

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		3000	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 Speed	MEMS type	10	20	msec
		50	100	μsec
		100	300	nsec
RF gain ^[4]	-10	0	10	dB
RF Response Flatness (within 1GHz)		± 0.5	± 1.0	dB
RF Input Level		0		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	°C
Storage Temperature	-40		80	°C
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, 18GHz, 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 ≤10μs.

[3] Depending on the bit number N, such as 100ns for 16-bit, 80ns for 16-bit, and 70ns for 15-bit.

[4]: It is defined @ 10GHz and 16-bit as well as 100μs delay in max.

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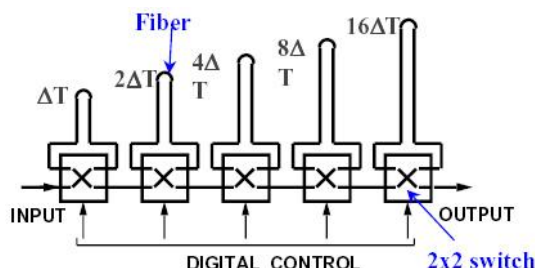
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Optical Path Diagram

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

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

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)

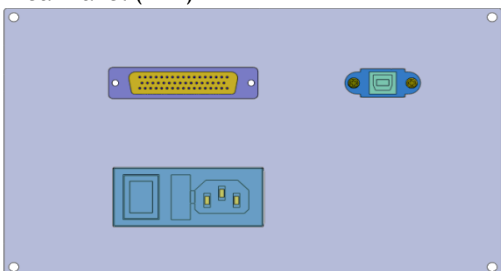
Typical 6U 19" rack for 16-19 bit system with the maximum delay of 0.1ms.

Front Panel (TBD)



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

Rear Panel (TBD)



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Ordering Information (Part Number)

Prefix	Resolution	Frequency	Package	Control ^[1]	Switch Type	LCD Display	Max Delay	RF Connector ^[2]
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 4-bit = 04	0.1 ~10GHz = 1 0.1 ~20GHz = 2 0.1 ~40GHz = 3 3GHz = 4 5GHz = 5 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 NS 100kHz = N NS 500kHz = F Special = 0	No = 1 Yes = 2 Special = 0	100μs = S 10μs = 1 50μs = 2 150μs = 3 200μs = 4 250μs = 5 300μs = 6 350μs = 7 400μs = 8 ... 1ms = U Special = 0	SMA = 1 K type = 2 Special = 0

[1]: Repeat rate > 2kHz must use TTL control.

[2]. 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.

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.