**RoHS** COMPLIANT

## 🔍 Description

The S4T miniature optical shaft encoder is a non-contacting rotary to digital converter. The S4T incorporates an LED light source, monolithic photo detector and mylar disk. A metal shaft with bushing or bearing versions are available. Useful for position feedback or manual interface, the encoder converts real-time shaft angle, speed, and direction into TTL-compatible quadrature outputs without index.  It operates from a single +5VDC supply.

The S4T encoder is available with ball bearings for motion control applications, or static drag to feel like a potentiometer for front-panel manual interface.

The S4T uses a high retention, 4 conductor snap-in polarized 1.25mm pitch connector. Mating cables and connectors (See the Cables / Connectors web page) are not included, and are available separately.
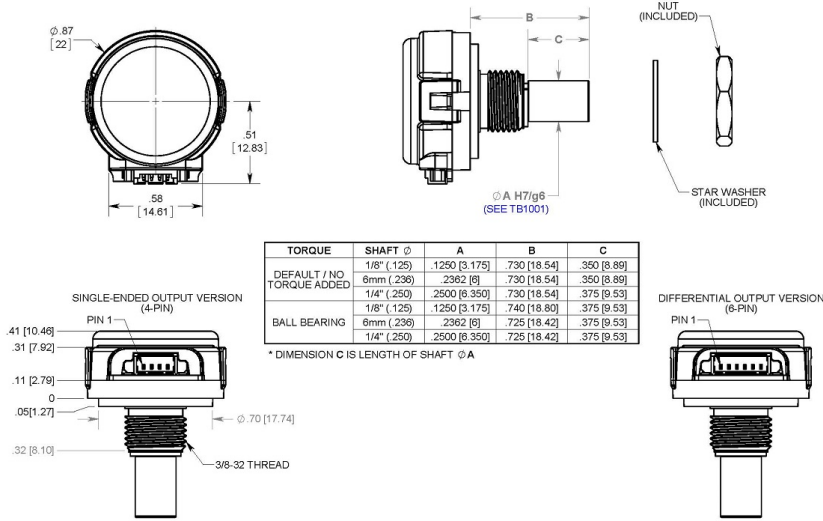


### Features

‣ Small size
‣ Low cost
‣ High retention snap-in polarized connector
‣ -20C to 100C operating temperature
‣ 100 to 360 cycles per revolution (CPR)
‣ 400 to 1440 pulses per revolution (PPR)
‣ 2 channel quadrature TTL square wave outputs

## 🗎 Mechanical Drawing

US DIGITAL

1400 NE 136th Avenue
Vancouver, Washington 98684, USA

info@usdigital.com
www.usdigital.com

Local: 360.260.2468
Toll-free: 800.736.0194

Rev. 160201115105

**S4T** Miniature Optical Shaft Encoder

RELEASE DATE: 01/20/2015

NUT
(INCLUDED)

Ø.87
[22]

.51
[12.83]

.58
[14.61]

B

C

STAR WASHER
(INCLUDED)

Ø A H7/g6
(SEE TB1001)

SINGLE-ENDED OUTPUT VERSION
(4-PIN)

PIN 1

.41 [10.46]
.31 [7.92]
.11 [2.79]
0
.05[1.27]
.32 [8.10]

Ø.70 [17.74]

3/8-32 THREAD

DIFFERENTIAL OUTPUT VERSION
(6-PIN)

PIN 1

| TORQUE | SHAFT Ø | 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 Ø **A**

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UNITS: INCHES [MM]
METRIC SHOWN FOR REFERENCE ONLY

## Environmental

| Parameter | Value | Units |
|---|---|---|
| Operating Temperature | -20 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/sec² | 250000 rad/sec² |
| Max. Shaft Speed | 100 rpm | 15000 rpm |
| Max. Shaft Torque | 0.5 ±0.2 in-oz (**D**-option) <br> 0.3 in-oz (**N**-option) | 0.05 in-oz |
| Max. Shaft Loading | 2 lbs. dynamic <br> 20 lbs. static | 1 lb. |
| Bearing Life | > 1,000,000 revolutions | $L_{10} = (22/F_r)^3$ * <br> Where $L_{10}$ = bearing life in millions of revs, and <br> $F_r$ = radial shaft loading in pounds |
| Weight | 0.48 oz. | 0.43 oz. |

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| Specification | Sleeve Bushing | Ball Bearing |
|---|---|---|
| Max. Shaft Total Indicated Runout | 0.0015 in. | 0.0015 in. |
| 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.

## Phase Relationship
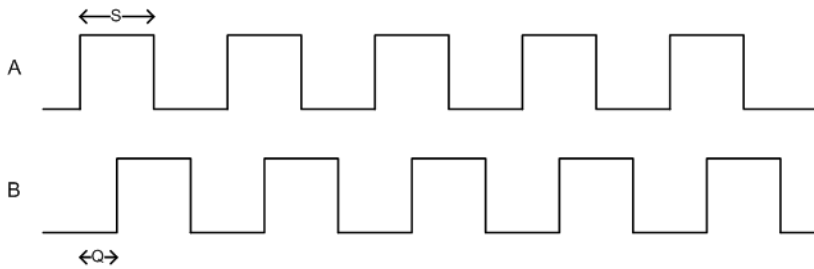


| Parameter | Min. | Typ. | Max. | Units |
|---|---|---|---|---|
| Symmetry, S | 105 | 180 | 255 | electrical degrees |
| Quadrature Delay, Q | 30 | 90 | 150 | electrical degrees |

(1) A leads B for clockwise shaft rotation, B leads A for counter clockwise shaft rotation viewed from the cover/label side of the encoder.

(2) Typical values represent the encoder performance at typical mounting alignment, whereas the maximum values represent the encoder performance across the range of recommended mounting tolerance.

## Single-ended Electrical

| Specifications | Min. | Typ. | Max. | Units | Notes |
|---|---|---|---|---|---|
| Supply Voltage | 4.5 | 5.0 | 5.5 | V | |
| Supply Current | | 25 | 30 | mA | no load |
| Low-level Output | | | 0.4 | V | $I_{OL}$ = 8 mA |
| | | 0.035 | | V | no load |
| High-level Output | 2.4 | | | V | $I_{OH}$ = -8 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 | 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)**

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

**6-pin Differential (2)**

| Pin | Description |
|---|---|
| 1 | Ground |
| 2 | A channel |
| 3 | A- channel |
| 4 | +5VDC power |
| 5 | B channel |
| 6 | B- channel |

(1) 4-pin single-ended mating connector isCON-MIC4
(2) 6-pin differential mating connector isCON-MIC6

## Ordering Information

S4T - [ CPR ] - [ Shaft ] - [ Output ] - [ Torque ]

| CPR | Shaft | Output | Torque | Notes |
|---|---|---|---|---|
| 100 | 125 = *1/8" diameter* | S = *Single Ended* | D = *Default* | ‣ For ordering information please see the Compatible Cables / Connectors section above. |
| 108 | | D = *Differential* | B = *Ball Bearing* | |
| 120 | 236 = *6mm diameter* | | N = *Light Static Drag* | ‣ US Digital warrants its products against defects in materials and workmanship for two years. See complete warranty for details. |
| 125 | | | | |
| 128 | 250 = *1/4" diameter* | | | |
| 200 | | | | |
| 250 | | | | |
| 256 | | | | |
| 300 | | | | |
| 360 | | | | |