

NanoGage 100: Short Range Position & Displacement Sensor

PRODUCT DESCRIPTION

NanoGage™ 100 is a non-contact ultra precision optical displacement sensor with a 100 micron measurement range and a resolution of 15 nanometers. It offers a 3mm working distance and can be used with a wide range of target materials including metal, semiconductor, or glass. The optical sensor is easy to adopt within existing designs and is equivalent to a high resolution capacitance gage while offering a larger stand-off. The NanoGage 100 sensor is an ideal tool to be used for maintaining constant position, vibration measurement, run-out measurement, or surface profiling.

NanoGage is a laser diode optical triangulation sensor assembled with exquisite precision and which employs diffraction-limited lenses. The small size of the NanoGage sensor allows for easy substitution when upgrading from other sensors, such as capacitance gages. It has a capture range of about 800 microns and a 100 micron linear measurement range. It is highly insensitive to temperature and electromagnetic interference. The small measurement footprint of a NanoGage can ensure proper measurement at a single point.

The large 3mm stand-off is advantageous in manufacturing applications where handling equipment requires additional clearance, such as with semiconductor wafers. It has been developed for convenience of installation. A large measurement bandwidth also makes the sensor well-suited for high speed run-out or vibration measurements.

OPTRA produces complementary high precision encoders, including NanoGrid and NanoScale, for feedback of all six degrees of freedom on ultra-precision positioning systems.



ADVANTAGES

- High measurement resolution
- Large stand-off: 3 mm
- Insensitive to temperature and electromagnetic interference
- Small measurement footprint: \square 100 μ m
- Large bandwidth: 100 kHz
- Easily replaces capacitance sensors
- Full technical support; customization available

APPLICATIONS

- Short-range servo control feedback
- Run-out measurements
- Auto focus sensor
- Vibration measurements
- Surface profiling

OPTRA, Inc.

461 Boston St. Topsfield, MA 01983
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

TECHNICAL SPECIFICATIONS

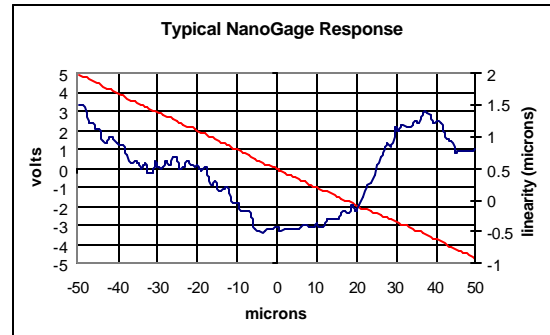
NanoGage 100 consists of a sensor head with a 0.46 meter (18 inch) cable attached to a small electronics module with a 9-pin output connector. A shielded extension cable can extend the length and connect to customer electronics. A 3-color diode indicates when the sensor has lost signal (red), when it is within the capture range (yellow) or near the zero crossing (green).

Performance

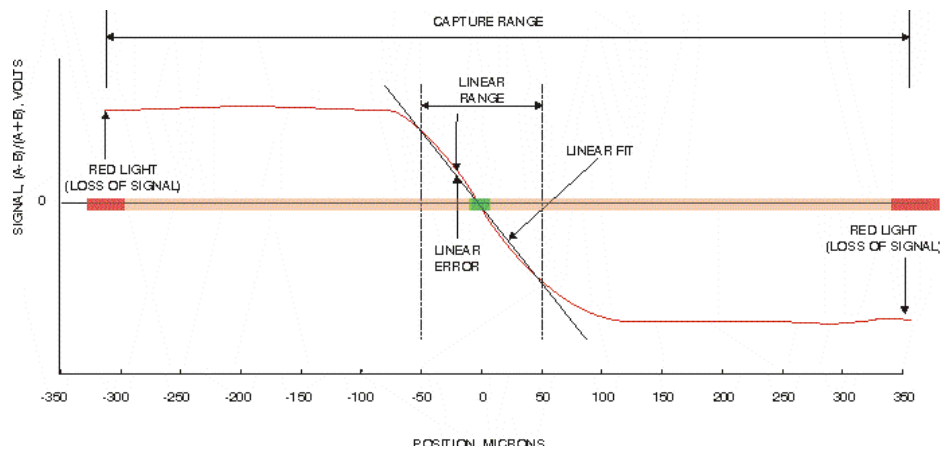
Resolution	15 nm rms @ f = 100 kHz
Measurement linear range	100 μm
Signal capture range ¹	± 400 μm
Bandwidth (3 dB) ²	100 kHz
Surface reflectivity for full resolution ³	4% to 100% specular

System

Nominal Responsivity ⁴	100 mV/μm ± 10%
Sensor head standoff	3.0 mm
Perpendicular tolerance	± 0.1 degrees
Input power	± 12 VDC @ 80 mA
Mounting	0.500 inch (12.7 mm) diameter body for collet
Sensor body length	2.31 inch (58.7 mm)
Maximum sensor diameter	0.623 inch (15.9 mm)
Measurement spot diameter	≈ 100 μm
Cable length	46 cm (18")
Electronics module size	98 mm × 32 mm × 13 mm
Connector to customer cable	9 pin D-connector



All specifications are subject to change without notice.



¹ Range which unambiguously determines which side of zero the measurement is being taken.

² For a sinusoidal motion at 100 kHz, the measured displacement amplitude would be down 3 dB of its actual value at a slope of -12 dB/octave.

³ The sensor also works with smooth diffusely reflective surfaces such as milled aluminum or steel.

⁴ Each unit is shipped with a linear response factor and calibration plot from -50 μm to +50 μm



OPTRA, NanoGrid and NanoScale are registered trademarks and NanoGage is a trademark of OPTRA, Inc..

OPTRA, Inc.

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

INNOTICS, Inc.

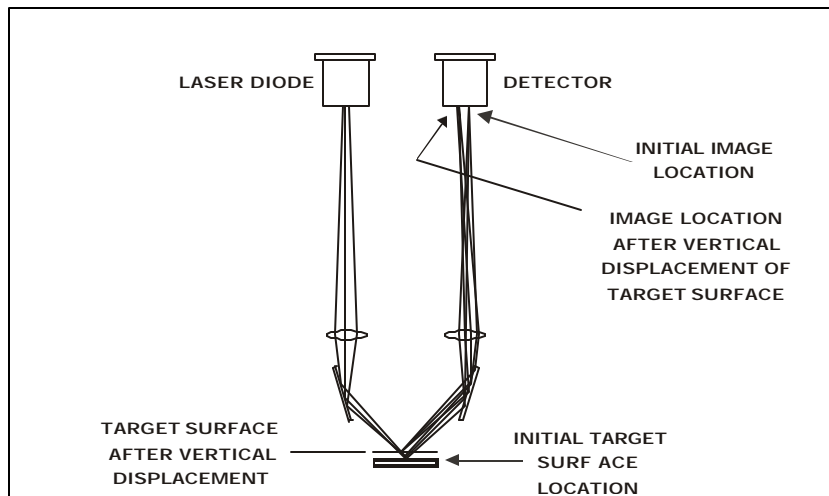
Tel:+82 53 816 1012
Fax:+82 53 816 9012

sales@innotics.com www.innotics.com

Measurement Principle

The NanoGage is a folded optical triangulation sensor based on a bi-cell detector and precisely controlled focal spot size. The optical layout is illustrated in figure 1 below. High resolution results from the use of a small focal spot size in conjunction with an AGC-controlled laser diode source and a bi-cell detector with a 10 micron gap. Individual sensors can be corrected to achieve 0.1% or better linearity over their specified measurement range. Automatic Gain Control (AGC) provides uniform response for a wide range of surface reflectivities. Unlike triangulation sensors based on position-sensing detectors, in which the linear range is set by the detector size, the NanoGage sensor has a linear range that is defined by its focal spot size. This allows for very high resolution in a compact and robust package.

Good linearity is achieved by tailoring of the lens aberrations to give a uniform circular focal spot; final linearity is accomplished based on individual sensor calibration and correction.



NanoGage optical layout

Because of the oblique illuminating and viewing angles, a vertical displacement of the target surface causes a lateral displacement of the laser image in the plane of the bi-cell detector. The signals from the bi-cell are processed to generate a voltage that is proportional to the vertical displacement. The fold mirrors allow the sensor to be configured as a compact cylinder.

OPTRA, Inc.

461 Boston St. Topsfield, MA 01983

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



NanoGage Operating Instructions

Enclosed with the NanoGage sensor we've included a cable terminated with a 9-pin connector for you to power up the sensor and look at the output.

- 1.) The lead color code is as follows:
 - red: + 12 V
 - white: - 12 V
 - black: gnd
 - yellow: V_{pos} (i.e. the analog output of the NanoGage)

Connect the red, white, and black leads to the power supply as coded. The current requirement is about 80 mA. The V_{pos} signal may be viewed on an oscilloscope or a DVM (or other data acquisition software / hardware).

- 2.) Mount the NanoGage in the 0.5" collet. We recommend a +/- 0.10° installation tolerance.

CAUTION: NanoGage emits 2.5 mW of visible (670 nm) radiation from the filter window. We recommend not powering the sensor until after it is mounted and pointed towards a surface.

- 3.) Power the NanoGage. Drive the sensor towards the target surface (the nominal standoff is 3 mm from sensor nose to target). Figure 1 illustrates the following series of events. The LED will first be red, and V_{pos} will be reading either + or - 5 V until the sensor is within its capture range (which is about 400 μm from the zero crossing). Once inside the capture range, the LED will turn orange, and the output voltage will hover around +10 V and then start to decrease as it approaches its linear region. At + 50 μm , V_{pos} will start at +5V and decrease linearly with distance. At +10 μm from the zero crossing the LED turns green. As the sensor is driven through the zero crossing, V_{pos} goes negative and continues to decrease linearly with distance (LED goes from green to orange at -10 μm) until -50 μm (\approx -5 V). V_{pos} will then increase to and then hover around -10 V until the sensor is out of the capture range where the LED goes red and V_{pos} goes to - 5 V. Note that NanoGage "remembers" which side of zero the sensor was sitting at before it went out of its capture range.

- 4.) Proceed with your application.

OPTRA, Inc.

461 Boston St. Topsfield, MA 01983

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



For technical support of this product, contact David Mansur at (978) 887-6600 x129, dmansur@optra.com

OPTRA, Inc.

461 Boston St. Topsfield, MA 01983

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