

## S2 Features

- 2-channel quadrature, TTL square wave outputs
- 3rd channel index option
- 64 to 10,000 CPR (256 to 40,000 PPR)
- Ball-bearing option tracks to 10,000 RPM
- Wide operating temperature
- Single +5V supply



## S2 Product Description

The S2 series high resolution optical shaft encoder is a non-contacting rotary to digital converter. Useful for position feedback or manual interface, the encoder converts real-time shaft angle, speed, and direction into TTL-compatible quadrature outputs with or without index. It operates from a single +5VDC supply.



The S2 is our first generation ball-bearing optical shaft encoder and is available for those customers who have designed it into their products; however, the S6 (<https://www.usdigital.com/products/encoders/incremental/shaft/s6/>) is recommended for new designs in place of the S2.

The S2 is designed to drive cables up to 10 feet long. For longer cable lengths, adding a PC4 (<https://www.usdigital.com/products/accessories/interfaces/cable-drivers/pc4/>)|PC5 (<https://www.usdigital.com/products/accessories/interfaces/cable-drivers/pc5/>) differential line driver is recommended.

Three shaft torque versions are available:

- The *default torque* version has a sleeve bushing designed to provide torque and feel ideal for front panel human interface applications.
- The *ball-bearing* version uses miniature precision ball bearings that are suitable for high-speed and ultra-low torque applications.
- The *light static drag* option has a sleeve bushing that does not intentionally add torque for low RPM applications where a small amount of torque is acceptable.

Connection to the S2 series encoder is made through a 5-pin standard connector. The mating connectors are available from US Digital with several cable options and lengths.

## Mechanical Drawings

**S2 Optical Shaft Encoder**

$\square$  .025 PINS  
 MATE TO CON-C5  
 OR CON-LC5

**BUSHING - .250" SHAFT**

**BALL BEARING - .250" SHAFT**

**BUSHING - .236" SHAFT**

**BALL BEARING - .236" SHAFT**

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UNITS: INCHES [MM]  
METRIC SHOWN FOR REFERENCE ONLY

RELEASE DATE: 12/18/2019

## Specifications

### ENVIRONMENTAL

PARAMETER	VALUE	UNITS
Operating Temperature, CPR < 2000	-40 to 100	C
Operating Temperature, CPR ≥ 2000	-25 to 100	C
Electrostatic Discharge, IEC 61000-4-2	± 4	kV
Vibration (10Hz to 2kHz, sinusoidal)	20	G
Shock (6 milliseconds, half-sine)	75	G

## MECHANICAL

PARAMETER	SLEEVE BUSHING	BALL BEARING
Max. Acceleration	250000 rad/sec <sup>2</sup>	250000 rad/sec <sup>2</sup>
Max. Shaft Speed (mechanical)	100 rpm (1)	10000 rpm (1)
Max. Shaft Torque	0.5 ±0.2 in-oz 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	$L_{10} = (19.3/F_r)^3 *$ Where $L_{10}$ = bearing life in millions of revs, and $F_r$ = radial shaft loading in pounds
Weight	1.28 oz.	1.28 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 EM1 (<https://www.usdigital.com/products/encoders/incremental/modules/em1/>) and EM2 (<https://www.usdigital.com/products/encoders/incremental/modules/em2/>) product pages.

## PHASE RELATIONSHIP

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

## 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 $\geq$ 1000 and < 3600, no load
		72	85	mA	CPR $\geq$ 3600, no load
Low-level Output			0.5	V	$I_{OL} = 8mA$ max., CPR < 3600
			0.5	mA	$I_{OL} = 5mA$ max., CPR $\geq$ 3600
		0.05		mA	no load, CPR < 3600
		0.25		mA	no load, CPR $\geq$ 3600
High-level Output	2.0			V	$I_{OH} = -8mA$ max., CPR < 3600
	2.0			V	$I_{OH} = -5mA$ max., CPR $\geq$ 3600
		4.8		V	no load, CPR < 3600
		3.5		V	no load, CPR $\geq$ 3600
Output Current Per Channel	-8		8	mA	CPR < 3600
	-5		5	mA	CPR $\geq$ 3600
Output Rise Time		110		nS	CPR < 3600
		50		nS	CPR $\geq$ 3600
Output Fall Time		35		nS	CPR < 3600
		50		nS	CPR $\geq$ 3600

## PIN-OUT

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

**Note:** 5-pin single-ended mating connector is CON-C5 (<https://www.usdigital.com/products/accessories/connectors/con-c5/>) or CON-LC5 (<https://www.usdigital.com/products/accessories/connectors/con-lc5/>)

## Notes

- Cables and connectors are not included and must be ordered separately.
- For ordering information please see the Compatible Cables / Connectors section above.
- 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

S2	CPR	Shaft Diameter	Index	Torque	Housing
	64	236 (6mm)	IE ( <i>Index</i> )	D ( <i>Default Torque</i> )	D ( <i>Default</i> )
	1000	250 (1/4")	NE ( <i>Non-Index</i> )	B ( <i>Ball Bearing</i> )	
	1024			N ( <i>Light Static Drag</i> )	
	2000				
	2048				
	2500				
	3600				
	4000				
	4096				
	5000				
	7200				
	8000				
	8192				
	10000				

**PLEASE NOTE:** This chart is for informational use only. Certain product configuration combinations are not available. Visit the S2 product page (<https://www.usdigital.com/products/S2/>) for pricing and additional information.