MEMS Ultra-Mini 1x2, 2x2 Latching Series Fiber Optical Switch

(Protected by US Patent 10752492B2)

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The MEMS Ultra-Mini Series Fiber Optical Switch uses a patented thermal activated micro-mirror, moving-in and -out optical paths, uniquely featuring high stability over wide temperature range without compensation, small size and very long life cycle. The thermal MEMS is insensitive to moisture and ESD without drift issues, providing a high reliability platform for over 25 years continuous operation. The ultra-mini series switches are configured in 1x1, Dual 1x1, Quad 1x1, 1x2, Dual 1x2, Full 2x2, and Dual Full 2x2 with single or multimode fibers. The Ultra-Mini switches are Telcordia standards GR1221 qualified.

Agiltron provides customized design and modular assemblies to meet control and integration applications.

This device is highly recommended for occasionally switching operation. For the frequently switching operation, please use our non-latching version.

Features

- Vacuum Compatible
- Direct DC drive
- Ultra Small
- ESD Insensitive
- Bidirectional
- High Reliability

Specifications

Parameter		Min	Typical	Max	Unit
Operation Wavelength	Single Mode	1260 ~ 1610			nm
	Multimode	820 ~ 1340 and / or 1260 ~ 1360			
Insertion Loss [1], [2]			0.6	1.0 / 1.2 [3]	dB
Polarization Extinction Ratio	PM	18			dB
Return Loss [1], [2]	SM, PM	50			dB
	Multimode	35			
Cross Talk/On-Off [1], [2]	SM, PM	50			dB
	Multimode	35			dB
PDL				0.2	dB
WDL				0.3	dB
TDL				0.3	dB
Switching Time			5	10	ms
Repeatability				± 0.05	dB
Repetition Rate				5	Hz
Durability		10^9			cycle
Power Consumption (in pulse)				170	mW
Switching Type		Latching Type			
Operating Temperature [4]		-5		70	°C
Storage Temperature		-40		85	°C
Optical Power Handling (CW)			300	500	mW
Package Weight		1.9			g

Notes:

[1]. Excluding connectors.

[2]. Multimode Series Switch measured @ Light Source CPR < 13dB.

[3]. Dual band, and Dual 1x2, Full 2x2, Dual Full 2x2.

[4]. Lower temperature version is available, please call us.

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]:

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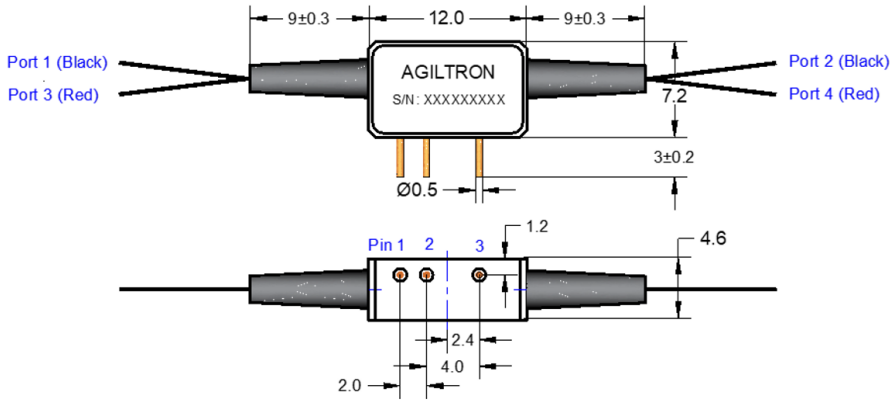
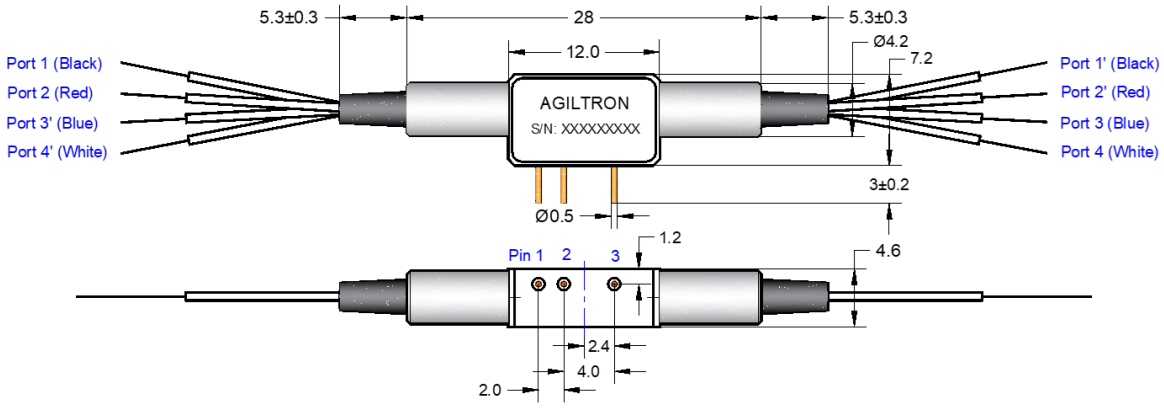
Mechanical Dimensions (mm)

Package 2: For 1 ~ 4 bare fibers and = 2 fibers with 900 um loose tube.

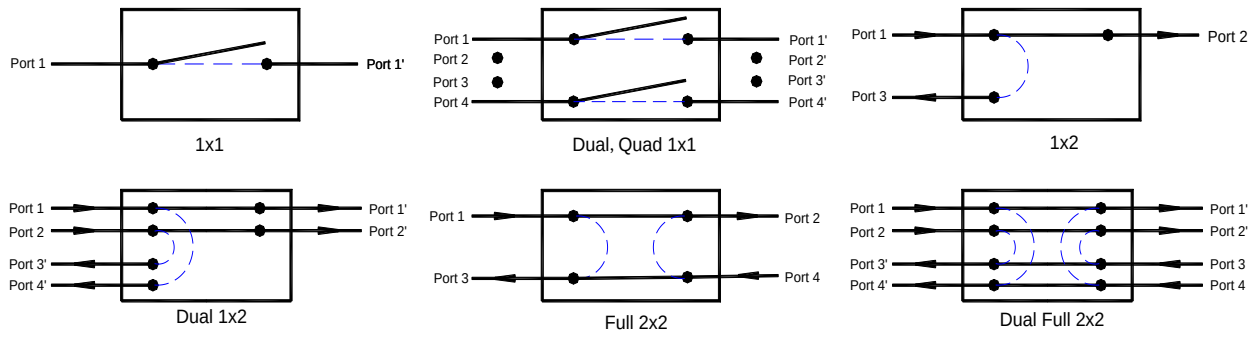


Package 3: For = 3 fibers with 900 um loose tube.



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

Functional Diagram



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Driving Table

Status	Optical Path							Pin No.		
	1x1	Dual 1x1	Quad 1x1	1x2	Dual 1x2	Full 2x2	Dual Full 2x2	Pin 1	Pin 2	Pin 3
Status I	Port 1→1’	Port 1→1’ Port 2→2'	Port 1→1' Port 2→2' Port 3→3' Port 4→4'	Port 1→2	Port 1→1’ Port 2→2’	Port 1→2 Port 4→3	Port 1→1' Port 2→2' Port 3→3' Port 4→4'	Pulse-1 [1-3]	Pulse-2 [1-3]	0V[4]
Status II	Dark	Dark	Dark	Port 1→3	Port 1→4’ Port 2→3’	Port 1→3 Port 4→2	Port 1→4' Port 2→3' Port 3→2' Port 4→1'	Pulse-3[1-3]	Pulse-4[1-3]	

[1]: The driving Pulse-1, Pulse-2, Pulse-3 and Pulse-4 have same pulse width as 20~40ms, but must be sequenced in time.

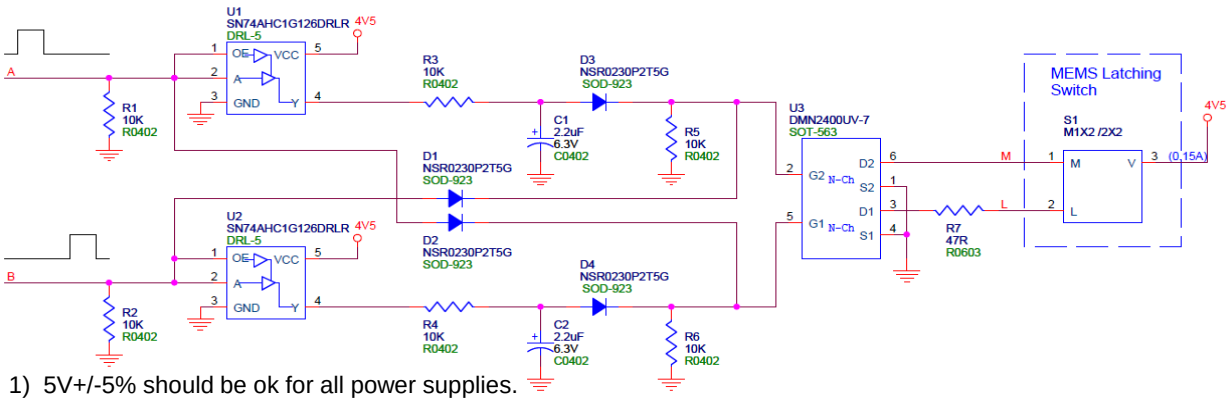
[2]: Pulse-1 is delayed about ~8ms to Pules-2; while Pulse-4 is delayed about ~8ms to Pules-3 .
The timing sequence of driving pulses in the next section can be referred.

[3]: Pulse-1/Pulse-3 has 4.5V and Pulse-2/Pulse-4 has 3.0V typically with +/- 5% variation. 40mA current in max is needed on all pulses.
ATTENTION: Over driving on time and voltage may burn the MEMS latching chip.

[4]: When using the recommended circuit below, it should be 4.5~5.0VDC.

Recommended Driving Circuit and Dring Pulse Timing

1) A recommended circuitry



1) 5V+/-5% should be ok for all power supplies.
2) R7 = 25ohm for avoiding the over-current applied on MEMS chip.

2) Driving Pulses

The latching switches require timing pulses of 4.5V (M) and 3.0V (L) to actuate MEMS latching chip. The driving pulses M and L are generated with different time sequence in this circuit per control signal Pulse-A or Pulse-B.

1) A and B are the control signals. Pulse-A is used for Status I of switches shown in the driving table above, while Pulse-B is used for Status II. The pulse width of control signal is 20~40ms typically.
2) The driving pulses M and L are generated in this circuit and applied on PIN#1 and #2 respectively per pulse A and B .
3) Under pulse A, Pulse M on PIN#1 is delayed, but Pulse L on PIN#2 isn’t.
4) Under pulse B, Pulse L on PIN#2 is delayed, but Pulse M on PIN#1 isn’t.
5) The falling delay between two driving pulses is ~8ms typically, and the rising delay is ~10ms typically in this circuitry.
6) The optical path changes is shown for 1x2 as example, and also valid for other optical configurations.

P +1 781-935-1200 E sales@photonwares.com W www.agiltron.com

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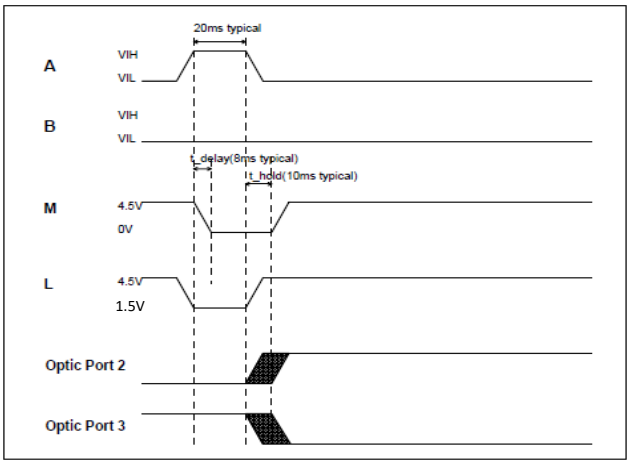
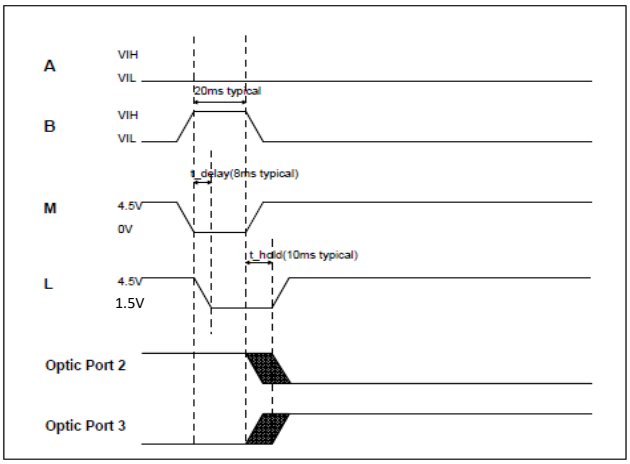
3) Time sequence of driving pulses



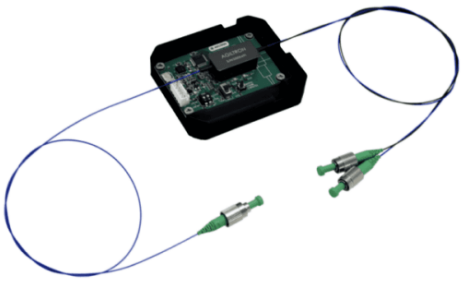
Timing of Port 1--> 2



Timing of Port 1--> 3

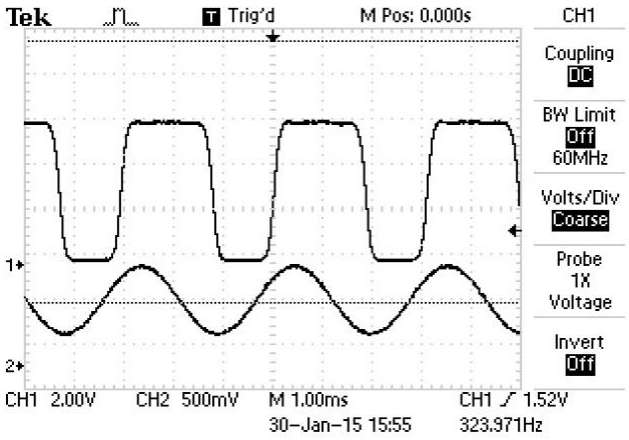
Demo Driving Board ($458)

Customer can buy this manual push button and computer USB interface board to test the switch.



10^9 Switching Cycle Test

We have tested MEMS 1x2 switch at the resonant frequency ~300Hz for more than 40 days, as shown in the attachment, which corresponds over 10^9 switching cycles. The measurements show little changes in Insertion loss, Cross Talk, Return loss, etc, all parameters are within our specs.



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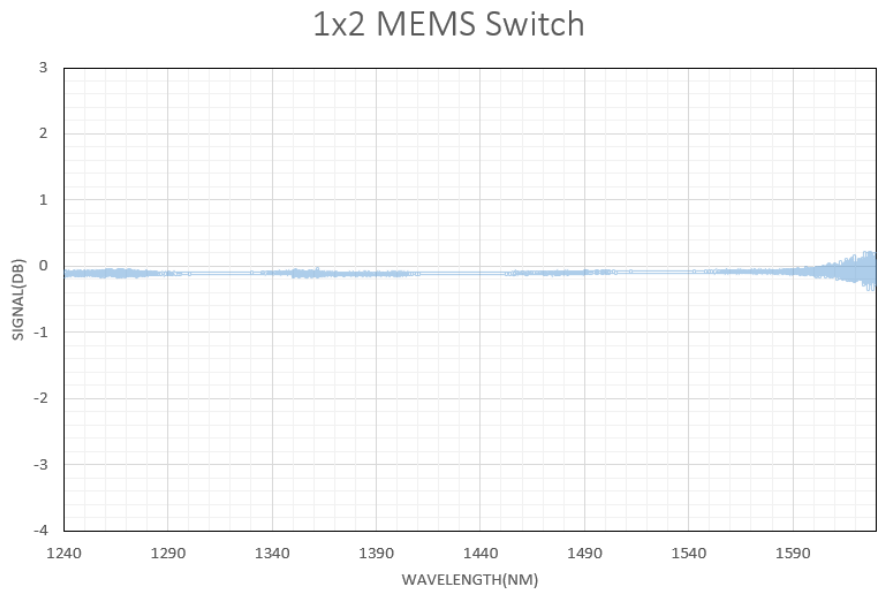
Typical Insertion Loss vs Wavelength (1240-1630nm)



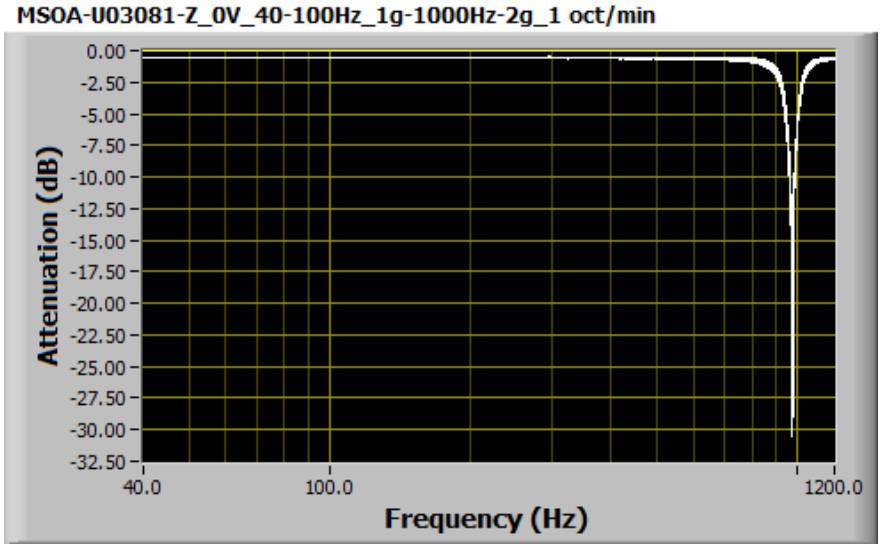
Vibration (40-1200Hz) Test Results

Test condition:

1. Acceleration: 1g from 40Hz to 100Hz, and then from 100Hz to 1200Hz, from 1g to 2g
2. Vibration direction: Z axis of MSOA SN# U03081
3. Measure fiber optical insertion loss change

Results:

1. Resonation frequency: ~976Hz, max IL change ~30dB
2. IL change <0.1dB for frequency <200Hz, 0.1-0.2dB for frequency 200-500Hz.



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Ordering Information

	☐☐	☐	1	☐	☐	☐	☐	☐
Prefix	**Type**	**Wavelength**	**Configuration**	**Package**	**Fiber Type**	**Fiber Cover**	**Fiber Length**	**Connector**
MISW- [1] **MIDU-** [2] **MIQU-** [3] **MIPM-** [4]	1x1 = 11 1x2 = 12 2x1 = 21 2x2 = 22 Special = 00	820~1340 = A 1260~1620 = B Special = 0	Latching = 1	Package 2 [5] = 2 Package 3 [6] = 3 Special = 0	SMF-28 = 1 PM 1550 = B PM 1310 = D PM 980 = E PM 850 = F MM 50/125 = 5 MM 62.5/125 = 6 Special = 0	Bare fiber = 1 900 um 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/APC = A LC/UPC = U Special = 0

[1]. **MISW**: **M**EMS U--MI**N**I 1x1, 1x2, 2x2 **SW**ITCH.

[2]. **MIDU**: **M**EMS U--MINI **DU**AL 1x1, 1x2, 2x2 Switch.

[3]. **MIQU**: **M**EMS U--MINI **QU**AD 1x1.

[4]. **MIPM**: **M**EMS U--MINI 1x1, 1x2 **PM** Switch.
For PM 2x2 configuration, please select a different version:
https://cdn-agl.agiltron.com/dlc/specs/MEMS%20Full%20Dual%20Full%202x2%20PM%20Non-latching%20Switch.pdf

[5]. Package 2 (see Drawing) is for 1 ~ 4 bare fibers and ≤ 2 fibers with 900 um loose tube.

[6]. Package 3 (see Drawing) is for ≥ 3 fibers with 900 um loose tube.

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.