

E5 Features

- Kit version for mounting on a motor or other shaft
- Supports 14 shaft sizes (2 to 10 mm and 1/8 to 3/8 in.)
- For NEMA 17 to 34 and larger motors
- 25 Resolutions from 32 to 5,000 CPR (128 to 20,000 PPR)
- Optional Index channel, Differential and High-Voltage outputs
- Choice of 4 base styles and 3 cover options
- Secure latching connector/cable (sold separately)



US Digital E5 Motor Encoder Description

The US Digital E5 motor encoder mounts directly to a motor or other rotating shaft. This optical encoder features a rugged, glass-filled polymer housing and is designed for easy installation and removal.



The E5 encoder contains a precision machined aluminum hub with a specially patterned Mylar disk. This disk, in combination with our proprietary optical encoder module, creates a system that is highly tolerant to mechanical misalignment.

The E5 is a versatile motor encoder, with four base configurations and three cover styles which allows it to fit a wide range of applications. This optical rotary encoder also has four available outputs—single-ended, single-ended High-Voltage, differential, and Avago differential. This incremental encoder is designed for use with a secure latching connector—connector/cable sold separately.

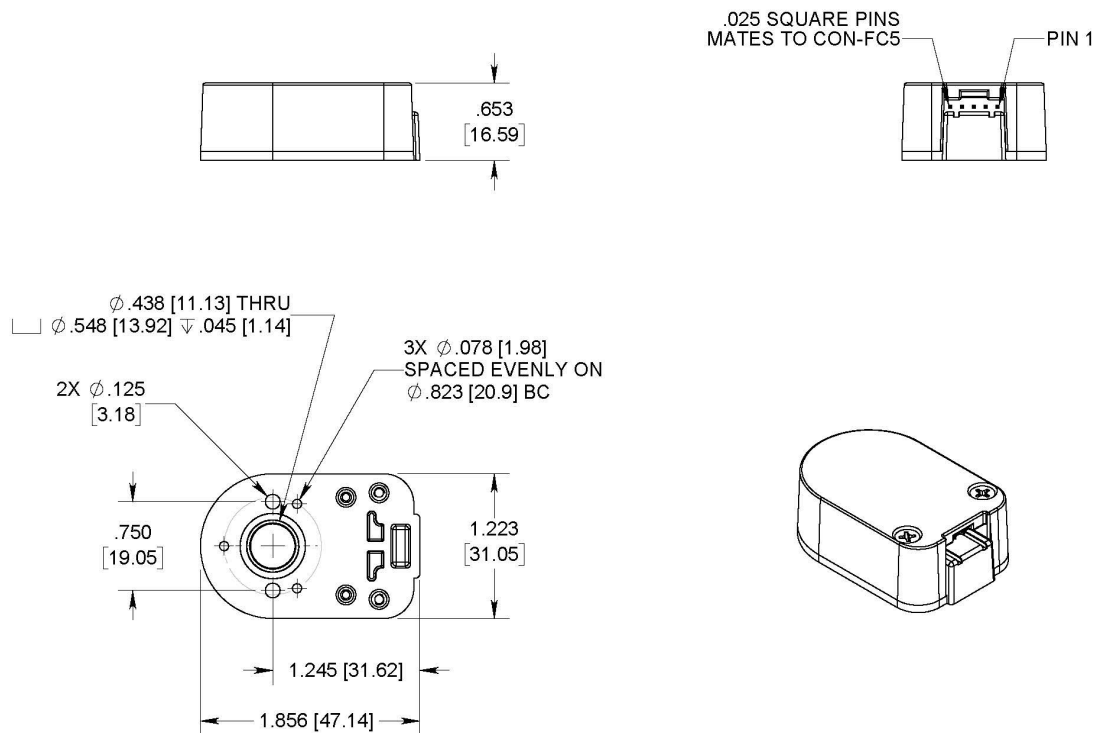
BROADCOM/AVAGO REPLACEMENTS:

US Digital's E5 encoder may be used as a replacement for Avago HEDL-5500, HEDL-5600

(<https://www.usdigital.com/support/resources/reference/compatibility-guides/us-digital-e5-compatibility-guide-for-broadcomavagoagilentp-hedl-5xxx-encoder/>).

Mechanical Drawings

E5 Single-Ended Optical Kit Encoder (Default)



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

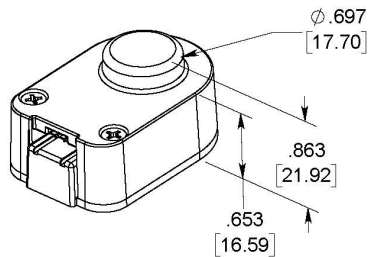
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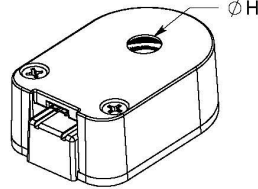
UNITS: INCHES [MM]
METRIC SHOWN FOR REFERENCE ONLY

E5 Optical Kit Encoder Base & Cover Options

E-OPTION COVER
(EXTENSION FOR SHAFT
LENGTHS UP TO .750 [19.05])

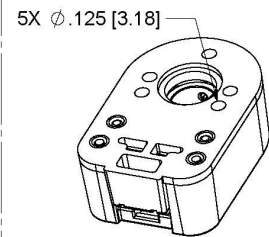


H-OPTION COVER
(COVER HOLE FOR SHAFT
LENGTHS OVER .750 [19.05])

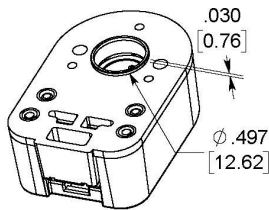


H = .295 [7.49] FOR SHAFT SIZES $\leq \phi .250$ [6.35]
H = .438 [11.13] FOR SHAFT SIZES $> \phi .250$ [6.35]

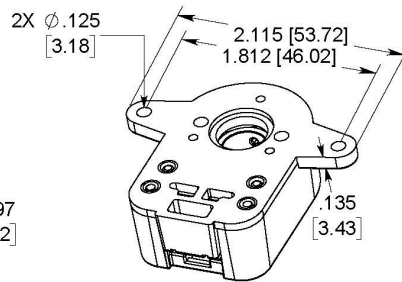
3-OPTION BASE
(LARGER MOUNTING HOLES)



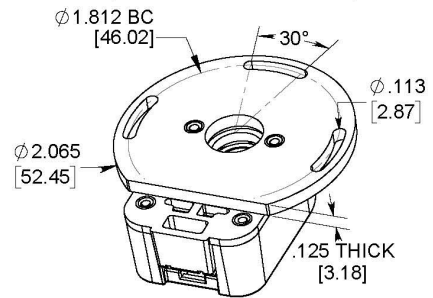
A-OPTION BASE
(ALIGNMENT BOSS)



G-OPTION BASE
(1.812" MOUNTING)



R-OPTION BASE
(ROTATIONAL MOUNTING)



REQUIRES ADDITIONAL .125 [3.18] SHAFT LENGTH

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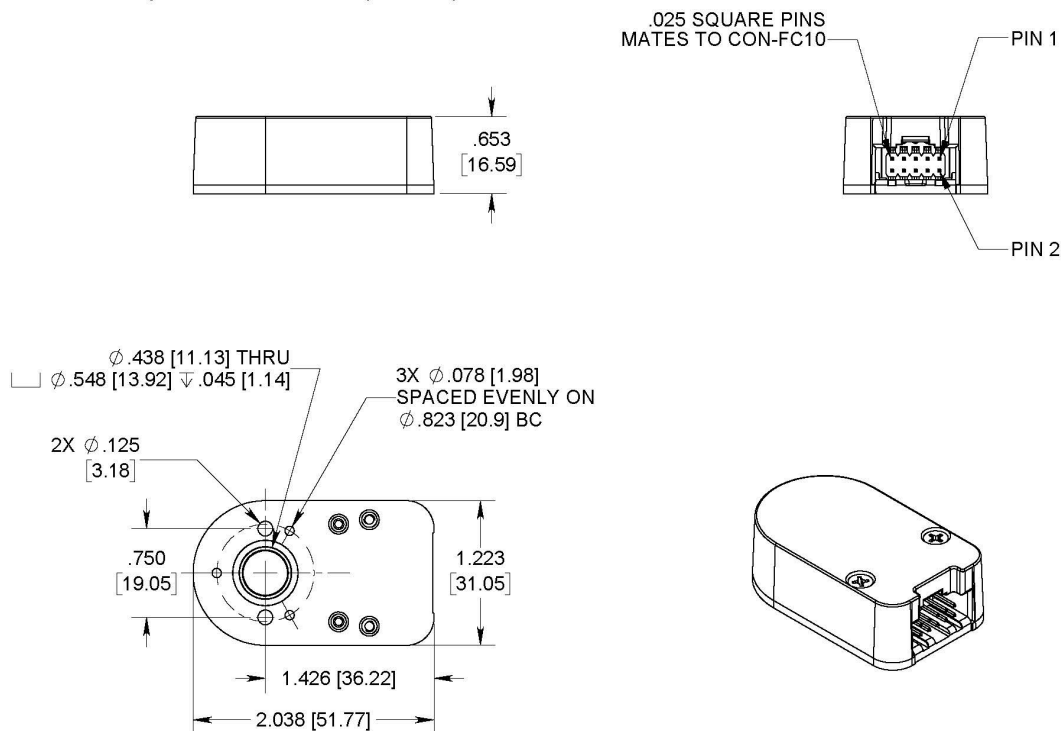
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RELEASE DATE: 1/7/2020

E5 Differential Optical Kit Encoder (Default)



RELEASE DATE: 1/7/2020



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UNITS: INCHES [MM]
METRIC SHOWN FOR REFERENCE ONLY

Specifications

ENVIRONMENTAL

Parameter	Value	Units
Operating Temperature, CPR < 2000	-40 to 100	C
Operating Temperature, CPR ≥ 2000	-25 to 100	C
Electrostatic Discharge		kV
Single-ended (S option), IEC 61000-4-2	± 4	
Differential (D, L option), Human Body Model	± 2	
High-Voltage, Open-collector (H, C option), IEC 61000-4-2	± 4	
Vibration (10Hz to 2kHz, sinusoidal)	20	G



Shock (6 milliseconds, half-sine)

Value

Units

MECHANICAL

PARAMETER	VALUE	UNITS
Max. Shaft Axial Play	±0.010	in.
Max. Shaft Runout	0.004 T.I.R.	in.
Max. Acceleration	250000	rad/sec ²
For CPR ≤ 1250: Max. RPM (1) Max. A/B Frequency e.x. CPR=1250, Max. RPM=14400 e.x. CPR=100, Max. RPM=60000	minimum value of ((18 x 10 ⁶) / CPR) and (60000) 300	RPM kHz
For CPR = 2000, 2048, 2500: Max. RPM (1) Max. A/B Frequency	minimum value of ((21.6 x 10 ⁶) / CPR) and (60000) 360	RPM kHz
For CPR = 4000, 4096, 5000: Max. RPM (1) Max. A/B Frequency	minimum value of ((43.2 x 10 ⁶) / CPR) and (60000) 720	RPM kHz
Typical Product Weight Single-ended (S option) Differential (D, L option) High-Voltage, Open-Collector (H, C option)	0.82 0.91 0.91	oz.
Codewheel Moment of Inertia	8.0 x 10 ⁻⁶	oz-in-s ²
Hub Set Screw	#4-48	
Hex Wrench Size	0.050	in.
Encoder Base Plate Thickness	0.135	in.
3 Mounting Screw Size	#0-80	
2 Mounting Screw Size	#2-56 or #4-40	
3 Screw Bolt Circle Diameter	0.823 ± 0.005	in.
2 Screw Bolt Circle Diameter	0.750 ± 0.005	in.
Required Shaft Length (2) With E-option (2) With H-option (2)	0.445 to 0.570 0.445 to 0.750 > 0.445	in.
Index Alignment to Hub Set Screw	180 Typical	degrees
Technical Bulletin TB1001 - Shaft and Bore Tolerances		Download



PARAMETER

VALUE

(https://www.usdigital.com/media/yyvb4qsy/tb_1001.pdf)

UNITS

(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) Add 0.125" to the required shaft length when using **R**-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

SINGLE-ENDED (S) / DIFFERENTIAL (D) / HIGH-VOLTAGE (H) / OPEN-COLLECTOR (C) OPTION:

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

BROADCOM/AVAGO COMPATIBLE PIN-OUT (L) OPTION:

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

SINGLE-ENDED OPTION

- S option provides 5V TTL compatible outputs
- Specifications apply over the entire operating temperature range
- Typical values are specified at Vcc = 5.0Vdc and 25°C
- For complete details, see the EM1 (<https://www.usdigital.com/products/encoders/incremental/components/modules/em1/>) or EM2 (<https://www.usdigital.com/products/encoders/incremental/components/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 < 500, no load
		54	62	mA	CPR ≥ 500 and < 2000, no load
		72	85	mA	CPR ≥ 2000, no load
Low-level Output			0.5	V	I _{OL} = 8mA max., CPR < 2000
			0.5	V	I _{OL} = 5mA max., CPR ≥ 2000
			0.25	V	no load, CPR ≥ 2000
High-level Output	2.0			V	I _{OH} = -8mA max. and CPR < 2000
	2.0			V	I _{OH} = -5mA max. and CPR ≥ 2000
	4.8			V	no load and CPR < 2000
	3.5			V	no load and CPR ≥ 2000
Output Current Per Channel	-8		8	mA	CPR < 2000
	-5		5	mA	CPR ≥ 2000
Output Rise Time		110		nS	CPR < 2000
		50		nS	CPR ≥ 2000, ± 5mA load
Output Fall Time		100		nS	CPR < 2000
		50		nS	CPR ≥ 2000, ± 5mA load

DIFFERENTIAL OPTION

- D Option provides differential line driver outputs
- Specifications apply over the entire operating temperature range
- Typical values are specified at V_{cc} = 5.0Vdc and 25°C
- For complete details, see the EM1 (<https://www.usdigital.com/products/encoders/incremental/components/modules/em1/>) or EM2 (<https://www.usdigital.com/products/encoders/incremental/components/modules/em2/>) product pages

PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITIONS
Supply Voltage	4.5	5.0	5.5	V	
Supply Current		29	36	mA	CPR < 500, no load
		56	65	mA	CPR ≥ 500 and < 2000, no load

PARAMETER	MIN.	74 TYP.	88 MAX.	mA UNITS	CPR ≥ 2000, no load CONDITIONS
Low-level Output		0.2	0.4	V	$I_{OL} = 20\text{mA max.}$
High-level Output	2.4	3.4		V	$I_{OH} = -20\text{mA max.}$
Differential Output Rise/Fall Time			15	nS	

HIGH-VOLTAGE OPTION

- H option uses a higher supply voltage and provides both single-ended and open-collector outputs
- Single-ended outputs are 5V TTL compatible (same as S option). See Pin-out.
- Specifications apply over the entire operating temperature range
- For complete details, see the EM1 (<https://www.usdigital.com/products/encoders/incremental/components/modules/em1/>) or EM2 (<https://www.usdigital.com/products/encoders/incremental/components/modules/em2/>) product pages

PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITIONS
Supply Voltage	7.5		30.0	V	
Supply Current, 24V power	8	10	mA		CPR < 500, no load
	16	19	mA		CPR ≥ 500 and < 2000, no load
	22	25	mA		CPR ≥ 2000, no load
Open Collector "On" Resistance	2		ohms		
Open Collector Sink Current			200	mA	
Output Low Voltage			0.4	V	200 mA sink current
Open Collector Pullup Voltage			50	V	

PIN-OUTS

5-PIN SINGLE-ENDED S OPTION (1)		10-PIN DIFFERENTIAL D OPTION (2)		10-PIN DIFFERENTIAL L OPTION (2,3)	
Pin	Description	Pin	Description	Pin	Description
1	Ground	1	Ground	1	No Connection
2	Index	2	Ground	2	+5VDC power
3	A channel	3	Index-	3	Ground
4	+5VDC power	4	Index+	4	No connection
5	B channel	5	A- channel	5	A- channel
		6	A+ channel	6	A+ channel
		7	+5VDC power	7	B- channel
		8	+5VDC power	8	B+ channel
		9	B- channel	9	Index-
		10	B+ channel	10	Index+

10-PIN HIGH-VOLTAGE H OPTION (2)	
Pin	Description
1	Ground
2	Ground
3	Index- (open collector)
4	Index+ (single-ended)
5	A- channel (open collector)
6	A+ channel (single-ended)
7	7.5-30V power
8	7.5-30V power
9	B- channel (open collector)



10-PIN HIGH-VOLTAGE H OPTION (2)

- (1) 5-pin single-ended mating connector is CON-FC5 (<https://www.usdigital.com/products/accessories/connectors/con-fc5/>).
(2) 10-pin differential mating connector is CON-FC10 (<https://www.usdigital.com/products/accessories/connectors/con-fc10/>).
(3) Broadcom / Avago compatible version.

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 encoder 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 encoder quantities of 9 or less. Included with **-3** packaging option for all order quantities.

3. Spacer Tool

Part #: SPACER-E5

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

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-440-250-PH

Description: Pan Head, Philips #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"

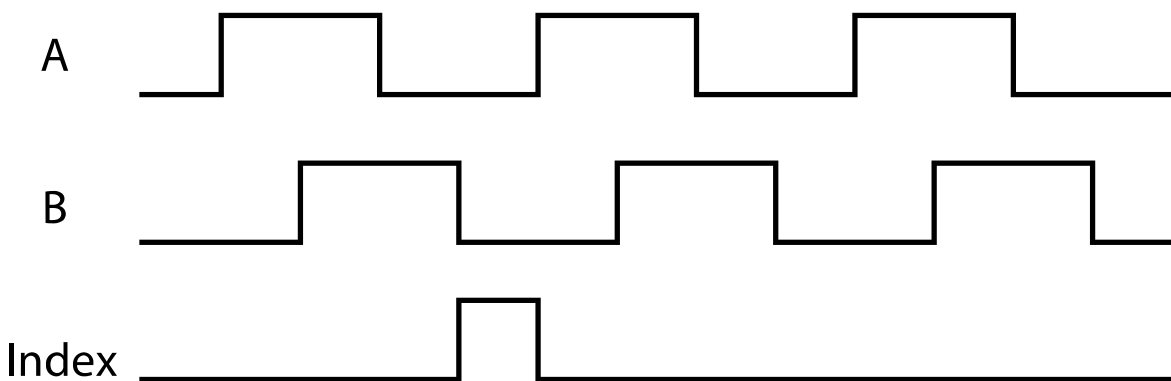
Use: Hub/Disk Mounting for 2mm - 1/4" Bore

Quantity Required: 1

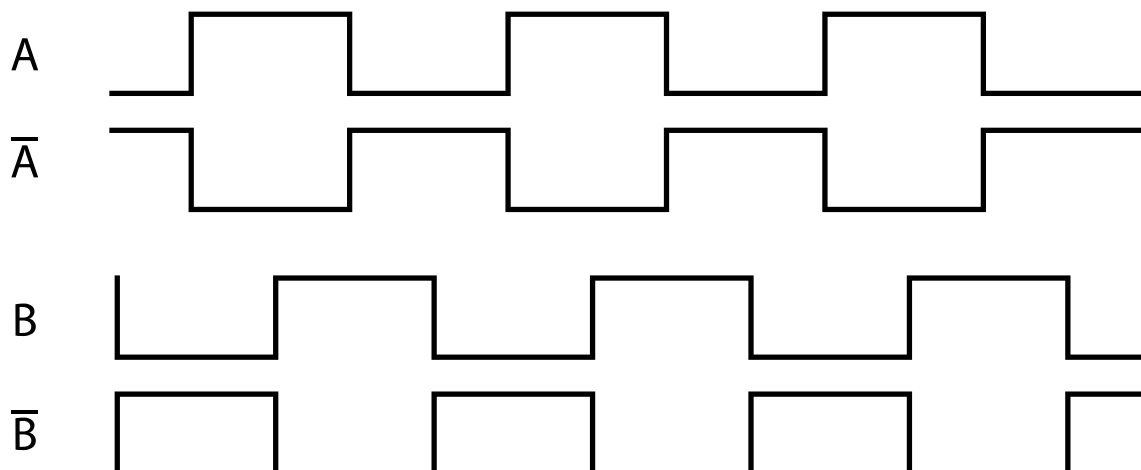
Screw is included

OUTPUT WAVEFORMS

SINGLE-ENDED



DIFFERENTIAL



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Notes

- Cables and connectors are not included and must be ordered separately.
- 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.

Configuration Options

E5	CPR (Cycles Per Revolution)	Bore Size	Index	Output	Cover	Base	Packaging
		079 (2.0mm)	IE (Index)	S (Single-Ended)	D (Default)	D (Default)	Bulk (B) - Includes one centering, hex and spacer tool per order, plus an extra set per 100 encoders.
	32	118 (3.0mm)	NE (Non-Index)	H (Single-Ended High-Voltage)	E (Extended)	3 (1/8" Mounting Holes)	Individual (1) - Includes one centering, hex, and spacer tool per order, plus an extra set per 100 encoders.
	50	125 (1/8")		D (Differential)	H (Through-Hole)	A (Aligning Shoulder)	
	96	156 (5/32")		L (Avago 10-pin Differential)		G (1.812" Diameter Bolt Circle, 3 Slot Rotational Mounting)	
	100	157 (4.0mm)					
	192	188 (3/16")					
	200	197 (5.0mm)					
	250	236 (6.0mm)					
	256	250 (1/4")					
	360	276 (7.0mm)					
	400	313 (5/16")					
	500	315 (8.0mm)					
	512	375 (3/8")					
	540	394 (10.0mm)					
	720						
	800						
	900						
	1000						
	1024						
	1250						
	2000						
	2048						
	2500						



E5 Motor Encoder

2500
4000
4096
5000

PLEASE NOTE: This chart is for informational use only. Certain product configuration combinations are not available. Visit the E5 product page (<https://www.usdigital.com/products/E5>) for pricing and additional information.