



## S16 Features

- **NEW FOR '22!**
- Small size (16mm OD)
- Low Cost
- Snap-in polarized connector
- 250/256 to 4,000/4096 cycles per revolution (CPR)
- 1,000/1024 to 16000/16384 pulses per revolution (PPR)
- Single +5V supply



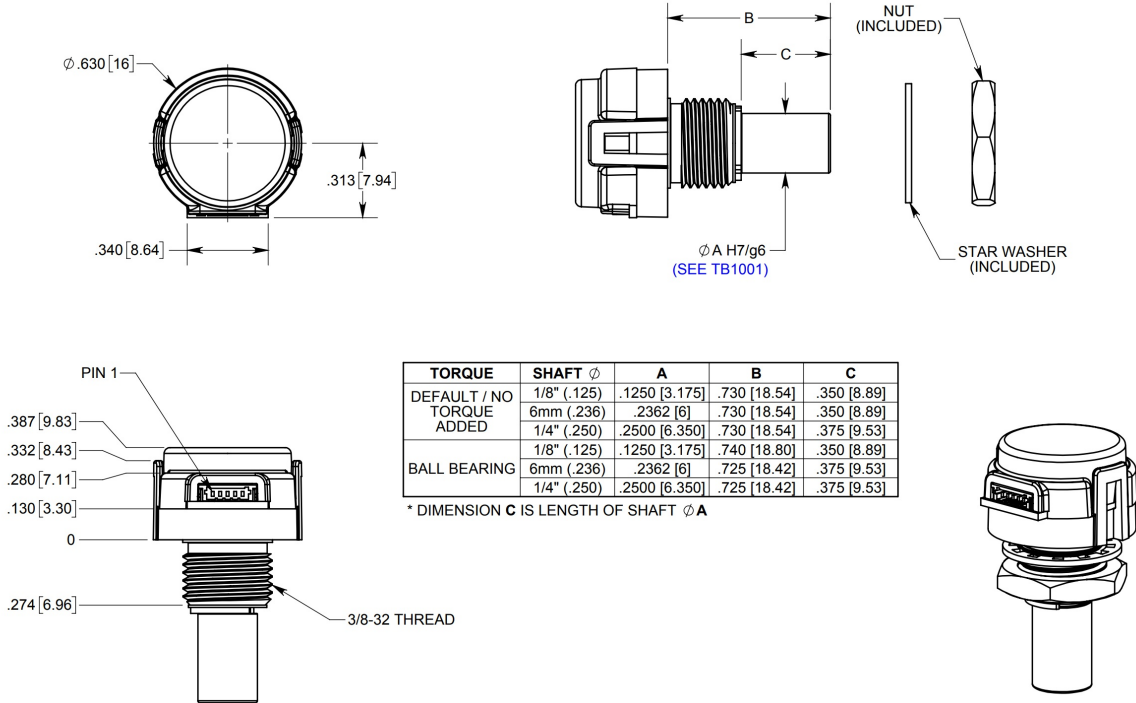
## S16 Product Description

The S16 16mm micro-optical shaft encoder is designed to provide A, B, and Index digital quadrature signals for high volume restricted space applications. The S16 encoder is available with either a bushing or ball bearing system for high speed applications. The shaft torque is designed to provide the feel of a potentiometer for front-panel manual interfaces. The S16 series encoder is connected using a 5-conductor, polarized, 0.8mm pitch connector (Hirose part number DF52-5P-0.8C). The mating cable (see the Cables web page) is not included and is available separately.



## Mechanical Drawings

S16 Micro Optical Shaft Encoder



RELEASE DATE: 03/30/2021

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UNITS: INCHES [MM]  
METRIC SHOWN FOR REFERENCE ONLY

## Specifications

### ENVIRONMENTAL

PARAMETER	VALUE	UNITS
Operating Temperature	-40 to 100	C
Electrostatic Discharge, IEC 61000-4-2	±12	kV
Shock, 6 millisecond, half-sine	75	G
Vibration (20Hz to 2kHz, sinusoidal)	20	G



## MECHANICAL

SPECIFICATION	SLEEVE BUSHING	BALL BEARING
Max. Acceleration	10000 rad/sec <sup>2</sup>	250000 rad/sec <sup>2</sup>
Max. Shaft Speed (1) (mechanical)	100 RPM	15000 RPM
Max. Shaft Torque	0.5 ±0.2 in-oz (D-option) 0.3 in-oz (N-option)	0.05 in-oz
Max. Shaft Loading	2 lbs. dynamic 20 lbs. static	1 lb.
Bearing Life	> 1000000 revolutions	$L_{10} = (22/F_r)^3 *$ Where $L_{10}$ = bearing life in millions of revs, and $F_r$ = radial shaft loading in pounds
Weight	0.48 oz.	0.43 oz.
Max. Shaft Runout	0.0015 in. T.I.R.	0.0015 in. T.I.R.
Max. Panel Nut Tightening Torque	20 in-lbs	20 in-lbs
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> )	

\* Only valid with negligible axial shaft loading.

(1) The maximum speed due to electrical considerations is dependent on the CPR. See the E16 (<https://www.usdigital.com/products/encoders/incremental/kit/e16/>) product page.



## ELECTRICAL

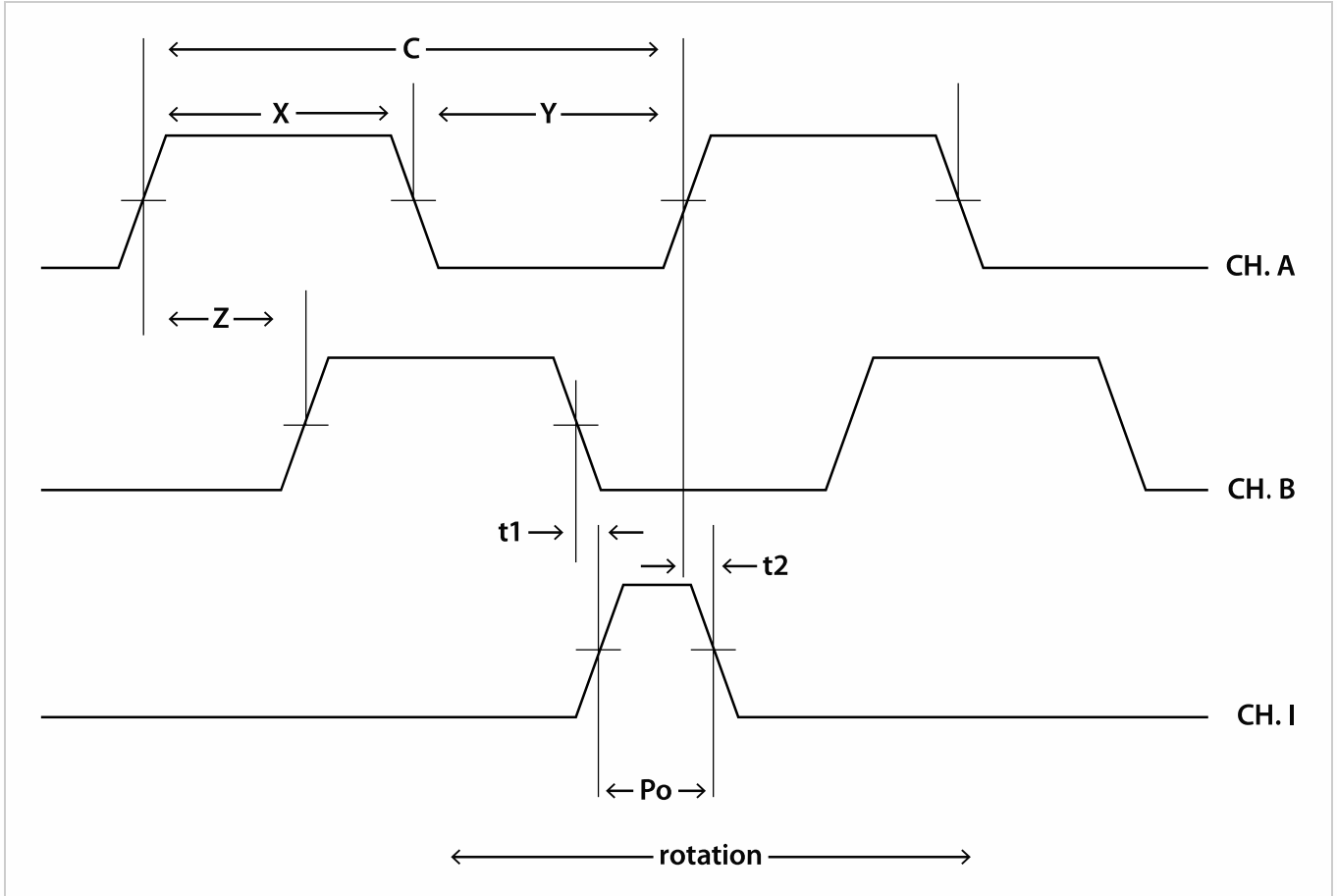
PARAMETER	MIN.	TYP.	MAX.	UNITS	NOTES
Supply Voltage	4.5	5.0	5.5	V	
Supply Current		18	26	mA	no load
Low-level Output			0.4	V	$I_{OL} = 4 \text{ mA}$ , $V_{CC} = 5V$
		0.1		V	no load
High-level Output	4.7			V	$I_{OH} = 4 \text{ mA}$ , $V_{CC} = 5V$
		4.9		V	no load
Output Rise Time		80	135	ns	no load
Output Fall Time		80	135	ns	no load
Maximum Output Frequency					
250/256 CPR	0.2			MHz	
500/512 CPR	0.4			MHz	
1,000/1,024 CPR	0.8			MHz	
2,000/2,048 CPR	1.6			MHz	
4,000/4,096 CPR	1.85			MHz	

## PHASE RELATIONSHIP

- Specifications apply over the entire operating temperature range.
- Values are for the worst error over full rotation.
- Refer to the timing diagram below.

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS
Symmetry	X, Y	150	180	210	$^{\circ}e$ <i>(<a href="https://www.usdigital.com/support/resources/glossary/#glossary_e">https://www.usdigital.com/support/resources/glossary/#glossary_e</a>)</i>
Quadrature	Z	60	90	120	$^{\circ}e$ <i>(<a href="https://www.usdigital.com/support/resources/glossary/#glossary_e">https://www.usdigital.com/support/resources/glossary/#glossary_e</a>)</i>
Index Pulse Width	Po	60	90	120	$^{\circ}e$ <i>(<a href="https://www.usdigital.com/support/resources/glossary/#glossary_e">https://www.usdigital.com/support/resources/glossary/#glossary_e</a>)</i>
Ch. I Rise After Ch. B or Ch. A Fall	t1		10		ns
Ch. I Fall After Ch. B or Ch. A Rise	t2		10		ns

## TIMING DIAGRAM



### CPR

The number of Cycles (C) of the A or B outputs Per Revolution.

### Index (I)

The index output goes high once per revolution, coincident with the low states of channels A and B, nominally 1/4 of one cycle (90°e).

### One Shaft Rotation

360 mechanical degrees.

### One Electrical Degree (°e)

1/360th of one cycle.

### One Cycle (C)

360 electrical degrees (°e). Each cycle can be decoded into 1, 2, or 4 states, referred to as x1, x2, or x4 resolution multiplication.

### PPR

The number of resolvable Positions Per Revolution of the encoder disk with x4 quadrature decoding.

### Quadrature (Z)

The phase lag or lead between channels A and B in electrical degrees, nominally 90°e.

### Symmetry

A measure of the relationship between (X) and (Y) in electrical degrees, nominally 180°e.



## PIN-OUT

PIN	DESCRIPTION
1	Ground
2	Index
3	A channel
4	+5VDC power
5	B channel

## 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.
- For ordering information please configure the product and you'll see the Compatible Cables / Connectors section above.