

Manual LD-PS/5 and LED pulsing system (LPS)

General remarks

The LD-PS/5 laser and the LPS have built-in synchronizers to generate light pulses and trigger signals for the camera. Signals and light pulses will only be generated if powered on and if a suitable signal is received via a wireless serial link. The synchronizer can be shipped with different firmwares for the supported cameras. Custom firmware is available on request. The timing of the pulses and camera signals can be controlled from PIVlab, a free PIV toolbox for MATLAB.

Before using the LD-PS and the LPS, please download the *latest version* of PIVlab from here:

<https://github.com/Shrediquette/PIVlab/releases/latest>

The communication between PIVlab and the synchronizer in the device is implemented with a wireless serial link. The white USB dongle must be inserted, and the driver ("CP210x Universal Windows Driver", supplied on the USB stick) must be installed. Check windows device manager to see if the dongle was installed properly:

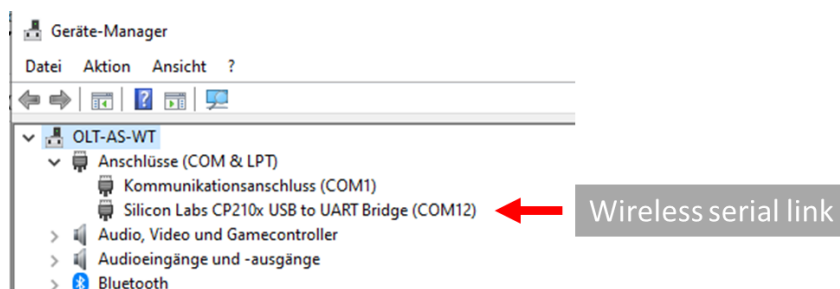


Figure 1: Windows device manager, serial ports.

Hardware setup



Figure 2: The LPS (using a LED array) and the LD-PS/5 (using a laser diode).

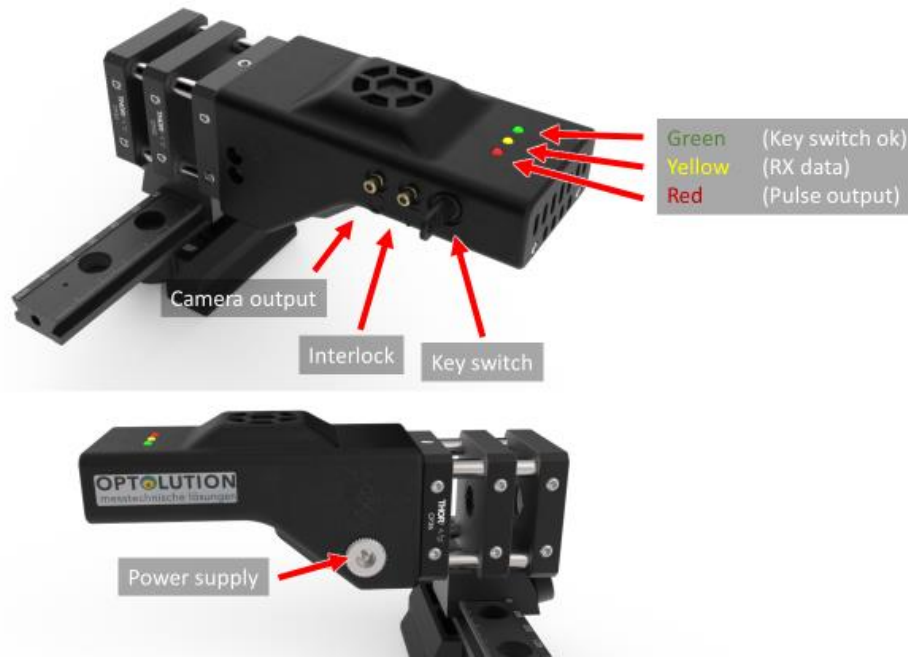


Figure 3: The available connections on the device..

- Insert the wireless dongle to your computer (make sure it is detected by windows).
- Connect the camera cable to your camera.
- Insert the 7.5 VDC power plug. The LEDs will flash briefly, the fan will turn on for a short time.
- Connect the interlock cable to a suitable mechanical switch (normally open, e.g. door switch). **WARNING: When the two wires from the interlock cable are connected, then the laser is ready to emit light. ALWAYS wear safety glasses! ALWAYS make sure that the laser light hits a suitable beam dump (e.g. a thick matte black metallic object).**
- Turn the key switch clockwise (to position "I") to arm the laser
- Start PIVlabs image acquisition module to control the laser.

Interlock

The cables of the interlock should be connected to a proper door switch (normally open). When someone opens the door (switch opens), the laser will turn off immediately.

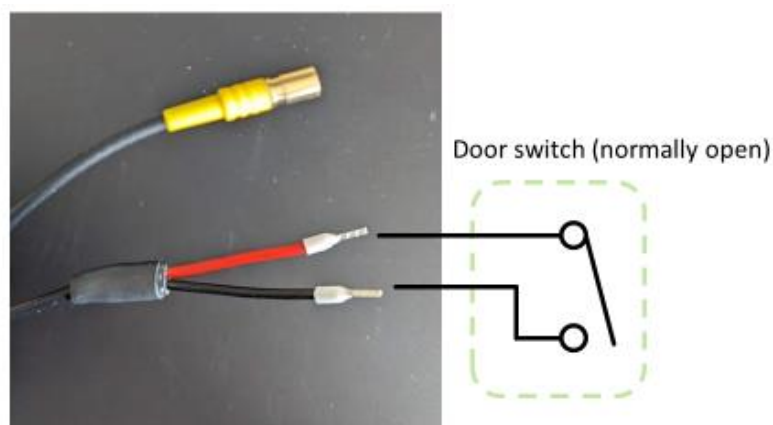


Figure 4: The interlock connection

LEDs

There are three LEDs on the top of the device, indicating the following:

- Green LED: Power OK, ready to emit light pulses.
- Red LED: Flashes with every 2nd laser pulse that is emitted
- Yellow LED: Data received from PIVlab

Optics

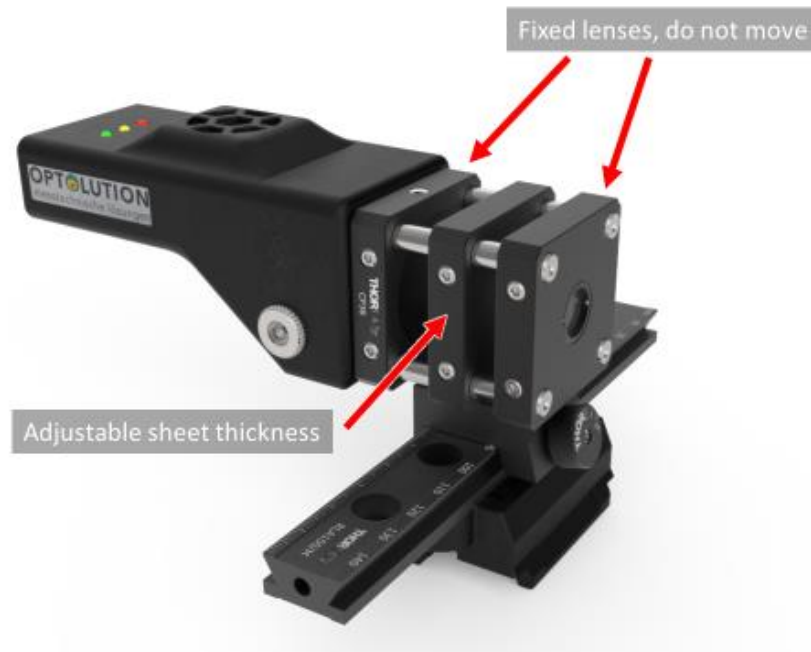


Figure 5: Light sheet optics.

The light sheet optics consists of several elements: **The cylindrical lens must not be rotated.** If you need to rotate the light sheet, then rotate the whole laser, not the cylindrical lens. To adjust the sheet thickness and focus distance, move the central lens element. Keep the optics free from dust, otherwise the lenses might be damaged. Installing a bandpass filter ($450 \text{ nm} \pm 40 \text{ nm}$) in the camera is highly recommended, as the exposure of the camera is longer than the laser pulses.

Control from PIVlab

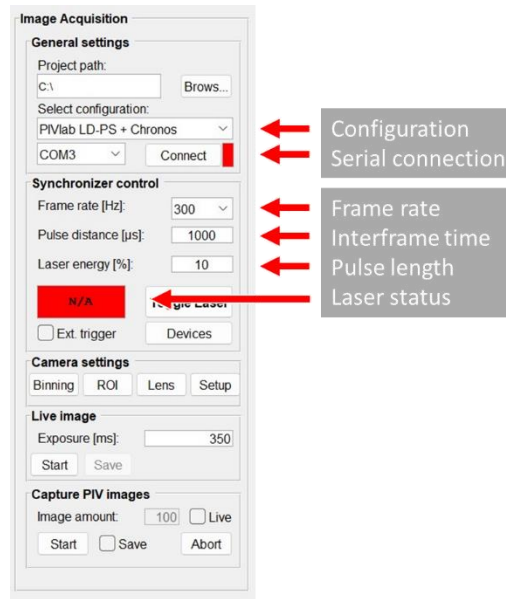


Figure 6: PIVlabs image acquisition module.

Select a suitable configuration (“PIVlab LD-PS” + your camera model), select the correct COM port for the wireless USB dongle and hit connect. When you connect for the first time to your laser, a message box will appear, asking you to insert the ID of the laser. This ID can be found on a small sticker on your LD-PS. When you entered the wrong ID, you can undo this and try again by deleting the file “laser_device_id.mat”, located in the folder “PIVlab_capture_resources”.

The yellow LED on the LD-PS should flash briefly, and the laser status should change to “Laser OFF”. Set the frame rate to a low value (e.g. 5 Hz), the pulse distance (interframe time) to 100 µs, and the laser energy (pulse length) to 10%. Place a suitable beam dump in front of the laser, close the interlock and start the laser by clicking “Toggle Laser”. The laser status should change to “Laser ON”. The laser now runs with a duty cycle of 0.01% (Two 10 µs long pulses, separated by 100 µs with 5 Hz). Click the toggle button again to turn off the laser.

“Frame rate”, “pulse distance” and “laser energy” are defined in the following figure:

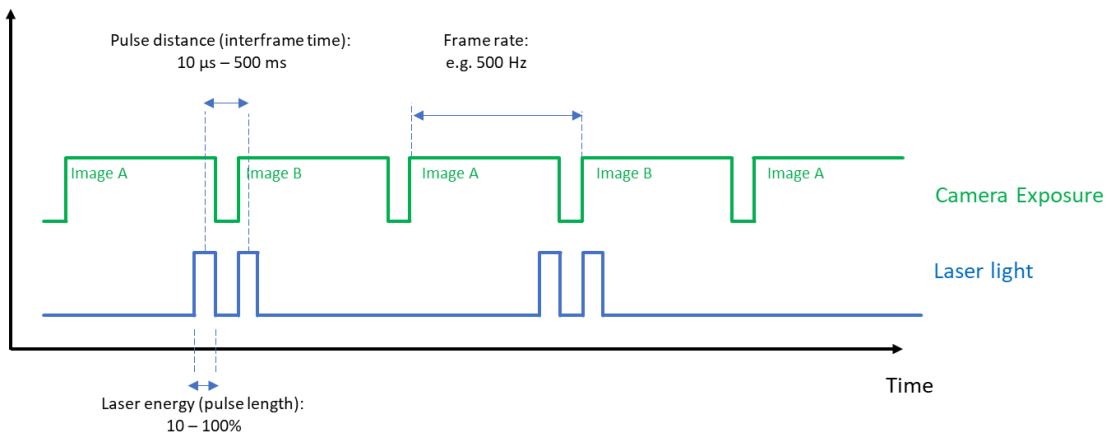


Figure 7: Definition of “Frame rate”, “pulse distance” and “laser energy”.

The setting for “laser energy” defines the pulse length. A setting of 100% means that the pulse length has approximately the same length as the pulse distance. The exact pulse length depends on a number of parameters; therefore, it is shown in the PIVlab GUI after the laser has been turned on. A higher laser energy makes the particle images brighter, but it will also increase the motion blur.

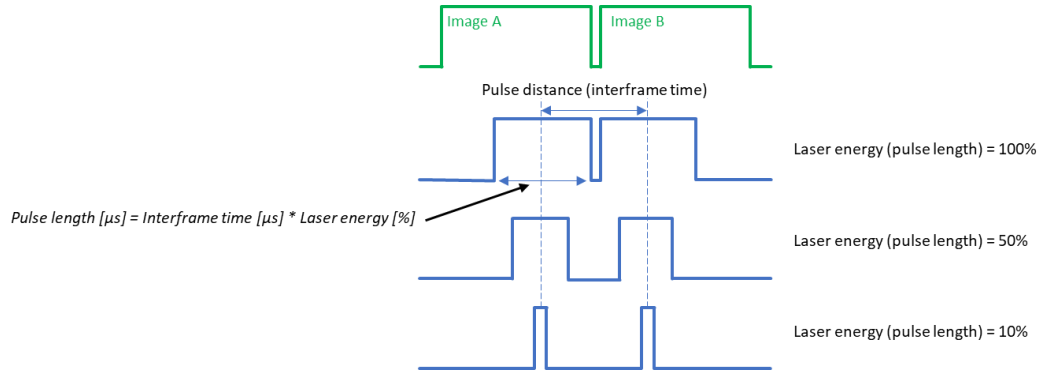


Figure 8: Details on the relation of laser energy and pulse length.