

# Detects microvibration without contact

# Laser Vibrometer



Sensor unit incorporated  
in the laser tube

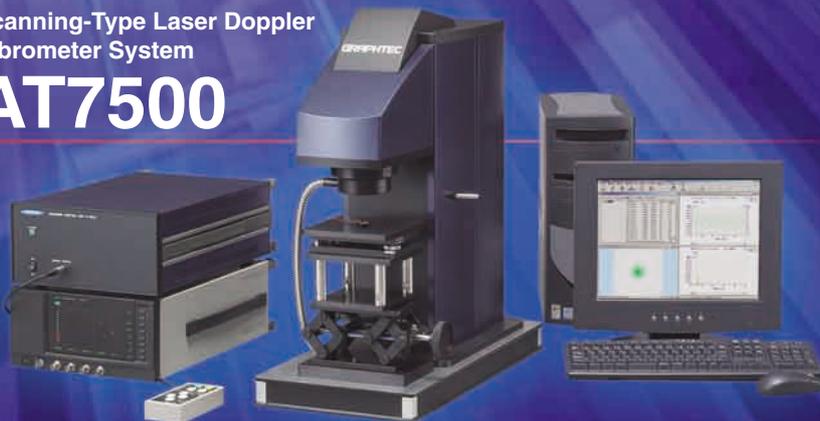
**AT0023**

Sensor unit incorporated in the  
laser tube and demodulator

**AT500**

Scanning-Type Laser Doppler  
Vibrometer System

**AT7500**

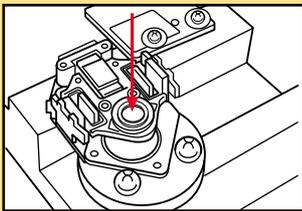


# LASER VIBROMETER

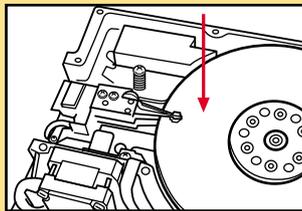
The AT Series Laser Doppler Vibrometer can measure the vibration of an object without contact, by means of the optical heterodyne method. By FM-demodulating the difference in frequency between reference and measured light, the AT Series can detect the speed and frequency of an object's vibration, rendering microvibration measurement possible.

The wide range of AT Series applications includes pickups for DVDs, CDs, and HDDs, vibration analysis of audio equipment, as well as applications relating to the automobile industry, general plant equipment, and micromachines.

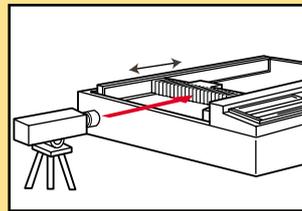
Measuring the transmission function of an optical pickup



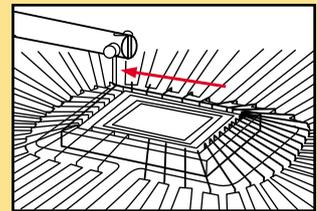
Measuring the runout of an HDD surface and analyzing the vibration of a slider



Measuring the moving rate and displacement of a scanner stage



Measuring the vibration of a wire bonder capillary



## AT500

The AT500, a laser vibration meter, enables non-contact sensing by the optical heterodyne method. It integrates a sensor unit with a built-in laser tube and a demodulator, so it has a wide range of uses in manufacturing, investigations, research, and development.

### Two models to meet various requirements

- **AT500-05**

For case vibration, Motor vibration

- **AT500-20**

For optical pickup, Actuator

- **Ease of installation**

The AT500 can be easily installed. A laser beam can be focused on the measuring spot simply by installing the AT500 horizontally. Necessary operations and displays are located on the front, which provides user-friendly operation.

- **Highly accurate vibration measurement for soft or light objects**

Non-contact vibration measurement achieves high accuracy without affecting the vibration of the object.

- **Vibration measurement for small structures**

As the diameter of a laser beam spot is very small (approx. 20  $\mu\text{m}$  when measured at close range), the vibration of very small structures can be measured.



- **Easy positioning of focus and reflected light**

The dedicated, highly sensitive lens enables comparatively easy sensing, even for a material that does not reflect a laser beam well. Moreover, the built-in auto-focus function automatically selects the optimum focal point.

- **Scalable functions**

As the AT500 has a single range demodulating function, measurement is enabled simply by connecting it to the output terminal. Connecting to AT3700 or AT3600 demodulation unit, which can be purchased separately, enables a wider range of measurement.

### Wide Focus distance

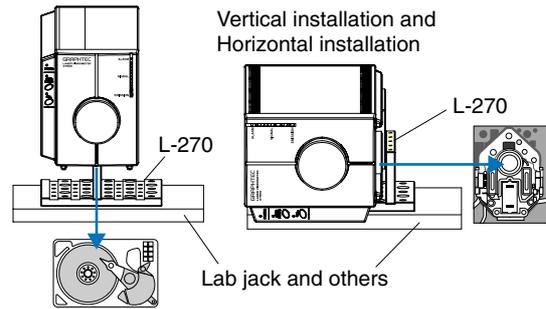


Measurement range scale  
From 90mm to 600mm

Frequency characteristic  
DC - 50kHz (AT500-05)  
DC - 200kHz (AT500-20)

90mm  
Focus distance  
600mm

### Safe and easy setting



## Specifications

		AT500-05	AT500-20	
Laser portion	Laser beam	He-Ne gas laser (wavelength 632.8nm)		
	Laser output	1mW or less		
	Measuring range of distance	90mm to 600mm from lens surface*1		
	Focus function	Manual/Auto*2		
	Shutter function	Electromagnetic system (Interlock and remote control)		
Demodulation portion	Velocity output	Frequency characteristics	DC to 50kHz*3	DC to 200kHz*3
		Velocity range	10 <sup>-3</sup> m/s/V	10 <sup>-2</sup> m/s/V
	Integrating function	Frequency band	10Hz to 20kHz	—
		Displacement range	1 μm/V	—
	Phase compensation	Phase compensation range	—	DC to 200kHz*4
		Output phase delay	—	Within ±5 deg*5
	Filter*6	H.P.F.	DC, 10Hz, 100Hz	DC, 10Hz, 100Hz
L.P.F.		1kHz, 10kHz, 50kHz	5kHz, 50kHz, 200kHz	
General	Remote functions	Input: Auto Focus, Shutter, CAL Output: Busy, Alarm, Level, Emission		
	Additional demodulation functions*7	Light acceptance signal output BNC terminal		
	Environment	5 to 35°C, 30 to 80%R.H.		
	Power source	AC adapter: AC100V to 240V/50 to 60Hz		
	Power consumption	Approx. 50VA (AC)		
External size [WxDxH] (Approx.)		113X329X142 mm (excluding protruding portions)		
Weight (Approx.)		4.5kg		

#### Remarks

\*1: Beam diameter φ 20 μm/90mm  
φ 100 μm/600mm

\*2: Detection is limited

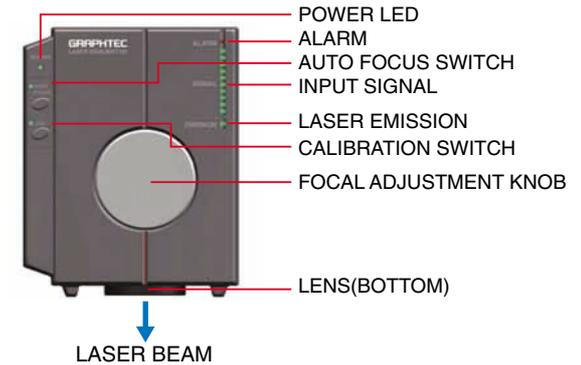
\*3: Within -3dB

\*4: Both H.P.F. and L.P.F. are OFF

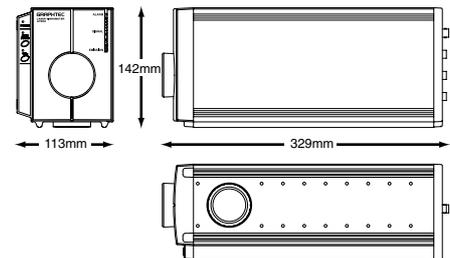
\*5: At 100kHz

\*6: Attenuation factor: -24dB/OCT

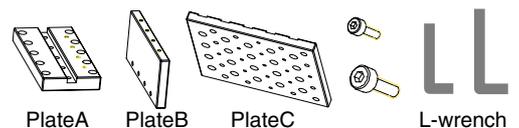
\*7: For other duplication unit



### External Dimensions



### L-270 Fixing brackets (Options)



## Sensor Unit

### AT0023

Sensor unit incorporated  
in the laser tube



The sensor unit measures the magnitude of interference (the difference in frequency) by irradiating the object to be measured with a reference beam, receiving the reflected light (now Doppler-shifted as a result of vibration), and O/E-converting the measured magnitude of interference (light is converted into analog signals).

The sensor head and laser unit, built as one piece, constitute the sensor unit. The unique aluminum die-cast frame substantially reduces size and improves ruggedness and ease of use (as compared to more conventional products). These features combine to provide a high degree of reliability, permitting use in DVD research and the like, as well as on production lines. Since option fiber is not used, measurement light and reflected light can be made to interfere very efficiently, thus permitting a high degree of sensitivity in measurement. In addition, the improved sensitivity of the AT0023 eliminates previous difficulties in adjusting and setting sensitivity levels.

### Specifications

**Laser light source**  
He-Ne gas laser  
**Wavelength**  
632.8nm  
**Laser beam output**  
1mW max. Sensor head tip: Class 2

#### Beam diameter

Approx. 20 μm for a measurement distance of 250 mm

Approx. 50 μm for a measurement distance of 500 mm

#### External dimensions (W×D×H) (approx.)

85mm×292mm×108mm

(not including projecting parts, such as the lens unit)

#### Mass (weight) (approx.)

3kg

# Demodulation Unit

The demodulation unit FM-demodulates signals that have O/E-converted by the sensor unit (i.e., where the optical signals have been converted to analog signals), subsequently outputting signals proportional to the vibration speed of the object of measurement. While the standard function outputs the speed and frequency of vibration, the differential-integral function (an optional feature that can be incorporated in the unit) can integrate speed to calculate displacement and differentiate the speed into an acceleration, outputting the results.

## Wide-band demodulation unit AT3700



### A broad measurement range and a rich variety of applications

The measurement frequency range, from DC to 2 MHz, permits the measurement of transitional characteristics from a static state, and of uniform motion and vibration at high frequencies. The measurable speed range is from 0.4  $\mu$ m/s to 10m/s (lower limit of speed: 5 kHz LPF). The AT3700 thus permits a broad range of vibration measurements and is applicable to a variety of fields.

### Various optional features

- Wide-band demodulation function: Incorporation of this in the unit raises the upper limit of the measurable frequency range to 10 MHz, rendering an ever broader range of measurement possible.
- Differential-integral function: Incorporating this in the unit makes it possible to differentiate speed signals from the Laser Doppler Vibrometer into an acceleration and to integrate these into a displacement.

## High-sensitivity demodulation unit AT3600



### Improved sensitivity helps overcome difficult measurement conditions

Measurement sensitivity has been greatly improved: the AT3600 is now twice as sensitive as before. This high sensitivity provides for convenient vibration measurement of objects that were previously difficult to measure.

### Optional differential-integral function

This feature enables the differentiation of speed signals from the Laser Doppler Vibrometer into an acceleration, and for their subsequent integration into a displacement (speed, displacement, and acceleration can be output at one time).

## AT3700/3600 Optional features

### Differential-integral function L-011

This is available for incorporation in the demodulation unit of the Laser Doppler Vibrometer. The L-011 integrates demodulated speed signals into a displacement or differentiates them into an acceleration.

### Wide-band demodulation function L-012 (for AT3700 only)

This adds a wide-band demodulation capability to the standard demodulation function. Designed to be incorporated in the demodulation unit. Expands the measurement frequency range to a maximum of 10 MHz at the speed range of  $10^0$  [m/s/V], thereby making it possible to analyze transitional phenomena otherwise unable to be measured with harmonic vibration measurement or with the standard demodulation function.

## Specifications

### Response frequency range

AT3600: DC to 200 kHz

AT3700: DC to 2 MHz

### Measurement speed range

AT3600: 2  $\mu$ m/s to 3 m/s

AT3700: 0.4  $\mu$ m/s to 10 m/s

(lower limit of speed: 5 kHz ON)

### Speed range

$10^0, 10^{-1}, 10^{-2}$  m/s/V

Displacement range

$10^{-3}, 10^{-4}, 10^{-5}, 10^{-6}, 10^{-7}, 10^{-8}$  m/V

### Acceleration range\*1

$10^0, 10^1, 10^2, 10^3, 10^4, 10^5$  m/s<sup>2</sup>/V

### Speed output

At  $10^0$  m/s/V: AT3600:  $\pm 3$ Vp

AT3700:  $\pm 10$ Vp

At  $10^{-1}$  m/s/V:  $\pm 10$ Vp

At  $10^{-2}$  m/s/V:  $\pm 10$ Vp

### Displacement output\*1

At  $10^{-3}$  m/V:  $\pm 10$ Vp (0.5 Hz to 2 kHz)

At  $10^{-4}$  m/V:  $\pm 10$ Vp (0.5 Hz to 10 kHz)

At  $10^{-5}$  m/V:  $\pm 10$ Vp (0.5 Hz to 50 kHz)

At  $10^{-6}$  m/V:  $\pm 10$ Vp (2 Hz to 200 kHz)

At  $10^{-7}$  m/V:  $\pm 10$ Vp (20 Hz to 200 kHz)

At  $10^{-8}$  m/V:  $\pm 10$ Vp (100 Hz to 200 kHz)

### Acceleration output\*1

At  $10^0$  m/s<sup>2</sup>/V:  $\pm 10$ Vp (100 Hz to 200 kHz)

At  $10^1$  m/s<sup>2</sup>/V:  $\pm 10$ Vp (100 Hz to 200 kHz)

At  $10^2$  m/s<sup>2</sup>/V:  $\pm 10$ Vp (20 Hz to 200 kHz)

At  $10^3$  m/s<sup>2</sup>/V:  $\pm 10$ Vp (20 Hz to 20 kHz)

At  $10^4$  m/s<sup>2</sup>/V:  $\pm 10$ Vp (2 Hz to 20 kHz)

At  $10^5$  m/s<sup>2</sup>/V:  $\pm 10$ Vp (2 Hz to 2 kHz)

At  $10^6$  m/s<sup>2</sup>/V:  $\pm 10$ Vp (2 Hz to 2 kHz)

### Filter

LPF/HPF functions provided

### Low-pass filter (LPF):

2 kHz, 5 kHz, 20 kHz, 50 kHz, 200 kHz, and

OFF (OFF available for AT3700 only)

### High-pass filter (HPF):

500 Hz, 50 Hz, 5 Hz, 0.5 Hz, and OFF

### Wide-range demodulation function (optional)

UP to a possible 10 MHz, with a speed range of  $10^0$  m/s/V

### Guaranteed operational temperature range

0°C to 40°C (no condensation allowable)

### Precision-guaranteed temperature range

5°C to 35°C (no condensation allowable)

### Rated power supply

100V AC at 50/60 Hz\*2

### Power consumption (approx.)

60 VA

### External dimensions (W×D×H) (approx.)

300mm×499mm×148mm

(projecting parts not included)

### Mass (weight) (approx.)

8 kg (without optional features)

\*1 When the optional differential-integral function is selected. \*2 For other power supply voltages, please contact your Graphtec vendor.

## Scanning-Type Laser Doppler Vibrometer System

# AT7500

*Enables some points of the small object to measure with high-speed, and surface vibration measurements to display, judge, and to animationize.*

AT7500 is a surface vibration system which can measure some points of the small object with high-speed, and which can display, judge, and animationize the measurements by using Laser Doppler Vibrometer. Concerning vibration answering frequency, AT7500 can measure it from DC to 1MHz. Also AT7500 can measure vibration quantity for the optional applied vibration signals (speed signals and displacement signals), and judge GO/NG for the rated value.

By using scanning function of laser beam with two axes galvano mirror, AT7500 can measure +/-20mm XY surface. Moreover, combining scanning function with electric stage (optional) will expand XY surface to +/-45mm.



### Features

#### Measurement area

AT7500 can measure XY surface to Max. +/-45mm to use laser beam scan in combination with electric XY stage (optional) by two axis galvano mirror.

#### Measurement point

Max. 10,000 points can be measured.

#### Vibration quantity measurement function

AT7500 can measure vibration quantity of object by set sampling frequency, and judge GO/NO for the rated value.

#### Data storage

Measurement conditions and measurement data can be saved into CSV file format or M scope file format.

### Animation function

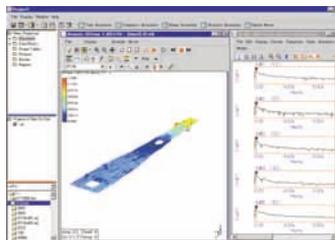
- Animation on the four screens or the single screen.
- Surface color display
- Rotation on the screen
- Interactive animation using line, peak and hand cursor from the area of time/frequency
- Shape animation from the shape table
- Comparison animation of two shape data

### Specifications

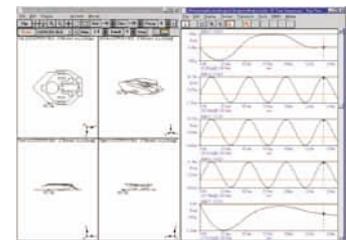
Items		AT7500
Scan range		40mm x 40mm
Number of measurement points		10,000 points (Max)
Measurement speed range		20 $\mu$ m/s ~ 3 m/s
The number of input channels		2ch
Measurement function		Speed measurement, displacement measurement (optional), acceleration measurement (optional)
Measurement frequency range	Speed measurement	AT3600: DC~200kHz AT3700: DC~1MHz
	Displacement measurement	0.5Hz~200kHz (Option)
	Acceleration measurement	2Hz~200kHz (Option)
Measurement data length		25,600 data/point (max)
Minimum beam diameter		Minimum 20 $\mu$ m
Return position accuracy		Within +/- 5 $\mu$ m (at the position of minimum beam diameter)
Sampling frequency		500Hz to 10MHz (Enables to set by 1, 2, and 5 steps)
A/D resolution		12 bits
Judge function		Level, frequency level
Measurement speed		Max 30 points/sec. (It varies with depending on measurement conditions.)
Rated power supply		AC100V AC at 50Hz/60Hz*1

\*1 Estimation except for AC 100V

### Contents of analysis



Vibration distribution analysis for hard disk slider



Vibration distribution analysis for optical pick up

### Example of use

- Vibration distribution for hard disk
- Vibration distribution for optical pick up
- Vibration distribution for mobile phone

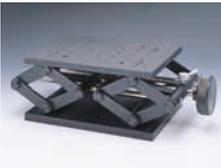
## Accessories

### Mirror component L-120



Aluminum total-reflection mirror	$\phi$ 30 mm; thickness: 5 mm
Coarse movement	360°
Fine movement	$\pm 5'$
Pole length	120 mm/300 mm
Festening	Magnetic

### Laboratory jack L-202, L-203



	L-202	L-203
Stage size	220mm×160mm	
Displacement	$\pm 35$ mm	
Displacement precision	Parallelism 0.05mm	Parallelism 0.1mm
Load withstand	294N(30 kgf)	
Material	Top and bottom plates: Iron	Aluminum
Weight	Approx. 11kg	Approx. 6.5kg

### Tripod L-232, L-233, L-234, L-235



Model no	Load withstand
L-232	98N(10 kgf)
L-233	45N(4.6 kgf)
L-234	58.8N(6 kgf)
L-235	92N(9.4 kgf)

### XYZ stage L-240, L-241, L-242



	X	Y	Z	$\alpha$	$\beta$
Stage size	120mm×120mm			70mm×50mm	74mm×50mm
Displacement	$\pm 12.5$ mm			$\pm 10$ mm	—
Turn angle	—			$\pm 30^\circ$	$\pm 20^\circ$
Displacement precision	Straightness: 3 $\mu$ m		Straightness: 5 $\mu$ m Parallelism: 30 $\mu$ m	—	
Min. reading	10 $\mu$ m(with micrometer)			5'	
Load withstand	196N(20kgf)	68N(7kgf)	98N(10kgf)		

L-240 XYZ-axes

L-241 XYZ-axes and  $\alpha$ -axis(XYZ+one axis for tilted rotation)

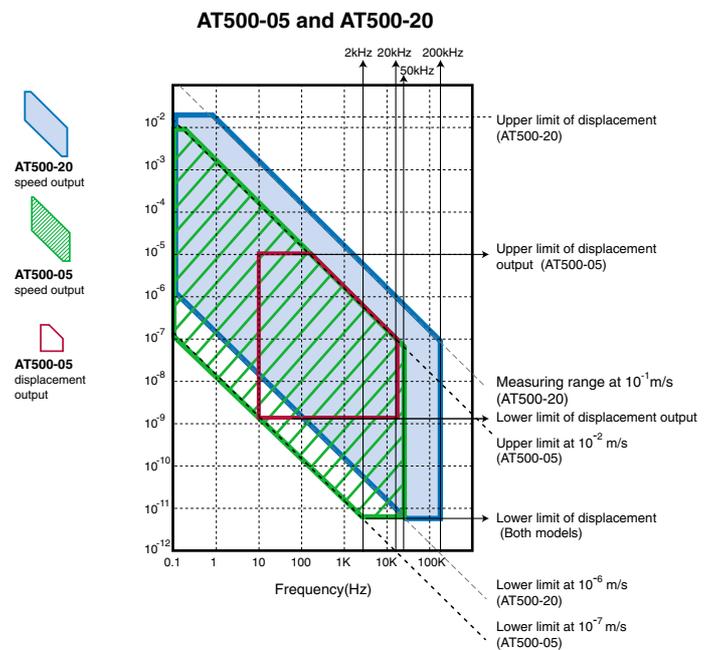
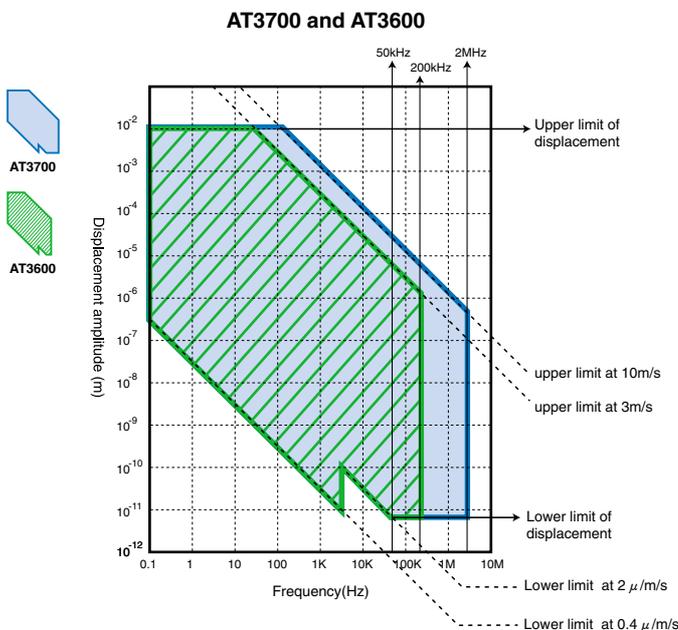
L-242 XYZ-axes and  $\alpha$   $\beta$ -axes(XYZ+two axes for tilted)

### Vibration absorber (bench type) L-310, L-311



	L-310	L-311
Proper frequency	2.5 to 2.7 Hz	
Surface plate dimensions	800 mm×600mm×50mm	
Unit dimensions	800mm×600mm×110.5mm $\pm$ 3mm	
Acceptable weight capacity	588N(60kgf)	
Unit weight	50kg	
Uses	Air supply form air source(compressor or the like); clamp mechanism provided	Air supply from accompanying manual pump; clamp mechanism provided

## Figure of Measuring Range



### To ensure correct and safe use of your laser doppler vibrometer:

- Read your User's Manual before using the laser doppler vibrometer, and operate it correctly in accordance with the procedures described.
- To prevent malfunctions or electrical shock due to current leakage, ensure that the laser vibrometer has a good protective ground, and ensure that the supply voltage conforms to the laser doppler vibrometer's power rating.