CAVITAR

- CAVILUX Laser Illumination
- Schlieren Imaging Solutions
- CAVILUX OEM

WELCOME TO THE
INVISIBLE WORLD
We at Cavitar are here to bring you Value in Sight with our diode-laser based illumination systems and welding cameras that reveal your application and processes with the level of clarity and detail you have never seen before.

We offer versatile products, systems and solutions for industrial visual process monitoring and R&D, as well as for scientific research, for integrators, OEM manufacturers, and end-users alike. In addition to our high-performance CAVILUX systems and Cavitar Welding Cameras, we also offer customized solutions.
SEE THROUGH HEAT - FREEZE THE MOTION

CAVILUX Laser Illumination Systems

Versatile high-performance laser illumination systems for machine vision and demanding high-speed and ultra-high-speed imaging up to 10 million fps.

For various industrial processes and R&D as a stand-alone product or as an integrated monitoring solution.

For imaging and monitoring of welding, additive manufacturing, shockwaves, flows, droplets, sprays and jets, Schlieren imaging, etc.

Plug-and-play systems and fully compatible with high-speed and machine vision cameras.

For high-speed imaging and monitoring

• See through blinding brightness of high-temperature processes
• Accurate imaging of processes involving extremely small and/or fast objects
• High-power, ultra-short pulses down to 10 ns eliminate motion blur and enable optimal image quality
• Versatility by varying pulse duration and repetition rate
• Versatility through changeable fiber optic illumination (fiber coupling, front/back illumination, light sheet illumination)
• Monochromatic and low-coherence light ensures the best possible image quality – without chromatic aberrations or speckle
• Fiber coupling enables efficient lighting of processes even in limited space and hard-to-reach places
• Light is immune to surrounding lighting conditions such as ambient or sunlight, as well as to process vibrations

CAVILUX ILLUMINATION SYSTEMS

CAVILUX HF
CAVILUX Smart
CAVILUX HF UHS
CAVILUX Smart UHS

Designed, Engineered and Manufactured in Finland
<table>
<thead>
<tr>
<th>Component</th>
<th>CAVILUX HF</th>
<th>CAVILUX Smart</th>
<th>CAVILUX HF UHS</th>
<th>CAVILUX Smart UHS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>System content</strong></td>
<td>Laser unit, control unit, illumination optics</td>
<td>Laser unit, control unit, illumination optics</td>
<td>Laser unit, control unit, illumination optics</td>
<td>Laser unit, control unit, illumination optics</td>
</tr>
<tr>
<td><strong>Software interface</strong></td>
<td>CAVILUX Control Software</td>
<td>CAVILUX Control Software</td>
<td>No software</td>
<td>No software</td>
</tr>
<tr>
<td><strong>Laser units</strong></td>
<td>1 to 4</td>
<td>1 to 4</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td><strong>Sync signal</strong></td>
<td>5 V TTL</td>
<td>5 V TTL</td>
<td>5 V TTL</td>
<td>5 V TTL</td>
</tr>
<tr>
<td><strong>Laser unit</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Wavelength options</strong></td>
<td>640 nm (visible), 810 nm (invisible)</td>
<td>640 nm (visible), 810 nm (invisible)</td>
<td>640 nm (visible), 810 nm (invisible)</td>
<td>640 nm (visible), 810 nm (invisible)</td>
</tr>
<tr>
<td><strong>Power options</strong></td>
<td>280 W @ 640 nm, 500 W @ 810 nm</td>
<td>200/400 W @ 640 nm, 300/500 W @ 810 nm</td>
<td>280 W @ 640 nm, 500 W @ 810 nm</td>
<td>200/400 W @ 640 nm, 300/500 W @ 810 nm</td>
</tr>
<tr>
<td><strong>Laser class</strong></td>
<td>Laser class 4</td>
<td>Laser class 3B or 4 (based on power and wavelength)</td>
<td>Laser class 4</td>
<td>Laser class 3B or 4 (based on power and wavelength)</td>
</tr>
<tr>
<td><strong>Min pulse duration</strong></td>
<td>50 ns</td>
<td>10 ns</td>
<td>50 ns</td>
<td>10 ns</td>
</tr>
<tr>
<td><strong>Min pulse duration</strong></td>
<td>100 ns</td>
<td>30 ns</td>
<td>100 ns</td>
<td>30 ns</td>
</tr>
<tr>
<td><strong>Pulses per frame</strong></td>
<td>up to 5</td>
<td>up to 5</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td><strong>Continuous duty cycle</strong></td>
<td>0.03%</td>
<td>0.03%</td>
<td>0.03%</td>
<td>0.03%</td>
</tr>
<tr>
<td><strong>High-speed duty cycle</strong></td>
<td>2%</td>
<td>0.1%</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td><strong>Max high-speed duration</strong></td>
<td>10 seconds (optional 30 seconds for 810 nm)</td>
<td>10 seconds</td>
<td>30 μs total laser time</td>
<td>30 μs total laser time</td>
</tr>
<tr>
<td><strong>Versatility</strong></td>
<td>(changeable fiber optics)</td>
<td>(changeable fiber optics)</td>
<td>(changeable fiber optics)</td>
<td>(changeable fiber optics)</td>
</tr>
<tr>
<td><strong>Fiber-coupled</strong></td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Adjustable illumination</strong></td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Light sheet illumination</strong></td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Pulse duration / frequency examples</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>10 ns</strong></td>
<td>Not applicable</td>
<td>100,000 Hz (@ 0.1% DC)</td>
<td>Not applicable</td>
<td>50,000,000 Hz (1500 pulses)</td>
</tr>
<tr>
<td><strong>50 ns</strong></td>
<td>400,000 Hz (@ 2% DC)</td>
<td>20,000 Hz (@ 0.1% DC)</td>
<td>12,000,000 Hz (500 pulses)</td>
<td>16,000,000 Hz (500 pulses)</td>
</tr>
<tr>
<td><strong>100 ns</strong></td>
<td>200,000 Hz (@ 2% DC)</td>
<td>10,000 Hz (@ 0.1% DC)</td>
<td>7,500,000 Hz (230 pulses)</td>
<td>90,000,000 Hz (270 pulses)</td>
</tr>
<tr>
<td><strong>1 μs</strong></td>
<td>20,000 Hz (@ 2% DC)</td>
<td>1,000 Hz (@ 0.1% DC)</td>
<td>100,000 Hz (30 pulses)</td>
<td>990,000 Hz (30 pulses)</td>
</tr>
<tr>
<td><strong>10 μs</strong></td>
<td>2,000 Hz (@ 2% DC)</td>
<td>100 Hz (@ 0.1% DC)</td>
<td>10,000 Hz (3 pulses)</td>
<td>10,000,000 Hz (3 pulses)</td>
</tr>
</tbody>
</table>

**Example applications**

- **Welding**
- **Shockwaves**
- **Flows/droplets/sprays/jets**
- **Schlieren imaging**
- **Additive manufacturing**
- **Flows/droplets/sprays/jets**
- **Materials testing**
- **Materials testing**
- **Ballistics/explosions**
- **Industrial webs**
- **Ballistics/explosions**
Application images

- MIG WELDING PROCESS WITH A GLOBULAR TRANSFER MODE (LABSOLDA, CAVILUX HF)
- SCHLIEREN IMAGING OF ARC WELDING – WITH FRONT-ILLUMINATION (CAVILUX HF)
- MAG WELDING (CAVILUX HF)
- FUEL INJECTION (CAVILUX HF)
- MEASUREMENT OF FLUID JETS IN DIESEL ENGINE – DOUBLE-PULSE AND BACK-ILLUMINATION (CAVILUX SMART)
- LASER WELDING - HUMPING EFFECT (CAVILUX SMART)
- NORMAL VISION VS. CAVITAR VISION
- TIG WELDING – (LABSOLDA, CAVILUX HF)
- SMAW (NOBBY TECH, CAVILUX HF)
- CMT WITH SCHLIEREN IMAGING (CAVILUX HF AND SMART)
- COMPARISON OF ILLUMINATION – SHOCKWAVE FORMATION IN GEL (TOHOKU UNIVERSITY AND NOBBY TECH, CAVILUX SMART)
- ADDITIVE MANUFACTURING – LASER WELDING (CAVILUX HF)

Visit our YouTube channel for the videos: CavitarLtd
Cavitar Schlieren Imaging Solutions

Flow visualization solutions

- Reveal the invisible flow patterns (gases, fluids) in your process by optical methods
- High-quality imaging
- High sensitivity for detection of fine details

High-performance plug-and-play solution

- Suitable for use in Schlieren and shadowgraph imaging
- Optimized to be used with CAVILUX laser illumination systems and/or Cavitar Welding Cameras
- Various solution options based on application
- Front and back illumination available (front illumination enables simultaneous visualization of e.g., melt pool and wire motion and melting)
- Protected compact design with an open test area for studying process phenomena

For visualization of changes in refractive index:

- Temperature gradients (heating processes)
- Phase differences (mixing of liquids, gas flows and evaporation)
- Small particles (efficient light scattering)
- Pressure gradients (shock waves in air or liquid)

<table>
<thead>
<tr>
<th>COMPLETE IMAGING SOLUTION*</th>
<th>Z-TYPE SCHLIEREN</th>
<th>LENS SCHLIEREN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>Self-contained Schlieren set-up including everything</td>
<td>Plug-and-play pre-aligned Z-type Schlieren imaging system</td>
</tr>
<tr>
<td>Method of visualization</td>
<td>Mirror or lens based</td>
<td>Mirror based</td>
</tr>
<tr>
<td>Includes</td>
<td>Everything included</td>
<td>- table frame</td>
</tr>
<tr>
<td></td>
<td>- table frame</td>
<td>- optical elements</td>
</tr>
<tr>
<td></td>
<td>- optical elements</td>
<td>- adjustable mask holder</td>
</tr>
<tr>
<td></td>
<td>- adjustable mask holder</td>
<td>- Schlieren masks</td>
</tr>
<tr>
<td></td>
<td>- laser illumination and/or welding camera</td>
<td></td>
</tr>
<tr>
<td>Options</td>
<td>- High-speed camera as an option</td>
<td>- CAVILUX lasers</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Cavitar Welding Cameras</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- High-speed camera</td>
</tr>
<tr>
<td>Dimensions (LxWxH)**</td>
<td>2.4 x 0.5 x 1.2 m</td>
<td>2.4 x 0.5 x 1.2 m</td>
</tr>
<tr>
<td>Test area**</td>
<td>0.5 x 0.5 m</td>
<td>0.5 x 0.5 m</td>
</tr>
<tr>
<td>Image field of view</td>
<td>ca. 60..100 mm (depending on lens and camera)</td>
<td>ca. 60..100 mm (depending on lens and camera)</td>
</tr>
</tbody>
</table>

* Working title
** Might vary depending on realization
For research and development of various applications and processes

- For welding process imaging (shadowgraph also possible)
- For welding research
- Additive manufacturing
- Energy technologies
- Chemical industry (mixing of liquids and gasses)
- Shockwaves
- Ballistics
- Aerospace
- Materials testing

Easy to use

- Comes pre-aligned to customer’s specifications
- Can be customized for specific cameras
- Plug-and-play: 1. Install the table legs, 2. Install camera and light source, 3. Start imaging (Z-type)
- Schlieren mask adjustment is possible during imaging
- Different Schlieren masks (also custom masks) are available for emphasizing different flow elements

CAVILUX OEM
Laser lighting for machine vision

Customized CAVILUX OEM for machine vision integrators

CAVILUX OEM lasers are ideal light sources for industrial machine vision solutions. You will get all the CAVILUX benefits to your own integrated monitoring solution.

The products are compact and robust as well as suitable for harsh industrial environments for 24/7 use. Fiber coupling brings further flexibility also in difficult to reach or in cramped spaces.

Application specific illumination profiles through customization bring further benefits and additional information to images.

Contact us to discuss your high-volume machine vision solution requirements.