

Optoplex's Products

for

Fiber Optic Sensing Applications

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Fremont, California

USA

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1. Introduction

Optoplex Corporation is a leading technology company with proprietary optical technologies and products for applications from Telecom, Datacom, Optical Sensing, to Optical Spectral Instrumentations. In addition to commercial applications, Optoplex has been designing and manufacturing high reliability products for fiber sensing applications.

In fiber sensing applications, usually scattering light is measured that is sensitive to the change of the environment conditions, such as temperature, pressure, and stress, etc.

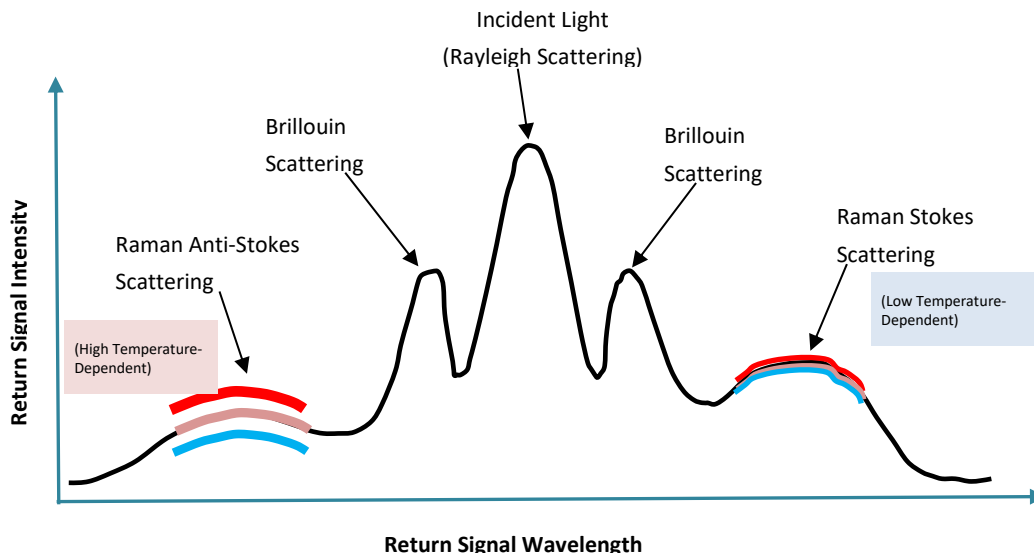


Figure 1. Scattering in fiber sensing

There are two major types of fiber sensing: FBG based fiber sensing and distributed fiber sensing.

Among the distributed fiber sensing, distributed temperature sensing (DTS) has been widely employed in the past ten years while distributed acoustic sensing (DAS) becomes more and more attractive.

DTS uses Raman Anti-Stokes scattering that is temperature dependent (while Raman Stokes scattering is very weakly temperature dependent). Usually 50 μ m multimode fiber (MMF) is used in DTS.

DAS usually uses single-mode-fiber (SMF). The fact that DAS system uses single-mode cable allows obtaining better spatial resolution and reducing noise.

2. Applications

2.1 Schematics of Coherent Detections

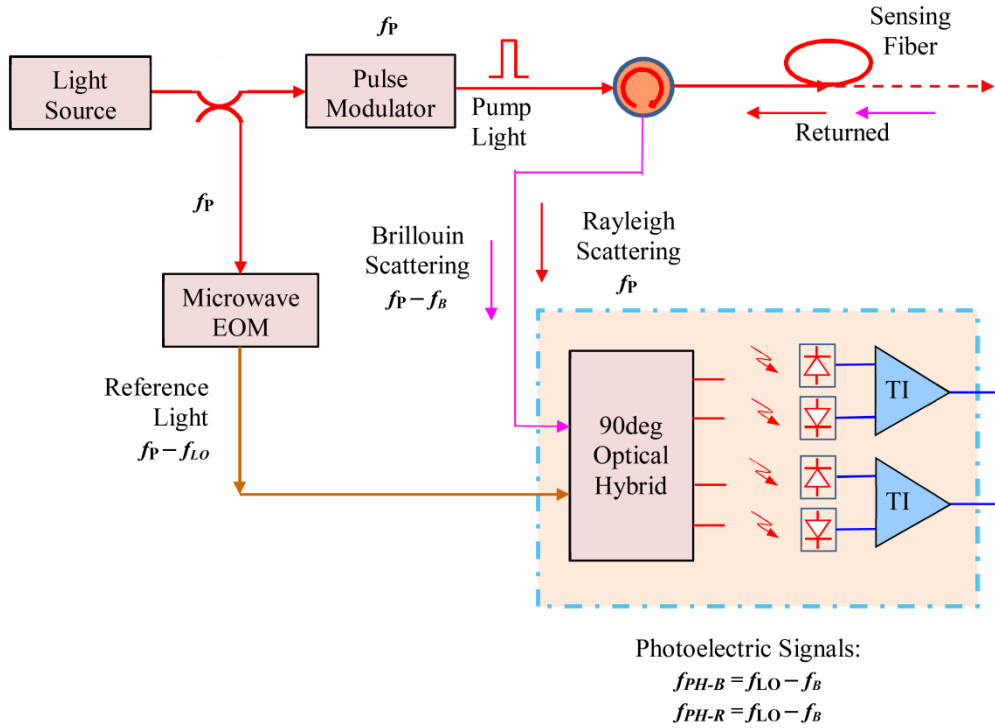


Figure 2.1. A schematic setup of Brillouin scattering fiber sensing system

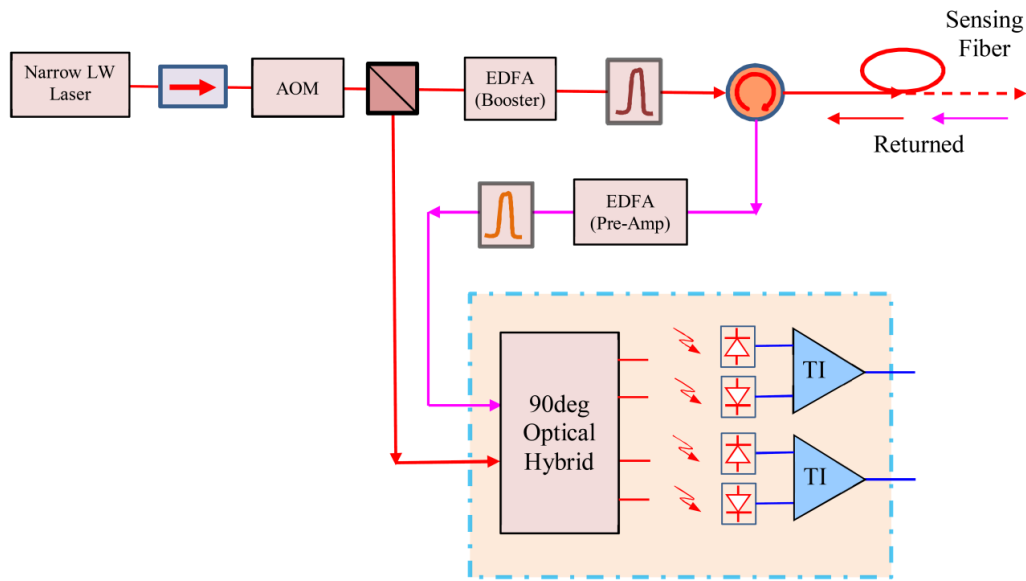


Figure 2.2. A schematic of a phase-sensitive coherent OTDR system

2.2 Examples of Coherent Detection in Distributed Fiber Sensing Applications

Table 2.1, Applications of Distributed Optic Fiber Sensing (DOFS)

Optical Networks	Network Monitoring by OTDR	Geoscience & Seismic	Seismic & Earthquake
	Network connection fault detection by OTDR		Geo-Mapping
			Geo-Imaging
Oil & Field Services	Reservoir Monitoring	Security	Intrusion Sensing
	Oil & Gas Pipe Monitoring		Event Detection
	Process Monitoring		Fire Detection
Transportation	Traffic Monitoring	Structural Monitoring	Building /Bridge stress monitoring
	Railway Monitoring		Dam/Well pressure monitoring
	Wheel Worn-out Monitoring		
Power Line Monitoring	Temperature Monitoring	Smart City or IoT Monitoring	A combination of communication networks. Pipeline, power grids, security, transportation, and seismic monitoring and management, ...
	Connection Worn-out Monitoring		
	Partial Discharge Monitoring		

3. Optoplex Products for Coherent Detections in Optic Fiber Sensing

3.0 90deg Optical Hybrids and Integrated Receivers for Coherent & Balanced Detections

Table 3.0, 90deg Optical Hybrids and Integrated Receivers

#	Product /Package	Fiber Pigtailed -In/-Out	Fiber Pigtailed - In/PD-Out	Integrated with Balanced Receivers ²⁾
1	90deg Optical Hybrid	x	x	x
2	Polarization-Diversified 90deg Hybrid For Balanced Detections (aka 2x8 Coherent Mixer)	x	x	x
3	Polarization-Diversified 90deg Hybrid For Single-ended Detections (aka 2x4 Coherent Mixer)	x	x	x
4	190deg Optical Hybrid	x	x	x

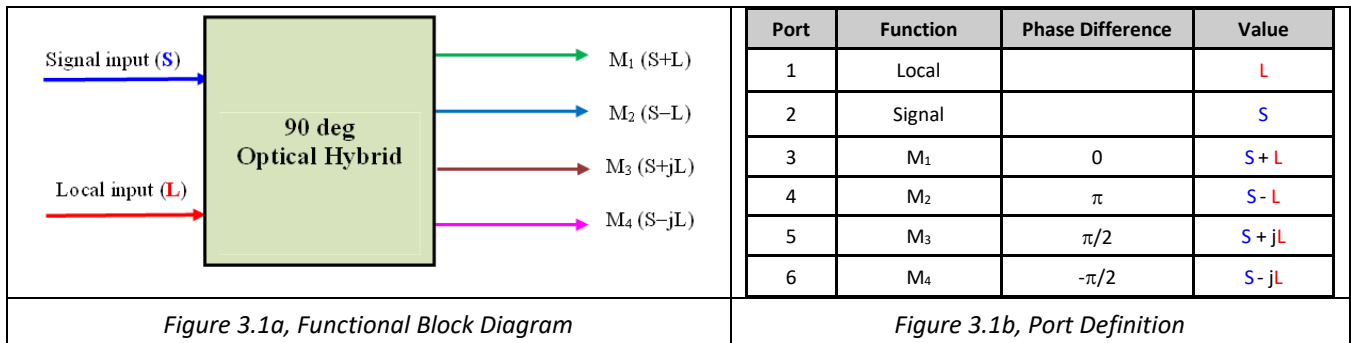
Notes

- 1) X – product available
- 2) For integrated receivers, currently, the available bandwidths are 15, 100, 200, 400, and 700MHz; and 1.2 and 1.6GHz.
- 3) Higher bandwidths of 5GHz and 7GHz will be available soon.

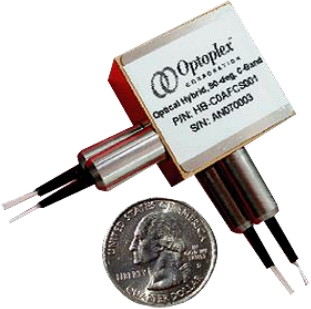
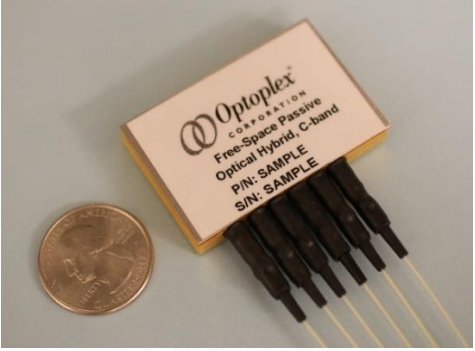
3.1 90deg Optical Hybrid

http://www.optoplex.com/Optical_Hybrid.htm

3.1.1 Product Description



3.1.2 Features

<ul style="list-style-type: none"> • Wavelength Range: C-band, 1310nm or 1064nm • Free-space optics and athermal design • Low insertion loss • Small Skew: < 2ps • I/Q Phase Difference: $90 \pm 10^\circ$ 	<p>Notes:</p> <p>a) Premium grade with I/Q phase: $90 \pm 5^\circ$ available;</p> <p>b) MIL- and Aersospace-grade products are available</p> <p>Contact Optoplex for details.</p>
	
<p>Figure 3.1c, 90deg Optical Hybrid (Special Package)</p>	<p>Figure 3.1d, 90deg Optical Hybrid (Std. Package)</p>

3.1.3, Major Part Numbers of 90deg Optical Hybrids

Table 3.1, List of Major Part Numbers of 90deg Optical Hybrids

	Products	MPN	Wavelength	Fiber-Type		
				Signal-Input	Lo- Input	Outputs
C-Band	90-degree Optical Hybrid, C-Band, SMF for All Ports, Phase 90±10°	HB-C0AFAS002	C-Band	SMF	SMF	SMF
	90-degree Optical Hybrid, C-Band, SMF for All Ports, Phase 90±5°	HB-C0AFAS013	C-Band	SMF	SMF	SMF
	90-degree Optical Hybrid, C-Band, PMF for Input Ports (both Signal- and Lo-), SMF for All Output Ports, Phase 90±10°	HB-C0AFAC016	C-Band	PMF	PMF	SMF
	90-degree Optical Hybrid, C-Band, PMF for Input Ports (both Signal- and Lo-), SMF for All Output Ports, Phase 90±5°	HB-C0AFAC057	C-Band	PMF	PMF	SMF
	90-degree Optical Hybrid, C-Band, PMF for All Input and Output Ports, Phase 90±10°	HB-C0AFAC055	C-Band	PMF	PMF	PMF
	90-degree Optical Hybrid, C-Band, PMF for All Input and Output Ports, Phase 90±5°	HB-C0AFAS066	C-Band	PMF	PMF	PMF
L-Band	90-degree Optical Hybrid, L-Band, SMF for All Ports, Phase 90±10°	HB-L0AFAS094	L-Band	SMF	SMF	SMF
	90-degree Optical Hybrid, L-Band, SMF for All Ports, Phase 90±5°	HB-L1AFAS094	L-Band	SMF	SMF	SMF
	90-degree Optical Hybrid, L-Band, PMF for Inputs; PMF for Outputs, Phase 90±10°	HB-L0AFAP095	L-Band	PMF	PMF	PMF
	90-degree Optical Hybrid, L-Band, PMF for Inputs; PMF for Outputs, Phase 90±5°	HB-L1AFAP095	L-Band	PMF	PMF	PMF
	90-degree Optical Hybrid, L-Band, PMF for Inputs; SMF for Outputs, Phase 90±10°	HB-L0AFAX096	L-Band	PMF	PMF	SMF
	90-degree Optical Hybrid, L-Band, PMF for Inputs; SMF for Outputs, Phase 90±5°	HB-L1AFAX096	L-Band	PMF	PMF	SMF
C+L Band	90-degree Optical Hybrid, C+L Band, SMF for All Ports, Phase 90±10°	HB-T0AFAS101	C+L Band	SMF	SMF	SMF
	90-degree Optical Hybrid, C+L Band, SMF for All Ports, Phase 90±5°	HB-T1AFAS101	C+L Band	SMF	SMF	SMF

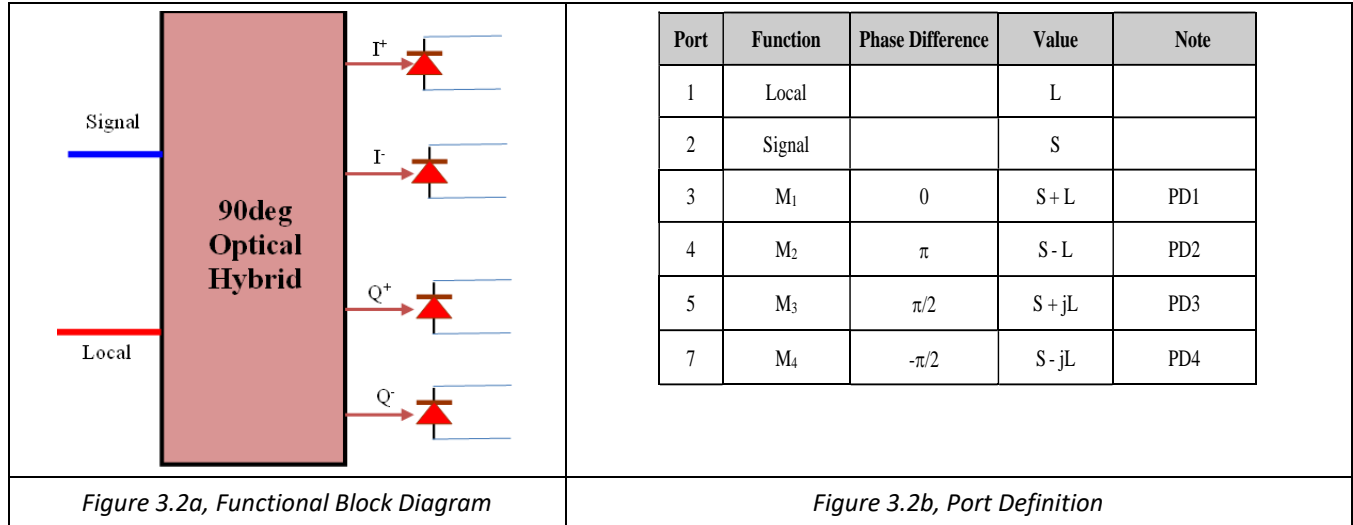
	90-degree Optical Hybrid, C+L Band, PMF for All Ports, Phase 90±10°	HB-T0AFAP102	C+L Band	PMF	PMF	PMF
	90-degree Optical Hybrid, C+L Band, PMF for All Ports, Phase 90±5°	HB-T1AFAP102	C+L Band	PMF	PMF	PMF
	90-degree Optical Hybrid, C+L Band, PMF for Inputs, SMF for Outputs, Phase 90±10°	HB-T0AFAX103	C+L Band	PMF	PMF	SMF
	90-degree Optical Hybrid, C+L Band, PMF for Inputs, SMF for Outputs, Phase 90±5°	HB-T1AFAX103	C+L Band	PMF	PMF	SMF
O-Band	90-degree Optical Hybrid, O-Band, SMF for All Ports, Phase 90±10°	HB-Q0AFAS1310	O-Band	SMF	SMF	SMF
	90-degree Optical Hybrid, O-Band, SMF for All Ports, Phase 90±5°	HB-Q1AFAS1310	O-Band	SMF	SMF	SMF
	90-degree Optical Hybrid, O-Band, PMF for Inputs; SMF for Outputs. Phase 90±10°	HB-Q0AFAX1310	O-Band	PMF	PMF	SMF
	90-degree Optical Hybrid, O-Band, PMF for Inputs; SMF for Outputs. Phase 90±5°	HB-Q1AFAX1310	O-Band	PMF	PMF	SMF
	90-degree Optical Hybrid, O-Band, PMF for All ports. Phase 90±10°	HB-Q0AFAP1310	O-Band	PMF	PMF	PMF
	90-degree Optical Hybrid, O-Band, PMF for All ports. Phase 90±5°	HB-Q1AFAP1310	O-Band	PMF	PMF	PMF
1064nm	90-degree Optical Hybrid, 1064+/-5nm, HI1060 SMF for All Ports, Phase 90±10°	HB-A0AFAS1064	1064nm	HI-1064	HI-1064	HI-1064
	90-degree Optical Hybrid, 1064+/-5nm, HI1060 SMF for All Ports, Phase 90±5°	HB-A1AFAS1064	1064nm	HI-1064	HI-1064	HI-1064
	90-degree Optical Hybrid, 1064+/-5nm, PM Fiber (PM980 Panda) Inputs, HI1060 SMF for Outputs, Phase 90±10°	HB-A0AFAX1064	1064nm	PM980	PM980	HI-1064
	90-degree Optical Hybrid, 1064+/-5nm, PM Fiber (PM980 Panda) Inputs, HI1060 SMF for Outputs, Phase 90±5°	HB-A1AFAX1064	1064nm	PM980	PM980	HI-1064
	90-degree Optical Hybrid, 1064+/-5nm, PM Fiber (PM980 Panda) for all Input and Output ports, Phase 90±10°	HB-A0AFAP1064	1064nm	PM980	PM980	PM980
	90-degree Optical Hybrid, 1064+/-5nm, PM Fiber (PM980 Panda) for all Input and Output ports, Phase 90±5°	HB-A1AFAP1064	1064nm	PM980	PM980	PM980

90deg Optical Hybrid Device with Fiber Pigtailed Inputs and Outputs

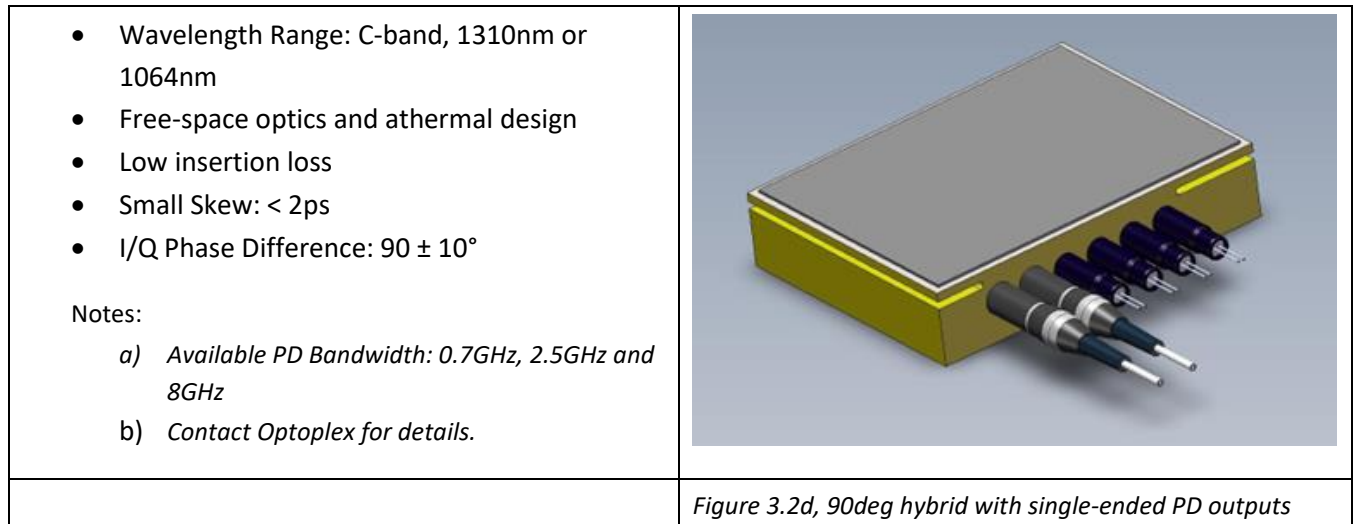
- Device Dimension: 48 x 31 x 8.35mm (Excluding the sleeves and the optical collimators)
- Weight: 96 grams

3.2 90deg Optical Hybrid with Single-ended PD Outputs

3.2.1 Functional Block



3.2.1 Features

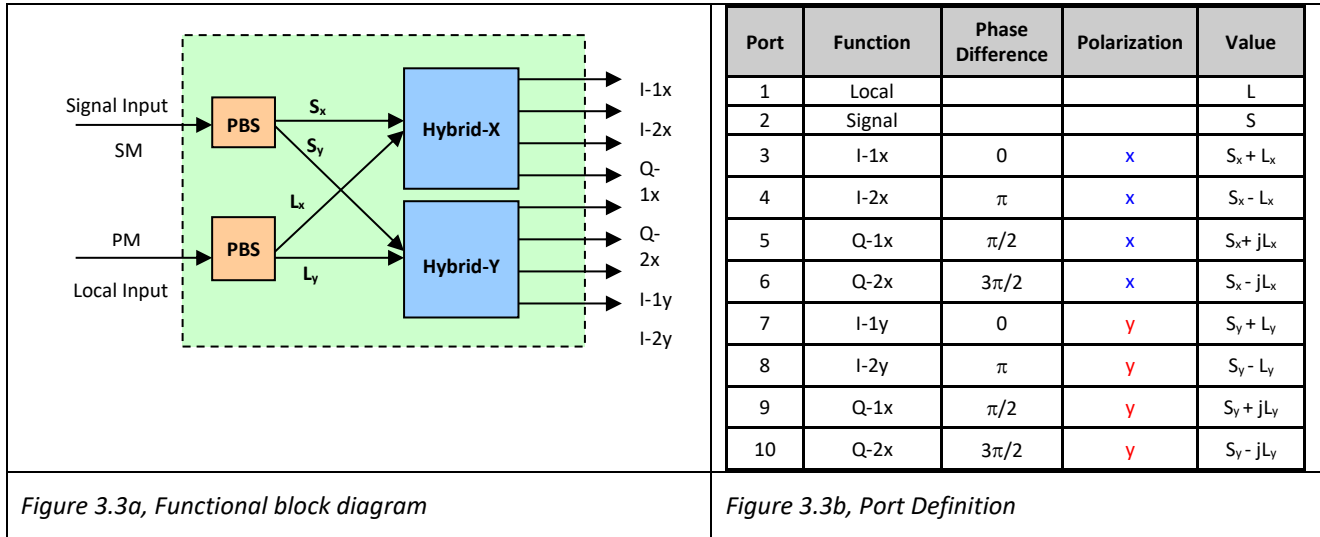


3.3 Polarization-Diversified 90deg Optical Hybrid for Balanced Detection

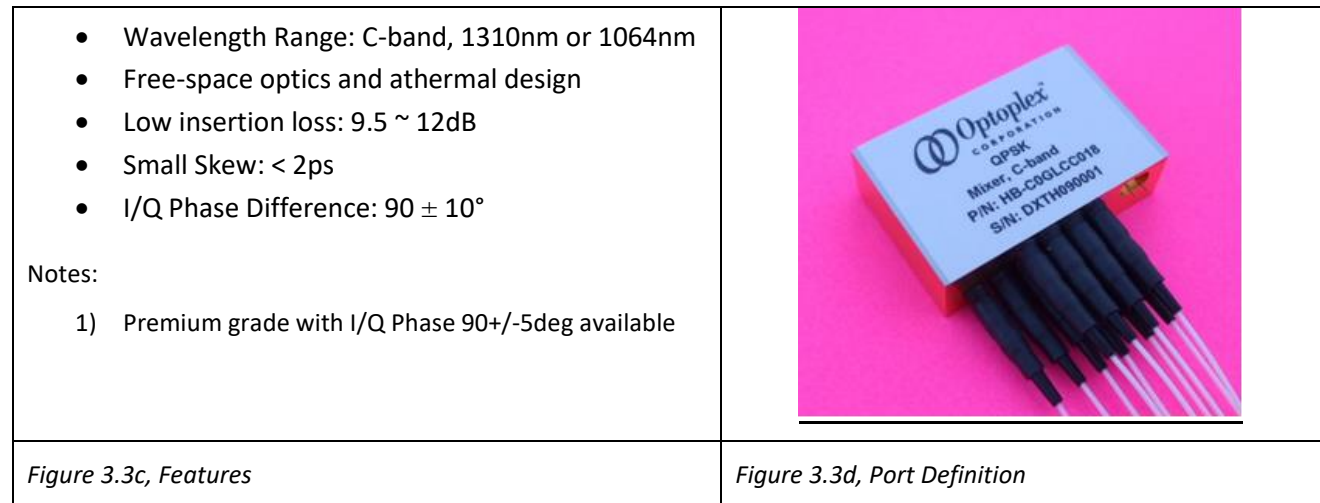
(aka DP-QPSK Coherent Mixer, or 2x8 Coherent Mixer)

https://www.optoplex.com/Coherent_Mixer.htm

3.3.1. Functional Diagram



3.3.2. Features



3.4 Polarization-Diversified 90deg Optical Hybrid with Single-ended PD Outputs for Balanced Detection

(aka 2x8 Coherent Mixer with Single-ended PD Outputs)

3.4.1. Functional Diagram

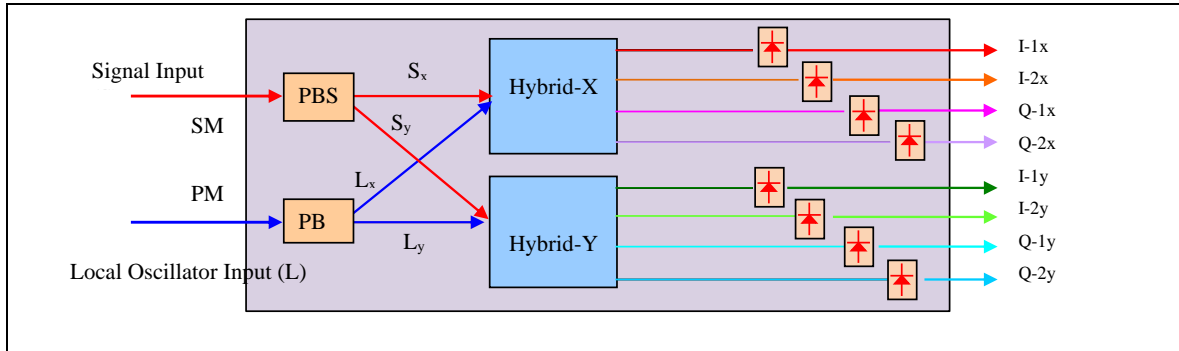
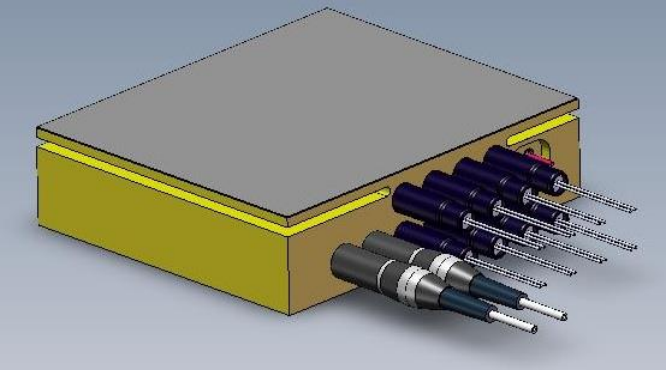


Figure 3.4a, Functional block diagram

Port	Function	Phase Difference	Polarization	Value	
1	Local			L	
2	Signal			S	
3	I-1x	0	x	$S_x + L_x$	PD1
4	I-2x	π	x	$S_x - L_x$	PD2
5	Q-1x	$\pi/2$	x	$S_x + jL_x$	PD3
6	Q-2x	$3\pi/2$	x	$S_x - jL_x$	PD4
7	I-1y	0	y	$S_y + L_y$	PD5
8	I-2y	π	y	$S_y - L_y$	PD6
9	Q-1x	$\pi/2$	y	$S_y + jL_y$	PD7
10	Q-2x	$3\pi/2$	y	$S_y - jL_y$	PD8

Figure 3.4b, Port Definition

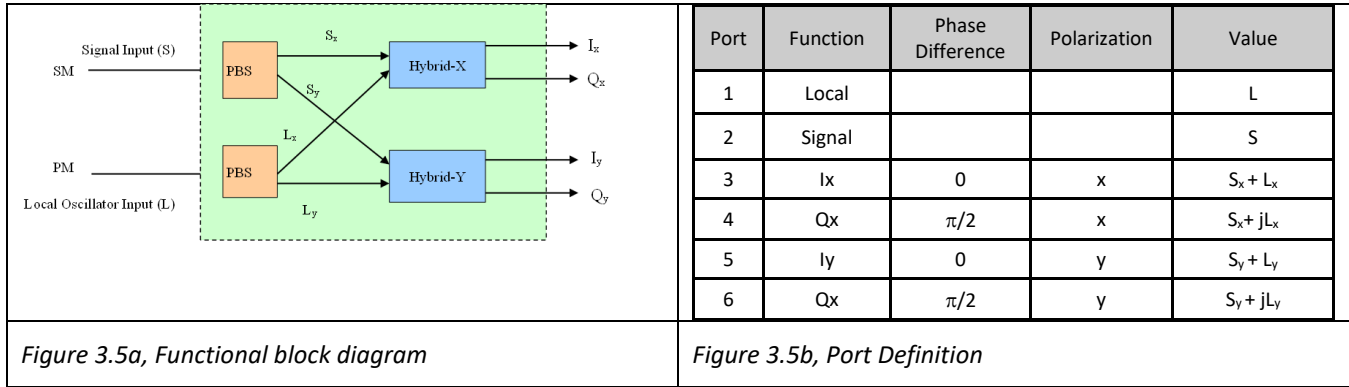
3.4.2. Features

<ul style="list-style-type: none"> • Wavelength Range: C-band, 1310nm or 1064nm • Free-space optics and athermal design • Low insertion loss: 9.5 ~ 12dB • Small Skew: < 2ps • I/Q Phase Difference: $90 \pm 10^\circ$ 	
<p>Figure 3.4c, Features</p>	<p>Figure 3.4d, Port Definition</p>

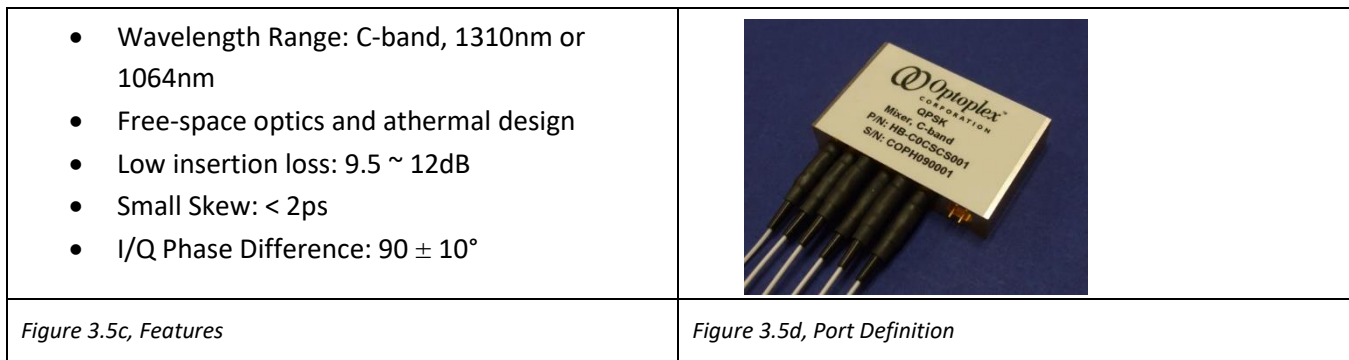
3.5 Polarization-Diversified 90deg Optical Hybrid for Single-ended Detection

(aka DP-QPSK Coherent Mixer for Single-ended Detection, or 2x4 Coherent Mixer)

3.5.1 Functional Block Diagram



3.5.2 Features



3.6 Balanced Photo-Receivers

https://www.optoplex.com/Balanced_Photo-Receivers.htm

Balanced photo-receivers with different small signal 3dB BW for coherent detections

Features:

- Large selections of bandwidth
- Either AC- or DC-coupled output
- High CMRR

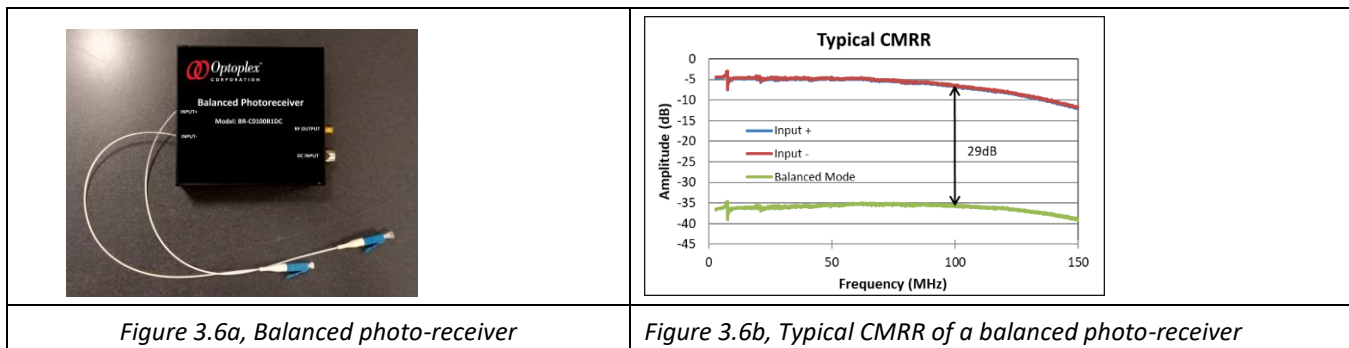


Table 3.6, List of Major Part Numbers of the Balanced Receivers

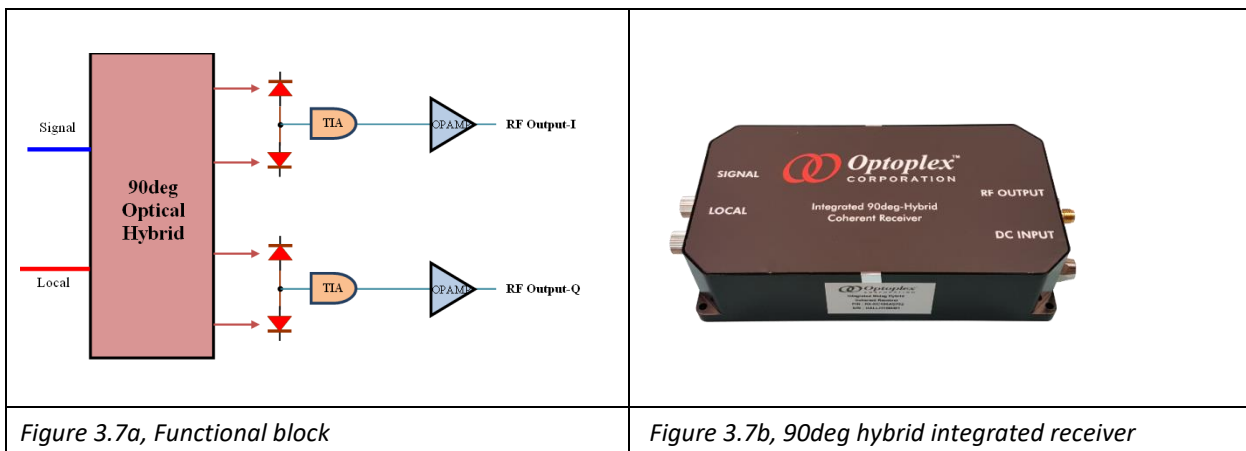
Part Number	Description
BR-C0100B1AC	Balanced Photoreceivers, 100MHz, SMF, FC/APC Inputs, SMA Outputs, AC-Coupled, 12VDC
BR-C0100B1DC	Balanced Photoreceivers, 100MHz, SMF, FC/APC Inputs, SMA Outputs, DC-Coupled, 12VDC
BR-C0200B1AC	Balanced Photoreceivers, 200MHz, SMF, FC/APC Inputs, SMA Outputs, AC-Coupled, 12VDC
BR-C0200B1DC	Balanced Photoreceivers, 200MHz, SMF, FC/APC Inputs, SMA Outputs, DC-Coupled, 12VDC
BR-C0400B1AC	Balanced Photoreceivers, 400MHz, SMF, FC/APC Inputs, SMA Outputs, AC-Coupled, 12VDC
BR-C0400B1DC	Balanced Photoreceivers, 400MHz, SMF, FC/APC Inputs, SMA Outputs, DC-Coupled, 12VDC
BR-C0700B1AC	Balanced Photoreceivers, 700MHz, SMF, FC/APC Inputs, SMA Outputs, AC-Coupled, 12VDC
BR-C0700B1DC	Balanced Photoreceivers, 700MHz, SMF, FC/APC Inputs, SMA Outputs, DC-Coupled, 12VDC
BR-C1600B1AC	Balanced Photoreceivers, 1600MHz, SMF, FC/APC Inputs, SMA Outputs, AC-Coupled, 12VDC
BR-C1600B1DC	Balanced Photoreceivers, 1600MHz, SMF, FC/APC Inputs, SMA Outputs, DC-Coupled, 12VDC

3.7 90deg Optical Hybrid Integrated with Balanced Receiver

http://www.optoplex.com/90deg_Hybrid_Balanced_Receiver.htm

3.7.1, Product Description

- Optical performance refers to **90deg Optical Hybrid**
- High CMRR
- Selections of Bandwidth: 15MHz, 100MHz, 200MHz, 400MHz, and 1600MHz. Other BW available upon request



3.7.2, Major Part Number of 90deg Hybrid Integrated Receivers

Table 3.7, List of Popular Part Numbers of 90deg Optical Hybrid integrated with Balanced Receivers

BW of the Balanced Receivers	Fiber Types of Input Ports		Part Numbers			
	Signal-	Local-	C-Band P/Ns	C+L Band P/Ns	O-Band P/Ns	1064nm P/Ns
15MHz	PMF	PMF	RX-KC0015P817xx	RX-KT0100P867xx	RX-KQ0015P837xx	RX-KA0015P897xx
15MHz	SMF	SMF	RX-KC0015S818xx	RX-KT0100S868xx	RX-KQ0015S838xx	RX-KA0015S898xx
100MHz	PMF	PMF	RX-KC0100P801xx	RX-KT0100P851xx	RX-KQ0100P831xx	RX-KA0100P881xx
100MHz	SMF	SMF	RX-KC0100S802xx	RX-KT0100S852xx	RX-KQ0100S832xx	RX-KA0100S882xx
200MHz	PMF	PMF	RX-KC0200P803xx	RX-KT0200P853xx	RX-KQ0200P833xx	RX-KA0200P883xx
200MHz	SMF	SMF	RX-KC0200S804xx	RX-KT0200S854xx	RX-KQ0200S834xx	RX-KA0200S884xx
350MHz	PMF	PMF	RX-KC0350P805xx	RX-KT0350P855xx	RX-KQ0350P835xx	RX-KA0350P885xx
350MHz	SMF	SMF	RX-KC0350S806xx	RX-KT0350S856xx	RX-KQ0350S836xx	RX-KA0350S886xx
400MHz	PMF	PMF	RX-KC0400P807xx	RX-KT0400P857xx	RX-KQ0400P837xx	RX-KA0400P887xx
400MHz	SMF	SMF	RX-KC0400S808xx	RX-KT0400S858xx	RX-KQ0400S838xx	RX-KA0400S888xx
700MHz	PMF	PMF	RX-KC0700P809xx	RX-KT0700P859xx	RX-KQ0700P839xx	RX-KA0700P889xx
700MHz	SMF	SMF	RX-KC0700S810xx	RX-KT0700S860xx	RX-KQ0700S840xx	RX-KC0700S890xx
1.2GHz	PMF	PMF	RX-KC1200P811AC	RX-KT1200P861AC	RX-KQ1200P841AC	RX-KA1200P891AC
1.2GHz	SMF	SMF	RX-KC1200S812AC	RX-KT1200S862AC	RX-KQ1200S842AC	RX-KA1200S892AC
1.6GHz	PMF	PMF	RX-KC1600P815AC	RX-KC1600P815AC	RX-KQ1600P845AC	RX-KA1600P895AC
1.6GHz	SMF	SMF	RX-KC1600S816AC	RX-KT1600S866AC	RX-KQ1600S846AC	RX-KA1600S896AC

Notes:

- 1) Part Number: RX - KCnnnnYnnnXX
 XX = DC, DC coupled RF Output
 XX = AC, AC coupled RF Output
 Y = S, SM Fiber for Optical Inputs

Y = P, PM Fiber for Optical Inputs

For 1.6GHz, only AC-coupled output available

- 2) By default, the optical connector of the input ports is FC/APC
 Other types of connector available

- 3) By default, the 90deg phase is 90+/-10deg.

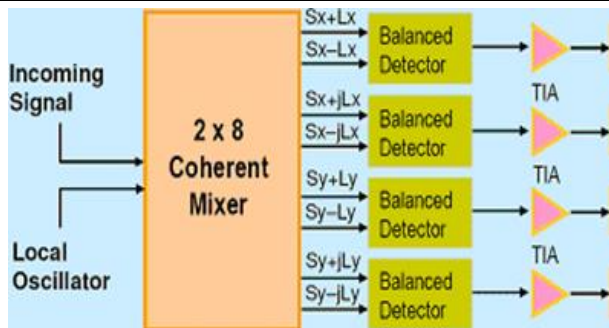
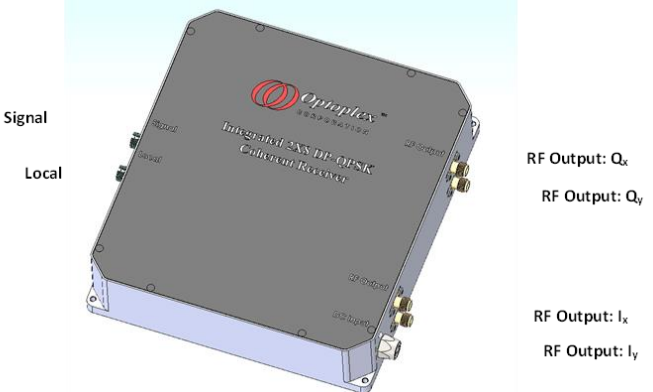
Premium grade of 90+/-5deg possible at extra cost. Contact Optoplex at sales@optoplex.com

90deg Optical Hybrid Integrated with Balanced Receivers

- Module Dimension: 150 x 82 x 36 mm
- Weight: 460 grams

3.8 Polarization-Diversified 90deg Optical Hybrid Integrated with Balanced Receiver

(aka Integrated DP-QPSK Coherent Receiver, or Integrated 2x8 Coherent Receiver)

	
<p>Figure 3.8a, Functional block</p>	
<p>Available bandwidths:</p> <ul style="list-style-type: none"> • 15, 100, 200, 400, 700 MHz • 1.2GHz; 1.6GHz. 	
	<p>Figure 3.8d, Integrated 2x8 Coherent Receiver</p>

4. Other Products for Fiber Optic Sensing Applications

4.1 List of Other Products for Fiber Optic Sensing Applications

Table 4.1, Other Products for Fiber Optic Sensing Applications

#	Category	Products	Notes
1	Lasers	iTLA Tunable Laser Assembly	C-Band, +8dBm
2		Tunable Laser – Full Function Module	
3		Wavelength Swept Lasers - Full Function Module	C-Band, O-Band, and 1064+/-30nm
4		Narrow Linewidth DFB Lasers - Full Function Module	1550nm
5	Optical Amplifiers	EDFA Booster Amplifiers	20, 23, 27, 30, and 33dBm MSA. C-Band
6		EDFA Pre-Amplifiers	20, 25, 30 dB Gain. C-Band, MSA
7	Etalon	Athermal F-P Etalons	FSR: 6.25, 12.5, 25, 50, 100, 200 and 400GHz.
8	Comb Filters	Flat-Top Comb Filters	FSR: 6.25, 12.5, 25, 50, and 100 GHz
9	Wavelength Lockers	Wavelength Lockers	FSR: 6.25, 12.5, 25, 50, 100, 200 and 200GHz.
10	Delay-Line-Interferometers (DLIs)	DPSK, DQPSK	FSR: 1.0, 1.25, 2.5, 5.0, 6.25, 12.5, 25, 50, and 100 GHz
11	Tunable Optical Filters (TOFs)	TOFs	C-, L-, O- Band, or 1064+/-20nm
12	Optical Spectrum Analyzers (OSAs)	OSA	C-, L-, C+L, O- Band, or 1064+/-30nm
13	Narrow Bandpass Filters	100GHz and 50GHz DWDM	Or custom-made
14	Laser-line Filters		Custom-made
15	Rayleigh Optical Filters		Custom-made
16	Wavelength Rulers	Or Frequency Ruler /Frequency Clock	FSR: 6.25, 12.5, 25, 50, 100, 200 and 400GHz. Or Custom-made

4.2 Light Sources

http://www.optoplex.com/Lasers_Light_Sources.htm

Key products are

- iTLA Tunable Laser (C-Band only)
- Swept Laser Sources (C-, C+L and O-Bands)
- ASE Light Source
- Comb Light Source
- Fiber Lasers
 - Single Frequency Narrow Linewidth CW FL
 - Single Frequency Narrow Linewidth Pulsed FL
 - Single Frequency Narrow Linewidth CW FL OEM Module (Coming Soon)



Figure 4.2a. iTLA Tunable Laser Source



Figure 4.2b. C-band Swept Laser

4.3 EDFA

<http://www.optoplex.com/EDFA.htm>

Key products are

- MSA EDFA Booster
- MSA EDFA Pre-Amp
- High Power EDFA
 - 2W
 - 10W (Coming Soon)



Figure 4.3, EDFA

4.4 Etalon

http://www.optoplex.com/F-P_Etalon_Products.htm

Applications include: Frequency clock, wavelength reference, noise suppressions or spectral shaping.

4.4.1 Standard Etalons

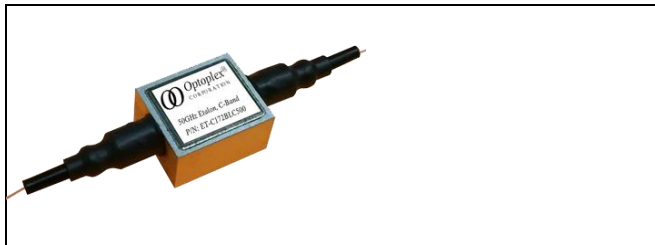
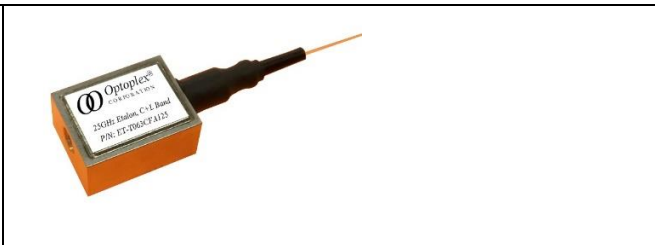
Types:

- Transmission Type
- Reflection Type
- Both Transmission and Reflection

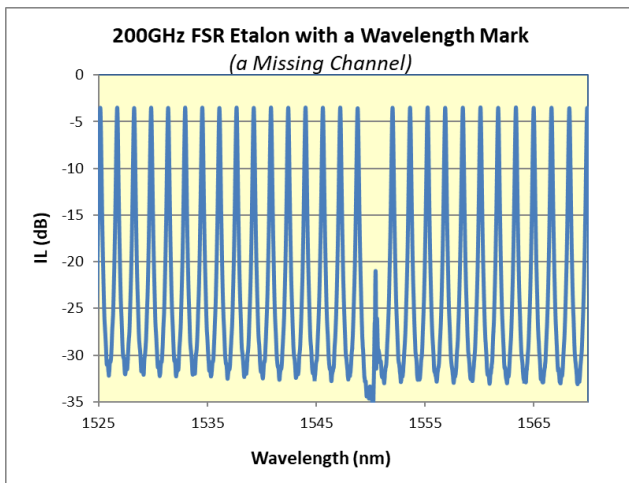
Key Features

- Free-space optics and athermal design
- Very small temperature dependent frequency shift (TDFS)
- Low insertion loss
- Broad Wavelength Range: C-, L-, C+L, O-Band, 1064nm
- FSR: 6.25 ~ 200GHz
- SMF/PMF, MMF

Packages:

	
<p><i>Figure 4.4a, Standard Etalon Device, Type A.</i> (Type-A: Input and output at opposite side. It can be Transmission type, Reflection type, or both)</p>	<p><i>Figure 4.4b, Standard Etalon Device, Type B</i> (Type-B: Input and output at same side with a dual-fiber collimator. Type-B offers better peak-to-valley contrast ratio. Transmission type only)</p>

4.4.2 Etalon with Built-In Wavelength Reference



This is particularly useful in fiber sensing system with swept light source. With this wavelength ruler, one can measure the signal's wavelength very precisely.

Figure 4.4c, Etalon with a built-in wavelength reference

4.5 Comb Filters

http://www.optoplex.com/F-P_Etalon_Products.htm

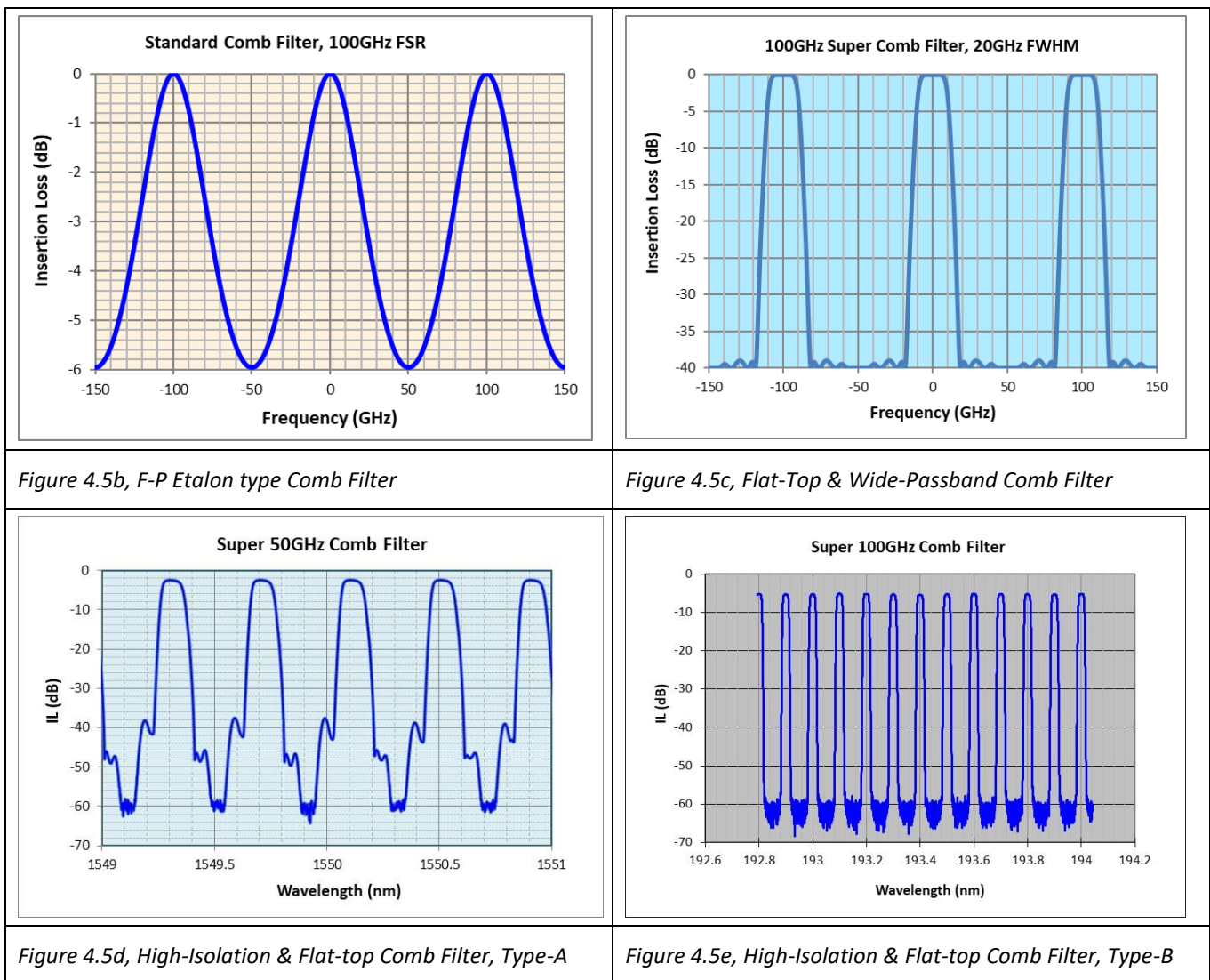
- Similar to Etalon

Spectral Shape: can be tailored per customer request

- Tunable Comb Filter
 - NGPON2 TF
 - Thermal TF



Figure 4.5a, Comb Filter



4.6 Mach-Zehnder Delay Line Interferometers (DLIs)

http://www.optoplex.com/Optical_Phase_Demodulators.htm

aka DPSK Demodulator

Key Features

- FSR: 2.5 ~ 500GHz
- Delay: customer specific (1ps for Telecom)
- Spectral Tunable, Semi Tunable, or Passive
- Large Spectral Tuning Range: > 10 FSR
- Low TDFS and PDFS
- Low IL and PDL



Figure 4.6, DPSK Phase Demodulator

4.7 Tunable Filters

http://www.optoplex.com/MEMS_tunable_Filter.htm

Optoplex's MEMS tunable filter is ideal for applications from wavelength locking, optical channel monitoring and optical add/drop in optical communications; optical filtering and wavelength management in fiber sensing and spectroscopic instrumentation.

Products include:

- Optical Engine
- Full Function Module

Key features are

- Athermal Design
- Fast Tuning Speed
- Wide Tuning Range: C-, L-, C+L, and O-Band
- Low TDL and WDL
- High Isolation
- Low Power Consumption

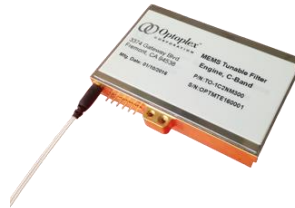


Figure 4.7a, MEMS Tunable Filter



Figure 4.7b, MEMS Tunable Filter (Full Function module)

4.8 Optical Spectrum Analyzers (OSA)

http://www.optoplex.com/Optical_Spectrum_Analyzers_Top.htm

- Wavelength Range: C-, L-, C+L, O-, Full Band
- Refer to link above

Other wavelength coverages are available, contact sales@optoplex.com for details.



Figure 4.8, MEMS-based OSA

4.9 Wavelength Lockers

http://www.optoplex.com/Wavelength_Locker.htm

Key Features

- Working Wavelength Range: C-band, 1310nm, or 1064nm
- Athermal design
- FSR: 25, 50, 100 or 200GHz. Or customer specific
- Small TDFS



Figure 4.9, Wavelength Locker

4.10 Rayleigh Filters

A very steep slope band-pass filter to separate the Brillouin or Raman scattering signals from the Rayleigh laser signal to increase the detection sensitivity and dynamic range. Able to separate them within 10GHz range with 60dB isolation

Key Features

- Center Wavelength: customer specific
- Steep slope ($> 750\text{dB/nm}$) to separate Brillouin and/or Raman Stokes signal(s) from Rayleigh laser signal
- High isolation, typical $> 50\text{dB}$ (60dB ok)
- Low insertion loss
- Free-space optics and Athermal design to offer extremely good thermal stability

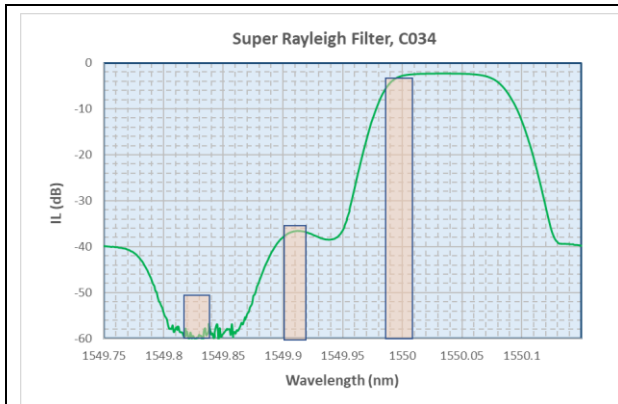


Figure 4.10a, High Isolation Rayleigh Filter (Type-A)

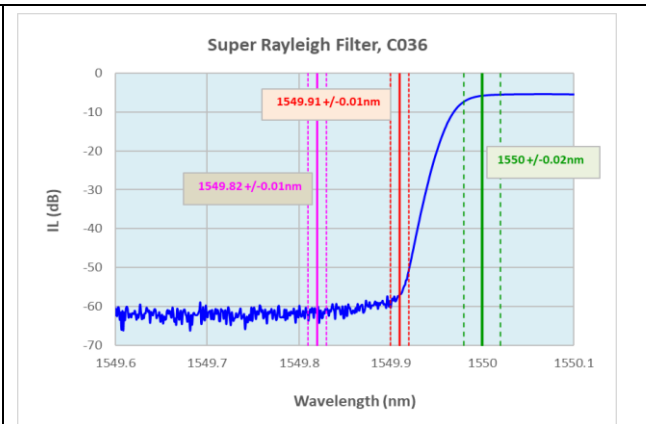
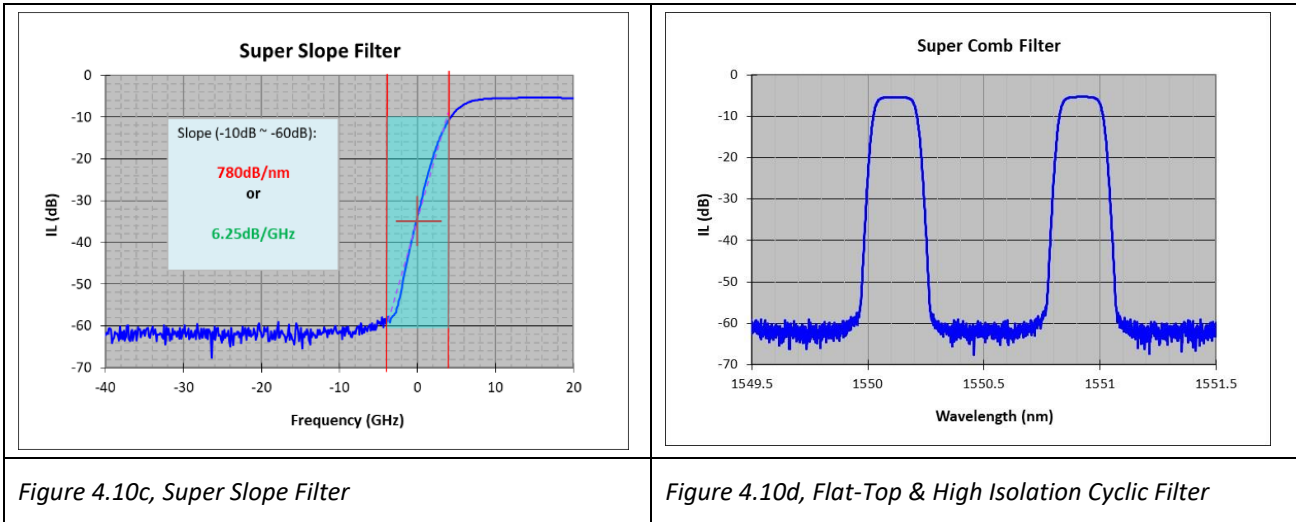


Figure 4.10b, High Isolation Rayleigh Filter (Type-2)



4.11 Special Filters

- Lidar Filter (see below)
- MOPA Filter
- Rayleigh Filter (see Section-1)
- Raman Filter (See Section-1)

Lidar Filters

- Center Wavelength: 1064nm or others
- FWHM: < 1nm or customer specific
- High Transmission: > 90% (typical 95%)
- Side-Band Blocking Wavelength Range: 300 ~ 1200nm
- Blocking Optical Density (OD): > OD 4 over 300 ~ 1200nm

