

Vibrometer using
the non-contact Laser
Doppler Method

LV series



Dynamic & High-Resolution

LV-1800

ONOSOKKI



Integrated sensor and camera

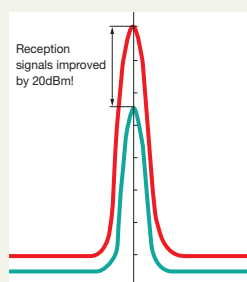
The LV-1800 has an integrated design of a sensor and a high sensitivity digital camera*1. Without degradation of the detection sensitivity, you can check targets and the parts irradiated by laser beams on a Windows® based PC*2. Additionally, by combining the objective lens and the illumination unit, amplitude of MEMS (Micro Electro Mechanical Systems) and micro objects can be detected.

*1. LV-0181 Built-in positioning camera, LV-0185 Illumination unit: options
 *2. Windows®/XP(SP2 or later)/Vista (SP1 or later)/7



Greatly increased detection ability

Newly designed interference optical system has achieved improvement of the detection sensitivity by 20dB compared to the conventional model. Restrictions of targets and detecting environment have been dramatically eased to facilitate sensor installation and setup.



Detectable various targets with wide range

Detectable velocity amplitude range is 10 m/s to 0.05 μm/s.* The LV-1800 can detect a wide range of behaviors of targets from high velocity amplitudes of ultrasonic tools and piezoelectric devices to small amplitudes generated by thin film, MEMS, and ceramic capacitors.



*When the LV-0800 (option:Minute velocity range board) is installed.

Vibrometer using the non-contact Laser Doppler Method

Dynamic & High-Resolution

LV-1800



Quick confirmation of the focal position and the detection status

The sensor is equipped with the distance scale used as a guideline for the laser's focal position, and the level indicator for showing the detection status. It has enabled quick and reliable setup, and checking of the detection status at hand.



Small and light-weight sensor with excellent ease of use

The sensor is separated from the laser light source.

Without any restrictions on installation, laser beams can be irradiated in all directions. Furthermore, using a wide variety of options provided, the amplitudes of back of the chassis and the narrow parts can be detected.



Noise-free design without cooling fan

The LV-1800 has countered for self generated vibration using fan-less cooling by means of natural convection. It prevents the transmission of vibration noise from the main body and the sensor to the detection target, so that the analyses of minute velocity amplitude and displacement will not be affected adversely.

Easy storage and transporting

The main body is equipped with the sensor storage and the cable winding part. The optional storage suitcase (LV-0350) can store major options such as the magnet stand and the illumination unit as well as the main body. Storage and moving among sites can be done easily and safely.



Class 2 laser beams for any sites

The laser beams of the LV-1800 conform to Class 2 safety standard. It employs a visible light laser of 1mW or less. The LV-1800 has been designed, tested and conformed according to the following safety standards, so it can be used at global sites.

Conforming standards:

- JIS C 6802 (Laser Product Radiation Safety Standards)
- IEC/EN 60825-1:2007
- FDA (CDRH)
- CE Marking(Low Voltage Directive, EN61010-1: 2010)
(EMC directive, EN61326-1: 2006 Class A Table 2)
- FCC (Part 15B)
- CANADA EMI Standard (ICES-003)

Wide range of options provide utmost solutions

The LV-1800 and its options, which have been produced based on an abundance of experiences at sites, make it possible to support various detection cases. Furthermore, Ono Sokki's waveform analysis unit and its software provide utmost solution smoothly by visualizing behavior and characteristics of a target.



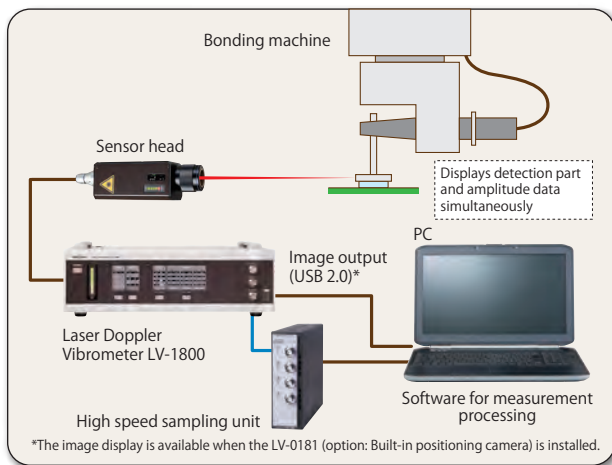
The LV-1800 is a laser Doppler type non-contact vibrometer that detects the amplitude velocity by using the Doppler shift of laser beams without load. It can perform non-contact measurements that are difficult with a contact type vibrometer such as high speed, high frequency, transparent, thin film, microscopic objects and long distance vibrations.

Applications

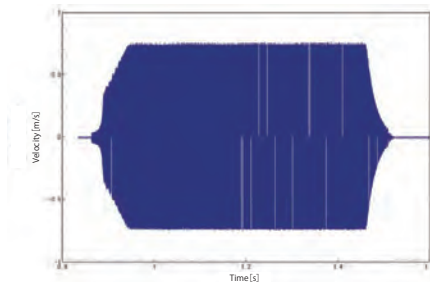
The LV-1800 enables amplitude detections in a wide range of fields.

- Measurement through a glass or a hole, thin film or transparent object measurement, amplitude or frequency measurement in liquid, transmission characteristics measurement of optical pickup such as CD, DVD or BD
- Vibration analysis of each component of HDD, a cell phone's microphone, thin film vibration of a receiver
- Amplitude measurement for general machine vibration including cars, trains and inverter, condenser or reactor of an EV/HEV
- Vibration detection of living body (insect etc.)
- Behavior detection of micromachines, ultrasonic motors

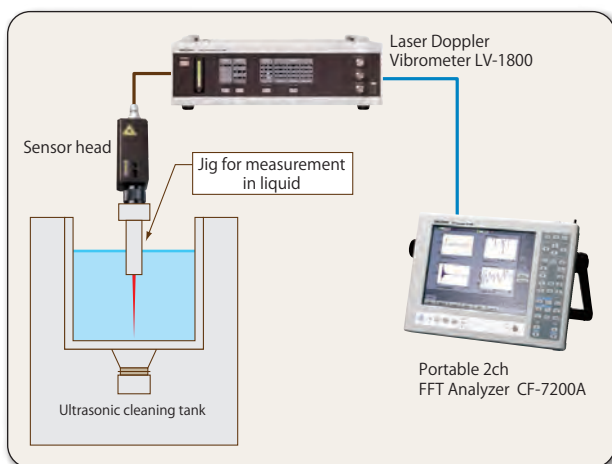
Vibration measurement of ultrasonic tools



The amplitude of an object with high velocity of 20kHz or higher, such as an ultrasonic tipping machine and a bonding machine, can be measured. Based on the amplitude value and frequency analysis, the tipping quality and the equipment maintenance time can be determined.

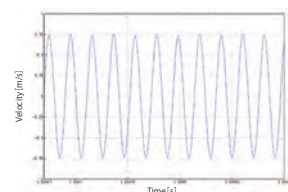
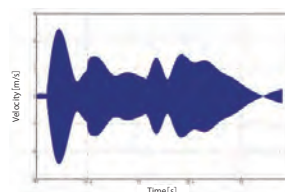


Vibration measurement in liquid (an ultrasonic cleaning tank)

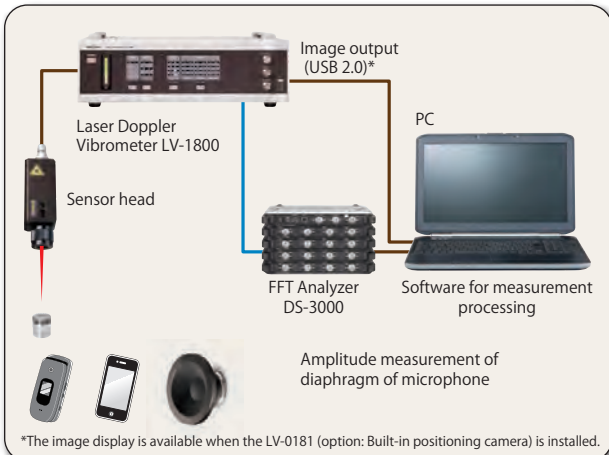


When laser beams permeate through liquid, amplitude measurement is possible for colors and ranges in which reflection returns from the target. By irradiating laser beams to the bottom and sides of an ultrasonic cleaning tank using a jig, the amplitude and frequency of the bottom can be measured. The amplitude of the target being washed can also be detected in the same manner.

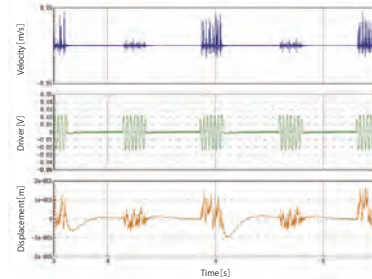
*using jig for laser incidence



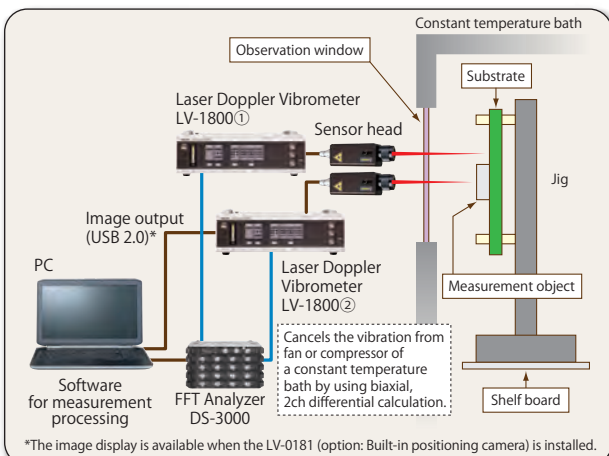
Measurement of thin film vibration



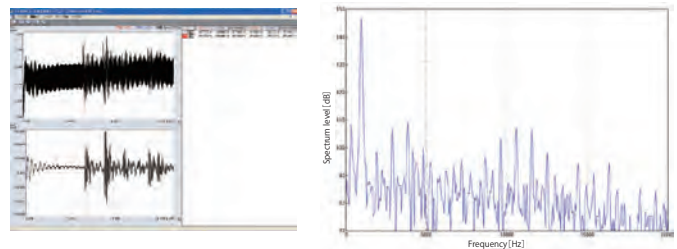
The LV-1800 is the most suitable for measurement of thin film velocity. It can measure the velocity of thin films such as a diaphragm of cell phone's microphone, a corn paper of receiver or speaker, and a transparent film like a liquid crystal display film.



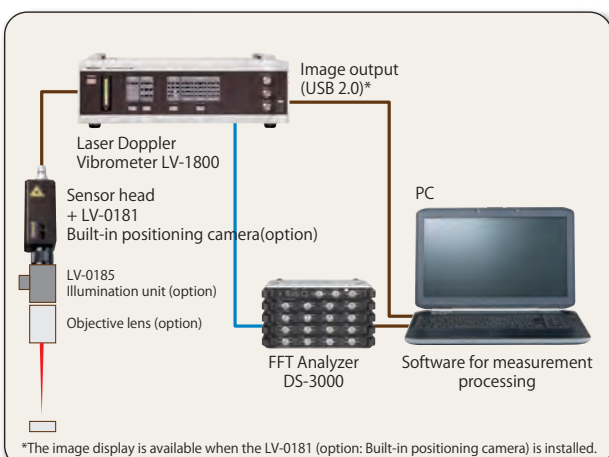
Measurement through a glass



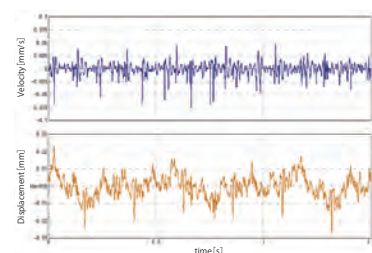
The LV-1800 does not detect transparent objects not located at focal position. Using this characteristic, it can detect vibration of an object inside a vacuum chamber or a constant temperature bath by irradiating laser through a glass or quartz.



Measurement of microstructures



The standard laser spot diameter of the LV-1800 is approx. $\phi 20\mu\text{m}$. By mounting an objective lens, the micro spot diameter of approx. $\phi 3\mu\text{m}$ can be achieved. With this high spatial resolution, microstructures represented by MEMS, the behavior of small insects, and other objects that could not be detected with the conventional vibration detectors can now be detected.



LV-0181 Built-in positioning camera

The LV-0181 is a high sensitivity digital camera to position the sensor head while checking the image of an object. (A camera module is built in the sensor head). The coaxial and confocal camera, in which the focal point of the laser beams and the focus of images are common, displays the images of detected parts on Windows® based PC through USB 2.0 output. The LV-0181 makes it possible to check small measuring objects and back parts which are not easily viewable, and also irradiate laser beams speedily. By combining the LV-0151A (objective lens) and the LV-0185 (illumination unit), amplitude of micro objects such as MEMS can be measured.



■ Specification of the LV-0181

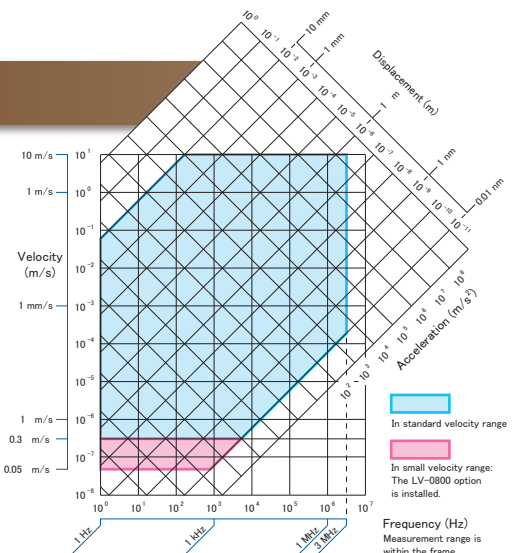
Connector type	USB 2.0 (Main unit side: mini-B type)
Imaging element	CMOS color 1/4-inch
Number of pixels	300,000 pixels or more
Image size	VGA (640 x 480)
Frame rate	30 frames / second
Range of shooting	10 x 7.5 mm ~ (measurement distance 100 mm ~)
Function	Exposure / gain / white balance (automatic)
Operating environment	Windows® / XP (SP2 or later) / Vista (SP1 or later) / 7 Direct-X 9.0b or later/ Display True Color 24 bit or more
Camera focus	Confocal with laser spot
Accessory	Camera monitor software CD-ROM USB cable (CF-0703)

LV-0800 Minute velocity range board

The LV-0800 is a minute velocity range board to be installed to the LV-1800. It enables measurements of those which are hard to be detected in standard measurement ranges such as amplitudes of ceramic capacitors, propagation of ultrasonic waves. By adding the LV-0800, it covers the detection of 4-range velocity amplitudes.

■ Specification of the LV-0800

Velocity range	0.001 (m/s) / V (0.01 $\mu\text{m/s}$ 0-p (MAX))
Velocity resolution	0.05 $\mu\text{m/s}$
Frequency range	0.3 to 200 kHz ($f_c = -3$ dB)



LV-0112 Displacement output board/LV-0111 Acceleration output board

When the LV-0112/0111 is built in the LV-1800, it converts the detected velocity (m/s) into displacement (m) or acceleration (m/s^2). Signal is output from an optional connector, and the velocity signal and the displacement/acceleration signal can be obtained simultaneously. Either one of the LV-0112 or the LV-0111 can be installed on the LV-1800.

■ Specification of the LV-0112

Setup range of the LV-1800	Displacement range		
	1 Hz to 20 kHz	10 Hz to 50 kHz	1 kHz to 200 kHz
1.0 (m/s) / V	100 mm/V	1 mm/V	10 $\mu\text{m/V}$
0.1 (m/s) / V	10 mm/V	100 $\mu\text{m/V}$	1 $\mu\text{m/V}$
0.01 (m/s) / V	1 mm/V	10 $\mu\text{m/V}$	100 nm/V
0.001 (m/s) / V	0.1 mm/V	1 $\mu\text{m/V}$	10 nm/V

■ Specification of the LV-0111

Setup range of the LV-1800	Acceleration range		
	1 Hz to 2 kHz	1 Hz to 20 kHz	100 Hz to 400 kHz
1.0 (m/s) / V	$10^3 (\text{m/s}^2) / \text{V}$	$10^5 (\text{m/s}^2) / \text{V}$	$10^7 (\text{m/s}^2) / \text{V}$
0.1 (m/s) / V	$10^2 (\text{m/s}^2) / \text{V}$	$10^4 (\text{m/s}^2) / \text{V}$	$10^6 (\text{m/s}^2) / \text{V}$
0.01 (m/s) / V	$10^1 (\text{m/s}^2) / \text{V}$	$10^3 (\text{m/s}^2) / \text{V}$	$10^5 (\text{m/s}^2) / \text{V}$

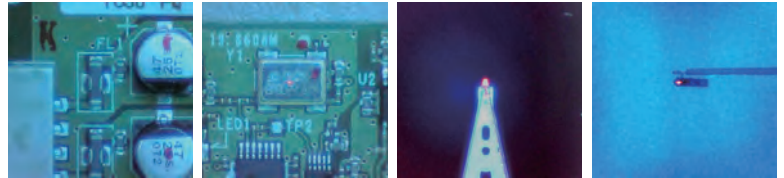
■ Common specification

Signal source	Internally receives the velocity signal from the LV-1800
Output form	Analog voltage
Output voltage	± 10 V (MAX) *Minimum input impedance: 100 k Ω or more
DC offset	20 mV or less
Maximum amplitude	Ten times of an each setup range (0-p)
Amplitude conversion error	± 5 % or less
Amplitude output polarity	+ voltage when moving closer to a sensor side.

LV-0185 Illumination unit



The LV-0185 is an option which illuminates a target coaxially with laser beams. The White LED and the laser beam illuminate the detecting part in the same working distance, and sharpens the images of the LV-0181. Mounting an objective lens is more effective to focus the light. It facilitates laser irradiation to a minute detecting part and a rear side where light is difficult to be illuminated.



■ Specification of the LV-0185

Applicable product	LV-1800
Applicable objective lens	LV-0150A (5x)/LV-0151A (10x)
	LV-0152A (20x)
Irradiation method	Cold-light coaxial epi-illumination by white LED
Cable length	1.5 m (when the dedicated extension cable is used.)
Light emitting part	Cold-light illumination by white LED

Control	Variable adjustment
Operating temperature range	0 to 40 °C (with no condensation)
Operating humidity range	30 to 80 %RH (with no condensation)
Input voltage	AC100 V to 240 V 50/60 Hz
Consumption voltage	3.5 VA when AC100 V, 9.0 VA when AC240 V







Measurement system for vibrating micro object

<Standard configuration>

- Laser Doppler Vibrometer LV-1800
- Built-in positioning camera LV-0181
- Objective lens
- Illumination unit LV-0185
- Magnet stand LV-0030
- Fine-positioning XY stage LV-0015
- Fine-positioning Z stage LV-0016

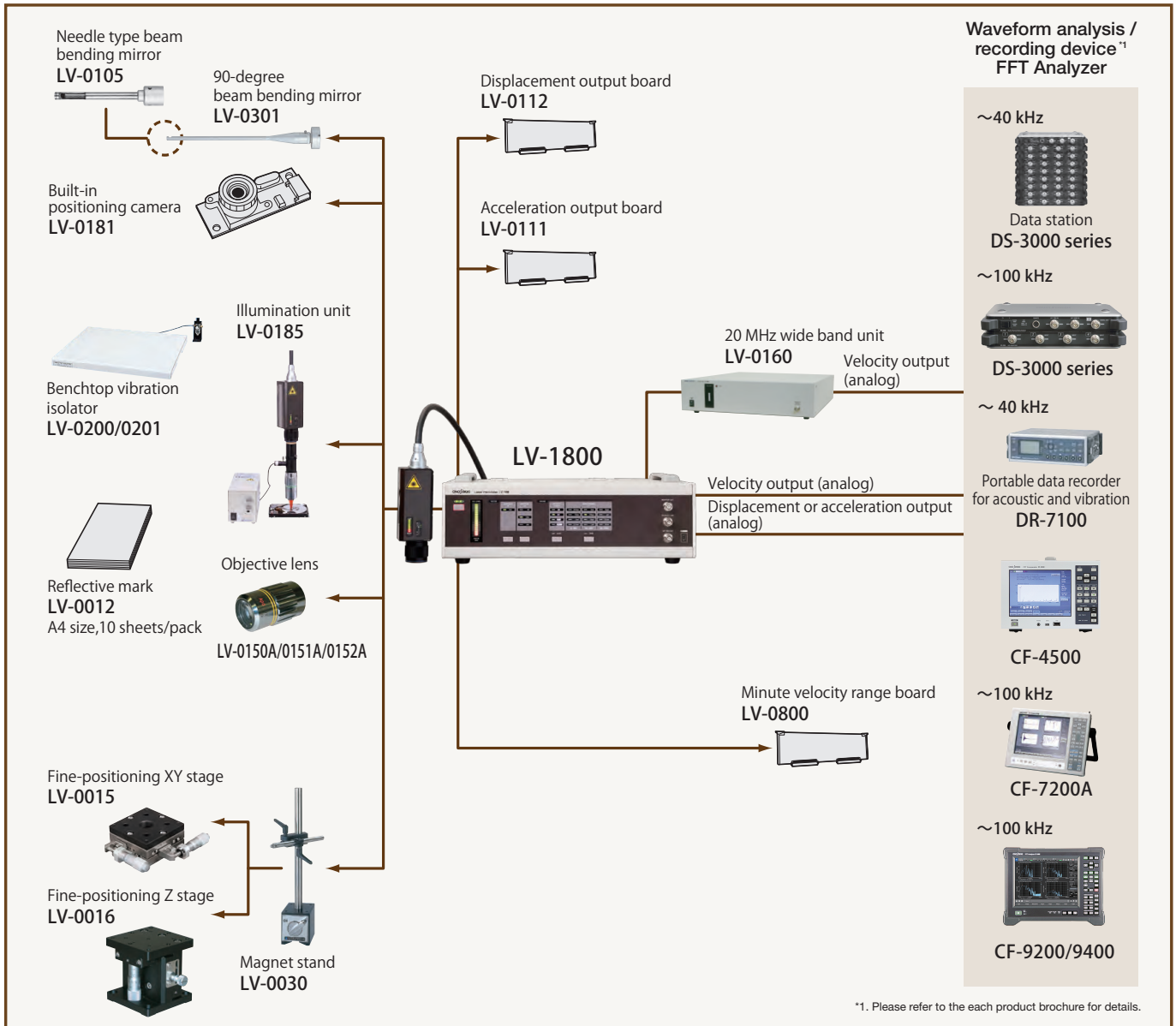


Installing the LV-0181 (Built-in positioning camera), the LV-0185 (Illumination unit) and an objective lens to the LV-1800 enables micro spotting of laser beams and image observation by epi-illumination. It makes laser positioning to microstructures and detection of multipoint parts possible.

Objective lens	Specification	The image of the LV-0181
LV-0150A 	Magnification: 5x WD:36.1 mm Spot diameter: $\phi 4 \mu\text{m}$ or less * A conversion adapter is provided as standard.	
LV-0151A 	Magnification: 10x WD:38.9 mm Spot diameter: $\phi 3 \mu\text{m}$ or less * A conversion adapter is provided as standard.	
LV-0152A 	Magnification: 20x WD:22.5 mm Spot diameter: $\phi 2.5 \mu\text{m}$ or less * A conversion adapter is provided as standard.	

*Objective scale: 100 μm /scale

System configuration



*1. Please refer to the each product brochure for details.

LV-0030 Magnet stand



The magnetic stand is used for positioning the sensor. With two joints, laser irradiation can be performed freely. Using it together with the LV-0015 or LV-0016 fine-positioning stage enables fine adjustment of the detecting position.

LV-0016 Fine-positioning Z stage



The Z stage enables precise alignment of the sensor up/down position. Using it together with the LV-0030 magnet stand, focusing of laser beams and image, and fine adjustment in horizontal direction can be performed.

Stage surface: 60 x 60 mm
Movable range: 0 to 10 mm

LV-0015 Fine-positioning XY stage



The XY stage enables precise alignment of the sensor position. Using it together with the LV-0030 magnet stand, fine adjustment in X and Y directions can be performed. Using as a standalone unit, positioning of samples can be performed.

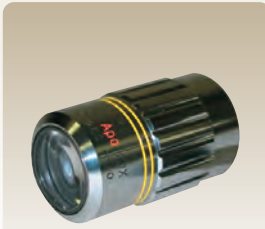
Stage surface: 60 x 60 mm
Movable range: ± 5 mm

LV-0018A Steel plate



By mounting this plate on the LV-0017A tripod, the LV-0030 magnet stand can be mounted on the tripod. It can be used as the base of the LV-0030.

LV-0151A Objective lens (10 x)



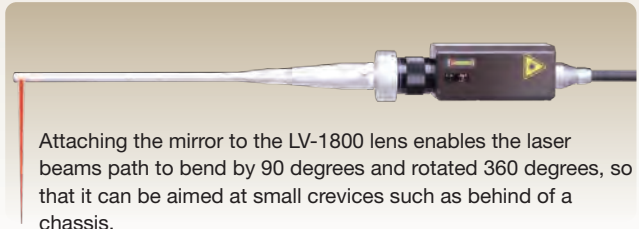
Attaching the LV-0151A to the LV-1800 lens enables the laser spot to be focused to approx. 3 μ m.

Measurement distance: approx. 40 mm

* A conversion adapter for attachment is provided as standard.

* Please refer to P7 [Measurement system for vibrating micro object] for the other magnifications.

LV-0301 90-degree beam bending mirror (ϕ 10 mm)



Attaching the mirror to the LV-1800 lens enables the laser beams path to bend by 90 degrees and rotated 360 degrees, so that it can be aimed at small crevices such as behind of a chassis.

ϕ = 10 mm

LV-0017A Tripod



Use this tripod to mount a sensor or a stand in a location without surface plate. It comes with the LV-0019 camera screw adapter (for direct mounting of a sensor to the tripod) and the LV-0018A steel plate on which the LV-0030 magnet stand can be attached by magnetization.

LV-0105 Needle type beam bending mirror (ϕ 4 mm)

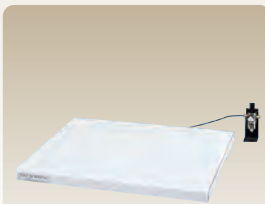


Attaching the mirror to the LV-0301, it enables the laser beams path to bend by 90 degrees, so that it can be aimed at narrower space.

ϕ = 4 mm

*The LV-0301 is required for the use of the LV-0105.

LV-0200 Benchtop vibration isolator (auto-leveling type)



Isolates the sensor from background vibration transmitted from the floor to improve detection accuracy. A regulator with filter is provided as standard.

Outer dimensions : 500 x 600 x 56 mm

Maximum load weight : 120 kg

Weight : approx. 29 kg

Leveling mechanism : Operated using 0.3 to 0.7 MPa pressurized air or nitrogen gas.

LV-0019 Camera screw adapter



The adapter for mounting the sensor of the LV-1800 to the platform of the tripod LV-0017A (1/4-inch screw).

LV-0201 Benchtop vibration isolator (manual-leveling type)



This benchtop vibration isolator does not require compressed air and can be installed anywhere. It isolates the sensor from background vibration transmitted from the floor to improve detection accuracy. The top plate is an SUS plate on which the LV-0030 can be mounted.

Outer dimensions : 500 x 600 x 56 mm

Maximum load weight : 120 kg

Weight : approx. 29 kg

Leveling : Hand pump

LV-0350 Storage suitcase



The storage suitcase can store the LV-1800 main unit together with options such as the magnet stand.

<Products can be stored>

- LV-1800
- LV-0030 (+LV-0015/0016)
- LV-0155
- LV-0185
- Utility space is provided.

LV-0160 20MHz wide band unit



Connecting this unit to the LV-1800 enables detection of amplitude up to 20 MHz.

<Usage> High frequency measurement such as ceramic condenser, piezoelectric device or crystal oscillator

Measurement velocity range : 2 mm/s to 5 m/s

Velocity range : 2 (m/s)/V

Measurement frequency range : 1 Hz to 20 MHz

Velocity output signal : ± 2.5 V (analog)

Output impedance : 75 Ω

Power supply : AC100 V ± 10 % 1 A

Operating temperature range : 0 to +40 $^{\circ}$ C

Outer dimensions : 420(W) x 500(D) x 100(H) mm

Weight : approx. 6.5 kg

*The modification is required to use the LV-0160 with the LV-1800. Please contact your nearest distributor for more details.

Specification of the LV-1800

1. Detection unit			
Detection demodulation system	Velocity demodulation using optical heterodyne detection		
Laser beam	Light source	He-Ne laser (approx. 632.8 nm wavelength)	
	Reflected light output	1 mW or less	
	Laser safety standard	Conforming to Laser Class 2 *Please refer to "3. Conforming standard" for more details.	
	Minimum laser spot diameter	Approx. 20 μm or less ($\phi=1/e^2$ when the focusing position is 100 mm.) Approx. 3 μm or less (When the LV-0151A is mounted) WD=approx. 38.9 mm	
Standard lens	Variable-focus lens	100 mm to 10 m (∞)	
	Distance scale	100 mm to 10 m (∞) *With the coherence length mark	
	Size of attachment	M22 x 0.5/Depth 5.5 mm	
Built-in positioning camera LV-0181 (option)	Installing method	Built-in sensor (Can be installed after delivery. Please contact your nearest distributor for more details.)	
	Interface	USB 2.0 *output from the conversion section USB mini-B connector	
	Imaging element	CMOS color 1/4-inch	
	Number of pixels	More than 300,000 pixels	
	Image size	VGA (640 x 480)	
	Frame rate	30 frames/second	
	Minimum imaging range	10 x 7.5 mm (TYP) WD=100 mm (at minimal length) 2.1 x 1.6 mm (TYP) When the LV-0151A objective lens is mounted.	
	Imaging position	An erect image when you see the indicator panel of the sensor head.	
	Exposure	Automatic	
	White balance	Automatic	
	Gain	Automatic	
	Operating environment	Windows® / XP (SP2 or later) / Vista (SP1 or later) / 7 Direct-X 9.0b or later / Display True Color 24 bit or more	
	Camera focus	Adjusted by an objective lens, confocal with laser spot	
Sensor suspending	Screw for sensor suspension	Backside x1 Side x1 Side x2	
		M8 depth 8mm *LV-0030 magnet stand can be used.	
		M4 depth 5 mm	
Tripod setup	Use the LV-0019 camera screw adapter (option)		
Demodulation sensitivity monitor	Signal level indicator	10-segment LED array display *Works with the signal level indicator on the conversion unit.	
	ERROR indicator	LED display (red)	
Signal cable	Cable length	3 m	The cable is wound up on the cable clamp. (rear panel of the conversion unit)
	Diameter	$\phi=10.5$ mm	
	Coating	Oil-resistant coating	
	Minimum bend radius	R=40 mm or more	
Outer dimensions of the detection unit	W	53 mm	Not including the protruded section
	H	52.5 mm	
	D	152.5 mm	
Weight of the detection unit	Approx. 750 g (When the LV-0181 is installed. Not including the cable.)		

2. Conversion unit				
Detection velocity	Frequency range	0.3 to 3 MHz ($f_c=-3$ dB) *common to each velocity range 0.001 (m/s)/V (option): 0.3 to 200 kHz ($f_c=-3$ dB)		
	Maximum detection velocity	10 m/s o-p (20 m/s p-p)		
	Minimum velocity resolution	0.3 $\mu\text{m/s}$ or less (when at 0.01 (m/s)/V) 0.05 $\mu\text{m/s}$ or less (when the LV-0800 is installed.)		
	Output	± 10 V (20 V p-p) *input impedance: 100 k Ω or more		
		Polarity of output voltage	+ voltage when moving closer to a sensor side	
		DC offset	20 mV or less	
		Output impedance	50 Ω	
		Minimum input impedance	100 k Ω or more	
Connector type		BNC (C02)		
Velocity range	1.0 (m/s)/V	10 m/s o-p (MAX)		
	0.1 (m/s)/V	1 m/s o-p (MAX)		
	0.01 (m/s)/V	0.1 m/s o-p (MAX)		
	0.001 (m/s)/V (option)	0.01 m/s o-p (MAX) *Please refer to P6 "LV-0800 Minute velocity range board" for more details.		
	Over indicator	Light up of red LED when the detected velocity exceeds +5 % of upper limit.		
Demodulation sensitivity monitor	Signal level indicator	20-segment LED array display/Works with the signal level indicator on the detection unit.		
	MONITOR output	0 to 10 V		
		Output impedance	50 Ω	
		Minimum input impedance	100 k Ω or more	
		Connector type	BNC (C02)	
ERROR indicator	Light up of red LED			
High-pass filter (HPF)	100 Hz	$f_c=-3$ dB		
	OFF (0.3 Hz)			

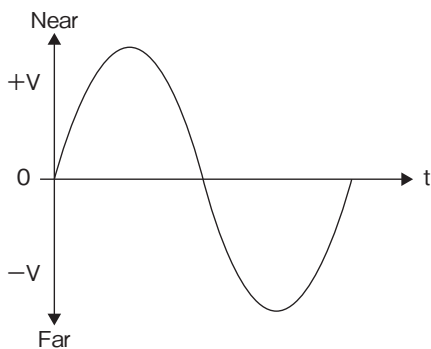
2. Conversion unit

Low-pass filter (LPF)		50 kHz	fc=-3 dB	
		100 kHz		
		1 MHz		
		OFF (3 MHz)		
Image output for positioning (option)	Image output	Digital		
	Standard	USB 2.0		
	Display	Light up of white LED *When the LV-0180 is installed.		
	Connector type	USB mini-B type		
Control of laser irradiation	ON/OFF	Operated by the laser control switch on front panel. Function of power-on laser irradiation can be specified at time of order.		
	Laser beam irradiation indicator	*Light up of green LED when laser beam is irradiated.		
	Mechanical shutter	Contact input	The laser beam irradiation is stopped at contact open.	
		Connector type	Receptacle:RM12BRB-2S Plug:RM12BPE-2PH(short-circuited)	
Storage device	Storage of detection unit	Stored in the conversion unit		
	Storage of cable	Wound up on the cable clamp (rear panel of the conversion unit)		
Outer dimensions	W	410 mm	Not including protruded section	
	H	120 mm		
	D	325 mm		
Weight	Approx. 8.1 kg (including the sensor and the cable)			
Operating temperature range	0 to 40°C			
Operating humidity range	30 to 80 % RH (with no condensation)			
Storage temperature range	-10 to +50°C			
Input voltage	AC100 to 240 V			
	50/60 Hz			
Power consumption	60 VA			
Cooling method	Convection air cooling (no-vibration cooling)			

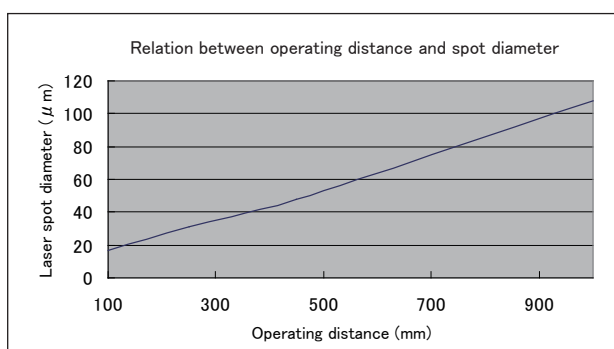
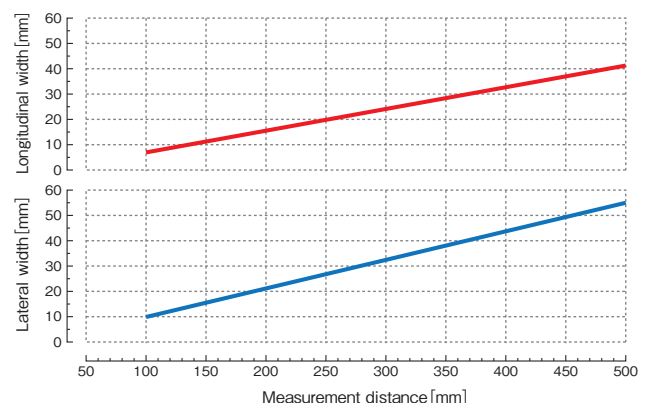
3. Conforming standard

IEC/EN60825-1:2007		
FDA(CDRH) 21CFR 1040.10 Laser Notice 50		
CE marking	Low voltage directive	EN61010-1:2010
	EMC directive	EN61326-1:2006 Class A Table 2
FCC (Part 15dB)		
CANADA EMI Standard (ICES-003)		

■ Relation between vibrating direction and voltage output



■ Imaging range taken by the LV-0181 Built-in positioning camera



Evaluation condition of resolution/dynamic range

LPF:100 kHz ON

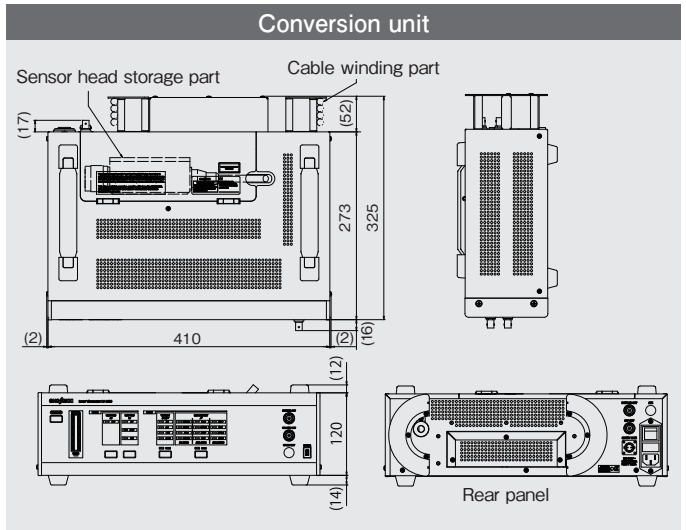
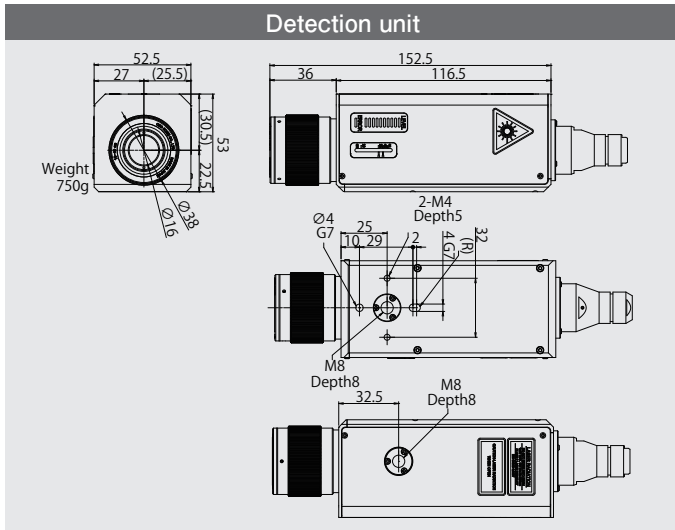
At maximum demodulation using a corner cube

Power spectrum observation by FFT Analyzer

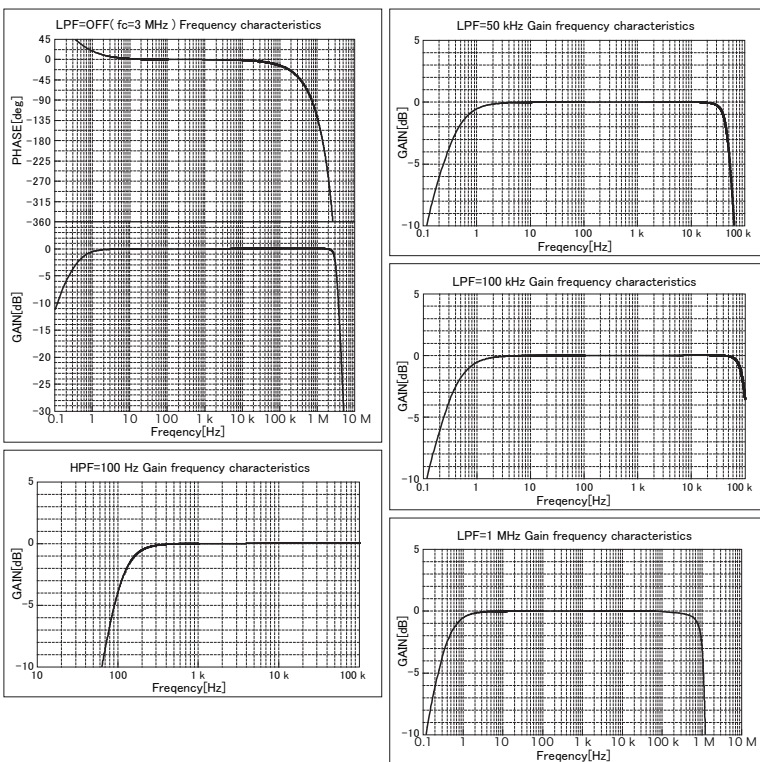
1 kHz range 1kHz, 2048 lines, averaging of 256 times

*Please refer to the above graph for the each filter characteristics.

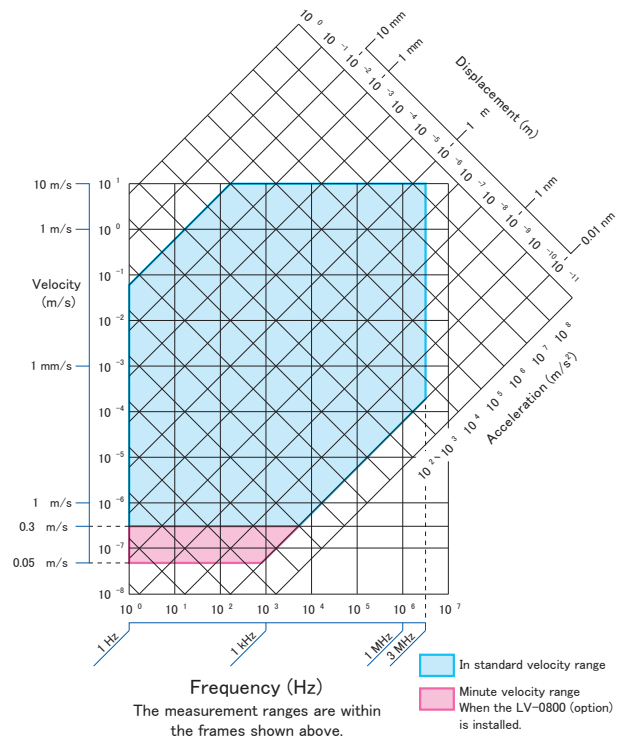
●LV-1800 Outer dimensions (unit: mm)



●LV-1800 Frequency characteristics graph



●Measurement ranges



●Certification

The LV-1800 model has been designed and tested in accordance with the following standards.

- Conforming standards: JIS C 6802 (Laser Product Radiation Safety Standards)
 IEC/EN 60825-1: 2007
 FDA (CDRH)
 CE Marking (Low Voltage Directive, EN61010-1: 2010)
 (EMC directive, EN61326-1: 2006 Class A Table 2)
 FCC (Part 15B)
 CANADA EMI Standard (ICES-003)



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*Outer appearance and specifications are subject to change without prior notice.

URL: <http://www.onosokki.co.jp/English/english.htm>

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