

BOC - TCBOC

Balanced Optical Cross Correlator

Lowest noise jitter measurement and synchronization between two femtosecond lasers



APPLICATIONS

- Repetition rate locking of femtosecond lasers
- Timing jitter and drift characterization of femtosecond 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 the ultra-precise measurement of timing jitter between two independent optical pulse trains, at the same or different central wavelengths.

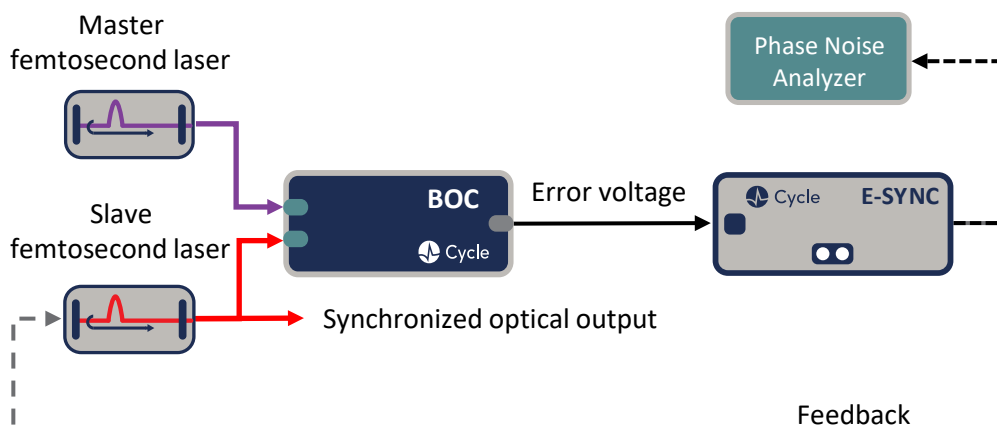
Its detection is amplitude invariant and robust against environmental fluctuations.

The BOC output is a baseband voltage signal that is proportional to the relative timing jitter between the input sources.

The output of the BOC is a baseband voltage signal that is proportional to the relative time delay between the two sources.

ESYNC Option: The BOC can optionally be combined with an electronic synchronization module, ESYNC, including necessary controllers to synchronize one of the laser oscillator to the other with a timing jitter below 15 fs RMS.

SETUP EXAMPLE





SPECIFICATIONS

Parameter	Specification	Comment
Detector specifications		
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
Option ESYNC: Additional Electronic Synchronization Unit		
Timing jitter	< 15 fs RMS	integrated residual noise [35 μHz – 100 kHz], i.e., for 8 hours ¹
Control unit type	Cycle ESYNC	Provides auto search, lock and feedback control functions
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
Option A: Low repetition rate integrator		
Integrator electronics for low repetition-rate lasers		
Input specifications		
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

¹with 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:

