



### smart welding

Designed for robot-assisted welding applications, intelliWELD 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 intelliWELD 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 does productivity.

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

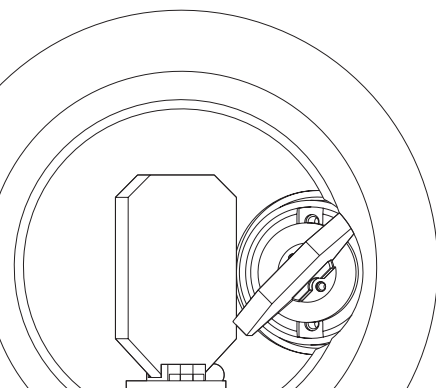
intelliWELD scan systems use SCANLAB's fully digital iDRIVE technology, providing an integrated approach to laser and process safety. It allows real-time monitoring of all important scan head status parameters. And its integrated interlock signal facilitates software-independent integration of the scan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

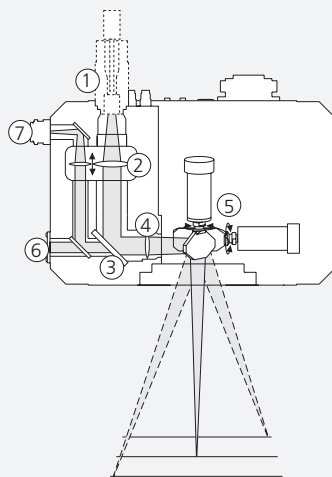
#### Typical Applications:

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

#### Typical Industries:

- Automotive
- Mechanical engineering and metalworking
- Aerospace industry





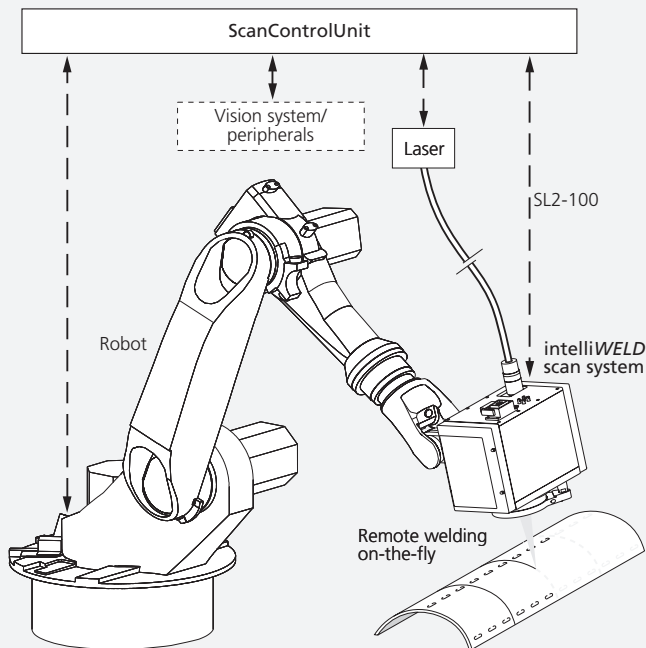
## Legend

- 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

## intelliWELD 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



## 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 intelliWELD PR employs a prefocus optic to focus the beam ahead of the deflection mirrors, whereas the intelliWELD 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 linAXIS linear axis. This alters the collimated beam's divergence, and thus its focus position along the z axis, thereby giving the intelliWELD 3D-processing functionality.

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

For process monitoring, all intelliWELD 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 RTC5 control board, intelliWELD systems support SCANLAB's fully digital iDRIVE technology. They feature integrated safety design and extensive possibilities for laser and process control. iDRIVE 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 intelliWELD's robotics suitability. It is a central operating/control unit for laser welding systems (robot, laser, intelliWELD and peripherals). Simple and intuitive system usage brings efficiency to programming of welding tasks (see figure, left).

For further information on the ScanControlUnit:

<http://www.blackbird-robotics.de/en/products-solutions/overview.html>



## 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
- fume protection module (optional)
- water cooling of electronics, entrance aperture, beam exit plate/objective
- internal air cooling of scan mirrors
- flexible, adjustable cross jet (available from Blackbird)

### • Safety

- temperature sensors for scan mirrors, galvo mounts, entrance aperture, coolant and electronics
- optional protective window sensor
- optional 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

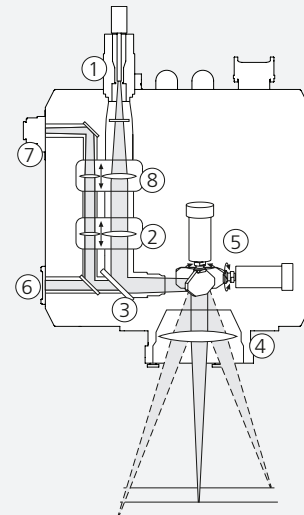
- custom image field calibration
- ASC sensor for drift compensation
- Teach-in module for easier setup of robot-mounted laser scan systems via cross hairs projected onto the work piece

### • Dynamic performance

- SCANLAB 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

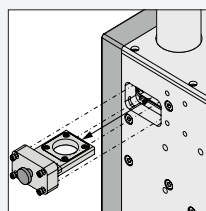


## intelliWELD II FT (with F-Theta objective)

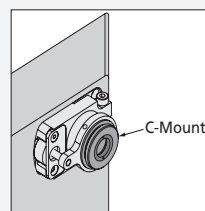
### – optimized for overlap welding

- 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
- New protective window sensor:
  - software-controlled gain
  - significantly shorter laser-on time < 1 second
  - integrated illumination for visual inspection of protective window
- Improved vision port
  - brighter image
  - sharp camera imaging at all xyz zoom settings

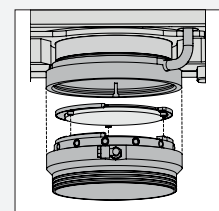
## Features



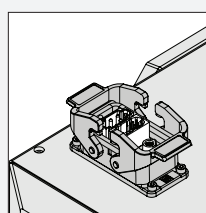
Collimator tray



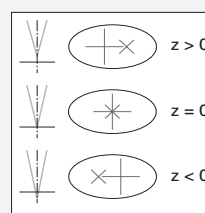
Tracking camera port



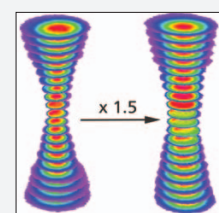
Protective window with sensor and fume protection



Industry-suitable connectors



Teach-in module



Zoom option

## Typical Optical Configurations

	intelliWELD PR (with prefocus optic)				intelliWELD II FT (with F-Theta objective)					
<b>Focal length, focusing optics</b>	470 mm		660 mm		255 mm		340 mm		460 mm	
<b>Focal length, collimator</b>	135 mm	110 mm	135 mm	110 mm	142 mm	125 mm	142 mm	125 mm	142 mm	125 mm
<b>Limiting NA (half angle)</b>	0.11	0.13	0.11	0.13	0.11	0.13	0.11	0.13	0.11	0.13
<b>Image ratio</b>	1:3.5	1:4.3	1:4.9	1:6.0	1:1.8	1:2.0	1:2.4	1:2.7	1:3.2	1:3.7
Focus diameter	350 $\mu\text{m}$ <sup>(1)</sup>	430 $\mu\text{m}$ <sup>(1)</sup>	490 $\mu\text{m}$ <sup>(1)</sup>	600 $\mu\text{m}$ <sup>(1)</sup>	360 $\mu\text{m}$ <sup>(2)</sup>	400 $\mu\text{m}$ <sup>(2)</sup>	480 $\mu\text{m}$ <sup>(2)</sup>	540 $\mu\text{m}$ <sup>(2)</sup>	640 $\mu\text{m}$ <sup>(2)</sup>	740 $\mu\text{m}$ <sup>(2)</sup>
<b>Max. image ratio with Zoom</b>	-	-	-	-	1:2.7	1:3.0	1:3.6	1:4.1	1:4.8	1:5.6
Focus diameter					540 $\mu\text{m}$ <sup>(2)</sup>	600 $\mu\text{m}$ <sup>(2)</sup>	720 $\mu\text{m}$ <sup>(2)</sup>	820 $\mu\text{m}$ <sup>(2)</sup>	960 $\mu\text{m}$ <sup>(2)</sup>	1120 $\mu\text{m}$ <sup>(2)</sup>
<b>Fiber diameter</b>	$\geq 50 \mu\text{m}$ <sup>(3)</sup>		$\geq 50 \mu\text{m}$ <sup>(3)</sup>		$\geq 50 \mu\text{m}$		$\geq 100 \mu\text{m}$		$\geq 100 \mu\text{m}$	
<b>Operating distance to protective window</b>	301 mm		494 mm		306 mm		439 mm		499 mm	
<b>Image field size (z=0, elliptical)</b>	ca. (300 x 330) mm <sup>2</sup>		ca. (450 x 480) mm <sup>2</sup>		ca. (160 x 90) mm <sup>2</sup>		ca. (200 x 100) mm <sup>2</sup>		ca. (370 x 250) mm <sup>2</sup>	
<b>Image field size (z=0, rectangular)</b>	ca. (270 x 270) mm <sup>2</sup>		ca. (450 x 470) mm <sup>2</sup>		ca. (100 x 80) mm <sup>2</sup>		ca. (160 x 80) mm <sup>2</sup>		ca. (220 x 220) mm <sup>2</sup>	
<b>Focus range in z direction</b>	ca. $\pm 50$ mm		ca. $\pm 100$ mm		ca. $\pm 25$ mm		ca. $\pm 40$ mm		ca. $\pm 70$ mm	

## Options

Zoom axis	-	-	-	X	X	X
Equipped for fillet seam tracking	-	X	-	-	-	-
Tracking camera port	X	X	X	X	X	X
Double protective window beam exit	-	X	X	-	-	X
Sensor beam-exit protective window	-	X	-	-	-	X
Collimator protective window	X	X	X	X	X	X
Flow sensor	X	X	X	X	X	X
Teach-in module	X	X	X	-	-	X

## Common Specifications

(all angles are in optical degrees)

Wavelength	1030 nm - 1105 nm <sup>(4)</sup>
Maximum laser power (with specified cooling)	8 kW
Fiber adapter	QBH, Q5/LLK-B, QD/LLK-D

## 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

## Dynamic performance

Positioning accuracy	< 0.2 mm
Repeatability (RMS)	< 2 $\mu\text{rad}$
Long-term drift over 8 h (after warm-up)	< 0.15 mrad <sup>(5)</sup>

<b>Power requirements</b>	30 V DC (29-33 V), max. 8 A each
<b>Input and output signals</b>	SL2-100
<b>Weight</b>	21 - 40 kg
<b>Operating temperature</b>	25 °C $\pm$ 10 °C
<b>Typical water requirements</b>	3 l/min at 20°C and $\Delta p < 0.1$ bar, $p < 4$ bar

<sup>(1)</sup> with 100  $\mu\text{m}$  fiber

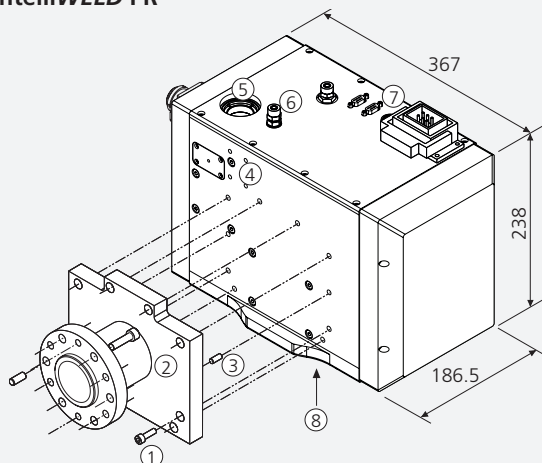
<sup>(2)</sup> with 200  $\mu\text{m}$  fiber

<sup>(3)</sup> for single mode available on request

<sup>(4)</sup> mirror coatings for 1030 - 1085 nm and 1065 - 1105 nm available

<sup>(5)</sup> intelliWELD II FT; < 0.2 mrad with ASC for intelliWELD PR

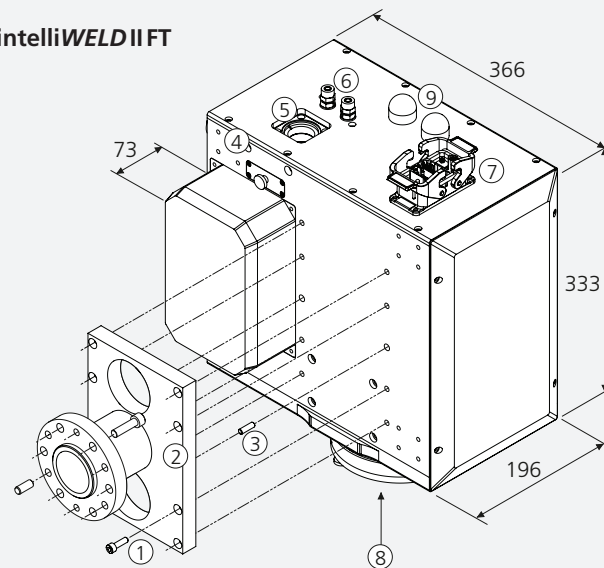
## intelliWELD PR



## 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 Interfaces (Data, Interlock, Power in)
  - 8 Bore holes for attaching an objective holder and a crossjet
  - 9 Signal lights (Power and Interlock)
- \* not included

## intelliWELD II FT



all dimensions in mm

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