BOMPD

Balanced Optical Microwave Phase Detector

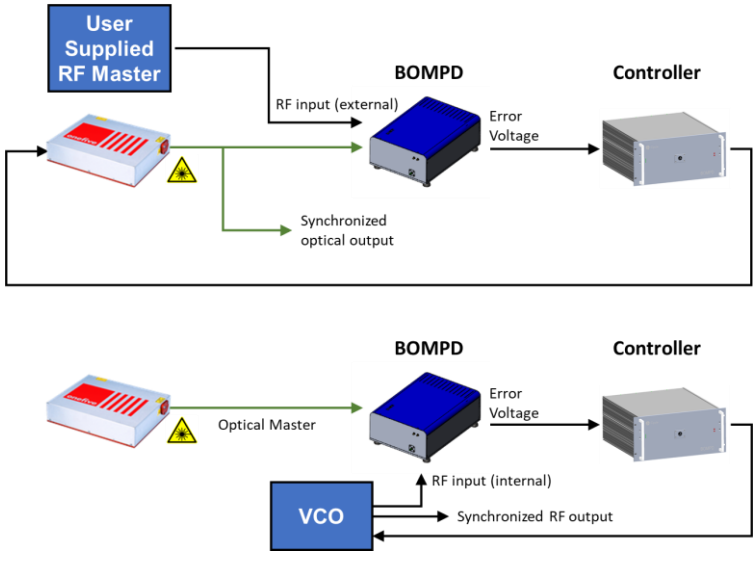
APPLICATIONS

- *Precise jitter measurement between ultrafast lasers and microwave signals*
- *Tight synchronization between ultrafast lasers and microwave signals*
- *Tight synchronization of microwave sources to the output of stabilized fiber links*
- *Generation of ultra-low-noise microwave signals from an ultrafast optical oscillator*

BENEFITS

- *More than* ***0.2 mV/fs sensitivity***
- *Lower than* ***0.5 fs noise floor***
- *Down to* ***1 fs RMS timing jitter***

SAMPLE SYNCHRONIZATION SETUPS



Cycle BOMPD measures the timing jitter between a user-supplied RF Master (e.g. RMO), the output of which is fed back to the slave laser repetition rate actuators to synchronize its output pulses to the RF standard (top). Alternatively, the output from the BOMPD can be fed back to a tunable RF source (e.g. VCO), in which case, the zero crossings of the RF signal is tightly synchronized to the optical pulse train of the master laser (bottom).

DESCRIPTION

The fully-automated BOMPD precisely detects the time delay between an optical pulse train and the zero-crossings of a microwave signal. It generates a baseband signal that is proportional to the timing error between the two inputs, which in turn can be used in a phase-locked loop to tightly synchronize a laser to a microwave source or vice versa. Due to its balanced detection scheme, the BOMPD is immune to amplitude fluctuations of both optical and microwave sources and greatly suppresses the AM-PM conversion noise in the photodetection process. Cycle offers three options to the BOMPD to complement our customers' applications: measurement device (MD) for measuring the timing jitter only, synchronization device (SD) which integrates the controllers and drivers necessary to synchronize a laser, and an RF-generation option which includes a fully integrated VCO (Voltage-Controlled Oscillator) for generating an RF signal based on an optical clock.

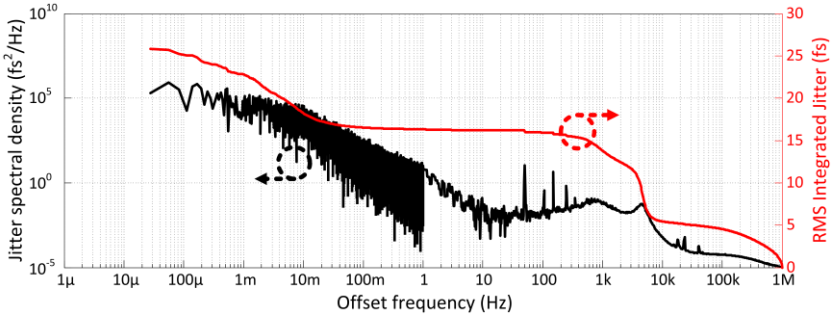
SPECIFICATION

Parameters	Value	Unit	Comment
Detector sensitivity	> 0.2	mV / fs	at the detector output (not amplified)
Detector resolution	< 0.5	fs	integrated detector noise floor within 10 kHz bandwidth
Residual Jitter (SD)[1]	< 5	fs	depends on noise characteristics of master/reference source
Control system	included		available in Epics, Tango
Auto lock	included		
Dimensions (H x W x L)	420 x 300 x 171	mm	plus controller (if synchronization option is chosen): 19 in. rack mount
Weight	10-20	kg	depending on options
Requirements			
RF input power	>15	dBm	up to 10 GHz. BOMPD tailored to frequency of interest
Optical input wavelength	800 ± 30 1030 ± 30 1550 ± 40	nm	
Optical input power	> 20	mW	
Optical input type	PM Fiber		SM possible upon request
Pulse repetition rate	< 10	GHz	BOMPD is tailored for the repetition rate of interest
RF Generation Option for BOMPD			
VCO	Included		customizable upon request
Integrated feedback	Included		optimized PID parameters
RF output power	> 10	dBm	50 Ω impedance
RF power stability	< 0.1	%	

[1] *in an environment with maximum 0.1 K temperature and 3 % relative humidity fluctuations. Higher precision is available upon request.*

MEASUREMENT DATA

Out-of-loop timing jitter spectral density between the generated RF from a customer-specified VCO and the optical reference, from 1 MHz down to 28 µHz[2], using a standard 1550nm BOMPD, with RF generation option:



[2] *The spectrum below 1 Hz is the Fourier transformation of the timing drift data, whereas the spectrum above 1 Hz is measured with a baseband analyzer.*