Wideband Multimode Optical Circulator

400–1600 nm, 400µm Core, 0.22NA – 600µm Core, 0.39NA

DATASHEET

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Wideband Multimode Circulators (WMCs) are fused-fiber, three-port optical devices designed to provide a flat spectral response, high-efficiency multimode transfer (Port 1 → Port 2), and bidirectional multimode transmission (Port 2 ↔ Port 3). They enable multiple optical signals or illumination and detection channels to be combined within a single fiber, making them a versatile solution for multimode light management. Unlike conventional fiber couplers, WMCs can operate as either circulators or combiners while providing significantly higher isolation and directivity between Ports 2 and 3. Light entering Port 1 is transferred exclusively to Port 2 with minimal insertion loss. At the same time, Ports 2 and 3 support bidirectional transmission, allowing signals entering Port 2 to exit Port 3 and signals entering Port 3 to exit Port 2 with low loss. Light entering either Port 2 or Port 3 experiences high isolation or directivity, respectively, toward Port 1, minimizing unwanted back-coupling. This unique three-port architecture makes WMCs well suited for applications that require efficient signal routing and channel separation, including diffuse reflectance spectroscopy, fluorescence spectroscopy, and optogenetics. WMCs are available with 2.0 mm narrow-key FC/PC or SMA905 connectors and are offered in a variety of numerical aperture (NA) and core diameter configurations for each port. Additional customization options—including hydroxyl content, lead length, low-autofluorescence packaging, connector type, housing configuration, and specialty fiber types — are available upon request.

Features

- Multimode Fused Fiber Circulators/Combiners
- High Coupling Efficiency
- Mode Insensitive
- Broad Wavelength
- Non-Reciprocating

Applications

- Metropolitan Area Network
- Fiber Optic Sensor
- Dispersion Compensation
- Test and Measurement
- Instrumentation
- Fluorescence, Spectroscopy, or Optogenetics

Note: For a polarized input light version, the isolation is optimized to block the light reflection of the same polarization. Although lights of other polarizations may also be blocked, the extinction may be poor. PM isolators can be specially made to block backward propagating lights of all polarizations. PM isolators can also be made with a light polarizing function.

RoHS COMPLIANT

Specifications

Parameter		Min	Typical	Max	Unit
Wavelength Range		400		1600	nm
Hydroxyl Content [1]			Low OH		
Transfer Insertion Loss [2], [3]	Port 1 to 2		≤ 0.9		dB
Transmission Insertion Loss [2], [3]	Port 2 to 3		≤ 0.9		dB
	Port 3 to 2		≤ 0.6		dB
Directivity [2], [4]	Port 1 to 3		≥ 27		dB
	Port 3 to 1		≥ 34		dB
Isolation	Port 2 to 1		≥ 10		dB
Connectors [1]		2.0 mm Narrow Key FC/PC [6], SMA905			
Max Power Level [9]		5 W (Connectors or Bare Fiber) 10 W (Spliced)			W
Port Configuration		2x1			
Jacket		Ø1.4 mm Hytrel® [10] Loose Tube			
Pigtail Tensile Load		10N			
Operating Temperature		0		+60	°C
Storage Temperature		-40		+85	°C
Port 1 (Blue)					
Core Diameter			400		µm
Core NA			0.22		
Cladding Diameter			440		µm
Bend Radius (Long Term)			≥ 94		mm
Port 2 (White) & Port 3 (Red)					
Core Diameter			600		µm
Core NA			0.39		
Cladding Diameter			630		µm
Bend Radius (Long Term)			≥ 96		mm

Notes:

[1]. Additional hydroxyl content, lead length, low-autofluorescence packaging, and connector options available upon request. Contact Tech Sales with inquiries.

[2]. Photodarkening may affect long-term performance at lower wavelengths (≤500 nm). Performance in the water absorption region centered at 1383 nm is not guaranteed.

[3]. Specified at room temperature over the bandwidth without connectors using the SLS201L halogen lamp.

[4]. Back reflection of connector surfaces will reduce directivity.

[5]. All ports use ceramic ferrules.

[6]. All ports use stainless steel ferrules.

[7]. Also compatible with any fibers with equal or smaller core size and NA, including single mode fibers. Performance may vary depending on launch conditions. Launching light using an incompatible fiber increases losses.

[8]. Compatible with Thorlabs Fibers FG010LDA, FG025LJA, FG105LVA, or GIF50C.

[9]. Specifies the total maximum power allowed through the component. Coupler performance and reliability under high-power conditions must be determined within the user's setup.

[10]. Hytrel® is a registered trademark of DuPont Polymers, Inc.

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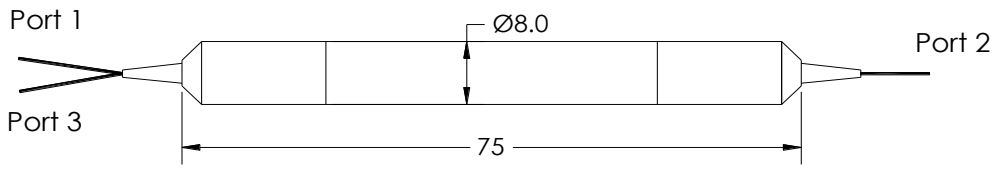
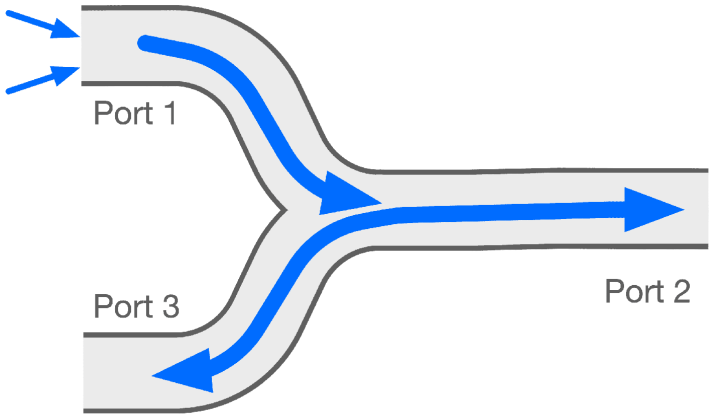
Mechanical Dimensions (mm)

3-Port Circulator



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

Light Path Diagram



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Ordering Information (Part Number)

	☐	☐	☐	☐	☐	☐	☐	☐	☐
Prefix	**Package**	**Input Fiber**	**In Fiber Length**	**Input Connector**	**Out/Reflect Fiber**	**Out Fiber Length**	**Out Fiber Connector**	**Reflect Fiber Length**	**Reflect Fiber Connector**
WMC-	Standard = 1 Special = 0	400 µm = 4	0.5m = 1 1.0m = 2 1.5 m = 3 Special = 0	None = 1 FC/PC = 2 SMA = 3 Special = 0	600 µm = 6	0.5m = 1 1.0m = 2 1.5 m = 3 Special = 0	None = 1 FC/PC = 2 SMA = 3 Special = 0	0.5m = 1 1.0m = 2 1.5 m = 3 Special = 0	None = 1 FC/PC = 2 SMA = 3 Special = 0

Application Notes

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.