



How we build reality

Zoller + Fröhlich

Zoller + Fröhlich GmbH was founded in Wangen im Allgäu in 1963. Initially 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 designed. Because of the complexity of these machines great attention is given to their operation. The human operators ensure that these run smoothly through permanent control. To achieve this, simulation studies and several specific operator simulations were carried out to create an ergonomic de-

sign optimizing 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 personalised CAD software solutions for 3D environment modeling represent a new 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 in the early 90s, the first laser system for measuring rail track and tunnels was developed. In 1996 the first "visual 3D laser measurement system for assessing the condition of objects" followed up and then in 2002 Zoller + Fröhlich stepped in the laser scanner market by launching the Z+F 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 Z+F 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.

Apart from the Z+F IMAGER for 3D laser scanning, other devices were developed as well. The Z+F PROFILER, a 2D laser measuring device for kinematical use, appeared on the market in 2002. These instruments are designed for the use on mobile platforms as railway or 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. mines or petrochemical plants.

Zoller + Fröhlich scanners come equipped with many accessories. In addition, numerous innovative solutions are offered to increase efficiency of individual applications.

For data evaluation and data processing Zoller + Fröhlich provides numerous solutions. The software packages LFM and Z+F LaserControl are designed for great flexibility in various applications and are well equipped with tools for point cloud processing.

Visionary ideas combined with down-to-earth expertise are the cornerstones of our success. Zoller + Fröhlich has always encouraged innovative thinking of open

minds to be translated into future-oriented products, reflected by the numerous patents and prizes awarded to the company.

Zoller + Fröhlich gives particular attention to customers and cooperation 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. Thanks to years of practise and countless concluded projects, we do dispose of a wealth of experience and success. 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[®] 5010



Integrated control panel

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



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 3,000 rev/min and a maximum scan rate of 1 million pixel/sec, it is possible to do complete panorama scans at a high resolution within extremely short time.



A simple, clear menu structure with many functions enhances efficiency and operation speed. For example, standard scans can be started with only two clicks.



In addition, simple measurement and navigation functions can be conducted in order to guarantee quality assurance already on-site.

The HD colour 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, as the M-Cam. Furthermore, external sensors like a GPS receiver can be connected. The submitted time stamps can be used to synchronize the scan data precisely and be fed into the scan data stream. Digital time-stamp output signals are available as well.



Connections for power supply and data download

These connections are located in the lower scanner part.

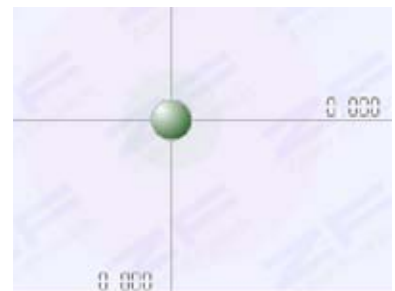
Ethernet/W-LAN interface

The integrated W-LAN interface allows to command the scanner using a standard web-browser (Internet Explorer, Mozilla Firefox, etc.) via the IP address.



Laser plummet

With the laser plummet, the instrument can be accurately positioned above a known physical coordinate.



Dual-axis compensator

The built-in dual-axis compensator helps to improve the registration and supports geodetic measurement techniques, as free positioning. The dual-axis compensator is also used as a bubble level for horizontal set-up of the scanner.



Z+F IMAGER[®] 5010

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

The Z+F IMAGER 5010 sets new standards for 3D laser scanning. The IMAGER 5010 is a high-end product deriving from the evolution of the most reliable phase-shift technology.

The IMAGER 5010 is outstanding for its incredible speed and simple operation interface allowing extreme efficiency.

Laser class 1

The IMAGER 5010 with a wavelength of 1.5 μm complies to laser class 1 (EN 60825-1) thus the laser beam is rated harmless.

Range 187 metres

Due to the wavelength and new ranging system the device operates within a maximum range of 187.3 m. This wide range opens up new applications for phase-based scanners.

High-speed 1 million pixel/second

With a maximum measurement rate of 1,016,027 pixel/sec the IMAGER 5010 is the fastest 3D laser scanner in the world.

Resolution/Quality

Four different quality levels can be combined with seven resolution sets at the extremely high measurement rate. Depending on the application or objective, the best fitting configuration can be chosen. In this way, it is possible to keep a high density resolution even at great distances.

320° x 360° field-of-view

The extended 320° x 360° field-of-view yields maximum coverage.

Light and compact

The IMAGER 5010 is very light – 9.8 kg. Another big advantage is its compact size – 170 x 286 x 395 mm (w x d x 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.

Quick-scan feature

The quick-scan button only needs to be pressed twice to start the pre-defined standard scan. The entire start phase takes only a few seconds.

100% stand-alone

The stand-alone principle has been improved. The scan data can be stored to two removable USB flash drives or a flash card. The colour display allows visual control of the scan with zoom and basic measuring functions. The external computer for scanning control has become obsolete.

High quality data

The IMAGER 5010 distinguishes through highest precision in angle and distance control. The low noise level conserves highest quality of data even on differing surfaces and long ranges. The typical high accuracy 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 a speed 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 hard 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 target types available.

The typical PaperTargets can also be employed with the IMAGER 5010.



PaperTarget



Z+F ProfiTarget



Z+F AutoTarget

The Z+F ProfiTargets can two-axially be rotated around the target centre for perfect alignment 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 onto the scanner, and is 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 camera calibration specifications are included in the bundle.

The aluminium tripod has low weight and is easy to handle. Its high stability gives suitability 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.

Detailed descriptions about numerous additional accessories with can be found at www.zf-laser.com or directly at the help menu of your IMAGER 5010.



The M-Cam can be mounted effortlessly



Aluminium tripod

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 in the 2D version Z+F PROFILER 5010 for kinematical applications (see page 13).



Laser system	IMAGER and PROFILER		
Laser class	1		
Beam divergence	< 0.3 mrad (fullangle)		
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 ¹	≤ 1 mm		
Range noise	black 14 %	grey 37 %	white 80 %
Range noise, 10 m ^{1 2}	0.5 mm rms	0.4 mm rms	0.3 mm rms
Range noise, 25 m ^{1 2}	1.0 mm rms	0.6 mm rms	0.5 mm rms
Range noise, 50 m ^{1 2}	2.7 mm rms	1.2 mm rms	0.8 mm rms
Range noise, 100 m ^{1 2 3}	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 ¹	0.007° rms	0.007° rms
Horizontal accuracy ¹	0.007° rms	---
Rotation speed	max. 50 rps (3,000 rpm)	max. 100 rps (6,000 rpm)



Deflection unit	IMAGER	IMAGER and PROFILER				PROFILER
		Scan duration				
Angle resolution	pixel/360° horizontal & vertical	less quality ⁶	normal quality ⁶	high quality ⁶	premium quality ⁶	pixel/360° vertical
"preview" ⁴	1,250	---	0:26 min	---	---	1,280
"low"	2,500	0:26 min	0:52 min	1:44 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" ⁵	40,000	---	13:28 min	26:56 min	53:20 min	40,960
"extremely high" ⁵	100,000	---	81:00 min	162:00 min	---	---

Miscellaneous	IMAGER	PROFILER
Dual-axis compensator	resolution: 0.001° measurement range: +/- 0.5° accuracy: < 0.007° selectable 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 32 GB USB external flash drive	
Data transmission	Ethernet or USB 2.0	
Integrated control panel	touch screen, colour display for browsing scan 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 e.g. 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, from bright sunlight to pitch darkness
Humidity	non-condensing
Protection class	IP 53



Dimensions and weights	IMAGER	PROFILER
Scanner		
Dimensions (w x d x h)	170 x 286 x 395 mm	170 x 286 x 395 mm
Weight	9.8 kg	9.8 kg
Battery		
Dimensions (w x d x 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
- 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 ("less quality") or halving ("high quality") the data rate (pixel/sec) theoretically increases the range noise on each pixel by 40% ("less quality") or decreases it by 40% ("high quality"), compared to "normal quality". Depending on the roughness of the surveyed surface, in the field this difference might result less, especially when scanning objects with a bright surface at short distances, e.g. indoors.



High precision and flexibility



*Town hall Wangen im Allgäu
in 3D view*

The new Z+F IMAGER 5010 is highly precise, reliable and flexible. These improvements can be appreciated in your daily work.

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

Meeting laser class 1 requirements, the IMAGER 5010 can be used without restriction in almost any environment. This makes the scanner an interesting option from heritage even to busy environment applications.

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 protected against splash water and dust.



*Complex 3D
model used in
palaeontological
research*

The extremely fast scanner makes it possible to work efficiently on-site. Scans can be completed in very short time, 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 rescue teams. Downtimes of production plants can similarly be reduced to a minimum.



Mapped 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 coloured,

which gives a photorealistic impression of a scan with a high level of detail.

The low noise level means that despite long distances, a very high data quality and scan resolution can be achieved and even small details can be captured.



Scanning sample areas

Forestry

The unique stand-alone concept and low weight make the Z+F IMAGER the ideal surveying instrument in this field. The absence of peripheral devices allows quick and effective work, even in most inaccessible field conditions. The new lightweight aluminium tripod completes full physical flexibility.

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



Helicopter crash
Regional CID Baden-Württemberg

Forensic science

The decisive advantage of the Z+F IMAGER in forensics is the immense speed.

The crime scene holistically can be documented without interfering with the running investigation.

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





Applications

Insurance

The enormous scan rate and high resolution allow the Z+F IMAGER to “freeze” rapidly scenes for later analysis and in extraordinary quality. In this case, the data serves mainly for preserving evidence and documenting damage.

Using the LFM/LRC software, the scenes can then be visualized afterwards.

This leads to great time savings for accident reconstruction, checking plausibility where manipulation is suspected and many other purposes of insurance interest.



3D point cloud of a burnt restaurant

Industry

Z+F IMAGER's extreme speed makes it possible to reduce downtimes of industrial plants to a minimum. The high level of detail facilitates modeling 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 °C to +45 °C.



BubbleView® in LFM

Archaeology

The Z+F IMAGER is the perfect choice on archaeological sites. Its high range, elegant stand-alone concept, low weight and large temperature range make this scanner the ideal measuring instrument around the globe.

Large areas can be mapped with only one or two scans, resulting in detailed three-dimensional true-scale models.

The optional M-Cam can be used to capture colour information. Compared to conventional methods, much time can be saved. Unrivaled levels of precision can be achieved.



Cave paintings in Wadi Sura

Find many more examples of applications at www.zf-laser.com

Z+F PROFILER 5010

The Z+F PROFILER 5010 is based on the Z+F 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 small objects can be captured and processed by the software.

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

A hardware-assisted tried and tested pixel-by-pixel synchronization allows processing of external signal input for scan data positioning. Using the LEMO connections, GPS, displacement sensors and counters can be attached, and the external timing pulses directly fed into the digital scan data stream.

The scanner can dispatch digital synchronisation pulses through the LEMO connectors. The new 1 GBit Ethernet interface allows the scan data to be transmitted online to an external PC in case of realtime evaluation or data visualization.

The PROFILER 5010 is equipped with a colour touch screen and intuitive operating concept. By just two clicks, the PROFILER 5010 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).

LaserControl Software

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

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

Filters

The filter functions 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 filters and 3D volume selection, thus reducing the amount of data. All filter results are stored on layers without altering the original scan data. All filter parameters can be configured individually by the user.

Registration

Before further evaluation, the individual scans within a project 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 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

Stitching colour information to the point clouds improves scan data interpretation. The LaserControl Color plug-in offers various mapping methods.

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 easily superimposed over the scan data. For small areas, individual pictures from any viewpoint can be coloured.

Import/Export

A great variety of import and export formats are supported by LaserControl. As well as many ASCII-based exchange formats, the new binary standard formats OSF, PTG and ASTM-E57 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 already while on-site:

- Measuring functions, rapid calculation of 3D paths and perpendicular distances (width, ceiling height)
- Creation of orthophotos and rectification of single pictures
- Processing of animations of 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 can only be fully realised with the best in 3D Laser scanning software.

LFM is a portfolio of highly innovative software products with 3D data at its core. LFM provides a powerful turn-key solution from registration of laser scan data through working with massive data sets to as-built modeling.

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

Since 1998 it has been engaged in a cycle of continual innovation which means it is now one of the most powerful and efficient 3D laser scanning suites available. Our philosophy lies on two principles: Continual Innovation and Support. We will take into account our customers needs and wants.

LFM is CAD vendor neutral. Surveyors and service providers can use LFM to create any number of CAD deliverables. Engineering companies and Owners / 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 IMAGER generation.

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, 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. Offer exceptional productivity and 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 and manipulate 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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