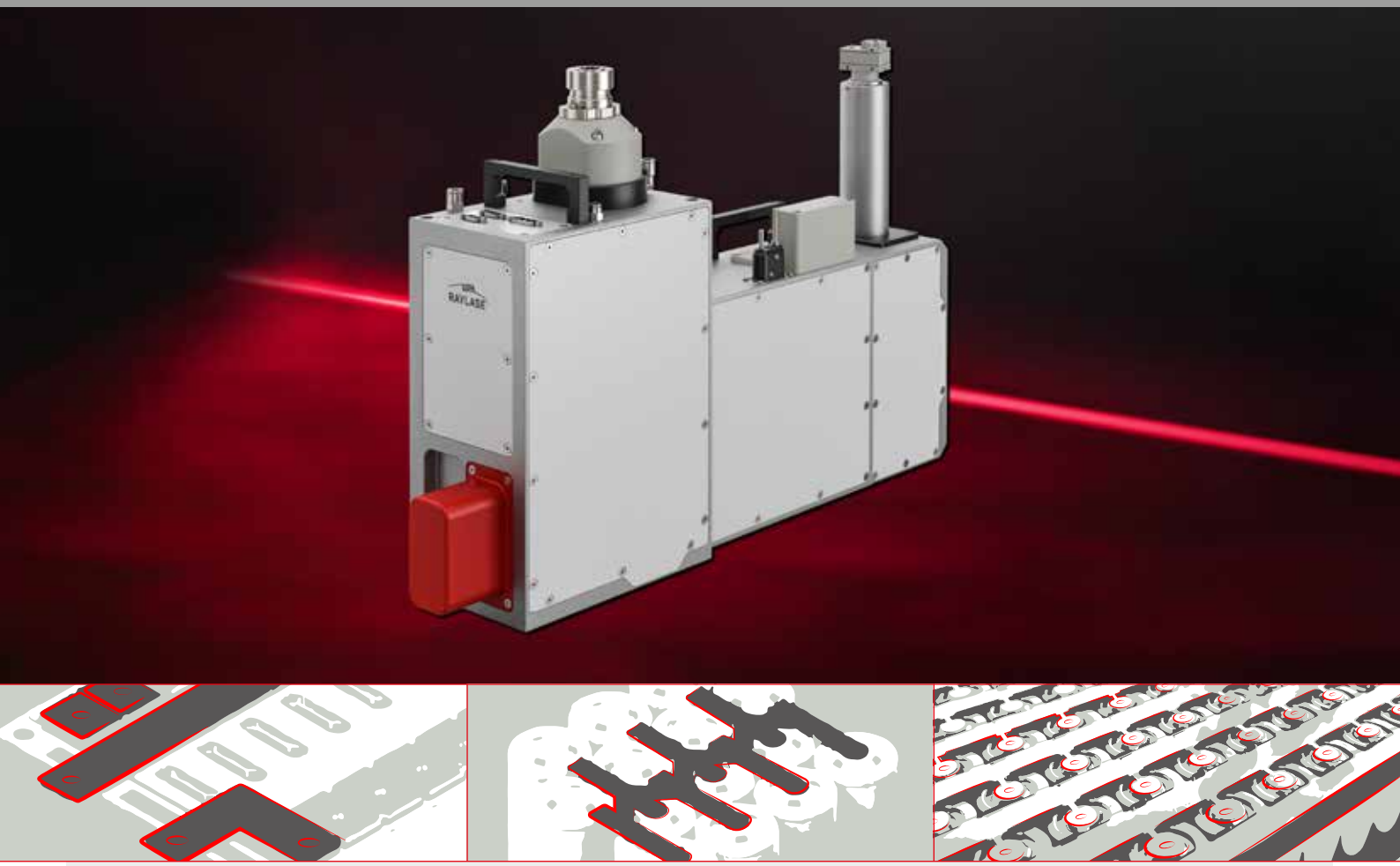
BUSBAR WELDING MODULE

LASER WELDING OF BATTERY BUSBARS



THE COMPLETE SOLUTION FOR BUSBAR WELDING

The RAYLASE BUSBAR WELDING MODULE is an **application-specific turnkey for the precise welding of busbars.** It was developed to provide a reliable solution for this challenging process step in battery production, while at the same time allowing for an **automated production in high quantities.**

To solve the manufacturing challenges of welding busbars, the BUSBAR WELDING MODULE combines an AXIALSCAN FIBER RD-30 with the RAYLASE DISTANCE MEASUREMENT SENSOR and the RAYGUIDE software plug-in RAYGUIDE MATCH. Using an **automatic and highly accurate measurement of the distance and position of the battery cells and busbars,** the position of the weld can be precisely corrected in three dimensions. This ensures that **the required small process window can be maintained.** Thus, despite a height difference of the battery cells of up to 1 mm and mechanical tolerances due to the transport system, a **fully automated serial production** becomes possible.

In addition, the BUSBAR WELDING MODULE offers a **large processing** field of up to 500 x 500 mm^2 thanks to the implementation of a pre-focusing deflection unit. This allows to process also large battery packs with just one scan system, without having to move the battery pack or the scan system by means of a robot axis or a gantry system.

The absence of additional transport systems **reduces the complexity of the overall system** for integrators significantly. Our tailored complete solution can thus help to meet the increasing demand for batteries through an optimized and highly efficient process.

Automated positioning and distance measurement

Large processing fields

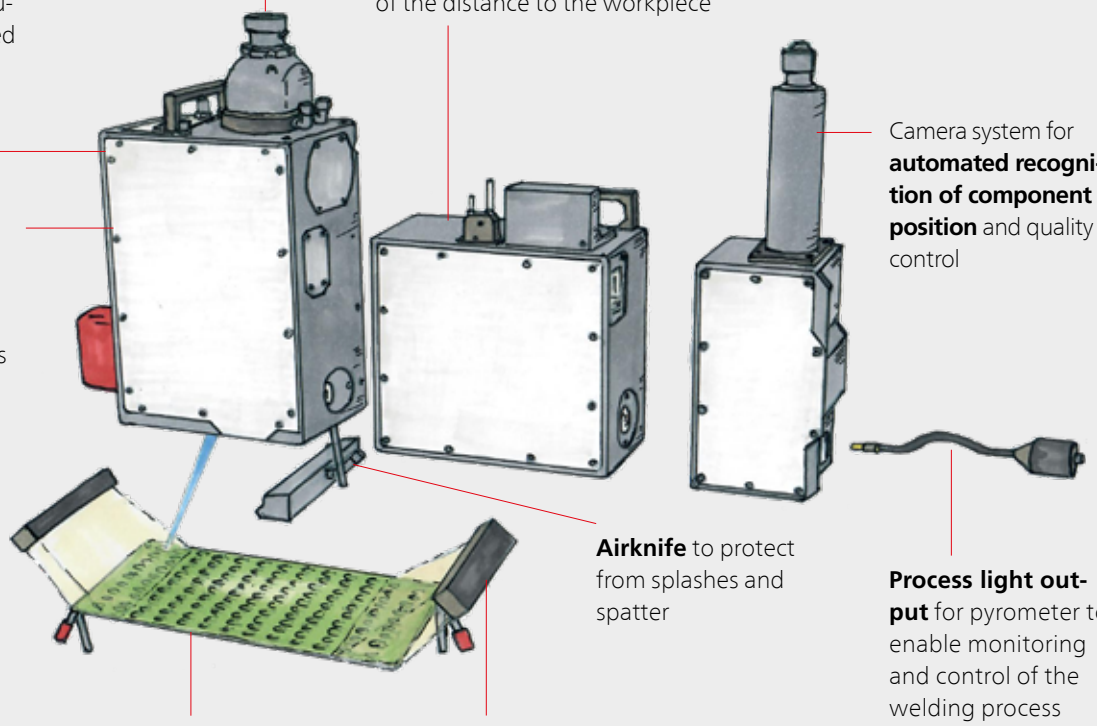
Application-specific all-in-one solution

www.raylase.com

OPTIMIZIED SOLUTION FOR AN CHALLENGING WELDING TASK

A complex serial production process requires a **reliably operating and well-matched production machine.** For busbar welding, we have therefore selected the optimum components and, where necessary, even developed new ones. The result is a perfectly matched package based on many years of experience with deflection units, sensor technology, software solutions and laser processes combined with our latest products.

We deliver **more than "just a scan head".** We offer our customers an **application-specific system solution:** the BUSBAR WELDING MODULE. See for yourself:



WELDING OF BUSBARS IN BATTERY PRODUCTION

Busbar welding is a critical step in **battery production** because the quality of the weld directly affects the efficiency and performance of the battery, as well as its safety. A **high-quality weld** ensures a low-resistance connection that allows for efficient energy distribution. On the opposite, a low-quality weld will result in increased resistance, energy loss, overheating, and even potential failures or fire hazards.

Busbars connect the individual battery cells to form a module with the desired voltage and storage capacity. (Source:Laserax)

High requirements for welding busbars
Welding busbars is challenging, because the battery cells can have a **height difference of up to 1 mm** and the transport system of the battery packs often leads to **additional mechanical tolerances.** Still, due to the thin battery housing, the cells must be welded within a **small process window.** This requires precise process control and represents a major challenge for the system integrator.

The need for a tailor-made complete solution
To find an efficient and automated solution for this complex welding application, it is necessary to **combine various components into a complete, tailored solution.** Thus, the AXIALSCAN FIBER RD-30 was combined with the RAYSPECTOR, the RAYLASE DISTANCE MEASUREMENT SENSOR and the RAYGUIDE MATCH software to form the BUSBAR WELDING MODULE. With its **large processing field of up to 500 x 500 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 BUSBAR WELDING MODULE can quickly and precisely compensate for height differences between batteries and ensures that the z-position of the focus remains constantly within 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.

With RAYGUIDE MATCH, features such as edges and circles can be detected on the workpiece and the position of the laser processing is automatically adjusted.

Process automation with the RAYLASE DISTANCE MEASUREMENT SENSOR and RAYGUIDE MATCH
To cover the global demand, **battery production must be fully automated.** This can be a challenge in a sensitive process such as busbar welding. Therefore, it is important to **automatically and precisely measure the exact working distance** to the battery before each weld. The same applies to the position of the workpiece.

This is exactly what the BUSBAR WELDING MODULE achieves by the integration of the RAYLASE DISTANCE MEASUREMENT SENSOR and RAYGUIDE MATCH. With RAYGUIDE MATCH, the **positions of the battery cells and the busbars are automatically detected,** and the position of the weld is autonomously corrected. By using the two sensor solutions, it becomes possible to run the **manufacturing process automated** and **without manual interaction.**

More efficient and reliable battery production due to BUSBAR WELDING MODULE
The need for **precision and quality in busbar welding** has become even more apparent with the **increasing demand** for electric vehicles. They require batteries that are not only powerful and efficient, but also safe and durable. Given the number of individual cells in an EV battery pack, **ensuring the quality and consistency of welds** across all these joints is of paramount importance. This is where the BUSBAR WELDING MODULE can play its part, **making this process step more efficient and reliable.**

THE CORE COMPONENTS

AXIALSCAN FIBER RD-30 – Integrated beam deflection unit for use in production environments

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 for **high laser powers up to 6 kW** and **special beam shapes such as ring modes or tophats.** With the RAYVOLUTION DRIVE, which is our highly dynamic z-axis, the AXIALSCAN FIBER RD-30 can utilize the full dynamics of its XY scanners while still maintaining the correct z-position of the focus. And its large **processing fields of up to 500 x 500 mm²** enable the processing of large battery packs with a single system and without complex and expensive movement of the workpiece or the scan system.

RAYLASE
Distance Sensor Technology

RAYLASE DISTANCE MEASUREMENT SENSOR

The correct focus position is crucial for a stable laser process. Therefore, we have developed our own RAYLASE DISTANCE MEASUREMENT SENSOR – specifically for pre-focusing laser deflection units. And the benefits of our distance sensor in combination with an AXIALSCAN FIBER RD-30 are obvious: **Precise distance measurements** in a **processing field of 500 x 500 mm²** with an **accuracy of ±10 µm,** completely without moving the component or the scan head. Plus, the AXIALSCAN's integrated z-axis can directly compensate for height differences between individual batteries. This way, complex height adjustment by means of a robot or gantry can be dispensed with, making the overall solution significantly less complex.

RAYGUIDE
MATCH

RAYGUIDE MATCH – Automated position detection of the workpiece

Adjusting the workpiece is a critical and time-consuming step in many manufacturing processes. Especially for precise welds, it is often much easier to detect the position of the workpiece and adjust the movement of the deflection unit accordingly. This becomes possible with our RAYGUIDE MATCH – fully automatically! The plugin extends the **camera-based position detection** RAYGUIDE CLICK&TEACH by an **automatic feature detection.** Position marks on the workpiece are detected and the laser processing is autonomously corrected by the software. As a result, higher tolerances can be tolerated during part feeding and alignment, and precise laser processes can be implemented fully automatically without manual interaction of an operator.

YOUR BENEFITS AT A GLANCE

Thanks to its carefully selected components, the BUSBAR WELDING MODULE enables even complex welding applications such as the welding of busbars in the e-mobility sector to be operated effectively and efficiently.

The system offers advantages that are unique in the market:

- Processing of large battery packs in **working fields up to 500 x 500 mm²** with a single system and without complex and expensive movement of the workpiece or scan system.
- High **laser powers up to 6 kW** and special beam shapes such as ring modes or tophats allow optimal welding dynamics and speed
- Camera-based **position recognition of the workpiece with RAYGUIDE MATCH** simplifies alignment and saves valuable time in the production process
- Fast and precise **distance measurement with the RAYLASE DISTANCE MEASUREMENT SENSOR** improves weld quality and reproducibility by ensuring the optimal focus position for each individual battery cell
- Fully **automatable solution via RAYGUIDE API** enables efficient operation with minimal human interaction in a production line
- The BUSBAR WELDING MODULE as an **optimally pre-configured solution** saves time and costs when designing the production line

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.