

S5 Features

- Small size
- 32 to 5,000 CPR (128 to 20,000 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



S5 Product 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 ideal for front panel human interface applications.

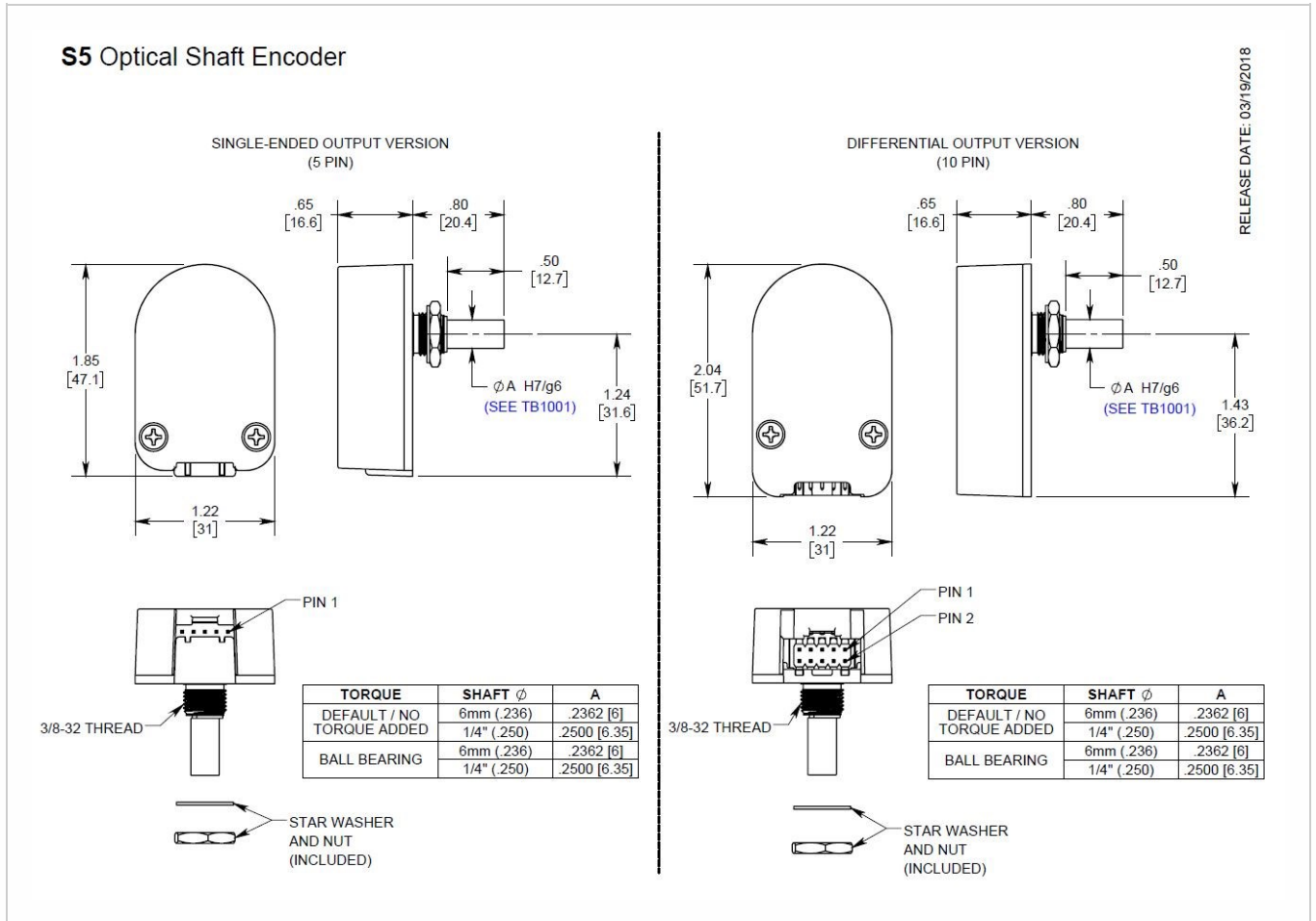
The *no torque added* option has a sleeve bushing that does not intentionally add torque for low RPM applications where a small amount of torque is acceptable.

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 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 150 Ω resistor in series with a .0047 μ F capacitor placed across each differential pair. The capacitor conserves power; otherwise, power consumption would increase by approximately 20mA per pair or 60mA for 3 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 | ± 4 | |
| Differential (D, L option), Human Body Model | ± 2 | |
| High-Voltage, Open-collector (H, C option), IEC 61000-4-2 | ± 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 ² | 250000 rad/sec ² |
| 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) | 1.01 oz. | 1.15 oz. |
| Differential (D option) | 1.28 oz. | 1.42 oz. |
| High-Voltage, Open-Collector (H, C option) | 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 (https://www.usdigital.com/support/resources/reference/technical-docs/technical-bulletins/shaft-and-bore-tolerances-tb1001/) |

* 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 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/>) or 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 < 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 | $I_{OL} = 8mA$ max., CPR < 2000 |
| | | | 0.5 | V | $I_{OL} = 5mA$ max., CPR \geq 2000 |
| | | 0.25 | | V | no load, CPR \geq 2000 |
| High-level Output | 2.0 | | | V | $I_{OH} = -8mA$ max. and CPR < 2000 |
| | 2.0 | | | V | $I_{OH} = -5mA$ 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 |
| Output Fall Time | | 100 | | nS | CPR < 2000 |
| | | 50 | | nS | CPR \geq 2000, $\pm 5mA$ load |

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 < 500, no load |
| | | 56 | 65 | mA | CPR \geq 500 and < 2000, no load |
| | | 74 | 88 | mA | CPR \geq 2000, 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.

Configuration Options

| S5 | CPR (Cycles Per Revolution) | Shaft Diameter | Index | Output | Torque |
|----|-----------------------------|----------------|----------------|-------------------------------|-----------------------|
| | 32 | 236 (6mm) | IE (Index) | S (Single-Ended) | D (Default Torque) |
| | 50 | 250 (1/4") | NE (Non-Index) | H (Single-Ended High-Voltage) | B (Ball Bearing) |
| | 96 | | | D (Differential) | N (Light Static Drag) |
| | 100 | | | | |
| | 192 | | | | |
| | 200 | | | | |
| | 250 | | | | |
| | 256 | | | | |
| | 360 | | | | |
| | 400 | | | | |
| | 500 | | | | |
| | 512 | | | | |
| | 540 | | | | |
| | 720 | | | | |
| | 800 | | | | |
| | 900 | | | | |
| | 1000 | | | | |
| | 1024 | | | | |
| | 1250 | | | | |
| | 2000 | | | | |
| | 2048 | | | | |
| | 2500 | | | | |
| | 4000 | | | | |
| | 4096 | | | | |
| | 5000 | | | | |

PLEASE NOTE: This chart is for informational use only. Certain product configuration combinations are not available. Visit the S5 product page (<https://www.usdigital.com/products/S5>) for pricing and additional information.