ESYNC

Electronic Synchronization Unit

Versatile & precise phase and frequency locking electronics

DESCRIPTION

ESYNC features versatile & precise locking electronics to synchronize ultrafast lasers and/or microwave sources with femtosecond precision.

Output signal is 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 configuration to synchronize i) a laser to a microwave source, ii) a microwave source to a laser, or ii) two lasers with each other.

ESYNC features a wide range of options including precise harmonic lock, laser stepper control, RF regeneration, external reference inputs (10 MHz / 100 MHz / 1 GHz), ECOPS, ASOPS etc.

BENEFITS

- Less than 100 fs RMS timing jitter
- Advanced fundamental and harmonic frequency lock functionality
- User adjustable delay while locking
- Automated search & lock mechanism via GUI

APPLICATIONS

- Synchronization of ultrafast lasers and microwaves
- Synchronization for pump-probe experiments
- Electronically controlled optical sampling
- Asynchronous electronic sampling

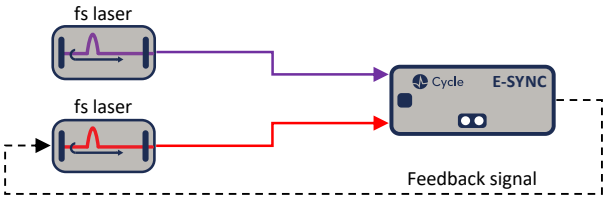
SPECIFICATIONS

Parameter	Specification	Comment
Timing jitter	< 500 fs RMS	integrated residual noise [0.1 Hz - 100 kHz][1]
Fund. input frequency	10 MHz – 1.3 GHz	shall be equal to pulse repetition rate in case of a laser
Output PZT voltage range	[0 – 100 V]	dual PZT amplifier outputs (i.e., for fast and slow PZTs)
Adjustable delay range	90% fundamental wave period	e.g., 9-ns range for 100-MHz pulse repetition rate
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: harmonic lock		
Timing jitter	< 100 fs RMS	integrated residual noise [0.1 Hz - 100 kHz]1
Harm. input frequency	40 MHz – 2.8 GHz	shall be a harmonic (4th to 10th) of the fund. frequency
Adjustable delay range	Full fundamental wave period	e.g., 10-ns range for 100-MHz pulse repetition rate
Option B: laser stepper		
Standard controllers: SMC100, Picomotor, PI C-663. Contact Cycle for other controller interfaces.		
Option C: RF regeneration		
Synchronized RF output	800 MHz – 12 GHz	any frequency output possible in this range
Option D: External reference inputs		
External RF input	10 MHz, 100 MHz, 1 GHz	contact Cycle for other external RF inputs.
Option E: Electronically controlled optical sampling (ECOPS)		
Specifications vary with scan range and resolution, please consult Cycle with your requirements.		
Option F: Asynchronous electronic sampling (ASOPS)		
Specifications vary with scan range and resolution, please consult Cycle with your requirements.		
Option G: Fundamental locking		
Fund. RF lock function to ensure same phase/delay bucket upon resynchronization & automatize an optical lock.		

[1] with appropriate input signals >200MHz, unit temperature +18 to +24°C, slope <0.4°C/h & variation <1°C pk-pk; humidity <60 %RH, variation <10 %RH pk-pk.

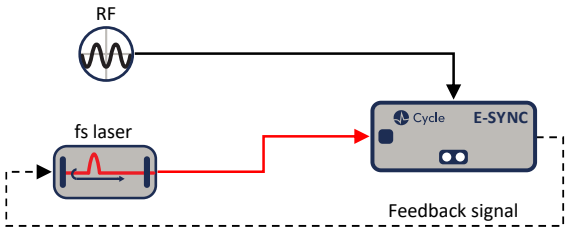
SETUP EXAMPLES

Femtosecond laser to femtosecond laser synchronization



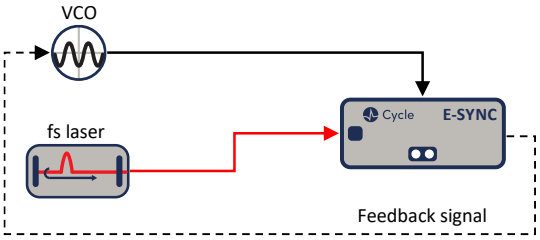
ESYNC inputs/outputs	
Input 1	Optical (PM/SM fiber)
Input 2	Optical (PM/SM fiber)
Output	Feedback signal for laser intracavity actuators

Femtosecond laser to RF synchronization



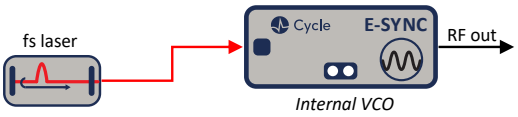
ESYNC inputs/outputs	
Input 1	RF (SMA)
Input 2	Optical (PM/SM fiber)
Output	Feedback signal for laser intracavity actuators

RF to femtosecond laser synchronization



ESYNC inputs/outputs	
Input 1	RF (SMA)
Input 2	Optical (PM/SM fiber)
Output	Feedback signal for a voltage-controlled oscillator

Photonic microwave generation

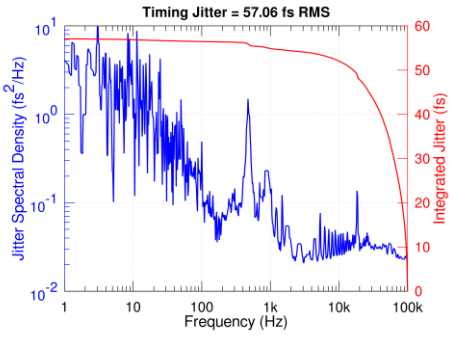


ESYNC inputs/outputs	
Input	Optical (PM/SM fiber)
Output	Synchronized VCO RF output

MEASUREMENT DATA

ESYNC performance locking a mode-locked laser to a microwave at 2856 MHz.

Out-of-loop timing jitter



Out-of-loop timing drift