



How we build reality

**Zoller+Fröhlich GmbH was founded in Wangen in Allgäu in 1963. At first the company concentrated on the design and implementation of individual control systems for the automobile and engineering industry.**

The construction of the company's own switch cabinet was the reason behind the invention of ferrules with plastic sleeves to simplify the wiring of control systems. Due to a constant process of development and innovation, the first machines for the manufacturing of crimp contacts and cable assembly were born. These machines are sometimes very complex, therefore a great deal of attention is given to their operation. The people who use these machines serve as a permanent control mechanism to ensure that they run smoothly. To achieve this, simulation studies and several specific operator simula-

tions were carried out to create an ergonomic design and to optimize the manual working processes and environment. Today Zoller+Fröhlich stands for innovation and quality in the electrical engineering world far beyond the borders of Europe.

Apart from these areas, the development and production of sensor systems with matching CAD software packages for 3D environment modelling represents a new and innovative cornerstone to secure the company's viability in the future. Laser measurement technology is an area that Zoller+Fröhlich began exploring in the 90s. In particular, the company's visual laser radar was awarded the Dr. Rudolf Eberle prize, "Innovations in Baden-Württemberg" in December 1998. Already at the beginning of the 90s, the first laser system for measuring rail track and tunnels was developed. This was followed in 1996 by the first "visual 3D laser measurement system for assessing the condition of objects". In 2002, Zoller+Fröhlich launched the IMAGER 5003, the first compact device produced in series with a range of 53.5 m and a maximum data capture rate of 500,000 pixel/sec.

In 2006, the success story of the IMAGER series was continued with the Zoller+Fröhlich IMAGER 5006. Thanks to its integrated control panel, powerful internal PC, hard disk and internal battery, the IMAGER 5006 was the first 3D laser measuring device where the stand-alone concept was realized 100%.



*The first compact device: Z+F IMAGER 5003*

# Making visions come true

Upgrades to the 5006i and 5006h versions followed in 2008 and in 2010.

With a data acquisition rate of 1,016,027 pixel/sec., the Z+F IMAGER 5006h is the fastest 3D laser measuring device in the world.

As well as the Z+F IMAGER for 3D laser scanning, other devices were also developed. The Z+F PROFILER, a 2D laser measuring device for kinematical use, also appeared on the market in 2002. These instruments are often employed for use on rail track or in vehicles. The development stages of the PROFILER are identical to those of the Z+F IMAGER.

In 2009 the IMAGER 5006EX was presented. Based on the IMAGER 5006, it was the first explosion proof 3D laser scanner worldwide. Due to its ATEX classification, this device could be used in environments where explosions may occur, e.g. in mines or in the chemical industry.

Zoller+Fröhlich scanners come equipped with many accessories. In addition, numerous innovative solutions are offered to increase efficiency in differing areas of use.

When it comes to data evaluation and data processing, Zoller+Fröhlich also provides numerous solutions. The software packages LFM and LaserControl can also be employed in various fields of application, and are well equipped with tools for processing point clouds.

Visionary ideas together with down-to-earth expertise are the cornerstones of the company's success.

Zoller+Fröhlich have always encouraged innovative thinking and turned this into future-oriented products. The great number of patents and prizes awarded to the company only underline this.

What is especially important for Zoller+Fröhlich is the cooperation with customers and partners.

Customers and users worldwide appreciate our personal service and technical support.

Today Zoller+Fröhlich is one of the leading enterprises in the field of contact-free laser measuring technology, and thanks to years of practise and countless successfully concluded projects. We have a wealth of experience at our disposal. At present, Zoller+Fröhlich is represented in 40 different countries with branches in England and USA, and many sales co-operations throughout the world.

The success of Zoller+Fröhlich can be attributed to first-class service and personal advice.



*Explosion proof:  
IMAGER 5006EX*

*In operation in Angkor Wat:  
Z+F IMAGER 5006i*





# Z+F IMAGER<sup>®</sup> 5010



### Integrated control panel

The high-resolution colour display with integrated touch screen enable the scanner to be used intuitively. The operating manual can also be viewed directly on the scanner's display.



*A simple, clear menu structure with many functions makes it efficient and fast to operate. For example, standard scans can be started with only two clicks.*



### Rotating mirror

The rotating mirror is completely encapsulated and extremely well protected from the environment. This makes the scanner ideal for outdoor use. With a maximum rotation speed of 3000 rev/min. and a maximum scan rate of 1 million pixel/sec., it is possible to take pictures at a high resolution in a short space of time.



*In addition, simple measurement and navigation functions can be conducted in order to guarantee quality assurance on the spot.*

### High resolution graphic display

This enables the scans to be displayed immediately after scanning in various views.





#### USB ports

The scanner has two USB ports for 32 GB flash drives which are integrated into sealed closure casings. This allows external data storage on removable devices. An external hard drive can also be connected to one of the USB ports.

#### LEMO connections

In combination with the USB ports, the external LEMO connections are used for controlling accessories like the M-Cam, for example. Furthermore, external sensors like a GPS receiver can be connected using the LEMO connection. The time stamps received can be used to synchronize the scan data precisely and be fed into the scan data stream. A digital outlet for outputting the time stamp is built-in.



#### Connections for power supply and data download

These connections can be found in the lower part of the scanner that does not turn.

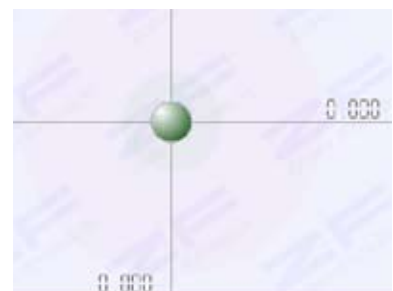
#### WLAN interface

The integrated WLAN interface makes it possible to control and operate the scanner using a standard web-browser (Internet Explorer, Mozilla Firefox, etc.) and the relevant IP address.



#### Laser plummet

With the laser plummet, the instrument can be accurately positioned over a particular point for greater ease of use.



#### Dual-axis compensator

The built-in dual-axis compensator helps to improve the registration and supports geodetic measurement techniques like free positioning. The dual-axis compensator is also used as a level to align the scanner horizontally.



# Z+F IMAGER® 5010

## **The fastest way of scanning: highly accurate, reliable and flexible**

The Z+F IMAGER 5010 sets new standards in the field of 3D laser scanning. The tried and tested, extremely fast phase comparison procedure was developed further and installed in a device with the latest technology. The IMAGER 5010 has won admiration for its incredible speed and simple operation, enabling people to work efficiently and quickly.

## **Laser class 1**

The IMAGER 5010 with a wavelength of 1.5  $\mu\text{m}$  belongs to laser class 1 (EN 60825-1). The laser beam is thus rated as harmless.

## **187 metre range**

Due to the wavelength and new measuring systems, the device can operate up to a maximum range of 187.3 m. This wide range opens up new areas of application for the scanner.

## **1 million points per second**

With a maximum measurement rate of 1,016,027 points per second, the Z+F IMAGER 5010 is the fastest 3D laser scanner in the world.

## **Resolution**

In combination with a very high measurement rate and seven different resolutions, four different quality levels can also be selected. Depending on the application or objective, the optimum scan configuration can be chosen. In this way, it is possible to have points very close together even at a great distance.

## **320° x 360° field of view**

The extended 320° x 360° field of view leads to coverage of the greatest possible scan areas.

## **Light and compact**

The Z+F IMAGER 5010 is very light – 9.8 kg.

Another big advantage is its compact size – 170 x 286 x 395 mm (w/d/h).

## **Intuitive operating concept**

The touch screen display, with a recently developed menu system offers the user a great deal of information and useful features, that are easy and clear to use because of the intuitive operating concept.

## **One-touch scan button**

The one-touch scan button only needs to be pressed twice to start the pre-defined standard scan quickly and efficiently. The entire start phase only takes one or two seconds.

## **100% stand-alone**

The stand-alone principle has been improved upon even further. The scan data can be stored onto two removable USB flash drives, as well as a flash card. The color display enables the scan to be viewed with a zoom function and a simple measuring function. This means that there is no need for an external computer to be connected to check the scanned data.

## **High quality data**

The IMAGER 5010 distinguishes itself through having a high precision of angle and distance measurement. Also the low noise level on differing surfaces even at great distances, is responsible for the highest quality of data. An accuracy to within millimeters can be achieved even at the highest data capture rates.

## **Encapsulated mirror**

The laser beam is reflected by a rotating mirror which can reach speeds of up to 50 rev/sec. This mirror is enclosed in a patented body with protective glass. A high degree of quality, robustness and durability are guaranteed.



# Accessories



*The stable case ensures the safe storage of the accessories*

**Every Z+F laser scanner comes complete with an accessory case that includes the following items:**

- 1 extra battery pack
- 1 charger cradle
- 1 battery charger
- 1 Ethernet cable
- 1 power cable
- 1 extension cable
- 1 seat of Z+F LaserControl software

For the registration of several scans in one project there are various targets available.

Typical paper targets can also be employed with the Z+F IMAGER 5010.



*paper target*



*Z+F ProfiTarget*



*Z+F AutoTarget*

The Z+F ProfiTargets can be rotated about two axes around the target centre, and so are always perfectly aligned to the scanner position.

The Z+F AutoTargets offer the fastest way of registration, since they are automatically recognized in the scan by the software. Numbering also takes place automatically with the integrated code ring.

Whichever target is used, the software automatically recognizes the target centre to an accuracy of less than one pixel.

In addition, it is possible to include tachymetry data for georeferencing, and it is possible to increase accuracy of registration through bundle adjustment.

The M-Cam, an industrial colour camera with a resolution of five megapixels takes pictures in order to colour the point clouds (360° x 320°). It can be easily mounted to the scanner, and is then connected via two USB cables and the LEMO cable. The camera and power supply are then controlled by the scanner.

The pictures are automatically associated with the respective scan and saved. The calibration data necessary for the camera is of course supplied as well.



*The M-Cam can be mounted effortlessly*

The aluminium tripod is a further accessory that is impressive because of its low weight and ease of handling. It is highly stable, making it suitable for various uses. The quick-release clamps make it very easy to adjust the height and quickly assemble and dismantle it. A dolly ensures maximum mobility.

Numerous additional accessories with detailed descriptions can be found at [www.zf-laser.com](http://www.zf-laser.com) or directly from the help menu of the Z+F IMAGER 5010.



# Technical Data

Compact, high-speed, phase-based laser scanner with great precision, range and spherical field of view. Unique stand-alone concept with integrated battery and color display with touch screen. Built-in dual-axis compensator and laser plummet. This device is also available as the Z+F PROFILER 5010 in the 2D version for kinematical applications (see also page 13).



Laser system	IMAGER and PROFILER		
Laser class	1		
Beam divergence	< 0.3 mrad		
Beam diameter	approx. 3.5 mm (at 0.1 m distance)		
Range	187.3 m (unambiguity interval)		
Minimum distance	0.3 m		
Resolution range	0.1 mm		
Data acquisition rate	Max. 1.016 million pixel/sec.		
Linearity error <sup>1</sup>	≤ 1 mm		
Range noise	black 14 %	gray 37 %	white 80 %
Range noise, 10 m <sup>1 2</sup>	0.5 mm rms	0.4 mm rms	0.3 mm rms
Range noise, 25 m <sup>1 2</sup>	1.0 mm rms	0.6 mm rms	0.5 mm rms
Range noise, 50 m <sup>1 2</sup>	2.7 mm rms	1.2 mm rms	0.8 mm rms
Range noise, 100 m <sup>1 2 3</sup>	10 mm rms	3.8 mm rms	2.0 mm rms
Temperature drift	negligible		



Deflection unit	IMAGER	PROFILER
Vertical system	completely encapsulated rotating mirror	
Horizontal system	device rotates about its vertical axis	
Vertical field of view	320°	320°
Horizontal field of view	360°	
Vertical resolution	0.0004°	0.0016°
Horizontal resolution	0.0002°	
Vertical accuracy <sup>1</sup>	0.007° rms	0.007° rms
Horizontal accuracy <sup>1</sup>	0.007° rms	
Scanning speed	max. 50 rev/s (3000 rev/min)	max. 100 rev/s (6000 rev/min)



Deflection unit	IMAGER	IMAGER and PROFILER				PROFILER
		Scan duration				
Angle resolution	pixel/360° horizontal & vertical	low quality <sup>6</sup>	normal quality <sup>6</sup>	high quality <sup>6</sup>	premium quality <sup>6</sup>	pixel/360° vertical
“preview” <sup>4</sup>	1,250	0:13 min	0:26 min	0:52 min	1:44 min	1,280
“low”	2,500	0:26 min	0:52 min	1:44 min	3:24 min	2,560
“middle”	5,000	0:52 min	1:44 min	3:22 min	6:44 min	5,120
“high”	10,000	1:44 min	3:22 min	6:44 min	13:28 min	10,240
“super high”	20,000	3:28 min	6:44 min	13:28 min	26:56 min	20,480
“ultra high” <sup>5</sup>	40,000	6:56 min	13:28 min	26:56 min	53:20 min	40,960
“extremely high” <sup>5</sup>	100,000	---	1:21 h	2:42 h	3:24 h	---



Miscellaneous	IMAGER	PROFILER
Dual-axis compensator	resolution: 0.001° measurement range: +/- 0.5° accuracy: < 0.007° choice of on / off	---
Laser plummet	laser class: 2 accuracy of plummet: 0.5 mm / 1m laser point diameter: < 1.5 mm at 1.5 m	---
Levelling display	electronic level in onboard display and LRC	---
Communication	Ethernet / W-LAN	Ethernet
Data storage	internal 64 GB flash card, 2 x external 32 GB USB flash drive	
Data transmission	Ethernet or USB 2.0	
Integrated operating panel	touch screen operation, colour display to view 3D laser data and colour pictures with measuring and navigation functions	
Interfaces	2 x USB, LEMO 9-pin und LEMO 7-pin connections for M-Cam and external sensors like GPS, odometer, etc.	



Power supply	IMAGER	PROFILER
Input voltage	24 V DC (scanner) 100 – 240 V AC (power unit)	24 V DC (scanner) 100 – 240 V AC (power unit)
Power consumption	< 65 W (on average)	< 75 W (on average)
Operating time	> 2.5 h (internal battery)	unlimited

Ambient conditions	IMAGER and PROFILER
Operating temperature	-10° C ... +45° C
Storage temperature	-20° C ... +50° C
Lighting conditions	operational in all conditions, even in bright sunlight or pitch darkness
Humidity	non-condensing
Protection class	IP 53



Dimensions and weights	IMAGER	PROFILER
Scanner		
Dimensions (w/d/h)	170 x 286 x 395 mm	170 x 286 x 395 mm
Weight	9,8 kg	9,8 kg
Battery		
Dimensions (w/d/h)	170 x 88 x 61 mm	---
Weight	1,2 kg	
AC power unit		
Dimensions	35 x 67 x 167 mm	35 x 67 x 167 mm
Weight	0,54 kg	0,54 kg



- 1) Detailed explanation on request – please contact [info@zf-laser.com](mailto:info@zf-laser.com)
- 2) Data rate 127,000 pixel/sec. (equivalent to "high resolution, high quality" scan), 1 Sigma range noise, unfiltered raw data, in high power mode
- 3) All values extrapolated
- 4) Resolution not recommended for exact measurements, only for positioning higher resolution scan selections!
- 5) Only recommended for scan selections because of the enormous amount of data
- 6) Doubling ("low quality") and halving ("high quality") the data rate (pixel/sec.) theoretically increases the range noise on each pixel by 40% ("low quality") or decreases it by 40% ("high quality") compared to "normal quality". Depending on the roughness of the surface measured, in reality this difference could be less, especially when scanning objects with a bright surface at short distances, e.g. indoors



# High precision and flexibility



Wangen town hall in Allgäu  
in 3D view

**The new Z+F IMAGER 5010 is highly precise, reliable and flexible.**

**The extent of these improvements can be appreciated when working day to day with the new scanner.**

The technical specifications of the IMAGER 5010 set new standards in the field of 3D laser scanning. Its enormous scanning speed, wide range of 187 m and low weight make it the perfect choice for countless areas of application.

Thanks to the laser class 1, the IMAGER 5010 can be used without restriction in almost any environment. This makes the scanner an interesting option for use in areas like the preservation of historical monuments or architecture, even in busy urban environments.

Due to the laser scanner's low weight and unique stand-alone concept, it can also be employed in areas difficult to access like industrial plants or forests.

Having the protection class IP 53 means that the device is almost insusceptible to most environmental influences.



Complex 3D model used in palaeontological research

The extremely fast scanner makes it possible to work efficiently on the spot. Scans can be completed in no time at all, depending on the requirements.

At the scene of an accident, for example, all the relevant data can be gathered very quickly without interrupting the work of the police or rescuer workers. Standstill times in production plants can similarly be reduced to a minimum.



Colorized point cloud - Warsaw University

# Applications



Fort Konstantin

## Cultural heritage

The Z+F IMAGER sets an impressive record in this field because of its contact-free, and above all rapid measuring ability. This reduces costs tremendously in comparison to traditional measurement systems.

The optional M-Cam enables the whole point cloud to be colored,

which gives a photorealistic view of a scan with a high degree of detail.

The low degree of measurement noise means that despite long distances, a very high data quality and scan resolution can be achieved and even the smallest of details can be recorded.



Scanning sample areas

## Forestry

The unique stand-alone concept and low weight make the Z+F IMAGER the ideal surveying instrument in this field. An absence of peripheral devices enables one to work quickly and effectively, even in the most inaccessible terrain, and without getting tired. The new lightweight aluminium tripod is especially practical.

The protection class IP 53 means that the scanner is not affected by environmental influences. The low measurement noise guarantees a detailed and precise evaluation of the forest land.



Helicopter crash  
Regional CID Baden-Württemberg

## Forensic science

The biggest advantage here of the Z+F IMAGER is its immense speed.

The scene of a crime can be documented in its entirety without interrupting the work of the investigators.



The optional M-Cam provides colour information in order to create a photorealistic image of a scene. The high resolution enables even the tiniest of details to be preserved as evidence.





# Applications

## Insurance

The enormous scan rate and high resolution allow the Z+F IMAGER to “freeze” scenes for later analysis in next to no time, and in unsurpassed quality. In this case, the data serves mainly for preserving evidence and documenting damage.

Using the LFM software, the scenes can then be visualized afterwards. This leads to great savings in time when reconstructing an accident, checking plausibility where manipulation is suspected, and many other purposes in insurance.



3D point cloud of a fire in a restaurant

## Industry

Z+F IMAGER's extreme speed makes it possible to reduce standstill times in industrial plants to a minimum. The high level of detail facilitates modelling of extraordinary accuracy.

This enables a subsequent comparison between the revamp design and the as - built site. One other advantage is that the scanner can operate in a temperature range of -10° to +45°C.



Bubble view™ in LFM

## Archaeology

The Z+F IMAGER is the perfect choice for archaeological work. Its high range, elegant stand-alone concept, low weight and large temperature range make this scanner the ideal measuring instrument for use all over the world.

Large areas can be mapped with only one or two scans, resulting in three-dimensional data which includes the smallest of details. The optional M-Cam can be used to capture colour information. Compared to conventional methods, much time can be saved. Unparalleled levels of precision can be achieved.



Cave paintings in Wadi Sura

Find many more examples of applications at [www.zf-laser.com](http://www.zf-laser.com)

# Z+F PROFILER 5010

**The PROFILER 5010 is based on the IMAGER 5010 and is the fastest 2D profiling laser measurement system in the world.**

With its scan rate of 1 million points per second and maximum scan speed of 100 rev/sec., very short distances between profiles can be achieved even at high speeds. At the highest point density of 40,960 points/360°, even the smallest of objects can be registered and processed by the software.

Since the new laser measurement system belongs to laser class 1, the scanner can be used in urban environments without restriction.

A hardware-assisted pixel-by-pixel synchronization, already tried and tested in previous models, makes it possible to process external signals to determine the position of the scan data. Using the LEMO connections, GPS, displacement sensors and counters can be attached, and the external timing pulses directly fed into the scan data stream.

Synchronization with a pulse from the scanner can also be managed using one of the connections. The new 1 GBit Ethernet interface allows the scan data to be transmitted online to an external PC if a real-time evaluation or visualization of the data is required.

The PROFILER 5010 is also equipped with a colour touch screen and intuitive operating concept. With only two clicks, the PROFILER can be configured and started.



*The PROFILER is also suitable for use on fast-moving mobile platforms like trains.*



*Mounting bracket for overhead use of the PROFILER available as accessory (see [www.zf-laser.com](http://www.zf-laser.com))*

# LaserControl Software

**Z+F LaserControl (32-bit or 64-bit) is the visualization and evaluation software for scan data for all Z+F IMAGER models.**

The LaserControl software is used to control the scanner. Using the download manager, scan data can be transmitted directly to a computer and made ready for further use.

## Filters

The filter function in LaserControl clean up unwanted pixels in point cloud data like mixed and single pixels, i.e. points which do not belong to any object. As well as that, the point cloud can be restricted to interesting areas using range and rectangle filters, thus reducing the amount of data. All filters are placed in a layer structure without altering the original scan data. All filter parameters can be configured individually by the user.

## Registration

Before further evaluation, the individual points in almost all projects have to be transferred to a common coordinate system. To a great extent, this can be carried out automatically with Z+F AutoTargets.

In the case of conventional black and white targets, the target centres can be calculated quickly and easily to within less than a pixel in Z+F 2D-View – in other words, without a laborious search for the points in the 3D point cloud. The transformation parameters are calculated using bundling adjustment, taking into account the coordinates of the tachymeter. Thorough and clear calculation protocols guarantee that the required precision is maintained.

## Colour mapping

Superimposing the point clouds with picture information leads to a considerably better way of interpreting the scan data. The Z+F LaserControl Color plug-in offers various kinds of colorizing.

In batch-mode, the data from the M-Cam is automatically processed with geometric precision, and the panoramic pictures of a nodal-point adapter or a Spheron camera can be effortlessly superimposed over the scan data. For small areas, individual pictures from any viewpoint can be colored.

## Import/Export

A great variety of import and export formats are supported by Z+F LaserControl. As well as many ASCII-based exchange formats, the new binary standard formats OSF and PTG can also be used for export.



*Visualization and evaluation of scan data using Z+F LaserControl. Interior view of Martin's Gate Wangen*

## Additional functions

There are various additional functions for extracting more information from the scan data, or doing evaluations of selected areas while on site:

- Measuring functions, rapid calculation of 3D paths and right-angled dimensions (width, ceiling height)
- Creation of orthophotos and rectification of single pictures
- Generation of animations with the point cloud
- Link management for georeferencing additional data (digital file)
- Forensic plug-in for reconstructing trajectories of bullets and checking evidence given by witnesses (view from eye function)



*Colour mapping with M-Cam Wangen town hall*



The benefits of 3D Laser scanning cannot be fully realised without the best in 3D Laser scanning software. LFM provides a powerful turn-key solution from registration of laser scan data through working with massive data sets to as-built modelling.

**LFM was one of the first 3D laser scanning software packages to be launched.**

Since 1998 it has been engaged in a cycle of continuous innovation which means it is now one of the most powerful and efficient 3D laser scanning suites available.

**LFM is CAD vendor neutral.**

Surveyors and service providers can use LFM to create any number of CAD deliverables. Engineering companies and Owner / Operators can work with LFM laser scan data in CAD packages from Autodesk, AVEVA Bentley, Intergraph or VR Context.

**LFM is compatible with the latest of the IMAGER series of 3D laser scanners.**

LFM also accepts 3D laser scan data from previous generations and other hardware systems. This has cost saving implications for LFM customers. If the hardware system changes, the software solution does not have to, avoiding expensive switching costs.

**LFM customers are loyal and longstanding owing to the powerful solution that meets their needs and the exceptional level of support which they receive.**

## The LFM Suite

### LFM Register

Automatically find targets and register scans. LFM reduces the need for control survey work.

### LFM Server

Bring laser scan data into any number of leading CAD packages. Create a database containing an unlimited number of high resolution scans using Infinite Core™ technology. Automatically detect clashes between a CAD design and as-built laser scan data.

### LFM NetView

Securely share laser scan data with colleagues and clients around the world.

### LFM Modeller

Rapidly create 3D Intelligent CAD models in an intuitive true-to-life BubbleView™.



*LFM is driven by the BubbleView™. Make annotations and measurements, create 3D models and view clashes in the BubbleView™*



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