

## 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 (pco pixelfly usb, pco panda 26 DS and Kron Technologies Chronos). 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:

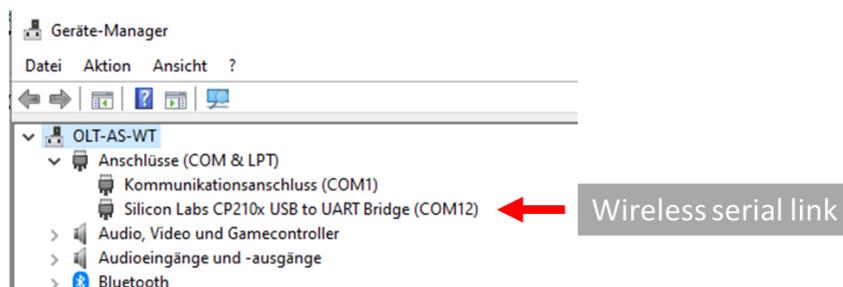


Figure 1: Windows device manager, serial ports.

### 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 12 VDC power plug. The LEDs will flash briefly, the fan will turn on for a short time. **WARNING: When powered on, the device is ready to emit light. ALWAYS wear safety glasses! ALWAYS make sure that the light hits a suitable beam dump (e.g. a thick matte black metallic object).**
- Start PIVlabs image acquisition module to control the laser.

## 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 2<sup>nd</sup> laser pulse that is emitted
- Yellow LED: Data received from PIVlab

## Optics

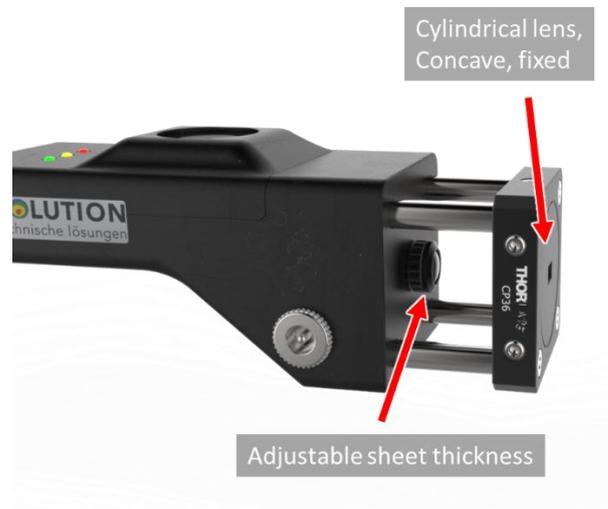


Figure 4: Light sheet optics.

The light sheet optics consists of two elements: A collimating lens array that can be rotated to adjust the laser sheet thickness and a fixed concave cylindrical lens. **The cylindrical lens must not be rotated.** If you need to rotate the light sheet, then rotate the whole laser, not the cylindrical lens. Keep the optics free from dust, otherwise the lenses will be damaged quickly. Installing a bandpass filter (450 nm  $\pm$  40 nm) in the camera is highly recommended, as the exposure of the camera is longer than the laser pulses.

## Control from PIVlab

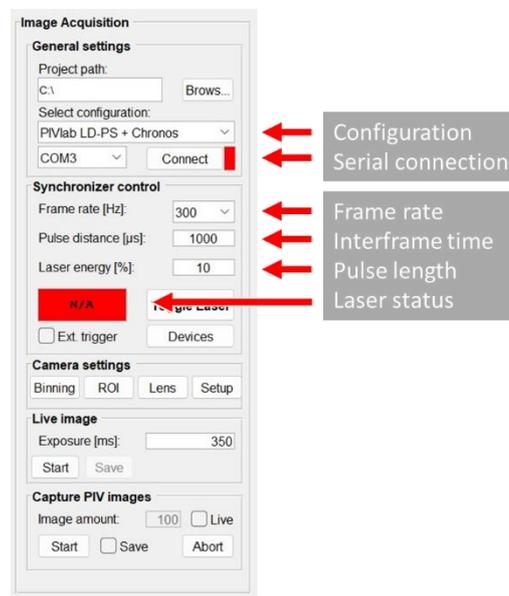


Figure 5: PIVlabs image acquisition module.

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 device, a message box will appear, asking you to insert the ID of the device. This ID can be found on a small sticker on your device. 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 device should flash briefly, and the laser status should change to “Laser OFF”. Set the frame rate to 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, and start the device by clicking “Toggle Laser”. The laser status should change to “Laser ON”. The device 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 device.

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

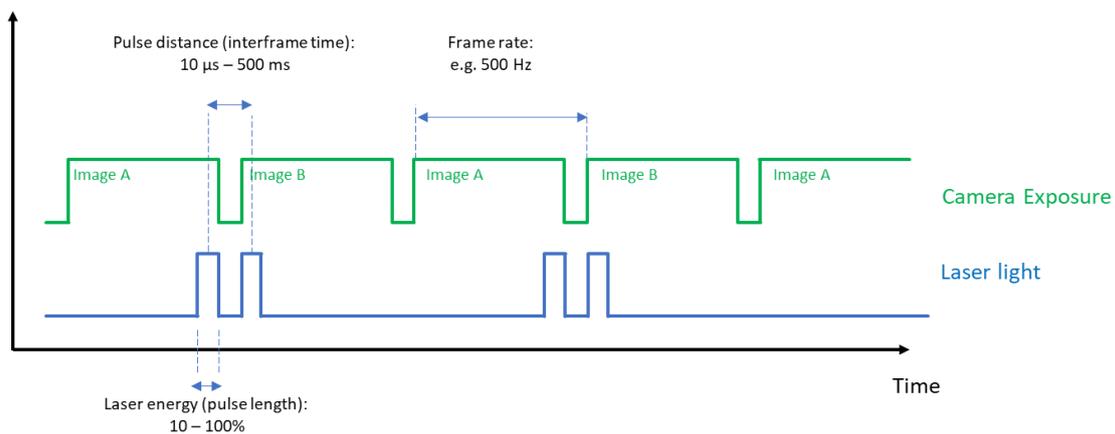


Figure 6: Definition of "Frame rate", "pulse distance" and "laser energy".

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 printed in Matlabs command window after the laser has been turned on. A higher laser energy makes the particle images brighter, but it will also increase the motion blur.

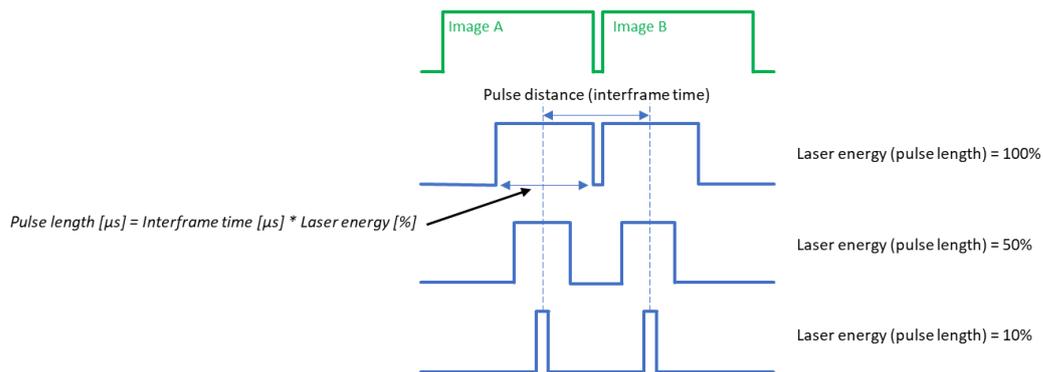


Figure 7: Details on the relation of laser energy and pulse length.