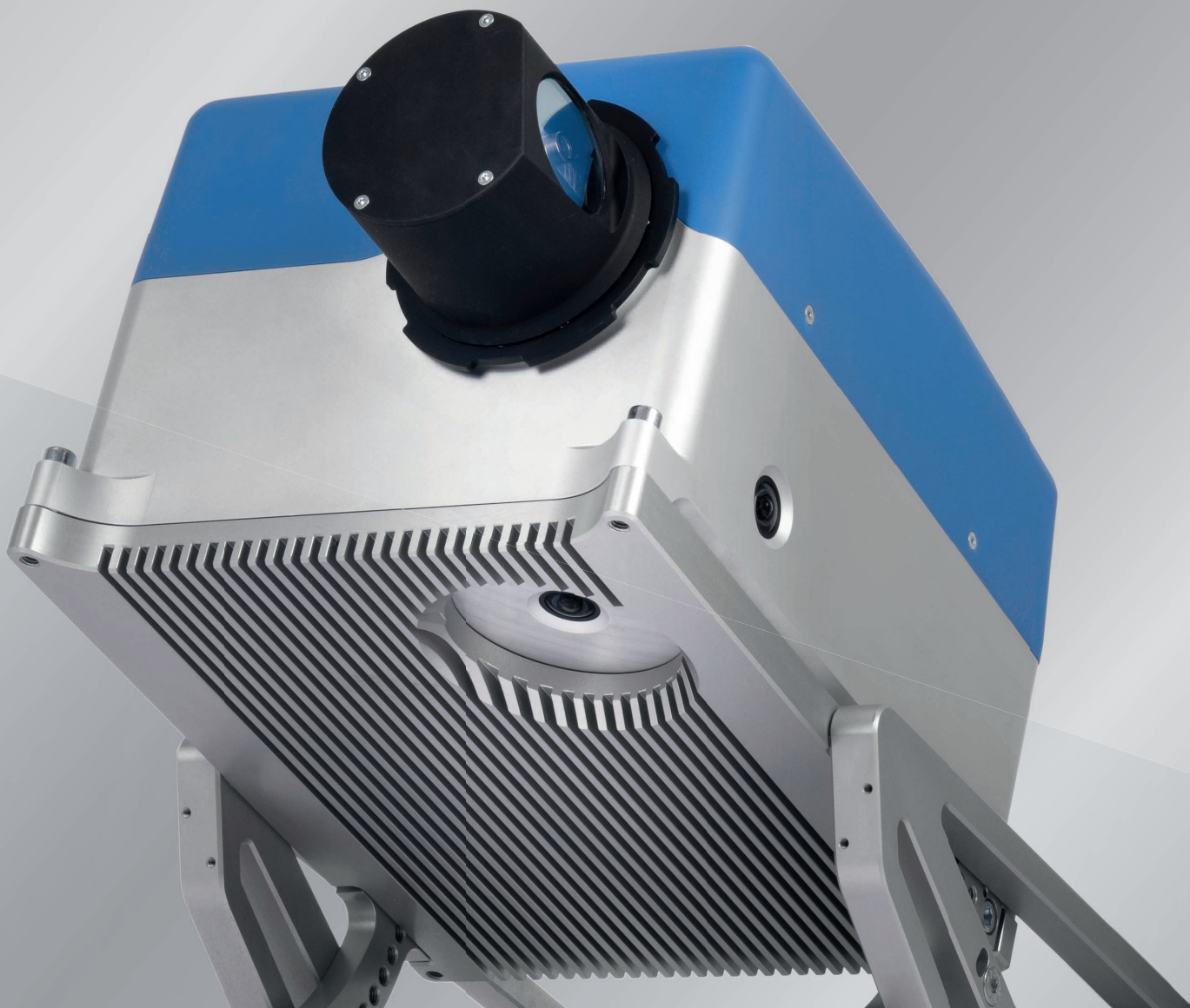


Z+F PROFILER[®]

9020C | 9020-2 | 9020

9012 | 9012A | 9012M | 9012MA



Z+F PROFILER® 9020C

2D Laser Scanner

The Z+F PROFILER® 9020C is the world's first mobile 2D laser scanner with integrated cameras.

Generate colored point clouds, without external cameras

The Z+F PROFILER® 9020C has four integrated cameras, each with 5 MPx, which cover the entire 360° scanning area as of a distance of 40 cm. The recordings have high color fidelity and a high dynamic range. Significant differences in light conditions are compensated in such a way that the processing of the images afterwards takes short time or is completely eliminated. Shaded or overexposed areas can hardly be seen in the colored 3D representations.

Less cabling and connection effort - only one USB 3.1 cable required

The Z+F PROFILER® 9020C built-in cameras allow quick installation. Only a USB 3.1 cable is required for the transmission and control of the system components. Fewer cables also mean less susceptibility to errors and, conversely, more security when collecting data. In addition to this efficiency and data security, a high degree of flexibility was taken into account during development. The construction of the Z+F PROFILER® 9020C corresponds to that of the Z+F PROFILER® 9020. This means that the scanners can be replaced in just a few simple steps, depending on their area of application.

Fully calibrated camera system

In contrast to external cameras, the permanently installed cameras of the Z+F PROFILER® 9020C do not need to be calibrated. The cameras and the scanner are perfectly matched and ready to use upon delivery. The components are also synchronized fully automatically during installation, so that the image and measurement points match exactly. The high accuracy and the low parallax are further optimized by the compact design.

Technical highlights

- + Laser class 1
- + 4 integrated cameras
- + Fully calibrated system
- + 267 profiles/sec.
- + 2 million pixel/sec.
- + 182 m range
- + 360° field of view

Z+F PROFILER® 9020C

- + Suitable for high speeds
- + Very high measurement accuracy
- + Flexible
- + Integrated cameras



Z+F PROFILER® 9020

2D Laser Scanner

The Z+F PROFILER® 9020 is a highly efficient 2D laser scanner for mobile mapping applications. The rotation speed of the Z+F PROFILER® 9020 is 267 Hz or 16,020 rpm max. It measures up to 182 m and has a very high data quality. For data capturing in close range, it is equipped with special optics.

Compared to previous models, it has an internal reference plate, a very low power consumption, very fast startup time and over 50% reduced weight and size.

A new, very powerful laser technology and further developed algorithms ensures highly accurate measurement results on rails, roads, street signs and other traffic control systems such as traffic lights.

The Z+F PROFILER® 9020 can be flexibly integrated into different MMS. The Z+F PROFILER® 9020 has several ports for fast and free from interference communication between the components like Z+F MapCam®, GNSS receiver and operator PC.

Technical highlights

- + Laser class 1
- + 267 profiles/sec.
- + 2 million pixel/sec.
- + 182 m range
- + 360° field of view

Z+F PROFILER® 9020

- + Suitable for high speeds
- + Very high measurement accuracy
- + Flexible
- + Smaller and lighter

Z+F PROFILER® 9020 ports

The Z+F PROFILER® 9020 can be flexibly integrated into different MMS. The Z+F PROFILER® 9020 has several ports for fast and free from interference in communication between the components like Z+F MapCam®, GNSS receiver and operator PC. The external signals of GNSS and IMU are directly fed into the Z+F PROFILER® 9020 data stream.



Z+F SynCaT®

Mobile Mapping Software

With Z+F SynCaT® as a plug-in for Z+F LaserControl®, Zoller + Fröhlich creates a connection between the Z+F PROFILER® and external positioning and navigation systems. Z+F SynCaT® stands for synchronization, calibration, colorization and transformation - also representing the main tasks of the software. Z+F SynCat® includes all the features below:

Synchronization

Synchronize Z+F PROFILER® laser scanner data with trajectory data and generate 3D point cloud files.

Calibration

Processing of calibration parameters due to different system integrations (translation, rotation offsets between the coordinate systems of the navigation-unit (trajectory) and the laser scanners).

Colorization

Z+F SynCaT® can be used to map color information captured by the Z+F MapCam® or the Z+F PROFILER® 9020C on the point clouds.

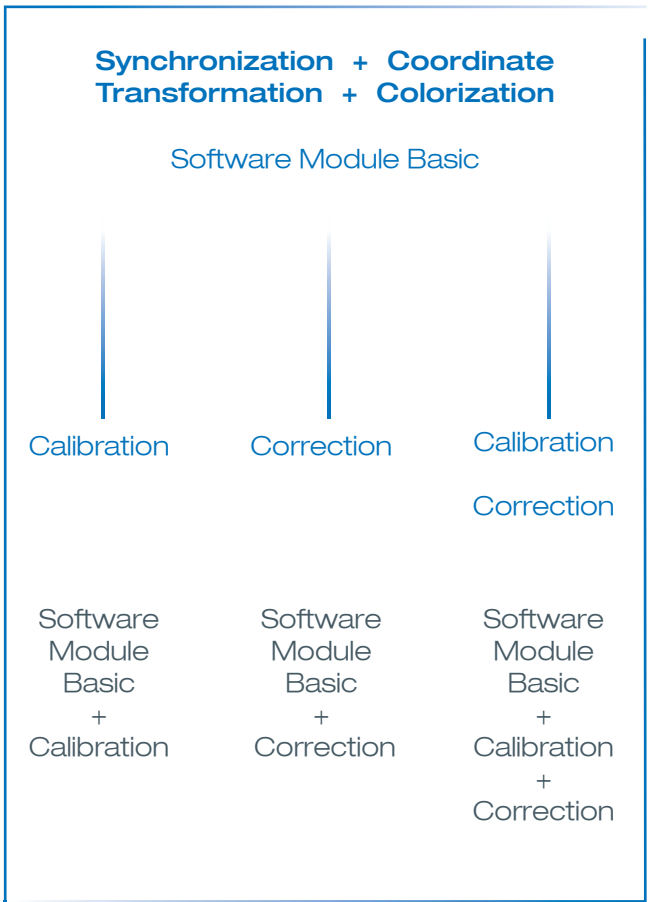
Transformation

Transform 3D point cloud data to different local coordinate systems and apply different local/global height correction models (geoid correction files).

Correction

Individual offset estimation referring to predefined ground control points (GCP's).

Z+F SynCaT® is a modular structured mobile mapping plug-in for Z+F LaserControl®. The modularization allows to combine the software package specifically for the customer needs.



Z+F PROFILER® 9012

2D Laser Scanner

The Z+F PROFILER® 9012 has a vertical 360° field-of-view and with its scan rate of more than 1 million pixel per second and a maximum scanning speed of 200 profiles/sec. short distances between the profiles can be achieved even at high speeds of the carrier vehicle. Due to the high point density, even small objects are registered and processed by the software.

Because the laser measurement system corresponds to laser class 1, the scanner can be used in urban environments without any restriction. A hardware-assisted pixel-by-pixel synchronization makes it possible to process signals from external devices. As a result, the position and orientation of the scan data can be determined.

Ports

With the ports it is no problem to connect GPS, positioning sensors or counters. The external signals are directly fed into the scan data stream.

The new 1-Gbit Ethernet port allows to transfer the scan data directly to an external PC in real-time.

Kinematic applications

Due to its high flexibility the Z+F PROFILER® 9012 is suitable especially for all kinds of mobile map-

ping applications. With its high rotation speed of 200Hz, details are recorded quickly and accurately.

Highlights

- + 1 (according to EN60825-1 / ANSI Z136.1)
- + 119 m ambiguity range
- + more than 1 million pixel/sec
- + up to 200 rps (profiles /sec)
- + 360 ° field of view
- + retracted reference plate
- + 24 V power supply / ~170W (at 200 rps)
- + 1 GBit Ethernet
- + Sync interface for GPS, PPS, etc.
- + Sync interface for second scanner
- + 14 kg weight
- + IP 54 (protected against rain/dust)
- + resistant to dust stains on glass
- + online data visualization
- + USB data logging



Z+F PROFILER® 9012 | 9012A | 9012M | 9012MA

2D Laser Scanner

Mobile Mapping

Because of the high data capture rate, Z+F 2D laser scanners operate accurately even from mobile platforms, at speeds of up to 120 km/h (approx. 75mph). This is particularly important for tunnel, rail track and road surveying (profiling systems).

The Z+F PROFILER® 9012 is mostly used for the surveying of rail and road networks, tunnels, towns, bridges, trees, forests (stocktaking and timber quality) and also for long-term range measuring (buildings, soil etc.).

Rail

In rail applications, Z+F 2D laser scanners are not only used for rail track surveying but also for capturing objects alongside the track like buildings, tunnels, bridges or other objects which might cause a potential danger for rail traffic. The high resolution surveying of objects like station platforms or tunnels is necessary for clearance analysis or analysing tunnel walls. When carrying oversized loads a preflight can be performed to detect narrow points. Due to the high measurement rate and the high rotation speed Z+F measurement systems are highly suitable for rail applications. Therefore, very short distances between profiles can be realised.

Technology faces specific challenges with each application. The Z+F PROFILER® 9012M, Z+F PROFILER® 9012A and Z+F PROFILER® 9012MA optimize close range surveying and visualization of measurements even further.



The Z+F PROFILER® 9012A is the optimal 2D laser scanner for close range applications due to its optimized range noise within 1 – 5 m.

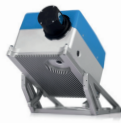


With the integrated marker mode of the Z+F PROFILER® 9012M, up to 5 segments of a scan can be visualized in parallel to the measurement to ensure greater planning reliability in the project.

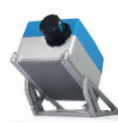
The Z+F PROFILER® is also available as a Z+F PROFILER® 9012MA model, which combines the marker mode and close range high precision surveying.

Z+F PROFILER® 9020C | 9020 | 9012

Technical data comparison



Z+F PROFILER® 9020C



Z+F PROFILER® 9020



Z+F PROFILER® 9012

Distance Measurement System			
Maximum range	182 m	182 m	119 m
Maximum scan rate	2 million pixel/sec.	1 million pixel/sec.	1 million pixel/sec.
Resolution settings	User definable	User definable	User definable
Laser class	1	1	1
Laser wavelength	1.5 µm	1.5 µm	1.5 µm
1 Sigma-Range Noise *1	0.2 mm @ 1 m 0.2 mm @ 5 m 0.2 mm @ 10 m 0.4 mm @ 50 m	0.2 mm @ 1 m 0.2 mm @ 5 m 0.2 mm @ 10 m 0.4 mm @ 50 m	0.5 mm @ 1 m 0.3 mm @ 5 m 0.2 mm @ 10 m 0.9 mm @ 50 m
Angular accuracy	0.007° rms	0.007° rms	0.02° rms
Linearity error	≤1mm	≤1 mm	≤1 mm

Imaging System			
External camera (Z+F MapCam)	✗	✓	✓
Integrated camera system	✓	✗	✗

General specifications			
Rotation speed	50 Hz - 267 Hz (max. 16,020 rpm)	50 Hz - 267 Hz (max. 16,020 rpm)	50 Hz - 200 Hz (max. 12,000 rpm)
Operating temperature	-10°C ... +50°C	-10°C ... +50°C	-10°C ... +45°C
Protection class	IP 66*2	IP 66*2	IP 54
Dimensions (w x d x h)	314 x 200 x 155 mm	314 x 200 x 155 mm	320 x 260 x 340 mm
Weight	7.0 kg (15,4 lbs)	6.5 kg (14,3 lbs)	13.5 kg (29,7 lbs)

General functionality			
Control with individual software	✓	✓	✓
Remote control	✓	✓	✓
Marker mode	✗	✗	✓
Upgrade options	✗	P9020-2*3	P9012-M*4 P9012-A*5
Order number	P9020C: V90LA007086	P9020: V90LA109020 P9020-2: V90LA109026	P9012: V90LA005026 P9012A: V90LA005035 P9012M: V90LA005045 P9012MA: V90LA005055

Additional sensors	
IMU	Optional / External
GNSS	Optional / External
Odometer	Optional / External

*1 for P9020: 136 kHz, white target (80%), for P9012: 127 kHz, white target (80%)

*2 rotor speed ≥ 50 rps or with protective cap

*3 upgrade to 2.2MHz pixel rate by Feature License

*4 additional red Marker Laser

*5 reduced range noise at close ranges

Z+F PROFILER® 9020C | 9020-2 | 9020

Data sheet

Camera system		P9020C			
Number of cameras		4			
Pixel size		3.5 μm			
Resolution		5.05 MPx			
Field of view		each camera 120° x 67°			
Calibration		Fully calibrated, relative to the laser data			
Laser system		P9020C P9020-2 P9020			
Laser class		1 (according to EN60825-1 / ANSI Z136.1)			
Beam divergence		< 0.5 mrad (half angle, 1/e²)			
Beam diameter		Approx. 1.9 mm (at 0.1 m distance)			
Ambiguity distance		182 m (above, range reading restarts at zero)			
Minimum distance		0.3 m			
Range resolution		0.1 mm			
Data acquisition rate:					
P9020C		Max. 2.188 million pixel/sec.			
P9020-2		Max. 2.188 million pixel/sec.			
P9020		Max. 1.094 million pixel/sec.			
Accuracy / Precision		P9020C P9020-2 P9020			
Linearity error		≤ 1 mm			
Range drift (full -10° C ... +50° C)		< 0.3 mm (shortly after internal reference activation), < 2 mm (without reference at steady operating temperature)			
Target Distance		White (80%) ¹	Grey (37%) ¹	Black (14%) ¹	
1 Sigma Range Noise, 1 m		0.2 mm	0.3 mm	0.4 mm	
1 Sigma Range Noise, 2 m		0.2 mm	0.2 mm	0.3 mm	
1 Sigma Range Noise, 5 m		0.2 mm	0.2 mm	0.3 mm	
1 Sigma Range Noise, 10 m		0.2 mm	0.2 mm	0.3 mm	
1 Sigma Range Noise, 25 m		0.2 mm	0.3 mm	0.5 mm	
1 Sigma Range Noise, 50 m		0.4 mm	0.6 mm	1.2 mm	
1 Sigma Range Noise, 80 m ⁸		0.8 mm	1.5 mm	3.5 mm	
Deflection unit		P9020C P9020-2 P9020			
Deflection system		Completely encapsulated, rotating mirror			
Vertical field of view		360° unobstructed			
Angular resolution		0.0088°			
Angular accuracy		0.007° rms ² (122 μrad)			
Rotation speed		50 Hz up to 267 Hz (max. 16,020 rpm)			
Available Settings (Resolution [Pixel/360°] / Rotor speed [rps] / Pixel rate [kHz])					
Data rate	2188 kHz	1094 kHz	547 kHz	274 kHz	137 kHz
Resolution	(x4) ^{3/9}	(x 2.8) ³	(x 2) ³	(x 1.4) ³	(x 1) ³
20.480 / 360°	107 rps	53 rps	---	---	---
10.240 / 360°	214 rps	107 rps	53 rps	---	---
8.192 / 360°	267 rps	134 rps	67 rps	---	---
6.827 / 360°	---	160 rps	80 rps	---	---
5.120 / 360°	---	214 rps	107 rps	53 rps	---
4.096 / 360°	---	267 rps	134 rps	67 rps	---
3.413 / 360°	---	---	160 rps	80 rps	---
2.048 / 360°	---	---	267 rps	134 rps	67 rps
1.024 / 360°	---	---	---	267 rps	134 rps

Interfaces	P9020C P9020-2 P9020
Data storage scanner	Internal 256 GB SATA
Storage camera pictures	external in host-PC
Data interface scanner	1 x GBit Ethernet (limited to 400 MBit/s)
Data interface cameras	1x USB 3.1
Data recording time ⁴	6h ... 12h in total for internal 256 GB memory ⁵
Synchronization interface	+ External encoder input for wheel sensor (Odometer) + GPS input (PPS pulse + NMEA message over RS232) + Linesync output (TTL pulse per profile) + Rotor sync in / out (angular movement of two parallel devices can be synchronized) + External camera-trigger

Power supply	P9020C P9020-2 P9020		
Input voltage	PROFILER: 20 - 30 V DC (24 V DC typ.), Inrush < 12A (@ 24 V) AC-Power supply: 100 – 240 V AC		
Power consumption ⁶ Current @ 24 V / Speed	100 Hz	200 Hz	267 Hz
+20°C, speed up	2.8 A	5.6 A	7.9 A
+20°C, scanning	1.9 A	3.5 A	5.0 A
-10°C, speed up	3.1 A	6.3 A	9.7 A
-10°C, scanning	2.2 A	4.5 A	6.6 A

Ambient conditions	P9020C P9020-2 P9020
Operating temperature	-10 °C ... +50 °C
Storage temperature	-20 °C ... +70 °C
Humidity	Non-condensing
Protection class	IP 66 (rotor speed ≥ 50 rps or with protective cap)

Dimensions and weight	P9020C P9020-2 P9020
Dimensions (w x d x h)	314 x 200 x 155 mm
Weight:	
P9020C	7.0 kg (15,4 lbs)
P9020-2	6.5 kg (14,3 lbs)
P9020	6.5 kg (14,3 lbs)
Mounting flanges ⁷	Only bottom flange 2 x 6.02 mm / H7 register pins 4 x 6.6 mm holes for M6 x 25 mm mounting screws

Additional technical specifications of the Z+F PROFILER® 9020M & 9020CM

Laser system marker-mode	
Laser class	3R (according to IEC EN 60825-1)

1. Range Noise (1-Sigma interval) is specified at 136 KHz data rate, which is the standard data rate for Z+F noise specs.
2. RMS (Root Mean Squared): root of mean squared errors.
3. The actual data rate in KHz (1,000 pixel/sec.) is stated for each available setting.
The Range Noise specs have to be multiplied by the stated factors, yielding the actual 1-Sigma range noise for a particular setting.
4. Continuous data recording at max. data rate of 2.188 million pixel/sec.
5. Data compression factor depends on scanned scene.
6. Additional +0.25 A when operating the camera.
7. See manual for drawings.
8. Not fully production tested, only verified for a small number of specimen.
9. Only applies to the P9020C and P9020-2



Z+F PROFILER® 9012 | 9012A | 9012M | 9012MA

Data sheet

Laser system						
Laser class	1 (according to EN60825-1 / ANSI Z136.1)					
Beam divergence	< 0.5 mrad					
Beam diameter	Approx. 1.9 mm (at 0.1 m distance)					
Ambiguity distance	119 m (above, range reading restarts at zero)					
Minimum distance	0.3 m					
Range resolution	0.1 mm					
Data acquisition rate	Max. 1.016 million pixel/sec.					
Linearity error	≤ 1 mm					
Range drift (full -10° C ... +45° C)	< 2 mm (without reference), < 0.3 mm (with reference)					
Accuracy	Z+F PROFILER® 9012	Z+F PROFILER® 9012A	Z+F PROFILER® 9012	Z+F PROFILER® 9012A	Z+F PROFILER® 9012	Z+F PROFILER® 9012A
Target Distance	White (80%) ¹		Grey (37%) ¹		Black (14%) ¹	
1 Sigma Range Noise, 1 m	0.5 mm	0.3 mm	0.6 mm	0.4 mm	1.0 mm	0.8 mm
1 Sigma Range Noise, 2 m	0.3 mm	0.2 mm	0.5 mm	0.3 mm	0.8 mm	0.4 mm
1 Sigma Range Noise, 5 m	0.3 mm	0.2 mm	0.4 mm	0.3 mm	0.6 mm	0.5 mm
1 Sigma Range Noise, 10 m	0.2 mm	0.2 mm	0.3 mm	0.3 mm	0.5 mm	0.5 mm
1 Sigma Range Noise, 25 m	0.4 mm	0.4 mm	0.6 mm	0.6 mm	1.1 mm	1.1 mm
1 Sigma Range Noise, 50 m	0.9 mm	0.9 mm	1.4 mm	1.4 mm	3.1 mm	3.1 mm

Deflection unit	
Deflection system	Completely encapsulated, rotating mirror
Vertical field of view	360° unobstructed
Angular resolution	0.0088°
Angular accuracy	0.02° rms ²
Rotation speed	50 Hz up to 200 Hz (max. 12,000 rpm)

Settings			
Spindle Speed	200 Hz (12,000 rpm)	100 Hz (6,000 rpm)	50 Hz (3,000 rpm)
Pixel/360°	Data rate / x noise factor ³	Data rate / x noise factor ³	Data rate / x noise factor ³
20,480	---	---	1016 KHz / x 2.8
10,240	---	1016 KHz / x 2.8	508 KHz / x 2.0
5,120	1016 KHz / x 2.8	508 KHz / x 2.0	254 KHz / x 1.4

1. Range Noise (1-Sigma interval) is specified at 127 KHz data rate, which is the standard data rate for any Z+F noise specs. However, these specs have to be converted to the appropriate data rate in KHz (1,000 pixel/sec.), see table "settings". Detailed explanation on request – please contact info@zf-laser.com
2. RMS (Root Mean Squared): mean value of squared errors
3. The actual data rate in KHz (1,000 pixel/sec.) is stated for each available setting. The Range Noise specs have to be multiplied by the stated factors, yielding the actual 1-Sigma range noise for a particular setting
4. Continuous data recording at max. data rate of 1.016 million pixel/sec., (i.e. 200 Hz spindle speed, 5120 pixel/360° or 100 Hz spindle speed 10,240 pixel/360°)
5. Data compression factor depends on scanned scene
6. Data stream is automatically routed to empty memory in case the selected memory stick is full – 2 x 32 GB are available in total
7. Technical drawing available upon request

Interfaces	
Data storage	Internal 128 GB SATA, 2 x external 32 GB USB flash drive
Data interface	1 GB Ethernet 2 x USB-2.0 (for removable memory sticks)
Data recording time ⁴	2h ... 4h for each 32 GB memory ⁵ 4h ... 8h in total for internal 128 GB memory ⁶
Control panel	Remote Controlbox for power on / off, emergency stop and display for status messages
Synchronization interface	+ External encoder input for wheel sensor (Odometer) + GPS input (PPS pulse + UTC message over RS232) + Linesync output (TTL pulse per profile) + Rotor sync in / out (angular movement of two parallel devices can be synchronized)

Power supply	
Input voltage	Z+F PROFILER®: 22 – 28 V DC (24 V DC typ.) Power supply: 100 – 240 V AC
Power consumption (24V)	7.0A @ 200Hz; 3.7A @ 100Hz; 3.0A @ 50Hz; 10.5A during rotor speed up

Ambient conditions	
Operating temperature	-10 °C ... +45 °C
Storage temperature	-20 °C ... +50 °C
Lighting conditions	All natural conditions
Humidity	Non-condensing
Protection class	IP 54

Dimensions and weight	
Dimensions (w x d x h) Weight	320 x 260 x 340 mm 13.5 kg (29,7 lbs)
Mounting flanges ⁷	Flanges on bottom / left / right sides, consisting of: 2 x 6 mm holes for orientation pins 6 x M6 x 10 mm threaded holes for mounting screws

Additional technical specifications of the Z+F PROFILER® 9012M

Laser system in Marker Mode	
Laser class	+ 3R (according to EN60825-1/ANSI Z 136.1), with active marker mode + 1 (according to EN60825-1/ANSI Z 136.1), without marker mode or with active marker mode at distances >2 m (NOHD)*
Wave length	635 nm
Pulse duration	185 µs
Repetition rate	49 Hz
Peak output power	< 6 mW
NOHD (Nominal Ocular Hazard Distance)	2 m

All further technical data are similar to the standard Z+F PROFILER® 9012.

We also have a Z+F PROFILER® 9012MA version available. Please contact info@zf-laser.com if you need any further information.

* Please contact Z+F for further information



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