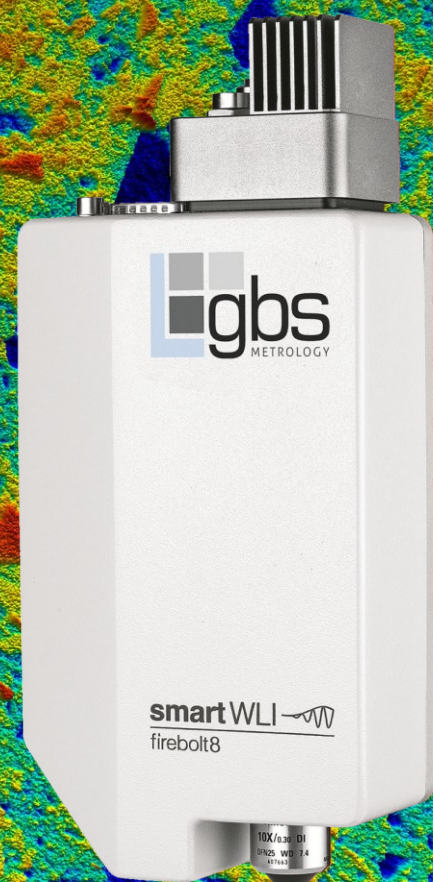
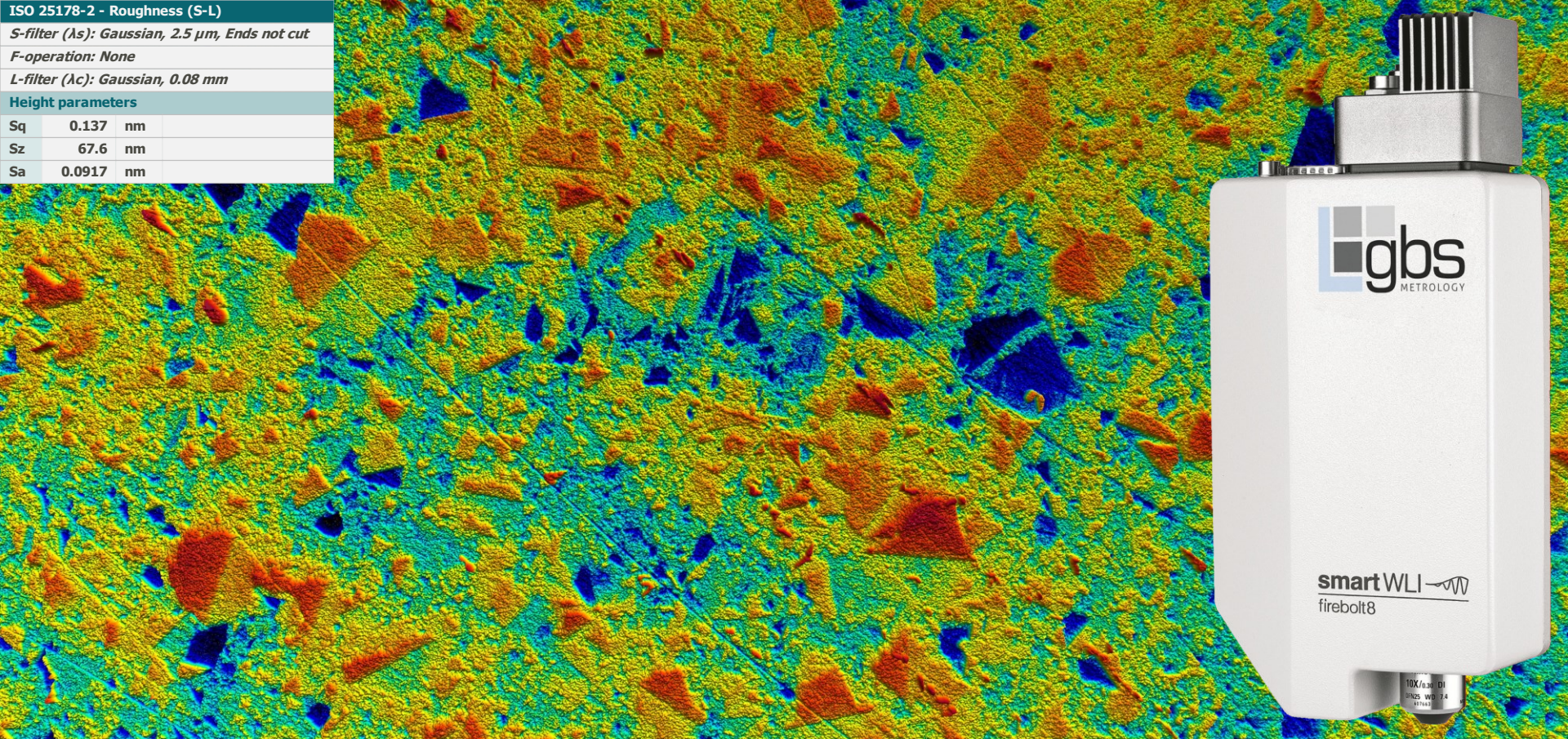


<b>ISO 25178-2 - Roughness (S-L)</b>		
<i>S-filter (<math>\lambda_s</math>): Gaussian, 2.5 <math>\mu\text{m}</math>, Ends not cut</i>		
<i>F-operation: None</i>		
<i>L-filter (<math>\lambda_c</math>): Gaussian, 0.08 mm</i>		
<b>Height parameters</b>		
Sq	0.137	nm
Sz	67.6	nm
Sa	0.0917	nm



smartWLI firebolt8

3D surface metrology

high-speed, extreme resolution sensor

## general features

measuring principle

coherence scanning (white-light) interferometer

high-speed and resolution camera

3488 x 2192 pixel / 160 fps 10GigE camera / optional decimation, binning and AOI

optical 3D sensor

high performance sensor with manual exchangeable objectives

scanning device

piezo positioning system / close loop capacity gauge control

400µm scanning range / 30nm linearity

## unique advantages of the smartWLI series

high speed measurements

real time image processing on advanced graphic boards

general evaluation algorithms

HD-EPSI with combined:  
VSI (vertical scanning interferometry / localization of the interference maxima with unlimited scanning range)  
PSI (phase shift interferometry for extreme height resolution)

fast and effective noise reduction

extreme small increments allows fast and effective noise reduction for single scans and can be combined with time consuming averaging processes using multiple scans

extreme lateral resolution

unlimited evaluation from up to 8 MP measuring points without range and resolution limitation (except accelerated measurements using decimation, binning and AOI)

increased acceptance angles

image corrections and contrast enhancement allows the detection of weak signals and the measurement of steep geometries on shine objects

outliner free scanning processes

AQC (advanced quality control) compares the interference signal of each measuring point with an ideal signal and eliminate outliner without matrix filters

hardware extensions

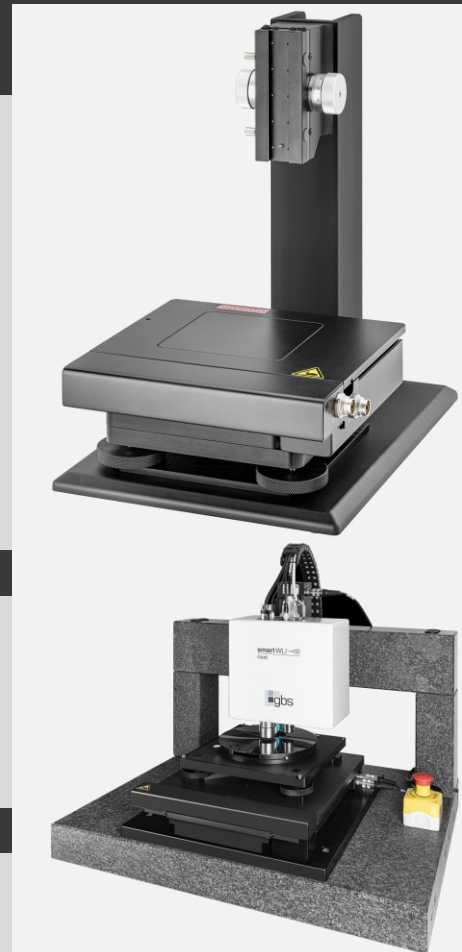
increment	xy - stages	z - stages	tip-tilt
manual stand	100 x 100 mm <sup>2</sup>	70 mm / manual	+3°, manual
motorized stand	100 x 100 mm <sup>2</sup>	70 mm / manual	+3°, manual
		optional motorized:	
		50 mm / 100 mm / 200 mm	
granite portal	200 x 200 mm <sup>2</sup>	70 mm manual	+2°, manual
		optional motorized:	optional +2.5° motorized
granite portal	300 x 300 mm <sup>2</sup>	70 mm manual	+1.5°, manual
		optional motorized:	optional +2.5° motorized
		50 mm / 100 mm / 200 mm	
customization	GBS metrology provide customized hardware system extensions on request		

scanning software

profilometer	smartVIS3d: application with the graphical user interface for the control of the scanning processes including all hardware components as motorized xyz stages and motorized tip-tilt units
optional extensions	smartSTITCH, HD-EPSI upgrade, smartLAYER
stand alone sensors	SDK (software development kit) C++ / C#
IO boards	control of all sensor functions including sample applications with source code
	simplified sensor integration with the triggering of predefined measuring processes over the IO board without programming

evaluation software MountainsMap®

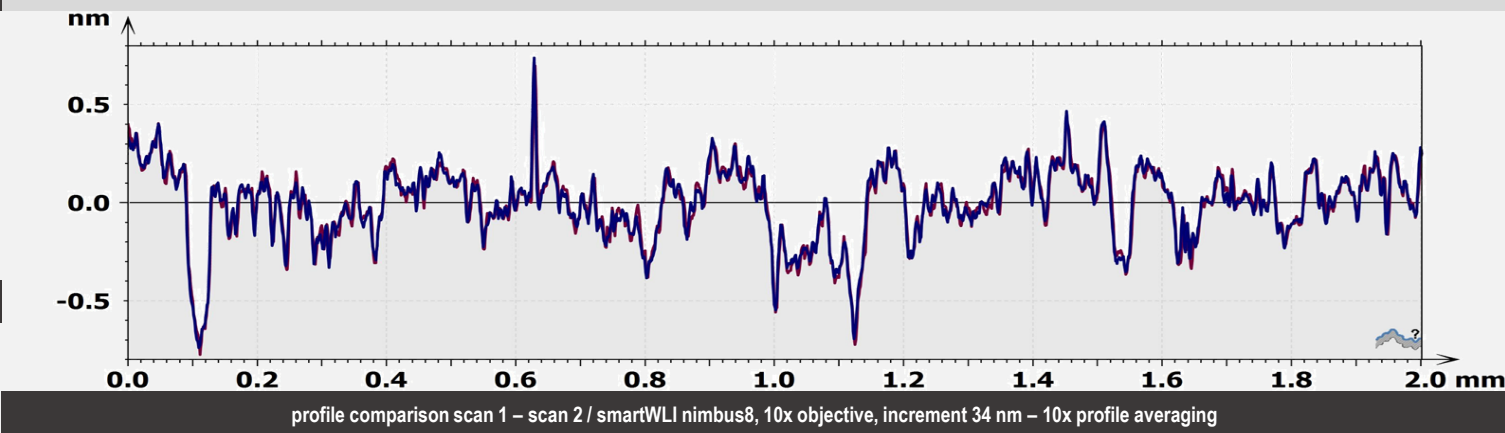
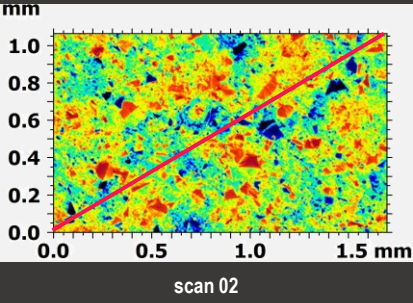
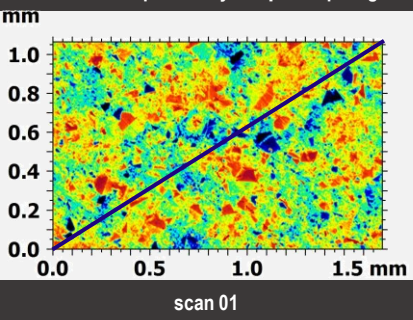
Imaging Topography	automated work flows, batch processing of multiple data, stitching and patching, visualization of 3d data and profiles, 2d and 3d roughness evaluation, manual measurements (step height, distances, slopes...)
optional extensions	Automotive, Advanced Profile, Contour, Advanced Contour, Advances Topography, Fourier and Wavelets, Colocalization, 4D Series, Particle Analysis, Scale Sensitive Analysis, Lens Analysis, Thickness Analysis, Honing Structures



# smartWLI designed for extreme height resolution

increment  
 scanning speed full resolution  
 repeatability RMS  
 single scan  
 topography reproducibility  
 single scan  
 profile averaging  
 1- $\sigma$  repeatability 245 nm step height  
 1- $\sigma$  repeatability 20  $\mu\text{m}$  step height  
 1- $\sigma$  repeatability 100  $\mu\text{m}$  step height

	34 nm	67 nm	201 nm
scanning speed full resolution	5.1 $\mu\text{m/s}$	10.2 $\mu\text{m/s}$	31.5 $\mu\text{m/s}$
repeatability RMS single scan	0.005 nm	0.01 nm	0.02 nm
topography reproducibility single scan	0.05 nm	0.1 nm	0.2 nm
profile averaging	unlimited, reduce the sensor noise proportional to the root of numbers of repetitions, increase the measurement time		
1- $\sigma$ repeatability 245 nm step height	0.3 nm	0.2 nm	0.15 nm
1- $\sigma$ repeatability 20 $\mu\text{m}$ step height	10 nm	7 nm	5 nm
1- $\sigma$ repeatability 100 $\mu\text{m}$ step height	20 nm	15 nm	10 nm



system test topography reproducibility according ISO 25178 / 604 – 2.1.11:

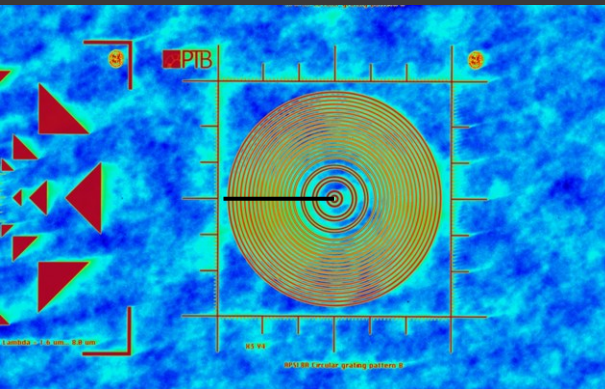
- shown are test results on a super polished SiC mirror with a sub-Angstrom roughness  $R_a$  0.08 nm (ISO conform filtering with  $\lambda_s = 2.5 \mu\text{m}$  /  $\lambda_c = 0.08 \mu\text{m}$ )
- measuring conditions: smartWLI nimbus8 – 10x objective,  $Sq/\sqrt{2}$  – profile difference of 2 scans laboratory conditions, 1 million points after 3x3 denoising filter
- the specified system noise allows the comparison of all smartWLI systems – comparisons between various measurements require additional specifications as measuring time (related to profile averaging or similar technologies), test object and a detailed specification of the achieved lateral resolution

# smartWLI objectives – designed for extreme lateral resolution

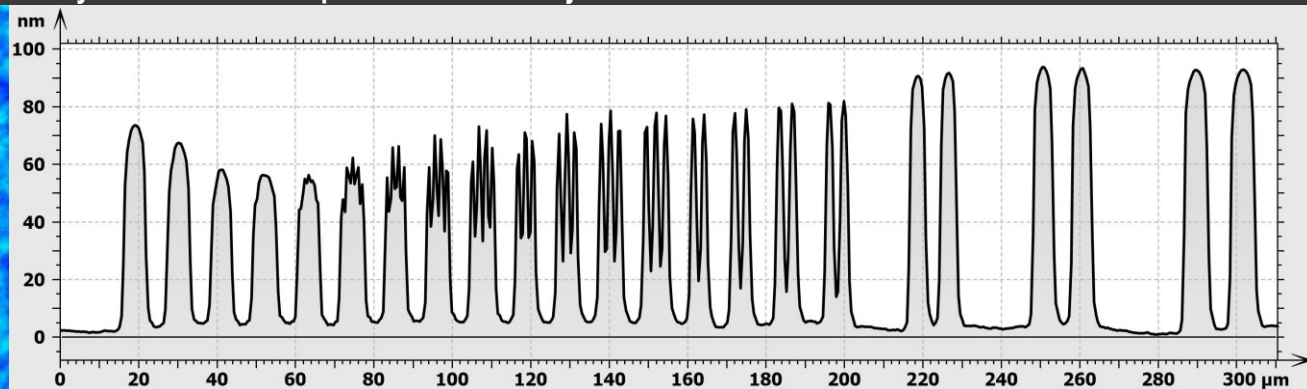
	standard objectives 2D localization				interference objectives for 3D measurements				
available objectives	2.5x	5x	2.5x*	5x	10x	20x	50x	100x	115x**
measuring area / mm <sup>2</sup>	6.8 x 4.4	3.4 x 2.2	6.8 x 4.4	3.4 x 2.2	1.7 x 1.1	0.85 x 0.55	0.34 x 0.22	0.17 x 0.11	0.15 x 0.1
sampling interval / μm	2.0	1.0	2.0	1.0	0.5	0.25	0.1	0.05	0.045
lateral period limit D <sub>LIM</sub> / μm	-	-	9.8	5.2	2.4	1.5	0.82	0.55	0.49
working distance / mm	8.8	22.5	10.3	9.3	7.4	4.7	3.4	2	0.7
Rayleigh criterion / μm	4.23	2.44	4.23	2.44	1.06	0.79	0.58	0.45	0.4
Sparrow criterion / μm	3.26	1.9	3.26	1.9	0.81	0.61	0.44	0.35	0.31

\*requires the adaptation of the parfocal distance from all other objectives

## system test – lateral period limit / 10x objective



PTB resolution standard with sinus structures

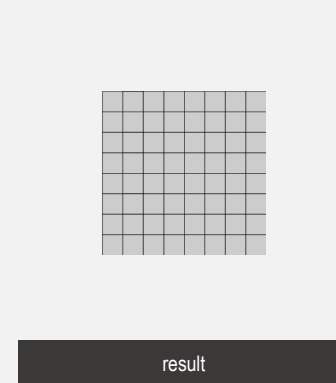
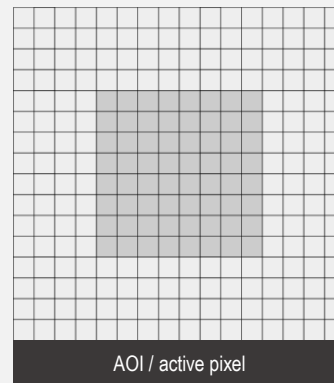
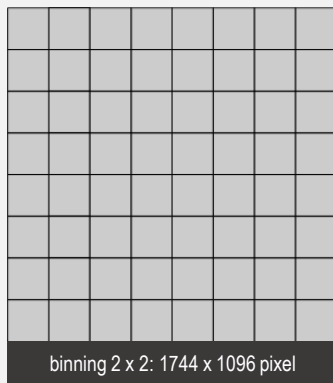
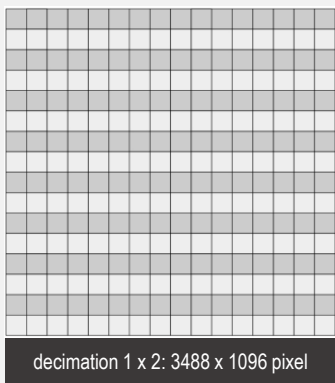
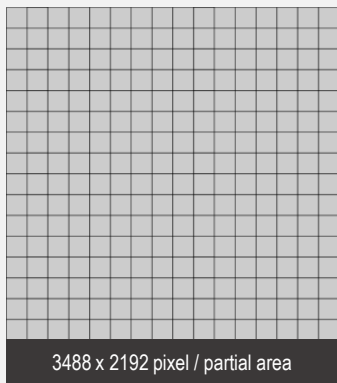


smartWLI nimbus8 – 10x objective / measured profile of the PTB resolution standard

ISO conform system test for the lateral resolution according ISO 25178 / 604 – 2.1.17 / lateral period limit D<sub>LIM</sub>

- shown is a test result using the smartWLI nimbus8 with a 10x objective
- the measured amplitude drops to 50% once the lateral period length of the sinus structures drops to 2.4 μm
- test are available for all smartWLI sensors and allows the comparison of the sensors and various objective among each others as the objective comparison to other sensors with available test results

# smartWLI acceleration through decimation and AOI



scanning increment*	camera speed	scanning speed** - $\mu\text{m/s}$				
	fps	34 nm	70 nm	200 nm	600 nm	1000 nm
3488 x 2192 / full resolution	160	5.4	10.7	32	96	160
3488 x 1096 / decimation 1x2	187	6.4	12.5	37.4	112.2	187
1744 x 1096 / binning 2x2	264	9.0	17.7	52.8	158.4	264
2176 x 2176 / AOI	258	8.8	17.3	51.6	154.8	258
1600 x 1200 / AOI	483	16.4	32.4	96.6	289.8	483
832 x 600 / AOI	962	32.7	64.5	192.4	577.2	962
640 x 480 / AOI	1200	40.8	80.4	240	720	1200
320 x 240 / AOI	2383	81.0	159.6	476.6	1429.8	2383

\*selection of possible scanning increments (height differences between images once the objective got moved for the data acquisition with coherence scanning interferometry)

\*\*higher scanning speed cause higher noise levels

# smartWLI sensor dimensions and connections

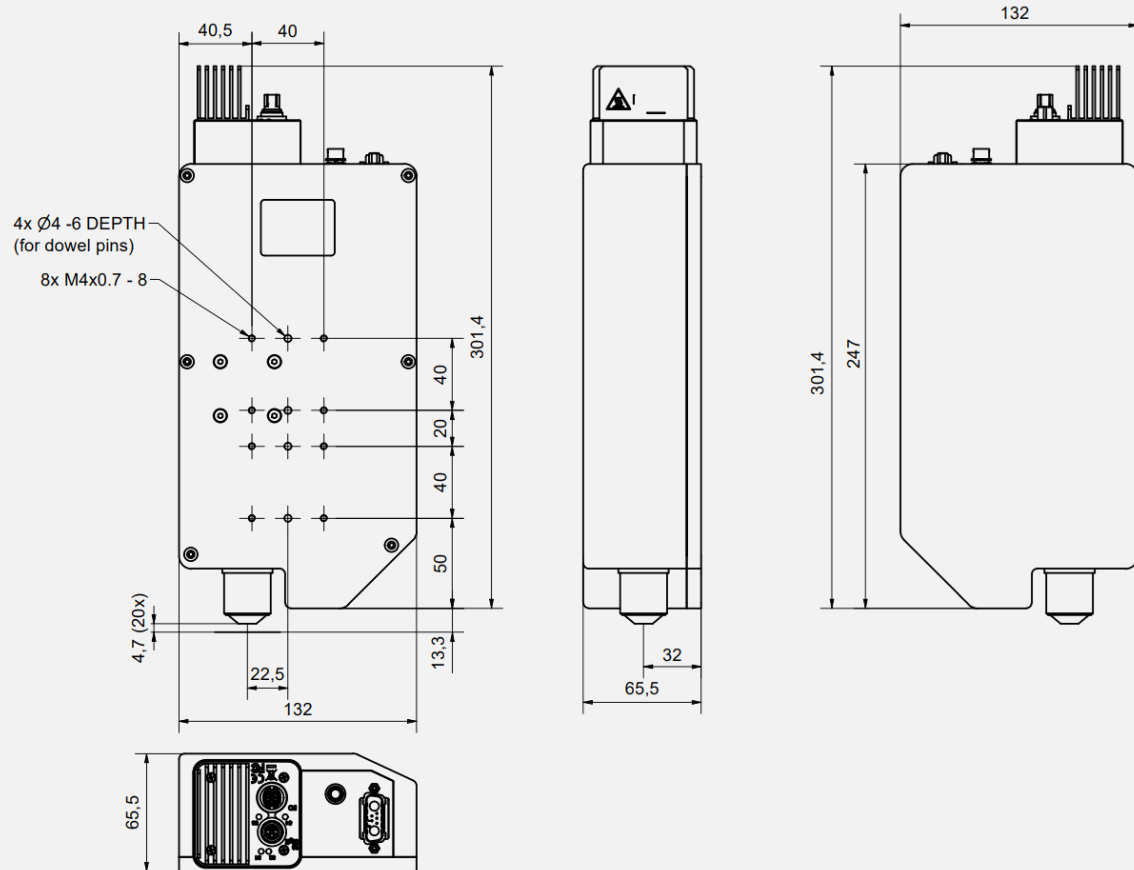
## sensor dimensions

height	301.4 mm
width	132 mm
depth	65.5 mm
weight*	2.5 kg

## connectivity - cables

cable length	3 m (optional up to 7 m)
camera	10GigE M12
piezo	special connector
power supply	HR-10A-7P-6S
trigger	M12, 17 pin
power consumption	13 – 17 W
LED	up to 4 W
spectrum	green / $\lambda \approx 520$ nm

\* without objective and cables



# smart WLI control unit



## controller

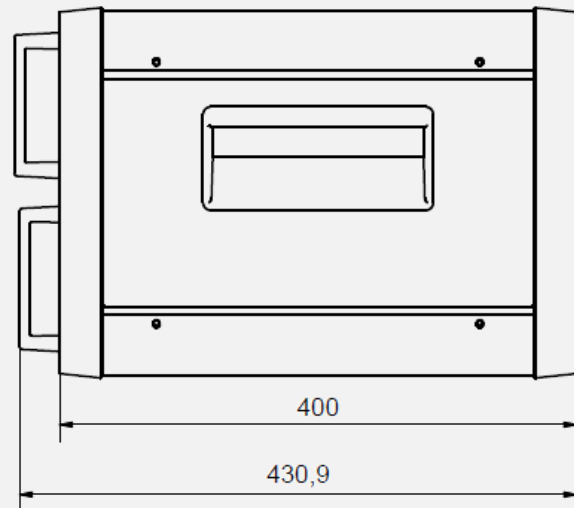
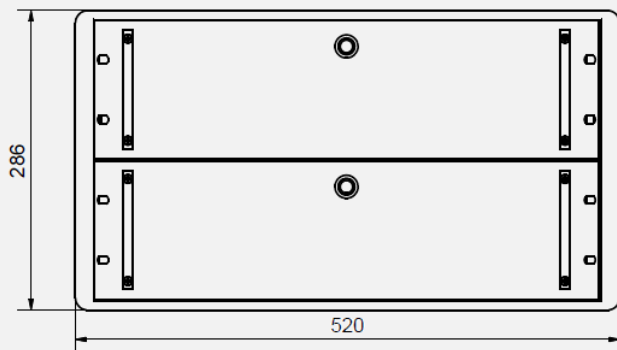
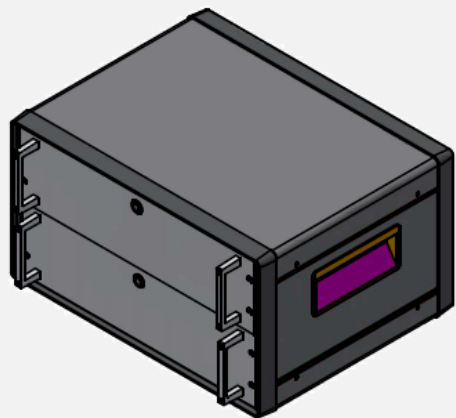
## key features

housing	industrial 19" rack / 6 height units	
power supply	100 – 240 V AC / 50-60 Hz	
LED	LED controller	
piezo	piezo control unit	
stages	optional controller for motorized xyz stages	
	standard PC	
operating system	Windows 11	
CPU	Core i9	
RAM	64 GB	
SSD	1 TB	
Graphic	dual graphic (one exclusive for image processing)	
	GPGPU (image processing)	optional GPGPU upgrade (image processing)
FP 32 (float)	22 TFLOPS	118 TFLOPS
memory	16 GB / GDDR6	32 GB / GDDR7
	optional components	
	27" monitor, keyboard, mouse	
	environmental conditions	
humidity	up to 80% / non-condensing	
operation temperature	10 - 35 °C	

# smartWLI controller dimensions

## controller dimensions

height	286 mm
width	520 mm
depth	430.9 mm
weight	app. 25 kg



modification date

July 17, 2025

disclaimer

changes are subject to technical progress