

E6 Features

- Quick, simple assembly, and disassembly
- Rugged screw-together housing
- Positive latching connector
- Accepts .010 in. axial shaft play
- 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)
- Fits shaft diameters from 2mm to 1 in.



E6 Product Description

The E6 Series rotary encoder has a rugged glass-filled polymer enclosure that utilizes either a 5-pin or 10-pin latching 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 module contains a highly collimated solid-state light source and monolithic phased array sensor, which together provide a system extremely tolerant to mechanical misalignments.

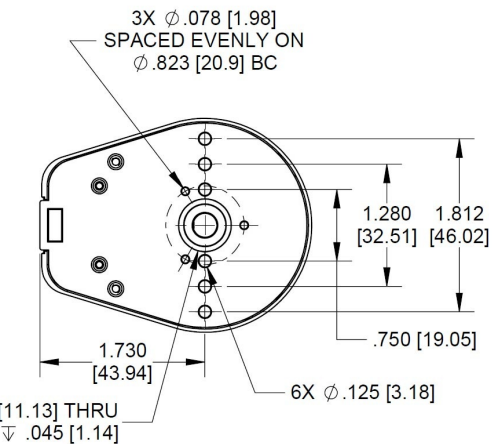
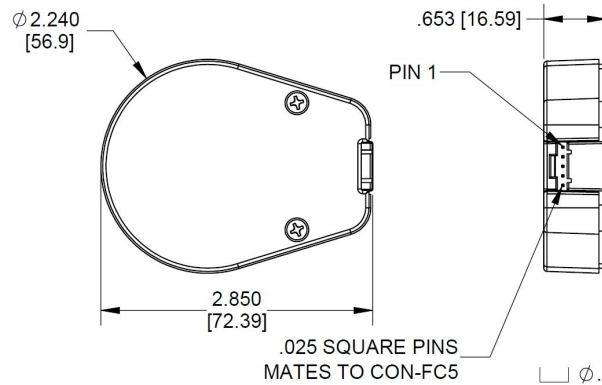
The single-ended output version (**S**-option) is typically used with cables of 10 feet or less. For longer cable lengths, the differential output version (**D**-option) is recommended.

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

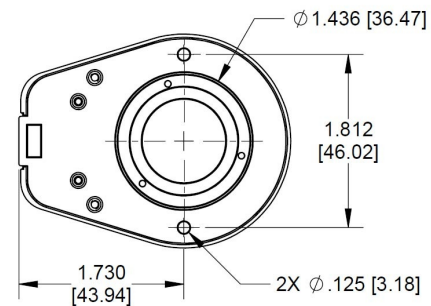
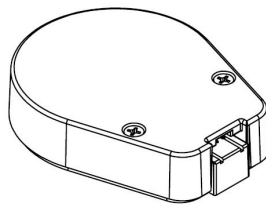
A secure connection to the E6 Series encoder is made through a 5-pin (single-ended versions) or 10-pin (differential versions) latching connector. The mating connectors are available from US Digital with several cable options and lengths.

Mechanical Drawings

E6 Single-Ended Optical Kit Encoder (Default)



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



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



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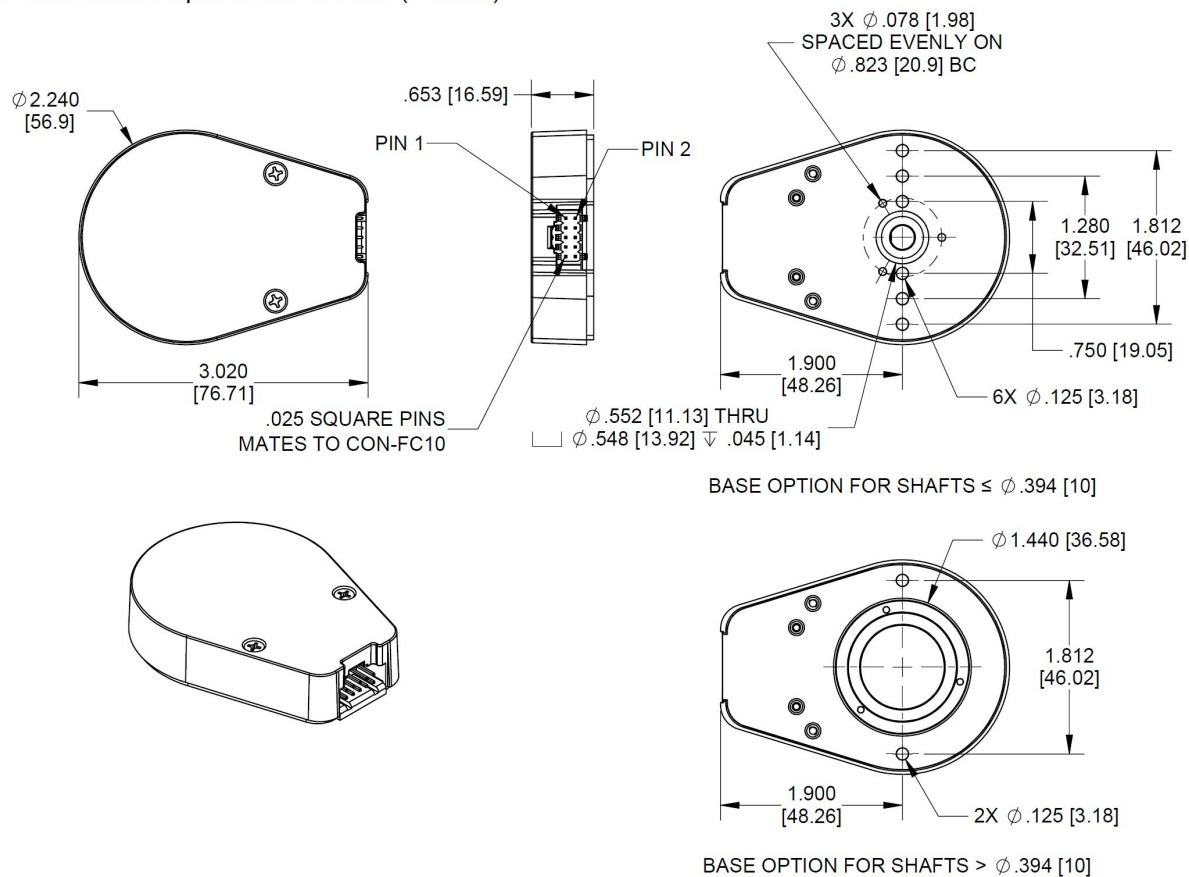
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RELEASE DATE: 05/19/2021

E6 Differential Optical Kit Encoder (Default)



RELEASE DATE: 05/19/2021



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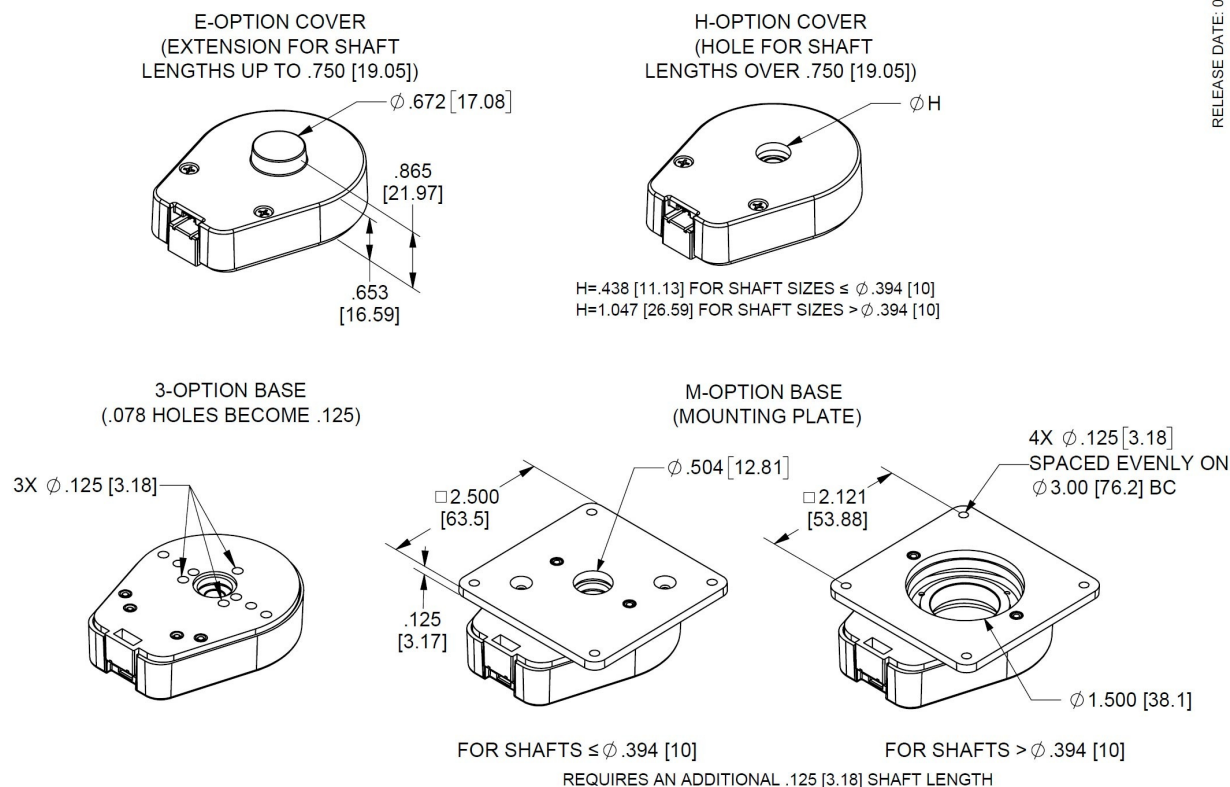
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E6 Optical Kit Encoder (Base and Cover Options)

RELEASE DATE: 05/19/2021



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Specifications

ENVIRONMENTAL

PARAMETER	VALUE	UNITS
Operating Temperature (CPR < 3600)	-40 to 100	C
Operating Temperature (CPR $\geq$ 3600)	-25 to 100	C
Vibration (5Hz to 2kHz)	20	G
Electrostatic Discharge		
Single-ended (-A, -S version), IEC 61000-4-2	± 4	kV
Differential (-D, -L version), Human Body Model	± 2	

MECHANICAL

PARAMETER	DIMENSION	UNITS
Max. Shaft Axial Play	±0.010	in.
Max. Shaft Runout	0.004 T.I.R.	in.
Max. Acceleration	250000	rad/sec ²
Max. RPM (1) (CPR ≤ 2500) e.x. CPR=2500, max. rpm=7200 e.x. CPR=100, max. rpm=60000	minimum value of $((18 \times 10^6) / \text{CPR})$ and (60000)	RPM
Max. RPM (1) (CPR > 2500 and ≤ 5000) e.x. CPR=4096, max. rpm=5273	$(21.6 \times 10^6) / \text{CPR}$	RPM
Max. RPM (1) (CPR > 5000) e.x. CPR=10000, max. rpm=4320	$(43.2 \times 10^6) / \text{CPR}$	RPM
Typical Product Weight Single-Ended (S-option) Differential (D-option, L-option)	1.55 1.83	oz.
Codewheel Moment of Inertia	8.9×10^{-5} for bore < 12mm 4.0×10^{-4} for bore ≥ 12 mm	oz-in-s ²
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	
2 Mounting Screw Size	#2-56 or #4-40	
3 Screw Bolt Circle Diameter (2)	0.823 ± 0.005	in.
2 Screw Bolt Circle Diameter	0.750 ± 0.005	in.
Required Shaft Length (3) With E-option (2) With H-option	0.445 to 0.570 0.445 to 0.750 > 0.445	in.
Index Alignment to Hub Set Screw	180 Typical	degrees

(1) 60000 rpm is the maximum rpm due to mechanical considerations. The maximum rpm due to the module's 300kHz maximum count frequency is $(18 \times 10^6) / \text{CPR}$.

(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

SINGLE-ENDED (S) / DIFFERENTIAL (D) 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 (A, 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 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 ≥ 1000 and < 3600, no load
		72	85	mA	CPR ≥ 3600, no load
Low-level Output			0.5	V	I _{OL} = 8mA max., CPR < 3600
			0.5	mA	I _{OL} = 5mA max., CPR ≥ 3600
		0.05		mA	no load, CPR < 3600
		0.25		mA	no load, CPR ≥ 3600
High-level Output	2.0			V	I _{OH} = -8mA max., CPR < 3600
	2.0			V	I _{OH} = -5mA max., CPR ≥ 3600
		4.8		V	no load, CPR < 3600
		3.5		V	no load, CPR ≥ 3600
Output Current Per Channel	-8		8	mA	CPR < 3600
	-5		5	mA	CPR ≥ 3600
Output Rise Time		110		nS	CPR < 3600
		50		nS	CPR ≥ 3600
Output Fall Time		35		nS	CPR < 3600
		50		nS	CPR ≥ 3600

DIFFERENTIAL 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		29	36	mA	CPR < 1000, no load
		56	65	mA	CPR $\geq$ 1000 and < 3600, no load
		74	88	mA	CPR $\geq$ 3600, 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	

PIN-OUTS

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

(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

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 **E6** 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.

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, .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-E6S

Description: For shaft sizes < 0.472"

Part #: SPACER-E6L

Description: For shaft sizes 12mm to 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, 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

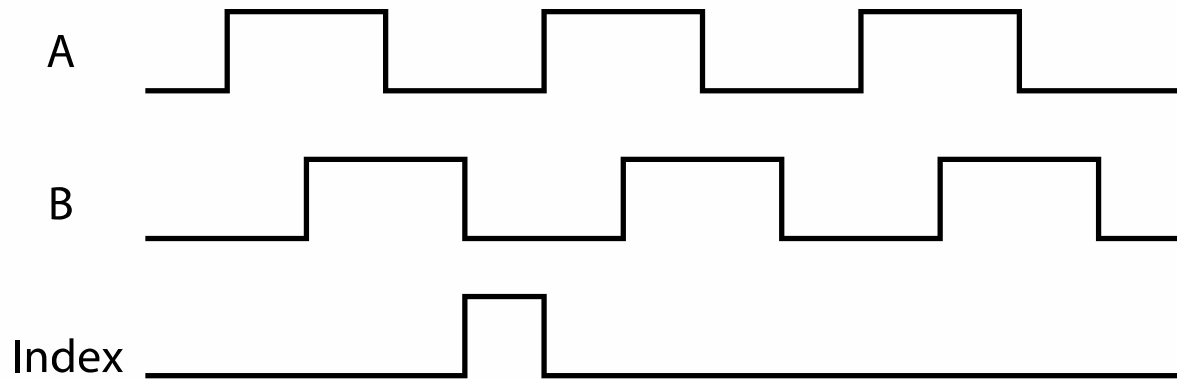
Description: Socket Head Set Screw, 4-48 UNC x 1/16"
Use: Hub/Disk Mounting for 5/16" - 10mm Bore
Quantity Required: 1
Screw is included

Part #: SCREW-448-125-SS

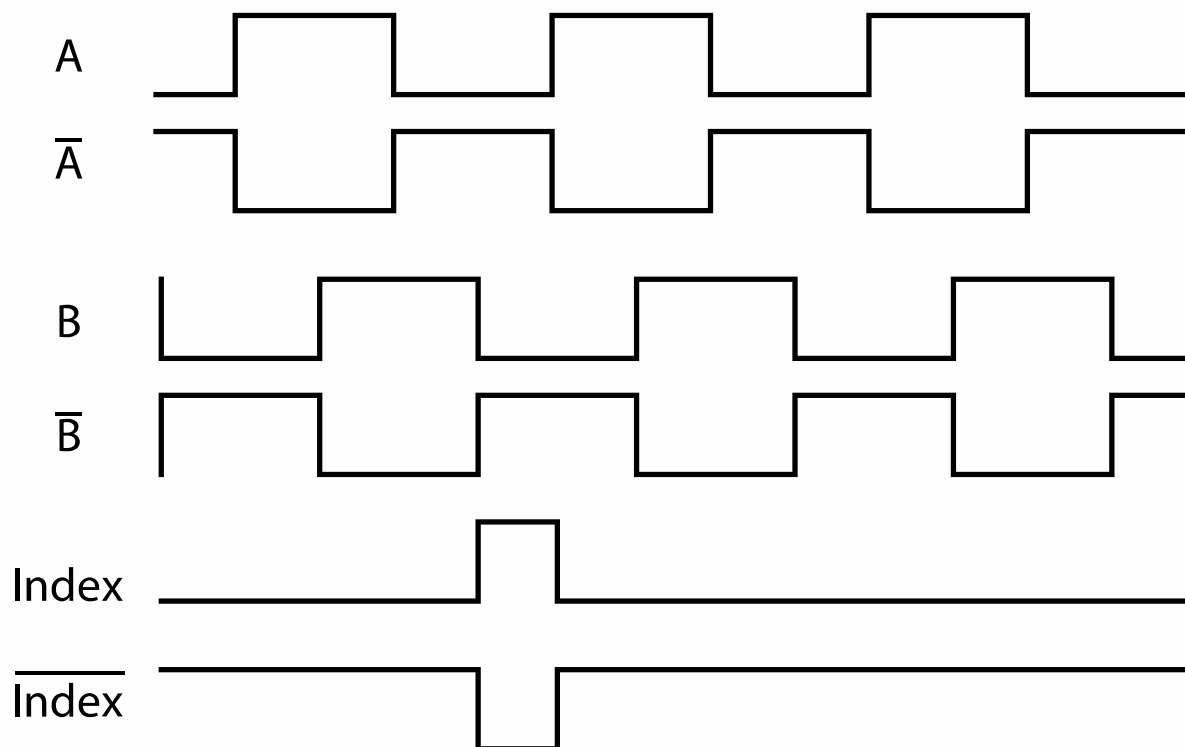
Description: Socket Head Set Screw, 4-48 UNC x 1/8"
Use: Hub/Disk Mounting for 2mm - 1/4" Bore
Quantity Required: 1
Screw is included

OUTPUT WAVEFORMS

SINGLE-ENDED



DIFFERENTIAL



PRODUCT CHANGE NOTIFICATIONS

Title	Date	Description	Download
Marketing/Insert - PCN 7058	11/04/2020	As part of our ongoing continuous improvement efforts, improvements are being incorporated into the E6, S6 and H6 series of Optical Encoders, including both single-end and differential output versions.	Download (https://www.usdigital.com/support/resources/product-change-notifications/pcn-7058-e6-s6-h6-marking-insert/)
2" Hub/Disk Assembly Screw Change - PCN 6644	9/27/2018	As part of our ongoing continuous improvement efforts, the screws used in the assembly of the 2" hub/disk assembly, that is with a bore of 12mm and larger, will be changed from a black oxide to a zinc plated screw. The zinc plating improves corrosion resistance as well as alleviates any potential for oil residue. The plating change has no effect on form, fit or function of our hubdisk assembly.	Download (https://www.usdigital.com/support/resources/product-change-notifications/pcn-6644-2-hub-disk-assembly-screw-change/)
Update to 1" and 2" Disks - PCN 6232	5/24/2018	This notice is to inform our customers of a minor disk design modification that is being implemented for standard 1" and 2" disks. This is a continuation of a change that was implemented for our index disks in 2015. We are revising the text on the disk, adding the US Digital logo and a line that is used internally by our manufacturing group. The change does not effect the quadrature or index tracks; therefore, it has no impact on form, fit or function.	Download (https://www.usdigital.com/support/resources/product-change-notifications/pcn-6232-updated-1-and-2-inch-disks/)
Hub Set Screw Production Change - PCN 5367	7/20/2015	As part of our ongoing continuous improvement efforts, US Digital is implementing a change related to the production of our 5/16" (.313), 8mm (.315), 3/8" (.375), and 10mm (.394) HUBDISK assemblies. We are adding a low strength threadlocker to the set screw during our assembly process to assist in securing the set screw in the hub during transportation. This will aid in the set screw retention of these specific hub sizes; ensuring the retention is sufficient and avoid the potential of them backing out of the hub assembly during transit. This change does not affect form, fit or function.	Download (https://www.usdigital.com/support/resources/product-change-notifications/pcn-5367-hub-set-screw-production-change/)
Laser Marking - PCN 5253	6/17/2015	As part of our ongoing continuous improvement efforts, US Digital is changing the labeling/marketing method for our E3, E6, H3, H6, S1, S2 and S6 products.	Download (https://www.usdigital.com/support/resources/product-change-notifications/pcn-5253-laser-marking/)

EM1 & EM2 Update - PCN 4199	1/14/2014	Based on our continuous process improvement program, US Digital is changing the current marking method for our EM1 and EM2 encoder modules to a serialization method. This change will allow for each module to have a unique code; the current marking method is based on a date code system that includes all encoder modules produced within a specific week / year. The serialization system will be based on a hexadecimal system.	Download (https://www.usdigital.com/support/resources/product-change-notifications/pcn-4199-em1-em2-update/)
EM1 LED Die - PCN 1016	2/7/2013	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: EM1, E2, E3, E5, E6, H1, H15, H3, H5, H6, HB5M, HB6M, HD25, PE, S1, S2, S5, S6, T5 and T6 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.	Download (https://www.usdigital.com/support/resources/product-change-notifications/pcn-1016-em1-led-die/)

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.