

Fiber Patchcord

Factsheet

Lumics offers high quality and reliable fiber optic multimode patch cables for all LuOcean diode laser modules. The fibers are integrated in a robust metal tube and a yellow PVC jacket and are strain relieved.

The fibers are an essential component of laser modules. Their design depends on the laser module, particularly the output power, and required fiber core diameter.

For low to moderate power levels, fibers can be glue-fixed to the connector. For higher power lasers, the fibers will be free-standing within the fiber connector.

In some cases, cooling of the fiber connector via forced air cooling or water cooling is required to maintain a low temperature and prevent fiber damage. For some wavelengths back reflections of laser light on the fiber end facet can damage the laser diodes. To prevent this, the fibers can be equipped with an AR coated fiber end cap.

Lumics will support the fiber selection process to ensure the safe and efficient operation of laser module.

FEATURES & FUNCTIONS

- Low-OH material for long wavelength up to 2 μ m
- Bending limit protection
- Dust cap
- Designed for LuOcean Modules Mini3, Mini4, Mini8, P2, M4

OPTIONS

- Passive air or water cooling for high power lasers
- F-SMA or D80 connector types
- Glue-fixed or free-standing fiber in connector
- AR coated end cap
- Mode-stripper
- Individual fiber lengths in steps of 1 m



Lumics

We manufacture diode lasers.




Fiber Properties

Parameter									Unit
General Fiber Properties									
Core Diameter	100	105	200	200	400	600	800	1000	µm
Cladding Diameter	660	125	280	280	480	720	880	1100	µm
Second Cladding Option				500					µm
Buffer (Silicon) Diameter	780	250	640	640	700	880	1050	1400	µm
Coating (Nylon, Tefzel, Vestamid) Diameter	1100	1100	1300	1300	1300	1320	1350	1400	µm
Numerical Aperture [NA]	0.22 ± 0.02	0.22 ± 0.02	0.22 ± 0.02	0.22 ± 0.02	0.22 ± 0.02	0.22 ± 0.02	0.22 ± 0.02	0.22 ± 0.02	
Centricity for glue-fixed fibers	≤ 10	≤ 10	≤ 10	≤ 10	≤ 10	≤ 12	≤ 12	≤ 15	µm
Centricity for free-standing fibers	≤ 12	≤ 12	≤ 12	≤ 12	≤ 12	≤ 15	≤ 15	≤ 20	µm
Mechanical Minimum Bending Radius	100	20	42	75	72	108	132	180	mm
Optical Minimum Bending Radius	50	50	100	100	200	300	400	800	mm
Effective NA at Mechanical Minimum Bending Radius	0.215	0.215	0.206	0.206	0.192	0.192	0.189	0.192	
Connector type compatibility	SMA, D80	SMA	SMA, D80	SMA, D80	SMA, D80	SMA, D80	SMA, D80	SMA, D80	
Protection Tube	Metal tube, strain relieve, bending limit, PVC coating (yellow color) – Outer diameter 6.4								mm
Options									
Mode stripper possible	Yes	No	No	Yes	Yes	Yes	Yes	Yes	
AR coated fiber end cap possible	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	
Operating Conditions									
Operating Temperature	0 to +60								°C
Storage Temperature	-10 to +55								°C
Humidity / Non-condensing Atmosphere	90								RH%
Fiber Cleaning	Use a fiber microscope to check fiber centricity and dust free fiber end facet. Lumics recommends link-free cleaning cloth integrated in dispensers for glue-fixed fibers and IPA rinse with blow dry by compressed nitrogen or clean dry air for free-standing fibers.								

Fiber Property Notes



- For fibers with small core diameter which require a mode stripper: The 105µm fiber will require a large cladding of 660µm. The 200µm fiber will require a second cladding of 500µm. The refractive index of the second cladding is larger than the refractive index of the first cladding.
- The refractive index of the buffer is lower than the refractive index of the cladding. Laser light will therefore remain within the cladding. For glue-fixed fiber connectors the glue of the connector has a larger refractive index than the refractive index of both the fiber core and the fiber cladding. Light may therefore be coupled into this area. High power modules cannot be operated with glue-fixed fiber connectors.
- A low fiber core centricity is important to ensure the specified power levels ex fiber. In addition, the maximum distance of the fiber core center after one 360° ferrule turn to the geometric circular center of the ferrule referred here as fiber core centricity should be as low as possible. The ferrule diameter tolerance must tightly match inner diameter of the diode laser module receptacle of F-SMA = 3.176 - <3.179 mm and D80 = 4.004 - 4.007mm.
- The mechanical bending limit prevents cracks. The values are determined by the factors 150 and 60 times the cladding diameter to prevent long-term and short-term cracks, respectively. Keep bending radius of fiber above mechanical and optical minimum bending radius.
- The optical bending limit prevents excessive power loss. The values for Numerical Apertures of 0.2 / 0.210 / 0.218 are determined by the factors 250 / 500 / 2000 times the fiber core diameter, respectively. The values above are calculated with an NA of 0.21.
- Typical laser light power loss from core to cladding for Lumics LuOcean diode lasers is approximately 2% when lowering the NA from 0.22 to 0.20, e.g., by excessive bending of the fiber.
- A mode stripper is used to strip out laser power from of the fiber cladding which may otherwise damage the fiber in bended regions in or which may distort the focused beam properties ex fiber. A proximal connector (module side) which contains a mode stripper may require a cooling element such as a forced air-cooling ferrule (F-SMA, D80) or a water-cooling ferrule (D80 only) to prevent overheating of the fiber connector.
- An AR coated fiber end cap can be used to prevent back reflections from the fiber end facet into the diode laser module which could otherwise impact the lifetime of the laser module. Fiber end caps may be required for diode lasers with wavelengths between 750nm – 985nm in which certain power levels are required. Please contact your Lumics sales representative for further details. A fiber with AR coated end cap will be labeled on the proximal side with "Input". Note that the end cap affects the coupling efficiency slightly.
- Fiber cables with AR coated end cap, free standing connector, or mode stripper are limited to a maximum of one 360° turn per cable.
- Optical feedback from impurities of the connected fiber must be avoided. Optical feedback shall not exceed 10% of the maximum power level.
- These products are compliant with RoHS.
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F-SMA Connectors

Parameter & Option / Connector Type	F-SMA glue-fixed			F-SMA free-standing			F-SMA free-standing with forced air cooling			Unit	
											
Maximum Operating Power Mini4 / Mini8	≤ 5	≤ 30	≤ 150	≤ 30	≤ 130	≤ 300	≤ 40	≤ 200	≥ 300	W	
Corresponding Core Fiber Diameter	105	200	≥ 400	105	200	≥ 400	105	200	≥ 400	μm	
Ferrule Diameter	3.166 - 3.172			3.166 - 3.172			3.166 - 3.172			mm	
End-face Ferrule to Flange Distance	9.8 ± 0.1			9.8 ± 0.1			9.8 ± 0.1			mm	
Required additional features for moderate to high power levels											
Cooling Options	No			No			Forced (convection) air cooling				
Cladding Mode Stripper	No			Optional (module side)			Optional (module side)				
AR coated end-cap OD / Length, depends on Power Level	No			Optional, OD 1.5 / Length 3.8 for fiber core ≤ 200 μm							mm
Ferrule Material				Arcap (AP1D CuNi25Zn12)							
Best Choice for LuOcean Diode Laser	Mini4, Mini8, P2			Mini4, Mini8, P2, M4			Mini8, P2, M4				

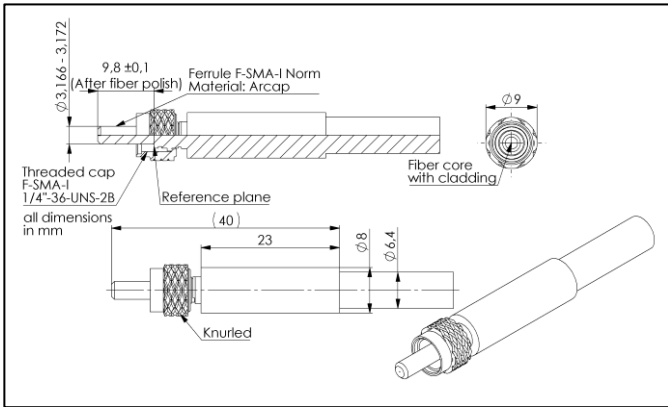
- Free-standing fibers have a higher tolerance for centricity errors, smaller diameter variations, and allow for higher power in the cladding on the exit side as no adhesive near the fiber end facet could potentially bum or extract power from the fiber.

D80 Connectors

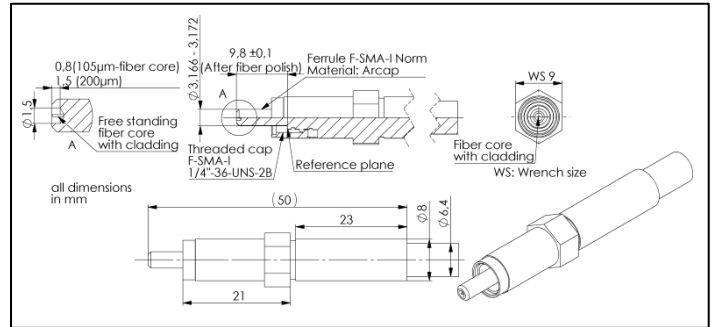
Parameter & Option / Connector Type	D80 free standing with forced air cooling		D80 free standing with water cooling		Unit
					
Maximum Operating Power M4	≤ 50	≤ 130	≤ 700	≤ 1500	W
Corresponding Core Fiber Diameter	200	≥ 400	200	≥ 400	μm
Ferrule Diameter	3.166 - 3.172		3.995 - <4.000		mm
End-face Ferrule to Flange Distance	9.8 ± 0.1		9.95 ± 0.1		mm
Required additional features for higher power levels					
Cooling Options	Forced (convection) air cooling		Water cooling		
Cladding Mode Stripper	optional (module side)				
Fiber End-Cap OD / Length, depends on Power Level	Optional OD 1.5 / Length 3.8 for fiber core ≤ 200 μm Optional OD 2.3 / Length 3.8 for fiber core ≥ 400 μm				mm
Ferrule Material	Arcap (AP1D CuNi25Zn12)				
Angular Ferrule Position fixed by Key Lock (2)			Yes		
Best Choice for LuOcean Diode Laser			M4		

- The D80 key lock ensures that the laser focus spot and the fiber core always align at the same angular position. This results in a highly stable power output from the fiber when plugging it in or removing it. The connector typically shows only a 5% power variation during a full 360° rotation.

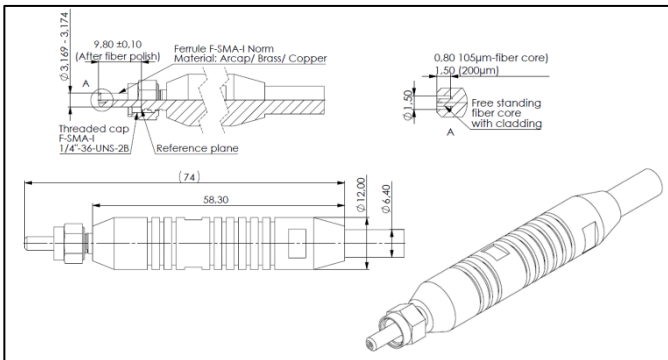
F-SMA glue-fixed fiber connector



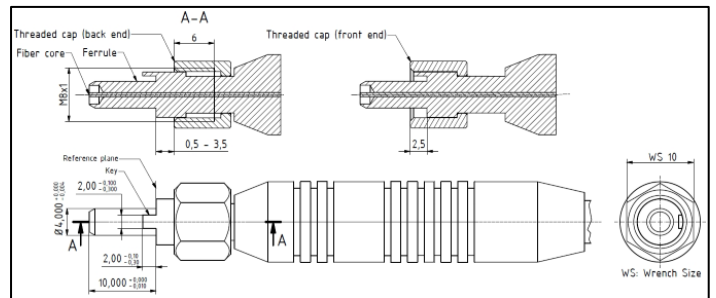
F-SMA free-standing fiber connector



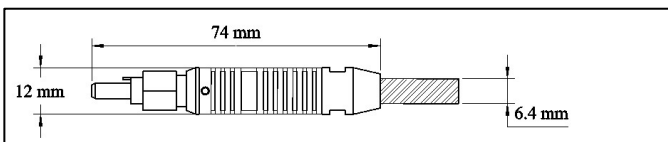
F-SMA free-standing fiber connector with forced air cooling



D80 fiber connector locking mechanism

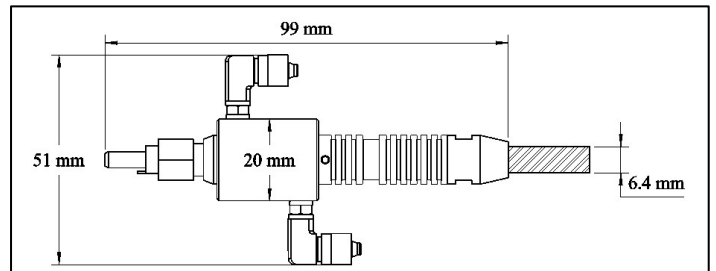


D80 fiber connector with forced air cooling



All fibers are glue fixed to the cooling connector body.

D80 fiber connector with water cooling



All fibers are glue fixed to the cooling connector body.

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