

## Description

The **E8P** optical incremental kit encoder is designed for high volume, low cost, mid-resolution OEM motion control applications. The **E8P** is small enough for a NEMA Size 11 stepper motor. The **E8P** uses a single 5V supply and offers two TTL quadrature outputs. Single-ended or differential output options are available. A single chip reflective encoder module incorporates an LED, monolithic detector and molded lenses. The phased array technology accepts far wider mechanical tolerance and misalignment than traditional aperture type encoders. The **E8P** uses an innovative, patent pending, push-on codewheel that provides extremely secure and accurate, yet easy installation without setscrews.

The **E8P** provides mounting holes for two #4-40, length .250" screws or two M2.5x.45mm, length 6mm screws on a 0.75" diameter bolt circle. When mounting holes are not available, an option with a transfer adhesive pre-applied to the base is available. A centering tool is provided to center the base to the motor shaft during installation. The codewheel pushes on by hand using a spacer tool to set the gap in one step. The cover snaps on to complete the assembly in seconds.

The single-ended output version has a 4-pin high retention polarized connector and is designed to drive cables up to six feet long. For longer cable lengths, the differential output version (6-pin connector) is recommended to maximize noise immunity. The internal 26C31 differential line driver can source and sink 20 mA at TTL levels. The recommended receiver is industry standard 26C32. Maximum noise immunity is achieved when the differential receiver is terminated with a 110  $\Omega$  resistor in series with a .0047  $\mu$ F capacitor placed across each differential pair. The capacitor simply conserves power. Otherwise power consumption would increase by approximately 20 mA per pair, or 40 mA for 2 pairs.



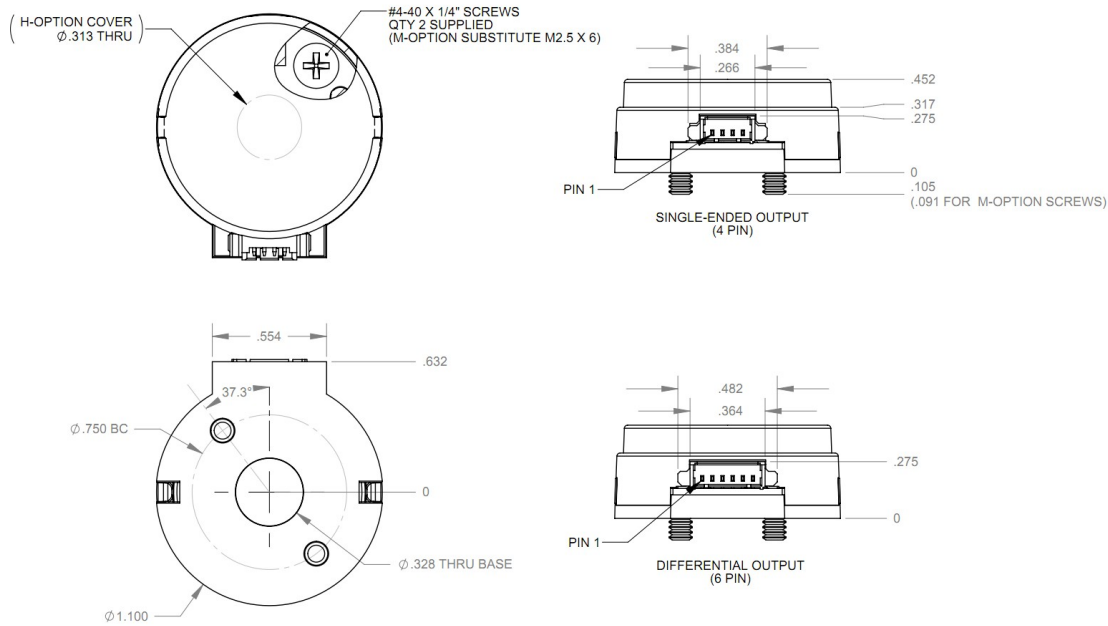
## Features

- ▶ Subminiature size, easy installation
- ▶ Single-ended or differential output option
- ▶ A and B quadrature TTL outputs
- ▶ Fits shaft diameters from 0.118" (3mm) to 0.276" (7mm)
- ▶ Accepts +/- 0.020" axial shaft play
- ▶ Off-axis mounting tolerance of 0.010"
- ▶ Count frequency from DC to 60 kHz
- ▶ 180 to 512 cycles per rev (CPR)
- ▶ 720 to 2048 quadrature states per rev.
- ▶ Single +5V supply

## Related Products & Accessories

- ▶ CA-FC5-SH-MIC4 5-Pin Latching / 4-Pin Micro Shielded Cable (Base price \$15.18)
- ▶ CA-MD6-SS-MIC4 6-Pin Modular / 4-Pin Micro Silver Satin Cable (Base price \$11.53)
- ▶ CA-MIC4-SH-NC 4-Pin Micro / Unterminated Shielded Cable (Base price \$7.30)
- ▶ CA-MIC4-W4-NC 4-Pin Micro / Unterminated 4-Wire Discrete Cable (Base price \$6.80)
- ▶ CA-MIC6-SH-NC 6-Pin Micro / Unterminated Shielded Cable (Base price \$10.46)
- ▶ CA-MIC6-W6-NC 6-Pin Micro / Unterminated 6-Wire Discrete Cable (Base price \$9.96)

## Mechanical Drawing



## Mechanical

Parameter	Value	Units
Moment of Inertia	1.069 x 10 <sup>6</sup> max.	oz-in-s <sup>2</sup>
Required Shaft Length		
With D-Cover option	0.385" to 0.400"	in.
With H-Cover option	>=0.385"	in.

## Materials

Part	Material
Base, Cover	20% glass filled polycarbonate
Codewheel	Aluminum

## Mounting

Base Option	Bolt Circle	Screws Included	Screw Torque
D	0.75"	#4-40, length .250" pan head phillips (qty: 2)	2-3 in.-lbs.
M	0.75"	M2.5x.45mm, length 6mm pan head phillips (qty: 2)	2-3 in.-lbs.
T	n/a	none - .005" thick transfer adhesive with peel away backing mount.	n/a

The included centering tool and spacer tool are used to center the base to the motor shaft and to set the codewheel gap.

## Absolute Maximum Ratings

Parameter	Min.	Max.	Units
Vibration (5 Hz to 2kHz)	-	20	G
Shaft Axial Play	-	±.020	in.
Off-axis Mounting Tolerance	-	0.010	in.
Acceleration	-	250,000	rad/sec <sup>2</sup>
Maximum RPM e.x. CPR = 512, max. rpm = 7031 e.x. CPR = 180, max. rpm = 20000		minimum value of (3600000/CPR) and (60000)	rpm
Relative Humidity	-	90	%
Storage Temperature	-40	100	C
Operating Temperature	-20	100	C

► Note: 60000 rpm is the maximum rpm due to mechanical considerations. The maximum rpm due to the module's 60kHz maximum count frequency is (3600000/CPR).

## Single-ended Electrical

Specifications	Min.	Typ.	Max.	Units	Notes
Supply Current	-	21	27	mA	
Supply Voltage	4.5	-	5.5	V	
High Level Output	2.4	-	-	V	loh = -2 mA
Low Level Output	-	-	0.4	V	lol = 8 mA
Rise Time	-	500	-	ns	CI = 25 pF, RI = 2.7 kΩ
Fall Time	-	100	-	ns	
Frequency Response	-	-	60	kHz	

For complete details see the AEDR page.

## Differential Electrical

Specifications	Min.	Typ.	Max.	Units	Notes
Supply Current	-	22	30	mA	
Supply Voltage	4.5	-	5.5	V	
High Level Output	2.4	3.4	-	V	loh = -20 mA
Low Level Output	-	0.2	0.4	V	lol = 20 mA
Rise Time	-	500	-	ns	

Specifications	Min.	Typ.	Max.	Units	Notes
Fall Time	-	100	-	ns	
Frequency Response	-	-	60	kHz	

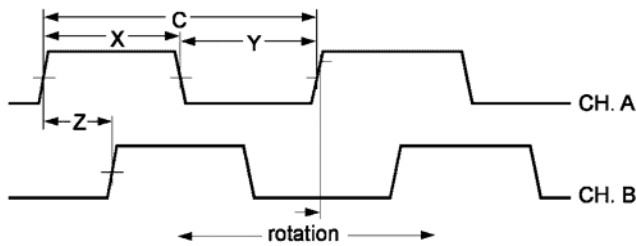
For complete details see the AEDR page.

## Encoding Characteristics

Parameter	Typ.	Max.	Units
Symmetry Error	16	75	deg.
Quadrature Error	12	60	deg.

A leads B for clockwise shaft rotation, and B leads A for counterclockwise rotation viewed from the cover/label side of the encoder (see the AEDR page for more details).

## Timing Diagram



### CPR (N):

The number of Cycles Per Revolution.

### One Shaft Rotation:

360 mechanical degrees, N cycles.

### One Electrical Degree (e):

1/360th of one cycle.

### One Cycle (C):

360 electrical degrees (e). Each cycle can be decoded into 1 or 4 codes, referred to as X1 or X4 resolution multiplication.

### Symmetry:

A measure of the relationship between (X) and (Y) in electrical degrees, nominally 180e.

### Quadrature (Z):

The phase lag or lead between channels A and B in electrical degrees, nominally 90e.

**Position Error:**

The difference between the actual shaft position and the position indicated by the encoder cycle count.

**Cycle Error:**

An indication of cycle uniformity. The difference between an observed shaft angle which gives rise to one electrical cycle, and the nominal angular increment of 1/N of a revolution.

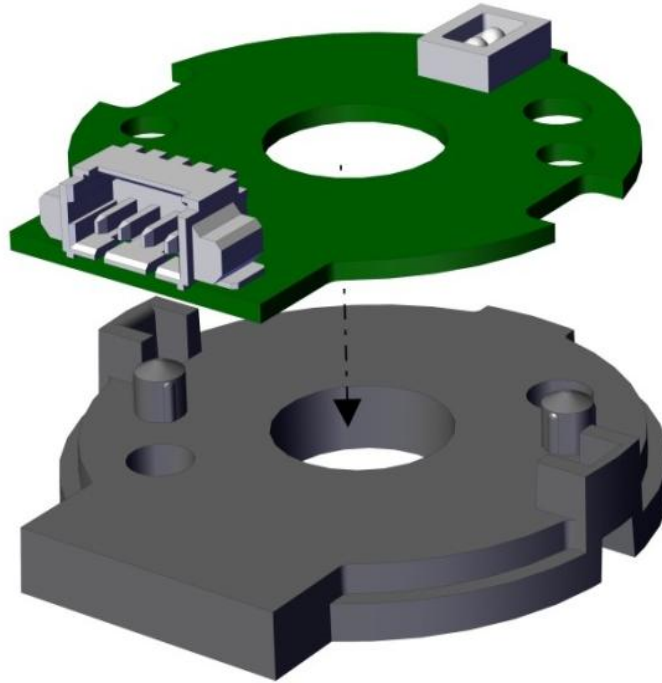
 **Pin-outs**

4-pin Single-ended		6-pin Differential	
Pin	Description	Pin	Description
1	+5VDC power	1	Ground
2	A channel	2	A channel
3	Ground	3	A- channel
4	B channel	4	+5VDC power
		5	B channel
		6	B- channel

 **Assembly Instructions**

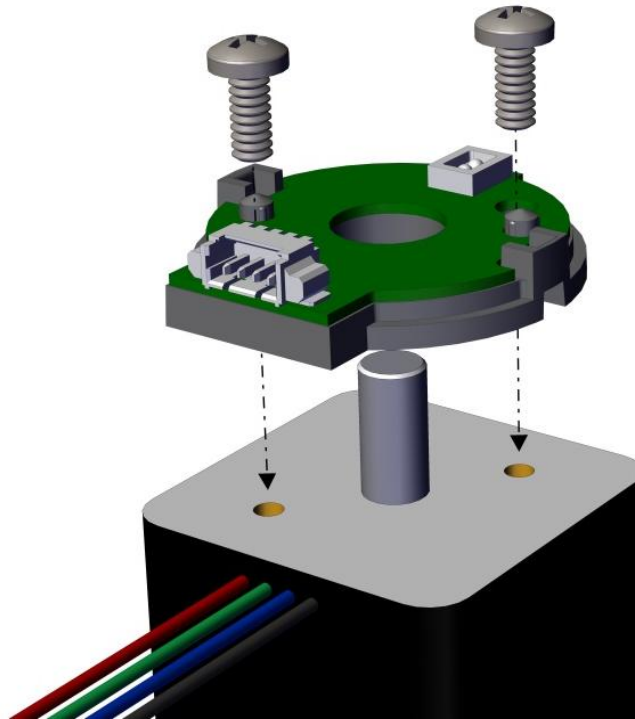
**1. PCB Installation**

Position the PCB so that connector lines up with flat side of base. Push PCB onto base by hand so that the two guide posts fit into associated PCB holes.

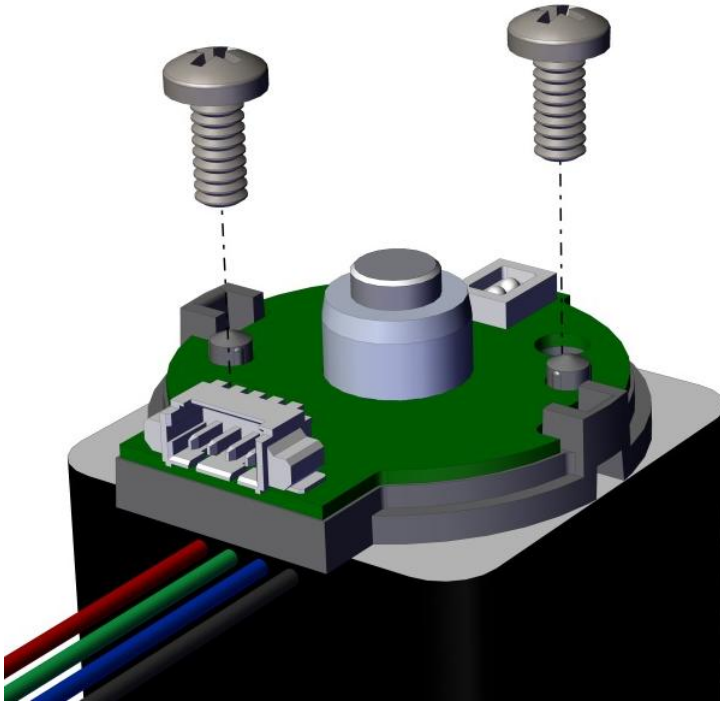


**2. Base Installation**

2a. **Standard:** Secure base to mounting surface with provided mounting screws.

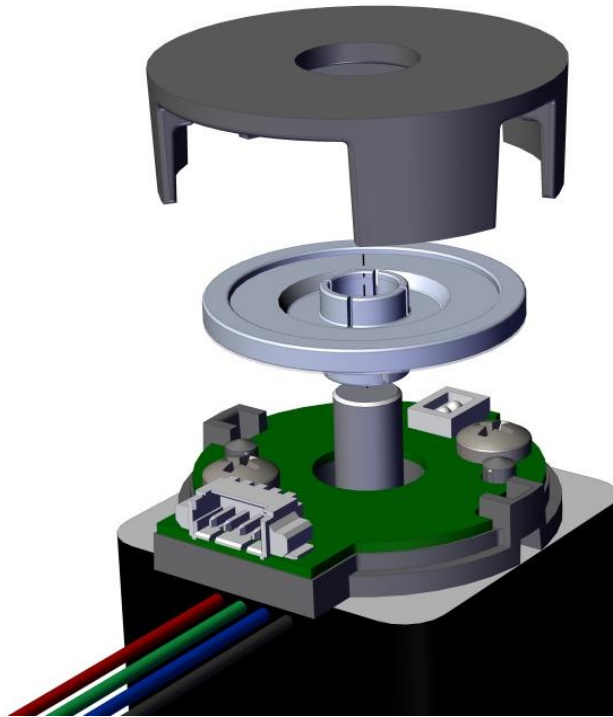


2b. **Transfer Adhesive:** Slip centering tool over shaft and into center hole of base. Slide both parts down shaft until they contact mounting surface. Press base firmly to assure good adhesion. Remove centering tool.



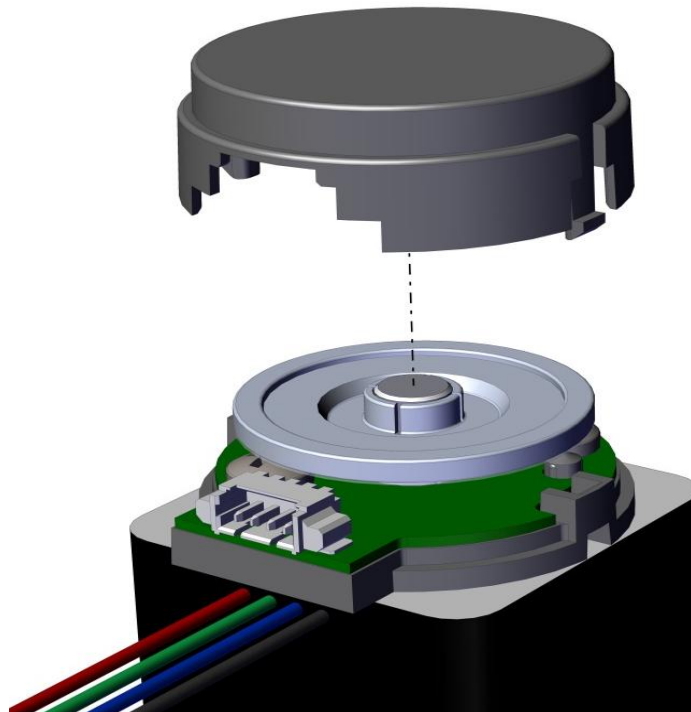
**3. Codewheel Installation**

Set codewheel on shaft with disk facing base. Place spacer tool over codewheel with recess areas over connector and base tabs. Push tool down by hand until it bottoms out against base. Remove reusable spacer tool. In order to prevent permanent damage to motor bearings (especially on small diameter shaft motors), it is recommended that the far end (drive end) of the motor shaft be supported while installing the push on hub.



**4. Cover Installation**

Snap cover onto base.





### Ordering Information

E8P	CPR	Bore	Output	Cover	Base	Packaging
	180	118 =	S = Single-ended	D = Default	D = Default (Two #4-40, length .250" mounting screws)	B = Encoder components packaged in bulk. One spacer and one centering tool per 100 encoders.
	200	3mm		H = Hole in Cover	M = Two M2.5x.45mm, length 6mm mounting screws	1 = Each encoder packaged individually. One spacer tool and one centering tool per 100 encoders.
	360	125 =	D = Differential		T = Adds transfer adhesive to base	2 = Each encoder packaged individually. One spacer and one centering tool per encoder.
	400	1/8"				
	500	156 =				
	512	5/32"				
		157 =				
		4mm				
		188 =				
		3/16"				
		197 =				
		5mm				
		236 =				
		6mm				
		250 =				
		1/4"				
		276 =				
		7mm				

### Notes

▶ US Digital warrants its products against defects in materials and workmanship for two years. See complete warranty for details.

### Base Pricing

Quantity	Price
1	\$37.35
10	\$27.12
50	\$22.01
100	\$18.64

- ▶ Add 25% per unit for **Output** of Differential
- ▶ Add 15% per unit for **Base** of Adds transfer adhesive to base
- ▶ Add \$4.00 per unit for **Packaging** of Each encoder packaged individually. One spacer tool and one centering tool per 100 encoders.
- ▶ Add \$7.00 per unit for **Packaging** of Each encoder packaged individually. One spacer and one centering tool per encoder.