# NanoSpeed™ Switchable Fiber Optical Splitter/Coupler

## (1x2, 2x2, SM, PM, Bidirectional)

DATASHEET

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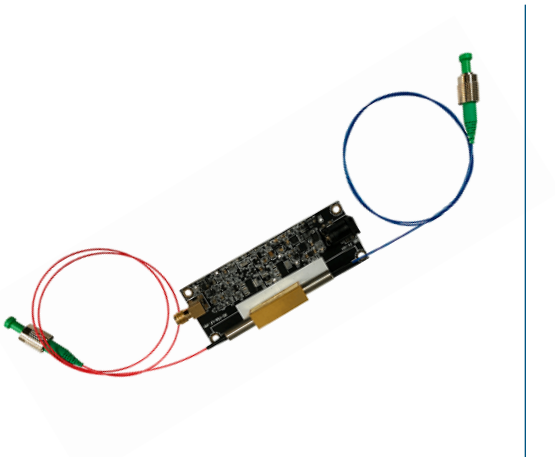

## Features

- High Speed
- High Reliability
- Low Loss
- Temperature Stable
- Compact

## Applications

- Instrumentation
- Power balance
- Sensor

The Switchable Fiber Optical Splitter in 1x2 format splits an incoming optical signal into two output optical fibers with the capability of switching between two splitting ratios. The initial split ratio should be predefined in design, while the second split ratio will be preset in delivery. When the control signal is low (<0.8V), the splitter sustains an initial ratio. When applying the high control voltage (3~5V), the splitting ratio will be switched from the initial ratio to the secondary one. The device is bidirectional, transmitting light in both directions simultaneously. In the 2x2 format, the input light from two inputs will be split into two outputs in a similar way of the 1x2 format, but the splitting ratio is reversed each other between two input lights. The switchable Fiber Optic Splitter has passed Telcordia reliability qualification tests as well as aerospace qualifications. It is designed to meet the most demanding ultra-high reliability requirements, fast response time, and continuous operation. The switch is intrinsically bidirectional and selectable for polarization-independent or polarization-maintain by the fiber type.

The unit is mounted on a driving board having a control signal input SMC connector and a wall plug-in power supply. Available with several drivers 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 | | 450 | | 2000 | nm |
| Insertion Loss [1] | 1260~1650nm | | 0.8 | 1.8 | dB |
| | 900~1260nm | | 0.6 | 1.0 | dB |
| | 760~900nm | | 0.8 | 1.3 | dB |
| | 650~850nm | | 1.2 | 1.5 | dB |
| | 450~580nm | | 1.5 | 2.3 | dB |
| Cross Talk at 100% splitter [2] | | 20 | 25 | 35 | dB |
| Durability | | $10^{14}$ | | | cycles |
| Splitting ratio [3] | Initial | 0 | | 100 | % |
| | Switching | 0 | | 100 | % |
| | Type | | Continuous | | |
| Response Time (Rise, Fall) | | | | 1000 | ns |
| Repetition Rate [4] | | DC | | 500 | kHz |
| Polarization Dependent Loss | | | 0.1 | 0.35 | dB |
| IL Temperature Dependency | | | 0.25 | 0.5 | dB |
| Polarization Mode Dispersion | | | 0.1 | 0.2 | Ps |
| Return Loss | | 45 | 50 | 60 | dB |
| Operating Temperature | | -5 | | 70 | °C |
| Optical Power Handling [5] | | | 0.3 | 20 | W |
| Storage Temperature | | -40 | | 85 | °C |

**Notes**:

[1] Excluding connectors.
[2] ± 25nm, Cross talk is measured at 5kHz, which may be degraded at the high repeat rate.
[3] The initial ratio must be predefined. The switching ratio will be preset in delivery.
[4] High repetition rate (up to 1MHz) is available in the premium version, please contact us.
[5] Defined at 1310/1550nm. For the shorter wavelength, the handling power may be reduced.

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 10/28/24

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## Mechanical Dimensions (Unit: mm)

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

## Driving Board Selection

| Maximum Repetition Rate | Part Number (P/N) |
|---|---|
| 100 kHz | SWDR-11a261111 |
| 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.

## Operation Instruction

1. Plug in the accompanied power supply
2. Plug in a 0-5V control signal to the input SMA connector (golden color). One can use a DC power supply first, and then a function generator. The optical output will change from maximum to minimum or from minimum to maximum depending on which port is measured.
3. Do not adjust settings on the board

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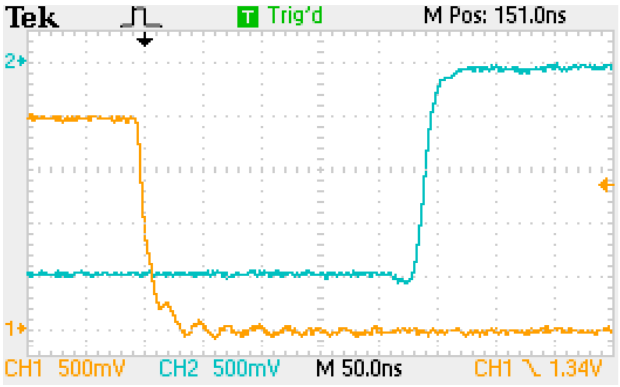
## Typical Speed Response Measurement




## Ordering Information

| | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
|---|---|---|---|---|---|---|---|---|---|---|
| **Prefix** | **Type** | **Wavelength** | **Repetition** | **Initial split ratio [1]** | **Switching split ratio [1]** | **Fiber Type** | **Fiber Cover** | **Fiber Length** | **Connector** | **Optical Power** |
| **NSSS-** | 1x2 = A<br>2x2 = B | 1060 = 1<br>L Band = 2<br>1310 = 3<br>1550 = 5<br>780 = 7<br>850 = 8<br>980 = 9<br>Special = 0 | 100kHz = 1<br>500kHz = 5<br>Special = 0 | 0:100 = A<br>10:90 = 1<br>20:80 = 2<br>30:70 = 3<br>40:60 = 4<br>50:50 = 5<br>60:40 = 6<br>70:30 = 7<br>80:20 = 8<br>90:10 = 9<br>Special = 0 | 100:0 = A<br>90:10 = 1<br>80:20 = 2<br>70:30 = 3<br>60:40 = 4<br>50:50 = 5<br>40:60 = 6<br>30:70 = 7<br>20:80 = 8<br>10:90 = 9<br>Special = 0 | SMF-28 = 1<br>HI1060 = 2<br>PM1550 = 5<br>HI780 = 3<br>PM780 = 7<br>PM850 = 8<br>PM980 = 9<br>Special = 0 | Bare fiber = 1<br>900um tube = 3<br>Special = 0 | 0.25m = 1<br>0.5m = 2<br>1.0 m = 3<br>Special = 0 | None = 1<br>FC/PC = 2<br>FC/APC = 3<br>SC/PC = 4<br>SC/APC = 5<br>ST/PC = 6<br>LC/PC = 7<br>Duplex LC/PC = 8<br>LC/APC = 9<br>E2000 APC = A<br>LC/UPC = U<br>Special = 0 | Regular = 1<br>1W = A<br>2W = B<br>5W = C<br>10W = D<br>20W = E |

[1]. Initial and Switched splitting ratios could be combined in arbitrary

**Note**:

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

**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.

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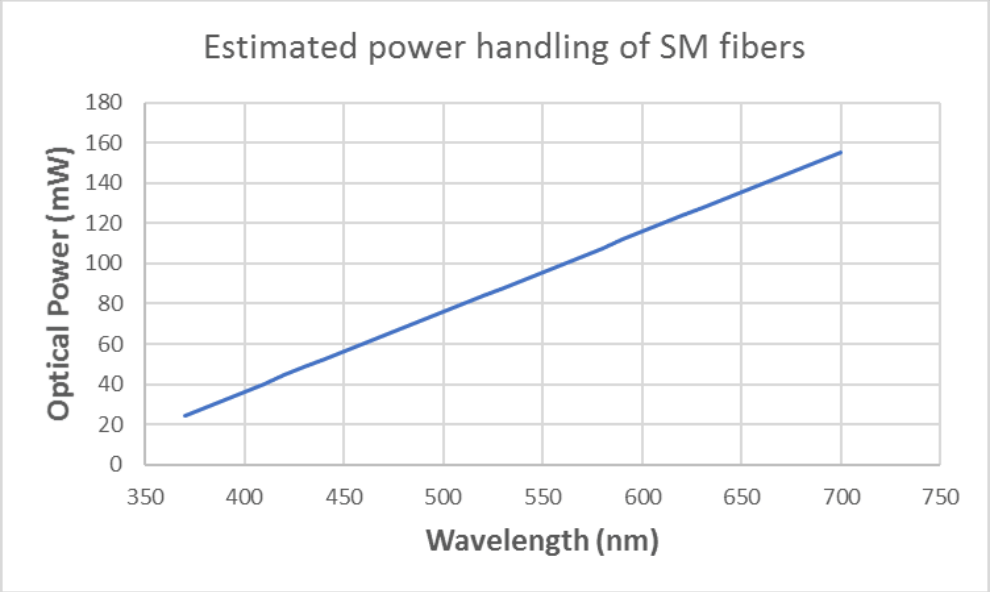
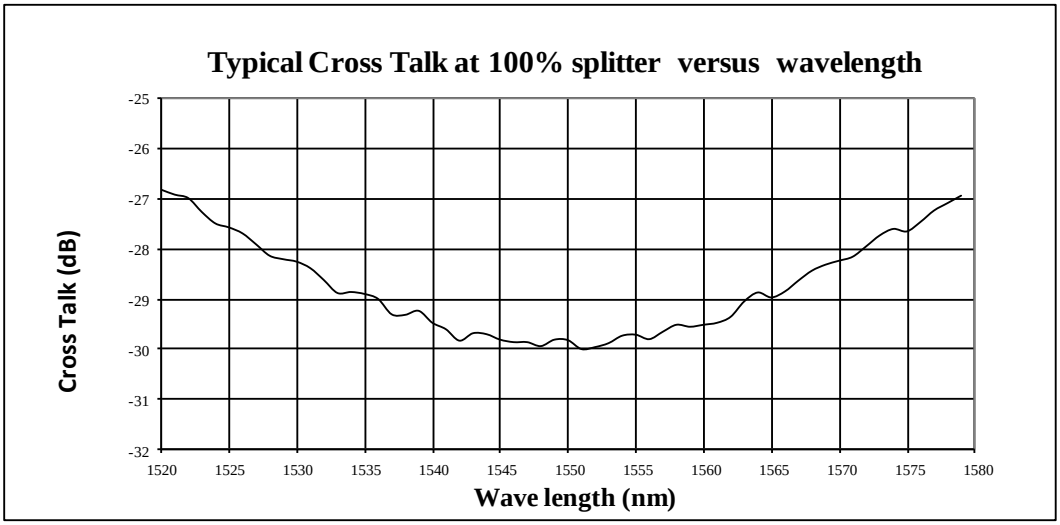
### Optical Power Handling vs Wavelength For Single-Mode Fibers




### Wavelength Bandwidth 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 $^0$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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