AvaSpec-ULS3648 with AvaSoft-Femto

Ava-Femto: Spectrometer & femtosecond laser measurements

Avantes spectrometers, in combination with the proprietary AvaSoft-Femto spectroscopy software, can be used for femtosecond laser measurements. On the backside of this flyer, we will explain the possibilities of this special version of the AvaSpec series spectrometers.

Apart from femtosecond laser measurements, this AvaSpec-ULS3648 is also a high quality spectrometer with a 0.30 nm resolution. It measures in the visible to near-infrared range of 600 to 1100 nm.

Included in the package is a cosine corrector to collect the emitted light from the laser. Furthermore a two meter long fiber optic cable designed for measurements above 300 nm wavelengths. The included tripod mount facilitates easy positioning of the cosine corrector in the path of the laser beam.

Technical Data Spectrometer

Optical Bench	ULS Symmetrical Czerny-Turner, 75 mm focal length
Wavelength range	600-1100 nm
Resolution	0.30 nm
Slit size	10 µm
Sensitivity	310,000 counts/µW per ms integration time
Detector	CCD linear array, 3648 pixels
Signal/Noise	350:1
AD converter	16-bit, 2 MHz
Integration time	10µs – 10 minutes
Interface	USB 2.0 high-speed, 480 Mbps RS-232, 115.200 bps
Sample speed with on-board averaging	3.7 ms /scan
Data transfer speed	3.7 ms /scan (USB2) 750 ms/scan (RS-232)
Digital IO	HD-26 connector, 2 Analog in, 2 Analog out, 3 Digital in, 12 Digital out, trigger, sync.
Power supply	Default USB power, 350 mA Optionally with SPU2 external 12VDC, 150 mA

Order information: Ava-Femto

Spectrometer	AvaSpec-ULS3648-USB2	Grating IB (600-1100nm) 10 µm slit
Fiber optics	FC-IR200-2 fiber optic cable, 2 meters	
Included	AvaSoft-Femto CC-VIS/NIR cosine corrector AvaTripod	

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APPLICATION NOTE: Ultrafast Laser Diagnostics

Overview

The femtosecond time scale is out of reach for even the fastest electronics, so to perform pulse diagnostics other measurement techniques need to be used.

The AvaSoft-Femto add-on turns your Avantes spectrometer into a femtosecond laser diagnostic tool that can provide you with an estimation of the transform limited pulse duration as well as measuring the peak wavelength and relative intensity of the laser output. Using the add-on users can also easily export the measurements to spread sheet programs like Microsoft Excel for record keeping or further analysis.

Many femtosecond mode-locked lasers can generate nearly bandwidth-limited pulses, especially when they are based on soliton mode locking. A femtosecond mode-locked Ti:Sapphire laser when fully optimized propagates a soliton-like pulse with a hyperbolic secant squared function intensity distribution in the frequency domain.

By accurately measuring the spectral output of a femtosecond mode-locked Ti:Sapphire and using the time-bandwidth product of different pulse shapes (Gaussian, Hyperbolic Secant Squared, Lorentzian) the lower limit for the pulse duration can be determined.

FWHM measurement

The full-width at half maximum (FWHM) is accurately measured using an Avantes spectrometer and this is then used in combination with a value of K (that is dependent on the symmetrical shape of the pulse) to calculate the transform limited pulse duration;

$\Delta v \Delta t \geq K$

Gaussian function	0.441
Hyperbolic secant	0.315
Lorentzian function	0.142

Values for K depending on the pulse shape
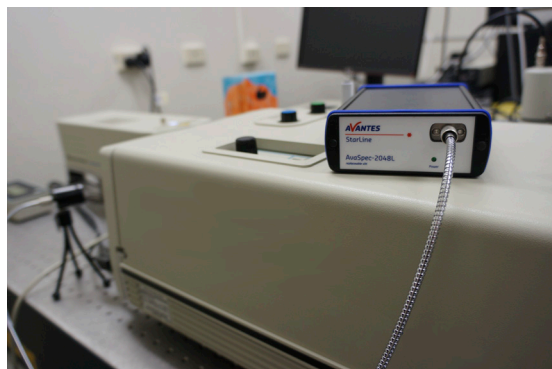
The AvaSoft-Femto software allows for a quick and convenient way to show the transform limited pulse duration according to the pulse shape selected in the software. The complete Femto package also provides a good general purpose spectrometer that can be used for various applications in the lab.

When using AvaSoft-Femto with an Avantes spectrometer that doesn't have an order sorting filter installed, you can also use the system to measure laser lines in the ~300-600 nm range by observing them in the second order. This means 500 nm will show up as 1000 nm on the spectrometer. Lines in the ~200-300 nm range can be seen in the third order (i.e. 300 nm will show up at 900 nm on the spectrometer). The spectrometer included in the Ava-Femto package can be used for second and third order measurements.

Typical configuration for AvaSoft-Femto

The AvaSoft-Femto can be used with virtually any existing Avantes spectrometer provided it covers the required wavelength range. A typical configuration for use with the AvaSoft-Femto application is shown on the flipside of this page.

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