

optomet.
LASER VIBROMETRY



- SMART Scanning Laser Doppler Vibrometer for full-field vibration measurements
- Intuitive, integrated and seamless software
- Non-contact reference measurements with additional fiber head
- Compact design with 7-inch touch display
- Synchronization with other SMART devices
- Built-in data acquisition and signal generation
- Upgradable to SMART 3D Scan or SMART Full-Body system

SMART SCAN+

The SMART Scan+ is a full-field and non-contact vibration visualization system offering optimum signal processing, enhanced accuracy, and user-friendly interface for effective data analysis.

General specifications



Overview

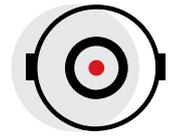
Measured quantities	Velocity, displacement, acceleration
Max. frequency bandwidth	DC to 50 MHz
Frequency range	Can be chosen individually using a freely configurable band-pass filter for velocity, displacement and acceleration signals
Max. velocity	50 m/s
Measurement ranges	Measurement range limits can be freely adjusted between <ul style="list-style-type: none">• 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 x width x height (excluding handle): 365 x 194 x 196 mm
Weight	~ 8.2 kg
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.

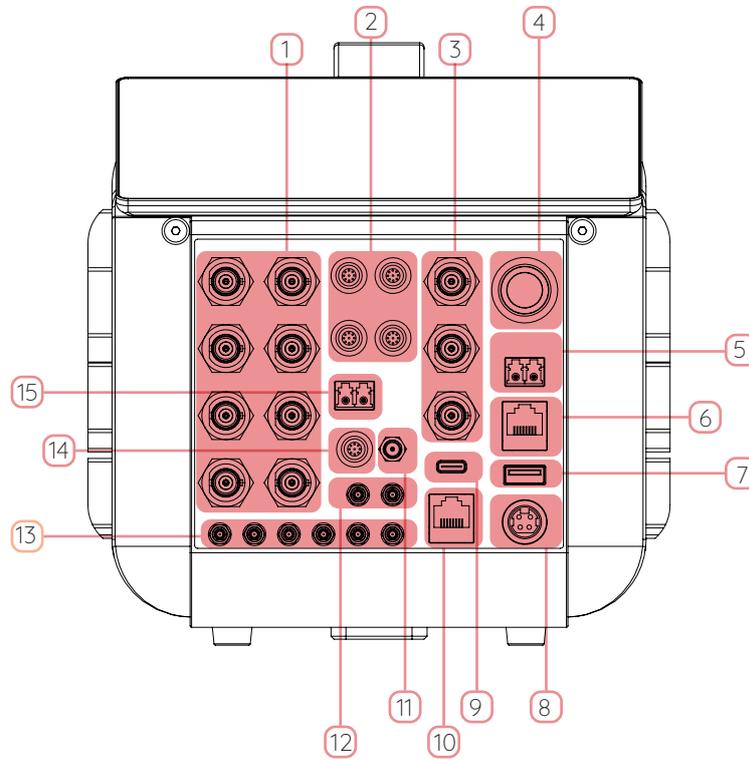
Measurement specifications

Scan angle	50° x 40°, resolution below 0.001°, stability better than 0.001°/h
Max. scan points per second	30
Scan point density	Up to 512 x 512 scan points
Camera	<ul style="list-style-type: none">• 4 K 2160p, 40 x hybrid zoom (1080p equivalent), 20 x optical zoom• Horizontal viewing angle: 63.7° (wide end) to 3.2°, driverless installation
Geometry unit	Measure distances to objects and their geometry
Sample size	Min. < 1 mm ² , max. > 10 m ²

Connectivity & Options



Schematic



1	Analog signal outputs (BNC)	9	USB port (Type-C)
2	LEMO signal inputs (12 channels)	10	Ethernet port: for device communication/data
3	BNC HF signal inputs (up to 50 MHz)	11	GNSS antenna connector
4	Power button	12	10 MHz SMB ports
5	Optical communication port	13	Multi-purpose SMB ports
6	Ethernet port: for device communication/data	14	Power output
7	USB port (Type-A)	15	Optical fiber connector (LC-Duplex)
8	Power input		

Analog inputs and outputs

	Connector type	Characteristics	Description
Analog signal inputs	Up to 4 x LEMO Up to 4 x 3 = 12 channels	$\pm 1 \text{ V} / \pm 10 \text{ V}$ (switchable) 24-bit A/D converter per channel 1.5 MSPS sample rate	<ul style="list-style-type: none"> 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)

	Connector type	Characteristics	Description
Analog HF signal inputs	Up to 3 x BNC	± 2 V 14-bit A/D converter 312.5 MSPS sample rate	<ul style="list-style-type: none"> Synchronous HF signal recording up to 50 MHz on 3 channels Input impedance: 50 Ohm
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	<ul style="list-style-type: none"> 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		<ul style="list-style-type: none"> Digital external trigger input for the device Input impedance: 50 Ohm
Trigger outputs	2 x SMB		<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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)	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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	4 x SMB	<ul style="list-style-type: none"> 2 x synchronization inputs (Input impedance: 50 Ohm, 3.3 V or 5 V) 2 x synchronization outputs (Source impedance: 50 Ohm, 3.3 V) Frequency synchronization with external devices using 10 MHz signals 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)	<ul style="list-style-type: none"> Connect USB devices such as cameras, keyboards or storage devices to the vibrometer for direct data recording
Wireless	Bluetooth 5.2 Wi-Fi 7	<ul style="list-style-type: none"> Bluetooth: connect human interface devices such as keyboard, mouse or head-phones to the vibrometer Wi-Fi: control your vibrometer wirelessly and stream measurement data over the air
GNSS-module	GPS, Galileo, GLONASS and BeiDou	<ul style="list-style-type: none"> Precise absolute time and position information using global navigation satellite systems (GNSS) External antenna connector
Inertial measurement unit (IMU)		<ul style="list-style-type: none"> Synchronous recording of the vibrometer's acceleration and orientation Vibration monitoring of vibrometer enables detection of disturbances More accurate alignment with your test object

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/s ² to 100 Mio. m/s ²	O

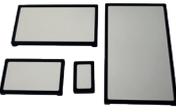
Warranty

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

Maintenance

Extended maintenance	Additional extension of hardware maintenance by 12+ months	<input type="radio"/>
Recalibration & cleaning	Check, cleaning & realignment of optical parts, check of laser output power, and factory calibration	<input type="radio"/>

Accessories

Transport case	<ul style="list-style-type: none"> Stable and waterproof Peli case for safe storage and transport of vibrometer External dimensions (L x W x H): 62.5 x 49 x 35 cm 	<input type="radio"/>	
Protection window	Protects the scanning unit against dust, wind and acoustic excitation at high sound pressure levels	<input type="radio"/>	
Close-up unit	For measurements of small objects with stand-off distances in the range of millimeters	<input type="radio"/>	
Coaxial unit	Aligns the optical axes of measurement laser and camera	<input type="radio"/>	
Transport bag	Compact and light transport bag for outdoor measurements	<input type="radio"/>	
Tripod with fluid head	Precisely align your vibrometer with high-quality tripods by Manfrotto	<input type="radio"/>	
Ring light	For illumination of small test objects. Requires Close-up Unit.	<input type="radio"/>	
Mirror set	Enables contactless vibration measurements even where access is difficult. The mirror set contains 4 front surface mirrors.	<input type="radio"/>	
IR-detector card	Transforming the invisible infrared light into a spot of visible light	<input type="radio"/>	

Optical specifications



Overview

Working distances	<ul style="list-style-type: none"> • Variable working distance from 250 mm to 100 m • With Coaxial Unit: 111 mm to 1 m • With Close-Up Unit: below 6.5 mm to 54 mm
Laser wavelength	Measurement laser: 1550 nm, Target laser: 510-530 nm
Laser safety class	<ul style="list-style-type: none"> • Measurement laser: output power: <10 mW, class 1 • Target laser: output power: <1 mW, class 2
Lens	Long-Range, 100 mm focal length
Optics	Auto-, and manual focusing

Spot size and depth of focus

Stand-off distance	Spot diameter (1/e ² , typical)	Depth of focus (typical)
mm	µm	± mm
250	65	2
500	89	4
1000	141	10
1500	190	18
2000	242	30
2500	293	44
5000	530	142
Every additional meter	+ 94	

Spot size and depth of focus with optional close-up unit

Stand-off distance	Spot diameter (1/e ² , typical)	Depth of focus (typical)
mm	µm	± mm
54	13	0.1
50	14	0.1
45	14	0.1
40	15	0.1
35	16	0.1
30	18	0.2
25	20	0.2
20	22	0.2
15	23	0.3
10.6	25	0.3
6.5	26	0.3



DO NOT STARE INTO BEAM Class 2 Laser Product

Laser CLASS 1: invisible, $\lambda = 1550$ nm, output power: < 10 mW

Laser CLASS 2: visible, green laser, $\lambda = 510-530$ nm, output power: < 1 mW

Software SMART Lab



SMART Lab - Setup module

- Define general measurement settings for vibrometer and reference channels
- Load 3D CAD models in STL (point cloud) or NASTRAN file format
 - Selection of CAD model parts
- Choose measurement area and measurement points using different options
 - CAD model-based area selection and automatic generation of measurement points
 - Creation of equidistant measuring grids even on curved surfaces
 - Shape-based area selection using different shapes (rectangles, circles and polygons) and measurement grid options (rectangular, radial, triangular)
- Measurement point editing including
 - Changing the point density (refining or coarsening the grid)
 - Manual manipulation of the measuring points (move, delete and add)
- Movement, rotation and zoom of the view via keyboard shortcuts and mouse
- Calculation of the approximate total measuring time

SMART Lab - Preparation module

- Remote control of vibrometer settings via a single ethernet connection including
 - Spatial position, autofocus, and brightness of measurement and target laser
 - Zoom, focus and color options of 4K video camera
- Display of all vibrometers and their live 4K video feed in one software
 - Calibration of laser movement with camera image
 - Positioning the measuring grid on the real measurement object
 - Automatic or manual spatial calibration of the vibrometer to the measurement object
 - Calibration quality check at any time, including mathematical error computations

SMART Lab - Acquisition module

- Fully automatic, phase correct acquisition of vibrometer signal and reference sensor data (e.g. from microphones or acceleration sensors)
- Convenient access to all your data in a single software - from vibrometers to multiple reference channels
- Simultaneous recording of velocity, displacement and acceleration (displacement is not an integration of the velocity signal)
- Triggering on measured signals or external triggers
- Seamless switching between time and frequency-domain representation
- Frequency-domain representation with up to 536 Mio FFT lines
- Several window functions, e.g., rectangular, hanning, hamming, exponential
- Multi-channel arbitrary signal generator to generate predefined signals (sine, sine sweep, rectangle, random, etc.) or custom signals from imported .csv or .wav files
- Real-time signal analysis and improvement based on speckle tracking and smart averaging
- Measurement dashboard: Convenient access to all information regarding the running measurement
 - Measurement progress and status (e.g. measurement point, live signal level)
 - Measurement data quality (total/individual points)
- Visualization of measurement data

SMART Lab - Post-processing module

- Calculation of various frequency functions: FRF, FFT, Auto-Spectrum, Cross-Spectrum, Coherence
- Presentation of frequency-domain results in magnitude and phase
- 3D-animation of mode shapes at user-defined frequencies based on FRF and FFT data
- Vibration animation of the entire assembly or of individual components
- 2D heatmaps of FRF magnitude and phase, FFT magnitude, time data RMS, and coherence
- Changeable reference channels and different reference points for different areas
- Manipulation of measurement area and points

- Entirely customizable view options including color maps, viewing angles, texture surfaces, etc.
- Comparison of measurement data from multiple sources in time and frequency domain
 - Measurement cursors
 - Display of several measured variables (FFT, FRF, time data, etc.) for vibrometer channels, reference channels, averaged measurement data
- Take screenshots of graphs and animations from within our software

SMART Lab - Data import and export

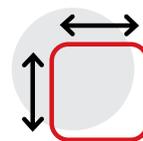
- Multithreaded data export to Universal File Format (.uff), to Hierarchical Data Format (.hdf5) and to MATLAB® file format (.mat)
 - Vibrometer and reference channel data
 - Time and frequency data including FFT, FRF and coherence
 - Coordinates and measurement grid
 - Export time data as .wav audio file
- Export animations of time data (wave-propagation) and frequency data (mode-shapes) as high resolution (up to 4K) video

SMART Lab - Software options

Time domain analysis and animation to visualize the propagation of vibrations	<input type="radio"/>
Modal analysis to gain insight in the dynamical properties of the device under test	<input type="radio"/>
2 years of included software updates	<input checked="" type="radio"/>
Extension of software updates by 2 years	<input type="radio"/>

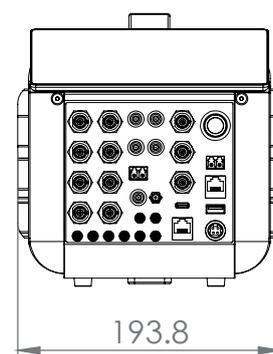
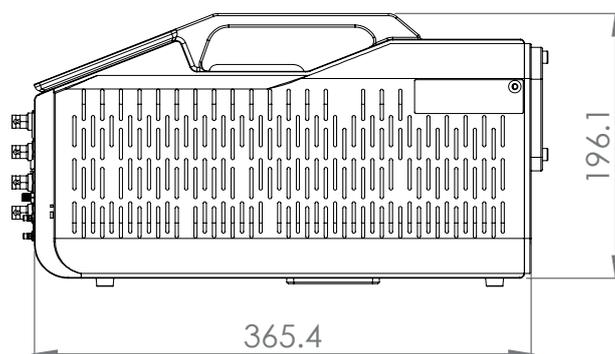
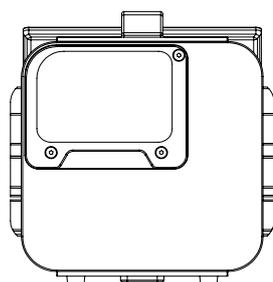
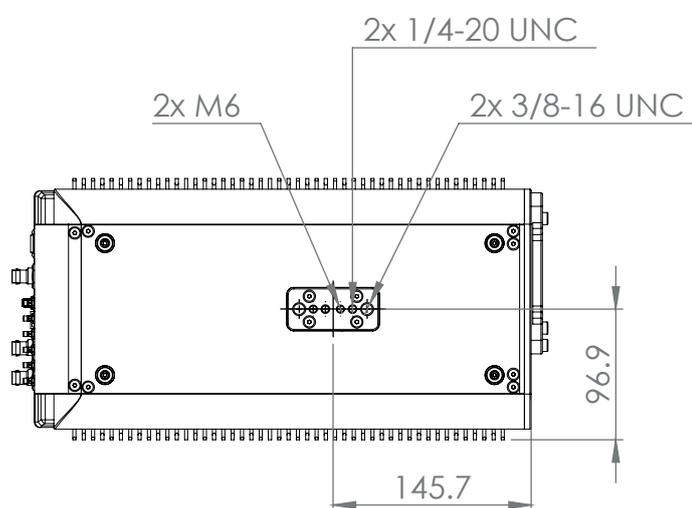
SMART Lab runs on any modern computer with Microsoft Windows.

Mechanical parameters



Overview

Dimensions	Length x width x height (excluding handle): 365 x 194 x 196 mm
Weight	~ 8.2 kg
Operating Temperature	0 °C to 40 °C
Storage Temperature	-10 °C to 65 °C
Relative Humidity	max. 80 %, non-condensing



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