10-bit MEMS Variable Fiber Optical Time Delay

(Protected by US Patent 10752492B2)

DATASHEET

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The MEMS Series Photonic Time Delay digitally varies the optical delay time in fiber by selectively routing optical signal through N fiber loops whose lengths increase successively by a power 2 of the increment time delay ΔT. Since each switching element allows the signal to either pass or bypass a fiber loop, a delay T may be inserted, which can take any value (in increments of ΔT) up to the maximum value ($T = (2^{N+1}-1)\,\Delta T$).

This is achieved using a patent pending MEMS switching configuration and activated via an direct DC electrical control signal.

The driver is available with USB and/or RS232 control interface separately.

This device also features a variable attenuation function, allowing the output power of each fiber port to be independently adjusted by varying the applied switching voltage.

Features

- 7-bit Resolution or more
- High Reliability
- Compact

Applications

- Phase-Array Antennas
- Instrumentation

Specifications

Parameter	Min	Typical	Max	Unit
Wavelength Band	780	1550	2000	nm
Insertion Loss [1]		3	4.5	dB
Polarization Dependent Loss (SM)		0.1	0.2	dB
Polarization Extinction Ratio (PM)	18	24		dB
Cross Talk On/Off Ratio	40	50		dB
Return Loss	50	55		dB
Switching Time (fall, rise)		2	10	ms
Fiber Segment Number	4		10	
Delay Time Range [2]			10	ms
Polarization Mode Dispersion (SM)		0.1	0.2	ps
Operating Temperature	-5		70	°C
Storage Temperature	-40		85	°C
Optical Power Handling	300			mW
Package Dimension [1]	See drawing			

Notes:

[1]. It is defined for 4-bit Time Delay with the short fiber loops. The maximum Insertion Loss is: 5.6dB for 5-bit version, 6.8 dB for 6-bit, 7.8 dB for 7-bit, and 12.0 dB for 10-bit respectively.

[2]. The delay fiber loops can be spliced in precise control per customer's request.

Rev 10/24/25

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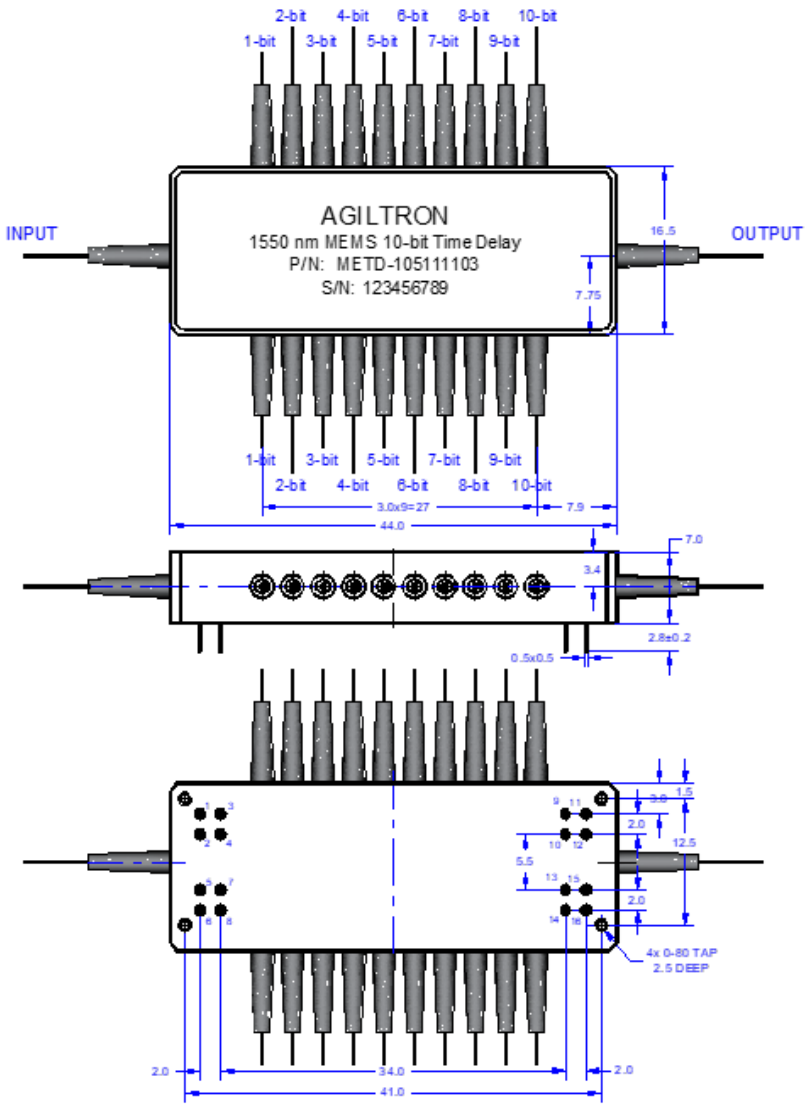
Mechanical Dimensions (mm)



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

Electrical Driving Requirements

The electrical driver is available with USB and/or RS232 control interfaces and Windows™ GUI. It comes with a wall-plug 5V power supply. Please contact us it.

Driving Voltage	Min	Typical	Max	Unit
+V	4.0	4.2	4.5	VDC
Power Consumption (For each MEMS Chip)		170		mW

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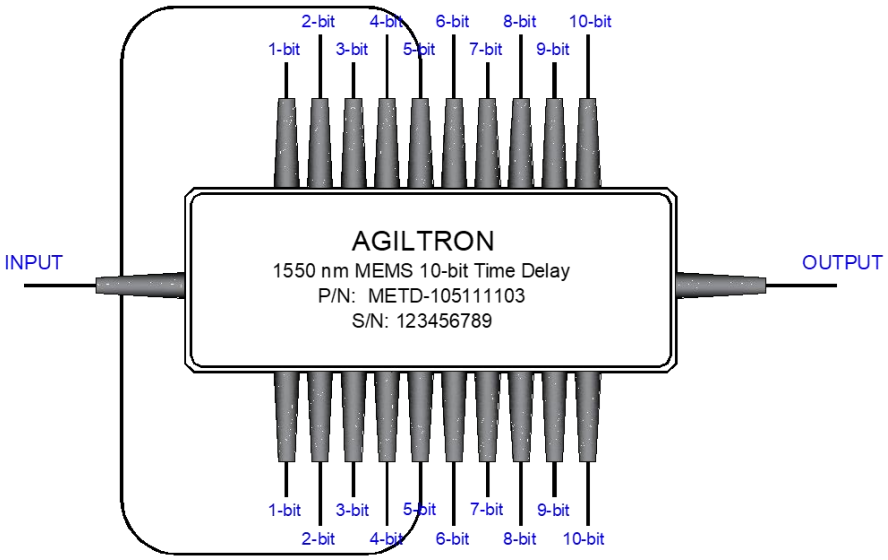
Electrical Driving Requirements

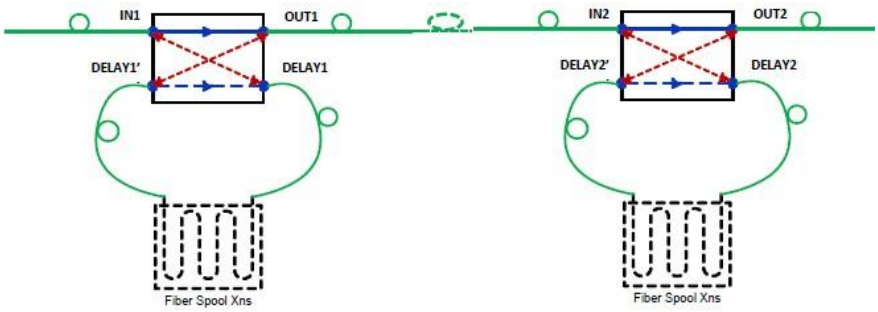
Status	Pin Number										
	1	2	3	4	5	9	10	11	12	13	6, 7, 8, 14, 15
Bypass	H	H	H	H	H	H	H	H	H	H	GND
1st bit	0	H	H	H	H	H	H	H	H	H	
2nd bit	H	0	H	H	H	H	H	H	H	H	
3rd bit	H	H	0	H	H	H	H	H	H	H	
4th bit	H	H	H	0	H	H	H	H	H	H	
5th bit	H	H	H	H	0	H	H	H	H	H	
6th bit	H	H	H	H	H	0	H	H	H	H	
7th bit	H	H	H	H	H	H	0	H	H	H	
8th bit	H	H	H	H	H	H	H	0	H	H	
9th bit	H	H	H	H	H	H	H	H	0	H	
10th bit	H	H	H	H	H	H	H	H	H	0	

Delay Path Definition: ex. 5th-bit path diagram



Optical Path Diagram

Switchable fiber loops in series



The variable time delay module selectively routes optical signals through N fiber segments having different lengths. Each fiber segment is defined to have the delay as

$$\Delta T_i = 2^{(i-1)}\delta T,\ i = 1, 2, ..., N$$

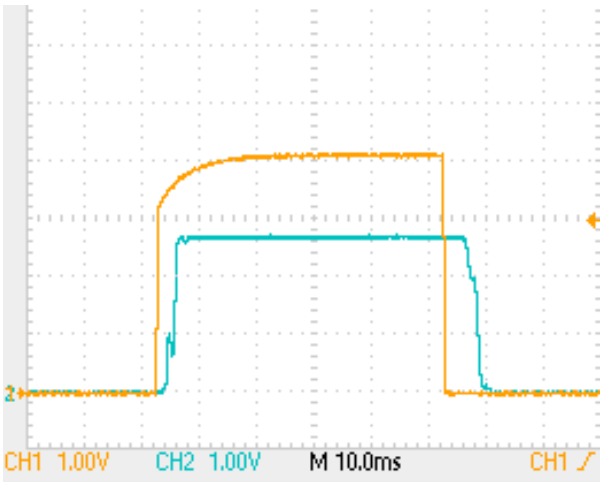
Where δT is the increment of time delay. Therefore, the module provides N-bit of digitally variable time delay, having the total time delay as

$$\Delta T_{Total} = (2^N - 1)\delta T$$

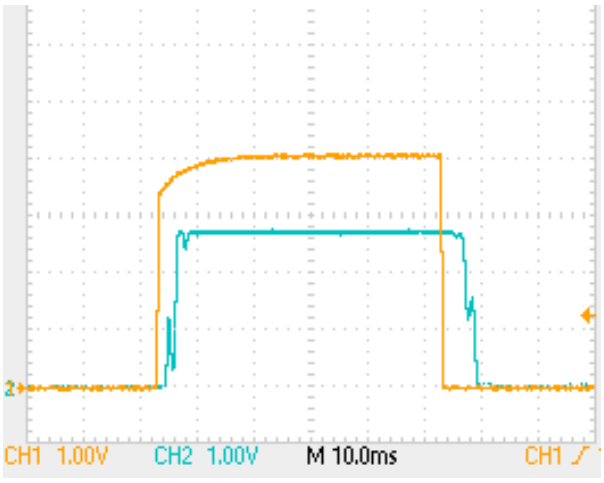
N and δT are defined by the customer.

Fiber Length = delay time * index of fiber (index of fiber ~1.456)

Typical Switching Rise/Fall at -40°C and 70°C

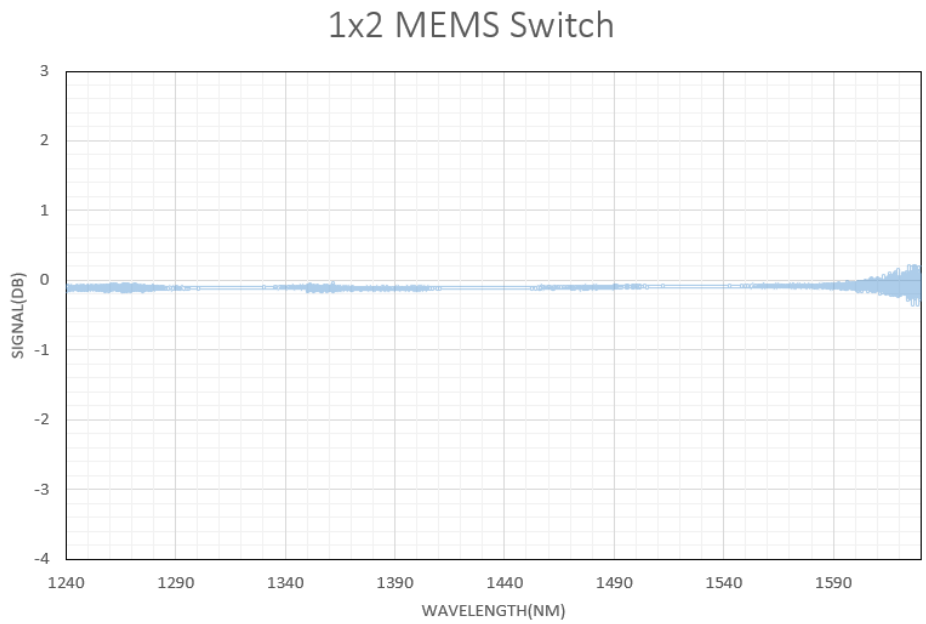


-40 °C



+70 °C

Typical Insertion Loss vs Wavelength (1240-1630nm)



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Ordering Information (Part Number)

	☐☐	☐	☐	☐	☐	☐	0	☐
Prefix	**Type**	**Wavelength**	**Configuration**	**Switch type**	**Fiber Type**	**Fiber Cover**	**Delay Range**	**Connector[1]**
METD-	2-Bit = 02 3-Bit = 03 4-Bit = 04 5-Bit = 05 6-Bit = 06 7-Bit = 07 8-Bit = 08 9-Bit = 09 10-Bit =10 Special=0	1260~1620 =1 Special=0	Standard = 1 Inversion = 2 Special = 0	Non-latching=2 Special=0	SMF-28=1 PM 1550=B PM 1310=D PM 980=E PM 850=F Special=0	Bare fiber = 1 0.9mm tube = 3 Special = 0	Customized=0	None=1 FC/PC=2 FC/APC=3 SC/PC=4 SC/APC=5 ST/PC=6 LC/PC=7 Special=0

[1]. 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.

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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Command List

Baud rate: 9600-8-N-1

CMD: Set Delay Bit:
0x01 0x14 <high byte> <low byte>
<high byte>:

Bits	7	6	5	4	3	2	1	0
Value	0	0	0	0	0	0	Bit 9 Enable	Bit 8 Enable

<low byte>:

Bits	7	6	5	4	3	2	1	0
Value	Bit 7 Enable	Bit 6 Enable	Bit 5 Enable	Bit 4 Enable	Bit 3 Enable	Bit 2 Enable	Bit 1 Enable	Bit 0 Enable

For each Bit X enable: 0 means Bit Disable, 1 means Bit Enable

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