FiberSwitch®

Light switching for optical systems

The Quality Connection

LEONI

光技術をサポートする
株式会社オプトサイエンス
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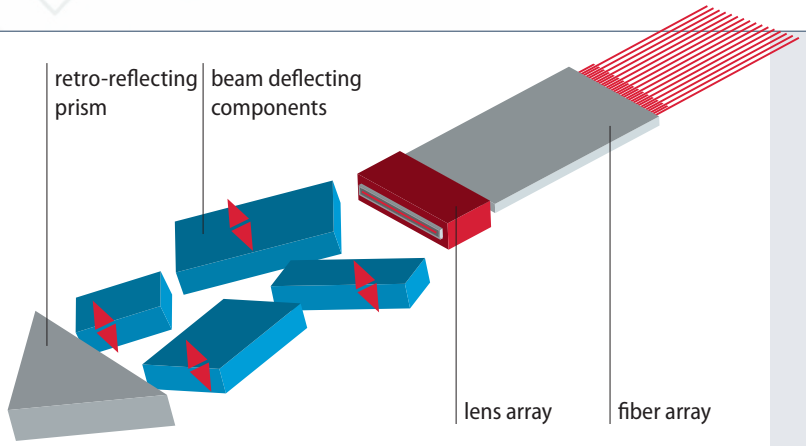
FiberSwitch®

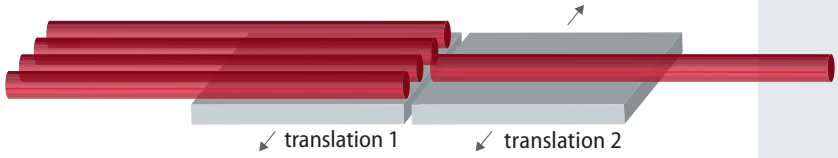
Fiber optical singlemode and multimode switches

Product description

The fiber optical switches from LEONI are based on a unique patented micro-mechanical / microoptical concept. For various applications they provide excellent parameters, high flexibility and long term stability. The switches are available for a broad wavelength range from the Ultraviolet to Infrared and can be fabricated with practically all possible fiber types.



Schematic diagram of a fiber optical singlemode switch 1×16



Schematic diagram of a fiber optical multimode switch 1×4

Optical parameters

- Low insertion loss
- Low polarization dependent loss (PDL) for eol series
- Excellent repeatability
- High optical isolation
- Ultra low back reflection (eol series)
- Very broad spectral ranges
- Short switching times down to 2.0 ms

Housing properties

- Compact rugged metal housing
- Flexible housing options available (compact with pigtails; table top or 19" rack mounts)
- In house optical connectorization
- Low power consumption
- Integrated microcontroller with several electrical interfaces serves for flexible switch control options

Reliability

- Excellent environmental stability, tested acc. to Telcordia GR-1073
- High long-term stability: > 10^8 switching cycles for both eol and mol series

Application & technology

LEONI´s fiber optical switches are mainly used for high demanding applications in telecommunications, optical measurement and test systems, industrial production and process control, as well as in biomedical section. Examples for such applications are laser guiding systems for confocal fluorescence microscopy and laser scanning microscopy, fiber optic strain and temperature sensors for pipelines, bridges, tunnels etc., fiber optical measurement systems for environmental monitoring and also test equipment of optoelectronic devices in their production chain.

- Redundant GPON networks
- Line monitoring and tracing (measurement)
- By-pass solutions
- Full matrix switches

Optical technologies and LEONI

The Business Unit Fiber Optics of the LEONI Group is one of the leading manufacturers of fiber optics for special applications in the industrial and energy sector, in communications, transportation, Life Science and optical metrology. LEONI Fiber Optics offers a unique product portfolio at every stage of the value-added chain: from the fused silica to preforms and drawn fibers up to fiber optic cables and complete fiber optic systems with in-house developed optical components such as optical switches, splitters and couplers. Having sites in Europe, the USA and Asia, production and services are within easy reach of clients and markets.

FiberConnect® Light Guide Fiber & Cable Solutions

We offer you fibers and cables according to international industrial standards (e.g. ITU-T G.651 – G.657, IEC 60793-2-10, IEC 60793-2-30, IEC 60793-2-40, IEC 60793-2-50) with optical waveguides:

- made from glass (singlemode and multimode)
- with glass core with polymer cladding (PCF ➔ Polymer Cladded Fiber)
- with polymer core and cladding (POF ➔ Polymer Optical Fiber).

Many fiber types are also available in a radiation-resistant version. We manufacture different cable designs from central core cables to breakout cables with all buffered fiber types and specific inner and outer jacketing materials as well as customized according to your needs. We use all fiber types to produce hybrid cables with optical fibers, electrical conductors, pneumatic lines or similar, covering almost all possible configurations. We furthermore offer you accessories for the periphery like splice and patch boxes, tools and measurement devices.

FiberTech® Special Optical Fiber Technologies

We manufacture singlemode and multimode fibers with different core sizes, core shapes, numerical apertures, coatings and claddings, as well as fiber bundles and arrays for a wavelength range of 200 nm up to 4 µm. All fibers can be assembled according to the customer's specific needs for industrial and medical applications, high-performance laser cables or optical metrology and sensor technologies. We happily work together with you to create individual approaches to solutions for your special areas of application.

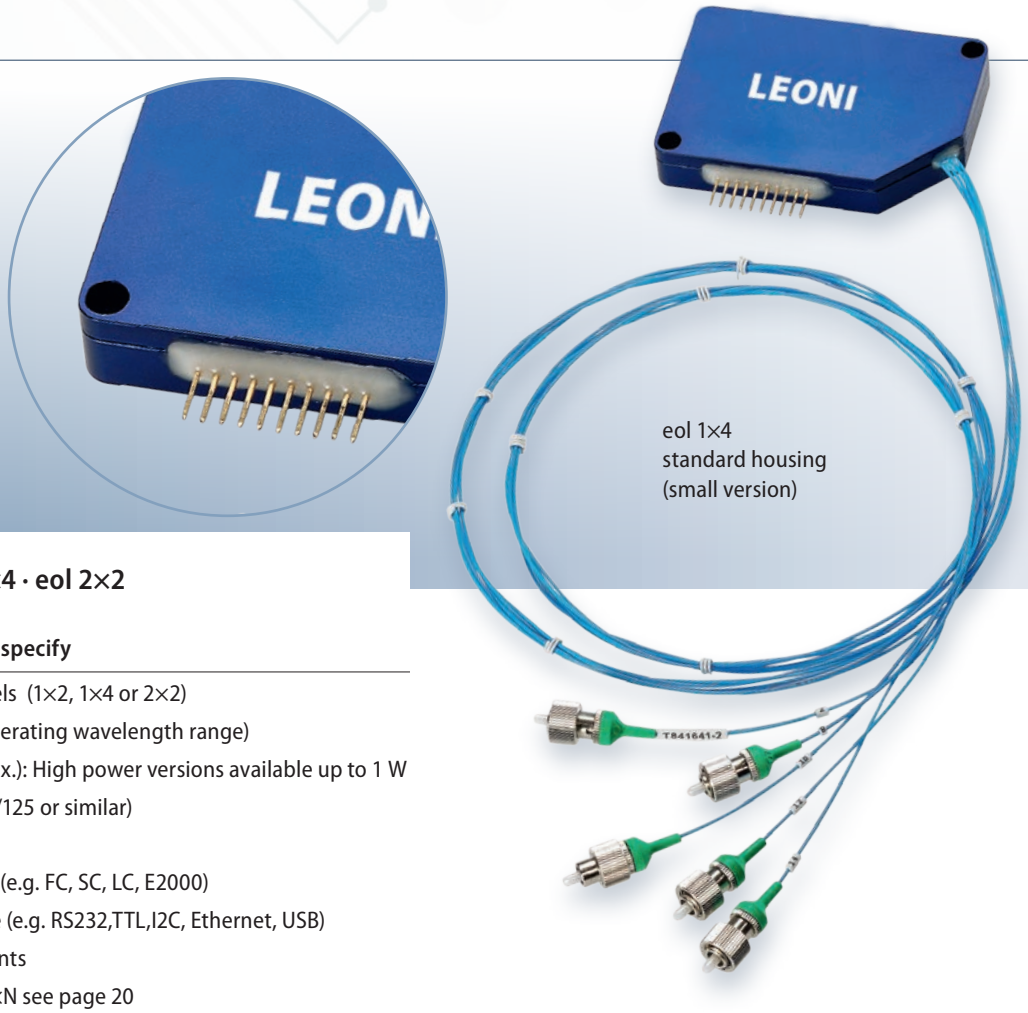
FiberSwitch® Light Switching for Optical Systems

Our fiber optical switches are based on a patented micromechanical/micro-optical design. This guarantees excellent properties, considerable flexibility and maximum long-term stability for many applications. The switches are available for wide wavelength ranges from the ultraviolet to the infrared and for a wide variety of fiber types. Our switches are designed for applications with the highest requirements in the telecommunications area, in measurement and testing and in the biomedical area. Examples of these complex applications include spectroscopy, laser scan microscopy, multi-channel optical performance monitoring, fiber bragg sensors, testing of fiber optical cables and environmental trace analysis.

FiberSplit® Light Distribution for Optical Systems

Based on optical chip technology, the FiberSplit® product portfolio includes standard components such as 1N or 2N splitters as well as customised modules or systems with integrated complex functionality for fiber optical singlemode and multimode systems. FiberSplit® products guarantee expandability with wide optical bandwidth and maximum bit rates thanks to extremely low PDL/PMD. Our products meet TELCORDIA standards and have been failure-free in the field for the past 17 years. We also produce customer-specific chips, components and modules, for example optical waveguide structures for wavelength ranges between 600 and 1700 nm for singlemode components and 450 nm to 2.000 nm for multimode components with various waveguide properties and functions including optical chips and fiber arrays.

FiberSwitch® Fiber optical singlemode switches



eol 1×2 · eol 1×4 · eol 2×2

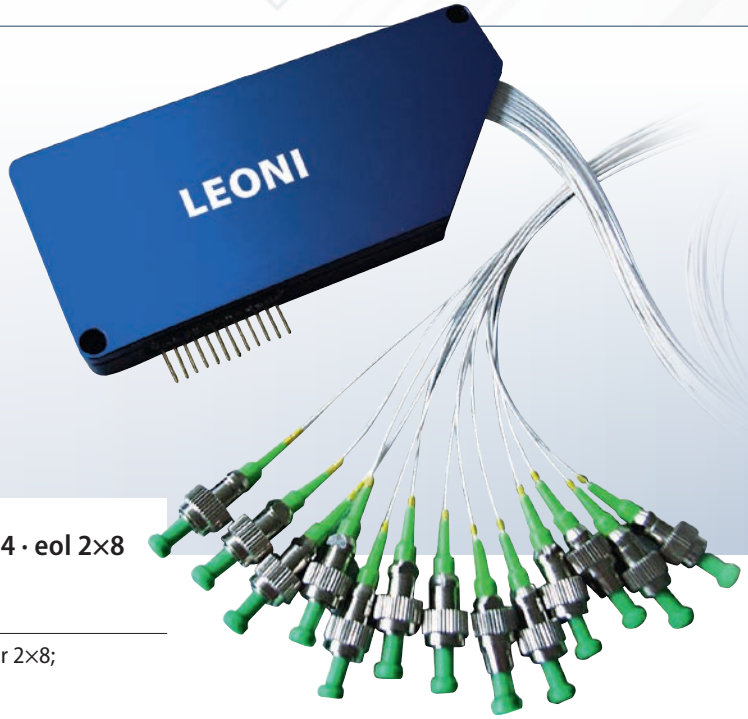
For requests please specify

- Number of channels (1×2, 1×4 or 2×2)
- Spectral range (operating wavelength range)
- Optical power (max.): High power versions available up to 1 W
- Fiber type (e.g. E9/125 or similar)
- Pigtail length (m)
- Connector type(s) (e.g. FC, SC, LC, E2000)
- Electrical interface (e.g. RS232,TTL,I2C, Ethernet, USB)
- Special requirements
- Switch versions 2×N see page 20

Spectral range		VIS	NIR I	NIR II	IR
Specifications					
Operating wavelength	[nm]	400 – 670	600 – 850	900 – 1200	1260 – 1380 1480 – 1650
max. insertion loss (typ.)	[dB]	2…2.5	1.4 (0.9)	1.4 (0.9)	1.0 (0.7)
Return loss	[dB]	> 40 (> 55 *)	> 55	> 60	> 60
Crosstalk	[dB]	≤ –55			
Repeatability	[dB]	≤ 0.01	≤ 0.01	≤ 0.01	≤ 0.005
Polarization dependent loss PDL	[dB]	≤ 0.05			
Switching times	[ms]	≤ 5			
Guaranteed lifetime	[switching cycles]	> 10^8			
Switching frequency	[s^{-1}]	≤ 30			
Operating voltage	[V]	5 (+/–10 %)			
Power consumption	[mW]	< 450			
Operating temperature	[°C]	0 up to +60			
Storage temperature	[°C]	–40 up to +80			
Housing dimensions	[mm]	standard large (124 × 56 × 13)		standard small (75 × 50 × 13)	
Housing options*		Alu Compact table top, 19" rack; different sizes on request			

* on request

FiberSwitch® Fiber optical singlemode switches



eol 1×12
standard housing
(large version)

eol 1×8 · eol 1×12 · eol 1×16 · eol 2×4 · eol 2×8

For requests please specify

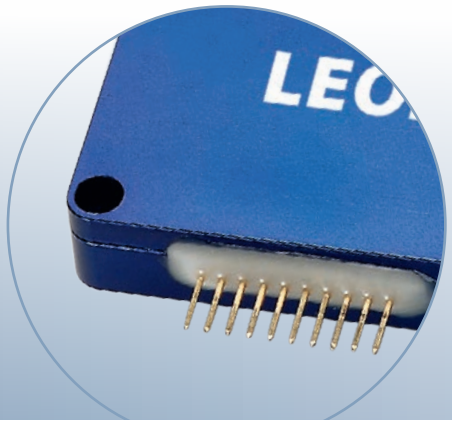
- Number of channels (1×8, 1×12, 1×16, 2×4 or 2×8; other channel counts on request)
- Spectral range (operating wavelength range)
- Optical power (max.): High power versions available up to 1 W
- Fiber type (e.g. E9/125 or similar)
- Pigtail length (m)
- Connector type(s) (e.g. FC, SC, LC, E2000)
- Electrical interface (e.g. RS232,TTL,I2C, Ethernet, USB)
- Special requirements
- Switch versions 2×N see page 20

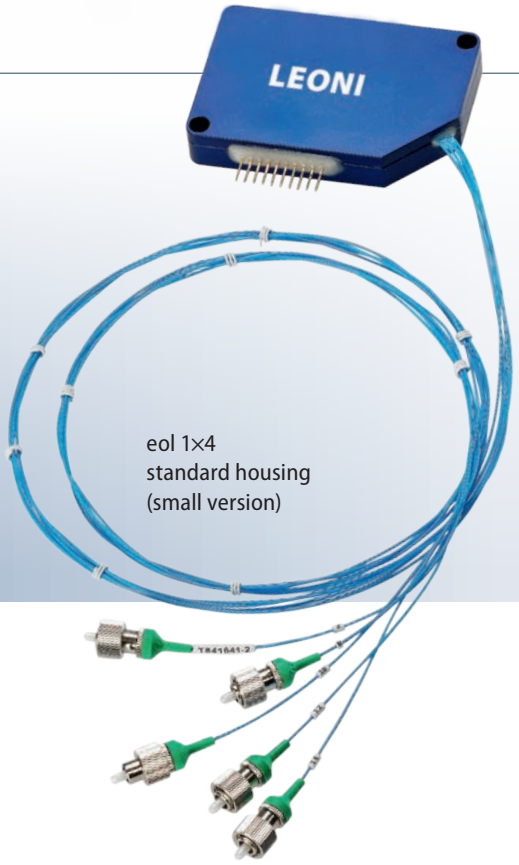
Spectral range		VIS	NIR I	NIR II	IR
Specifications					
Operating wavelength	[nm]	400 – 670	600 – 900	900 – 1200	1260 – 1380 1480 – 1650
max. insertion loss (typ.)	[dB]	2.5...3	1.4 (0.9)*	1.4 (0.9)*	1.0 (0.7)*
Return loss	[dB]	> 40	> 55	> 55	> 60
Crosstalk	[dB]	≤ –55			
Repeatability	[dB]	≤ 0.01			
Polarization dependent loss PDL	[dB]	≤ 0.1			
Switching times	[ms]	≤ 5			
Guaranteed lifetime	[cycles]	> 10^8			
Switching frequency	[s^{-1}]	≤ 30			
Operating voltage	[V]	5 (+/–10 %)			
Power consumption	[mW]	< 450			
Operating temperature	[°C]	0 up to +60			
Storage temperature	[°C]	–40 up to +80			
Housing dimensions	[mm]	standard large (124 × 56 × 13)			
Housing options		Alu Compact table top, 19" rack; different sizes on request			

* For eol 1×16: max. insertion loss is 1.5 dB for IR version and 2.0 dB for all other versions

FiberSwitch® Fiber optical singlemode switches

(polarization maintaining)





eol 1×4
standard housing
(small version)

eol 1×2 PM · eol 1×4 PM · eol 1×8 PM · eol 1×12 PM · eol 1×16 PM

For requests please specify

- Number of channels (1×2, 1×4, 1×8, 1×12 or 1×16; other channel counts on request)
- Spectral range (operating wavelength range)
- Optical power (max.): High power versions available up to 1 W
- Fiber type (e.g. PMF)
- Pigtail length (m)
- Connector type(s) (e.g. FC, SC, LC, E2000)
- Electrical interface (e.g. RS232,TTL,I2C, Ethernet, USB)
- Special requirements

Spectral range		VIS	NIR I	NIR II	IR
Specifications					
Operating wavelength	[nm]	400 – 670	600 – 900	900 – 1200	1260 – 1380 1480 – 1650
Insertion loss	[dB]	2.5...3	2.0 (1.6)	2.0 (1.6)	1.5 (1.2)
Return loss	[dB]	> 40	> 55	> 55	> 60
Crosstalk	[dB]	≤ –55			
Repeatability	[dB]	≤ 0.01			
Polarization extinction ratio PER	[dB]	18 (20)	18 (20)	20 (22)	20 (25)
Switching times	[ms]	≤ 5			
Guaranteed lifetime	[cycles]	> 10^8			
Switching frequency	[s^{-1}]	≤ 30			
Operating voltage	[V]	5 (+/–10 %)			
Power consumption	[mW]	< 450			
Operating temperature	[°C]	0 up to +60			
Storage temperature	[°C]	–40 up to +80			
Housing dimensions	[mm]	standard large (124 × 56 × 13)			
Housing options		Alu Compact table top, 19" rack; different sizes on request			

FiberSwitch® Fiber optical singlemode switches

(UV/VIS, polarization maintaining)

UV/VIS-PM

eol 1×N UV/VIS · eol 1×N UV/VIS-PM (N= 2…16) super-wideband

For requests please specify

- Number of channels N (N = 2…16; other channel counts on request)
- Spectral range (operating wavelength range)
- Optical power (max.): High power versions available up to 100 mW
- Fiber type (e.g. NUFERN PM-S350 HP)
- Pigtail length (m)
- Connector type(s) (e.g. FC, SC, LC, E2000)
- Electrical interface (e.g. RS232,TTL,I2C, Ethernet, USB)
- Special requirements

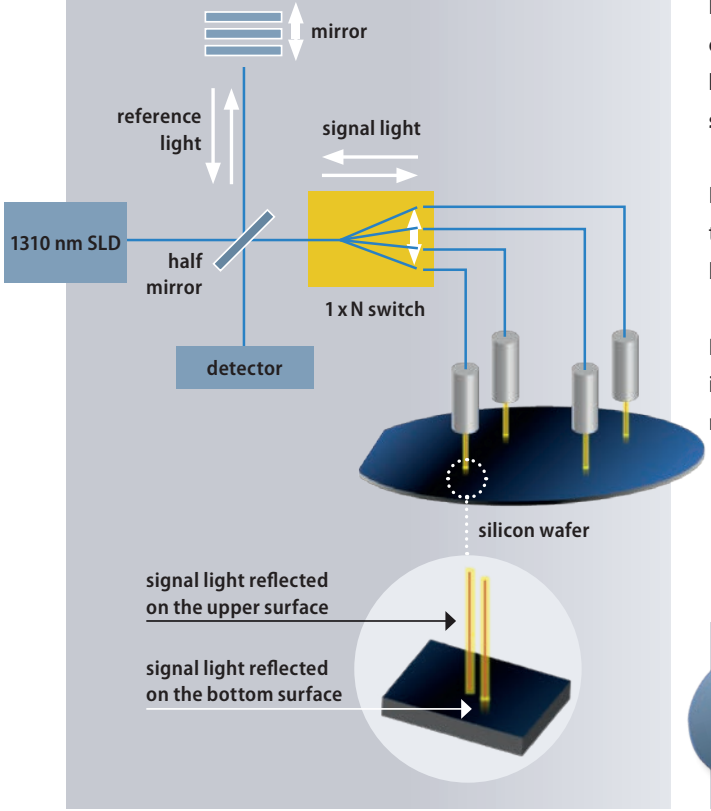
		eol N×1 (λ-Combining)		eol 1×N (Mix-Assigning)	
Specifications					
Operating wavelength	[nm]	350 – 460	400 – 650	350 – 460	400 – 650
max. insertion loss (typ.)	[dB]	2.5 (2)	2.5 (2)	3.5 (3)	3.5 (3)
Return loss	[dB]	> 40	> 40	> 40	> 40
Crosstalk	[dB]	≤ –55			
Repeatability	[dB]	0.01			
Polarization extinction ratio PER	[dB]	18 (20)			
Switching times	[ms]	5			
Guaranteed lifetime	[cycles]	≥ 10^8			
Switching frequency	[s^{-1}]	≤ 50			
Operating voltage	[V]	5 (+/–10 %)			
Power consumption	[mW]	≤ 450			
Operating temperature	[°C]	0 up to +60			
Storage temperature	[°C]	–40 up to +80			
Housing dimensions (standard)	[mm]	standard large (124 × 56 × 13)*			
Housing dimensions, e.g. socket version		Alu Compact			

* Custom housings on request

FiberSwitch® Optical switch integrated OCT system

(Optical coherence tomography)

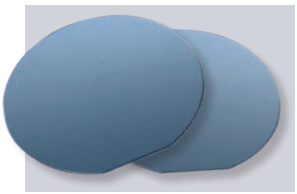
Thickness measurement of silicon wafer



In an OCT measurement, the thickness of a silicon wafer can be measured accurately, by detecting the reflection lights reflected on the upper surface and the bottom surface respectively.

By integrating an optical switch in an OCT measurement system, the thickness of a large size wafer can be measured efficiently.

LEONI supplies various types of singlemode switches, including polarization maintaining switches, suited for OCT measurements.

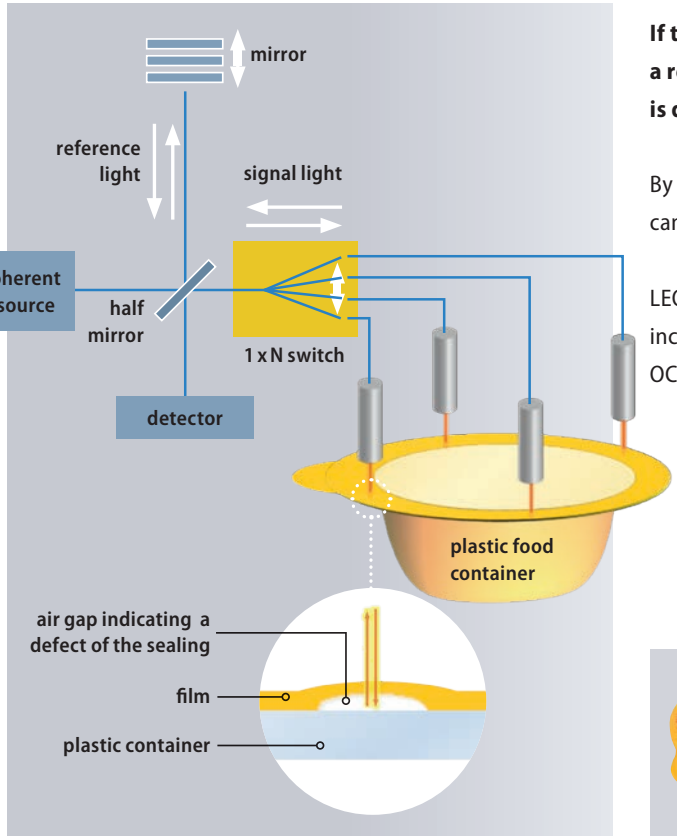


Spectral range		UV/VIS	NIR I	NIR II	IR
Number of channels		1x2, 1x4, 1x8, 1x12 and 1x16 2x2, 2x4 and 2x8 (other channel counts on request)			
Operating wavelength	[nm]	350 – 460 400 – 650	600 – 900	900 – 1200	1260 – 1380 1480 – 1650
Switching frequency	[s^{-1}]	≤ 30			

FiberSwitch® Optical switch integrated OCT system

(Optical coherence tomography)

Sealing inspection of plastic food container



If there is a defect in the sealing of a food container, a reflection signal indicating the peeling of the film is detected in an OCT measurement.

By integrating an optical switch, the measurements can be performed at multiple spots in a short time.

LEONI supplies various types of singlemode switches, including polarization maintaining switches, suited for OCT measurements.

Spectral range		UV/VIS	NIR I	NIR II	IR
Number of channels		1x2, 1x4, 1x8, 1x12 and 1x16 2x2, 2x4 and 2x8 (other channel counts on request)			
Operating wavelength	[nm]	350 – 460 400 – 650	600 – 900	900 – 1200	1260 – 1380 1480 – 1650
Switching frequency	[s^{-1}]	≤ 30			

FiberSwitch® Optical switch integrated Confocal Laser Microscopy

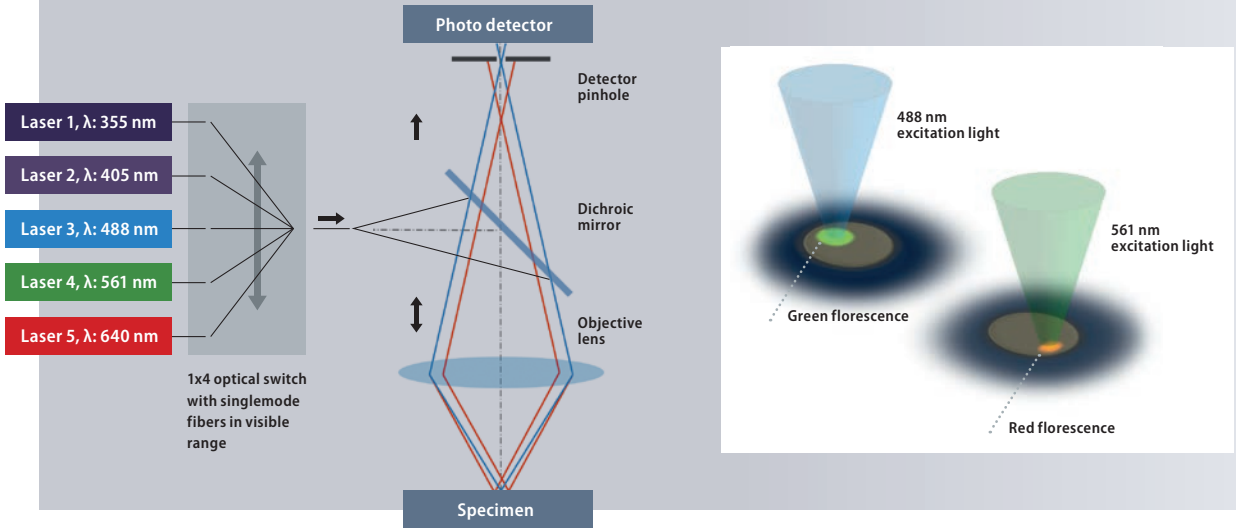
Confocal Laser Micrsocopy

Benefits

- Light emitted from a small core singlemode fiber (mode field diameter: approx. 2.3 µm @ 355nm) enhances the resolution of the image
- The switch is available for the UV range (350 – 460 nm) as well as the visible VIS spectrum (400 – 650 nm)
- The fiber integrated switch simplifies and downsizes the system constitution
- The switch frequency of 30 Hz enhances the measurement speed

Application

- Acquisition of florescence emitted from cells (GFP, RFP, etc.)
- By combining several laser sources suited for each fluorescent with the optical switch, fluorescent of cells can be measured more efficiently



Specifications for Optical Switch		
Switch configuration		1x2, 1x4, 1x8, 1x12, 1x16, 2x4, 2x8
Mode field diameter		~3.3 µm @ 405 nm, other options available
Operating wavelength	[nm]	350 – 460 or 400 – 650
Crosstalk	[dB]	< –55
Switching frequency	[s^{-1}]	30

FiberSwitch® Fiber optical multimode switches

mol 1×9
standard housing
(multiple module)

mol 1×4
standard housing
large

mol 1×N (N = 1…16) · mol 2×N

For requests please specify

- Number of output channels N
- Spectral range (operating wavelength range / UV-VIS; VIS-IR; Broadband)
- Low-Etalon-Effect option available for spectroscopy
- Fiber type (e.g. core diameter, NA, GI or SI)
- Pigtail length (m)
- Connector type(s) (e.g. SMA, FC, ST)
- Electrical interface (e.g. RS232, TTL, I2C, Ethernet, USB)
- Special requirements
- Switch versions 2×N see page 20

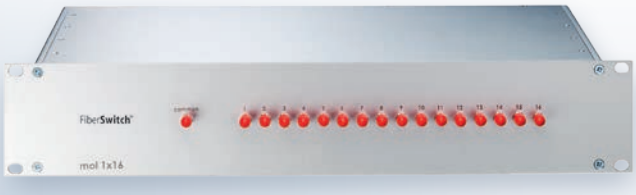
Core diameter		50–100 µm	
Specifications			
Number of output channels N		1…4	5…16
Operating wavelength	[nm]	Depending only on fiber characteristics	
Insertion loss	[dB]	< 1.0 (0.7)	< 2.0 (1.4)
Crosstalk	[dB]	< –60	
Repeatability	[dB]	0.03	
Switching times	[ms]	5	
Guaranteed lifetime	[cycles]	> 10^8	
Switching frequency	[s^{-1}]	≤ 50	
Operating voltage typ.	[V]	5 (+/–10 %)	
Power consumption	[mW]	< 450	
Operating temperature	[°C]	0 up to +60	
Storage temperature	[°C]	–40 up to +80	
Housing dimensions (example) for pigtail version	[mm]	standard large	standard multiple module
Housing dimensions, e.g. for coupling sleeve version		Alu Compact 1	Alu Compact 4

Please note: To minimize back reflection and spectral etalon effects both AR coatings and angle polished fiber ends can be implemented; please request for this.

Selection of useable housing dimensions	
Standard large	124 × 56 × 13
Standard multiple module	172 × 134 × 13.5
Alu Compact 1	187 × 125 × 30-80
Alu Compact 2	227 × 166 × 30-80
Alu Compact 3	187 × 225 × 30-80
Alu Compact 4	227 × 266 × 30-80

FiberSwitch® Fiber optical multimode switches

mol 1×4 Alu Compact 4



mol 1×16 19" 2 HU

mol 1×N (N = 1 bis 16) · mol 2×N

For requests please specify

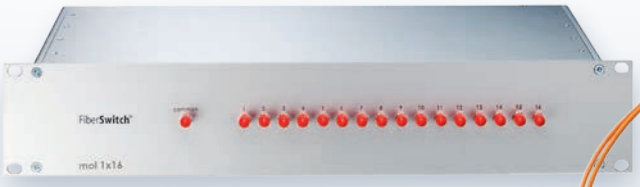
- Number of output channels N
- Spectral range
  (operating wavelength range / UV-VIS; VIS-IR; Broadband)
- Low-Etalon-Effect option available for spectroscopy
- Fiber type (e.g. core diameter, NA, GI or SI)
- Pigtail length (m)
- Connector type(s) (e.g. SMA, FC, ST)
- Electrical interface (e.g. RS232,TTL,I2C, Ethernet, USB)
- Special requirements
- Switch versions 2×N see page 20
- **Optional feature: manual front control panel**
  Channel display and manual control option without external devices

Core diameter		200 µm		400 µm		600 µm		800 µm	
Specifications									
Number of output channels N		1…4	5…16	1…4	5…16	1…4	5…16	1…4	5…16
Operating wavelength	[nm]	Depending only on fiber characteristics							
Insertion loss	[dB]	< 1.0 (0.7)	< 2.0 (1.4)	< 1.2 (1.0)	< 2.4 (2.0)	< 1.2 (1.0)	< 2.4 (2.0)	< 1.3 (1.0)	< 2.6 (2.0)
Crosstalk	[dB]	< –55		< –45		< –40		< –40	
Repeatability	[dB]	0.03							
Switching times	[ms]	10		20		30		40	
Guaranteed lifetime	[cycles]	$> 10^8$							
Switching frequency	[s^{-1}]	≤ 30							
Operating voltage typ.	[V]	5 (+/–10 %) or 100 – 240							
Power consumption	[mW]	< 450							
Operating temperature	[°C]	0 up to +60							
Storage temperature	[°C]	–40 up to +80							
Housing dimensions (example) for pigtail version	[mm]	AluComp1	AluComp3	AluComp2	AluComp4	AluComp1 287 length	19" 2HU 340 depth	AluComp1 287 length	19" 3HU 340 depth
Housing dimensions (example) for coupling sleeve version	[mm]	AluComp3	AluComp4	AluComp4	19" 2HU 280 depth	19" 1HU 280 depth	19" 2HU 340 depth	19" 1HU 280 depth	19" 3HU 340 depth

Please note: To minimize back reflection and spectral etalon effects both AR coatings and angle polished fiber ends can be implemented; please request for this.

Optical switch integrated **pattern defect detection** system

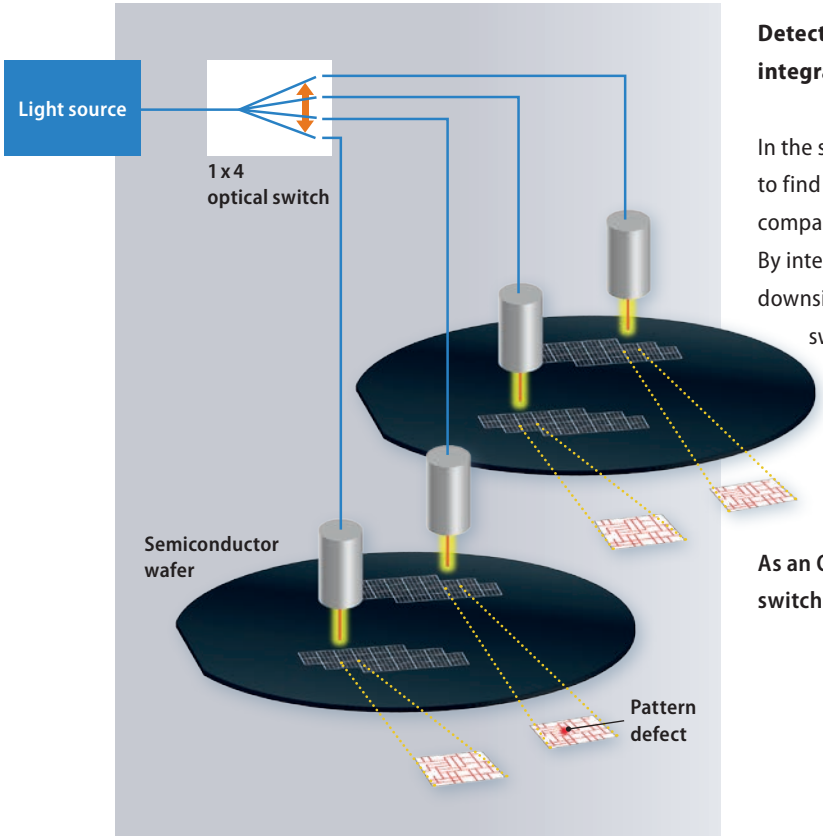
for semiconductor manufacturing



mol 1×16 19" 2 HU

mol 2x4

Pattern defect detection system for semiconductor manufacturing



Detecting pattern defects in semiconductor wafers with integrated 2xN optical switch

In the semiconductor manufacturing process, optics is applied to find pattern defects. A pattern defect can be detected by comparing the pattern images of each die (integrated circuit). By integrating LEONI 2xN optical switches the system can be downsized and the throughput can be enhanced. LEONI optical switches will be applicable to some enhanced configurations, such as a multiple light source system. LEONI supplies various types of 1xN and 2xN single- & multi-mode switches, i.e. LargeCore fibers up to 800 µm, PM, UV-VIS, VIS-IR and broadband.

As an OEM service partner we can also easily integrate the switch into the final measuring system.

Specifications for Optical Switch		
Number of channels		1x2, 1x4, 1x8, 1x12, 1x16, 2x4, 2x8 **(2 ports are switched synchronously)** ➔ Other channel counts on request
Operating wavelength	[nm]	Depending only on fiber characteristics
Switching frequency	[s^{-1}]	≤ 30

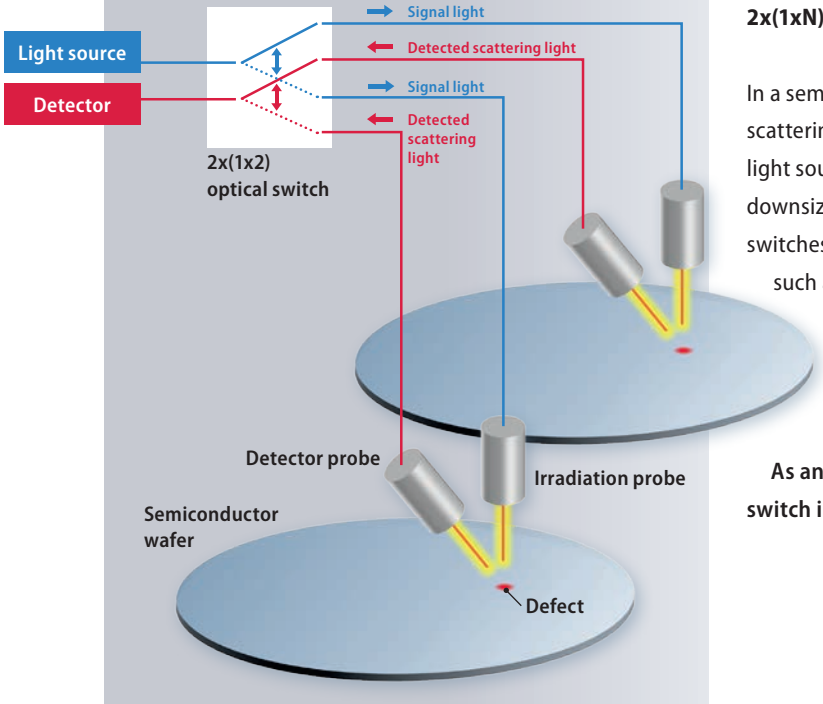
Optical switch integrated **defect detection** system

for semiconductor manufacturing

mol 1×16 19" 2 HU

mol 2x4

Defect detection system for semiconductor manufacturing



Detecting defects in semiconductor wafers with integrated 2x(1xN) optical switch

In a semiconductor wafer, defects can be found by detecting scattering light. By integrating LEONI 2xN optical switches, a light source and a detector can be shared. The system can be downsized and the throughput can be enhanced. LEONI optical switches will be applicable to some enhanced configurations, such as a multiple light source system. LEONI supplies various types of single- & multimode switches, i.e. Large-Core fibers up to 800 µm, PM, UV-VIS, VIS-IR and broadband.

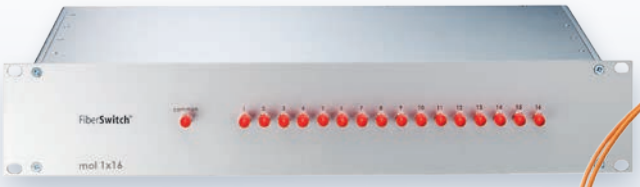
As an OEM service partner we can also easily integrate the switch into the final measuring system.

Specifications for Optical Switch		
Number of channels		1x2, 1x4, 1x8, 1x12, 1x16, 2x4, 2x8 **(2 ports are switched synchronously)** ➔ Other channel counts on request
Operating wavelength	[nm]	Depending only on fiber characteristics
Switching frequency	[s^{-1}]	≤ 30

Optical switch integrated **CMP** system

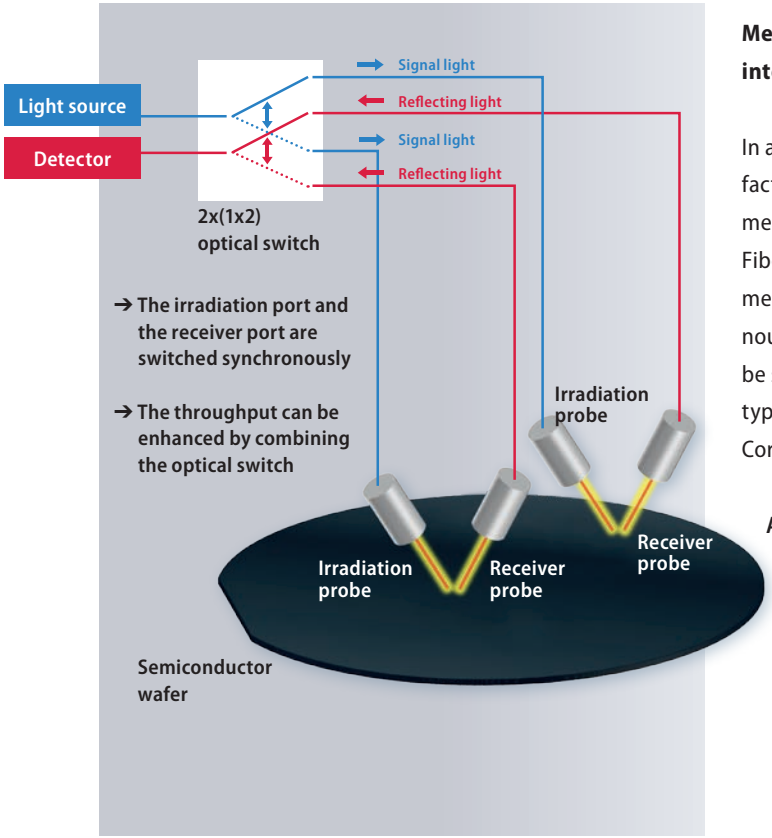
for semiconductor manufacturing

CMP >> Chemical Mechanical Polishing



mol 1×16 19" 2 HU

Chemical Mechanical Polishing system for semiconductor manufacturing



Measurement of semiconductor wafer surface state with integrated 2x(1xN) optical switch

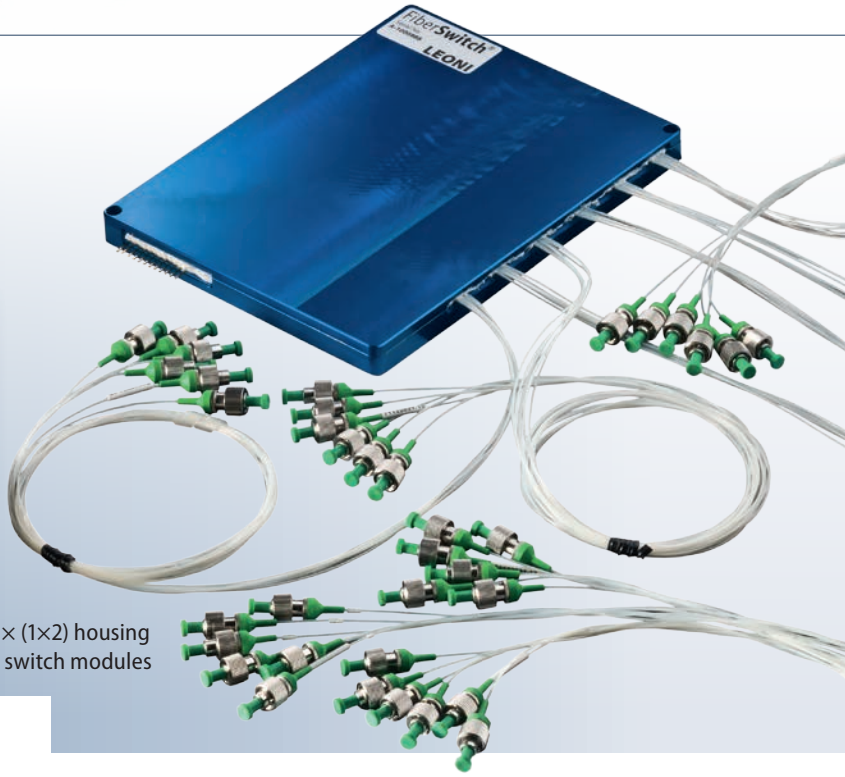
In a CMP (Chemical Mechanical Polishing) process of manufacturing the semiconductor wafer, optical light is applied to measure the actual wafer's surface state. By integrating LEONI's FiberSwitch® 2xN optical switches into the CMP process, the measurement efficiency can be enhanced by the synchronously switching of 2 ports. A light source and a detector can be shared, so the system is downsized. LEONI supplies various types of 1xN and 2xN single- & multimode switches, i.e. Large-Core fibers up to 800 µm, PM, UV-VIS, VIS-IR and broadband.

As an OEM service partner we can also easily integrate the switch into the final measuring system.

Specifications for Optical Switch		
Number of channels		1x2, 1x4, 1x8, 1x12, 1x16, 2x4, 2x8 **(2 ports are switched synchronously)** ➔ Other channel counts on request
Operating wavelength	[nm]	Depending only on fiber characteristics
Switching frequency	[s^{-1}]	≤ 30

FiberSwitch® Fiber optical multiple switches / switch systems

Switch system consisting of two eol 1×16
and one mol 1×16
with one control unit (interface selection:
Ethernet; USB or RS232)



eol 12 × (1×2) housing
with 6 switch modules

eol M × (1×N) · mol M × (1×N)

For requests please specify

- Number of channels (N 1…16)
- Number of switch modules M
- Spectral range
  (Operating wavelength range / UV-VIS; VIS-IR; Broadband)
- Maximum optical power
- Fiber type (e.g. E9/125 or similar or MM Core Diameter,
  NA, GI or SI)
- Pigtail length (m)
- Connector type(s) (e.g. FC, SC, SMA, ST)
- Electrical interface (z.B. RS232, TTL, Ethernet, USB)
- Special requirements
- Higher number of output channels N > 4 in different housing
  versions available
- Higher number of switching modules M upon request
- Further specifications please see pages for single switches

Switch systems

- Combinations of several different switches
  (incl. singlemode and multimode) in different housing
  versions, e.g. 19" racks available
- Control of different switches through one single interface

Number of channels	eol 1×2	eol 1×4	mol 1×2	mol 1×4
No. of switch modules M	2…12	2…6	2…6	2…6
Housing dimensions[mm]	130×106×13.5 (M 2…6)	130×106×13.5 (M 2…3)		
	134×172×13.5 (M 7…12)	134×172×13.5 (M 4…6)		
Housing options	Alu Compact table top, 19" rack; different sizes on request			

FiberSwitch® Fiber optical high channel count switches

Example for high channel count switches:
Optical switch mol 1×1248 with
48-channel MPO connectorization

Example for high
channel count switches:
mol 1×400 19" rack
mount switch box

eol 1×N · mol 1×N

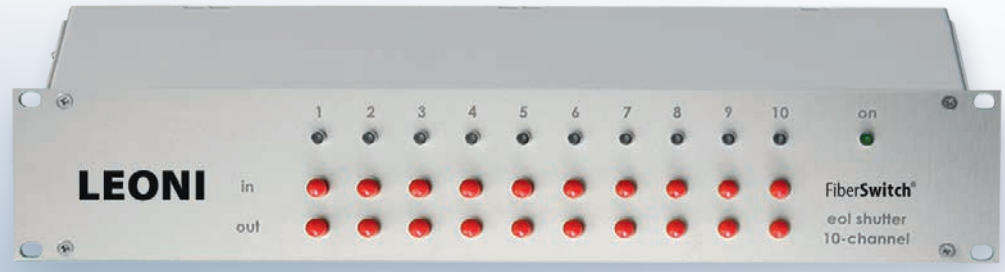
For requests please specify

- Number of output channels N
- Spectral range (Operating wavelength range / UV-VIS; VIS-IR; Broadband)
- Low-Etalon-Effect option available for spectroscopy
- Fiber type (e.g. core diameter, NA, GI or SI)
- Pigtail length (m)
- Connector type(s) (e.g. SMA, FC, ST)
- Electrical interface (e.g. RS232,TTL,I2C, Ethernet, USB)
- Special requirements
- Switch versions 2×N see page 20

Switching principle		standard	high speed version	
Configuration		**cascaded**	**non-cascaded**	**cascaded**
Specifications				
Number of output channels N			≤ 100	> 100 (dep. on fiber type)
Insertion loss	[dB]	dep. on no. of cascades	≤ 1.0	dep. on no. of cascades
Switching frequency	[s^{-1}]	≤ 50	≤ 200	
Guaranteed lifetime	[cycles]	> 10^8		
Operating temperature	[°C]	0 up to +60		
Storage temperature	[°C]	−40 up to +80		
Housing options		19" racks or switch boxes in different sizes on request		

FiberSwitch® Fiber optical multichannel shutters

eol N (N= 1…32)



eol 10-channel Shutter 19" rack, 2 HU

eol N (N=1…32)

For requests please specify

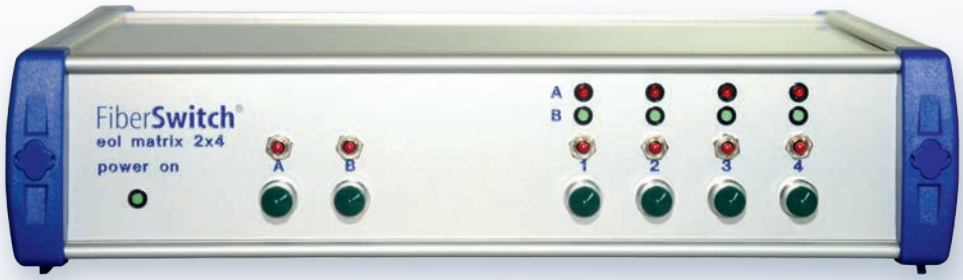
- Channel number
  (N = 1, 2, 3…32; higher channel count on request)
- Spectral range (operating wavelength range)
- Optical power (max.): High power versions available up to 1 W
- Fiber type (e.g. E9/125 or similar)
- Pigtail length (m)
- Connector type(s) (e.g. FC, SC, LC, E2000)
- Electrical interface (z.B. RS232, TTL, I2C, Ethernet, USB)
- Special requirements

Spectral range		VIS	NIR I	NIR II	IR
Specifications					
Operating wavelength	[nm]	400 – 670	600 – 850	900 – 1200	1260 – 1380 1480 – 1650
Insertion loss max. (typisch)	[dB]	3.0 (2.0)	1.4 (0.9)	1.4 (0.9)	1.0 (0.7)
Return loss	[dB]	< 40	< 55	< 55	< 60
Crosstalk	[dB]	≤ 55			
Repeatability	[dB]	≤ 0.01			
Polarization dependent loss PDL	[dB]	≤ 0.1			
Switching times	[ms]	≤ 2			
Guaranteed lifetime	[cycles]	> 10^8			
Switching frequency	[s^{-1}]	≤ 50			
Operating voltage	[V]	5 (+/–10 %) or 100 – 240			
Power consumption	[mW]	< 450			
Operating temperature	[°C]	0 up to +60			
Storage temperature	[°C]	–40 up to +80			
Housing (standard)		19" rack 3 HU*			

*) Custom housings on request

FiberSwitch® Fiber optical full matrix

matrix N×M (N,M≤16) singlemode and multimode

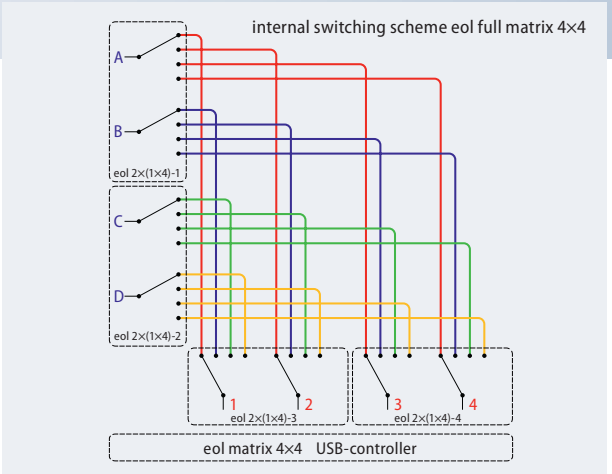


eol full matrix 2×4, Alu Compact 4

matrix N×M (N,M≤16)

For requests please specify

- Channel configuration (N×M)
- Spectral range (operating wavelength range)
- Optical power (max.): High power version available
- Fiber type (e.g. G100/140; SMF28)
- Polarization maintaining available
- Connector type(s) (e.g. FC, SC, LC, E2000)
- Electrical interface (e.g. RS232, Ethernet, USB)
- Special requirements (e.g. Manual control on front-panel)



Spectral range		VIS	NIR I	NIR II	IR
Specifications for singlemode					
Operating wavelength	[nm]	400 – 670	600 – 850	900 – 1200	1260 – 1650
Insertion loss max. (typisch)	[dB]	6 (5)	3 (2)	3 (2)	2.5 (1.6)
Return loss	[dB]	> 40	> 55	> 55	> 60
Crosstalk	[dB]	≤ –55			
Repeatability	[dB]	≤ 0.01			
Polarization dependent loss PDL	[dB]	≤ 0.1			
Switching times	[ms]	≤ 5			
Guaranteed lifetime	[cycles]	> 10^8			
Switching frequency	[s^{-1}]	≤ 30			
Operating voltage	[V]	110 – 240			
Power consumption	[mW]	< 450			
Operating temperature	[°C]	0 up to +60			
Storage temperature	[°C]	–40 up to +80			
Housing (standard)		Alu Compact or 19“ rack*			

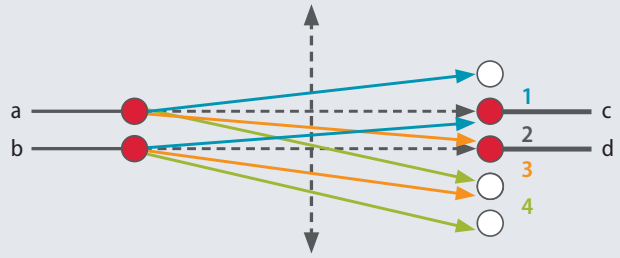
*) Custom housings on request

Switching principles of fiber optical switches

eol 2×N · mol 2×N

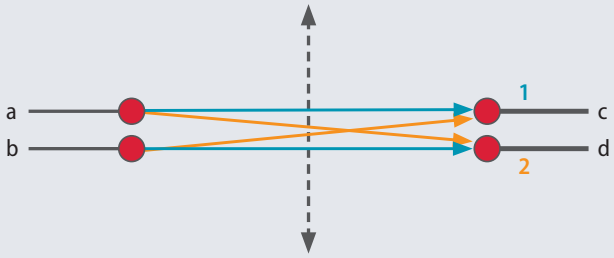
Version 1

eol 2×2 · mol 2×2 (4 switch positions)



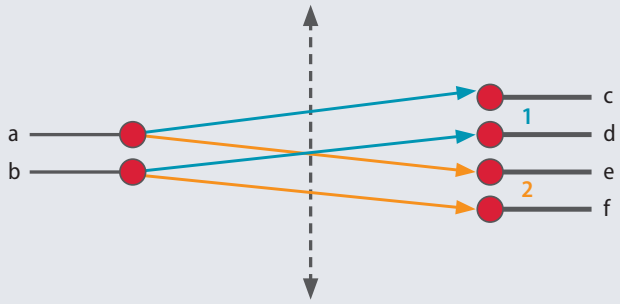
Version 2

eol 2×2 · mol 2×2 (2 switch positions)



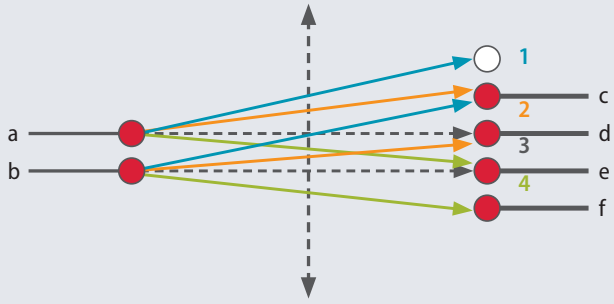
Version 3

eol 2×4 · mol 2×4 (2 switch positions)



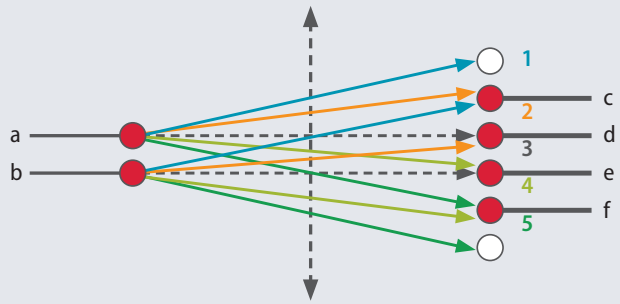
Version 4

eol 2×4 · mol 2×4 (4 switch positions)



Version 5

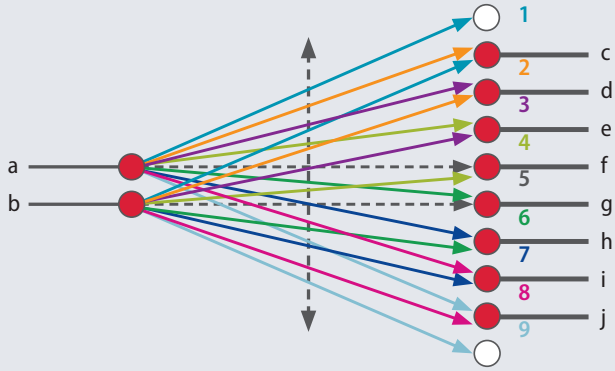
eol 2×4 · mol 2×4 (5 switch positions)



further configurations on request

Version 6

eol 2×8 (9 switch positions)



Notes

Business Unit Fiber Optics
Performance for every application

Our fields of competence

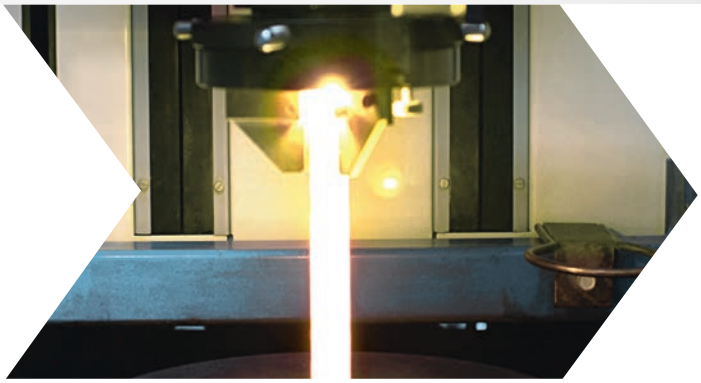
- **Communications** (wiring systems for buildings and industry)
- **Energy** (mining, wind, solar, nuclear, petroleum, utilities)
- **Mechanical and Plant Engineering** (drag chains and switches)
- **Automation and Robotics** (Industrial Ethernet, bus systems, high -performance lasers for materials processing)
- **Transportation Engineering** (air and space travel, transport)
- **Defense** (system components and mobile field cables)
- **Laser Technology** (active and passive optical fibers for laser welding/laser treatment)
- **Audio / Video / Multimedia**
- **Medicine and Life Sciences** (laser probes, endoscopic equipment)
- **Sensor Technology / Analytics** (colour, opacity and gas sensor technology, environmental engineering)
- **Lighting Technology**
- **Naval and Maritime Engineering** (steering control cables)
- **Spectroscopy (chemical and food industries, astrophysics)**
- **Scientific Institutions** (universities, research centers)
- **Optics** (Fused Silica)

Design & development

- Development of customer-specific system solutions and prototypes
- Industrial research projects on materials science and technology development

Silica, preform & fiber production

- Production of fused silica
- Production of customer specific graded index and step index preforms
- Production of multimode fibers with a core diameter of 10 to 2700 µm



Special optical fiber & cable production

- In-house production of standard and special optical fibers (glass, silica, POF, PCF)
- Hybrid cables with electrical and optical waveguides

Customized assembly & special components

- Assembly of fiber optical systems for applications in industry, medicine and science
- Manufacturing of planar optical fibers as optical splitters
- Manufacturing of fiber optical switches

Your system partner throughout the entire value chain

Find out more:

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