

OPDL Delay Line

## MPS Fiber Optic Delay Line Systems



### High Performance Fiber Optic Delay Lines Enable Accurate Time delays from picoseconds to 5 milliseconds.

The Microwave Photonic Systems Optical / Photonic Delay Line (OPDL) family of products exhibits industry leading performance with the smallest volumetric footprints available at economical price points.

Microwave Photonic Systems has been a leader in the design and manufacture of high performance optical delay lines for years and can currently support almost any delay line system requirement. These fiber optic delay products, leverages MPS's field proven optical packaging methodologies, proprietary control software, and RF / Photonic integration techniques.

The OPDL product line can provide time delay capabilities for Radio Frequency (RF) input signals with instantaneous bandwidths from DC to over 60 GHz, are packaged in modular enclosures, as well as rack chassis configurations, and can support time delays exceeding 5 ms.

Members of the OPDL product family can be configured with multiple time delay segment values. The delay values of the segments can either be configured as discrete time delay values, or can be configured as a binary  $2^n$  series. The binary  $2^n$  series configuration provides the ability to select delay values over a broader range with smaller time increments. Delay values are visible on the front panel display, of some models, and can be incremented through the use either the front panel key pad or remotely using the digital communications interface.

The OPDL products can also be enhanced through the addition of integrated Variable Optical Attenuators (VOA) and Optical amplifiers which allow the operator to adjust and balance the system gain profile. Performing these gain adjustments in the optical domain results in no gain slope variation in the RF signals. This yields a more consistent system performance than can be achieved with traditional RF variable attenuators at high frequencies.

Contact MPS for additional details and available options.

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DS-DelayLine Rev10



### Applications:

- Test & Calibration Labs
- Radar Target Simulation
- Moving Target Indicators
- Target Simulators
- RADAR Warning Receivers
- EW/ECM/ECCM Systems
- Signal Processing
- Phased Array Antenna Systems
- Multipath Simulators
- Redundant Path Equalization
- Phase Noise Testing
- BIT - Built in Test Systems

### Features:

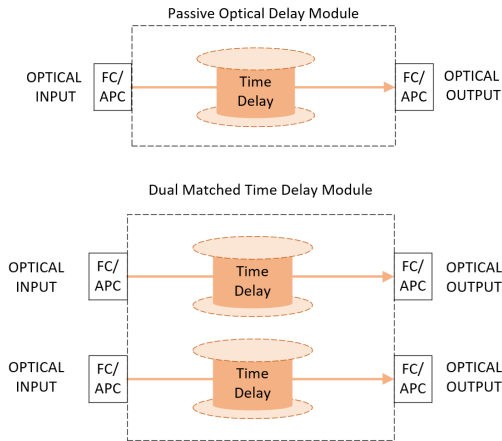
- Wide Bandwidth DC-60 GHz
- Time Delays to 5 milliseconds
- High Dynamic Range
- Fixed or Variable Delay
- High Phase Linearity
- Virtually No Triple Transit Response
- No EM Emissions or Susceptibility
- Temperature and Vibration Insensitive
- Modulation Type Agnostic
- Supports Multiple Optical Fiber Types
- Plug and Play Operation
- Supports Military Environments
- Small Size and Weight
- Various Mechanical Package Options
- 2 Year Limited Warranty



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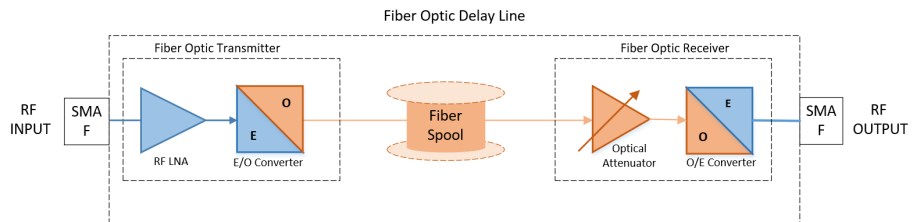
## General OPDL System Features and Configurations

Fiber optical delay lines have become the de facto standard for all high performance applications that need to support microwave RF frequencies. These products can be configured to support a wide range of system requirements and are manufactured in many mechanical formats that support ground, shipboard, aerospace applications and environments. In general, MPS OPDL products can be classified into three product groups.

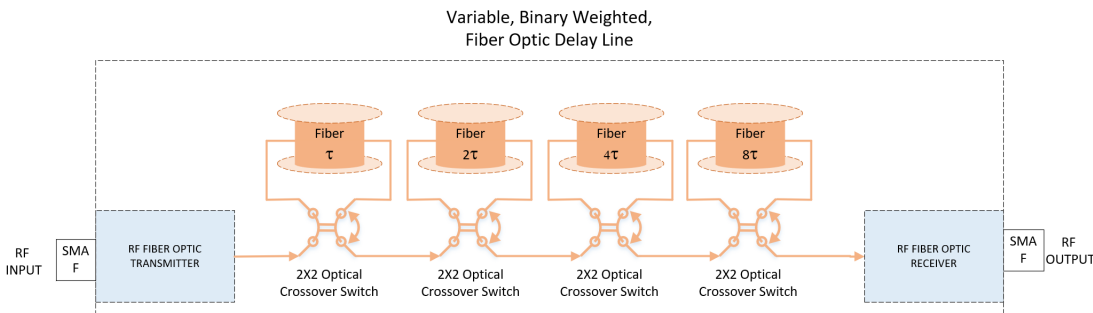


**Passive Fiber Spools** - MPS manufactures custom passive fiber spools for a diverse customer base, as well as for internal use. Passive fiber spools contain no active components and the designed time delay is measured from the input optical connector to the output optical connector. These fiber spools can be constructed from many different optical fibers including: standard single mode, polarization maintaining, dispersion shifted, multi-mode, etc. Our in-house fiber winding and terminating capability allows us to customize the fiber type, length, and dispersion properties to individual applications. Fiber spools can be ordered in matched dual spool configurations which exhibit exceptional spool to spool time delay variations.

**Active Delay Line Modules** - A active delay line module incorporates an fiber optic transmitter, a precision fiber spool and a fiber optic receiver. A typical simplified block diagram is shown above. The technology used to perform the electrical to optical conversion may vary due to the desired operating frequency range and the total time delay requirement, but the basic operation is unchanged. In cases where extremely low noise figures are desired, a low noise amplifier (LNA) may be used in front of the E/O converter to reduce the overall system noise figure and to normalize the link gain. An optical attenuator may be used before the O/E converter to provide link gain control which is independent from the RF frequencies. Many internal amplifier, VOA, Optical and RF amplifiers can be supported to optimize performance.



**Switched Delay Line Modules** - Multiple delay line spools can be incorporated into an integrated rack chassis. These spools are electronically switched to provide a calibrated variable time delay system. The spools can be configured as individual time delays or configured in a binary weighted, configuration as shown. This configuration provides  $2^n$  delays where n is the number of fiber spools and the shortest spool defines the minimum time step. MEMS optical switches are standard but LiNbO3 switches can be incorporated where submicrosecond switching times are required.



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Typical Performance Specifications

MP-5000 Flange Mounted RF Photonic Delay Line Series

RF/ Optical Link Specifications

Delay Type	Fixed
RF Bandwidth	10 MHz to 18 GHz
RF Link Gain	0 dB typ. , other gains available
Noise Figure	20dB typ, dependent on delay
Delay Range	0.002 to 40 uSec
Delay Accuracy	+/- 1% standard, higher accuracy on request
Spur Free Dynamic Range	100 dB/Hz <sup>2/3</sup> typ.

General Specifications:

Optical Wavelength	1310nm, 1550nm
Fiber Optic Cable Type	SM, PM, DSF, DCF, Others
Storage / Operating Temp	-40°C to +85°C / -40°C to +85°C
Dimensions	6.75" x 6.00" x 2.38"



MP-6000 Rack Mount RF Photonic Delay Line Series

RF/ Optical Link Specifications

Delay Type	Fixed and Variable
RF Bandwidth	10 MHz to 22 GHz
RF Link Gain	0 dB typ. , other gains available
Noise Figure	20dB typ, dependent on delay
Delay Range	0.002 to 500 uSec
Delay Accuracy	+/- 1% standard
Spur Free Dynamic Range	100 dB/Hz <sup>2/3</sup> typ.

General Specifications:

Optical Wavelength	1310nm, 1550nm
Fiber Optic Cable Type	SM, PM, DSF, DCF, Others
Storage / Operating Temp	-40°C to +85°C / -40°C to +60°C
Dimensions	19" 3RU with optional Ext Cabinet



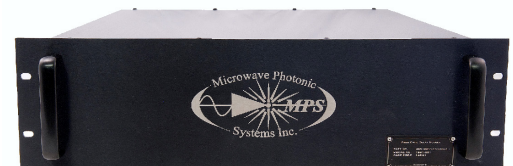
MP-8000 Rack Mount RF Photonic Delay Line Series

RF/ Optical Link Specifications

Delay Type	Fixed and Variable
RF Bandwidth	10 MHz to 60 GHz
RF Link Gain	0 dB typ. , other gains available
Noise Figure	20dB typ, dependent on delay
Delay Range	0.002 to 5000 uSec
Delay Accuracy	+/- 1% standard
Spur Free Dynamic Range	100 dB/Hz <sup>2/3</sup> typ.

General Specifications:

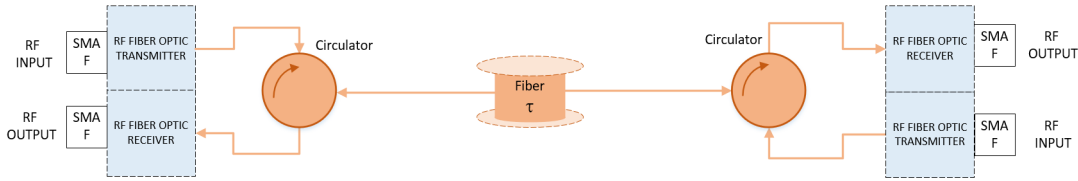
Optical Wavelength	1550nm
Fiber Optic Cable Type	SM, PM, DSF, DCF, Others
Storage / Operating Temp	-40°C to +85°C / -40°C to +60°C
Dimensions	19" 1RU with optional Ext Cabinet



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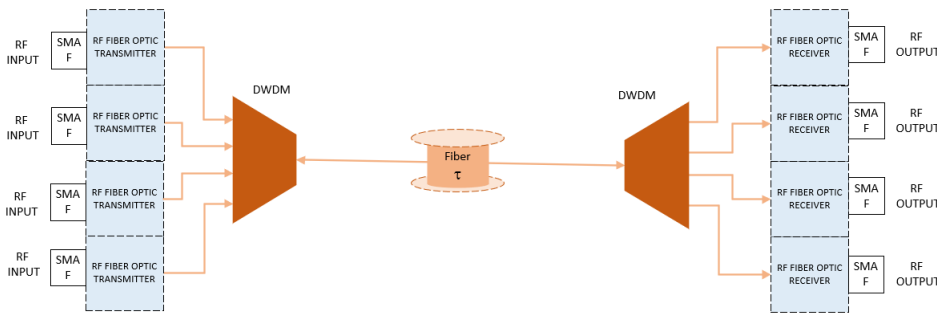
Specialized and Custom Configurations

One of Microwave Photonic Systems core competencies is it's ability to design and develop custom hardware and systems solutions on extremely aggressive program schedules. In fact at MPS we say, **"Custom IS Standard"**. We have leveraged the core technologies of the OPDL product portfolio to develop customized system solutions for both industrial and defense applications. Some of the possible product variants are highlighted below.



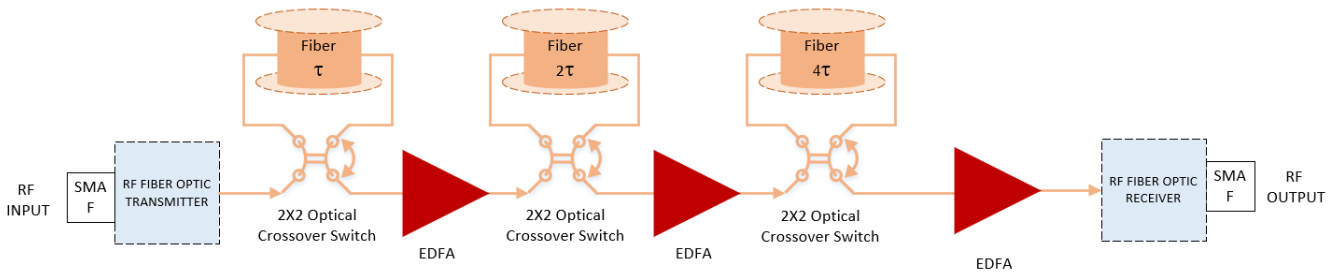
**Bidirectional Delay Line**

This configuration is useful for simulating a full duplex transmission link from two locations



**Wavelength Multiplexed Delay Line**

Multiple RF signal channels can be evaluated simultaneously using a common delay fiber spool



**Switched Equal Amplitude Delay Line**

Optical Amplifiers can be used to equalize link gain and compensate for loss when very long fiber delays are required.

The OPDL line of Optical Delay Line Products is adaptable to almost any application. MPS can supply both off-the-shelf and custom equipment configurations to meet any need. Please contact MPS with your specific program requirements.