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

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.
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 on request.

Encoder with 7.25" disk shown

ENCODER DATA SHEET

BEI Precision Systems & Space Company, Inc.
1100 Murphy Drive ▪ Maumelle, AR 72113 USA ▪ Tel: 501-851-4000 ▪ Fax: 501-851-5476
Connector Pinout:

The standard nanoSeries® TRACKER output connector is a 9-pin D-Sub Micro-D Connector (M83513/04-A12N) 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>Output</td>
<td>Position data output (LVDS)</td>
</tr>
<tr>
<td>6</td>
<td>-POS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>+CMD</td>
<td>Input</td>
<td>Command word input (LVDS)</td>
</tr>
<tr>
<td>8</td>
<td>-CMD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>+CLK</td>
<td>Input</td>
<td>Synchronous clock input (LVDS)</td>
</tr>
<tr>
<td>7</td>
<td>-CLK</td>
<td></td>
<td></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:

![Electrical Interface Timing Diagram](image)

**TABLE 1. ELECTRICAL INTERFACE TIMING VALUES (SEE 190-0323-01 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>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 45µS (typ) of the CMD pulses, it is not shifted out until the next cycle.
General Specifications:

<table>
<thead>
<tr>
<th>Quanta/Revolution</th>
<th>Resolution (Arc Seconds)</th>
<th>Accuracy (RMS) (Arc Seconds)</th>
<th>Speed (rips 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>
</tr>
<tr>
<td></td>
<td></td>
<td>2.5*</td>
<td>5 max(1)</td>
</tr>
<tr>
<td>Interrogation Rate</td>
<td>1 kHz max</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>
</tr>
<tr>
<td>Slew Speed (non-operating)</td>
<td>5 rps max</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operating Temperature Range</td>
<td>-40°C to +85°C(2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Storage Temperature Range</td>
<td>-55°C to +90°C</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Mass

<table>
<thead>
<tr>
<th>Structural Component Material(3)</th>
<th>Max Mass (grams)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Readhead with 36” cable</td>
<td>151</td>
</tr>
<tr>
<td>Readhead with L” cable</td>
<td>103.2+1.35(L)</td>
</tr>
<tr>
<td>3.00” Disk/Hub</td>
<td>59</td>
</tr>
<tr>
<td>4.00” Disk/Hub</td>
<td>97</td>
</tr>
<tr>
<td>5.00” Disk/Hub</td>
<td>144</td>
</tr>
<tr>
<td>6.00” Disk/Hub</td>
<td>243</td>
</tr>
<tr>
<td>7.25” Disk/Hub</td>
<td>292</td>
</tr>
</tbody>
</table>

Input Power +5 VDC ± 5% at 40 ma nominal
Altitude Vacuum-compatible
Vibration 20.7 grms from 10 to 2000 Hz per MIL-STD-202, Condition1; 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.

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:

nanoSeries® TRACKER

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

Product Assurance Level

(omitted) = Commercial, vacuum-compatible materials

- CS = Commercial, Space Assembly, TVAC bakeout
- S2 = Space Level 2
- S1 = Space Level 1

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

Specifications subject to change without notice.