



## NanoScale Linear Metrology System: Model A (High Resolution)

### PRODUCT DESCRIPTION

NanoScale<sup>®</sup> is an ultra-precise interferometric encoder measurement system for linear displacements. It avoids the turbulence effects which are commonly encountered with laser interferometers, while offering repeatability and resolution at the nanometer level. NanoScale is easy to adopt within most existing stage designs.

The NanoScale sensor is a highly precise electro-optic device using a laser diode source. Its patented tri-phase 90-element detector captures the first order diffracted signals reflected by the scale. The three signals provide unambiguous measurements of encoder phase with high interpolation depth and insensitivity to encoder reflectivity.

The NanoScale 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 NanoScale sensor and associated high resolution phase processor electronics provide 14 bits of interpolation, corresponding to a measurement resolution of 0.305 nm.

The glass scale has a basic period of 10 microns (5 micron effective optical period). OPTRA scales are derived from state-of-the-art semiconductor direct-write lithography processes under highly controlled conditions. Various scale sizes, from 70 mm to 380 mm, are available to meet the needs of precision machinery and measurement products. Scales are available on various glass and quartz substrates.

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.

NanoScale Model A is a superior ultra precision linear encoder. NanoScale Model B is a cost effective alternative for resolutions greater than 20nm.



### ADVANTAGES

- Sub-nanometer measurement resolution
- High-velocity capability
- Insensitivity to turbulence and atmospheric pressure changes
- Measurement repeatability of  $\leq 5$  nm
- Replace existing metrology without major stage redesign
- Small footprint & low moving mass
- Vacuum compatible models available
- Low sensitivity to alignment errors
- Full technical support; customization available

### OPTRA, Inc.

461 Boston St. Topsfield, MA 01983  
978-887-6600 FAX: 978-887-0022  
info@optra.com or <http://www.optra.com>

# NanoScale 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	3.0 $\pm$ 0.1mm
Scale sizes	Up to 380mm
Operating temperature	+10 $^{\circ}\text{C}$ to +40 $^{\circ}\text{C}$
Storage temperature	-20 $^{\circ}\text{C}$ to +70 $^{\circ}\text{C}$

### NanoScale Sensor Head

Dimensions	61mm $\times$ 33mm $\times$ 17mm
Housing material	6061-T6 aluminum
Light source (785nm)	Class IIIb 3mw laser diode
Weight without cable	70gm
Interface cable	18" ribbon, 9-pin D-connector

### High Resolution Processor Board

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

### NanoScale 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:	$0.7 \times 10^{-6} / ^{\circ}\text{C}$
Other materials available – consult factory	

### System Components

The NanoScale System consists of a mounted linear encoder scale, sensor head with cable, and high-resolution processor board.

### NanoScale Sensor Head

The NanoScale Sensor Head contains a single laser diode source and electro-optical systems for making the linear position measurements. Output signals from the Sensor Head go to the PC processor board.

### High Resolution Processor Board

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

### NanoScale Encoder

The standard NanoScale encoder is a 10  $\mu\text{m}$  pitch linear grating on soda-lime glass. Other substrates are available together with various mounting options.

### Documentation Package

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



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978-887-6600 FAX: 978-887-0022  
info@optra.com or <http://www.optra.com>

## INNOTICS, Inc.

Tel: +82 53 816 1012  
Fax: +82 53 816 9012  
sales@innotics.com [www.innotics.com](http://www.innotics.com)