Description:
The E6D is a high resolution differential rotary encoder with a molded polycarbonate enclosure, which utilizes a finger-latching 10-pin connector. This optical incremental encoder is designed to easily mount to and dismount from an existing shaft to provide digital feedback information.

The E6D is easy to add to existing applications and only consists of four main components; base, cover, hub/code wheel, optical encoder module and internal differential line driver.

The base and cover are both constructed of rugged 20% glass filled polycarbonate. 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.

The internal components consist of a shatterproof mylar disk mounted to a precision machined aluminum hub and an encoder module. The hub is available for diameters up to 1”. The module consists of a highly collimated solid state light source and monolithic phased array sensor, which together provide a system extremely tolerant to mechanical misalignments.

The internal differential line driver (26C31) can source and sink 20mA at TTL levels. The recommended receiver is industry standard 26C32. Maximum noise immunity is achieved when the differential receiver is terminated with a 110 ohm resistor in series with a .0047uf capacitor placed across each differential pair. The capacitor simply conserves power; otherwise power consumption would increase by approximately 20mA per pair, or 60mA for 3 pairs.

Connection to the E6D product is made through a 10-pin finger-latching connector (sold separately) and provides a secure connection to the E6D. The mating connectors are available from US Digital with several cable options and lengths.

Features:
- Quick, simple assembly and disassembly
- Rugged screw-together housing
- Low cost
- Optional Agilent compatible pin-out
- Accepts ±.010” axial shaft play
- Small size
- Tracks from 0 to 100,000 cycles/sec
- Differential line driver outputs
- 64 to 2500 cycles per revolution (CPR)
- 256 to 10,000 pulses per revolution (PPR)
- 2 channel quadrature TTL squarewave outputs
- Optional index (3rd channel)
- -40 to +100°C operating temperature
- Fits shaft diameters 2mm to 1”
- Single +5V supply
- Flush back or through shaft hole
- US Digital warrants its products against defects in materials and workmanship for two years. See complete warranty for details.

Mechanical Drawing:

Pin-outs:

<table>
<thead>
<tr>
<th>Pin</th>
<th>Standard</th>
<th>Agilent (L-option)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ground</td>
<td>No connection</td>
</tr>
<tr>
<td>2</td>
<td>Ground</td>
<td>+5VDC power</td>
</tr>
<tr>
<td>3</td>
<td>Index-</td>
<td>Ground</td>
</tr>
<tr>
<td>4</td>
<td>Index+</td>
<td>No connection</td>
</tr>
<tr>
<td>5</td>
<td>A- channel</td>
<td>A- channel</td>
</tr>
<tr>
<td>6</td>
<td>A+ channel</td>
<td>A+ channel</td>
</tr>
<tr>
<td>7</td>
<td>+5VDC power</td>
<td>B- channel</td>
</tr>
<tr>
<td>8</td>
<td>+5VDC power</td>
<td>B+ channel</td>
</tr>
<tr>
<td>9</td>
<td>B- channel</td>
<td>Index-</td>
</tr>
<tr>
<td>10</td>
<td>B+ channel</td>
<td>Index+</td>
</tr>
</tbody>
</table>
Assembly Instructions (shafts <= .394"):

1. **Base Mounting:**
   Secure base to mounting surface using two or three screws (sold separately). If a centering tool is used, slide centering tool down shaft until it slips into centering hole of encoder base. Tighten mounting screws, then remove centering tool.

2. **Spacer Installation:**
   Place spacer tool around shaft, flat on base.

3. **Hub/Disk Assembly Installation:**
   Slip hub over shaft until it bottoms out against spacer tool. Tighten set screw with hex wrench provided while pressing down on hub. Remove spacer tool.

4. **Encoder Module Installation:**
   Orient module with thin part of module toward top. Slide module from front to back, being careful not to damage disk. Stop when two alignment pins on base fit into holes of module. Secure with two 4-40 1/2" pan head screws (supplied).

5. **Cover Installation:**
   Place cover over assembly and secure with two 4-40 5/8" flat head screws (supplied).

Assembly Instructions (shafts > .394"):

1. **Base Mounting:**
   Secure base to mounting surface using two or three screws (sold separately). If a centering tool is used, slide centering tool down shaft until it slips into centering hole of encoder base. Tighten mounting screws, then remove centering tool.

2. **Spacer Installation:**
   Push spacer tool onto bottom section of hub/disk assembly. Make sure spacer tool snaps only on lower part of hub.

3. **Hub/Disk Assembly Installation:**
   Slip hub over shaft until it bottoms out against spacer tool. Make sure spacer tool clears mounting screws on base. Tighten both set screws with hex wrench provided while pressing down on hub. Remove spacer tool.

4. **Encoder Module Installation:**
   Orient module with thin part of module toward the top. Slide module from front to back, being careful not to damage disk. Stop when two alignment pins on base fit into holes of module. Secure with two 4-40 1/2" pan head screws (supplied).

5. **Cover Installation:**
   Place cover over assembly and secure with two 4-40 5/8" flat head screws (supplied).
E6D Differential Optical Kit Encoder

3-option:
3-option makes all five of these hole diameters .125".

E-option:
The E-option provides a cylindrical extension to the housing cover allowing for longer shafts of up to .750". This option is only for shaft diameters < .472".

H-option:
The H-option adds a hole to the housing for the shaft to pass through.

- Shafts 2mm to 5mm, a .203" diameter hole is supplied.
- Shafts 6mm to 1/4", a .295" diameter hole is supplied.
- Shafts 5/16" to 10mm, a .438" diameter hole is supplied.
- Shafts 12mm to 14mm, a .594" diameter hole is supplied.
- Shafts 5/8" to 3/4", a .797" diameter hole is supplied.
- Shaft 1", a 1.047" diameter hole is supplied.

T-option:
When mounting holes are not available, a pre-applied transfer adhesive (with peel-off backing) is available for "stick-on" mounting. Use the centering tool (sold separately) to slide the base into position. T-option specifies transfer adhesive on the standard mounting base.

Instructions: To use transfer adhesive, peel off paper backing and slip tool into center hole of base and slide both down shaft as one piece. Press to form a good bond, then slip tool off and continue with standard mounting instructions. A centering tool is highly recommended when using this option.

M-option:
4 - .125 holes on Φ3.0 Bolt Circle
These adapter plates are for mounting to a 3" diameter bolt circle. Use two 4-40 x 1/4" screws (sold separately) to attach the E6D base to the plate. Comes attached when ordered with encoder (see options below).
E6D Differential Optical Kit Encoder

Accessories:

Centering Tool:
This reusable tool provides a simple method for accurately centering the E6D base to 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 T-option transfer adhesive.
- When using the 3-option base.

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.

Base Mounting Screws:
- SCREW-184 (qty. 3) Price: $0.25
  080 x 1/4"
- SCREW-176 (qty. 2) Price: $0.25
  256 x 1/4"
- SCREW-290 (qty. 2) Price: $0.25
  4-40 x 1/4"

> Quantity shown are required for mounting.

Hex Tools:
- HEXD-3404 Price: $5.00
  Hex driver, .050” flat-to-flat for 3-48 or 4-48 set screws.
- HEXW-349 Price: $0.50
  Hex wrench, .050” flat-to-flat for 3-48 or 4-48 set screws.

Spacer Tools:
- SPACER-265 Price: $1.50
  For shaft sizes <=.394”.
- SPACER-260 Price: $3.00
  For shaft sizes .472 or .500”.
- SPACER-555 Price: $3.00
  For shaft sizes >=.551”.

Disk Optics:
Be sure to keep different diameters, resolutions and options separated. The resolution of the optoelectronic modules and the code wheels must match. Index and non-index parts cannot be mixed since the optical patterns are different. An identifier is stamped on each optoelectronic module.

For Agilent Modules (HEDS):
The 2-channel (non-index) version can be identified by a 9100 or 9200. The 3-channel (index) version can be identified by a 9140. One letter specifies the resolution as shown in the table below.

For US Digital Modules (EM1):
Only available in 3-channel (index) version and are identified by a 2 for 2” disk. The second number indentifies the resolution as shown in the table below (in italics).

Absolute Maximum Ratings:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Max.</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vibration (5 to 2kHz)</td>
<td>20</td>
<td>g</td>
</tr>
<tr>
<td>Shaft Axial Play</td>
<td>±0.01</td>
<td>in.</td>
</tr>
<tr>
<td>Shaft Eccentricity Plus Radial Play</td>
<td>0.004</td>
<td>in.</td>
</tr>
<tr>
<td>Acceleration</td>
<td>250,000</td>
<td>rad/sec²</td>
</tr>
</tbody>
</table>

> Note that radial play translates directly to position inaccuracy.

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>2-3 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 (4-40 screws)</td>
<td>4-6 in.-lbs.</td>
</tr>
<tr>
<td>Adapter Plate to Mounting Surface (6-32 screws)</td>
<td>6-8 in.-lbs.</td>
</tr>
</tbody>
</table>

Disk

<table>
<thead>
<tr>
<th>Standard</th>
<th>Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>64</td>
<td>2-64</td>
</tr>
<tr>
<td>100</td>
<td>S</td>
</tr>
<tr>
<td>200</td>
<td>C</td>
</tr>
<tr>
<td>400</td>
<td>E</td>
</tr>
<tr>
<td>512</td>
<td>A</td>
</tr>
<tr>
<td>1000</td>
<td>B</td>
</tr>
<tr>
<td>1024</td>
<td>J</td>
</tr>
<tr>
<td>1800</td>
<td>2-1800</td>
</tr>
<tr>
<td>2000</td>
<td>T</td>
</tr>
<tr>
<td>2048</td>
<td>U</td>
</tr>
<tr>
<td>2500</td>
<td>2-2500</td>
</tr>
</tbody>
</table>

1000 ne 34th circle • vancouver, washington 98682 USA
### Mechanical Specifications

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Dimension</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moment of Inertia</td>
<td>8.0 x 10^6</td>
<td>oz-in-s²</td>
</tr>
<tr>
<td>Hub Wrench Size</td>
<td>.050</td>
<td>in.</td>
</tr>
<tr>
<td>Encoder Base Plate Thickness</td>
<td>.135</td>
<td>in.</td>
</tr>
<tr>
<td>3 Mounting Screw Size</td>
<td>0-80</td>
<td>in.</td>
</tr>
<tr>
<td>2 Mounting Screw Size</td>
<td>2.56 or 4-40</td>
<td>in.</td>
</tr>
<tr>
<td>3 Screw Bolt Circle Diameter</td>
<td>.323 ±.005</td>
<td>in.</td>
</tr>
<tr>
<td>2 Screw Bolt Circle Diameter</td>
<td>.750 ±.005</td>
<td>in.</td>
</tr>
</tbody>
</table>

- Required Shaft Length: .445 to .570** in.
- With E-option*: .445 to .750** in.
- With H-option**: >=.445** in.

- Weight: 1.69 oz.

** Only for shaft diameters <.472".
* Add .125" to the required shaft length when using the M-option.

### Electrical Specifications:

<table>
<thead>
<tr>
<th>Specification</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Units</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply</td>
<td>4.5</td>
<td>5.0</td>
<td>5.5</td>
<td>Volts</td>
<td></td>
</tr>
</tbody>
</table>

- Current Consumption
  - Index - 64 CPR: - 28 53 mA No load
  - Index - 1800, 2500 CPR: - 56 59 mA No load
  - Index - All Other Resolutions: - 58 88 mA No load
  - Non-index <2000 CPR: - 18 43 mA No load
  - Non-index >=2000 CPR: - 58 88 mA No load

- Output Voltage
  - Sourcing to +5: 2.4 3.4 Volts @ -20mA
  - Sinking to Ground: 0.2 0.4 Volts @ 20mA

### Compatible Cables & Connectors:

<table>
<thead>
<tr>
<th>Finger Latching</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Command</td>
<td>Connector on one end of a 6' shielded round cable</td>
</tr>
<tr>
<td>CA-4174-6FT</td>
<td>Same as CA-4174, but for L-option only</td>
</tr>
<tr>
<td>CA-3619-6FT</td>
<td>Connector on both ends of a 6' shielded round cable</td>
</tr>
<tr>
<td>CA-3807-6FT</td>
<td>Same as CA-3619, but for L-option only</td>
</tr>
</tbody>
</table>

**Attention:**
- Specify cable length when ordering.
- Custom cable lengths are available. See the Cables & Connectors data sheet for more information.

### Ordering Information:

- Price: $62.00 / 1
- Index/HiRes*: $71.30 / 1

- Price: $58.00 / 10
- Index/HiRes*: $66.70 / 10

- Price: $54.00 / 50
- Index/HiRes*: $62.10 / 50

- Price: $51.00 / 100
- Index/HiRes*: $58.65 / 100

- Price: $49.00 / 500
- Index/HiRes*: $56.35 / 500

- Price: $45.00 / 1K
- Index/HiRes*: $51.75 / 1K

### Phase Relationship:

A leads B for clockwise shaft rotation, and B leads A for counterclockwise rotation viewed from the cover/label side of the encoder (see the EM1 & HEDS data sheet).

### Notes:

- * Index / resolutions >=2000 CPR.
- ** Index option not available.
- *** 64, 1800, 2500 CPR only available with index.
- **** Not available for shaft diameter 12mm or higher.
- ***** A centering tool is highly recommended when using this option.

### Cost Modifiers:

- Add $6 for T-option transfer adhesive.
- Add $7 for M-option adapter plate.
- Add $12 for shaft diameters = 12mm, 1/2", 14mm or 5/8".
- Add $16 for shaft diameters = 3/4" or 1".
- Add $3 for PKG1-option packaging.
- Add $4 for PKG2-option packaging.
- Add $10 for PKG3-option packaging for 10mm or less.
- Add $13 for PKG3-option packaging for 12mm or higher.

### Packaging Options:

- (default) = Encoder components packaged in bulk. One spacer tool and one hex driver per 100 encoders.
- PKG1 = Each encoder packaged individually. One spacer tool and one hex driver per 100 encoders.
- PKG2 = Each encoder packaged individually with one spacer tool and one hex wrench per encoder.
- PKG3 = Each encoder packaged individually with one spacer tool, one hex wrench, and one centering tool per encoder.

### Important:

When a centering tool is needed it may be most cost effective to use the default packaging option and to order a centering tool separately. This is especially true when ordering a single encoder.

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All information subject to change without notice.

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