

## S6 Features

- Small size
- 64 to 10,000 CPR (256 to 40,000 PPR)
- Optional differential / line-driver output
- Positive latching connector
- 2-channel quadrature with optional index
- Multiple Output Drive Options
- Ball-bearing option tracks to 10,000 RPM
- Wide operating temperature



## S6 Product Description

The S6 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.



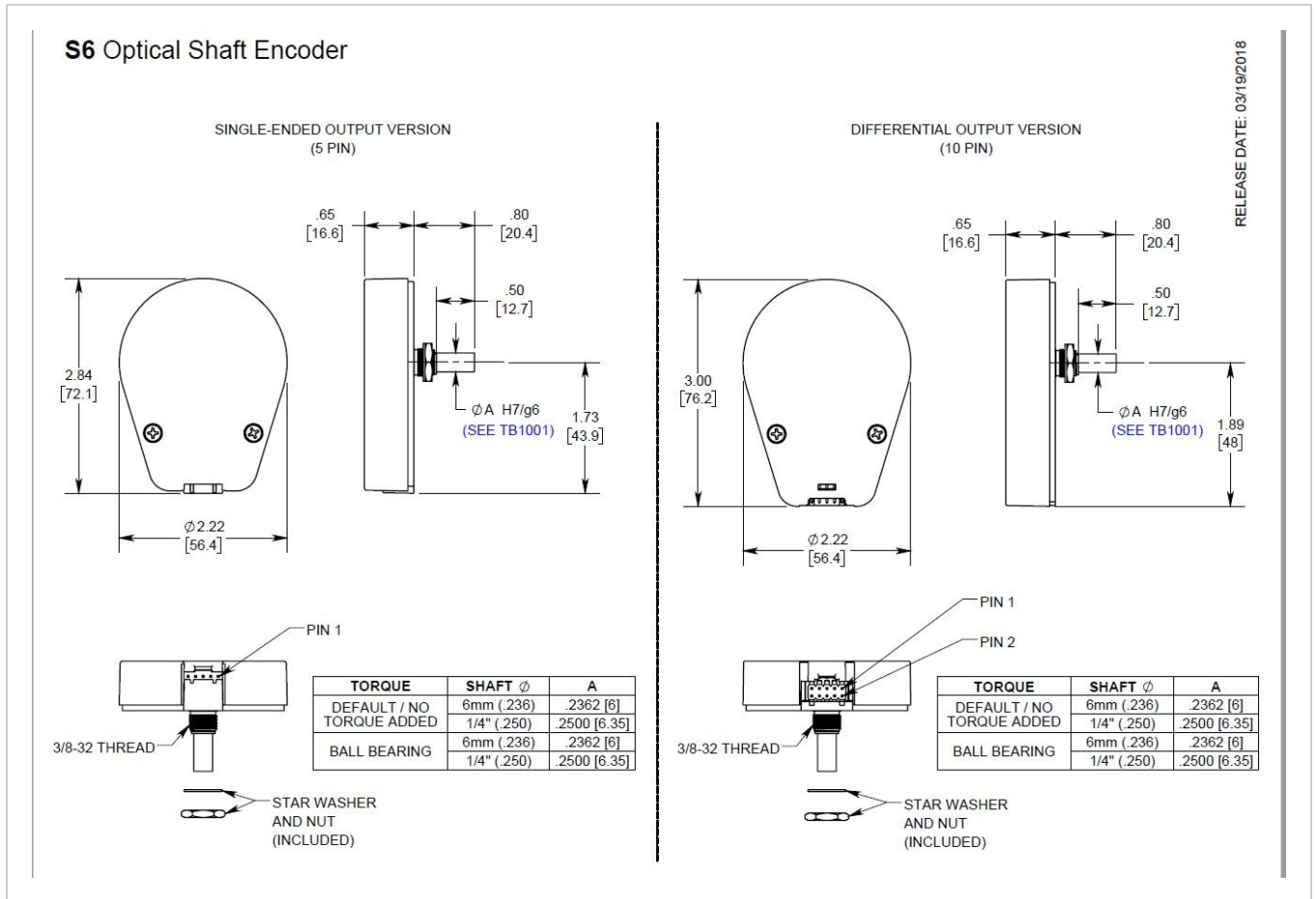
Three shaft torque versions are available:

- 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.

A secure connection to the S6 Series encoder is made through a 5-pin (single-ended versions) or 10-pin (differential or high-voltage versions) latching connector. The mating connectors are available from US Digital with several cable options and lengths.

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

## Mechanical Drawings



## Specifications

### ENVIRONMENTAL

Parameter	Value	Units
Operating Temperature, CPR < 2000	-40 to 100	C
Operating Temperature, CPR $\geq$ 2000	-25 to 100	C
Electrostatic Discharge		kV
Single-ended (S option), IEC 61000-4-2	$\pm 4$	
Differential (D, L option), Human Body Model	$\pm 2$	
High-Voltage, Open-collector (H, C option), IEC 61000-4-2	$\pm 4$	
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		
Single-ended (S option)	1.92 oz.	1.78 oz.
Differential (D option)	2.00 oz.	1.86 oz.
High-Voltage, Open-Collector (H, C option)	2.00 oz.	1.86 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.

## SINGLE-ENDED OPTION

- S option provides 5V TTL compatible outputs
- 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

## DIFFERENTIAL OPTION

- D Option provides differential line driver outputs
- 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	

## HIGH-VOLTAGE OPTION

- H option uses a higher supply voltage and provides both single-ended and open-collector outputs
- Single-ended outputs are 5V TTL compatible (same as S option)
- Specifications apply over the entire operating temperature range
- For complete details, see the EM1 (<https://www.usdigital.com/products/encoders/incremental/modules/em1/>) or EM2 (<https://www.usdigital.com/products/encoders/incremental/modules/em2/>) product pages

PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITIONS
Supply Voltage	7.5		30.0	V	
Supply Current, 24V power		8	10	mA	CPR < 500, no load
		16	19	mA	CPR $\geq$ 500 and < 2000, no load
		22	25	mA	CPR $\geq$ 2000, no load
Open Collector "On" Resistance		2		ohms	
Open Collector Sink Current			200	mA	
Output Low Voltage			0.4	V	200 mA sink current
Open Collector Pullup Voltage			50	V	

## PIN-OUTS

5-PIN SINGLE-ENDED S OPTION (1)		10-PIN DIFFERENTIAL D OPTION (2)	
Pin	Description	Pin	Description
1	Ground	1	Ground
2	Index	2	Ground
3	A channel	3	Index-
4	+5VDC power	4	Index+
5	B channel	5	A- channel
		6	A+ channel
		7	+5VDC power
		8	+5VDC power
		9	B- channel
		10	B+ channel

10-PIN HIGH-VOLTAGE H OPTION (2)	
Pin	Description
1	Ground
2	Ground
3	Index- (open collector)
4	Index+ (single-ended)
5	A- channel (open collector)
6	A+ channel (single-ended)
7	7.5-30V power
8	7.5-30V power
9	B- channel (open collector)
10	B+ channel (single-ended)

(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/>).

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

## Configuration Options

S6	CPR (Cycles Per Revolution)	Shaft Diameter	Index	Output	Torque
	64	236 (6mm)	IE (Index)	S (Single-Ended)	D (Default Torque)
	1000	250 (1/4")	NE (Non-Index)	H (Single-Ended High-Voltage)	B (Ball Bearing)
	1024			D (Differential)	N (Light Static Drag)
	1800			L (Avago 10-pin Differential)	
	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 S6 product page (<https://www.usdigital.com/products/S6/>) for pricing and additional information.