# S4 MINIATURE OPTICAL SHAFT ENCODER

## S4 Features

- Miniature size
- Low High retention snap-in polarized connector
- Tracks from 0 to 30,000 cycles/sec
- Ball-bearing option tracks up to 10,000 RPM
- Wide operating temperatures
- 100 to 360 cycles per revolution (CPR)
- 400 to 1,440 pulses per revolution (PPR)
- 2 channel quadrature TTL squarewave outputs

**The S4 is no longer available for purchase.**

The S4 is no longer available for purchase, and has been replaced by our recently released S4T *(/products/encoders/incremental/shaft/s4t/)*. The S4T is a redesigned, enhanced version of the S4, and is already available for purchase.

## S4 Product Description

The S4 miniature 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 without index. The encoder utilizes a mylar disk, metal shaft, and bushing or bearing. It operates from a single +5VDC supply.

The S4 encoder is available with ball bearings for motion control applications or static drag to feel like a potentiometer for the front-panel manual interface.

The reflective sensor incorporates an LED light source and a monolithic photodetector with signal shaping electronics, providing two-channel bounceless quadrature TTL outputs.

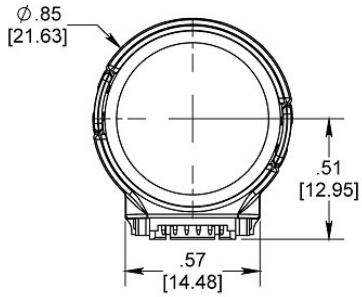
You can connect the S4 by using a high retention 4 conductor snap-in polarized 1.25mm pitch connector. The mating connector is polarized and should attach smoothly to the encoder; do not force. See below for Cables & Connectors.

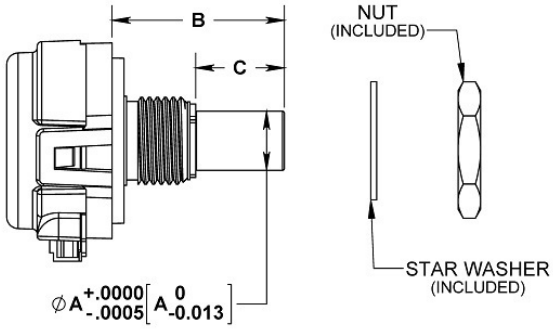
**Please note:** On January 16, 2012, US Digital modified the S4 part number. The S4 optical encoder is now offered with a differential output option; thus, we changed the S4 part number to accommodate either the *single-ended* or *differential* output options. The S4 part number also has a place holder added for a possible future index option. The index option is currently unavailable, and there is no projected date at which it will be made available. We also removed the current "Power" option for the S4 from the part number. The power option is very rarely selected and therefore is being eliminated from the S4 part number.

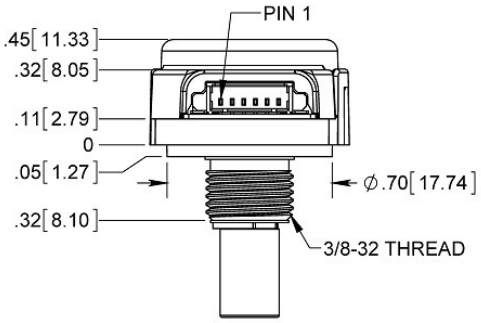
## Mechanical Drawings

**S4** Differential Miniature Optical Shaft Encoder

RELEASE DATE: 12/09/2011




| Torque | Shaft Ø | A | B | C |
|---|---|---|---|---|
| Default / No Torque Added | 1/8" (.125) | .1250 [3.175] | .725 [18.42] | .350 [8.89] |
| | 6mm (.236) | .2361 [6] | .725 [18.42] | .350 [8.89] |
| | 1/4" (.250) | .2500 [6.350] | .725 [18.42] | .375 [9.53] |
| Ball Bearing | 1/8" (.125) | .1250 [3.175] | .740 [18.80] | .375 [9.53] |
| | 6mm (.236) | .2361 [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**

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

UNITS: INCHES [MM]
METRIC SHOWN FOR REFERENCE ONLY

## Specifications

### ENVIRONMENTAL

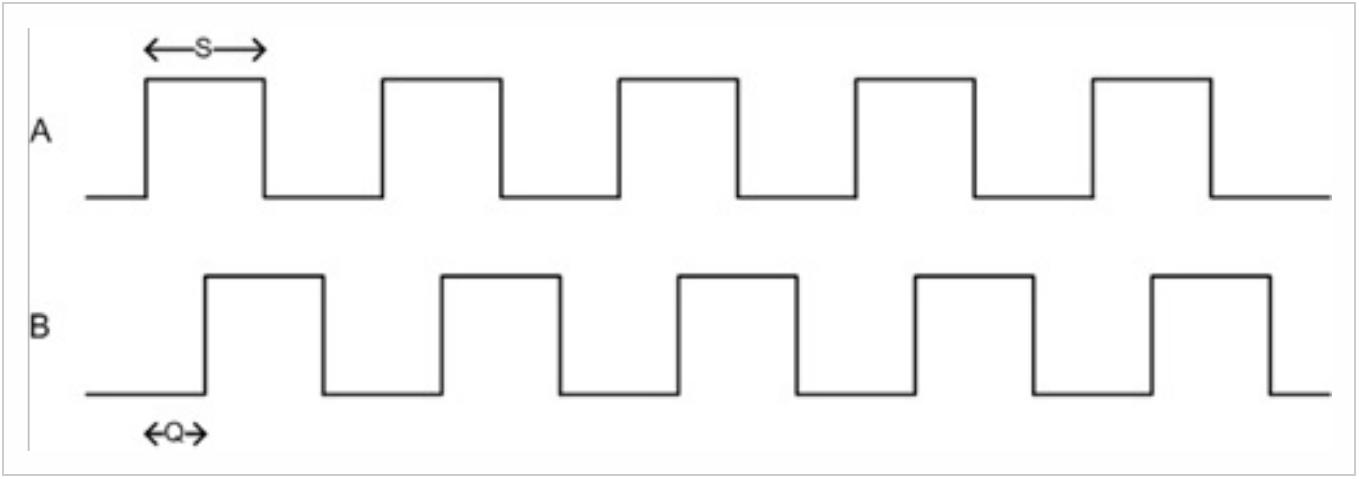
| PARAMETER | VALUE | UNITS |
|---|---|---|
| Vibration (5Hz to 2kHz) | 20 | G |
| Operating Temperature | -20 to 100 | C |
| Electrostatic Discharge, IEC 61000-4-2<br>Single-ended (**S**-option)<br>Differential (**D**-option) | <br>± 3<br>± 15 | <br>kV |

## 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 | 0.46 oz. | 0.42 oz. |
| 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 *(https://www.usdigital.com/support/resources/reference/technical-docs/technical-bulletins/shaft-and-bore-tolerances-tb1001/)* |

* only valid with negligible axial shaft loading.

## PHASE RELATIONSHIP




| PARAMETER | TYP. | MAX. | UNITS |
|---|---|---|---|
| Symmetry, S | 180 ± 16 | 180 ± 75 | electrical degrees |
| Quadrature Delay, Q | 90 ± 10 | 90 ± 60 | electrical degrees |

(1) B leads A for clockwise shaft rotation, and A leads B for counterclockwise rotation viewed from the shaft 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 | | 21 | 27 | mA | no load |
| Low-level Output | | | 0.4 | V | $I_{OL}$ = 6 mA |
| High-level Output | 2.4 | | | V | $I_{OH}$ = -1 mA |
| Rise Time | | 500 | | ns | CL = 25 pF, RL = 2.7 kΩ |
| Fall Time | | 100 | | ns | |

## DIFFERENTIAL ELECTRICAL

| SPECIFICATIONS | MIN. | TYP. | MAX. | UNITS | NOTES |
|---|---|---|---|---|---|
| Supply Voltage | 4.5 | 5.0 | 5.5 | V | |
| Supply Current | | 23 | 29 | mA | no 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/CON-MIC4)*
(2) 6-pin differential mating connector is CON-MIC6 *(https://www.usdigital.com/products/CON-MIC6)*

## PRODUCT CHANGE NOTIFICATIONS

| Title | Date | Description | Download |
|---|---|---|---|
| E4, E4P, S4 - PCN 5741 | 05/09/2016 | As part of our on-going product lifecycle management process, we have identified products that will be transitioned to an "End-of-Life" status. Products targeted for end-of-life may be available for a last time buy option prior to being made obsolete, however quantities are limited and special requirements may apply. | Download *(https://www.usdigital.com/support/resources/product-change-notifications/pcn-5741-e4-e4p-and-s4/)* |
| E4 - E4P - S4 Update - PCN 1014 | 11/29/2011 | We have modified the E4, E4P and S4 product lines in order to improve the performance and durability of the encoder. Changes include new molds for the plastic base and cover parts with an over-molded bushing in the S4 base, a new SMT connector (compatible with current mating connector), and a modified PCB profile to accommodate the new connector and plastic part modifications. | Download *(https://www.usdigital.com/support/resources/product-change-notifications/pcn-1014-e4-e4p-s4-update/)* |

# Notes

- 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.