Description

The E5 Series rotary encoder has a rugged glass-filled polymer enclosure with either a 5-pin or 10-pin latching connector. This optical incremental encoder is designed to easily mount to and dismount from an existing motor shaft to provide digital feedback information.

The internal components consist of a mylar disk mounted to a precision machined aluminum hub and an encoder module. The module contains a highly collimated solid state light source and monolithic phased array sensor, which together provide a system extremely tolerant to mechanical misalignments.

The single-ended output version (S-option) is typically used with cables of 10 feet or less. For longer cable lengths, the differential output version (D-option) is recommended.

Attachment of the base to a surface may be accomplished by utilizing one of several machine screw bolt circle options. Positioning of the base to the centerline of a shaft is ensured by use of a centering tool (sold separately). The cover is securely attached to the base with two 4-40 flat head screws to provide a resilient package protecting the internal components.

A secure connection to the E5 Series encoder is made through a 5-pin (single-ended versions) or 10-pin (differential versions) latching connector. The mating connectors are available from US Digital with several cable options and lengths.

Avago Replacements:

US Digital's E5 encoder may now be used as a replacement for Avago HEDL-5500, HEDL-5600.

Features

- Quick, simple assembly and disassembly
- Rugged screw-together housing
- Positive latching connector
- Accepts .010” axial shaft play
- 32 to 5000 cycles per revolution (CPR)
- 128 to 20000 pulses per revolution (PPR)
- 2 channel quadrature TTL squarewave outputs
- Optional index (3rd channel)
- Mounting compatibility with HEDS-5500
**Single-Ended**

**E5 Single-Ended Optical Kit Encoder (Default)**

- Single-ended single-ended encoder with various dimensions and tolerances.

**Base & Cover Options**

**E5 Optical Kit Encoder Base & Cover Options**

- Base with various configurations:
  - A: Option Base (Alignment Boss)
  - G: Option Base (1812 Mounting)
  - R: Option Base (Rotational Mounting)
  - T: Option Base (Adhesive Mounting)

- Cover options:
  - Option Cover (Extension for Shaft Lengths Up to 750 [19.05])
  - Option Cover (Cover Hole for Shaft Lengths Over 750 [19.05])

**Dimensions and Tolerances**

- Various dimensions and tolerances are provided for the encoder and base options.

**FAQ**

- Q: What is the maximum shaft length for the E5 encoder?
  - A: The maximum shaft length for the E5 encoder is 750 [19.05] for bases and covers.

**Contact Information**

- 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

**RoHS Compliant**

- The E5 encoder is RoHS compliant.
### Environmental

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating Temperature, CPR &lt; 2000</td>
<td>-40 to 100</td>
<td>C</td>
</tr>
<tr>
<td>Operating Temperature, CPR ≥ 2000</td>
<td>-25 to 100</td>
<td>C</td>
</tr>
<tr>
<td>Vibration (5Hz to 2kHz)</td>
<td>20</td>
<td>G</td>
</tr>
<tr>
<td>Electrostatic Discharge</td>
<td>± 4</td>
<td>kV</td>
</tr>
<tr>
<td>Single-ended (-S version), IEC 61000-4-2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Differential (-D, -L version), Human Body Model</td>
<td>± 2</td>
<td></td>
</tr>
</tbody>
</table>

### Mechanical

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. Shaft Axial Play</td>
<td>±0.010</td>
<td>in.</td>
</tr>
<tr>
<td>Max. Shaft Eccentricity Plus Radial Play (1)</td>
<td>0.004</td>
<td>in.</td>
</tr>
<tr>
<td>Max. Acceleration</td>
<td>250000</td>
<td>rad/sec²</td>
</tr>
<tr>
<td>Parameter</td>
<td>Value</td>
<td>Units</td>
</tr>
<tr>
<td>-----------</td>
<td>-------</td>
<td>-------</td>
</tr>
<tr>
<td>For CPR &lt; 2000 Max. RPM (2) (300 kHz) e.x. CPR=1250, max. rpm=14400 e.x. CPR=100, max. rpm=60000</td>
<td>minimum value of ((18 x 10^6) / CPR) and (60000)</td>
<td>rpm</td>
</tr>
<tr>
<td>For CPR &gt;= 2000 and &lt; 4000 Max. RPM (2) (360 kHz)</td>
<td>minimum value of ((21.6 x 10^6) / CPR) and (60000)</td>
<td>rpm</td>
</tr>
<tr>
<td>For CPR &gt;= 4000 Max. RPM (2) (720 kHz)</td>
<td>minimum value of ((43.2 x 10^6) / CPR) and (60000)</td>
<td>rpm</td>
</tr>
<tr>
<td>Typical Product Weight Single-ended (S-option) Differential (D-option, L-option)</td>
<td>0.82 0.91</td>
<td>oz.</td>
</tr>
<tr>
<td>Codewheel Moment of Inertia</td>
<td>8.0 x 10^-6</td>
<td>oz-in-s^2</td>
</tr>
<tr>
<td>Hub Set Screw</td>
<td>#4-48</td>
<td></td>
</tr>
<tr>
<td>Hex Wrench Size</td>
<td>0.050</td>
<td>in.</td>
</tr>
<tr>
<td>Encoder Base Plate Thickness</td>
<td>0.135</td>
<td>in.</td>
</tr>
<tr>
<td>3 Mounting Screw Size</td>
<td>#0-80</td>
<td></td>
</tr>
<tr>
<td>2 Mounting Screw Size</td>
<td>#2-56 or #4-40</td>
<td></td>
</tr>
</tbody>
</table>
Parameter | Value | Units
--- | --- | ---
3 Screw Bolt Circle Diameter | 0.823 ± 0.005 | in.
2 Screw Bolt Circle Diameter | 0.750 ± 0.005 | in.
Required Shaft Length (3) With E-option (3) | 0.445 to 0.570 | in.
With H-option (3) | 0.445 to 0.750 | in.
> 0.445 |
Index Alignment to Hub Set Screw | 180 Typical | mechanical degrees

Technical Bulletin TB1001 - Shaft and Bore Tolerances Download

(1) Position inaccuracy is proportional to shaft radial play.

(2) 60000 rpm is the maximum rpm due to mechanical considerations. The maximum RPM due to the module's maximum frequency response is dependent upon the module's resolution (CPR). For resolutions of 32 to 1999 CPR the frequency response is 300 kHz, 2000 to 3999 CPR the frequency response is 360 kHz and 4000 CPR and greater the frequency response is 720 kHz.

(3) Add 0.125" to the required shaft length when using R-option.

### Torque Specifications

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Torque</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hub Set Screw to Shaft</td>
<td>2-3 in-lbs</td>
</tr>
<tr>
<td>Cover (4-40 screws through cover into base)</td>
<td>2-4 in-lbs</td>
</tr>
<tr>
<td>Base to Mounting Surface</td>
<td>4-6 in-lbs</td>
</tr>
<tr>
<td>Base to Mounting Adapter Plate</td>
<td>4-6 in-lbs</td>
</tr>
<tr>
<td>Adapter Plate to Mounting Surface</td>
<td>4-6 in-lbs</td>
</tr>
<tr>
<td>Module to Base</td>
<td>3.5-4 in-lbs</td>
</tr>
</tbody>
</table>

### Phase Relationship

**Single-Ended (S) / Differential (D) Option:**
A leads B for clockwise shaft rotation, and B leads A for counterclockwise rotation as viewed from the cover side of the encoder.

**Broadcom/Avago compatible pin-out (L) Option:**
B leads A for clockwise shaft rotation, and A leads B for counterclockwise rotation as viewed from the cover side of the encoder.

### Single-ended Electrical

› Specifications apply over entire operating temperature range.
› Typical values are specified at Vcc = 5.0Vdc and 25 °C.
› For complete details, see the EM1 or EM2 product pages.
### Parameter

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Units</th>
<th>Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply Voltage</td>
<td>4.5</td>
<td>5.0</td>
<td>5.5</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Supply Current</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>27</td>
<td>33</td>
<td>mA</td>
<td>CPR &lt; 500, no load</td>
<td></td>
</tr>
<tr>
<td></td>
<td>54</td>
<td>62</td>
<td>mA</td>
<td>CPR &gt; 500 and &lt; 2000, no load</td>
<td></td>
</tr>
<tr>
<td></td>
<td>72</td>
<td>85</td>
<td>mA</td>
<td>CPR &gt; 2000, no load</td>
<td></td>
</tr>
<tr>
<td>Low-level Output</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.5</td>
<td></td>
<td>V</td>
<td>IOL = 8mA max., CPR &lt; 2000</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.5</td>
<td></td>
<td>V</td>
<td>IOL = 5mA max., CPR &gt; 2000</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.25</td>
<td></td>
<td>V</td>
<td>no load, CPR &gt; 2000</td>
<td></td>
</tr>
<tr>
<td>High-level Output</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.0</td>
<td></td>
<td>V</td>
<td>IOH = -8mA max. and CPR &lt; 2000</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.0</td>
<td></td>
<td>V</td>
<td>IOH = -5mA max. and CPR &gt; 2000</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4.8</td>
<td></td>
<td>V</td>
<td>no load and CPR &lt; 2000</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3.5</td>
<td></td>
<td>V</td>
<td>no load and CPR &gt; 2000</td>
<td></td>
</tr>
<tr>
<td>Output Current Per Channel</td>
<td></td>
<td></td>
<td></td>
<td>mA</td>
<td></td>
</tr>
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<td></td>
<td>-8</td>
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<td>8</td>
<td>CPR &lt; 2000</td>
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<tr>
<td></td>
<td>-5</td>
<td></td>
<td>5</td>
<td>CPR &gt; 2000</td>
<td></td>
</tr>
<tr>
<td>Output Rise Time</td>
<td></td>
<td></td>
<td></td>
<td>nS</td>
<td></td>
</tr>
<tr>
<td></td>
<td>110</td>
<td></td>
<td>nS</td>
<td>CPR &lt; 2000</td>
<td></td>
</tr>
<tr>
<td></td>
<td>50</td>
<td></td>
<td>nS</td>
<td>CPR &gt; 2000, ± 5mA load</td>
<td></td>
</tr>
<tr>
<td>Output Fall Time</td>
<td></td>
<td></td>
<td></td>
<td>nS</td>
<td></td>
</tr>
<tr>
<td></td>
<td>100</td>
<td></td>
<td>nS</td>
<td>CPR &lt; 2000</td>
<td></td>
</tr>
<tr>
<td></td>
<td>50</td>
<td></td>
<td>nS</td>
<td>CPR &gt; 2000, ± 5mA load</td>
<td></td>
</tr>
</tbody>
</table>

### Differential Electrical

- Specifications apply over entire operating temperature range.
- Typical values are specified at Vcc = 5.0Vdc and 25 °C.
- For complete details, see the EM1 or EM2 product pages.

### Pin-outs

1400 NE 136th Avenue
Vancouver, Washington 98684, USA
info@usdigital.com
www.usdigital.com
Local: 360.260.2468
Toll-free: 800.736.0194

Rev. 181003091231
<table>
<thead>
<tr>
<th>5-pin Single-Ended (1)</th>
<th>10-pin Differential, Standard (2)</th>
<th>10-pin Differential, L-option (2,3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pin</td>
<td>Description</td>
<td>Pin</td>
</tr>
<tr>
<td>1</td>
<td>Ground</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>Index</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>A channel</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>+5VDC power</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>B channel</td>
<td>5</td>
</tr>
<tr>
<td>6</td>
<td>A+ channel</td>
<td>6</td>
</tr>
<tr>
<td>7</td>
<td>+5VDC power</td>
<td>7</td>
</tr>
<tr>
<td>8</td>
<td>+5VDC power</td>
<td>8</td>
</tr>
<tr>
<td>9</td>
<td>B- channel</td>
<td>9</td>
</tr>
<tr>
<td>10</td>
<td>B+ channel</td>
<td>10</td>
</tr>
</tbody>
</table>

(1) 5-pin single ended mating connector is CON-FC5.
(2) 10-pin differential mating connector is CON-FC10.
(3) Broadcom / Avago compatible version.

**Accessories**

1. **Centering Tool**

   **Part #:** CTOOL - (Shaft Diameter)
   **Description:** This reusable tool provides a simple method for accurately centering the E5 base onto the shaft. It is recommended for the following situations:
   - When using mounting screws smaller than #4-40.
   - When the position of the mounting holes is in question.
   - When using the 3-hole mounting pattern.
   - When using the T-option transfer adhesive.

   **Instructions:** When mounting encoder base, slide centering tool down shaft until it slips into centering hole of encoder base. Tighten mounting screws, then remove centering tool.

2. **Hex Tool**

   Depending on the order packaging option, either a hex driver or hex wrench is included.

   **Part #:** HEXD-050
   **Description:** Hex driver, 0.050” flat-to-flat for #3-48 or #4-48 set screws. Only included with -B or -1 packaging options.

   **Part #:** HEXW-050
   **Description:** Hex wrench, .050” flat-to-flat for #3-48 or #4-48 set screws. Only included with -2 or -3 packaging options.

3. **Spacer Tool**

   A spacer tool is included for all packaging options.
Part #: SPACER-E5

4. Screws

Screws for base mounting must be purchased separately. Screws for mounting the housing to the base are included.

Part #: SCREW-080-250-PH
Description: Pan Head, Philips #0-80 UNF x 1/4"
Quantity Required for Mounting: 3 per encoder

Part #: SCREW-256-250-PH
Description: Pan Head, Philips #2-56 UNC x 1/4"
Quantity Required for Mounting: 2 per encoder

Part #: SCREW-440-250-PH
Description: Pan Head, Philips #4-40 UNC x 1/4"
Quantity Required for Mounting: 2 per encoder

Output Waveforms

Assembly Instructions

E5 Assembly Instructions - http://usdigital.com/assets/assembly/E5%20Assembly%20Instructions.pdf

Ordering Information

E5 -
### CPR
- 32 = 50
- 50 = 96
- 100 = 192
- 200 = 250
- 256 = 360
- 360 = 400
- 500 = 512
- 512 = 540
- 720 = 900
- 900 = 1000
- 1024 = 1250
- 2000 = 2048
- 2500 = 315
- 4000 = 4096
- 5000 =

### Bore
- 079 = 2mm
- 118 = 3mm
- 125 = 1/8"
- 156 = 5/32"
- 157 = 4mm
- 188 = 3/16"
- 197 = 5mm
- 236 = 6mm
- 250 = 1/4"
- 276 = 7mm
- 313 = 5/16"
- 315 = 8mm
- 375 = 3/8"
- 394 = 10mm

### Index
- NE = No Index
- IE = Index

### Output
- S = Single-ended
- D = Differential
- L = Avago/Agilent compatible pin-out

### Cover
- D = Default
- E = Cover Extension
- H = Hole in Cover

### Base
- D = Default
- 3 = Base
- 5 = Base
- 6 = Base
- 7 = Base
- 10 = Base
- 10 = Base
- 12 = Base
- 14 = Base
- 16 = Base
- 18 = Base
- 20 = Base
- 22 = Base
- 24 = Base
- 26 = Base
- 28 = Base
- 30 = Base
- 32 = Base
- 34 = Base
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- 330 = Base
- 332 = Base
- 334 = Base
- 336 = Base
- 338 = Base
- 340 = Base
- 342 = Base
- 344 = Base
- 346 = Base
- 348 = Base
- 350 = Base
- 352 = Base
- 354 = Base
- 356 = Base
- 358 = Base
- 360 = Base

### Notes
- Cables and connectors are not included and must be ordered separately.
- US Digital® warrants its products against defects in materials and workmanship for two years. See completewarranty for details.