

## NanoGrid Planar Encoder System: Model A (High Resolution)

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### PRODUCT DESCRIPTION

The NanoGrid<sup>®</sup> Planar Encoder System is used to measure 2-dimensional ultra-precise planar displacements. NanoGrid is an XY grid-based encoder system that avoids the turbulence effects which are commonly encountered with laser interferometers or the Abbe errors associated with separate linear scales. NanoGrid captures the precision of laser interferometry within the manufacturing process of the grid and packages it in a lower cost, more usable, and rugged format.

The XY encoder, or grid, has a basic period of 10 microns in both the X and Y directions, and the metrology system generates a measurement period of 5 microns. The NanoGrid's patented tri-phase 90-element detector captures first order laser diffracted signals reflected from the grid. The three signals generated by the detector provide an unambiguous measurement of phase for extremely small movements.

The NanoGrid Model A metrology system is unique in a number of its features, but particularly in the high degree of accurate interpolation that it provides. The NanoGrid sensor and associated high resolution phase processor electronics provide 14 bits of interpolation, corresponding to a measurement resolution of 0.3nm.

Several standard grid sizes are available to meet the requirements of semiconductor equipment manufacturers and other customers. Custom grid sizes can also be purchased for an exact fit.

The standard position output signal is in the form of a 32-bit parallel word. A-quad-B output format can be derived from the 32-bit word via a separate optional board. Yaw (rotation about the axis perpendicular to the plane) can be measured by adding a second single-axis sensor head.

NanoGrid is an excellent choice for submicron ultra precision XY positioning or as a calibration tool for high precision machine tools and stages.

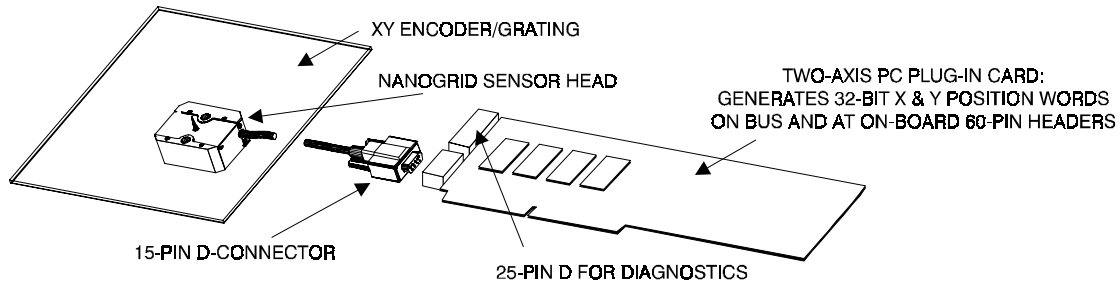


### ADVANTAGES

- Sub-nanometer position resolution
- Measurement repeatability of  $\leq 5$  nm
- Reduce Abbe Error
- Insensitivity to turbulence and atmospheric pressure changes
- Small footprint & low moving mass
- Vacuum compatible units available
- Easy to install; stress-relieved grid mounting included
- 12 mm clearance between grid and sensor head
- Low sensitivity to alignment errors
- Full technical support; customization available

# NanoGrid Model A (High Resolution)

## TECHNICAL SPECIFICATIONS



### System Performance

|  |  |
|--|--|
| Resolution   | 20nm up to 0.305nm                         |
|  |  |
| * (Temperature stabilization to $\pm 0.25^\circ\text{C}$ ) |  |
| Maximum velocity   | 700mm/sec                                  |
| Encoder to sensor head gap                                 | 12.0 $\pm$ 0.1 mm                          |
| Measurement area<br>(others available)                     | 40x45mm, 150x150mm<br>210x210mm, 380x380mm |
| Operating temperature                                      | +10°C to +40°C                             |
| Storage temperature  | -20°C to +50°C                             |

### NanoGrid Sensor Head

|                      |                             |
|----------------------|-----------------------------|
| Dimensions           | 23.5 x 47.0 x 60.5mm        |
| Housing material     | 6061-T6 aluminum            |
| Light source (785nm) | Class IIIb 3mW laser diode  |
| Weight without cable | 110gm                       |
| Interface cable      | 3 m cable, 15-pin connector |

### Two-Axis High-Resolution Processor

|   |  |
|---|--|
| Resolution                                      | LSB = $5\mu\text{m} \div 2^{14} \approx 0.305 \text{ nm}$  |
| Update rate/axis                                | (parallel out) 375 kHz   |
| Range   | $\sim 1300 \text{ mm}$ (32 bit rollover)   |
| Data age  | $< 8\mu\text{sec}$ ; stability $< 25 \text{ nsec}$   |
| Interfaces                                      | 25-pin test connector<br>Two 60-pin parallel connectors<br>PC-compatible 16-bit ISA bus<br>15-pin HD to Sensor Head                                      |
| Output format                                   | 32-bit parallel word (each axis)   |
| A-quadrant (optional)                           | Edge rate: 1.875, 3.75, 7.5, 15MHz<br>Resolution: $5\mu\text{m} \div 2^N$ ; N = 9 to 14;<br>$\approx 0.3$ to 9.8 nm<br>Edge-rate & resolution selectable |
| Mechanical                                      | ISA-compatible 16-bit PC board   |
| Power<br>(Does not include<br>A-quadrant board) | +5VDC (+0.25/-0.13 V) @ 2.2 A;<br>+12VDC $\pm 0.5\text{V}$ @ 120 mA;<br>-12VDC $\pm 0.5\text{V}$ @ 70 mA   |

### NanoGrid Encoder

|  |                                     |
|--|-------------------------------------|
| Pitch (mechanical/optical)                         | 10 $\mu\text{m}$ / 5 $\mu\text{m}$  |
| Soda-lime expansion coefficient:                   | $7.0 \times 10^{-6}/^\circ\text{C}$ |
| Quartz (fused silica) expansion coeff:             | $0.7 \times 10^{-6}/^\circ\text{C}$ |
| <i>Other materials available – consult factory</i> |                                     |

### System Components

The NanoGrid Model A System consists of a planar encoder (XY grid), sensor head with cable, and 2-axis high-resolution processor board.

### NanoGrid Sensor Head

The NanoGrid Sensor Head contains a single laser diode source and separate optical systems for making planar position measurements. Output signals from the Sensor Head go to the Processor.

### Two-Axis High-Resolution Processor

The Two-Axis High-Resolution Processor is a full size, ISA-bus-compatible PC plug-in card. It supplies power to, and receives signals from the NanoGrid Sensor Head via an interface cable. After processing these signals, it generates 32-bit words which describe the position of the encoder relative to the NanoGrid Sensor Head. Binary (TTL) flags and board-mounted LED's indicate excess speed and low signal conditions. An optional daughter board provides an A-quadrant output with selectable resolution.

### NanoGrid Encoder

The standard NanoGrid encoder is a 10  $\mu\text{m}$  pitch, 2-dimensional diffraction grating on soda-lime glass. The XY grid can be attached to a metal ring with incorporated flexures that provides kinematic KineFlex mounting with stress relief and ease of installation.

### Documentation Package

This package contains dimensional and tolerance information needed to properly locate the NanoGrid sensor head relative to the NanoGrid encoder, instructions for mounting the NanoGrid encoder, and an operating manual.



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