system components for integrators

dyn*AXIS* **galvanometer scanners** are high-performance rotary motors for optical applications. They consist of a motor section based on moving magnet technology and a high-precision position detector. The primary area of application is the fast and precise positioning of mirrors for the deflection of laser beams.

The exceptional dynamics of SCANLAB's dyn*AXIS* scanners are the result of years of experience in developing and manufacturing scanners, scan systems and scan solutions for industrial use.

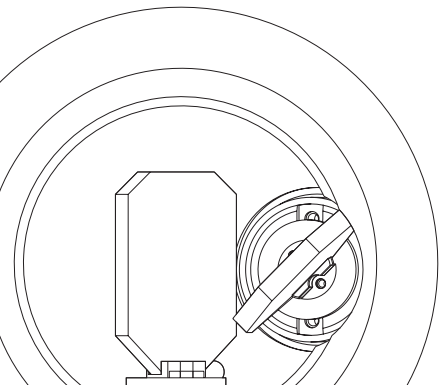
The motor section of each dyn*AXIS* is ideally matched to the deflection mirror´s inertial load. The optimized rotor design is largely responsible for the favorable dynamic properties and resonance characteristics. Axially pre-loaded precision ball bearings guarantee a backlash-free rotor assembly with high stiffness and low friction. Special attention has been paid to long bearing lifetimes.

The optical position detector system is characterized by high resolution, as well as good repeatability and drift values. The scanners are equipped with heaters and temperature sensors (except dyn*AXIS* XS and dyn*AXIS* T). This allows temperature stabilization for further enhancing long-term stability, even under fluctuating ambient conditions.

The new scanners of the dyn*AXIS* 3 series feature a revised position detector for exceptionally low drift, highest linearity and, optionally, extended deflection angles.

For all dyn*AXIS* scanners, SCANLAB provides suitable mirrors and mirror coatings for all common laser wavelengths and power levels. In addition to excellent reflection properties, the mirrors are also optimized with respect to inertial load, stiffness and flatness.

The high quality of SCANLAB's galvanometer scanners enables error-free operation in long-term and continuous use. Comprehensive measurements on custom test benches assure that the highest level of quality is continuously maintained.



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Mounting

A rotation-symmetric flange facilitates mounting of the galvanometer scanner. When mounting, ensure that the galvanometer housing is electrically insulated from the machine assembly. Mirror stoppers are already integrated in the scanners.

Mirrors are directly bonded to the galvanometer´s shaft. The mirrors of the dyn*AXIS* M and dyn*AXIS* L are attached via a mirror mount to the shaft.

Type-Dependent Specifications	**dyn*AXIS*, dyn*AXIS* 3** [1]				
	XS	**T**	**S**	**M**	**L**
Rotor inertia [2]	0.028 g·cm²	0.125 g·cm²	0.34 g·cm²	1.2 g·cm²	5.1 g·cm²
Torque constant	2.3 N·mm/A	5.3 N·mm/A	7.5 N·mm/A	15 N·mm/A	24 N·mm/A
Coil resistance	3.9 Ω	2.8 Ω	2.7 Ω	2.2 Ω	0.85 Ω
Coil inductance	90 µH	145 µH	165 µH	275 µH	300 µH
Max. RMS current (max. case temp. 50 °C)	1.8 A	2.2 A	2.5 A	3.5 A	5 A
Peak current	6 A	10 A	10 A	10 A	15 A
Weight					
Without cable	approx. 25 g	approx. 40 g [5]	approx. 220 g	approx. 300 g	approx. 400 g
Connector					
Without heater [3]	DE9M	DE9M			
With heater [3]		DA15F	DA15F	DA15F	DA15F
Inertial load					
Recommended	0.02 g·cm²	0.1 g·cm²	0.35 g·cm²	1.2 g·cm²	8 g·cm²
Maximum	0.05 g·cm²	0.5 g·cm²	1.5 g·cm²	6 g·cm²	25 g·cm²
Recommended aperture	7 mm	8.5 mm	10 mm	14 mm	20 – 30 mm
Dynamic performance (with SCANLAB control board)					
Step response time 1% of full scale [4]	0.23 ms	0.24 ms	0.25 ms	0.40 ms	0.70 ms

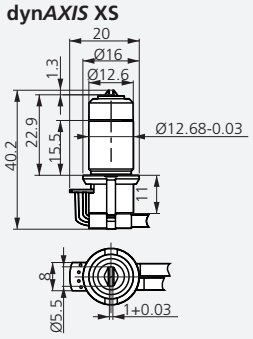
[1] only available as dyn*AXIS* 3 T, 3 S, 3 M and 3 L
[2] dyn*AXIS* XS, S and T with integrated mirror mount, dyn*AXIS* M and L without mirror mount
[3] D-sub plugs resp. sockets; heating available for dyn*AXIS* 3 T, but not dyn*AXIS* XS or dyn*AXIS* T
[4] rated for 1/1000 of full scale, with mirrors for the recommended aperture
[5] weight for dyn*AXIS* 3 T: approx. 100 g

Common Specifications
(with SCANLAB control board, all angles are in mechanical degrees)

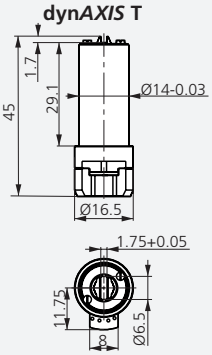
	dyn*AXIS*	**dyn*AXIS* 3** [6]
Maximum scan angle	±12°	up to ±19°
Position detector		
Nonlinearity [7]	< 0.4 %	< 0.1 %
Offset drift	< 15 µrad/K	< 3 µrad/K [8]
Gain drift	< 50 ppm/K	< 12 ppm/K [8]
Repeatability (RMS)	< 1 µrad	< 1 µrad
Typical output signal		
- differential mode	–11 µA/°	–10.5 µA/°
- common mode	–140 µA	–110 µA
Supply current	35 – 60 mA	max. 45 mA
Heater [3]		
Heater resistance	120 Ω	
Temperature sensor resistance	1000 Ω at 25 °C 578 Ω at 40 °C	
Max. heater current	0.25 A	
Cable length	standard 0.22 m	
Installation	electrically insulated	
Operating temperature	5 – 50 °C noncondensing	

[6] only available as dyn*AXIS* 3 T, 3 S, 3 M and 3 L; preliminary values
[7] for scan angles from –11° to +11°
[8] without temperature control < 5 µrad/K and < 25 ppm/K

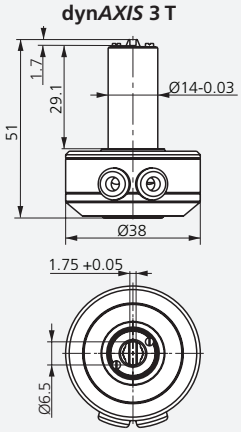
dyn*AXIS* XS



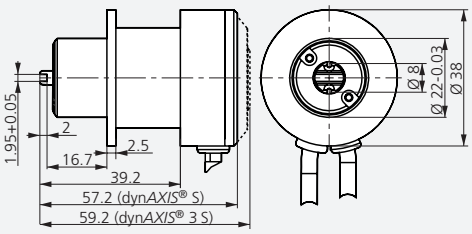
dyn*AXIS* T



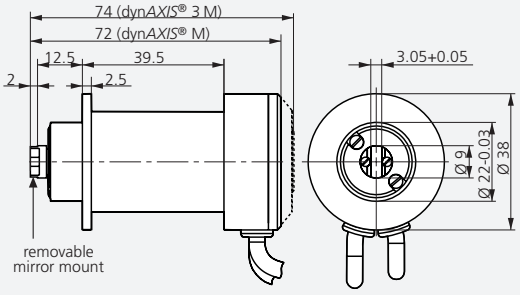
dyn*AXIS* 3 T



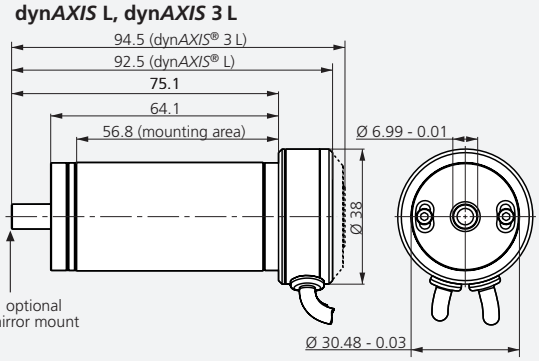
dyn*AXIS* S, dyn*AXIS* 3 S



dyn*AXIS* M, dyn*AXIS* 3 M



dyn*AXIS* L, dyn*AXIS* 3 L



all dimensions in mm

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SCANLAB innovators for industry

dyn*AXIS* 421

Compact High Performance Galvanometer Scanner

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dyn*AXIS* 421

SCANLAB expands its product range with the dyn*AXIS* 421 galvanometer scanner. This moving-magnet closed-loop galvo is particularly suitable for applications with small apertures and highest dynamic performance. With its very small dimensions, it is ideal for compact and handheld devices, including medical and ophthalmic instruments.

The dyn*AXIS* 421 is available with both analog and digital servo-driver boards, and a variety of mirrors and coating options.

Quality Made in Germany

The dyn*AXIS* 421 galvanometer scanner is engineered and manufactured in Germany with ISO 9001:2015 certification.

SCANLAB stands for over 25 years of innovation in galvanometer motors and scanning solutions, as well as scan system optimization and rigorous in-house testing to ensure unsurpassed system performance and reliability in any application.

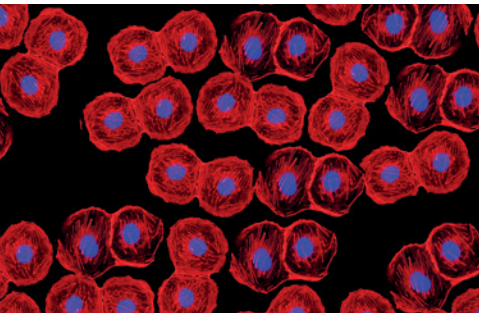
Our scanning solutions are proven in the most challenging industrial and medical applications worldwide.

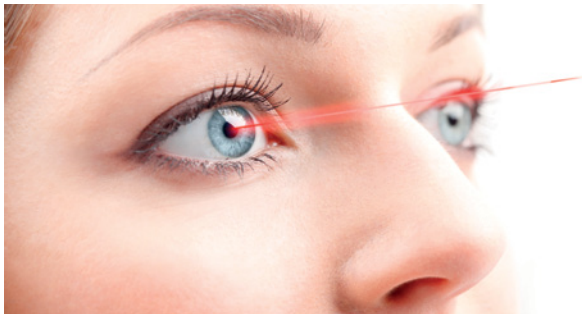
Key Features

- Suitable for very small apertures (3 mm – 7 mm)
- Optimized motor design enabling faster and more efficient scanning
- A new optical position detector, resulting in high precision and stability
- Superior acceleration and efficient power handling, for minimum heat generation and maximum scan speeds
- Highest dynamic performance when used in combination with SCANLAB´s innovative digital servo drivers

Typical Applications

- Ophthalmic imaging
- Microscopy
- Medical laser treatments
- Laser material processing





Recommended Servo-Driver Boards

In combination with the new, compact SCANLAB **microISB digital servo-driver board**, the dyn*AXIS* 421 achieves maximum dynamic performance and precision with low heat generation. The digital technology also provides the system status values and output signals relevant for the respective application.

Very high accelerations and scan rates can also be achieved with the high performance and compact **miniSSV analog servo-driver board**. Also the miniSSV allows optimized scan efficiency while heat generation is kept low.

Flexibility to the User

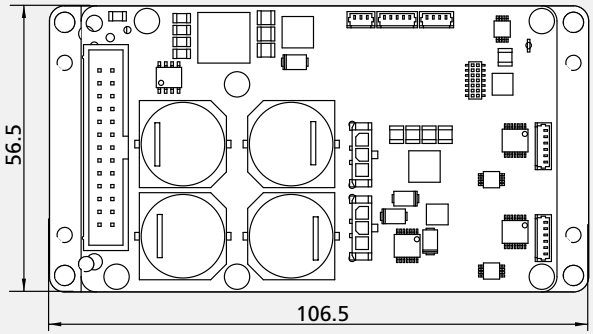
- Extensive choice of control options depending upon cost and performance goals
- Miniature analog servo drivers to fit the most compact systems
- Fully digital servo control options, including advanced and customizable system status monitoring

Control Boards

Digital and analog galvanometer scanning systems can be operated using SCANLAB's RTC control boards via digital commands. Alternatively customers may use their own controllers to provide either digital or analog command signals.

Examples of suitable SCANLAB servo boards

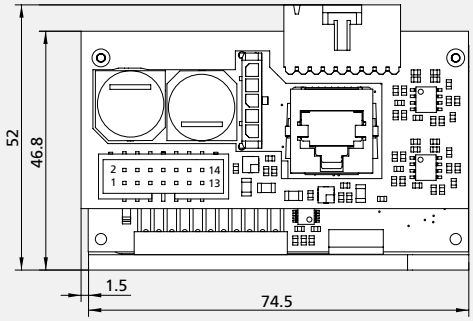
microISB (digital dual axis servo-driver)



Length x Width x Height: (106.5 x 56.5 x 25) mm³

miniSSV * (analog single axis servo-driver)

with optional extension board for signal-out (e.g. actual position)



Length x Width x Height (with extension board): (76 x 52 x 27.3) mm³

Length x Width x Height (without extension board): (74.5 x 46.8 x 27.3) mm³

* Please contact SCANLAB for additional compact servo-driver options.

Specifications dyn*AXIS* 421

Rotor inertia	0.018 g·cm²
Torque constant	1.6 N·mm/A
Coil resistance	1.3 Ω
Coil inductance	55 µH
Max. RMS current (with scanner housing max. 50 °C)	4.2 A
Max. peak current [1]	17 A
Thermal resistance (coil to case)	2 K/W
Weight without cable	approx. 19 g
Inertial load	
Recommended	0.01 g·cm²
Maximum	0.05 g·cm²
Recommended aperture	3 – 7 mm
Dynamic (with SCANLAB control board)	
Step response time 1% of full scale [2]	140 µs

[1] short term pulse width: 90 µs

[2] settling to 1/1000 of full scale; step response time depends on the tuning and the inertia of the mirror

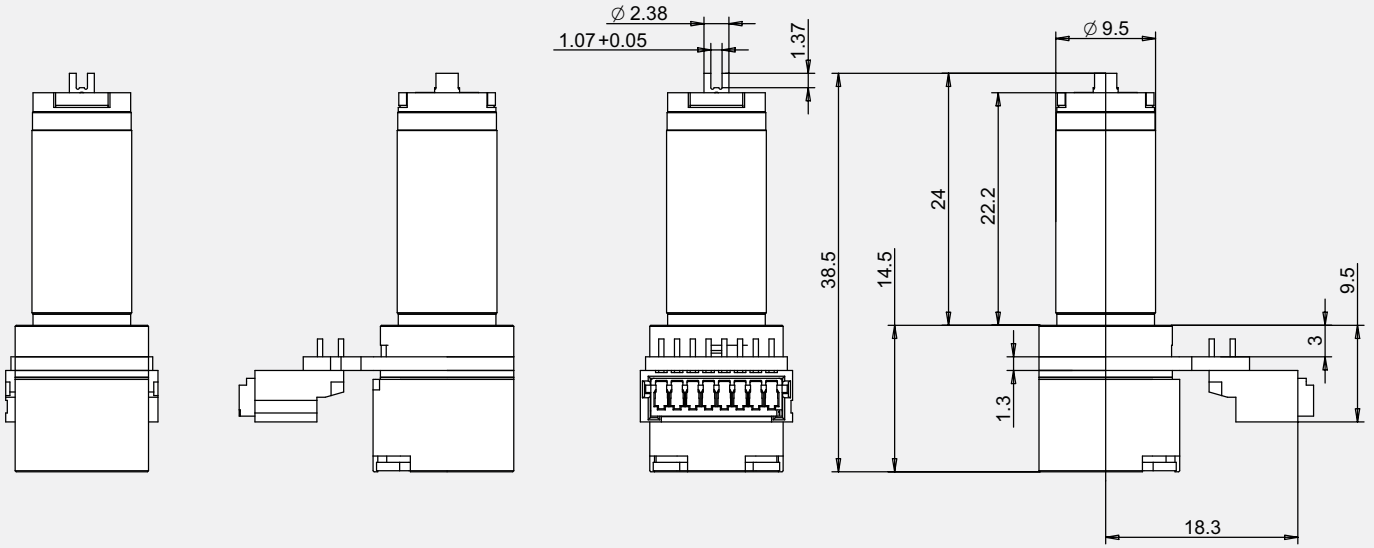
Maximum scan angle	± 17 °
Position detector	
Nonlinearity [3]	< 0.1 %
Offset drift	< 15 µrad/K
Gain drift	< 50 ppm/K
Repeatability (RMS)	< 1 µrad
Typical output signal	
- differential mode	– 115 µA/°
- common mode	– 1130 µA
Supply current	20 – 55 mA
Typical cable length	0.5 m (standard) [4]
Installation	electrically insulated
Operating temperature	5 – 50 °C non-condensing

(all angles are in mechanical degrees)

[3] for scan angles from –11° to +11°

[4] other cable lengths on request

dyn*AXIS* 421



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smart scanning

SCANLAB's intelli*SCAN* **scan heads** stand out with variant diversity and high dynamics. They're among the **2D scan systems** that enable deflecting and positioning of laser beams in the working plane.

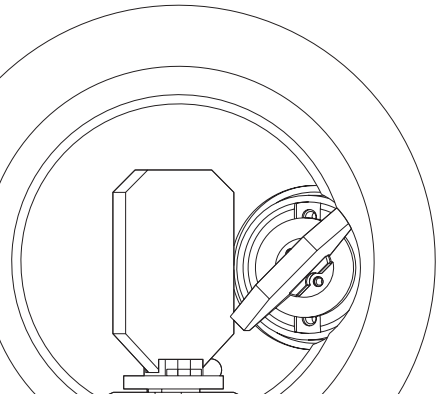
The intelli*SCAN* series allows versatile and flexible usage. It's designed for tasks with very high scan requirements across a broad variety of application areas.

Key Features

- Highest dynamic performance
- Maximum flexibility due to switchable tunings
- Ideal adaptability enabled by a multitude of variants
- Comprehensive diagnostic and monitoring functions
- High long-term stability
- Water & air cooling option

Typical Applications

- Additive manufacturing (3D printing)
- Materials processing, micro-structuring
- Marking, welding, drilling
- Processing-on-the-fly



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Range of intelli*SCAN* Product Lines

- **intelli*SCAN***
  (10, 14, 20 and 30 mm apertures)
- **intelli*SCAN* III**
  (10, 14, 20 and 30 mm apertures)
- **intelli*SCAN*$_{se}$**
  (10 and 14 mm apertures)
- **intelli*SCAN*$_{de}$**
  (14, 20 and 30 mm apertures)

Advantages of intelli*SCAN* series

- Variant diversity (customer-specific tunings, assorted housings and cooling methods)
- High extendibility (e.g. z-axes, camera adapter)
- Application-specific and customer-specific tunings
- Lower heat generation due to digital control

Advantages of i*DRIVE* technology

- Digital servo electronics provides improved dynamics and higher marking quality
- Up to three switchable tunings reduce process times
- Comprehensive diagnostics and communication possibilities between the scan system and RTC
- Acquisition of all key state variables in real time

Options & Variants

Housing Variants

- Standard water cooling (optional 10 mm and 14 mm aperture)
- Standard air cooling (20 mm and 30 mm aperture)
- Available as a scan module without housing (not all apertures)

Extensions

- vario*SCAN*: Extension into a 3-axis scan system
- excelli*SHIFT*: Extension into a high-speed, 3-axis scan system
- Camera adapter for optical process monitoring

Optics

- Over 50 standard coatings for various wavelengths (UV to infrared)
- Extensive variety of objectives
- High-performance variants with light-weight mirrors
- Customer-specific variants possible

Control Boards

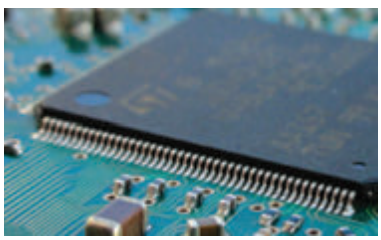
- RTC5 and RTC6 (PCIe, Ethernet)

Software

- Application-specific and customer-specific tunings (servo algorithms and parameter sets) available
- laserDESK: professional software for laser marking and materials processing
- *SCAN*align: software for automatic and exact placement of laser beams; process integratable high-precision calibration solution
- Flexible calibration solutions: correXion pro, CALsheet


Laser drilling/Laser cutting


3D laser sintering


Marking

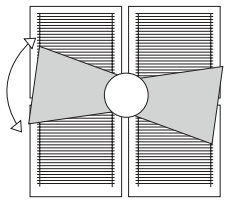
Scan Heads with Analog Position Detectors

intelli*SCAN* and intelli*SCAN* III

Analog Position Detectors

The position detector (PD, angle transmitter) is a critical galvanometer scanner component that determines the entire scan system's accuracy.

SCANLAB's standard portfolio of galvanometer scanners with analog optical position detectors currently comprises two product generations (dyn*AXIS* and dyn*AXIS* 3). Both of them work according to the same shadowing principle.



Analog Technology

- Working principle of an analog position detector with proportionate shadowing of different photo diodes.

intelli*SCAN* III Scan Heads

intelli*SCAN*III scan heads take advantage of dyn*AXIS* 3 galvanometer scanners.

Among them, the lighting of the position detector was optimized.

With the following benefits:

- Highest dynamic performance
- Low drift values
- Very good linearity.

Scan Heads with Digital Encoders

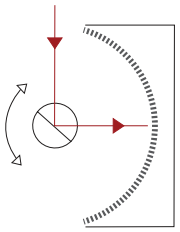
intelli$SCAN_{de}$ and intelli$SCAN_{se}$

Digital encoder technology

The scan heads with digital encoder technology achieve superior positioning accuracy and long-term stability thus they are especially suited for high-end applications.

Compared to analog position detectors, they are characterized by:

- Highest precision due to the PD signal's low noise (lowest dither values)
- Very high long-term stability and Linearity
- Ideal for applications that demand highest throughput and precision
- SL2-100 interface supports 20-bit resolution with a SCANLAB RTC5/RTC6 control board
- Ensures highest processing accuracy thanks to excellent noise immunity

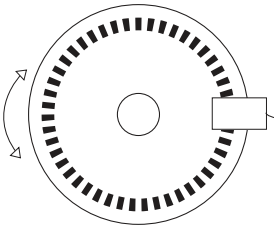


se-encoder Technology

- Interferometric principle of operation
- SCANLAB patented technology employs a "light pointer encoder" with reduced inertia mirror at rotor end

intelli$SCAN_{se}$ scan heads

- The dyn$AXIS_{se}$ galvanometer scanners used here deliver superlative precision
- Best quality with a very good price/ performance ratio
- Fastest scan head with 10-mm aperture and digital encoder



de-encoder Technology

- Galvanometer scanners based on digital encoder disk with radial graduated scale

intelli$SCAN_{de}$ scan heads

- Very low dither and lowest drift values with highest linearity
- Industrial proven digital encoder technology

Principle

Tuning refers to a scan system's dynamics configuration. It's a fine adjustment of the digital servo control that determines the scan system's dynamic reactions while driven with a scan pattern.

Digital systems with i*DRIVE* technology – such as the intelli*SCAN* – can store up to three tunings in memory. Switching between those tunings is possible even during marking.

Always the ideal tuning

Special tunings can optimize scan systems to meet diverse requirements, such as for vectors, jumps or micro-machining.

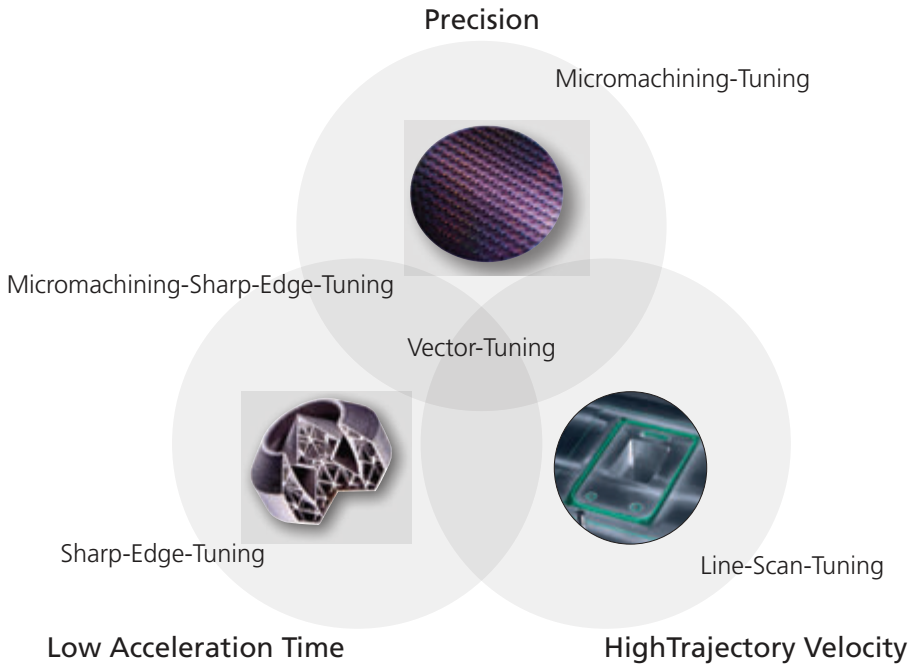
Application-specific tunings bring increased speed and positioning accuracy. The digitally implemented output stages reduce heat generation, leading to improved temperature stability.

What kinds of tunings are available?

Most tunings are characterized by tracking error and maximum speed.

Low tracking error facilitates spatially-small/intricate marking, but accompanied by limited maximum speed. In contrast, elevating speed will also increase tracking error.

Jump tuning is a special case where jump times are minimized for long jumps, resulting in complete elimination of constant tracking error. Jump tuning is particularly well-suited for drilling applications.

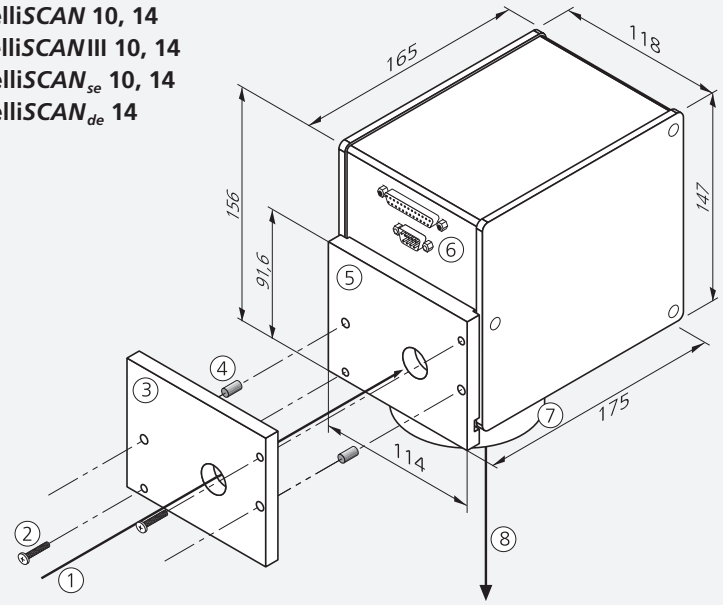


Overview of selected tunings

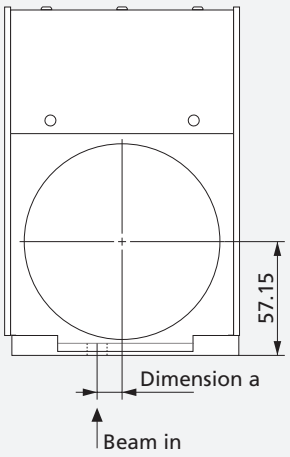
Some tunings aren't available for every aperture and variant!

Tuning	Optimized for	Application
Fast vector tuning	balanced optimum of all parameters in a wide range of applications	vector marking
Step tuning	minimal step response time	drilling, perforating
Sharp edge tuning	low acceleration time, small edge rounding	micro structures
Micromachining tuning	low dither, low line waviness	vector marking, micro structures
Micromachining-sharp edge tuning	low acceleration time, low dither	micro structures
Line scan tuning	highest marking speed (limitation: higher acceleration time)	ultrashort pulse laser processing

intelli*SCAN* 10, 14
intelli*SCAN*III 10, 14
intelli*SCAN*$_{se}$ 10, 14
intelli*SCAN*$_{de}$ 14

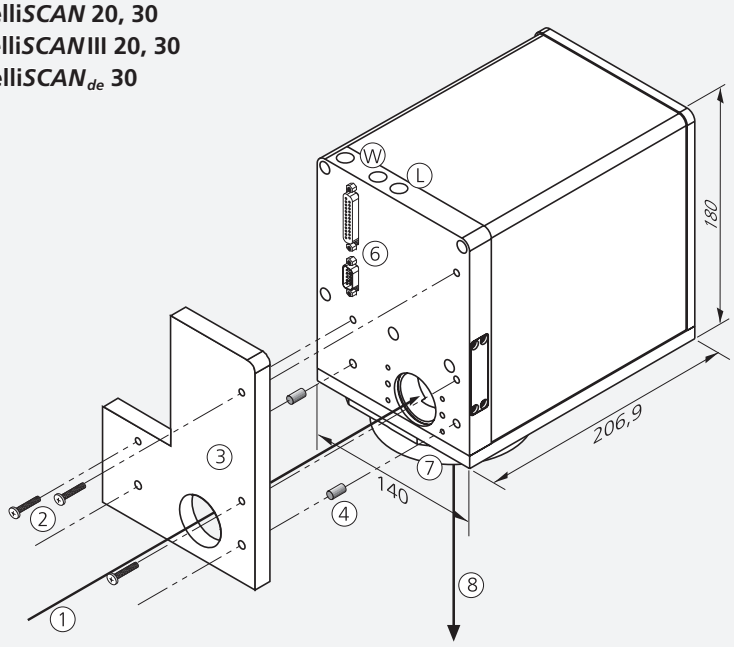


Beam exit side

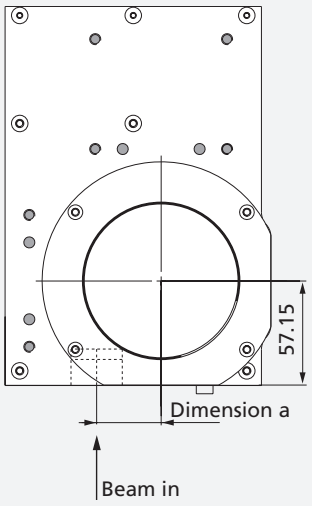


Denoted dimensions refer to the **standard housing type** (with standard mounting bracket). Variations in size and form are possible; also housings with water cooling have other dimensions.

intelli*SCAN* 20, 30
intelli*SCAN*III 20, 30
intelli*SCAN*$_{de}$ 30



Beam exit side



Legend

1 Beam in
2 Screws (M6 threads) *
3 Flange *
4 Alignment pins (6_{h6}) *
(* not included)
5 Mounting bracket
6 Electrical connectors
7 Objective
8 Beam out
A Connection for cooling air
W Connections for cooling water

all dimensions in mm

Dimensions

Aperture	10 mm	14 mm	20 mm	30 mm
Beam displacement (dimension a)	12.56 mm	16.42 mm	25.25 mm	35.53 mm
Weight	approx. 3 kg	approx. 3 kg	approx. 5.8 kg	approx. 5.8 kg

Specifications

Dynamics (for selected tunings)

	intelli*SCAN* 10	**intelli*SCAN* 14**	**intelli*SCAN* 20**	**intelli*SCAN* 30**
Product line	intelli*SCAN* intelli*SCAN* III intelli$SCAN_{se}$	intelli*SCAN* intelli*SCAN* III intelli$SCAN_{se}$ intelli$SCAN_{de}$	intelli*SCAN* intelli*SCAN* III intelli$SCAN_{de}$	intelli*SCAN* intelli*SCAN* III intelli$SCAN_{de}$
Aperture [mm]	10	14	20	30
Tuning	Fast Vector	Sharp Edge	Fast Vector	Fast Vector
Tracking error [ms]	0.11	0.15	0.32	0.55
Typical speeds [1]				
Marking speed [m/s]	3.5	2.0	1.0	0.7
Positioning speed [m/s]	12.0	5.0	11.0	9.0
Writing speed [cps]				
good writing quality [cps]	1080	680	340	220
high writing quality [cps]	760	480	230	150
Step response time [2]				
1 % of full scale [ms]	0.40	0.45	0.70	1.1
10% of full scale [ms]	1.1	3.0	1.9	2.5

(all angles are in optical degrees)

[1] with F-Theta objective, f = 160 mm [2] settling to 1/1000 of full scale

Precision & Stability (tuning dependent)

	intelli*SCAN*	**intelli*SCAN* III**	**intelli$SCAN_{de}$**	**intelli$SCAN_{se}$**
Repeatability (RMS) [µrad]	< 2	< 2	< 0.4	< 0.4
Positioning resolution [bit] [3]	18	18	20	20
Nonlinearity	< 3.5 mrad/44°	< 0.9 mrad / 44°	< 0.5 mrad/44°	< 0.5 mrad/44°
Temperature drift				
Offset [µrad/K]		< 15 [5]	< 15	< 15
Gain [ppm/K]		< 25 [5]	< 8	< 8
Long-term drift				
8-h-drift (after 30 min warm-up) [4]	< 0.6 mrad			
Offset [µrad]		< 100	< 20	< 20
Gain [ppm]		< 100	< 20	< 20
24-h-drift (after 3 h warm-up) [4]				
Offset [µrad]		< 100	< 20	< 20
Gain [ppm]		< 100	< 25	< 25
Dither (position noise, RMS) [µrad]	< 5 [6]	< 5 [6]	< 1.6	< 2.0 [7]

[3] based on the full angle range (e.g. positioning resolution 2.8 µrad for angle range ±0,36 rad), resolutions better than 16 bit (11 µrad) only together with SL2-100 interface [4] at constant ambient temperature and load; achievable even under varying load when equipped with temperature-controlled water cooling [5] for intelli*SCAN* III 20 und 30: T-Offset < 20 µrad/K and T-Gain < 15 µrad/K [6] for micromachining tuning [7] intelli$SCAN_{se}$ 14: 1.6

SCANcalc App

Google Play App Store

Common Specifications

Optical performance	
Typical scan angle [rad]	±0.35
Gain error [mrad]	< 5
Zero offset [mrad]	< 5
Power requirements	
intelli*SCAN*, intelli*SCAN* III	30 V DC, max. 3 A [8] or 48 V DC, max. 3 A [8]
intelli$SCAN_{de}$	30 V DC, max. 6 A or 48 V DC, max. 6 A [9]
intelli$SCAN_{se}$	30 V DC, max. 3 A
Interface	SL2-100, XY2-100 Enhanced
Operating temperature [°C]	25 ± 10

[8] max. 6 A for intelli*SCAN* 20, 30, [9] max. 3 A for intelli$SCAN_{de}$ 14;

06/2017 Information is subject to change without notice.
Product photos are non-binding and may show customized features.
Application picture: iStock.com/Viper161288;
Tuning pictures: Sharp-Edge: eos GmbH, Line-Scan: Trumpf GmbH + Co. KG

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SCANLAB innovators for industry

universal and compatible

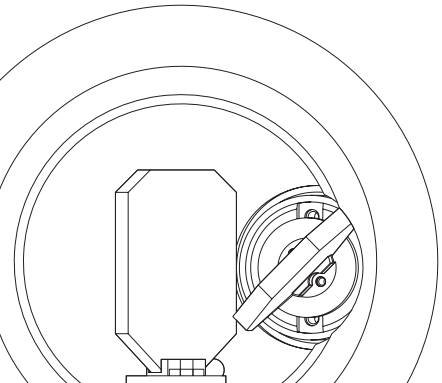
These compact **scan heads** from SCANLAB provide optimal solutions for nearly all challenges found in industrial laser materials processing. The mechanically and electrically inter-compatible scan heads have apertures ranging from 7 to 30 mm and various levels of dynamics. High long-term stability and low drift values are ensured via integrated temperature stabilization.

SCANLAB has products for practically every customer need. Small-aperture systems optimally combine top speed and exceptional precision. Marking speeds exceeding 1000 characters per second can be achieved.

Also available are large-aperture scan heads offering small spot size, high speed and laser-power handling up to the multi-kilowatt range.

The housing concept as well as tight manufacturing and assembly tolerances bring high flexibility and certainty to the design and operation of laser materials processing systems. This also facilitates speedy adaptation to individual customer requirements.

hurry*SCAN* III scan heads take advantage of the new dyn*AXIS* 3 series galvanometer scanners. In conjunction with new electronics, these galvos deliver highest dynamic performance, lowest drift and best linearity.



Typical Applications:

- Materials processing
- Marking
- Microstructuring
- Rapid manufacturing
- 3D applications
- Processing-on-the-fly

SCANLAB
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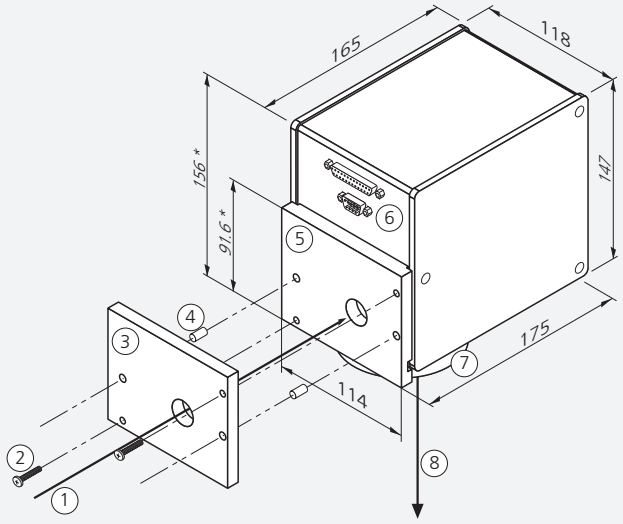


Denoted dimensions refer to the **standard housing** type with 10 mm aperture.
Variations in height and depth of the housing are possible; also housings with water cooling have other dimensions.

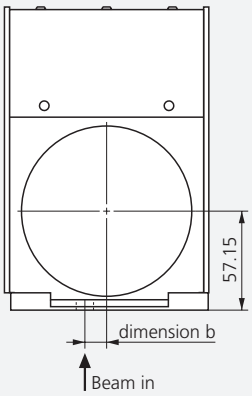
Legend

1 Beam in
2 Screws (M6 thread) (#)
3 Flange (#)
4 Alignment pins (6_{h6}) (#)
5 Mounting bracket
6 Connectors
7 Objective
8 Beam out

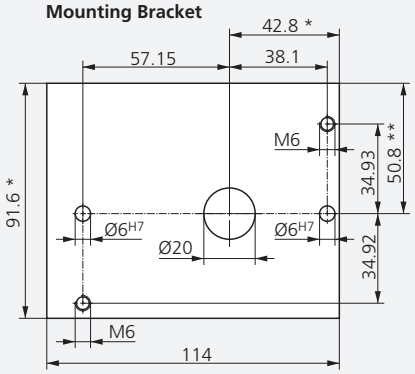
(#) not included

all dimensiions in mm

Beam Exit Side with Beam Displacement



Mounting Bracket



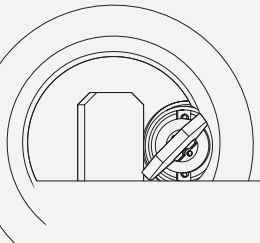
Standard mounting bracket (10 mm aperture): rectangular, without cut-out

* The hurry*SCAN* II 7's mounting bracket is higher (101.6 mm instead of 91.6 mm) and the bore holes are horizontally displaced (45.3 mm instead of 42.8 mm).

** True for 10 mm aperture scan heads, for hurry*SCAN* II 14 and hurry*SCAN* III 14 the dimension is 50.1 mm.

Dimensions

Aperture	7 mm	10 mm	14 mm
Beam displacement (dimension b)	9.98 mm	12.56 mm	16.42 mm



Optics

Scan mirrors and objectives with optimized mounts are available for all typical laser types and working fields.

To optimally utilize standard objectives, the hurry*SCAN* 25's two scan axes have differing maximum scan angles. This results in an elliptical image field with the larger semi-axis perpendicular to the entrance beam axis.

Control

All scan heads of these series are equipped with either analog or digital standard interfaces and are easily controlled via SCANLAB's RTC control boards. All scan heads are optionally available with an optical fiber data interface.

Attachment Provisions

Threaded and non-threaded holes at the housing's beam entrance side of hurry*SCAN* 20, 25 and 30 facilitate mounting of the scan head and installation of fiber optic outputs.

On the beam exit side, threaded holes are available for attaching add-on components such as cross jets, illumination, distance sensors or thermal shields.

Cooling

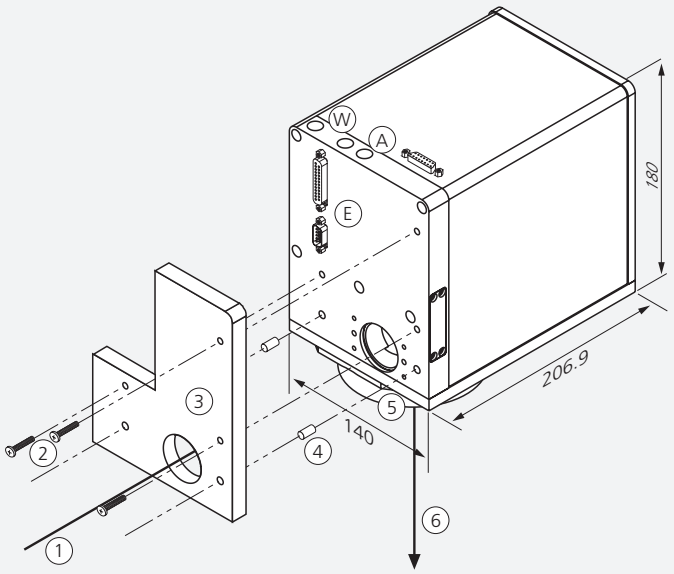
The hurry*SCAN* 20, 25 and 30 scan heads provide water-cooling connections for the entrance aperture, electronics and galvanometer scanners, along with air-cooling of the deflection mirrors. This ensures constant working conditions and excellent long-term stability, thus guaranteeing reliable operation even in high-laser-power applications.

Options

- varioSCAN: upgrade to a 3-axis scan system (hurry*SCAN* 20, 25 and 30 also with vario*SCAN* 40_{FLEX})
- Additional reference sensor system (ASC) for automatic self-calibration (10 mm apertures and higher; not needed with hurry*SCAN* III)
- High-performance variants with light-weight mirrors (14 mm apertures and higher)
- Available as a scan module without housing (except hurry*SCAN* 30)
- Water and air cooling (10 mm apertures and higher; standard for hurry*SCAN*20, 25 and 30)
- Camera adapter for optical process monitoring

Quality

The high quality of SCANLAB's scan heads is the result of years of experience in the development and manufacture of galvanometer scanners and scan systems. In addition, every scan system must first pass the *SCAN*check burn-in test before it is released for shipment to the customer.



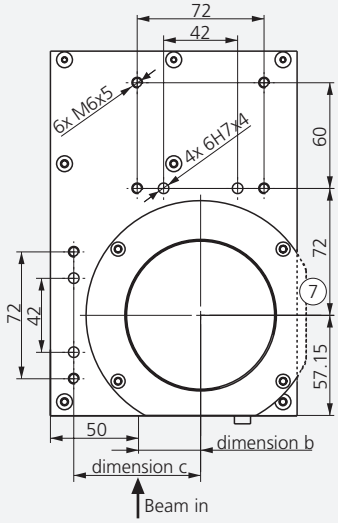
Legend

1 Beam in
2 Mounting screws (M6 threads) (#)
3 Flange (#)
4 Alignment pins (6_{h6}) (#)
5 Objective
6 Beam out
7 Wider construction (drawn dashed) only for hurry*SCAN* 30
E Electrical connectors
A Connection for cooling air
W Connections for cooling water

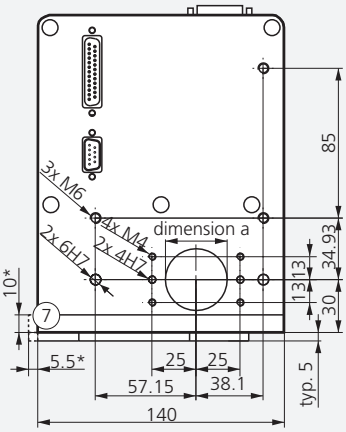
(#) not included

all dimensions in mm

Beam exit side with beam displacement



Beam entrance side



Dimensions	hurry*SCAN* 20	hurry*SCAN* 25	hurry*SCAN* 30
Aperture (dimension a)	20 mm	25 mm	30 mm
Beam displacement (dimension b)	25.25 mm	29.88 mm	35.53 mm
Dimension c	67.25 mm	72.00 mm	72.00 mm

Type-Dependent Specifications

	hurry*SCAN* III 10	hurry*SCAN* III 14
Aperture	10 mm	14 mm
Tracking error	0.12 ms	0.18 ms
Step response time [1]		
1% of full scale	0.35 ms	0.35 ms
10% of full scale	1.7 ms	1.2 ms
Typical speeds [2]		
Marking speed	3.0 m/s	2.0 m/s
Positioning speed	12 m/s	12 m/s
Writing speed		
Good writing quality	1000 cps	660 cps
High writing quality	700 cps	410 cps
Long-term drift		
8-h-drift (after 30 min warm-up) [3]		
Offset	< 100 µrad	< 100 µrad
Gain	< 100 ppm	< 100 ppm
24-h-drift (after 3 h warm-up) [3]		
Offset	< 100 µrad	< 100 µrad
Gain	< 100 ppm	< 100 ppm
Temperature drift		
Offset	< 15 µrad/K	< 15 µrad/K
Gain	< 25 ppm/K	< 25 ppm/K
Optical performance		
Typical scan angle of scanner 1	±0.35 rad	±0.35 rad
Typical scan angle of scanner 2	±0.35 rad	±0.35 rad
Typical field size – square [2], [4]	110 x 110 mm²	90 x 90 mm²
Nonlinearity	< 0.9 mrad / 44°	< 0.9 mrad / 44°
Weight (without objective)	approx. 3 kg [5]	approx. 3 kg [5]

(all angles are in optical degrees)

Common Specifications

Repeatability (RMS)	< 2 µrad
Positioning resolution	18 bit [8]
Optical performance	
Gain error	< 5 mrad
Zero offset	< 5 mrad
Skew	< 1,5 mrad
Power requirements	±(15+1.5) V DC, max. 3 A (max. 6 A for hurry*SCAN*20-30)
Input signals	
Digital version	SL2-100, XY2-100 Standard or optical data transfer
Analog version	alternatively: ±4.8 V; ±9.6 V; ±4.8 mA; ±9.6 mA
Output signals	3 status signals per axis
Digital version	SL2-100, XY2-100 Standard or optical data transfer
Analog version	TTL level
Operating temperature	25 °C ± 10 °C
Typical air requirements [9]	clean, filtered air 20 l/min at Δp < 2 bar
Typical water requirements [9]	5 l/min at Δp < 0.1 bar, p < 4 bar

(all angles are in optical degrees)

[8] based on the full angle range (e.g. positioning resolution 2.8 µrad for angle range ±0.36 rad), resolutions better than 16 bit (11 µrad) only together with SL2-100 interface

[9] air and water cooling optional for hurry*SCAN* III 10 and 14, hurry*SCAN II* 7-14 and hurry*SCAN* 10

Type-Dependent Specifications

	hurry*SCAN II*			hurry*SCAN*			
Aperture	7 mm	10 mm	14 mm	10 mm	20 mm	25 mm	30 mm
Tracking error	0.11 ms	0.12 ms	0.24 ms	0.18 ms	0.35 ms	0.50 ms	0.55 ms
Step response time [1]							
1% of full scale	0.23 ms	0.35 ms	0.40 ms	0.35 ms	0.80 ms	0.90 ms	1.20 ms
10% of full scale	-	1.70 ms	1.60 ms	0.90 ms	2.50 ms	3.20 ms	4.50 ms
Typical speeds [2]							
Marking speed	3.5 m/s	3.0 m/s	1.5 m/s	2.0 m/s	1.0 m/s	0.8 m/s	0.7 m/s
Positioning speed	15.0 m/s	12.0 m/s	7.0 m/s	7.0 m/s	6.0 m/s	5.0 m/s	3.0 m/s
Writing speed							
Good writing quality	1100 cps	1000 cps	500 cps	640 cps	320 cps	260 cps	220 cps
High writing quality	800 cps	700 cps	340 cps	400 cps	210 cps	170 cps	150 cps
Long-term drift (8-h-drift)	< 0.3 mrad [6]	< 0.6 mrad [7]	< 0.6 mrad [7]	< 0.6 mrad [7]	< 0.6 mrad [7]	< 0.6 mrad [7]	< 0.6 mrad [7]
Optical performance							
Typical scan angle of scanner 1	±0.35 rad	±0.35 rad	±0.35 rad	±0.35 rad	±0.35 rad	±0.26 rad	±0.35 rad
Typical scan angle of scanner 2	±0.35 rad	±0.35 rad	±0.35 rad	±0.35 rad	±0.35 rad	±0.40 rad	±0.35 rad
Typical field size – ellipse [2], [4]	-	-	-	-	-	80 x 130 mm²	-
Typical field size – square [2], [4]	110 x 110 mm²	110 x 110 mm²	90 x 90 mm²	110 x 110 mm²	90 x 90 mm²	75 x 75 mm²	50 x 50 mm²
Nonlinearity	< 3.5 mrad / 44°	< 3.5 mrad / 44°	< 3.5 mrad / 44°	< 3.5 mrad / 44°	< 3.5 mrad / 44°	< 3.5 mrad / 44°	< 3.5 mrad / 44°
Weight (without objective)	approx. 3 kg [5]	approx. 3 kg [5]	approx. 3 kg [5]	approx. 3 kg [5]	approx. 5.8 kg	approx. 5.8 kg	approx. 5.8 kg

(all angles are in optical degrees)

[1] settling to 1/1000 of full scale
[2] with F-Theta objective, f = 160 mm respectively f = 163 mm (hurry*SCAN* 20-30)
[3] at constant ambient temperature and load, without water cooling; achievable even under varying load when equipped with temperature-controlled water cooling
[4] limited by vignetting at objective
[5] with optional water cooling up to 4.7 kg
[6] at constant ambient conditions, plus offset drift < 30 µrad/K and gain drift < 100 ppm/K
[7] after warm-up

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SCANLAB innovators for industry

high speed scanning in pocket size

SCANLAB's *SCAN*cube series of **scan heads** are characterized by their remarkably compact construction. These **2D scan systems** enable deflecting and positioning of laser beams in the working plane.

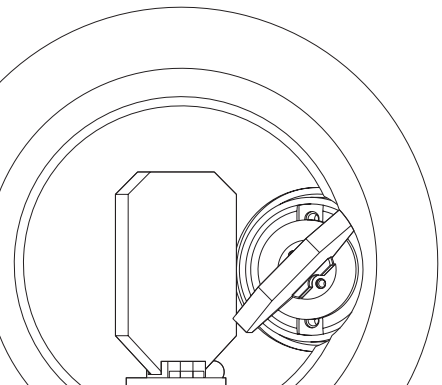
In addition to its robust housing, the SCANcube series offers an attractive price/performance ratio, making it the best choice for your standard applications.

Key Features

- Compact & lightweight design
- Robust, sealed housing
- High dynamic performance
- Large selection of mirror coatings

Typical Applications

- Marking tasks
- Semiconductor-industry materials processing
- Microstructuring
- Processing-on-the-fly



SCANLAB
innovators for industry

Features of the *SCAN*cube und *SCAN*cube III Product Lines

Summary

The *SCAN*cube product line is optimized for the demands of typical marking applications.

*SCAN*cube III scan heads address marking tasks that prioritize faster write speeds and far higher precision, along with long-term stability.

Shared Characteristics

- Full electrical compatibility
- Full mechanical compatibility
- Design optimized for labeling and marking in industrial environments

*SCAN*cube III Performance Enhancements

Boosts in:

- Scan speed: up to 100%
- Dynamic performance: up to 50%

Reductions in:

- Long-term drift: more than 50%
- Temperature drift: more than 40%
- Heat generation: more than 50%

Options & Variants

Extensions

- vario*SCAN*: Extension into a 3-axis scan system
- Camera adapter: Optical process monitoring

Mirrors

- Over 40 standard coatings for various wavelengths
- Maximum average powers up to 250 W for standard systems

Objectives

- Standard range of over 330 objectives available for the SCANcube series from leading manufacturers to achieve various image fields and focal lengths
- Matching mechanical objective mount on scan head, optimized to take occurring back reflections into account
- Objective-specific correction files

Control boards

- RTC4 (PCIe, Ethernet) or RTC5

Software

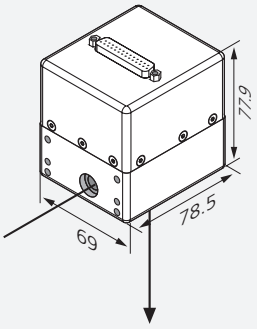
- *SCAN*align: software for automatic and exact placement of laser beams; process integratable high-precision calibration solution
- laserDESK: Professional software for laser marking and laser processing of materials
- correXion pro: System-specific customizing of correction files

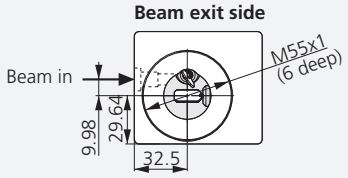
Laser Engraving

Marking

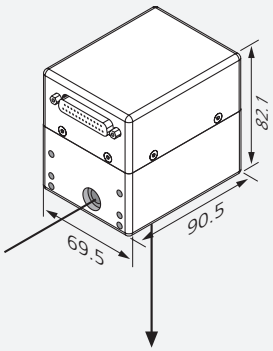
Day & Night Design

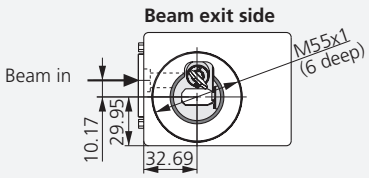
*SCAN*cube 7



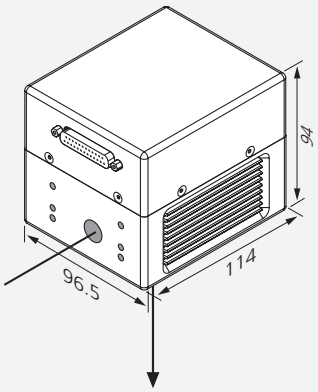


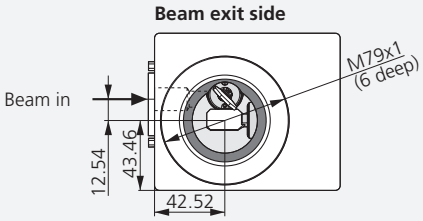
*SCAN*cube 8.5



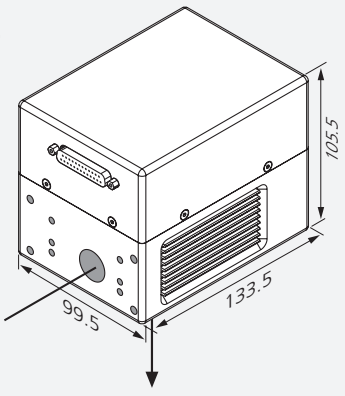


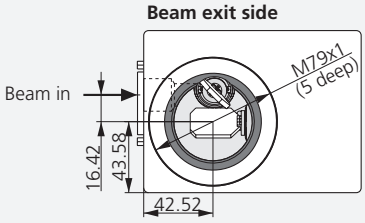
*SCAN*cube 10
*SCAN*cube III 10





*SCAN*cube 14
*SCAN*cube III 14





	*SCAN*cube		*SCAN*cube, *SCAN*cube III	
Aperture	7 mm	8,5 mm	10 mm	14 mm
Beam displacement	9,98 mm	10,17 mm	12,54 mm	16,42 mm
Weight	650 g	1 kg	1,9 kg	2,3 kg

all dimensions in mm

Specifications

Dynamics

	***SCAN*cube 7**	***SCAN*cube 8.5**	***SCAN*cube 10**		***SCAN*cube 14**	
Product line	*SCAN*cube	*SCAN*cube	*SCAN*cube	*SCAN*cube III	*SCAN*cube	*SCAN*cube III
Aperture [mm]	7	8.5	10	10	14	14
Tracking error [ms]	0.14	0.14	0.16	0.12	0.30	0.15
Typical speeds [1]						
Marking speed [m/s]	2.5	2.5	2.0	3.0	1.0	2.0
Positioning speed [m/s]	15.0	15.0	10.0	16.0	7.0	14.0
Writing speed [cps] [2]						
good writing quality [cps]	900	900	640	925	410	740
high writing quality [cps]	600	600	400	700	280	500
Step response time [3]						
1 % of full scale [ms]	0.25	0.30	0.40	0.30	0.65	0.35
10% of full scale [ms]	0.70	0.70	1.2	0.80	1.6	0.90

[1] with F-Theta objective, f = 160 mm
[2] single-stroke characters of 1 mm height
[3] settling to 1/1000 of full scale

Precision & Stability

	***SCAN*cube**	***SCAN*cube III**
Repeatability (RMS) [µrad]	< 2	< 2
Positioning resolution [bit] [4]	16	16
Nonlinearity	< 3.5 mrad/44°	< 0.9 mrad / 44°
Temperature drift		
Offset [µrad/K]	< 30	< 25
Gain [ppm/K]	< 80	< 25
Long-term drift		
8-h-drift (after 30 min warm-up) [5]	< 0.3 mrad [6]	
Offset [µrad]		< 100
Gain [ppm]		< 100

[4] based on the full angle range (e.g. positioning resolution 11 µrad for angle range ±0,36 rad)
[5] at constant ambient temperature and load
[6] plus temperature-includet Gain and Offset drift

SCANcalc App

Google Play App Store

Common Specifications

	***SCAN*cube Serie**
Optical performance	
Typical scan angle [rad]	±0.35
Gain error [mrad]	< 5
Zero offset [mrad]	< 5
Power requirements	±15 V DC, max. 3 A each
Interface	
digital version	SL2-100 or XY2-100
analog version	±4.8 V
Operating temperature [°C]	25 ± 10

(all angles are in optical degrees)

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SCANLAB innovators for industry

compact and economic

SCANLAB's basiCube **scan heads** are the ideal entry-level **2D scan systems** for deflecting and positioning laser beams in the working plane.

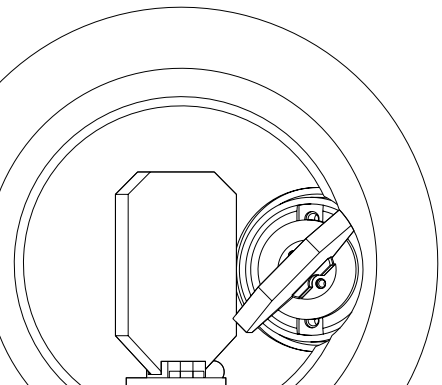
The basiCube scan head series offers superior cost effectiveness and is optimized for coding and marking.

Key Features

- Compact & light-weight design
- Very fast writing speed
- Excellent price/performance ratio

Typical Applications

- Marking
- Processing-on-the-fly



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innovators for industry

Specifications

Dynamics

	basiCube 10
Aperture [mm]	10
Tracking error [ms]	0.14
Typical speeds [1]	
Marking speed [m/s]	2.5
Positioning speed [m/s]	12.0
Writing speed [2]	
Good writing quality [cps]	800
High writing quality [cps]	570
Step response time [3]	
1% of full scale [ms]	0.35
10% of full scale [ms]	1.0

[1] with F-Theta objective, f = 160 mm
[2] single-stroke characters of 1 mm heigth
[3] settling to 1/1000 of full scale

Precision & Stability

	basiCube
Repeatability (RMS) [µrad]	< 2.0
Positioning resolution [Bit] [4]	16
Nonlinearity	< 3.5 mrad/44° [6]
Temperature drift	
Offset [µrad/K]	< 30
Gain [ppm/K]	< 160
Long-term drift	
8-h-drift (after 30 min warm-up) [5]	
Offset [µrad]	< 100
Gain [ppm]	< 250

[4] based on the full angle range (e.g. positioning resolution 11 µrad for angle range ±0.36 rad)
[5] at constant ambient temperature and load
[6] 44° = 0.768 rad

Further Specifications

	basiCube
Optical performance	
Typical scan angle [rad]	±0.35
Gain error [mrad]	< 5
Zero offset [mrad]	< 5
Power requirements	±15 V DC, max. 3 A each
Interface (digital)	SL2-100, XY2-100
Operating temperature [°C]	25 ± 10

(all angles are in optical degrees)

Options & Variants

Extensions

- vario*SCAN*: Extension into a 3-axis scan system

Optics

- Coatings for the following wavelengths: 355 nm, 532 nm, 1064 nm, 10600 nm
- Suitable objectives available for various image fields and focal lengths

Control Boards

- RTC4 (PCIe, Ethernet) and RTC5

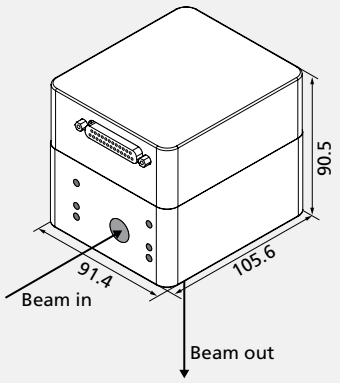
Software

- correXion pro: System-specific customizing of correction files
- Flexible calibration solutions: correXion pro, CALsheet

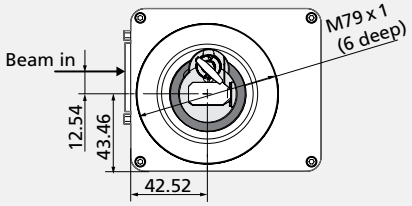
SCANcalc App
Google Play App Store

Housing

Diagonal View



Beam exit side



	basiCube 10
Aperture	10 mm
Beam displacement	12.54 mm
Weight	1.5 kg

all dimensions in mm

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SCANLAB innovators for industry

the new premium scanning standard

excelli*SCAN* **scan heads** set new standards for the most demanding laser scanning requirements. As SCANLAB **2D scan systems**, they enable deflecting and positioning of laser beams in the working plane.

Its groundbreaking *SCAN*ahead control technology attain previously unreachable dynamic performance and precision. This translates to enormous gains in productivity and process accuracy.

*SCAN*ahead control

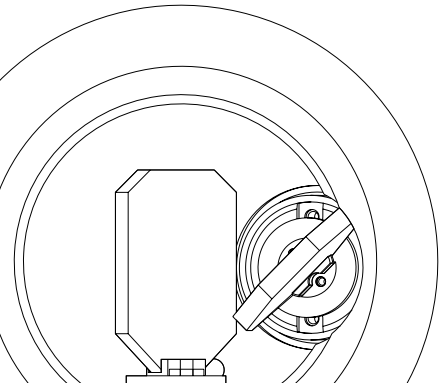
- Full utilization of scanner dynamics for higher throughput
- No unwanted necking effects when rapidly processing circles
- Universal tuning optimized for all applications

dyn*AXIS*$_{se}$ digital-encoder galvanometers

- Maximum linearity and minimum position noise ensure highest positioning accuracy
- High long-term stability even with ambient temperature fluctuations and 24/7-operation

Housing innovations

- Enhanced thermal management for higher load resilience
- Variant with active air cooling available for applications that don't allow water as a coolant
- Increased tightness (IP56) and robustness



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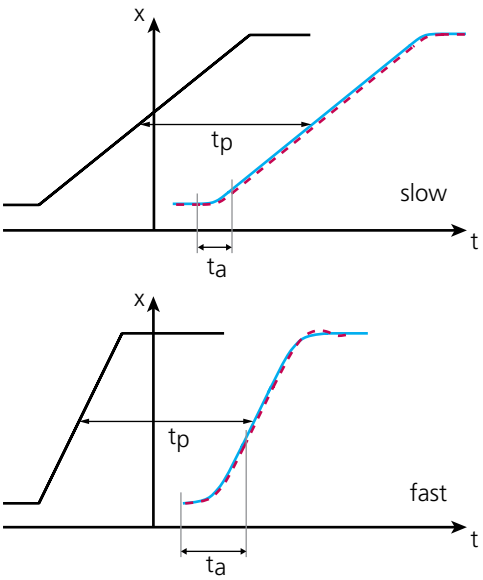
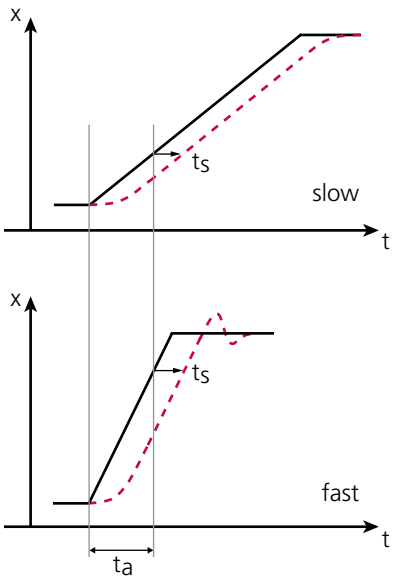
*SCAN*ahead control

*SCAN*ahead principle of operation



Conventional control



***SCAN*ahead control** allows excelli*SCAN* to deliver **full acceleration** even at slow scan speeds (i.e. with minimum acceleration duration t_a). Pre-computed set-point trajectories make this possible. Computation occurs in real time, offset by the look-ahead time t_p, prior to actual execution.

Limiting trajectory acceleration to the scanner axes' full acceleration produces a set-point trajectory (blue curve) that the *SCAN*ahead control can track without tracking error (red curve). Thus, the galvos' dynamic performance potential is optimally utilized.

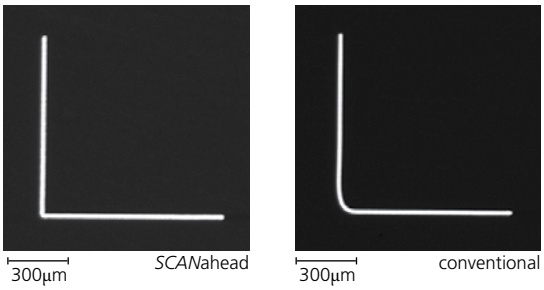
In contrast, **conventional** control is afflicted with a constant tracking error t_s, independent of scan speed. Likewise constant is the acceleration duration t_a until reaching the intended scan speed.

The higher the maximum speed, the higher the tracking error and longer the acceleration duration. As maximum speed goes up, the scan axes' acceleration potential gets decreasingly utilized at low scan speeds.

Application Benefits

Enhanced accuracy

Corner
v=1m/s:

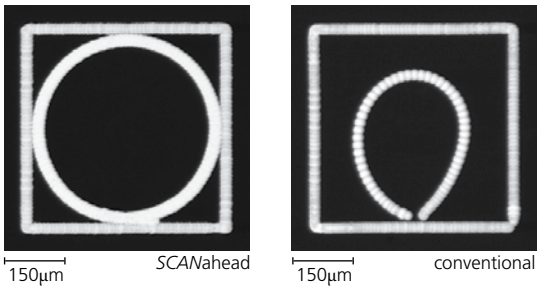


*SCAN*ahead control fully exploits the galvos' dynamic performance potential. Hence traversal of 90° corners at a wide range of speeds produces far less corner-rounding. Additionally, *SCAN*ahead allows faster traversal of corners having identical radii.

In contrast, traditional control with tracking error may cause substantial corner rounding – speed-dependent and if no delays were implemented.

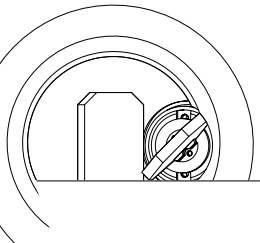
Fast and precise circle processing

Circle
v=2,8m/s:



*SCAN*ahead control ensures precise traversal of the defined set circle even at high circle speeds. This substantially simplifies correct processing of circles and boosts productivity thanks to increased trajectory velocities.

In contrast, tracking errors of traditional scanner control produce a necking effect during high-speed circle traversal. The control effectively behaves as a low-pass filter that attenuates control-signal amplitudes at high circle frequencies.



	*SCAN*ahead control	Conventional control
Dynamics	• Scanner axis acceleration always at maximum: acceleration time is minimized.	• Acceleration time is constant at all scan speeds: acceleration potential isn't fully utilized.
Processing circles, arcs	• Necking effects avoided.	• Necking effects (caused by tracking error) need to be offset by adjusting circle diameters.
Tracking error	• Concept fundamentally eliminates it. • Precise image field correction even at high speeds • Only **one** tuning needed. Optimum performance across all applications. • A uniform look-ahead time t_p is used to determine the navigable trajectory.	• Finite, constant value • Limits precision of image field correction at high speeds • Optimized typically for a single application. Digital scan systems allow a variety of tunings.
Use of delays	• Auto-delay eliminates the need to set delays for high-quality results.	• Need to be set in advance • User must monitor processing results and needs to optimize delay settings iteratively.

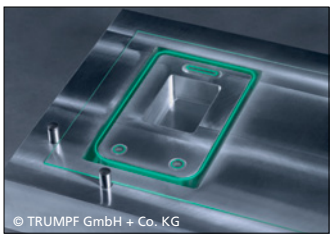
Control via RTC6

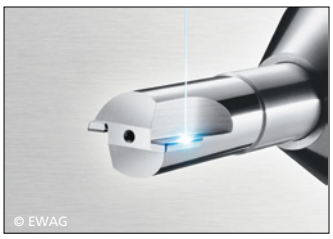
Equipped with expanded memory and a high-performance DSP and FPGA, the new RTC6 enables powerful applications and is ready for future functional extensions.

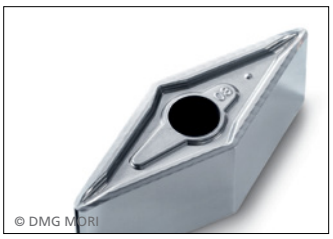
When synchronously controlling the excelli*SCAN* and a laser, the RTC6 board takes into account the *SCAN*ahead control's look-ahead time (used for computing scanner trajectories) so as to optimally utilize dynamic performance and accuracy. The RTC6's auto-delay functionality facilitates simple, fast excelli*SCAN* deployment. This frees users from needing to determine or define laser and scanner delays.

Innovative Housing

- Robust, tight shell construction
- Two cooling variants available:
  - Water cooling for maximum cooling performance
  - Active air cooling with innovative heat-pipe technology for applications that prohibit using water coolant
- Air-cooling connection for mirrors (standard)
- Broad assortment of objectives available, thanks to proven standard interface
- Electrical connections can be positioned at either the beam entrance or opposite to the beam exit side







Specifications

Dynamics

	excelli*SCAN* 14
Aperture [mm]	14
Tuning	universal
Tracking error [ms]	0
Typical speeds [1]	
Positioning, jump & shoot [m/s]	< 30
Line scan / raster scan [m/s]	< 30
Typical vector marking [m/s]	< 4
Good writing quality [cps]	1000
High writing quality [cps]	850
Positioning times [1]	
1 mm jump width [ms]	0.28
10 mm jump width [ms]	0.88
100 mm jump width [ms]	3.70
Acceleration [m/s²]	51 000 [1],[2]

[1] with F-Theta objective, f = 160 mm
[2] this corresponds to an angular acceleration of $3.2 \cdot 10^5$ rad/s²

Precision & Stability

	excelli*SCAN*
Repeatability (RMS) [µrad]	< 0.4
Positioning resolution [bit]	20 [5]
Nonlinearity	< 0.5 mrad / 44°
Long-term drift [3], [4]	
8-h-drift (after 30 min warm-up)	
Offset [µrad]	< 20
Gain [ppm]	< 20
24-h-drift (after 3 h warm-up)	
Offset [µrad]	< 20
Gain [ppm]	< 25
Temperature drift [4]	
Offset [µrad/K]	< 10
Gain [ppm/K]	< 4

[3] at constant ambient temperature and load
[4] with water cooling
[5] based on the full angle range (e.g. positioning resolution 0.7 µrad for angle range ± 0.36 rad)

Further Specifications

	excelli*SCAN*
Optical performance	
Typical scan angle [rad]	±0.35
Gain error [mrad]	< 5
Zero offset [mrad]	< 5
Power requirements	30 V DC, max. 3 A
Interface	SL2-100
Operating temperature [°C]	25 °C ± 10 °C
Weight [kg]	approx. 7

(all angles are in optical degrees)

SCANcalc App

Google Play iTunes

Options & Variants

Housing Variants

- Air and water cooling
- Active air cooling on request (heat-pipe technology)

Extensions

- excelli*SHIFT*: Extension into a high-speed 3-axis scan system
- vario*SCAN*: Extension into a 3-axis scan system
- Camera adapter for process monitoring

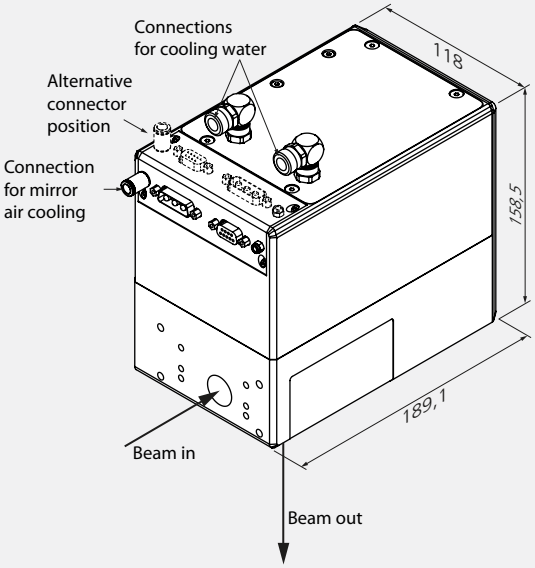
Optics

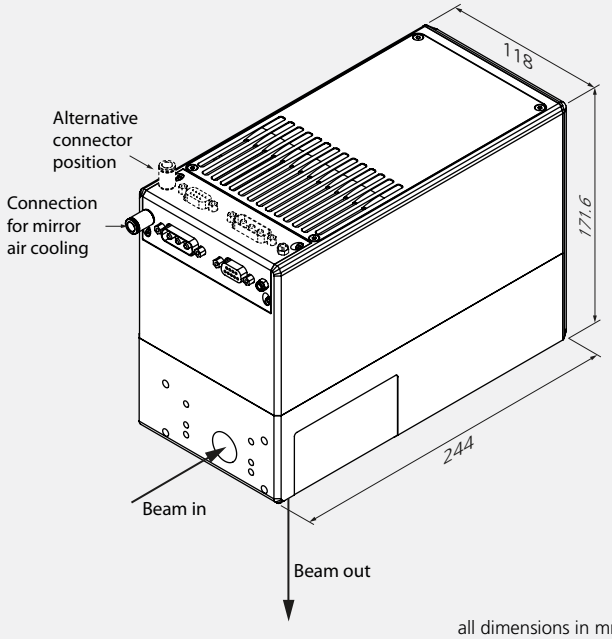
- Coatings for the following wavelengths are currently available: 355 nm, 532 nm and 1064 nm
- Suitable objectives available for various image fields and focal lengths

Control Boards/Software

- RTC6 (PCIe und Ethernet) with SCANahead servo control
- laserDESK: professional software for laser marking and materials processing
- *SCAN*align: software for automatic and exact palcement of the laser beam to a workpiece; process integrable high-precision calibration solution
- Flexible calibration solutions: correXion pro, CALsheet

Housing variants





all dimensions in mm

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SCANLAB innovators for industry

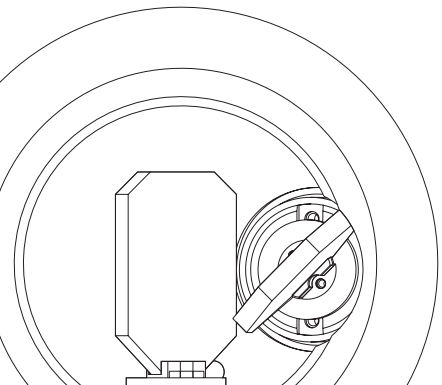
maximum-power laser scanning

The **scan systems** of the power*SCAN* series enable positioning multiple kilowatts of laser power onto a workpiece in just a few milliseconds. In combination with a vario*SCAN*, the laser beam can be dynamically focused within working volumes, thus allowing non-flat workpieces to be processed.

Apertures from 33 mm up to 70 mm allow small spot sizes and therefore high power densities even with large working distances. The XY mirrors and the vario*SCAN*´s optics are air cooled, while the scanners, electronics and vario*SCAN* are water cooled. This ensures reliable operation with excellent long-term stability – even under challenging environmental conditions and with high laser powers.

Each axis of the power*SCAN* 50, 50i, 70 and 70i is individually implemented as a sealed submodule – a calibrated and tuned unit containing a galvanometer scanner with a mirror and the scanner's drive electronics. Thus, rapid replacement of individual axes is ensured. Located in a separate sealed base module, the modularly-designed main electronics provide functions such as a digital interface and a power management system with comprehensive monitoring functions.

The power*SCAN* i-series of scan systems employs the same i*DRIVE* electronic concept used in the success-proven intelli*SCAN*. This brings improved dynamics and advanced querying possibilities. The series includes both the power*SCAN* 50i and power*SCAN* 70i.



Typical Applications:

- Laser processing of materials
- Rapid manufacturing
- 3D applications
- Processing-on-the-fly

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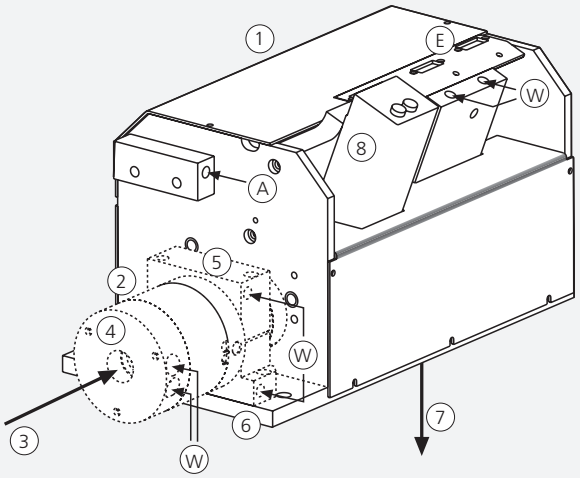
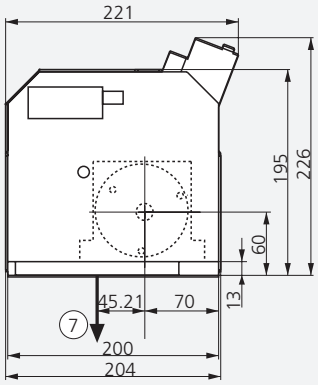


Legend

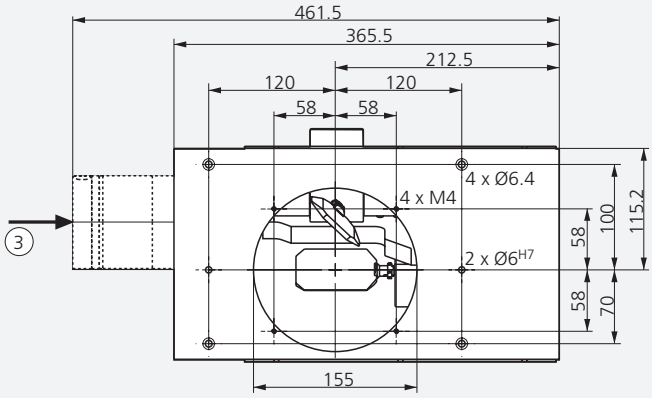
1 power*SCAN* 33
2 vario*SCAN* 40
3 Beam in
4 Entrance aperture (water-cooled)
5 Clamping block (water-cooled)
6 Base plate
7 Beam out
8 Galvanometer scanner
E Electrical connectors
A Connector for cooling air
W Connectors for cooling water

all dimensions in mm

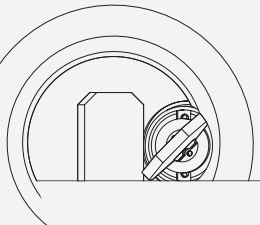
Beam entrance side



Beam exit side



Dimensions	power*SCAN* 33
Aperture	33 mm
Beam displacement	45.21 mm



Optics

SCANLAB precisely optimizes and tunes all optical components to one another to ensure maximum focus quality and stable process parameters.

The power*SCAN* can be equipped with a vario*SCAN* for dynamically focusing the laser beam.

Numerous optical configurations – specially developed for the vario*SCAN* and matched to the power*SCAN* – are available for various wavelengths, laser powers and image fields or working volumes.

Customers can easily self-install these exchangeable vario*SCAN* optics sets to adapt the scan system for their applications.

Control

The power*SCAN* systems can be controlled via a SCANLAB RTC control board. This facilitates straight-forward implementation of applications – even complex ones.

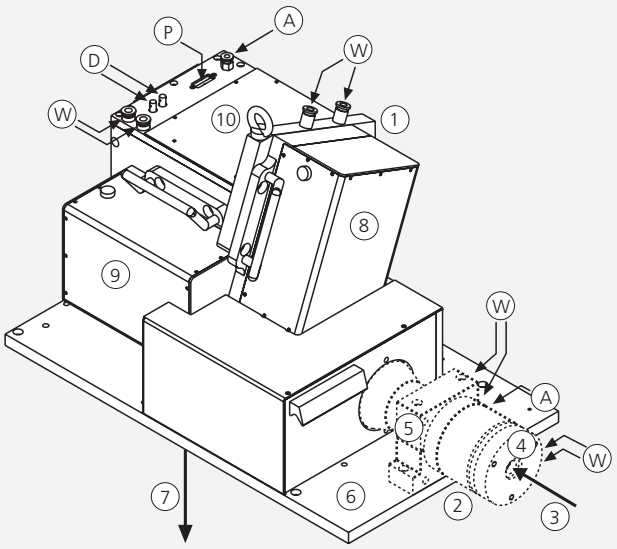
The RTC board automatically performs all required computations, such as micro-vectorization and image field correction, and synchronously controls the power*SCAN*, vario*SCAN* and laser.

Processing-on-the-fly functionality is optionally available.

power*SCAN* 50 and power*SCAN* 70 scan systems may be equipped with interfaces for electrical or optical data transfer. power*SCAN* 50i and power*SCAN* 70i systems are controlled via the SL2-100 interface.

Options

- power*SCAN* systems can be equipped with an additional reference sensor system for automatic self-calibration for applications requiring extremely high long-term stability
- power*SCAN* systems can be equipped with sensors for monitoring the cooling air (standard at power*SCAN* 50, 50i, 70 and 70i)
- Beryllium mirrors are optionally available for maximized dynamic performance (power*SCAN* 33 and 50)
- power*SCAN* 50i and 70i afford all advantages of the i*DRIVE* technology: high flexibility, high dynamic and real-time querying of the actual position and other status data

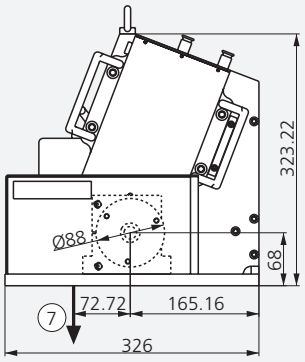


Legend

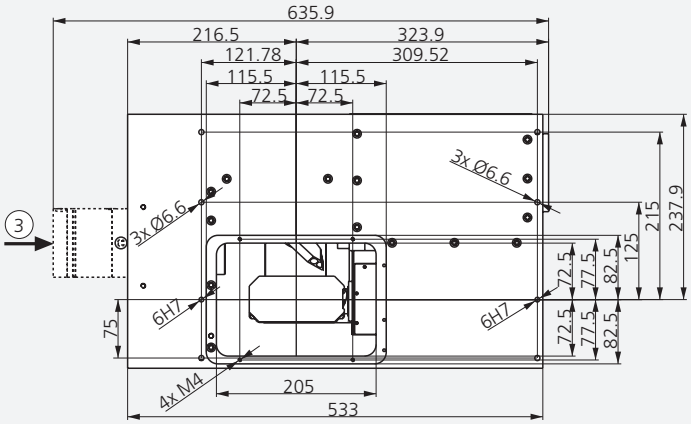
1	power*SCAN* 50
2	vario*SCAN* 60
3	Beam in
4	Entrance aperture (water-cooled)
5	Clamping block (water-cooled)
6	Base plate
7	Beam out
8,9	Submodules
10	Base module with main electronics
D	Fiber connector for optical data transfer
P	Power supply connector
A	Connectors for cooling air
W	Connectors for cooling water

all dimensions in mm

Beam entrance side



Beam exit side



The power*SCAN* 70 and 70i have a larger housing (L/W/H 566mm/360mm/342mm) compared to the pictured power*SCAN* 50 and 50i, but have the same function unit.

Dimensions	**power*SCAN* 50/50i**	**power*SCAN* 70/70i**
Aperture	50 mm	70 mm
Beam displacement	72.72 mm	97.5 mm

Typical Optical Configurations

	powerSCAN 33 with varioSCAN 40			powerSCAN 50/50i with varioSCAN 60/varioSCAN$_{de}$ 60i			
Wavelength	10.6 µm	10.6 µm	10.6 µm	10.6 µm	10.6 µm	10.6 µm	10.6 µm
Max. laser power cw	2000 W	2000 W	2000 W	2000 W	2000 W	2000 W	2000 W
Max. laser power for 50% duty cycle	4000 W	4000 W	4000 W	4000 W	4000 W	4000 W	4000 W
Image field size	(170 x 170) mm²	(500 x 500) mm²	(1.5 x 1.5) m²	(400 x 400) mm²	(600 x 600) mm²	(800 x 800) mm²	(1.0 x 1.0) m²
Typical processing speed	0.8 m/s	2.0 m/s	6.0 m/s	1.3 m/s	2.0 m/s	2.7 m/s	3.2 m/s
Focus range in z direction	±4 mm	±35 mm	±75 mm	±10 mm	±40 mm	±50 mm	±100 mm
Focus diameter (1/e²)	210 µm (M²=1)	450 µm (M²=1)	1.3 mm (M²=1)	250 µm (M²=1)	375 µm (M²=1)	500 µm (M²=1)	600 µm (M²=1)
Beam expansion factor	2.5	2.4	2.2	3.8	3.6	3.5	3.4
Focal length	(414 ± 15) mm	(850 ± 75) mm	(2300 ± 500) mm	(750 ± 50) mm	(1050 ± 90) mm	(1350 ± 150) mm	(1650 ± 250) mm

	powerSCAN 70/70i with varioSCAN 80/varioSCAN$_{de}$ 80i		
Wavelength	10.6 µm	10.6 µm	10.6 µm
Max. laser power cw	2000 W	2000 W	2000 W
Max. laser power for 50% duty cycle	4000 W	4000 W	4000 W
Image field size	(440 x 440) mm²	(1.0 x 1.0) m²	(1.6 x 1.6) m²
Typical processing speed	0.9 m/s	2.0 m/s	3.2 m/s
Focus range in z direction	±10 mm	±75 mm	±200 mm
Focus diameter (1/e²)	220 µm (M²=1)	450 µm (M²=1)	650 µm (M²=1)
Beam expansion factor	4.9	4.5	4.6
Focal length	(860 ± 45) mm	(1680 ± 200) mm	(2440 ± 400) mm

Type-Dependent Specifications
(all angles are in optical degrees)

	powerSCAN 33	powerSCAN 50/50i	powerSCAN 70/70i
Aperture	33 mm	50 mm	70 mm
Beam displacement	45.21 mm	72.72 mm	98.2 mm
Step response time (settling to 1/1000 of full scale)			
1% of full scale	1.3 ms	1.5 ms / 2.0 ms [1]	2.8 ms / 3.5 ms [1]
10% of full scale	4.5 ms		
Typical processing speed	3 rad/s	2.5 rad/s	1.5 rad/s
Typical positioning speed	18 rad/s	15 rad/s / 25 rad/s [1]	12 rad/s / 15 rad/s [1]
Dynamic performance			
Tracking error	0.75 ms	0.9 ms	1.6 ms
Power requirements	±(15+1.5) V DC, max. 4.5 A each	±(24+1.5) V DC, max. 10 A each (20 A peak current)	±(24+1.5) V DC, max. 10 A each (20 A peak current)
Weight (with varioSCAN)	12 kg	33 kg	35 kg
Typical air requirements	clean, filtered air > 1.5 bar	clean, filtered air 1.5 bar to 2.0 bar	clean, filtered air 1.5 bar to 2.0 bar

[1] the higher value applies to the powerSCAN i

Common Specifications
(all angles are in optical degrees)

Dynamic performance	
Repeatability (RMS)	< 4 µrad
Long-term drift over 8 hours (after warm-up)	< 0.6 mrad
Optical performance	
Typical scan angle	±0.35 rad
Gain error	< 5 mrad
Zero offset	< 5 mrad
Skew	< 1.5 mrad
Nonlinearity	< 2.1 mrad / 44°
Input signals	
Analog version (not powerSCAN i)	alternatively: ±4.8 V; ±9.6 V; ±4.8 mA; ±9.6 mA
Digital version	
• powerSCAN	XY2-100 Standard, optionally optical data transfer
• powerSCAN i	SL2-100
Ouput signals	3 status signals per axis
Analog version (not powerSCAN i)	TTL level
Digital version	
• powerSCAN	XY2-100 Standard, optionally optical data transfer
• powerSCAN i	SL2-100
Operating temperature	25 °C ± 10 °C
Typical water requirements	max. 4.5 bar

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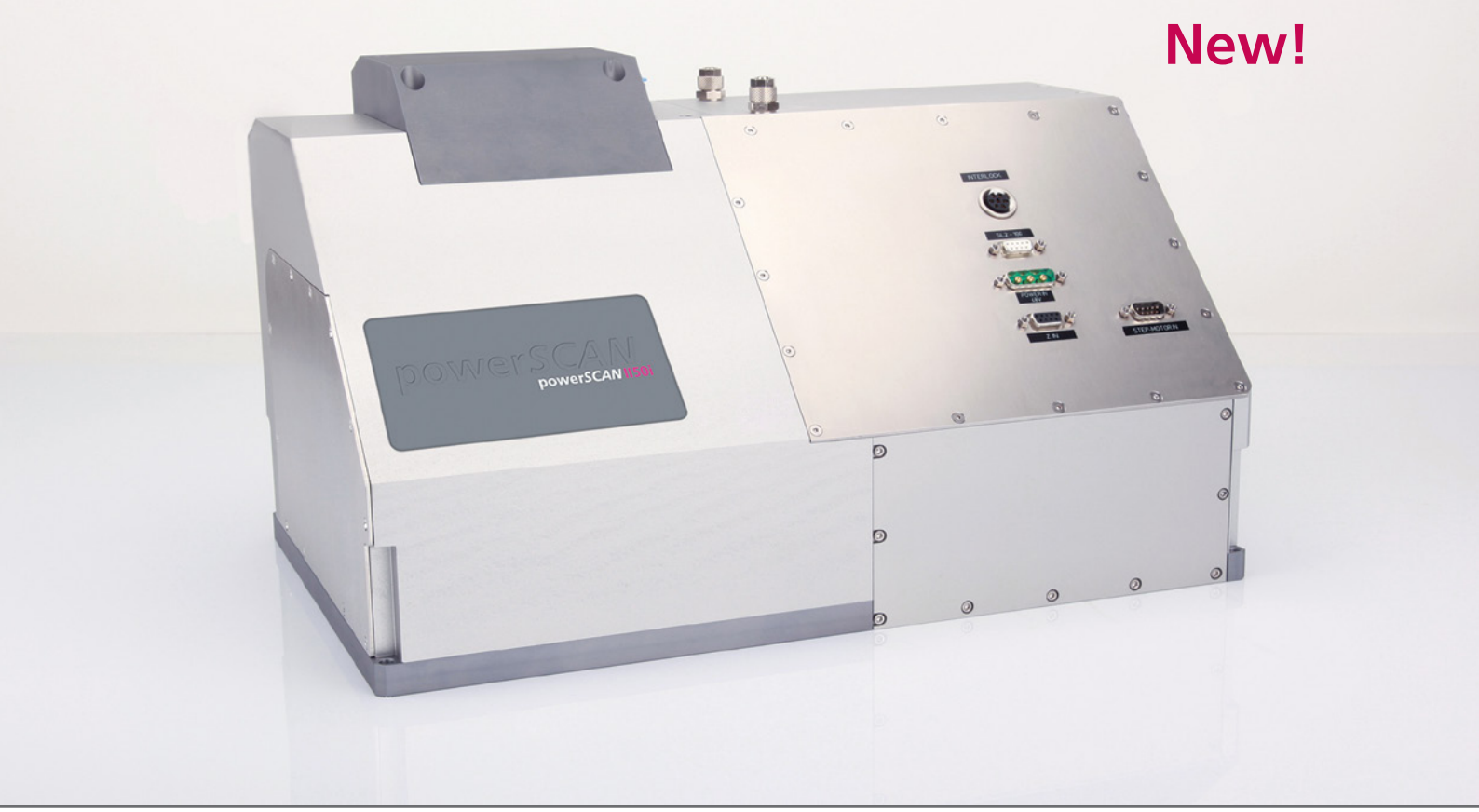
SCANLAB innovators for industry

power*SCAN* II 50i



high power. small spots. flexible field sizes

The new power*SCAN* II scan system sets standards for cutting and welding applications with high-power lasers.

Features

- Suitable for multi-kW CO_2 lasers
- Spot sizes as small as 165 µm
- 3D processing thanks to integrated z-axis

Innovations

- Flexible image field sizes with motorized, continuous adjustability
- Light-weight mirrors for highest dynamic performance
- Reduced Drift
- Digital servo electronics
- Application-specific tunings
- Software-independent Interlock signal
- Industrial-suited housing, optional protective window at beam exit
- More compact design: approx. 33% smaller footprint

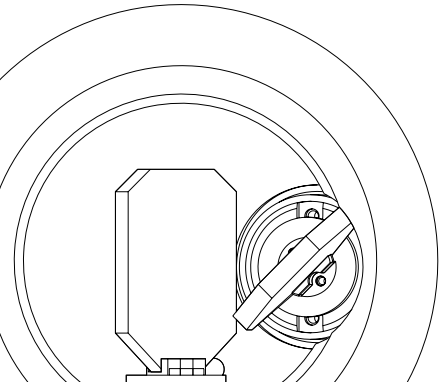
The large mirror aperture of 50 mm and a high-dynamics z-axis enable power*SCAN* II systems to focus the laser beam onto very small spots, also in combination with large field sizes. A supplementary stepper motor can achieve any needed image field size within a wide range.

Typical Applications

- Cutting of paper, cardboard, films
- Marking of textiles, wood, leather
- Welding of metal components
- Cutting of fiber composite materials

Industries

- Packaging and printing industry
- Textile processing
- Automotive



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Optical Specifications (Examples) – CO_2-Laser

Image field size [1] [mm²]	250 x 250	300 x 300	500 x 500	800 x 800	1000 x 1000	1200 x 1200	1500 x 1500
Free working distance A' [1]	252 mm	317 mm	592 mm	1007 mm	1282 mm	1557 mm	1967 mm
Focus diameter (center of image field) [1,2]	165 µm	195 µm	300 µm	455 µm	560 µm	665 µm	820 µm
Mean focus diameter (field) [1,2]	175 µm	200 µm	315 µm	480 µm	590 µm	700 µm	865 µm
Rayleigh length	1.5 mm	2.1 mm	4.9 mm	11.5 mm	17.4 mm	24.4 mm	37.4 mm
Focus range in z direction	± 5 mm	± 10 mm	± 40 mm	± 120 mm	± 200 mm	± 295 mm	± 470 mm
Typical processing speed	2.5 m/s	3 m/s	5 m/s	8 m/s	10 m/s	12 m/s	15 m/s

[1] for z = 0

[2] $1/e^2$, M^2=1, fully illuminated, 10.6 µm.

Dynamics

(all angles are in optical degrees)

with Be-Vector Tuning	
Tracking error	< 0,45 ms
Typical positioning speed	20 rad/s
Step response time [3]	
1% of full scale	1,0 ms
10% of full scale	4,5 ms

with Be-Linescan Tuning	
Tracking error	< 0,9 ms
Typical positioning speed	60 rad/s
Step response time [3]	
1% of full scale	1,8 ms
10% of full scale	2,6 ms

[3] settling to 1/1000 of full scale

Precision & Stability

(all angles are in optical degrees)

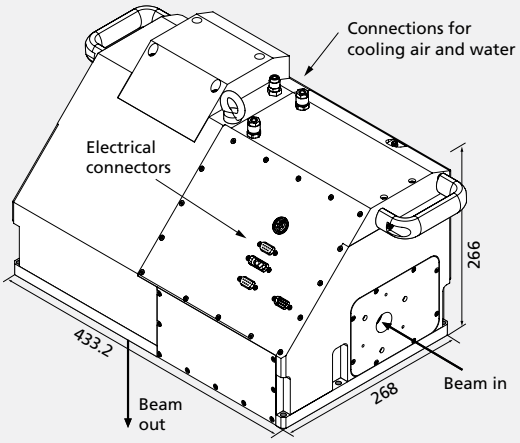
Repeatability (RMS)	< 4 µrad
Positioning resolution	18 Bit für XY, 16 Bit für Z
Temperature drift	< 15 ppm/K
Long-term drift [4]	
8-h-drift (after 30 min warm-up)	
Offset [µrad]	< 50 µrad
Gain [ppm]	< 50 ppm
Optical performance	
Typical scan angle	±0.35 rad
Gain error	< 5 mrad
Zero offset	< 5 mrad

[4] at constant ambient temperature and load

Common Specifications

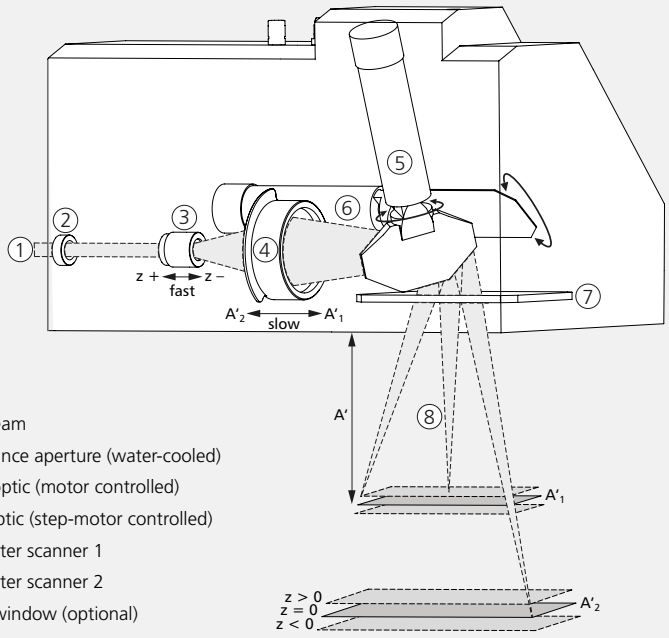
Wavelength	10.6 µm or 9.4 µm
Max. laser power cw	2 kW
for 50% duty cycle	4 kW
Entrance aperture	16 mm
Power requirements	(48 ± 2) V DC, max. 20 A
Interface	SL2-100
Water cooling	3 l/min, Δp < 4.5 bar
Air cooling	20 l/min, Δp < 2 bar
Operating temperature	25 °C ± 10 °C
Weight	ca. 35 kg

powerSCAN II 50i



All dimensions in mm

Principle of operation



Legend

1 Entering beam
2 Beam entrance aperture (water-cooled)
3 Diverging optic (motor controlled)
4 Focusing optic (step-motor controlled)
5 Galvanometer scanner 1
6 Galvanometer scanner 2
7 Protective window (optional)
8 Emerging beam

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SCANLAB innovators for industry

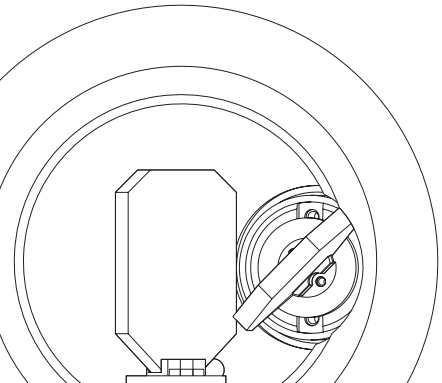
smart welding

Designed for robot-assisted welding applications, intelli*WELD* **3D scan systems** are capable of swiftly positioning the laser beam along 3D contours. While a robot guides the scan system along a part's contour, the intelli*WELD* quickly and accurately deflects and fine-positions the laser spot. Complex motions and time-wasting robot repositioning are avoided, thereby boosting speeds and cutting weld-to-weld positioning time down to a few milliseconds. Hence, beam source utilization climbs significantly, as does productivity.

The intelli*WELD* system's compactness facilitates straightforward mounting onto industrial robots. Its optics are optimized for fiber-coupled disk or fiber lasers with powers up to 8 kW.

The intelli*WELD* family includes a version with prefocus optics for vision-assisted applications (e.g. fillet welding with precise contour tracking), as well as the newly developed intelli*WELD* II with integrated zoom axis (particularly well-suited for overlap welding, its variable spot size enables flexible seam widths).

intelli*WELD* scan systems use SCANLAB's fully digital i*DRIVE* technology, providing an integrated approach to laser and process safety. It allows real-time monitoring of all important scan head status parameters. And its integrated interlock signal facilitates software-independent integration of the scan system into safety circuits.



Typical Applications:

- Robot-assisted welding (remote welding)
- 3D applications
- Processing-on-the-fly

Typical Industries:

- Automotive
- Mechanical engineering and metalworking
- Aerospace industry

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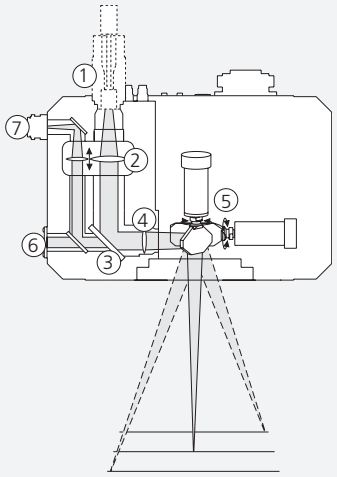
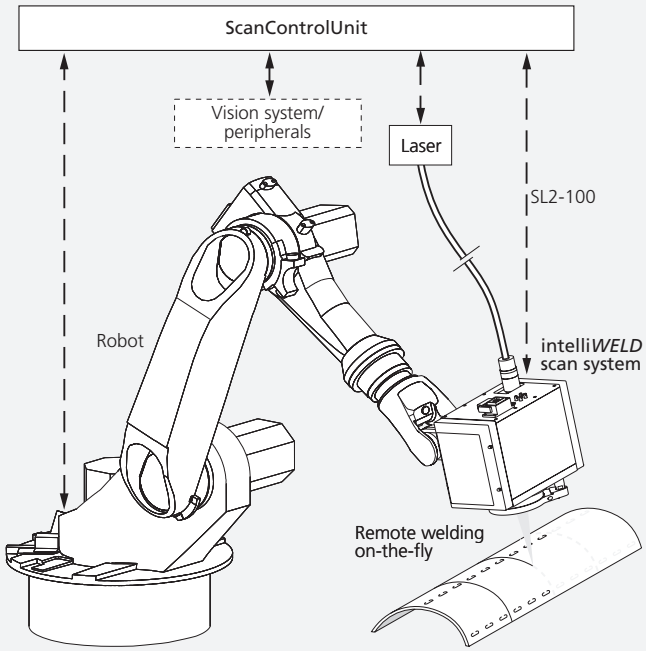


Legend

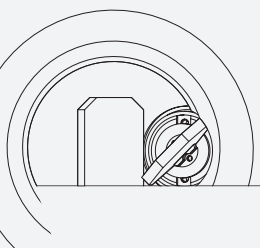
1 Fiber adapter
2 Variable collimator
3 Dichroic mirror
4 Focusing optics
5 Galvanometer scanner
6 Attachment provision for process monitoring
7 Variable camera tracking optics

intelli*WELD* PR with prefocus
– optimized for vision applications (e. g. fillet welding)

- High transmission of Vis/NIR wavelengths – ideal for coaxial sensors, illumination and observation
- No divergence between observation points and processing points (no chromatic aberration)
- Wide scan angles possible – large image field
- Extensive z-range – thanks to larger aspect ratio
- High imaging quality – also usable with lasers of high beam quality, even in single mode
- No objective required – compact and lightweight scan system



For further information on the ScanControlUnit:
http://www.blackbird-robotics.de/en/products-solutions/overview.html



Principle of Operation

The laser beam is fiber-delivered to the scan system's variable collimator and then directed to the scan system's moving deflection mirrors (galvos).

The intelli*WELD* PR employs a prefocus optic to focus the beam ahead of the deflection mirrors, whereas the intelli*WELD* II FT uses an F-Theta objective after the deflection mirrors – see depictions top left and right.

The variable collimator's optic is dynamically driven along the optical axis via the lin*AXIS* linear axis. This alters the collimated beam's divergence, and thus its focus position along the z axis, thereby giving the intelli*WELD* 3D-processing functionality.

The intelli*WELD* II FT can be equipped with an optional zoom axis for continuously enlarging the spot size.

For process monitoring, all intelli*WELD* systems can be equipped with a second camera port containing variable camera-tracking optics. This facilitates process monitoring with autofocus (coupled to the z axis or zoom axis) throughout the entire working volume.

Control

When combined with an RTC5 control board, intelli*WELD* systems support SCANLAB's fully digital i*DRIVE* technology. They feature integrated safety design and extensive possibilities for laser and process control. i*DRIVE* technology enables real-time monitoring of all the scan system's key status parameters, e.g. the replaceable protective window or entrance-aperture temperature.

The **ScanControlUnit** (RobotSyncUnit) supports intelli*WELD*'s robotics suitability. It is a central operating/control unit for laser welding systems (robot, laser, intelli*WELD* and peripherals). Simple and intuitive system usage brings efficiency to programming of welding tasks (see figure, left).

System Features

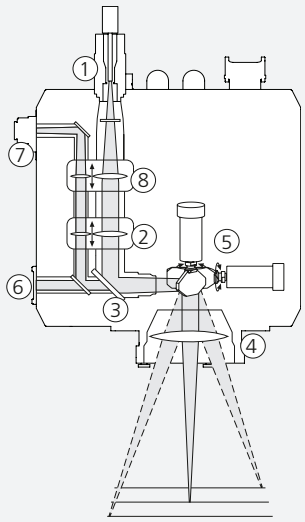
intelli*WELD* systems particularly excel in the following characteristics:

- Robustness
  - sealed housing
  - encapsulated optical path
  - replaceable collimator protective window
  - replaceable beam-exit protective window
  - fume protection module (optional)
  - water cooling of electronics, entrance aperture, beam exit plate/objective
  - internal air cooling of scan mirrors
  - flexible, adjustable cross jet (available from Blackbird)
- Safety
  - temperature sensors for scan mirrors, galvo mounts, entrance aperture, coolant and electronics
  - optional protective window sensor
  - optional flow sensor
  - axes monitoring (voltages, error states, position signal retrieval)

  All internal sensors are joined in a software-independent interlock signal to enable emergency shutdown in critical situations.
- Precision
  - custom image field calibration
  - ASC sensor for drift compensation
  - Teach-in module for easier setup of robot-mounted laser scan systems via cross hairs projected onto the work piece
- Dynamic performance
  - SCANLAB galvos developed in-house
  - optimized mirror design
  - various tunings available
  - quick repositioning, high oscillation frequency (wobble)
  - optimized control functions (e.g. processing-on-the-fly, sky writing, variable scanner and laser settings)

Legende

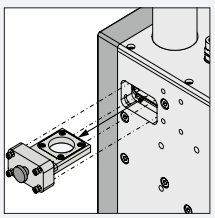
1 Fiber adapter
2 Variable collimator
3 Dichroic mirror
4 F-Theta objective
5 Galvanometer scanner
6 Attachment provision for process monitoring
7 Variable camera tracking optics
8 Zoom

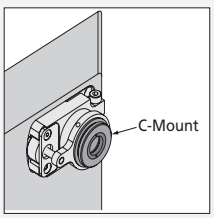


intelli*WELD* II FT (with F-Theta objective)
– optimized for overlap welding

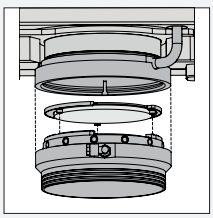
- Additional zoom axis:
  - enlarges spot size up to x 1.5
  - dynamic, continuous intra-seam adjustability
  - independent of/in addition to defocusing
- Constant spot size while varying x, y and z at all zoom settings throughout the entire accessible volume
- Small aspect ratio, therefore small spots even with low beam quality or large fiber diameter
- Lower drift, thanks to III-series galvos
- Interlock monitoring of all four axes
- Status indicator lights for power and interlock
- New protective window sensor:
  - software-controlled gain
  - significantly shorter laser-on time < 1 second
  - integrated illumination for visual inspection of protective window
- Improved vision port
  - brighter image
  - sharp camera imaging at all xyz zoom settings

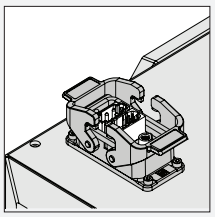
Features

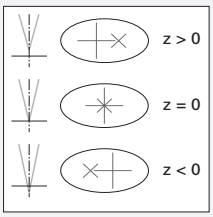

Collimator tray



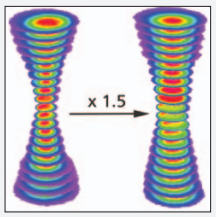
Tracking camera port


Protective window with sensor and fume protection


Industry-suitable connectors



Teach-in module



Zoom option

Typical Optical Configurations

	intelli*WELD* PR (with prefocus optic)				intelli*WELD* II FT (with F-Theta objective)					
Focal length, focusing optics	470 mm		660 mm		255 mm		340 mm		460 mm	
Focal length, collimator	135 mm	110 mm	135 mm	110 mm	142 mm	125 mm	142 mm	125 mm	142 mm	125 mm
Limiting NA (half angle)	0.11	0.13	0.11	0.13	0.11	0.13	0.11	0.13	0.11	0.13
Image ratio	1:3.5	1:4.3	1:4.9	1:6.0	1:1.8	1:2.0	1:2.4	1:2.7	1:3.2	1:3.7
Focus diameter	350 µm [1]	430 µm [1]	490 µm [1]	600 µm [1]	360 µm [2]	400 µm [2]	480 µm [2]	540 µm [2]	640 µm [2]	740 µm [2]
Max. image ratio with Zoom	-	-	-	-	1:2.7	1:3.0	1:3.6	1:4.1	1:4.8	1:5.6
Focus diameter					540 µm [2]	600 µm [2]	720 µm [2]	820 µm [2]	960 µm [2]	1120 µm [2]
Fiber diameter	≥ 50 µm [3]		≥ 50 µm [3]		≥ 50 µm		≥ 100 µm		≥ 100 µm	
Operating distance to protective window	301 mm		494 mm		306 mm		439 mm		499 mm	
Image field size (z=0, elliptical)	ca. (300 x 330) mm²		ca. (450 x 480) mm²		ca. (160 x 90) mm²		ca. (200 x 100) mm²		ca. (370 x 250) mm²	
Image field size (z=0, rectangular)	ca. (270 x 270) mm²		ca. (450 x 470) mm²		ca. (100 x 80) mm²		ca. (160 x 80) mm²		ca. (220 x 220) mm²	
Focus range in z direction	ca. ± 50 mm		ca. ± 100 mm		ca. ± 25 mm		ca. ± 40 mm		ca. ± 70 mm	

Options

Zoom axis	-	-	x	x	x
Equipped for fillet seam tracking	-	x	-	-	-
Tracking camera port	x	x	x	x	x
Double protective window beam exit	-	x	x	-	x
Sensor beam-exit protective window	-	x	-	-	x
Collimator protective window	x	x	x	x	x
Flow sensor	x	x	x	x	x
Teach-in module	x	x	x	-	x

Common Specifications

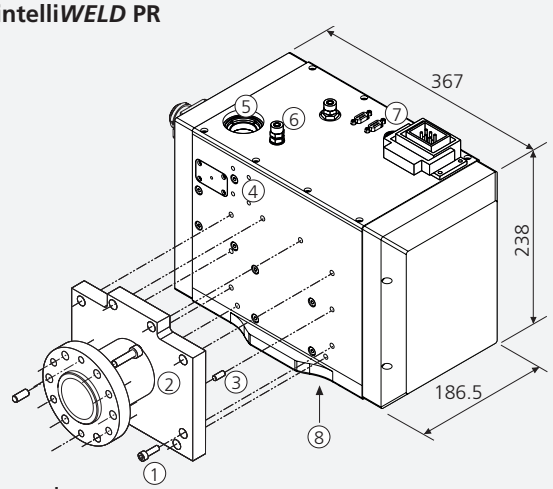
(all angles are in optical degrees)

Wavelength	1030 nm - 1105 nm [4]
Maximum laser power (with specified cooling)	8 kW
Fiber adapter	QBH, Q5/LLK-B, QD/LLK-D
Step response time (with step tuning) (settling to 1/1000 of full scale)	
1% of full scale	1.2 ms
10% of full scale	3.5 ms
100% of full scale	11 ms
Dynamic performance	
Positioning accuracy	< 0.2 mm
Repeatability (RMS)	< 2 µrad
Long-term drift over 8 h (after warm-up)	< 0.15 mrad [5]

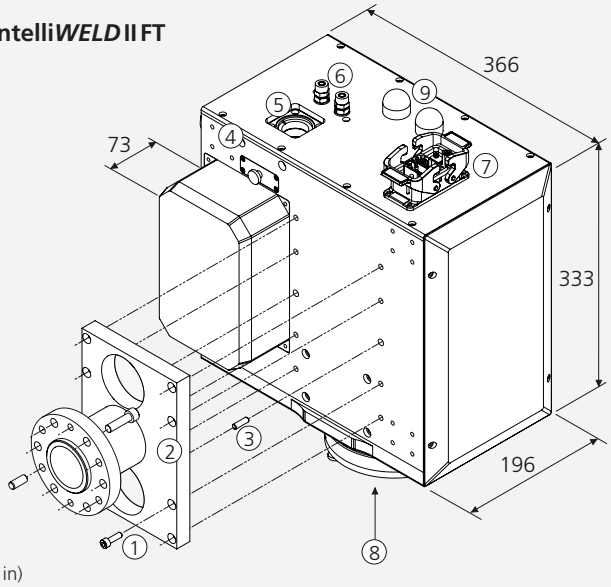
Power requirements	30 V DC (29-33 V), max. 8 A each
Input and output signals	SL2-100
Weight	21 - 40 kg
Operating temperature	25 °C ± 10 °C
Typical water requirements	3 l/min at 20°C and Δp < 0.1 bar, p < 4 bar

[1] with 100 µm fiber
[2] with 200 µm fiber
[3] for single mode available on request
[4] mirror coatings for 1030 - 1085 nm and 1065 - 1105 nm available
[5] interlli*WELD* II FT; < 0.2 mrad with ASC for intelli*WELD* PR

intelli*WELD* PR



intelli*WELD* II FT



Legend

1 Mounting screws *
2 Flange (robot adapter plate) *
3 Alignment pins *
4 Attachment provision for strain relief (fiber)
5 Attachment provision for fiber adapter
6 Connectors for cooling water
7 Interfaces (Data, Interlock, Power in)
8 Bore holes for attaching an objective holder and a crossjet
9 Signal lights (Power and Interlock)

* not included

all dimensions in mm

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SCANLAB innovators for industry

high power meets high dynamics

The wel*DYNA* **scan head** enables innovative high power applications by a unique set of properties:

- Suitable for multi-kW lasers
- Designed for highest beam quality (single mode)
- High oscillation frequencies >2 kHz
- Modular integration with standard collimation and focussing units
- Low long-term and temperature drift
- Fully digital servo circuitry
- Integrated sensor system with real-time monitoring
- Software-independant interlock interface
- Water and air cooling in a robust housing

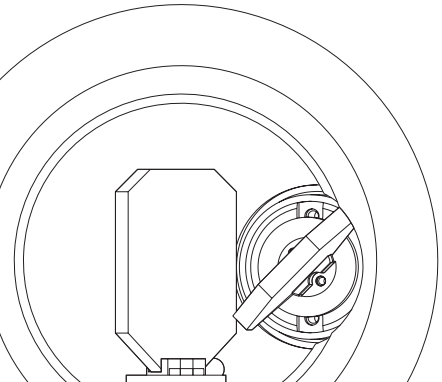
The wel*DYNA* scan head joins high power with high dynamics. On the one hand, the high power suitability is supported by ultra-low absorption coatings, air-cooling of the mirrors, strict separation of electronics and optical path and in addition a set of built-in sensors. Empowered by the fully digital electronics, the integrated sensors provide extensive possibilities for real-time surveillance of the system's operational state. On the other hand, light-weight SiC mirrors and highly dynamic galvanometer scanners of the dyn*AXIS* 3 series enable beam oscillation frequencies that are unprecedented in high-power scan heads. An innovative optical configuration leads to opposing beam-entrance and exit apertures, thus facilitating the integration in gantry- or robot-based machines, e. g. in the automotive or metalworking industry.

Typical Applications:

- Welding of dissimilar materials, e. g. aluminum and copper
- Joining of materials with low weldability, e. g. for power train or body-in-white components
- Cutting of thick metal sheets or fiber-reinforced plastics (FRP)

Typical Industries:

- Automotive
- Mechanical engineering and metalworking
- Aerospace industry



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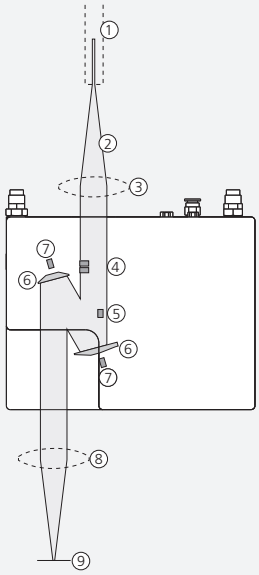
Specifications

Aperture	20.8 mm
Mirrors	
Working wavelength	1030 - 1090 nm
Reflectivity	
at 1030-1090 nm	> 99.5% per mirror
at 633 nm	> 50% per mirror
Max. laser power (with air cooling)	3000 W
at 50% duty cycle	6000 W
Max. XY oscillation amplitude	
at 2000 Hz	± 3.1 mrad
at 4000 Hz	± 0.6 mrad
Tuning	Vector
Tracking error	< 0.16 ms
Step response time (1)	
1% of full scale	0.4 ms
10% of full scale	2.3 ms
Positioning speeds	
typical	40 rad/s
(with f=245 mm focusing)	(10 m/s)
maximal	55 rad/s
(with f=245 mm focusing)	(13 m/s)

(1) settling to 1/1000 of full scale
(2) dependent on collimation and focusing module
(3) with f=245 mm focusing

Long-term drift (8h)	
Offset	< 150 µrad
Gain	< 150 ppm
Temperature drift	
Offset	< 30 µrad/K
Gain	< 20 ppm/K
Repeatability (RMS)	< 2 µrad
Positioning resolution	18 Bit
Optical performance	
Typical scan angle (2)	± 25 mrad
Typical field size (3)	10 x 10 mm²
Gain error	< 5 mrad
Zero offset	< 5 mrad
Nonlinearity	< 0.9 mrad/44°
Power requirements	30 V DC, max. 7 A or ± 15 V DC, max. 7 A
Interface	SL2-100
Operating temperature	25 °C ± 10 °C
Weight	7.5 kg
Cooling specifications	
Air cooling	20 l/min (Δp < 1 bar)
Water cooling	3 l/min (p < 4 bar)

(all angles are in optical degrees)

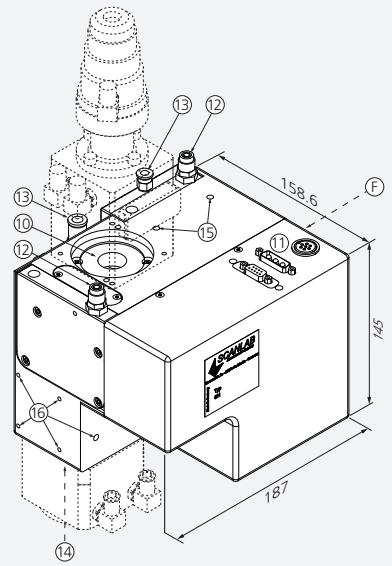


Legend

1 Fiber*
2 Laser beam
3 Collimation optics*
4 Two IR photo diodes
5 Temperature sensor galvo mount
6 Two scan mirrors
7 Two mirror temperature sensors
8 Focusing optics*
9 Image field

10 Beam entrance, mounting option for collimation module*
11 Electrical connectors for data, power, interlock
12 Connections for cooling water
13 Connections for cooling air
14 Beam exit, mounting option for focusing module*
15 Bore holes at free disposal, e.g. for cable relief
16 Bore holes at free disposal, e.g. for illumination, camera, crossjet
F Flange surface

(*not included)



All dimensions in mm

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SCANLAB innovators for industry

hand-held scan device

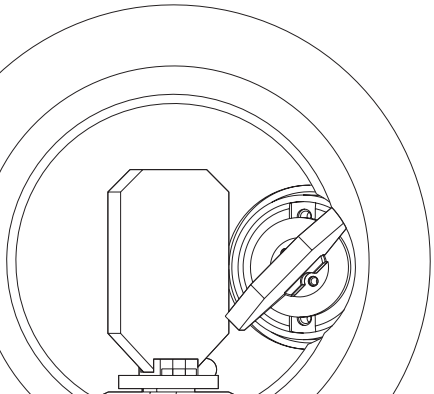
The palm*SCAN*'s ultra-compact dimensions make this **scan system** especially suitable for hand-held laser systems. Its ergonomic design and light weight ensure natural, fatigue-free handling. The palm*SCAN* is primarily destined for dermatological applications such as wrinkle reduction, hair removal and vascular treatment.

Two high-performance galvanometer scanners, optimized for small apertures, enable fast and precise guidance and positioning of the laser beam – a must for uniform application of laser energy over large surface areas.

The palm*SCAN* is equipped with a 6 mm clear aperture and can be delivered with mirror coatings for all typical laser wavelengths. This OEM subsystem is designed for straight-forward integration into existing systems. Standardized threads facilitate mounting on articulated arms or attachment of a fiber collimation optic, as well as additional customer-specific components at the beam exit.

Typical Applications:

- Wrinkle reduction
- Hair removal
- Vascular treatment



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Housing

The compact, light-alloy housing is easily cleaned and disinfected.

Mounting

The palm*SCAN* provides several standardized threads for mounting an optical guidance system (e.g. an articulated arm or an optical fiber).

A customer-specified optics adapter for focusing the laser beam can be integrated into the system. At the beam exit, a spacer can be mounted to ensure the correct working distance.

Mirrors

Optimized mirror sets are available for various laser types (e.g. Er:YAG, CO_2 or Nd:YAG).

Control

The palm*SCAN* is delivered with two servo amplifier boards and an optional digital interface board that allows the palm*SCAN* to be controlled by RTC control boards.

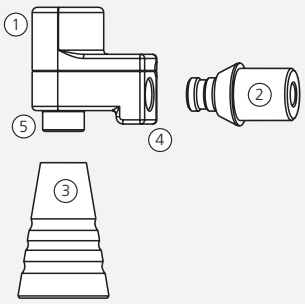
Specifications
(all angles are in optical degrees)

Aperture	6 mm
Step response time (settling to 1/1000 of full scale)	
1% of full scale	0.35 ms
10% of full scale	0.90 ms
Dynamic performance	
Tracking error	0.14 ms
Optical performance	
Typical scan angle	±0.10 rad
Gain error	< 5 mrad
Zero offset	< 5 mrad
Nonlinearity	< 4.2 mrad / 44°
Power requirements	±(15 + 1.5) V DC, max. 0.5 A each
Input signals	
Analog version	alternatively: ±4.8 V; ±9.6 V; ±4.8 mA; ±9.6 mA
Digital version	XY2-100 standard
Output signals	3 status signals per axis
Analog version	TTL level
Digital version	XY2-100 standard
Weight	
palm*SCAN*	approx. 200 g
SSV30 servo amplifier boards	approx. 190 g each
SDIREC digital interface board	approx. 150 g
Operating temperature	25 °C ± 10 °C

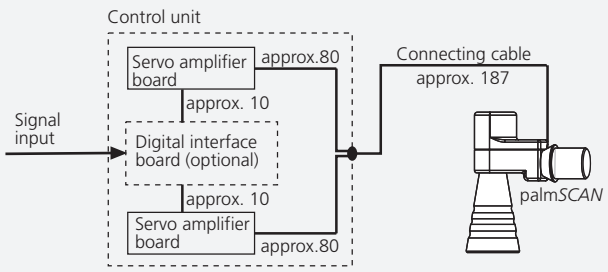
Components

1 palm*SCAN*
2 Optics adapter*
3 Spacer*
4 Beam in
5 Beam out

* not included



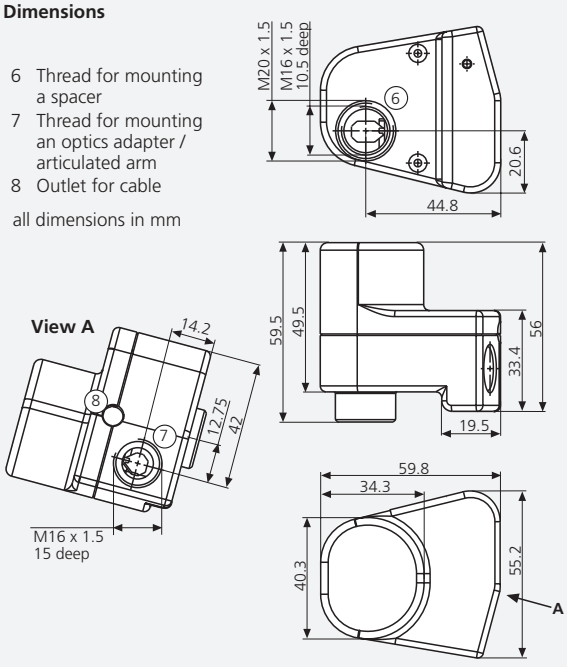
Control



Dimensions

6 Thread for mounting a spacer
7 Thread for mounting an optics adapter / articulated arm
8 Outlet for cable

all dimensions in mm



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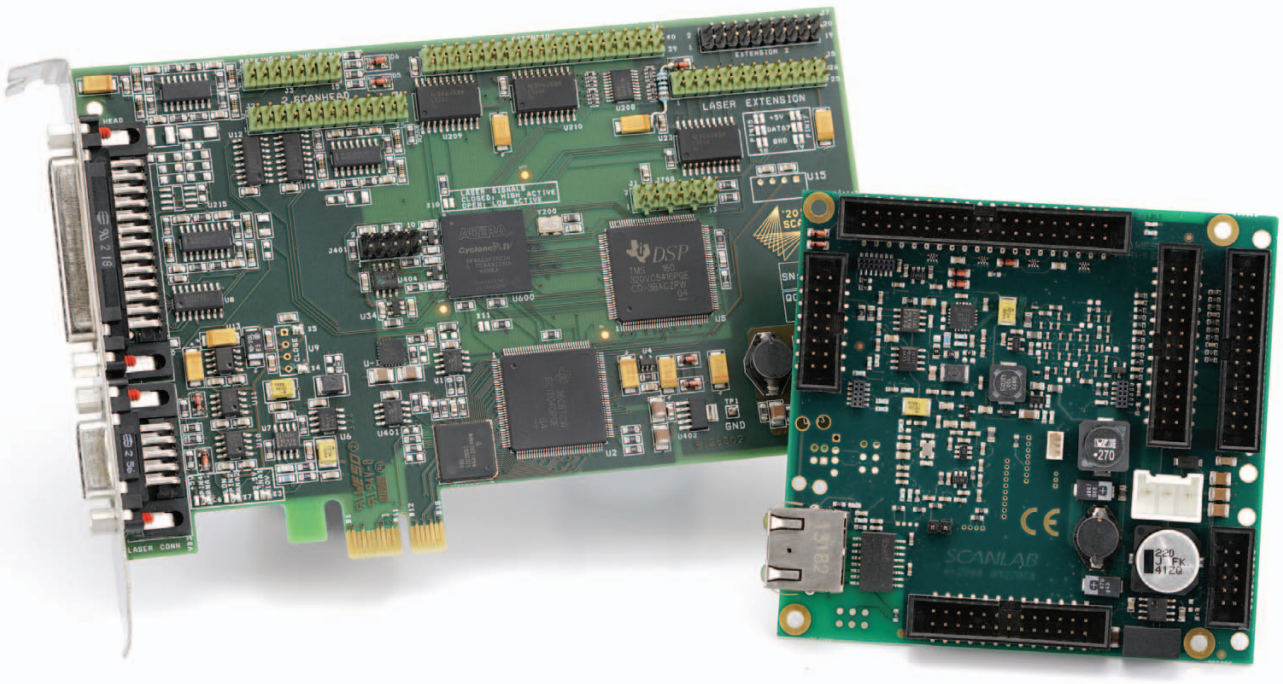


control and versatility

The RTC4 series of **control boards** is available with two different interfaces:

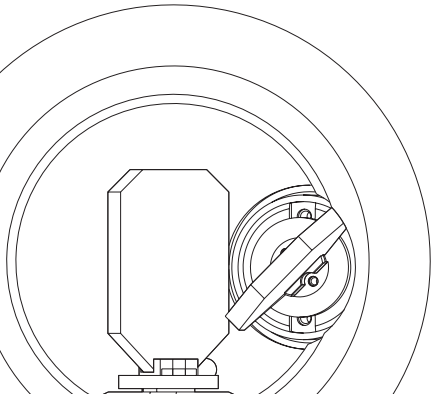
- PCI Express (RTC4 PCIe)
- Ethernet (RTC4 Ethernet).

Equipped with a powerful signal processor, these boards enable synchronous, real-time control of scan systems and lasers. Included DLLs facilitate straightforward program development under Windows. Alternatively, industry-proven software Packages from various third-party suppliers are also available for handling a palette of standard applications.

Every 10 µs, a 16-bit control signal is transmitted to the scan system. The RTC board's processor performs vital steps such as micro-vectorization and image field correction. Various programmable laser signals are available for vector and bitmap processing.

For controlling external components, the RTC4 boards provide 16 digital input ports and 16 digital output ports. Additionally, a multitude of available options (e.g. 3D, galvanically isolated laser signals, processing-on-the-fly) give system integrators maximum flexibility in meeting diverse customer requirements.

The RTC4 Ethernet dispense with needing to integrate a PC into laser processing machines. End customers can connect their own PCs/laptops via Ethernet and this control board also eliminates requiring a PC to be near the scan system (as is normally the case).



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Common Specifications

- XY2-100 enhanced protocol
- 16-bit positioning resolution
- 10 µs output period
- Drivers for (32-bit and 64-bit) Windows 10/8/7/Vista/XP and DLLs (32-bit and 64-bit)
- Outputs for controlling a scan head and a laser
- Various laser modes selectable (e.g. YAG modes, CO2 mode, fiber laser, polarity)
- Two 10-bit analog outputs
- One 8-bit digital output
- One 16-bit digital output and one 16-bit digital output for controlling external components
- Support of i*DRIVE* technology for scan system diagnostics and tuning selection

Further Options

- Functionality for controlling of 3-axis scan systems
- Processing-on-the-fly functionality for processing objects in motion
- Functionality for simultaneous control of two scan systems
- Opto-decoupled laser control signals

Interface-Dependent Specifications

	RTC4 PCIe	**RTC4 Ethernet**
PC interfaces	PCI Express	Ethernet (10/100 MBit/s)
Multi board functionality	yes, up to 16 boards in 1 PC	no
Control of vario*SCAN*$_{FLEX}$ (with step motor extension)	yes	no
Power requirements	via PCIe bus	+12 ... 48 V DC (max. power draw 2 W) [1]
Mechanical dimensions	(161 × 106) mm	(96 × 90) mm

[1] measured without any attached peripherals

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control and versatility

The RTC5 **control board** provides synchronous, interference-resistant control of scan systems, lasers and peripheral equipment in real time. It is available as a PC interface board, as a PCI-Express board, or as a PCIe/104 module.

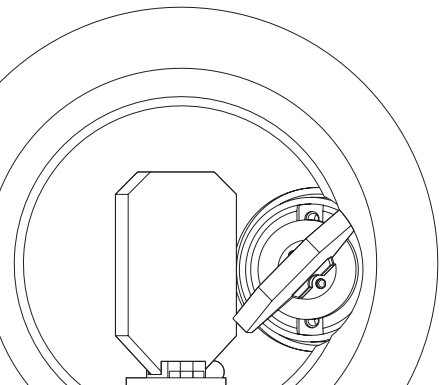
A high-performance signal processor and the supplied DLL simplify programming under Windows. Software commands are loaded into the RTC5's freely-configurable list buffer and processed by the DSP. Every 10 µs, appropriate signals are output to or read-out from the scan system, laser and peripheral equipment.

The RTC5 communicates with scan systems via the new SL2-100 data transfer protocol. This protocol supports 20-bit control signals and thereby a 16x higher positioning resolution compared to the RTC4 predecessor board. The RTC5's processor automatically performs micro-vectorization and image field correction.

For laser control, various programmable laser signals are available for vector and bitmap processing. During execution, the board can provide automatic position/speed/vector-dependent readjustment of laser power. Furthermore, the scan system can be synchronized to the laser. This "output synchronization" is a prerequisite for exact and reproducible laser processing when the laser-pulse signal is defined by a fixed (external) laser clock, as is the case for ultrashort pulse lasers.

For SCANLAB scan systems with fully digital servo electronics (e.g. intelli*SCAN*, intelli*cube*, intelli*DRILL*, intelli*WELD*, power*SCAN* i), the RTC5 also supports all possibilities arising from the i*DRIVE* technology. This includes real-time monitoring and remote diagnosis of key operational parameters, simulation-assisted process optimization and the use of different dynamics tunings. The feedback of the scan-system speed can be used for speed-dependent laser control.

Numerous options provide the extensive flexibility system integrators need for meeting diverse customer requirements.



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System Integration

- PCI bus interface, PCI-Express interface (PCIe-x1 version 1.0) or PCIe/104-interface
- Any number of RTC5 PCI or PCIe boards in one PC
- Master/slave synchronization
- Drivers for (32-bit and 64-bit) Windows 10/8/7/Vista/XP (SP2 or later)
- Multi threading, multi processing

Scan System Control

- SL2-100 transfer protocol (control of scan systems per XY2-100 transfer protocol via an optional converter)
- 20-bit positioning resolution
- Virtual processing field (24 bit)
- 10 µs output period
- Galvanically isolated signals
- Tuning selection
- Vector and jump mode, tuning auto-switching
- Scan-system diagnosis
- Reading back actual-position values
- Synchronization of scanning motions to the laser clock (e.g. ultrashort pulse lasers) – "output synchronization"

Laser Control

- 15-pin D-Sub connector
- Laser signals with 15 ns resolution and 20 mA output current
- Various laser modes for controlling all typical lasers
- Bitmap mode with pixel frequencies up to 300 kHz, 15 ns resolution, 0-100% laser pulse width
- RS232 interface
- Speed- and position-dependent laser control

Control of Peripheral Equipment

- 16-bit digital output and input
- 8-bit digital output
- 2-bit digital output and input
- 12-bit analog output (0...10 V)
- McBSP interface
- Stepper motor signals

Command Management

- Configurable list buffers with 1,000,000 list positions, protected memory area definable
- Lists and subroutines
- "Short" list commands for changing (laser) output signals without interrupting polygonal traversal (the laser remains on)
- Download verification
- Enhanced list and list execution status
- Definable and selectable character sets
- Marking of dates, times and serial numbers
- Marking of circles and ellipses
- Sky writing
- Conditioning of all list commands possible

Options

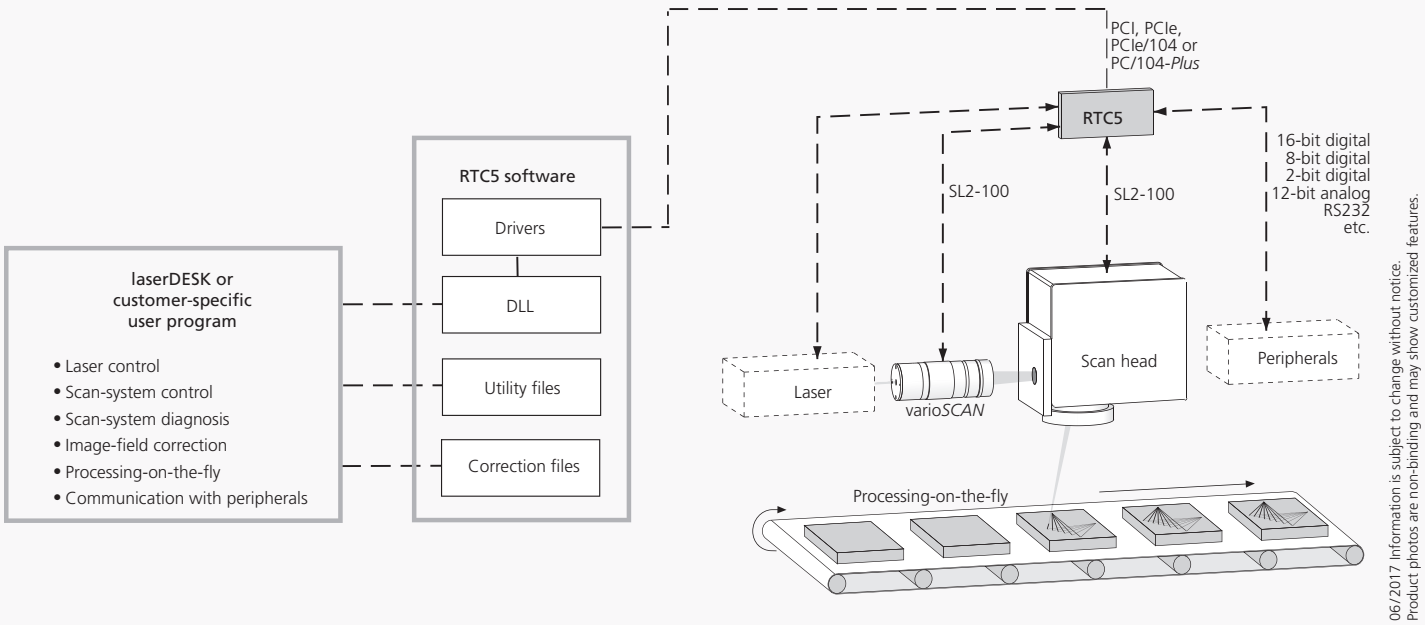
- Control of 3-axis scan systems
- Processing-on-the-fly functionality for objects in motion (two encoder inputs with 32-bit counter, up to 8 objects between trigger and marking position, etc.)
- Dual-head capability for simultaneous control of two scan systems
- Customer-specific extensions possible

Other RTC control boards

- RTC4 (PCIe, Ethernet)
- RTC6 (PCIe, Ethernet)

Accessories

- laserDESK laser processing software



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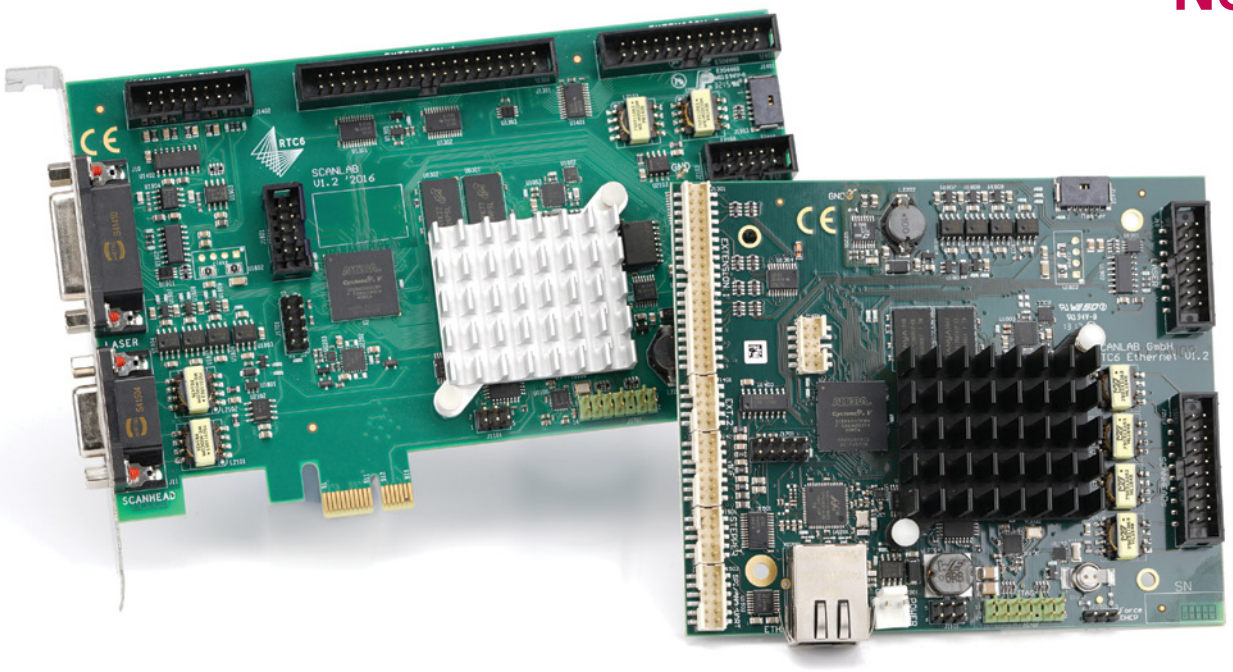
New!



high-performance. advanced scan control.

RTC6 **control boards** enable smart and flexible control of scan systems, lasers and peripheral devices in real time.

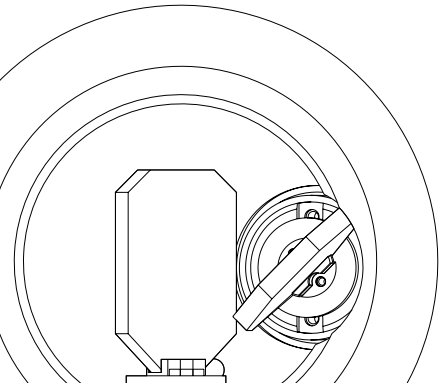
Key Features:

- *SCAN*ahead control
- UltraFastPixelMode (up to 3.2 MHz)
- Enlarged list memory

The RTC6 is available as a PCI-Express board and as an Ethernet variant (soon incl. standalone functonality).

Based on the field-proven RTC5, the RTC6 control board delivers new functionalities to tackle complex control tasks. Examples are improved speed and position-dependent laser control and the synchronization of the usually faster x/y scan axes with the slower z-axis. This allows more precise results in 3D processing.

Complete incorporation of all RTC5 functions ensures quick, easy migration to the new RTC6 board.



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System Integration

- PCIe bus interface, Ethernet interface
- Up to 255 RTC6 control boards per PC
- Master/slave synchronization
- Drivers for Windows 10/8/7 (32-bit and 64-bit)
- Multi threading, multi processing

Scan System Control

- SL2-100 transfer protocol (control of scan systems with XY2-100 transfer protocol via an optional converter)
- 20-bit positioning resolution
- Virtual processing field (29 bit)
- 10 µs output period
- Synchronization of the 10 µs RTC clock to an external laser clock signal
- Galvanically isolated signals
- Tuning selection
- Vector and jump mode, tuning auto-switching
- Scan-system diagnosis
- Reading back actual-position values

Laser Control

- 15-pin D-Sub connector
- Laser signals with 15 ns resolution and 20 mA output current
- Various laser modes for controlling all typical lasers
- Bitmap mode with pixel frequencies up to 3.2 MHz, 0-100% laser pulse width (15 ns resolution), additional digital-ports as output ports
- RS232 interface
- Speed- and position-dependent laser control

Control of Peripheral Equipment

- 16-bit digital output and input
- 8-bit digital output
- 2-bit digital output and input
- 12-bit analog output (0...10 V)
- McBSP interface
- Stepper motor signals

Command Management

- Configurable list buffers with more than 8 million list positions, protected memory area definable
- Lists and subroutines
- "Short" list commands for changing (laser) output signals without interrupting polygonal traversal or laser switch-off
- Download verification
- Enhanced list and list execution status
- Definable and selectable character sets
- Marking of dates, times and serial numbers
- Marking of circles and ellipses
- Sky writing
- Conditional execution of all list commands possible

Options

- *SCAN*ahead
- Control of 3-axis scan systems
- Processing-on-the-fly functionality for objects in motion (two encoder inputs with 32-bit counter, up to 8 objects between trigger and marking position, etc.)
- simultaneous control of two scan systems
- Customer-specific software extensions possible
- UltraFastPixelMode (UFPM) for frequencies higher than 800 kHz
- Spot Distance Control (SDC) (only with *SCAN*ahead and with special pulse-on-demand lasers)

Accessories

- laserDESK laser processing software

Comparison of RTC6 – RTC5

	RTC6	RTC5
PC Interface	PCIe, Ethernet	PCI, PCIe
***SCAN*ahead control**	optional, for controlling excelli*SCAN*	no
Synchronization (scan system control)	10 µs RTC clock synchronization	output synchronization
Pixel frequency (bitmap mode)	800 kHz maximum (standard)	308 kHz maximum
UltraFastPixelMode (UFPM)	3.2 MHz maximum (optional)	no
List memory	8 million list positions	1 million list positions
3D correction files	up to eight 3D correction files	up to two 3D correction files
Output period	10 µs	10 µs
Transfer protocol	SL2-100	SL2-100
Software drivers	drivers for Windows 10/8/7 (32-Bit and 64-Bit)	drivers for Windows 10/8/7 (32-Bit and 64-Bit) Vista/XP (ab SP2)

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SCANLAB innovators for industry

new dimensions – optics in motion

The dynamic focusing units of the vario*SCAN* and vario*SCAN*$_{de}$ i series enable exceptionally precise, high-performance positioning of the laser focus along the optical axis.

In XY scan systems, the vario*SCAN* can replace costly flat field objectives. Therefore, the vario*SCAN* is an ideal solution in applications for which standard flat field objectives are unavailable. The vario*SCAN* can also extend XY scan systems into 3D beam deflection systems. The laser focus is guided along the contour of the workpiece being processed, thus enabling processing in three dimensions. The vario*SCAN*$_{FLEX}$ additionally allows continuously adjusting the image field size, working distance and spot size.

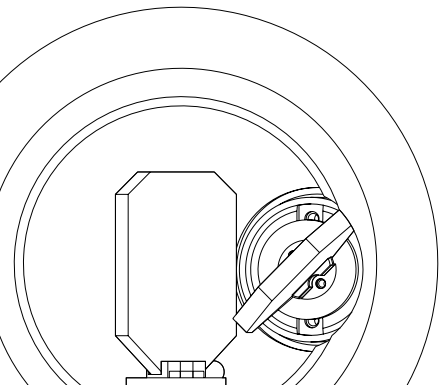
The high-end member of the vario*SCAN* series of focusing units is the vario*SCAN*$_{de}$i. It is equipped with a digital linear encoder.

The vario*SCAN*$_{de}$i offers double the maximum travel of conventional vario*SCAN*s and much lower tracking error, resulting in a larger focus-shift range and better spot quality. Its accuracy, speed, resolution and linearity, too, are clearly superior to those of all other vario*SCAN* units, while substantially eliminating the effects of drift.

In addition, the vario*SCAN*$_{de}$ i delivers all advantages of i*DRIVE* technology: extensive flexibility, high dynamic performance, real-time querying of actual position and other status parameters, etc.

Typical Applications:

- Drilling, cutting, welding
- Laser deep engraving
- Rapid prototyping, rapid tooling
- Microstructuring
- 3D workpiece processing



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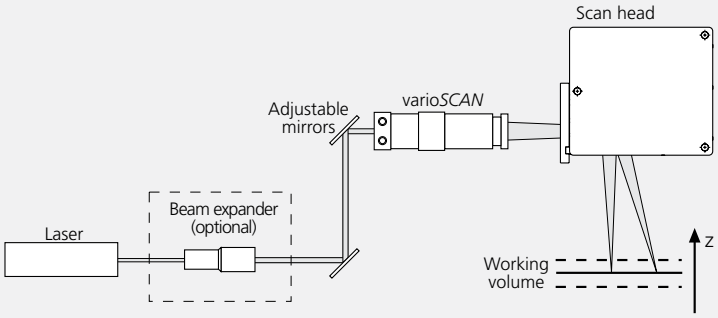
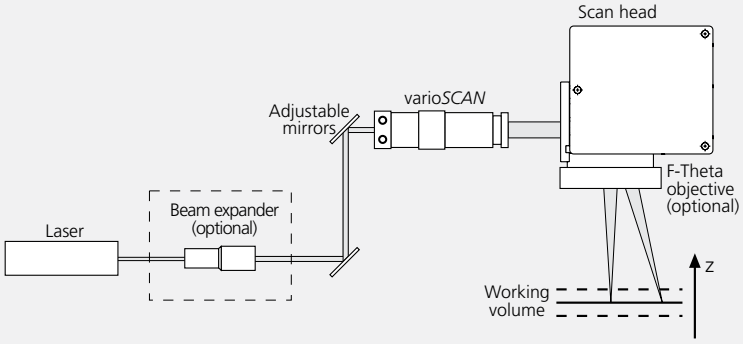
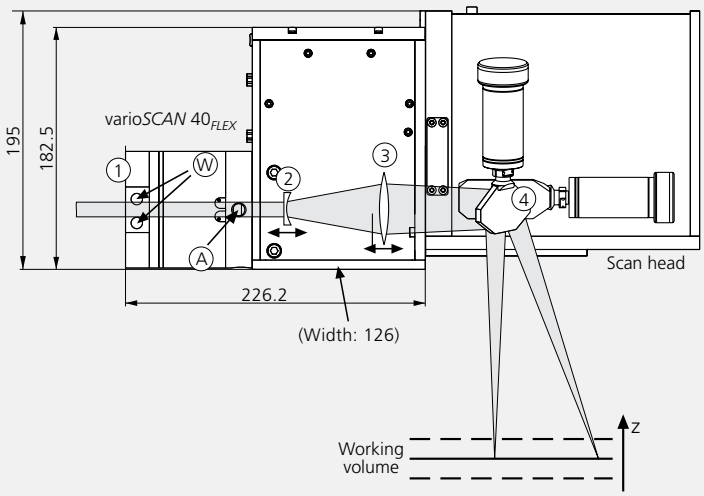
vario*SCAN* Functionality



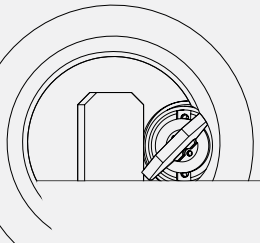




Legend

1 Water-cooled aperture
2 Linear motor with diverging optic
3 Focusing optic
4 Motorized deflection mirrors
A Connection for cooling air
W Connections for cooling water

all dimensions in mm



How it Works

During the scanning process, a diverging optic in the vario*SCAN* and vario*SCAN*$_{de}$i is positioned with high dynamics along the optical axis with respect to a stationary focusing optic. This produces a change in the system's overall focal length, synchronized with the mirror motion. The vario*SCAN* and vario*SCAN*$_{de}$i focusing unit can thereby expand 2D scan systems into 3-axis scan systems. In 2D applications, the vario*SCAN* and vario*SCAN*$_{de}$i can replace costly flat field objectives. In 3D beam deflection systems it enables processing in three dimensions.

The focusing optic of the vario*SCAN* 40$_{FLEX}$ is motor-driven, enabling continuously variable image field sizes and working distances. The vario*SCAN* 40$_{FLEX}$'s housing contains all optical components and the electronics.

For scan systems with apertures exceeding 40 mm, SCANLAB offers the vario*SCAN* 60, 60i, 80 and 80i and the vario*SCAN* FC.

Control

The vario*SCAN*$_{de}$i is equipped with a digital standard interface and is easily controlled – even synchronously with a 2D scan system – via SCANLAB's RTC 4 or RTC 5 PC interface board.

The vario*SCAN* is available for digital and analog-based control.

Optics

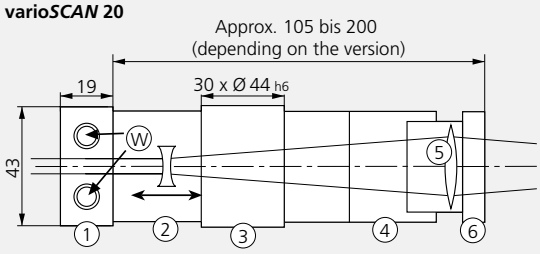
SCANLAB offers – for vario*SCAN,* vario*SCAN*$_{de}$ i and the whole scan system – optical configurations for a wide variety of working distances, image field sizes, beam diameters, wavelengths and laser powers for optimally tuning the system to the customer's particular application. Thus, a maximum image field size is achieved with the minimum spot size.

The vario*SCAN* 40 and vario*SCAN*$_{de}$ 40i allows the customer to self-install various exchangeable optics sets. The vario*SCAN* 40´s and vario*SCAN*$_{de}$ 40i's integrated air and water cooling ensure operation at very high laser powers. The vario*SCAN*$_{de}$ 20i is equipped with a water-cooled entrance aperture.

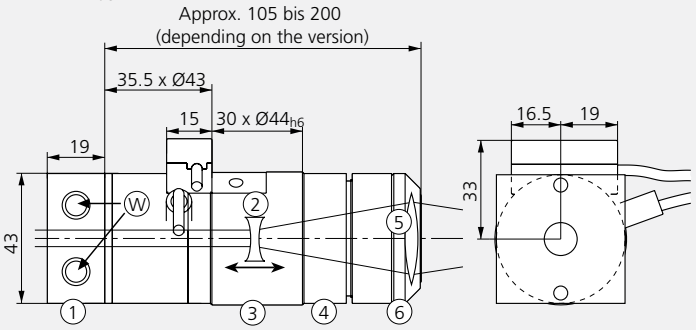
Options

- vario*SCAN* 20 also available with water cooling
  (standard for vario*SCAN*$_{de}$ i systems)

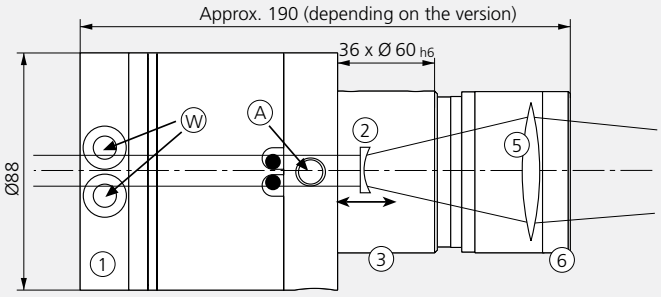
vario*SCAN* 20



vario*SCAN*$_{de}$ 20i



vario*SCAN* 40/40i



Legend

1 Water-cooled aperture
(optional for vario*SCAN* 20)
2 Linear motor with
diverging optic
3 Clamping surface
4 Objective adapter
5 Focusing optic
6 Focusing ring
A Connection for cooling air
W Connections for cooling water

all dimensions in mm

Typical 3-Axis Scan System Optical Configurations

	varioSCAN$_{de}$ 20i		varioSCAN$_{de}$ 40i	varioSCAN 40$_{FLEX}$ / varioSCAN$_{de}$ 40i$_{FLEX}$	
Laser	Nd:YAG	Nd:YAG x 3	CO_2	CO_2	
Wavelength	1064 nm	355 nm	10.6 µm	10.6 µm	
XY scan unit	10 mm aperture	14 mm aperture	30 mm aperture	30 mm aperture	
Flat field objective	with f = 160 mm	without	without	without	
Image field size	(110 x 110) mm²	(600 x 600) mm²	(500 x 500) mm²	(200 x 200) mm² to (2000 x 2000) mm²	[e.g.(1) (600 x 600) mm²]
Focus range in z direction	± 32 mm	± 80 mm	± 70 mm	±2 mm to ±400 mm	[e.g.(1) ±40 mm]
Focus diameter (1/e²)	< 35 µm (M²= 1)	< 70 µm (M²= 1)	570 µm (M²= 1)	200 µm (M²=1) to 1.8 mm (M²=1)	[e.g.(1) 550 µm (M²=1)]
Beam expansion factor	2.8	3.8	2.05	2.4 to 1.9	[e.g.(1) 2.1]
Average focus shift per lens travel	16 mm/mm	71 mm/mm	40 mm/mm	-	-
Focal length varioSCAN	-	(1390 ± 143) mm	(850 ± 118) mm	(395 ± 18) mm to (2850 ± 600) mm	[e.g.(1) (940 ± 60) mm]
Max. laser power cw	60 W	25 W	2000 W	500 W	

(1) Example for a possible position of the focusing unit

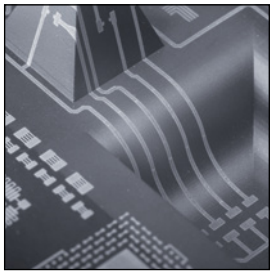
Type-Dependent Specifications

	varioSCAN$_{de}$ 20i	varioSCAN 20	varioSCAN$_{de}$ 40i / 40i$_{FLEX}$	varioSCAN 40 / 40$_{FLEX}$
Beam input aperture	up to max. 8 mm	up to max. 8 mm	up to max. 16 mm	up to max. 16 mm
Output aperture	up to max. 20 mm	up to max. 20 mm	up to max. 40 mm	up to max. 40 mm
Motor specifications				
Maximum lens travel	±2 mm	±1 mm	±3 mm	±1.5 mm
Tracking error	0.55 ms	0.9 ms	0.7 ms	1.4 ms
Typical travel speed	≤280 mm/s	≤140 mm/s	≤140 mm/s	≤100 mm/s
Repeatability	< 0.5 µm	< 1 µm	< 0.5 µm	< 1 µm
Nonlinearity	0.05 % FS	1.5 % FS	0.05 % FS	1.5 % FS
Long-term drift (over 8 hours, at constant environmental conditions)	< 3 µm	< 6 µm	< 3 µm	< 10 µm
Power requirements	30 V DC (29-33V), max. 1.5 A each	±(15+1.5) V DC, max. 1.5 A each	30 V DC (29-33V), max. 1.5 A each	±(15+1.5) V DC, max. 1.5 A each
Electrical connections	XY2-100 Enhanced, SL2-100	XY2-100 Standard, SL2-100 or analog (2)	XY2-100 Enhanced, SL2-100 or optical data transfer (3)	XY2-100 Standard, SL2-100, optical data transfer (3) or analog (2)
Boards included	DSCB + interface board	SSV30	DSCB + interface board	SSV30
Weight (depending on optical configuration)	500 g to 700 g	500 g to 700 g	approx. 2.4 kg / 5.0 kg (4)	approx. 2.4 kg / 4.4 kg (4)

(2) analog version: input signals alternatively: ±4.8 V; ±9.6 V / ±4.8 mA; ±9.6 mA; output signals: TTL level
(3) optical data transfer only with varioSCAN 40$_{FLEX}$ and 40i$_{FLEX}$; additional step motor inputs and limit-switch output signals
(4) higher value with FLEX housing

Common Specifications

Operating temperature	25 °C ± 10 °C
Installation	horizontal position, electrically insulated, thermally connected



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SCANLAB innovators for industry

New!

z-shifting that breaks the speed limit

SCANLAB's new excelli*SHIFT* extends your 2D scan head into a **highly dynamic 3D system**. Based on tried-and-proven galvanometer technology, its completely new design drastically improves dynamic performance compared to conventional z-axes.

The Z-scanner is no longer a limiting factor, so that identical acceleration can be achieved in all in all three spatial directions.This opens up entirely new possibilities for laser processing of 3-dimensional, complexly-shaped surfaces. Moreover, the new technology uses no transmissive optical components. That means dispersion effects are avoided when working with different wavelengths, and thermal-lens effects are minimized, too.

The excelli*SHIFT* is ideal in combination with excelli*SCAN*, intelli*SCAN* and *SCAN*cube scan heads.

Key advantages:

- Extends 2D scan heads into highly dynamic 3D scan systems
- Highest reliability due to field-proven galvanometer technology
- High-dynamic processing of complex 3D-surfaces
- Designed without transmissive optical components
- Flat field correction of pre-focused systems without dynamic limitations

Preliminary specifications

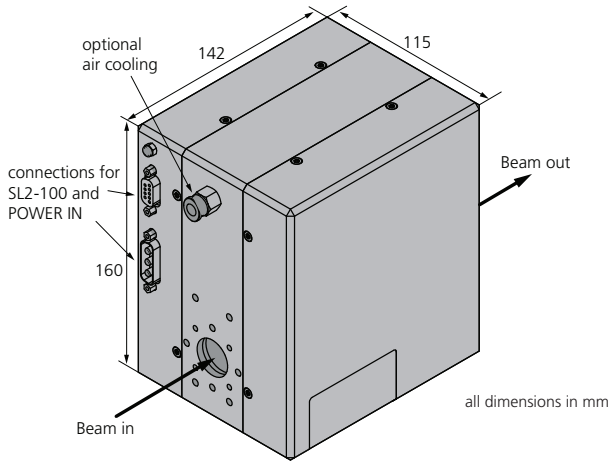
Aperture	14 mm
Wavelength	515 nm - 532 nm, 1030 nm - 1070 nm (1)
Beam expansion	1-fold
Tracking error	0.1 ms
Beam guidance	reflective
Dimensions W x H x D	(115 x 160 x 142) mm^3
Weight	3.7 kg

Focal-length-dependent specifications

Focus range (2)	±15 mm
Focus speed in image field (2)	up to 30 m/s

(1) other wavelengths available on request

(2) with f-theta lens, f = 163 mm; at larger focal lengths corresponding higher values are achieved



Typical applications:

- Micromachining
- Marking of curved surfaces
- Deep engraving
- Ultra-fast 3D processing

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SCANLAB innovators for industry

Collimation Module

fiber connection for scan heads

The **Collimation Module** enables direct connection of a fiber-coupled laser to a scan head (typical: 30-mm aperture).

Key benefits:

- Robust housing (water-cooled entrance aperture; stainless steel)
- Manually adjustable collimation optic, incl. scale ring
- Optionally with or without camera port (90°/180° variants)
- Flexible mounting possibilities
- Replaceable protective window in front of collimation optic
- Good transmission for red pilot lasers

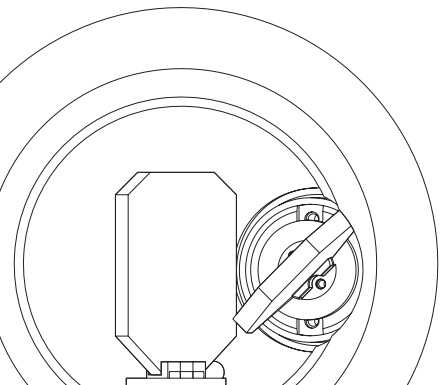
The module features robust mechanical coupling, along with optical collimation of laser radiation to match the scan head's aperture. The employed optical components are suitable for multi-kW laser powers and adaptable to various beam qualities.

Typical Applications:

- Welding, micro-welding
- Cutting
- Rapid prototyping, additive manufacturing

Typical Industries:

- Automotive
- Mechanical engineering and metalworking



SCANLAB
innovators for industry

Collimation Module

Layout and Principle of Operation

The solidly designed Collimation Module includes an adapter for mounting the module and scan system to a machine. Installation is possible from four sides, providing a high level of integration flexibility.

Various fiber adapters are offered for laser coupling. The water-cooled, stainless-steel beam entrance aperture is corrosion-free even when using DI water. A scale ring facilitates manual adjustment of the movable collimation optic. This allows precisely setting the focus position to the scan system's nominal working distance, as well as compensating for tolerances.

Housing

The Collimation Module's robust housing is dust and splash proof – particularly at the junction to the scan head. A replaceable protective window in front of the collimation optic additionally protects the lens unit from dust infiltration when changing fibers. This guarantees a long service life in industrial environments.

Optional Camera Port

The Collimation Module can be optionally equipped with a camera adapter for process control or workpiece position detection. The light arriving from the workpiece is coupled out of the laser beam path by an integrated beam splitter and directed to an observation port. The laser light itself, however, is nearly fully reflected by the beam splitter to establish a 90° angle between fiber-in and beam-out.

Specifications

Laser wavelength	1030 - 1090 nm	
Max. average laser power	5 kW [1]	
Collimator		
Fiber adapter	QBH, QD/LLK-D, Q5/LLK-B	
Focal length	116 mm	132 mm
Limiting NA (half angle)	125 mrad	110 mrad
Manual z-adjustment range	approx. ± 6 mm	
Water cooling		
Material	stainless steel	
Flow rate	5 l/min	
Compatible scan systems [2]	intelliSCAN 30, hurrySCAN 30	

(all angles are in optical degrees)

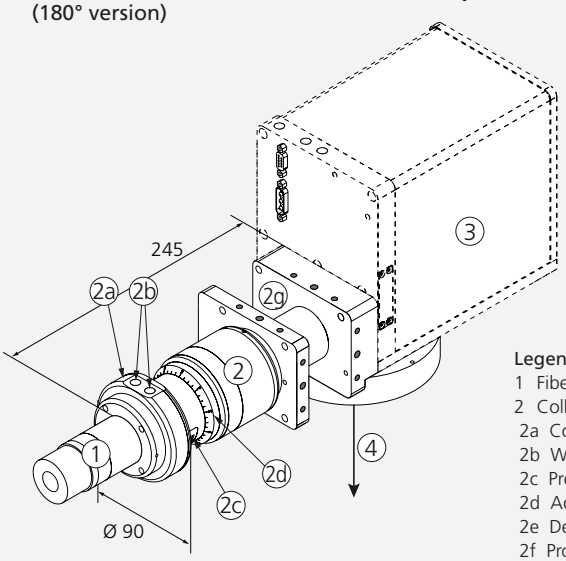
[1] depends on scan system
[2] others on request

Versions

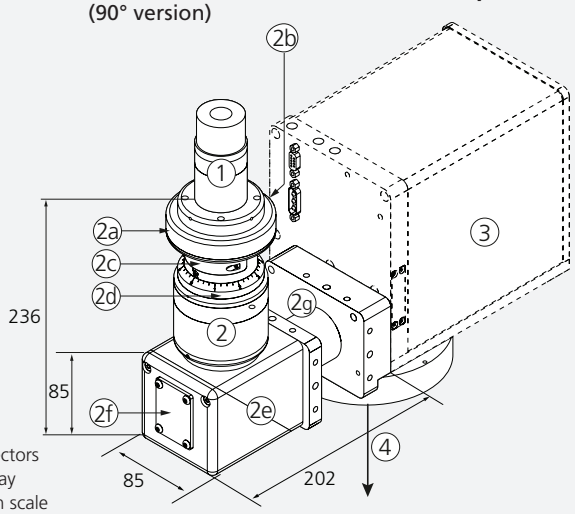
	without camera port	with camera port
Fiber adapter position	180°	90°
Camera port		
Wavelength		600 - 900 nm
Clear aperture		23 mm
Recommended objective focal length [3]		> 100 mm
Weight	4.5 kg	6 kg

[3] for 1/2" camera chip

Collimation Module without camera adapter
(180° version)



Collimation Module with camera adapter
(90° version)



Legend
1 Fiber adapter
2 Collimation module
2a Cooling ring
2b Water cooling connectors
2c Protective window tray
2d Adjustment ring with scale
2e Deflection unit
2f Process monitoring connector (under lid)
2g Adapter
3 Scan head with objective
4 Emerging beam

all dimensions in mm

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SCANLAB innovators for industry

Camera Adapter

vision for scan heads

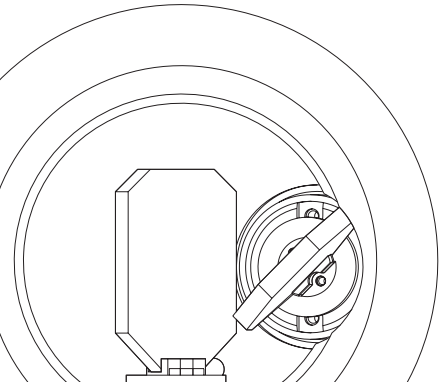
The **camera adapter** enables camera-based observation of a galvanometer scan head's working field. Typical applications include process monitoring or determination of a workpiece's orientation during laser processing.

The camera adapter ensures easy integration into new as well as existing systems. The adapter's mechanical interfaces enable straightforward mounting between the scan head and laser flange. The system allows 4 alternative orientations of the objective with camera.

To facilitate monitoring of work surfaces, light arriving from the workpiece is decoupled via the adapter's beam splitter and directed through the camera's objective onto its imaging chip. The laser beam on the other hand passes practically unattenuated through the beam splitter to the scan system. Optical configurations are available for various wavelengths. Customers can freely select a camera suitable for their requirements and attach it via a C-mount.

The camera adapter is specifically designed for maximum observation field size and its integrated iris diaphragm can be adjusted for optimal imaging quality. In addition, color or interference filters can be installed.

The camera adapter is also available as a part of SCANLAB's camera vision package.



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Camera Adapter

Installation

The camera adapter is mounted between the scan head's beam entrance and the laser flange (see drawing). The bore holes at the camera adapter's beam entrance and exit side are compatible with the mounting holes of the hurry*SCAN*/ hurry*SCAN II*, intelli*SCAN*, *SCAN*gine, *SCAN*cube or intelli*cube* scan heads from SCANLAB. The beam splitter housing can be adjusted so that the camera and objective unit are oriented either up, down or sideways (see drawing).

Principle of Operation

The camera adapter enables camera-based observation of a scan head's working field. Therefore, a dichroitic beam splitter inside the beam splitter housing decouples light reflected from the illuminated workpiece and arriving the scan head's beam entrance via the scan objective and the scan mirrors. The light is decoupled from the beam path and then directed to the camera. The laser bam on the other hand passes through the beam splitter practically unattenuated.

The decoupled light is directed through the camera objective onto the active imaging surface of the camera (e.g. CCD chip).

Threaded in the beam splitter housing, the objective unit contains the camera objective, an iris diaphragm and provisions at the beam entrance side for mounting a color filter. Camera image sharpness is achieved by manually adjusting the objective unit's focus ring.

Customers can select an illumination wavelength compatible with the optical specifications of the beam splitter, scan mirrors and other system optics.

Observation Field and Resolution

The size of the observation field depends on the focal lengths of the scan objective and camera objective and on the camera chip's size. A scan objective focal length of 163 mm typically produces a camera image field size of approx. 7.5 mm x 10 mm and a maximum optical resolution of around 10 µm (see table).

Typical Optical Configurations with Scan Head

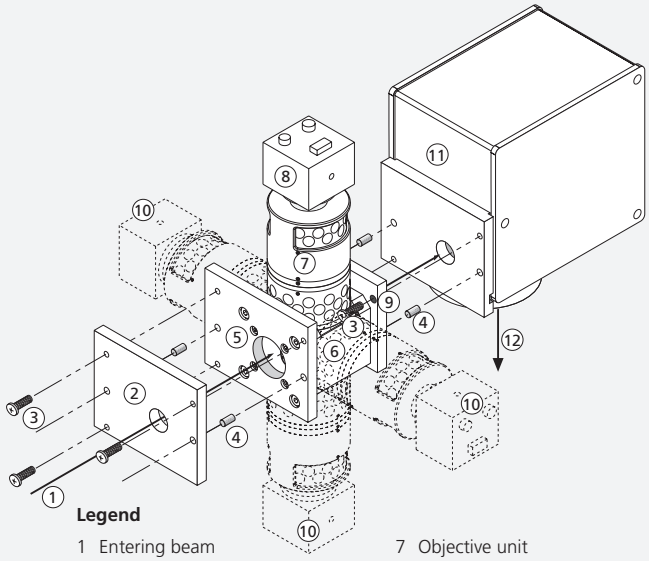
Laser wavelength	1064 nm	532 nm	355 nm	266 nm
Observation wavelength	880 nm	635 nm	635 nm	635 nm
Scan head aperture	14 mm	10 mm	10 mm	10 mm
Scan head mirror coating [1]	1064 nm + 880 nm	532 nm + 635 nm	355 nm + 635 nm	266 nm + 635 nm
Flat field objective	163 mm	160 mm	100 mm	103 mm
Processing field size	110 x 110 mm²	110 x 110 mm²	50 x 50 mm²	50 x 50 mm²
Beam splitter				
Laser wavelength	1030 nm - 1110 nm	488 nm - 532 nm	350 nm - 360 nm	257 nm - 266 nm
Range for observation wavelength[1]	450 nm - 900 nm	615 nm - 900 nm	510 nm - 680 nm	630 nm - 670 nm
Focal length camera objective	105 mm	105 mm	105 mm	105 mm
Camera chip size	1/2"	1/2"	1/2"	1/2"
Interference filter	880 nm	635 nm	635 nm	635 nm
Observation field size	approx. 7.5 x 10 mm²	approx. 7 x 9.5 mm²	approx. 5 x 6.5 mm²	approx. 5 x 6.5 mm²
Max. optical resolution	approx. 10 µm	approx. 15 µm	approx. 10 µm	approx. 10 µm

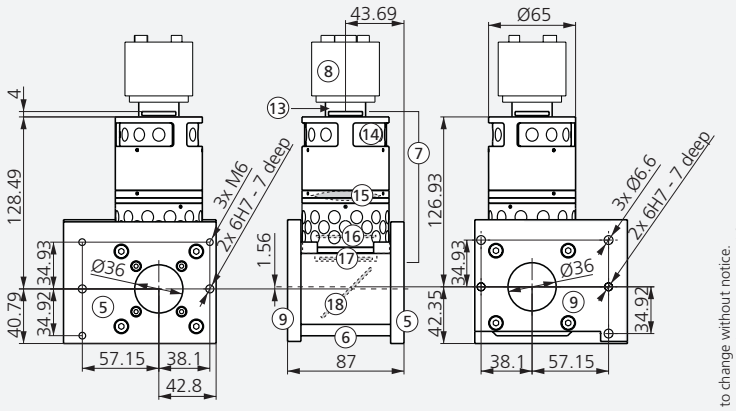
[1] observation only in the wavelength range reflected by the scan mirrors

Common Specifications

Diameter of entering beam	max. 30 mm [1]
Camera	
Connection type	C-Mount
Maximum chip size	2/3"
Weight (without camera)	approx. 1.6 kg
Operating temperature	25 °C ± 10 °C

[1] depending on the scan head





Legend

1 Entering beam
2 Laser flange [a]
3 Mounting screws [a]
4 Alignment pins [a]
5 Beam-entrance side camera adapter
6 Beam splitter housing
7 Objective unit
8 Camera [a]
9 Beam-exit side camera adapter [b]
10 Alternative orientation
11 Scan head [a]
12 Emerging beam
13 C-mount extension (optional)
14 Focus ring
15 Camera objective
16 Iris diaphragm
17 Color filter [a]
18 Beam splitter

all dimensions in mm

[a] not included
[b] for *SCAN*cube and intelli*cube* scan heads, the camera adapter is equipped with a special adapter plate at its beam-exit side

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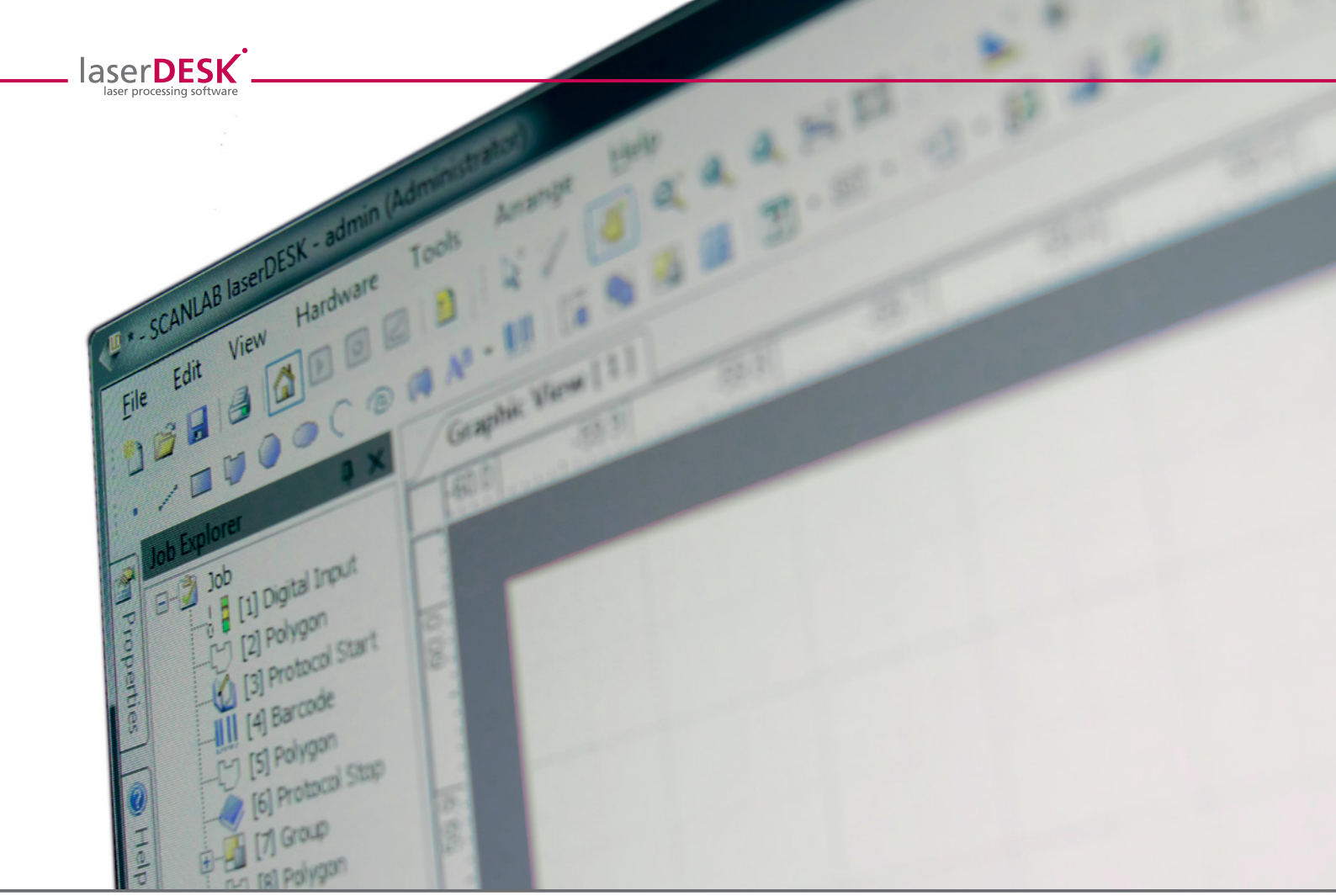
SCANLAB innovators for industry



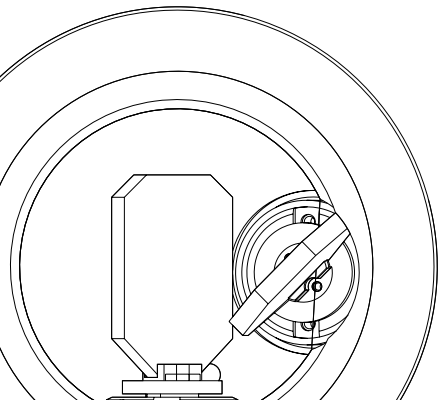
from process development to processing

laserDESK is the program professionals use to set up and perform laser processing. It takes full advantage of the functionality in SCANLAB's newest control boards and scan systems.

laserDESK enables:

- **Easy setup and execution** of laser processing jobs for diverse applications
- **Professional process development** for laser applications utilizing the numerous functionalities of RTC boards with the SL2-100 interface
- **Series-production safety** via integrated automation and user-privilege capabilities
- ***SCAN*ahead Technologie** is automatically supported when using RTC6 and excelli*SCAN* systems, the setting of the classical delay parameters becomes needless
- **Integration in diverse manufacturing environments** via support for numerous laser types and axis controllers
- **Simplified equipment setup and workflow** thanks to modal wizards
- **Quick time-to-market** of innovative projects and processes via unified software for development and series production
- **Optimal integration** of SCANLAB components such as *SCAN*align, 3D systems or vario*SCAN*$_{FLEX}$

Our team of expert programmers ensures future-proof, on-going development using .NET Frameworks.



SCANLAB
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Operational Flexibility

laserDESK lets you create or execute laser jobs and professionally set up your laser systems. It features an intuitive graphical user interface. Automation solutions are implemented in a variety of ways to accommodate particular system designs.

Graphical Processing

Visualization and Object Editing

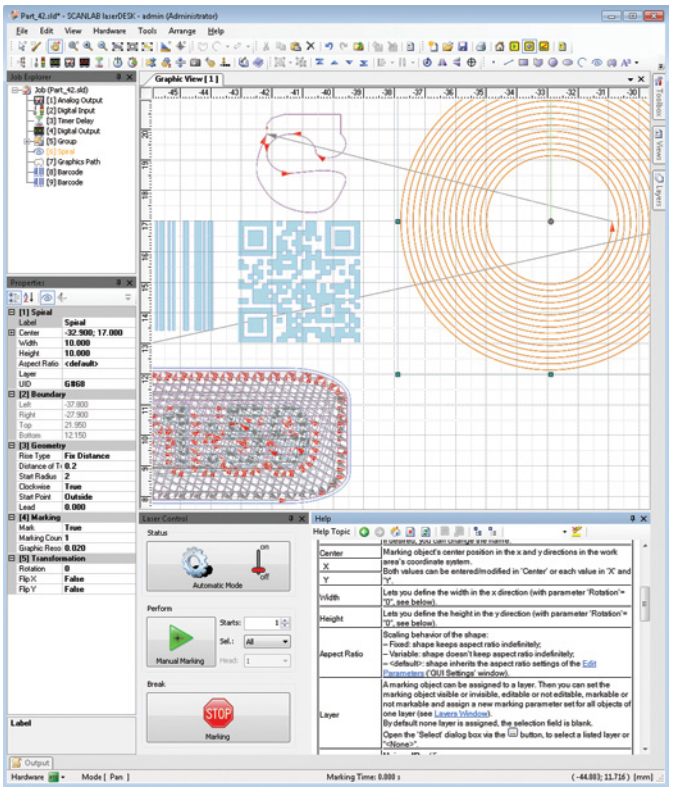
- Comprehensive functionality for object editing and creation
- User management with different privilege levels
- Visualization of process sequences, output data and protocolled data

Dialog-based Control

- Wizards for hardware configuration and calibration, e.g. the Parameter Wizard
- Modal dialogs for hardware configuration
- Interactive dialoges, e.g. for laser and motor control

Sequence Control

- Define the job's process sequence
- Automatic sorting of fillings and graphic sets
- Conditional execution of job versions by hardware signals



Parameter Sets

- Object-dependend definitions
- Assignment to groups or layers
- Library management

Switchable program profiles

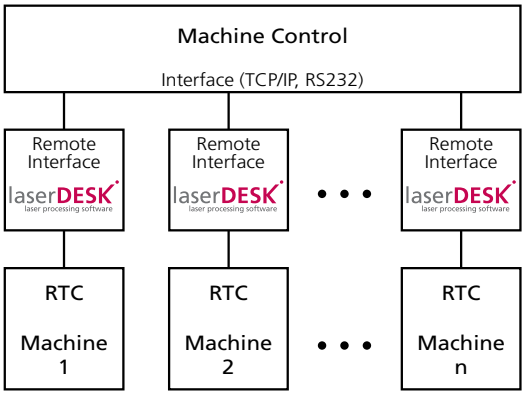
- Creation and direct testing with the design profile
- Projection-based positioning and previewing with the pilot laser profile
- Simple series production with the production profile

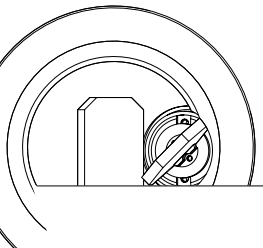
Automated Processing

The programmable remote interface provides countless possibilities for intelligent integration into automated manufacturing environments – e.g. within the framework of Industry 4.0. Processes can be flexibly executed. laserDESK's diverse communication options allow integration in production systems as master or slave.

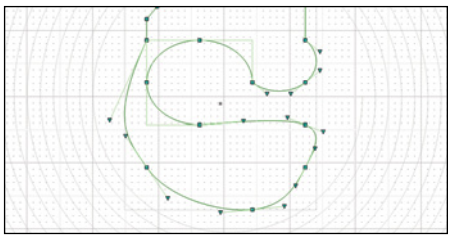
Automation by Remote Interface

- Activation of hardware and laser system
- Loading and execution of jobs and variants
- Updating of text content or vector data
- System-status monitoring during execution
- Integration of external sensors into the processing sequence





laserDESK provides diverse tools for setting up, executing, optimizing and managing complex laser processing tasks, as well as for directly controlling RTC boards.

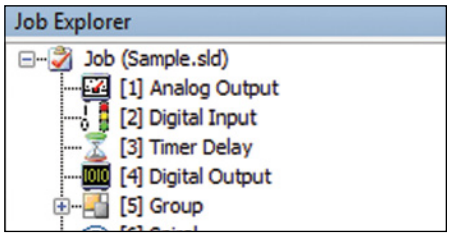


Markable Objects

In addition to point and line objects, complex marking objects such as graphic paths or 3D spirals are available. For creation, you can use Bézier curves or circle segments, which will be automatically prepared for laser processing. Those marking objects can be previewed graphically prior to execution. All objects are easily created, modified or positioned with the mouse or via direct input of coordinates.

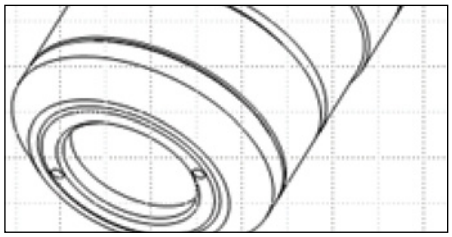
Typography and Numerals

All TrueType fonts are available for text marking. Coding algorithms are integrated for single-line typefaces, outputting barcodes or 2D codes. At runtime, the content of text objects can be automatically sequenced and loaded, or individually assigned by remote control.



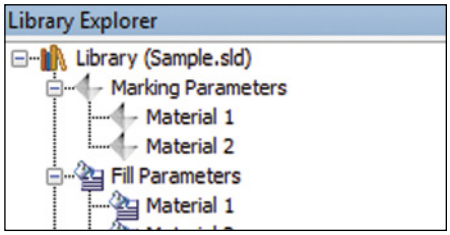
Safety and Control Elements

Analog and digital inputs and outputs of the RTC boards are fully integrated. This facilitates implementation of safety circuits and allows signals for initialization and monitoring of specialized laser types during job execution. Additionally, control signals can be outputted or queried during job processing.



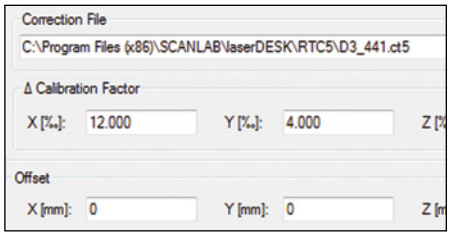
File Import

Import lets you load image files for bitmap processing and vector files for pre-defined 2D shapes or 3D object structures. During import, vector data can be sorted and collected. These objects are scalable, rotatable and positionable. Vector data can also be post-processed at the point level.



Parameter Sets

All object parameters can be easily edited in a clearly-structured properties list. Here, separate data sets are defined for object, text, fill and bitmap parameters. These parameters can be assigned individually to each object or managed collectively via the library. You can easily assign parameters collectively to objects in groups or layers.



Positioning Corrections

SCANLAB correction files ensure correctly scaled object processing by the scan system. Positioning corrections are globally defined in the job via offset, scaling and rotation. The integrated pilot-laser profile lets you visually place marking positions relative to the workpiece. SCANLAB also offers it's fully integrated, camera-based *SCAN*align software package as an alternative process calibration solution.

3D Calibration Wizard

Calibrating 3-axis scan systems is a very involved task, but laserDESK's new 3D calibration function does make it much easier now. A dialog wizard fully guides the user through the complex calibration process, resulting in an individualized, specific 3D correction file with which the system is optimally calibrated.

UltraFastPixelMode (UFPM)

laserDESK also supports RTC6 control boards with the activated UFPM option. With the UltraFastPixelMode feature, pixel frequencies up to 3.2 MHz are achievable.

Spot Distance Control (SDC)

laserDESK supports the SDC option for enhanced **speed-dependent laser control** in combination with excelli*SCAN* scan heads and RTC6 control boards. When used with pulse-on-demand capable laser systems, a constant pulse distance can be ensured along any contour.

Protocol Function

In conjunction with digital-servo scan systems of the intelli*SCAN* and excelli*SCAN* product families, laserDESK can query the traversed trajectory after processing and display it graphically. This enables tuning of marking parameters independently of contour fidelity or downstream quality control.

*SCAN*ahead Technology

The laserDESK software can be used together with the combination of SCANLAB's excelli*SCAN* scan head and RTC6 PCI Express Board. In order to fully utilize the new features of the *SCAN*ahead technology, the laserDESK software is extended by some additional functions.

Calibration and Positioning with *SCAN*align

The *SCAN*align stand-alone software-package is perfectly integrated in laserDESK and enables optimal inclusion of a camera calibrated to the scan system. Varied optical coupling allows mounting of the camera coaxially or side-ways. *SCAN*align provides easy visualization of sequences for calibration and job creation, thus significantly boosting the accuracy of text positioning and sizing.

Support and Service

Comprehensive English-language laserDESK documentation is provided as context-sensitive help. Responsive customer support is offered for laserDESK and SCANLAB regularly posts software updates on its website.

Hardware Requirements

- PC with Windows OS (.NET 4.5)
- USB port for dongle
- RTC5 or RTC6 board

Features of the Version 1.4

	Basic	Standard	Premium	Office
RTC integration	●	●	●	n. a.
Markable objects	●	●	●	●
Typography	○	○	●	●
Graphical editing	○	●	●	●
Fillings	○	●	●	●
Laser support	○	●	●	n. a.
Control elements	-	●	●	●
Variants	-	●	●	●
Pilot laser mode	-	●	●	n. a.
Privilege settings	-	●	●	●
Marking on the fly	-	●	●	n. a.
Layers	-	○	●	●
Wizard-based control	-	●	●	n. a.
Protocol function	-	●	●	n. a.
Sky-Writing	-	●	●	●
2nd scan head	-	●	●	n. a.
Remote interface	-	-	●	●
Tiling	-	-	●	●
*SCAN*align integration	-	-	●	○
Speed-dependent laser control	-	-	●	○
*SCAN*ahead technology	-	-	●	○
UltraFastPixelMode (UFPM)	-	●	●	●
RTC6 Ethernet	-	●	●	○
3D Calibration Wizard	-	-	●	n.a.
Working volumes	2D	2,5D	3D	3D
Languages	en	de, en, ru, zh		

*) The Office Edition is executable without RTC board and serves exclusively to create and store jobs

- ● enabled
- \- not enabled
- ○ limited use
- n.a. not applicable, because hardware isn't addressable

Test laserDESK now!

Software download: www.scanlab.de/downloads
(Can also be tested without dongle in demo mode.)

Demo Video:

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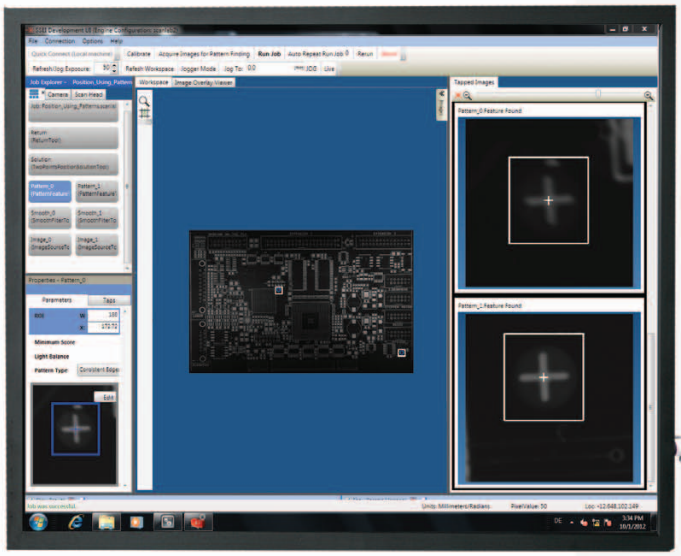
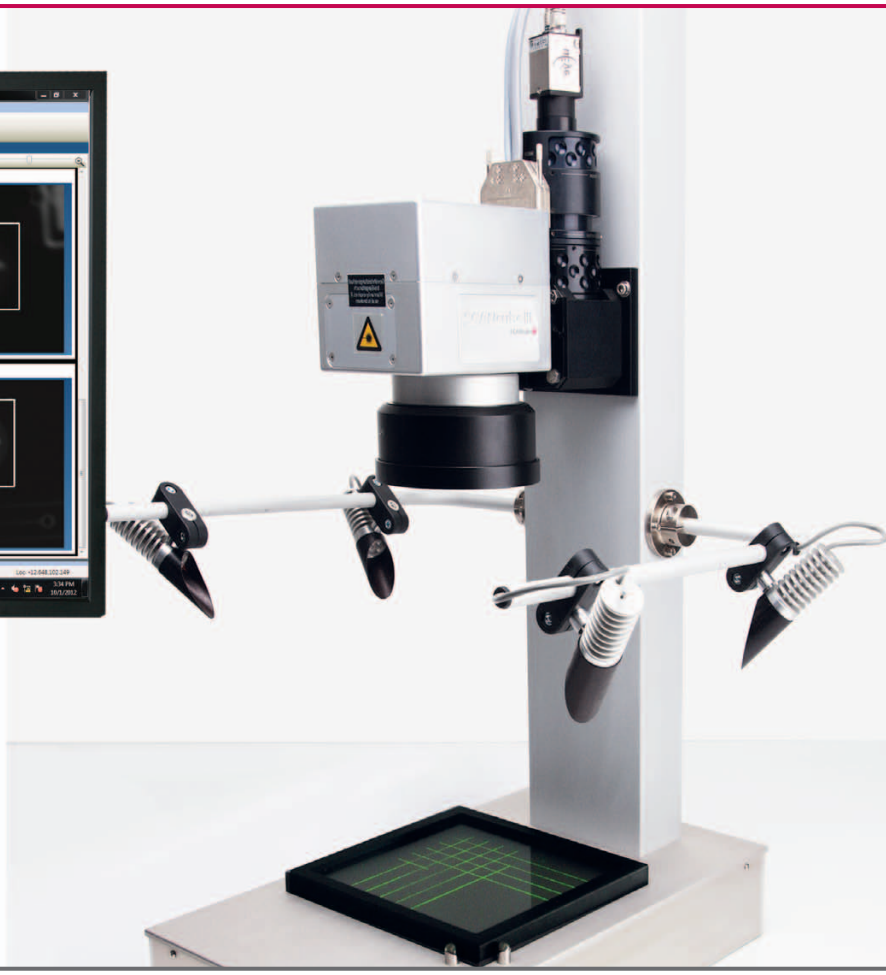
SCANLAB innovators for industry





self-aligned laser processing

*SCAN*align is a complete, easy-to-use **vision solution** specifically developed for laser scan systems. *SCAN*align extends your scan system with highly precise calibration of the whole working field, automatic process alignment and visual quality control of laser processing results.

*SCAN*align's software enables:

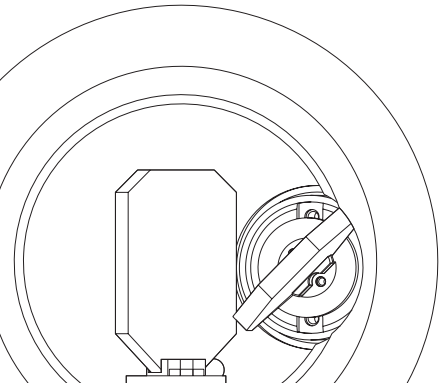
- Fast, high-precision calibration of the complete laser system,
- Ultra-accurate measuring of positions within the scan system's working field,
- Automatic alignment of laser processes to workpiece positions,
- Capture of correctly-scaled and straightened images in the scan system's working field before and after laser processing,
- Integration with laserDESK laser processing software.

*SCAN*align's key components are a software package, a camera, suitable illumination and a high-precision calibration plate.

- All components seamlessly integrate with SCANLAB's scan heads, camera adapters and RTC5 control boards.
- All components are perfectly matched to each other.
- All *SCAN*align packages are adaptable to customers' specific laser application requirements.

The camera captures images either coaxially via a camera adapter or side-mounted via a standard objective. *SCAN*align's algorithms ensure transfer of generated image data as laser coordinates, thus enabling direct correction of laser scan processes.

All *SCAN*align functionality is accessible via a graphic user interface (GUI), eliminating the need for programming expertise. A complete system calibration can thus be performed within a short period of time. The GUI lets you directly create new vision jobs or modify existing ones. These typically contain functions for image capture and smoothing, as well as for pattern recognition and defining position data.



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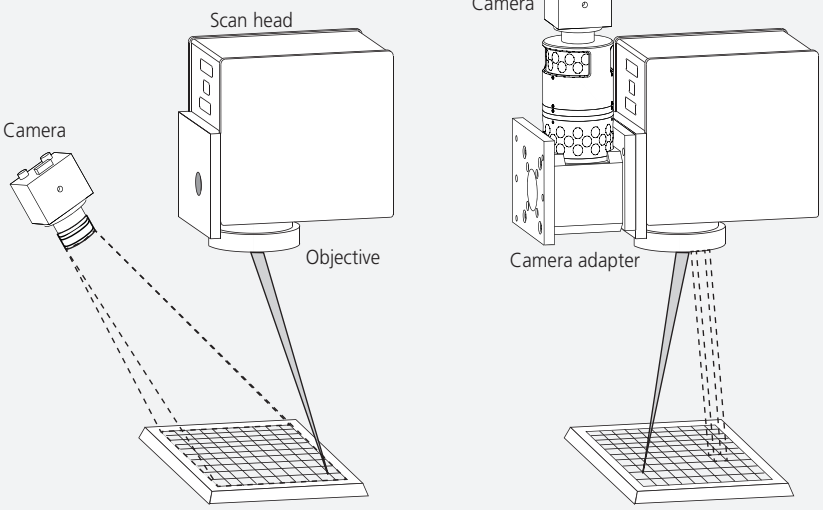
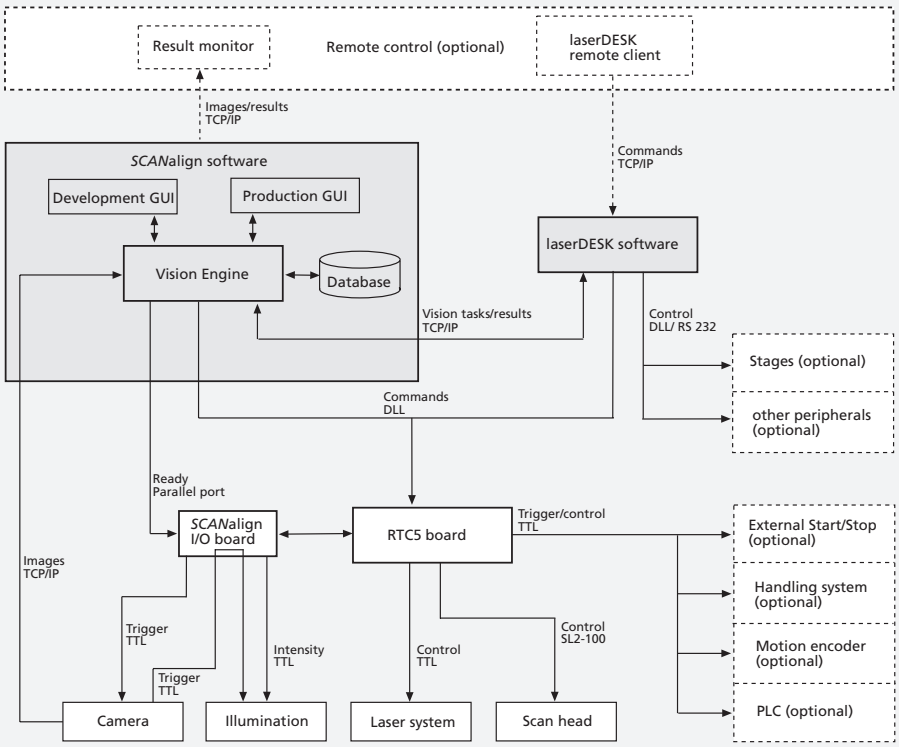


(a) side-mounted camera set-up

(b) coaxial camera set-up



System Set-Up and Control

The diagrams on the left depict two different approaches to configuring a laser scan system for *SCAN*align: with a side-mounted camera (a) or with an integrated camera (b). Both configurations allow GUI-based calibration and control, thereby enabling adaptation of camera hardware to your system's design specifics.

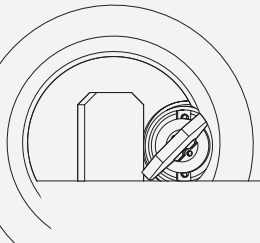
In addition to the software and camera, *SCAN*align also includes interfaces and complete pluggable cabling for communication between the RTC 5 board, camera, illumination and laserDESK software.

*SCAN*align provides two software GUIs: a Development Interface and a Production Interface. These configure the software and facilitate definition and execution of vision jobs. The Vision Engine runs in the background and communicates with the GUIs, laserDESK, an RTC 5 board, the camera and an included database. Vision jobs created with the Development Interface can be started directly over TCP/IP on the Vision Engine for automatic processing via the laser processing software. These coordinate image capturing and analysis.

Functional Principle

Camera calibration is performed for the laser coordinates of each mirror position. This ensures that the laser will mark the exact position determined by software analysis of the camera's images. Calibration takes all possible influencing factors into account – e.g. mirror positions, objective distortion and system alignment tolerances.

A calibration plate is used to perform absolute calibration of field coordinates for the overall laser scan system. This is a straightforward way to quickly, economically and precisely optimize each system's laser processing. For production involving multiple systems, this substantially simplifies system-specific correction of processing jobs.



*SCAN*align's Vision Engine automatically provides undistorted, correctly-scaled camera images – as shown top right.

*SCAN*align vision jobs can automatically analyze these corrected images, e.g. for determining a workpiece's position and orientation using reference marks or other geometric properties of the workpiece. The Vision Engine provides analysis results that the laser scan application can use to align scan patterns relative to a workpiece's actual position and orientation. By creating this automation, *SCAN*align delivers optimal processing results while eliminating the need to precisely position workpieces within a scan head's working field.

User-Friendly GUIs

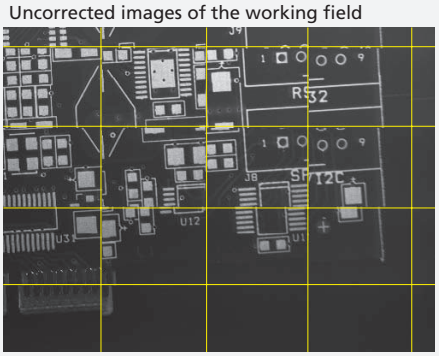
The easy-to-use **Development Interface** lets users calibrate the scan system, as well as define and execute vision jobs – as shown on the right. Jobs can be stored in the associated database as a starting point for further job definitions. The software includes a set of predefined job templates.

The **Production Interface** enables users to view *SCAN*align's intermediate results (e.g. images) and corrections. You can run it either on your local computer or over TCP/IP on a remote PC for monitoring results during production.

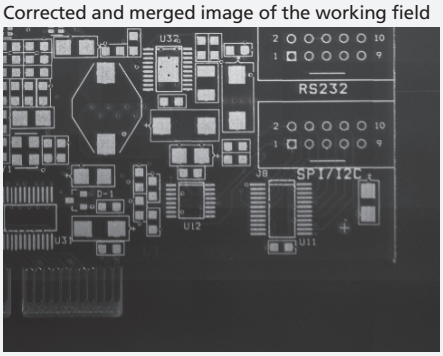
Integration with laserDESK

*SCAN*align seamlessly integrates with the laserDESK software. Predefined vision jobs can be easily integrated into a laserDESK job. The Vision Engine executes and returns results for jobs launched via laserDESK. Additionally, laserDESK can directly display the most recently captured, correctly-scaled camera image as a GUI-background image. This facilitates straightforward manual alignment for laser marking, as well as direct process structuring on workpieces.

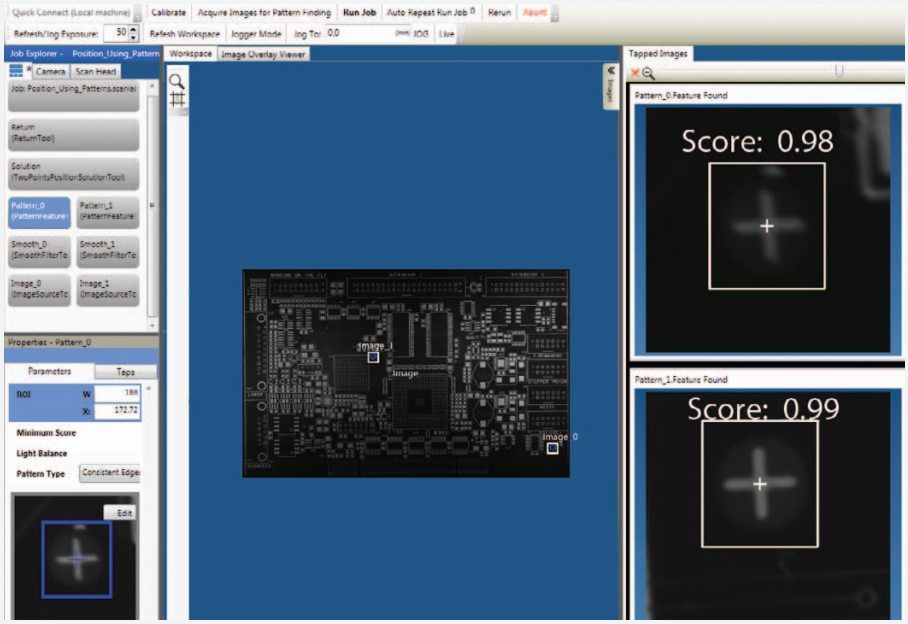
Uncorrected images of the working field



Corrected and merged image of the working field

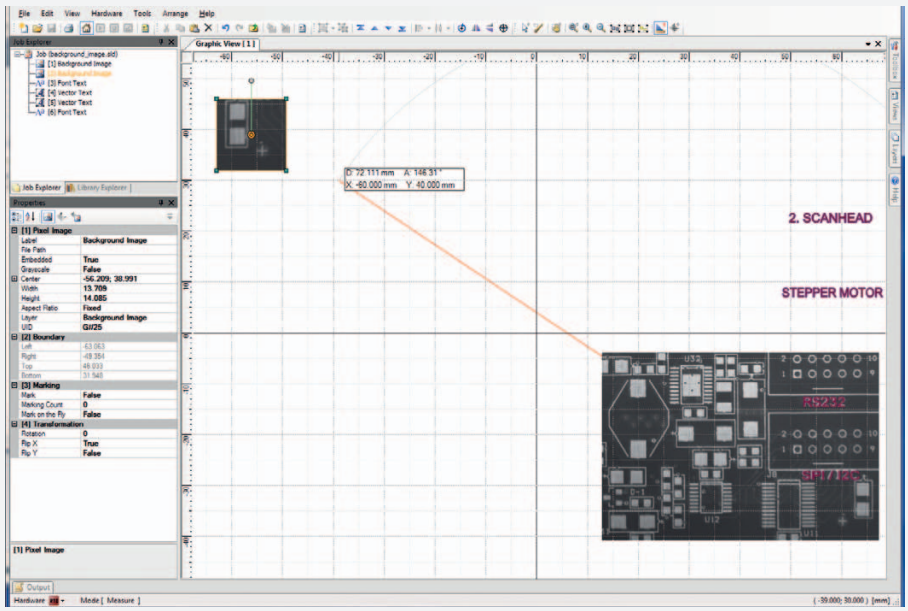


Development GUI (development of a pattern matching vision job for fiducial detection on an electronic board)



job explorer | full working field with image locations | tapped images of detected features

laserDESK GUI with background image



Example Configuration

	coaxial camera set-up	side-mounted camera set-up
Scan head aperture	14 mm	14 mm
Scan objective	255 mm	255 mm
Control board	RTC 5	RTC 5
Laser wavelength	1064 nm	1064 nm
Camera	1 megapixel	5 megapixel
Camera triggering	hardware signal	software signal
Power supply	via PC	via PC (PoE possible)
Camera objective	f = 105 mm (camera adapter)	f = 8 mm (standard camera objective)
Calibration plate	glass plate (180 x 180) mm^2	mylar (180 x 180) mm^2
Illumination / Filter	617 nm, included in package	ambient light
Processing field size	(170 x 170) mm^2	(170 x 170) mm^2
Camera field of view (max.)	(16 x 13) mm^2 single image, merged images possible	(180 x 180) mm^2
Effective pixel resolution	13 µm	100 µm
Absolute accuracies (by calibration)	10 µm	50 µm
Relative accuracies (position detection)	5 µm	50 µm
Scaled and undistorted images	yes	yes
Position detection	yes	yes (optional)
Laser systems calibration	yes	yes (optional)
Drift compensation	yes	no (by calibration)

Typical *SCAN*align Packages [1]

	coaxial camera set-up	side-mounted camera set-up
Included parts	*SCAN*align software	*SCAN*align software
	*SCAN*align IO board	*SCAN*align IO board
	Cabling, 5m	Cabling, 5m
	Camera	Camera incl. objective
	Camera filter and mount	
	Illumination at 617 nm	
	Illumination controller	
Options	Calibration plate	Calibration plate
	laserDESK software (premium)	laserDESK software (premium)
	Various illumination options (e.g. illumination at 850 nm)	
System requirements	RTC5 board	RTC5 board
	Scan head	Scan head
	Laser System	Laser System
	Scan head objective	Scan head objective
	Desktop PC	Desktop PC
	Camera adapter	Camera mounting fixture

[1] All components (especially illumination parts and camera as well as scan head and camera adapter optics) must be selected according to the requirements of the specific laser application.

PC System Requirements

- Desctop PC with PCI or PCIe bus
- RTC5 control board
- 32-bit or 64-bit operating system: Windows 7, Windows XP
- USB ports for *SCAN*align/laserDESK dongles
- PC internal power supply with 12 V and 5 V;
  - max. 0.5 A for camera and controls,
  - max. 2 A when used for lighting

Service Offerings

- Training on a demo system at SCANLAB
- Development of customer-specific vision jobs
- Customer support on illumination and installation

Key Functions of *SCAN*align Software:

- Calibration of the scan head's working field
- Highly precise detection of workpiece positions (e.g. edge finder, ridge finder, pattern matching)
- Ultra-accurate positioning of the laser beam for marking applications and other laser processes
- Straightforward integration into existing systems
- Documentation of laser processing results
- Laser processes previewed as background images in laserDESK GUI

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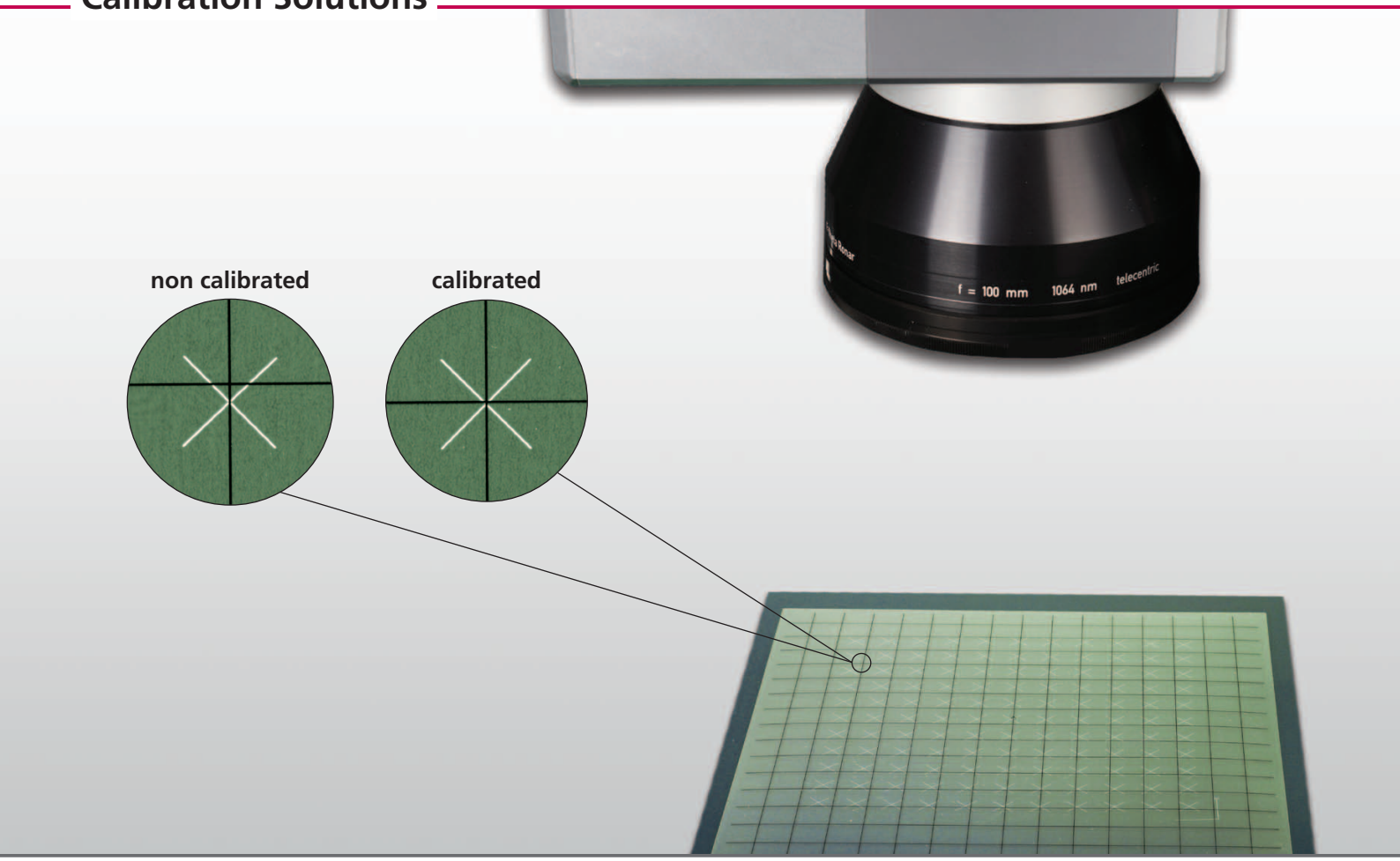


perfect solution for your workflow

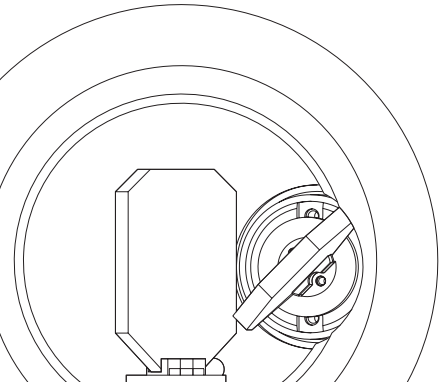
2D scan systems with an F-Theta objective produce characteristically distorted image fields. This is particularly noticeable when marking repetitive, large-area grid patterns.

For SCANLAB scan systems used in conjunction with RTC boards, such image field distortion can be compensated by standard correction files.

RTC correction files don't take system-specific properties into account. For applications requiring highest accuracy, special software solutions are available to create system-specific correction files.

	Accuracy [1]	Effort	Software	Required hardware
RTC correction file	< 150 µm	low	-	-
CALsheet software	< 50 µm < 30 µm	moderate	CALsheet	digital camera / smartphone flatbed scanner
correXion pro software	< 20 µm	high	correXion pro	coordinate measuring device
*SCAN*align	≥ 10 µm	high	*SCAN*align	*SCAN*align packet

[1] Typical values at f=163 mm



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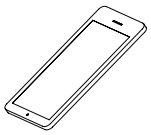
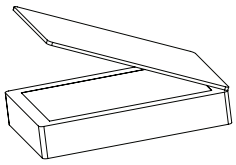
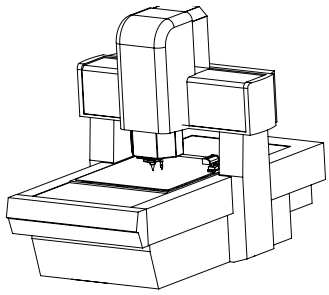
Calibration Solutions

Solution	Tool	Accuracy [1]
RTC Correction File The pre-calculated correction files are suitable for many laser scan applications, e.g. marking with normal accuracy requirements. Workflow • Load the supplied standard correction files (*ctb/*ct5) onto SCANLAB's RTC board • RTC board calculates on the basis of correction file improved output values for scan head control	Correction File	< 150 µm
CALsheet Creation of individual, system-specific correction files for applications with high accuracy requirements; ideal for simple and quick onsite checking and recalibration of a 2D scan system. Workflow 1. Mark a pre-defined grid pattern 2. Place a transparent master (supplied by SCANLAB) onto the marked pattern 3. Capture an image of the marking plus master with a flatbed scanner or suitable digital camera 4. Generate an optimized correction file using the CALsheet software in conjunction with the captured image data	Smartphone  Flatbed scanner 	< 50 µm < 30 µm
correXion pro For creating individual, system-specific correction files that achieve very high accuracy; especially for factory calibration when a coordinate measuring device is available. Workflow 1. Mark a grid pattern 2. Determine the real position of every grid point with a coordinate measuring machine 3. Create a source file for the correXion pro software 4. Generate a new, system-specific correction file with correXion pro	Coordinate measuring machine 	< 20 µm
***SCAN*align** This product isn't a calibration-only solution. Instead, it's a complete machine vision package for laser scan systems. Here, the focus is on automated process alignment and visual quality control of laser processes. Suitable for applications with the highest accuracy requirements *SCAN*align allows process-integrated calibration.	Coaxial camera set-up	≥ 10 µm

[1] Typical values at f=163 mm

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