

## E3 Features

- Quick, simple assembly, and disassembly
- Rugged screw-together housing
- Accepts .010 in. axial shaft play
- Small size
- 64 to 10,000 cycles per revolution (CPR)
- 256 to 40,000 pulses per revolution (PPR)
- 2 channel quadrature TTL squarewave outputs
- Optional index (3rd channel)



## E3 Product Description

The E3 is a high-resolution rotary encoder with a rugged glass-filled polymer enclosure, which utilizes either a 5-pin locking or standard connector. This optical incremental encoder is designed to easily mount to and dismount from an existing shaft to provide digital feedback information.



The internal components consist of a mylar disk mounted to a precision machined aluminum hub and an encoder module. The hub is available for diameters up to 1 in. The module contains a highly collimated solid-state light source and monolithic phased array sensor, which together provide a system extremely tolerant to mechanical misalignments.

The E3 is normally designed for applications of 10 feet or less. For applications requiring longer cable lengths, we recommend adding a PC4 (<https://www.usdigital.com/pc4/>) / PC5 (<https://www.usdigital.com/pc5/>) differential line driver or check out our E6 (<https://www.usdigital.com/products/encoders/incremental/kit/e6/>) which has an optional differential output.

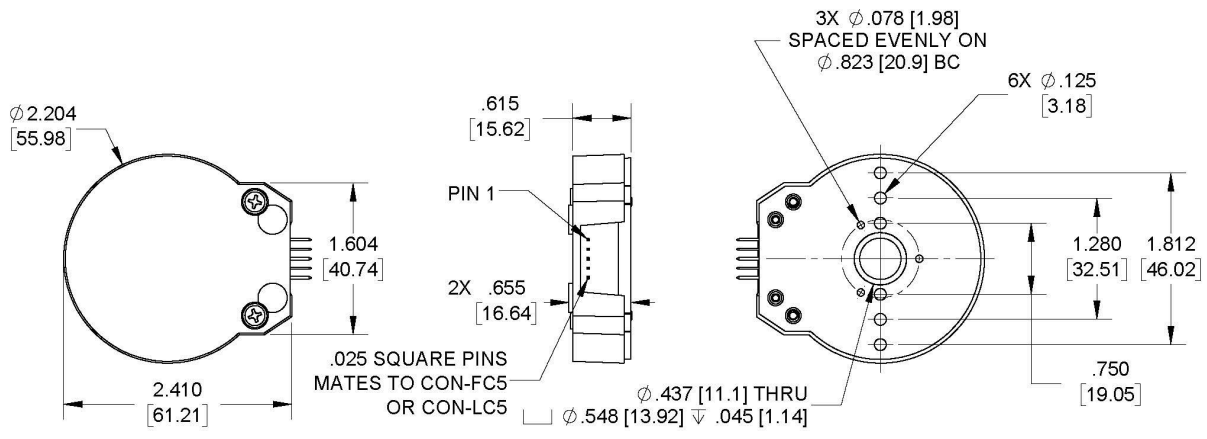
Attachment of the base to a surface may be accomplished by utilizing one of several machine screw bolt circle options. Positioning of the base to the centerline of a shaft is ensured by use of a centering tool. The cover is securely attached to the base with two 4-40 flat head screws to provide a resilient package protecting the internal components.

Connection to the E3 product is made through either a 5-pin locking or standard connector. The mating connectors are available from US Digital with several cable options and lengths.

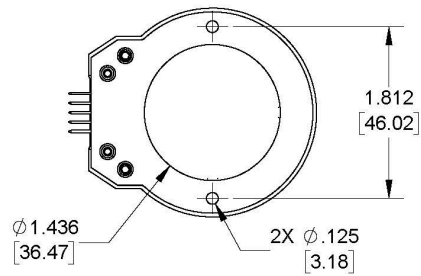
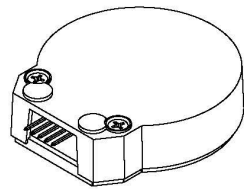
## Mechanical Drawings

E3 Optical Kit Encoder (Default)

RELEASE DATE: 7/19/2019



BASE OPTION FOR SHAFTS  $\leq \phi$ .394 [10]



BASE OPTION FOR SHAFTS  $> \phi$ .394 [10]

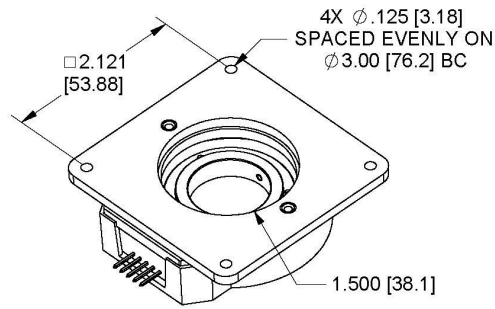
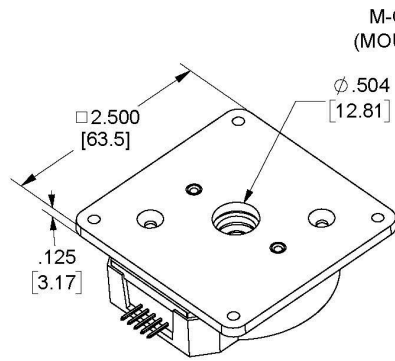
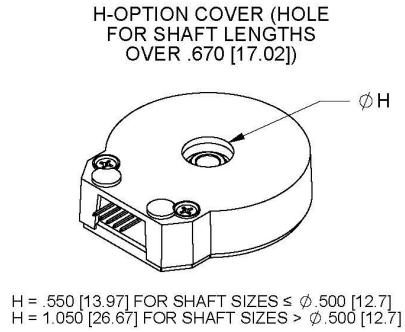
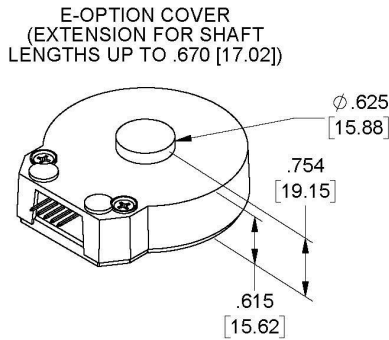
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UNITS: INCHES [MM]  
METRIC SHOWN FOR REFERENCE ONLY

E3 Optical Kit Encoder (Base & Cover Options)



FOR SHAFTS  $\leq \phi .394$  [10]

FOR SHAFTS  $> \phi .394$  [10]

REQUIRES AN ADDITIONAL .125 [3.18] SHAFT LENGTH

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## Specifications

### ENVIRONMENTAL

PARAMETER	VALUE	UNITS
Operating Temperature, CPR < 2000	-40 to 100	C
Operating Temperature, CPR $\geq$ 2000	-25 to 100	C
Electrostatic Discharge, IEC 61000-4-2	$\pm 4$	kV
Vibration (10Hz to 2kHz, sinusoidal)	20	G
Shock (6 milliseconds, half-sine)	75	G

### MECHANICAL

PARAMETER	VALUE	UNITS
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# E3 Optical Kit Encoder

Max. Shaft Axial Play	±0.010	in.
Max. Shaft Runout	0.004 T.I.R.	in.
Max. Acceleration	250000	rad/sec <sup>2</sup>
For CPR ≤ 2500: Max. RPM (1) Max. A/B Frequency e.x. CPR=2500, Max. RPM=7200 e.x. CPR=100, Max. RPM=60000	minimum value of ((18 x 10 <sup>6</sup> ) / CPR) and (60000) 300	RPM kHz
For CPR = 3600, 4000, 4096, 5000: Max. RPM (1) Max. A/B Frequency	(21.6 x 10 <sup>6</sup> ) / CPR 360	RPM kHz
For CPR = 7200, 8000, 8192, 10000: Max. RPM (1) Max. A/B Frequency	(43.2 x 10 <sup>6</sup> ) / CPR 720	RPM kHz
Typical Product Weight	1.28	oz.
Codewheel Moment of Inertia	8.9 x 10 <sup>-5</sup> for bore < 12mm 4.0 x 10 <sup>-4</sup> for bore ≥ 12 mm	oz-in-s <sup>2</sup>
Hub Set Screw	#3-48 or #4-48	
Hex Wrench Size	0.050	in.
Encoder Base Plate Thickness	0.135	in.
3 Mounting Screw Size	#0-80	
3 Screw Bolt Circle Diameter (2)	0.823 ± 0.005	in.
2 Mounting Screw Size	#2-56 or #4-40	
2 Screw Bolt Circle Diameter	0.750 ± 0.005	in.
2 Screw Bolt Circle Diameter	1.280 ± 0.005	in.
2 Screw Bolt Circle Diameter	1.812 ± 0.005	in.
Required Shaft Length (3) With E-option (2) With H-option	0.445 to 0.525 0.445 to 0.670 > 0.445	in. in. in.



Index alignment to hub set screw    180 ± Typical    degrees

Technical Bulletin TB1001 - Shaft and Bore Tolerances    Download (<https://www.usdigital.com/support/resources/reference/technical-docs/technical-bulletins/shaft-and-bore-tolerances-tb1001/>)

(1) 60000 RPM is the maximum rpm due to mechanical considerations. The maximum RPM due to the module's maximum frequency response is dependent upon the module's resolution (CPR).

(2) Only for shaft diameters < 0.472".

(3) Add 0.125" to all required shaft lengths when using M-option.

## TORQUE SPECIFICATIONS

PARAMETER	VALUE	TORQUE
Hub Set Screw	2-3	in-lbs
Cover Screw	2-4	in-lbs
Base Mounting Screw (#0-80)	1-2	in-lbs
Base Mounting Screw (#2-56)	2-3	in-lbs
Base Mounting Screw (#4-40)	4-6	in-lbs
Adapter Plate Mounting Surface (#2-56 screws)	2-3	in-lbs
Adapter Plate Mounting Surface (#4-40 screws)	4-6	in-lbs
Module Mounting Screw	3.5-4	in-lbs

## PHASE RELATIONSHIP

A leads B for clockwise shaft rotation, and B leads A for counterclockwise rotation viewed from the cover side of the encoder.

## ELECTRICAL

- Specifications apply over the entire operating temperature range.
- Typical values are specified at  $V_{cc} = 5.0V_{dc}$  and  $25^{\circ}C$ .
- For complete details, see the EM1 (<https://www.usdigital.com/products/encoders/incremental/modules/em1/>) and EM2 (<https://www.usdigital.com/products/encoders/incremental/modules/em2/>) product pages.

PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITIONS
Supply Voltage	4.5	5.0	5.5	V	
Supply Current		27	33	mA	CPR < 1000, no load
		54	62	mA	CPR $\geq$ 1000 and < 3600, no load
		72	85	mA	CPR $\geq$ 3600, no load
Low-level Output			0.5	V	$I_{OL} = 8mA$ max., CPR < 3600
			0.5	mA	$I_{OL} = 5mA$ max., CPR $\geq$ 3600
		0.05		mA	no load, CPR < 3600
		0.25		mA	no load, CPR $\geq$ 3600
High-level Output	2.0			V	$I_{OH} = -8mA$ max., CPR < 3600
	2.0			V	$I_{OH} = -5mA$ max., CPR $\geq$ 3600
		4.8		V	no load, CPR < 3600
		3.5		V	no load, CPR $\geq$ 3600
Output Current Per Channel	-8		8	mA	CPR < 3600
	-5		5	mA	CPR $\geq$ 3600
Output Rise Time		110		nS	CPR < 3600
		50		nS	CPR $\geq$ 3600
Output Fall Time		35		nS	CPR < 3600
		50		nS	CPR $\geq$ 3600



## PIN-OUT

PIN	DESCRIPTION
1	Ground
2	Index
3	A channel
4	+5VDC power
5	B channel

**Note:** 5-pin single-ended mating connector is CON-C5 (<https://www.usdigital.com/products/accessories/connectors/con-c5/>) or CON-LC5 (<https://www.usdigital.com/products/accessories/connectors/con-lc5/>)

## ACCESSORIES

### 1. Centering Tool

The centering tool is only included with the **-3** packaging option. It has to be ordered separately for other packaging options.

**Part #: CTOOL - (Shaft Diameter)**

**Description:** This reusable tool provides a simple method for accurately centering the E3 base onto the shaft in order to promote concentricity and thus, higher accuracy. It is recommended for the following situations:

- When using mounting screws smaller than #4-40.
- When the position of the mounting holes is in question.
- When using the 3-hole mounting pattern.
- When using the T-option transfer adhesive.

**Instructions:** When mounting encoder base, slide centering tool down shaft until it slips into centering hole of encoder base. Tighten mounting screws, then remove centering tool.

### 2. Hex Tool

Depending on the order packaging option, either a hex driver or hex wrench is included.

**Part #: HEXD-050**

**Description:** Hex driver, 0.050" flat-to-flat for #3-48 or #4-48 set screws. Only included with **-B** or **-1** packaging options.

**Part #: HEXW-050**

**Description:** Hex wrench, 0.050" flat-to-flat for #3-48 or #4-48 set screws. Only included with **-2** or **-3** packaging options.

### 3. Spacer Tool

A spacer tool is included for all packaging options.

**Part #: SPACER-E3S**

**Description:** For shafts  $\leq 0.394$ "

**Part #: SPACER-E3L**

**Description:** For shafts 12mm - 1"

### 4. Screws

**Part #: SCREW-080-250-PH**

**Description:** Pan Head, Philips #0-80 UNF x 1/4"

**Use:** Base Mounting

Quantity Required: 3  
Screws are not included

**Part #: SCREW-256-250-PH**

Description: Pan Head, Phillips #2-56 UNC x 1/4"  
Use: Base Mounting  
Quantity Required: 2  
Screws are not included

**Part #: SCREW-348-125-SS**

Description: Socket Head Set Screw, 3-48 UNC x 1/8"  
Use: Hub/Disk Mounting for 12mm - 1" Bore  
Quantity Required: 2  
Screws are included

**Part #: SCREW-440-250-PH**

Description: Pan Head, Phillips #4-40 UNC x 1/4"  
Use: Base Mounting  
Quantity Required: 2  
Screws are not included

**Part #: SCREW-440-500-PH**

Description: Pan Head, Phillips #4-40 UNC x 1/2"  
Use: Module Mounting  
Quantity Required: 2  
Screws are included

**Part #: SCREW-440-625-FH**

Description: Flat Head, Phillips 4-40 UNC x 5/8"  
Use: Cover Mounting  
Quantity Required: 2  
Screws are included

**Part #: SCREW-448-063-SS**

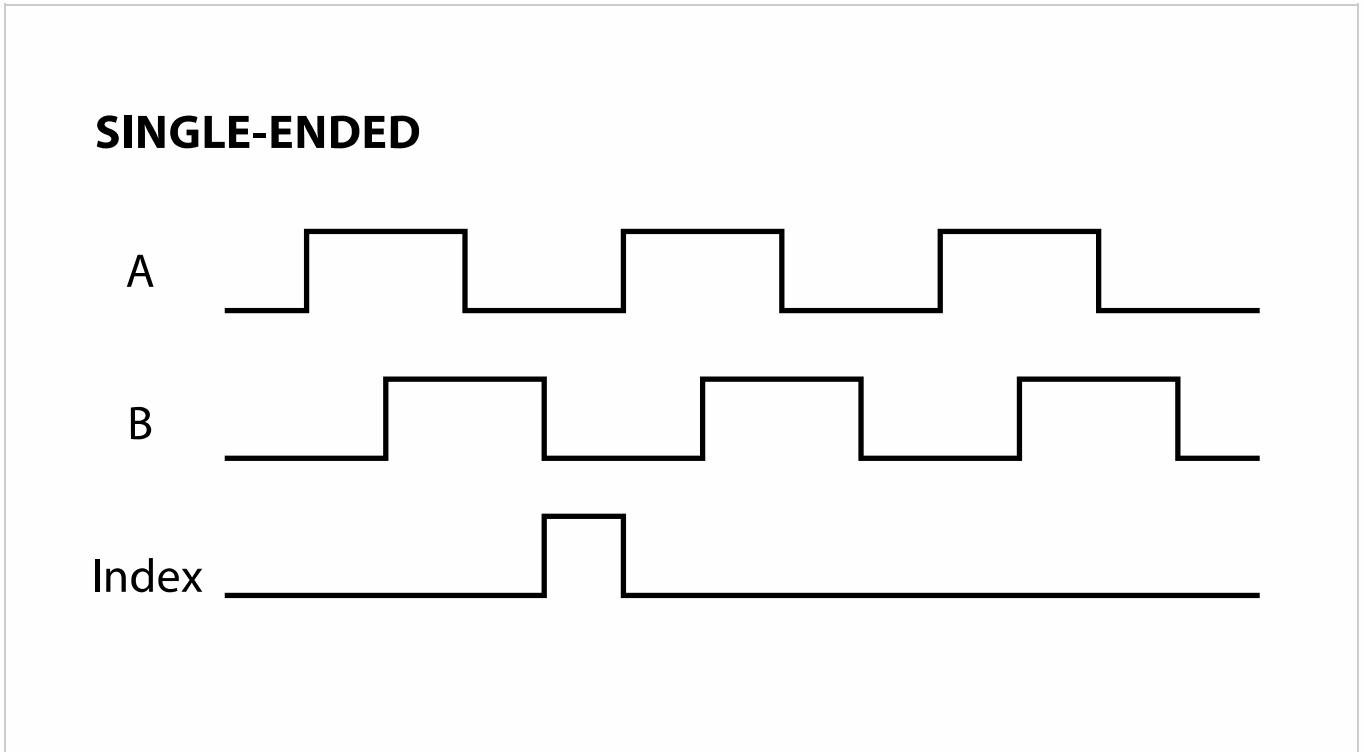
Description: Socket Head Set Screw, 4-48 UNC x 1/16"  
Use: Hub/Disk Mounting for 5/16" - 10mm Bore  
Quantity Required: 1  
Screw is included

**Part #: SCREW-448-125-SS**

Description: Socket Head Set Screw, 4-48 UNC x 1/8"  
Use: Hub/Disk Mounting for 2mm - 1/4" Bore  
Quantity Required: 1  
Screw is included



## OUTPUT WAVEFORMS



## Notes

- US Digital® warrants its products against defects in materials and workmanship for two years. See complete warranty (<https://www.usdigital.com/company/warranty>) for details.
- Cables and connectors are not included and must be ordered separately.

## Configuration Options

E3	CPR (Cycles Per Revolution)	Bore Size	Index	Cover	Base	Packaging
		079 (2.0mm)	IE (Index)	D (Default)	D (Default)	B (Encoders packaged in bulk. Every order includes one centering tool, hex tool and spacer tool. An additional set of tools is included for each 100 encoders ordered.)
	64	118 (3.0mm)	NE (Non-Index)	E (Extended)	M (3" Diameter Bolt Circle)	
	100	125 (1/8")				H (Through-Hole)
	200	156 (5/32")				1 (Encoders packaged individually. Every order includes one centering tool, hex tool and spacer tool. An additional set of tools is included for each 100 encoders ordered.)
	400	157 (4.0mm)				
	500	188 (3/16")				3 (Encoders packaged individually. Every order includes one centering tool, hex tool and spacer tool per encoder.)
	512	197 (5.0mm)				
	1000	236 (6.0mm)				
	1024	250 (1/4")				
	1800	313 (5/16")				
	2000	315 (8.0mm)				
	2048	375 (3/8")				
	2500	394 (10.0mm)				
	3600	472 (12.0mm)				
	4000	500 (1/2")				
	4096	551 (14.0mm)				
	5000	625 (5/8" Bore)				
	7200	750 (3/4" Bore)				
	8000	787 (20.0mm)				
	8192	875 (7/8")				
	10000	984 (25.0mm)				
		1000 (1")				

**PLEASE NOTE: This chart is for informational use only.** Certain product configuration combinations are not available. Visit the E3 product page (<https://www.usdigital.com/products/E3>) for pricing and additional information.