

## About Pharad

Founded in 2003 and located in Hanover, Maryland, Pharad is a customer focused company carrying out innovative research, development, and manufacturing in the areas of highly efficient, electrically small antennas and RF-over-Fiber technologies. Pharad operates an ISO9001: 2008 manufacturing facility that delivers high quality production volume products to a wide range of government and commercial customers. In response to increased customer demand, Pharad formed the **octane**® division in 2007 and we now sell our products through the **octane**® brand.

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Made in USA

# RF over Fiber Systems



## Applications

- Ultra Wideband Analog Communications
- Fiber Optic Antenna Remoting
- Wireless Backhaul
- SATCOM
- Terrestrial Communications
- Electronic Warfare
- SIGINT/ISR
- RF Distribution
- Secure Communications

## Features

- 3 MHz to 50 GHz Operating Bandwidths
- 1550 nm Wavelength
- High Spurious-Free Dynamic Range
- Low Noise Figure
- Low Loss
- WDM Compliant
- Power and Status LED's
- Remote Status/Alarm Monitoring
- 90 – 264 VAC Power
- 1U Rack and Custom Packaging Available
- Transceiver, Transmitter, and Receiver Module Configurations

## High Performance RF Photonic Links

Pharad has developed a comprehensive family of high performance RF over Fiber products that meet the challenging requirements of today's modern communication systems. Our product line comprises analog fiber optic transceivers, transmitters and receivers to support the high dynamic range and low loss transport of RF signals over optical fiber links.

The transport of RF signals over optical fiber offers numerous benefits and performance improvements over links employing conventional RF coaxial cables and waveguide, including reduced cabling size and weight, low loss over a wide RF bandwidth, and improved signal isolation. Pharad's RF over Fiber products employ proprietary techniques to achieve the best gain, noise figure, and spurious-free dynamic range (SFDR) performance available. They are the ideal solution for supporting the high fidelity uni- or bi-directional transport of wideband RF signals over an optical fiber link or network.

Pharad's RF over Fiber link products are available in many frequency ranges and packaged as a transceiver module in addition to individual transmitter and receiver configurations. The analog optical links provide electrical-to-optical (E/O) and O/E conversion of RF signals over ultra wideband operating bandwidths covering 3 MHz to 50 GHz. Fiber-optic remoting of a multitude of RF signals can be supported using a single set of transmitter and receiver modules with a multi-band operating frequency range.

### Examples of RF over Fiber Products\*

Transceiver Model Number <sup>^</sup>	Operating Frequency	RF Gain <sup>†</sup> (Typ)	Noise Figure <sup>†</sup> (Max)	SFDR <sup>‡</sup> (Min)
PXR-005-030	0.5 - 3 GHz	0 dB	12 dB	105 dB-Hz <sup>2/3</sup>
PXR-001-120	0.003 - 12 GHz	10 dB	10 dB	103 dB-Hz <sup>2/3</sup>
PXR-004-155	0.4 - 15.5 GHz	4 dB	8 dB	108 dB-Hz <sup>2/3</sup>
PXR-001-190	0.003 - 19 GHz	15 dB	7 dB	104 dB-Hz <sup>2/3</sup>
PXR-020-200	2 - 20 GHz	10 dB	10 dB	105 dB-Hz <sup>2/3</sup>
PXR-100-200	10 - 20 GHz	0 dB	10 dB	114 dB-Hz <sup>2/3</sup>
PXR-260-400	26 - 40 GHz	5 dB	7 dB	108 dB-Hz <sup>2/3</sup>
PXR-030-400	3 - 40 GHz	10 dB	10 dB	104 dB-Hz <sup>2/3</sup>
PXR-030-500	3 - 50 GHz	5 dB	10 dB	98 dB-Hz <sup>2/3</sup>

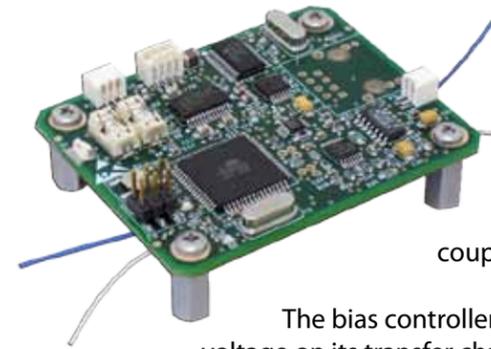
\* Custom frequency ranges and optimized performance specifications also available.  
<sup>^</sup> Transmitter and Receiver configurations designated as PTX and PRX.  
<sup>†</sup> RF Link Gain, Noise Figure, and SFDR specified with optical loss over 1 meter of fiber.  
<sup>‡</sup> SFDR specified over single octave.

RF Photonic Transceiver 1U 19" Packaging: Front and Rear Panels



## Dither-Free Bias Controllers

Pharad's Dither-Free Bias Controllers for analog modulators have been developed for OEM applications. They provide accurate and highly stable bias voltage control of electro-optic modulators used in externally modulated analog photonic links and operate with modulators having both periodic and non-periodic transfer functions. As the modulator bias point drifts over time, the bias controller automatically adjusts the bias voltage to maintain its set point.



The non-dither based control operates in conjunction with on-board inline optical power monitors and ensures unwanted pilot tones do not impact link performance; they are the ideal solution for analog applications. The power monitors also eliminate the need for external optical couplers, greatly simplifying experimental set-ups.

The bias controllers enable continuous tuning of the modulator bias voltage on its transfer characteristic via a standard RS-232 communications interface. Ethernet control of the modulator bias setting is also available as an option.

## Photonic Cross-Connect

Pharad has developed a Photonic Cross-Connect that interfaces with our high performance RF over Fiber products and supports the low loss optical routing, switching and distribution of multiple RF over fiber signals. It replaces conventional RF switches for the routing of RF signals to different locations and enables dynamic, real-time reconfiguration of the RF photonic links.

The module incorporates a non-blocking, transparent optical switch matrix that



can switch any of four input optical signals carrying RF signals to any of four output ports, as required in a particular application. The Photonic Cross-Connect operates independently of the frequencies of the RF signals being transported over fiber. In addition to providing real-time creation and reconfiguration of the photonic signal paths, the Photonic Cross-Connect includes continuous optical power monitoring to ensure reliable operation of the entire system.

## Speciality and Custom Products

Pharad's engineering team has over 50 years of collective experience and leadership in the design and development of high performance RF over Fiber and microwave photonic technologies. We leverage this expertise to create custom photonic products and systems for our customers. As an example, we recently developed a photonic co-site interference mitigation system that can reduce interference between a co-located transmit and receive antenna. The photonic co-site interference mitigation circuit can be readily interfaced with Pharad's high performance wideband analog fiber optic links and adds a unique new capability to our existing line of RF over Fiber technology products.

## Features

- Precise Bias Control of Optical Modulators
- Dither-Free Operation
- No External Optical Couplers Required
- Continuous Tuning

## Applications

- LiNbO<sub>3</sub>, InP, GaAs Modulators

## Options

- Ultra-Compact and Direct Mount Configurations
- Ethernet Control
- Extended Wavelength Range

## Features

- Photonic Switching and Routing of RF over Fiber Signals
- Dynamic Reconfiguration of RF Photonic Link Paths
- Non-Blocking Optical Switch Matrix
- Millisecond Switching Time
- Low Insertion Loss
- RF Frequency Independent
- Optical Power Monitoring
- 4 x 4 Fiber Ports
- Optical Path Configuration and Monitoring via RS-232

## Examples

- Photonic Co-Site Interference Mitigation System
- Integrated Antenna/Modulator Module
- Adaptive Linearized Wideband RF Photonic Link