PRODUCT DATASHEET

UV-EXP series of photolithography exposure systems

Designed for the most stringent light quality needs, the idonus UV-EXP series of exposure systems features a high-power UV-LED source, premium light homogenizers and a telecentric optical system. It is suited as a standalone, table-top equipment with ample workspace for your substrate or for integration in your system. This document guides you to select the best model for your needs and to plan its integration in your workflow.

idonus
creative engineering and manufacturing

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www.idonus.com

Optical system architecture

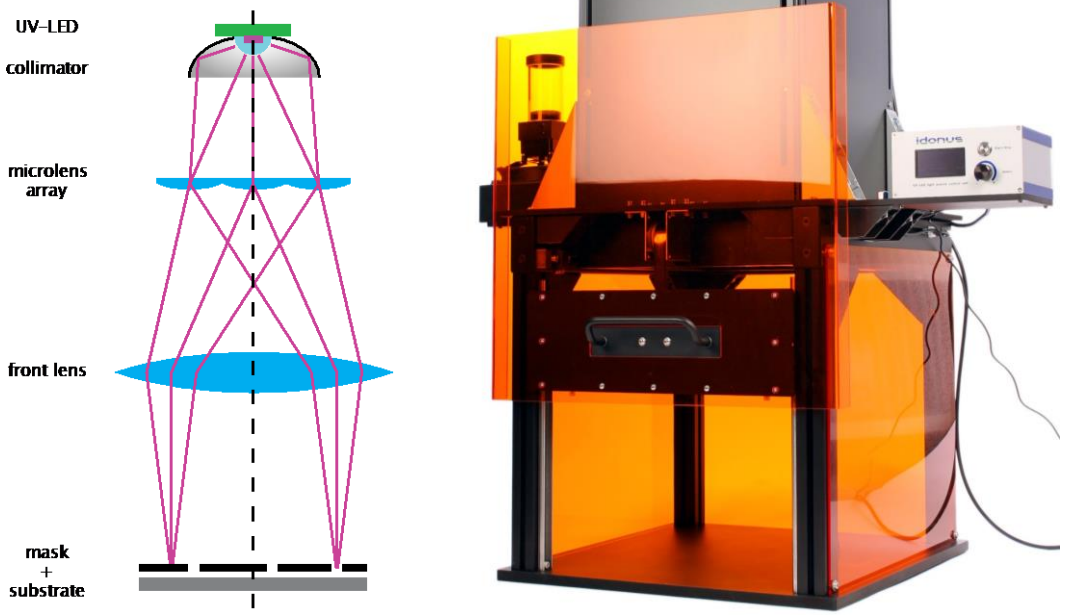


Figure 1: *Simplified schematic of the optical system architecture.*
Photograph of the standalone UV-EXP200S-SYS (here, with our 1st generation of UV-EXP-CU).

Light Engine (*UV-EXP-LE*)

Inside the lamphouse is embedded our high-performance UV-LED light engine (*UV-EXP-LE*). Typically, a single LED generates light at either 365 nm, 385 nm, 395 nm, 405 nm, 435 nm, or a combination of these wavelengths (365/405/435 in our standard offer). The *UV-EXP-LE* is precisely controlled by electronics and cooled by either air or water. The power module mounted on the back side of the lamphouse provides the needed operating current.

The raw light generated by the LED is uniformized by a premium set of homogenizer optics before being released for further processing into the exposure source enclosure.

Mechanical base (*UV-MB*) and UV protection shield (*UV-SHIELD*)

The mechanical base (*UV-MB*) supports the *UV-EXP* system, and the UV shield encloses the workspace. It is designed to offer plenty of working room for your substrate and alignment tool. The surrounding UV protection shield filters out the aggressive UV light, protecting your eyes and any materials nearby, while always allowing visual control.

Exposure source (*UV-EXP*)

With non-reflecting housing, the light source encloses the light engine and supports the telecentric optical system. The collimation optics are aligning the diverging (yet already homogenized) rays of UV light perpendicular to your substrate.

The source is built for a specific exposure area. Depending on your substrate size, you might want to choose between our standard sizes (Ø150, □150, □200, □300mm). Custom sizes are also available.

Control unit (*UV-EXP-CU*) and feedback sensor (*UV-SENS-GaP*)

The operation of the exposure system is controlled by the *UV-EXP-CU* control unit. Using UV and temperature sensors feedback loops, the *UV-EXP-CU* controls power, exposure time, irradiance, or dose. Interlocks are provided for your safety.

A remote-control unit *UV-EXP-RCU* is also available for integration with your existing equipment protocols.

UV-EXP line




Model	UV-EXP150R-SYS	UV-EXP150S-SYS	UV-EXP200S-SYS or UV-EXP200R-SYS	UV-EXP300S-SYS
Exposure area	∅ 150 mm	150 × 150 mm²	200 × 200 mm² or ∅ 200 mm	300 × 300 mm²
Wavelength	365 nm and/or 385 nm / 395 nm / 405 nm / 435 nm *(one wavelength standard)* *all models can be configured with UV-LEDs with multiple wavelength peaks* *(e.g., 1LE-3WL: Light Engine with 365/405/435 nm combination)*			
Irradiance @ 365 nm	40 mW/cm²	40 mW/cm²	25 mW/cm²	12 mW/cm²
Irradiance @ 385, 395 and 405 nm	50 mW/cm²	50 mW/cm²	30 mW/cm²	17 mW/cm²
Irradiance non-uniformity [a]	±3%	±3%	±3%	±3%
Collimation angle [b] (+/- α, FWHM [c])	±1.8°	±1.8°	±1.4°	±0.9°
Working distance (WD)	350 mm	300 mm	400 mm	300 mm
Options and variants	☐ **Adjustable Collimation Angle – *UV-ACA***: manually exchanged apertures to decrease the collimation angle at the detriment of the irradiance. The module is installed on the light engine and the lamphouse comes with an access opening for manual exchange of apertures ☐ **Water cooling – *UV-WA***: for continuous use with highly stable output. ☐ **Light engine upgrade to 2× or 3× LEDs with different wavelengths – (*2LE* or *3LE*)**: for increased versatility of use (a mechanical switch accessible from outside the lamp house allows the user to select the LED to use) ☐ **Sample holders**: Substrate and mask holder (chucks) for soft contact or vacuum contact: ☐ ∅ 2'' ☐ ∅ 3'' ☐ ∅ 100 mm ☐ ∅ 150 mm ☐ ∅ 200 mm ☐ ∅ 300 mm			

[a] Irradiance non-uniformity is given as ±*C*, where *C* is the Michelson contrast ratio: *C* = (max – min) / (max + min).

[b] To avoid ambiguity, the half-angle is noted α while the full angle is written 2α. The collimation angle is thus 2α or ±α, as indicated in our datasheet.

[c] FWHM: Full Width Half Maximum

High-power UV-LED source

Mercury free

Our *UV-EXP* exposure systems integrate high-power Light-Emitting Diodes (LED) to generate UV light. In comparison with the mercury (Hg) lamps currently used in traditional systems, LEDs have many advantages which are triggering an industry-wide transition. In the table below we have highlighted the main technical features of LED technology, while the spectral distribution of the 4 wavelengths of interest to UV photolithography are introduced in Figure 2.

The 365 nm UV-LED offers best versatility and is our recommended choice for most of the applications. Should the process efficiency be a critical parameter, the 385 nm is the best choice for certain photoresists.

***2LE* or *3LE* option** allows ×2 or ×3 LEDs to be installed on the exposure unit which can be manually switched in a few seconds when needed.

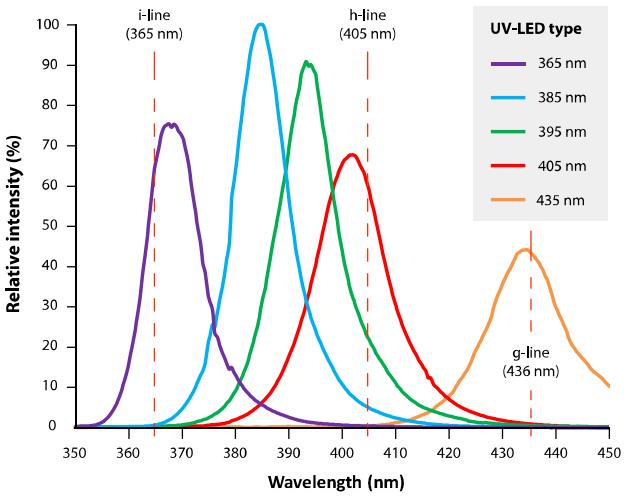


Figure 2: *Spectral distribution of our UV-LEDs. The i-, h-, and g-lines that are characteristic of Hg spectrum are indicated for comparison purpose.*

For recommendations regarding the UV-LED wavelength for your process, please refer to our technical note: *Photolithography exposure process with UV-LED*. For further recommendations, we will put you in contact with our sales engineers.

	High-power UV-LED

Light spectrum	• Each LED has a quasi-gaussian distribution about a single designed wavelength (mixed wavelength possible):
	  • 365 nm, 385 nm, 395 nm, 405 nm, 435 nm
	  • 365/405 nm (i-line and h-line)
	  • 365/405/435 nm (i-, h- and g-line)
	• No energy wasted outside the needed wavelengths: minimum sample heating
	• Necessary dose can be calculated for each application and precisely controlled

Lifespan [d]	> 10’000 h (actual exposure time)
Stability in time	• No warm-up time required (instant ON) • No shutter • Performance variable with temperature (approx. -10% at maximum operating temperature, control feedback loop compensated)
Environment impact	• No hazardous materials • High energy efficiency

[d] The LED industry has standardized the definition of LED lifetime. For example, L70 rated life gives the number of operating hours until the LED is emitting 70% of its initial light output. The lifespan shown in the table is indicative. Note that mercury-vapor lamp must be turned ON continuously, while LEDs are only turned ON during exposure.

Light quality

Photolithography requires the light illuminating the wafer to be uniform, collimated, and telecentric.

The **uniformity** assures the same level of curing/exposure of the complete photoresist surface. A typical requirement for irradiance non-uniformity is below ±5%. Our *UV-EXP* products guarantee ± 3%, un-matched by most of our competitors. For each delivered lamp, we scan the illumination area in more than 4000 points to assure its uniformity.

The **collimation angle** of our standard line is comprised between ±1° and ±2° (depending on the model). It is sufficiently low for the creation of small and sharp features and is also suitable for thick photoresist layers.

***UV-ACA* (Adjustable Collimation Angle) option** introduces a set of interchangeable fixed apertures, serving the purpose of decreasing the collimation angle at the expense of a reduced irradiance output.

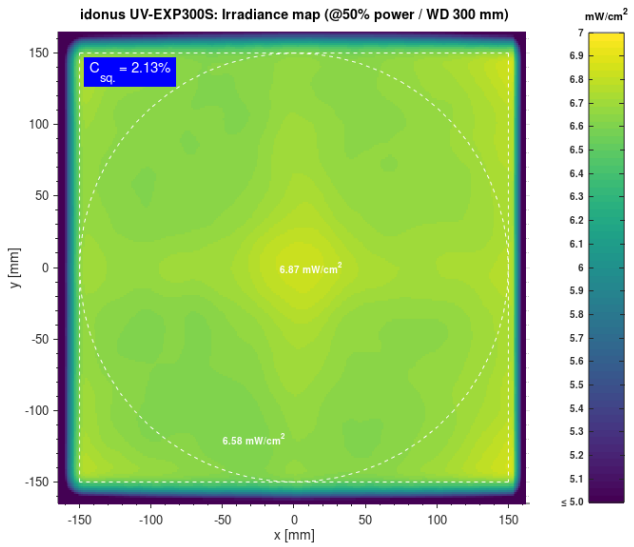


Figure 3: *Excerpt from a quality control report (as performed for all our products). The homogeneity test result is that of an UV-EXP300S system.*

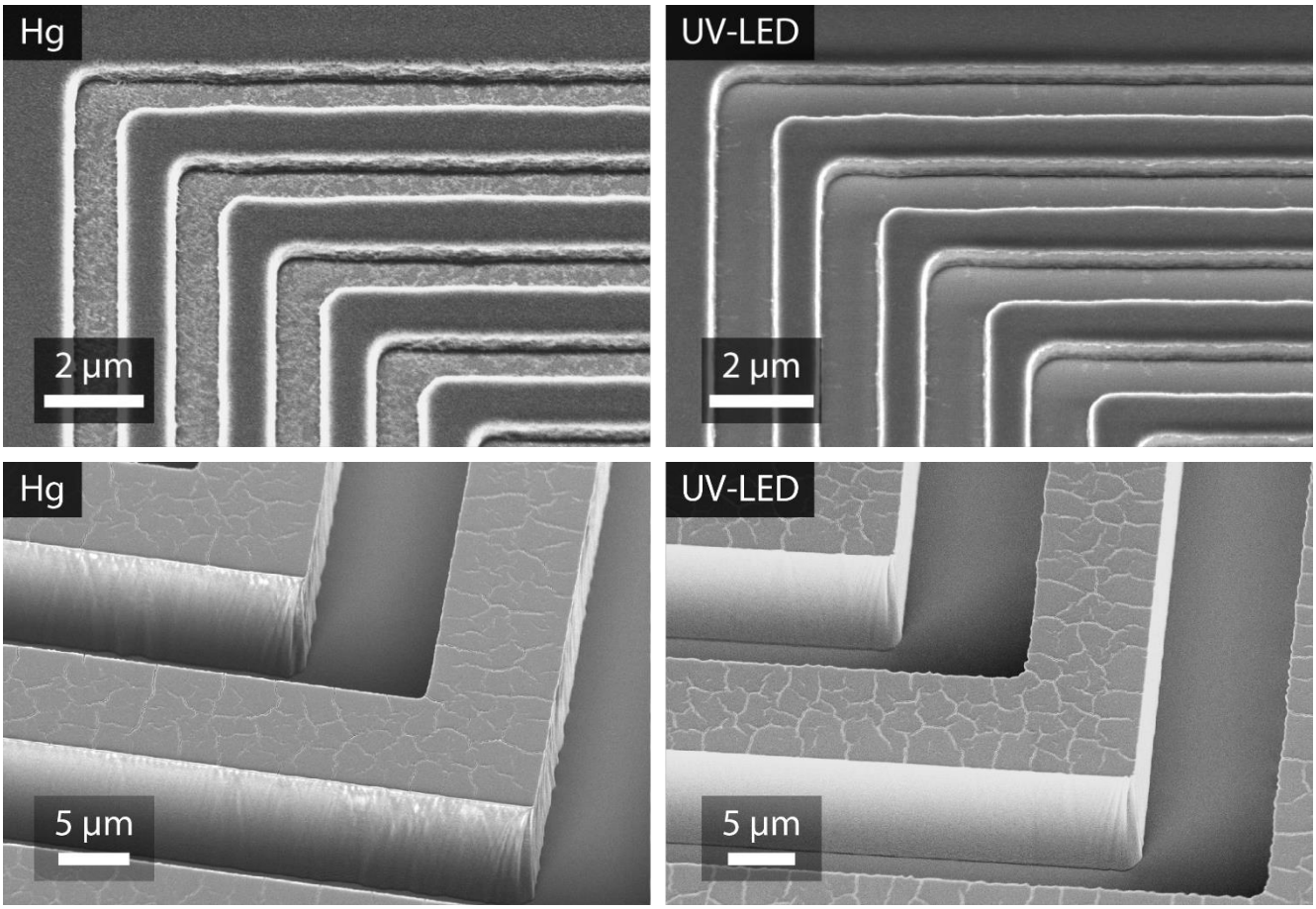


Figure 4: *Scanning Electron Microscope (SEM) micrographs comparing photolithography exposure of different resists exposed to conventional Hg-vapor lamp vs. our UV-LED exposure equipment.*

UV-EXP-CU Control Unit and feedback control

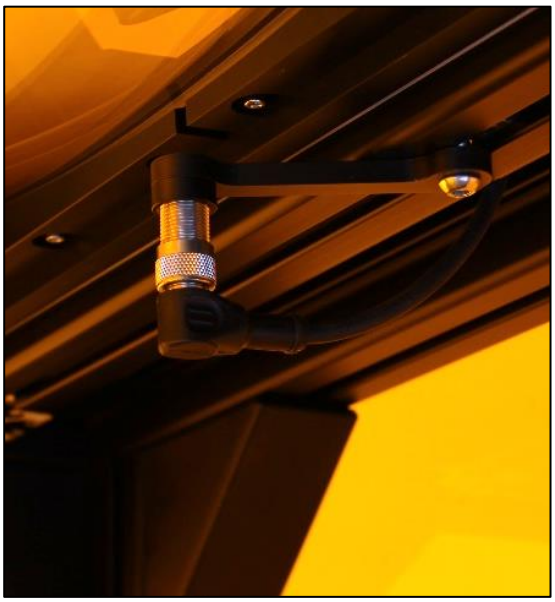
The *UV-EXP-CU* Control Unit (*Gen. 2* model, included by default) allows full control of your exposure parameters:

- **Duration**: controls the exposure time from 0.1 to 600 s
- **Current**: controls the electrical current supplied to LED from 10 to 100% of the rated current.
- **Irradiance**: controls the *UV-EXP* irradiance from min. 5 mW/cm² to the max. irradiance level of the system.
- **Dose**: controls the total dose (irradiance times the duration) from 10 to 9'000 mJ/cm².

Accurate output is ensured by a Gallium Phosphide, GaP, ***UV-SENS-GAP*** sensor (standard with system) mounted on the lamp housing. Together with the control unit, it regulates the irradiance through closed-loop feedback control.

The temperature of the light engine is measured and displayed, and the cooling system is controlled automatically to maintain safe operation temperature. Standard cooling method is **air-cooled heat-pipe**. When accurate process stability is required (for long duty cycles) we recommend selecting the **water-cooling option (*UV-WA*)**.

An advanced **Remote-Control Unit (*UV-EXP-RCU*)** is available as an option for OEM integrators, which enables direct lamp control by master process control via modBus TCP protocol. Pulse operation is also supported via the *UV-EXP-RCU*. Please contact our sales team if you wish to receive the specific technical documentation on the *UV-EXP-RCU*.



UV-SENS-GaP sensor installed on our UV-EXP system

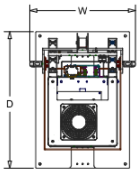
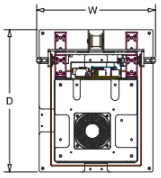
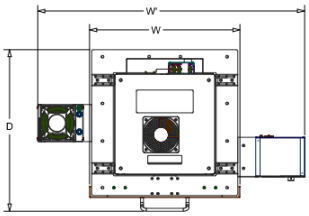
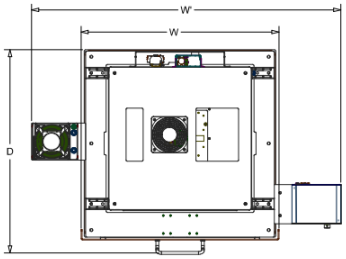
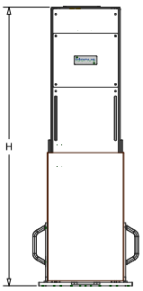
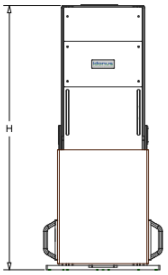
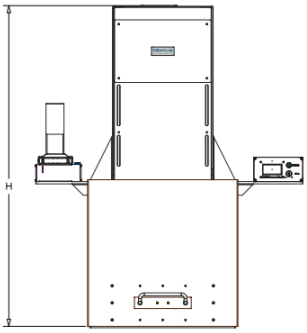
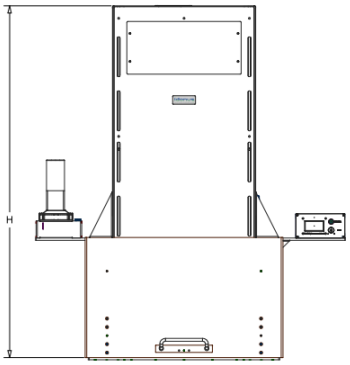
Detail of an air-cooled heat pipe system

The UV-EXP-CU Gen.2 comes with a 10-inch touch screen.

Detail of the UV-EXP150R-SYS

Dimensions: *UV-EXP-SYS*

UV-EXP-SYS are standalone systems for end-use.

Model	**UV-EXP150R-SYS**	**UV-EXP150S-SYS**	**UV-EXP200S-SYS** or **UV-EXP200R-SYS**	**UV-EXP300S-SYS**
Top view				
Front view				
Exposure area	∅ 150	150 × 150	200 × 200 or ∅ 200	300 × 300
Working distance (WD) [e]	350	300	400	300
Working volume (h × w × d)	340 × 260 × 265	282 × 310 × 302	240 × 374 × 448	252 × 514 × 584
Size (H × W × D)	1000 × 330 × 480	960 × 420 × 500	1170 × 530 × 570	1270 × 700 × 715
Size (H × W' × D)	-	-	1170 × 940 × 570	1270 × 1100 × 715
Control unit / *UV-EXP-CU* or ***-RCU***	Detached	Detached	Detached/Attached	Detached/Attached
Water cooling [f]	Detached	Detached	Detached/Attached	Detached/Attached
Power Supply	100-240 VAC 150 VA	100-240 VAC 150 VA	100-240 VAC 150 VA	100-240 VAC 150 VA
Weight	30 kg	45 kg	78 kg	120 kg

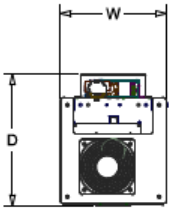
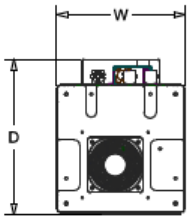
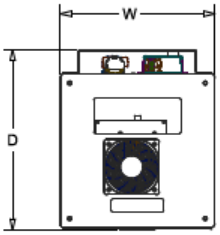
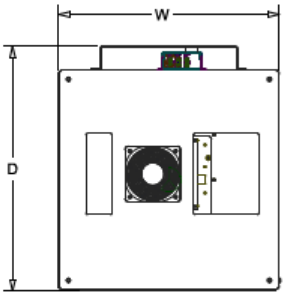
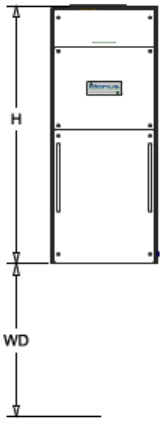
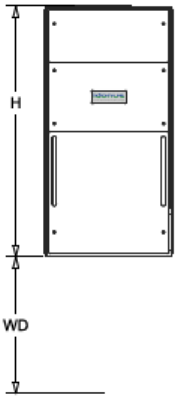
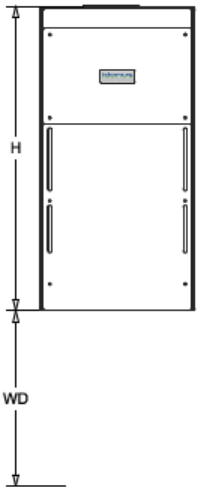
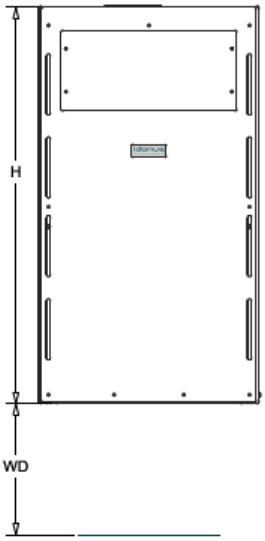
All units in [mm], unless otherwise specified

[e] WD (working distance) corresponds to the position of the focal plane of the UV light and is the ideal position of the exposure surface measured from the base of the lamp house (see next page for graphical illustration). Small deviations from this distance will not impact the exposure performance. Further away from the plane, minor losses in homogeneity are noted (approximately 1% increase in inhomogeneity at 100mm distance from the prescribed working distance).

[f] Water cooling module is optional.

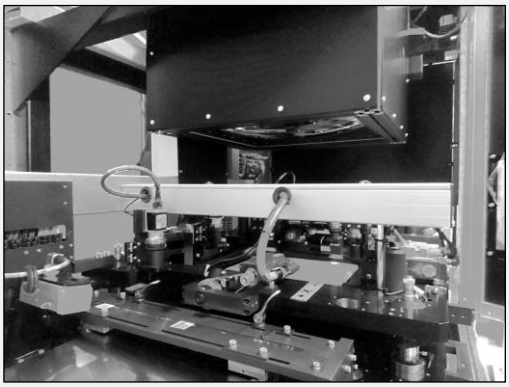
Dimensions: *UV-EXP* lamphouse

UV-EXP lamphouse are for integration into a production line or an equipment.

Model	**UV-EXP150R**	**UV-EXP150S**	**UV-EXP200S** or **UV-EXP200R-SYS**	**UV-EXP300S**
Top view				
Front view				
Exposure area	∅ 150	150 × 150	200 × 200	300 × 300
Working distance (WD)	350	300	400	300
Size (H × W × D)	610 × 250 × 305	600 × 300 × 360	730 × 360 × 415	920 × 510 × 560
UV-EXP-CU / ***-RCU***	Detached	Detached	Detached	Detached
Water cooling	Detached	Detached	Detached	Detached
Power Supply	100-240 VAC 150 VA	100-240 VAC 150 VA	100-240 VAC 150 VA	100-240 VAC 150 VA
Weight	17 kg	25 kg	42 kg	55 kg
Mounting	Item Profile 6	Item Profile 8	Item Profile 8	Item Profile 8

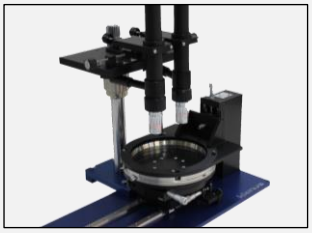
All units in [mm], unless otherwise specified. See footnotes e and f on page 3.

Creative engineering and manufacturing • Our engineering team is accustomed to developing products according to client's needs. In-house machining and assembling facilities shorten the time from concept to finished products.

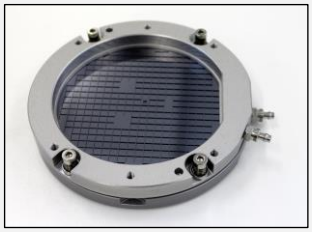


Customized UV-LED exposure system installed on a roll-to-roll machine

Visit our website to have an insight into our other products and activities. Contact us for further technical information and to obtain a quotation.



Double image microscope



A model of wafer chuck

About Idonus

Founded in 2004, Idonus is a Swiss company that develops and manufactures equipment for the MEMS and watchmaking industries. Our product portfolio includes UV-LED exposure systems for photolithography, IR microscope for wafer inspection and vapor phase chemical etcher for silicon-based devices. We also provide ion implantation services and machines for the surface treatment of materials.

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