

## S4T Features

- Small size
- Low cost
- High retention snap-in polarized connector
- -20C to 100C operating temperature
- 100 to 1,000 cycles per revolution (CPR)
- 400 to 4,000 pulses per revolution (PPR)
- 2-channel quadrature TTL square wave outputs



## S4T Product Description

The S4T miniature optical shaft encoder is a non-contacting rotary to digital converter. The S4T contains an LED light source, monolithic photodetector, and mylar disk. The encoder converts real-time shaft angle, speed, and direction into TTL-compatible quadrature outputs without index. It operates from a single +5VDC supply.



Three shaft torque options are available:

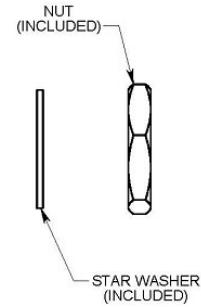
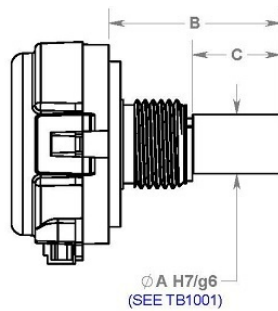
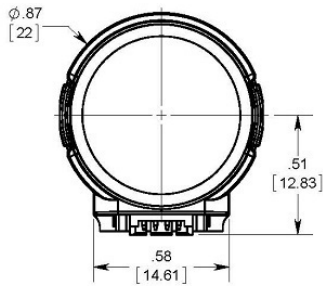
- Default (-D): sleeve bushing with higher damping for human interface applications.
- Ball bearing (-B): miniature precision ball bearings suitable for high-speed applications.
- Light static drag (-N): sleeve bushing with lower damping for low-speed applications.

The S4T uses a high retention, 4 conductor snap-in polarized 1.25mm pitch connector. Mating cables and connectors (see the Cables (<https://www.usdigital.com/products/accessories/cables/>)/Connectors (<https://www.usdigital.com/products/accessories/connectors/>) web page) are not included and are available separately.

## Mechanical Drawings

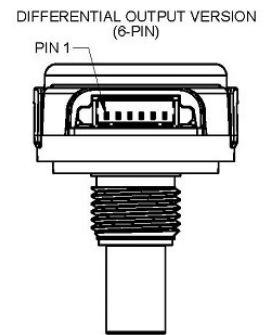
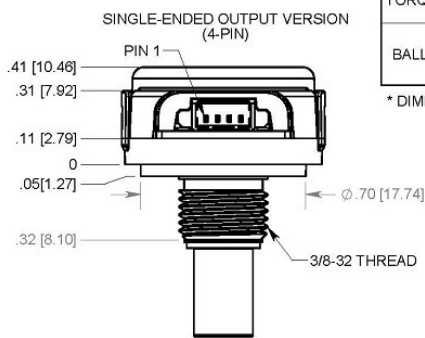
## S4T Miniature Optical Shaft Encoder

RELEASE DATE: 01/20/2015



TORQUE	SHAFT $\phi$	A	B	C
DEFAULT / NO TORQUE ADDED	1/8" (.125)	.1250 [3.175]	.730 [18.54]	.350 [8.89]
	6mm (.236)	.2362 [6]	.730 [18.54]	.350 [8.89]
	1/4" (.250)	.2500 [6.350]	.730 [18.54]	.375 [9.53]
BALL BEARING	1/8" (.125)	.1250 [3.175]	.740 [18.80]	.375 [9.53]
	6mm (.236)	.2362 [6]	.725 [18.42]	.375 [9.53]
	1/4" (.250)	.2500 [6.350]	.725 [18.42]	.375 [9.53]

\* DIMENSION C IS LENGTH OF SHAFT  $\phi A$



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UNITS: INCHES [MM]  
METRIC SHOWN FOR REFERENCE ONLY

## Specifications

### ENVIRONMENTAL

PARAMETER	VALUE	UNITS
Operating Temperature	-20 to 100	C
Electrostatic Discharge, IEC 61000-4-2		
Single-ended (-S version)	$\pm 12$	KV
Differential (-D version)	$\pm 7$	
Vibration (10Hz to 2kHz, sinusoidal)	20	G
Shock (6 milliseconds, half-sine)	75	G



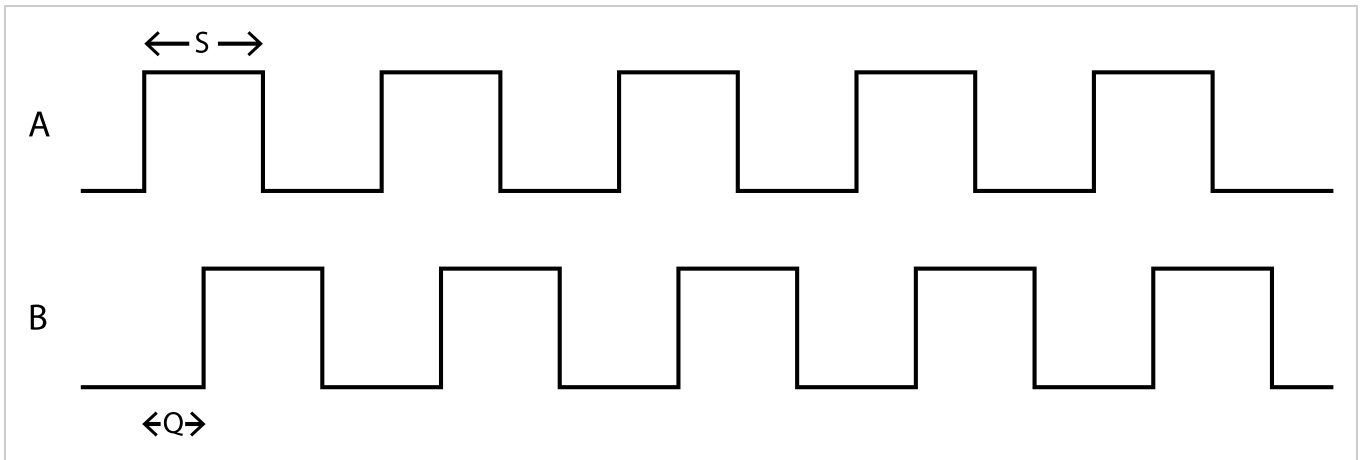
## MECHANICAL

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 in-oz (D-option) 0.3 in-oz (N-option)	0.05 in-oz (B-option)
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 E4T (<https://www.usdigital.com/products/encoders/incremental/kit/e4t/>) product page.

## PHASE RELATIONSHIP



PARAMETER	MIN.	TYP.	MAX.	UNITS
Symmetry, S	105	180	255	electrical degrees
Quadrature Delay, Q	30	90	150	electrical degrees

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

## SINGLE-ENDED ELECTRICAL

SPECIFICATIONS	MIN.	TYP.	MAX.	UNITS	NOTES
Supply Voltage	4.5	5.0	5.5	V	
Supply Current		25	30	mA	CPR ≤ 500, no load
		34	42	mA	CPR > 500, no load
Low-level Output			0.4	V	CPR ≤ 500, $I_{OL} = 8$ mA
					CPR > 500, $I_{OL} = 5$ mA
		0.035		V	no load
High-level Output	2.4			V	CPR ≤ 500, $I_{OH} = -8$ mA
					CPR > 500, $I_{OH} = -5$ mA
			4.0	V	no load
Output Rise Time		100		ns	no load
Output Fall Time		50		ns	no load



## DIFFERENTIAL ELECTRICAL

SPECIFICATIONS	MIN.	TYP.	MAX.	UNITS	NOTES
Supply Voltage	4.5	5.0	5.5	V	
Supply Current		27	32	mA	CPR ≤ 500, no load
		36	44	mA	CPR > 500, no load
Single-Ended Output Voltage High	4.75	5.0		V	Min. @ 25mA load, Typ. @ no load
Single-Ended Output Voltage Low		0.25	0.60	V	Typ. @ no load, Max. @ 4.5mA load
Differential Output Voltage	3.0	3.8		V	RL = 100 ohm
Differential Output Rise/Fall Time			20	ns	

## PIN-OUT

4-PIN SINGLE-ENDED (1)		6-PIN DIFFERENTIAL (2)	
Pin	Description	Pin	Description
1	+5VDC power	1	Ground
2	A channel	2	A channel
3	Ground	3	A- channel
4	B channel	4	+5VDC power
		5	B channel
		6	B- channel

(1) 4-pin single-ended mating connector is CON-MIC4 (<https://www.usdigital.com/products/accessories/connectors/con-mic4/>)

(2) 6-pin differential mating connector is CON-MIC6 (<https://www.usdigital.com/products/accessories/connectors/con-mic6/>)

## Notes

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



## Configuration Options

S4T	CPR (Cycles Per Revolution)	Shaft Diameter	Output	Torque
	100	125 (1/8")	S (Single-Ended)	D (Default Torque)
	108	236 (6mm)	D (Differential)	B (Ball Bearing)
	120	250 (1/4")		N (Light Static Drag)
	125			
	128			
	200			
	250			
	256			
	300			
	360			
	400			
	500			
	512			
	720			
	800			
	1000			

**PLEASE NOTE: This chart is for informational use only.** Certain product configuration combinations are not available. Visit the S4T product page (<https://www.usdigital.com/products/S4T>) for pricing and additional information.