Cycle

BOC / TCBOC

Balanced Optical Cross Correlator

Lowest noise synchronization between two femtosecond lasers

APPLICATIONS

- Repetition rate locking of femtosecond lasers
- Timing jitter and drift compensation of laser amplification chains
- Timing jitter and drift characterization of femto-second lasers
- Measurement and stabilization of optical path lengths (e.g., fiber link stabilization)
- Synchronization for pump-probe experiments

BENEFITS

- More than 1 mV/fs sensitivity
- Lower than 0.5 fs RMS noise floor
- Less than 15 fs RMS timing jitter and timing drift
- Attosecond-level timing jitter resolution

DESCRIPTION

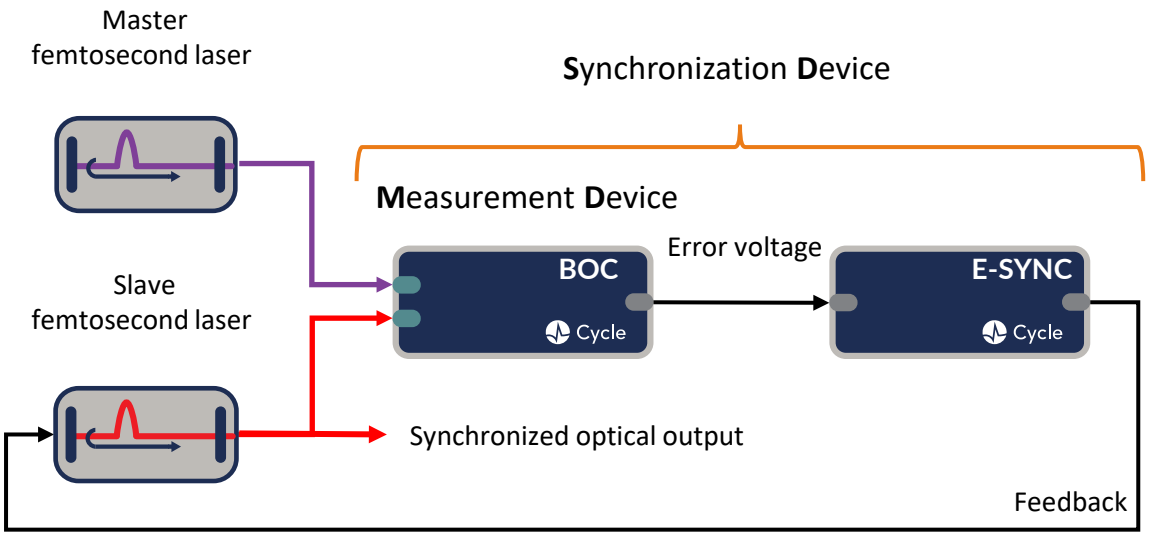
BOC allows ultra-precise measurement of timing jitter between two independent optical pulse trains, at the same or different central wavelengths.

BOC detection is amplitude invariant and robust against environmental fluctuations.

BOC output is a baseband voltage signal that is proportional to the relative timing jitter between the input sources. It can be implemented as:

- **measurement device (MD)** for measuring the timing jitter and drift,
- **synchronization device (SD)** including necessary controllers to synchronize a laser, via both PZT and stepper drivers,
- **link device (LD)** including necessary controllers and actuators to transmit optical pulse trains via stabilized fiber links within our PULSE Timing Distribution System.

SETUP EXAMPLE



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Contact us to discuss your timing and synchronization requirements

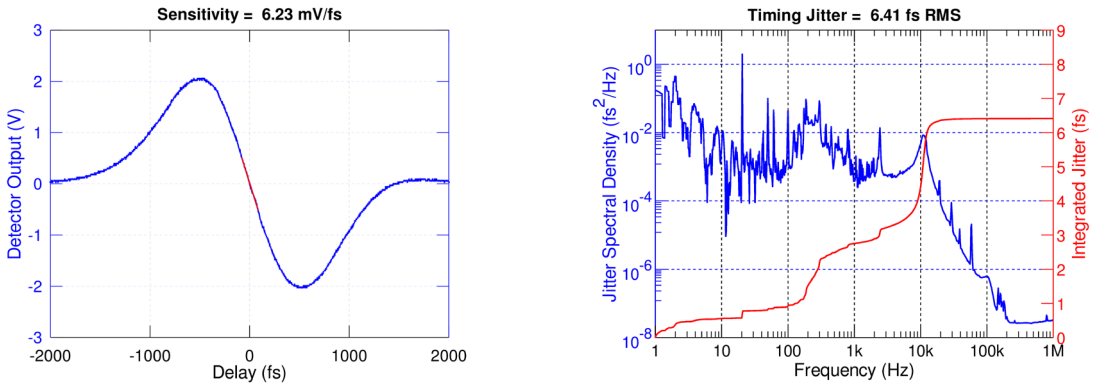
SPECIFICATIONS

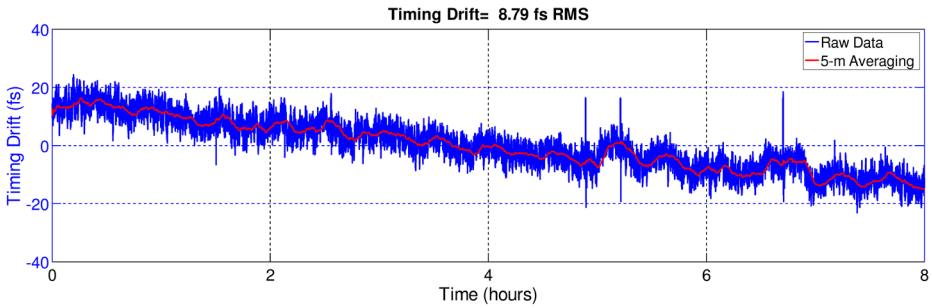
Parameter	Specification	Comment
Detector specifications		
Timing jitter	< 15 fs RMS	integrated residual noise [35 µHz – 100 kHz], i.e., for 8 hours[1]
Timing sensitivity	> 1 mV/fs	main balanced output with 1 MΩ load impedance
Timing noise floor	< 0.5 fs RMS	integrated noise floor [1 Hz - 100 kHz]
Timing resolution	< 0.05 fs RMS	integrated noise floor within 1 Hz bandwidth above 100 Hz
Detector bandwidth	> 100 kHz	3-dB signal bandwidth
Dimensions (H x W x L)	220×200×60 mm^3	dimensions of the optical detector head
Synchronization Device (SD) option specifications		
Control unit type	Cycle E-SYNC	additional electronic synchronization unit to control the lock
Control unit dimensions	3 U	19” rack module
Control system interface	EPICS	via TCP/IP
Integrated feedback	included	applied to a slave laser’s actuators
Auto lock	included	via graphical user interface on a computer
Input requirements		
Optical input wavelength	800 ± 20 nm 1030 ± 10 nm 1555 ± 10 nm	standard center wavelengths with one-color (BOC) or two-color input (TCBOC). Contact Cycle for other wavelengths.
Optical input type	PM fiber Free-space	e.g., for laser oscillators e.g., for laser amplifiers
Optical input power	< 30 mW	depending on the wavelength and other laser parameters
Pulse peak power	> 2.5 kW	per pulse with uniform temporal shape
Pulse repetition rate	1 kHz – 10 GHz	tailored for the repetition rate of interest

[1] with appropriate laser inputs, in a thermally controlled environment (temperature +18 to +24°C, with slope < 0.4°C/h and variation < 1°C pk-pk; humidity < 60 %RH with variation < 10 %RH pk-pk).

MEASUREMENT DATA

Out-of-loop timing jitter and drift of a Ti:Sa laser locked to a 1550-nm optical master oscillator:





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