PSV-500 Scanning Vibrometer

Polytec Scanning Vibrometer

- **PSV-500 Scanning Vibrometer**
- PSV-500-3D Scanning Vibrometer
- MSA-500 Micro System Analyzer
- PSV-400 Scanning Vibrometer
- PSV-A-440 Optical Derotator
- RoboVib Structural Test Station

Optical Non-contact Vibration Mapping and Analysis

Polytec Scanning Vibrometers are time- and cost-effective tools for resolving noise and vibration issues during research and development in NVH, acoustics, structural dynamics and ultrasonics. There has never been an easier or more precise way to determine operational deflection shapes and Eigen modes. The PSV-500 Scanning Vibrometer represents the fifth generation of an instrument that, because of its unique features, has become a vital asset for researchers and developers worldwide.

Your Benefits

- Non-contact – measure the true vibration of your structure
- Full-field – don't miss any important details – high spatial resolution over mm^2 to m^2 areas with a 50° x 40° scan angle
- Versatile – tailored solutions for NVH, acoustics, structural dynamics or ultrasonics plus a wide range of accessories and software options
- Open-minded – PSV software provides open data interfaces and control interfaces for automation and for tailored solutions in science and development
- Safe investment – every PSV-500 can be extended for 3-D measurements

Non-contact, Optical Measurement

At the heart of every Polytec PSV-500 system is the laser Doppler vibrometer – a precision optical transducer for determining vibration velocity and displacement at a fixed point. The technology is based on the Doppler effect; sensing the frequency shift of back scattered light from a moving surface.

More details can be found at: **www.polytec.com/vib-university**.

Features That Give You Time and Quality Advantages in Your Product Development

The PSV-500 is a highly sophisticated and versatile vibration measurement tool, yet it's as easy to use as a camera. It provides solutions to issues spanning from acoustics to materials research. This cutting edge system enables you to examine dynamic processes in nature and technology. Many scientific achievements, high quality products and performance characteristics have only been made possible with the aid of Polytec's Scanning Vibrometer.

Cost-effective

Quick measurements can be achieved with processes that can be automated to save time.

Easy and Intuitive to Operate

It takes only a few minutes to start a PSV-500 measurement. This is made possible with a quick setup, intuitive definition of the measurement grid, clear step-by-step user guidance and fully automated measurements at up to 50 points/second.

Non-contact and Surface Independent

The system is non-contact with no need to attach sensors or run cables. Vibrations are measured exactly as they occur, without any interference caused by the surface features or sensor itself. Measurements can be made accurately from large working distances with ease.

Safe and Secure Laser Beam

There is no need for a dedicated lab or laser safety specialist.

Stay on Top of Things

You see what you get with the new built-in EagleView HD camera. Pin sharp images document your setup. Larger objects or bigger portions of their surface can now be captured with the elaborate low-noise WideScan scanner technology providing a 50° x 40° scan area. PSV is truly a full-field probing technology allowing scan fields from 1 mm^2 [1)] up to many m^2.

Accurate Localization

The PSV-500 exclusively measures structure-borne vibration in the direction of the laser beam. This allows the source of noise and its location to be clearly identified, not reflections of the sound from other surfaces.

High Frequencies

Traditional vibration measurement techniques have an upper limit in the kHz range – the PSV-500 goes far beyond this. Configurations are available for almost any application due to a linear frequency response from the acoustic range into the high ultrasonic range at 2 MHz.

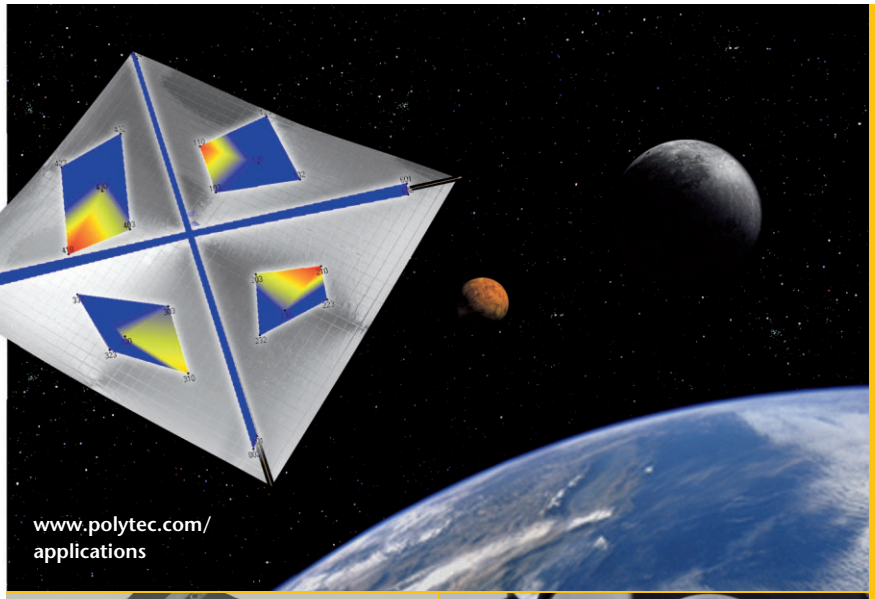
Highly Integrated Fully Digital

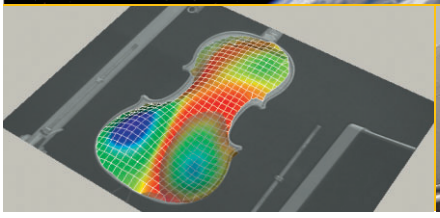
The PSV-500 Front-End design integrates the latest digital decoding and data acquisition[2)] in one compact box. VibroLink transfers all measurement data without conversion losses to the Data Management System. Unparalleled low noise is the benefit.

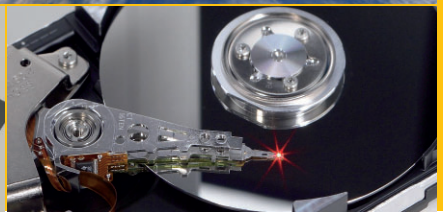
Coping with Geometry

The integrated Geometry Scan Unit[3)] allows users to automatically generate a three-dimensional point grid of the test object which can be exported into other software applications. Alternatively a 3-D geometry data set can be imported from an existing FE model. 3-D shapes are probed quickly and reliably using the QuickSnap laser autofocus and optional Coherence Optimizer laser stabilization.

Applications: Everything Vibrates







Benefit from the Unique Properties of Laser Light

- Non-invasive – lightweight structures such as membranes and sheet metal surfaces
- Full-field – high measurement density structural dynamics in seconds
- Wide bandwidth – for ultrasonic tools, actuators, sensor arrays
- High spatial resolution – for micro structures
- Frequency independent spatial resolution – for resolving high order mode deflection shapes

Acoustics

- Appliances
  - Optimization and quality control on washing machines, vacuum cleaners, toothbrushes or electrical tools
- Car Acoustics
  - Determining the source of noise and acoustic properties
  - Qualification of damping materials
- Audio
  - Optimization of deflection shapes in loudspeaker and microphone diaphragms
  - Study and optimization of musical instruments
- Medical Audio
  - Hearing aids and hearing apparatus
  - Studying hearing and communication mechanisms in the animal world

Structural Dynamics

- Automotive Development
  - Modal analysis
  - FE model validation
  - Operational vibration shapes of rotating parts
- Material Research
  - Non-destructive evaluation of material properties
- Aviation and Aerospace Industry
  - Airplane components, satellites and antennas
- Dynamics of Rotating Parts
  - Derotated[4] evaluation of fans, turbines and tires

Ultrasonics and Microsystems

- Ultrasonic Medical Tools
  - Performance and FE model validation
- Ultrasonic Diagnostics
  - Crosstalk in and timing of CMUT and PMUT transducer arrays
- Ultrasonic Welding and Cutting
  - Uniformity of welding tool deflection shape
- Ultrasonic Actuators
  - ODS and FE model validation
- Non-destructive Evaluation
  - Visualization of surface wave propagation in composites and metals
- Data Storage Technology
  - Read-write heads in hard disk drives
  - Dynamics testing and vibration analyses
- Microstructures
  - Sensors and actuators
  - Micro-mirrors, printer jets
  - Micro-pumps, pressure sensor membranes

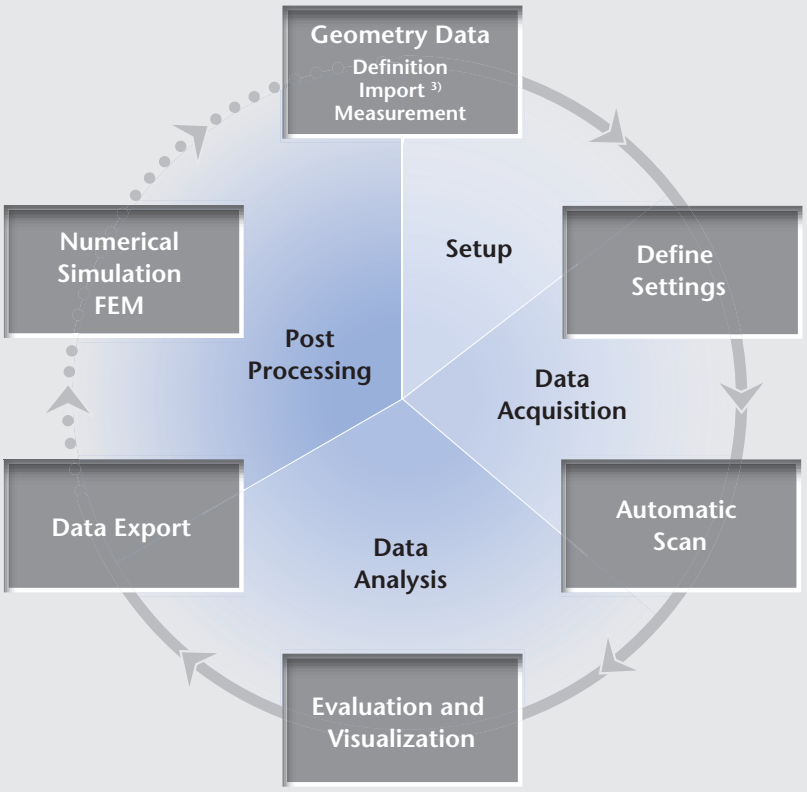
Rotating Samples

- Tracking of rotating samples with the PSV-A-440 Optical Derotator[3]
- Bending vibration of drivetrains

[1] With PSV-A-410 close-up unit
[2] Available for PSV-500-B and -H
[3] As an option/with optional accessories
[4] With PSV-A-440 Optical Derotator

Scanning Vibrometer Technology – Modular and Future-proof

The PSV-500 Scanning Vibrometer represents an integral full-field vibration mapping system, comprising a scanning head with Geometry Scan Unit[3)] and a front-end with integrated digital decoding electronics and interfaces for external reference signals. Common exchange formats and an open data interface link the Scanning Vibrometer into the CAE data workflow.

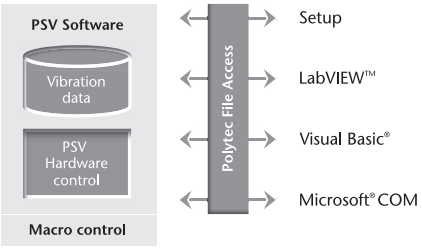


Open-minded

Due to its open system architecture, the PSV-500 Scanning Vibrometer is a powerful data acquisition platform that can be seamlessly integrated into engineering workflows and IT environments.

3 Models to Choose From

The PSV-500 Scanning Vibrometer is available in three tailored models all equipped with broadband digital decoding. The PSV-500-B Acoustics Scanning Vibrometer is tailored for research work at acoustic frequencies down to the low ultrasound. The PSV-500-H Structural Dynamics Scanning Vibrometer is equipped with more reference channels for multi-shaker excitation in experimental modal analysis and comes with a preinstalled bundle of software options. The H version offers the highest sensitivity of all models. The PSV-500-M Ultrasonics Scanning Vibrometer addresses the needs of researchers in material science and ultrasonics R&D. A MHz bandwidth is supported by a rugged data acquisition system backed up by a powerful data management system based on a 19“ industrial PC.



Scanning Vibrometer Model	No. of Reference Channels	Max. frequency	Max. vibration velocity
PSV-500-B Acoustics	1[1)]	50 kHz	10 m/s
PSV-500-H Structural Dynamics	4 (8)[1)]	100 kHz	10 m/s
PSV-500-M Ultrasonics	3[1)]	1 (2)[2)] MHz	10 m/s

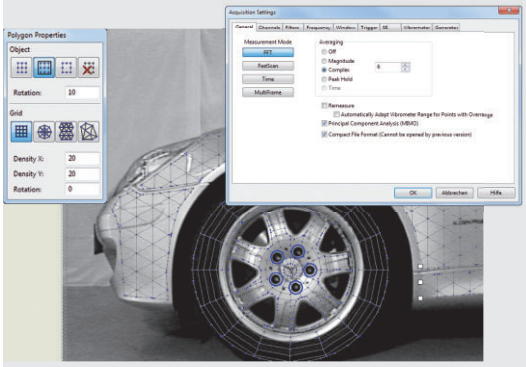
[1)] IEPE support included [2)] With PSV-S-Bw2M Option

Making Measurements with the PSV-500 is Simple

Operating the PSV-500 is intuitive and simple in comparison with conventional multi-channel methods. Set up the system, define geometry and measurement grid – and you are ready to make your measurements. All functions are driven by a common software control.
More info: www.polytec.com/psv

Interactive Setup

User-friendly drawing tools help you define the shape, orientation and point density of the measurement grid on a video image of the object. Absolute geometry can either be read in from CAE/FEM files or measured directly on the object under investigation using the integrated Geometry Scan Unit[3]. The preferences for bandwidth, frequency resolution, vibration excitation and reference channels are easily defined in a dialog. The PSV only requires one setup for all measurement points. Settings that have been saved from previous measurements can be loaded by a simple mouse click from the project browser. The internal signal generator[3] ensures precisely defined vibration excitation.



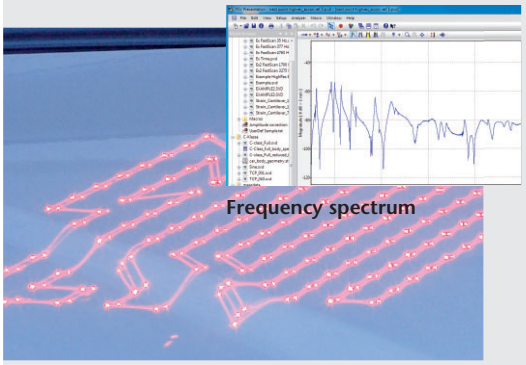
Measurement grid in live video image

Quick Scan

The laser beam automatically scans the whole grid and makes a vibration measurement at each of the predefined points. While doing so, the laser is always optimally focused; the signal-to-noise ratio is permanently monitored and optimized. The time responses and frequency spectra of the vibrometer and reference signals are displayed during the scan.

The PSV-500 records the complete spectrum for every measurement point and all deflection shapes of the measurement surface.

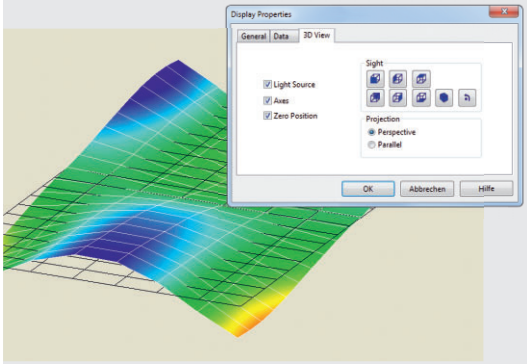
The FastScan mode[3] enables deflection shapes to be determined in the shortest possible time (hundreds of measurement points in a few seconds).



Laser scan (time exposure)

Perfect Visualization

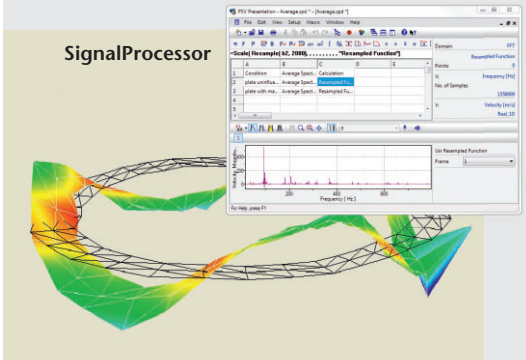
The deflection shapes can be color-coded as 2-D or 3-D graphics for display purposes. Frequencies of interest are selected from the spectra using a cursor. The video image itself can be animated in 3-D to show exaggerated, life-like motion of the structure. Animated profile slices also help you to understand the vibration in detail. Response to transient events can be shown in a high resolution slow motion time domain animation[3]. The pertinent spectra, transmission functions, coherence and time signals[3] are available for analysis at every individual measurement point. The impressive graphics and animations can be easily pasted into reports and presentations.



3-D Animation

Flexible Analysis

The Polytec SignalProcessor is a high performance analysis tool similar to a spread sheet that makes numerous mathematical and statistical operations available for individual pieces of data or whole data sets. Data from other sensors can simply be imported and linked to the vibrometer data. Using standardized export filters or the Polytec File Access open interface, external software packages or your company's internal software can access the measurement data for modal analysis, sound field or power flow calculations.



Combined vibrometer and accelerometer data

[3] As an option/with optional accessories

Technical Data

PSV-500-B and PSV-500-H Standard Components	
Vibrometer system & data acquisition	■ PSV-I-500 Scanning Head with high precision scanner and HD video 20x zoom camera ■ PSV-F-500 Front-End with digital broadband decoder, signal generator[1)] and data acquisition for reference channels ■ PSV-C-510 main cable, 10 m
Computer	■ PSV-W-500 Data Management System: 19" industrial PC ■ Windows® 7 64-bit for "embedded systems" and PSV Software preinstalled
Accessories	■ VIB-A-T02 Tripod with tip-tilt head ■ PSV-A-535 Storage Case for Scanning Head ■ Hardware manual, software manual, and theory manual

PSV-500-M Standard Components	
Vibrometer system	■ PSV-I-500 Scanning Head with high precision scanner and HD video 20x zoom camera ■ PSV-F-500 Front-End with digital broadband decoder ■ PSV-C-510 main cable, 10 m
Computer & data acquisition	■ PSV-W-500-M Data Management System: 19" industrial PC with data acquisition and signal generator board installed ■ Windows® 7 64-bit for "embedded systems" and PSV Software preinstalled
Accessories	■ VIB-A-T02 Tripod with tip-tilt head ■ PSV-A-535 Storage Case for Scanning Head ■ Hardware manual, software manual, and theory manual

PSV-I-500 Scanning Head	
Dimensions [W x L x H]	238 mm x 384 mm x 163 mm (9.4 in x 15.1 in x 6.4 in)
Weight	9 kg (19.8 lbs); 9.3 kg with PSV-G-500 Geometry Scan Unit[1)]
Laser type, vibrometer	HeNe Laser (633 nm)
Laser type, PSV-G-500 Geometry Scan Unit [1)]	Diode laser (660 – 680 nm)
Laser safety class	Class 2 (<1 mW visible output)
Working distance	125 mm … ~100 m vibrometer ; 250 mm ... 30 m Geometry Scan Unit[1)]
Scan angle [h x v]	50° x 40°
Scanner properties	angular resolution <0.002°, angular stability <0.01°/h, max. 50 scan points/s
Sample size	From few mm² up to several m²
Camera	HD format, 20x optical zoom, max. field of view [h x v] 55° x 32°
Interfaces, electrical	Multi-pin bayonet connector, DIN plug for pan/tilt head control or external scanner control
Interfaces, mechanical	Hexagon type tripod adapter for VIB-A-T02, 2x M6 thread
PSV-F-500 Front-End	
Dimensions [W x L x H]	450 mm x 360 mm x 150 mm (17.7 in x 14.1in x 5.9 in)
Weight	~10 kg (~22 lbs)
Protection class	IP-20
Interfaces, electrical	■ Front: BNC connectors for reference channels, signal generator, trigger ■ Rear: multi-pin bayonet connector, mains cable, monitor velocity output, 2x RJ45 Ethernet to computer
Interfaces, mechanical	19" Rack mount adapters available
General Specifications	
Power	100 VAC...240 VAC ±10 %, 50/60 Hz; overall max. 600 VA
Environmental conditions	■ 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
Calibration	Every 24 months (shorter re-calibration intervals available upon request)

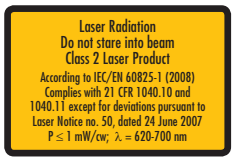
[1)] depending on model: optional

PSV-500 Performance Specifications							
Model	Decoder	# of ranges	Full scale m/s (peak)	Decoder frequency range	Resolution[2] µm $s^{-1}\sqrt{Hz}$	# of reference channels	# of signal generator channels[3]
PSV-500-B Standard	DV-01	7	0.1…10	0 Hz … 50 kHz	0.04 ... 0.5	1	1 (option)
PSV-500-B Enhanced	DV-02	10	0.01…10	0 Hz … 50 kHz	0.02 ... 0.5	1	1 (option)
PSV-500-H	DV-03	13	0.001…10	0 Hz … 100 kHz	0.01 ... 0.5	4 / 8 (option)	4
PSV-500-M	DV-04	13	0.001…10	0 Hz … 1(2) MHz	0.01 ... 2.5	3	1

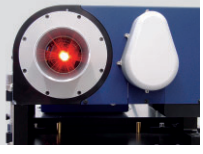
[2] The noise-limited resolution is defined as the signal amplitude (rms) at which the signal-to-noise ratio is 0 dB with 1 Hz spectral resolution, measured on 3M Scotchlite Tape® (reflective film). The attainable resolution is frequency-dependent and is specified for frequencies above 10 Hz.

[3] Bandwidth corresponding to acquisition bandwidth.

Compliance with Standards	
Electrical safety	IEC/EN 61010-1:2011-07
	IEC/EN 61326-1:2006-10; 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 (2008) (CFR 1040.10, CFR 1040.11)



Options and Accessories

General Accessories		
PSV-G-500 Geometry Scan Unit	Integrated laser distance sensor to measure the geometry of sample.	 PSV-500 Scanning Head
PSV-A-560 Coherence Optimizer	Laser stabilization improves overall signal-to-noise ratio. (not available for PSV-500-B).	
PSV-A-525 Front Window	Protects the scanning mechanism against dust, wind and acoustic excitation at high dB levels.	
PSV-A-515 External Camera	Digital B&W camera with special wide angle lens provides wider field of view for narrow test cells.	
PSV-A-013 System Cabinet	Ergonomic mobile workstation with storage for all parts and accessories.	 PSV-A-013 System Cabinet
PSV-A-T11 Pan/Tilt Head	Motorized pan/tilt head for remote-controlled positioning of the PSV scan head.	
OFV-A2 Video Dolly	For moving scanning head and tripod conveniently.	
PSV-C-5xx Main Cable	Available length: 5, 10, 20 and 30 m.	
For Measurements on Small Parts		
PSV-A-410 Close-up Unit	For close-up measurements, particularly on small parts. Includes a set of close-up lenses. Special PSV-A-CL-xx micro scan lenses for small shiny parts available.	 PSV-A-410 Close-up Unit
PSV-A-HeNe Helium-Neon Block filter	Notch filter for improvement of laser spot visibility when measuring very small parts or mirror-like surfaces.	
PSV-A-RLight Ring Light	Fiber-optic ring-light for illumination of small test objects. Requires PSV-A-410.	
PSV-A-T18 Vertical Test Stand	Motorized positioning of PSV scan head for small part testing.	
Accessories for (Brake) Acoustics and Modal Analysis		
PSV-A-430 Acoustic Gate Unit	Activates the gate input if a noise exceeds a certain threshold.	 PSV-A-430 Acoustic Gate Unit
PSV-A-MIR/PSV-A-MIR+ Mirror Set	Mirror set for measurements in difficult-to-access areas. The mirror set comprises 4 (PSV-A-MIR+: 5) HeNe coated mirrors including magnetic fixtures.	
A-MIR-2030 Mirror Kit	Includes one mirror 200 mm x 300 mm and magnetic fixtures.	
VIB-A-HEAD Headphones	Headphone with noise limiter to listen to the vibrometer signal.	
Accessories for Measuring on Rotating Parts		
PSV-A-440 Optical Derotator	For axial measurement of rotating objects. Locks onto the rotation and allows measurements as if stationary up to 24,000 rpm. Refer to PSV-A-440 brochure for details: **www.polytec.com/derotator**.	 PSV-A-440 Optical Derotator

PSV Software Options

Model	PSV-500-X Scanning Vibrometer	-B	-H	-M
Preparation				
APS Professional	For arbitrary definition of measurement points and individual object properties.	o	s	s
Geometry Data Import	Geometry module for importing geometry data to the PSV software for defining the scan points.	o	s	s
VideoTriangulation®	Image processing for enhanced automatic alignment of the laser spot with the grid points.	o	o	o
Signal Generator	Internal arbitrary signal generator for vibration excitation.	o	s	s
Measurement				
High Resolution Scan	Up to 512 x 512 scan point density for higher spatial resolution.	o	s	s
FastScan	Fast scan routine for analyzing the response of structures at a single frequency.	o	s	s
Time Domain Animation	Time domain data are acquired while scanning. Allows for "slow motion" animation e.g. of surface waves propagation or switches.	o	o	o
Extended FFT Lines	Various options to extend the number of FFT lines up to 819,200.	o	o	o
Multi Frame	For triggered measurements on combustion engines and brakes.	x	o	x
Bandwidth Extension	Extends the acquisition bandwidth to 2 MHz.	x	x	o
Gate Input	Allows gated measurements with external TTL signal.	o	o	o
Analysis				
SignalProcessor	The user interface to the math library included in the PSV software, designed as an easy-to-use spreadsheet.	o	s	s
PCA	Principal Component Analysis. For MIMO measurements in experimental modal analysis.	x	o	x
ME'scope Modal Software	Software package for modal analysis. Including data interface.	o	o	o
Data Export to ME'scope	Data export to Vibrant's ME'scope modal analysis software.	o	o	o
Audio Analysis	Makes vibration data audible. Allows listening to live and stored vibration signals.	s	o	o
Desktop Analysis Version	Desktop version of PSV Software for offline post processing and presentation of measurement results. Single or network license.	o	o	o
Automation and programming interface				
Macro Programming	SAX Basic Engine: Visual Basic® for Applications (VBA) compatible. Allows automation of test routines.	s	s	s
Polytec File Access	API for retrieval of Polytec data via external applications supporting Microsoft's Component Object Model (COM), e.g. Visual Basic®.NET(R), C#(R), MATLAB®, LabVIEW™.	s	s	s
Maintenance package				
Software Maintenance Basic	Basic software maintenance. Free PSV Software updates for a duration of 1 year.	s	s	s
Extended Software Maintenance	Entitles for software updates for an additional period. Available in 12 month increments.	o	o	o
University Program	Entitles universities and educational institutes for updates of the software package purchased with the measurement system. New releases of the software are provided free of charge during the lifetime of the system.	o	o	o

s: Standard; o: Option; x: not available

For more technical information and applications of the PSV-500 Scanning Vibrometer please contact your local Polytec sales engineer or visit our website at **www.polytec.de/psv**

Advancing Measurements by Light

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