SCANLAB AG

Applications

Principle of Operation

Products

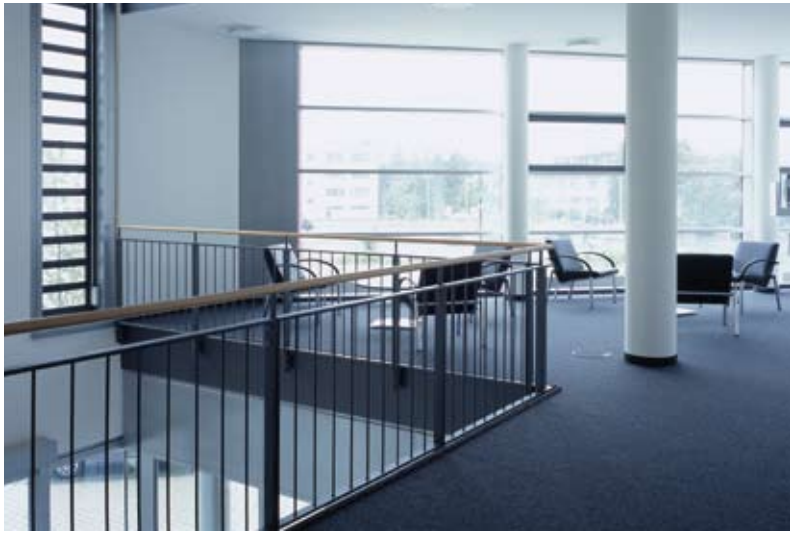
Optical Configuration

Control

i*DRIVE*® Technology

SCANLAB
innovators for industry

At Home in the World Market



The SCANLAB AG – since its founding in 1990 – has successfully focused on developing and manufacturing galvanometer scanners and scan solutions. Our products turn lasers into highly dynamic and flexible tools for materials processing. This is achieved via moving mirrors and optical elements that quickly, precisely and reliably position laser beams in three dimensions.

Our highly qualified and motivated team has accumulated extensive expertise based on delivering more than 10,000 scan solutions per year. With this solid basis, SCANLAB is the global leader in its market.


SCANLAB
Typ
SCANcube 10
SN
92069
λ
1064 nm
LINOS

Enabling Success

SCANLAB is firmly committed to high product quality and dependable deliveries. Our manufacturing processes are characterized by precisely-defined production steps and high reliability. SCANLAB has developed a comprehensive test suite that assures quality excellence. Each system is subjected to numerous tests both during and after manufacturing. Only after a product successfully passes the final test does it receive the *SCAN*check quality seal.

SCANLAB's competent customer-guidance team collaborates closely with R&D specialists in electronics, software, mechanics and optics to ensure rapid and focused fulfillment of customers' wishes and requirements. This is our way of contributing to your own success.

Shaping the Future

We leverage advances in lasers and optics to deliver innovative scan solutions, and thus contribute significantly to the creation of new application areas for laser technology.

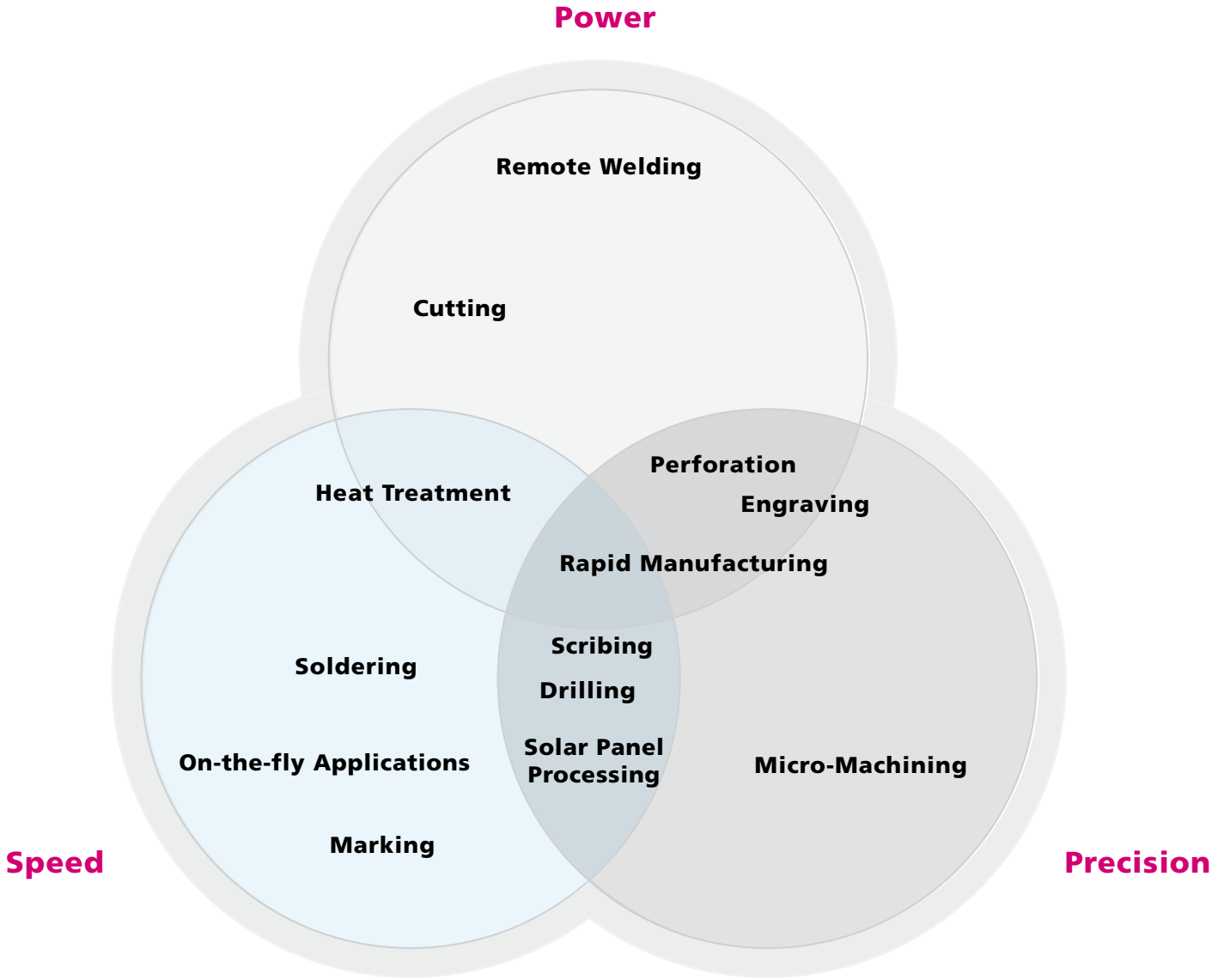
Applications

A Diversity of Applications and Requirements

Our products and services are used for laser-based materials processing (e.g. marking, welding, cutting, drilling, rapid prototyping) and medical/biomedical technology (e.g. ophthalmology, dermatology, confocal microscopy), as well as science and research. Each application area has specific – sometimes even conflicting – requirements regarding speed, precision and laser power. To address those needs, SCANLAB provides a comprehensive palette of products and custom-tailored solutions that continue to set new standards and offer forward-looking opportunities for our customers.

A Diversity of Scan Solutions

SCANLAB offers scan systems and optics for all typical wavelengths and laser powers up to the multi-kW range. Our scan systems are available with various dynamics settings, and customer-specific designs are possible, too. Product options include water cooling, air cooling and sensors for automatic self-calibration.


Power
Remote Welding
Cutting
Perforation
Heat Treatment
Engraving
Rapid Manufacturing
Scribing
Soldering
Drilling
Solar Panel Processing
On-the-fly Applications
Micro-Machining
Marking
Speed
Precision


MADE IN GERMANY
GERMANY

Principle of Operation

Beam Deflection

Laser beams are deflected via scan systems that integrate galvanometer scanners, mirrors and electronics in a sealed housing.

Beam Focusing

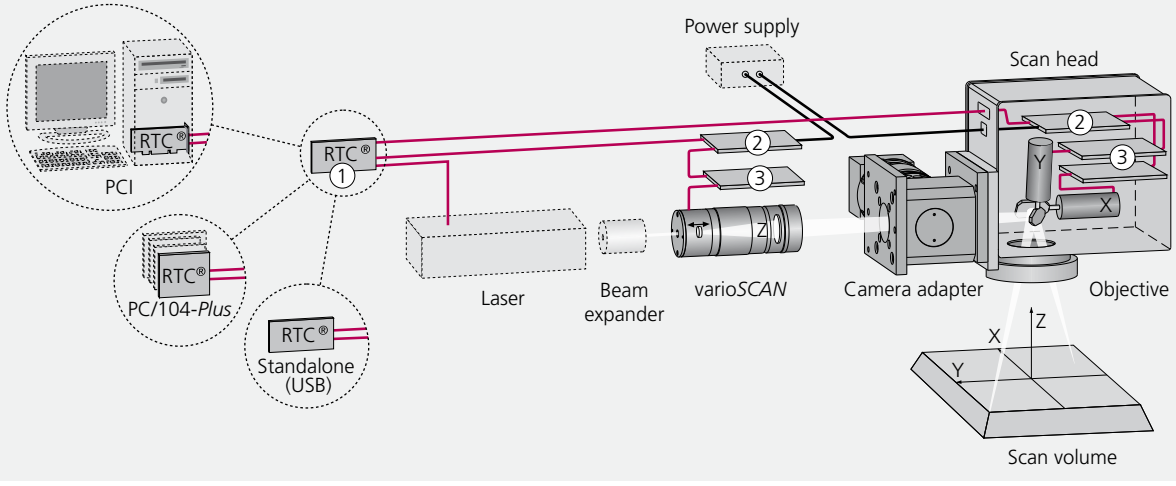
The laser beam is focused via an objective at the scan system's beam exit and/or a vario*SCAN* focusing unit at the beam entrance.

Control

For synchronized control of scan systems, lasers and peripheral equipment, SCANLAB offers its RTC® controller boards.

Process-Monitoring Interfaces

Status information generated by SCANLAB's scan systems can be evaluated to monitor operational states. For optical monitoring of work processes, SCANLAB offers camera adapters.



Legend

1 RTC® PC interface board, RTC® PC/104-*Plus* board or RTC® *SCAN*alone board
2 Digital interface
3 Digital or analog servo amplifier boards

Products

1D

SCANLAB's industry-proven galvanometer scanners and servo amplifiers are the core components for reliable laser positioning systems. The most basic product type – the single-axis module – allows positioning of laser beams in one dimension with a positioning resolution of up to 18 bit.

2D

A 2D scan module (consisting of two single-axis modules) deflects laser beams in two dimensions. Its mounting blocks are optimized for correct geometric orientation of the scanners and also provide mechanical stability to the scan system. A scan head offers the additional advantage of integrating all scan components in a sealed housing.

3D

To position the laser spot along the beam axis, the spot's focal length needs to be dynamically varied. As an add-on to 2D scan systems, SCANLAB offers its line of vario*SCAN* focusing units. 3D scan systems can be easily controlled by SCANLAB's RTC® boards, thus turning the laser beam into a flexible tool for 3D processing of materials.

Aperture, Laser Power and Dynamics

Deflection mirror size decisively influences the scan system's overall dimensions and dynamic properties. In general, higher laser powers require larger deflection mirrors (and apertures). However, maximum speeds (more than 1,000 cps) can only be obtained via small apertures. SCANLAB offers scan systems with beam-entrance apertures normally ranging from 7 to 70 mm.

7-14 mm Aperture

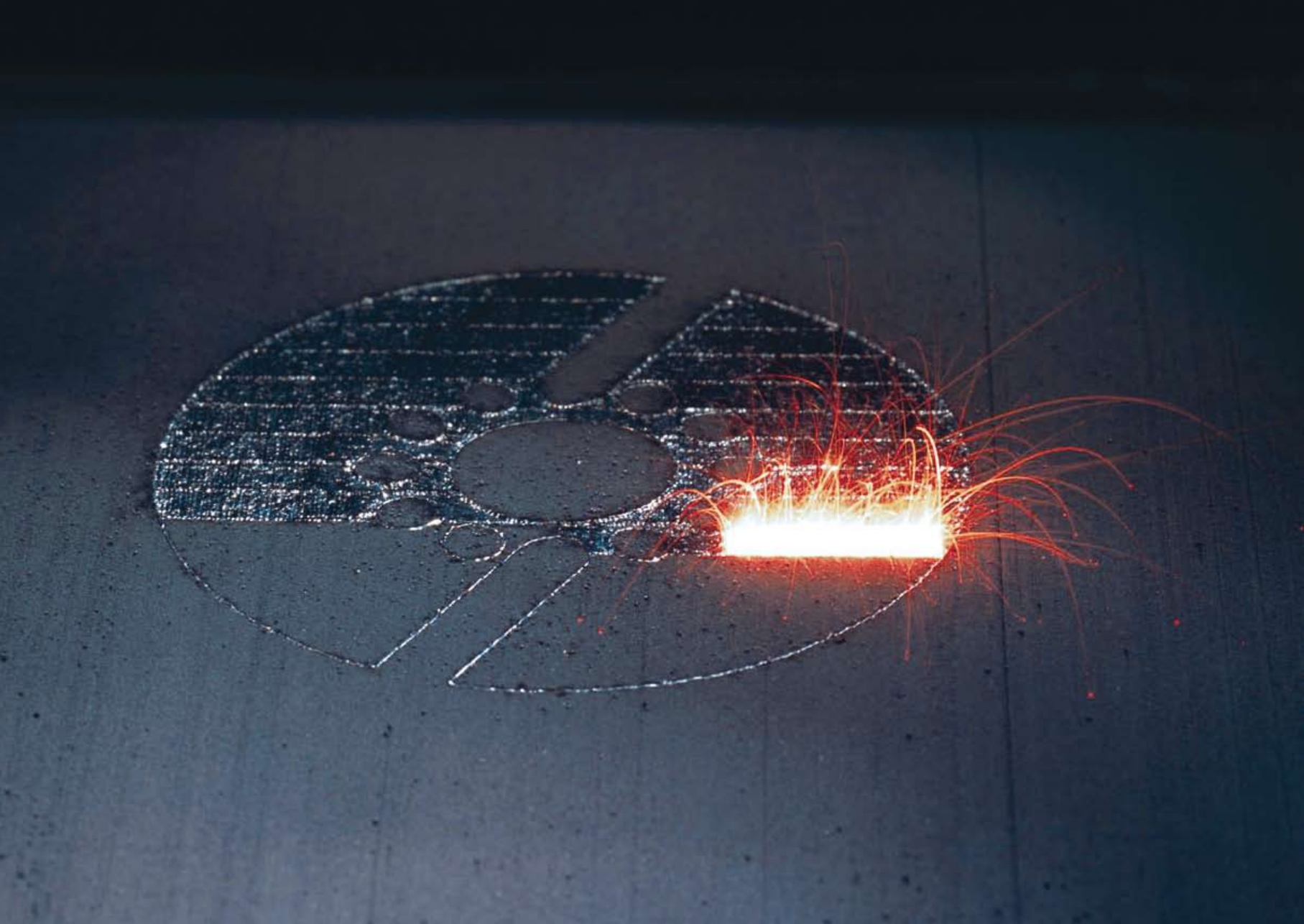
In this aperture range, SCANLAB offers several scan head product lines enabling a broad variety of applications to attain high speeds. Scan heads of the intelli*SCAN*®, hurry*SCAN*® *II*, hurry*SCAN*® and *SCAN*gine® series share a mechanically compatible housing, while offering different dynamic capabilities. They are also available with water cooling. The *SCAN*cube® and intelli*cube*® series of scan heads are noted for their extraordinarily compact housing.

20-30 mm Aperture

This aperture range is covered by SCANLAB's intelli*SCAN*®, intelli*DRILL*® and hurry*SCAN*® series of scan heads, which offer outstanding dynamic performance even at high laser powers. Their innovative design also includes air and water cooling. For fiber-coupled high power lasers, SCANLAB also offers the intelli*WELD*® 30 FC, a 30-mm-aperture 3D scan system developed for robot-assisted welding applications.

> 30 mm Aperture

In this aperture class, SCANLAB furnishes power*SCAN* systems for applications requiring very high laser powers up to the multi-kW range. Large working fields are achievable while maintaining small spot diameters.



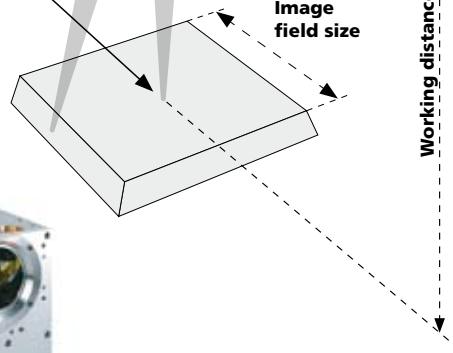
Optical Configuration

For each application, we create an optimized product package. The system's optical and dynamic capabilities are determined by considering many factors, including:

- Focal Diameter
- Working Distance
- Image Field Size / Working Volume
- Wavelength
- Laser Power
- Pulse Length

The following pages describe how these parameters interrelate and influence scan-system construction.

$$\frac{\lambda \cdot f \cdot M^2 \cdot k}{d} = s$$



Focal Diameter

The focal diameter of the laser spot depends on the laser wavelength, the scan system's aperture and the focal length of the system's focusing optics, as well as the quality of the coupled laser beam.

The focal diameter ($1/e^2$) can be approximated via the following equation:

$$s = \lambda \cdot f \cdot M^2 \cdot k / d$$

s	**Focal diameter ($1/e^2$)**
λ	**Wavelength (typically 193 nm – 10.6 µm)**
f	**Focal length (typically 30 mm – 2,000 mm)**
M^2	**Beam quality (laser-dependent)**
k	**Correction factor (ideally 1.27; more typically between 1.5 and 2.0)**
d	**Beam diameter prior to focusing (typically 6 – 70 mm)**

Working Distance and Image Field Size or Working Volume

The available working distance between the scan system and the workpiece depends primarily on the focusing optic's focal length and design. The image field size depends on the scan system's scan angle as well as the objective's focal length and design. For SCANLAB's scan systems with F-Theta objectives, the image field side length is typically 0.5 to 0.8 times the focal length. If the laser focus needs to be positioned not just in a plane, but in a (3D) working volume, then the focal length must be dynamically varied. For this purpose, SCANLAB offers vario*SCAN* dynamic focusing units.

Wavelength, Laser Power, Pulse Length

Our scan systems are equipped with optically coated deflection mirrors and objectives or vario*SCAN* focusing units appropriate for your laser's wavelength, power and pulse length. SCANLAB offers optical components for all typical laser types used to process materials at wavelengths from 193 nm to 10.6 µm and for laser powers ranging to more than 8 kW.

Control

Servo Functionality

The servo electronics in SCANLAB's scan systems are responsible not only for quickly and precisely positioning the laser beam with a positioning resolution of up to 18 bit, but also for generating status signals for system monitoring. The servo boards in intelli*SCAN*®, intelli*cube*®, intelli*WELD*® and intelli*DRILL*® systems also deliver the substantial benefits of SCANLAB's i*DRIVE*® technology.

Data Transfer

All SCANLAB scan systems are available with a digital interface for RTC®-based control. Alternatively, an analog interface can be specified for almost all SCANLAB scan systems. Digital data transfer between the scan system and the controller is either electronic or optical. For i*DRIVE*® technology (e.g. for controlling an intelli*SCAN*®, intelli*cube*®, intelli*WELD*® or intelli*DRILL*®), SCANLAB transfer protocols also support extended capabilities such as servo tuning and highly advanced system-monitoring capabilities.

Control Boards

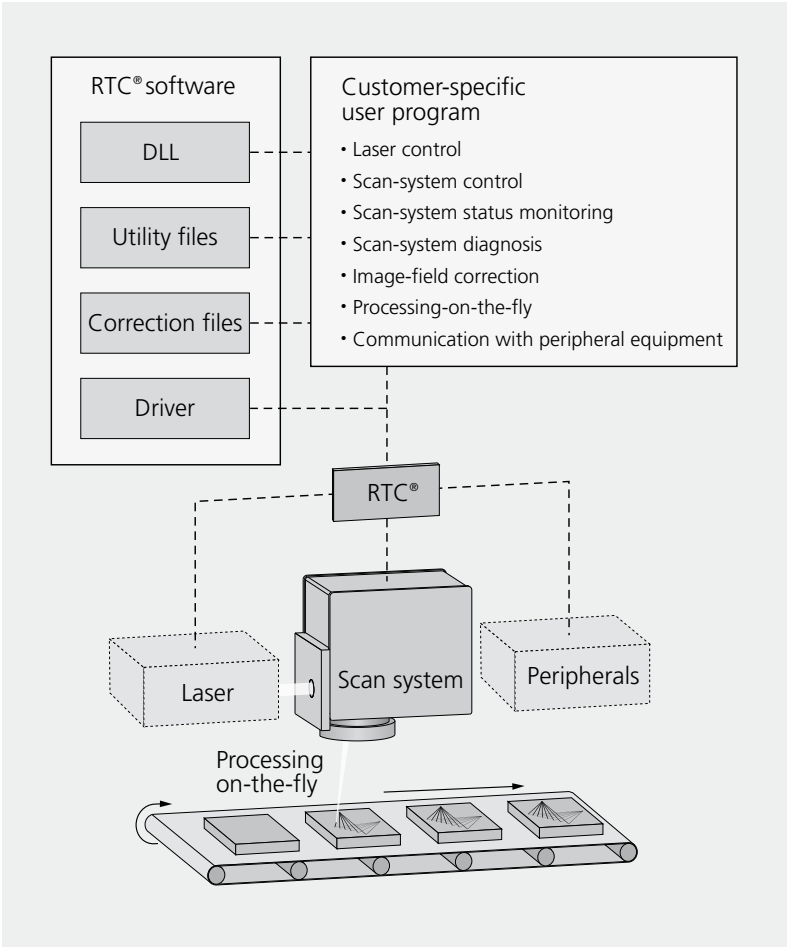
SCANLAB's solution for convenient control of laser scan systems is the RTC® family of control boards. Simple software commands enable synchronized, real-time control of the scan head, laser and peripheral equipment. The RTC® is available as a PC interface board (PCI), as a standalone product or as PC/104-*Plus* version. RTC® PC interface boards are intended for control via a personal computer. Even multiple RTC® PCI boards can operate in one PC. RTC® *SCAN*alone boards enable control without a PC, and only require an external power supply for operation. The PC/104-*Plus* version is designed for integration into a PC/104-*Plus* stack.

Additional RTC® features and options include:

- 2D and 3D image field correction
- Status signal evaluation
- Processing-on-the-fly functionality for moving objects
- Control of 3-axis scan systems
- Simultaneous control of two scan systems
- Optical data transfer interface

The latest model, the RTC®5, sets new standards like:

- 20-bit positioning resolution
- Full i*DRIVE*® support
- Virtual processing field (via 24-bit vector coordinates)
- Multiple boards in one PC
- PC/104-*Plus* version
- Master/slave synchronization of multiple boards
- RS232 interface, additional I/O signals, stepper motor signals, ...
- Enhanced processing-on-the-fly functionality
- Speed- and position-dependent laser control
- Multi-threading, multi-processing

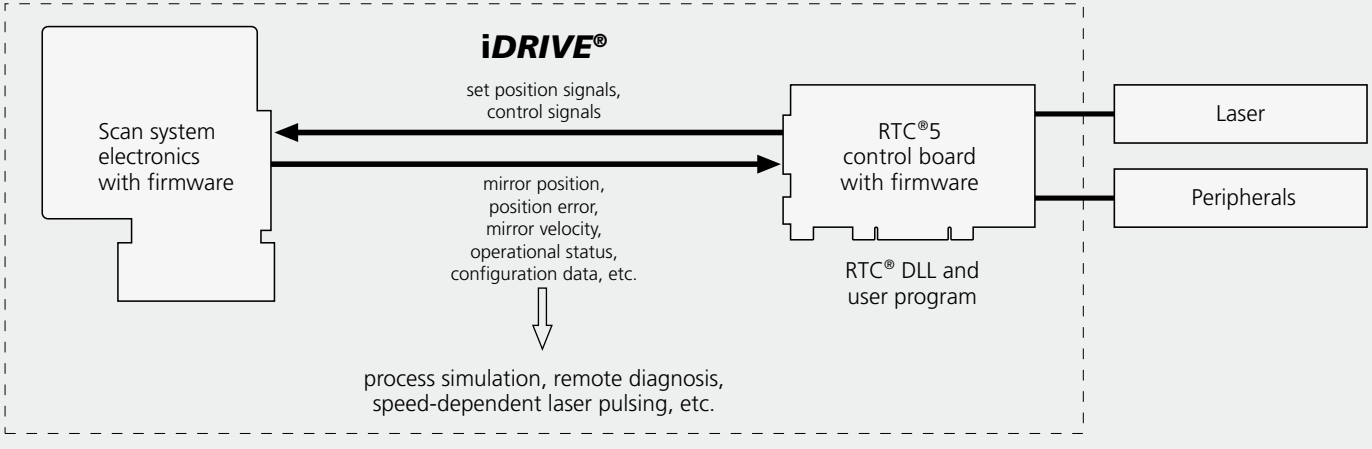


i*DRIVE*® Technology

Discover New Possibilities with i*DRIVE*®

SCANLAB's i*DRIVE*® technology redefines the industry standard for galvanometer scan head control and is used in the intelli*SCAN*®, intelli*cube*®, intelli*WELD*® and intelli*DRILL*® series. i*DRIVE*® introduces a completely digital control concept encompassing scan systems with fully digital servo electronics and the RTC®5 control board from SCANLAB.

The RTC®5 communicates with the scan systems via a new data transfer protocol that presents numerous new opportunities to boost scan system productivity – e.g. via tailoring of status, servo and reset behaviors.



Convenient Process Optimization

The system information provided by i*DRIVE*® allows processing to be simulated. This significantly reduces process development time as software optimization occurs with little or no need to process and manually inspect sample workpieces. Another i*DRIVE*® control feature is proportional laser pulsing, where speed feedback from the galvanometer is used to modulate the laser, ensuring consistent energy deposition.

Multiple dynamics settings can be stored in the scan system. These are derived from mathematical models and can also be selected on a per-vector basis for optimal results. Dynamics settings tailored to application-specific requirements enable faster and more precise positioning. The scan system's digital output stages dissipate significantly less power, resulting in enhanced temperature stability.

Quality Assurance and Remote Monitoring

i*DRIVE*® advantages include simultaneous monitoring of multiple galvanometer parameters and system status parameters. Real-time position and speed values can be queried, too. Such capability is indispensable for tracking or logging of processes and remote monitoring of systems.

intelli*SCAN*®, intelli*cube*®, intelli*WELD*®, intelli*DRILL*®

Fully digital servo electronics

Tailoring the status behavior

Tailoring the servo behavior

Tailoring the reset behavior

Several scan systems in one product

Several dynamics settings (except intelli*cube*®)

Enhanced operational safety

Internal status monitoring

System status information

Position feedback

Velocity feedback

Operational status feedback

Optimized scan dynamics

Exact scanner mapping in the control algorithm

Stable, fast positioning

RTC®5

Process monitoring

Scan process logging

Quality control and traceability

Remote system monitoring

Process simulation

Speed-dependent laser pulsing

Automatic dynamics change

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