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LASER VIBROMETRY

SMART SINGLE+

Start SMART - Lab in a device: The SMART Single+ combines a laser Doppler vibrometer, data acquisition system, and signal generator into one device, enhancing non-contact vibration measurements.
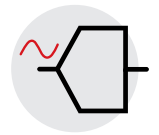
- SMART Laser Doppler Vibrometer

- Highly accurate non-contact vibration measurements and integrated data visualization

- Versatile 7-inch touch display

- Determine the transfer function of the test object

- Synchronization with other SMART devices

- Improved connectivity: Wi-Fi, Bluetooth & USB

- Extremely easy to handle: Class leading performance per weight

General specifications

Overview

Measured quantities	Velocity, displacement, acceleration
Max. frequency bandwidth	DC to 50 MHz
Frequency range	Can be chosen individually using a freely configurable band-pass filter for velocity, displacement and acceleration signals
Max. velocity	50 m/s
Measurement ranges	Measurement range limits can be freely adjusted between • 1 mm/s and 50 m/s for velocity • 10 nm and 100 m for displacement • 10 m/s² and 100 Mio. m/s² for acceleration
Signal processing	Digital (FPGA based)
Filter	Low-pass and high-pass filters are defined by the selected frequency range Tracking filter: off / slow / fast
User interface	7" Full HD+ touchscreen with 1000 nits peak brightness
Operating temperature	0 °C to 40 °C
Dimensions	Length × width × height (excluding handle and lens): 288 × 136 × 198 mm
Weight	~ 4 kg + objective lens
Power supply	100 - 240 V AC (50-60 Hz) or 12 V DC
Portability	Convenient all-in-one design for seamless portability and simple setup
Storage temperature	-10 °C to 65 °C
Relative humidity	Max. 80%, non-condensing
Calibration interval	Every 24 months (recommended)

The exact features depend on the configured options.

Connectivity

Schematic
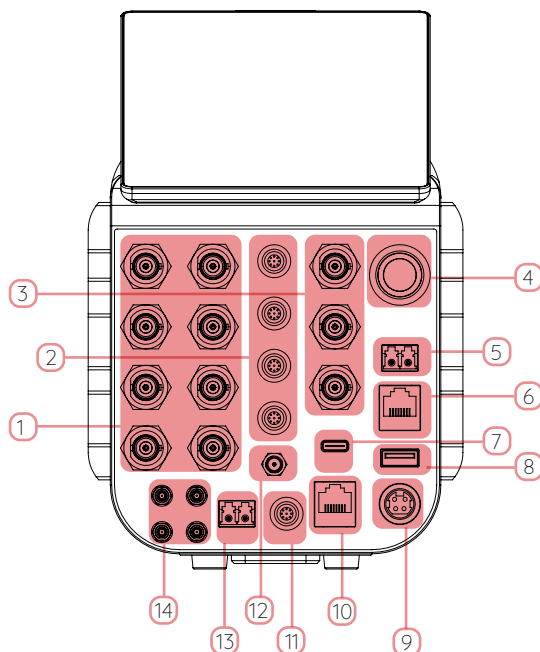
1	Analog signal outputs (BNC)	8	USB port (Type-A)
2	LEMO signal inputs (12 Channels)	9	Power input
3	BNC HF signal inputs (up to 50 MHz)	10	Ethernet port for device communication/data
4	Power button	11	Power output
5	Optical communication port	12	GNSS antenna connector
6	Ethernet port for device communication/data	13	Optical fiber connector (LC-Duplex)
7	USB port (Type-C)	14	Multi-purpose SMB ports

Inputs and outputs

	Connector type	Characteristics	Description
Analog signal inputs	Up to 4 x LEMO Up to 4 x 3 = 12 channels	± 1 V / ± 10 V (switchable) 24-bit A/D converter per channel 1.5 MSPS sample rate	• Synchronous reference signal recording up to 750 kHz on 12 channels • Support for IEPE (Integrated Electronic Piezoelectric), TEDS and DC/AC coupling • Input impedance: 1 MOhm ‖ 20 pF (optional 1 GOhm ‖ 3 pF)
Analog HF signal inputs	Up to 3 x BNC	± 2 V 14-bit A/D converter 312.5 MSPS sample rate	• Synchronous HF signal recording up to 50 MHz on 3 channels • Input impedance: 50 Ohm

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	Connector type	Characteristics	Description
Analog signal outputs	Up to 8 x BNC Up to 8 independent channels	± 2 V 16-bit D/A converter 312.5 MSPS sample rate	• Versatile signal outputs: Analog velocity, displacement, acceleration and arbitrary signal generator • Generate various preset functions (sine, chirp, gaussian, …) or load arbitrary signals • Source impedance: 50 Ohm
Trigger inputs	2 x SMB		• Digital external trigger input for the device • Input impedance: 50 Ohm
Trigger outputs	2 x SMB		• Digital trigger output for external devices • Source impedance: 50 Ohm

Digital interface

	Connector type	Characteristics	Description
Ethernet (copper)	Up to 2 x RJ45	1 Gbit/s data rate	• Stream the measurement data over Ethernet with up to 312.5 MSPS and 48-bit • Digital remote control of device settings • Interface with digital data acquisition and analysis software SMART Lab • Use your device as control hub for your Ethernet-based equipment
Ethernet (fiber optical)	Up to 2 x LC-Duplex	10 Gbit/s / 1 Gbit/s data rate (switchable)	• Stream the measurement data over Ethernet with up to 312.5 MSPS and 48-bit • Digital remote control of device settings • Interface with data acquisition and analysis software SMART Lab • PTP-based synchronization with other SMART series devices • Up to 20 km range (up to 160 km on request)

Connectivity options

	Connection type	Description
Reference vibrometer	1 x LC-Duplex	• Contactless and synchronous vibration data recording, enabled by second interferometer and additional fiber head • Choice of robust and compact fiber head placed independent of vibrometer
Synchronization	2 x SMB (optional)	• 1 x synchronization input (Input impedance: 50 Ohm, 3.3 V or 5 V) • 1 x synchronization output (Source impedance: 50 Ohm, 3.3 V) • Frequency/phase synchronization with external devices via PPS (Pulse per second)
USB	1 x USB-C (USB 3.2) 1 x USB-A (USB 3.0)	• Connect USB devices such as cameras, keyboards or storage devices to the vibrometer for direct data recording
Wireless	Bluetooth 5.2 Wi-Fi 7	• Bluetooth: connect human interface devices such as keyboard, mouse or headphones to the vibrometer • Wi-Fi: control your vibrometer wirelessly and stream measurement data over the air
GNSS-module	GPS, Galileo, GLONASS and BeiDou	• Precise absolute time and position information using global navigation satellite systems (GNSS) • External antenna connector
Inertial measurement unit (IMU)		• Synchronous recording of the vibrometer's acceleration and orientation • Vibration monitoring of vibrometer enables detection of disturbances • More accurate alignment with your test object

Configurable options

Frequency options

Frequency 250 kHz	Measure frequencies up to 250 kHz, covering the entire acoustic range and beyond	S
Frequency 5 MHz	Measure frequencies up to 5 MHz	O
Frequency 15 MHz	Measure frequencies up to 15 MHz	O
Frequency 25 MHz	Measure frequencies up to 25 MHz	O
Frequency 35 MHz	Measure frequencies up to 35 MHz	O
Frequency 50 MHz	Measure frequencies up to 50 MHz to the limit of what is technologically feasible	O
Frequency upgrade M	Upgrade the frequency limitation of any option by 500 kHz	O
Frequency upgrade L	Upgrade the frequency limitation of any option by 1 MHz	O
Frequency upgrade XL	Upgrade the frequency limitation of any option by 5 MHz	O

Velocity options

Basis	Continuously adjust the velocity measurement range between 10 mm/s and 15 m/s	S
High Speed	Measure velocities up to 25 m/s	O
Pro	Measure velocities up to 35 m/s	O
Master	Measure velocities up to 50 m/s	O
Ultra	Measure velocities up to 50 m/s and get access to the high resolution upgrade with the smallest velocity measurement range of 1 mm/s	O
High-resolution upgrade	Smallest velocity measurement range 1 mm/s	O
Velocity upgrade M	Increase the maximum velocity of any velocity option by 2.5 m/s	O

Measurement quantities

Velocity	Measure vibrational velocities	S
Displacement	Measure vibrational displacements with continuously adjustable ranges from 10 nm to 100 m	O
Acceleration	Measure vibrational accelerations with continuously adjustable ranges from 10 m/s² to 100 Mio. m/s²	O

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Warranty

Waranty	12 months	S
Warranty extension	Extension of standard warranty by 12 months	O

Maintenance

Extended maintenance	Additional extension of hardware maintenance by 12+ months	O
Recalibration & cleaning	Check, cleaning & realignment of optical parts, check of laser output power, and factory calibration	O

Accessories

Transport case	• Stable and waterproof Peli case for safe storage and transport of the vibrometer • External dimensions (L x W x H): 62 x 49 x 22 cm	S	
Transport bag	Compact and light transport bag for outdoor measurements	O	
Tripod with fluid head	Precisely align your vibrometer with high-quality tripods by Manfrotto	O	
IR-detector card	Transforming the invisible infrared light into a spot of visible light	S	

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Optical specifications

Overview

Working distances	• Variable working distance from 6 mm to 100 m • Choice of various lenses
Laser wavelength	Measurement laser: 1550 nm, Target laser: 510-530 nm
Laser safety class	• Measurement laser: output power: < 10 mW, class 1 • Target laser: output power: < 1 mW, class 2
Optics	Auto-, and manual focusing

Spot size

Short-range lens

Stand-off distance	Spot diameter (1/e², typical)
mm	µm
6	19
30	29
50	38
100	61
250	127
500	238
1000	460
1500	682
2000	903
Every additional meter	+ 450

Mid-range lens

Stand-off distance	Spot diameter (1/e², typical)
mm	µm
125	38
200	55
375	95
500	124
1000	238
1500	353
2000	467
2500	582
Every additional meter	+ 230

Long-range lens

Stand-off distance	Spot diameter (1/e², typical)
mm	µm
450	66
750	101
1000	129
1500	187
2000	245
2500	302
3000	360
Every additional meter	+ 120

Software SMART Lab

Highlights

- Lifetime license with no recurring costs
- Installation on any capable computer with Windows 10 / Windows 11
- 1 x license key included (via dongle or online license key)
- Analysis of measurement files for up to 3 users with a single software license
- Connection and control of multiple vibrometers simultaneously for reference, multipoint, and 3D vibration measurements
- Selection of measurement point on loaded 3D-model
- Convenient access to all data in a single software - from vibrometers to multiple reference sensors
- Seamless switching between time and frequency domain representation
- Multichannel arbitrary signal generator for generating predefined signals (sine, sine sweep, square, random, etc.) or custom signals from imported .csv or .wav files
- Real-time signal analysis and enhancement based on speckle tracking and intelligent averaging
- Calculation of various frequency functions: FRF, FFT, auto-spectrum, cross-spectrum, coherence
- Multithreading export of time data, all frequency functions, and reference channel data into the Universal File Format (.uff), Hierarchical Data Format (.hdf5), and MATLAB® file format (.mat)
- Save and load all settings and measurement data in Optomet File Format

SMART Lab - Features

Remote control	• All vibrometer settings via a single ethernet connection • Measurement and pilot laser: autofocus, pilot laser brightness • Multiple vibrometers at once for reference, multipoint and 3D vibration measurements
Acquisition module	• Phase correct acquisition of vibrometer signal and reference channels • Convenient access to all your data in a single software - from vibrometers to multiple reference sensors • Live view of measured time and frequency data • Multi-channel arbitrary signal generator to generate predefined signals (sine, sine sweep, rectangle, random, etc.) or custom signals from imported .csv or .wav files • Triggering on measured signals or external triggers • Trace history to record and recall multiple traces of the velocity/displacement/acceleration data
Analysis module	• Real-time Fast Fourier Transform (FFT) for responsive data analysis • Frequency domain representation with up to 536 Mio FFT lines • Fourier boundaries to limit FFT calculations to certain time ranges of the time data • Several window functions for FFT calculations, including rectangular, hanning, hamming, exponential • Phase correct calculation of the frequency response function (FRF) • Live Spectrogram of the ongoing measurements FFT's
Data export	• Export time and frequency data to .csv, .h5, or .mat files • Export time data as .wav audio file • Take screenshots from within our software and export with up to 4K resolution • Save projects to and load projects from the native file format

SMART Lab runs on any modern computer with Microsoft Windows.
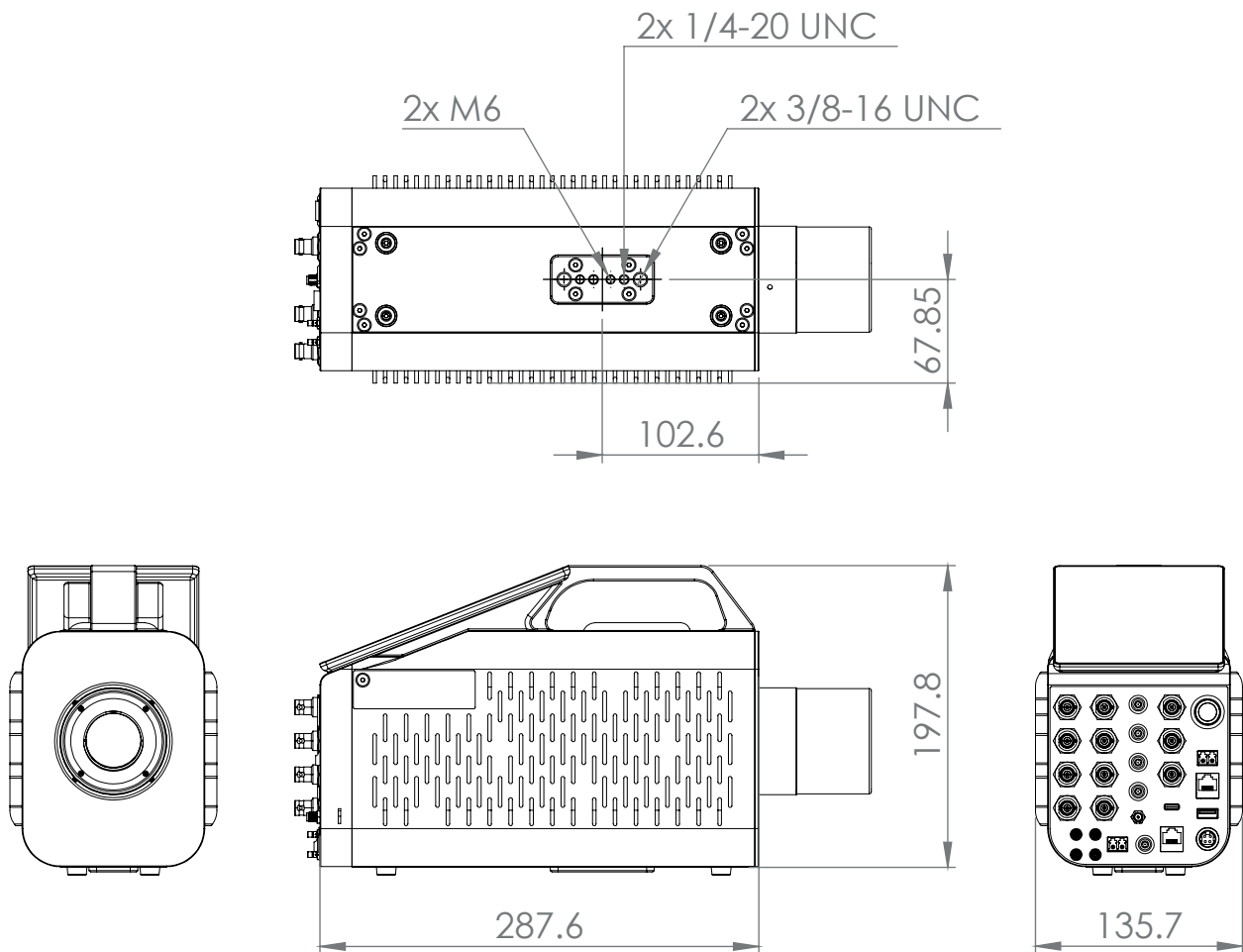
SMART Lab - Software updates

2 years of included software updates	S
Extension of software updates by 2 years	O

Mechanical parameters
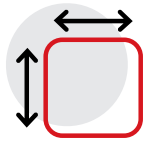
Overview

Dimensions	Length × width × height (excluding handle and lens): 288 × 136 × 198 mm
Weight	~ 4 kg + objective lens
Operating Temperature	0 °C to 40 °C
Storage Temperature	-10 °C to 65 °C
Relative Humidity	max. 80 %, non-condensing

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