

Preliminary

# HIGH POWER WELDING MODULE



Machine/plant manufacturers | Automation service providers | Research & development | End OEM

## How to handle high laser power outputs with total process reliability

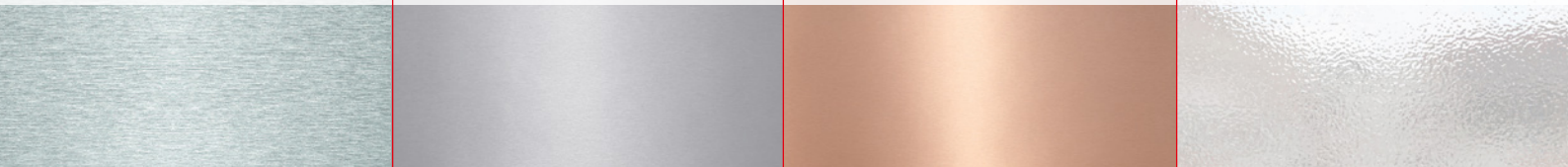


Steel and stainless steel

Aluminium

Copper

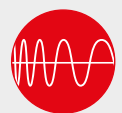
Plastics



### What the High Power welding module can do for you:

The High Power welding module with infrared (or, alternatively, green or blue) wavelength is an established piece of laser welding technology based on F-Theta lenses. With the High Power welding module, you, as a machine and plant manufacturer or integrator, are ideally positioned to meet customer requirements for very **high laser power outputs** with 100% process reliability. The High Power welding module with the digitally controlled SUPERSCAN IV-30 2-axis deflection unit can be quickly and easily integrated into new or existing machine and production lines.

The **cost-efficient, modular** laser welding application is ideally suited to industrial applications with a specified **laser working field** of up to **300 x 300 mm**. These include, for example, welding of battery cell covers or tab welding, i.e. welding of cell contact surfaces made of aluminium or copper plates. The High Power welding module uses remote welding in combination with a robot. Deflection units with apertures of 20 to 30 mm ensure top-quality results during laser welding of metals and plastics.



Flexible wavelengths  
and materials



Clean-room  
manufacturing



## What you can rely on with Raylase:

We strive, above all, to achieve usability, quality and productivity. That's why all **development, manufacturing** and **functional testing** of high-quality laser applications for virtually all sectors happens exclusively in our own **in-house** laboratories and **production facilities**. We guarantee fast service and expert maintenance by means of our global support network.



## Flexibility that you can see:

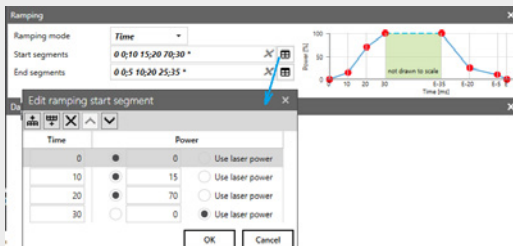
The **wealth of variants** within the various component groups of our High Power welding module maximises your flexibility as a machine and plant manufacturer when planning, designing and (re)constructing diverse production lines. As an engineer, the diversity of options to choose from means that you'll enjoy a greater **scope of design** and more freedom to realise your complex developments. The High Power welding module guarantees the following for all standard fibers and laser wavelengths:

- stable laser power outputs due to diverse mirror substrates and coatings
- flexible process planning thanks to lenses with a range of focal lengths
- creative scope of design thanks to various collimators
- significantly reduced programming effort thanks to highly functional control cards



## How we define quality assurance:

Innovative weldseam quality assurance is based on coaxial on-axis process monitoring, achieved by means of a high-power camera adapter for a camera, welding monitoring or a pyrometer.



Monitoring of the welding contour throughout the entire process

In terms of software, the **preconfigured control cards** also enable fast, smooth integration of the High Power welding module into machines and systems, as well as into high-level systems if required. Preconfigured cards facilitate the customised definition of individual welding cycles.

This is done by the end customer before the start of the process using the **mapped laser process** in the software – much like a geometry in a CAD system. The plant operator sees the welding contour

in the complete process field and can assign various parameters to it, such as laser power output or speed. For example, it is possible to specify that the laser power is to ramp up over a certain period at the start of a contour, distributed over several curve points. Over the course of the welding contour, the metal heats up and absorption increases. It is then possible to specify in the **programming** that the power should decrease linearly (e.g., by 5%) between two or more points. Finally, at the point where the end and the start of the welding contour meet, the process can be ended with a somewhat steeper downward slope.

A modulation in the laser beam in a spiral-shaped forward motion creates a homogeneous melt pool. With highly functional control cards, you as a machine manufacturer or integrator, will significantly reduce your programming costs, as the software development kit (SDK) makes it much easier to modify a client-side library.

Stable production times with a longer operating time are achieved in the High Power welding module thanks to an optional air knife, which improves optical cleanliness. Optional stainless steel components also offer protection from corrosion.

## Variants

Exemplary application for blue wavelength (450 nm)



- |   |                                  |    |   |
|---|----------------------------------|----|---|
| 1 | SS-IV-30                         | 7  | Collimator bracket set                  |
| 2 | Camera adapter HP 420–480        | 8  | Collimator QBH WL 450 D40 f = 68        |
| 3 | Collimator QBH WL 450 D40 f = 68 | 9  | 6" or 9" air knife                      |
| 4 | Sensor adapter                   | 10 | Lens ring 3.5; f-theta 420–480 f = 339  |
| 5 | Camera lens and camera           | 11 | Lens ring -7.5; f-theta 440–460 f = 262 |
| 6 | Camera lens and camera           |    |   |

## The perfect companion:

**RAYGUIDE**

### SIMPLE PROCESS SOFTWARE

Guarantees fast and easy interactions for customised programming. User-friendly set-up and calibration of the deflection unit and effortless automation.

**SP-ICE 3**

### CONTROL CARD WITH FEEDBACK

Can be used universally as well as specifically for individual requirements. The laser system can thus be optimally controlled, optimised during development and monitored during operation.

**GENERAL SPECIFICATIONS**

|  |  |   |
|--|--|---|
| <b>Power supply</b>  | <b>Voltage [V]</b>                               | + 48 or + 30                                  |
|  | <b>Current (RMS) [A]</b>                         | 2   |
|  | <b>Current (max.) [A]</b>                        | 5   |
|  | <b>Ripple / noise @ 20 MHz bandwidth [mV pp]</b> | Max. 20                                       |
| <b>Ambient temperature [°C]</b>  |  | +15 to +35                                    |
| <b>Storage temperature [°C]</b>  |  | -10 to +60                                    |
| <b>Humidity non condensing [%]</b>   |  | ≤ 80  |
| <b>Interface signals</b>   | <b>Digital</b>                                   | XY2-100 Enhanced Protocol<br>SL2-100 Protocol |
| <b>Typical deflection (optical) [rad]</b>  |  | ± 0.393                                       |
| <b>Resolution XY2-100-E 16-Bit [μrad]</b>  |  | 12  |
| <b>Resolution SL2-100 20-Bit [μrad]</b>  |  | 0.76  |
| <b>Repeatability (RMS) [μrad]</b>  |  | < 2.0   |
| <b>Position noise (RMS) [μrad]</b>   |  | < 3.2   |
| <b>Temperature drift</b>   | <b>Max. Gaindrift [ppm/K]</b>                    | 15  |
|  | <b>Max. Offsetdrift [μrad/K] <sup>1</sup></b>    | 10  |
| <b>Long-term drift 8 h without water temperature control [μrad] <sup>1</sup></b> |  | < 60  |
| <b>Long-term drift 8 h with water temperature control [μrad] <sup>1, 2</sup></b> |  | < 40  |

<sup>1</sup> Angles optical. Drift per Axis, after 30 min. warm-up, at constant ambient temperature.

<sup>2</sup> After 30 min. warm-up, under varying process loads, with water temperature control set for ≥ 2 l/min and 22°C water temperature.

**APERTURE DEPENDING SPECIFICATIONS – MECHANICAL DATA**

| <b>Deflection Unit</b>                                 | <b>SUPERSCAN IV-30</b>  |
|--|-------------------------|
| <b>Input aperture [mm] <sup>1</sup></b>                | 30                      |
| <b>Beam displacement [mm]</b>                          | 35.4 (QU), 36.0 (SC)    |
| <b>Weight (without F-Theta Lens) [kg] <sup>2</sup></b> | approx. 8 – 10          |
| <b>Dimensions (L x W x H) [mm]</b>                     | approx. 360 x 163 x 355 |

Either a collimator bracket set or a high-power camera adapter with water-cooled aperture and process light output is used to adapt a fiber collimator.

| <b>Typical fiber collimators (QBH / QD) <sup>3</sup></b>                                      | <b>Typ. beam divergency 1/e<sup>2</sup> full angle</b> | <b>Max. beam divergency 1/e<sup>2</sup> full angle</b> |
|---|--|--|
| <b>Fiber collimator d50, f = 120 mm [mrad]<br/>BPP = 2 mm mrad, fiber core d = 50 μm</b>      | 160  | 170  |
| <b>Fiber collimator d50, f = 160 mm [mrad]<br/>BPP = 3.5 mm x mrad, fiber core d = 100 μm</b> | 140  | 150  |

<sup>1</sup> Deflection units with 20 mm aperture are also available for plastic welding applications.

<sup>2</sup> Weight and dimensions with camera adapter, without f-theta Lens, Air Knife and process monitoring.

<sup>3</sup> For each combination with a fibre laser, the appropriate collimation focal length must be calculated and specified by RAYLASE.

**TYPE DEPENDENT SPECIFICATIONS – TUNINGS**

| <b>Tuning</b>             | <b>Description</b>  |
|---------------------------|---|
| <b>Vector-Tuning (VC)</b> | Optimized tuning with a wide range of applications with emphasis on processing speed. |

**TYPE DEPENDENT SPECIFICATIONS – DYNAMIC DATA**

| Deflection Unit   | SUPERSCAN IV-30 QU |           | SUPERSCAN IV-30 SC |           |
|---|--------------------|-----------|--------------------|-----------|
| <b>Tuning</b>   | VC                 |           |                    |           |
| <b>Processing speed [rad/s] <sup>1</sup></b>                    | 30 @ 30 V          | 50 @ 48 V | 40 @ 30 V          | 65 @ 48 V |
| <b>Positioning speed [rad/s] <sup>1</sup></b>                   | 30 @ 30 V          | 50 @ 48 V | 40 @ 30 V          | 65 @ 48 V |
| <b>Tracking error [ms] <sup>2</sup></b>                         | 0.48               |           | 0.3                |           |
| <b>Step response time at 1% of full scale [ms] <sup>3</sup></b> | 1.2                |           | 0.8                |           |

<sup>1</sup> See "Calculation of speed".

<sup>2</sup> With F-Theta Lens f = 254 mm.

<sup>3</sup> Setting to 1/5,000 of full scale.

**Calculation of speed:**

Speed in processing field = Focal length F-Theta Lens x processing speed

Example 1: SUPERSCAN IV-30 QU with F-Theta Lens f = 254 mm Processing speed 50 rad/s (48V),

$$v = 254 / 1,000 \times 50 = 12.7 \text{ m/s}$$

Example 2: SUPERSCAN IV-30 SC with F-Theta Lens f = 254 mm Processing speed 65 rad/s (48V),

$$v = 254 / 1,000 \times 65 = 16.5 \text{ m/s}$$

**Deflection mirrors and F-Theta Lenses:**

Deflection mirrors and F-Theta Lenses with optimized mounts are available for all typical laser types, wavelength, power densities, focal length and processing fields.

Customer specific configurations are also possible. Please contact the RAYLASE support team for specific information and possible combinations on +49 8153 9999-699 or support@raylase.de.

**Options:**

The SUPERSCAN IV deflection units offer the possibility of water temperature control (W) for the electronic components and galvanometer scanners.

The SUPERSCAN IV deflection units offer the possibility of air cooling (A) for the deflection mirrors.

Both ensure constant working conditions as well as excellent long-term stability and guarantee reliable operation of high-performance applications.

All water-bearing components of the deflection units and the Camera Adapter High Power are optionally available in stainless steel.

This should be considered for cooling circuits without additives against corrosion, especially when using DI water, in order to protect aluminium and copper parts in the deflection unit and cooling circuit.

The SUPERSCAN IV deflection units can also be operated without water temperature control. In consequence the drift values may increase.

**WATER TEMPERATURE CONTROL**

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

<sup>1</sup> **Caution:** When using cooling water including deionised water, suitable additives must be used to prevent the growth of algae and protect the aluminium and copper components against corrosion.

**Additive recommendations (Please consult your additive supplier for dosage information):**

**Standard industrial applications:** Products of company NALCO, e.g. CCL 105 (Premix) oder TRAC105A\_B (Additive)

**Food & beverage, packaging applications:** Polypropylene glykol of company Dow Chemicals, e.g. DOWCAL N

## AIR FLUSHING

| Specification compressed air <sup>1</sup> |         |
|---|---------|
| Max. water shares [g/m <sup>3</sup> ]     | ≤ 0.05  |
| Max. oil shares [mg/m <sup>3</sup> ]      | ≤ 0.005 |
| Pore filter [μm]                          | ≤ 5     |
| Recommended air flow [l/min] approx.      | 50–100  |
| Tube outer diameter [mm]                  | 6       |

<sup>1</sup> ISO 8573-1 Compressed air Part 1: Impurities and purity classes

## OPTICS SPECIFICATIONS

| Wavelength and Coating   | Mirror Substrate | Maximum permissible laser power [W] <sup>1</sup> |
|--------------------------|------------------|--|
| 425 nm – 465 nm + AL     | QU               | 2,000  |
| 780 nm – 980 nm +AL      | QU               | 4,000  |
| 900 nm – 1,100 nm + AL   | QU, SC           | 4,000  |
| 1,064 nm                 | QU               | 4,000  |
| 1,060 nm – 1,090 nm + AL | QU, SC           | 4,000  |
| 1,020 nm – 1,040 nm      | QU               | 6,000 (8,000 @ 75% duty cycle)                   |
| 1,060 nm – 1,080 nm      | QU               | 6,000 (8,000 @ 75% duty cycle)                   |

<sup>1</sup> Valid for single-mode and multi-mode continuous wave (CW) lasers

## PROCESS-MONITORING

| Camera Adapter High Power (HP)     | Process light wavelength              |
|------------------------------------|---------------------------------------|
| Camera Adapter HP 420 – 480        | 630 nm – 2,100 nm                     |
| Camera Adapter HP 1070 001 / 002   | 450 nm – 880 nm                       |
| Camera Adapter HP 1060 – 1090 + WM | 400 nm – 900 nm + 1,300 nm – 2,600 nm |

Other camera adapters on request. Water-bearing parts are also available in stainless steel.

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