BOC and TCBOC

(Two Color) Balanced Optical Cross Correlator

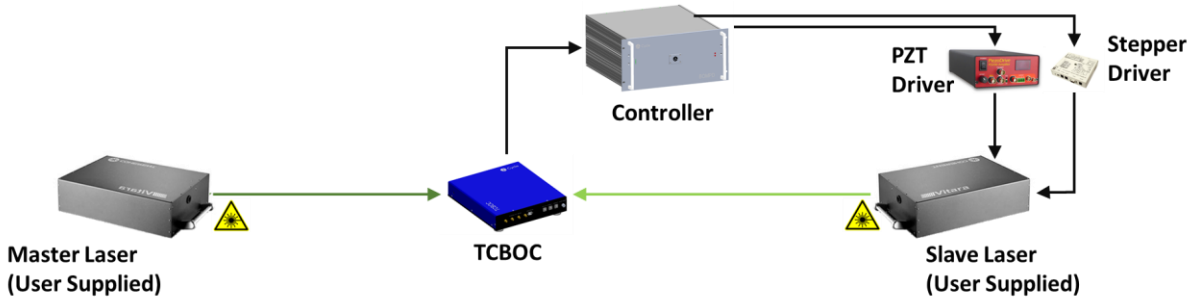
APPLICATIONS

- Precise synchronization of the repetition rates of two optical pulse trains, at same or different wavelengths
- Precise synchronization of the repetition rate of an ultrafast laser to the output of a stabilized fiber link
- Compensation of jitter, introduced by amplifiers in a laser amplifier chain or in similar setups
- Measurement of jitter and drift between two synchronized lasers or two optical beam paths from the same source
- Measurement of optical path length fluctuations (e.g. caused by temp. changes)

BENEFITS

- More than **5 mV/fs sensitivity**
- Lower than **0.5 fs noise floor**
- Less than **15 fs RMS timing jitter and timing drift**

SAMPLE SYNCHRONIZATION SETUPS



A TCBOC synchronizes the pulse trains of two ultrafast lasers at different wavelengths. Two options of the TCBOC is being offered:

- **Measurement device (MD):** standalone TCBOC
- **Synchronization device (SD):** standalone TCBOC equipped with feedback and control electronics, including a pre-locker.

DESCRIPTION

The fully automated TCBOC precisely detects the relative time jitter between two independent optical pulse trains, with different center wavelengths. It is a natural extension to Cycle's well-known and patented (one-color) BOC that is used for sub-femtosecond fiber link stabilization over kilometer distances. Due to a balanced optical detection scheme, the TCBOC provides exceptionally high timing sensitivity, attosecond timing resolution, amplitude invariance and robustness against environmental fluctuations. The output of the TCBOC is a baseband voltage signal that is proportional to the relative time delay between the two sources. This output can in turn be used in a phase-locked loop to synchronize the two optical sources (e.g. locking a Ti:Sapphire laser to a low-noise fiber oscillator). Standard wavelengths are 800nm, 1030nm or 1550nm.

SPECIFICATIONS

Parameters	Value	Unit	Comment
Detector sensitivity	> 5	mV / fs	at the detector output (not amplified)
Detector resolution	< 0.5	fs	integrated detector noise floor within 10 kHz bandwidth
Timing Jitter[1]	< 15	fs	within 35 µHz - 1 MHz bandwidth, depending on noise characteristics of master/reference laser and performance of slave laser intracavity actuators
Dimensions (H x W x L)	300 x 270 x 66	mm	
Weight	5	kg	depending on options
Requirements			
Optical input wavelength	<2000	nm	tailored for the wavelengths of interest
Optical input power	10 - 50	mW	depending on wavelength range and other laser parameters
Optical input type	PM Fiber		FC or SC connector (free space input optional)
Pulse repetition rate	< 10	GHz	tailored for the repetition rate of interest
Control unit for SD version (Synchronization Device)			
Dimensions			rack mountable, 19 inch width, 4 height units
Integrated feedback	included		optimized PID parameters
Control system interface	included		available in Epics, Tango…
Auto lock	included		

[1]when operated in an environment with maximum 0.5 K temperature and 3 % relative humidity deviation. Please note that the timing jitter between the lasers must be lower than the target precision above the locking bandwidth.

MEASUREMENT DATA

Out-of-loop timing jitter (left) and timing drift (right – 2 Hz sampling) of an 800-nm Ti:Sapphire laser locked to an optical reference using a TCBOC (measured between the output of a Cycle PULSE link and a Coherent Vitara oscillator at 800-nm)

Contact sales@cyclelasers.com to discuss your requirements and receive a free white paper on timing jitter measurements.