

## Timing Distribution System (TDS)



### APPLICATION

Tight synchronization of distributed RF and laser sources in facilities such as:

- Free-Electron-Lasers
- Particle Accelerators
- Radio Telescope Arrays
- Laser Research Centers
- Laser Amplifier Chains

### DESCRIPTION

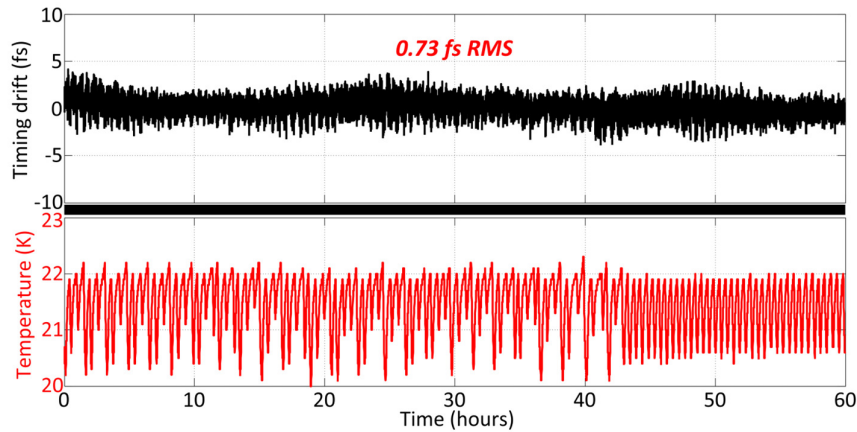
The Timing Distribution System enables precise timing between remote locations. The system uses ultralow-noise pulse trains generated by a mode-locked laser (i.e. optical master oscillator) as its timing signal. The timing signal of the optical master oscillator is transferred through fiber-optic timing links from a central location to multiple end stations whose transmission delays are stabilized by balanced optical cross-correlators. Either an ultrafast laser or a microwave source can be tightly synchronized to the end of each stabilized fiber link, with Cycle's TCBOC or BOMPD respectively. One TDS-platform is capable of serving up to 8 links. Due to the modular design, several platforms can be added after each other, so that the system can provide more links. The TDS comes with its own control system, which is fully automated, including an electronic pre-locking system to have a completely self-starting and self-locking solution. Please contact one of our timing experts for your customization needs.

**SPECIFICATIONS**

Parameter	Value	Unit	Comment
Timing jitter	5	fs RMS	Within 35 $\mu$ Hz - 1 MHz bandwidth, between two stabilized fiber links
Fiber link length	< 10	km	
Fiber links per TDS-platform	8		Several platforms can be combined to arbitrary number of links
Fiber type	PM		With FC or SC connector
Power per client	> 10	mW	Average power available at each fiber end
Optical wavelength	1550 $\pm$ 50	nm	Operating at pulsed mode
Pulse repetition rate	< 500	MHz	Tailored for the frequency of interest
Dimension of one TDS platform <sup>1</sup>	1500 mm x 800 mm x 300 mm		
Weight of one TDS platform	270 kg		
Rack for Controls System	Included		Temperature-controlled
Integrated feedback	included		Optimized PID parameters
Control system interfaces	included		Available in Epics, Tango
Auto lock	included		

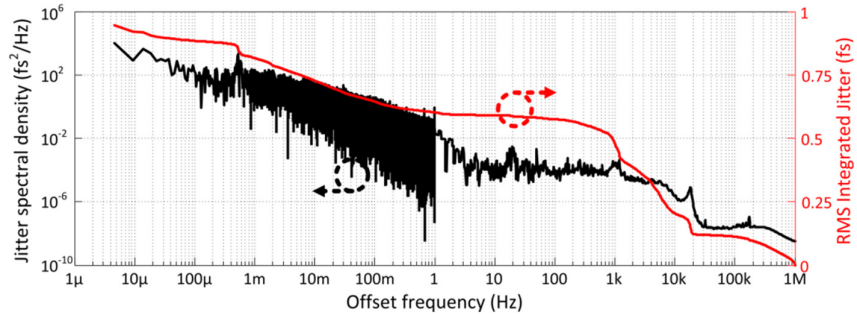
**MEASUREMENT DATA**

Out-of-loop timing drift below 1 Hz between two stabilized fiber links<sup>1</sup>. Underneath the environment temperature:



<sup>1</sup>The length of each fiber link is 150 m.

Out-of-loop timing jitter spectral density between the fiber links from 1 MHz down to 4.63  $\mu$ Hz<sup>2</sup>:



<sup>2</sup>The spectrum below 1 Hz is the Fourier transformation of the timing drift data over 2.5 days, whereas the spectrum above 1 Hz is measured with a baseband analyzer.