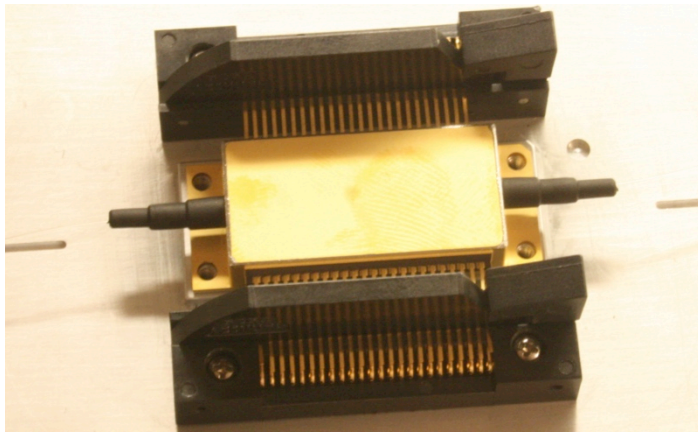


TTD-S1 devices represent a breakthrough in optical time delay technology, providing broadband tunable delay, suitable for high spurious free dynamic range (SFDR) systems, and timing applications. Each TTD-S1 device includes 40 independently tuned microresonators coupled to an input/output waveguide. These Silicon Photonics devices can provide True Time Delay (TTD) for Phased Array systems; Radar, Communications, Electronic Warfare, MMW Imaging, and Multi-Function Systems. The state of the art nanophotonic devices utilize MPs patented Balanced SCISSOR<sup>1</sup> and Balanced Thermal Tuning<sup>2</sup> concepts to provide broad bandwidth, tunable time delay with fast switching and no long term thermal transients. The patented Separate Carrier Tuning<sup>3</sup> concept provides 5x to 10x (Delay x BW) improvement in high frequency RF Photonic Systems.



## 48 Pin Hermetic Butterfly Package

- Thermoelectric Cooler (TEC) and 10kΩ Thermistor
- Polarization Maintaining (PM) Fiber Pigtails
- 48 Pin Ceramic Package, 0.05" Pin Spacing
- Options for Tuning Speed/Power and Coupling Loss

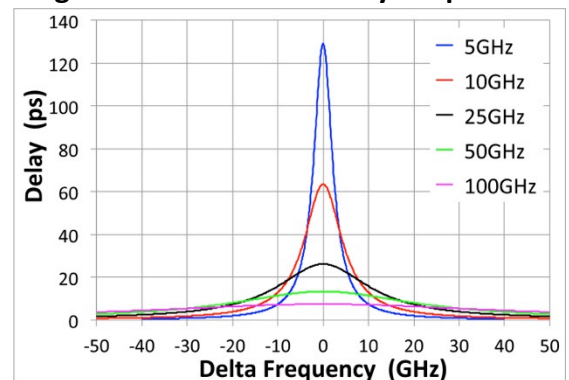
## Preliminary Specifications

Operating Wavelength Range	1530 – 1565 nm		
Delay Loss	2 dB/ns		
Device Coupling Loss Options	2 & 4 dB Total		
Microresonator Performance <sup>4</sup>	Bandwidth	$\Delta$ Delay	
	TTD-S1-005	5 GHz	125 ps
	TTD-S1-010	10 GHz	60 ps
	TTD-S1-020	25 GHz	25 ps
	TTD-S1-050	50 GHz	12 ps
	TTD-S1-100	100 GHz	6 ps

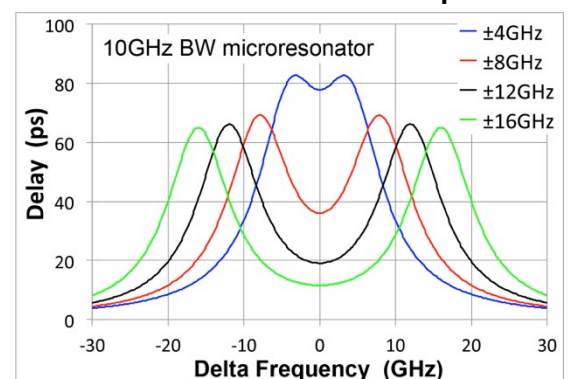
## Key Features

- Broadband Tunable Time Delay<sup>1</sup>
- Linear Device – No SFDR Degradation
- Ultra-Low Loss for High SFDR Systems
- Designed for High Optical Power Operation
- Various Bandwidth Options; 5 – 100 GHz
- Fast Thermal Tuning (down to 10μs)

## Single Microresonator Delay Responses



## Balanced SCISSOR Concept<sup>1</sup>

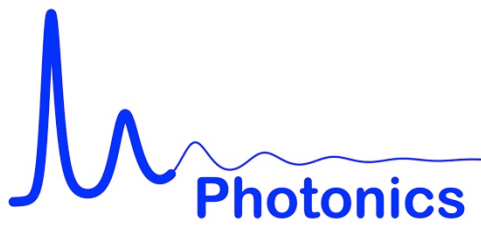


1 - US 7,831,119, Nov 2010, Tunable Optical Group Delay based on Microresonator Structures.

2 - US 8,406,586, March 2013, Tunable Optical Group Delay.

3 - US 7,558,450, July 2009, Microwave Photonic Delay Line with Separate Tuning of the Optical Carrier.

4 - Bandwidth is the -3dB point of the single microresonator delay versus frequency curve.  $\Delta$ Delay is at the peak of the delay.

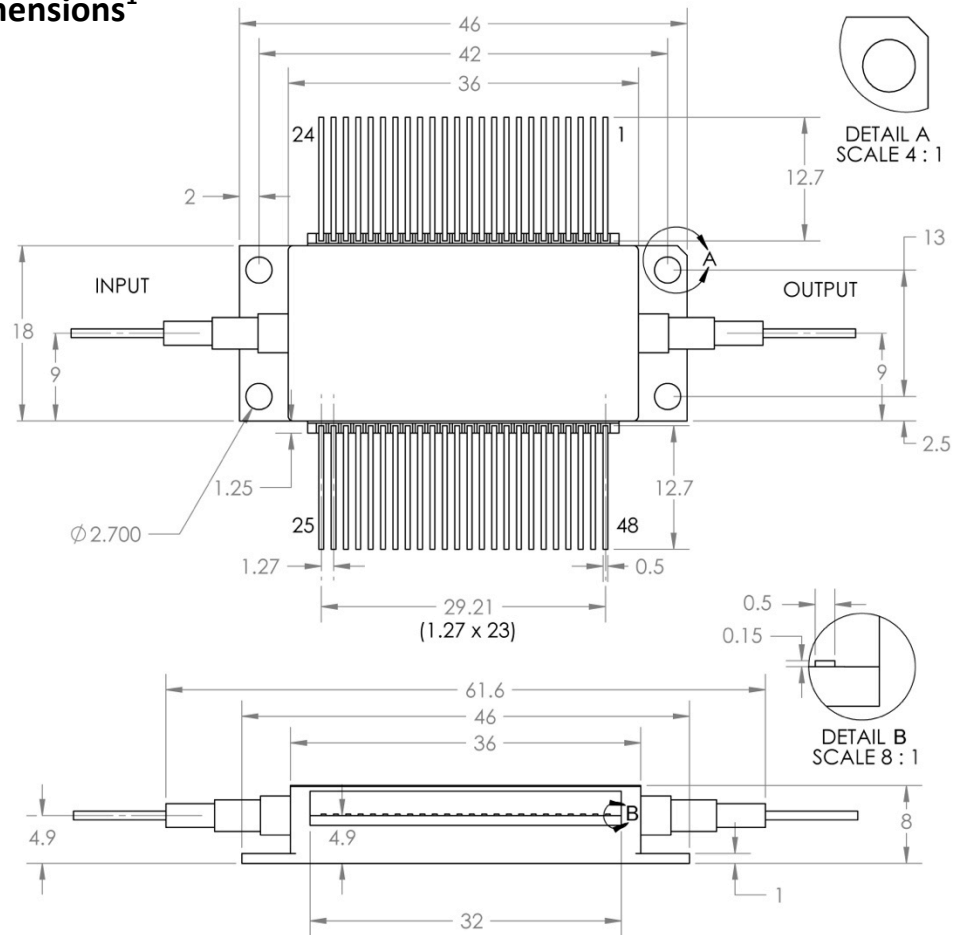


# Optical True Time Delay (TTD) Devices

Preliminary Data Sheet: TTD-S1-XXX

## Device Pin Assignments and Dimensions<sup>1</sup>

1 <sup>2</sup>	TEC (+)	48	TEC (-)
2	Ring 1	47	Ring 40
3	Ring 2	46	Ring 39
4	Ring 3	45	Ring 38
5	Ring 4	44	Ring 37
6	Ring 5	43	Ring 36
7	Ring 6	42	Ring 35
8	Ring 7	41	Ring 34
9	Ring 8	40	Ring 33
10	Ring 9	39	Ring 32
11	Ring 10	38	Ring 31
12	Ring 11	37	Ring 30
13	Ring 12	36	Ring 29
14	Ring 13	35	Ring 28
15	Ring 14	34	Ring 27
16	Ring 15	33	Ring 26
17	Ring 16	32	Ring 25
18	Ring 17	31	Ring 24
19	Ring 18	30	Ring 23
20	Ring 19	29	Ring 22
21	Ring 20	28	Ring 21
22	Chip Heater	27	NC
23	Case Therm. <sup>3</sup>	26	TTD Therm. <sup>3</sup>
24	GND	25	GND



<sup>1</sup> Suggested Sockets for Device: Azimuth Electronics 5253-050-24 or 5254-050-24 (low profile).

<sup>2</sup> Pin 1 is marked by a bevel in the housing base (Detail A).

<sup>3</sup> Thermistors are 10kΩ. 'Case Therm.' measures case temperature; 'TTD Therm.' measures TTD chip Temperature.

**Drive Requirements** – contact MP.