

Laser Synchronization Module

Licel GmbH

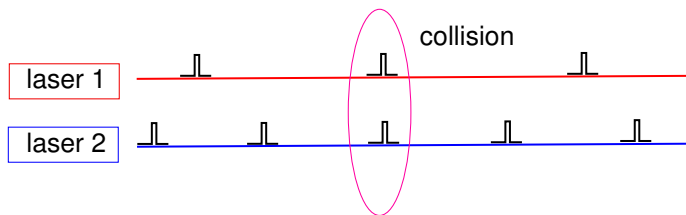
1. Dezember 2021

1 Overview

The Licel Laser Sync Module allows to synchronize up to 3 lasers with different individual repetition rate. Together with the Licel Trigger Generators it ensures collision free laser shots in a Lidar where multiple lasers are involved.

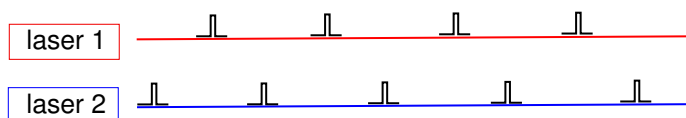
2 Problem description

If more than one laser are used in a lidar then there is a need for synchronization of them, as they might interfere when emitting the light pulse or electrical interference might occur due to flash light pumping.



3 Strategy to avoid this for two lasers with the same repetition rate

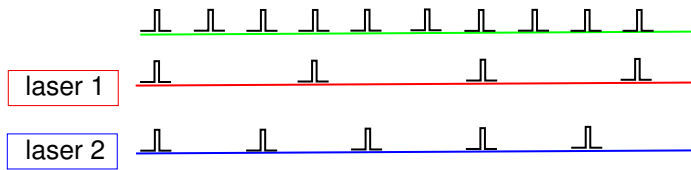
If one shifts laser 2 in between the pulses of laser 1 no interference can occur.



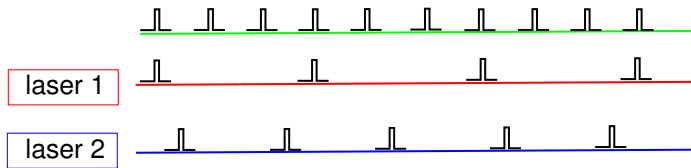
This can be achieved with two trigger generators where the external trigger in of laser 2 is the lamp output of the trigger generator for laser 1.

4 Strategy for two lasers with different repetition rates.

The scheme above will not work. One could use the least common multiple of the both repetition rates as a heart beat and omit pulses so that the individual repetition rates are correct. Just for an example to make this clear. Laser 1 should emit at 20 Hz and Laser 2 at 30 Hz then the least common multiple would be 60 Hz. So starting with a heart beat of 60 Hz, laser 1 should emit on every third heart beat pulse and laser 2 on every second.



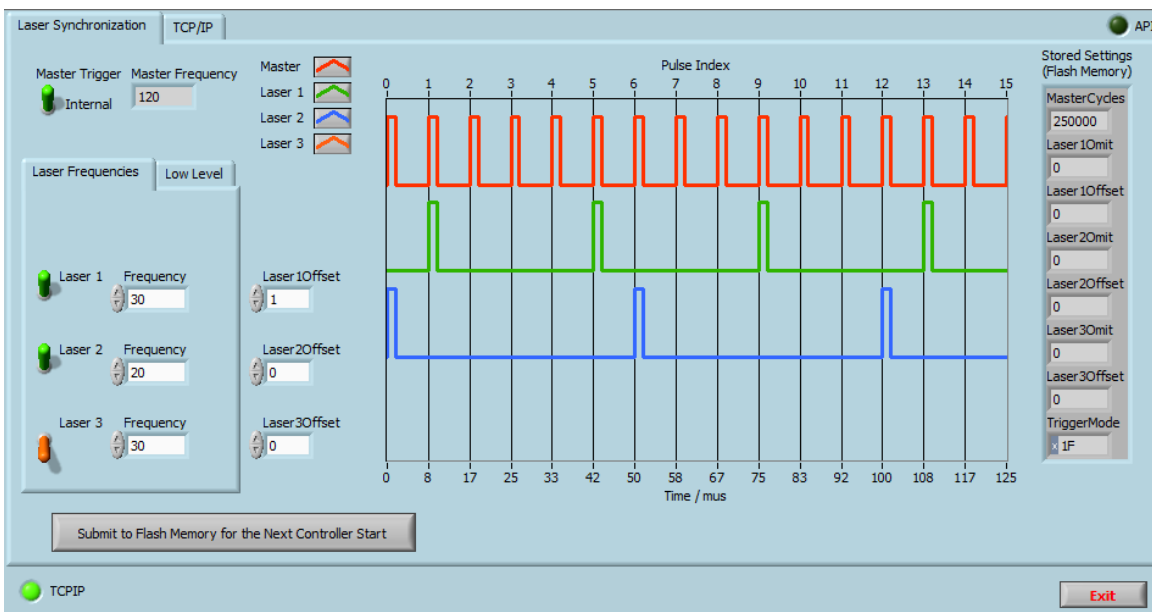
Instead of the random pulse overlap from the beginning one would have a collision one every sixth heart beat pulse. But this can be easily corrected by shifting laser 2 by 8.3ms (this corresponds to $2 \times 60\text{Hz}$)



This will by design never produce a collision.

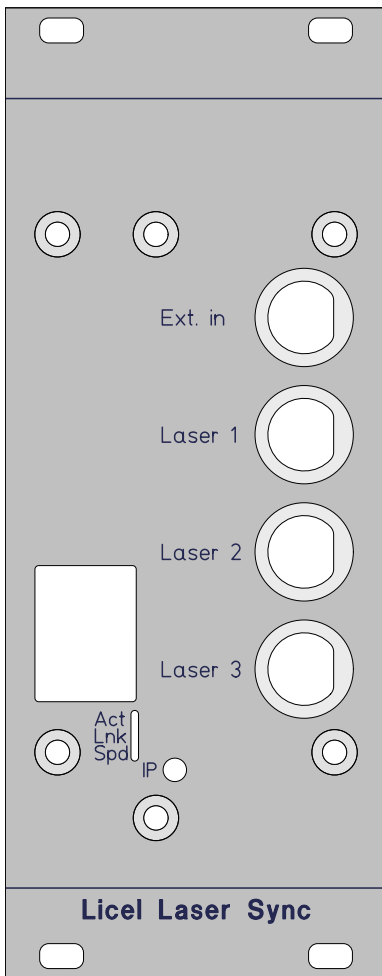
4.1 Doubling the master

Another strategy would be to double the master frequency and to use the offset at the first laser



Here the slower laser shoots at even pulse indices and the faster at odd. This is also by design save

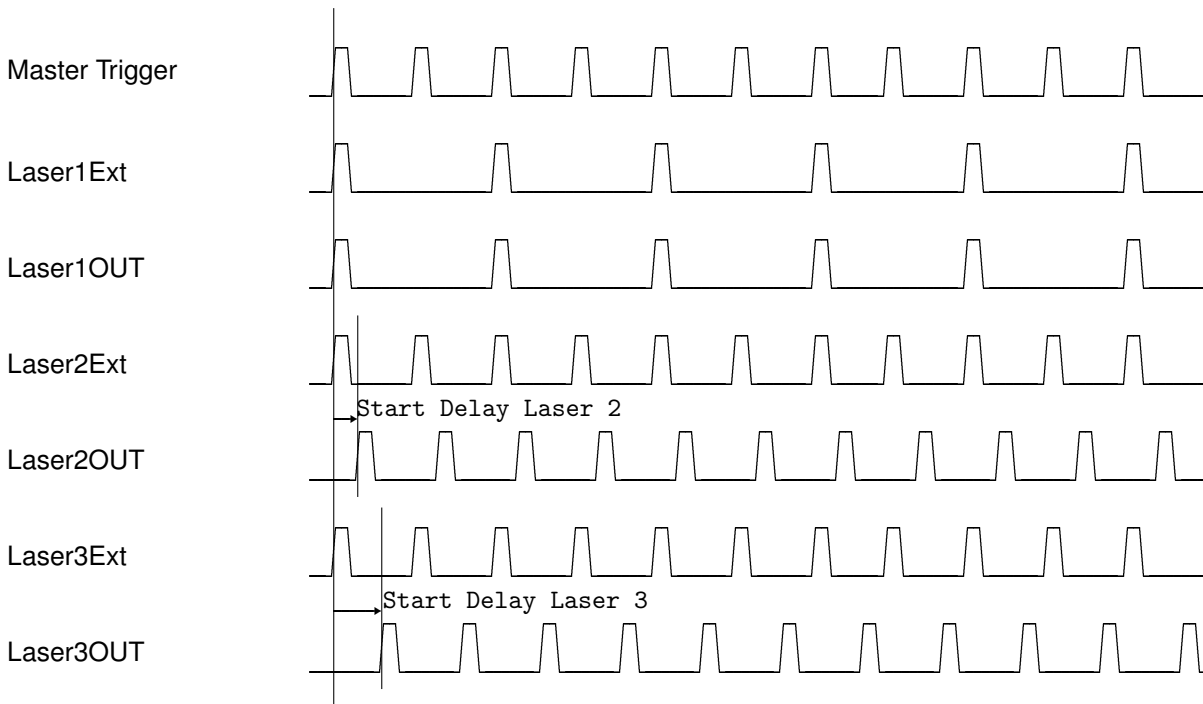
5 Laser-Sync Module



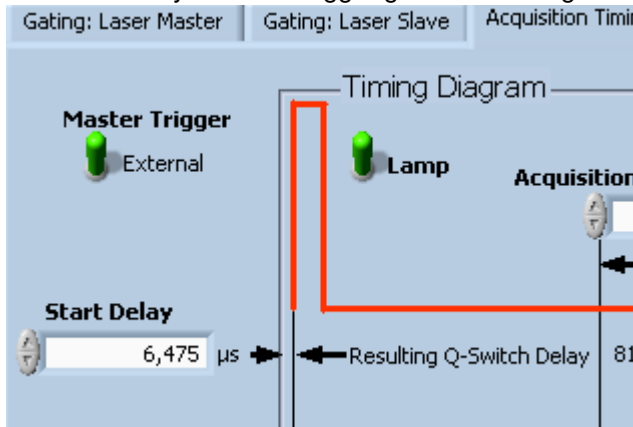
The Laser Sync Module is special trigger generator where the outputs are either internally connected to the other trigger boards or are wired to the front panel. The typical setup is the internal connection, but this requires that is specified, when the other trigger generators are ordered.

- The Laser sync can run internally generating heart beat frequency, or as controlled by an external trigger source which provides the heart beat.
- It can control up to 3 Lasers.
- One can setup the heart beat frequency and for each laser the number of omitted pulses.
- For the picture above laser 1 would omit 1 pulse and laser 2 2 pulses.
- Typically these parameters are set once with the MULTIMASTERSTORE command and then loaded on each power up.

5.1 Timing diagram



The Start delay is set for trigger generator timings



6 TCPIP Commands

6.1 MULTIMASTER <MasterCycles><Laser1Omit><Laser1Offset> <Laser2Omit><Laser2Offset><Laser3Omit><Laser3Offset><TriggerMode>

Sets the master cycles and the number of master cycles omitted for each laser. It also switches the trigger mode which allows to run the master with internal and external trigger.

The internal trigger frequency is controlled via the number of cycles of the master oscillator, each cycle is 200ns long so a number of 1000 here will correspond to 200 us.

Then for each laser one can give the number of omitted master cycle triggers. Giving there 0 will output a trigger on each master trigger, putting there a 1 will produce a trigger only on every second trigger. This number must be between 0 and 15.

One can also give a offset so that the counting of the omitted pulses starts not with 0 but with the offset this makes sure that for higher numbers of omitted pulses different lasers can be set to use different master trigger.

To run a master at 20 Hz this means every 50ms there is a master trigger. To get the number of master cycles we divide this by 200ns and get 250000. For Laser 1 which runs on 10 HZ we need to omit 1 Pulse. And put the offset to 0 For laser 2 and laser 3 we do not omit laser pulses and put the offset to 0.

The trigger mode is internal so we add 0x10 to the trigger mode and activate all trigger outputs which corresponds 0x0F. This gives 0x1F (31)

Parameter	Value
MasterCycles	250 000
Laser 1 Omit	1
Laser 1 Offset	0
Laser 2 Omit	0
Laser 2 Offset	0
Laser 3 Omit	0
Laser 3 Offset	0
TriggerMode	31

Response MULTIMASTER executed

**6.2 MULTIMASTERSTORE <MasterCycles><Laser1Omit><Laser1Offset>
<Laser2Omit><Laser2Offset><Laser3Omit><Laser3Offset><TriggerMode>
< "Password" >**

Sets the parameters like MULTIMASTER and stores them into flash memory. These parameters are used when the unit starts the next time.

Response MULTIMASTERSTORE executed
if successful. Or an error message if it fails.

6.3 MULTIMASTERSTORE?

returns values that have been previously set.

Response MULTIMASTERSTORE 250000 1 0 0 0 0 0 31

6.4 Parameter range

Name	Min.	Max
MasterCycles	100	260000
LaserXOmit	0	15
LaserXOffset	0	15