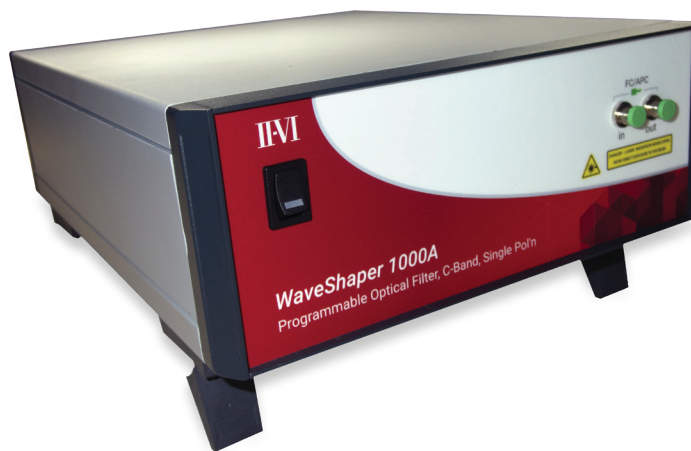


WAVESHAPER® 1000A/SP

Programmable Single Polarization Filter

The WaveShaper® 1000A/SP is a Polarization Maintaining (PM) programmable optical filter which provides full control of the amplitude and phase spectra across the entire operating wavelength range.

Typical applications include the creation and shaping of short laser pulses in the picosecond and down to the femtosecond regime. The WaveShaper 1000A/SP operating around 1 μm has been optimized to control the optical signals of Neodymium and Ytterbium fiber lasers; the WaveShaper 1000A/SP operating around 1.55 μm has been optimized to control the signal of Erbium lasers. It is typically applied in a Master Oscillator Power Amplifier (MOPA) configuration following the seed laser.



FEATURES

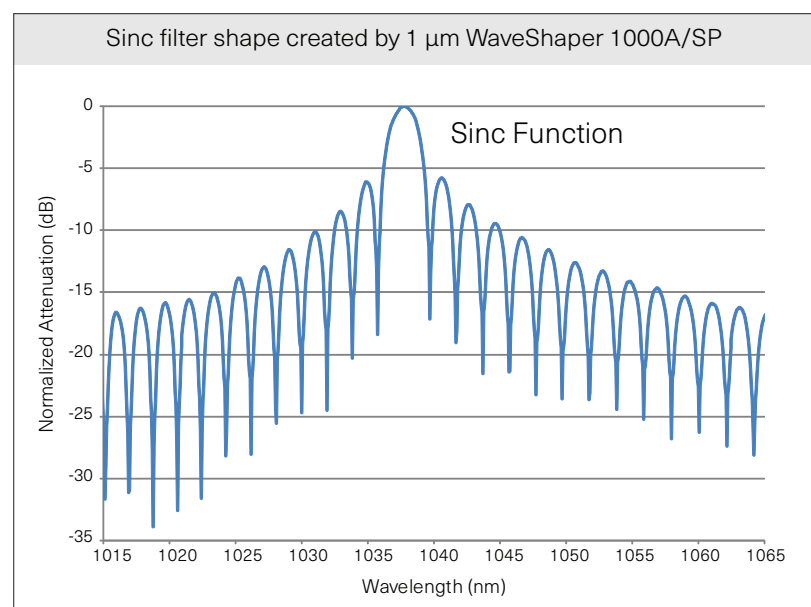
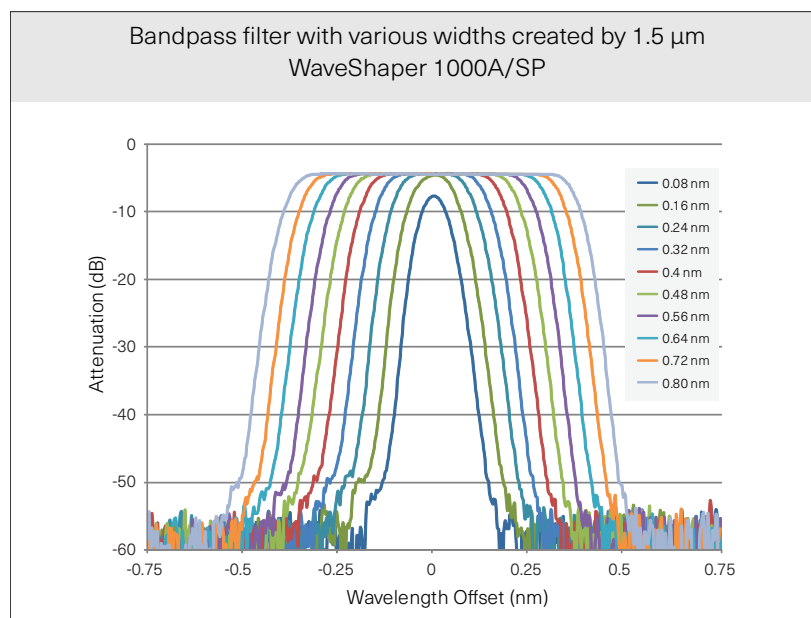
- Arbitrarily programmable shape of attenuation and phase
- C-band, C+L-band and 1 μm versions available
- Resolution bandwidth starting at 0.06 nm
- Group delay adjustable
- Large attenuation range
- Single polarization operation
- Fully fiberized with PM pigtailed on input and output
- Gigabit Ethernet and USB control interface
- Integrated Web server
- No moving parts; based on LCoS technology

APPLICATIONS

- Laser pulse manipulation
 - Stretching
 - Compressing
 - Shaping: flat top, Gaussian, double, etc.
 - Spectral broadening
- Compensation of higher order dispersion
- CPA laser systems: compensation for drift induced by temperature, stress, etc.

The WaveShaper 1000A/SP transmits and processes the signal which is launched into the slow axis of the input PM fiber. The signal launched into the fast axis is not transmitted and will be extinguished by more than 20 dB. This instrument is available as a bench-top unit as well as an OEM module which can be integrated into systems. The fiberized setup ensures stable turn-key operation without manual re-adjustments.

The integrated Webserver ensures control of the WaveShaper independent of the client's operating platform. The USB control interface offers full backward compatibility with previous generation's WaveShapers.



Pulse Shaping Video Demonstration

Learn more about the pulse shaping capabilities of the WaveShaper by watching our product demos at: <https://www.youtube.com/user/finisarcorp>



Application Examples for Short Pulse Lasers

Material Processing

Material processing is one of the largest application areas for short pulsed lasers. Precision micromachining requires athermal ablation which is achieved through the rapid delivery of energy from ultra-short pulses in the pico-second and femtosecond regime.

Microscopy

In biology and medicine multi-photon optical microscopy is applied to produce sharper images at greater physical depths and with less background scatter by exploiting nonlinear processes. A crucial requirement of higher-order photon excitation processes is high intensity light for maximization of interaction rate. Here ultra-short laser pulses are favored due to high peak intensity and relatively low energy per pulse.

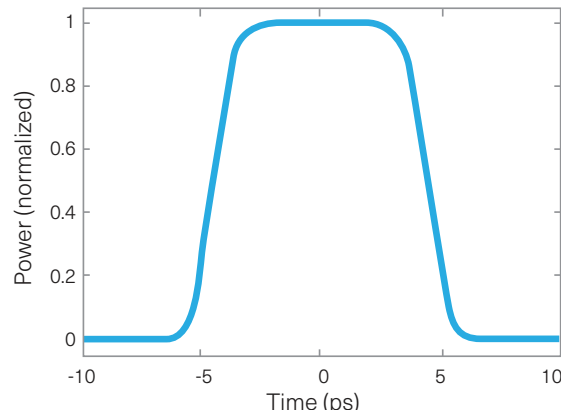
Coherent Quantum Control

In coherent quantum control schemes desired transitions can be selectively excited using short optical pulses and pulse pairs with high peak power and defined amplitude and phase characteristics. Using the pulse shaping capabilities of the WaveShaper 1000A/SP supports the optimization of such optical pulses.

Fiber Communications

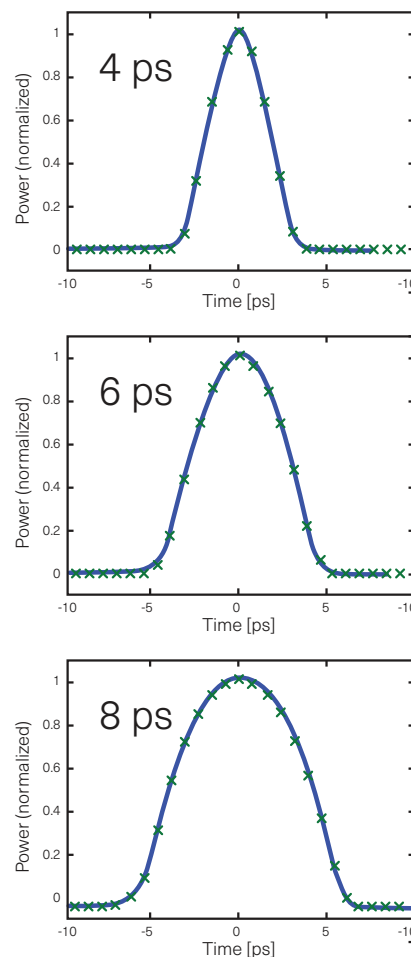
Advanced communication systems rely heavily on fiber-optics for transmitting signals over globally distributed networks. The ever-increasing demand for higher transmission bandwidth drives advanced signal coding schemes. To increase spectral efficiency, stringent requirements are placed on the temporal waveform of the data which results in a need to control the amplitude and the phase of the signal.

Sinc filter shape created by 1 μm WaveShaper 1000A/SP



Examples of some of the pulse shapes which can be generated using a WaveShaper 1000A/SP in combination with a short pulse laser and appropriate compressive elements.

Parabolic pulses with various durations



Specifications (Guaranteed except where stated as typical (typ)).

| Model | | 1000A/SP 1 μm Programmable Single Polarization Filter | 1000A/SP 1 μm High-Res Programmable Single Polarization Filter (1) | 1000A/SP C-Band Programmable Single Polarization Filter | 1000A/SP C+L-Band Programmable Single Polarization Filter (1) |
|--|---------------------------------------|---|--|---|---|
| Operating Range | | 1015 nm to 1065 nm | 1020 nm to 1040 nm | 1527.4 nm to 1567.5 nm (191.250 THz to 196.275 THz) | 1527.6 nm to 1600.6 nm |
| Loss and Dispersion (2, 3) | Insertion Loss (incl. Connectors (4)) | 6.5 dB (typ. 5 dB) | | 5 dB | 6.5 dB (typ. 5 dB) |
| | Insertion Loss Non-Uniformity (4) | typ. < 1 dB | | < 0.7 dB | typ. < 1 dB |
| | Return Loss | > 25 dB | | | |
| | Group Delay Ripple | < ± 0.75 ps | | | |
| Polarization Extinction Ratio | | > 20 dB | | | |
| Filter Control (2, 3) | Filter Shape | Arbitrary | | | |
| | Filter Bandwidth | 0.1 nm to 50 nm | 0.06 nm to 20 nm | 0.08 nm to 40.1 nm (10 GHz to 5 THz) | 0.14 nm to 70 nm (18 GHz to 8.8 THz) |
| | Filter Center Setting Resolution | 0.05 nm | 0.02 nm | 8 pm (1 GHz) | |
| | Filter Center Setting Accuracy | ± 0.1 nm | | ± 20 pm (± 2.5 GHz) | ±40 pm (±5 GHz) |
| | Bandwidth Setting Resolution | 0.05 nm | 0.02 nm | 8 pm (1 GHz) | |
| | Bandwidth Setting Accuracy | ± 0.1 nm | | ± 40 pm (± 5 GHz) | ±80 pm (±10 GHz) |
| | Bandwidth Setting Repeatability | ± 0.1 nm | | ± 20 pm (± 2.5 GHz) | ±40 pm (±5 GHz) |
| | Group Delay Control Range | - 13 ps to + 13 ps | -20 ps to +20 ps | - 25 ps to + 25 ps | -15 ps to +15 ps |
| | Settling Time | 500 ms | | | |
| Attenuation Control | Attenuation Control Range | 0 to 25 dB | | 0 to 35 dB | |
| | Attenuation Setting Resolution | 0.01 dB | | | |
| | Attenuation Setting Accuracy | ± 1.0 dB from 0 to 10 dB, ± 10 % from 10 to 20 dB | | ± 1.0 dB from 0 to 10 dB, ± 10 % from 10 to 30 dB | |
| Optical Power (5) | Maximum Total Input Optical Power | 500 mW | | | |
| | Maximum CW Power Spectral Density | 20 mW / 0.5 nm | | | |
| Mechanical, Electrical and Environmental | Operating Temperature | 15 °C to 35 °C (Benchtop unit) 15 °C to 55 °C (Modular unit) | | | |
| | Operating Humidity | 10 % to 80 % | | | |
| | Operating Voltage | 100 V to 240 V (Benchtop unit) 5 V (Modular unit) | | | |
| | Power Consumption | < 50 VA | | | |
| | Communications Interface | Gigabit Ethernet (GbE), USB 2.0 | | | |
| | Connector Type | FC/APC | | | |
| | Fiber Type | Corning Type PM 980, signal in slow-axis | | Corning Type PM 1550, signal in slow-axis | |
| | Size | 316 mm x 241 mm x 88 mm (Benchtop unit) | | 220 mm x 120 mm x 37 mm (Modular unit) | |
| | Weight | 3.8 kg (Benchtop unit) | | 0.8 kg (Modular unit) | |

Notes:

(1) Specifications are preliminary

(2) For WaveShaper 1000A/SP 1 μ m: Measured over 0.5 dB passband on a 1 nm band-pass filter

(3) For WaveShaper 1000A/SP 1.5 μ m: Measured over 0.5 dB passband on a 0.8 nm band-pass filter

(4) Measured on signal in slow axis

(5) Optical signals with spectral components below 600 nm must be avoided.

| | Order Code | Wavelength band | Housing Option | Fiber type | Connector type |
|---|-----------------------|---------------------|----------------|------------|----------------|
| WaveShaper 1000A/SP Programmable Single Polarization Filter | WS-01000A-Y-S-1-AA-01 | 1 μ m | Benchtop | PM | FC/APC |
| | WS-01000A-Y-M-1-AA-01 | 1 μ m | Module | PM | FC/APC |
| | WS-01000A-Z-S-1-AA-01 | 1 μ m, high res | Benchtop | PM | FC/APC |
| | WS-01000A-Z-M-1-AA-01 | 1 μ m, high res | Module | PM | FC/APC |
| | WS-01000A-C-S-1-AA-01 | C (1.55 μ m) | Benchtop | PM | FC/APC |
| | WS-01000A-C-M-1-AA-01 | C (1.55 μ m) | Module | PM | FC/APC |
| | WS-01000A-X-S-1-AA-01 | C+L | Benchtop | PM | FC/APC |
| | WS-01000A-X-M-1-AA-01 | C+L | Module | PM | FC/APC |