**FEATURES:**
- 1.5 Inch Diameter Kit (Frameless) Encoder
- True Absolute 24-Bit Position Output
- Accurate to <30 arcseconds RMS
- In-Situ Auto-Calibration
- Health and Status Diagnostic Reporting
- Radiation tolerant to 50 krad(Si) Co60

**APPLICATIONS:**
- Commercial Space Applications
- Low Earth Orbit
- CubeSats
- Miniature DC Motor
- Robotics

**DESCRIPTION:**

The Micro Kit Encoder, or MKE, is BEI Precision’s smallest flight-worthy optical encoder. This true-absolute optical encoder delivers high performance rotary sensing in a package well suited for CubeSats & small satellites. The code disk hub is customizable to fit small shafts <5 mm (3/16”), such as common DC motors. The electronic components are commercial grade, but specifically chosen to meet the environmental and radiation demands of low Earth orbit.

Like other encoders in the nanoSeries family, the MKE employs a long-life LED light source to illuminate our high-accuracy code disk. The code patterns constitute ratiometric tiers of advancing frequencies to create the high-resolution 24-bit contiguous angular position, all while maintaining positional stability over temperature and time.

FOR MORE INFORMATION CONTACT
SALES@BEIPRECISION.COM
<table>
<thead>
<tr>
<th>Specification</th>
<th>Units</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full Revolution Accuracy</td>
<td>arcsec RMS</td>
<td>-</td>
<td>30</td>
</tr>
<tr>
<td>Resolution - Quanta</td>
<td>Bits</td>
<td>24</td>
<td>-</td>
</tr>
<tr>
<td>Resolution - ENOB</td>
<td>Bits</td>
<td>18</td>
<td>-</td>
</tr>
<tr>
<td>Interrogation Rate</td>
<td>Hz</td>
<td>100</td>
<td>1000</td>
</tr>
<tr>
<td>Speed (operating)</td>
<td>RPM</td>
<td>0</td>
<td>1000</td>
</tr>
<tr>
<td>MTBF, MIL-HDBK-217 Parts Count</td>
<td>Hours</td>
<td>100000</td>
<td>-</td>
</tr>
<tr>
<td>Direction of Increasing Count</td>
<td>-</td>
<td>CCW</td>
<td></td>
</tr>
<tr>
<td>Input Voltage</td>
<td>VDC</td>
<td>4.3</td>
<td>5.7</td>
</tr>
<tr>
<td>Input Current</td>
<td>mA</td>
<td>-</td>
<td>50</td>
</tr>
<tr>
<td>ESD Sensitivity</td>
<td>V, HBM</td>
<td>8000</td>
<td>-</td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>°C</td>
<td>-40</td>
<td>+85</td>
</tr>
<tr>
<td>Storage Temperature</td>
<td>°C</td>
<td>-55</td>
<td>+90</td>
</tr>
<tr>
<td>Low-Outgassing Design</td>
<td>-</td>
<td>-</td>
<td>1.0% TML 0.1% CVCM</td>
</tr>
<tr>
<td>Total Ionizing Dose</td>
<td>krad</td>
<td>-</td>
<td>50</td>
</tr>
</tbody>
</table>

¹ Tested to this limit. Actual limit is much higher. Consult factory.
CONNECTOR PINOUT:

The standard nanoSeries® Micro Kit Encoder output connector is a 9-socket Micro-D Connector (M83513/04-A__N type) with the following pinout:

<table>
<thead>
<tr>
<th>Pin</th>
<th>MNEMONIC</th>
<th>I/O</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>+POS</td>
<td>Out</td>
<td>Position data output</td>
</tr>
<tr>
<td>6</td>
<td>-POS</td>
<td>Out</td>
<td>Position data output</td>
</tr>
<tr>
<td>3</td>
<td>+CMD</td>
<td>IN</td>
<td>Command word input</td>
</tr>
<tr>
<td>8</td>
<td>-CMD</td>
<td>IN</td>
<td>Command word input</td>
</tr>
<tr>
<td>2</td>
<td>+CLK</td>
<td>IN</td>
<td>Synchronous clock input</td>
</tr>
<tr>
<td>7</td>
<td>-CLK</td>
<td>IN</td>
<td>Synchronous clock input</td>
</tr>
<tr>
<td>4</td>
<td>+5 VDC</td>
<td></td>
<td>Supply Voltage</td>
</tr>
<tr>
<td>9</td>
<td>5V RTN</td>
<td></td>
<td>Supply Voltage return</td>
</tr>
<tr>
<td>5</td>
<td>CHAS</td>
<td></td>
<td>Chassis (case) ground</td>
</tr>
</tbody>
</table>

I/O: LVDS or RS422

OUTPUT PROTOCOL:

Figure 1.
Electrical Interface Timing Diagram (System)
Timing Values Per Table 1

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Min</th>
<th>TYP</th>
<th>Max</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Encoder Data Relevancy*</td>
<td>T_REL</td>
<td>43</td>
<td>45.5</td>
<td>48</td>
<td>µS</td>
</tr>
<tr>
<td>Encoder Interrogation Period</td>
<td>T_INT</td>
<td>1000</td>
<td>–</td>
<td>–</td>
<td>µS</td>
</tr>
<tr>
<td>Clock Frequency</td>
<td></td>
<td>1.5</td>
<td>2</td>
<td>2.5</td>
<td>MHz</td>
</tr>
</tbody>
</table>

*Although data is sampled within 45 µs (typ) of the CMD pulses, it is not shifted out until the next cycle

Table 1.
Electrical Interface Timing Values (See 190-0323-03 For Details)
**NOTES:**

1. See outline drawing 190-0343-01 for complete dimensional specifications and mounting interface recommendations.
2. Unbracketed dimensions are inches and bracketed [x.xxx] dimensions are millimeters.
3. BEI Precision can provide mounting plates to adapt stator interface to any existing hole pattern. Consult the factory for details.
4. Readhead mass: 50.3 + 1.35(L) grams max, L = cable length
   Disk hub mass: 10.8 grams max

Micro Kit Encoder

Optical Encoder > Absolute Kit Encoder > Micro Kit Encoder
INSTALLATION SEQUENCE

1. MOUNT HARDWARE

2. FULLY INSERT SHIM

3. RAISE DISK TO SHIM

4. REMOVE SHIM

5. INSTALL FRONT COVER

- MAX torque values:
  - 7.5 in-lb (0.85 N-m)
  - 3.8 in-lb (0.43 N-m)
ORDERING INFORMATION:

MKA 24 / 188 P1 M1 D1 L CS - 72

Resolution
Bits/ Turn

Shaft Diameter
188 = 3/16 inch
156 = 5/32 inch
125 = 1/8 inch
094 = 3/32 inch
50M = 5.0 mm
45M = 4.5 mm
40M = 4.0 mm
35M = 3.5 mm
30M = 3.0 mm
25M = 2.5 mm

Component Materials
M1 = Aluminum readhead, stainless steel disk hub

Input voltage
P1: 5 VDC

Serial Output Data Driver
D1 = LVDS
D2 = RS485

Product Assurance Level
Commercial, vacuum-compatible materials
Commercial, Space Assembly, TVAC bakeout

Cable Exit
L = Left Exit
R = Right Exit
T = Top exit

Cable Length
(4-72 inches in 1 inch increments)
72 = 72 inch
36 = 36 inch
24 = 24 inch
12 = 12 inch
4 = 4 inch

etc.

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