

NanoSpeed™ Ultrafast 28dB Extinction 1x1, 1x2 Dual Stage Fiber Optical Switch

(10ns rise/fall, 1.5dB loss, 700kHz, bidirectional, SMF, PMF, up to 10W optical power)



DATASHEET

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Features

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

Applications

- Optical blocking
- Configurable operation
- Instrumentation

The NS Ultrafast Series fiber-optic switch delivers low insertion loss, ultrafast response, and high optical power handling. The NFSM model cascades two switching elements on an integrated driver to achieve ~28 dB on-off extinction, using a patented electro-optical architecture that provides clean, ripple-free switching and stable temperature performance. The device is intrinsically bidirectional and offered in either polarization-independent or polarization-maintaining fiber configurations. Designed for continuous 24/7 operation over 25 years, the solid-state non-mechanical design ensures exceptional reliability and immunity to vibration and shock. Each NFSW switch is supplied on a dedicated PCB driver with a single 0–5 V TTL trigger input and a DC power supply for plug-and-play integration. The optical rise/fall times are governed by the electro-optic crystal response, while the maximum switching repetition rate is determined by the driver electronics. As with all resonant electro-optic structures, narrow frequency regions of reduced modulation efficiency may appear within the usable bandwidth. Optical power is transferred continuously between output ports during switching, ensuring no interruption to the optical path. The NS Ultrafast Series accepts arbitrary control waveforms from DC to the MHz range, and power consumption scales with switching frequency.

Specifications

Parameter		Min	Typical	Max	Unit
Insertion Loss ^[1]	1900~2200nm ^[2]		1	2.5	dB
	1700~2300nm		0.8	1.8	
	1260~1650nm		1	1.5	
	850~1100nm		1.6	3	
	780~850nm ^[2]		2	4.5	
Cross Talk On/Off Ratio ^[3]	1x1, 1x2	25	26	30	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				200	ns
Optical Rise/Fall Time ^[4]		8	10	12	ns
Repetition Rate		DC		700	kHz
Optic power Handling ^[5]	Normal power version		0.3	0.5	W
	High power version		5	10	W
Operating Temperature range		-20		70	°C
Storage Temperature		-40		100	°C

Notes:

[1]. Measured without connectors. Each connector adds 0.3dB.

[2]. Wavelengths < 850nm or > 1900nm will be implemented in the special version.

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

[4]. It is defined as the rising or fall time between 10% and 90% of optical intensities.

[5]. Defined at 1310nm/1550nm. For the shorter wavelength, the handling power is reduced, see graph

[1b]. NPLC version available for high power and low loss that incorporates fiber core enlargement (expensive).

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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Rev 11/09/25

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Mechanical Dimensions (mm)

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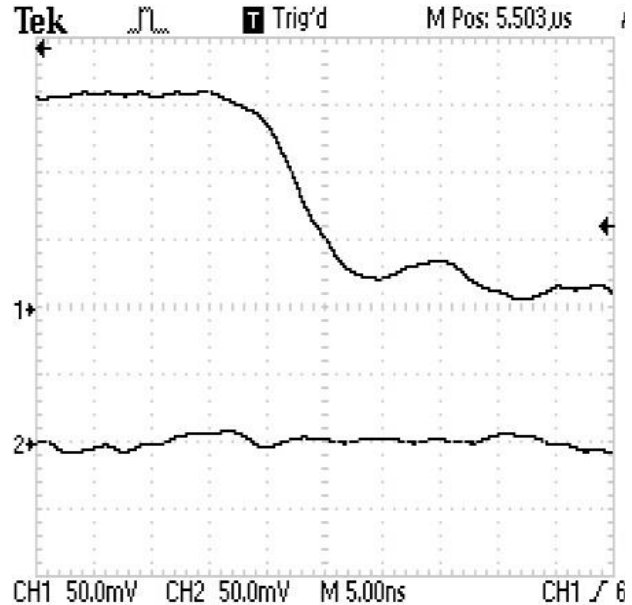
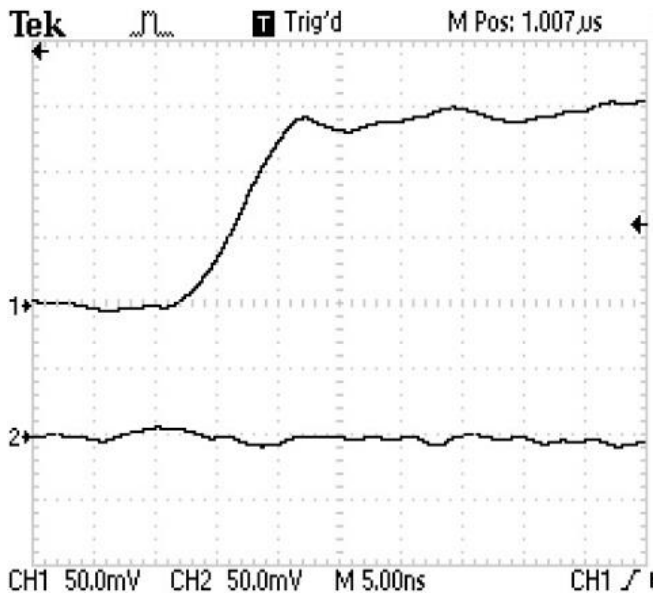
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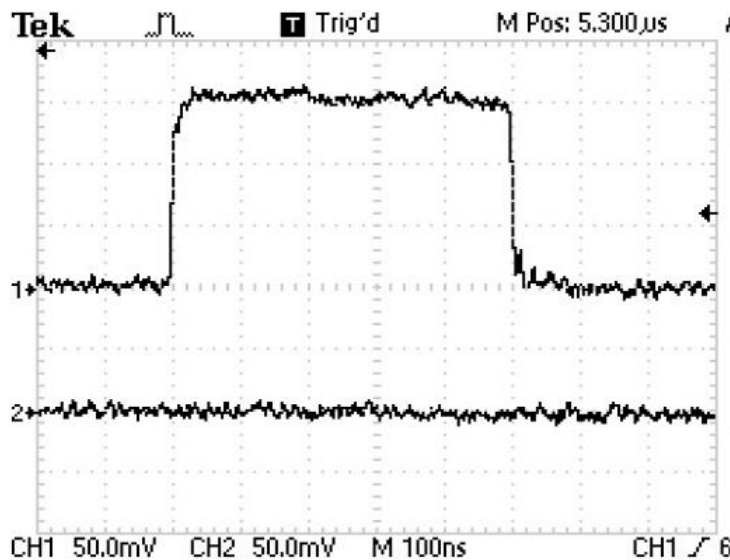
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Typical Rise/Fall Response

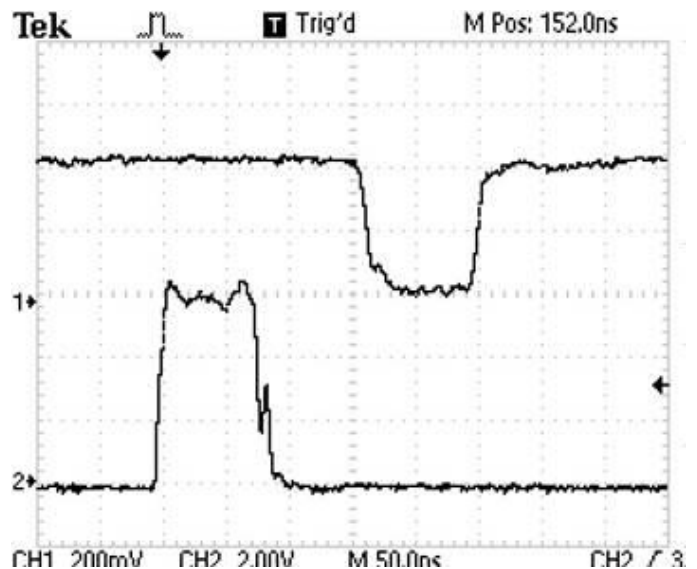


Note: Top Traces are electrical; Bottom traces are optical

Typical 20KH Switching



Typical Pulse Generation



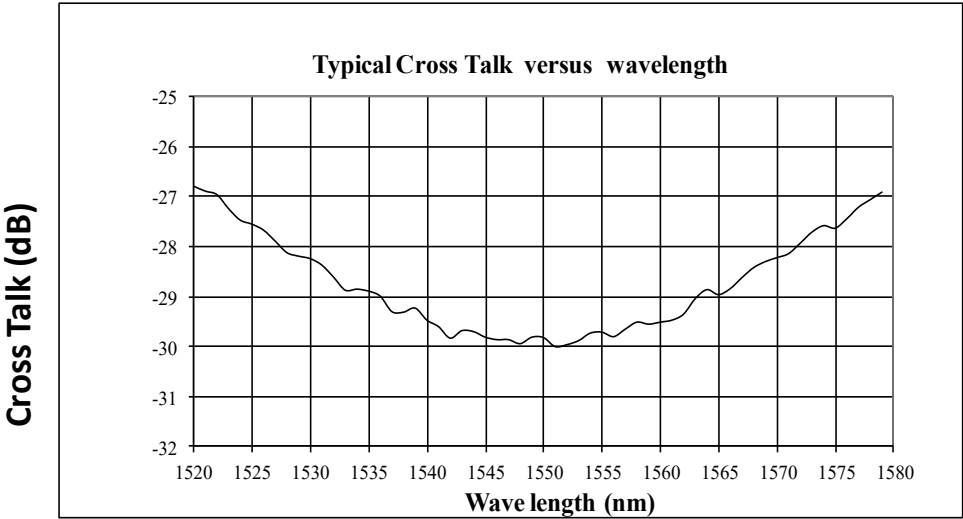
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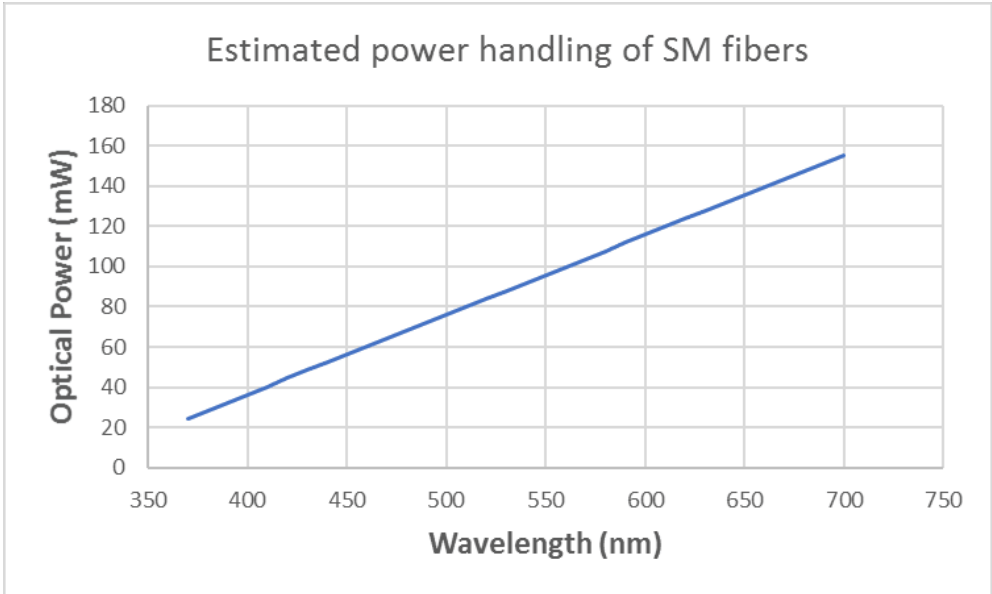


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Typical Bandwidth Measurement



Optical Power Handling vs Wavelength For Single-Mode Fibers (core size related)



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Optical Path Driving Table

Driving Board

It has an SMA connector for TTL input.
It comes with a 12V wall-pluggable power supply.

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Ordering Information

Prefix	Type	Wavelength	Power	Repetition Rate	Fiber Type	Fiber Cover	Fiber Length	Connector ^[1]	Benchtop
NFSM-	1x1 Transparent = 1T 1x1 Opaque = 1O 1x2 = 12	1060 = 1 2000 = 2 1310 = 3 1550 = 5 1625 = 6 1750 = A 850 = 8 780 = 7 650 = E 550 = F 450 = G Special = 0	0.3W = 1 5W = 2 10W = A 15W = C 20W = D	700kHz = 1	SMF-28 = 1 Hi1060 = 2 Hi780 = 3 PM1550 = 5 SM600 = 6 SM800 = 8 PM850 = A PM780 = B PM630 = C PM980 = 9 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 LC/APC = A E2000 APC = 9 LC/UPC = U Special = 0	None = 1 Benchtop = B

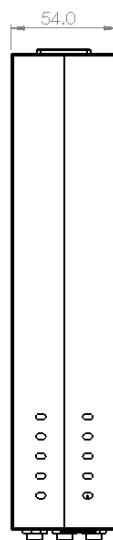
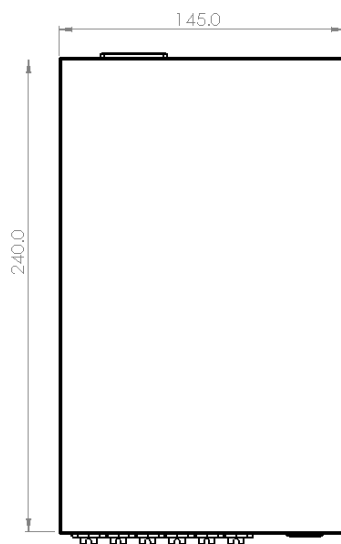
[1]. High power connector can be ordered separately

* This unit comes with an integrated driver, and a power supply is included.

Note:

- ☐ **Opaque** – light is blocked without applying a voltage
- ☐ **Transparent** – light goes through without applying a voltage

Benchtop Box Mechanical Dimension



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Q & A

Q: Can NP device be directly mounted on PCB driver, such as NSDR?

A: **NO.** NP devices can be operated at high frequency up to 1MHz, but the IL and CT are sensitive to the non-uniformity of temperature across device. So, it is highly recommended to separate the NP device with the driver in a platform such as shown in the following example. The delivery of NPSW with driver will be packaged in the 3D printed platform.

The following is one module of NPSW-1x2 & 100kHz of NSDR in a 3D printed platform.

Q: Does NP device drift over time and temperature?

A: NP 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 300V depending on the version.

Q: How does the device work?

A: NP 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: NP 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.