

II-VI



# WaveShaper®

1000B Programmable Optical Filter  
4000B Programmable Optical Processor

# WaveShaper® 1000B and 4000B

## Full flexibility for Filtering and Switching operations across the entire C+L band

The WaveShaper 1000B Programmable Optical Filter and the 4000B Programmable Optical Processor allow arbitrary optical filtering of attenuation and phase across the entire C+L band. The 4000B allows wavelength selective optical switching using the 1 x 4 optical port configuration and in addition it provides a high resolution mode of operation in which the optical signal passes twice through the grating based monochromator. This high resolution mode ensures narrow channel shapes in combination with steep filter slopes of more than 700 dB/nm. This instrument family is broadly used in Research, Development and Manufacturing applications.

The newly introduced **network simulation** capability allows simulating the characteristics of optical networks including the impact of cascaded filtering components like ROADMs, amplifiers etc.

The WaveShaper is based on II-VI's proprietary Liquid Crystal on Silicon (LCoS) technology which enables a filter update rate of up to 30 Hz. Fast switching and rapidly scanning filter applications are supported – allowing high throughput testing as required for example in system test or manufacturing where fast uploading of different filter shapes is required.

### Key Features

- Coverage of C+L band
- Arbitrary control of attenuation and phase
- Filter update rate up to 30 Hz
- High resolution: bandwidth down to 10 GHz (FWHM)
- Power splitting (4000B)
- Webserver included

### Applications

- DWDM System Test
- Network Simulation
- Transceiver test
- Pulse shaping
- Optical comb generation
- Quantum optics

### Power Splitting and Broadcasting

The WaveShaper 4000B has the ability to split an input signal between multiple output ports. Simple structures like wavelength-dependent couplers and splitters (Figure 1) can be created with user defined coupling ratios and frequency dependencies.

The phase of signals in the different ports can also be adjusted, enabling more complex structures like delay line interferometers (e.g. DPSK-Demodulator – shown in Figure 2) or DQPSK-Demodulators with a variable, easily-programmable, optical transfer function.



Figure 1: Splitter      Figure 2: Variable Delay Line Interferometer

### Control and Programming

The WaveShaper B Series instruments can be controlled in a number of ways:

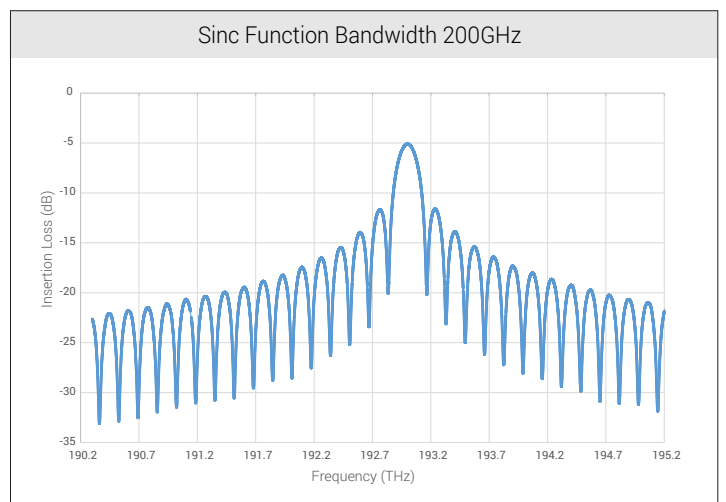
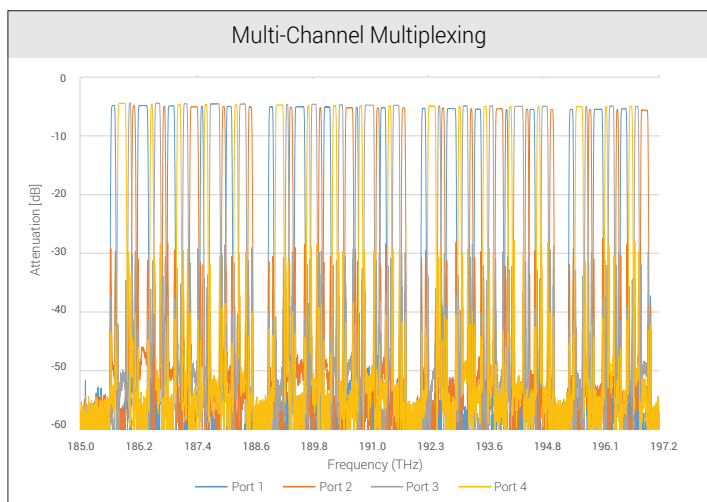
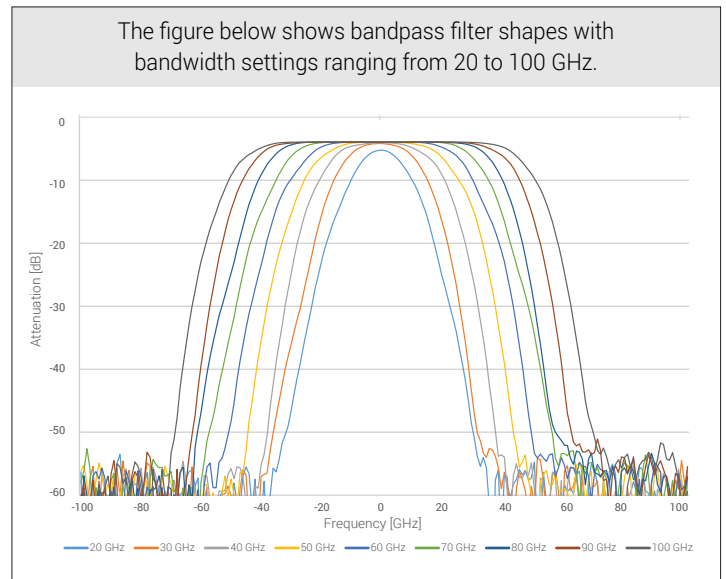
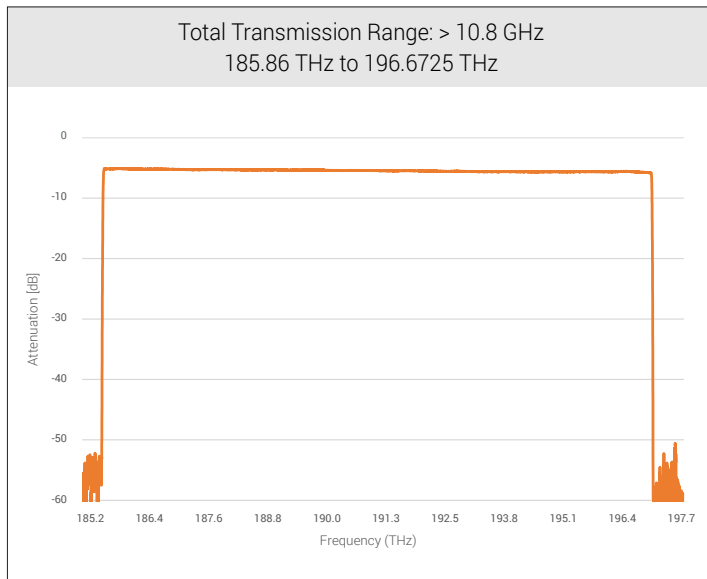
- From a Win 10 system using the WaveShaper App Graphical User Interface (GUI) package.
- From a Web-Browser using the WaveShaper-internal Web-Server. This Web-Server provides full control without installing software on the user computers. Control from any platform (Windows, Linux, Android, iOS etc) is provided.
- A RESTful http based Application Programming Interface (API) provides control of the WaveShaper from other programming environments. Programming examples are available for LabView, Matlab, Python, Octave, Visual Basic and C#.

### WaveSketch

WaveSketch enables users of the WaveShaper 1000B and 4000B to manually create filter shapes using a 'drag and drop' graphical interface. As both the loss and phase of the filter curve are manipulated on screen, the WaveShaper transfer function is updated in real time thus allowing, for example, continuous adjustments to eliminate drift in system test applications.

# WaveShaper® 1000B and 4000B

Measurements of sample filter shapes generated with a WaveShaper 4000B



## Additional Resources

Visit <https://ii-vi.com/instruments> for the latest product information, news and software for the WaveShaper and WaveAnalyzer product families.

### Knowledge Base

Obtain further application and technical information about the Optical Instrumentation portfolio by visiting: <https://ii-vi.com/waveshaper-and-waveanalyzer-knowledgebase>

### Product Demonstration Videos

Watch product demos at: <https://www.youtube.com/user/iiviincorporated>

# WaveShaper® 1000B and 4000B

## Specifications (preliminary)

The device will meet all specifications following a warm-up period of 10 minutes from a temperature within the Operating Temperature range. Specifications may change without notice.

Model		1000B/X	4000B/X
Optical Ports	Port Configurations	1x1	1x4
Filter Control	Operating Frequency Range	185.86 THz to 196.672 THz (1524.33 nm to 1613.0 nm)	
	Filter Bandwidth	18 GHz to 10.8 THz	18 GHz to 10.8 THz 14 GHz to 10.8 THz (1)
	Filter Shape	Arbitrary Attenuation and Arbitrary Phase	
	Frequency Setting Resolution	±0.1 GHz (±0.8 pm)	
	Frequency Setting Accuracy	±5 GHz (±40 pm)	
	Bandwidth Setting Resolution	±0.1 GHz (±0.8 pm)	
	Bandwidth Setting Accuracy	±10 GHz (±80 pm)	
	Bandwidth Setting Repeatability	±5 GHz (±40 pm)	
	Group Delay Control Range	±15 ps	
	Attenuation Control Range	0 to 40 dB	
	Attenuation Setting Resolution	0.01 dB	
	Attenuation Setting Accuracy	±1 dB for 0.01 to 10 dB ±10% for 10.01 to 25 dB ±15% dB for 25.01 to 30 dB	
	Settling Time (Filter update rate)	<0.1 s (>10 Hz)	
Loss and Dispersion	Insertion Loss	6.5 dB (2)	6.5 dB (2) 12 dB (1, 2)
	Insertion Loss Non-Uniformity	0.8 dB	
	Polarization Dependent Loss (PDL)	0.6 dB	
	Differential Group Delay (DGD)	0.5 ps	
	Return Loss	30 dB	
Optical Power (3)	Max Total Input Optical Power	27 dBm	
	Max Optical Power per 50 GHz channel	13 dBm	
Environment	Operating Temperature	10 to 35 °C	
	Operating Humidity	10% to 90% non condensing	
Electrical	Communications Interface	USB 2.0, Ethernet (GbE)	
	Power Consumption	< 50 W	
Mechanical	Connector Interface	FC/APC, FC/UPC	
	Dimensions, weight	Bench-top: 241 mm x 88 mm x 316 mm, 3.8 kg Module: 220 mm x 140 mm x 37 mm, 0.8 kg	

Notes: (1) Valid for port 1 when selecting "High Resolution" mode

(2) Valid for Filter Bandwidth settings of 25 GHz and larger. For Filter Bandwidth settings below 25 GHz an additional loss of up to 2 dB may apply.

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

Model	Order Code	Description	Wavelength band	Housing Option	Fiber type	Connector type
WaveShaper 1000B	WS-01000B-X-S-1-AA-00	Programmable Optical Filter	C+L	Benchtop	Single-mode	FC/APC
	WS-01000B-X-S-2-AA-00	Programmable Optical Filter	C+L	Benchtop	Single-mode	FC/UPC
	WS-01000B-X-R-1-AA-00	Programmable Optical Filter	C+L	Rackmount	Single-mode	FC/APC
WaveShaper 4000B	WS-04000B-X-S-1-AA-00	Programmable Optical Processor	C+L	Benchtop	Single-mode	FC/APC
	WS-04000B-X-S-2-AA-00	Programmable Optical Processor	C+L	Benchtop	Single-mode	FC/UPC
	WS-04000B-X-R-1-AA-00	Programmable Optical Processor	C+L	Rackmount	Single-mode	FC/APC