

# OPTRA

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

### 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.

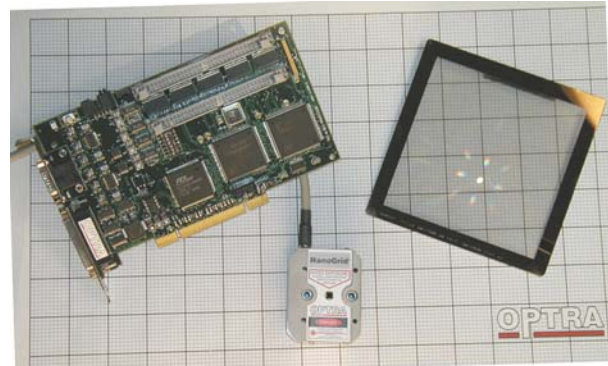
The XY encoder, or grid, has a basic period of 10 microns in both the X and Y directions, and the metrology system generates a measurement period of 5 microns. The NanoGrid's patented tri-phase 90-element detector captures first order laser diffracted signals reflected from the grid. The three signals 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 available in the form of a 32-bit parallel word or in A-quad-B format. Position data is also available over the PCI bus at rates up to 110kHz. 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.



**NanoGrid System Components. High Resolution Processor Board, NanoGrid Sensor Head and Grid Encoder. A 100mm grid is shown; other sizes are available upon request.**

### ADVANTAGES

- Sub-nanometer position resolution
- Measurement repeatability of  $\leq 5$  nm
- Reduced 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 available.
- 12 mm clearance between grid and sensor head
- Low sensitivity to alignment errors
- Full technical support; customization available
- High-speed operation

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**System Performance**

Repeatability	±5nm
Accuracy *	See Plot
* For more information on NanoGrid system accuracy please visit <a href="http://www.optra.com">www.optra.com</a>	
Maximum tracking velocity	4 meters/sec
Encoder to sensor head gap	12.0 ±0.05 mm
Measurement area (others available)	40×45mm, 150×150mm 210×210mm, 380×380mm
Operating temperature	+10C to +40C
Storage temperature	-20C to +50C

**NanoGrid Sensor Head**

Dimensions	23.5 × 47.0 × 60.5mm
Housing material	6061-T6 aluminum
Light source (690nm)	Class IIIb 35mW 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) 2MHz
Range	~1300 mm (32 bit rollover)
Data age @ parallel out	< 1.2µsec; stability < 25 nsec
Interfaces	25-pin test connector Two 60-pin parallel connectors 32-bit PCI bus: 33MHz @3.3 or 5V 15-pin HD to Sensor Head
Output format	32-bit parallel word (each axis)
A-quadr-B	Edge rate, MHz: 2.5, 5, 10, 20 Resolution: $5\mu\text{m} \div 2^N$ ; N = 9 to 14; $\approx 0.3$ to 39.1 nm Edge-rate & resolution selectable
Mechanical	PCI-compatible 32-bit PC board
Power (Does not include A-quadr-B board)	+5VDC (+0.25/-0.13 V) @ 0.5 A; +12VDC ±0.5V @ 120 mA; -12VDC ± 0.5V @ 150 mA

**NanoGrid Encoder**

Pitch (mechanical/optical)	10 µm / 5µm
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 hi-resolution processor board.

**NanoGrid Encoder**

The standard NanoGrid encoder is a 10 µm 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 mounting with stress relief and ease of installation.

**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, PCI-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 A-quadr-B output with selectable resolution is available as well as the parallel digital word. Diagnostic signals are available at the 25-pin test connector, and over the PCI bus.

**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.

