



## NanoScale Linear Metrology System: Model B (Standard Resolution)

### PRODUCT DESCRIPTION

NanoScale® Model B is an ultra-precise interferometric encoder system for measuring linear displacements. It avoids the turbulence effects commonly encountered with laser interferometers while offering high repeatability and resolution. 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 B uses a proprietary 8-bit/cycle interpolation algorithm embodied in the PolarFlash™ ASIC. This provides 20 nm resolution and repeatability, and generates an A-quadrant-B output signal with a selectable trade-off between resolution and maximum encoder speed. The A-quadrant-B (TTL) output allows for easy substitution when upgrading from other encoder-based metrology systems.

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 are available to meet the requirements of semiconductor equipment manufacturers and other customers, ranging from 70 mm to 380 mm. Scales are available on various glass and quartz substrates.

The more expensive NanoScale Model A uses different electronics to provide deeper interpolation and finer resolution (0.3 nm). It is the most precise linear encoder commercially available ( $\pm 5$  nm).



### ADVANTAGES

- Measurement repeatability of  $\pm 20$  nm
- Accuracy of better than  $\pm 200$  nm for scales less than 175 mm (7 inches) long
- High velocity capability
- Insensitivity to turbulence and atmospheric pressure changes
- Replaces existing metrology without major stage redesign
- Standard A-quadrant-B encoder output
- Low sensitivity to alignment errors
- Full technical support; customization available
- High performance, low cost

### OPTRA, Inc.

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# NanoScale Model B (Standard Resolution)

## TECHNICAL SPECIFICATIONS

### System Performance

Repeatability	± 20 nm
Accuracy (175mm) <sup>1</sup>	± 200 nm
Accuracy (380 mm) <sup>1</sup>	± 1.2 µm
<sup>1</sup> (Temperature stabilization to ±0.25°C)	
Maximum velocity <sup>2</sup>	1400mm/sec
<sup>2</sup> (V-MAX = [selectable max .edge rate] × [selectable LSB])	
Encoder to sensor head gap	3.0 ±0.1 mm
Scale Sizes	up to 380 mm
Operating temperature	+10°C to +40°C
Storage temperature	-20°C to +70°C

### NanoScale Sensor Head

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

### PolarFlash™ Processor (A-quad-B)

Resolution (LSB)	(selectable) 5µm÷2 <sup>N</sup> ; N = 5,6,7,8; ≈ 20,39,78,156 nm
Max. edge rate	(selectable) 1.25, 2.5, 5, or 10 MHz
Data age	< 4 µsec
N.E. ΔX	< 5 nm
Output format	A-quad-B differential TTL
Mechanical	127mm × 84mm × 24mm
Power	+5VDC (+0.25V/-0.13V) @ 0.4 A

### NanoScale Encoder

Pitch (mechanical/optical)	10 µm / 5µm
Soda-lime expansion coefficient:	7.0 × 10 <sup>-6</sup> /°C
Quartz (fused silica) expansion coeff:	0.7 × 10 <sup>-6</sup> /°C
<i>Other materials available – consult factory</i>	

### System Components

The NanoScale System consists of a linear encoder scale, sensor head with cable, and a PolarFlash module capable of processing two sets of signals.

### NanoScale Sensor Head

The NanoScale Sensor Head contains a laser diode source, optical system, and detector for making linear position measurements. Output signals from the Sensor Head go to the processor board.

### PolarFlash Processor

The PolarFlash Processor is a small printed circuit board in an aluminum housing. It supplies power to and receives signals from the NanoScale sensor head via the interface cable. After processing these signals, it generates an A-quad-B signal which describes the displacement of the scale relative to the NanoScale sensor head with a (selectable) resolution down to 20 nm. A binary flag (TTL level) indicates EXCESS SPEED; an LED indicates proper alignment between the sensor head and the encoder scale.

### NanoScale Encoder

The standard NanoScale encoder is a 10µm pitch linear chromate 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 to mount the NanoScale encoder; and an operating manual.

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