## Features:
- Housed Optical Encoder
- Absolute Non-Volatile Serial Output
- All Electronics Contained in Unit
- Light Weight 9.0 lb (Max)
- Sample Rate up to 8.0 kHz
- Angular Velocity up to 5 RPS
- Running Torque = 15.0 oz-in max @ 25°C
- Bearings Rated Life of $10^9$ revolutions (Min)
- Optional Internal and External Couplings
- Bearings Can Support Payloads up to 50 lb
- Operating Temperature Range -40 to +75°C
- The nanoSeries nSH/80 can be configured as a drop in replacement for the legacy Microseries µS/80 housed encoders.
- The Optional Tachometer feature reports real-time position data.
- The Tachometer Outputs $2^{18}$ counts per revolution and consists of two square waves in quadrature.
- The Tachometer is Operational up to 30 RPM.

## General Description
NanoSeries Housed Encoders are thin, through-hole, absolute, optical encoders. They have substantially better accuracy than other shaft angle digitizers. These encoders are designed for applications where high resolution, minimum height, and insensitivity to power interruptions are desired. The nSH/80 family of encoders incorporates BEI Precision’s latest technology with AIME-II read stations. The AIME-II modular design reduces build complexity, lead time, and cost while providing overall performance improvements when compared to legacy Microseries encoder systems. The nSH/80 Encoder options include LCRS read mode or LCNS update mode and ultimately provides a modern replacement for the Microseries µS/80 housed encoders operating in these modes.

Typical applications include aerospace/weapon systems, radar/optical tracking systems, and astronomical telescopes.

### ENCODER PROPERTIES

<table>
<thead>
<tr>
<th>Model</th>
<th>Stations</th>
<th>Resolution (Quanta)</th>
<th>Resolution (ENOB)</th>
<th>RMS Accuracy (Min)</th>
<th>Max Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>nSH28/80</td>
<td>1</td>
<td>28 bits</td>
<td>24 bits</td>
<td>2.0 arc-sec</td>
<td>2.2W</td>
</tr>
<tr>
<td>nSH29/80</td>
<td>2</td>
<td>29 bits</td>
<td>25 bits</td>
<td>0.8 arc-sec</td>
<td>2.9W</td>
</tr>
<tr>
<td>nSH30/80</td>
<td>4</td>
<td>30 bits</td>
<td>26 bits</td>
<td>0.5 arc-sec</td>
<td>5.0W</td>
</tr>
</tbody>
</table>
# nanoSeries® Housed nSH/80

**ENCODER DATA SHEET**

**3D CAD MODELS AVAILABLE ON REQUEST**

## General Specifications

<table>
<thead>
<tr>
<th></th>
<th>Quanta</th>
<th>Resolution (quanta)</th>
<th>RMS Accuracy (Min)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Per Revolution</td>
<td>Arc-sec</td>
<td>Nanoradian</td>
</tr>
<tr>
<td>nSH28/80</td>
<td>268,435,456</td>
<td>0.0048</td>
<td>23.41</td>
</tr>
<tr>
<td>nSH29/80</td>
<td>536,870,912</td>
<td>0.0024</td>
<td>11.70</td>
</tr>
<tr>
<td>nSH30/80</td>
<td>1,073,741,824</td>
<td>0.0012</td>
<td>5.85</td>
</tr>
</tbody>
</table>

- **Input Voltage**: 5.0 ±10% VDC
- **Interrogation Rate**: 8.0 kHz max
- **Data Clock Rate**: 10.0 MHz max
- **Data Relevancy**: 27 µS
- **Signaling**: RS-422 per EIA-422
- **Operating Speed**: 5 RPS max\(^{(1)}\)
  - 30 RPM with Tachometer option
- **Rotation (for increasing count)**: Clockwise facing mounting surface
- **Slew Speed (non-operating)**: 200 RPM max
- **Operating Temperature Range**: -40 to +75° C (Consult factory for extended range)
- **Storage Temperature Range**: -55 to +90° C
- **Vibration – Locked Shaft**: MIL-STD-202, Method 214, Condition 1, Profile F (20.7 grms)
- **Float Shaft**, 0 lb payload: MIL-STD-202, Method 214, Condition 1, Profile A (5.35 grms)
- **Shock – Locked Shaft**: MIL-STD-202, Method 213B, Condition A
  - 50 g’s, 11 msec pulse, half-sine
- **Altitude**: 70,000 ft
- **Torque – Breakaway**: 15.0 oz-in max at 25°C
  - Running: 15.0 oz-in max at 25°C
- **Moment of Inertia**: 0.84 oz-in-sec\(^2\) max (excluding coupling)
- **Shaft Loading – Axial**: 50 lb max
  - Radial: 50 lb max (@ Shaft Mounting Face)
- **Weight**: 9.0 lb (excluding coupling)
- **Rated Life, Bearings**: 10^9 revolutions min
- **Rated Life, LED**: 100,000 hours min
- **Sealing**: IP50 (dust protected)

\(^{(1)}\) nSH/80 is a strobed encoder, higher speeds = greater position lag
Connector Pinout:
The standard nSH/80 output connector is an OMNETICS MMCP-16-RP connector type with the following pinout:

<table>
<thead>
<tr>
<th>PIN</th>
<th>FUNCTION</th>
<th>PIN</th>
<th>FUNCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>HOST_CMD</td>
<td>9</td>
<td>TACH_A_OUT</td>
</tr>
<tr>
<td>2</td>
<td>/HOST_CMD</td>
<td>10</td>
<td>5V RTN</td>
</tr>
<tr>
<td>3</td>
<td>HOST_DATA</td>
<td>11</td>
<td>TACH_B_OUT</td>
</tr>
<tr>
<td>4</td>
<td>/HOST_DATA</td>
<td>12</td>
<td>/TACH_B_OUT</td>
</tr>
<tr>
<td>5</td>
<td>/HOST_CMD_CLOCK</td>
<td>13</td>
<td>/TACH_A_OUT</td>
</tr>
<tr>
<td>6</td>
<td>HOST_CMD_CLOCK</td>
<td>14</td>
<td>+5V</td>
</tr>
<tr>
<td>7</td>
<td>/HOST_CMD_DATA</td>
<td>15</td>
<td>5V RTN</td>
</tr>
<tr>
<td>8</td>
<td>HOST_CMD_DATA</td>
<td>16</td>
<td>+5V</td>
</tr>
</tbody>
</table>

Output Protocol:

![Electrical Interface Timing Diagram](image)

**Electrical Interface Timing Diagram (System)**

**Timing Values Per Table Below**

<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>125</td>
<td>–</td>
<td>–</td>
<td>µS</td>
</tr>
<tr>
<td>Encoder Interrogation Period During Calibration</td>
<td>$T_{CAL}$</td>
<td>125</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>89*</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

**Electrical Interface Timing Values (See 190-0308-07 For Details)**
**Ordering Information:**

```
NS H 28 / 80 (1) - OPTION
```

Housed Resolution Bits/Turn

Outside Diameter

80 = 8.00 inch

Read Station

1 = 1 Read Station
2 = 2 Read Station
4 = 4 Read Station

Omit for no options

LCRS = μS Read Mode
LCNS = μS Update Mode
T = 218 Tachometer

**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.

**Optional BEI Precision Couplings Available:**

**EXTERNAL COUPLER**

**INTERNAL COUPLER**

NOTES: 1. Consult BEI PSSC for other Lengths

**Misalignment Specifications**

1. Parallel Misalignment Range 0.004 FIM
2. Mounting Surface Perpendicularity 0.001 FIM
3. Drive Shaft Runout 0.001 FIM
4. Axial Displacement Range +0.000/-0.010