Features:

- Modular Kit Encoder
- All Electronics Contained in Read Station
- High Resolution 28 bits
- Accuracy < 1 Arcsecond RMS
- Sample rate to 16 kHz
- Wide Temperature Range
- In-Situ Auto Calibration (360° or limited angle)
- Cancellation of Repeatable Errors
- Large Air Gap
- Absolute Serial Output
- High Reliability
- Monolithic Photodiode Array
- Long life LED light source
- Low Profile, Light Weight and Low Power
- +6.0 to +36 VDC input power (+5 VDC opt)
- Built-In-Test and Diagnostics
- Piloted Hub to Ease Installation
- Tangential and Radial Alignment Error Reporting
- Radiation tested sample to 10 krad (Si) Co60

General Description

BEI Precision Systems & Space Company is now offering an Absolute Intuitive Modular Encoder (AIME-II) configuration in the nanoSeries® Encoder family. This is a high resolution, single read station, absolute optical encoder available in our standard array of 3-7.25” disk diameters. The 4” disk model achieves a resolution of 24 bits ENOB with accuracy of 1 arc-second RMS (excluding user bearing and spindle errors). Standard disk sizes are 3, 4, 5, 6, & 7.25” with special diameters, configurations, and resolutions available on request at an additional cost.

The encoder comes equipped with in situ auto-calibration capability and wide angle error correction. The encoder may be calibrated in full revolution as well as partial angle designs with as few as 10 deg swept arc, making it an excellent choice for gimbal applications. Mounting and alignment on a piloted shaft simplifies the installation on a user bearing/shaft assembly by removing the need for optical alignment. The optical system uses a large air gap (0.015”) 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 continuous 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.

There are a number of BEI PSSC proprietary techniques used in these encoders that allow most repeatable errors to be removed from the output data. These encoders incorporate algorithms that can cancel disk centering and bearing eccentricities, even with a single readhead. The ultimate limitation of how accurate and repeatable the nanoSeries® AIME-II can be is determined by the thermal and mechanical stability of the axis of rotation of the spindle — most other errors are cancelled or minimized. Tangential and radial alignment error reporting feature makes precise mounting of the code disk and readhead easy and fast. For detailed information on this feature see MM-247 ARA/AIME-II nanoSeries® Encoder Alignment Mode Technical Bulletin.

Approved for general release
Encoder with 4” disk shown

See outline drawing:
- 190-0315-01 (3.00”)
- 190-0315-02 (4.00”)
- 190-0315-03 (5.00”)
- 190-0315-04 (6.00”)
- 190-0315-05 (7.25”)

3D CAD models available on request
Connector Pinout:

The standard nanoSeries® AIME-II output connector is a 15-pin Micro-D connector (M83513/04-B14N) type with the following pinout:

<table>
<thead>
<tr>
<th>SIGNAL NAME</th>
<th>SIGNAL TYPE</th>
<th>PIN NUMBER</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>HOST_CLK_IN_P</td>
<td>LVDS</td>
<td>1</td>
<td>Differential clock received from the host for latching CMD</td>
</tr>
<tr>
<td>HOST_CLK_IN_N</td>
<td>LVDS</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>SPARE1</td>
<td>TBD</td>
<td>3</td>
<td>Not used</td>
</tr>
<tr>
<td>HOST_CMD_P</td>
<td>LVDS</td>
<td>4</td>
<td>Differential command data bus received from the host</td>
</tr>
<tr>
<td>HOST_CMD_N</td>
<td>LVDS</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>SPARE2</td>
<td>TBD</td>
<td>6</td>
<td>Not used</td>
</tr>
<tr>
<td>DC_5VIN</td>
<td>PWR</td>
<td>7</td>
<td>SVDC input</td>
</tr>
<tr>
<td>DC_VIN</td>
<td>PWR</td>
<td>8</td>
<td>6 - 36VDC input</td>
</tr>
<tr>
<td>CHASSIS</td>
<td>GND</td>
<td>9</td>
<td>Chassis GND</td>
</tr>
<tr>
<td>HOST_CLK_OUT_P</td>
<td>LVDS</td>
<td>10</td>
<td>Differential clock transmitted to the host for latching DATA</td>
</tr>
<tr>
<td>HOST_CLK_OUT_N</td>
<td>LVDS</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>SPARE3</td>
<td>TBD</td>
<td>12</td>
<td>Not used</td>
</tr>
<tr>
<td>HOST_DATA_P</td>
<td>LVDS</td>
<td>13</td>
<td>Differential data bus transmitted to the host</td>
</tr>
<tr>
<td>HOST_DATA_N</td>
<td>LVDS</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>DC_RTN</td>
<td>PWR</td>
<td>15</td>
<td>PowerGND</td>
</tr>
</tbody>
</table>

Output Protocol:

![Electrical Interface Timing Diagram](image)

**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 INTERROGATION PERIOD</td>
<td>t_INT</td>
<td>62.5</td>
<td>–</td>
<td>–</td>
<td>µS</td>
</tr>
<tr>
<td>ENCODER INTERROGATION PERIOD DURING CALIBRATION</td>
<td>t_CAL</td>
<td>62.5</td>
<td>–</td>
<td>–</td>
<td>µS</td>
</tr>
<tr>
<td>ENCODER DATA RELEVANCY</td>
<td>t_REL</td>
<td>25</td>
<td>27</td>
<td>29</td>
<td>µS</td>
</tr>
<tr>
<td>ENCODER DATA ACQUISITION TIME</td>
<td>t_ACQ</td>
<td>47*</td>
<td></td>
<td></td>
<td>µS</td>
</tr>
<tr>
<td>HOST_CLOCK PERIOD</td>
<td>t_CLK</td>
<td>100</td>
<td>–</td>
<td>1000</td>
<td>nS</td>
</tr>
<tr>
<td>HOST CLOCK DUTY CYCLE</td>
<td>t_CLK</td>
<td>45</td>
<td>50</td>
<td>55</td>
<td>%</td>
</tr>
</tbody>
</table>

* +1.5 TO 2.5 HOST_CMD_CLK PERIODS

**TABLE 1. ELECTRICAL INTERFACE TIMING VALUES (SEE 190-0308-04 FOR DETAILS)**
**General Specifications:**

<table>
<thead>
<tr>
<th>NS 28/xxx</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>268,435,456 (28-bit)</td>
<td>0.077 (0.375 µrad)</td>
<td>1.0*</td>
<td>5 max(1)</td>
<td></td>
</tr>
</tbody>
</table>

**Interrogation Rate/Acquisition Time:**
- 16 kHz max / data Acquisition Time 47 µSec typ

**Slew Speed (non-operating):**
- 3600 rpm max

**Operating Temperature Range - Standard:**
- -40°C to +85°C

**Storage Temperature Range:**
- -55°C to +90°C

<table>
<thead>
<tr>
<th>Mass</th>
<th>Structural Component Material(2)</th>
<th>Max Mass (grams)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Stainless Steel</td>
<td>Titanium</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Readhead with 72” cable</th>
<th>267</th>
<th>221</th>
</tr>
</thead>
<tbody>
<tr>
<td>Readhead with L” cable</td>
<td>132.3+1.87(L)</td>
<td>86.7+1.87(L)</td>
</tr>
<tr>
<td>3.00” Disk/Hub</td>
<td>59</td>
<td>44</td>
</tr>
<tr>
<td>4.00” Disk/Hub</td>
<td>97</td>
<td>72</td>
</tr>
<tr>
<td>5.00” Disk/Hub</td>
<td>144</td>
<td>98</td>
</tr>
<tr>
<td>6.00” Disk/Hub</td>
<td>243</td>
<td>166</td>
</tr>
<tr>
<td>7.25” Disk/Hub</td>
<td>292</td>
<td>210</td>
</tr>
</tbody>
</table>

**Input Power:**
- Standard: +6.0 to 36 VDC at 1.5 watts, Switching Regulator
- Optional: +5VDC ± 5% at 240 mA nominal

**Altitude:**
- To 70,000 feet (21,335 meters)

**Vibration:**
- 20.7 grms from 10 to 2000 Hz per MIL-STD-202, Method 214, Cond. B

**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

(1) AIME II is a strobed encoder, higher speeds = greater position lag
(2) 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, special materials, cable or connector variations, etc. Contact the factory for price and delivery information.
Ordering Information:

nanoSeries® AIME II

<table>
<thead>
<tr>
<th>NS</th>
<th>28 / 300</th>
<th>P1</th>
<th>M1</th>
<th>D1</th>
<th>VB</th>
<th>L</th>
<th>72</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: 5 VDC
- P2: 6-36 VDC

**Structural Component Materials**

- M1 = 416 stainless steel
- M2 = titanium
- M3 = titanium readhead, steel disk hub
  (See Note 1 pg 4)

**Serial Output Data Driver**

- D1 = LVDS
- D2 = RS485

**Vacuum Option**

- (omitted) = vacuum-compatible materials (standard)
- VB = Vacuum-compatible materials + TVAC bakeout

**Cable Length**

(4-72 inches in 1 inch increments)

- 72 = 72 inch
- 36 = 36 inch
- 12 = 12 inch
- 4 = 4 inch

**Cable Exit**

- L = Left from electronics side
- R = Right from electronics side

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Specifications subject to change without notice.