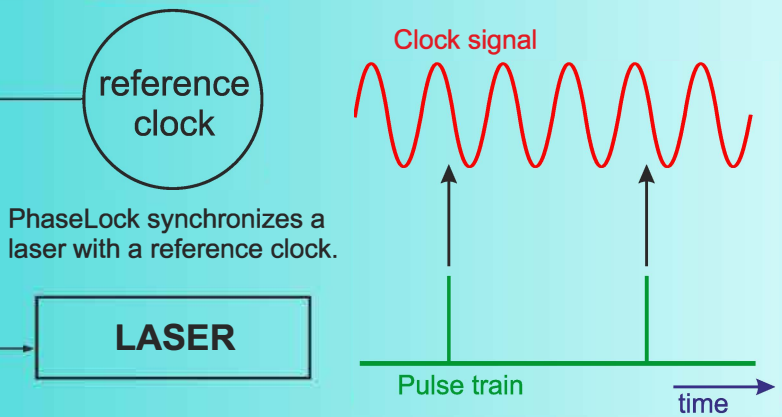

PhaseLock

# PhaseLock

## Universal phase locking / pulse timing controller

- **Synchronization of a laser with electronic reference clocks or other lasers**
- **Arbitrary electronic phase scanning / pulse delay shifting**
- **Best solution for pump & probe experiments**

## Application

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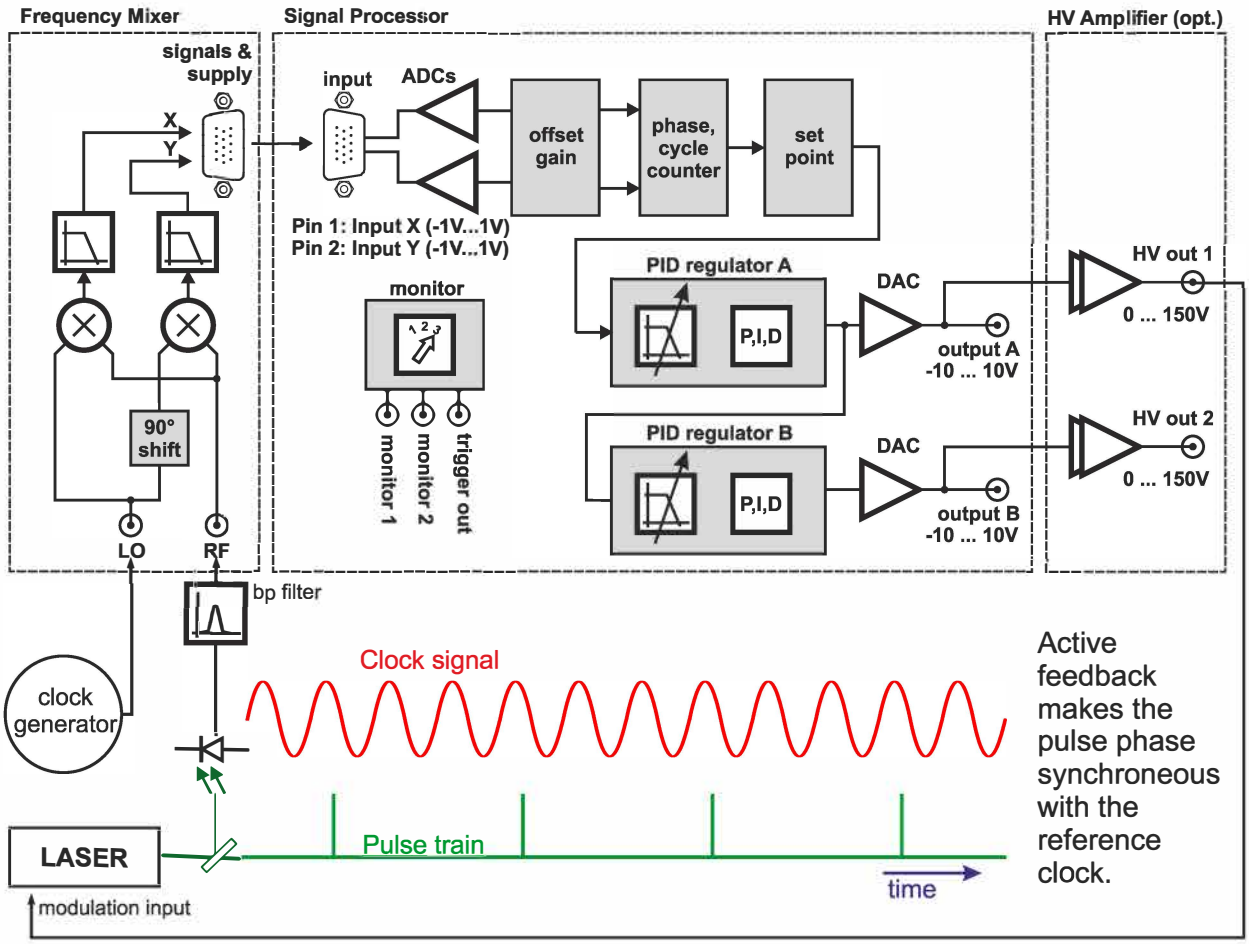
## Principle of Operation




PhaseLock compares the pulse frequency of a laser with the frequency of some reference oscillator (a crystal oscillator, the clock of a synchrotron, or another pulsed laser, e.g.).

PhaseLock controls the laser in a way that both frequencies are always equal and stabilizes the relative phase of both oscillations. For a pulsed laser, the "phase" corresponds to the time at which the pulse occurs with respect to the period of the reference oscillation.

PhaseLock can adjust the relative phase to arbitrary values between 0 and 2π and beyond (i.e., adjust the timing of the laser pulses to arbitrary values within one period of the reference signal or even shift it by multiples thereof).


PhaseLock desktop electronics

PhaseLock RF mixer / phase detector

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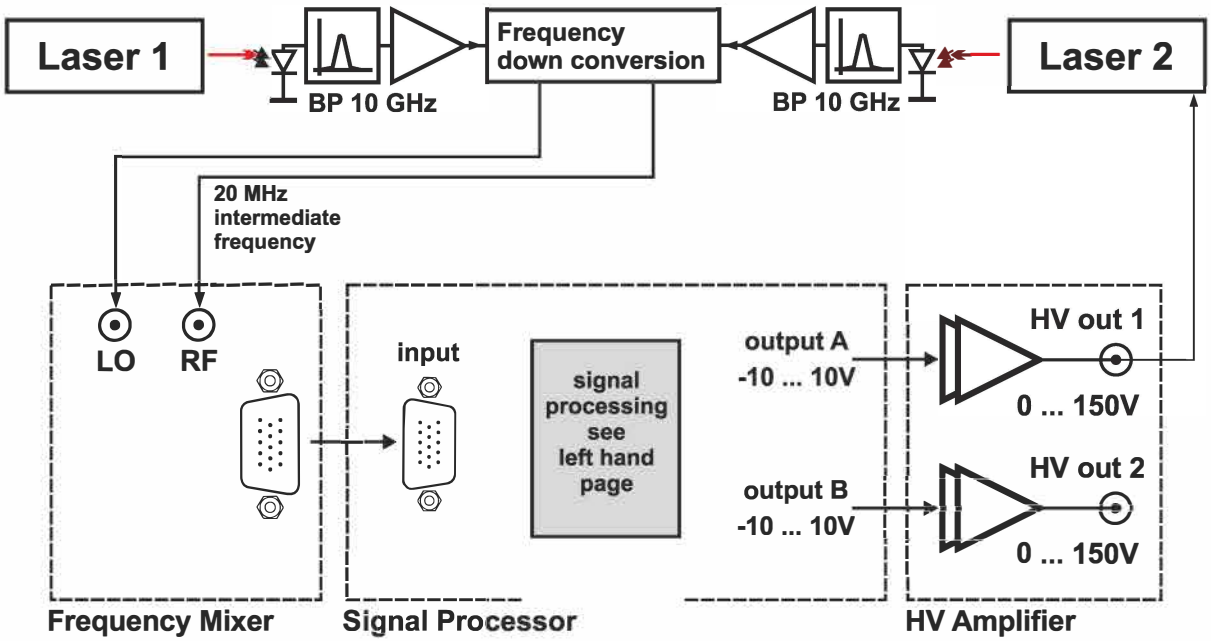
## Special application

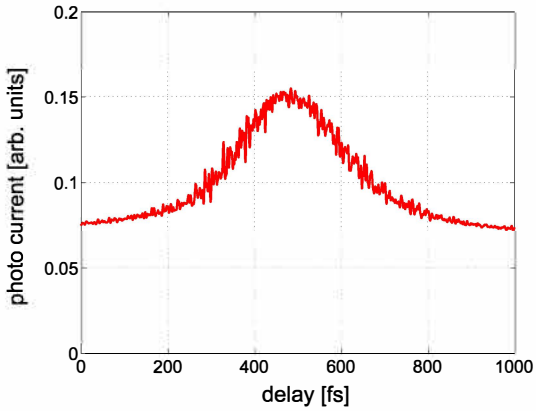
**Laser-to-laser synchronization**

PhaseLock can synchronize the pulse train of one laser with that of another laser. The pulse trains can be shifted relative to each other over several microseconds without moving elements. I. e., no mechanical delay stage is needed.




The RF frequency mixer used with PhaseLock requires sinusoidal input signals. For laser-to-laser locking, both pulse trains are converted to sine signals using bandpass filters. The selection of high harmonics near 10GHz results in a timing with single-femtosecond precision. A frequency converter generates a pair of sine/ cosine signals at an intermediate frequency near 20MHz suitable for the PhaseLock standard RF mixer / phase detector. This so called quadrature signal allows for arbitrary phase adjustment between both lasers. Thus, PhaseLock can shift the pulse trains of both lasers relative to each other over +/-3µs without the necessity of a mechanical delay stage. The resolution is as low as 1.5fs.

**Temporal shift of two pulse trains relative to each other without moving elements.**




Superposition of two laser pulse trains on a nonlinear photo diode: photo current versus relative delay (crosscorrelation)

## Optional equipment

**HV amp**
- High voltage amplifier for PZT actuators
- Output voltage: 0...150V (others on request)
- Output current: 100mA / channel

**PDR-1G**
- Fast photo detector: bandwidth 900MHz
- Si or InGaAs photo diode
- Fiber coupled or free space optical input

**PhaseLock 19"**
- PhaseLock in 19" rack case
- RF mixer built-in

**Frequency down converter**
- 10GHz high harmonics extraction for laser-to-laser synchronization
- Down conversion to intermediate frequency 19...21MHz
- Quadrature signal output

**Nonlinear photodiodes**
- For pulse overlap detection, e.g.
- Different wavelength ranges:
  1550nm
  1064nm

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## Technical Data

| | | |
|---|---|---|
| **Signal input** | Impedance | 50 Ohm |
| | Frequency range | 20MHz ... 1GHz (others on demand) |
| | Power level of signal | typ. 0dBm (600mV pp), depends on application |
| | Power level of ref clock | +7 ... +10 dBm (1.5...2V pp) |
| | Sampling Rate | 1.25 MS/s |
| | Over-all signal delay | < 5µs |
| **Outputs** | Voltage range | +/- 10.0 V at 1 kOhm load |
| | Impedance | 50 Ohm |
| | Sampling Rate | 1.25 MS/s, 14 bit |
| | (High voltage amplifier on demand.) | |
| **Phase detector** | Phase resolution | 2pi / 65536 = 0.005° |
| | Phase adjustment range | +/- 2pi x 32768 = 11796480° |
| | Cut-off frequency | 300kHz |
| **Supply** | Voltage range | 100...240 V AC, 50...60 Hz |
| | Power consumption | Typ. < 10 W, (20 W with HV option) |
| **Housing** | Desktop electronics | 88mm x 260mm x 373mm (H x W x D) |
| | RF mixer (separate) | 60mm x 130mm x 180mm |
| **Display** | Size | 4.3" (11 cm) |
| | Resolution | 480 x 272, 16-bit color |
| | Technology | resistive touchscreen, LED backlight |

Subject to change without notice

## Development, Manufacturing and Distribution

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02/2019