

Description

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

The E5 Series is easy to add to existing applications and only consists of five main components: base, cover, hub/code wheel, optical encoder module and internal differential line driver (differential version only).

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.

The base and cover are both constructed of a rugged 20% glass filled polycarbonate. 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 (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.

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

For differential versions: the internal differential line driver (26C31) can source and sink 20mA at TTL levels. The recommended receiver is industry standard 26C32. Maximum noise immunity is achieved when the differential receiver is terminated with a 150 Ω resistor in series with a .0047 μ F capacitor placed across each differential pair. The capacitor simply conserves power; otherwise power consumption would increase by approximately 20mA per pair, or 60mA for 3 pairs.

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

Avago Replacements:

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



Features

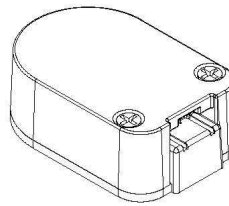
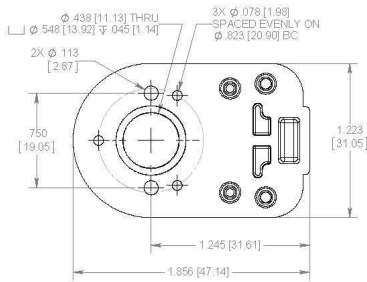
- ▶ Quick, simple assembly and disassembly
- ▶ Rugged screw-together housing
- ▶ Positive finger-latching connector
- ▶ Accepts .010" axial shaft play
- ▶ 32 to 1250 cycles per revolution (CPR)
- ▶ 128 to 5000 pulses per revolution (PPR)
- ▶ 2 channel quadrature TTL squarewave outputs
- ▶ Optional index (3rd channel)
- ▶ -40 to +100C operating temperature
- ▶ Mounting compatibility with HEDS-5500

Single-Ended

E5 Single-Ended Optical Kit Encoder



DEFAULT BASE & COVER OPTIONS SHOWN



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

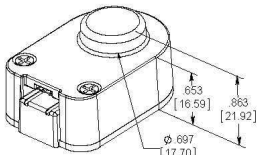
UNITS: INCHES (MM)
METRIC DIMENSIONS FOR REFERENCE ONLY

RELEASE DATE: 7/2/2012

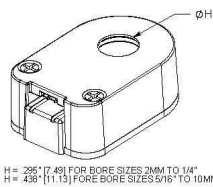
Base & Cover Options

E5 Optical Kit Encoder Base & Cover Options

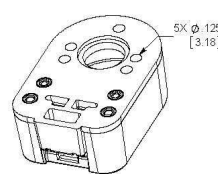
E-OPTION COVER
(EXTENSION FOR SHAFT LENGTHS .571" TO .750")



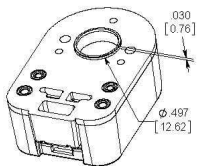
H-OPTION COVER
(COVER HOLE FOR EXTENDED SHAFT LENGTHS)



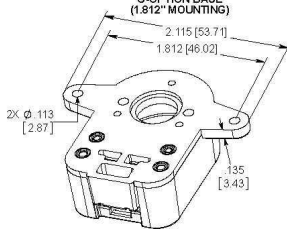
3-OPTION BASE
(LARGER MOUNTING HOLES)



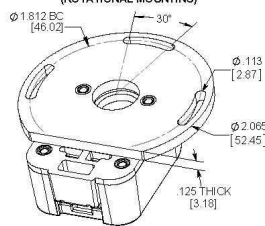
A-OPTION BASE
(ALIGNMENT BOSS)



G-OPTION BASE
(1.812" MOUNTING)



R-OPTION BASE
(ROTATIONAL MOUNTING)



*REQUIRES ADDITIONAL .125" SHAFT LENGTH

T-OPTION BASE
(ADHESIVE MOUNTING)



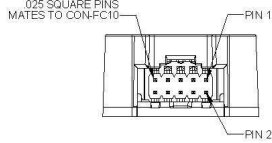
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UNITS: INCHES (MM)
METRIC DIMENSIONS FOR REFERENCE ONLY

RELEASE DATE: 7/2/2012

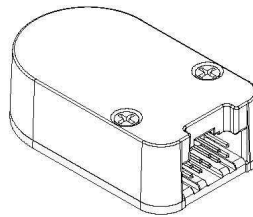
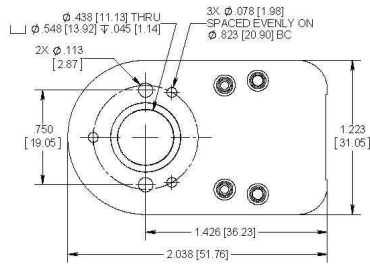
Differential

E5 Differential Optical Kit Encoder



RELEASE DATE: 07/2012

DEFAULT BASE & COVER OPTIONS SHOWN



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UNITS: INCHES (MM)
METRIC DIMENSIONS FOR REFERENCE ONLY

Environmental

Parameter	Value	Units
Operating Temperature	-40 to 100	C
Vibration (5Hz to 2kHz)	20	G
Electrostatic Discharge, Human Body Model	± 4	kV

Mechanical

Parameter	Value	Units
Max. Shaft Axial Play	±0.010	in.
Max. Shaft Eccentricity Plus Radial Play (1)	0.004	in.
Max. Acceleration	250000	rad/sec ²
Max. RPM (2) e.x. CPR=1250, max. rpm=14400 e.x. CPR=100, max. rpm=60000	minimum value of ((18 x 10 ⁶) / CPR) and (60000)	rpm
Typical Product Weight Single-ended (S-option) Differential (D-option, L-option)	0.82 0.91	oz.
Codewheel Moment of Inertia	8.0 x 10 ⁻⁶	oz-in-s ²

Parameter	Value	Units
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 (3)	0.445 to 0.570	in.
With E -option (3)	0.445 to 0.750	
With H -option (3)	> 0.445	
Index alignment to hub set screw	180 ± 5	mechanical degrees
Technical Bulletin TB1001 - Shaft and Bore Tolerances		Download

(1) Position inaccuracy is proportional to shaft radial play.

(2) 60000 rpm is the maximum rpm due to mechanical considerations. The maximum rpm due to the module's 300kHz maximum count frequency is $(18 \times 10^6) / \text{CPR}$.

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

Torque Specifications

Parameter	Torque
Hub Set Screw to Shaft	2-3 in-lbs
Cover (4-40 screws through cover into base)	2-4 in-lbs
Base to Mounting Surface	4-6 in-lbs
Base to Mounting Adapter Plate	4-6 in-lbs
Adapter Plate to Mounting Surface	4-6 in-lbs
Module to Base	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/label side of the encoder.

Single-ended Electrical

- Specifications apply over entire operating temperature range.
- Typical values are specified at $V_{cc} = 5.0\text{Vdc}$ and 25°C .

› For complete details, see the EM1 product page.

Parameter	Min.	Typ.	Max.	Units	Conditions
Supply Voltage	4.5	5.0	5.5	V	
Supply Current		27	33	mA	CPR < 500, no load
		50	62	mA	CPR ≥ 500, no load
Low-level Output			0.5	V	IOL = 8mA max.
High-level Output	2.0			V	IOH = -8mA max.
	4.2	4.8		V	no load
Output Current Per Channel	-8		8	mA	
Output Rise Time		110		nS	
Output Fall Time		35		nS	

Differential Electrical

- › Specifications apply over entire operating temperature range.
- › Typical values are specified at Vcc = 5.0Vdc and 25 ° C.
- › For complete details, see the EM1 product page.

Parameter	Min.	Typ.	Max.	Units	Conditions
Supply Voltage	4.5	5.0	5.5	V	
Supply Current		29	36	mA	CPR < 500, no load
		57	65	mA	CPR ≥ 500, no load
Low-level Output		0.2	0.4	V	IOL = 20mA max.
High-level Output	2.4	3.4		V	IOH = -20mA max.
Differential Output Rise/Fall Time			15	nS	

Pin-outs

5-pin Single-Ended (1)		10-pin Differential, Standard (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

5-pin Single-Ended (1)	10-pin Differential, Standard (2)	10-pin Differential, L-option (2,3)
	8	+5VDC power
	9	B- channel
	10	B+ channel
		8
		9
		10
		B+ channel
		Index-
		Index+

- (1) 5-pin single ended mating connector is CON-FC5.
- (2) 10-pin differential mating connector is CON-FC10.
- (3) Avago / Agilent / HP compatible version.

Options

Index

Provides a single pulse per revolution.

3-option

The 3-option makes all five of these hole diameters .125". The .438" diameter center hole can also mate with a motor boss.

View option:

- Single-ended Version



- Differential Version



A-option

The A-option adds a .497" diameter alignment shoulder designed to slip into a .500" diameter recess in the mounting surface centered around the shaft.

View option:

- Single-ended Version



- Differential Version



E-option

The **E**-option provides a cylindrical extension to the cover allowing for longer shafts of up to .750".

View option:

- Single-ended Version



- Differential Version



G-option

This option includes molded ears on the **E5** base which enable it to be mounted to a 1.812" diameter bolt circle. The mounting holes are designed to fit 4-40 screws. Because the ears are molded to the **E5** base this does not increase the thickness of the encoder and does not add to the required shaft length. This option will work with shaft lengths of .445" to .570".

View option:

- Single-ended Version



- Differential Version



H-option

The **H**-option adds a hole to the cover for the shaft to pass through.

- Shafts 2mm to 1/4", a .295" diameter hole is supplied.
- Shafts 5/16" to 10mm, a .438" diameter hole is supplied.

View option:

- Single-ended Version



▶ Differential Version



L-option

Provides Avago / Agilent / HP compatible pin-out.

Please note: Only available for E5D and E5MD (differential versions).

R-option

This adapter is an 1/8" thick fiberglass adapter which is pre-mounted to the base of the encoder. It allows the E5 to be rotated 15 ° while operating for index orientation. Use three 4-40 x 1/4" screws (sold separately). When installing the hub, rotate the index to the approximate position. After assembly, with the 3 screws loose, rotate while operating to the desired index location and tighten. Note that this adds 1/8" to the required shaft length. **Please note:** Only available in polycarbonate versions (E5D and E5S).

View option:

▶ Single-ended Version



▶ Differential Version



T-option

When mounting holes are not available, a pre-applied transfer adhesive (with peel-off backing) is available for stick-on mounting. Use the centering tool (sold separately) to slide the base into position. T-option specifies transfer adhesive on the standard mounting base.

Please note: Only available in polycarbonate versions (E5D and E5S).

▶ Single-ended Version



▶ Differential Version



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 **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 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, .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-4218

4. Screws

Screws for base mounting must be purchased separately. Screws for mounting the housing to the base are included.

Part #: SCREW-080-250-PH

Description: Pan Head, Cross Drive #0-80 UNF x 1/4"

Quantity Required for Mounting: 3 per encoder

Part #: SCREW-256-250-PH

Description: Pan Head, Cross Drive #2-56 UNC x 1/4"

Quantity Required for Mounting: 2 per encoder

Part #: SCREW-440-250-PH

Description:

Pan Head, Cross Drive #4-40 UNC x 1/4"
Quantity Required for Mounting: 2 per encoder

Product Change Notifications

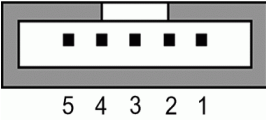
Title	Date	Description	Download
E5 Insert Overmold - PCN 1008	8/23/2011	In an effort to enhance the robustness of our E5 encoder; the four threaded inserts pressed into the base are being replaced with similar threaded nuts that will be insert-molded into the encoder base. This change in process will retain the insert with much greater strength.	Download
E5 Laser Marking - PCN 1009	8/23/2011	The primary purpose for this change is to create a more durable and longer lasting solution compared to the previous stick on label solution. The E5 encoder covers will now have the US Digital logo, part number, lot code, and pin-outs laser marked onto the top surface.	Download
E5 Mold Update - PCN 1007	8/23/2011	The plastic E5 base and covers have been redesigned for improved moldability and aesthetics. Design changes are primarily alteration of surface drafts, additional or increased corner radii and additional coring out of thick regions. This update was carefully done to preserve the size and shape of the encoder. The new parts are dimensionally equivalent and will fit within the envelope of the previous parts. Only the E-option covers and the G-option bases have features with dimensional changes.	Download
EM1 LED Die - PCN 1016	2/7/2013	<p>As part of US Digital's continual assurance of supply strategy, we have qualified additional sources for our LED die used in our EM1 encoder module, which in turn impacts all of the following products:</p> <p>EM1, E2, E3, E5, E6, H1, H15, H3, H5, H6, HB5M, HB6M, HD25, PE, S1, S2, S5, S6, T5 and T6</p> <p>The device specification will remain the same, i.e. there will be no change to form, fit or function of the product(s) as specified by US Digital. The appropriate quality and reliability testing has been performed on representative products to ensure normal parametric distribution, consistent with US Digital's quality and reliability standards.</p>	Download
EM1 Component Change Notice	N/A	Unless otherwise specified, the US Digital EM1 optical encoder module will be phased in to replace our previous encoder module, HEDS-9000 Series, supplied by Avago Technologies.	View

Wiring Diagram

Single Ended	
Pin	Function
1	Ground
2	Index
3	A

Pin	Function
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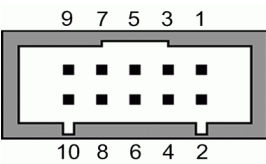
4	+5 VDC
5	B



Differential

Pin	Function
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1	Ground
2	Ground
3	Index-
4	Index
5	A-
6	A
7	+5 VDC
8	+5 VDC
9	B-
10	B

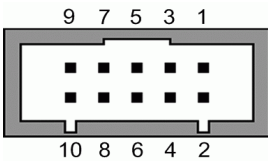


Differential (L-Option)

Pin	Function
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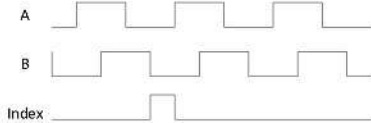
1	N/C
2	+5 VDC
3	Ground

Pin	Function
4	N/C
5	A-
6	A
7	B-
8	B
9	Index-
10	Index

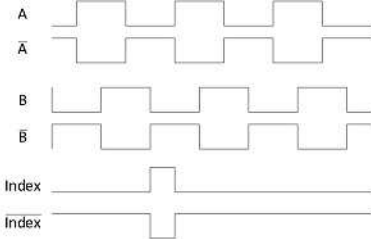


Output Waveforms

SINGLE-ENDED



DIFFERENTIAL



Assembly Instructions

E5 Single-Ended Assembly Instructions - <http://usdigital.com/assets/assembly/E5S%20Assembly%20Instructions.pdf>

E5 Differential Assembly Instructions - <http://usdigital.com/assets/assembly/E5D%20Assembly%20Instructions.pdf>

Ordering Information

E5	CPR	Bore	Index	Output	Cover	Base	Packaging
	32 =	079 =	NE =	S =Single-ended	D =Default	D =Default	B =Encoder components packaged in bulk. One spacer tool and one hex wrench for orders up to 9 units, for orders of 10 units and above one spacer tool and one hex driver per 100 encoders.
	50 =	2mm	No	D =Differential	E =Cover	3 =Base	1 =Encoders Individually packaged. One spacer tool and one hex wrench for orders up to 9 units, for orders of 10 units and above one spacer tool and one hex driver per 100 encoders.
	96 =	118 =	Index	L =Avago/Agilent compatible pin-out	Extension	Mounting	2 =Encoders packaged individually with one spacer tool and one hex wrench per encoder.
	100 =	3mm	IE =		H =Hole in Cover	Holes	3 =Encoders packaged individually with one spacer tool, one hex wrench, and one centering tool per encoder.
	192 =	125 =	Index			become .125"	
	200 =	1/8"				A =Adds self-aligning shoulder to base	
	250 =	156 =				G =Adds 1.812 mounting "ears" to base	
	256 =	5/32"				R =Adds 3-slot adapter to bottom of base	
	360 =	157 =				T =Transfer Adhesive	
	400 =	4mm					
	500 =	188 =					
	512 =	3/16"					
	540 =	197 =					
	720 =	5mm					
	900 =	236 =					
	1000 =	6mm					
	1024 =	250 =					
	1250 =	1/4"					
		276 =					
		7mm					
		313 =					
		5/16"					
		315 =					
		8mm					
		375 =					
		3/8"					
		394 =					
		10mm					

Rules

- Index must be equal to NE when CPR is equal to 32
- Cover must be something other than E when Bore is greater than 394

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 for details.

Base Pricing

Quantity	Price
1	\$74.90
5	\$51.50
10	\$43.09

For volume discounts, please contact us at sales@usdigital.com or 800.736.0194.

- Add 29% per unit for **Output** of Differential or Avago/Agilent compatible pin-out
- Add \$7.00 per unit for **Base** of Adds 3-slot adapter to bottom of base
- Add \$6.00 per unit for **Base** of Transfer Adhesive
- Add \$3.00 per unit for **Packaging** of Encoders Individually packaged. One spacer tool and one hex wrench for orders up to 9 units, for orders of 10 units and above one spacer tool and one hex driver per 100 encoders.
- Add \$4.00 per unit for **Packaging** of Encoders packaged individually with one spacer tool and one hex wrench per encoder.
- Add \$7.00 per unit for **Packaging** of Encoders packaged individually with one spacer tool, one hex wrench, and one centering tool per encoder.
- Add 21% per unit for **Index** of IE or **CPR** greater than or equal to 1000.