



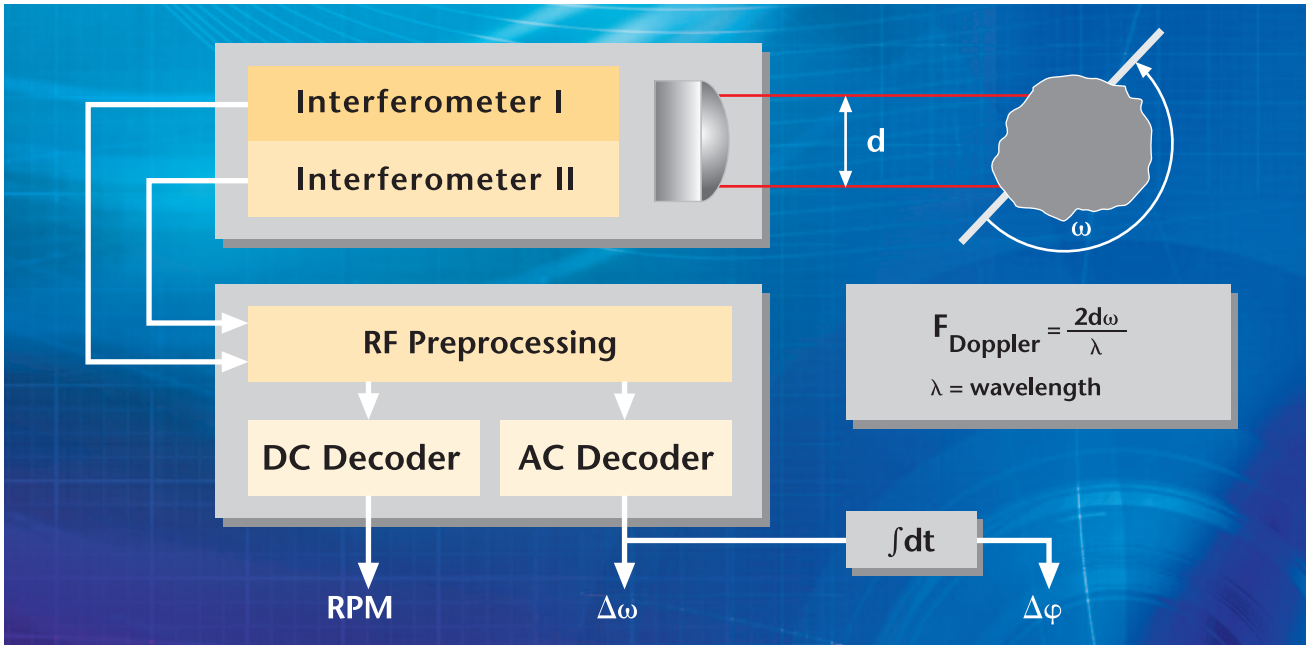
4000 Series Rotational Vibrometer

Non-Contact Laser Measurement of Torsional and Angular Vibration



**Fast
Accurate
Convenient**

Principle of Operation



Advancing Measurements by Light

The 4000 Series Rotational Vibrometer uses two parallel laser beams which exit the OFV-400 front lens and strike the rotating surface. Each back-scattered laser beam is Doppler shifted in frequency by the surface velocity vector in the beam direction.

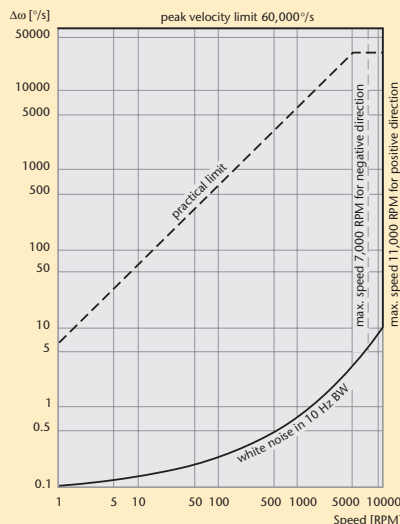
This velocity is made up of rotational and lateral components. Raw velocity information from each beam is independently sent to the OFV-4000 for processing. Using a simple geometric relationship, the difference of the two velocity components is a direct measure for the pure rotational velocity of the object and eliminates lateral vibrations.

The advantage of Polytec's dual interferometer approach lies in optical gain that is orders of magnitude higher than designs using only one interferometer operating in an optically differential mode. The resulting high optical sensitivity allows measurements on poorly reflecting surfaces, thereby increasing the range of applications and ease of use. For measuring positive and negative rotations as well as vibrations around zero RPM, a Bragg cell is incorporated into the dual interferometer. The Bragg cell produces a constant angular velocity offset by frequency shifting the laser beams.

For more information about how a Rotational Vibrometer works please visit our vibrometer university website:

www.polytec.com/usa/vib-university

Operating range of the rotational vibrometer

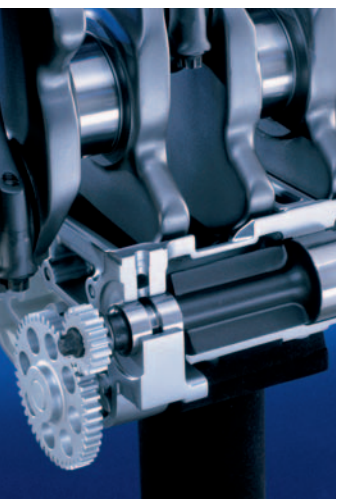


Rotational Vibrometer



Improvement of Rotating Parts and Structures

Polytec's rotational vibrometers measure angular velocity and displacement without contact from rotating structures such as crankshafts, axels and pulleys. The vibrometer's large standoff distance makes repositioning the laser probe fast, safe and convenient and enables the precision measurement of operating machinery at several locations without interruption. As proof of its success, automotive design and test engineers have skilfully used rotational vibrometer data to reduce engine noise and to increase product durability.



Designed for Accurate Measurements

The Polytec 4000 Series Rotational Vibrometer system is a portable, non-contact laser Doppler system for measuring angular vibrations on rotating structures. Designed to be eye-safe and simple to set-up and operate, the Rotational Vibrometer provides accurate measurements without enhancing the rotating surface with retro-reflective materials. Combining these features with the large standoff distance gives the test engineer the flexibility of setting up, making a measurement, tearing down and repositioning to other locations without stopping the machinery under test. Additionally, the large standoff distance and excellent sensitivity permit measure-

ments on hot surfaces where it is not possible to artificially improve reflectivity. Finally, the accuracy of the data is independent of the measured rotating surface shape.

Conventional contact transducers are subject to wear and slippage leading to unplanned maintenance. The Polytec Rotational Vibrometer can be remotely located and is not subject to the harsh conditions necessitated by close proximity to the measurement location. Another advantage of the Polytec design is its ability to measure anywhere within the range $-7,000$ RPM to $+11,000$ RPM including directional changes, torsional transients and rotational vibrations around the rest position.

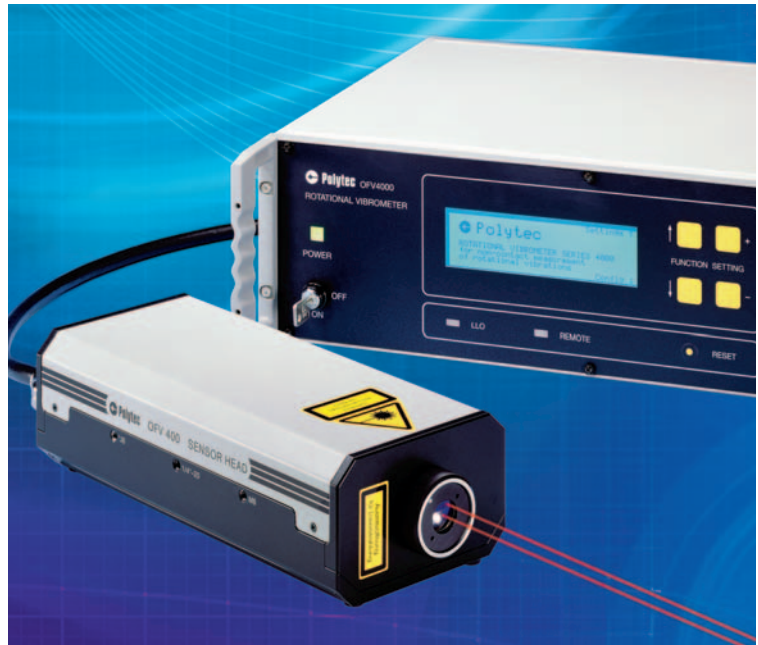
Measuring Angular Vibration

Features

- Measures angular velocity and displacement from $-7,000$ RPM to $+11,000$ RPM
- Senses direction, measures velocities and vibrations around standstill
- Portable, eye-safe class 2 visible laser
- OFV-400 Sensor Head conveniently mounts to standard tripods and customized positioners
- IEEE-488 and RS-232 interfaces for remote control and fast data transfer (RPM)
- Separate analog outputs for angular velocity and vibration amplitude (angle)

Benefits

- Wide dynamic range for high speeds, fast transients and fine resolution
- Simple set-up and easy-to-use menu-driven operation
- High efficiency optics gather sufficient light even from untreated surfaces where no contact is possible
- Eliminates down-time associated with contact methods
- Easily repositioned to different areas of rotating machinery

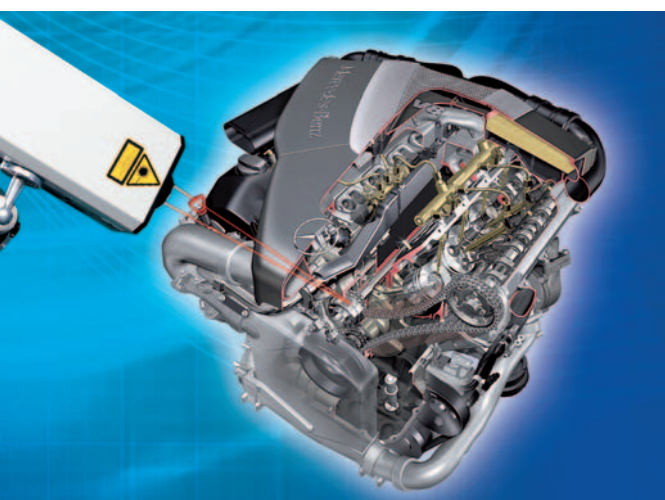


The System

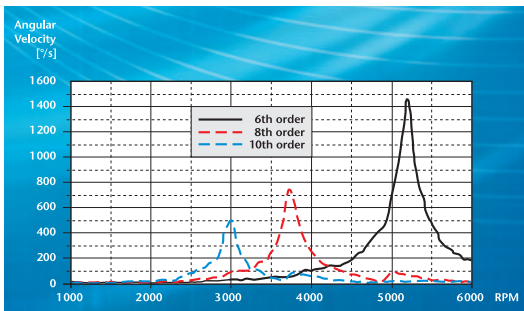
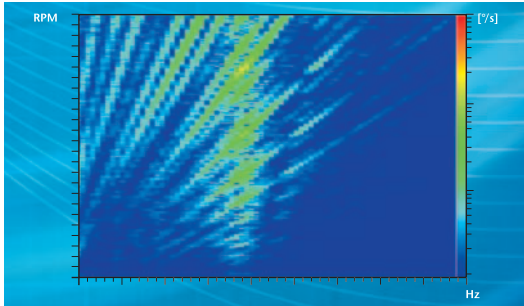
The 4000 Series Rotational Vibrometer comprises the OFV-400 Optical Sensor Head and the OFV-4000 Controller.

Polytec's long-standing experience in the development of laser vibrometers has been applied to the design of the OFV-400 Measuring Head, with a compact dual interferometer whose high optical sensitivity enables high resolution measurements on untreated objects. Signals from the OFV-400 are processed by the OFV-4000 Controller/Power Supply. It provides four selectable angular velocity ranges (one of them DC-capable), three angular displacement ranges and twenty-eight selectable high and low-pass filters. There are two computer interfaces: IEEE-488 and RS-232. The controller bandwidth is large enough to handle fast transients such as sudden accelerations of a shaft during gear changes.

All instrument settings are shown on the OFV-4000's large, backlit display including signal strength from both laser beams and RPM. Three BNC jacks provide analog signal outputs including angular vibrational velocity, angular vibrational displacement and RPM. These outputs can be examined further with signal processing, such as an order tracking analyzer.



Applications



The left images show an order tracking analysis of a crankshaft. Results are completely equivalent to the output from a traditional magnetic encoder. Set-up, data acquisition and tear-down were accomplished by the Rotational Vibrometer in a fraction of the time needed to install the encoder.

Right image: Measurement on a rotary printing press

Polytec’s rotational vibrometers measure torsional or angular vibrations, without contact, on arbitrarily shaped structures including engine crankshafts, vehicle axels, marine driveshafts, electrical generator shafts and rotating parts in lithographic machines, printers & photocopiers. Automotive engineers use the rotational vibrometer to develop torsional vibration dampers that reduce engine noise and increase product durability. Faults in gearboxes, compressors and generators cause torsional vibrations at certain system specific frequencies. Measurements are made for:

- Reduction of noise and vibration
- Studies of rotational fatigue
- Improving the precision and quality of tool-making machines
- Monitoring and trouble shooting in power plant and production machinery
- Speeding up adjustment of torsional vibration dampers in vehicle drive shafts
- Studying run-up and run-down of machines (order tracking and Campbell plots)

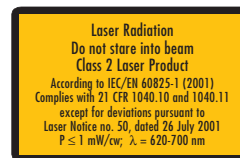


Technical Data

| Metrological Properties | |
|--|---|
| Rotations per Minute | |
| Measurement range | -7,000 RPM ... +11,000 RPM |
| Accuracy | ±1 % (or ±5 RPM) |
| DC signal output | 1 V/1000 RPM |
| Data transfer | Via interfaces; up to 500 samples/s |
| Time constant switch | Time constant switch slow/fast for detection of machine run-up characteristic |
| Angular Velocity | |
| Angular velocity ($\Delta\omega$) ranges | 4 Velocity ranges: 100 °/s; 1,000 °/s; 10,000 °/s and 60,000 °/s (full scale range) |
| Analog output | ±10 V |
| Frequency range | 0.5 Hz ... 10 kHz (0 ... 10 kHz @ 60,000 °/s) |
| Linearity error | <0.25 % |
| Filters | High- and low-pass filters, 4th order, wide range of cut-off frequencies |
| Angular Displacement | |
| Angular displacement ($\Delta\phi$) ranges | 3 Angle ranges: 0.1° / 1° / 10° (full scale range) |
| Analog output | Nom. ±10 V |
| Frequency range | 1 Hz ... 10 kHz |
| Linearity error | <0.5 % |

| Optics | |
|---------------------------------|--|
| Laser type | Helium-Neon (Red HeNe) |
| Laser output | 633 nm, <1 mW per beam, Class 2 |
| Separation of measurement beams | 8 mm |
| Operating distance | 400 mm ±50 mm (200 mm or 600 mm optional) |

Operating range diagram: see page 5



| General Properties, Housing and Power | | |
|---------------------------------------|---|--|
| System | Dual interferometer system with frequency shift | |
| Components | OFV-4000 Controller | OFV-400 Sensor Head |
| Dimensions [L x W x H] | 450 mm x 360 mm x 145 mm (17.7 in x 14.2 in x 5.7 in) 19" housing, rack mountable | 320 mm x 120 mm x 78 mm (12.6 in x 4.7 in x 3.1 in) |
| Weight | 11 kg | 3.7 kg |
| Display | Large 4-digit LCD display | LED bar graph for balance |
| Operating temperature | +5 °C ... +40 °C (41 °F ... 104 °F) | |
| Relative humidity | <80 %, non-condensing | |
| Optics mounting | Multiple mounting positions | |
| Mains voltage | 100 V / 115 V / 230 V | |
| Power consumption | max. 150 VA | |
| Interfaces | IEEE interface and RS-232 computer interface | |
| Outputs | 3 separate BNC output sockets | |

| Compliance with Standards | |
|---------------------------|--|
| Electrical safety | IEC/EN 61010 |
| EMC | IEC/EN 61326; Emission: FCC Class B, IEC/EN 61000-3-2 and 61000-3-3 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) |

For more information please contact your local Polytec sales engineer or visit our website www.polytec.com/usa/rotvib

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