

# NanoSpeed™ Dual-stage 1x2 Series Fiber Optical Switch

(SM, PM, High Power, Bidirectional)

(Protected by U.S. patent 7,403,677B1 and pending patents)



DATASHEET

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## Features

- Solid-State
- High on-off ratio
- High speed
- Ultra-high reliability
- Low insertion loss
- Compact

## Applications

- Optical blocking
- Configurable operation
- Instrumentation

The NS Series dual-stage 1x2 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-pending non-mechanical configurations with solid-state all-crystal designs, eliminating the need for mechanical movement and organic materials. The dual-stage series of NS fiber-optic switches is designed to meet the demand of high cross-talk in addition to ultra-high reliability, fast response time, and continuous switching operation. The device is bidirectional. The switch is intrinsically bidirectional and selectable for polarization-independent or polarization-maintain by the fiber type.

5V TTL signals control the NS Series switch with a specially designed electronic driver having performance optimized for various repetition rates.

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 <sup>[1]</sup>	960		1650	nm	
Insertion Loss <sup>[2]</sup>	1260~1650nm	1.0	1.4	dB	
	960~1100nm	1.4	2.4	dB	
Cross Talk <sup>[3]</sup>	30	35	45	dB	
Durability	10 <sup>14</sup>			cycles	
PDL (SMF Switch only)		0.2	0.35	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)			300	ns	
Fiber Type	SMF-28, Panda PM, or equivalent				
Driver Repeat Rate	60kHz driver	DC	60	kHz	
	300kHz driver	DC	300	kHz	
Optic power Handling <sup>[4]</sup>	Normal power switches		0.3	0.5	W
	High power switches		2	20	W
Operating Temperature	-5		70	°C	
Storage Temperature	-40		85	°C	

### Notes:

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

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

[3] ±25nm, Cross talk is measured at 10kHz, which may be degraded at the high repeat rate.

[4] Defined at 1310nm/1550nm.

**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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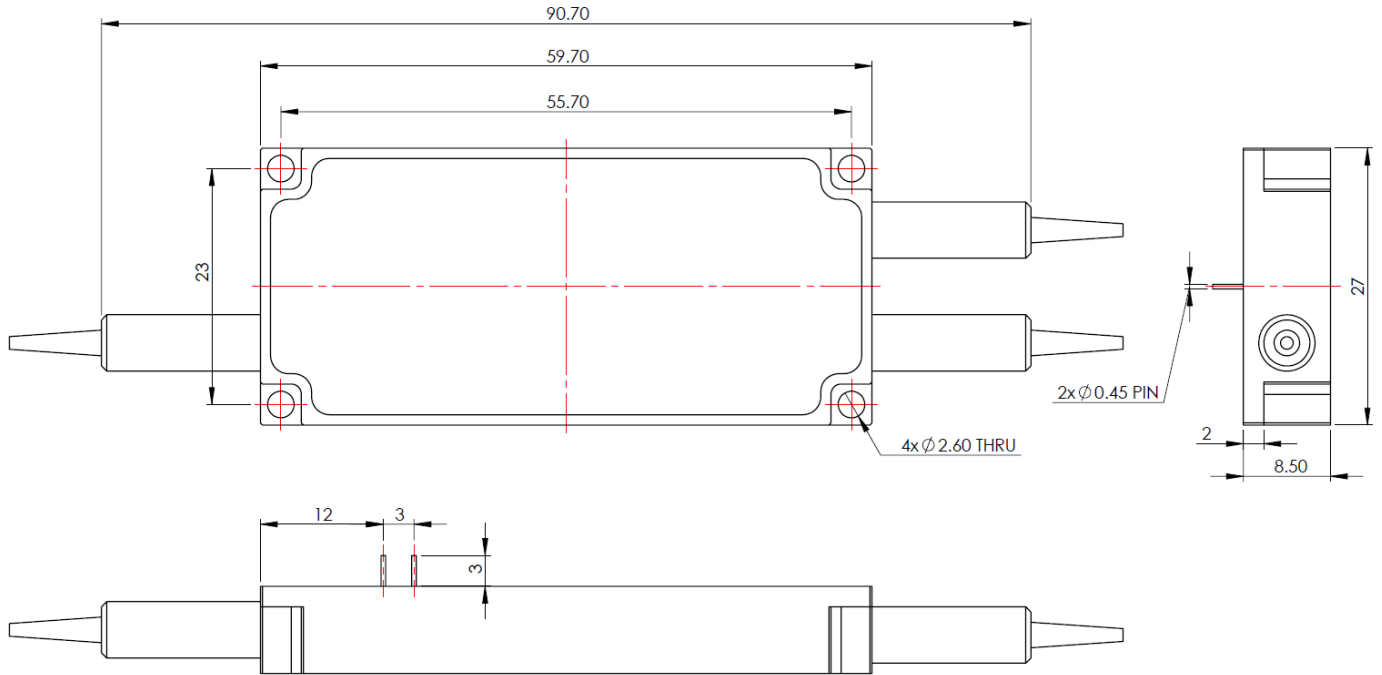
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### Mechanical Dimensions (mm)



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

### Optical Path Driving Table

Optical Path	TTL Signal with Driver	Direct driving	
		Port 1 → Port 2	L (< 0.8V)
Port 1 → Port 3	H (> 3.5V)	HV on PIN 1	
HV for direct driving: 360V ~ 420V			

### Driving Board Selection

Maximum Repetition Rate	Part Number (P/N)
60 kHz	NSSW100ns100kHzD
300 kHz	NSSW100ns300kHzD

\* 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.

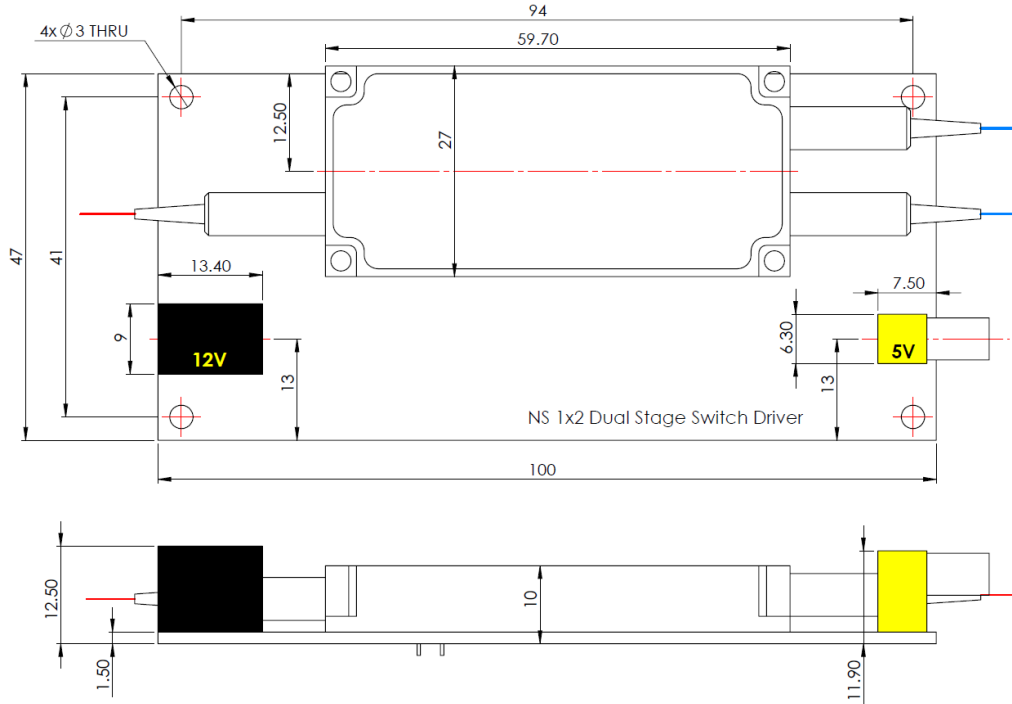
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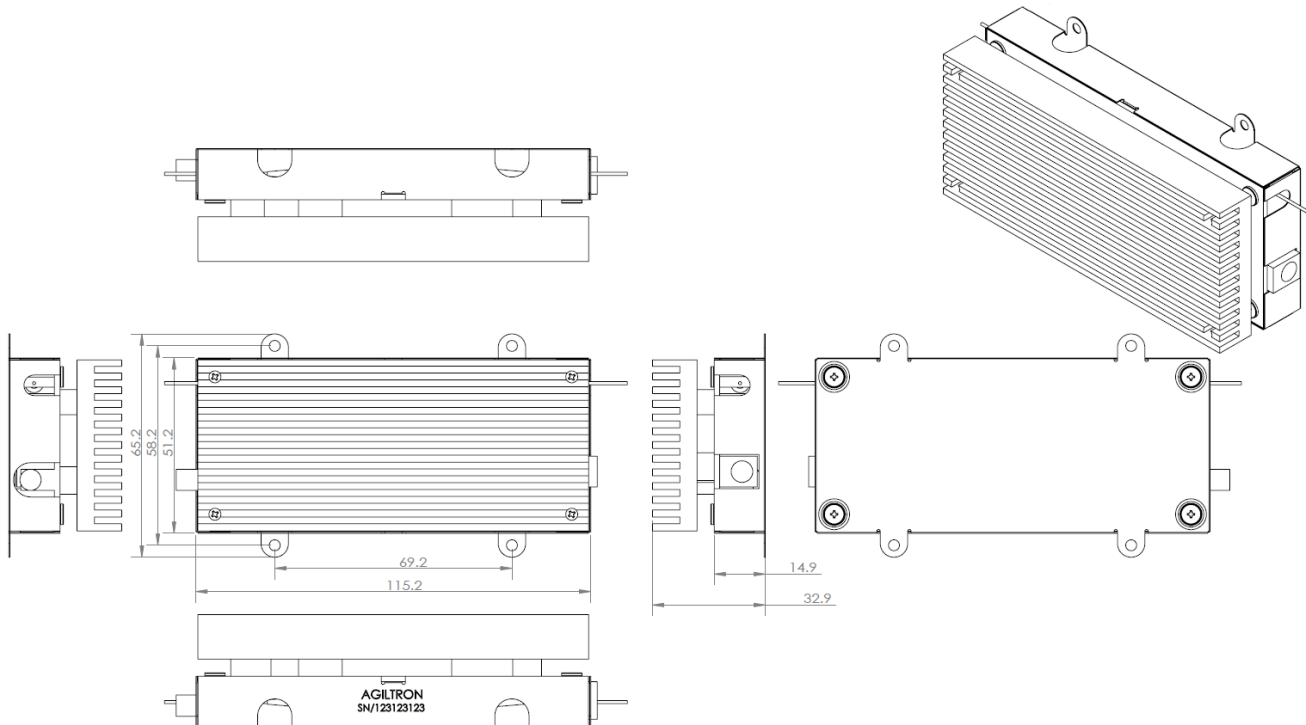


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### Mechanical Dimensions, mounting on 60 kHz driver (mm)



### Module with 300kHz Driver (Mechanical Drawing, mm)



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### Ordering Information

Prefix	Type	Wavelength <sup>[4]</sup>	Configuration	Optical Power	Fiber Type	Fiber Cover	Fiber Length	Connector <sup>[5]</sup>	Benchtop
<b>NSSW</b> - <sup>[1]</sup>	1x2 = 12	1060nm = 1	Dual stage = 2	Regular ( $\leq 0.5W$ ) = 2	SMF-28 = 1	Bare Fiber = 1	0.25m = 1	None = 1	None = 1
<b>NHSW</b> - <sup>[2]</sup>		1310nm = 3		1W = A	HI1060 = 2	900um Tube = 3	0.5m = 2	FC/PC = 2	Benchtop = B
<b>NHHW</b> - <sup>[3]</sup>		1410nm = 4		2W = B	PM1550 = 5	Special = 0	1.0 m = 3	FC/APC = 3	
		1550nm = 5		5W = C	PM980 = 9		Special = 0	SC/PC = 4	
		1625nm = 6		10W = D <sup>[6]</sup>	PM1950 = L			SC/APC = 5	
		2000nm = 2		20W = E	Special = 0			ST/PC = 6	
		Special = 0						LC/PC = 7	
								Duplex LC/PC = 8	
								LC/APC = 9	
								E2000 APC = A	
								LC/UPC = U	
								Special = 0	

**REMARK: All Dual stage of 1x2 will use 3-cap package.**

[1]. **NSSW** – Low power ( $\leq 0.5W$ ) version

[2]. **NHSW** – Power  $> 0.5W$ , but  $\leq 2W$  version

[3]. **NHHW** –  $\geq 5W$  version

[4]. Please check NP type of switch for the wavelength shorter than 960nm

[5]. There isn't any connector in high power switches. Please contact us for high power connectors

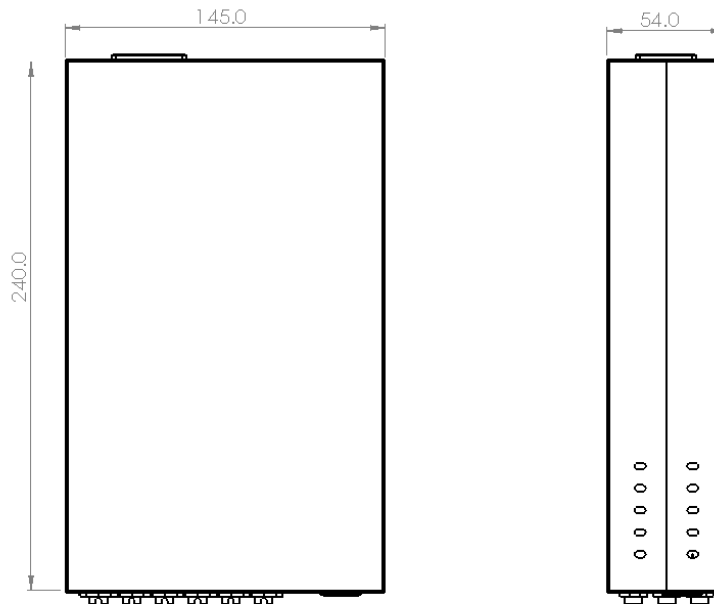
[6]. High power  $> 5W$  of 1x2 will take a long lead time, for which the special package will be customized. Please contact us.

[7]. High-lighten version of 1x2 switch on red will take a long lead-time.

**Note:**

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

### Benchtop Box Mechanical Dimension



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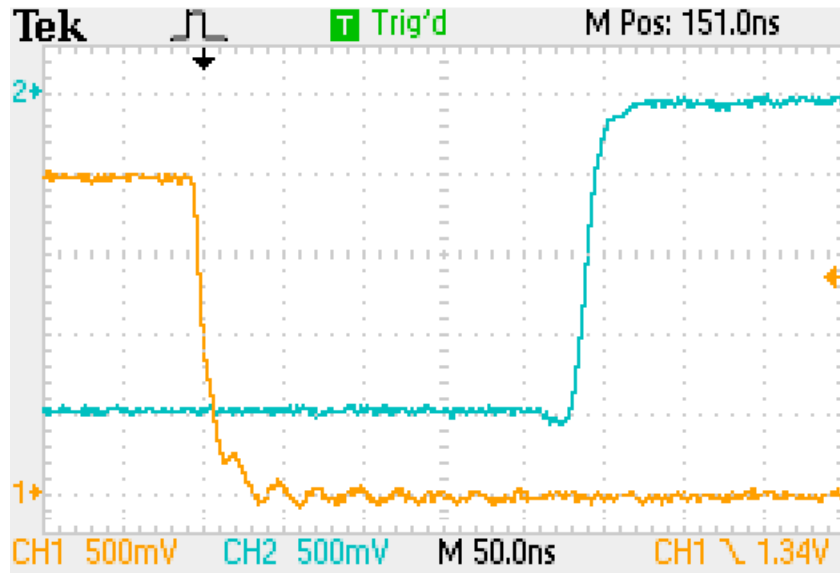
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### Typical Speed Response Measurement



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### 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,  $V_p$ , 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.

### 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  $\mu\text{m}$ ) 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.