LV-1800

Laser Doppler Vibrometer

ONO SOKKI

Dynamic & High-Resolution

Vibrometer using Non-contact Laser Doppler Method

Dynamic & High-Resolution

LV-1800

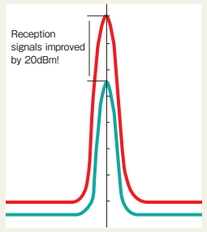
A positioning camera built-in a sensor

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 (LV-0151B) and the illumination unit (LV-0185), 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®10,11

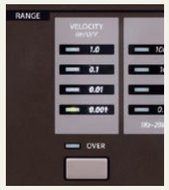
Greatly increased detection ability

Newly designed interference optical system has achieved improvement of the detection sensitivity by +20 dBm 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 4 velocity ranges

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



The minimum resolution at the maximum modulation with the LV-0800 (Minute velocity range) installed.

Quick confirmation of the focal position and the detection status

The sensor part has an indicator to show the detection status and a distance scale used for a guideline of the laser's focal position. It enables quick and reliable setup, and checking of the detection status at hand. It enables quick and reliable setup, and checking of the detection status at hand.

Noise-free design without cooling fan

LV-1800 is subjected to countermeasure for self-vibration by means of fan-less natural air cooling. 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.

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
■IEC 60825-1:2007
■FDA (CDRH) 21CFR 1040.10 and 1040.11

Excellent ease of use with a small and light-weight sensor

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, and amplitude in the deep position or narrow parts can be detected.

Easy storage and transporting

The main body has a sensor storage and a cable clamp for winding cable (3 m). The optional storage trunk (LV-0350) can store the main body and major options such as the magnet stand and the illumination unit. You can organize quickly, and transport safely.

Wide range of options provide utmost solutions

LV-1800 and its options, which have been developed based on our abundant experience at measurement sites, support detection in various cases. Furthermore, Ono Sokki's waveform analyzer and its software provide utmost solution by visualizing behavior and characteristics of a target.

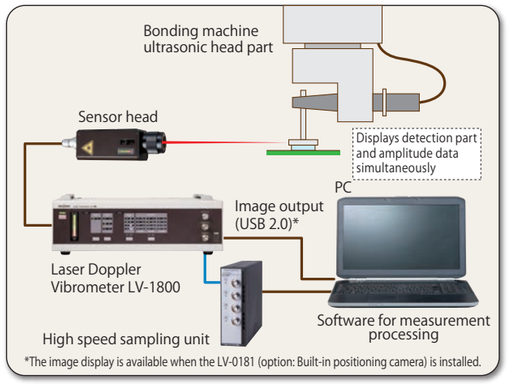
Laser Doppler vibrometer with No load and Non-contact

The LV1800 is a vibrometer that uses the Doppler shift of laser beams to detect the velocity amplitude of vibration without load and without contact. Wide range of targets difficult to detect with a contact can be measured, such as high speed, high frequency, transparent, thin-film, and micro objects.

Applications

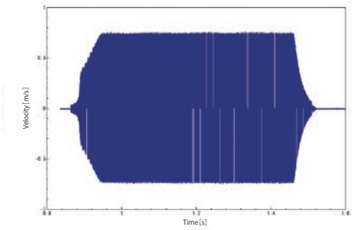
- ■Vibration and resonance point measurement of substrate mount component
- ■Vibration measurement of inverters, capacitors, reactors of EV/HEV.
- ■Measurement through glass
- ■Vibration measurement of transparent or thin film
- ■Resonance point measurement of optical pickup such as CD, DVD, or BD.
- ■Evaluation of component parts including HDD
- ■Evaluation of microphones and receivers included in cell phones.
- ■Amplitude measurement of ultrasonic welding machine and bonding machine tools
- ■Measurement of piezoelectric elements, MEMS etc.
- ■Behavior measurement of ultrasonic motors

Vibration measurement of ultrasonic tools

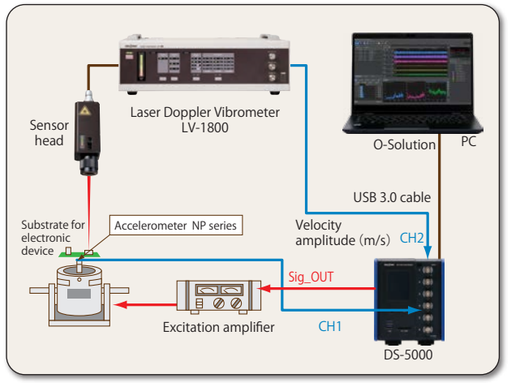


*The image display is available when the LV-0181 (option: Built-in positioning camera) is installed.

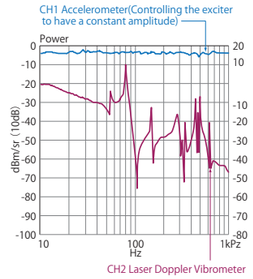
This application can measure the amplitude of objects vibrating at high speeds, such as ultrasonic welders and bonding machine tools, at frequencies above 20 kHz.
Using the amplitude values and frequency analysis, you can check welding quality or determine maintenance timing of equipment.



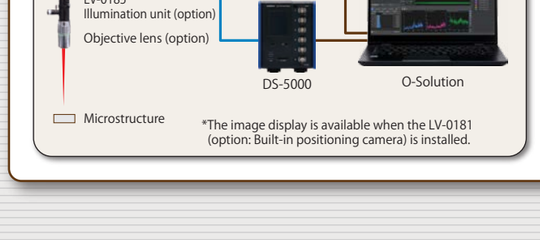
Measurement of components mounted on a substrate



As LV-1800 Laser Doppler Vibrometer has high spatial resolution, it can detect the amplitude of electronic components mounted on substrates in pin point when vibration testing.
This system is useful to see the status of targets when unexpected overload is applied. For example, you can see the status of parts in a case when overload is applied to the target with larger amplitude more than the specified acceleration owing to the variety of each part mass and substrate vibration mode.

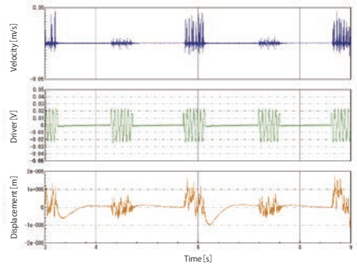


Measurement of thin film vibration

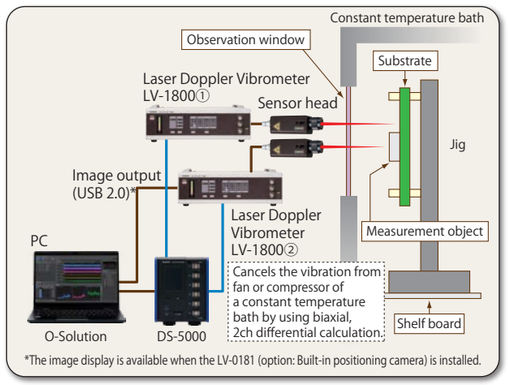


*The image display is available when the LV-0181 (option: Built-in positioning camera) is installed.

LV-1800, that features non-contact and no-load detection, is the most suitable device for amplitude measurement of thin film, such as a diaphragm of cell phone microphone, a corn paper of receiver or speaker, and a transparent film like a liquid crystal display film.

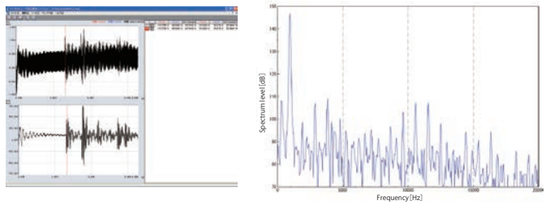


Measurement through a glass

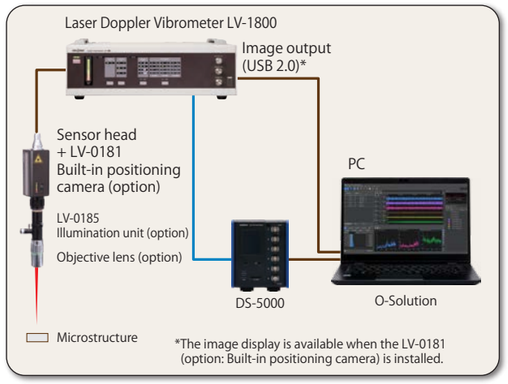


*The image display is available when the LV-0181 (option: Built-in positioning camera) is installed.

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

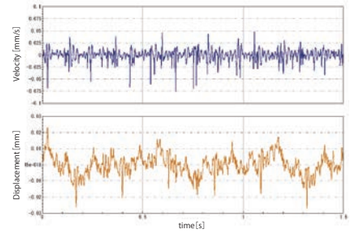


Measurement of microstructures



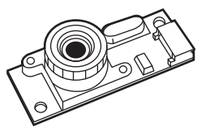
*The image display is available when the LV-0181 (option: Built-in positioning camera) is installed.

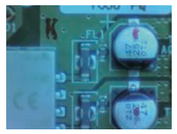
LV-1800 has high spatial resolution by mounting the LV-0150B optional objective lens having micro spot diameter up to ϕ 3 µm (standard spot diameter: ϕ20 µm). You can detect the amplitude of microstructures, such as MEMS (Micro Electro Mechanicall Systems) with this system.

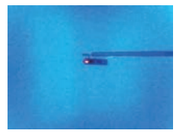


LV-0181 Built-in positioning camera

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 also irradiate laser beams speedily. By combining the LV-0151B (objective lens) and the LV-0185 (illumination unit), amplitude of micro objects such as MEMS can be measured.





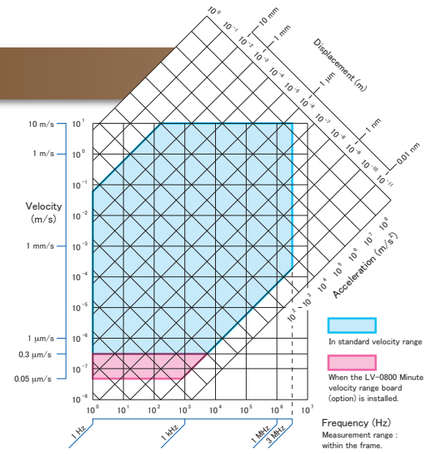


■Specification of the LV-0181

Connector type	USB 2.0（Main unit side：mini-B type）
Imaging element	CMOS color sensor 1/4-inch
Number of pixels	300,000 pixels or more
Image size	VGA (640 x 480)
Frame rate	30 frames / second
Minimum imaging range	WD= 100 mm (shortest): 10 mm x 7.5 mm (TYP.)
Function	Exposure / gain / white balance (automatic)
Compatible OS	Windows® 10,11
Camera focus	Confocal with laser spot
Accessory	LV-0181 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 0.05 μm/s to 10 m/s velocity amplitudes with 4 ranges.



■Specification of the LV-0800

Velocity range	0.001 (m/s) / V (0.01 m/s $_{0\text{-}p}$ (MAX))
Minimum resolution	0.05 μm/s * at maximum modulation
Frequency range	0.3 to 200 kHz (fc=-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 in 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 μm/V
0.1 (m/s) /V	10 mm/V	100 μm/V	1 μm/V
0.01 (m/s) /V	1 mm/V	10 μm/V	100 nm/V
0.001 (m/s) /V	0.1 mm/V	1 μm/V	10 nm/V

■Specification of the LV-0111

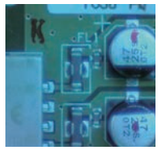
Setup range of the LV-1800	Acceleration range		
	1 Hz to 2 kHz	1 Hz to 20 kHz	100 Hz to 400 kHz
1.0 (m/s) /V	10^3 (m/s^2) /V	10^5 (m/s^2) /V	10^7 (m/s^2) /V
0.1 (m/s) /V	10^2 (m/s^2) /V	10^4 (m/s^2) /V	10^6 (m/s^2) /V
0.01 (m/s) /V	10 (m/s^2) /V	10^3 (m/s^2) /V	10^5 (m/s^2) /V

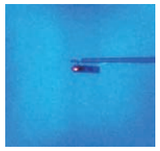
■Common specification

Signal source	Internally receives the velocity signal from the LV-1800
Output form	Analog voltage
Output voltage	±10 V (MAX) *Minimum input impedance: 100 kΩ 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 objective lens	LV-0150B (5x) / LV-0151B (10x)
	LV-0152B (20x)
Irradiation method	Coaxial epi-illumination by cold-light white LED
Light emitting part	Cold-light illumination by white LED
Cable length	1.5 m (when the dedicated extension cable in used.)

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	100 V AC to 240 V AC, 50/60 Hz
Consumption voltage (VA)	3.5 VA when 100 V AC, 9.0 VA when 240 V AC

Measurement system for vibrating micro object

<Basic configuration : example>

- ・Laser Doppler Vibrometer LV-1800
- ・Built-in positioning camera LV-0181
- ・Objective lens LV-0152B
- ・Illumination unit LV-0185
- ・Large size magnet stand LV-0030
- ・Fine-positioning XY stage LV-0015
- ・Fine-positioning Z stage LV-0016

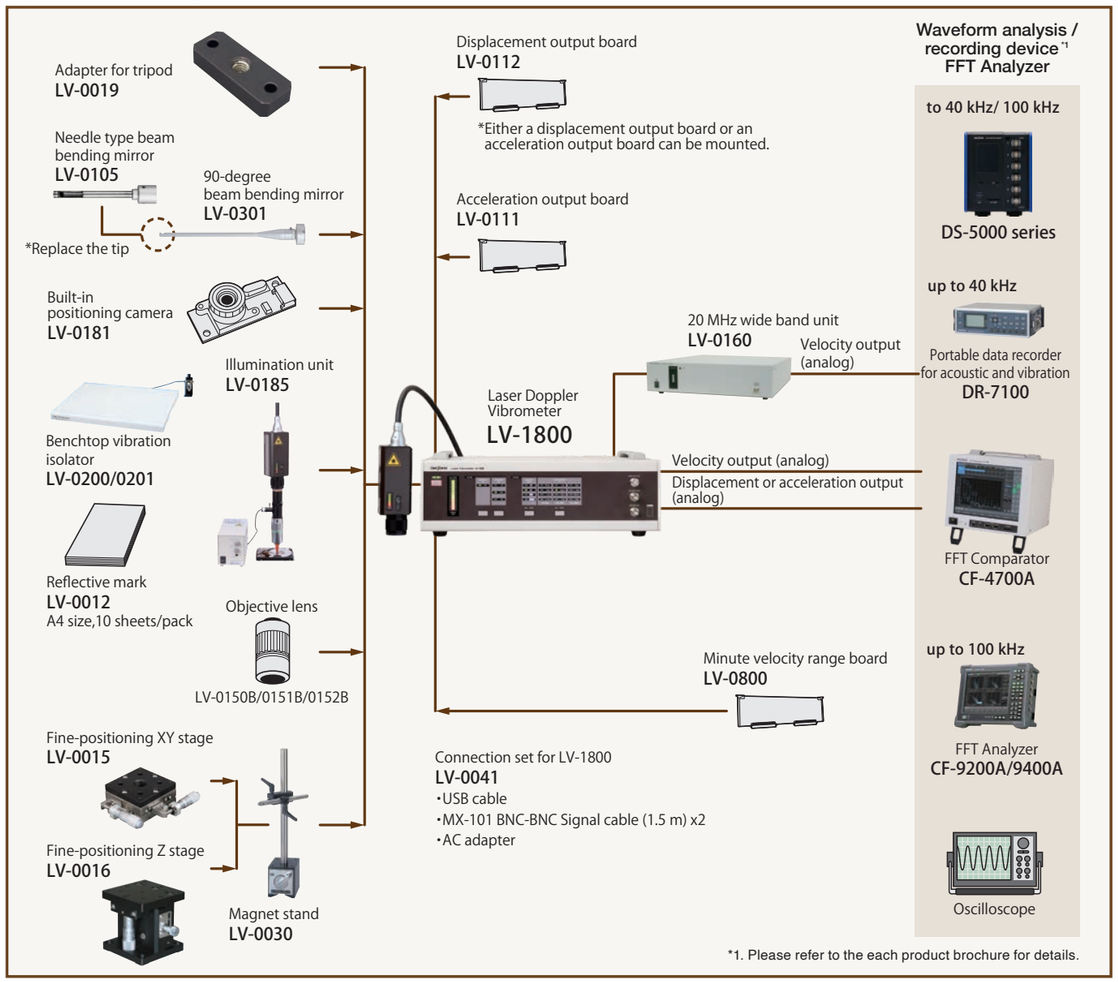
* A PC is required to display the image.

Installing the LV-0181 (Built-in positioning camera), 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-0150B 	Magnification: 5x WD: 36.1 mm Spot diameter: ϕ4 μm or less * A conversion adapter is provided as standard.	
LV-0151B 	Magnification: 10x WD: 38.8 mm Spot diameter: ϕ3 μm or less * A conversion adapter is provided as standard.	
LV-0152B 	Magnification: 20x WD: 22.5 mm Spot diameter: ϕ2.5 μm or less * A conversion adapter is provided as standard.	

* Objective scale: 100 μm /scale
* Please contact us for 20 or more magnification of objective lens.

System configuration



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

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.

LV-0301 90-degree beam bending mirror

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

Tip of the rod diameter : ϕ=10 mm

LV-0150B/0151B/0152B Objective lens

The above photo is an image.

The laser spot diameter can be narrowed to 20μm or less by attaching the objective lens to the tip of the LV-1800.
Three types of lens are available according to the spot diameter or magnification. Please refer to P.7 for details.

* A conversion adapter for attachment is provided as standard.
* Please contact us for the other magnifications.

LV-0105 Needle type beam bending mirror

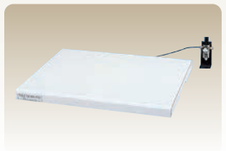
This mirror has ϕ4 mm of rod tip diameter, useful for the guide of detection at narrower space. Used by attaching to the tip of the 90-degree beam bending mirror LV-0301.

Tip of the rod diameter: 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 S/N ratio.
A regulator with filter is provided as standard.The top plate is made with SUS 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 mechanism :Operated using 0.3 to 0.7 MPa pressurized air or nitrogen gas.

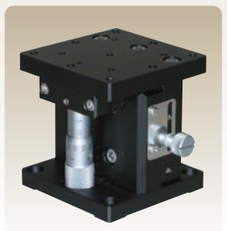
LV-0019 Camera screw adapter

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

LV-0030 Magnet stand

The magnet stand is used for sensor positioning. Laser can be irradiated with high angular flexibility with cross clamp.
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 fine alignment of the sensor up/down position. Using it together with the LV-0030 magnet stand, you can easily perform focusing of laser beams and image, and fine adjustment.

Stage surface: 60 x 60 mm
Movable range: 0 to 13 mm
* An adapter plate is required separately when attaching only LV-0016 to LV-0030.

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 S/N ratio. The top plate is made with SUS 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 mechanism : Hand pump

LV-0350 Storage trunk

This storage trunk can store the LV-1800 main unit and other optional products together.

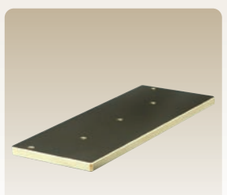
<Products containable>
•LV-1800 x 1
•LV-0030 (+LV-0015/0016) x 1
•Objective lens x 2
•LV-0185 x 1
•LV-0018A x 1
*Utility space is provided.

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: ±6.5 mm

LV-0018A Steel plate



You can use this plate as a base on the LV-0030 magnet stand by mounting on the LV-0017A tripod. Fixing the LV-0015/0016 fine-positioning stage directly with screws prevents the stage and sensor from falling.

LV-0160 20 MHz wide band unit <made to order>

By connecting this unit to the LV-1800, detection of high velocity amplitudes up to 20 MHz is available.
<Usage> High frequency measurement such as ceramic capacitor, piezoelectric device or crystal oscillator

Measurement velocity range : 2 mm/s to 5 m/s
Velocity range : 2 (m/s)/V
Frequency range : 1 Hz to 20 MHz
Velocity output signal : Analog voltage ±2.5 V (at 100 kΩ or more of input impedance)
Output impedance : 75 Ω
Power supply : 100 V to 240 V AC (50/60 Hz), 40 VA MAX
Operating temperature range : 0 to +40 ℃
Outer dimensions : 420(W) x 500(D) x 100(H) mm (not including protruded section)
Weight : approx. 7 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. 633 nm wavelength)	
	Emission output	1 mW or less	
	Laser safety class	Conforming to Laser Class 2	
	Minimum laser spot diameter	Approx. 20 μm or less (ϕ=1/e^2 when the focusing position is 100 mm.)	
		Approx. 3 μm or less (When the LV-0151B is mounted) WD=approx. 38.8 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-0151B objective lens is mounted.	
	Imaging position	An erected image when you see the indicator panel of the sensor head.(rotatable)	
	Exposure	Automatic	
	White balance	Automatic	
	Gain	Automatic	
	Operating environment	Windows® 10,11	
	Camera focus	Adjusted by an objective lens, confocal with laser spot	
Sensor suspension	Screw for sensor suspension	Backside x1	M8 depth 8 mm *exclusive for LV-0030 magnet stand.
		Side x1	
		Side x 2	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	ϕ=10.5 mm	
	Coating	Oil-resistant coating	
	Minimum bend radius	R=40 mm or more	
Outer dimensions	W	53 mm	Not including the protruded section
	H	52.5 mm	
	D	152.5 mm	
Weight		Approx. 750 g (When the LV-0181 is installed. Not including the cable.)	

2. Conversion unit

Detection velocity	Frequency range	0.3 Hz to 3 MHz (fc=−3 dB) *common to each velocity range 0.001 (m/s)/V (option) 0.3 Hz to 200 kHz (fc=−3 dB)	
	Maximum detection velocity	10 m/s $_{0\text{-}p}$ (20 m/s $_{p\text{-}p}$)	
	Minimum velocity resolution*	0.3 μm/s or less (when at 0.01 (m/s)/V) 0.05 μm/s or less (when the LV-0800 is installed.)	
	Output	±10 V (20 V $_{p\text{-}p}$) *input impedance: 100 kΩ 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 kΩ or more
		Connector type	BNC (C02)
Velocity range	1.0 (m/s)/V	10 m/s $_{0\text{-}p}$ (20 m/s p-p)	
	0.1 (m/s)/V	1 m/s $_{0\text{-}p}$ (2 m/s p-p)	
	0.01 (m/s)/V	0.1 m/s $_{0\text{-}p}$ (0.2 m/s p-p)	
	0.001 (m/s)/V (option)	0.01 m/s $_{0\text{-}p}$ (0.02 m/s p-p) *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 kΩ or more
		Connector type	BNC (C02)
	ERROR indicator	Light up of red LED	
High-pass filter (HPF)		100 Hz	fc=−3 dB
		OFF (0.3 Hz)	

*Resolution evaluation conditions:LPF : 100 kHz ON/At maximum demodulation using a corner cube/Power spectrum observation by FFT Analyzer/1 kHz range 1 kHz, 800 lines, averaging of 256 times

2. Conversion unit

Low-pass filter (LPF)		50 kHz	fc=−3 dB * Not selectable when used at 0.001 (m /s) / V range
		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-0181 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 the 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	324 mm	
Weight		Approx. 8.1 kg (including the sensor and the cable)	
Operating temperature range		0 to 40 ℃	
Operating humidity range		30 to 80 % RH (with no condensation)	
Storage temperature range		−10 to +50 ℃	
Input voltage		100 to 240 V AC	
		50/60 Hz	
Power consumption		60 VA	
Cooling method		Natural air cooling (non-vibration cooling)	

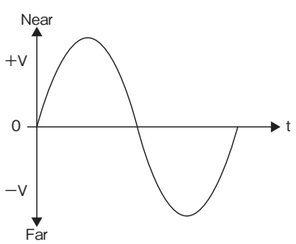
3. Conforming standard

Laser safty	IEC 60825-1:2007:2014		
	EN 60825-1:2007:2014/A11:2021		
	FDA (CDRH) 21CFR 1040.10 and 1040.11 except for conformance with IEC 60825-1 Ed.3., as described in Laser Notice No.56		
CE marking	Low voltage Directive	2014/35/EU	EN 61010-1, EN 60825-1
	EMC Directive	2014/30/EU	EN 61326-1
	RoHS Directive	2011/65/EU	EN IEC 63000

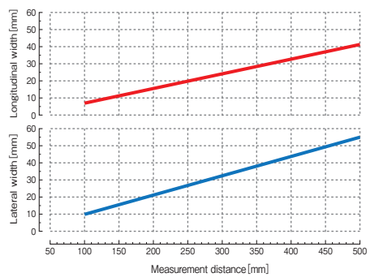
4.Accessory

Product name	No. of pcs.	Remarks
AC Power cable	1	
Safety lock connector	1	After short-circuit processing
Output signal cable	2	MX-101 BNC-BNC 1.5 m
Lens cap	1	Attached to the lens tip
Reflection mark	1	LV-0012 A4-size
Backup fuse	1	Built-in AC inlet of a main unit, T3.15 A 250 VAC
Instruction manual	1	

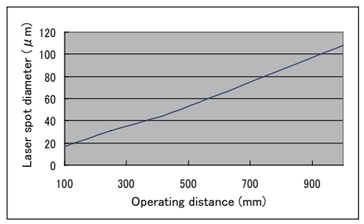
■Target amplitude: Polarity of output voltage



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

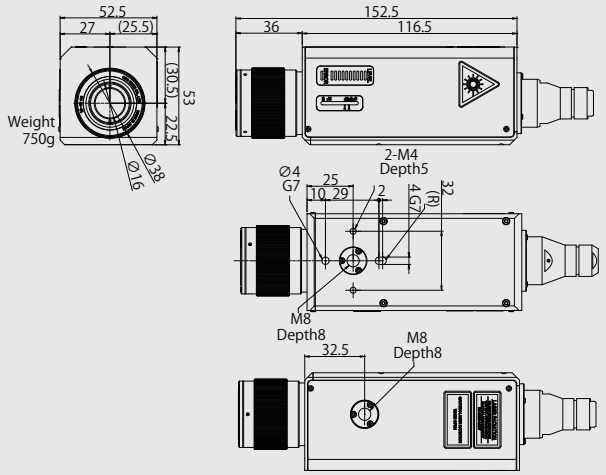


■Relation between operating distance and spot diameter

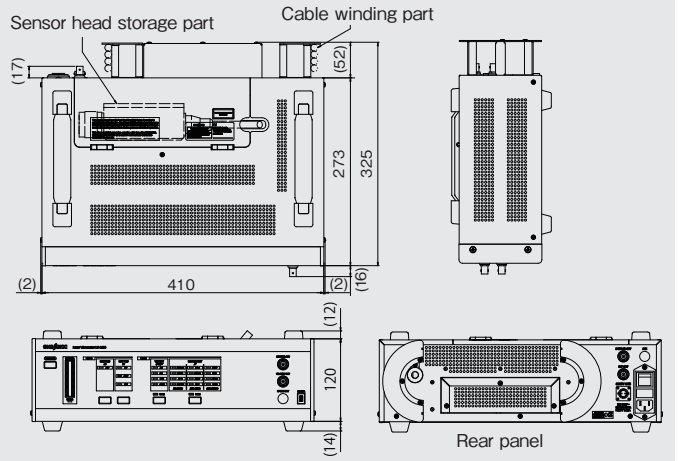


●LV-1800 Outer dimensions (unit: mm)

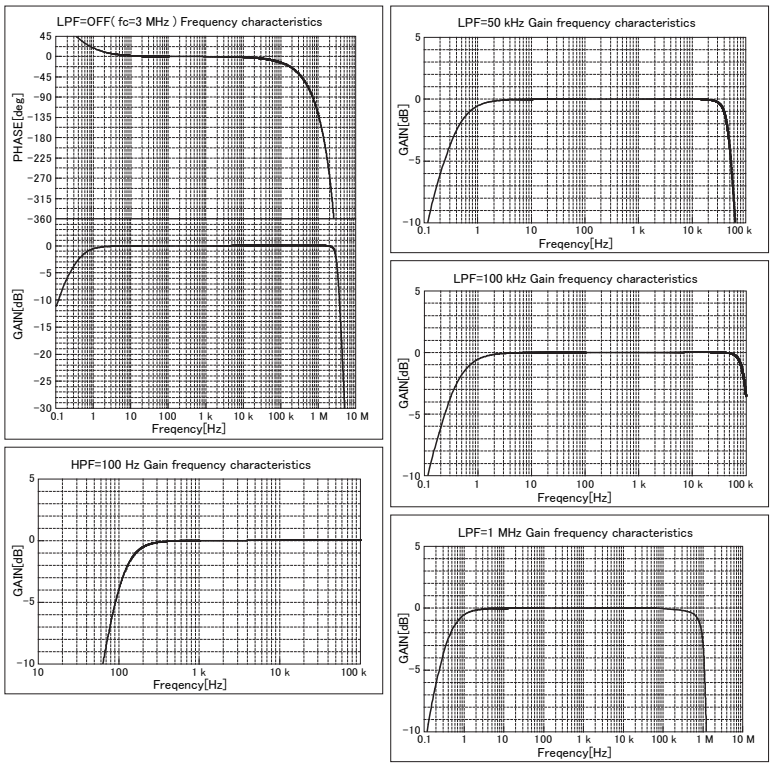
Detection unit



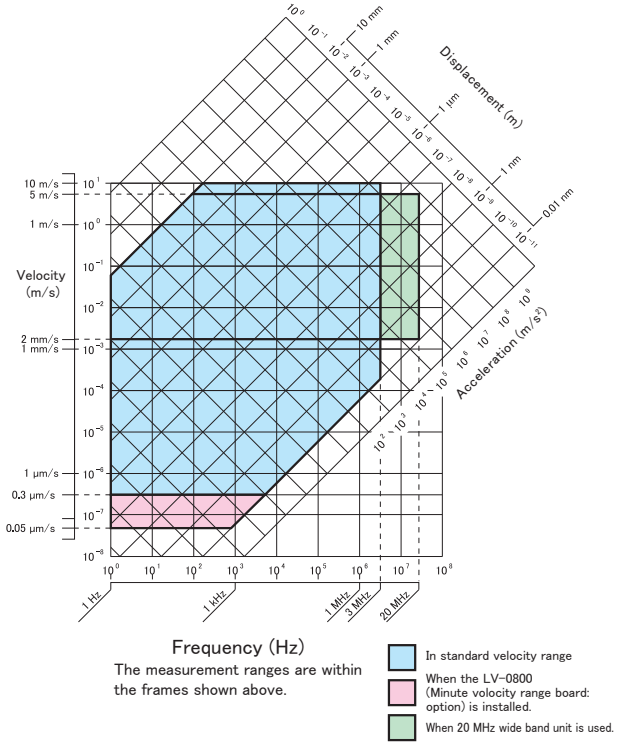
Conversion unit



●LV-1800 Frequency characteristics graph



●Measurement range



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CAT. NO. 1654-06E Printed in Japan (LI)2601