Without Schmitt Trigger, With Locating Lug, With Ribbon Cable  
291C...B – With Schmitt Trigger, With Locating Lug, With Ribbon Cable



GENERAL TOLERANCE:  $\pm .010$  inch  
 $\pm 0.25$  mm

Figure 8 – 291C...A – Without Schmitt Trigger, Without Locating Lug, With Ribbon Cable  
291C...S – With Schmitt Trigger, Without Locating Lug, With Ribbon Cable

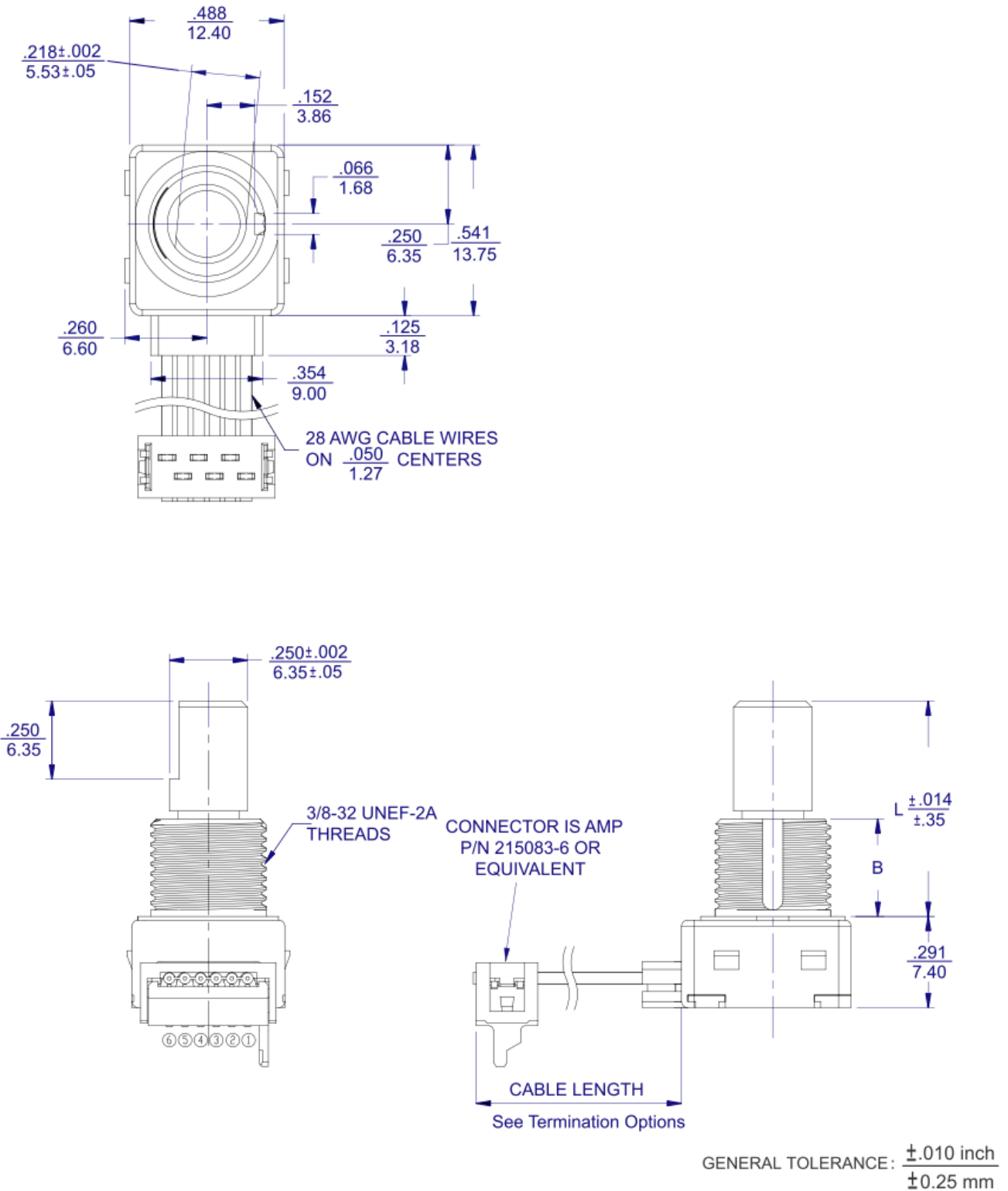
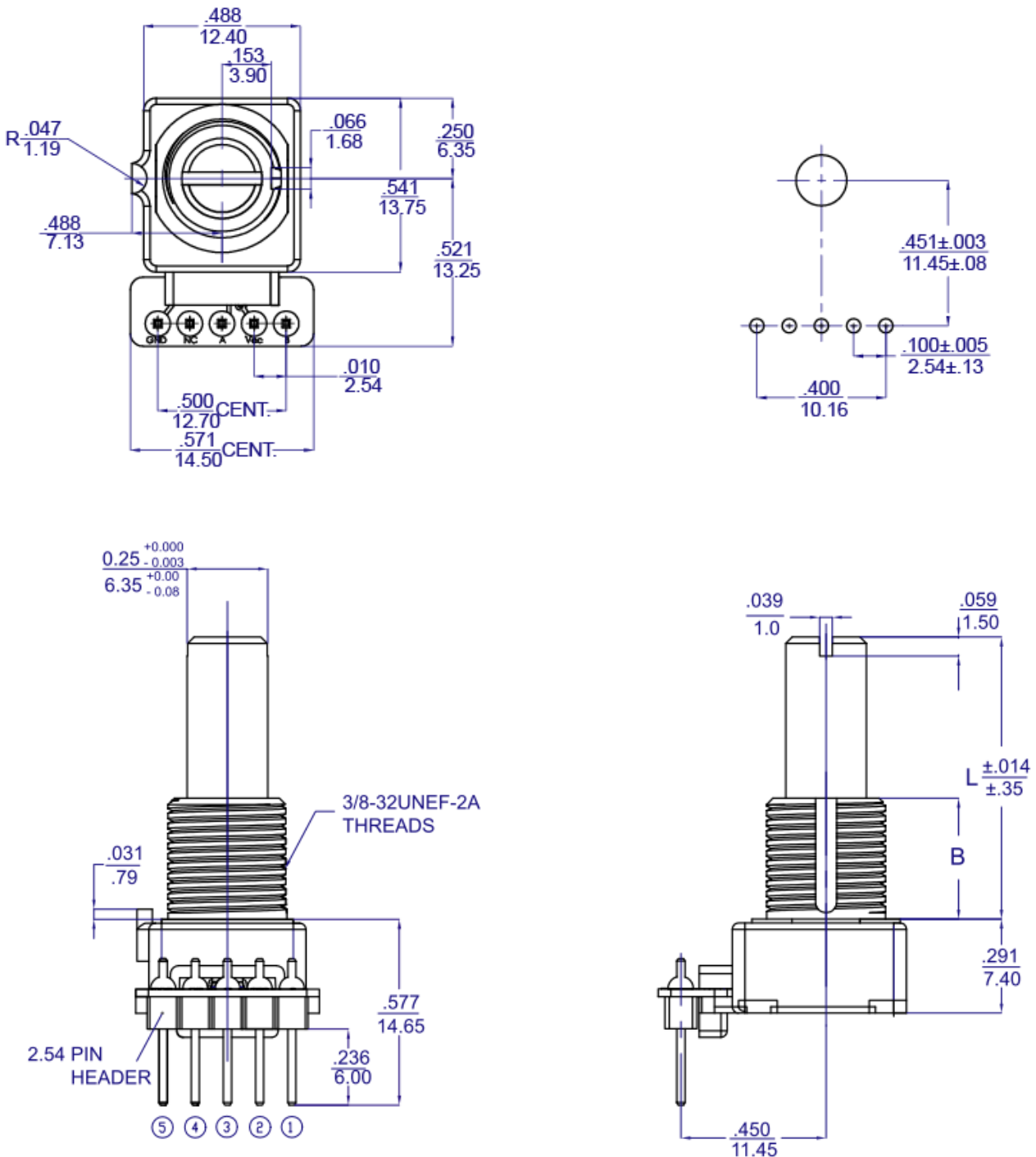


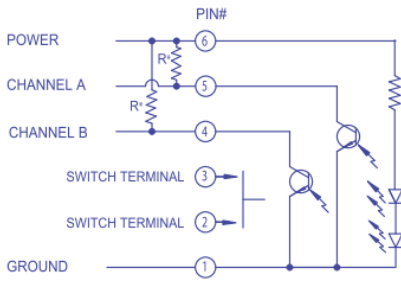
Figure 9 – 291P1...Z00AA – 64 PPR, With Schmitt Trigger, With Locating Lug, .100" Pitch Pins Facing Rear, Without Momentary Switch



GENERAL TOLERANCE:  $\pm .010$  inch  $\frac{\text{inch}}{\text{mm}}$   
 $\pm 0.25$  mm

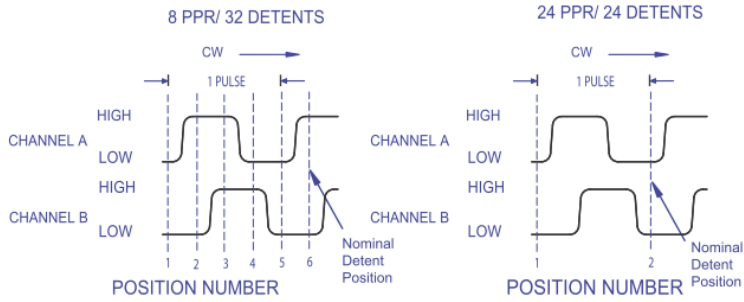
**4, 6, 8, 24 PPR**

**Electric Circuit And Waveform  
(Without Schmitt Trigger Design)**



\*Product will function properly with external 2.2KΩ pull up resistors.

**Standard Quadrature 2-Bit Code**

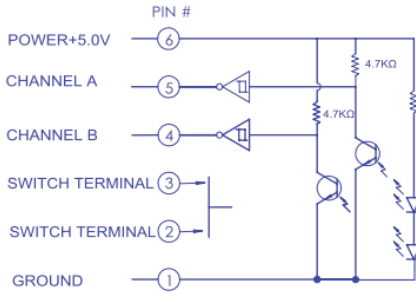


1. 8 PPR/32 detents is shown
2. Code repeats every 4 positions
3. Channel A Leads Channel B in CW direction and lags in CCW direction

1. 24 PPR/24 detents is shown
2. The nominal detent position is located when both Channel A and B are low
3. Channel A Leads Channel B in CW direction and lags in CCW direction

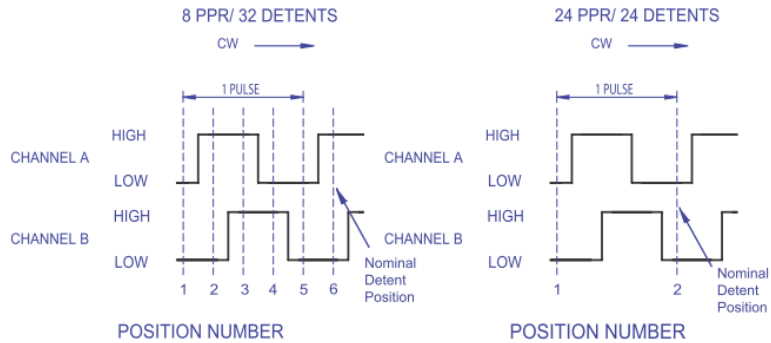
**4, 6, 8, 24, 32 PPR**

**Electric Circuit And Waveform  
(With Schmitt Trigger Design)**



\*Schmitt trigger and pull-up resistor (4.7KΩ) are integrated inside CTS optical encoder, so it's not necessary to have external pull-up resistors for application circuit.

**Standard Quadrature 2-Bit Code**

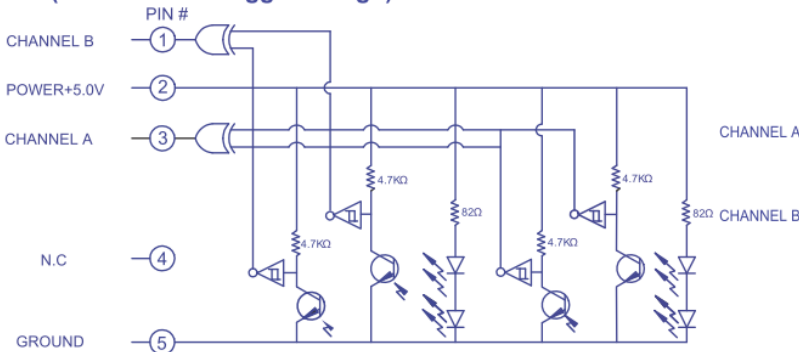


1. 8 PPR/32 detents is shown
2. Code repeats every 4 positions
3. Channel A Leads Channel B in CW direction and lags in CCW direction

1. 24 PPR/24 detents is shown
2. The nominal detent position is located when both Channel A and B are low
3. Channel A Leads Channel B in CW direction and lags in CCW direction

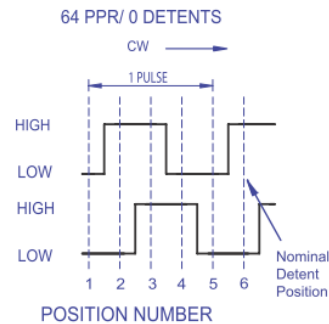
**64 PPR**

**Electric Circuit And Waveform  
(With Schmitt Trigger Design)**



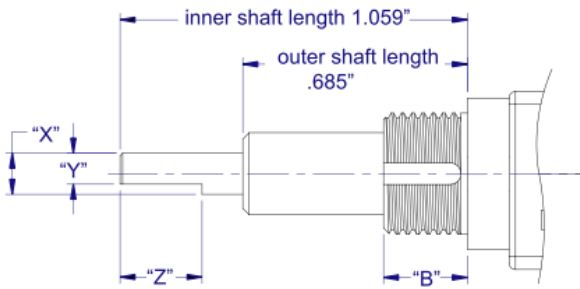
\*Open collector with integrated XOR Gate, schmitt trigger and 4.7KΩ pull-up resistor are inside CTS optical encoder, so it's not necessary to have external pull-up resistors for application circuit.

**Standard Quadrature 2-Bit Code**

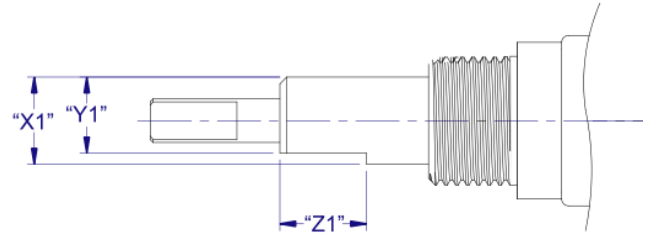


1. 64 PPR/0 detents is shown
2. Code repeats every 4 positions
3. Channel A Leads Channel B in CW direction and lags in CCW direction

### Dual Shaft Construction



### OUTER FLATTED SHAFT DIMENSION

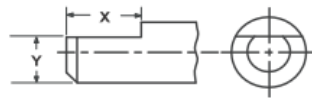


### D - DUAL

|          | X     | Y     | Z     | B     |
|----------|-------|-------|-------|-------|
| Imperial | .125" | .094" | .250" | .256" |
| Metric   | 3.18  | 2.40  | 6.35  | 6.50  |

### Single Shaft Trim Options

FLATTED



| Shaft Trim | Diameter        | X               | Y               |
|------------|-----------------|-----------------|-----------------|
| F          | .250" (6.35 mm) | .250" (6.35 mm) | .218" (5.53 mm) |

SD SLOT



| Shaft Trim | Diameter        | X             | Y             |
|------------|-----------------|---------------|---------------|
| S          | .250" (6.35 mm) | .059" (1.5mm) | .039" (1.0mm) |

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- Регистрацию проекта у производителя компонентов.
- Техническую поддержку проекта.
- Защиту от снятия компонента с производства.
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