FEATURES:
• Modular Kit Optical Encoder
• All Electronics Contained in Read Station
• True Absolute 24-bit Position Output
• Vacuum Compatible
• Sample rate to 1kHz
• In-Situ Auto Calibration (360° or limited angle)
• +5.0 Volts Input Power < 0.5 Watt
• EEE-INST-002 Qualified Electronics
• Radial alignment reporting
• Radiation tolerant to 50 krad(Si)

APPLICATIONS:
• High Reliability Space Applications
• Earth Observing - featured on NASA PACE
• SmallSats
• Mechanisms/Gimbals
• Laser Communications

FOR MORE INFORMATION CONTACT
SALES@BEIPRECISION.COM
DESCRIPTION:

BEI Precision is now offering a Space Qualified Encoder configuration in the nanoSeries® TRACKER family. This is a single read station, absolute optical encoder available in disk sizes 3.0” (76.2 mm) to 7.25” (184.2 mm) diameter. This model achieves a resolution of 24 bits with accuracy of < 2.5 arcsec RMS (excluding user bearing and spindle errors). Electronic components are qualified to Level 1 or Level 2 per GSFC EEE-INST-002. The encoder comes equipped with in situ auto-calibration capability for full revolution movements and also for limited angles (minimum sweep 22.5°). Mounting and alignment on a loose pilot shaft along with the radial alignment reporting feature makes precise alignment of the code disk and readhead easy and fast. The optical system uses a large air gap (0.015 in.) and is tolerant to shock and vibration induced gap variations.

The absolute encoder data is derived from several tiers of multi-speed sinusoidal data tracks which are digitized and merged into a contiguous data word. The resultant absolute position word is not sensitive to power interruptions. This technique minimizes the number of data tracks (minimizes size and parts count). All data is derived from ratiometric tracks on the code disk, resulting in excellent tolerance to aging, temperature, etc.
3D CAD MODELS AVAILABLE AT BEIPRECISION.COM

READHEAD & CODE DISK IN INSTALLED STATE
(7.25" CODE DISK & LEFT-EXIT READHEAD SHOWN)

NOTES:
1. SEE APPLICABLE OUTLINE DRAWING FOR COMPLETE DIMENSIONAL SPECIFICATIONS AND MOUNTING INTERFACE RECOMMENDATIONS.
   - 190-0324-01 (7.25")
   - 190-0324-02 (3.00")
   - 190-0324-03 (4.00")
   - 190-0324-04 (5.00")
   - 190-0324-05 (6.00")
2. UNBRACKETED DIMENSIONS ARE INCHES AND BRACKETED [X.XX] DIMENSIONS ARE MILLIMETERS.
The standard nanoSeries® Space TRACKER 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>

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

<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>$\mu$s</td>
</tr>
<tr>
<td>Encoder Interrogation Period</td>
<td>$T_{INT}$</td>
<td>1000</td>
<td>--</td>
<td>--</td>
<td>$\mu$s</td>
</tr>
<tr>
<td>Clock Frequency</td>
<td>1.5</td>
<td>2</td>
<td>2.5</td>
<td>MHz</td>
<td></td>
</tr>
</tbody>
</table>

*Although data is sampled within 45 $\mu$s (typ) of the CMD pulses, it is not shifted out until the next cycle.

Electrical Interface Timing Values (See 190-0323-03 For Details)
**NanoserieS®**
**Space Tracker**

**Optical Encoder > Absolute Kit Encoder > Space Tracker**

## General Specifications:

<table>
<thead>
<tr>
<th>Quanta/ Revolution</th>
<th>Resolution (Arc Seconds)</th>
<th>Accuracy (RMS) (Arc Seconds)</th>
<th>Speed (RPS for full accuracy)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NST 24/xxx</td>
<td>16,777,216 (24-BIT)</td>
<td>0.077 (0.375 µrad)</td>
<td>2.5&lt;sup&gt;(1)&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>5 max&lt;sup&gt;(2)&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

- **Interrogation Rate**: 1kHz max
- **Acquisition Time**: 45.5 µsec typ (See note on Table 1)
- **Operating Temperature Range**: -40°C to +67°C
- **Storage Temperature Range**: -55°C to +90°C
- **Mass, Max (grams)**:
  - Structural Component Material<sup>(3)</sup>:
    | Stainless Steel | Titanium |
    |-----------------|----------|
    | Readhead with 36” cable | 151      | 124      |
    | Readhead with L” cable | 103.2±1.35(L) | 75.5±1.35(L) |
    | 3.00” Disk/Hub | 59       | 44       |
    | 4.00” Disk/Hub | 97       | 72       |
    | 5.00” Disk/Hub | 144      | 98       |
    | 6.00” Disk/Hub | 243      | 166      |
    | 7.25” Disk/Hub | 292      | 210      |

- **Input Power**: +5 VDC ± 10% at 40 ma nominal
- **Altitude**: Vacuum-compatible
- **Vibration**: 20.7 grms from 10 to 2000 Hz per MIL-STD-202, Condition 1, profile F
- **Shock**: 50g at 11ms half-sine pulse per MIL-STD-202, Method 213B, Test Condition A
- **Relative Humidity**: To 99% (avoid condensation)
- **Electromagnetic Compatibility**: Consult Factory
- **ESD (HBM)**: 8kV

<sup>(1)</sup> Does not include mounting errors
<sup>(2)</sup> TRACKER is a strobed encoder, higher speeds = greater position lag
<sup>(3)</sup> Structural component materials are limited to readhead housing, disk hub, and optics housing. Other components are made of aluminum.

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For more information contact

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ORDERING INFORMATION:

NST  24  /  300  P1  M1  D1  S1  -  L  36

Resolution
Bits/Rotation

Outside disk diameter
x100
300 = 3.00 inch
400 = 4.00 inch
500 = 5.00 inch
600 = 6.00 inch
725 = 7.25 inch

Input voltage
P1: 5V

Structural Component Materials
M1 = 416 stainless steel
M2 = titanium
M3 = titanium readhead, steel disk hub
(See Note 3 pg 4)

Serial Output Data Driver
D1 = LVDS

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

Cable Exit
L = Left from electronics side
R = Right from electronics side

Product Assurance Level
S2 = Space Level 2
S1 = Space Level 1

SPECIAL MODELS:

Many other sizes and configurations are possible at a nominal NRE fee. Available options (priced separately) include special materials, cable or connector variations, etc. Contact the factory for price and delivery information.