Variable RF-Photonic Time Delay System

up to 40 GHz, ms long delay, ns fast delay change, 25-bit highest resolution

The Variable RF-Photonic Time Delay system (RPTD) is an all-in-one turn-key unit that provides true-time delay with convenient RF input/output without the need for pre or post-RF amplifiers. Perfected over 15 years, it uniquely features a long delay of up to ms, low (ms) to ultra-fast (ns) delay variation speed, up to 25 bits high resolution, and high RF frequency of up to 40 GHz. Internally, the RF signal is converted to an optical signal and transmitted over a fiber optic link to the receiver, where it converts back to an RF signal. Signal delay time can be digitally varied by switching to pass through N fiber segments, therefore providing N-bit resolution. Delay length and link performance can be tailored to meet customer-specific requirements with great flexibility. Our unique optic amplifiers with short intrinsic delay are used in this unit to compensate for loss through long fiber loop segments and switches. The system has the reliability function of built-in temperature sensors and checking the switchable delay segments. USB/GUI or RS232 interface is a standard, while high-speed switching is controlled by TTL through a D connector. A front touchscreen display is also an option. The system delivers unmatched performance for radar testing, signal processing, phased array antennas, and phase noise testing with greater flexibility than traditional coax or waveguide solutions

Features

- Switching Option Available
- Smaller Size and Less Weight
- 0.1 ~ 40 GHz Bandwidth
- Flat Phase Response
- Minimal Triple-Transit Echoes
- Low Link Loss Options
- Low-Temperature Sensitivity

Applications

- Radar System Testing
- Phased Array Antennas
- Signal Processing
- Electronic Warfare (EW) Systems

Specifications [1]

Parameter		Min	Typical	Max	Unit
Frequency Range		0.1	20	40	GHz
Delay Range		0.1		1000	μsec
Delay Accuracy [2]		0.1	1		ns
Delay Increment		0.1			ns
Delay Resolution			20	25	Bit
System Intrinsic Delay [3]			100	200	ns
Delay Changing Time	MEMS type		10000	20000	μsec
	CL type		50	100	
	NS type		0.1	0.3	
Changing Repetition Rate	MEMS type		0.01	0.02	kHz
	CL type		1	2	
	NS type		100	5000	
RF Insertion Loss [4]			0	10	dB
RF Response Flatness (within 1GHz)			± 0.5		dB
RF Input Level			-10dBm	0 [5]	dBm
SFDR			90		$dB/Hz^{2/3}$
VSWR[4]			1.5:1	1.8:1	
Noise Figure [4]			32	40	dB
Operating Temperature		0		50	ºC
Storage Temperature		-40		80	ºC
Power Supply		110		240	AVC
Power Consumption				250	W
Size			19" mount rack		

Notes:

[1]: These specs generically cover the achievable performances, such as in an RPTD system with 20Bit, 20GHz, and 0.1ms of delay in max, which will be finalized in detail for the RPTD system per the customer's requests of RF frequency, delay bit resolution, switch type, maximum delay.

[2] It is defined @ maximum delay <=10us.

[3] Depending on the bit number N and switch type, such as 100ns for 19-bit, 80ns for 17-bit, and 70ns for 16-bit in MEMS type.

[4]: It is defined @ 20GHz and 16-bit as well as 100us delay in max.

[5]: Insertion loss could be ~10dB.

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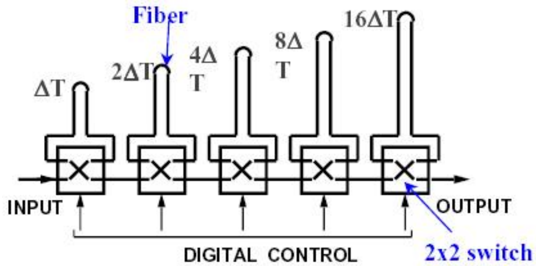
Optical Path Diagram

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

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

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

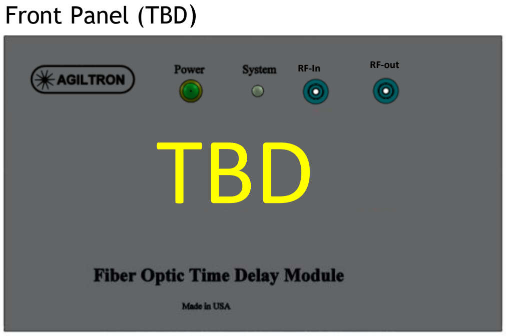
$$\Delta T_{Total} = (2^N - 1)\delta T$$

N and δT are defined by the customer.

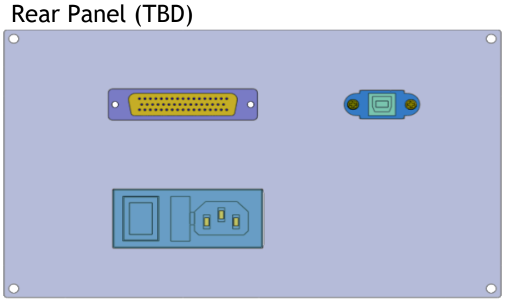
Enclosure Dimension (mm)

Typical 10U 19" rack for 16-19 bit system with the maximum delay of 0.1ms.

Front Panel (TBD)



Rear Panel (TBD)



a. Width of panel:	482mm
b. Width of rack:	420mm
c. Max. deep of rack:	550mm

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Ordering Information

	□□	□	□	□	□	□	□	□
Prefix	**Resolution**	**Frequency**	**Package**	**Control [1]**	**Switch Type**	**LCD Display [2]**	**Max Delay**	**RF Connector**
RPTD-	19-bit = 19 17-bit = 17 16-bit = 16 15-bit = 15 14-bit = 14 13-bit = 13 12-bit = 12 11-bit = 11 10-bit = 10 9-bit = 09 8-bit = 08	0.1 ~ 6GHz = 1 1 ~ 20GHz = 2 1 ~ 40GHz = 3 Special = 0	2RU = 2 4RU = 4 6RU = 6 10RU = L 12RU = U 14RU = X Special = 0	TTL = 1 USB = 2 RS232 = 3 Special = 0	MEMS = M CLSW = C NSSW = N	No = 1 Yes = 2 Special = 0	100µs = S 1ms = U Special = 0	SMA = 1 K type = 2 Special = 0

[1]: Repeat rate > 2kHz must use TTL control.
[2]: The functionality will be defined per the customer's request later.

Laser Safety

This product meets the appropriate standard in Title 21 of the Code of Federal Regulations (CFR). FDA/CDRH Class 1M laser product. This device has been classified with the FDA/CDRH under accession number 0220191. All versions of this laser are Class 1M laser products, tested according to IEC 60825-1:2007 / EN 60825-1:2007. An additional warning for Class 1M laser products. For diverging beams, this warning shall state that viewing the laser output with certain optical instruments (for example eye loupes, magnifiers, and microscopes) within a distance of 100 mm may pose an eye hazard. For collimated beams, this warning shall state that viewing the laser output with certain instruments designed for use at a distance (for example telescopes and binoculars) may pose an eye hazard.

Wavelength = 1.3/1.5 µm.

Maximum power = 30 mW.

*Caution - Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.
*IEC is a registered trademark of the International Electrotechnical Commission.

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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.

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