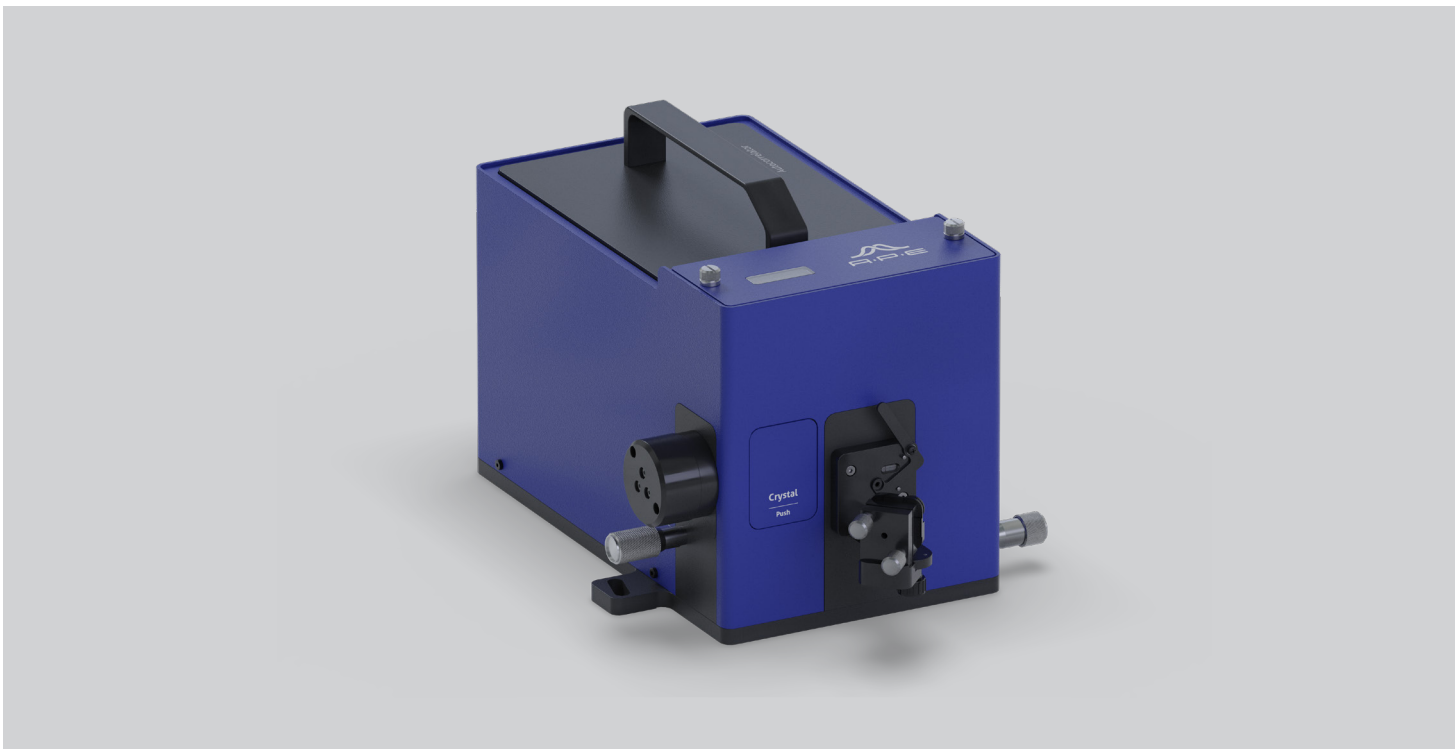


pulseCheck NX Modular Autocorrelator

Pulse Measurement Perfection with the Multitalent from APE

The pulseCheck platform grows with your tasks. Suitable for characterizing virtually all ultrafast pulsed lasers, APE's pulseCheck autocorrelator covers a wide range of wavelengths and pulse widths. This flexibility is achieved by using interchangeable Optics Sets, typically consisting of a nonlinear crystal and a dedicated detector module.



- Exchangeable Optics Sets for wavelength coverage from 200 nm to 12 μm
- Wide range of sensitivity levels covered with PMT, PD, and TPA
- High temporal resolution with a sampling resolution down to 50 attoseconds
- Toggle between interferometric and intensity autocorrelation
- Integrated controller for data acquisition, data fitting, and fast FPGA data processing
- Software supported wavelength tuning of crystal (phase matching)
- Fully compliant with DIN 58175-2:2021-04 (autocorrelation measurement methods)
- NX-Software and USB as well as Ethernet connection
- TCP/IP remote control with standardized command set for easy programming
- Option: FROG for complete pulse characterization

pulseCheck NX Overview

pulseCheck	NX 50	NX 150	SM 2000
Pulse width	5 fs ... 15 ps	10 fs ... 40 ps	20 fs ... 500 ps
Wavelength range	depending on Optics Set		
Recommended repetition rate	PMT: 250 kHz, for UV only: <2 MHz		
Sensitivity*, typical	depending on Optics Set		
Max. input power, energy	0.5 W / 0.1 J / 10 mJ laser		
Input beam polarization	polarization rotator optional		
Input beam coupling	Fiber coupling (FC/APC or APC/APC) optional		
Input beam height	76 mm		
Measurement refresh rate	10 Hz	7.5 Hz	120 ps/sec
Delay resolution	50 attoseconds	200 attoseconds	1 femtosecond
Contrast	10 ⁻⁴		
Type of measurement mode	PMT: Pico-branch interferometry and collinear interferometric - switchable		
Available detector types	Exchangeable detection (PMT), Photodiode (PD) and		
Calibration	NIST traceable calibration certificate included		
Electronics	Completely integrated and self-sustained		
Trigger mode	TTL <50 kHz		TTL <10 kHz
Phase matching	Automatic		Software-supported
Intensity resolution	18 bit		
Connectivity	Ethernet, USB, TCP/IP (SCPI command set)		
Remote control	Programmable via API		

* The sensitivity can be calculated as $(P_{\text{average}} * P_{\text{peak}}) = (P_{\text{average}}^2 / (f_{\text{rep.rate}} * \tau_{\text{pulse duration}})) = W^2$. The resulting value of W^2 must be higher than the specification.

Note: Sensitivity gives an approximation within an order of magnitude as it doesn't take into account other factors such as beam parameters and pulse quality.

... Flexibility for your Experiments

High Resolution & Strong Processing Performance

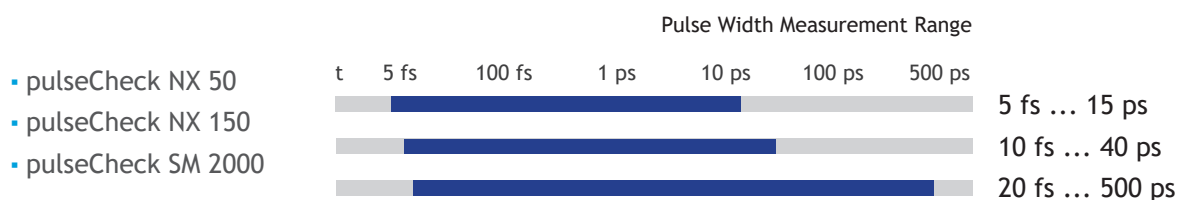
The advanced system-on-chip based architecture enables measurements with low latency, a high time resolution down to 50 attoseconds and an intensity dynamic range of 18 bit. This allows full access to even the tiniest autocorrelation features.

Maximum Functionality through Modular Design

APE meets the growing need for maximum functionality and flexibility with the modular concept on which the pulseCheck autocorrelator series is based. Thus, Optics Sets to upgrade the wavelength range or FROG capability can be added at any time.

From Ultrashort to Longer Pulses

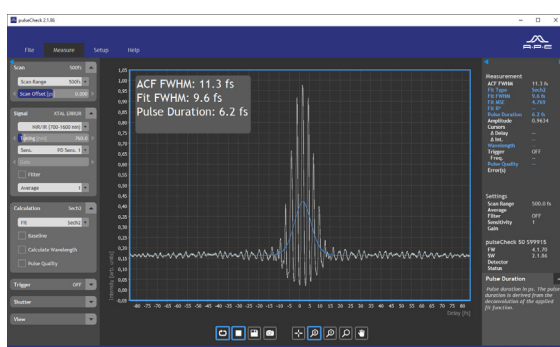
Various pulseCheck configurations can be adapted to the individual needs of pulse width measurements. The measurement of extra long pulse widths up to 500 ps is possible with pulseCheck SM.



High Sensitivity and Low Noise with Three Types of Detectors

- Photodiode Detector (PD)
- Photomultiplier (PMT)
- Two-Photon Absorption (TPA)

Standard sensitivity up to 1 W^2
 Highest sensitivity up to 10^{-6} W^2
 High sensitivity up to 10^{-2} W^2



Software GUI for pulseCheck NX



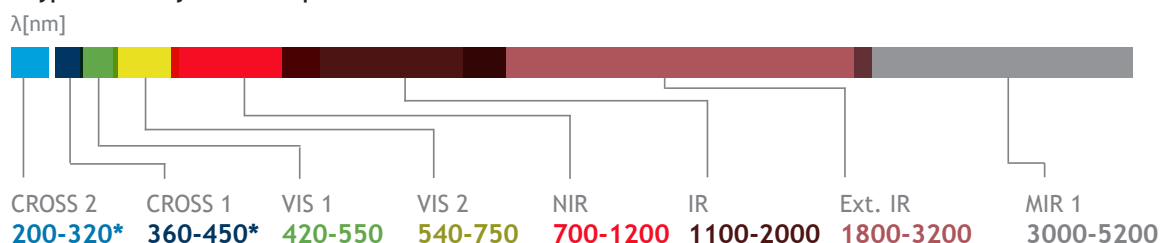
pulseCheck NX

Optics Sets

A variety of different and exchangeable Optics Sets cover a wide wavelength range: from UV at 200 nm to Mid-IR at 12 μm .

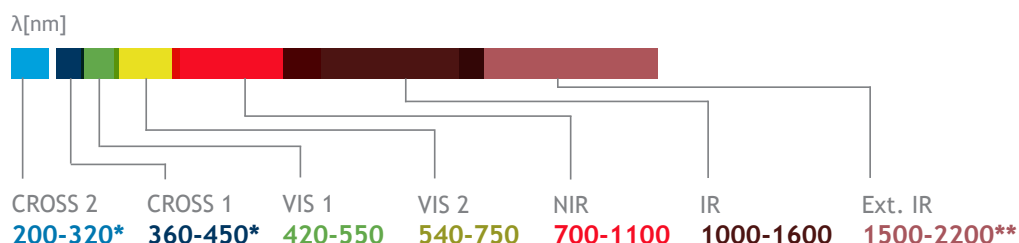
Photodiode (PD)

▪ **Typ. Sensitivity:** 1 W^2 ▪ **Rep. Rate:** $> 10 \text{ Hz}$ ▪ **Measurement Mode:** Collinear and Noncollinear



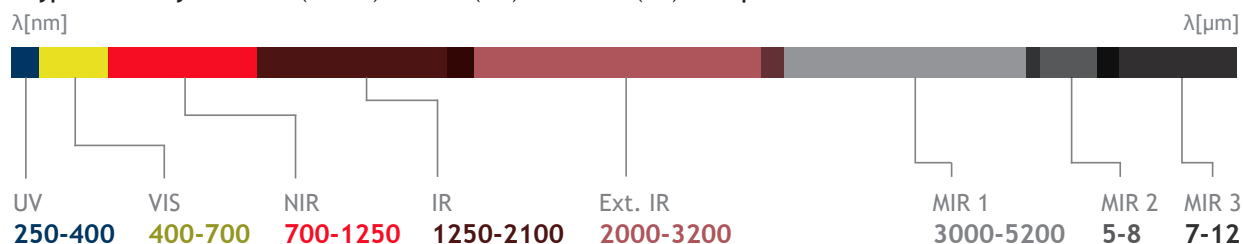
Photomultiplier (PMT)

▪ **Typ. Sensitivity:** up to 10^{-6} W^2 ▪ **Rep. Rate:** $> 250 \text{ kHz}$ ▪ **Measurement Mode:** Collinear and Noncollinear



Two Photon Absorption (TPA)

▪ **Typ. Sensitivity:** $< 0.1 \text{ W}^2$ (NIR/IR) ▪ $< 1 \text{ W}^2$ (VIS) ▪ $< 100 \text{ W}^2$ (UV) ▪ **Rep. Rate:** $> 10 \text{ Hz}$ ▪ **Measurement Mode:** Collinear Intensity



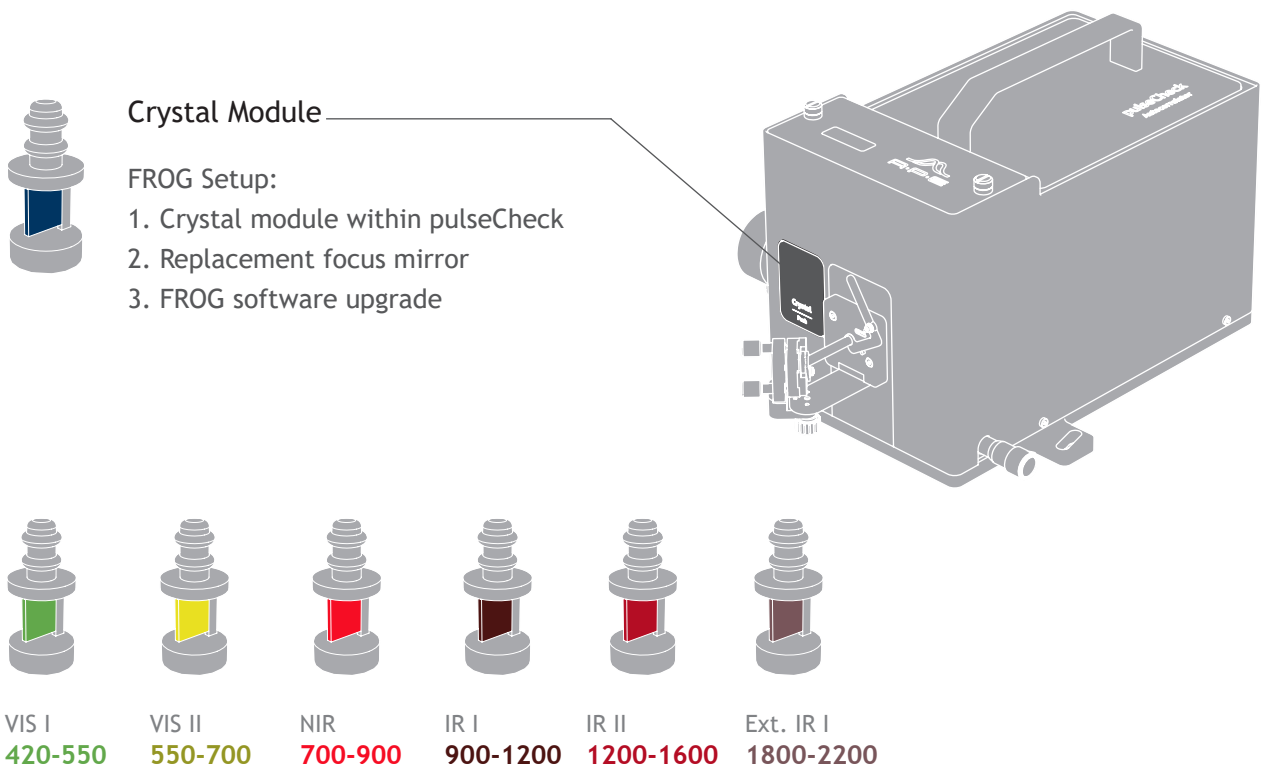
* For cross-correlation: wavelength range depends on pump wavelength

** For the wavelength range 1500 ... 2200 nm we recommend to use the highly sensitive IR detector "Extended IR PD SELECTED"

FROG

Complete Pulse Characterization with pulseCheck NX and FROG Option

Second harmonic generation FROG is the most popular spectrometer-less Frequency Resolved Optical Gating method. The pulseCheck autocorrelators by APE optionally integrate FROG, giving access to complete pulse characterization. This option opens the door to complete spectral and temporal pulse characterization.



Different crystal modules for various wavelength ranges.

- Complete spectral and temporal pulse characterization
- Different crystal modules available to cover wavelengths from 420 ... 2200 nm
- FROG trace data processing and visualization with included software
- Pulse width ranges from as low as 20 fs up to 6 ps
- High spectral resolution up to 0.1 nm
- Available for the pulseCheck NX autocorrelator*

* Required laser rep. rate >10 kHz

... FROG Pulse Characterization Software

FROG Trace

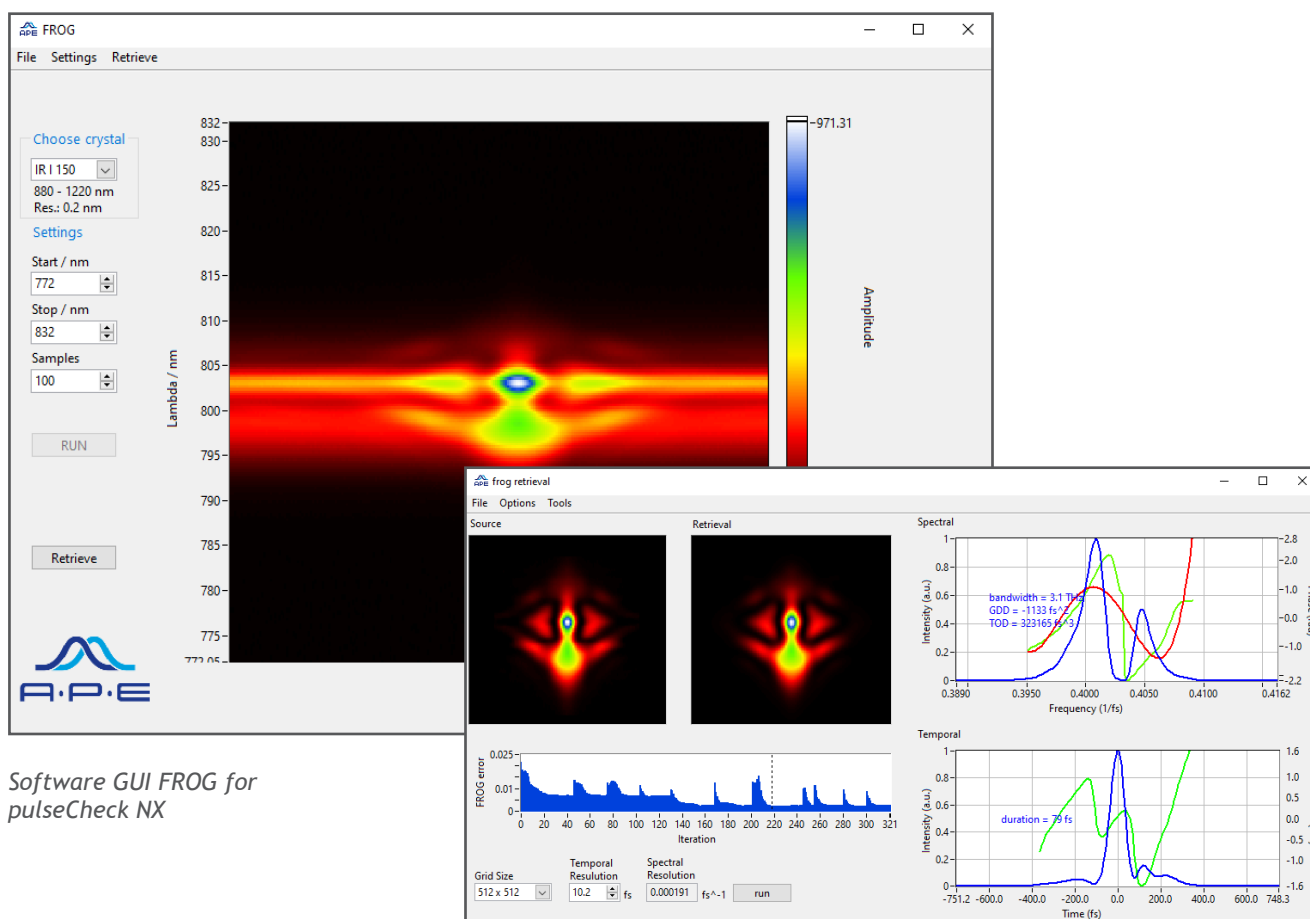
The software provides laser pulse intensity as a function of time and frequency (wavelength). Results are visualized in the form of a FROG trace diagram as well as pulse shape and spectrum.

It is a matter of seconds to automatically find the required phase matching tuning angle - thanks to the automated phase matching routine by pulseCheck NX.

Wavelength and Pulse Width Coverage

Various crystals guarantee coverage of wavelengths from 420 nm up to 2200 nm and pulse widths from 20 fs to 6 ps (numbers given for Fourier transform limited pulses). High spectral resolution down to 0.1 nm are supported.

The FROG option is designed for laser repetition rates above 10 kHz and is available for the pulseCheck NX autocorrelator series (except for pulseCheck SM 2000).



Software GUI FROG for pulseCheck NX

FROG Crystals

FROG crystals	Wavelength range	Pulse width	Required spectral bandwidth	Spectral measurement
VIS-I-200	420 nm ... 550 nm	>200 fs	>1 nm	0.1 nm
VIS-I-50	420 nm ... 550 nm	50 fs ... 200 fs	>3 nm	0.3 nm
VIS-I-20	420 nm ... 550 nm	20 fs ... 70 fs	>10 nm	1.0 nm
VIS-II-150	550 nm ... 700 nm	>150 fs	>1 nm	0.1 nm
VIS-II-50	550 nm ... 700 nm	50 fs ... 200 fs	>3 nm	0.3 nm
VIS-II-20	550 nm ... 700 nm	20 fs ... 60 fs	>20 nm	2.0 nm
NIR-200	700 nm ... 900 nm	>200 fs	>1 nm	0.1 nm
NIR-50	700 nm ... 900 nm	50 fs ... 500 fs	>2 nm	0.2 nm
NIR-20	700 nm ... 900 nm	20 fs ... 50 fs	>30 nm	3.0 nm
IR-I-150	900 nm ... 1200 nm	>150 fs	>2 nm	0.2 nm
IR-I-60	900 nm ... 1200 nm	60 fs ... 200 fs	>10 nm	1.0 nm
IR-I-30	900 nm ... 1200 nm	30 fs ... 60 fs	>50 nm	5.0 nm
IR-II-100	1200 nm ... 1600 nm	>100 fs	>5 nm	0.5 nm
IR-II-50	1200 nm ... 1600 nm	50 fs ... 100 fs	>20 nm	2.0 nm
IR-II-30	1200 nm ... 1600 nm	30 fs ... 50 fs	>90 nm	9.0 nm
Ext. IR-I-50	1800 nm ... 2200 nm	>50 fs	>190 nm	19 nm


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A FROG crystal is suitable if the "Pulse width range" matches or, if the actual spectral bandwidth of the laser is wider than the "Required spectral bandwidth".

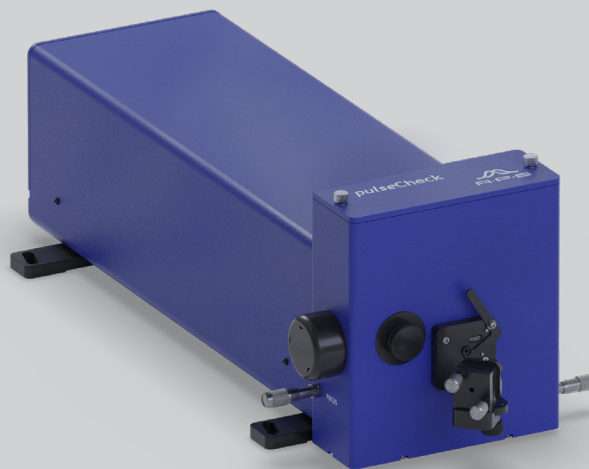
pulseCheck SM 2000

Long-Range Autocorrelator

Pulse Width Measurement up to 500 ps

With the revised version of the long-range delay technology in pulseCheck SM, the new autocorrelator offers a scanning range up to three times larger and a measuring speed up to five times faster than the previous long-range models. The pulseCheck SM includes a high performance controller that is integrated into the device.

The pulseCheck SM is suitable for particularly long pulse widths of up to 500 ps. At the other end, short pulses down to 20 fs widths can be measured. A resolution of 1 fs and a sampling rate of 1 MHz is available over the entire measurement range.



- Pulse widths from 20 fs up to 500 ps
- Optics Sets from 200 nm to 12 μm
- Measurement speed of 120 ps/sec
- Integrated high performance controller
- Toggle between interferometric and intensity autocorrelation
- Wide range of sensitivity levels covered with PMT, PD, and TPA
- USB & Ethernet connectivity and TCP/IP remote control
- Gaussian, Sech^2 , and Lorentzian fitting routines
- NIST traceable calibration

pulseCheck SM Type 2

High Dynamic Range Autocorrelator for High Contrast

Revealing Pre- & Post-pulses, Pedestals, Satellites

High contrast measurements with the Autocorrelator pulseCheck Type 2 provide information about how far in time and intensity the main pulse is accompanied by pre-pulses, post-pulses and pedestals.

With a high dynamic range of 10^7 , pulseCheck SM Type 2 is ideally suited for the characterization of high intensity, high repetition rate laser pulses, such as those in material processing or in ultra-high intensity light-matter interaction experiments.

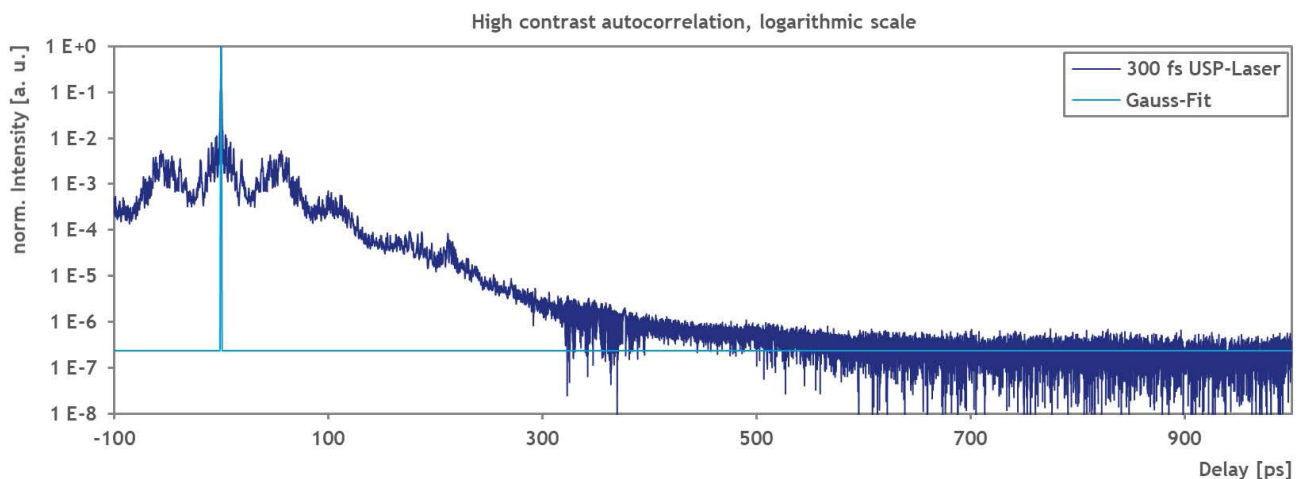
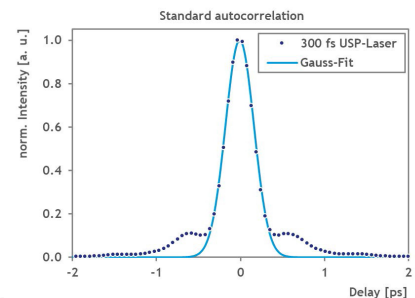


Figure: SM Type 2 high contrast autocorrelation measurement of an industrial femtosecond fiber laser with a nominal pulse width of ~ 280 fs (please note the ps scale of the measurement).
Measurement conditions: ~1030 nm, 35 mW, 1 MHz

- Measuring intense pulses and their pre-pulses, post-pulses, pedestals
- High dynamic range measurements
- Ultra-precise delay resolution
- Automatic phase matching
- NIST traceable calibration
- Ready to use software and USB interface
- TCP/IP remote control with standardized command set for easy programming

pulseCheck SM Type 2 High Contrast Specification

pulseCheck	SM Type 2
Pulse width	<100 fs ... 400 ps
Wavelength range	700 nm ... 1100 nm
Recommended repetition rate	>10 Hz
Pulse repetition power, Pulse repetition rate	0.5 W / 10 kHz laser
Input beam polarization	Linear, any
Input beam coupling	Free-space with 6 mm aperture
Input beam height	76 mm
Measurement refresh rate	Depends on scan range
Delay resolution	25 fs in high contrast operation
Contrast	Depending on laser repetition rate: 10 ⁻⁷ for >100 kHz, 10 ⁻⁶ for >10 Hz
Type of measurement mode	Non-collinear intensity and collinear interferometric - switchable
Available detector types	Photodiode (PD) with fixed wavelength range
Calibration	NIST traceable calibration certificate included
Trigger mode	TTL <100 kHz
Phase matching	Software-supported
Intensity resolution	18 bit
Connectivity	Ethernet, USB, TCP/IP (SCPI command set)
Remote control	Programmable via API