NANOSERIES® SPACE 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 +67°C
- In-Situ Auto Calibration (360° or limited angle)
- Absolute Serial Output – LVDS
- High Reliability
- Monolithic Photodiode Array
- Long life LED light source
- Light Weight
- +5.0 Volts Input Power < 0.5 Watt
- Micro-D Connector on Pendant Cable
- Built-in-Test and Diagnostics
- Radial alignment reporting
- Radiation tolerant to 50 krad(Si)

FOR MORE INFORMATION CONTACT
SALES@BEIPRECISION.COM
GENERAL 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) OD to 7.25" (184.2 mm) diameter. This model achieves a resolution of up to 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 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

3D CAD models available upon request

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”)

NOTE 2

CODE DISK CHROME SIDE
DIRECTION OF INCREASING COUNT

NOTE 2
CODE DISK OD
HUB PILOT ID

OUTPUT CONNECTOR
MICRO-D, M83513/04-A12N

SECTION A-A
DISK MOUNTING SURFACE
READHEAD MOUNTING SURFACE

LEFT EXIT DIRECTION SHOWN
RIGHT EXIT DIRECTION (OPTIONAL)

NOMINAL R0:
0.0028

UNITED STATES PATENT OFFICE

NOTES:
1. BRACKETED DIMENSIONS ARE IN MILLIMETERS, UNBRACKETED DIMENSIONS ARE IN INCHES.
2. CABLE LENGTH MAY BE SPECIFIED IN ANY 1 INCH INCREMENT BETWEEN 4 AND 36 INCHES.
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>

I/O: LVDS or RS422

**OUTPUT PROTOCOL:**

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)
### General Specifications:

<table>
<thead>
<tr>
<th></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&lt;sup&gt;(1)&lt;/sup&gt;</td>
<td>5 max&lt;sup&gt;(2)&lt;/sup&gt;</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>Operating Temperature Range</td>
<td>-40°C to +67°C</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>
<tr>
<td>Mass</td>
<td>Structural Component Material&lt;sup&gt;(3)&lt;/sup&gt;</td>
<td>Stainless Steel</td>
<td>Titanium</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Readhead with 36&quot; cable</td>
<td>151</td>
<td>124</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Readhead with L&quot; cable</td>
<td>1032+1.35(L)</td>
<td>75.5+1.35(L)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3.00&quot; Disk/Hub</td>
<td>59</td>
<td>44</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4.00&quot; Disk/Hub</td>
<td>97</td>
<td>72</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5.00&quot; Disk/Hub</td>
<td>144</td>
<td>98</td>
<td></td>
</tr>
<tr>
<td></td>
<td>6.00&quot; Disk/Hub</td>
<td>243</td>
<td>166</td>
<td></td>
</tr>
<tr>
<td></td>
<td>7.25&quot; Disk/Hub</td>
<td>292</td>
<td>210</td>
<td></td>
</tr>
<tr>
<td>Input Power</td>
<td>+5 VDC ± 10% at 40 ma nominal</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Altitude</td>
<td>Vacuum-compatible</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vibration</td>
<td>20.7 grms from 10 to 2000 Hz per MIL-STD-202, Condition 1; profile F</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shock</td>
<td>50g at 11ms half-sine pulse per MIL-STD-202, Method 213B, Test Condition A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relative Humidity</td>
<td>To 99% (avoid condensation)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electromagnetic Compatibility</td>
<td>Consult Factory</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ESD (HBM)</td>
<td>8kV</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<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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02/2020  
MM-275
ORDERING INFORMATION:

NST / 24 300 P1 M1 D1 S1 L 36

- 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
- Cable Exit
  L = Left from electronics side
  R = Right from electronics side
- Cable Length
  (4-72 inches in 1 inch increments)
  36 = 36 inch
  24 = 24 inch
  12 = 12 inch
  4 = 4 inch
- 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.