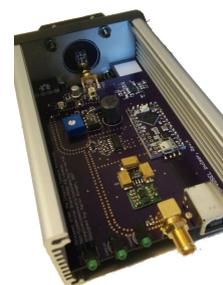


These custom build and individually characterized light sources offer a compact and affordable solution for ultrafast illumination applications. Using LEDs, nearly arbitrary wavelengths can be realized with sub-ns timing precision. In conjunction with 850 nm VCSEs, light curves as short as 100 ps are achieved. The light source is attached via a SMA breakout board, so that different sources can be used with the same module. Biasing of the electric drive pulse allows for intensity modulation.

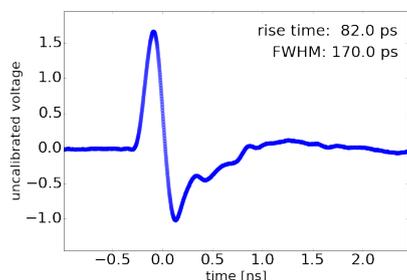


## Specifications

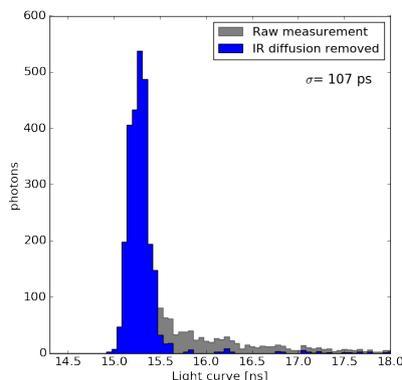
Parameter	Min	Typical	Max	Units	Parameter	Min	Typical	Max	Units
Light curve [ $\sigma$ ]	100	200	1000	ps	Trigger Input				
Pulse frequency	<1		25000	Hz	amplitude	3		5	V
Biasing	-2.5		0.7	V	rise-time			10	ns
Power & Comms	USB1+ B-type				Trigger Output				
Safe temperature	-40		60	°C	amplitude	3		5	V
Power consumption			0.2	W	width		78		ns

## Example Timing Characteristics

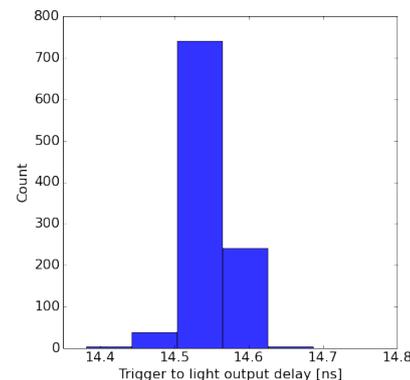
All units come with an individual characterization report, which also outlines the testing procedure in more detail. Light curves are obtained as single-photon timing histograms, using an IDQ ID-100 APD (IRF  $\sim 40$  ps) and a TDC-7200 with 55 ps resolution.



Electric drive pulse



850nm VCSEL light curve (the long time constant tail is a measuring artefact from infrared diffusion in the APD)



Optical trigger jitter

## Available Wavelengths

The following wavelengths have so far been characterized. More wavelengths will be added over time or upon request. Larger biasing voltages result in brighter but less narrow light curves. In addition, higher discharge capacities can be implemented to give brighter pulses at the expense of timing. The stated intensities are at the lowest specified biasing.

Wavelength	Example configuration	Shortest possible pulse [ $\sigma$ ]	Photons per pulse
370 nm	8 pF, +0.7 V	$\sim 800$ ps	tbd
375 nm	12 pF, -0.3V	$\sim 570$ ps	$\sim 2 \cdot 10^7$
385 nm	10 pF, -2.0V	$\sim 280$ ps	$\sim 5 \cdot 10^4$
590 nm	4 pF, -2.5 V	$\sim 400$ ps	tbd.
605 nm	0 pF, -0.5 V	$\sim 430$ ps	tbd.
680 nm	4 pF, -1.0 V	$\sim 430$ ps	tbd.
770 nm	4 pF, -2.5 V	$\sim 550$ ps	tbd.
850 nm	0 pF, -2.5V	$\sim 100$ ps	$\sim 4 \cdot 10^7$ .

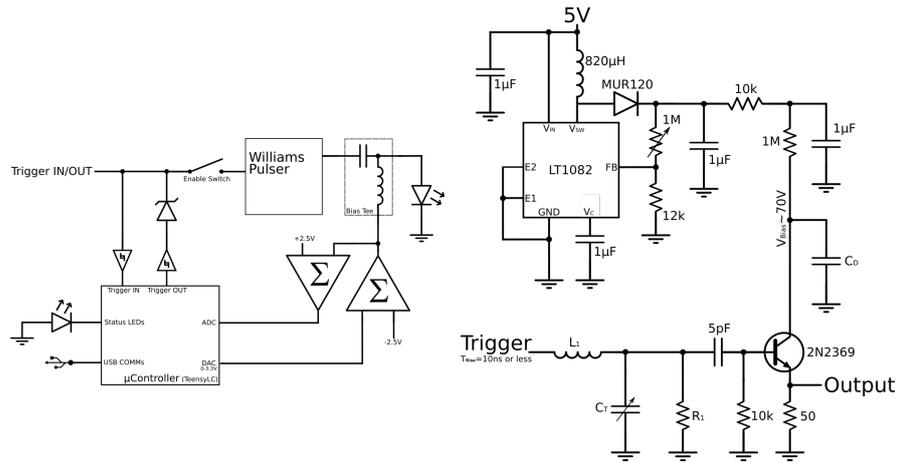
## Communications Specifications

Upon USB connection the module registers itself as a serial device. The specifications are 9600 baud, 8 data bits, no parity bits, and 1 stop bit. Commands have to be terminated with a CR and a NL symbol. Available commands are:

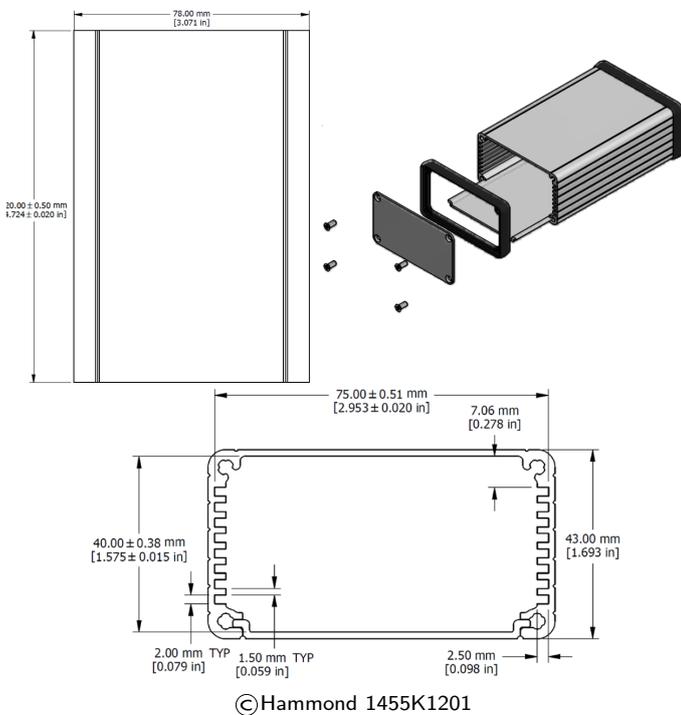
COMMAND	VARIABLE	DESCRIPTION	
trigger	'internal' or 'external'	enable/disable the internal trigger	status get status information
frequency	FLOAT	specify the frequency in Hz (max. 25kHz)	on enable pulsed light output
bias	FLOAT	specify the bias voltage in V (-2.5V to +0.7V)	off disable pulsed light output
LEDs	'on' or 'off'	enable or disable the status LEDs	help show these instructions

## Block Diagram

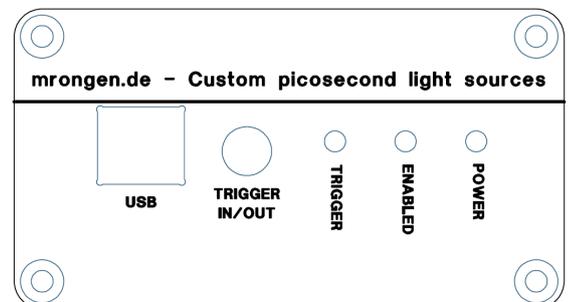
In addition to the electric pulse driver the module provides a micro-controller for trigger control and a 10GHz bandwidth bias tee to shift the DC level of the drive pulse. This allows for an effective intensity control, without changing the shape of the drive pulse. The light source is attached via a SMA breakout board, so that different sources can be easily used with the same module. The trigger can either be provided externally or can be generated by the micro-controller directly. In both cases the light output can be inhibited by an analogue switch.



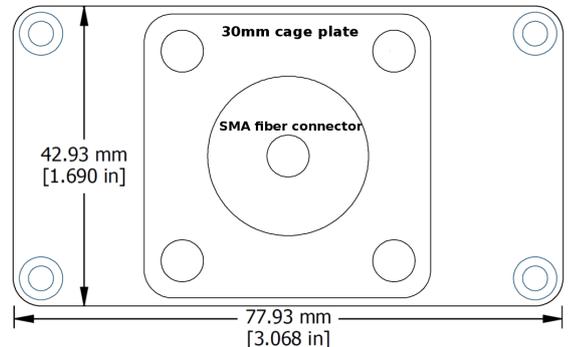
## Dimensional Outline



Frontplane



Backplane



## Open Hardware Statement

Design files for this hardware are released under the Creative Commons Attribution Non-Commercial Share-Alike 4.0 License ([creativecommons.org/licenses/by-nc-sa/4.0](http://creativecommons.org/licenses/by-nc-sa/4.0)) and are available from [www.mrongen.de](http://www.mrongen.de).