NanoSpeed™ Fiber Optical Phase Switch

SMF, PMF, 0, π/2, π, 3π/2, 400-2650nm

DATASHEET

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The NanoSpeed™ Series fiber optic phase switch is a two-port device that provides high phase-shift precision, low loss, fast response, and high optical power handling. These performance levels are achieved through a patented all-crystal design that switches between two optical paths regardless of polarization, without mechanical movement or organic materials, ensuring exceptional reliability and continuous operation. The phase shift is precisely controlled by passing or bypassing a passive waveplate, and the switch is intrinsically bidirectional—configurable for either polarization-independent or polarization-maintaining operation depending on the fiber type. Multiple switches can be cascaded and mounted on a single driver to provide a range of discrete phase-shift values.

Each NS Series switch is driven by 5V TTL control signals using a matched electronic driver optimized for specific repetition rates. The rise/fall time and operating frequency range depend on both the crystal properties and the driver design. Certain frequency bands may exhibit reduced response due to natural device resonances; therefore, every NS device is shipped pre-mounted on a tuned driver. The switches support arbitrary control timing with frequencies from DC up to the MHz range, and electrical power consumption scales with the operating repetition rate. A dual-stage configuration is available to further enhance extinction ratio and minimize crosstalk.

Features

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

Applications

- Optical blocking
- Configurable operation
- Instrumentation

Specifications

Parameter		Min	Typical	Max	Unit
Central Wavelength		400		2650	nm
Wavelength Bandwidth			50		nm
Insertion Loss [1]	1700-2300nm		0.8	1.8	dB
	1260-1650nm		0.6	1.0	
	960-1100nm		0.8	1.3	
	780-850 nm		1.3	1.9	
	550-650 nm		1.8	2.5	
Cross Talk On/Off Ratio [2]		18	25	35	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
Electrical-Optical Delay				250	ns
Response Time (Rise, Fall)				300	ns
Driver Repeat Rate	100kHz driver	DC	100		kHz
	300kHz driver	DC	300		
Optic power Handling [3]	Normal power		0.3	0.5	W
	High power		2	20	W
Operating Temperature		-5		70	°C
Storage Temperature		-40		85	°C

Notes:

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

[2]. ±25nm, Measured at 5kHz, which may be degraded at higher repeat rate.

[3]. Defined at 1310nm/1550nm. For the shorter wavelength, the handling is reduced due to smaller core.

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.

Rev 10/10/25

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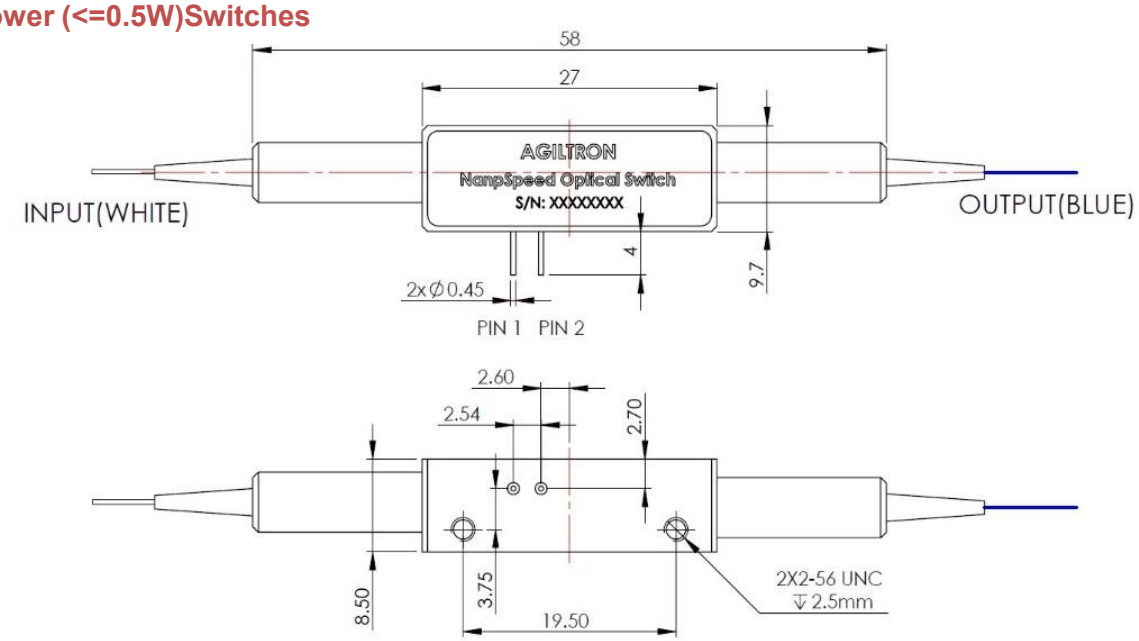
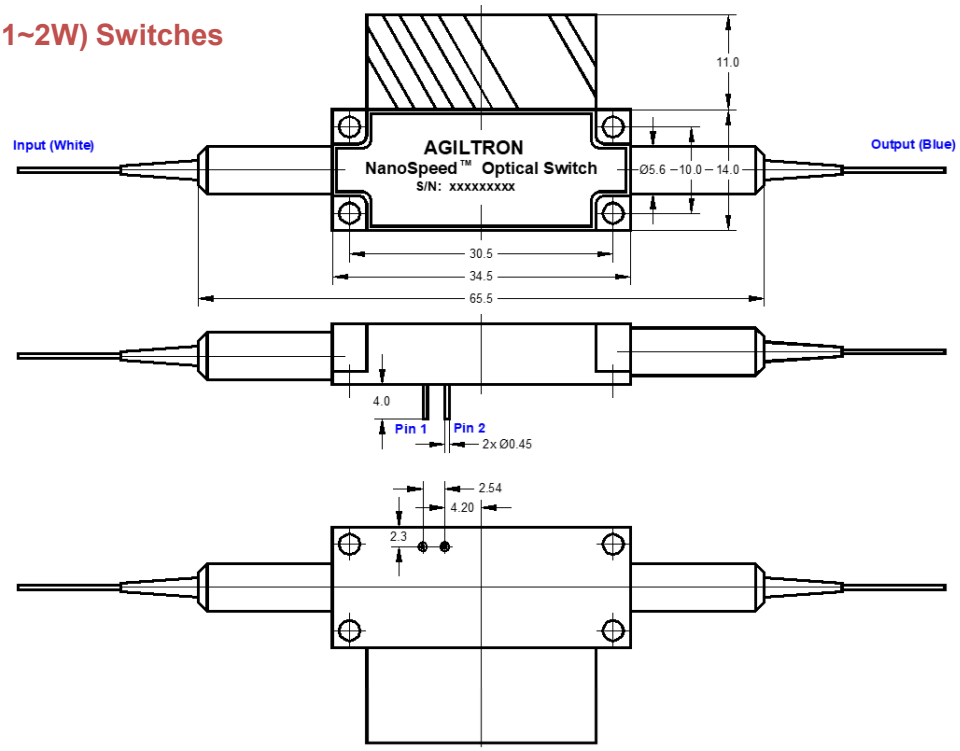
Mechanical Dimensions (mm) of 1x1 Switches

Normal Power (<=0.5W)Switches



High Power (1~2W) Switches



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

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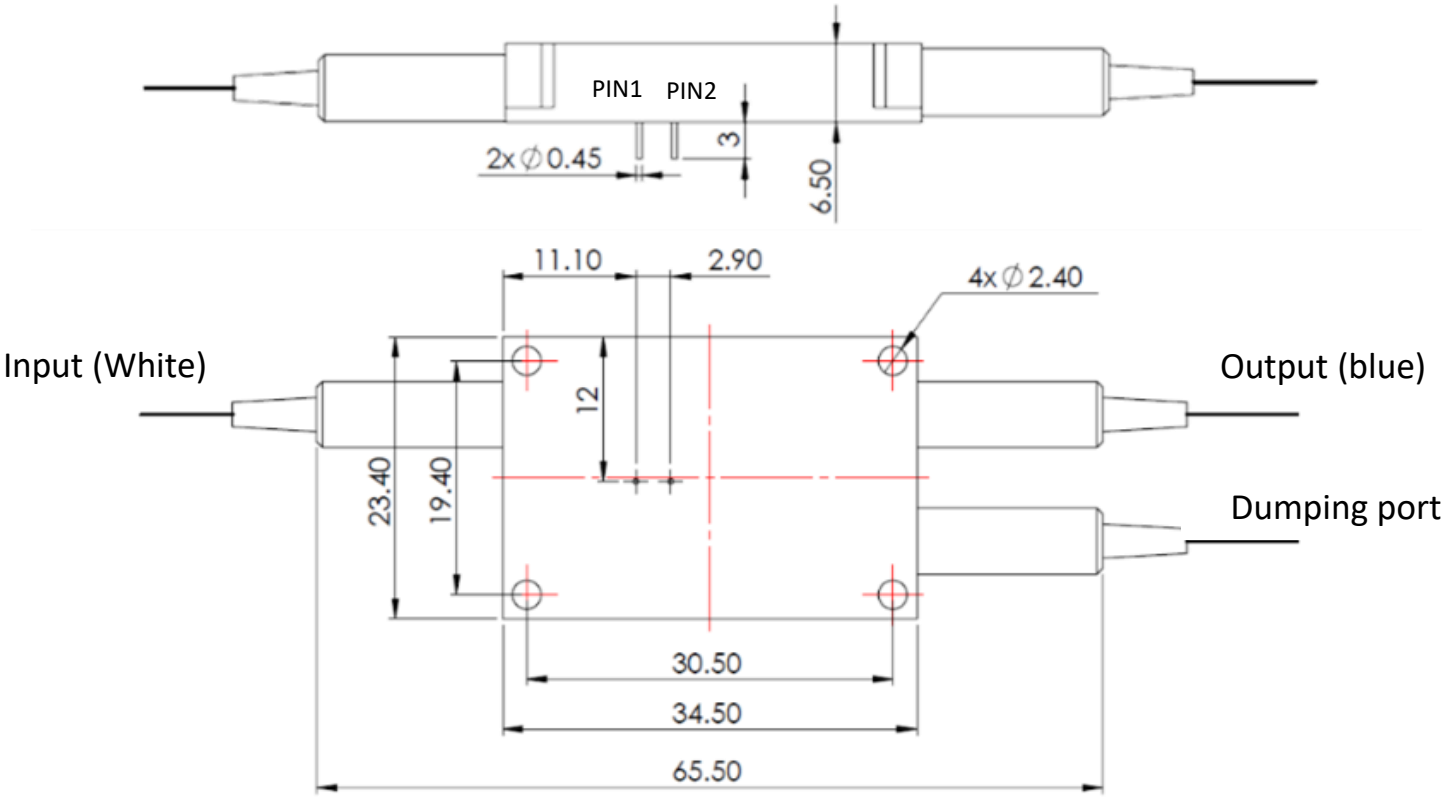
Mechanical Dimensions (mm) of 1x1 Switches



High Power (5~10W) Switches

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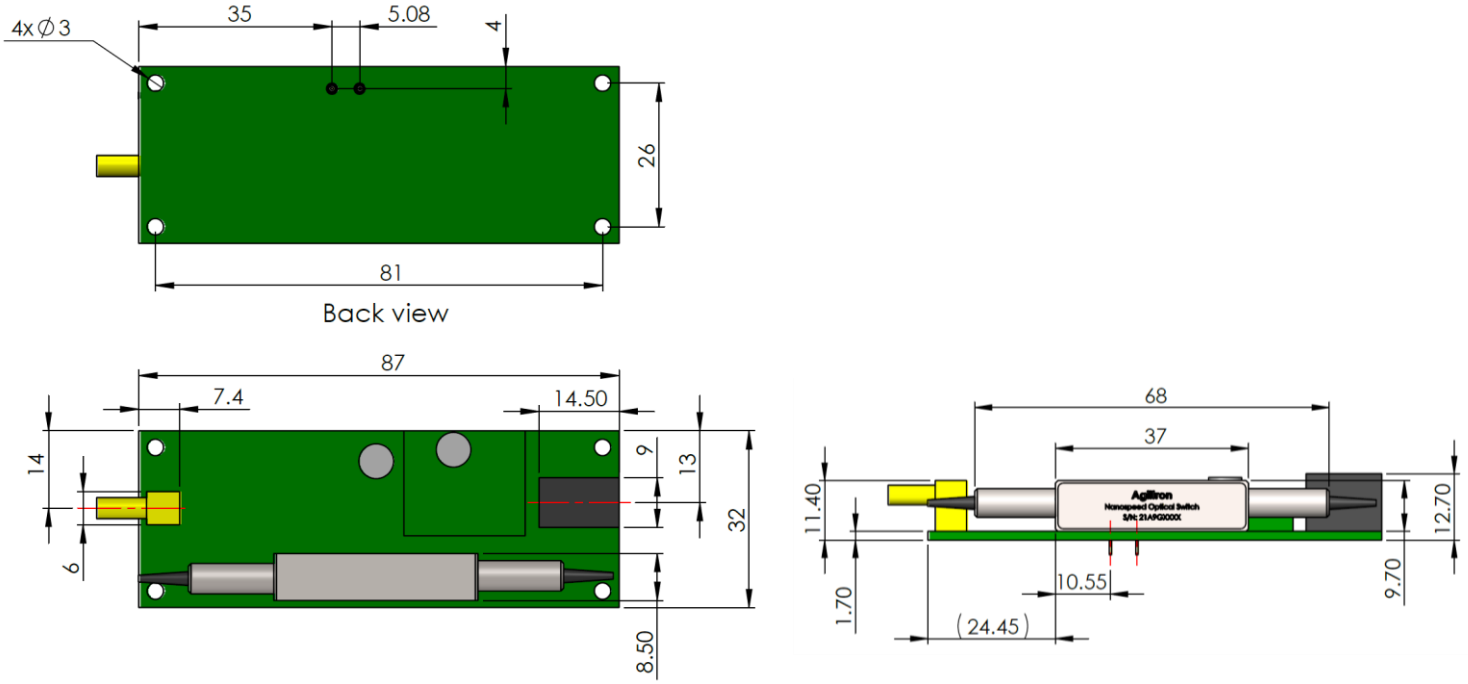
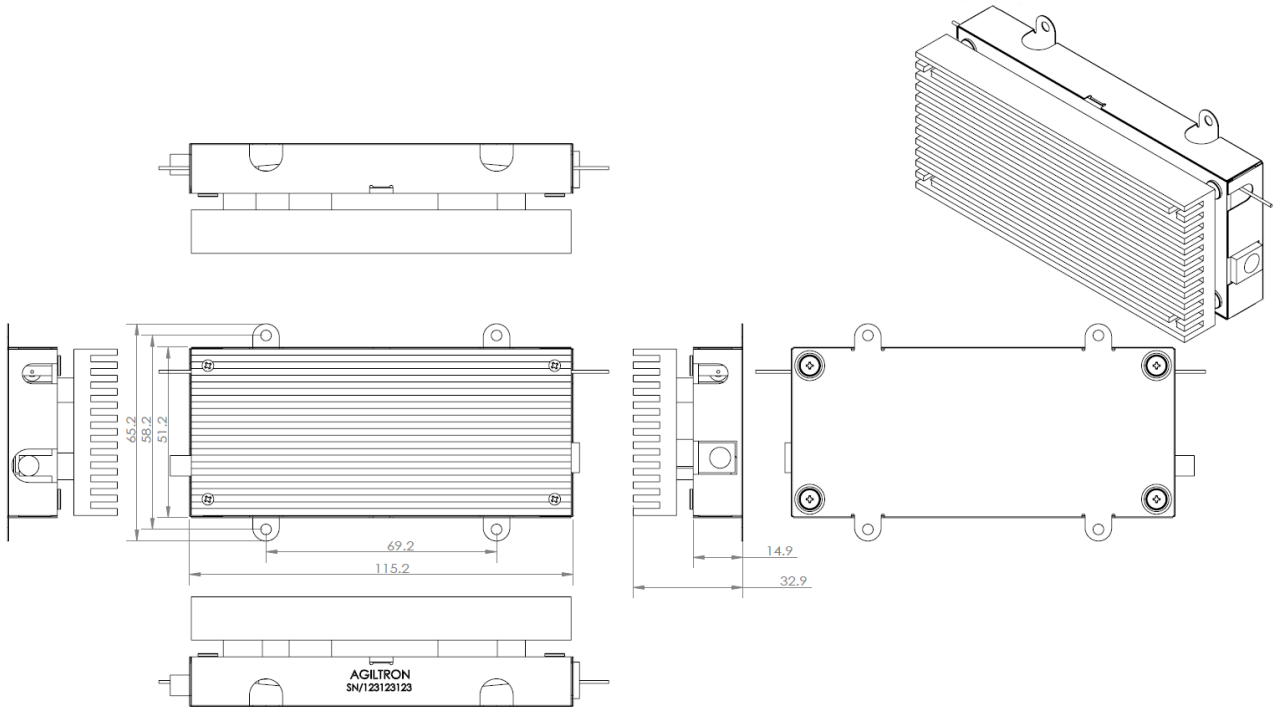
Mechanical Dimensions of 100kHz driver (mm) with single NS device of normal power



300kHz Driver Mechanical Drawing (mm)



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Optical Path Driving Table

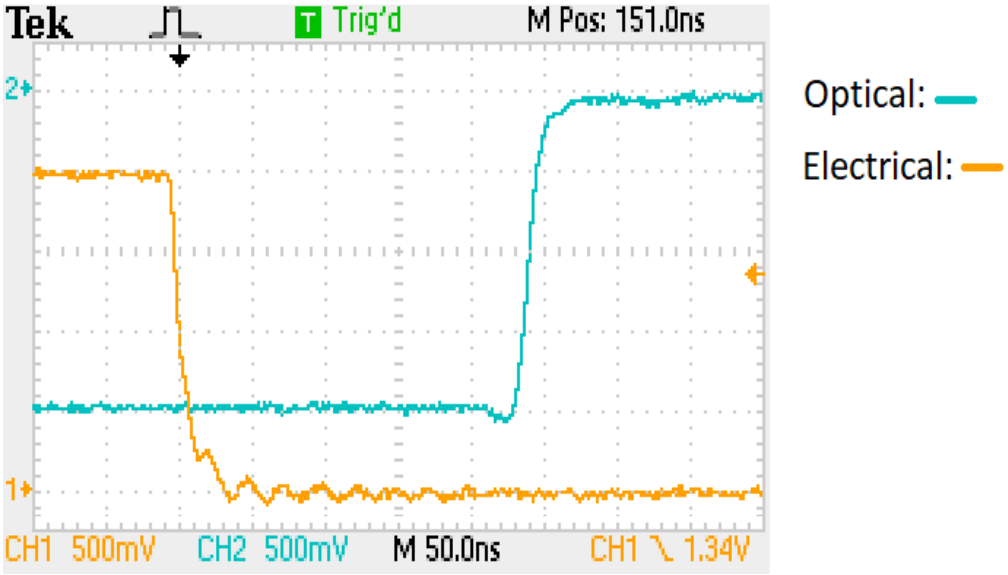
Optical Path	TTL with Driver	Direct Driving	
ON for normal-open or OFF for normal-dark	L (< 0.8V)	0V on PIN 1	0V on PIN 2
OFF for normal-open or ON for normal-dark	H (> 3.5V)	HV on PIN 1	
HV: 360 ~420V			

Driving Board Selection

Maximum Repetition Rate	Part Number (P/N)
100 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.

Typical Speed Response Measurement



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Ordering Information

	☐ ☐	☐	1	☐	☐	☐	☐	☐	☐
Prefix	**Phase Change [1]**	**Wavelength**	**Configuration**	**Optical Power**	**Fiber Type**	**Fiber Cover**	**Fiber Length**	**Connector [2]**	**Benchtop[3]**
NSPW-	π/2 = HP π = 1P 3π/2 = SP 2π = 2P π/2 and π = 2X π/2 , π , and 3π/2 = 3X Special = 00	1060nm = 1 2000nm = 2 1310nm = 3 1410nm = 4 1550nm = 5 1625nm = 6 1750nm = A 980nm = 9	Single stage = 1	Regular (≤ 0.5W) = 1 1W = A 2W = B 5W = C 10W = D	SMF-28 = 1 ***Select below table***	Bare Fiber = 1 900um Tube = 3 Special = 0	0.25m = 1 0.5m = 2 1.0 m = 3 Special = 0	None = 1 FC/PC = 2 FC/APC = 3 SC/PC = 4 SC/APC = 5 ST/PC = 6 LC/PC = 7 Duplex LC = 8 LC/APC = 9 E2000 APC = A LC/UPC= U Special = 0	None = 1 Benchtop = B

[1]. The default state is zero phase shift

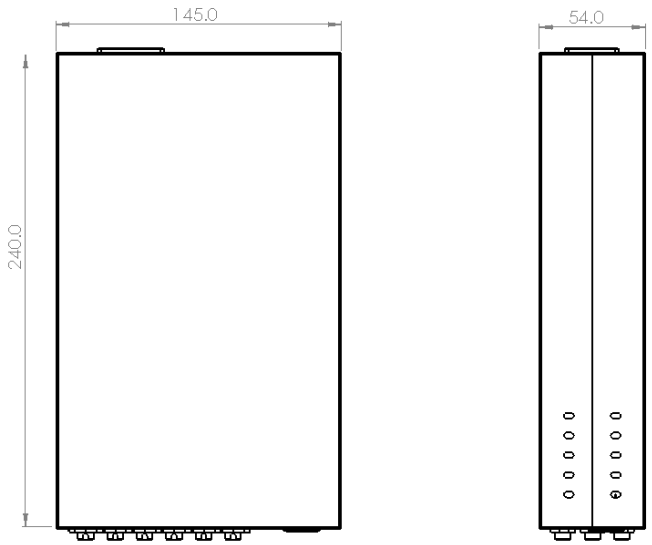
[2]. Please contact for high power connectors.
Regular fiber connector has PER ~22dB. Connector with PER >27 dB is available using special process

[3]. The Benchtop Metal Enclosure include a driver and power supply protects the device against static damage and fiber breakage making it an instrument grade.

Fiber Type Selection Table:

1	**SMF-28**	A	**PM1550**
2	**Hi1060**	B	**PM1950**
3	**SM400**	C	**PM1310**
4	**SM450**	D	**PM400**
5	**SM1950**	E	**PM480**
6	**SM600**	F	**PM630**
7	**Hi780**	G	**PM850**
8	**SM800**	H	**PM980**
9	**SM980**	I	**PM780**
		J	**PM460**

Benchtop Box Mechanical Dimension



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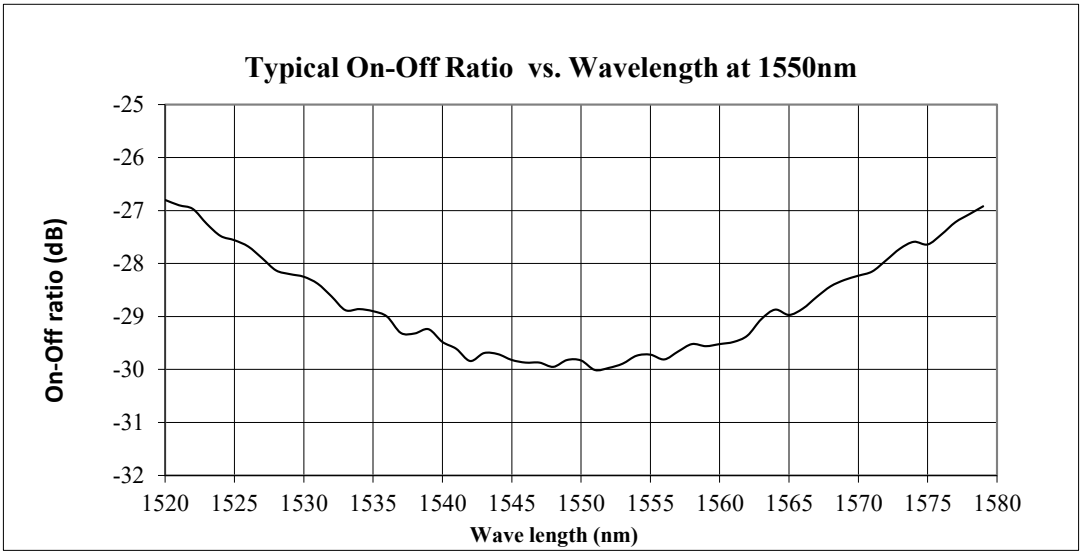
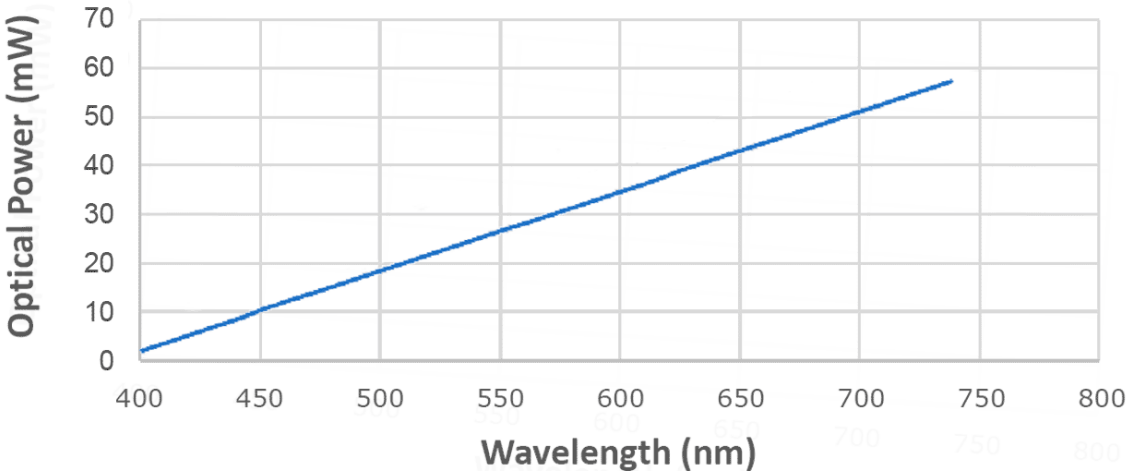
Optimal Bandwidth Measurement



Optical Power Handling vs Wavelength for Standard SM Fibers



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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, 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.

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 μm) 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 how handling by expanding the core side at the fiber ends.