

multimode • fiber • switches

optojena®

FSM – Fiber Optical Switches customized solutions

- fast switching time
- low insertion loss
- high optical isolation
- no additional wavelength dependence
- customized switch design
- flexible switch control
- bulkhead connectors



Fig.: customized fiber switch with 19" industrial casing

- **Applications:**
- optical measurement systems
- spectroscopy

Customized fiber-optic switches are an important part of the product range offered by **piezosystem jena GmbH**. Individually manufactured, the optical switches are designed and developed in close collaboration with the end user. The customer receives a custom tailored solution which guarantees the best results for each application.







Based on a modular system, components are selected in combinations for various special solutions. Housing, fiber type, connector configurations and control interfaces are all selectable from a wide range of possibilities to meet customer requirements. Typically fiber-optical switches are used for spectroscopy and chemical analytics applications.

Using fiber switches is an ideal method for combining different sensor points in just one spectrometer. As a result, the end-user derives a cost benefit by directly comparing different optical channels using a single spectrometer/detector system.

List of customizable fiber-optical switches (selection)

- **Multimode fiber switch with 2 times FSM – 1by9 for 200µm core fiber**
- **Multimode fiber switch with 2 times FSM – 1by6 for 600µm core fiber**
 - **Multimode fiber switch FSM - 1by11 for 600µm core fiber**
 - **Multimode fiber switch FSM - 1by12 for 62.5µm core fiber**
 - **Multimode fiber switch FSM - 1by16 for 200µm core fiber**
 - **Multimode fiber switch FSM – 4to5 for 100µm core fiber**

piezosystem jena has expanded its line to a variety of fiber switches for different types of fibers, types of connectors, and numbers of channels. Switches with more than 80 output channels are easily achievable by cascading the switching modules. **piezosystem jena** specializes in fiber switch customization. The chart below shows customizable fiber switches.

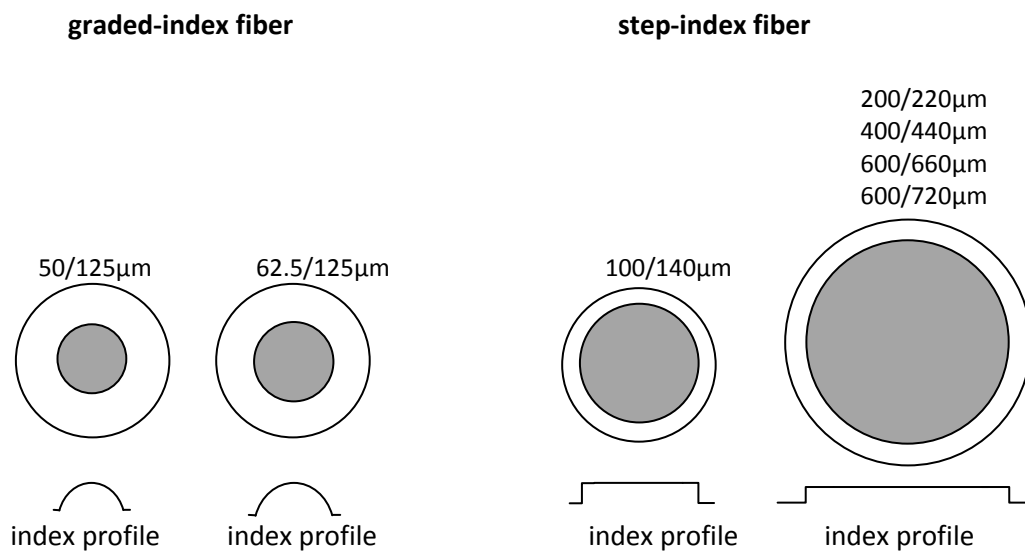
Multimode fiber switch 2times FSM 1x9 with 200 μm fiber	
insertion loss: 1.5 dB switching time: 2 ms fiber: 200/280 μ m connector: E 2 108.6/K operating voltage: 100–240 VAC control signal: BCD code housing (l/w/h): 429x320x126 mm ³	
Multimode fiber switch 2times FSM 1x6 for 600 μm fiber	
insertion loss: 3.0 dB switching time: 7 ms fiber: 600/660 μ m connector: SMA bulkhead operating voltage: 100–240 VAC control signal: BCD, RS232, USB control: synchronously housing (l/w/h): 448x375x132 mm ³	
Multimode fiber switch FSM 1x11 for 600 μm fiber	
insertion loss: 3.0 dB switching time: 7 ms fiber: 600/720 μ m connector: SMA bulkhead operating voltage: 100–240 VAC control signal: BCD, RS232, USB housing (l/w/h): 448x375x132 mm ³	
Multimode fiber switch FSM 1x12 for 62.5 μm fiber	
insertion loss: 2.5 dB switching time: 3 ms fiber: 62.5/125 μ m connector: FC/PC bulkhead operating voltage: 7–12 VAC control signal: BCD code housing (l/w/h): 448x375x89 mm ³	
Multimode fiber switch FSM 1x16 for 200 μm fiber	
insertion loss: 2.5 dB switching time: 3 ms fiber: 200/220 μ m connector: SMA bulkhead operating voltage: 5V control signal: BCD code housing (l/w/h): 429x360x126 mm ³	
Multimode fiber switch FSM 4 by 5 with 100 μm fiber	
insertion loss: 1.5 dB switching time: 3 ms fiber: 100/140 μ m connector: ST fiber length: 1 m operating voltage: 100–240 VAC control signal: RS 232 housing (l/w/h): 448x375x89 mm ³	

Control interfaces:

piezosystem jena offers different options for fiber switch control. They can be controlled easily via TTL signal (high and low) with BCD code. This is also the most practical solution for switches built into small size casing (FSM 1 by 2 or 1 by 3 up to 200 micron core size diameter). For the small casing, we offer a separate control box (part. no. Z-950-95) that houses the interface board. RS232 as well as USB interfaces are included in fiber switches built into industrial rack casing. A new feature for control is an Ethernet interface (part. no. Z-950-100) for all switches that are assembled into a standard 19"-industrial rack. This gives customers the benefit of easy installation into existing network systems. Selecting the Ethernet interface is a substitute for the USB interface.

Types of optical fibers:

Optical fibers are mainly classified with respect to the lateral dimensions of the light-guiding section, the fiber core. The core diameter together with the refractive index distribution of the core-cladding assembly determines the number of modes the fiber supports. The following figures and table give a rough overview on the various fiber types:



fiber diameter µm	index-profile	wavelength range nm	spectrum	NA*	connector typ	part no.for fiber (without optical connector)
50/125	graded-index	850-1300	-	0,20	SMA, ST, FC/PC, FC/APC, E2000	C-319-**
62.5/125	graded-index	850-1300	-	0,28	SMA, ST, FC/PC, FC/APC, E2000	C-329-**
100/140	graded-index	850-1300	-	0,29	SMA, ST, FC/PC, FC/APC	C-339-**
100/110	step-index	180-1100	UV, VIS	0,22	SMA, ST, FC/PC	C-230-**
100/140	step-index	600-2600	IR	0,22	SMA, ST, FC/PC, FC/APC	C-130-**
105/125	step-index	600-2600	IR	0,22	SMA, ST, FC/PC	C-120-**
200/220	step-index	180-1100	UV, VIS	0,22	SMA, ST, FC/PC	C-240-**
200/220	step-index	600-2600	IR	0,22	SMA, ST, FC/PC	C-140-**
400/440	step-index	180-1100	UV, VIS	0,22	SMA	C-260-**
400/440	step-index	600-2600	IR	0,22	SMA	C-160-**
600/660	step-index	180-1100	UV, VIS	0,22	SMA	C-280-**
600/720	step-index	600-2600	IR	0,22	SMA	C-185-**

*NA – numerical aperture

**when ordering please use the suffix: ST: -10; SMA: -20, FC/PC: -30, FC/APC: -50, E2000: -60

All fibers can be provided with an anti –reflection option; please request. The anti-reflection option is recommended for spectroscopy applications.

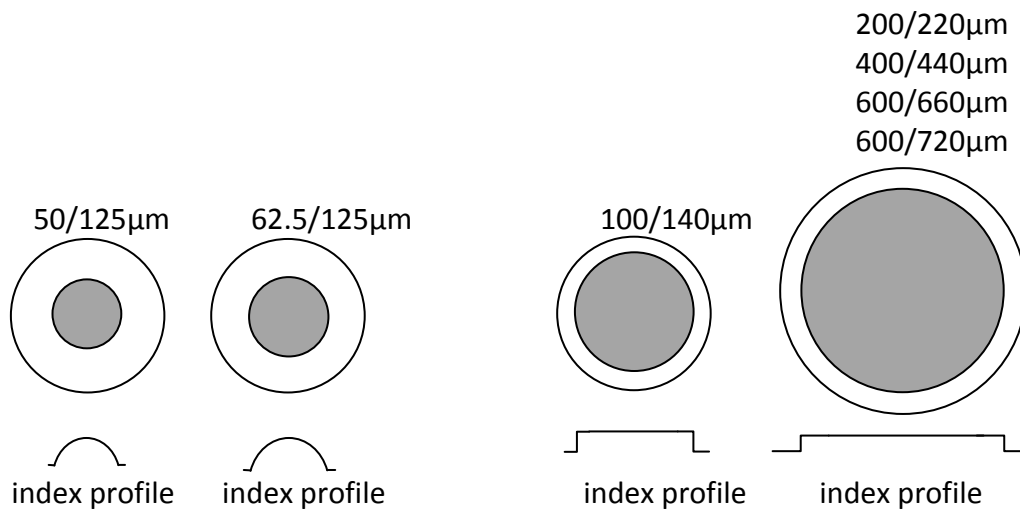
FSM – optical fibers and connectors

Types of optical fibers:

Optical fibers are mainly classified with respect to the lateral dimensions of the light-guiding region, the so-called fiber core. The core diameter together with the refractive index distribution of the core-cladding assembly determines the number of modes the fiber carries. The following figure and table give a rough overview on the different fiber types.

graded-index fiber

step-index fiber



fiber diameter µm	index-profile	wavelength range nm	spectrum	NA*	connector typ	part no. for fiber (without optical connector)
50/125	graded-index	850-1300	-	0,20	SMA, ST, FC/PC, FC/APC, E2000	C-319-**
62.5/125	graded-index	850-1300	-	0,28	SMA, ST, FC/PC, FC/APC, E2000	C-329-**
100/140	graded-index	850-1300	-	0,29	SMA, ST, FC/PC, FC/APC	C-339-**
100/110	step-index	180-1100	UV, VIS	0,22	SMA, ST, FC/PC	C-230-**
100/140	step-index	600-2600	IR	0,22	SMA, ST, FC/PC, FC/APC	C-130-**
105/125	step-index	600-2600	IR	0,22	SMA, ST, FC/PC	C-120-**
200/220	step-index	180-1100	UV, VIS	0,22	SMA, ST, FC/PC	C-240-**
200/220	step-index	600-2600	IR	0,22	SMA, ST, FC/PC	C-140-**
400/440	step-index	180-1100	UV, VIS	0,22	SMA	C-260-**
400/440	step-index	600-2600	IR	0,22	SMA	C-160-**
600/660	step-index	180-1100	UV, VIS	0,22	SMA	C-280-**
600/720	step-index	600-2600	IR	0,22	SMA	C-185-**

*NA – numerical aperture

**when ordering please use the suffix: ST: -10; SMA: -20, FC/PC: -30, FC/APC: -50, E2000: -60

All fibers can be provided with anti –reflection option after request. The anti-reflection option is recommended for spectroscopy application.

Fiber optic connectors types



ST – The ST connector is high-precision, ceramic ferrule. The bayonet style keyed coupling mechanism featuring push and turn locking of the connector prevents overturning and damaging of the fiber end. The insertion loss of the ST connector is less than 0.3 dB.

Drilled-out, metallic ST connectors having insertion losses of > 1 dB are being used with large-core (> 140µm) fibers.

suffix for ordering: -10



SMA – Due to its stainless steel structure and low-precision, threaded fiber locking mechanism, this connector is used mainly in applications requiring the coupling of high-power laser beams into large-core, multimode fibers. The typical insertion loss of an SMA connector is greater than 1 dB.

suffix for ordering: -20



FC/PC –This high-precision, ceramic ferrule connector is equipped with an anti-rotation key, reducing fiber endface damage and rotational alignment sensitivity of the fiber. The typical insertion loss of the FC connector is around 0.3 dB.

Drilled-out, metallic FC/PC connectors having insertion losses of >1 dB are being used with large-core (>140µm) fibers.

suffix for ordering: -30



FC/APC –The Angle FC (APC) polish, adds an 8 degree angle to the connector endface; equipped with an anti-rotation key and axially spring-loaded. The typical insertion loss is less than 0.2 dB.

suffix for ordering: -50



E2000 – This fiber optic connector features secure transmission of high bit-rate protocols, zirconia ceramic ferrule fully protected by spring loaded shutter and push-pull locking mechanism for easy installation.

suffix for ordering: -60

Control interfaces

piezosystem jena offers different options for controlling of the fiber switch.

The fiber switches can be controlled easily via TTL signal (high and low) by BCD code. This is the most practical solution for switches which are built in the small size casing (FSM 1 by 2 or 1 by3 up to 200micron core size diameter).

RS232 interface is included into the fiber switches which are built in the

industrial rack size casing. For the small casing size we offer a separate control box (part. no. Z-950-95) where the interface board is located.

An USB interface is also standard for the switches built into the 19"-industrial rack. Now the line of switches is extended by the addition of an Ethernet interface (part. no. Z-950-100) for all switches that are assembled into a standard 19"-industrial rack. The customers benefit

from the easy installation into existing network systems. Selection of Ethernet interface substitutes the USB interface. In general, for every interface type, the required software comes with the switch. A demo program for Lab-View™ controlling of the switch is also supplied on a CD-Rom when the switch is supplied.