E5 Features

- Quick, simple assembly, and disassembly
- Rugged screw-together housing
- Positive latching connector
- Accepts .010 in. axial shaft play
- 32 to 5,000 cycles per revolution (CPR)
- 128 to 20,000 pulses per revolution (PPR)
- 2 channel quadrature with optional index
- Multiple Output Drive Options
- Mounting compatibility with HEDS-5500

E5 Product Description

The E5 Series rotary encoder has a rugged glass-filled polymer enclosure with either a 5-pin or 10-pin latching connector. This optical incremental encoder is designed to easily mount to and dismount from an existing motor shaft to provide digital feedback information.

RoHS COMPLIANT

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

The single-ended output version (S-option) is typically used with cables of 10 feet or less. For longer cable lengths, the differential output version (D-option) is recommended.

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

A secure connection to the E5 Series encoder is made through a 5-pin (single-ended versions) or 10-pin (differential, high-voltage or open-collector versions) latching connector. The mating connectors are available from US Digital with several cable options and lengths.

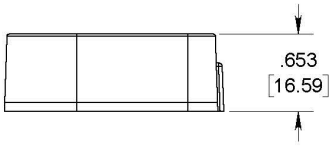
BROADCOM/AVAGO REPLACEMENTS:

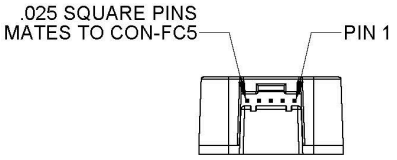
US Digital's E5 encoder may be used as a replacement for Avago HEDL-5500, HEDL-5600
(https://www.usdigital.com/support/resources/reference/compatibility-guides/avago-hedl-5xxx-encoder-us-digital-e5-compatibility-guide/).

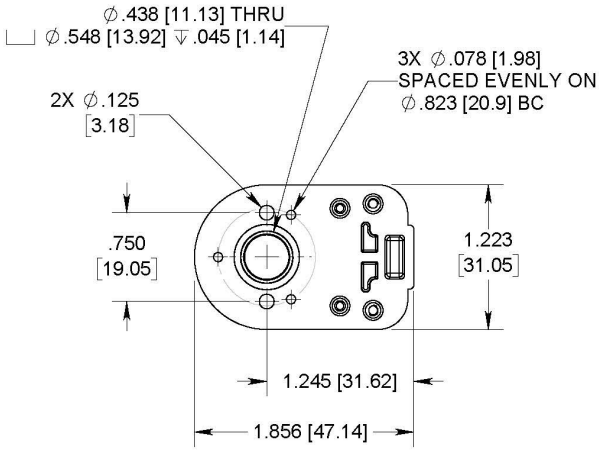
Mechanical Drawings

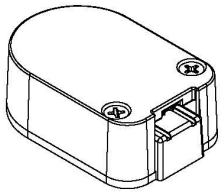
E5 Single-Ended Optical Kit Encoder (Default)

RELEASE DATE: 1/7/2020









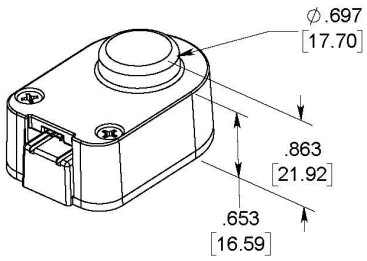
US DIGITAL
1400 NE 136th Avenue
Vancouver, Washington 98684, USA
info@usdigital.com
www.usdigital.com
Local: 360.260.2468
Toll-free: 800.736.0194

UNITS: INCHES [MM]
METRIC SHOWN FOR REFERENCE ONLY

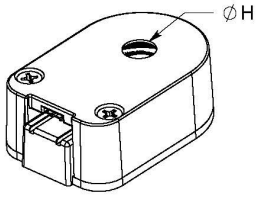
E5 Optical Kit Encoder Base & Cover Options

RELEASE DATE: 1/7/2020

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

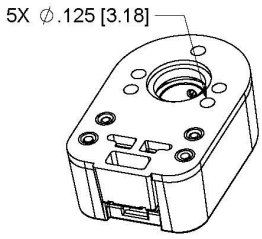


H-OPTION COVER
(COVER HOLE FOR SHAFT
LENGTHS OVER .750 [19.05])

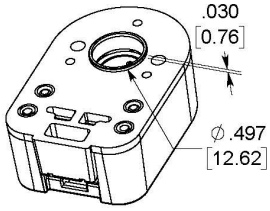


H = .295 [7.49] FOR SHAFT SIZES ≤ ∅.250 [6.35]
H = .438 [11.13] FOR SHAFT SIZES > ∅.250 [6.35]

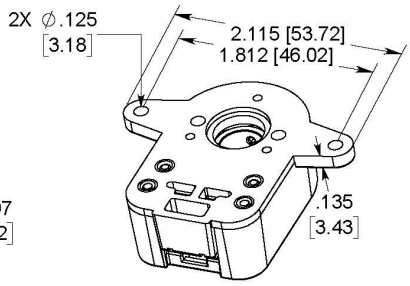
3-OPTION BASE
(LARGER MOUNTING HOLES)



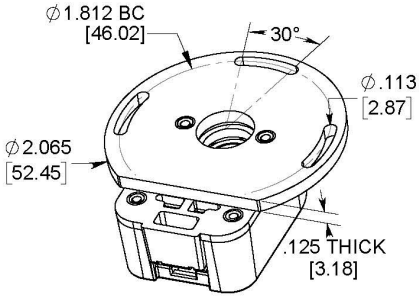
A-OPTION BASE
(ALIGNMENT BOSS)



G-OPTION BASE
(1.812" MOUNTING)



R-OPTION BASE
(ROTATIONAL MOUNTING)

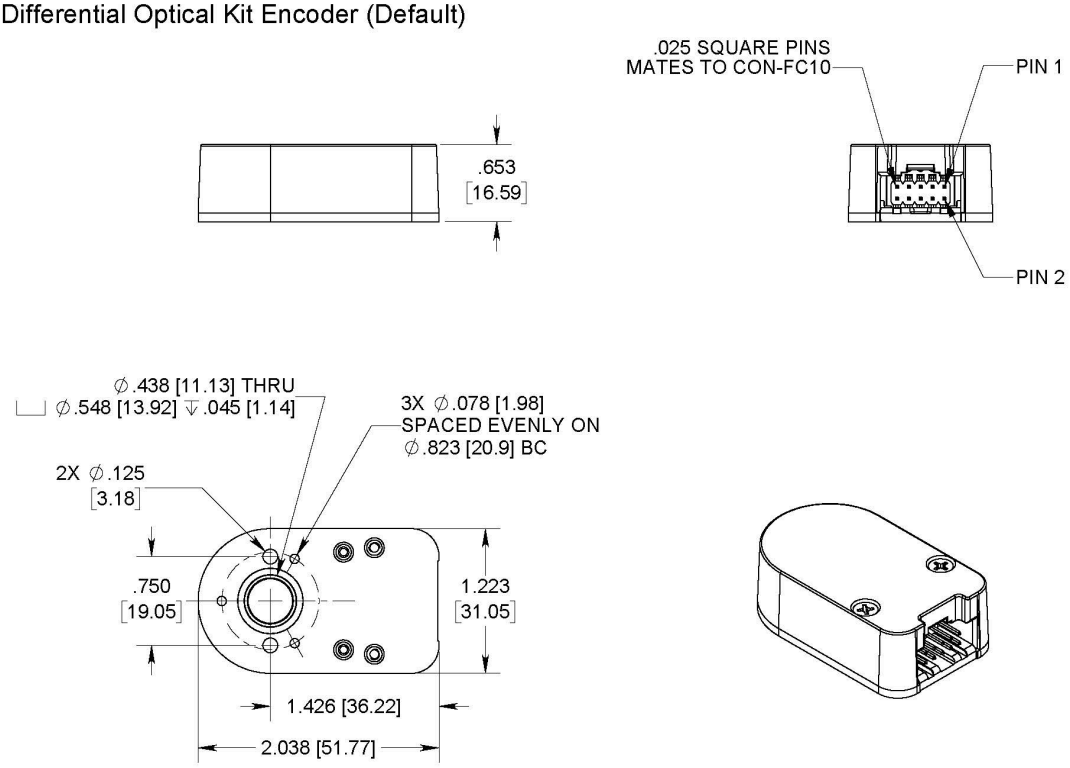


REQUIRES ADDITIONAL .125 [3.18] SHAFT LENGTH

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

E5 Differential 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

Specifications

ENVIRONMENTAL

Parameter	Value	Units
Operating Temperature, CPR < 2000	-40 to 100	C
Operating Temperature, CPR ≥ 2000	-25 to 100	C
Electrostatic Discharge Single-ended (S option), IEC 61000-4-2 Differential (D, L option), Human Body Model High-Voltage, Open-collector (H, C option), IEC 61000-4-2	 ± 4 ± 2 ± 4	kV
Vibration (10Hz to 2kHz, sinusoidal)	20	G
Shock (6 milliseconds, half-sine)	75	G

MECHANICAL

PARAMETER	VALUE	UNITS
Max. Shaft Axial Play	±0.010	in.
Max. Shaft Runout	0.004 T.I.R.	in.
Max. Acceleration	250000	rad/sec²
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-s²
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 *(https://www.usdigital.com/media/yyvb4qsy/tb_1001.pdf)*

(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/modules/em1/)* or 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 < 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 Vcc = 5.0Vdc and 25°C
- For complete details, see the EM1 *(https://www.usdigital.com/products/encoders/incremental/modules/em1/)* or 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		29	36	mA	CPR < 500, no load
		56	65	mA	CPR ≥ 500 and < 2000, no load
		74	88	mA	CPR ≥ 2000, no load
Low-level Output		0.2	0.4	V	I_{OL} = 20mA max.
High-level Output	2.4	3.4		V	I_{OH} = -20mA 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)
- Specifications apply over the entire operating temperature range
- For complete details, see the EM1 *(https://www.usdigital.com/products/encoders/incremental/modules/em1/)* or EM2 *(https://www.usdigital.com/products/encoders/incremental/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	B+ channel (single-ended)

(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)
Description: This reusable tool provides a simple method for accurately centering the **E5** base onto the shaft.

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

2. Hex Tool

Depending on the order quantity and 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, .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-E5

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

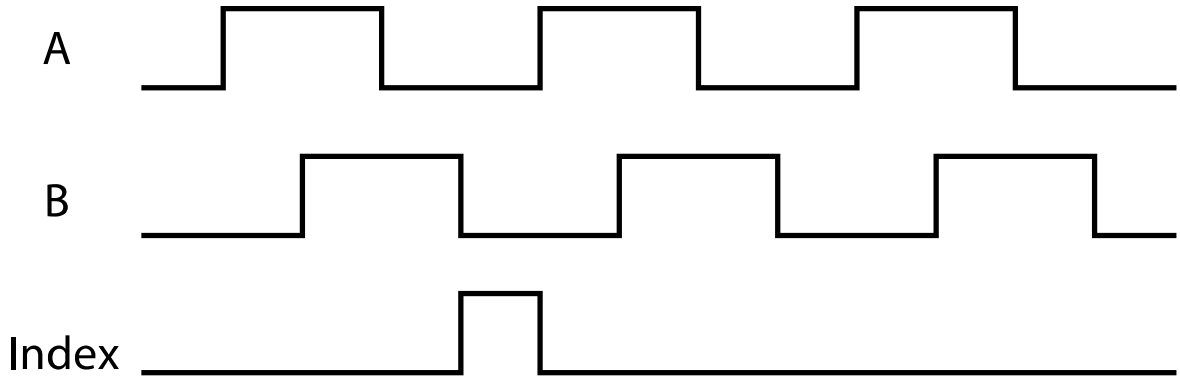
Description: Flat Head, Phillips 4-40 UNC x 5/8"
Use: Cover Mounting
Quantity Required: 2
Screws are included

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

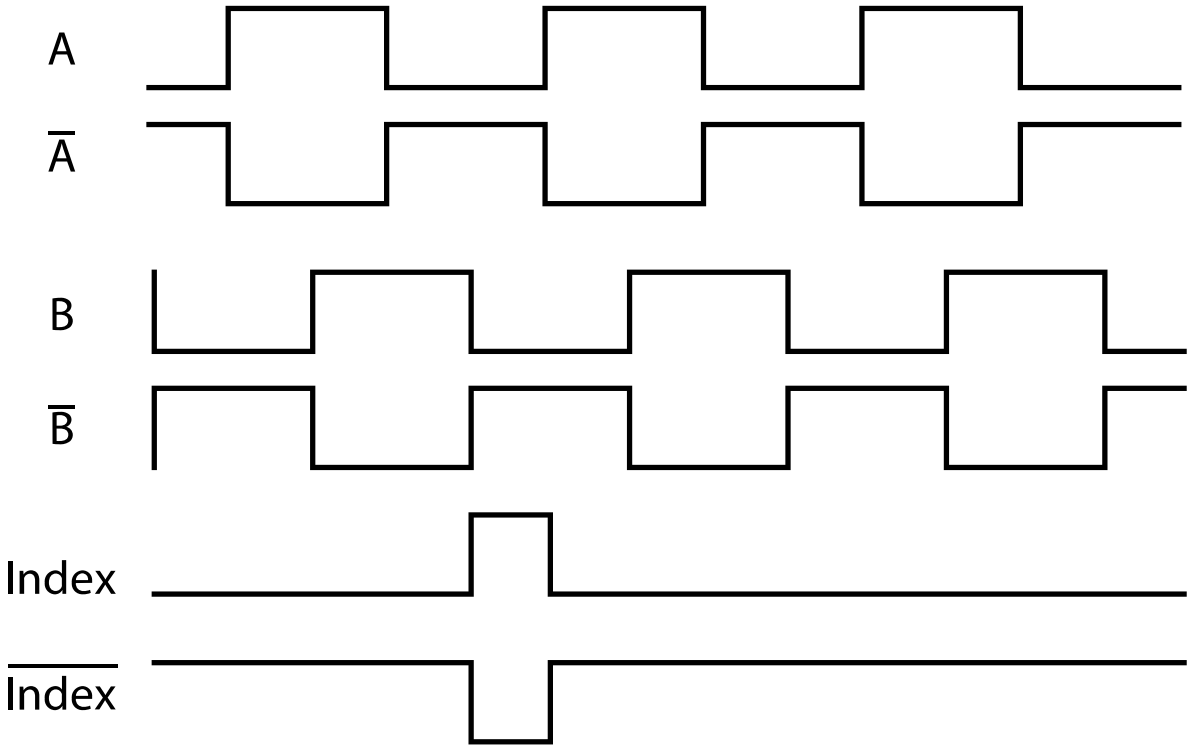
Part #: SCREW-448-125-SS
Description: Socket Head Set Screw, 4-48 UNC x 1/8"
Use: Hub/Disk Mounting for 2mm - 1/4" Bore
Quantity Required: 1
Screw is included

OUTPUT WAVEFORMS

SINGLE-ENDED



DIFFERENTIAL



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