smart welding

Designed for robot-assisted welding applications, intelli*WELD* **3D scan systems** are capable of swiftly positioning the laser beam along 3D contours. While a robot guides the scan system along a part's contour, the intelli*WELD* quickly and accurately deflects and fine-positions the laser spot. Complex motions and time-wasting robot repositioning are avoided, thereby boosting speeds and cutting weld-to-weld positioning time down to a few milliseconds. Hence, beam source utilization climbs significantly, as dœs productivity.

The intelli*WELD* system's compactness facilitates straightforward mounting onto industrial robots. Its optics are optimized for fiber-coupled disk or fiber lasers with powers up to 8 kW.

The intelli*WELD* family includes a version with prefocus optics for vision-assisted applications (e.g. fillet welding with precise contour tracking), as well as the intelli*WELD* II with integrated zoom axis (particularly well-suited for overlap welding, its variable spot size enables flexible seam widths).

intelli*WELD* scan systems use SCANLAB's fully digital i*DRIVE* technology, providing an integrated approach to laser and process safety. It allows real-time monitoring of all important scan head status parameters. And its integrated interlock signal facilitates software-independent integration of the scan system into safety circuits.
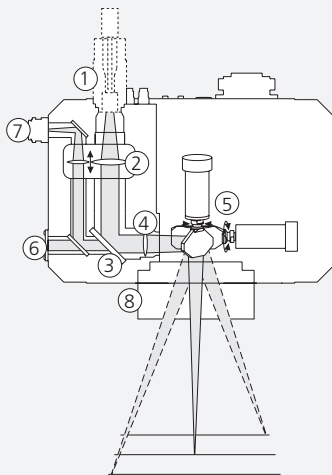
Typical Applications:

- Robot-assisted welding (remote welding)
- 3D applications
- E-Mobility
- Processing-on-the-fly

Typical Industries:

- Automotive
- Mechanical engineering and metalworking
- Aerospace industry

SCANLAB
innovators for industry
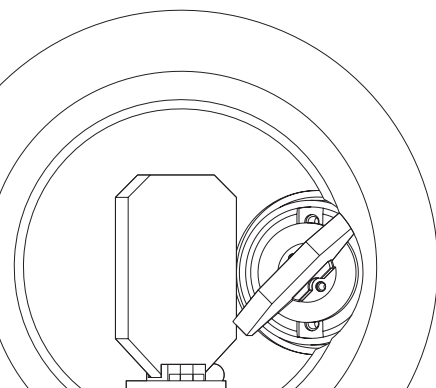
Legend

1 Fiber adapter
2 Variable collimator
3 Dichroic mirror
4 Focusing optics
5 Galvanometer scanner
6 Attachment provision for
   process monitoring
7 Variable camera tracking optics
8 Fume protection module

intelli*WELD* II PR with prefocus
– optimized for vision applications (e.g. fillet welding)

- High transmission of Vis/NIR wavelengths –
  ideal for coaxial sensors, illumination and observation
- No divergence between observation points and processing points
  (no chromatic aberration)
- Wide scan angles possible – large image field
- Extensive z-range – thanks to larger aspect ratio
- High imaging quality – also usable with lasers of high beam quality,
  even in single mode
- No objective required – compact and lightweight scan system
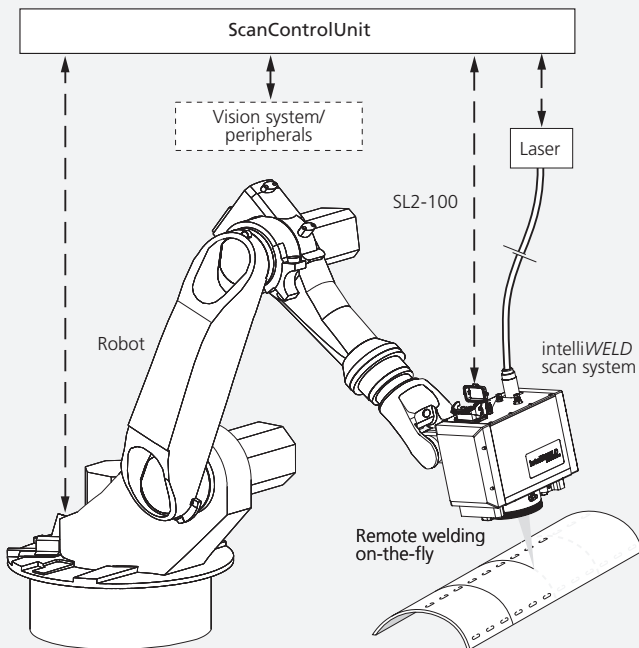
For further information on the ScanControlUnit:

www.blackbird-robotics.de/en/products

Principle of Operation

The laser beam is fiber-delivered to the scan system's variable collimator and then directed to the scan system's moving deflection mirrors (galvos).

The intelli*WELD* II PR employs a prefocus optic to focus the beam ahead of the deflection mirrors, whereas the intelli*WELD* II FT uses an F-Theta objective after the deflection mirrors – see depictions top left and right.

The variable collimator's optic is dynamically driven along the optical axis via the lin*AXIS* linear axis. This alters the collimated beam's divergence, and thus its focus position along the z axis, thereby giving the intelli*WELD* 3D-processing functionality.

The intelli*WELD* II FT can be equipped with an optional zoom axis for continuously enlarging the spot size.

For process monitoring, all intelli*WELD* systems can be equipped with a second camera port containing variable camera-tracking optics. This facilitates process monitoring with autofocus (coupled to the z axis or zoom axis) throughout the entire working volume.

Control

When combined with an RTC control board, intelli*WELD* systems support SCANLAB's fully digital i*DRIVE* technology. They feature integrated safety design and extensive possibilities for laser and process control. i*DRIVE* technology enables real-time monitoring of all the scan system's key status parameters, e.g. the replaceable protective window or entrance-aperture temperature.

The **ScanControlUnit** (RobotSyncUnit) supports intelli*WELD*'s robotics suitability. It is a central operating/control unit for laser welding systems (robot, laser, intelli*WELD* and peripherals). Simple and intuitive system usage brings efficiency to programming of welding tasks – see figure, left.

System Features

intelliWELD systems particularly excel in the following characteristics:

- **Robustness**
  - sealed housing
  - encapsulated optical path
  - replaceable collimator protective window
  - replaceable beam-exit protective window
  - purge-air beetween the inner and outer protective window
  - water cooling of electronics, entrance aperture, beam exit plate/objective
  - internal air cooling of scan mirrors
  - fume protection module (optional)
  - flexible, adjustable cross jet (optional)

- **Safety**
  - temperature sensors for scan mirrors, galvo mounts, entrance aperture, coolant and electronics
  - protective window sensor
  - flow sensor
  - axes monitoring (voltages, error states, position signal retrieval)

  All internal sensors are joined in a software-independent interlock signal to enable emergency shutdown in critical situations.

- **Precision**
  - low drift due to equipment with III galvos
  - custom image field calibration
  - Teach-in module for easier setup of robot-mounted laser scan systems via cross hairs projected onto the work piece

- **Dynamic performance**
  - SCANLAB III galvos developed in-house
  - optimized mirror design
  - various tunings available
  - quick repositioning, high oscillation frequency (wobble)
  - optimized control functions (e.g. processing-on-the-fly, sky writing, variable scanner and laser settings)

Legende

1. Fiber adapter
2. Variable collimator
3. Dichroic mirror
4. F-Theta objective
5. Galvanometer scanner
6. Attachment provision for process monitoring
7. Variable camera tracking optics
8. Zoom
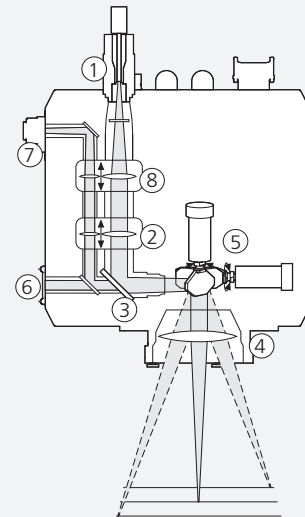
**intelliWELD II FT** (with F-Theta objective) – optimized for overlap welding

- Additional zoom axis:
  - enlarges spot size up to x 1.5
  - dynamic, continuous intra-seam adjustability
  - independent of/in addition to defocusing
- Constant spot size while varying x, y and z at all zoom settings throughout the entire accessible volume
- Small aspect ratio, therefore small spots even with low beam quality or large fiber diameter
- Lower drift, thanks to III-series galvos
- Interlock monitoring of all four axes
- Status indicator lights for power and interlock
- Integrated illumination for visual inspection of protective window
- Vision port
  - brighter image
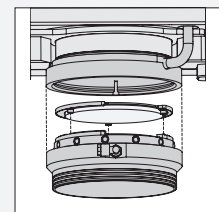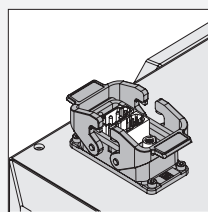 - sharp camera imaging at all xyz zoom settings
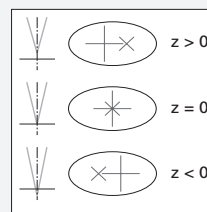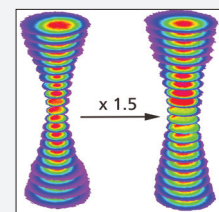
Features
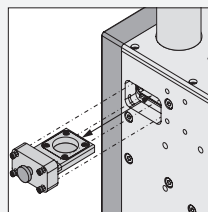
Collimator tray
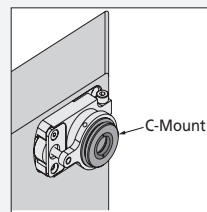
Tracking camera port — C-Mount

Protective window with sensor and fume protection

Industry-suitable connectors

Teach-in module — z > 0, z = 0, z < 0

Zoom option (intelliWELD II FT) — x 1.5

Typical Optical Configurations

	intelli*WELD* II PR (with prefocus optic)				intelli*WELD* II FT (with F-Theta objective)			
Focal length, focusing optics	470 mm		660 mm		255 mm		460 mm	
Focal length, collimator	135 mm	110 mm	135 mm	110 mm	142 mm	125 mm	142 mm	125 mm
Limiting NA (half angle)	0.11	0.13	0.11	0.13	0.11	0.13	0.11	0.13
Image ratio	1:3.5	1:4.3	1:4.9	1:6.0	1:1.8	1:2.0	1:3.2	1:3.7
Focus diameter	350 µm [1]	430 µm [1]	490 µm [1]	600 µm [1]	360 µm [2]	400 µm [2]	640 µm [2]	740 µm [2]
Max. image ratio with Zoom	-	-	-	-	1:2.7	1:3.0	1:4.8	1:5.6
Focus diameter					540 µm [2]	600 µm [2]	960 µm [2]	1120 µm [2]
Fiber diameter	≥ 50 µm [3]		≥ 50 µm [3]		≥ 50 µm		≥ 100 µm	
Operating distance to protective window	301 mm		494 mm		303 mm		499 mm	
Image field size (z=0, elliptical)	ca. (300 x 330) mm²		ca. (450 x 480) mm²		ca. (160 x 90) mm²		ca. (370 x 250) mm²	
Image field size (z=0, rectangular)	ca. (270 x 270) mm²		ca. (450 x 470) mm²		ca. (100 x 80) mm²		ca. (220 x 220) mm²	
Focus range in z direction	ca. ± 50 mm		ca. ± 100 mm		ca. ± 25 mm		ca. ± 70 mm	

Options

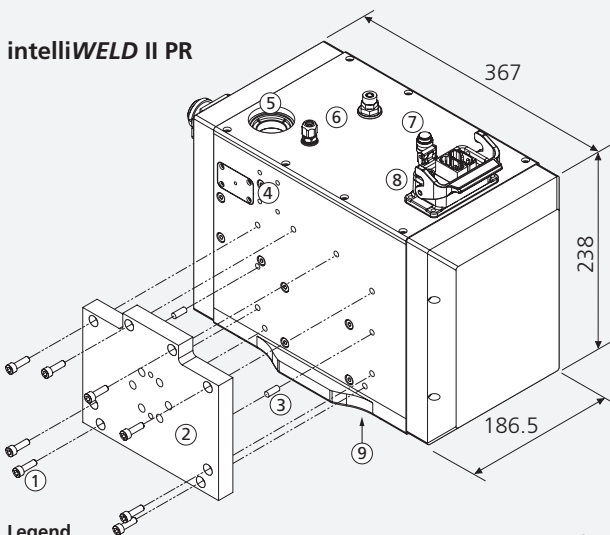|				
Zoom axis	-	-	x	x
Tracking camera port	x	x	x	x
Teach-in module	x	x	x	x

Basic equipment: double protective window beam exit, sensor beam exit protective window with fume protection module, flow sensor
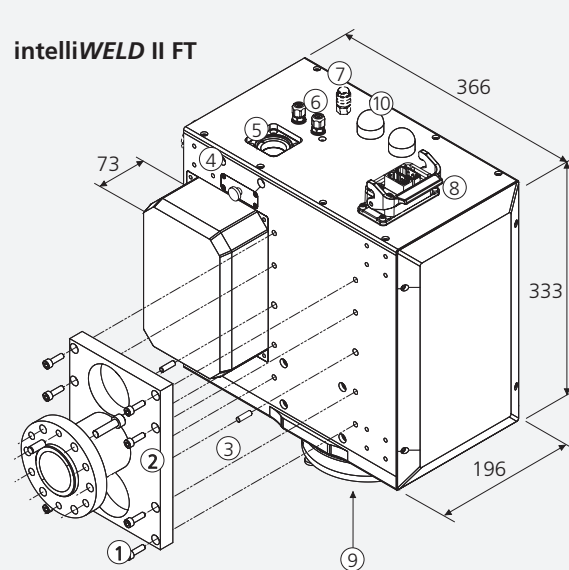
Common Specifications
(all angles are in optical degrees)

Wavelength	1030 – 1080 nm + NIR [4]	Power requirements	30 V DC (29-33 V), max. 8 A each
Maximum laser power (with specified cooling)	8 kW	Input and output signals	SL2-100
Fiber adapter	QBH, Q5/LLK-B, QD/LLK-D	Weight	21 – 40 kg
		Operating temperature	25 °C ± 10 °C

Step response time (with step tuning)
(settling to 1/1000 of full scale)

1% of full scale	1.2 ms
10% of full scale	3.5 ms
100% of full scale	11 ms

Typical water requirements: 3 l/min at 20°C and Δp < 0.1 bar, p < 4 bar

Compressed-air (for purge-air operation): intelli*WELD* II PR : 25±2.5 l/min, intelli*WELD* II FT: 20±2 l/min and p ≤ 2 bar each ISO purity class 1:6:1

Dynamic performance

Positioning accuracy	< 0.2 mm
Repeatability (RMS)	< 2 µrad
Long-term drift over 8 h (after warm-up)	< 0.15 mrad

[1] with 100 µm fiber
[2] with 200 µm fiber
[3] for single mode available on request
[4] mirror coatings for 1065 – 1105 nm + NIR nm available

intelli*WELD* II PR

367
238
186.5

intelli*WELD* II FT

366
73
333
196

Legend

1 Mounting screws *
2 Flange (robot adapter plate) *
3 Alignment pins *
4 Attachment provision for strain relief (fiber)
5 Attachment provision for fiber adapter
6 Connectors for cooling water
7 Connector for compressed air
8 Interfaces (Data, Interlock, Power in)
9 Bore holes for attaching an objective holder and a crossjet
10 Signal lights (Power and Interlock)

* not included

all dimensions in mm