FSAC Interferometric Autocorrelator

Chapter 8 Specifications

8.1. General Specifications

General Specifications		
Full Scan Range	50 fs to 10 ps	
Input Pulse Duration	Without Precompensation	40 fs - 1 ps (FWHM)
	With Precompensation[5]	15 fs - 1 ps (FWHM)
Full Scan Rate	5 Hz	
Noise-Equivalent Sensitivity	10^{-1} W^2 at 800 nm for Ø1 mm Beam $(1/e^2)$[6]	
Input Wavelength Range	650 nm to 1100 nm	
Input Polarization	Horizontal	
Input Beam Diameter	<Ø4 mm $(1/e^2)$	
Input Repetition Rate	>300 kHz[7]	
Required Sampling Rate	>1.5 MHz for 10 ps Delay at 650 nm >150 kHz for 1 ps Delay at 650 nm	
Internal Dispersion	GDD	230 fs^2 at 800 nm (Nominal)
	TOD	345 fs^3 at 800 nm (Nominal)
Maximum Average Power	150 mW	
Dimensions	6.90" x 5.53" x 4.82" (175.3 mm x 140.4 mm x 122.4 mm)	

8.2. Electrical Requirements

Electrical Requirements	
Input Voltage	±12 VDC
Power Consumption	6 W (Max)
Connector	Lumberg RSV3-657/2M Female Connector

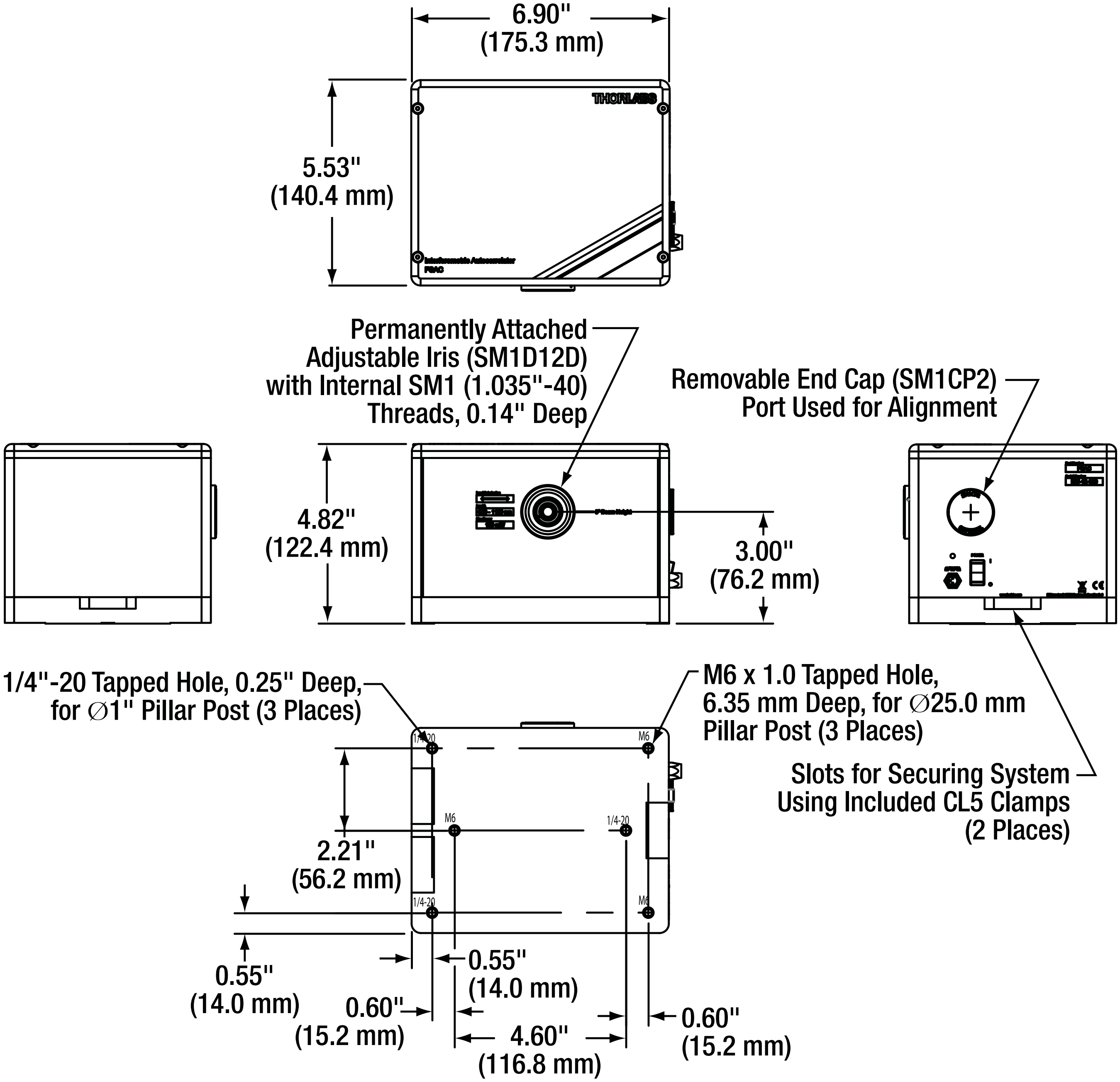
FSAC is designed to use the included Thorlabs LDS1212 power supply, which meets these requirements.

8.3. Environmental Requirements

Environmental Requirements	
Room Temperature Range	17 °C to 25 °C

[5] Pulses as low as 15 fs may be measured with use of dispersion compensation.
[6] Sensitivity is defined as the noise-equivalent product of the average power and the peak power of the laser.
[7] Lower repetition rates are possible when using triggered acquisition.

8.4. Mechanical Drawings



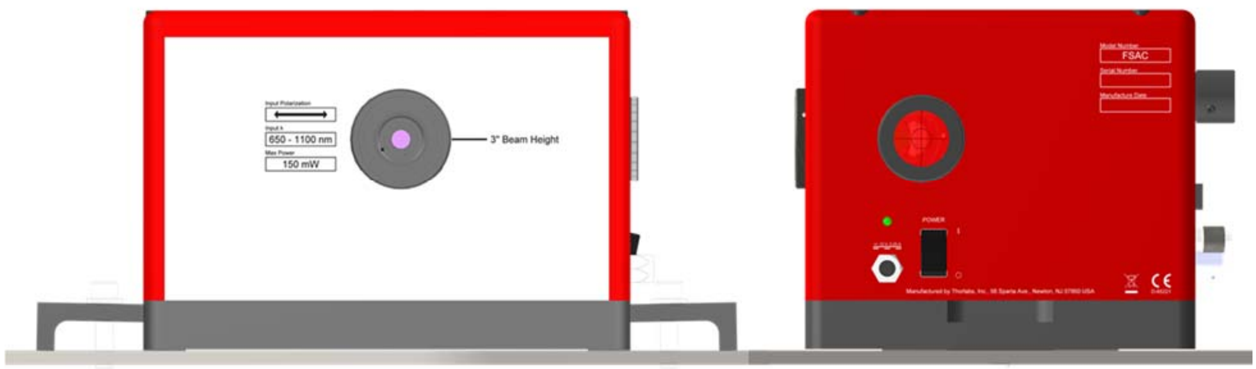


Figure 3 Front and Side Views Showing the Input Aperture (Left) and Alignment Aperture (Right)

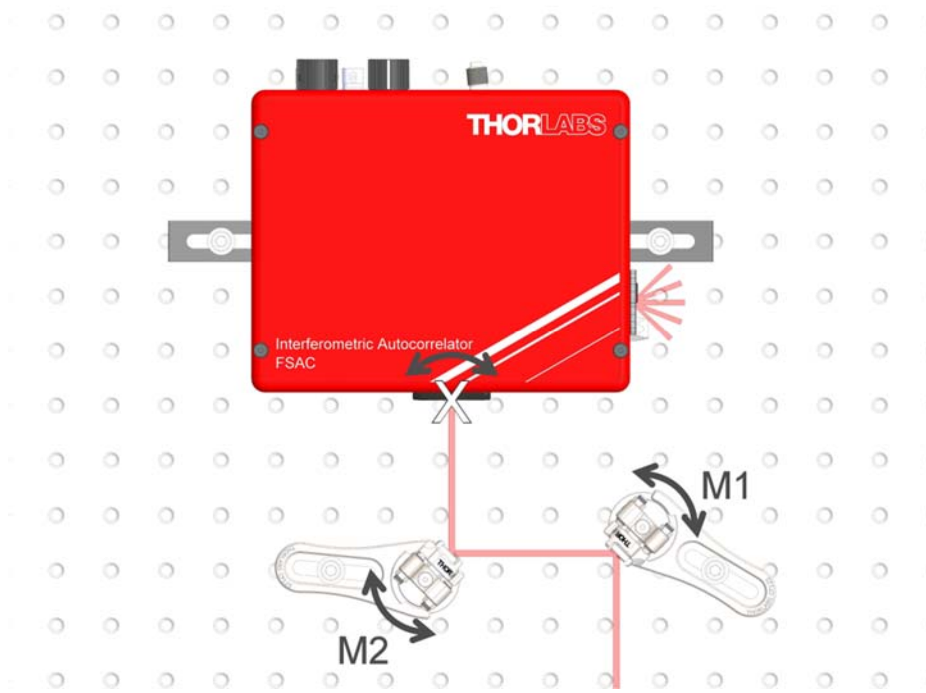


Figure 4 Use two mirrors to center the beam on the input port and alignment aperture.

The easiest way to complete the coarse alignment of the FSAC is to start by using the steering mirror to set the beam height to that of the autocorrelator input aperture, and ensure that the beam is parallel (level) to the table. M1 is adjusted to set the height of the beam, and M2 is used to level the beam, usually in alternating fashion. The FSAC may be moved towards M2 to check the height, and away from M2 to check the level. Several iterations may be required. Once the beam is level, place the FSAC at the desired location so that the beam is centered on the aperture. Open the aperture so that the beam just passes, then carefully rotate the entire FSAC about the input aperture (marked by the white X in Figure 4) until the beam spot on the alignment target is roughly centered. Make minor adjustments until the beam is roughly centered on both the input aperture and the VRC2SM1 alignment

Chapter 5 Theory and Interpretation

5.1. Working Principle

Figure 11 shows the optical layout of the FSAC. The input beam pulse is split and copies are reflected from a delay mirror and a reference mirror and then recombined at the beamsplitter. The recombined beam is focused onto the detector. When the delay and reference path lengths are exactly equal so that the optical path difference (OPD) is zero, the pulses overlap in time and add constructively to produce the maximum possible signal on the detector. When the OPD exceeds the full width of the pulse so that the pulses no longer overlap in the combined beam, there is no interference and the photodiode signal is at a minimum.

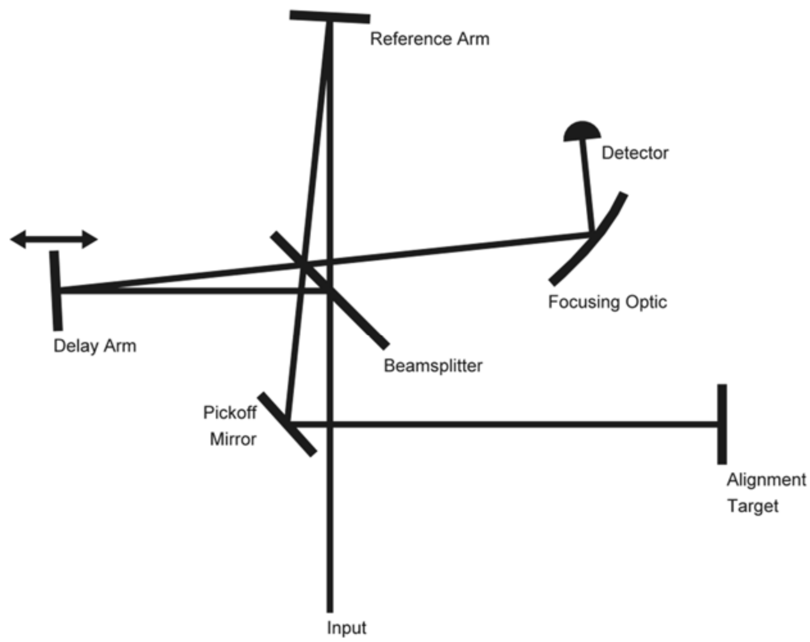


Figure 11 FSAC Optical Layout

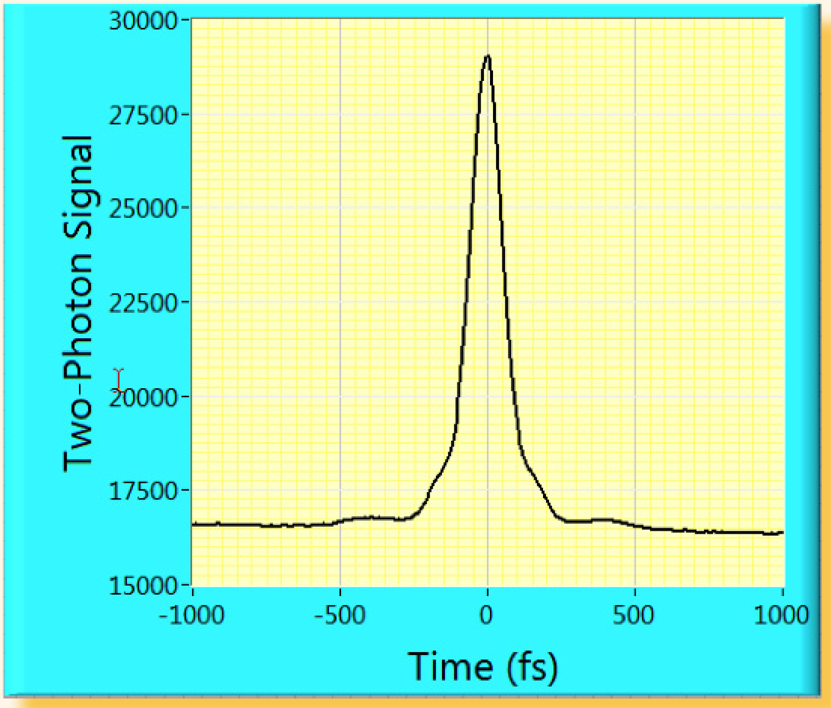
As photocurrent in the FSAC is generated by a two-photon process, the output signal is proportional to the square of the irradiance incident on the detector, which in turn is proportional to the square of the total electric field amplitude. And since the speed of the photodiode is several orders of magnitude longer than pulse width, it must be time integrated. This is written as

$$I_{AC}(\tau) = \int_{-\infty}^{\infty} |[\boldsymbol{E}(t) + \boldsymbol{E}(t-\tau)]^2|^2 \mathrm{d}t \,,$$

where $\boldsymbol{E}(t)$ is the complex electric field of the pulse and τ is the time delay between the two pulses arriving at the detector[1]. The integrand may be expanded to give

[1] *Rulliere, Claude.* Femtosecond laser pulses*. Springer Science+ Business Media, Incorporated, 2005.*

Autocorrelator



Autocorrelation of a fiber laser with pulse width of < 100 fs, single 1 sec scan

- 1 fs resolution
- Time window up to 60 ps
- High sensitivity
- Easy alignment
- Stand-alone operation via USB or external analog control
- Fiber coupled options available
- Analog or digital data acquisition
- Digital scan rates over USB up to 4 Hz
- 40 Hz scan rate under analog control
- Suitable for high repetition rate lasers
- Wavelength coverage from 700–1350 nm and 1200–2100 nm

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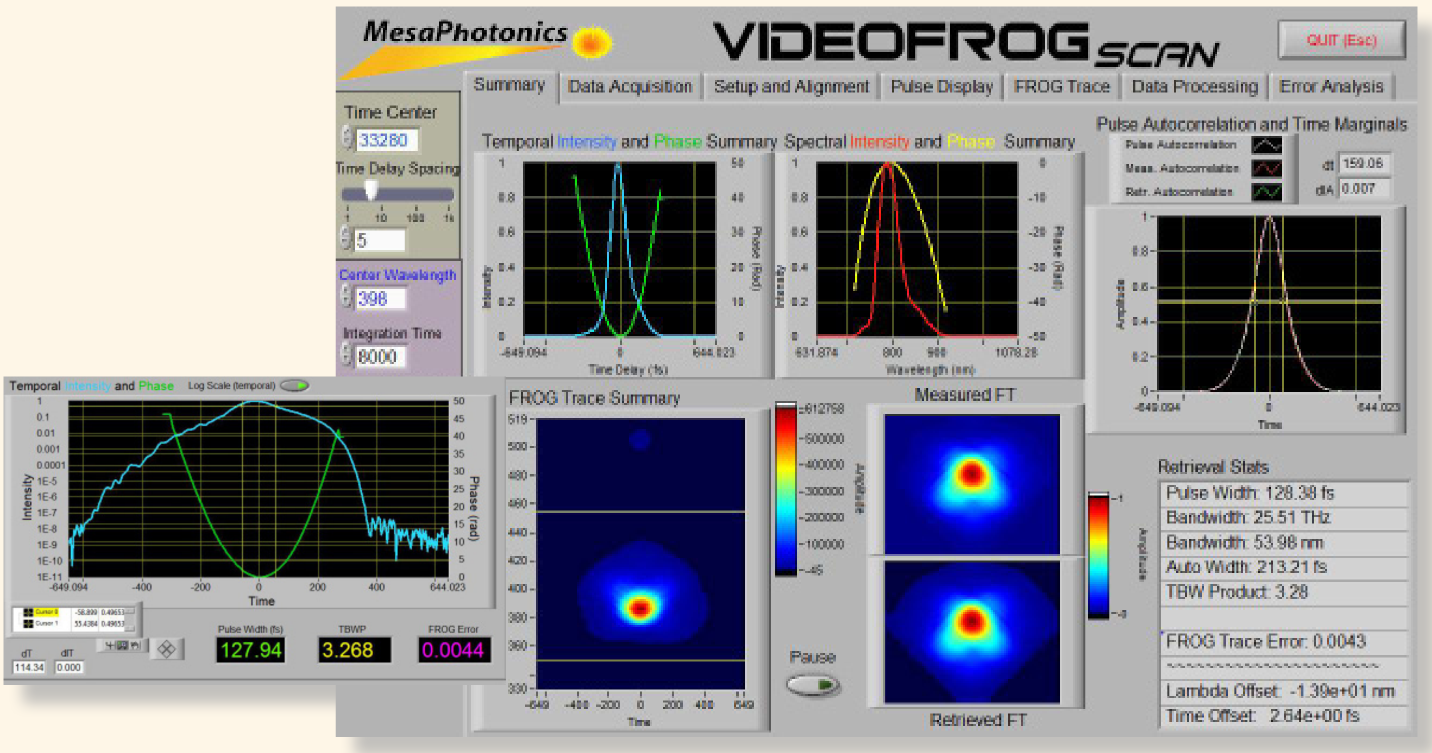
FROGscan

FROGscan is a revolutionary, high-accuracy, real-time ultrafast laser pulse measurement system

FROGscan Ultra provides wider wavelength coverage, higher resolution and up to 75dB dynamic range

- Pulse durations: 12 fs to >10ps
- Wavelength range: 450 nm to 2 μm
- Measurement rates: >2 Hz
- Time-bandwidth products: >50

- Easy to align
- Field configurable
- Easy to use
- Includes **VideoFROGscan** software
- Integral alignment laser
- High sensitivity



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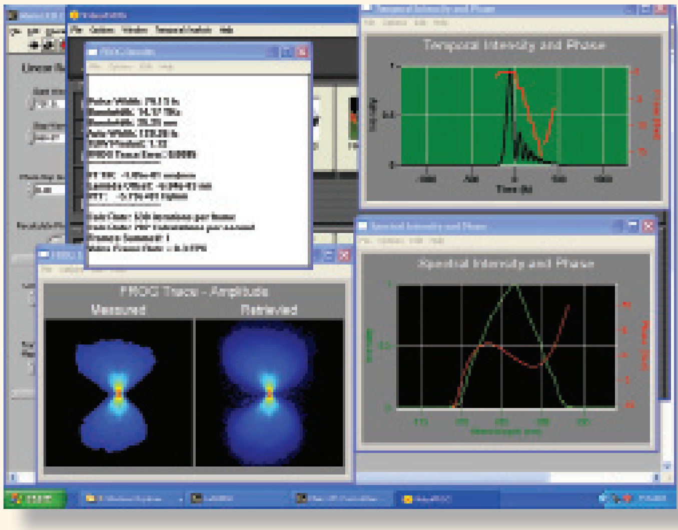

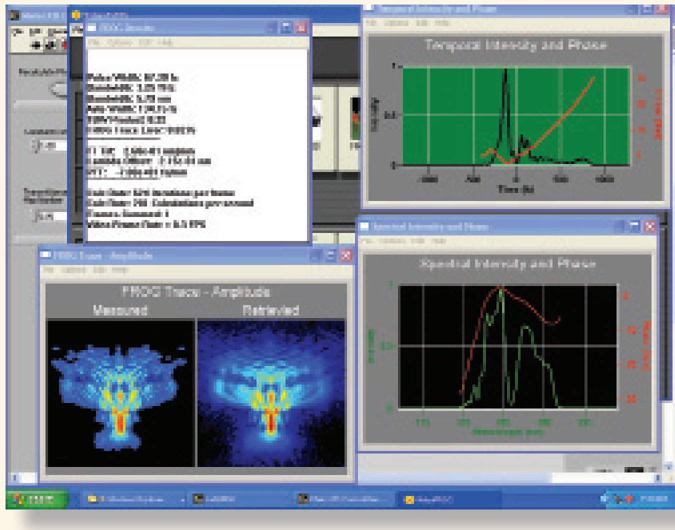

Specifications

Wavelength Range	450 nm - 1800 nm (for 1.8-3.4 µm contact us)
Pulse Length Range	12 fs to >10 ps
Temporal Range	30 ps
Temporal Resolution	2 fs or better
Delay Increment	1 fs
Spectral Resolution	0.20 nm - 1 nm (Ultra: 0.05 nm - 1 nm)
Spectral Range	100 nm - 600 nm
Pulse Complexity	TBWP > 50
Intensity Accuracy	2%
Phase Accuracy	0.01 radians
Real-time Sensitivity ($I_{peak} \bullet I_{ave}$)	4 W^2
Averaged Sensitivity ($I_{peak} \bullet I_{ave}$)	< 0.1 W^2 (Ultra: 0.01 W^2)
Input Beam Size	2 - 4 mm collimated
Polarization	Horizontal
Acquisition Speed	> 2 Hz (64 x 64 grid)
Spectra Required for Measurement	Grid width
Size on Table	16 cm x 30.5 cm (Ultra: 30 cm x 30 cm)
Software	VideoFROGscan included

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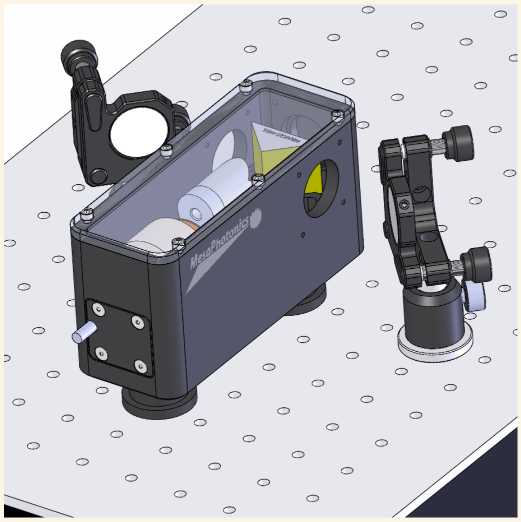
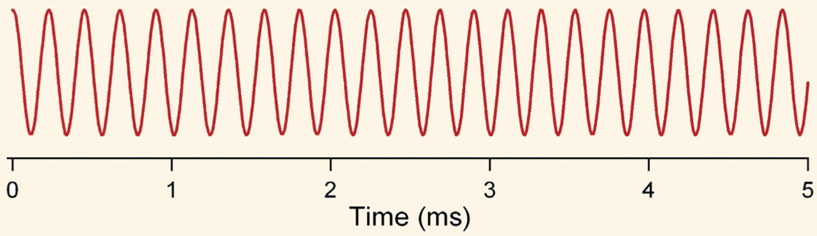
Peregrine High Speed Optical Delay Line

Specifications

- 1 cm travel
- 1 fs resolution
- 150 nm precision
- 200 nm short-term repeatability
- 50 ppm long-term repeatability
- No backlash
- Fiber compatible
- 15 mm beam spacing
- 15 mm aperture
- Analog & digital control
- Two 16-bit A/D's
- Digital triggering
- 1 kHz response
- USB control





Interferogram showing **Peregine ODL** stability

Applications

- Autocorrelation
- Pump-probe
- Interferometry

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