Cycle

BOMPD

Balanced Optical Microwave Phase Detector

Lowest noise synchronization between lasers and microwaves

APPLICATIONS

- Synchronization between ultrafast lasers and microwave signals
- Photonic microwave generation
- Synchronization between ultrafast lasers and relativistic electron beams
- Electron bunch timing in free-electron lasers
- RF over fiber distribution

BENEFITS

- More than 0.2 mV/fs sensitivity
- Lower than 5 fs RMS noise floor
- Less than 20 fs RMS timing jitter and timing drift
- Attosecond-level timing jitter resolution

DESCRIPTION

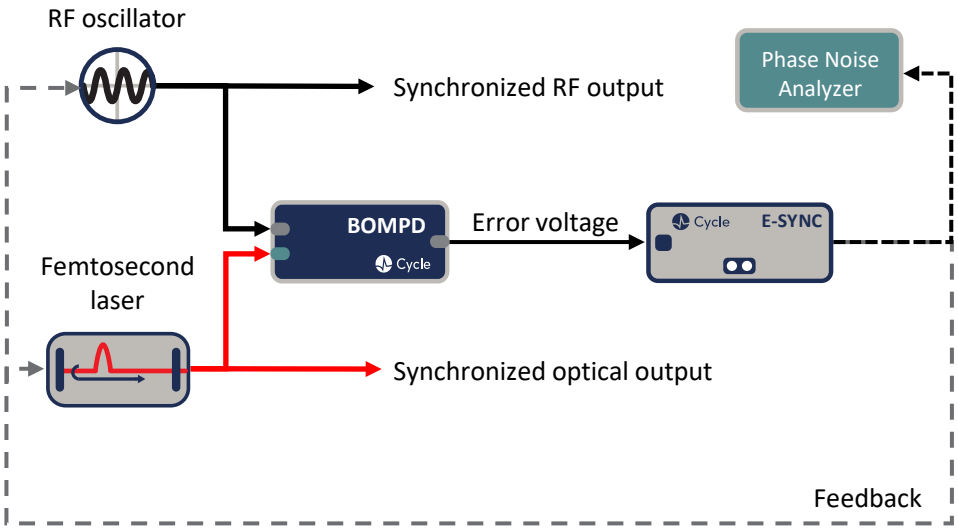
BOMPD allows ultra-precise measurement of timing jitter between an optical pulse train and the phase of a microwave signal.

BOMPD detection is amplitude invariant and bias-drift free.

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

ESYNC Option: the BOMPD can be combined with an electronic synchronization module, ESYNC, including necessary controllers to synchronize the laser oscillator to the RF source with a jitter below 20 fs RMS. Alternatively, it can be used to generate a RF signal that is locked to the optical oscillator input.

SETUP EXAMPLE



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Contact us to discuss your timing and synchronization requirements

SPECIFICATIONS

Parameter	Specification	Comment
Detector specifications		
Timing sensitivity	> 0.2 mV/fs	main balanced output with 1 MΩ load impedance
Timing noise floor	< 5 fs RMS	integrated noise floor [1 Hz - 100 kHz]
Timing resolution	< 0.1 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)	101×171×224 mm^3	dimensions of the optical detector head
Option ESYNC: Additional Electronic Synchronization Unit		
Timing jitter	< 20 fs RMS	integrated residual noise [35 µHz – 100 kHz], i.e., for 8 hours[1]
Control unit type	Cycle ESYNC	Electronic sync. unit for auto lock and feedback control
Control unit dimensions	3 U	19” rack module
Control system interface	EPICS	via TCP/IP
Integrated feedback	included	applied either to a VCO or a slave laser’s actuators
Auto lock	included	via graphical user interface on a computer
Input specifications		
Optical input wavelength	800 ± 30 nm 1030 ± 30 nm 1550 ± 40 nm	center wavelength
Optical input power	< 5 mW	coupled in PM fiber, collimator provided
Pulse repetition rate	10 MHz – 1.3 GHz	
Harm. RF input frequency	200 MHz – 20 GHz	shall be a harmonic of pulse repetition rate, contact Cycle for frequencies higher than 20 GHz.
Harm. RF input power	+13 to +18 dBm	contact Cycle for lower input power.

[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 RF master oscillator at 5712 MHz.