**Mercury™ 1000V: Vacuum Rated Analog Encoder**

*For Customer Interpolation- Resolution to 0.078μm; Rated to 10⁻⁸ Torr*

Reflective Linear and Rotary Vacuum Encoders

The New Mercury 1000V encoder represents the next level of encoder performance. With smallest sensor size, easiest alignment and 10⁻⁸ Torr vacuum rating, the M1000V delivers Best-in-Class performance. Shown with customer-supplied vacuum-wall connectors.

**Imagine what you can do with this!**
The new Mercury 1000V can reduce the cost and size of your system, and improve its performance all at once! MicroE Systems’ Mercury 1000V kit encoders are smaller, higher performance, faster to install, and easier to set up and align than any other encoder. The tiny sensor fits into very tight spaces and works in both linear and rotary applications. The M1000V sensor is vented and constructed with vacuum compatible materials and designed for a 48 hour bake out at 150°C. Color coded bare leads are provided for customer termination.

**Standard features**
- Small sensor with ultra-low Z height; flush screw mounting
- Sensor is 8.4mm (H) x 12.7mm (W) x 20.6mm (L) and weighs 1.6g
- SmartPrecision automatic offset and gain set up
- Analog Sine/Cosine output and Index window
- Fundamental resolution: Linear 20μm; Rotary 2,500 - 16,384 CPR
- Interpolated resolution determined by customer electronics:
  - Linear: 20μm - 0.078μm; rotary: 2,500 to 4.2M CPR
- Bi-directional index signal
- Index mark at the center or end of the glass scale (linear)
- Alignment Tool enables fast set up (Required, see pg 6 for ordering info.)

**Resolution**
Determined by Customer Electronics
- Linear: 20μm to 0.078μm
- Rotary: 2,500 to 4.2M CPR

**Accuracy**
- Linear: ± 1μm available
- ± 3μm to ± 5μm standard
- Rotary: Up to ± 2.1 arc-sec

**Output**
- Analog Sine/Cosine and Index Window

**Vacuum**
- 10⁻⁸ Torr

**Table of Contents**
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- Scales pg . 5-6
- Ordering Information pg. 6

**Required accessories**
- SmartPrecision Alignment Tool

**Optional features**
- Glass scale length or diameter:
  - Linear lengths from 5mm to 2m
  - Rotary diameters from 12mm to 108mm
- Vacuum cable length of 1.5m or custom
- SmartPrecision Software for set up
System Configurations
Standard and Optional Equipment

M1000 Encoder System
Standard Equipment

Encoder Sensor
Same for linear and rotary scales.

Shielded Vacuum Cable
Supplied with 1.5m standard length and color-coded bare leads for customer termination.

Controller Interface Cable
The cable includes a 15 pin standard D-sub connector with SmartPrecision™ electronics for automatic gain and offset adjustments.

SmartPrecision™
Alignment Tool
Required for set up, the built-in LED indicators make alignment fast and easy, eliminating the need for an oscilloscope. In addition, SmartPrecision gain and offset are automatically adjusted to optimize accuracy.

Optional Software

SmartPrecision™
Alignment Software
Optional software lets you view signal strength, Lissajous plots, position data and diagnostics.

RS 232 Interface Adaptor
The adaptor provides power to the encoder and connections to a PC and the controller. Included with the Alignment Tool.

vacuum wall
Broader Alignment Tolerances, Increased Standoff Clearance, Smallest Sensor and More
Why Mercury Encoders Make It Easier To Design High Performance Into Your Equipment

Eliminate the Frustration of Touchy Encoder Alignment

Mercury Solves this Problem for Good
Fussy alignment is no longer a concern. With Mercury’s patented PurePrecision™ optics, advanced SmartPrecision™ electronics and LED alignment indicators, you can push the sensor against your reference surface, tighten the screws and you’re finished. Try that with brand X or Y.

This performance is possible thanks to relaxed alignment tolerances, particularly in the theta Z axis. Mercury offers a ± 2° sweet spot— that’s a 300% improvement over the best competitive encoder. And that will result in dramatic savings in manufacturing costs.

No other commercially available encoder is easier to align, easier to use, or easier to integrate into your designs.

Alignment Tolerance Comparison**

<table>
<thead>
<tr>
<th></th>
<th>Mercury*</th>
<th>Brand X</th>
<th>Brand Y</th>
<th>Mercury vs. Best Competitor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Z Standoff</td>
<td>± 0.15mm</td>
<td>± 0.1mm</td>
<td>± 0.1mm</td>
<td>Mercury is 50% better</td>
</tr>
<tr>
<td>Y</td>
<td>± 0.20mm for linear</td>
<td>± 0.1mm</td>
<td>unspecified</td>
<td>Mercury is 100% better</td>
</tr>
<tr>
<td></td>
<td>± 0.10mm for rotary ≥ 19mm dia.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>theta X</td>
<td>± 1.0°</td>
<td>unspecified</td>
<td>± 1.0°</td>
<td>Mercury is 100% better</td>
</tr>
<tr>
<td>theta Y</td>
<td>± 2.0°</td>
<td>± 0.1°</td>
<td>± 1.0°</td>
<td>Mercury is 100% better</td>
</tr>
<tr>
<td>theta Z</td>
<td>± 2.0°</td>
<td>± 0.006°</td>
<td>± 0.5°</td>
<td>Mercury is 300% better</td>
</tr>
</tbody>
</table>

*Measured at a constant temperature for one axis at a time with all other axes at their ideal positions.
**Based on published specifications

Mercury Can Reduce System Size and Cost
Mercury’s sensor height is 44% shorter than competitive encoders, making it easy to fit into your design. This reduction can also cut total system weight and cost by allowing the use of smaller motors and stages. Safe system operation is also enhanced thanks to Mercury’s generous standoff clearance— 200% greater than other encoders. And its standoff tolerance is 50% greater than the best alternative.

This significantly relaxes mechanical system tolerances, while reducing system costs.

Mechanical Dimension Comparison**

<table>
<thead>
<tr>
<th></th>
<th>Mercury</th>
<th>Brand X</th>
<th>Brand Y</th>
<th>Mercury vs. Best Competitor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensor Z height</td>
<td>8.4mm</td>
<td>23mm</td>
<td>15mm</td>
<td>44% better</td>
</tr>
<tr>
<td>Standoff clearance</td>
<td>2.4mm</td>
<td>0.5mm</td>
<td>0.8mm</td>
<td>200% better</td>
</tr>
<tr>
<td>Standoff tolerance</td>
<td>± 0.15mm</td>
<td>± 0.1mm</td>
<td>± 0.1mm</td>
<td>50% better</td>
</tr>
<tr>
<td>System height</td>
<td>11.7mm</td>
<td>28.5mm</td>
<td>15.8mm</td>
<td>26% better</td>
</tr>
</tbody>
</table>

*Dimensions shown illustrate encoder system standoff clearance; see Mercury Encoder Interface Drawings for correct design reference surfaces.

**Based on published specifications
System Specifications

**System**
Grating Period 20µm  
Signal Period 20µm  
**System Resolution**  
Fundamental resolution: Linear 20µm; Rotary 2500 - 16,384 CPR  
Interpolated resolution determined by customer electronics: Linear: 20µm - 0.078µm; rotary: 2,500 to 4.2M CPR  
Linear Accuracy* Better than ±1µm available; contact MicroE  
Better than ±3µm up to 130mm, ±5µm from 155mm to 1m  
*Maximum peak to peak error over the specified movement when compared to a NIST-traceable laser interferometer standard, used at room temperature and with MicroE interpolation electronics.  
**Rotary Accuracy**  
Scale O.D. Microradians Arc-Seconds  
| Scale O.D. | ±100 | ±21  
|------------|------|------  
| 12.00mm    | 19.05mm | ±63 | ±13  
| 31.75mm    | 57.15mm | ±38 | ±7.8  
| 107.95mm   | 107.95mm | ±10 | ±2.1  

*Based on ideal scale mounting concentricity

**Sensor Size**
W: 12.70mm 0.500*  
L: 20.57mm 0.810*  
H: 8.38mm 0.330*  

**Operating and Electrical Specifications**
Vacuum 10⁻⁸ Torr, negligible outgassing  
Bake Out Up to 150°C, up to 48 hours, non-operating  
Power Supply 5VDC ±5% @ 60mA  
Temperature  
Operating: Sensor: 0 to 70°C  
Storage: -20 to 70°C  
Humidity: 10 - 90% RH non-condensing  
Shock: 1500G 0.5ms half sine  
Sensor Weight: 2.7g (Sensor without cable)  
Cable: The 1.5m vacuum-compatible cable is EMI shielded and comes standard with bare leads for customer termination within the vacuum bulkhead. Custom cable lengths and connectors are available.

**Maximum Speed**
Scale Length/Diameter Maximum Speed*  
Linear All Lengths 7200mm/s  
Rotary 0.75" 8640 RPM  
1.25" 5272 RPM  
2.25" 2637 RPM  
4.25" 1318 RPM  
*Assumes customer electronics have adequate bandwidth

**Mercury 1000V Outputs**
15-pin Standard Male D connector  
<table>
<thead>
<tr>
<th>Pin</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Index Window-</td>
</tr>
<tr>
<td>2</td>
<td>Index Window+</td>
</tr>
<tr>
<td>3</td>
<td>Reserved - do not connect</td>
</tr>
<tr>
<td>4</td>
<td>Reserved - do not connect</td>
</tr>
<tr>
<td>5</td>
<td>Reserved - do not connect</td>
</tr>
<tr>
<td>6</td>
<td>Reserved - do not connect</td>
</tr>
<tr>
<td>7</td>
<td>Cosine+</td>
</tr>
<tr>
<td>8</td>
<td>Sine+</td>
</tr>
<tr>
<td>9</td>
<td>Reserved - do not connect</td>
</tr>
<tr>
<td>10</td>
<td>Reserved - do not connect</td>
</tr>
<tr>
<td>11</td>
<td>Reserved - do not connect</td>
</tr>
<tr>
<td>12</td>
<td>+5V</td>
</tr>
<tr>
<td>13</td>
<td>Ground</td>
</tr>
<tr>
<td>14</td>
<td>Cosine-</td>
</tr>
<tr>
<td>15</td>
<td>Sine-</td>
</tr>
</tbody>
</table>

**Index Window Pin 2**

**Mechanical Information - Sensor**

All Specifications are subject to change. All data is accurate to the best of our knowledge. MicroE Systems is not responsible for errors.
Scale Specifications
Standard and Customized Scales

MicroE Systems offers a wide array of chrome on glass scales for the highest accuracy and best thermal stability. Easy to install, standard linear and rotary scales meet most application requirements. Customized linear, rotary, and rotary segment scales are available where needed. All scales include an optical index. Mercury’s glass scales save time by eliminating motion system calibrations or linearity corrections required by other encoders, and provide better thermal stability than metal tape scales.

Options include:
- **Standard linear**: 18mm - 2m
- **Standard rotary**: 12mm - 107.95mm diameter, with or without hubs
- **Custom linear**: special lengths, widths, thickness, index mark locations and special low CTE materials
- **Custom rotary**: special ID’s, OD’s (up to 304.8mm), index mark outside the main track and special low CTE materials
- **Mounting of hubs for rotary scales**: MicroE Systems can mount and align standard, custom, or customer-supplied hubs
- **Rotary segments**: any angle range; wide range of radius values

*Custom scales or rotary segments are available in OEM quantities. Contact your local MicroE Systems sales office.

### Standard Short Linear Scales
130mm and Shorter

**Key**: inches[mm]

<table>
<thead>
<tr>
<th>Model</th>
<th>L18</th>
<th>L30</th>
<th>L55</th>
<th>L80</th>
<th>L105</th>
<th>L130</th>
</tr>
</thead>
</table>

**Specifications**
- **Accuracy**: ±3µm standard
- **Material**: Soda lime glass
- **Index**: Center or End

**Custom scales available**

### Standard Long Linear Scales
155mm and Longer

**Key**: inches[mm]

<table>
<thead>
<tr>
<th>Model</th>
<th>L155</th>
<th>L225</th>
<th>L325</th>
<th>L425</th>
<th>L525</th>
<th>L1025</th>
<th>L2025</th>
</tr>
</thead>
</table>

**Specifications**
- **Accuracy**: ±5 µm <1m
- **Material**: Soda lime glass
- **Index**: Center or End

**Custom scales available**

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## Standard Rotary Scales

![Diagram of a rotary scale](Image)

### Key:
- inches [mm]

### Specifications

<table>
<thead>
<tr>
<th>Material</th>
<th>Soda lime glass</th>
</tr>
</thead>
<tbody>
<tr>
<td>Typical CTE</td>
<td>8ppm/°C</td>
</tr>
</tbody>
</table>

### Model No.
- **M1000V-MV**
- **R1206**
- **R1910**
- **R3213**
- **R5725**
- **R10851**

<table>
<thead>
<tr>
<th>Scale Diameter</th>
<th>Scale Inner Diameter</th>
<th>Optical Diameter</th>
<th>Hub Inner Diameter</th>
<th>Hub Thickness</th>
<th>Fundamental CPR</th>
</tr>
</thead>
<tbody>
<tr>
<td>R1206 0.472 [12.00]</td>
<td>0.250 [6.35]</td>
<td>0.413 [10.50]</td>
<td>0.1253 [3.18]</td>
<td>0.040 [1.02]</td>
<td>1650</td>
</tr>
<tr>
<td>R1910 0.750 [19.05]</td>
<td>0.375 [9.52]</td>
<td>0.627 [15.92]</td>
<td>0.1253 [3.183]</td>
<td>0.040 [1.02]</td>
<td>2500</td>
</tr>
<tr>
<td>R3213 1.250 [31.75]</td>
<td>0.500 [12.70]</td>
<td>1.027 [26.08]</td>
<td>0.2503 [6.358]</td>
<td>0.050 [1.27]</td>
<td>4096</td>
</tr>
<tr>
<td>R5725 2.250 [57.15]</td>
<td>1.000 [25.40]</td>
<td>2.053 [52.15]</td>
<td>0.5003 [12.708]</td>
<td>0.060 [1.52]</td>
<td>8192</td>
</tr>
</tbody>
</table>

### How to Order Mercury 1000V Encoder Systems

To specify your Mercury encoder with the desired scale, cable length and software, consult the chart below to create the correct part number for your order. Call MicroE Systems’ Rapid Customer Response team for more information [508] 903-5000.

**Example (Linear Encoder):** M1000V-MV-L55-C1  
**Example (Rotary Encoder):** M1000V-MV-R1910-HA

- **M1000V-MV** – Scale Model – Scale Mounting
- **MV = 1.5m cable**  
- **Lxx or Rxxxx**  
- **C1 = 3 scale clamps**
- **C2 = 10 scale clamps**

### Hubs for Rotary Scales:
- **NH = Without Hub**
- **HE = for R1206**
- **HA = for R1910**
- **HB = for R3213**
- **HC = for R5725**
- **HD = for R10851**

### How to Order SmartPrecision Alignment Tool

Required for M1000V setup

**Example:** Alignment Tool for Mercury 1000 encoder, 120 VAC = SSAT1000-120

- **SSA**
- **1000** – Voltage
  - **120 = 120 VAC, 60Hz US Std. 2-prong plug**
  - **220 = 220 VAC, 50Hz European Std. 2-prong plug**

### How to Order SmartPrecision Software

- **SmartPrecision Software**
  - **SSWA120** for 120 VAC, 60Hz US Standard 2-prong plug
  - **SSWA220** for 220 VAC, 50Hz European Standard 2-prong plug

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