Polytec

# HSV-2000 High Speed Vibrometer

## Measurement of Vibration Velocity and Displacement at High Speeds

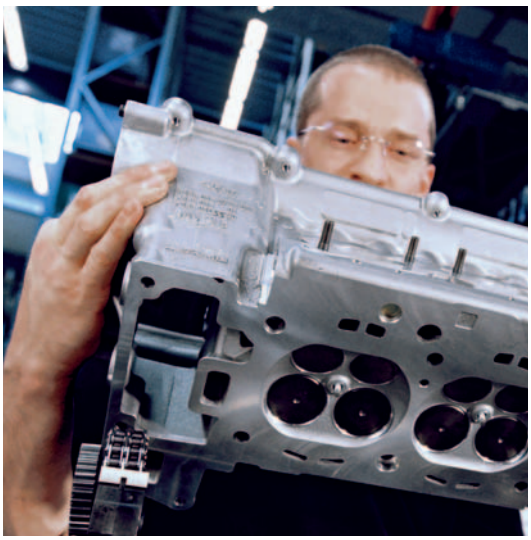

**Non-contact**
**Single point or differential**
**Velocities up to ± 30 m/s**

# High Speed Capability


*The HSV-2000 High Speed Vibrometer measures vibration velocity and displacement at high speeds up to 30 m/s for single point or dual-point measurements plus differential. This system is widely used by Formula1 engineers for the development of high performance valve trains for racing engines.*

While vibration velocities up to 20 m/s can be handled with Polytec's standard line of Laser Doppler Vibrometers (LDVs), high performance applications require significantly increased speed capabilities.

To make these aggressive measurements on valve trains for motorsport engines, high power transducers, special drilling machines and aerospace components for impact and fatigue testing, Polytec designed the HSV to extend the maximum operating velocity by 50 % to 30 m/s.



## Key Features

- Velocity and displacement measurement for vibration speeds up to 30 m/s
- Single or dual points plus differential measurements
- Compact sensor head with fixed or variable focus
- Eye-safe, visible, low-power laser probe
- Ruggedized industrial IP-64 housing
- Compatible with AK-800 Beam Steering Unit for difficult-to-access locations
- Large displacement impact testing from a safe operating distance

# The System


*The HSV-2000 system comprises an HSV-2001/2002 Controller, an HSV-800 Laser Unit and a rugged, compact HSV-700 Sensor Head. The Laser Unit houses the interferometer and the low power laser.*

The Sensor Head is available in either fixed or variable focus versions. The fixed focus head has an extra long depth of field and is recommended for measuring large displacements. One Laser Unit connects to the HSV Controller for the single channel (HSV-2001) version and two units for dual or differential measurements (HSV-2002).

The HSV-2001 incorporates a 6 range displacement decoder with 0.32 mm resolution and a maximum displacement of ±82 mm. In addition there is a single range velocity decoder for vibration frequencies up to 50 kHz with a fixed scaling of 5 m/s/V.

Applications such as valve train testing require differential measurements. One laser beam is targeted onto the valve while the other is directed onto the cylinder. The HSV-2002 provides separate velocity outputs for channel A, channel B and the difference A – B. Displacement information is available for channel A and the difference A – B. The desired velocity and displacement output signals are selected by a rotary switch on the front panel.

Both controllers feature a large bar-graph display showing the amount of return signal from the test object. The actual displacement range is selected by push buttons and indicated on the LCD display. An input signal from the device being tested (e.g. a cam shaft position) can trigger the displacement measurement through a front panel connector. Please find detailed technical data of the system on pages 4 and 6.

For data acquisition, an FFT analyzer, digital oscilloscope or A/D board is connected to the analog HSV signal outputs. In addition, the Polytec displacement PC board (fringe counter) may be connected to the rear panel digital interface. Please check the VibSoft-FC data sheet for more information.

To learn more about laser Doppler vibrometry, please visit **www.polytec.com/usa/vib-university**.

# Applications

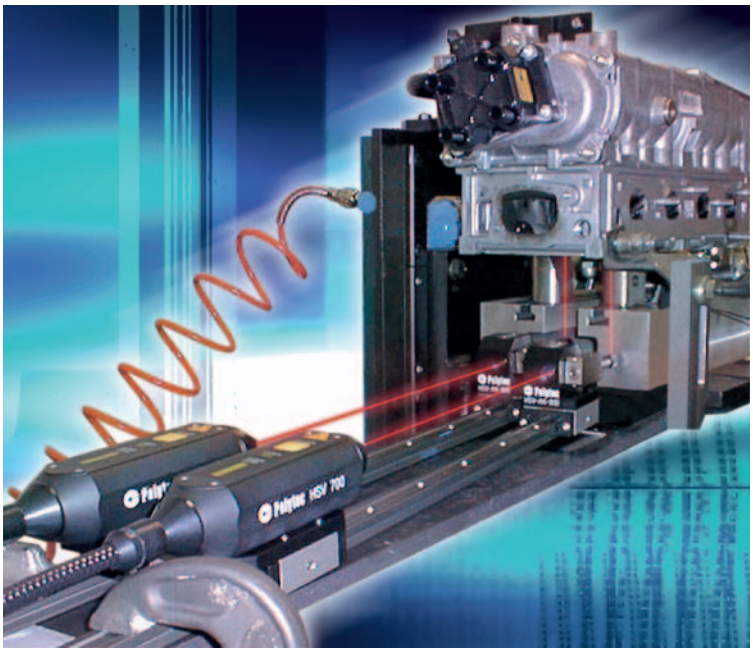
## Combustion Engine Development

The gas exchange cycle is extremely important for combustion engine development because of its influence on the mixture formation and combustion processes. Valve train performance (kinematics and dynamics) is intimately associated with this cycle and offers considerable opportunity for increasing engine performance.

The HSV-2002 is a unique tool that significantly contributes to advanced valve train engineering by allowing for independent measurements of both valve lift and velocity. Displacement and velocity up to 160 mm and 30 m/s, respectively, may be measured. This is important for detecting high frequency bouncing effects.

Both results and resolution are independent of distance, material properties and temperature. The sensor is installed in a safe distance avoiding temperature and oil pollution problems. Using the HSV 2002, development engineers can now optimize valve train parameters early in the product development cycle.

For more information see the application note VIB-C-03 "Measurement of Valve Train Dynamics" which can be downloaded from **www.polytec.com/usa/Lm-download**.

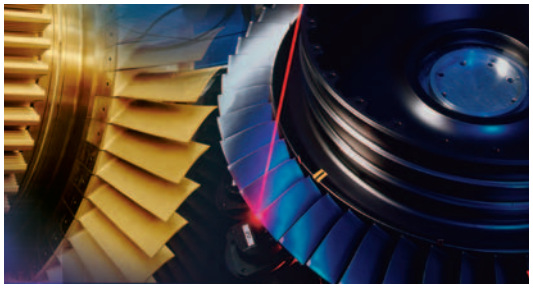



The HSV is designed to investigate high speed processes such as:

- High speed machinery kinematics
- High speed engine valve dynamics
- Ultrasonic welding
- Explosion, shock impact, door slam and other transient high speed events

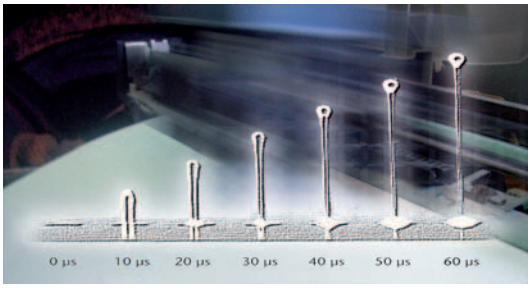
## Fatigue Testing of Turbine Blades

If continuous amplitude and resonance frequency monitoring of test structures (e.g. turbine blades) is required, the HSV is the best choice. In fatigue testing setups, where structures are excited at their resonant frequencies, the HSV enables non-contact monitoring of high amplitude displacement from a safe standoff distance. Durability can be measured by the number of cycles necessary for the onset of cracking, allowing verification of numerical predictions.



## High Speed Measurements Through a Microscope on Bubble Jet Drops

For bubble jet printers the ink drop velocities can be as high as 30 m/s. Only the HSV High Speed Vibrometer is capable of making measurements at such high velocities. The HSV can be combined with a microscope via the CLV-A-Micro adapter piece. The measurements are made on the bubble jet drops when leaving the printer head capillaries.



# Technical Data

| Performance Specifications | | |
|---|---|---|
| | Velocity | Displacement |
| Frequency range | 0… 50 kHz | 0... 250 kHz (small signal) |
| Output swing | ± 6 V | ± 8 V |
| Scaling factor | 5 m/s/V | 0.32; 0.64; 1.28; 2.56; 5.12; 10.24 [mm/V] |
| Full scale | ± 30 m/s | 5.12; 10.24; 20.48; 40.96; 81.92; 163.84* [mm p-p] |
| Resolution | < 15 µm/s** | 0.32; 0.64; 1.28; 2.56; 5.12; 10.24 [µm] *** |
| Max. acceleration | 1,000,000 g | 45,000,000 g**** |

* VibSoft-FC extends the maximum range to virtually unlimited
** The noise-limited resolution is defined as the signal amplitude (rms) at which the signal-to-noise ratio is 0 dB in a 10 Hz spectral bandwidth (BW), measured at 3M Scotchlite Tape® (reflective film).
*** The resolution is defined as 1 increment of the fringe counter output, which is equivalent to a 1 mV output voltage step.
**** At 10.24 mm/V, with the tracking filter switched off.

| HSV Output Channels | | |
|---|---|---|
| | HSV-2001 Single Channel | HSV-2002 Dual Channel |
| Velocity output | Channel A | Channel A, Channel B<br>Channel A – Channel B (differential) |
| Displacement output | Channel B | Channel A, Channel A – Channel B (differential) |

| Optics | |
|---|---|
| Laser output power | < 1 mW (eye safe class 2) |
| Stand-off distance | ▬ Variable focus: 0.11 m … 10 m (depending upon surface scattering properties)<br>▬ Fixed focus: 520 mm |

| Housing and Operational Conditions | | | |
|---|---|---|---|
| System component | HSV-2001/2002 Controller | HSV-800 Laser Unit* | HSV-700 Sensor Head |
| Dimensions [L x W x H] | 450 mm x 355 mm x 135 mm (17.7 in x 14.0 in x 5.3 in) (19" Rack mounting) | 340 mm x 130 mm x 115 mm (13.4 in x 5.1 in x 4.5 in) | 174 mm x 48 mm x 39 mm (6.9 in x 1.9 in x 1.2 in) (Fixed focus version) |
| Weight | 8 kg (17.6 lb) | 6 kg (13.2 lb) | 0.5 kg (1.1 lb) |
| Protection class | I (protective ground) | IP 64 | IP 64 |
| Operating temperature | +5 °C ... +40 °C (41 °F ... 104 °F) | | |
| Storage temperature | –10°C ... +65 °C (14 °F ... 149 °F) | | |
| Relative humidity | max. 80%, non-condensing | | |
| Connection cables | Sensor Head to Laser Unit: standard 3 m (9.8 ft)<br>Laser Unit to Controller: standard 5 m (16.4 ft), optional up to 10 m (32.8 ft) | | |
| Mains voltage | 100 VAC ... 240 VAC ±10 %, 50/60 Hz | | |
| Power consumption | max. 100 VA | | |

| Compliance with Standards | |
|---|---|
| Electrical safety | IEC/EN 61010-1 |
| EMC | IEC/EN 61326 Emission: FCC Class A, IEC/EN 61000-3-2 and 61000-3-3<br>Immunity: IEC/EN 61000-4-2 to 61000-4-6 and IEC/EN 61000-4-11 |
| Laser safety | IEC/EN 60825-1 (CFR 1040.10, CFR 1040.11) |

* Two laser units are required for differential operation using the HSV-2002.

# Accessories

## AK-800 Beam Steering Unit

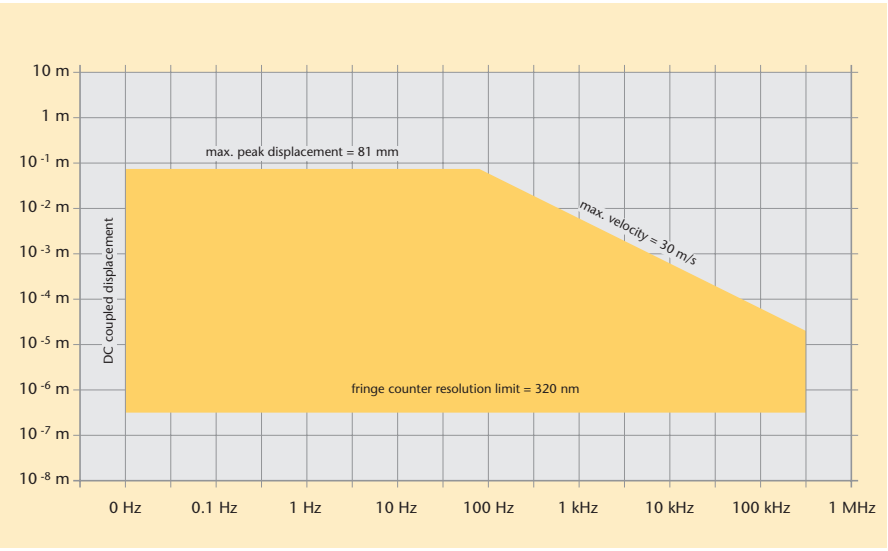
The AK-800 Beam Steering Unit was designed for precise positioning of the measuring laser spot on the test object. For spot positioning, the beam exit tube may be tilted and/or rotated. The AK-800 can only be used with the fixed focus version (ff) of the HSV-700 Sensor Head.

Focus adjustment is achieved by moving the HSV-700 Sensor Head mounted on a common traverse stage with the AK-800. The AK-800 is oil-tight and was engineered specifically for valve train measurements.

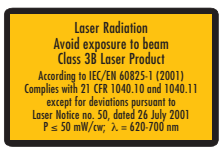
## CLV-A-Micro Microscope Adapter

This adaptor enables interfacing the HSV-700 Sensor Head to our standard microscope adapters MSV-050 and MSV-100 to enable high speed measurements through a microscope.

## Range Diagram




For general specifications and applications of the HSV-2000 High Speed Vibrometer please contact your local Polytec sales engineer or visit our web-site at **www.polytec.com/usa/highspeed.**





**Polytec GmbH (Germany)**
Polytec-Platz 1-7
76337 Waldbronn
Tel. + 49 (0) 7243 604-0
Fax + 49 (0) 7243 69944
info@polytec.de

**Polytec-PI, S.A. (France)**
32 rue Délizy
93694 Pantin
Tel. + 33 (0) 1 48 10 39 34
Fax + 33 (0) 1 48 10 09 66
info@polytec-pi.fr

**Lambda Photometrics Ltd. (Great Britain)**
Lambda House, Batford Mill
Harpenden, Herts AL5 5BZ
Tel. + 44 (0) 1582 764334
Fax + 44 (0) 1582 712084
info@lambdaphoto.co.uk

**Polytec KK (Japan)**
Hakusan High Tech Park
1-18-2 Hakusan, Midori-ku
Yokohama-shi, 226-0006
Kanagawa-ken
Tel. +81 (0) 45 938-4960
Fax +81 (0) 45 938-4961
info@polytec.co.jp

**Polytec, Inc. (USA)**
North American Headquarters
1342 Bell Avenue, Suite 3-A
Tustin, CA 92780
Tel. +1 714 850 1835
Fax +1 714 850 1831
info@polytec.com

Midwest Office
3915 Research Park Dr.,
Suite A-12
Ann Arbor, MI 48108
Tel. +1 734 662 4900
Fax +1 734 662 4451

East Coast Office
25 South Street, Suite A
Hopkinton, MA 01748
Tel. +1 508 544 1224
Fax +1 508 544 1225


Technical specifications are subject to change without notice. LM_DS_HSV-2000__2005_09_3000_E