

## Description

The **S5** series 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.

Three shaft torque versions are available. The standard torque version has a sleeve bushing designed to provide torque and feel that is ideal for front panel human interface applications.

The no torque added option has a sleeve bushing that does not intentionally add torque for low RPM applications where a small amount of torque is acceptable.

The ball bearing version uses miniature precision ball bearings that are suitable for high speed and ultra low torque applications.

A secure connection to the **S5** series encoder is made through a 5-pin (single-ended version) or 10-pin (differential version) latching connector (sold separately). The mating connectors are available from US Digital with several cable options and lengths.

For differential versions, the internal differential line driver (26C31) can source and sink 20mA at TTL levels. The recommended receiver is the industry standard 26C32. Maximum noise immunity is achieved when the differential receiver is terminated with a 150  $\Omega$  resistor in series with a .0047  $\mu$  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.



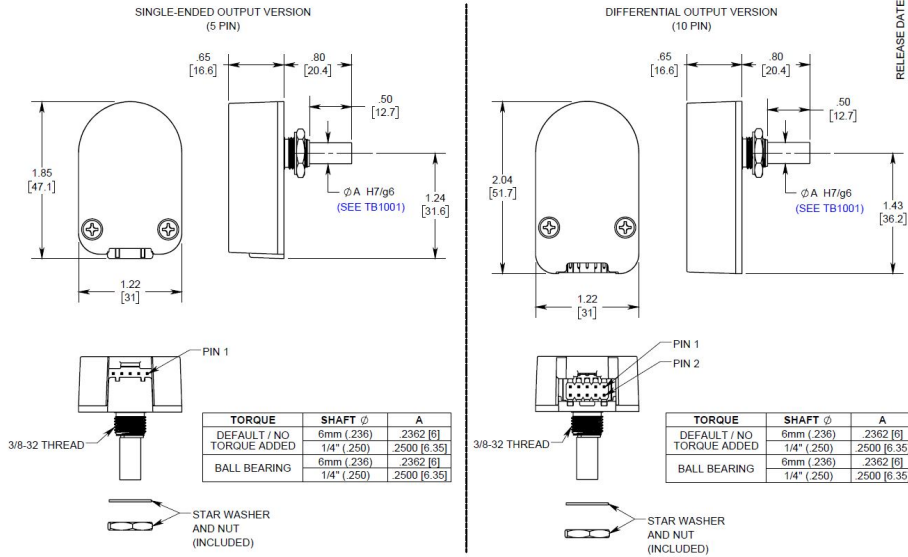
## Features

- ▶ Small size
- ▶ 32 to 5000 CPR (128 to 20000 PPR)
- ▶ Optional differential / line-driver output
- ▶ Positive latching connector
- ▶ 2-channel quadrature, TTL squarewave outputs
- ▶ 3rd channel index option
- ▶ Ball bearing option tracks to 10,000 RPM
- ▶ Wide operating temperature
- ▶ Single +5VDC supply

**Mechanical Drawing**

S5 Optical Shaft Encoder

RELEASE DATE: 03/19/2018



**Environmental**

Parameter	Value	Units
Operating Temperature, CPR < 2000	-40 to 100	C
Operating Temperature, CPR $\geq$ 2000	-25 to 100	C
Vibration (5Hz to 2kHz)	20	G
Electrostatic Discharge		
Single-ended (-S version), IEC 61000-4-2	$\pm 4$	kV
Differential (-D version), Human Body Model	$\pm 2$	

**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 $\pm$ 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

Parameter	Sleeve Bushing	Ball Bearing
Weight		
Single-ended	1.01 oz.	1.15 oz.
Differential	1.28 oz.	1.42 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

\* Only valid with negligible axial shaft loading.

(1) The maximum speed due to electrical considerations is dependent on the CPR. See the EM1 and EM2 product pages.

### Phase Relationship

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

### Single-ended Electrical

- Specifications apply over entire operating temperature range.
- Typical values are specified at  $V_{CC} = 5.0V_{DC}$  and  $25^{\circ}C$ .
- For complete details, see the EM1 or 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 $\geq$ 500 and <2000, no load
		72	85	mA	CPR $\geq$ 2000, no load
Low-level Output			0.5	V	IOL = 8mA max., CPR < 2000
			0.5	V	IOL = 5mA max., CPR $\geq$ 2000
		0.25		V	no load, CPR $\geq$ 2000
High-level Output	2.0			V	IOH = -8mA max. and CPR < 2000
	2.0			V	IOH = -5mA max. and CPR $\geq$ 2000
		4.8		V	no load and CPR < 2000
		3.5		V	no load and CPR $\geq$ 2000
Output Current Per Channel	-8		8	mA	CPR < 2000
	-5		5	mA	CPR $\geq$ 2000
Output Rise Time		110		nS	CPR < 2000
		50		nS	CPR $\geq$ 2000, $\pm$ 5mA load

Parameter	Min.	Typ.	Max.	Units	Conditions
Output Fall Time		100		nS	CPR < 2000
		50		nS	CPR ≥ 2000, ± 5mA load

### 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 and 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	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)

Pin	Description
1	Ground
2	Index
3	A channel
4	+5VDC power
5	B channel

#### 10-pin Differential Standard: (2)

Pin	Description
1	Ground
2	Ground
3	Index-
4	Index+
5	A- channel
6	A+ channel

Pin	Description
7	+5VDC power
8	+5VDC power
9	B- channel
10	B+ channel

- (1) 5-pin single-ended mating connector is CON-FC5.
- (2) 10-pin differential mating connector is CON-FC10.

### Ordering Information

S5 -  -  -  -  -

CPR	Shaft	Index	Output	Torque
32 =	236 = 6mm diameter	NE = No Index	S = Single-ended	D = Default
50 =	250 = 1/4" diameter	IE = Index	D = Differential	B = Ball Bearing
96 =				N = No torque added
100 =				
192 =				
200 =				
250 =				
256 =				
360 =				
400 =				
500 =				
512 =				
540 =				
720 =				
800 =				
900 =				
1000 =				
1024 =				
1250 =				
2000 =				
2048 =				
2500 =				
4000 =				
4096 =				
5000 =				

## 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 for details.