Fiber Coupled 90° Optical Hybrid

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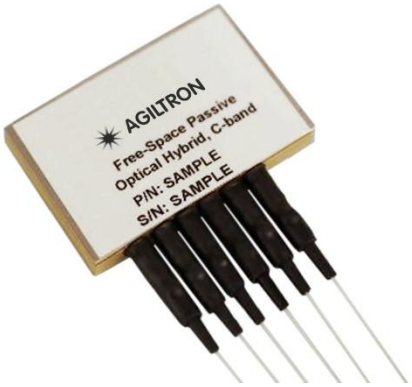

The FCOH is a passive, micro-optics-based 90° optical hybrid designed for coherent optical signal demodulation, including BPSK and QPSK formats. It functions by mixing the incoming signal (S) with a local oscillator reference signal (L), generating four optical outputs corresponding to the vector sums and differences of the two inputs: S+L, S−L, S+jL, and S−jL. These outputs represent four quadrature states in the complex optical field space. The signals are then directed to two pairs of balanced photodetectors, enabling differential detection of the in-phase (I) and quadrature (Q) components. This configuration allows the extraction of both amplitude and relative phase information through digital signal processing. In a coherent receiver system, preserving the optical phase enables advanced functionalities such as dispersion compensation and phase noise mitigation in the electrical domain, improving overall system performance and enabling cost-effective compensation of optical transmission impairments. A block diagram illustrating the integration of the 90° Optical Hybrid in a coherent receiver is shown below.

Features

- Passive
- Compact Size
- Polarization Diversified Version Also Available

Applications

- Optical Coherent Detection
- QPSK Demodulation

Specifications

Parameter		Min	Typical	Max	Unit
Wavelength Range (C-Band)		1527		1567	nm
Phase Difference [1] (between M_1, M_2 and M_3, M_4)			90±10		deg
Insertion Loss [1] (w/o connector)	S (polarization scrambled) → All Outputs	9.5		11.5	dB
	L (45° linear polarized) → All Outputs	9.5		11.5	
Insertion Loss Difference [1]	among S → All Outputs; among L → All Outputs		< 0.7		dB
	among All Others		< 1.0		
Optical Return Loss			27		dB
Optical Path Difference [1] (skew, among S → All Outputs)			< 1		ps
Optical Path Difference [1] (skew, among L → All Outputs)			< 1		mm
Polarization Extinction Ratio [1] (for ether S or L)					
Optical Power Handling (CW)				300	mW
Operating Temperature		0		+65	°C
Storage Temperature		-40		+85	°C
Fiber Type (for all, exclud. L)		SMF-28 with 900 µm loose tube			
Fiber Type (for L)		PM with 900 µm loose tube			
Connector Type		TBD			

Notes:

[1]. Over the stated spectral and operating temperature ranges and all polarization states.

[2]. Subject to change, not including collimator sleeves extending from the two adjacent sides by 21 mm.

RoHS COMPLIANT

Note: The specifications provided are for general applications with a cost-effective approach. If you need to narrow or expand the tolerance, coverage, limit, or qualifications, please [click this link]:

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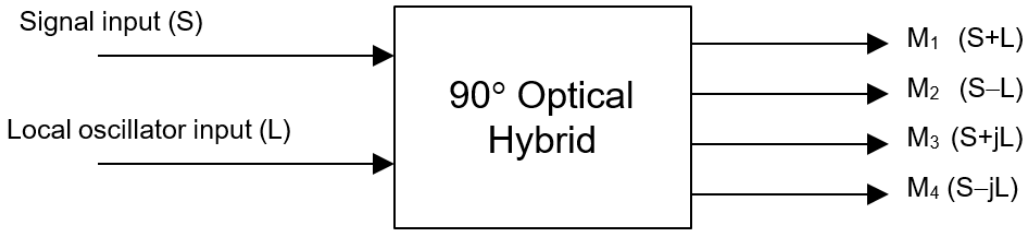
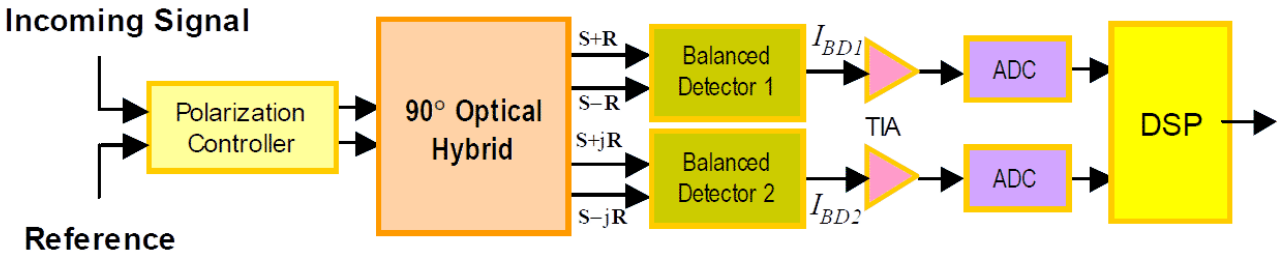
Function Diagram





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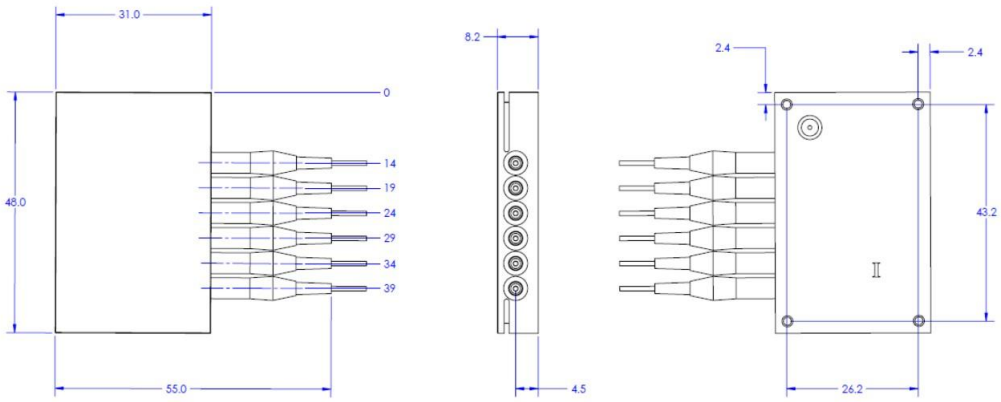
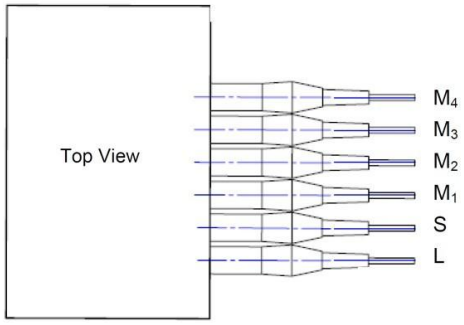
Mechanical Dimension





Port	Function	Phase Difference	Value
1	Local		L
2	Signal		S
3	M_1	0	S + L
4	M_2	π	S - L
5	M_3	π/2	S + jL
6	M_4	-π/2	S - jL

*Product dimensions may change without notice. This is sometimes required for non-standard specifications.

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Ordering Information (Part Number)

	11	B	1	1	1	3	☐	☐
Prefix	**Type**	**Wavelength**		**Version**		**Fiber Cover**	**Fiber Length**	**Connector [1]**
FCOH-	Regular = 11 Special = 00	1260~1620 = B Special = 0		Standard = 1 Special = 0		900 um tube = 3 Special = 0	0.25m = 1 0.5m = 2 Special = 0	None = 1 FC/PC = 2 FC/APC = 3 SC/PC = 4 SC/APC = 5 LC/PC = 7 Duplex LC/PC = 8 Special = 0

[1]. 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.

- **PM1550** fiber works well for **1310nm**

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.

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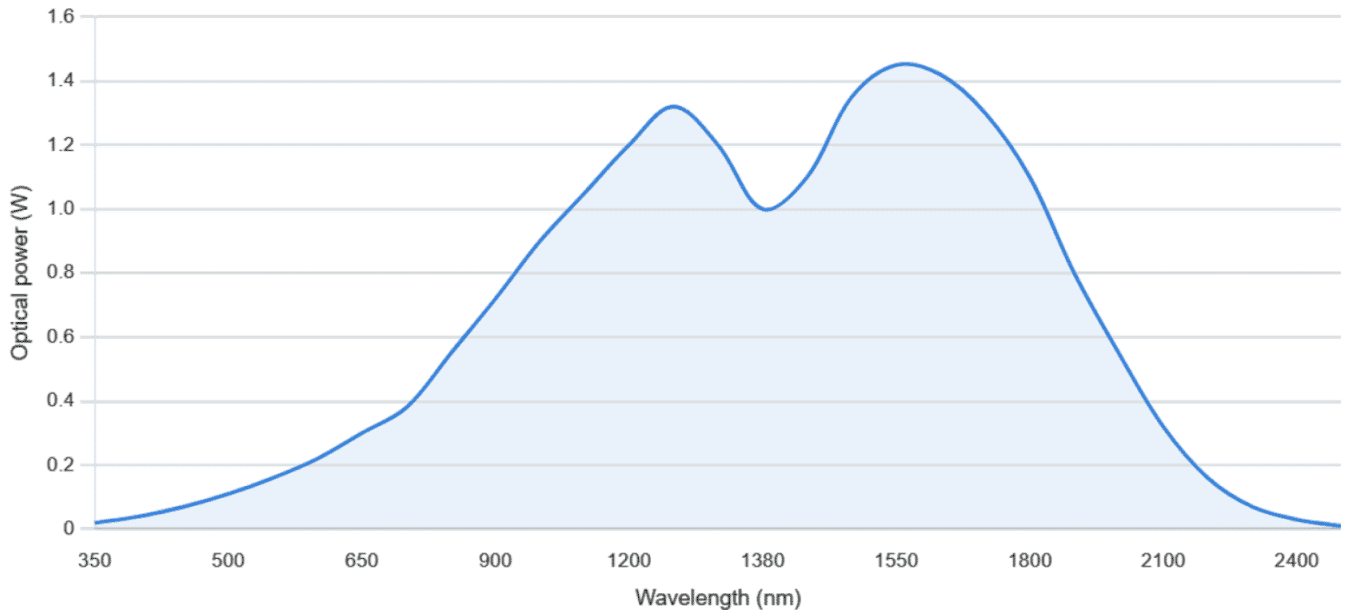
Regular Single Mode / Polarization Maintaining Fiber Optical Power Handing vs Wavelength



Single mode fiber optical power is limited by nonlinear effects in addition to absorption that increase loss and generate heat. The curve shows the approximate safe CW power envelope for standard single-mode fiber. Actual limits depend on fiber design, core size, length, and laser characteristics. Specialty fibers can significantly increase the power limit.

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