

NanoSpeed™ 1x3, 1x4 Fiber Optical Switch (Cascaded)

(SMF, PMF, High Power, Bidirectional)



DATASHEET

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Features

- Solid-State
- High speed
- High reliability
- Low insertion loss
- Compact

Applications

- Optical protection
- Configurable operation
- Instrumentation



The NanoSpeed™ Series 1x3/1x4 solid-state fiber optic switch connects optical channels by redirecting an incoming optical signal into a selected output optical fiber. This is achieved using patent non-mechanical configurations with solid-state all-crystal designs, which eliminates the need for mechanical movement and organic materials. The device is intrinsic bidirectional and has variable coupler behavior in which light is transferred from one to another port without loss. The NS fiber optic switch is designed to meet the most demanding switching requirements of ultra-high reliability, fast response time, and continuous switching operation. The switch is intrinsically bidirectional and selectable for polarization-independent or polarization-maintain by the fiber type.

The NS Series 1x3/1x4 switch is cascade several NS 1x4. The device is mounted on a specially designed electronic PCB and controlled by 5V TTL input signals. A wall plug power supply is provided. Box mounted version is an option.

The rise/fall time is intrinsically related to the crystal properties, and the repetition rate is associated with the driver. There are poor frequency response sections due to the device resonances. The NS devices are shipped mounted on a tuned driver.

The NS series switches respond to a control signal with any arbitrary timing with frequency from DC up to MHz. The switch is usually mounted on a tuned driver before shipping. The electrical power consumption is related to the repetition rate at which the switch is operated.

The dual-stage configuration increases the extinction ratio or cross-talk value.

Specifications

Parameter		Min	Typical	Max	Unit
Central wavelength ^[1]		980		1650	nm
Insertion Loss ^[2]	1700~2300nm		0.8	1.8	dB
	1260~1650nm		1.2	2.2	
	960~1100nm		1.6	2.6	
Cross Talk On/Off Ratio ^[3]		20	25	45	dB
Durability		10 ¹⁴			cycles
PDL (SMF Switch only)			0.15	0.3	dB
PMD (SMF Switch only)			0.1	0.3	ps
ER (PMF Switch only)		18	25		dB
IL Temperature Dependency			0.25	0.5	dB
Return Loss		45	50	60	dB
Response Time (Rise, Fall)		50		300	ns
Fiber Type		SMF-28, Panda PM, or equivalent			
Driver Repeat Rate	100kHz driver	DC	100		kHz
	500kHz driver	DC	500		kHz
Optic Power Handling ^[4]	Normal power switches		0.3	20	W
	High power switches			5	W
Operating Temperature ^[5]		-5		45	°C
Storage Temperature		-40		85	°C

Notes:

[1]. Operation bandwidth is ± 25 nm approximately at 1550nm.

[2]. Measured without connectors. For other wavelength, please contact us.

[3]. ± 25 nm, Cross talk is measured at 100kHz, which may be degraded at the high repeat rate.

[4]. Defined at 1310nm/1550nm. For the shorter wavelength, the handling power may be reduced, please contact us for more information.

[5]. The switches can be operated in a wider temperature range from as -10 to 70°C, but some performances such as on/off ratio will be degraded.

Note: The specifications provided are for general applications with a cost-effective approach. If you need to narrow or expand the tolerance, coverage, limit, or qualifications, please [click this link](#):

Warning: This is an OEM module designed for system integration. Do not touch the PCB by hand. The electrical static can kill the chips even without a power plug-in. Unpleasant electrical shock may also be felt. For laboratory use, please buy a Turnkey system.

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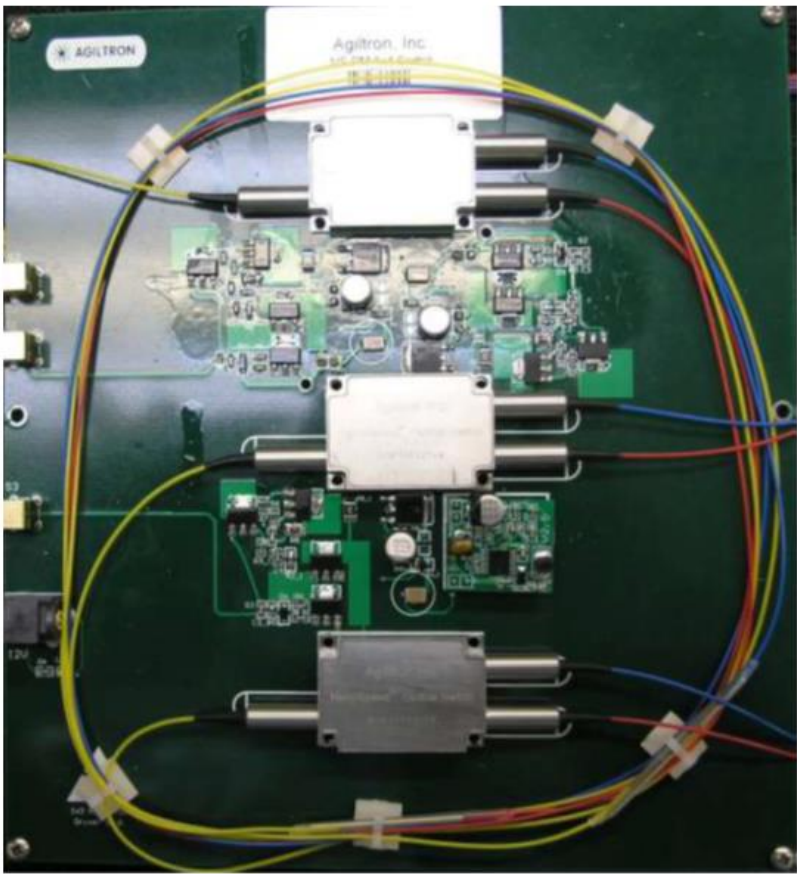
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Mechanical Dimensions (Unit: mm)

The size is varied.



*Product dimensions may change without notice. This is sometimes required for non-standard specifications.

Optical Path Driving Table

Optical Path	TTL Signal
Port 1 → Port 2	L (< 0.8V)
Port 1 → Port 3	H (> 3.5V)

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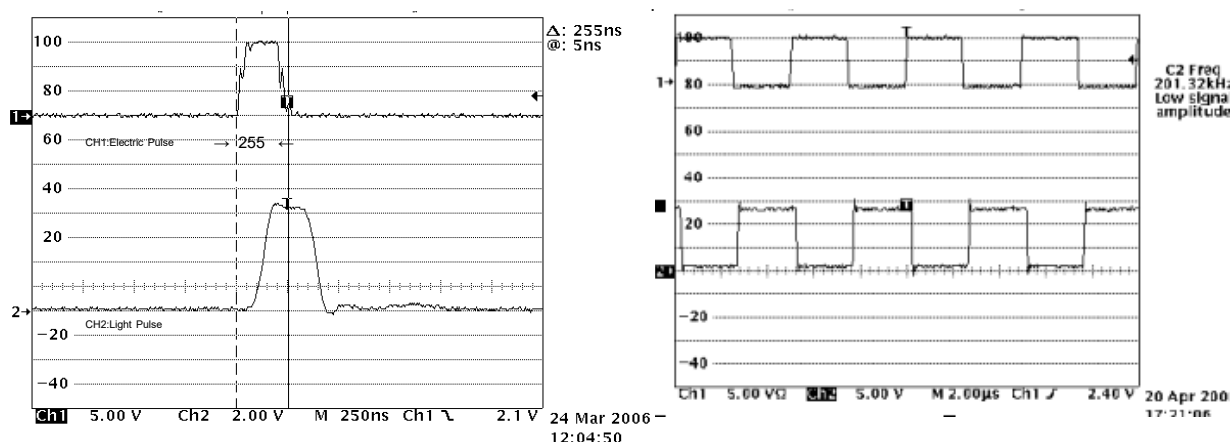
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Driving Board Selection

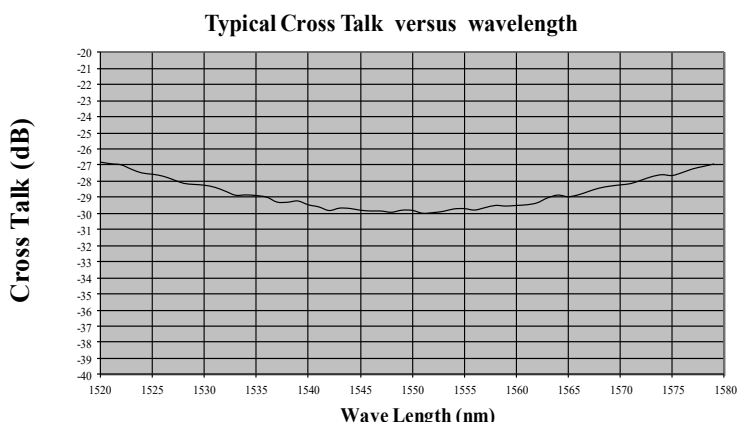
Maximum Repetition Rate	Part Number (P/N)
100 kHz	NSSW100ns100kHzD
500 kHz	SWDR-11a291111

* Note: For customers that prefer to design their own driving circuit, they are responsible for the optical performance. For more technical information, please contact us.

Speed and Repetition Measurement



Bandwidth Measurement



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Ordering Information (Part Number)

Prefix	Type	Wavelength ^[4]	Configuration	Package	Fiber Type	Fiber Cover	Fiber Length	Connector ^{[5][6]}	Optical Power	Benchtop
NSSW - ^[1]	1x3 = 11	1060nm = 1	Single stage = 1	Standard = 1	SMF-28 = 1	Bare Fiber = 1	0.25m = 1	None=1	Regular = 1	None = 1
NHSW - ^[2]	1x4 = 14	L Band = 2		Special = 0	HI1060 = 2	900um Tube = 3	0.5m = 2	FC/PC=2	1W = A	Benchtop = B
NHHW - ^[3]		1310nm = 3			PM1550 = 5	Special = 0	1.0 m = 3	FC/APC=3	2W = B	
		1410nm = 4			PM980 = 9		Special = 0	SC/PC=4	5W = C	
		1550nm = 5			MM50/125 ^[4] =M			SC/APC=5	10W = D	
		1750nm = A			Special = 0			ST/PC=6	20W = E	
		2000nm = B						LC/PC=7		
		Special = 0						Duplex LC/PC=8		
								LC/APC=9		
								E2000 APC=A		
								LC/UPC = U		
								Special=0		

[1]. **NSSW** – Normal power version

[2]. **NHSW** – 2W version

[3]. **NHHW** – 5W version

[4]. For shorter wavelength, please refer to **Premium NS switches**

[5]. Please contact us for high power connectors

[6]. The default connector configuration uses fiber with 0.9 mm buffer protection. The connector cannot be installed directly onto bare fiber because the bare fiber is prone to damage during shipping. However, the connector can be assembled on bare fiber if a 3 cm protective loose tube is added for reinforcement. The customer may remove this protective tube after testing. The optical power handling of a standard connector is less than 0.5 W for SMF-28 fiber and decreases further for smaller-core fibers.

[4]. For laser with mode fill ratio CPR <14

Note:

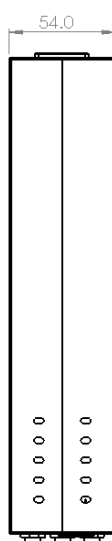
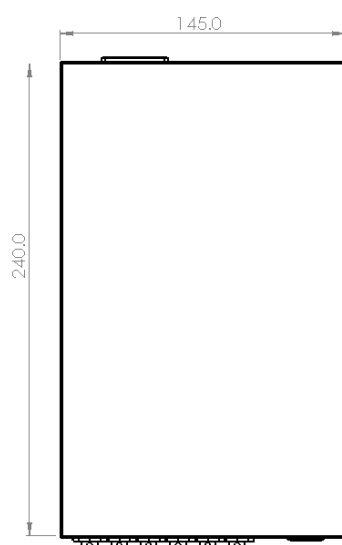
- ☐ **PM1550** fiber works well for **1310nm**

Note:

Standard fiber optical connectors can only handle optical power of about 0.5W and will slowly burn over 1W. Agiltron produces high-power connectors with optical power handling of up to 15W, but they must work in pairs. *For details, click the link below.*

<https://agiltron.com/product/high-power-fiber-optic-connector/>

Benchtop Box Mechanical Dimension



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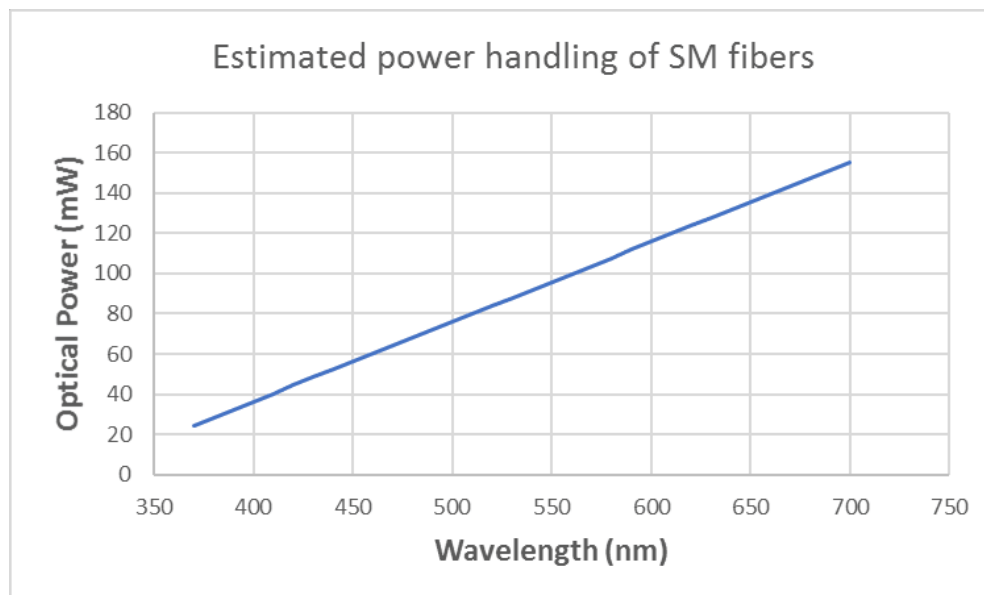
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Optical Power Handling vs Wavelength For Single-Mode Fibers



Q & A

Q: Does NS device drift over time and temperature?

A: NS devices are based on electro-optical crystal materials that can be influenced to a certain range by the environmental variations. The insertion loss of the device is only affected by the thermal expansion induced miss-alignment. For extended temperature operation, we offer special packaging to -40 -100 °C. The extinction or cross-talk value is affected by many EO material characters, including temperature-dependent birefringence, Vp, temperature gradient, optical power, at resonance points (electronic). However, the devices are designed to meet the minimum extinction/cross-talk stated on the spec sheets. It is important to avoid a temperature gradient along the device length.

Q: What is the actual applying voltage on the device?

A: 100 to 400V depending on the version.

Q: How does the device work?

A: NS devices are not based on Mach-Zander Interference, rather birefringence crystal's nature beam displacement, in which the crystal creates two different paths for beams with different polarization orientations.

Q: What is the limitation for faster operation?

A: NS devices have been tested to have an optical response of about 300 ps. However, practical implementation limits the response speeds. It is possible to achieve a much faster response when operated at partial extinction value. We also offer resonance devices over 20MHz with low electrical power consumption.

Operation Manual

1. Connect a control signal to the SMA connector on the PCB.
2. Attach the accompanied power supply (typically a wall-pluggable unit).
3. The device should then function properly.

Note: Do not alter device factory settings.

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Application Notes

Fiber Core Alignment

Note that the minimum attenuation for these devices depends on excellent core-to-core alignment when the connectors are mated. This is crucial for shorter wavelengths with smaller fiber core diameters that can increase the loss of many decibels above the specification if they are not perfectly aligned. Different vendors' connectors may not mate well with each other, especially for angled APC.

Fiber Cleanliness

Fibers with smaller core diameters ($<5\text{ }\mu\text{m}$) must be kept extremely clean, contamination at fiber-fiber interfaces, combined with the high optical power density, can lead to significant optical damage. This type of damage usually requires re-polishing or replacement of the connector.

Maximum Optical Input Power

Due to their small fiber core diameters for short wavelength and high photon energies, the damage thresholds for device is substantially reduced than the common 1550nm fiber. To avoid damage to the exposed fiber end faces and internal components, the optical input power should never exceed 20 mW for wavelengths shorter 650nm. We produce a special version to increase the handling by expanding the core side at the fiber ends.

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