mtiinstruments

A worldwide leader in precision measurement solutions

MTI-2100 FOTONIC™ SENSOR

High resolution, non-contact measurement of vibration and displacement

MTI-2100 Fotonic™ Sensor

Unmatched Resolution and Frequency Response in Non-Contact, Fiber-Optic Measurement

The MTI-2100 features advanced fiber-optic and electronic technologies for precise measurements of displacement, position and vibration. It sets new performance standards with resolution as low as 0.01 µin. (2.5 angstroms) and frequency response from direct-coupled (dc) to 500 kHz.

The MTI-2100's modular design has the flexibility to be tailored to specific requirements through the use of a wide range of interchangeable and custom fiber-optic probes. These probes are immune to electromagnetic interference (EMI) and operate on almost any type of surface: metallic, composite, plastic, glass, ceramic or liquid.

Dual-channel capability enables the user to make simultaneous measurements, essential for studies of structure dynamics and modal analysis. For increased versatility, all probe modules offer the advantage of two distinct operating ranges: one for high resolution and the other for greater measurement range.

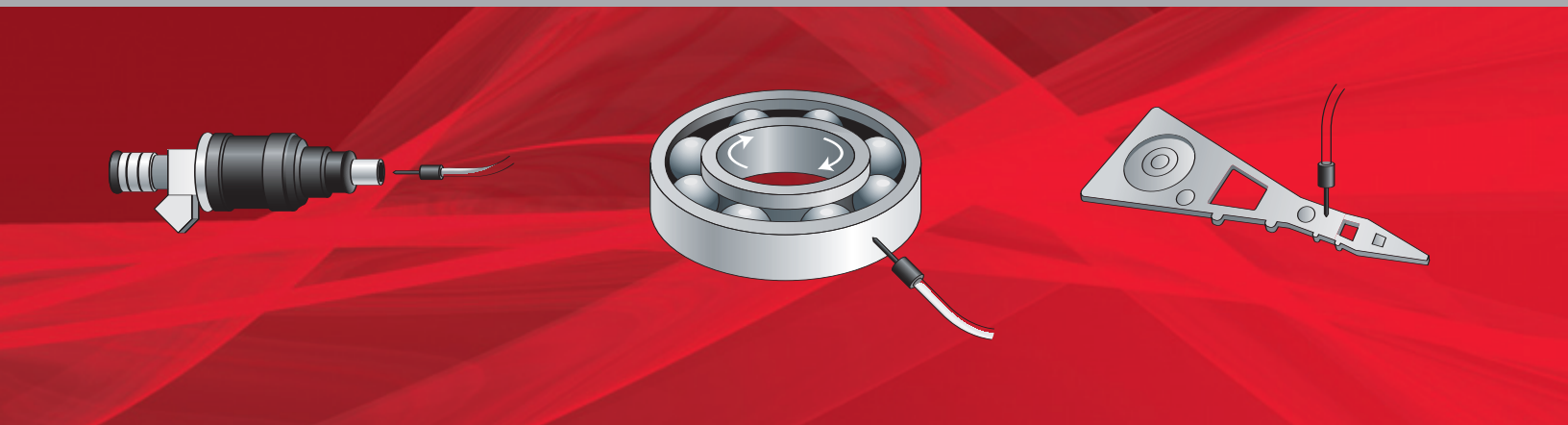
Application Solutions for R&D, Quality and Process Control

- **Vibration**
- **Modal Analysis**
- **Micro-Positioning**
- **Run-out**
- **Displacement**
- **Structural Dynamics**
- **Defect Detection**
- **Resonance Analysis**
- **Reciprocating Motion**
- **Speed Sensing**
- **Surface Finish Analysis**
- **Edge Detection**
- **Liquid Surface Motion**
- **Profiling**

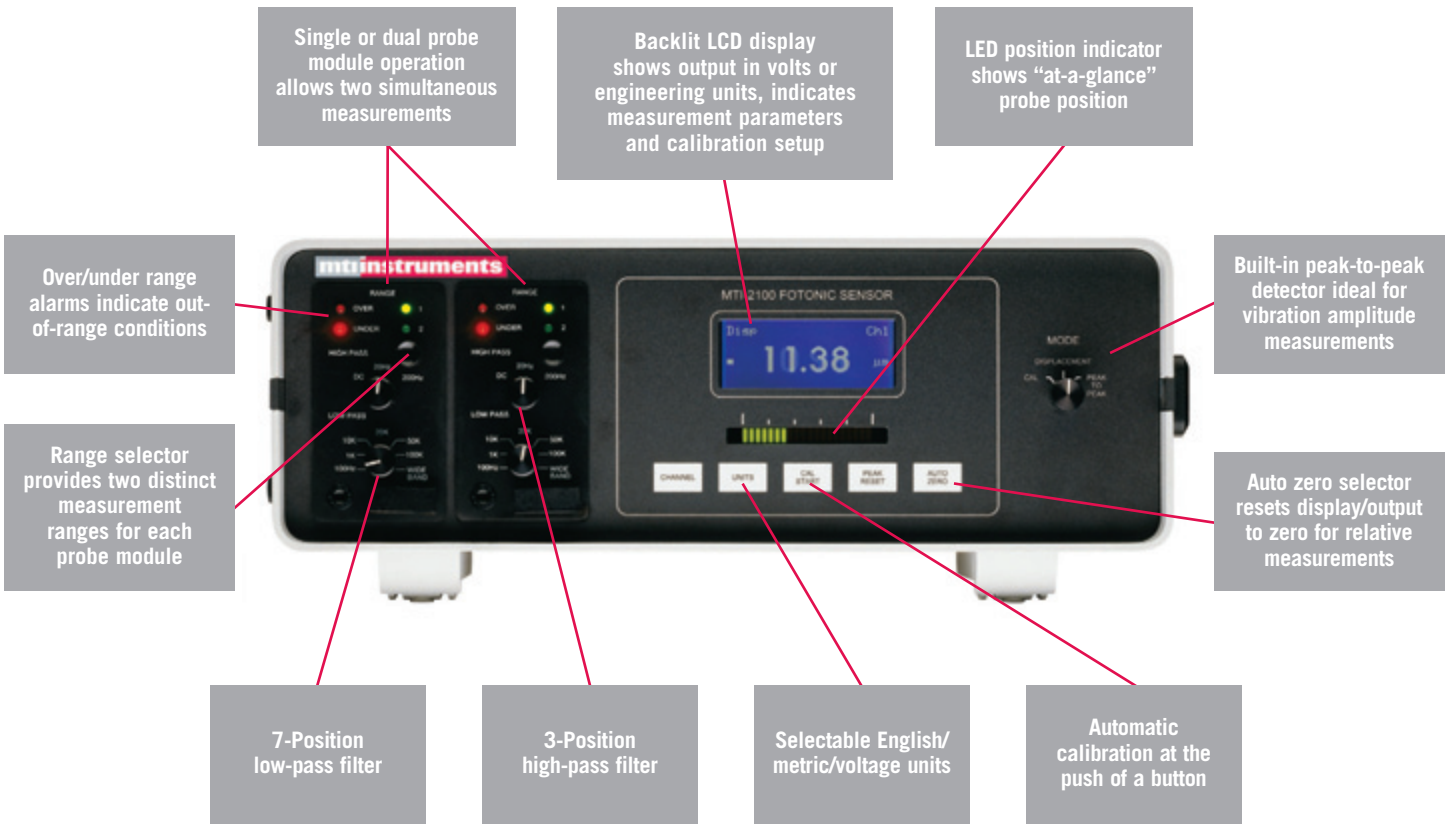
Displacement and Timing of Fuel Injectors and Solenoids

Bearing Defect Analysis

Modal Analysis of Disk Drive Suspensions

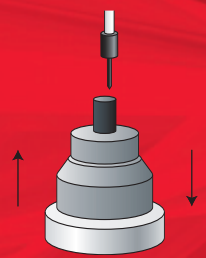


System Features & Advantages

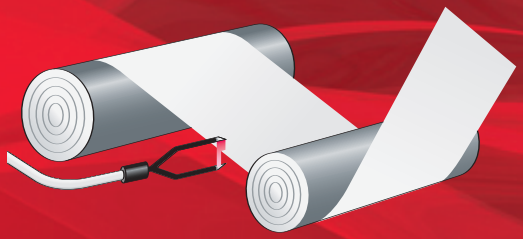


- **High Resolution Module** resolves to 0.01 µin. (2.5 angstroms)
- **Interchangeable Probe Modules** for application flexibility
- **Bent Tip Probes** for hard-to-reach areas
- **Reflective Compensated Modules** eliminate reflection errors
- **Unique Edge Probe Design** for lateral motion measurements
- **High Frequency Measurements** to 500 kHz

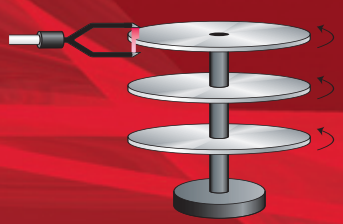
Vibration of Ultrasonic Horns



Tape and Web Edge Positioning



Run-out of Computer Disk Drives

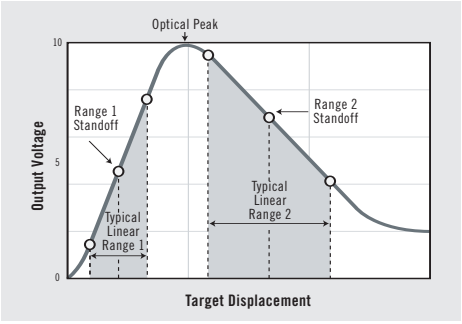


Standard Fotonic Probe

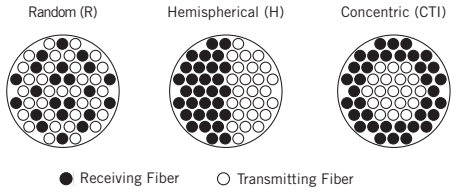
Operating Principle

Each MTI-2100 Fotonic probe contains a set of light transmitting and light receiving fibers, which can be arranged in three different configurations (random, hemispherical or concentric). A tungsten halogen lamp feeds light down the transmit fibers, where it exits the probe tip and hits the target. Light that is reflected from the target is captured by the receive fibers and transmitted to the MTI-2100. The light intensity is monitored, which is proportional to the distance between the probe tip and the target being measured.

At contact, no light is exiting or received by the fibers, giving an output signal of zero. As the probe-to-target distance increases, increasing amounts of light are proportionally captured by the receive fibers. The result is a very sensitive, linear output response (Range 1) from the MTI-2100. As the distance is further increased, the amount of light received approaches the maximum or "optical peak." After the optical peak is reached, a continued increase in probe gap will proportionally reduce the amount of light received. This results in a sensitive, linear output response (Range 2) with a large measurement range and standoff distance.



Fiber Distribution



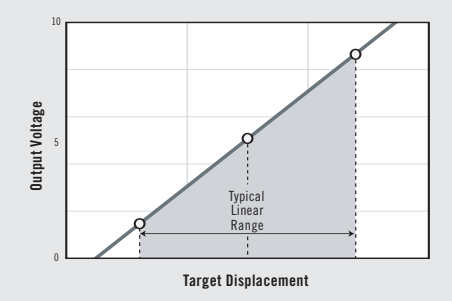
Standard Fotonic Probe Specifications

Probe Module Model No.	Probe Tip Diameter in. (mm) Total	Active	Cable Length in. (mm)	Maximum Frequency Response (-3 dB) kHz	Output Signal Noise[1] mV p-p	Meter Resolution[2, 9] µin. (µm) Range 1	Range 2	Range 1 Characteristics Sensitivity[3] µin./mV (µm/mV)	Linear Range[3, 4] mils (mm)	Standoff[3] mils (mm)	Range 2 Characteristics Sensitivity[3] µin./mV (µm/mV)	Linear Range[3, 4] mils (mm)	Standoff[3] mils (mm)	Optical Peak[5] mils (mm) Mid-point[6, 7]	Range[8]
MTI-2020R	0.020[10] (0.508)	0.007 (0.178)	54 (1372)	120	30	1.0 (0.01)	1.0 (0.1)	0.65 (0.016)	4.0 (0.102)	5.0 (0.127)	3.0 (0.076)	12.0 (0.305)	20.0 (0.508)	12.0 (0.305)	5.0 (0.127)
MTI-2032R	0.032[10] (0.813)	0.019 (0.483)	54 (1372)	120	20	1.0 (0.01)	10.0 (0.1)	0.74 (0.019)	5.0 (0.127)	5.0 (0.127)	5.0 (0.127)	29.0 (0.737)	35.0 (0.889)	20.0 (0.508)	5.0 (0.127)
MTI-2047R	0.047 (1.194)	0.027 (0.686)	54 (1372)	130	10	1.0 (0.01)	10.0 (0.1)	0.80 (0.020)	5.0 (0.127)	5.0 (0.127)	8.0 (0.203)	40.0 (1.016)	44.0 (1.118)	18.0 (0.457)	5.0 (0.127)
MTI-2062R	0.063 (1.600)	0.047 (1.194)	54 (1372)	150	5	1.0 (0.1)	10.0 (0.1)	1.0 (0.025)	6.0 (0.152)	5.0 (0.127)	15.0 (0.381)	60.0 (1.524)	70.0 (1.778)	26.0 (0.660)	9.0 (0.229)
MTI-2062H	0.063 (1.600)	0.047 (1.194)	54 (1372)	150	5	10.0 (1.0)	10.0 (1.0)	5.0 (0.127)	30.0 (0.762)	30.0 (0.762)	20.0 (0.508)	75.0 (1.905)	150.0 (3.810)	100.0 (2.540)	14.0 (0.356)
MTI-2125R	0.125 (3.175)	0.090 (2.286)	54 (1372)	190	3	1.0 (0.1)	10.0 (1.0)	1.0 (0.025)	6.0 (0.152)	7.0 (0.178)	30.0 (0.762)	140.0 (3.556)	120.0 (3.048)	32.0 (0.813)	14.0 (0.356)
MTI-2125CTI	0.125 (3.175)	0.090 (2.286)	54 (1372)	150	3	10.0 (1.0)	10.0 (1.0)	7.0 (0.178)	20.0 (0.508)	30.0 (0.762)	30.0 (0.762)	140.0 (3.556)	220.0 (5.588)	100.0 (2.540)	20.0 (0.508)
MTI-2125H	0.125 (3.175)	0.090 (2.286)	54 (1372)	150	3	10.0 (1.0)	10.0 (1.0)	13.0 (0.330)	70.0 (1.778)	50.0 (1.270)	40.0 (1.016)	175.0 (4.445)	300.0 (7.620)	180.0 (4.572)	50.0 (1.270)
						Range X1	Range X10	Range 1 Characteristics			Range 2 Characteristics				
MTI-2032RX	0.032 (0.813)	0.019 (0.483)	54 (1372)	100	30	1.0 (0.01)	0.1 (0.001)	0.20 (0.005)	1.4 (0.036)	1.5 (0.038)	0.02 (0.0005)	0.4 (0.010)	1.50 (0.038)	5.0 (0.127)	1.50 (0.038)

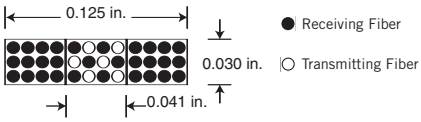
1. When measuring to a 2 µin. AA electroformed, GAR surface-finish comparator block. Noise given is with low pass adjustable filter set at "wide band." Noise decreases as lower filter settings are selected. 2. The analog output resolution is a product of the sensitivity and the noise. 3. Nominal value ± 10%. 4. For approximate ± 1% linear range, multiply by 0.75. 5. Nominal value ± 10%. 6. Optimal standoff for reflectivity/surface finish measurements. 7. Nominal value ± 15%. 8. Displacement range producing 5% change from peak output when making reflectivity/surface finish measurements. 9. Highest possible meter resolution shown for intrinsic English and intrinsic metric engineering units. Probe module's intrinsic (English or metric) engineering units must be specified at the time probe module is ordered. Alternate engineering units selected via the front panel "UNITS" button offer reduced meter resolution. 10. MTI-2020R and MTI-2032R probe modules use a 0.062" diameter sleeve starting 0.250" (6.35 mm) back from the probe tip.

Reflectance Compensated Fotonic Probe

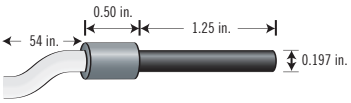
MTI also offers a Fotonic probe design that automatically compensates for large changes in reflectivity of the target being measured. This unique design makes it possible to monitor targets over a dynamic reflectance range of 100:1, while maintaining high resolution and accuracy. The probe consists of three integrated glass fiber bundles. One bundle transmits light while the other two receive light, with different response characteristics. The probe module's electronics use the difference between the two receive bundles to compensate for reflectivity changes and provide a linear response proportional to probe gap. This concept allows the MTI-2100 to be used in applications where the target is translating or rotating.



Fiber Distribution



Probe Dimensions



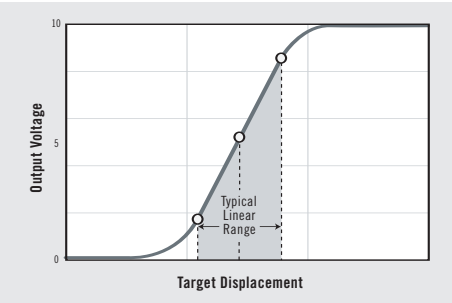
Reflectance Compensated Fotonic Probe Specifications

Probe Module Model No.	Probe Tip Diameter in. (mm)		Cable Length in. (mm)	Maximum Frequency Response (-3 dB) kHz	Output Signal Noise mV p-p	Meter Resolution[1] µin. (µm)		Range 1 Characteristics[2]			Range 2 Characteristics[2]		
	Total	Active				Range 1	Range 2	Sensitivity $\frac{\mu in.}{mV}$	Linear Range[3] mils	Standoff mils	Sensitivity $\frac{\mu m}{mV}$	Linear Range[3] mm	Standoff mm
200RC	0.200 (5.080)	0.125 x 0.030 (3.175 x 0.762)	54 (1372)	100	60	10	(1)	16	100	100	0.406	2.540	2.540

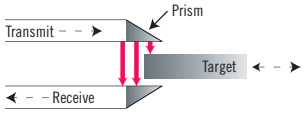
1. The analog output resolution is a product of the sensitivity and the noise. 2. Nominal value ± 10%. 3. For approximate ± 1% linear range, multiply by 0.75.

Fotonic Edge Probe

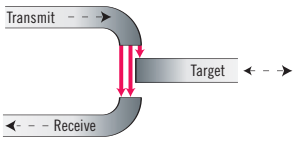
The Fotonic Edge probe is a specially designed sensor used to determine displacement and position of thin objects. The high frequency response obtained makes it ideal for dynamic measurements of computer drive disks, magnetic tapes, ultrasonic tools and production line applications. Each sensor consists of a transmit and receive fiber-optic bundle located opposite each other. Light is directed past the edge of the target being measured to the receive fiber-optic bundle. As the target moves between the probes, the amount of light received fluctuates. The MTI-2100 monitors this fluctuation and precisely converts it to a target position. This highly sensitive design provides a larger probe standoff and can resolve measurements to 0.1 µin. (2.5 nanometers).



Prism Probe Configuration



Bent Tip Probe Configuration



Fotonic Edge Probe Specifications

Probe Module Model No.	Probe Tip Diameter in. (mm)		Cable Length in. (mm)	Maximum[5] Frequency Response (-3 dB) kHz	Output[5] Signal Noise mV p-p	Meter Resolution[1,4] µin. (µm)		Range 1 Characteristics[2]			Range 2 Characteristics[2]		
	Total	Active				Range 1	Range 2	Sensitivity $\frac{\mu in.}{mV}\left(\frac{\mu m}{mV}\right)$	Linear Range[3] mils (mm)	Standoff mils (mm)	Sensitivity $\frac{\mu in.}{mV}\left(\frac{\mu m}{mV}\right)$	Linear Range[3] mils (mm)	Standoff mils (mm)
MTI-2047E	0.047 (1.194)	0.027 (0.686)	54 (1372)	100	13	1.0 (0.01)	1.0 (0.01)	0.75 (0.019)	5.0 (0.127)	N/A	0.10 (0.0025)	2.0 (0.051)	N/A
MTI-2062E	0.063 (1.600)	0.047 (1.194)	54 (1372)	100	18	1.0 (0.01)	1.0 (0.01)	1.20 (0.031)	7.5 (0.191)	N/A	0.16 (0.004)	2.4 (0.061)	N/A

1. The analog output resolution is a product of the sensitivity and the noise. 2. Nominal value ± 10%. 3. For approximate ± 1% linear range, multiply by 0.75. 4. Highest possible meter resolution shown for intrinsic English and intrinsic metric engineering units. Probe module's intrinsic (English or metric) engineering units must be specified at the time probe module is ordered. Alternate engineering units selected via the front panel "UNITS" button offer reduced meter resolution. 5. Actual frequency response and noise levels are dependent upon probe tip separation.

General Specifications

Power Requirements
100 to 240 Vac, 50/60 Hz.
Maximum Power Dissipation: 35 W.
Fuse: 1.25 A, time delay, 250 V, 5 x 20 mm.

Dimensions
5.6 in. (14.2 cm) H.
14.1 in. (35.8 cm) W.
10.5 in. (26.7 cm) D.

Weight
10 lb. (4.5 kg).

Environmental Requirements
Instrument Operating Temperature:
50°F to 110°F (10°C to 43°C) non-condensing.
Instrument Storage Range:
0°F to 150°F (-18°C to 65°C) non-condensing.

Display
Meter: graphic LCD, white on blue background, 100 Hz response, updates 3 times per second.
Bar Graph: 20-element green LED (0.5 Volt step size), 10 Hz response.

Displacement Measurements
Output Signal: 0 to 10 Vdc, 51 Ω output impedance.
Stability at 12 hrs., ± 2°F (± 1°C): drift less than 1.0% of full scale.
Stability at 60°F to 95°F (16°C to 35°C): drift less than 2.0% of full scale.

Vibration Measurements
Output Signal: 0 to 10 Vdc full-scale range, 51 Ω output impedance.
Accuracy: within 1.0% for peak-to-peak readings from 15 Hz to 150 kHz (probe-dependent).
System Noise: dependent upon probe type and surface reflectivity.

High/Low Pass Filters
High Pass Filter: DC, 20 Hz, 200 Hz front-panel selectable 4-pole Butterworth response (-3 dB at value selected).
Low Pass Filter: 100 Hz, 1 kHz, 10 kHz, 20 kHz, 50 kHz, 100 kHz and wide band, 1-pole response (-3 dB at 1.2 X value selected).

RS-232 Data Output
Displacement Data Accuracy: within 1% for signals from dc to 100 Hz.
Vibration Data Accuracy: within 1% for peak-to-peak displacements from 15 Hz to the maximum frequency response of probe module in use.

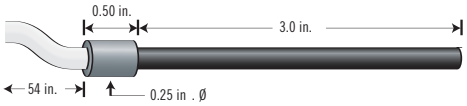
Standard Probe Specifications

Temperature Range: -100°F to 300°F (-70°C to 150°C).

Operating Pressure Range: vacuum of 29 in. Hg to 500 psig. (MTII does not guarantee leak-proof operation)

Tip Length: 3 in. (76.2 mm).

Cable Length: 54 in. (1,372 mm) standard.



Options

- Bent Probe Tips: consult factory for minimum bend radius.
- High-Pressure/High-Vacuum Probes.
- Wide Temperature Range Probes: from -310°F to 1,380°F (-190°C to 750°C).

Accessories

Optical Probe Extenders: Precision lens systems that permit operation of standard fiber-optic probes at a greater standoff distance with no loss of probe sensitivity or frequency response.

FS-3 Probe Mounting Fixture: Used to position the probe over the target being measured. Consists of a magnetic base, two extension arms, probe mounting clamp for diameters up to 0.125 in. (3.2 mm) and micrometer for fine position adjustment.

MTI Instruments has been at the forefront of non-contact measurement technology for nearly 50 years. Our application engineers will be happy to work with you to determine the best solution for your measurement needs.

For information on other non-contact products or custom solutions from MTI Instruments, contact us at 1-800-342-2203 or +1-518-218-2550.

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