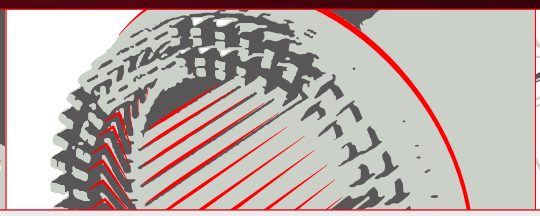
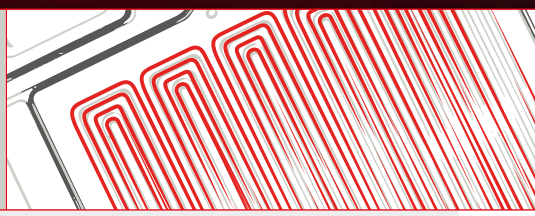
AXIALSCAN FIBER RD-30

RAYLASE

LASER WELDING – LASER CUTTING – LASER CLEANING





HIGHEST DYNAMICS, EASY INTEGRATION

The AXIALSCAN FIBER RD-30 is a **highly integrated pre-focusing beam deflection unit for use in industrial production environments.** Whether laser welding, cutting or cleaning, thanks to its dust-proof housing and integrated collimation optics, the AXIALSCAN FIBER RD-30 is the ideal deflection unit even under harsh production conditions.

The focus here is all on **dynamics and productivity.** Thanks to our highly dynamic z-axis with RAYVOLUTION DRIVE technology, the AXIALSCAN FIBER RD-30 can use the full dynamics of its XY scanners without losing the z-position of the focus. This makes the AXIALSCAN FIBER RD-30 ideal for **processing very thin materials such as battery foils or bipolar plates for fuel cells.** Here, a **stable penetration depth** and a **uniform focus** are particularly important in order to avoid damage to the bipolar plate and to obtain a uniform cutting result.

Thanks to its **high power compatibility of up to 6 kW,** the AXIALSCAN FIBER RD-30 is well suited for **welding battery housings or cell connectors of prismatic cells.** Due to the **large processing fields,** the AXIALSCAN FIBER RD-30 also enables **hairpin welding of electric motors** without the need to move the motor or the deflection unit.

Highest dynamics

Stable focus position

Easy integration & maintenance

www.raylase.com

RELIABILITY AND DYNAMICS FOR YOUR PRODUCTION

Thanks to its optimized dust-proof design, lightweight mirrors and the innovative RAYVOLUTION DRIVE technology, the AXIALSCAN FIBER RD-30 offers the ideal combination for maximum dynamics in **industrial production environments.**

This focus on production is reflected in various aspects: For example, the digital electronics of the scanners enable **convenient read-back of position data,** which can then be easily merged with measurement data from the coaxial process light and camera port. This enables **precise process monitoring and control.** And also the housing is designed for productivity: Thanks to "quadruple design" with 100% overlap across the build area, **four lasers can work simultaneously on one component,** enabling even the **shortest cycle times** in demanding production lines.

And it is precisely this combination that makes the AXIALSCAN FIBER RD-30 the optimal solution for your production. See for yourself:

Integrated fiber adapter and collimator for all common fiber lasers

Ensures optimal beam configuration and simplifies integration into a production line

Digital control with RL3-100 or SL2-100 protocol

Enables high-precision control and additionally feedback of position and status signals for process monitoring and optimization

Lightweight mirrors with high power compatibility

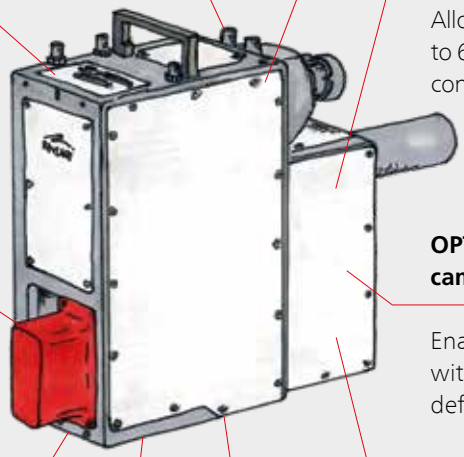
Enable high cutting and welding speeds and higher productivity

"Quadruple Design" with 100 % overlap in the working area

Enables 4x productivity by simultaneous processing of one workpiece with four deflection units

Second protective glass with quick-change mounting frame

Reduces maintenance times and increases productivity and process reliability



Highly dynamic z-focusing with RAYVOLUTION DRIVE technology

Ensures stable z-position and penetration depth independent of machining speed

Dust-proof housing (IP64) and clean room production

Allows the use of high laser powers up to 6kW even under harsh production conditions

OPTIONAL: Focus tracking camera port with RAYSPECTOR.

Enables an "on-axis" vision solution with sharp imaging independent of deflection angle and z position

Integrated process light output without chromatic aberrations

Offers a wide range of possibilities for "on-axis" process monitoring and process control such as pyrometer

Flexible process field sizes

Enables processing of components in processing fields between 250 x 250 mm^2 and 1000 x 1000 mm^2

WELDING OF BUSBARS IN BATTERY PRODUCTION

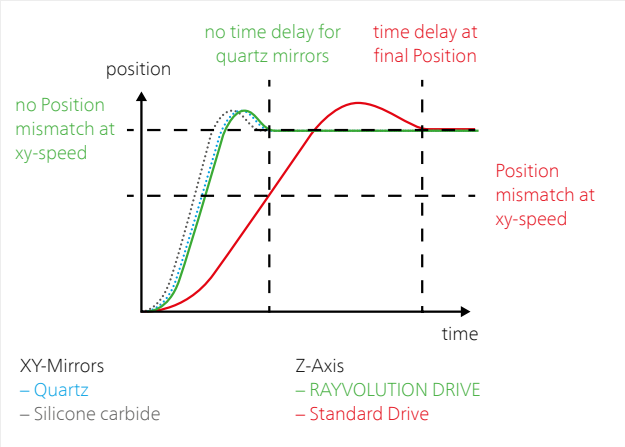
The welding of busbars is one of the most **challenging welding applications in the field of e-mobility and battery production.** A reason is that the battery cells can vary in height by up to 1 mm and an extra mechanical tolerance is often caused by the transport system of the battery packs. Nevertheless, the cells must be welded within a **small process window** due to the thin battery housing. This requires **precise process control** and represents a major challenge for the system integrator.

Battery module made of cells connected with laser-welded busbars (source: Laserax)

Here, the **AXIALSCAN FIBER RD-30** offers a good solution. With its large processing field of up to 1000 x 1000 mm², it enables the processing of complete battery packs without having to move the battery or the laser system. This significantly reduces the complexity of the overall system. Thanks to its **highly dynamic z-axis** with RAYVOLUTION DRIVE, the AXIALSCAN FIBER RD-30 can **quickly and precisely compensate for height differences between batteries** and ensures that the z-position of the focus remains constant in the process window, even at high scan dynamics. At the same time, the **achromatic process light output and the tracked camera port** via the RAYSPECTOR enable **precise process monitoring and control.**

As a **specific solution for welding busbars,** the AXIALSCAN FIBER RD-30 can additionally be combined with the RAYLASE DISTANCE MEASURMENT SENSOR and the RAYGUIDE MATCH software to form the **BUSBAR WELDING MODULE.** In this expansion stage, the AXIALSCAN FIBER RD-30 offers a **fully automated solution** for this important process step in **battery production** and thus helps to meet the increasing demand for batteries through an optimized and highly efficient process.

FASTER WELDING SPEEDS AND STABLE Z-FOCUS



With RAYVOLUTION DRIVE, the z-axis follows the xy-movements of deflection units with quartz mirrors without delay. Quite in contrast to a standard z-axis, which shows significantly slower dynamics. When using highly dynamic silicon carbide mirrors, a small difference in dynamics still remains visible, which can be compensated using the function Tracking Error Compensation of the SP-ICE-3 Control Card.

Pre-focusing beam deflection units such as the AXIALSCAN series use a moving lens in front of the scan mirrors to focus the laser. The lens is repositioned with each movement to keep the focus in a constant z-plane, **and the focal length is adjusted.** However, at higher dynamics, many focus shifters can no longer follow the movement of the XY mirrors, which can lead to uneven power input or fluctuating penetration depth.

To take advantage of a pre-focusing system and simultaneously **use the full dynamics of the XY-deflection unit,** the RAYVOLUTION DRIVE (RD) technology was developed. It is based on the moving coil principle to shift the lenses, **which allows swift movements of the lens.** It can thus follow even highly dynamic XY mirrors without delay and maintain a **stable z-position of the focus.**

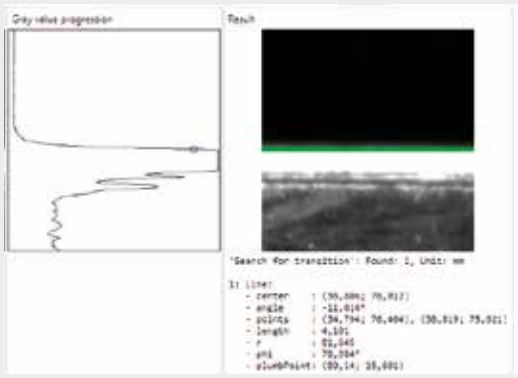
In addition, an innovative mount used for the RAYVOLUTION DRIVE allows **highly accurate alignment and guiding of the lenses,** even under dynamic movements. It enables **excellent imaging performance of the lens system.** Even single-mode fiber lasers or special beam shaping, like Ring mode lasers, remain nearly undisturbed. The **frictionless guidance** also leads to significantly reduced wear, making the RAYVOLUTION Drive technology almost maintenance-free.

With its high **dynamics and reliability in industrial production environments,** the RAYVOLUTION DRIVE technology is ideally suited for the AXIALSCAN FIBER RD-30, providing optimal flat field correction even at high scanning speeds in the entire processing field of up to 1000 x 1000 mm². The RAYVOLUTION DRIVE technology also enables **highly dynamic scanning strategies such as wobbling or hatching** with a constant focus position. The AXIALSCAN FIBER RD-30 is the ideal solution for precise and highly dynamic applications.

RAYGUIDE MATCH

PROCESS AUTOMATION WITH CAMERA-BASED POSITION DETECTION

In precise manufacturing processes, **the adjustment of the workpiece is a critical step.** While a manual and complex adjustment might still be tolerable in the laboratory, alignment becomes very time-consuming, even for small series. To **simplify this part of the process** preparation, we have developed RAYGUIDE CLICK&TEACH. After all, it is often much more accessible to **detect the workpiece's position and adjust the deflection unit's movement** accordingly.



Automatic edge detection with RAYGUIDE MATCH for correction of the workpiece position

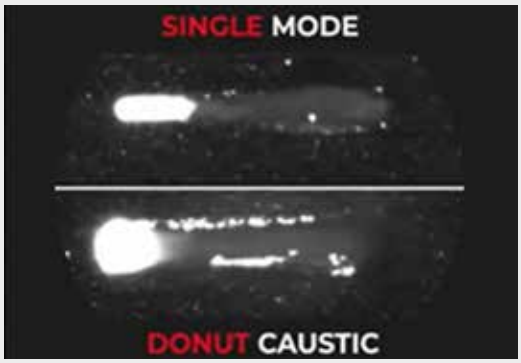
Images of the processing field are captured by a camera on the AXIALSCAN FIBER RD-30 **and displayed as background in the RAYGUIDE software.** The RAYSPECTOR ensures a sharp image in the entire image field through its **dynamic focus tracking.** The RAYGUIDE CLICK&TEACH plugin can then be used to adjust the laser processing to the actual positions and dimensions.

But what if you want to take the step to **series production?** Any manual action here can make the whole process unprofitable. In this case, RAYGUIDE MATCH offers help. The plugin **extends the camera-based position recognition by an automatic feature recognition.** Position marks or workpiece structures are detected, and the laser processing is corrected autonomously. As a result, part feeding and alignment can be performed with higher tolerances, and **precise laser processes** can be realized **automatically without manual interaction** by a user.

RAYSPECTOR

PROCESS OPTIMIZATION WITH PYROMETER & HIGHSPEED CAMERA

Data is the new gold, allowing process control, process optimization, and quality control. Therefore, it is essential to **collect data already during the manufacturing process.** However, process monitoring only works smoothly if the scanning system and the components are optimally matched. For example, **on-axis data** can only be meaningfully interpreted **if combined with the mirrors' position values.** The AXIALSCAN FIBER RD-30 offers optimal conditions for such a task because the position values of the galvos can be read back together with the data of a pyrometer via the SP-ICE-3 card and then **conveniently combined to a heat map.**



Highspeed camera images of a melting pool with donut and gaussian beam caustics

For **observation of the welding process with high-speed cameras,** the combination of RAYSPECTOR and AXIALSCAN FIBER RD-30 also offers the right solution. Thanks to the RAYVOLUTION DRIVE, **the camera's imaging optics can be tracked dynamically and synchronously with the scan mirrors.** This allows the laser process to be observed always in focus. This information is particularly interesting for process optimization, as it helps the user **analyze the melt pool dynamics and optimize the process parameters.**

OTHER SUITABLE ACCESSORIES

RAYGUIDE

INTUITIVE PROCESS SOFTWARE

Our software solution for a quick and easy programming of your scanning solution. User-friendly set-up and calibration of the deflection unit and effortless automation through the built-in API.

SP-ICE 3

CONTROL CARD WITH FEEDBACK FUNCTION

The control center for runtime-critical process steps. Allows synchronous control of deflection unit, laser and peripherals and a combined readback of scanner and of scanner and sensor signals.

THIS MAKES RAYLASE SPECIAL

Technical specifications are important and often decisive. But at RAYLASE, we believe that there is more to it than pure technology that matters. For this reason, we are your partner for reliable and successful laser processes and offer more than just technical components.

Systems view instead of components

Modern production systems for laser processing are usually designed specifically for one process step and are highly optimized. It is therefore important to consider the interplay with the other machine components when selecting suitable beam deflection units. At RAYLASE, we therefore always have the entire solution in mind and offer our customers assistance in putting together suitable components.

Broad application knowledge

For many processes, the beam deflection unit is a decisive component. Often it determines whether the desired spot parameters and processing speeds can be implemented on the component. To identify the optimal solution here, we support our customers in selecting the right beam delivery components and sensor technology. and perform simulations of the laser processes developed by our customers. In addition, we provide support in the parameterization of the laser and deflection unit or software functionality through the experts at our Technical Competence Center TCC.

On-site support for implementation and service

Our customers are the experts for their application – we are the experts for our beam deflection units. That's why we support our customers during the commissioning of our products – if necessary also directly on site. In this way, we at RAYLASE ensure that our system is optimally adjusted and permanently delivers what it is capable of.

Education & training on the system

Modern laser deflection units are complex systems. Therefore, it is important to have a good knowledge of their characteristics. Because only when users know how the various parameters interact the optimum process becomes possible. For this reason, we at RAYLASE put a high priority on training for our products. In addition, we also offer our customers on-site training directly on the system, if required, to enable users to operate the system independently.

The POWER OF WE

Together you achieve more. At RAYLASE, we are convinced about this. That's why we place great value on cooperation in a spirit of partnership and open communication at equal level – from expert to expert. Because only when we jointly find the best solution and successful integrate it into the machine, everyone involved benefits in the end – our customers, us and also the end users.

GENERAL SPECIFICATIONS

Power Supply	**Voltage [V]**	+ 48	
	Current (RMS) [A]	4	
	Current (max.) [A]	8	
	Riple / Noise @ 20 MHz bandwith [mV pp]	Max. 200	
Ambient temperature [°C]		+15 to +35	
Storage temperature [°C]		-10 to +60	
Relative humidity non condensing [%]		≤ 80	
IP Code [1]		64	
Interface signals	**Digital**	RL3-100 protocol 20 Bit and SL2-100 protocol 20 Bit	
		Standard	**HPS***
Typical deflection (optical) [rad]		± 0.393	± 0.393
Resolution RL3-100 / SL2-100 20 Bit [µrad]		0.76	0.76
Repeatability (RMS) [µrad]		< 2.0	< 0.4
Position noise (RMS) [µrad]		< 3.2	< 1.0
Temperature Drift	**Max. Gaindrift [ppm/K]**	15	8
	Max. Offsetdrift [µrad/K] [2]	10	15
Long-term drift 8 h without water temperature control [µrad] [2]		< 60	< 50
Long-term drift 8 h with water temperature control [µrad] [2, 3]		< 40	< 30

[1] When actively using cooling air (not with open cooling air connections if available)
[2] Angles optical. Drift per axis, after 60 min warm-up, at constant ambient temperature and process stress.
[3] After 60 min warm-up, under varying process loads, with water temperature control set for ≥ 2 l/min and 22°C water temperature.
* High Performance System

APERTURE DEPENDENT SPECIFICATIONS – MECHANICAL DATA

Deflection unit		**AXIALSCAN FIBER RD-30**	
Laser fiber socket		QBH	
Position of fiber socket		optional top (T) or rear (R)	
Weight [kg] approx.		15	
Dimensions excluding fiber socket and electrical plug connections (L x W x H) [mm]		288.0 x 140.0 x 320.0	
		Typ. beam divergence	**max. beam divergence**
Typical collimator focal lengths available [1]		1/e² full angle [mrad]	1/e² full angle [mrad]
f = 63 mm		136	150
f = 85 mm		100	110
f = 104 mm		82	96
f = 165 mm		52	58
f = 50 mm for Multi-Core Laser	**Fiber core [2]**	115	125
	Fiber ring [2]	170	200
Free beam version (without collimator), Position of beam entrance: top with 14.4 mm full beam		–	–

[1] Optical sets optimized for maximum beam divergence. Other available collimator focal lengths on request.
[2] Measured with 2nd moment methode.

TYPE DEPENDENT SPECIFICATIONS – TUNING

Tuning	Description
Vector-Tuning (VC)	Optimized tuning for a wide range of applications with emphasis on processing speed
Hatching Tuning (H)	Optimized tuning for high precision beam deflection and fastest beam direction change during hatching

TYPE DEPENDENT SPECIFICATIONS – DYNAMIC DATA

Deflection unit	AXIALSCAN FIBER RD-30 QU	AXIALSCAN FIBER RD-30 SC		AXIALSCAN FIBER RD-30 HPS*
Tuning	VC	H	VC	H
Processing speed [rad/s]	50	30	65	30
Positioning speed [rad/s] [1]	50	30	65	30
Tracking error deflection unit [ms]	0.48	0.23	0.3	0.25
Acceleration time approx. [ms]	0.86	0.41	0.6	0.43
Step response time at 1% of full scale [ms] [2]	1.2	0.7	0.8	0.66
Tracking error focusing unit [ms]	0.9	0.9	0.9	0.9
Speed of moving lens [mm/s]	900	900	900	900

[1] See "Calculation of speed". [2] Settling to 1/5,000 of full scale.
* HPS = High Performance System

Calculation of maximum speed in field:

1 rad/s @ ± 0.393 rad deflection (45°) ≙ 0.12 m/s for 100 mm working field size.
Example: AXIALSCAN FIBER RD-30 QU, Working field size 400 mm × 400 mm (field factor = 4),
Positioning speed 50 rad/s => 50 × 0.12 m/s × 4 = 24 m/s.
Note: Lower speeds may be produced by the z-axis, depending on which control card is used, the laser job, field size and optical configuration.

Option of air cooling and water temperature control:

AXIALSCAN FIBER RD-30 deflection units offer the option of water cooling (W) of the electronic components and galvanometer scanner. Air cooling (A) is recommended and is required for laser power > 2 kW for silicon carbide mirrors. For quartz mirrors, air cooling is recommended from 3 kW laser power
This ensures constant working conditions and excellent long-term stability and guarantees reliable operation of high-power laser applications.
AXIALSCAN FIBER RD-30 deflection units can also be operated without water cooling. Without water cooling, drift values may increase.

Option of additional protective window:

Each AXIALSCAN FIBER RD-30 can be equipped with an optional extra protective window. This external protective window is housed under a flap and is quickly replaced. This ensures fast and easy replacement of the protective window under harsh conditions in dusty environments. This means that all cleaning of the protective window is done externally and the system is operational again after a very short time.

AIR COOLING

Specifications	
Compressed air [1]	Clean air free of water and oil
Flow rate	SC: 0l/min up to 2 kW, 30l/min up to 4 kW, 45l/min up to 6 kW Quarz: 0l/min up to 4 kW, 30 l/min up to 6 kW

[1] ISO 8573-1:2010 [1:4:0(0,005)]

WATER TEMPERATURE CONTROL

Specifications	
Cooling water [1]	Clean tap water with additives
Water hardness [ppm]	< 10
ph value	7 – 8.6
Bacterial content [cfu/ml]	< 1,000
Recommended cooling temperature [°C]	22 – 28
Temperature stability [K]	± 1
Max. water pressure at deflection unity [bar]	< 3
Min. water flow [l/min] and pressure drop [bar]	2 / 0.4
Tube outer diameter [mm]	8

[1] **Caution:** When using cooling water including deionised water, suitable additives must be used to prevent the growth of algae and protect the aluminium parts against corrosion.

Additive recommendations (Please consult your additive supplier for dosage information):
Standard industrial applications: Products of company NALCO, e.g. CCL105 (Premix) or TRAC105A_B (Additive)
Food & beverage, packaging applications: Polypropylene glycol of company Dow Chemical, e.g. DOWCAL N

CONFIGURATION EXAMPLES – AXIALSCAN FIBER RD-30

Field size [mm x mm]	250 x 250	300 x 300	400 x 400	500 x 500	600 x 600	700 x 700	800 x 800
Working distance [mm] [1]	256	318	442	566	689	813	937
Spot diameter 1/e² approx. [µm]	32	38	49	60	72	83	94
Free focus range [mm]	25	40	90	160	260	390	560

[1] From the bottom edge of deflection unit to the processing field.

OPTICS SPECIFICATIONS

Laser	Fiber Laser infrared 1,060 nm – 1,080 nm	Fiber Laser infrared 1,060 nm – 1,090 nm
Mirror substrate / Wavelength [nm]	QU 1,060 – 1,080	SC 1,060– 1,090 + AL
Max. laser power, cw [W]	6,000	6,000

QU = quartz, air cooling > 3,000 W laser power recommended, > 4 kW mandatory SC = silicon carbide, air cooling > 2,000 W laser power mandatory

PROCESS MONITORING

	AXIALSCAN FIBER RD-30
Process light output wavelengths [nm]	400 – 900 + 1,300 – 2,100

Every AXIALSCAN FIBER RD-30 is equipped with a dust-proof optical output for process light radiation. Both very short wavelengths below the laser wavelength and long-wave thermal radiation are transferred externally. This means that various sensors can be connected, e.g. cameras for position detection, weld quality monitoring and pyrometers.

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