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### Precision, Long-life Compact 12mm Size Optical Encoder

#### Features

- Package Size (12 X 14 X 7 mm)
- 3 Million life cycles (No detent)
- 1 Million life cycles (With detent)
- Durable Metal Shaft & Bushing
- Optional momentary switch
- Multiple options for terminations, resolution, cables, voltage
- RoHS Compliant



### Electrical and Mechanical Specifications

#### Encoder:

##### Operating Voltage

5.0 ± 0.25 VDC  
3.3 ± 0.125 VDC

##### Supply Current

5.0 VDC @ 30mA maximum  
3.3 VDC @ 24mA maximum

##### Output Code

2-Bit Quadrature  
Channel A leads channel B by 90°  
electrically during clockwise rotation  
of the shaft

##### Minimum Sink Current

2.0 mA for 5.0 VDC  
1.0 mA for 3.3 VDC

##### Power Consumption

150 mW maximum for 5.0 VDC  
80 mW maximum for 3.3 VDC

##### Rotational Torque

Running: 20 ± 10 gf-cm  
Detent: 140 ± 50 gf-cm (24 Detents)  
100 ± 50 gf-cm (16, 32 Detents)

##### Detent Options

0, 16, 24, 32

##### Resolution

4, 6, 8, 24 Pulses per Revolution

##### Rotational Life (@30 RPM)

3 Million cycles (No detent)  
1 Million cycles (With detent)

##### Temperature Range

Operating: - 40°C to 85°C  
Storage: - 55°C to 100°C

##### Push-Pull Strength of Shaft

20 kg minimum for 10 seconds

##### Terminal Pull-out Strength

6 kg minimum for 10 seconds

##### Solder Heat Resistance

350°C for 5 seconds

##### Mechanical Vibration

15G ( MIL-STD-883F-2004)

##### Mechanical Shock

100G ( MIL-STD-883F-2004)

#### Note:

Consult CTS for other common standard features not listed.

## Electrical and Mechanical Specifications (continued)

### Optional Momentary Switch:

#### Switch Contact Resistance

10 Ω maximum

#### Switch Rating

5 VDC @ 10 mA

#### Switch Travel

0.5 ± 0.25 mm

#### Actuation Force

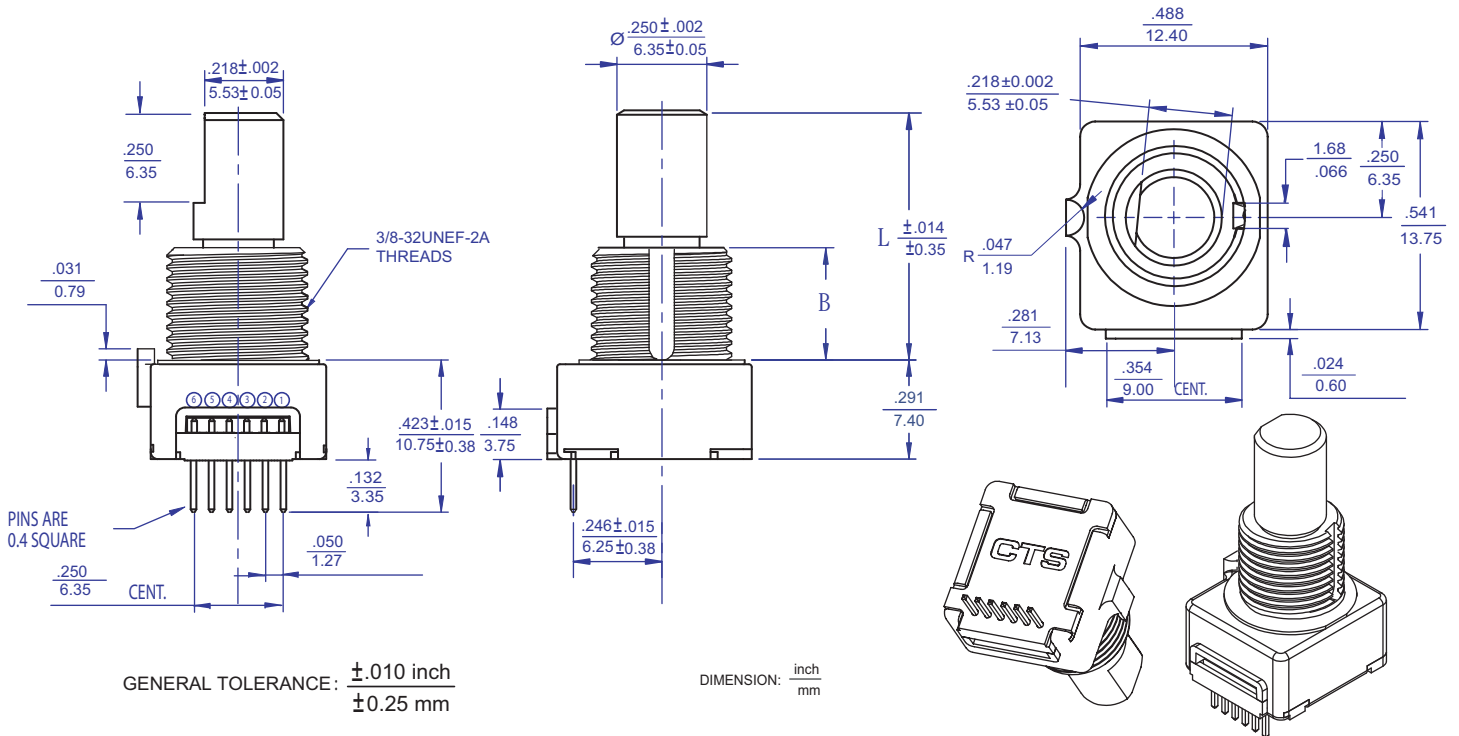
510 ± 110 grams

#### Switch Life

Standard: 1 Million actuations minimum

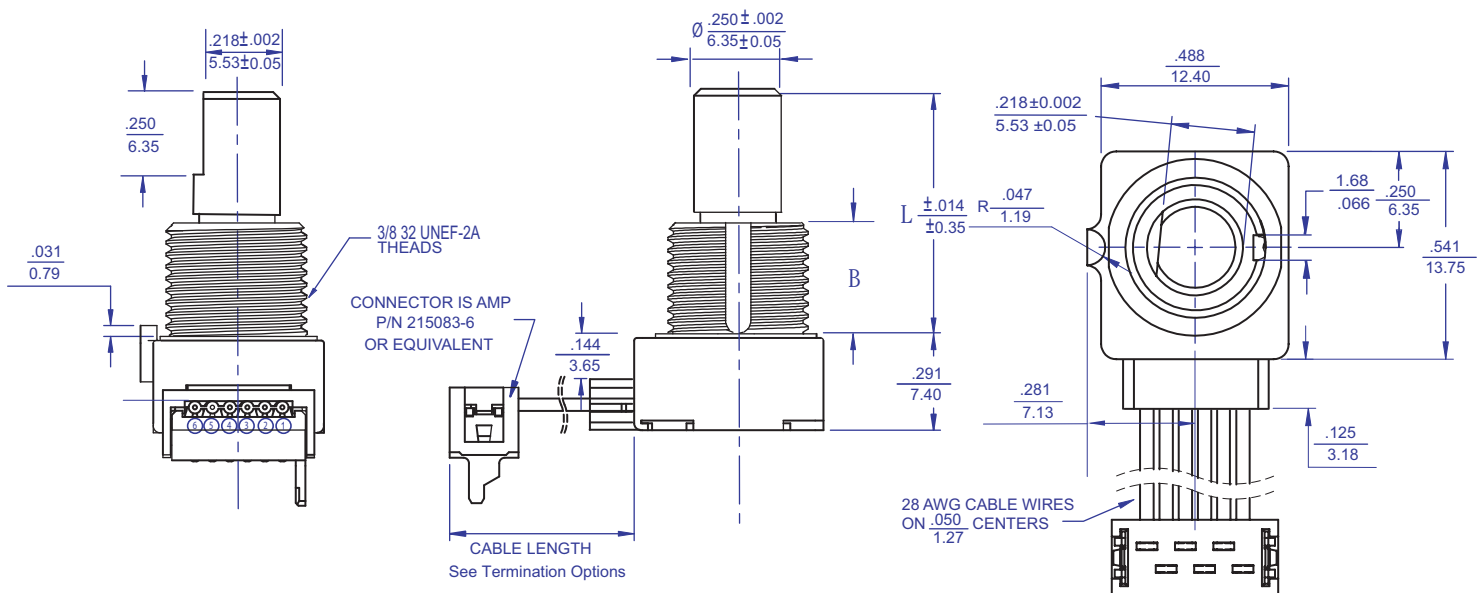
Special: Consult CTS for custom life requirements.

### TYPE 291V1... 2-Bit Encoder Without Schmitt Trigger, With Left Locating Lug, 0.05" Pitch Pins Formed to Rear

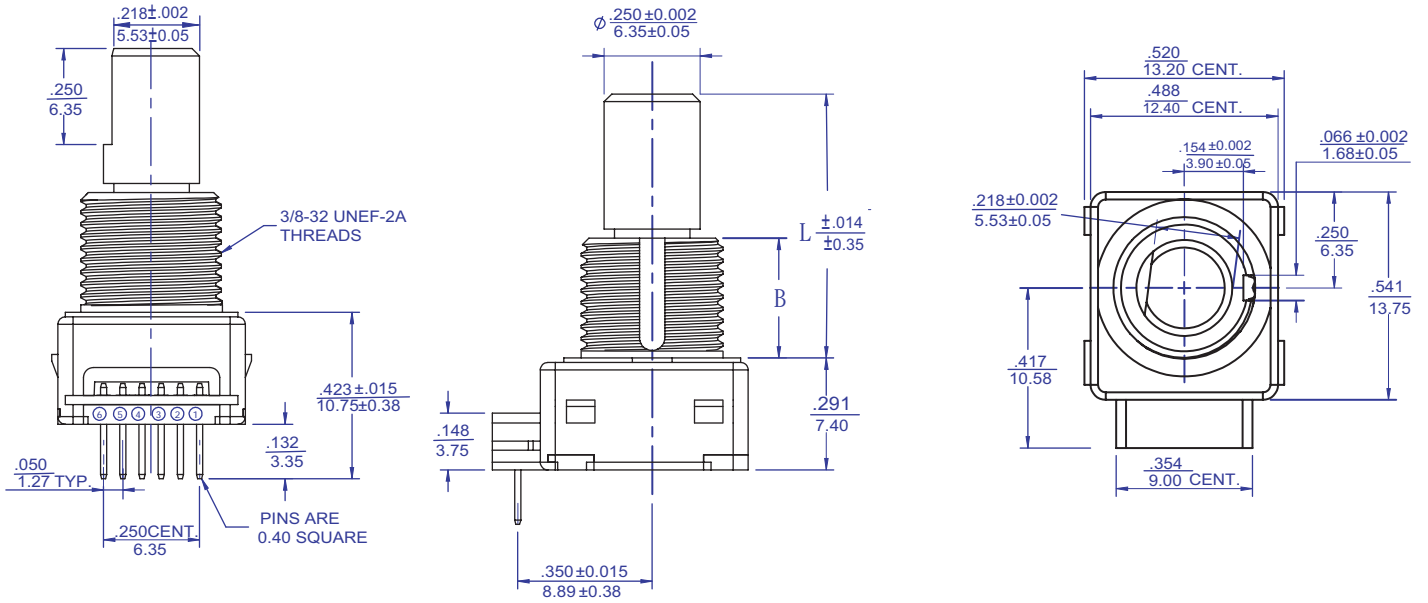


### TYPE 291C... 291C...B

2-Bit Encoder Without Schmitt Trigger, With Left Locating Lug, With Cable and Connector  
2-Bit Encoder With Schmitt Trigger, With Left Locating Lug, With Cable and Connector

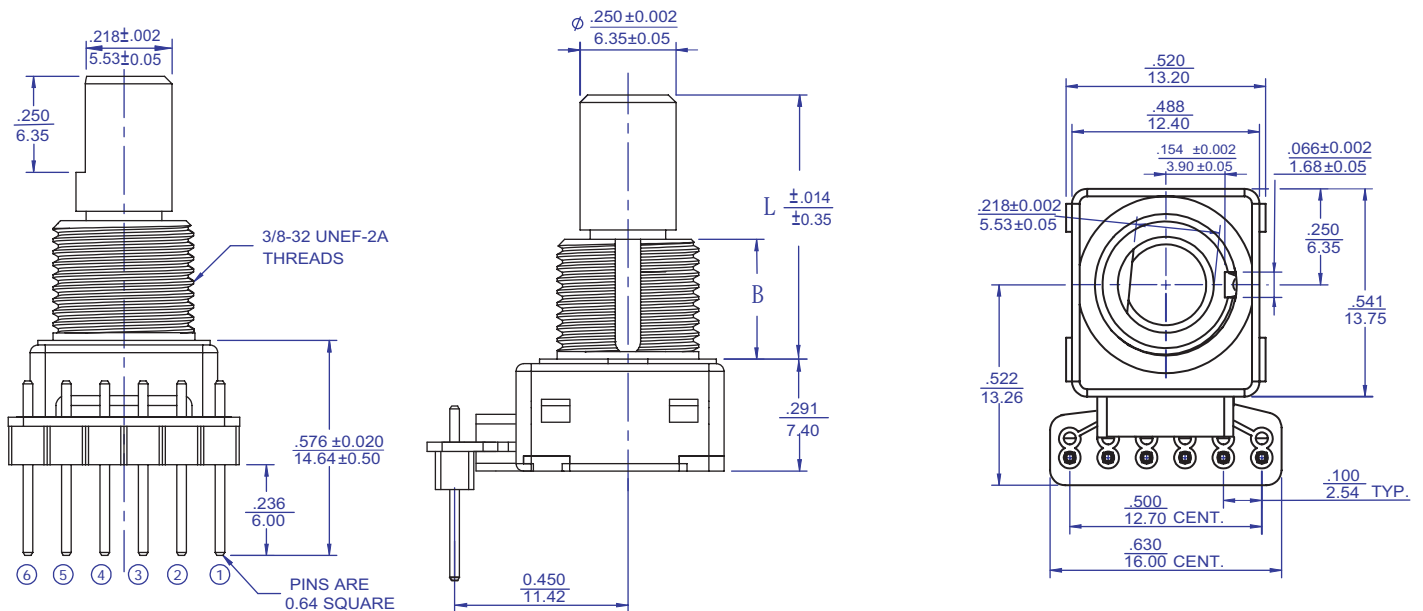


**TYPE 291V1...S** 2-Bit Encoder With Schmitt Trigger, Without Locating Lug, 0.05" Pitch Pins Formed to Rear



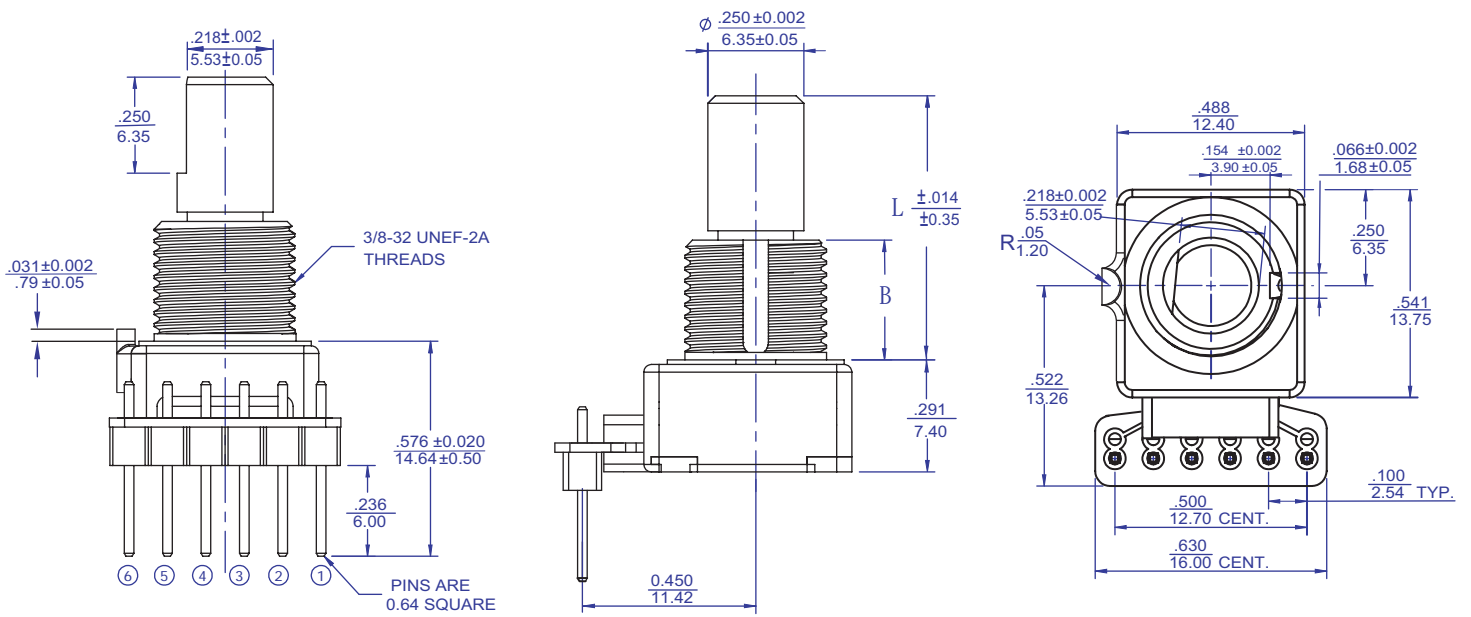
GENERAL TOLERANCE:  $\pm .010$  inch  
 $\pm 0.25$  mm

**TYPE 291P1...A** 2-Bit Encoder Without Schmitt Trigger, Without Locating Lug, 0.1" Pitch Pins Formed to Rear  
**291P1...S** 2-Bit Encoder With Schmitt Trigger, Without Locating Lug, 0.1" Pitch Pins Formed to Rear



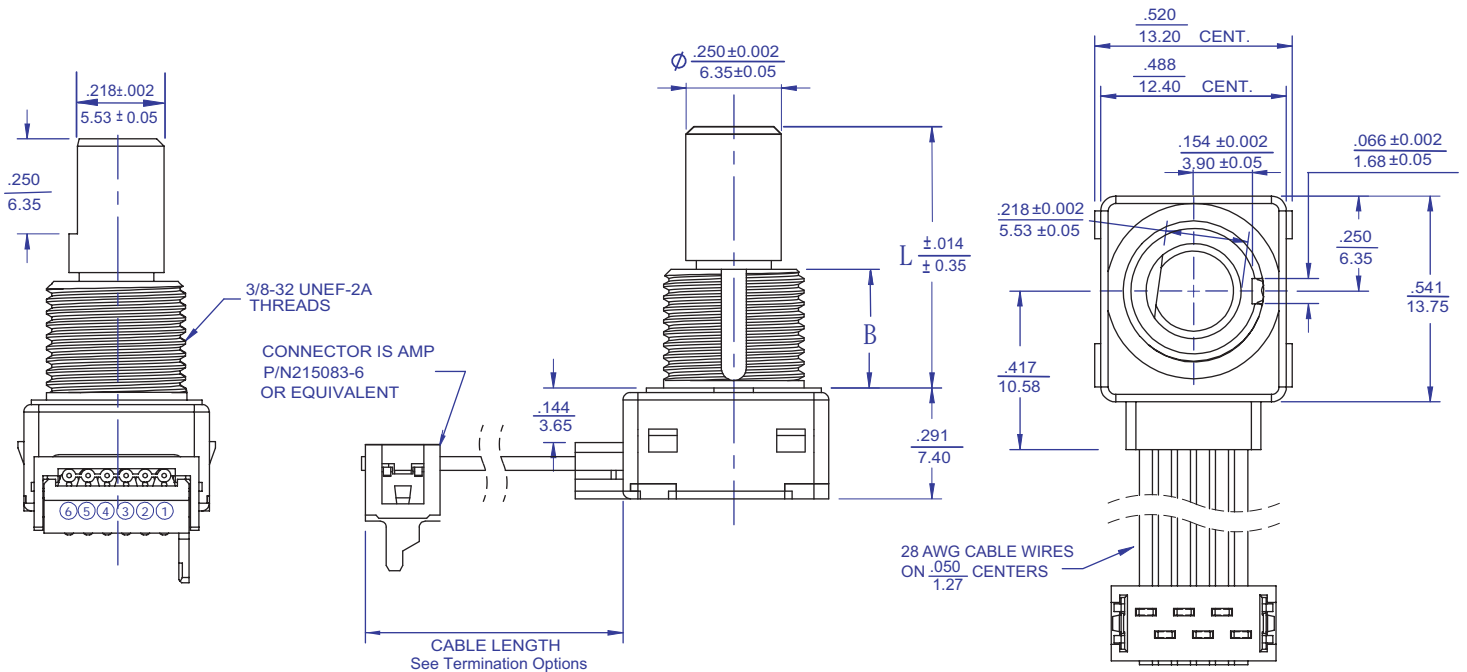
GENERAL TOLERANCE:  $\pm .010$  inch  
 $\pm 0.25$  mm

**TYPE 291P1...** 2-Bit Encoder Without Schmitt Trigger, With Left Locating Lug, 0.1" Pitch Pins Formed to Rear  
**291P1...B** 2-Bit Encoder With Schmitt Trigger, With Locating Lug, 0.1" Pitch Pins Formed to Rear



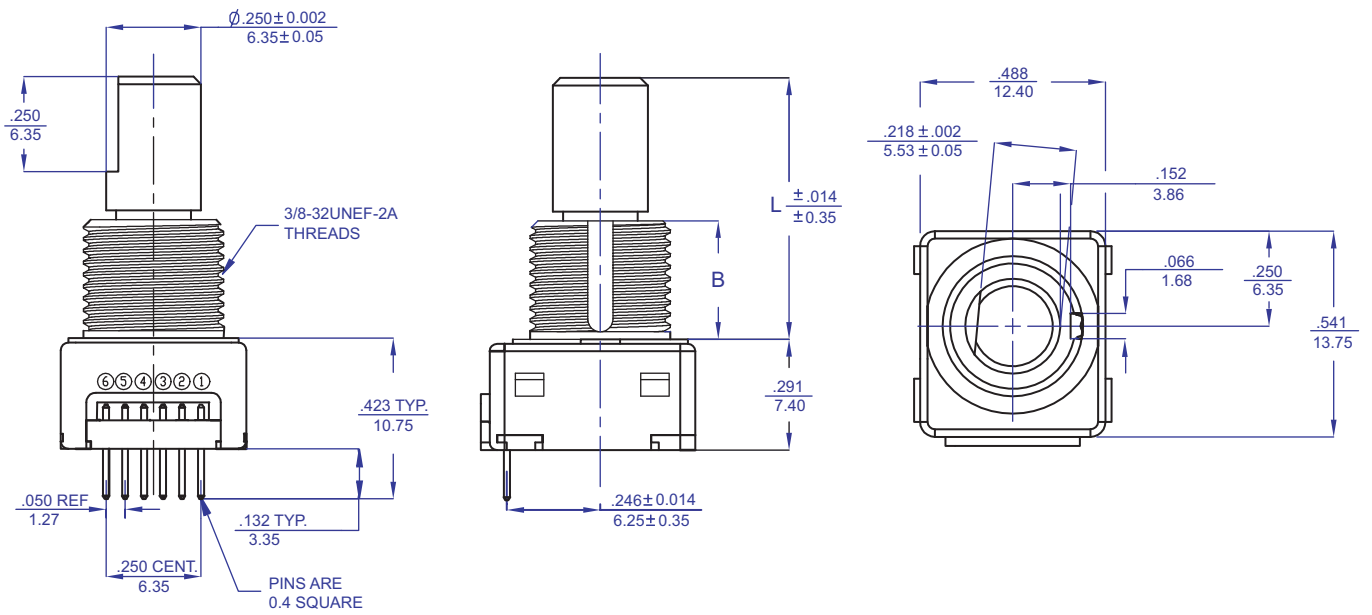
GENERAL TOLERANCE:  $\pm .010$  inch  
 $\pm 0.25$  mm

**TYPE 291C...A** 2-Bit Encoder Without Schmitt Trigger, Without Locating Lug, With Cable and Connector  
**TYPE 291C...S** 2-Bit Encoder With Schmitt Trigger, Without Locating Lug, With Cable and Connector



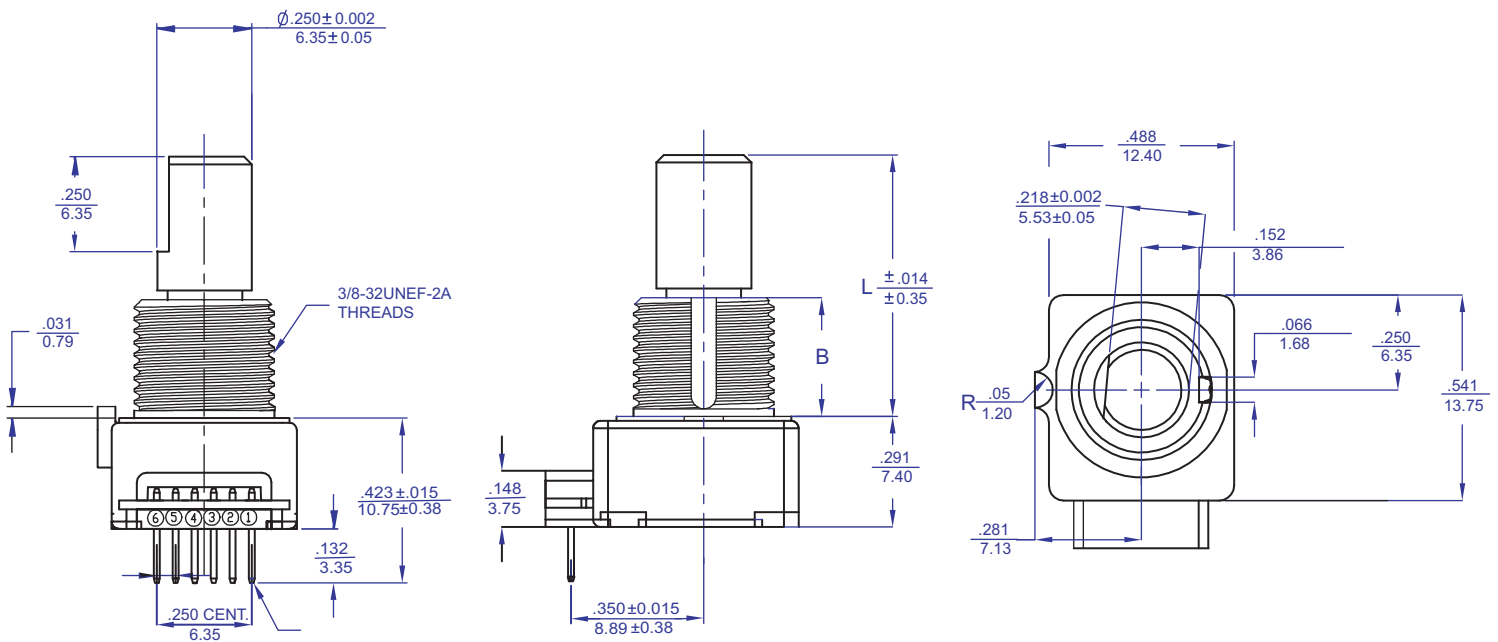
GENERAL TOLERANCE:  $\pm .010$  inch  
 $\pm 0.25$  mm

**TYPE 291V1...A** 2-Bit Encoder Without Schmitt Trigger, Without Locating Lug, 0.05" Pitch Pins Formed to Rear



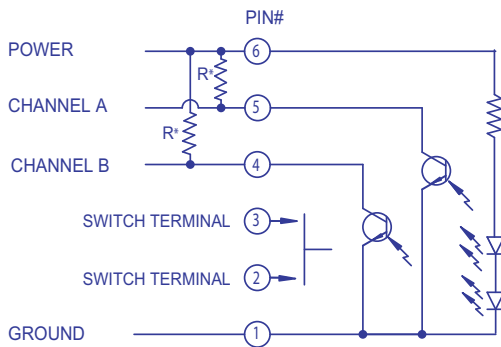
GENERAL TOLERANCE:  $\pm .010$  inch  
 $\pm 0.25$  mm

**TYPE 291V1...B** 2-Bit Encoder With Schmitt Trigger, With Left Locating Lug, 0.05" Pitch Pins Formed to Rear



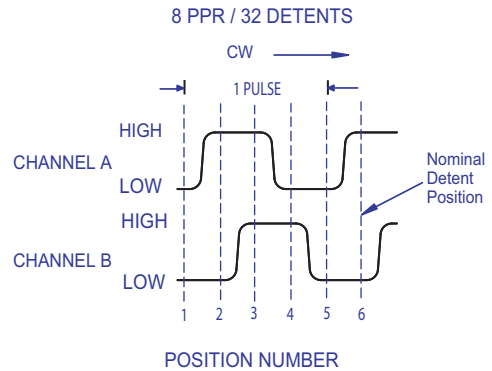
GENERAL TOLERANCE:  $\pm .010$  inch  
 $\pm 0.25$  mm

## ELECTRIC CIRCUIT AND WAVEFORM (WITHOUT SCHMITT TRIGGER DESIGN)



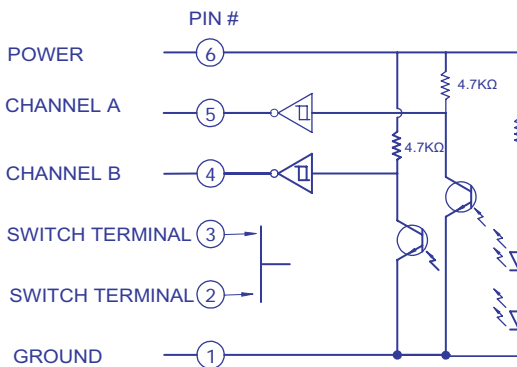
\* Require pull-up resistors (2.2K or 4.7K  $\Omega$ ) for application

### 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

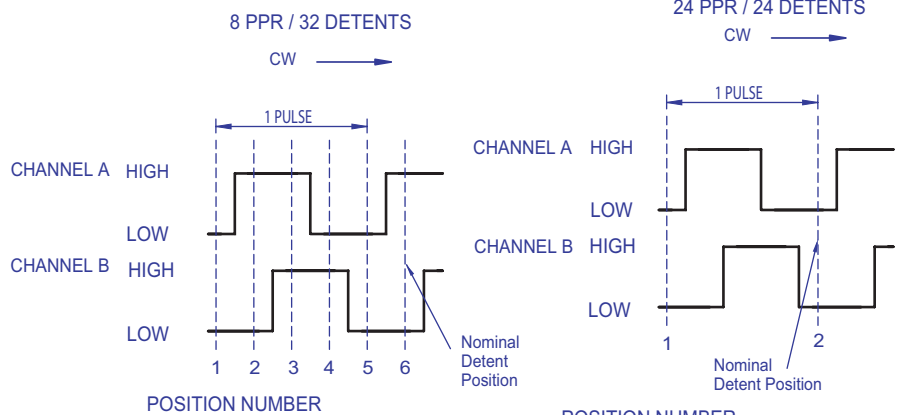
## ELECTRIC CIRCUIT AND WAVEFORM (WITH SCHMITT TRIGGER DESIGN)



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

\* Product will function properly with external 2.2K $\Omega$  pull up resistors.

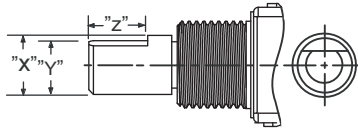
### Standard Quadrature 2-Bit Code



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

# Single Shaft Construction

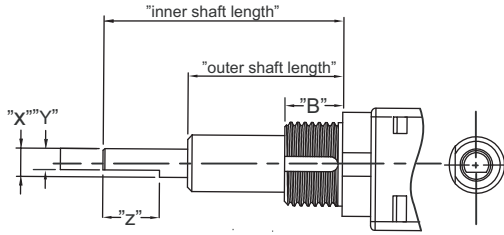


F - FLATTED

	X	Y	Z
Imperial Shaft	.250"	.218"	.250"
Metric Shaft	6.35	5.53	6.35

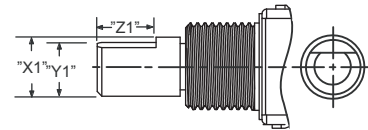
DIMENSION:  $\frac{\text{inch}}{\text{mm}}$

# Dual Shaft Construction



D - DUAL

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

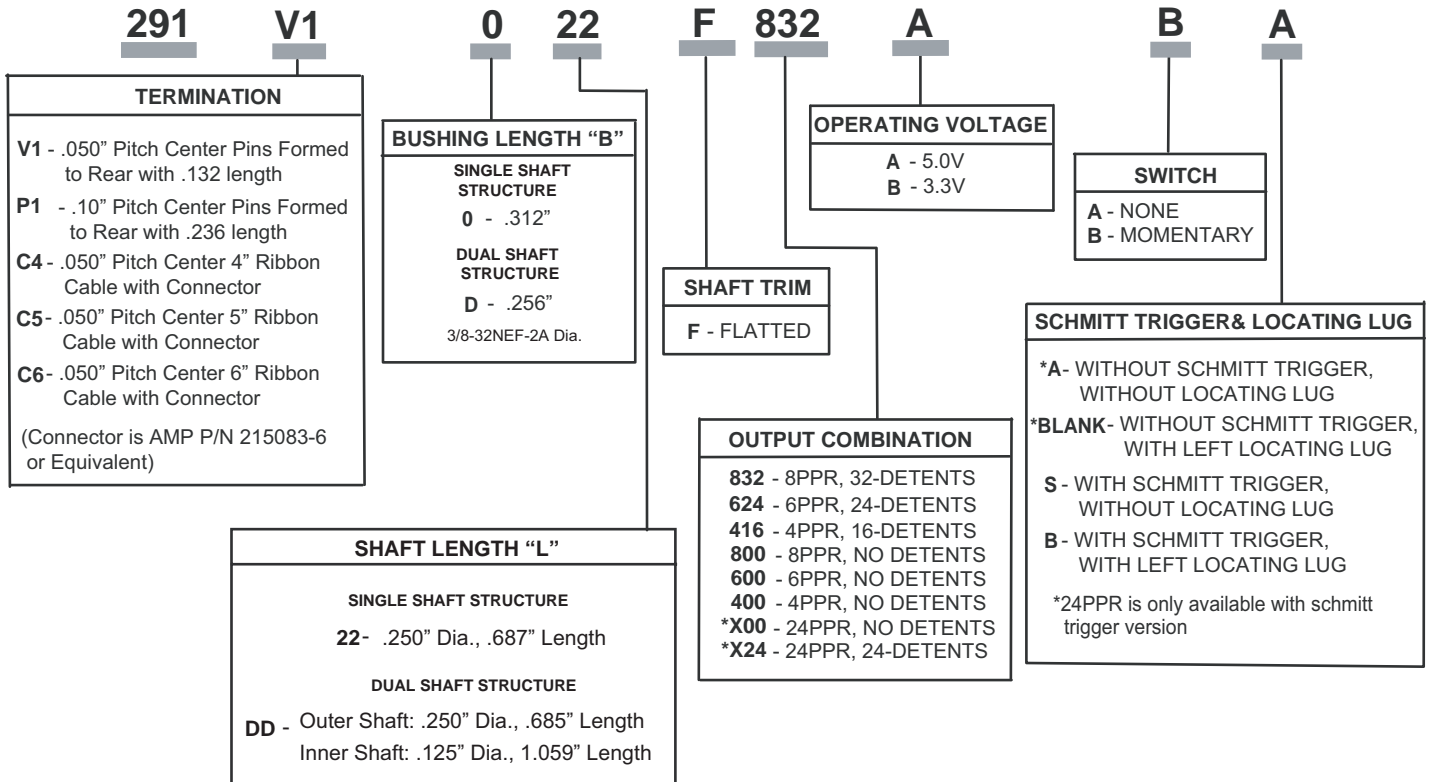


OUTER FLATTED SHAFT DIMENSION

	X1	Y1	Z1
Imperial Shaft	.250"	.218"	.250"
Metric Shaft	6.35	5.53	6.35

DIMENSION:  $\frac{\text{inch}}{\text{mm}}$

# Ordering Information



**Note:**

Consult CTS for other common features not listed.