the new premium scanning standard

SCANLAB's excelli*SCAN* **scan head** sets new high-end standards for meeting the most challenging demands. Its groundbreaking *SCAN*ahead control technology and field-proven dyn*AXIS*$_{se}$ digital-encoder galvanometers attain previously unreachable dynamic performance and precision. This translates to enormous gains in productivity and process accuracy.

Innovative excelliSCAN design features:

New *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

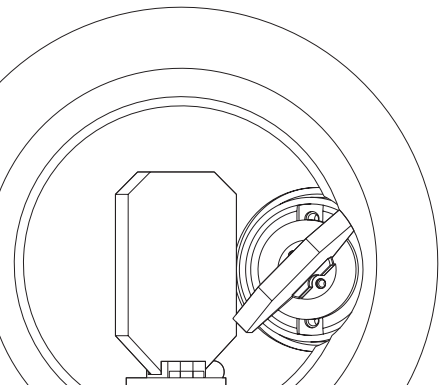
dyn*AXIS*$_{se}$ digital-encoder galvanometers

- 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

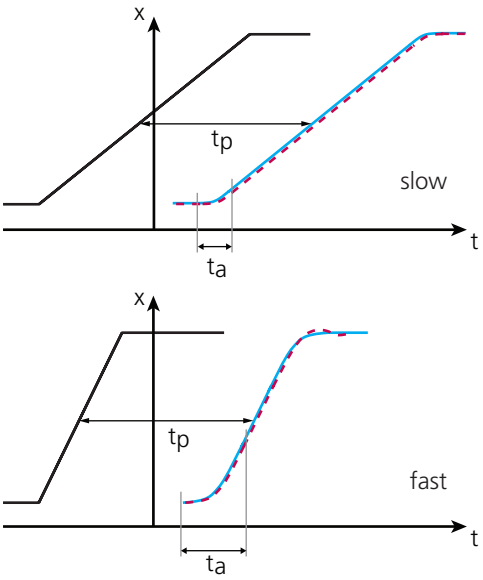
SCANLAB offers excelliSCAN in combination with the RTC6 PCI-Express control board. With its substantially increased processing power and optimum support of SCANahead control technology, the RTC6 opens up new system-control possibilities.



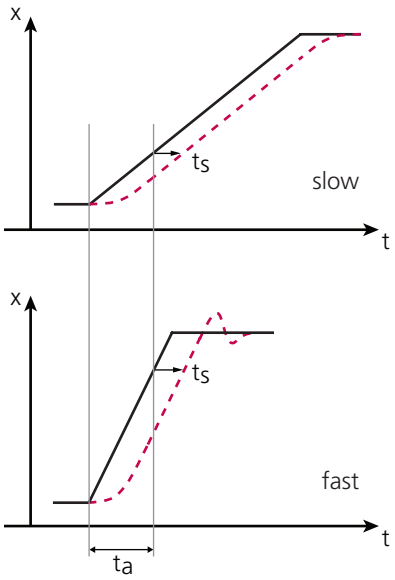
SCANLAB
innovators for industry

*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.

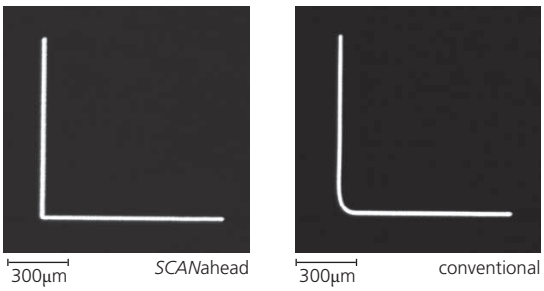
In contrast, **conventional** control is afflicted with a constant tracking error t_s, independent of scan speed. Likewise constant is the acceleration duration t_a until reaching the intended scan speed.

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:

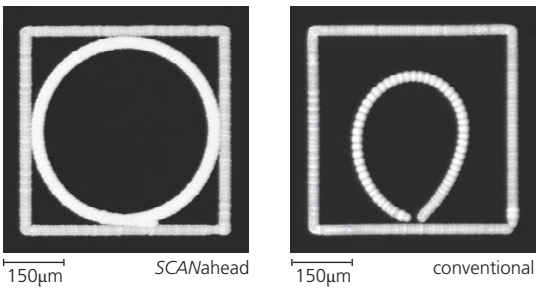


*SCAN*ahead control fully exploits the galvos' dynamic performance potential. Hence traversal of 90° corners at a wide range of speeds produces far less corner-rounding. Additionally, *SCAN*ahead allows faster traversal of corners having identical radii.

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

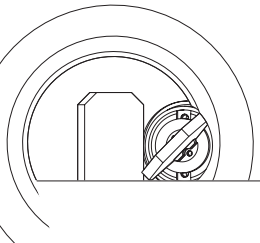
Fast and precise circle processing

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.

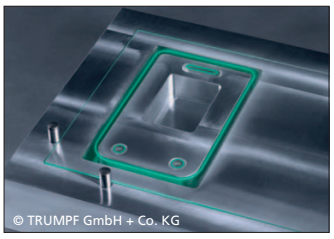
Control via RTC6

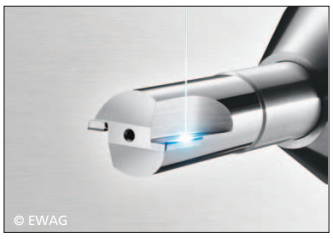
Equipped with expanded memory and a high-performance DSP and FPGA, the new RTC6 enables powerful applications and is ready for future functional extensions.

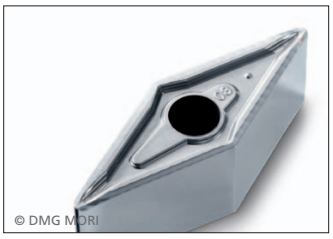
When synchronously controlling the excelli*SCAN* and a laser, the RTC6 board takes into account the *SCAN*ahead control's look-ahead time (used for computing scanner trajectories) so as to optimally utilize dynamic performance and accuracy. The RTC6's auto-delay functionality facilitates simple, fast 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
- 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
- Optional air-cooling connection for mirrors







Preliminary specifications excelli*SCAN* 14

Aperture	14 mm
Tuning	universal
Tracking error	0 ms
Acceleration	51000 m/s² [1],[2]
Typical speeds [1]	
Positioning, jump & shoot	< 30 m/s
Line scan / raster scan	< 30 m/s
Typical vector marking	< 4 m/s
Good writing quality	1000 cps
High writing quality	850 cps
Positioning times [1]	
1 mm jump width	0.28 ms
10 mm jump width	0.88 ms
100 mm jump width	3.70 ms
Long-term drift [3], [4]	
8-h-drift (after 30 min warm-up)	
Offset	< 20 µrad
Gain	< 20 ppm
24-h-drift (after 3 h warm-up)	
Offset	< 20 µrad
Gain	< 25 ppm
Temperature drift [4]	
Offset	< 10 µrad/K
Gain	< 4 ppm/K

Repeatability (RMS)	< 0.4 µrad
Positioning resolution	20 bit [5]
Optical performance	
Typical scan angle	±0.35 rad
Gain error	< 5 mrad
Zero offset	< 5 mrad
Nonlinearity	< 0.5 mrad / 44°
Power requirements	30 V DC, max. 3 A
Interface	SL2-100
Operating temperature	25 °C ± 10 °C
Weight	approx. 7 kg

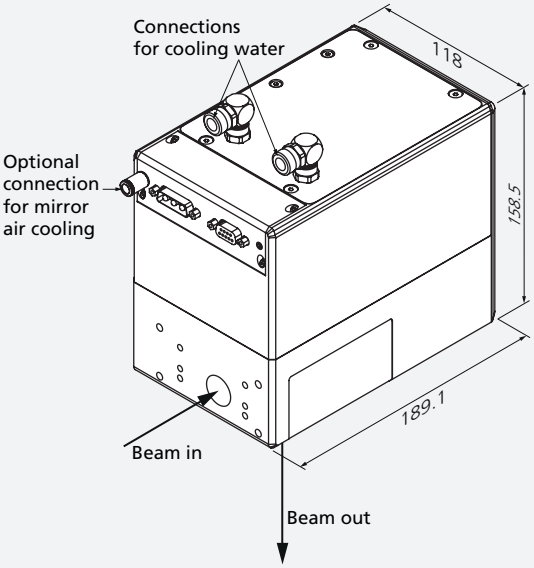
(all angles are in optical degrees)

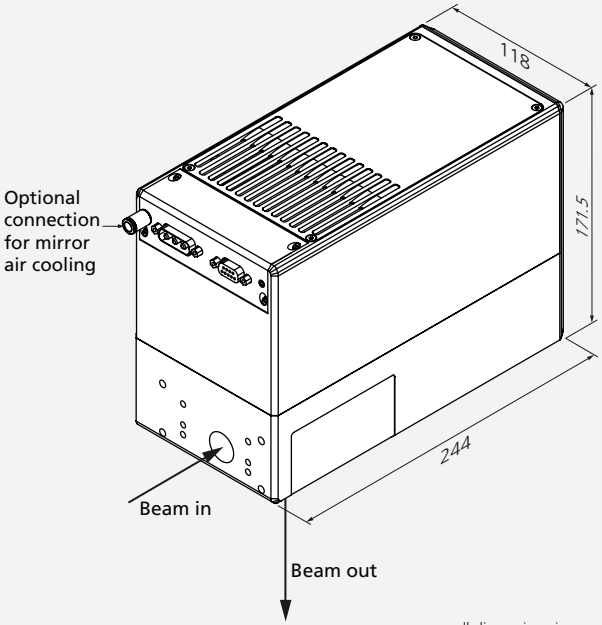
[1] with F-Theta objective, f = 160 mm
[2] this corresponds to an angular acceleration of $3.2 \cdot 10^5$ rad/s²
[3] at constant ambient temperature and load
[4] with water cooling
[5] based on the full angle range (e.g. positioning resolution 0.7 µrad for angle range ±0.36 rad)

Preliminary specifications RTC6

- Enables excelli*SCAN* *SCAN*ahead functionality
- PC interface: PCI-Express (in preparation: Ethernet with standalone functionality)
- Supported Windows versions (driver and DLL): 32-bit and 64-bit Windows 8, 7, Vista, XP (SP2 or higher)
- Any number of RTC6 boards installable in one PC
- Performance enhancements: processing power, memory, FPGA, allows future implementation of more complex functionalities
- Pixel output mode with pixel frequencies up to 1 MHz
- List memory with over 2 million list positions
- Expanded measurement-value recording: 4 recording channels, each for 2 million data values
- Multiple 3D correction files storable
- Fully downward compatible with RTC5

Housing variants





all dimensions in mm

SCANLAB AG · Siemensstr. 2a · 82178 Puchheim · Germany
Tel. +49 (89) 800 746-0 · Fax +49 (89) 800 746-199
info@scanlab.de · www.scanlab.de

SCANLAB America, Inc. · 100 Illinois St · St. Charles, IL 60174 · USA
Tel. +1 (630) 797-2044 · Fax +1 (630) 797-2001
info@scanlab-america.com · www.scanlab-america.com

SCANLAB innovators for industry