NANOSERIES® TRACKER

FEATURES:

- Modular Kit Optical Encoder
- All Electronics Contained in Read Station
- Vacuum Compatible
- High Resolution up to 0.077 arcsec (24 bits)
- Accuracy 2.5 arcsec RMS (excluding mounting errors)
- Sample rate to 1kHz
- Rotational Rate of 5 RPS max
- Temperature Range Standard -40°C to +85°C
- In-Situ Auto Calibration (360° or limited angle)
- Large Air Gap
- Absolute Serial Output – LVDS
- High Reliability
- Monolithic Photodiode Array
- Long life LED light source
- Light Weight – (See Page 4)
- +5.0 Volts Input Power < 0.5 Watt
- Micro-D Connector on Pendant Cable
- Built-in-Test and Diagnostics
- Radial alignment reporting
- Radiation tested sample to 40 krad(Si) Co60

FOR MORE INFORMATION CONTACT
SALES@BEIPRECISION.COM
**GENERAL DESCRIPTION:**

BEI Precision Systems & Space Company is now offering an Absolute Modular Encoder configuration in the nanoSeries® Encoder family, intended for a commercial space application. This is a single read station, absolute optical encoder available in disk sizes 3.0" (76.2 mm) OD to 7.25" (184.2 mm) OD disk diameter. This model achieves a resolution of up to 24 bits with accuracy of < 2.5 arcsec RMS (excluding user bearing and spindle errors). 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 a 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.
Encoder with 7.25" disk shown

See outline drawing: 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"")

3D CAD models available upon request

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The standard nanoSeries® 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>

**OUTPUT PROTOCOL:**

I/O: LVDS or RS422

**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>$T_e$</td>
<td>43</td>
<td>45.5</td>
<td>48</td>
<td>µS</td>
</tr>
<tr>
<td>Encoder Interrogation Period</td>
<td>$T_{QI}$</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)
<table>
<thead>
<tr>
<th>General Specifications:</th>
<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*</td>
<td>5 max(1)</td>
</tr>
<tr>
<td>Interrogation Rate</td>
<td>1kHz max</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acquisition Time</td>
<td>45.5 µsec typ (See note on Table 1)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Slew Speed (non-operating)</td>
<td>5 rps max</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operating Temperature Range</td>
<td>-40°C to +85°C(2)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Storage Temperature Range</td>
<td>-55°C to +90°C</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Mass

<table>
<thead>
<tr>
<th>Structural Component Material (3)</th>
<th>Stainless Steel</th>
<th>Titanium</th>
</tr>
</thead>
<tbody>
<tr>
<td>Readhead with 36&quot; cable</td>
<td>151</td>
<td>124</td>
</tr>
<tr>
<td>Readhead with L&quot; cable</td>
<td>103.2+1.35(L)</td>
<td>75.5+1.35(L)</td>
</tr>
<tr>
<td>3.00&quot; Disk/Hub</td>
<td>59</td>
<td>44</td>
</tr>
<tr>
<td>4.00&quot; Disk/Hub</td>
<td>97</td>
<td>72</td>
</tr>
<tr>
<td>5.00&quot; Disk/Hub</td>
<td>144</td>
<td>98</td>
</tr>
<tr>
<td>6.00&quot; Disk/Hub</td>
<td>243</td>
<td>166</td>
</tr>
<tr>
<td>7.25&quot; Disk/Hub</td>
<td>292</td>
<td>210</td>
</tr>
</tbody>
</table>

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)

Rated Life, LED

100,000 hours min.

Electromagnetic Compatibility

Per MIL-STD-461F:

CE102: Conducted Emissions, Power Leads, 10kHz – 10MHz

RE102: Radiated Emissions, Electric Field, 10kHz – 18GHz

ESD (HBM)

8kV

(1) Tracker is a strobed encoder; higher speeds = greater position lag
(2) Consult factory for specifications of S1 or S2 models
(3) Structural component materials are limited to readhead housing, disk hub, and optics housing other components are made of aluminum.

* Does not include mounting errors
**SPECIAL MODELS:**
Many other sizes, configurations, and resolutions are possible at a nominal NRE fee. Available options (priced separately) include vacuum rating, radiation resistance, special materials, cable or connector variations, etc. Contact the factory for price and delivery information.

**ORDERING INFORMATION:**

<table>
<thead>
<tr>
<th>NST</th>
<th>/</th>
<th>24</th>
<th>300</th>
<th>P1</th>
<th>M1</th>
<th>D1</th>
<th>CS</th>
<th>-</th>
<th>L</th>
<th>36</th>
</tr>
</thead>
<tbody>
<tr>
<td>NST /</td>
<td>24</td>
<td>300</td>
<td>P1</td>
<td>M1</td>
<td>D1</td>
<td>CS</td>
<td>-</td>
<td>L</td>
<td>36</td>
<td></td>
</tr>
</tbody>
</table>

- **Resolution**: Bits/Turn
- **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: 5VDC
- **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
  - D2 = RS485
- **Cable Length**: (4-36 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**:
  - (omitted) = Commercial, vacuum-compatible materials
  - CS = Commercial, Space Assembly, TVAC bakeout.

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