

NanoSpeed™ 1x2 Fiber Optical Switch

(SMF, PMF, MM, 960-1650 nm, High Power, Bidirectional, Dual-Stage)

(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 NanoSpeed™ Series fiber optic phase switches deliver high precision, ultra-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 any mechanical movement or organic materials, ensuring exceptional reliability and continuous operation. The switch is intrinsically bidirectional and can be configured for either polarization-independent or polarization-maintaining operation depending on the fiber type.

Each NS Series switch is driven by 5V TTL control signals through 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 the extinction ratio and minimize crosstalk.

Specifications

Parameter		Min	Typical	Max	Unit
Central Wavelength ^[1]		960		1650	nm
Insertion Loss ^[2]	1700~2300nm		0.8	1.8	dB
	1260~1650nm		1.0	1.4	
	960~1100nm		1.4	2.4	
Cross Talk On/Off Ratio ^[3]		30	32	45	dB
Durability		10 ¹⁴			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
Electrical-Optical Delay				250	ns
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 ^[4]	Normal power switches		0.3	0.5	W
	High power switches		2	20	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 10kHz, which may be degraded at the high repeat rate.

[4] Defined at 1310nm/1550nm.

[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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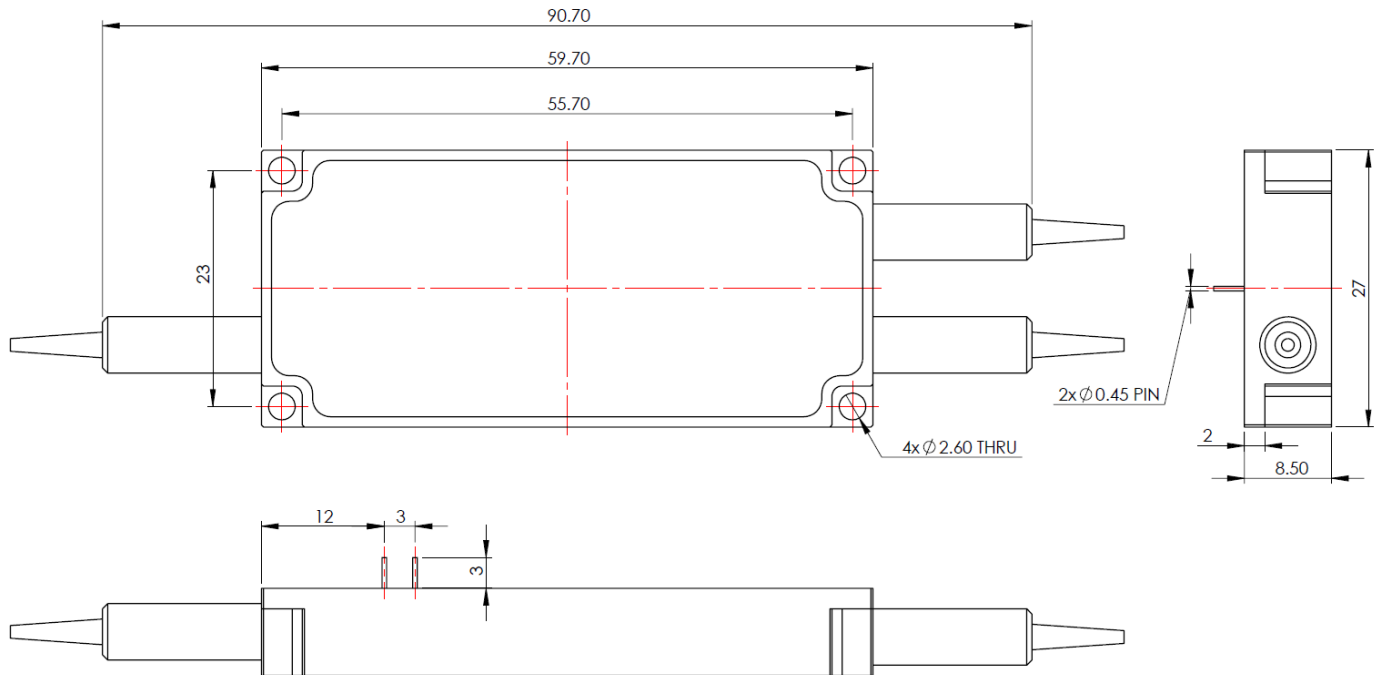
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Mechanical Dimensions (mm)



*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)	0V on PIN 1	0V on PIN 2
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.

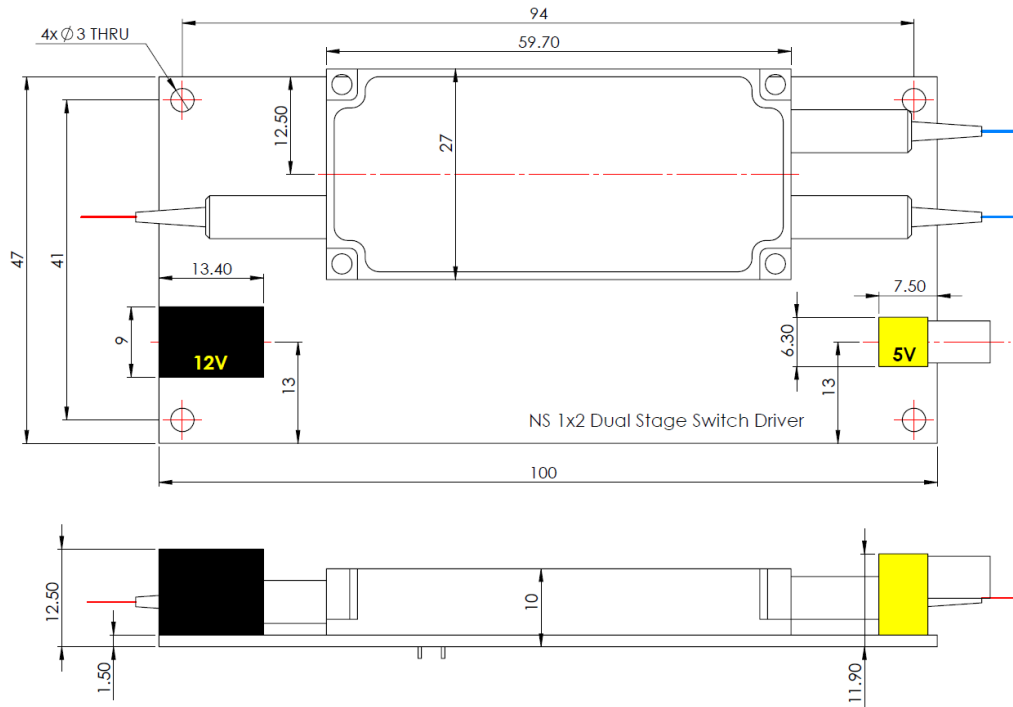
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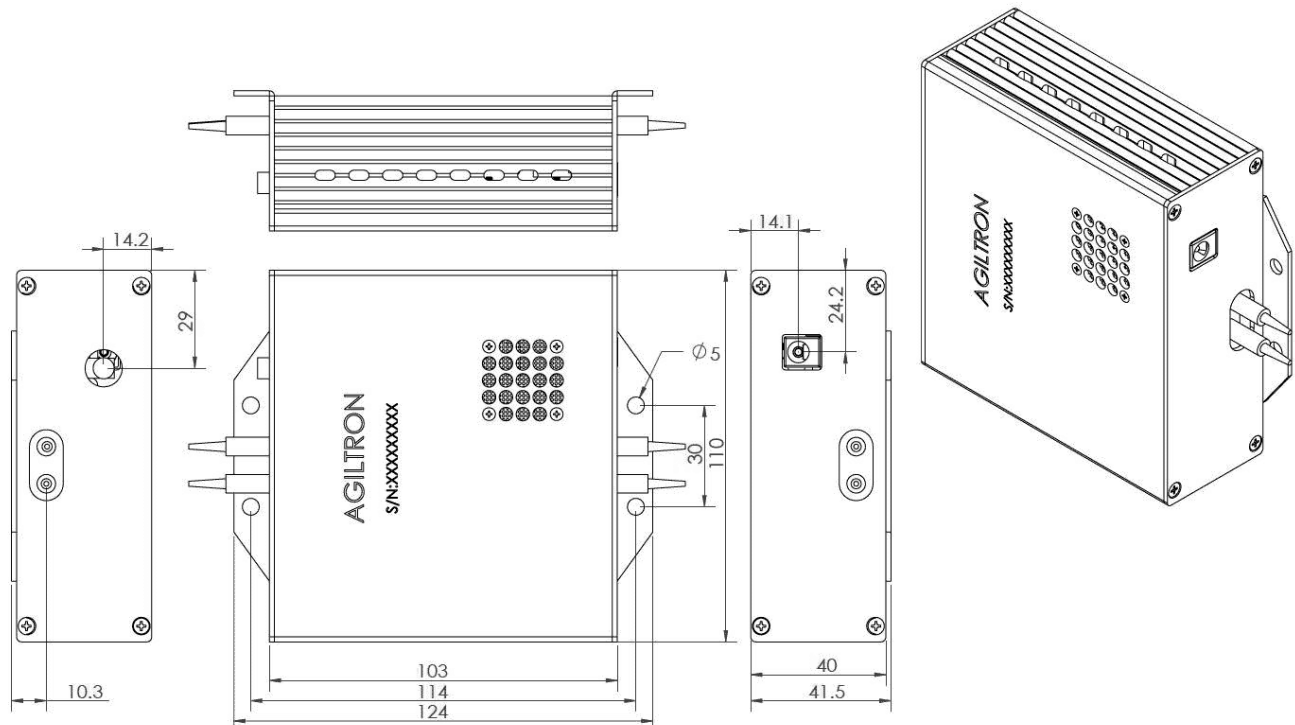


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Mechanical Dimensions, mounting on 60 kHz driver (mm)



Module with 300kHz Driver (Mechanical Drawing, mm)



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Ordering Information (Part Number)

Prefix	Type	Wavelength ^[4]	Configuration	Optical Power	Fiber Type	Fiber Cover	Fiber Length	Connector ^{[5][8]}	Benchtop
NSSW - ^[1] NHSW - ^[2] NHHW - ^[3]	1x2 = 12	1060nm = 1 1310nm = 3 1410nm = 4 1550nm = 5 1625nm = 6 1750nm = A 2000nm = 2 Special = 0	Dual stage = 2	Regular ($\leq 0.5W$) = 2 1W = A 2W = B 5W = C 10W = D ^[6] 20W = E	SMF-28 = 1 HI1060 = 2 PM1550 = 5 PM980 = 9 PM1950 = L MM50/125 ^[9] = M Special = 0	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/PC = 8 LC/APC = 9 E2000 APC = A LC/UPC = U Special = 0	None = 1 Benchtop = B

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.

Regular fiber connector has PER $\sim 22dB$. Connector with PER $> 27 dB$ is available using special process

[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.

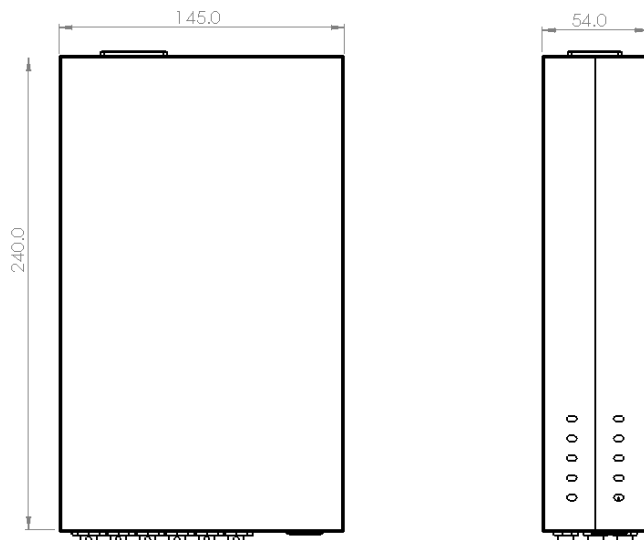
[8]. The default connector configuration uses fiber with 0.9 mm buffer protection. The connector cannot be installed directly onto bare fiber because the bare fiber is prone to damage during shipping. However, the connector can be assembled on bare fiber if a 3 cm protective loose tube is added for reinforcement. 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.

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

Note:

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

Benchtop Box Mechanical Dimension



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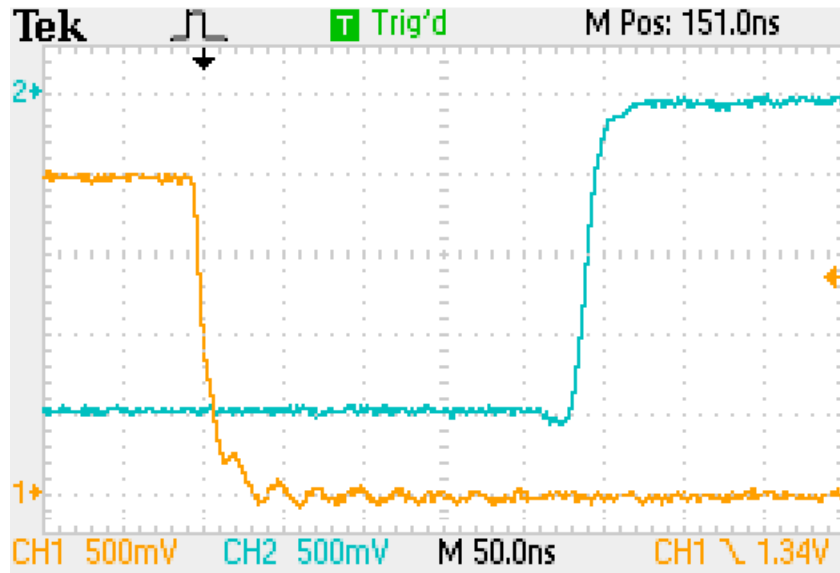
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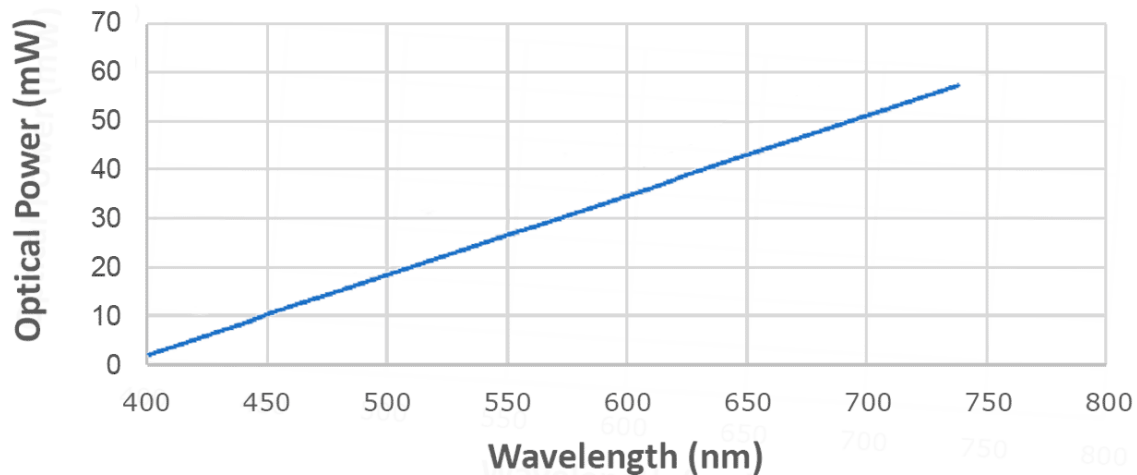


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Typical Speed Response Measurement



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 mis-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.

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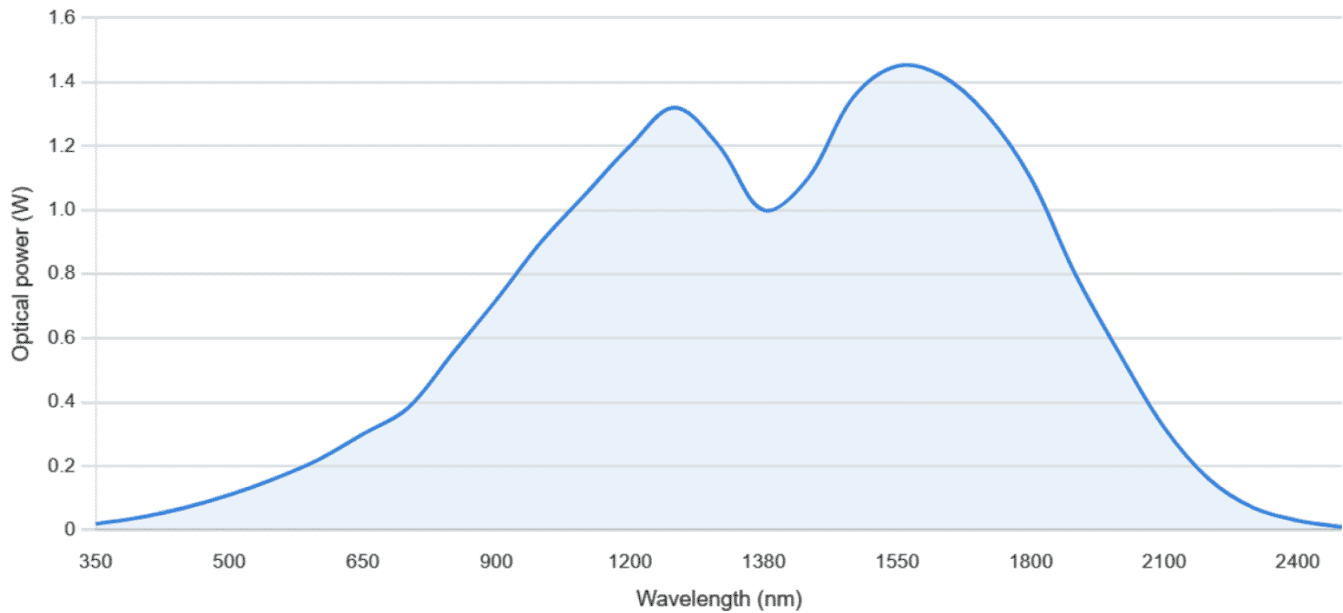
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Regular Single Mode / Polarization Maintaining Fiber Optical Power Handling vs Wavelength



Single mode fiber optical power is limited by nonlinear effects in addition to absorption that increase loss and generate heat. The curve shows the approximate safe CW power envelope for standard single-mode fiber. Actual limits depend on fiber design, core size, length, and laser characteristics. Specialty fibers can significantly increase the power limit.