56 Sparta Avenue • Newton, New Jersey 07860
(973) 300-3000 Sales • (973) 300-3600 Fax
www.thorlabs.com

THORLABS

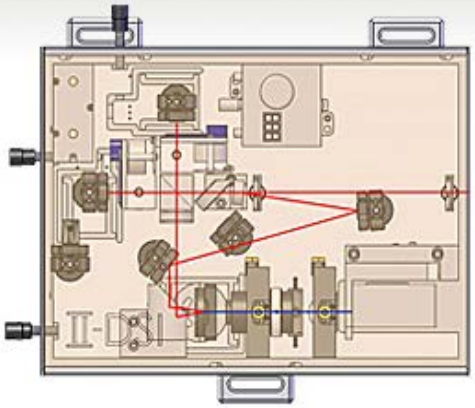
2DSI - August 10, 2015

Item # 2DSI was discontinued on August 10, 2015. For informational purposes, this is a copy of the website content at that time and is valid only for the stated product.

2DSI FEW-CYCLE PULSE CHARACTERIZATION: 4 - 50 FS

- **Two-Dimensional Spectral Shearing Interferometry**
- **No Calibration Required**
- **Direct Representation of Spectral Group Delay**

2DSI

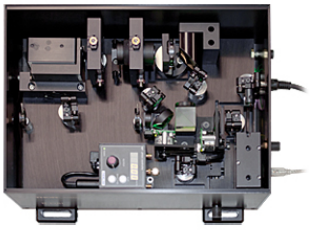


Hide Overview

OVERVIEW

2DSI Advantages

- Avoids Sensitive Calibration
- Direct Reconstruction, No Iterative Search Algorithm Required
- 50 Attosecond Phase Delay Precision
- Dispersion Free
- Octave-Spanning Bandwidth
- Fundamental and Up-Converted Spectrum Measured in Same Device
- Fully Automated
- Guide Laser for Easy Set Up



Overhead View Showing Optical Layout

Thorlabs' solution for measuring sub-two-cycle pulses is Two-Dimensional Spectral Shearing Interferometry (2DSI). 2DSI measures an ultrashort pulse envelope by interfering neighboring spectral components. This technique was developed in close collaboration with MIT.

2DSI overcomes certain disadvantages in other femtosecond pulse measurement techniques by encoding the spectral group delay in the spectrum of a single nonlinearly transformed pulse, rather than two. This avoids the need to calibrate the delay between two pulses to high precision, a potential complication with other techniques for few-cycle pulses and below. In addition, the interferogram produced by 2DSI is a direct representation of the spectral group delay of the pulse, allowing for reconstruction of the pulse shape without the need for iterative search algorithms.

This allows 2DSI to accurately measure the spectral group delay of pulses with time-bandwidth products in excess of 20, precisely resolving all pulse features, such as weak satellite pulses, which other techniques can miss. The 2DSI geometry also inherently avoids having the pulse pass through any dispersive materials and uses type II up-conversion with a phase-matching bandwidth of nearly an octave.

Thorlabs' 2DSI automates the measurement process so that the only user intervention required is the initial alignment, which is made simple by a green counter-propagating alignment laser. The mechanical setup is based on our proven flexure stage design for all critical components. Long-term hands-off operation was one of the major design goals. A high-quality, high-dynamic-range spectrometer allows for simultaneous measurement of both the 2DSI inteferogram and fundamental spectrum.

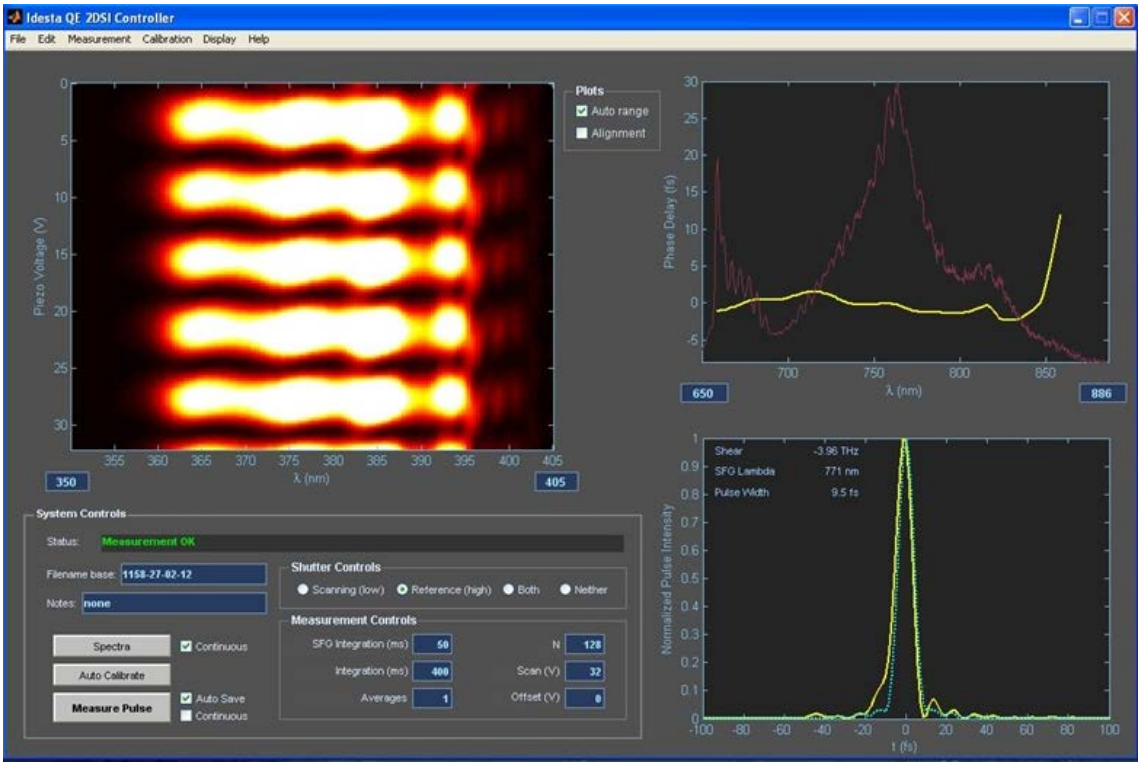
Item #	2DSI
Wavelength	650 - 1000 nm
Pulse Width*	4 - 50 fs
Time-Bandwidth Product	>20 (Max)
Spectral Phase Precision	50 attoseconds
Pulse Energy	1 nJ - 1 µJ
Single Shot	No
Refresh Rate	Up to 10 Hz
Dimensions	326 mm x 240 mm (12.85" x 9.45")

*Longer pulse widths are available upon request.

Hide Software

SOFTWARE

The left graph in the software screenshot below shows raw 2DSI traces. The raw data allows for an intuitive and qualitative estimate of the chirp on the pulse under test. Any deviation from a horizontal line is an indication of a non-transform limited pulse. In this screenshot, the top right graph shows Group Delay vs. Wavelength, while the lower right graph is a reconstructed temporal pulse shape.



Hide Pulse Measurement

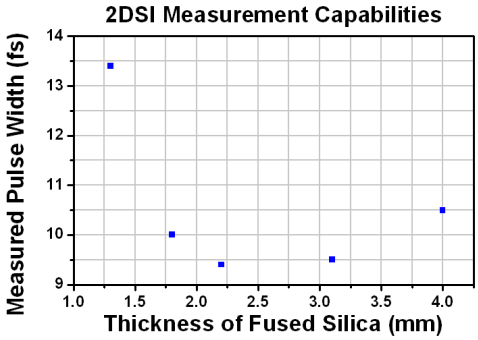
PULSE MEASUREMENT

Pulse Measurement with 2DSI

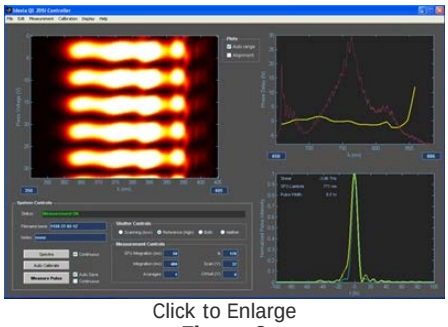
To demonstrate the measurement capabilities of the 2DSI, we used our Octavius 2P femtosecond laser, which was optimized for a pulse width limit of 9 fs. First, the pulse is dispersed by transmission through air. Then, the pulses undergo five reflections from dispersion compensating mirrors to compensate for the dispersion. To further compensate the dispersion, the pulses pass through a thickness of fused silica glass. The pulse width is then measured by the 2DSI.

Figure 1 shows the measured pulse width vs. the thickness of fused silica. Notice that between 2 and 3 mm of fused silica, the pulse width is very close to its theoretical minimum. With a fused silica thickness greater than 3 mm, the pulse width begins to increase, due to negative dispersion.

Figure 2 shows a screen shot of the 2DSI GUI interface taken during the measurement. The lower right panel shows the measured pulse in yellow, which is similar to the theoretical pulse in blue.



Click to Enlarge
Figure 1



Click to Enlarge
Figure 2

Hide Part Numbers

Part Number	Description	Price	Availability
2DSI	Two-Dimensional Spectral Shearing Interferometer, 650 – 1000 nm	$25,000.00	Lead Time