

## 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 high-retention 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.

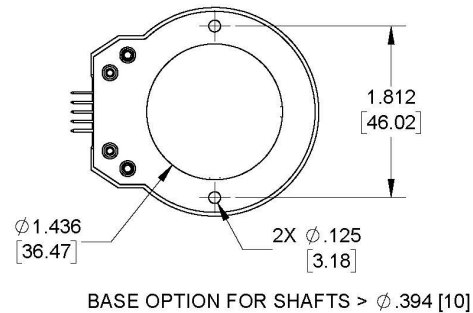
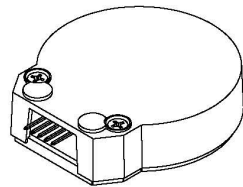
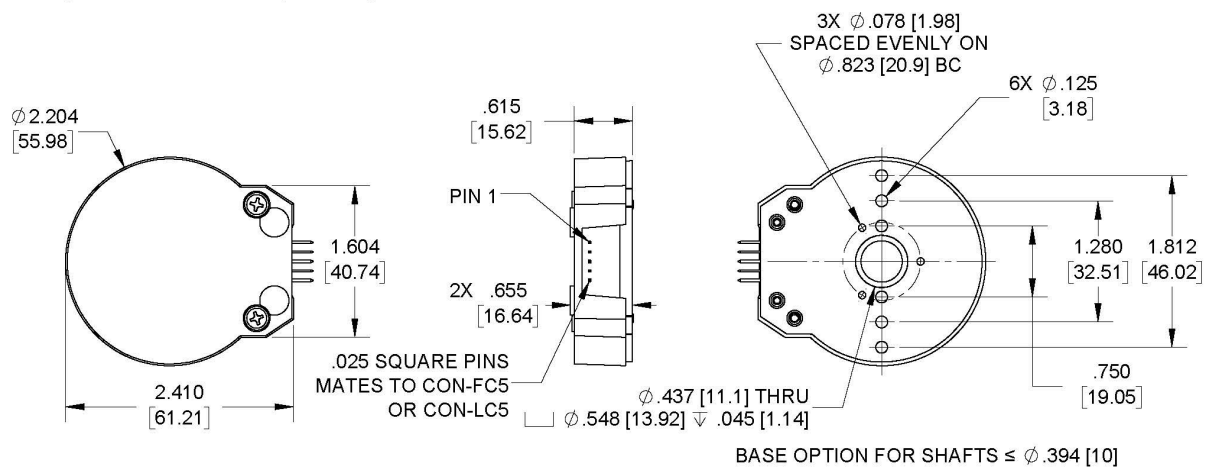
The E3 is normally designed for applications of 10 feet or less. For applications requiring longer cable lengths, we recommend adding a PC4 (<https://www.usdigital.com/pc4/>) / PC5 (<https://www.usdigital.com/pc5/>) differential line driver or check out our E6 (<https://www.usdigital.com/products/encoders/incremental/kit/e6/>) 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 high-retention or standard connector. The mating connectors are available from US Digital with several cable options and lengths.

## Mechanical Drawings

## E3 Optical Kit Encoder (Default)



**US DIGITAL** 1400 NE 136th Avenue  
Vancouver, Washington 98684, USA

info@usdigital.com  
www.usdigital.com

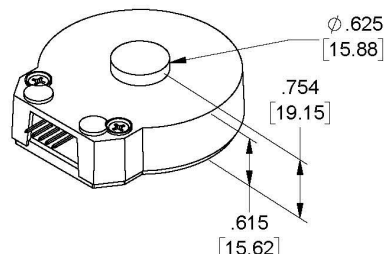
Local: 360.260.2468  
Toll-free: 800.736.0194

UNITS: INCHES [MM]  
METRIC SHOWN FOR REFERENCE ONLY

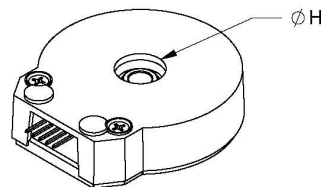
RELEASE DATE: 7/8/2019

## E3 Optical Kit Encoder (Base & Cover Options)

E-OPTION COVER  
(EXTENSION FOR SHAFT  
LENGTHS UP TO .670 [17.02])

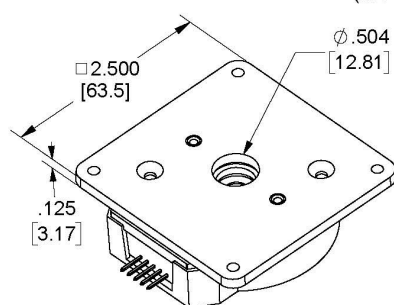


H-OPTION COVER (HOLE  
FOR SHAFT LENGTHS  
OVER .670 [17.02])

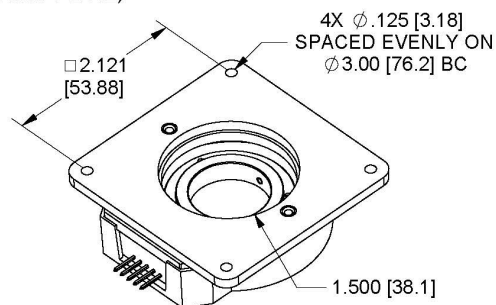


H = .550 [13.97] FOR SHAFT SIZES  $\leq \phi .500$  [12.7]  
H = 1.050 [26.67] FOR SHAFT SIZES  $> \phi .500$  [12.7]

M-OPTION BASE  
(MOUNTING PLATE)



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



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

REQUIRES AN ADDITIONAL .125 [3.18] SHAFT LENGTH



1400 NE 136th Avenue  
Vancouver, Washington 98684, USA

info@usdigital.com  
www.usdigital.com

Local: 360.260.2468  
Toll-free: 800.736.0194

UNITS: INCHES [MM]  
METRIC SHOWN FOR REFERENCE ONLY

RELEASE DATE: 7/8/2019

## 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
-----------	-------	-------



1400 NE 136th Ave.  
Vancouver, WA 98684  
USA

info@usdigital.com  
sales@usdigital.com

Toll Free: 800.736.0194  
Worldwide: 360.260.2468  
Support: 360.397.9999

Page: 3 of 10  
6/18/2025 59251

E3



# E3 Optical Kit Encoder

PARAMETER	VALUE	UNITS
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.



PARAMETER	VALUE	UNITS
Required Shaft Length	0.445 to 0.525	in.
(3)	0.445 to 0.670	in.
With E-option (2)	> 0.445	in.
With H-option		
Index alignment to hub set screw	180 ± Typical	degrees
Technical Bulletin TB1001 - Shaft and Bore Tolerances	Download ( <a href="https://www.usdigital.com/support/resources/reference/technical-docs/technical-bulletins/shaft-and-bore-tolerances-tb1001/">https://www.usdigital.com/support/resources/reference/technical-docs/technical-bulletins/shaft-and-bore-tolerances-tb1001/</a> )	

(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

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

This reusable tool centers the shaft within the encoder base during assembly. It is required for the proper functioning of the encoder.

### 2. Hex Tool

**Part #: HEXD-050**

Hex driver, 0.050" flat-to-flat for #3-48 or #4-48 set screws. Included with **-B** or **-1** packaging options for order quantities of 10 or more.

**Part #: HEXW-050**

Hex wrench, 0.050" flat-to-flat for #3-48 or #4-48 set screws. Included with **-B** or **-1** packaging options for order quantities of 9 or less. Included with **-3** packaging option for all order quantities.

### 3. Spacer Tool

This reusable tool sets the proper spacing between the disk and sensor during assembly. It is required for the proper functioning of the encoder.

**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, Philips #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

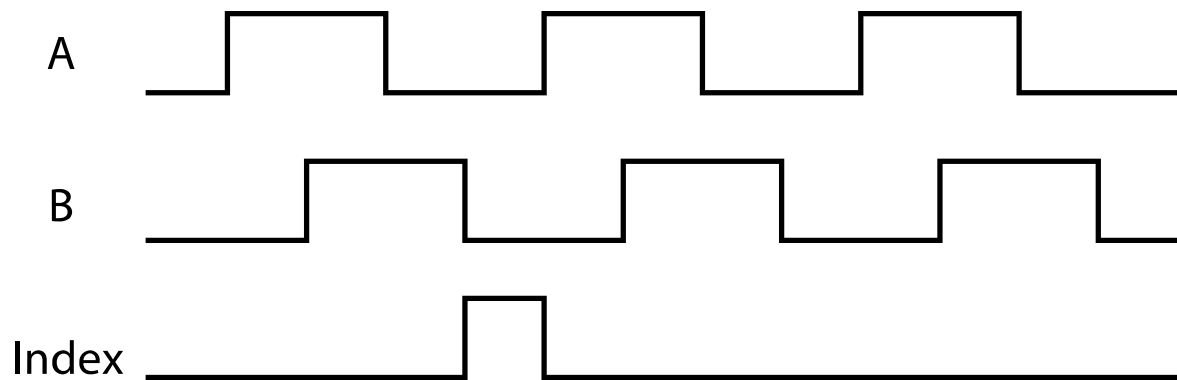
Quantity Required: 1

Screw is included



## OUTPUT WAVEFORMS

### SINGLE-ENDED



## 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.)
		118 (3.0mm)	NE (Non-Index)	E (Extended)	M (3" Diameter Bolt Circle)	
	64	125 (1/8")		H (Through-Hole)		
	100	156 (5/32")				
	200	157 (4.0mm)				
	400	188 (3/16")				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.)
	500	197 (5.0mm)				
	512	236 (6.0mm)				
	1000	250 (1/4")				
	1024	313 (5/16")				
	1800	315 (8.0mm)				
	2000	375 (3/8")				3 (Encoders packaged individually. Every order includes one centering tool, hex tool and spacer tool per encoder.)
	2048	394 (10.0mm)				
	2500	472 (12.0mm)				
	3600	500 (1/2")				
	4000	551 (14.0mm)				
	4096	625 (5/8"				
	5000	Bore)				
	7200	750 (3/4"				
	8000	Bore)				
	8192	787 (20.0mm)				
	10000	875 (7/8")				
		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.