



LVM-4000 LASER VALVE MOTION measurement system

LASER-BASED TECHNOLOGY

SIMULTANEOUS, REAL-TIME DISPLACEMENT,
VELOCITY and ACCELERATION ANALOG OUTPUTS

ENGINE HEAD VIBRATION SUBTRACTION

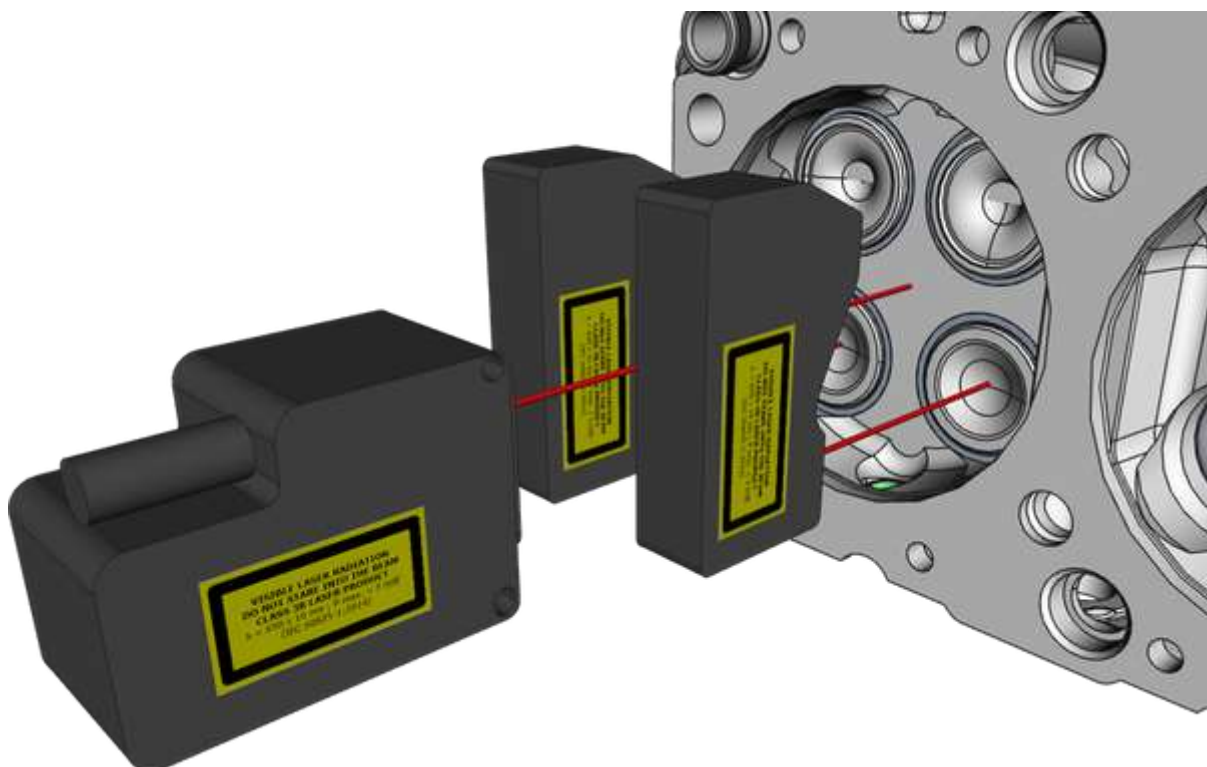
UP TO 100 kHz BANDWIDTH

MODULAR RACK – UP TO 3 CHANNELS:
2x LASER DISPLACEMENT SENSORS
1x LASER DOPPLER VIBROMETER

*OH-1000
LASER VIBROMETER HEAD*



*LT-14040
LASER TRIANGULATION
DISPLACEMENT SENSOR*



STATE-OF-THE-ART LASER DISPLACEMENT SENSORS

The LVM-4000 laser system includes up to two LT-14040 laser displacement sensors for easy and accurate measurement of the valve motion, with the possibility of using **two sensors for the same cylinder** to simultaneously measure the motion of two valves (intake-intake, intake-exhaust, exhaust-exhaust). The wavelengths of the light emitted by the two lasers are selected to be different to avoid any possible interference.

Julight's unique signal processing electronic system makes available the **displacement**, and also the instantaneous **velocity and acceleration** of the valve. All the signals are obtained in **real-time with no delays**, to ease synchronization with the encoder signal from the rotating crankshaft.

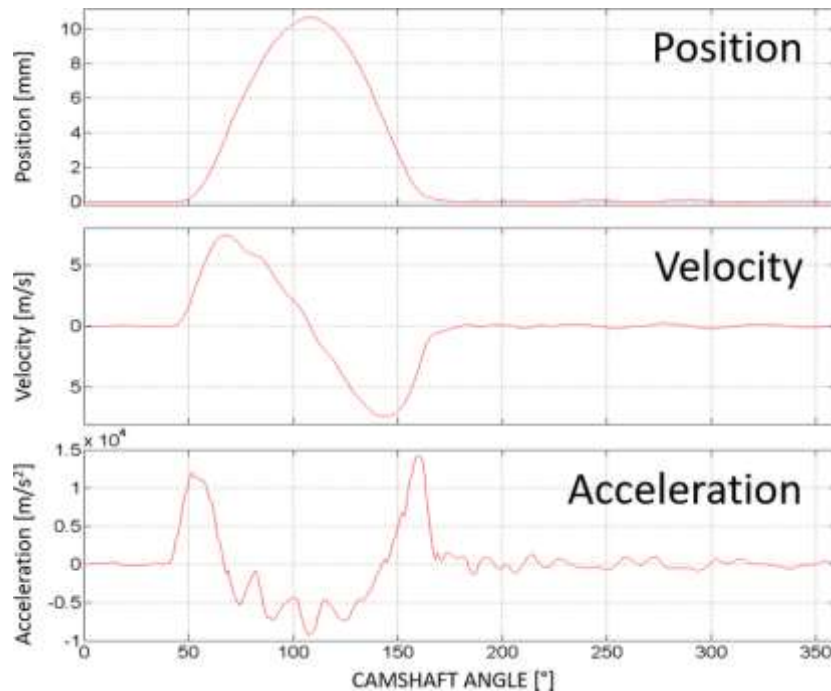
The high-accuracy is guaranteed by **the low noise level**, which is less than 10 μm peak-to-peak in the time domain. The best performance is obtained on matte white painted surface.



OPTIONAL LASER DOPPLER VIBROMETER – The LVM-4000 can include one optional **Laser Doppler Vibrometer channel OH-1000**, with the smallest optical head available on the market thanks to Julight's proprietary “Self-Mixing” laser interferometric configuration.

The signal from the Laser Doppler Vibrometer **can be internally subtracted** from the valve displacement measured by triangulation sensors. This is highly useful to **get rid of the unwanted vibration of the engine head**, thus obtaining a cleaner and smoother valve motion signal. For this purpose, the Laser Doppler Vibrometer beam is aimed at the center of the cylinder's head (see picture on front cover).

The Laser Doppler Vibrometer can also be used independently for **general purpose vibration measurement**, thus serving also the **NVH** (noise, vibration, harshness) departments of automotive research centers. The Laser Doppler Vibrometer channel can be remotely controlled from a PC, via a software that allows to activate all its functions.



The special **hardware and software tool LVM-4000-UltraResolution** provides an off-line, ultra-high resolution analysis of the valve motion, directly derived from the laser Doppler interferometric signal, which is capable of a time-domain displacement **accuracy of 1 μm** . This tool is useful in analyzing the fine details of the valve motion, and can reveal non-repetitive or unexpected events.

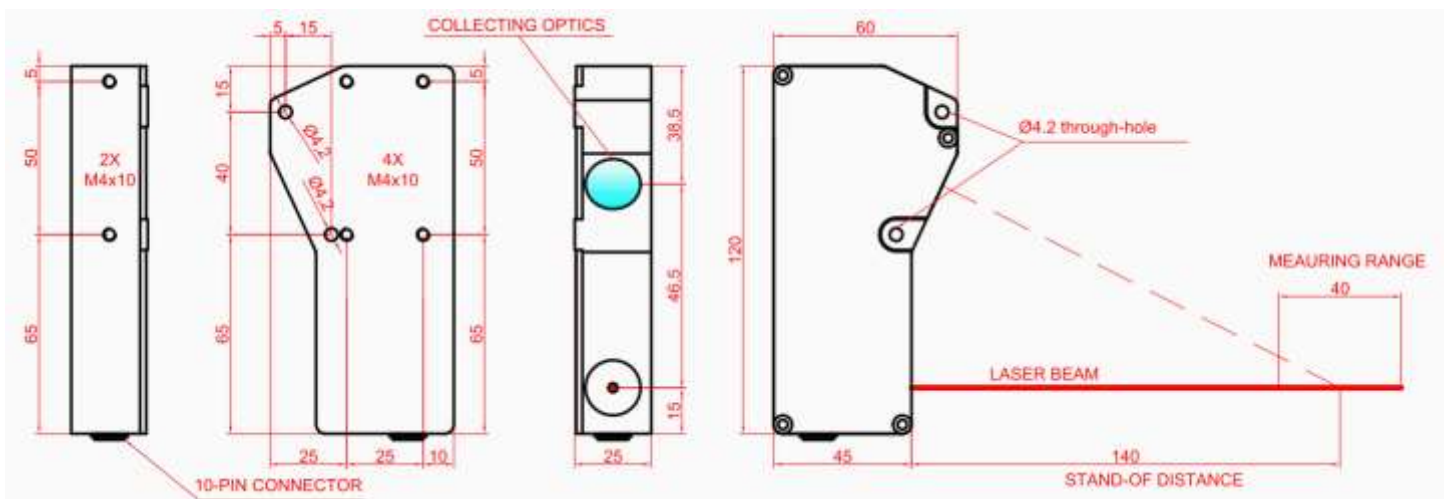
The LVM-4000-UltraResolution tool includes:

- i) a hardware for the high-speed acquisition of the signal from the Laser Doppler Vibrometer channel;
- ii) a laptop PC with Windows 10;
- iii) a software that manages the acquisition of the time signals, performs the post-processing, provides detailed traces of the valve displacement, velocity and acceleration, for up to 125 valve cycles.

LT-14040 – LASER DISPLACEMENT SENSOR TECHNICAL DATA

Stand-off Distance (SoD)	140 mm
Measuring Range (MR)	120 ÷ 160 mm (SoD ± 20 mm)
Maximum measurable valve lift	40 mm
Bandwidth	Selectable low-pass filters at 2 kHz and 20 kHz
Linearity Error	< 10 µm (for SoD ±10 mm) ; < 40 µm (for SoD ±20 mm)
Analog outputs	Displacement [0.5 V/mm] Velocity [0.5 V/(m/s)] Acceleration [0.5 mV/(m/s ²)]
Displacement Resolution and Accuracy (time-domain)	5 µm RMS, limited by noise, for 2 kHz bandwidth
Noise Equivalent Displacement	0.1 µm/√Hz
Spatial transverse resolution	1.0 mm
Target surface	Diffusive, matte white painted recommended
Laser wavelength	630 ± 10 nm, or 660 ± 10 nm
Laser Power	>20 mW (in standard operating condition) < 1 mW (in safety mode)
Laser Safety Class (according to IEC 60825-1:2014)	Class 3B in standard operating condition Class 2 in safety mode (i.e. when target surface is not present)
Optical head cable length	2.5 m (5 m, 10 m optional)
Sensor head dimensions (L x H x W)	60 mm x 120 mm x 25 mm
Weight (sensor's head only)	0.3 kg
Operating temperature (optical head)	+5 °C to +60 °C (non-condensing humidity)

LT-14040 – LASER DISPLACEMENT SENSOR OPTICAL HEAD

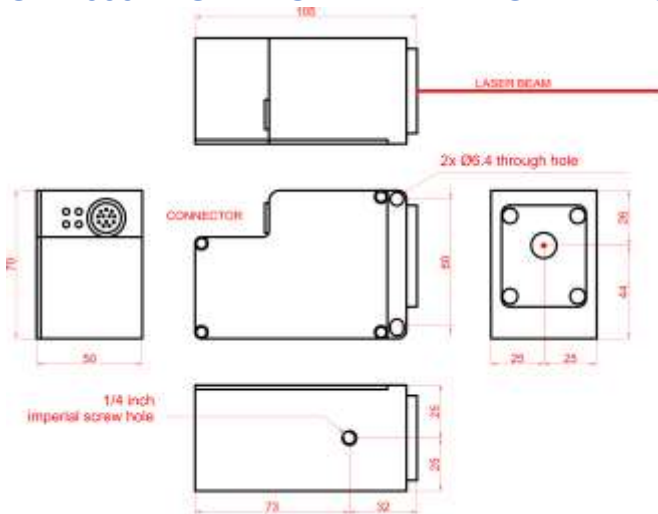


(all dimensions in mm)

OH-1000 LASER DOPPLER VIBROMETER TECHNICAL DATA

Maximum measurable vibration (peak-to-peak)	43 mm (theoretical) / 1 mm (practical)
Maximum measurable velocity	0.5 m/s
Output signals	<ul style="list-style-type: none"> • Displacement/Velocity (BNC connector) • Monitor: Optical Signal Level + Speckle-Tracking active (3.5mm jack) • (Optional) Doppler signal for <i>LVM-4000-UltraResolution</i> tool
Output signal responsivity	<ul style="list-style-type: none"> • Displacement: 0.5 mV/μm • Velocity: 5 V/(m/s)
Resolution	Noise-limited
Noise Equivalent Displacement	0.04 nm/ \sqrt Hz
Output signal accuracy	1 %
Spatial transverse resolution	100 μ m
Target surface	Diffusive or back-reflecting
Working distance	0.1m ÷ 5.0m (autofocus)
Laser radiation	<ul style="list-style-type: none"> • Visible pointer (visible): Power < 1 mW @ 650 nm (collimated) • Measuring beam (invisible): Power < 15 mW @ 1310 nm (focused)
Laser safety class (according to IEC 60825-1:2014)	<ul style="list-style-type: none"> • Visible pointer: Class 2 • Invisible measuring beam: Class 1
Optical head dimensions	50 mm x 70 mm x 105 mm
Optical head cable length	2.5 m (5 m optional)
Weight (sensor's head only)	0.5 kg
Operating temperature (optical head)	-20 °C to +70 °C (non-condensing humidity)

OH-1000 LASER DOPPLER VIBROMETER OPTICAL HEAD

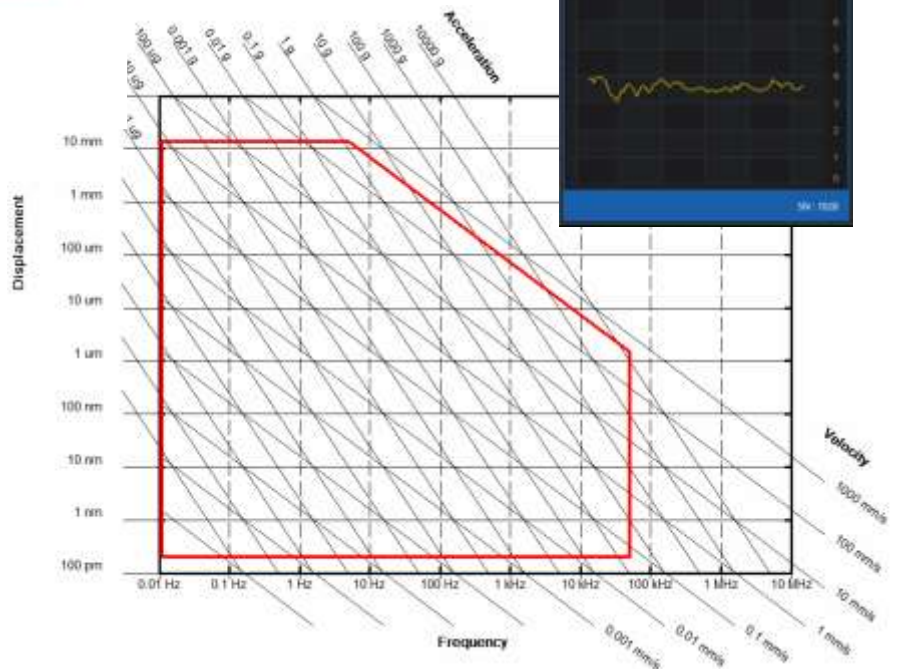


(all dimensions in mm)

PC Software



MEASURABLE VIBRATIONS



LVM-4000 MAIN UNIT – FRONT VIEW



LT-14040
LASER DISPLACEMENT
SENSOR CHANNEL #1

LT-14040
LASER DISPLACEMENT
SENSOR CHANNEL #2

OH-1000
LASER
VIBROMETER
CHANNEL

- displacement + velocity + acceleration
- selectable low-pass filters
- (optional) subtractor of laser vibrometer signal

LVM-4000 MAIN UNIT TECHNICAL DATA

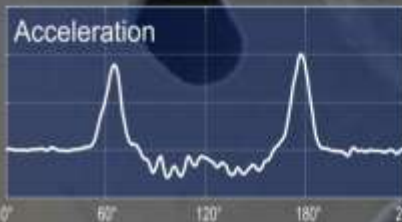
Dimensions	320 mm x 360 mm x150 mm
Power supply	<ul style="list-style-type: none"> • 110-120 VAC / 60 Hz • 220-240 VAC / 50 Hz
Maximum power consumption	15 VA
Remote control port	USB 2.0 (for Laser Vibrometer channel)
Weight	6 kg (max)
Temperature (operating)	+10 °C to +50 °C (non-condensing humidity)

LVM-4000 – ORDERING INFORMATION

PRODUCT CODE	PRODUCT DESCRIPTION
LVM-4000-T2-V0	2x laser displacement sensors
LVM-4000-T1-V1	1x laser displacement sensor + 1x laser vibrometer
LVM-4000-T2-V1	2x laser displacement sensor + 1x laser vibrometer
LVM-4000-T1-V1- UR	1x laser displacement sensor + 1x laser vibrometer + 1x UltraResolution tool
LVM-4000-T2-V1-UR	2x laser displacement sensor + 1x laser vibrometer + 1x UltraResolution tool

Full valve motion measurement

Save space, money, time



0° 60° 120° 180° 240°

LASER-BASED TECHNOLOGY

NO POST-PROCESSING

Triple, real-time (zero-phase delay) analog output: displacement, velocity and acceleration at the same time

MODULAR

Simultaneous measurement on 1, 2, or 4 valves

ACCURATE

Subtraction of engine head vibration

www.julight.it/product/valve-motion



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