MTI-2000
Fotonic Sensor

High-resolution, noncontact measurement of vibration and displacement

The MTI-2000 Fotonic Sensor:

Unmatched performance in noncontact, fiber-optic measurement

The MTI-2000 Fotonic™ Sensor is the newest addition to the MTI Instruments' product line of high-resolution, fiber-optic measurement systems.

The MTI-2000 offers new features and performance improvements that meet the exacting measurement requirements of displacement and vibration applications in the 1990s. It sets new performance standards with resolution to 0.01 microinch (2.5 angstroms) and frequency response from direct-coupled (dc) to 150 kHz. User-defined features assure simple setup and easy operation.

A. Dual-channel capability permits simultaneous measurements of amplitude and phase at two locations.

B. Digital display readout in engineering units eliminates the need to convert volts to displacement units or to double integrate acceleration signals.

C. A peak-to-peak display mode allows the MTI-2000 to be used as a self-contained vibration measurement tool.

D. An easy-to-read **bargraph display** simplifies setup and gives an "analog feel" to the instrument.

E. An **out-of-range indicator** notifies the user if a probe moves out of preset range, preventing measurement error.

F. Pushbutton operation simplifies the calibration of fiber-optic probes.

G. Interchangeable probe modules allow the user to select from seven standard fiber-optic probe designs for the sensitivity, range and frequency response they need. Custom modules can be supplied to meet specific frequency response or gain requirements.

- **High-resolution module** resolves 0.1 µin. standard or 0.01 µin. (2.5Å) optional. With external filtering, 0.004-µin. resolution is possible.

- (Rear Panel) Standard **0-to-10 V analog real-time output** is compatible with most signal conditioning equipment. An optional **RS-232 output** is also available.

Versatile for many applications

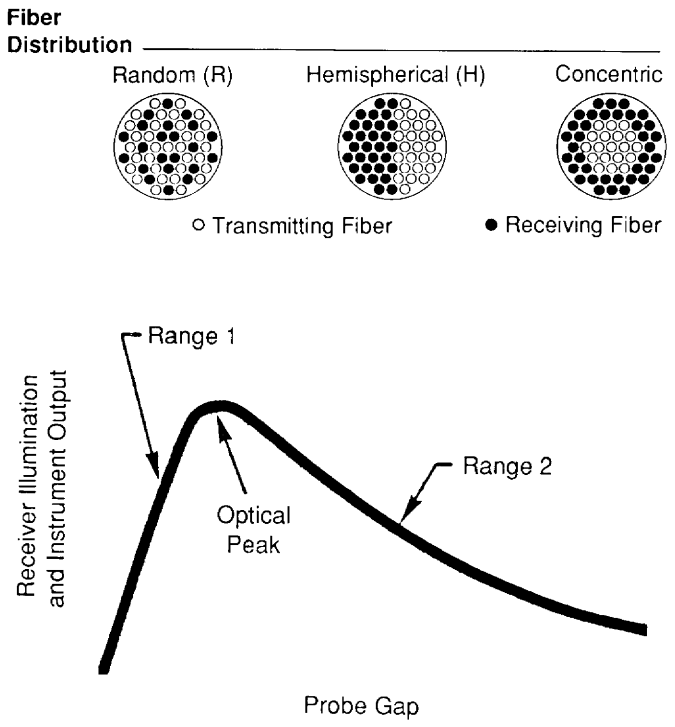
The MTI-2000's modular design has the flexibility to be tailored to specific requirements through the use of a wide range of interchangeable optic probes. Fotonic Sensor probes are immune to electromagnetic interference (EMI) and operate on almost any type of surface or material: metallic, nonmetallic, composite, plastic, glass, ceramic or liquid.

Dual-channel capability enables the user to use two probes to make simultaneous measurements, essential for studies of structural dynamics. For increased versatility, all probe modules feature two operating ranges: one for high resolution and the other for greater range. Each probe module has integral high-pass and low-pass filters that minimize interference and increase resolution.

Designed for customer value

We designed the MTI-2000 with our customers' needs in mind. It includes the latest developments in electronic design to simplify measurement procedures, enhance efficiency and increase customer value.

Operating Principle



MTI-2000 Fotonic probe modules contain two sets of optical fibers. Light-transmitting fibers and light-receiving fibers are bundled together in three different configurations (random, hemispheric, and concentric transmit inside). Displacement measurement is based on the interaction between the field of illumination of the transmitting fibers and the field of view of the receiving fibers.

At contact, or zero gap, most of the light exiting the transmitting fibers is reflected directly back into those fibers. No light is provided to the receiving fibers and the output signal is "zero." As the probe-to-target distance increases, increasing amounts of light are captured by the receiving fibers. This relationship will continue until the entire face of the receiving fiber is illuminated with reflected light. This point is called the "optical peak" and corresponds to the maximum voltage output.

After the optical peak is reached, a continued increase in distance will cause the diverging field of reflected light to exceed the field of view of the receiving fibers, producing a reversal in the output vs. distance signal relationship.

In the typical response curve, Range 1 is the initial, highly sensitive positive slope. This area of response is used for measurements in the microinch range. The less sensitive, negative portion of the curve (Range 2) is used for measurements that require greater standoff distances with less sensitivity and resolution.

Probe Module Specifications

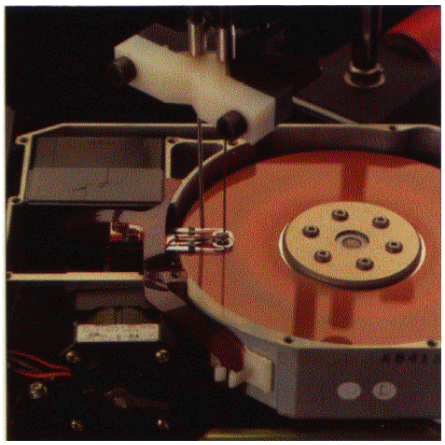
Probe Module Model Number	Probe Tip Diameter in. (mm)		Cable Length in. (mm)	Maximum Frequency Response (-3 dB) kHz	Output Signal Noise[1] mV p-p	Meter Resolution[2] µin. (µm)		Range 1 Characteristics			Range 2 Characteristics			Optical Peak[8] mils (mm)	
	Total	Active				Range 1[3]	Range 2[4,5]	Sensitivity[6] µin./mV (µm/mV)	Linear Range[7] mils (mm)	Standoff[8] mils (mm)	Sensitivity[6] µin./mV (µm/mV)	Linear Range[5,6] mils (mm)	Standoff[8] mils (mm)	Mid-point[10]	Range[11]
MTI 2020R	0.020 (0.508)	0.007 (0.178)	54 (1372)	90	30	1.0 (0.03)	10.0 (0.25)	0.65 (0.016)	4.0 (0.101)	2.8 (0.07)	3.6 (0.09)	18.0 (1.457)	22.0 (0.56)	10.0 (0.25)	3.0 (0.07)
MTI 2032R	0.032 (0.813)	0.019 (0.483)	54 (1372)	130	20	1.0 (0.03)	10.0 (0.25)	0.74 (0.02)	5.0 (0.13)	3.0 (0.17)	4.1 (0.10)	29.0 (0.74)	30.0 (0.76)	15.0 (0.38)	10.0 (0.25)
MTI 2047R	0.047 (1.194)	0.027 (0.686)	54 (1372)	130	10	1.0 (0.03)	10.0 (0.25)	0.80 (0.02)	5.3 (0.14)	4.9 (0.13)	10.8 (0.27)	45.0 (1.14)	44.0 (1.12)	17.0 (0.43)	10.0 (0.25)
MTI 2062R	0.063 (1.600)	0.047 (1.194)	54 (1372)	130	5	1.0 (0.03)	10.0 (0.25)	0.90 (0.03)	5.4 (0.14)	5.0 (0.13)	15.0 (0.38)	52.0 (1.32)	70.0 (1.47)	26.0 (0.65)	12.0 (0.30)
MTI 2062H	0.063 (1.600)	0.047 (1.194)	54 (1372)	130	5	10.0 (0.25)	10.0 (0.25)	4.7 (0.12)	30.0 (0.76)	30.0 (0.76)	14.0 (0.36)	57.0 (1.45)	125.0 (3.18)	90.0 (2.28)	15.0 (0.38)
MTI 2125R	0.125 (3.175)	0.090 (2.286)	54 (1372)	150	3	1.0 (0.03)	10.0 (0.25)	0.96 (0.02)	6.0 (0.15)	7.0 (0.18)	30.0 (0.76)	100.0 (2.54)	110.0 (2.79)	32.0 (0.80)	22.0 (0.56)
MTI 2125CTI	0.125 (3.175)	0.090 (2.286)	54 (1372)	150	3	10.0 (0.25)	10.0 (0.25)	6.9 (0.18)	40.0 (1.02)	21.0 (0.53)	30.0 (0.76)	120.0 (3.05)	240.0 (6.09)	135.0 (3.43)	48.0 (1.22)
MTI 2125H	0.125 (3.175)	0.090 (2.286)	54 (1372)	150	3	10.0 (0.25)	10.0 (0.25)	13.0 (0.33)	80.0 (2.03)	130.0 (3.30)	45.0 (1.14)	208.0 (5.28)	350.0 (8.89)	240.0 (6.10)	44.0 (1.12)
						Range X1	Range X10	Range 1 X1 Characteristics			Range 1 X10 Characteristics				
MTI 2032RX	0.032 (0.813)	0.019 (0.483)	54 (1372)	130	30	1.0 (0.03)	0.1 (0.0025)	0.215 (0.005)	1.0 (0.03)	1.0 (0.03)	0.0215 (0.0005)	1.0 / 0.4 (0.03)(0.01)	1.0 (0.03)	5.0 (0.13)	3.0 (0.07)

NOTES:

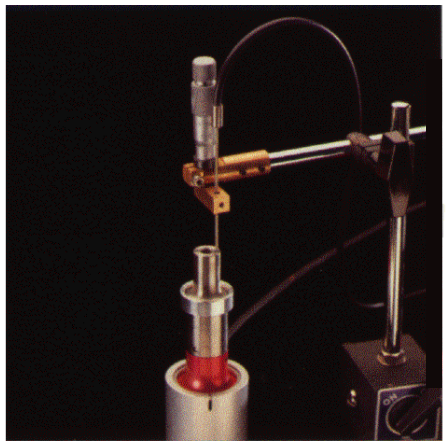
1. *When measuring to a 2 µin. AA electroformed, GAR surface-finish comparator block. Noise increases proportionally with less reflective surface finish.*
2. *Resolution @ 10 Hz bandwidth. Full bandwidth resolution is the product of the sensitivity and the wideband noise.*
3. *Meter resolution using vibration mode. Instrument noise adds a constant offset to the actual reading. Once measured, it may be subtracted.*
4. *Meter resolution using displacement mode.*
5. *With the MTI-2032RX module, factory adjustment of scaling factor will increase meter resolution 10x with a corresponding decrease in linear range. 2.5 Angstrom meter resolution available via probe module switch programming.*
6. *Nominal value ±10%.*
7. *For approximate ±1% linear range, multiply by 0.75.*
8. *Nominal value ±5%.*
9. *Optimum standoff for reflectivity/surface finish measurements.*
10. *Nominal value ±15%.*
11. *Displacement range producing 5% change from peak output when making reflectivity/surface finish measurements.*

Advanced solutions for demanding applications

MTI Fotonic Sensors have been used successfully in the computer disk-drive, aircraft, microelectronics and automotive industries; research laboratories; and universities.



Two fiber-optic probes are used to perform modal analysis on a computer read/write head. With a high frequency response that makes it possible to measure both displacement and phase, the Fotonic Sensor has been chosen as the best instrument for this type of analysis by measurement experts in the U.S. and Japan.



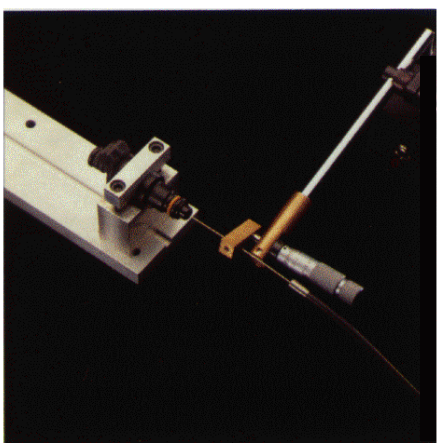
The Fotonic Sensor accurately measures the vibration amplitude of on ultrasonic welder tip at high frequencies and accelerations.

Nonintrusive Vibration Analysis

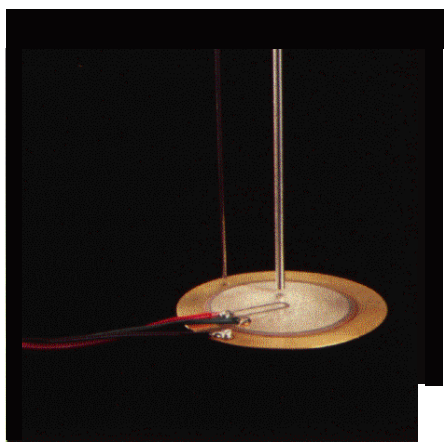
- Displacement and phase of magnetic and optical disk-drive read/write heads, actuators and servo mechanisms.
- Resonant response of printed circuit boards and electronic components
- Model analysis of composite materials
- Vibration of fuel rods submerged in hot water

High-Frequency Measurement

- Vibration amplitude of ultrasonic equipment components
- Sonar transducer displacement, frequency and waveshape



With frequency response from dc to 150 kHz, the Fotonic Sensor is ideal fur analyzing squarewave and complex motions. The MTI-2000 is used here to measure the absolute travel and bounce of a fuel-injector valve.



Two fiber-optic probes are used to measure surface displacement of a ceramic resonator. Fotonic probes are immune to electromagnetic interference (EMI) and operate effectively on a wide range of surfaces including nonmetalic materials, ceramic, glass, plastics, and composites.

Complex Motion Analysis

- Micromechanism motions
- Stepper-motor dynamics and repeatability
- Mechanical shock pulse displacement and waveshape
- Rolling element bearing performance
- Dot-matrix printer mechanism motion
- Ink-jet printer mechanism motion
- Speaker cone modal studies

Measurement of Nonmetallic Materials

- Liquid surface dynamics
- Magnetic tape vibration
- Thin-film vibration and thickness

Other Applications

- Surface flaws in metals, semiconductors and ceramics
- Biomcchanics: muscle response and hearing studies
- Nonrepetitive runout of precision spindle
- Amplitude feedback in materials fatigue testing
- Displacement of sealed assemblies using optical viewport
- X-Y-Z detection of out-of-plane motions

General Specifications

Power Requirements
117 V ac @ 0.35 amps or 220 V ac @ 0.2 amps, 50 to 400 Hz
Maximum Power Dissipation: 20 W
Line Voltage Stability: 105 to 130 V ac
Fuse: 0.5 amp, fast-blow (requires an IEC standard 3-prong grounded AC plug)

Dimensions
4.5 in. (11.4 cm) H
13.3 in. (33.8 cm) W
10.0 in. (25.4 cm] D

Weight
18 lb (6.1 kg)

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

Display
Meter Readout: 4.5-digit green vacuum fluorescent, updates 4 times per second
Bargraph: 20-element green LED (0.5-volt step size), 10 Hz response

Displacement Measurements
Output Signal: 0 to ±10 V dc, 100Ω output impedance
Switchable Offset Range: 0 to -15 V
Stability at 12 hrs. ±2° F (-1° C): Drift less than 1.0% of full scale
Stability at 60° to 95° F (16° C to 35° C): Drift less than 2.0% of full scale

Vibration Measurements
Output Signal: 0 to ±10 V dc full-scale range, 100Ω output impedance
Accuracy: Within 1.0% for peak-to-peak readings from 1 Hz to 150 kHz
System Noise: Dependent upon probe type and surface reflectivity

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

Tip Length: 3 in. (76.2 mm]

Cable Length: 54 in. (1372 mm] standard

Options

- 220 Vac input power configuration
- Display in metric engineering units
- RS-232 digital output
- Bent probe tips
- High-pressure/high-vacuum probes
- Wide-temperature-range probes from -310°F to 1382°F (-190°C to 750°C)

Accessories

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

Fixture Stands: Proridcs a stationary mounting for probes of any size.

Calibration Fixture: Secures the probe and calibrates the instrument to a nonrotating target, utilizing a precision micrometer. Can be used for initial calibration, calibration to a fluid medium, or in-place calibration checks.

MTI Instruments: Pioneers in fiber-optic sensor technology

MTI has been in the forefront of noncontact measurement technology for over 25 years. Our experienced application engineers are prepared to help you determine the best solution to you mcasurement problems, before and after the sale.

MTI's quick-turnaround maintenance and repair services are available to keep your instrument on-line. For price information or assistance with your application, call us toll-free:

l-800-342-2203.

MTI Instruments Inc. 325 Washington Avenue Extension • Albany, NY 12205
Phone: (518) 218-2550 • FAX: (518) 218-2506

MTI Instruments Inc.