Fiber-Fiber™ Optical Switch 1x1, Dual 1x1, 1x2

(SM, PM, MM, Broadband, Bidirectional, <0.5ms Fast Switching)

DATASHEET

BUY NOW

The FF Series fiber optic switch provides exceptional performances of nearly lossless transition, ultra-broadband with little wavelength dependence that is only limited by fiber characters, fast optical switching of less than ms, little temperature dependence, large on/off ratio, vibration insensitive as well as low cost. It connects optical channels by fiber-to-fiber direct coupling using a silicon-based micro-mechanical auto-alignment platform that is wafer-level produced in-house. The established optical path has no air gap, using no lens or coating, eliminating unwanted surface reflection-related issues. The platform is robust and insensitive to temperature and vibration. The FF Series switch can accommodate all types of fibers with 0.125mm outer diameter, including SM. MM, PM, double cladding, bendable, large core, small core. The FF switches uniquely provide performance no other technologies can match.

The FF switches are activated via an electrical relay. The latching operation preserves the selected optical path after removing the electrical power. The switch is bidirectional and conveniently controllable by 4.5V.

Features

- Ultra Low Loss ~0.2dB
- Ultra Broadband
- Little Wavelength Dependence
- Little Temperature Dependence
- Fast <0.5ms
- Vibration Insensitive

Applications

- Laser Systems
- Reconfigurable Optics
- Instrumentations

Specifications

Parameter	Min	Typical	Max	Unit
Wavelength	350		5500	nm
Insertion Loss [1]	0.01	0.2	0.4	dB
Wavelength Dependent Loss			0.01	dB
Polarization Dependent Loss			0.05	dB
Polarization Extinction Ratio (PM)	18	25	35	dB
Return Loss	50 (SM)			dB
	35 (MM) [3]			dB
Cross Talk	50		75	dB
Optical Rise/Fall Time (slow MEMS) [2]	5		20	ms
Optical Rise/Fall Time (fast MEMS) [2]	0.2	0.4	0.8	ms
Repetition Rate (slow MEMS)			1	Hz
Repetition Rate (fast MEMS)			5	Hz
Repeatability			± 0.02	dB
Durability	10^8			cycles
Operating Optical Power [3]		0.3	0.5	W
Operating Voltage	4.3		4.5	VDC
Operating Current		30	60	mA
Switching Type	Latching / Non-Latching			
Operating Temperature	-40		80	°C
Storage Temperature	-50		90	°C

Notes:

[1]. SM 28 Fiber, Typical loss is 0.3dB. Ultra-low loss 0.1 is special order. Excluding Connectors. For small core fibers the specs are reduced. For IR fluoride fiber loss increase.

[2].Define as 10/90% optical signal change. Slow MEMS chip can use all fiber types. Fast MEMS chip can only use SM fibers and PM1550. It can be used for other PM fiber but need NRE charge which is suitable for volume orders.

[3].For 1310/1550nm. The optical power handling rapidly reduces as fiber core size/ reduces. At 650nm the max is 2mW. Expanding the fiber core can increase the power handling.

Rev 12/07/23

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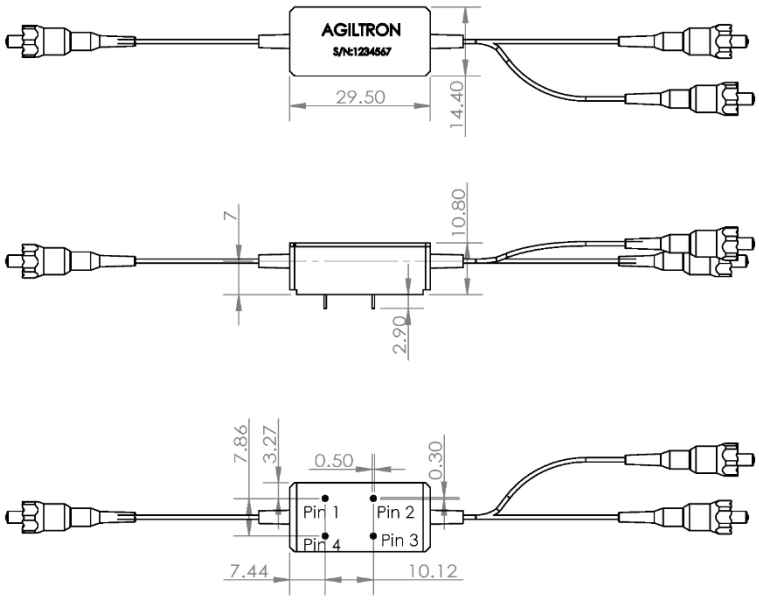
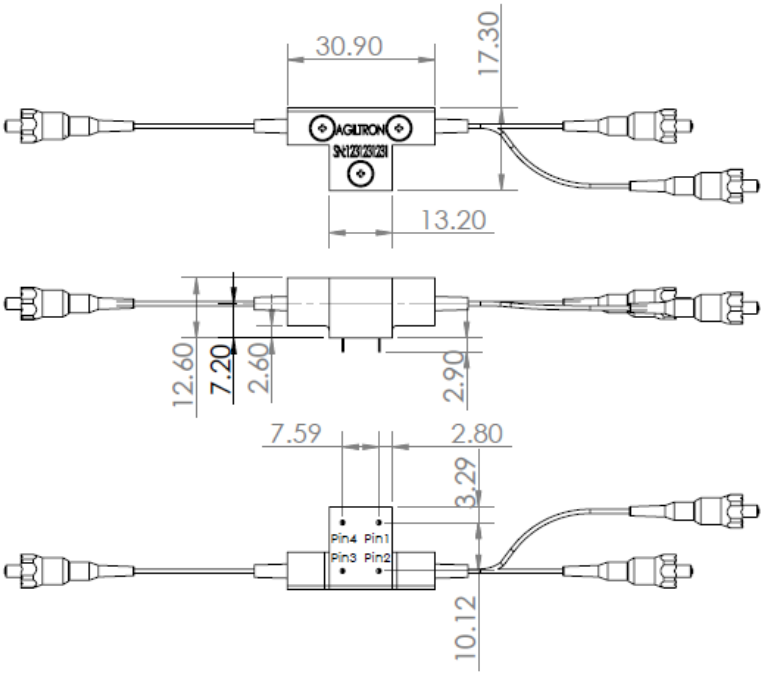
Mechanical Dimensions For Slow Version (S) (square shape, PM fiber) (Unit: mm)



S

Mechanical Dimensions For Fast Version (F) (T-shape, SM. MM Fibers) (Unit: mm)



F

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

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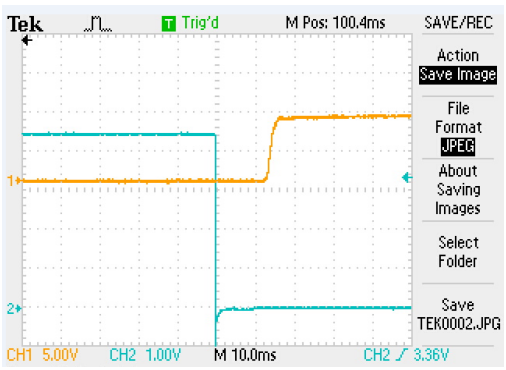
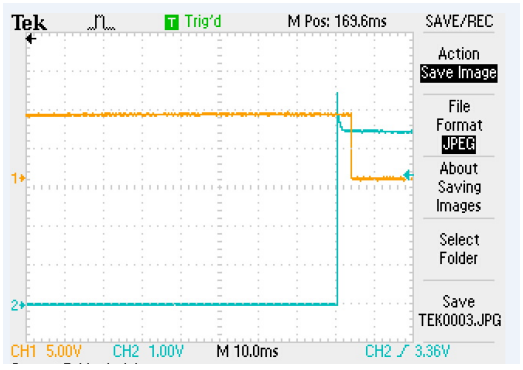
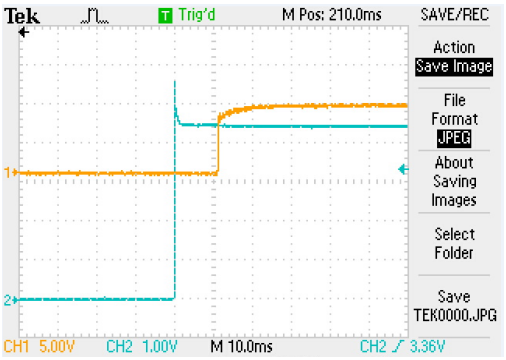
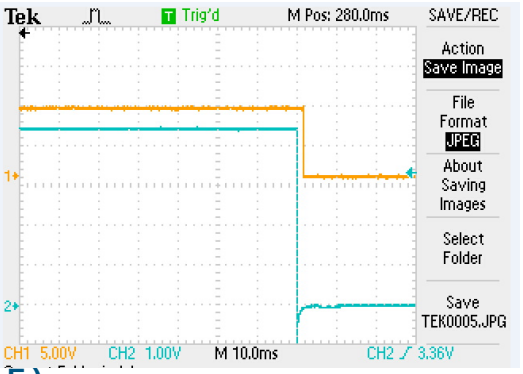
Typical Response Speed (SM, Package S)





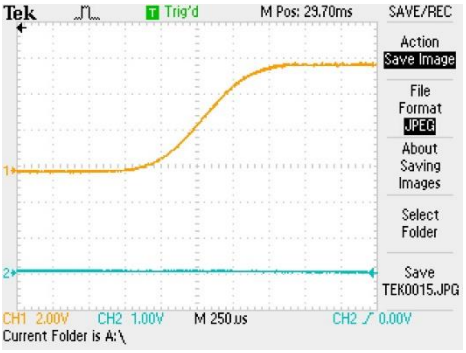
Channel 1 Optical Rise and Fall

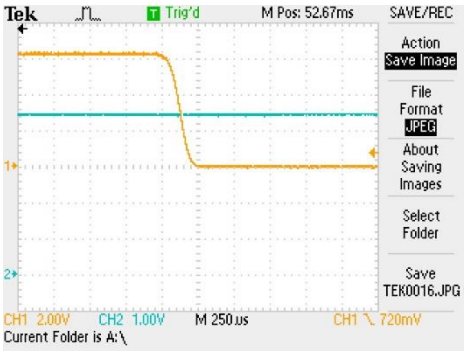




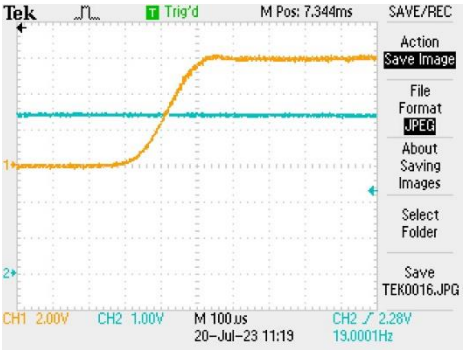
Channel 2 Optical Rise and Fall

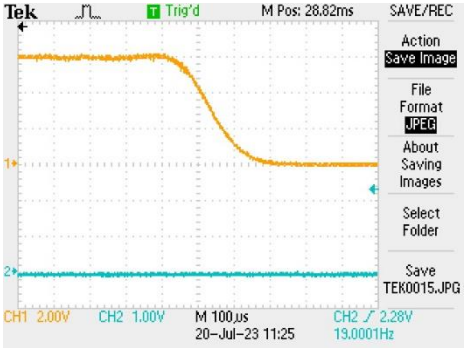
Optical Response Speed (SM Package F)





Channel 1 Optical Rise and Fall





Channel 2 Optical Rise and Fall

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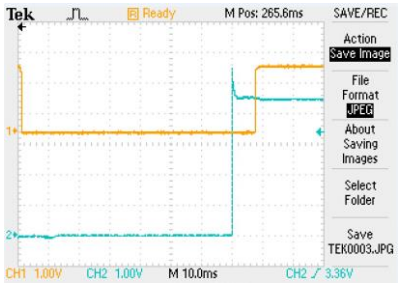
Typical Response Speed (SM Package F)

Channel 1 Optical Rise and Fall



Channel 2 Optical Rise and Fall

Electrical Connector Configurations

Important Note: The device must be driven by the reference circuit. Otherwise, it is not stable. This is because the device contains a permanent magnet inside; thus current must flow in the correct direction to counter the magnet field.

The load is a resistive coil which is activated by applying 4.5V (draw ~ 40mA). The latching switches can also be driven by a pulse mode for energy saving. The switch can withstand 5V which may reduces its durability.

Agiltron offers a computer control kit with TTL and USB interfaces and Windows™ GUI. We also offer RS232 interface as an option.

Latching Type

The activation requires a 4.5V pulse with a duration >15ms

Optical Path	Electric Drive	
	Pin 2	Pin 3
Port 1 → Port 2	4.5V	0V
Port 1 → Port 3	0V	4.5V

Non-Latching Type

Optical Path	Electric Drive	
	Pin 2	Pin 3
Port 1 → Port 2	0V	0V
Port 1 → Port 3	0V	4.5V

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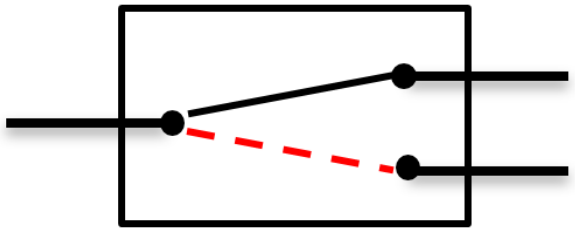
Functional Diagram



Ordering Information

	☐☐	☐	☐	☐☐	☐	☐	☐
Prefix	**Type**	**Package [2]**	**Test Wavelength [3]**	**Fiber Type**	**Fiber Cover**	**Fiber Length**	**Connector**
FFSW-	1x1 (Transparent) [1] = 11 1x1 (Opaque) = 1D 1x1 (Ultralow Loss) = U1 1x2 = 12 1x2 (Ultralow Loss) = U2 1x1 High Power [4] (trans) = T1 1x2 High Power [4] = T2	Fast Latching (F) = 6 Fast Non-Latching (F) = 7 Slow Latching (S) = 2 Slow Non-Latching (S) = 3	488 nm = 4 360 nm = A 430 nm = B 532 nm = 5 630 nm = 6 780 nm = 7 850 nm = 8 980 nm = 9 1060 nm = 1 1310 nm = 3 1550 nm = C 2000 nm = 2 2.3-4 µm = F 3.3-5.5 µm = G	Pick from below table to match the wavelength range	Bare fiber = 1 900um tube = 3 Special = 0	0.25m = 1 0.5m = 2 1.0m = 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 MTP = 9 LC/UPC = U Special = 0

[1]. Transparent means light passes without activation. Opaque means light is blocked at the nonactivation state.

[2]. **Slow MEMS** chip is cost effective for PM fiber. **Fast MEMS** chip is suited for all **SM/MM** fibers, and only available for **PM1550**. It can be used for other PM fiber but requires a NRE charge which is suitable for volume orders.

[3]. The device is ultra-broadband limited by fiber transmission. We only test at one selected wavelength. If a customer needs to test at several wavelengths, the selection is special =0 with added cost. Our experience indicates no such need unless a special wavelength.

[4]. The beam size is expanded about 5X inside the fiber tip

Red means special order

NOTE:

- **PM1550** fiber works well for **1310nm** and the short fiber in the switch does not affect system performance. **PM1550** can be spliced with **PM1310**

Fiber Type Selection Table:

01	**SMF-28**	34	**PM1550**	71	**MM 50/125µm**
02	**SMF-28e**	35	**PM1950**	72	**MM 62.5µm**
03	**Corning XB**	36	**PM1310**	73	**105/125µm**
04	**SM450**	37	**PM400**	74	**FG105LCA**
05	**SM1950**	38	**PM480**	75	**FG50LGA**
06	**SM600**	39	**PM630**	76	**STP 50/125**
07	**Hi780**	40	**PM850**	77	**IRZS23**
08	**SM800**	41	**PM980**	78	**IRFS32**
09	**SM980**	42	**PM780**		
10	**Hi1060**	43			
11	**SM400**	44	**PM405**		
12		45	**PM460**		
13		46			

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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 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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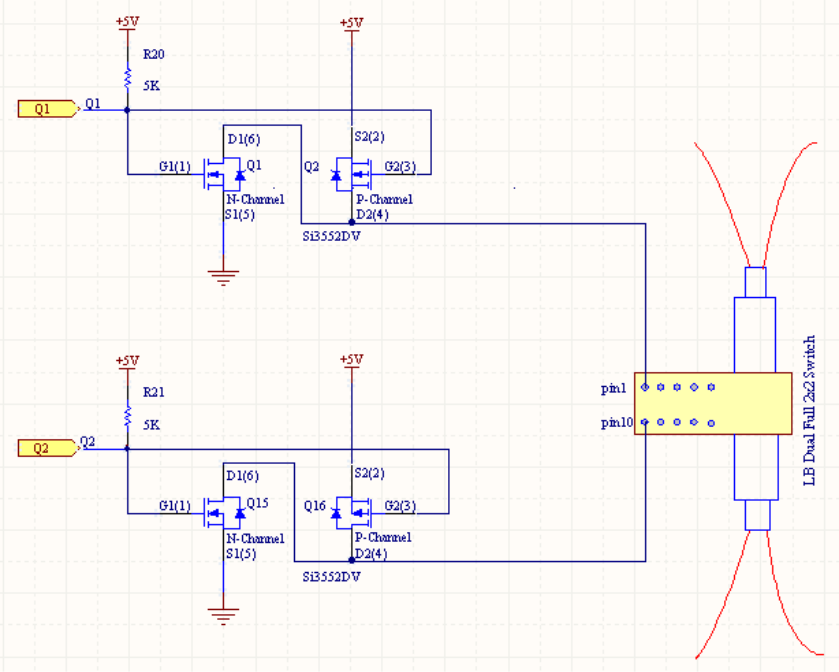
Driver Reference Design



Optical Power Handling vs Wavelength For Single-Mode Fibers