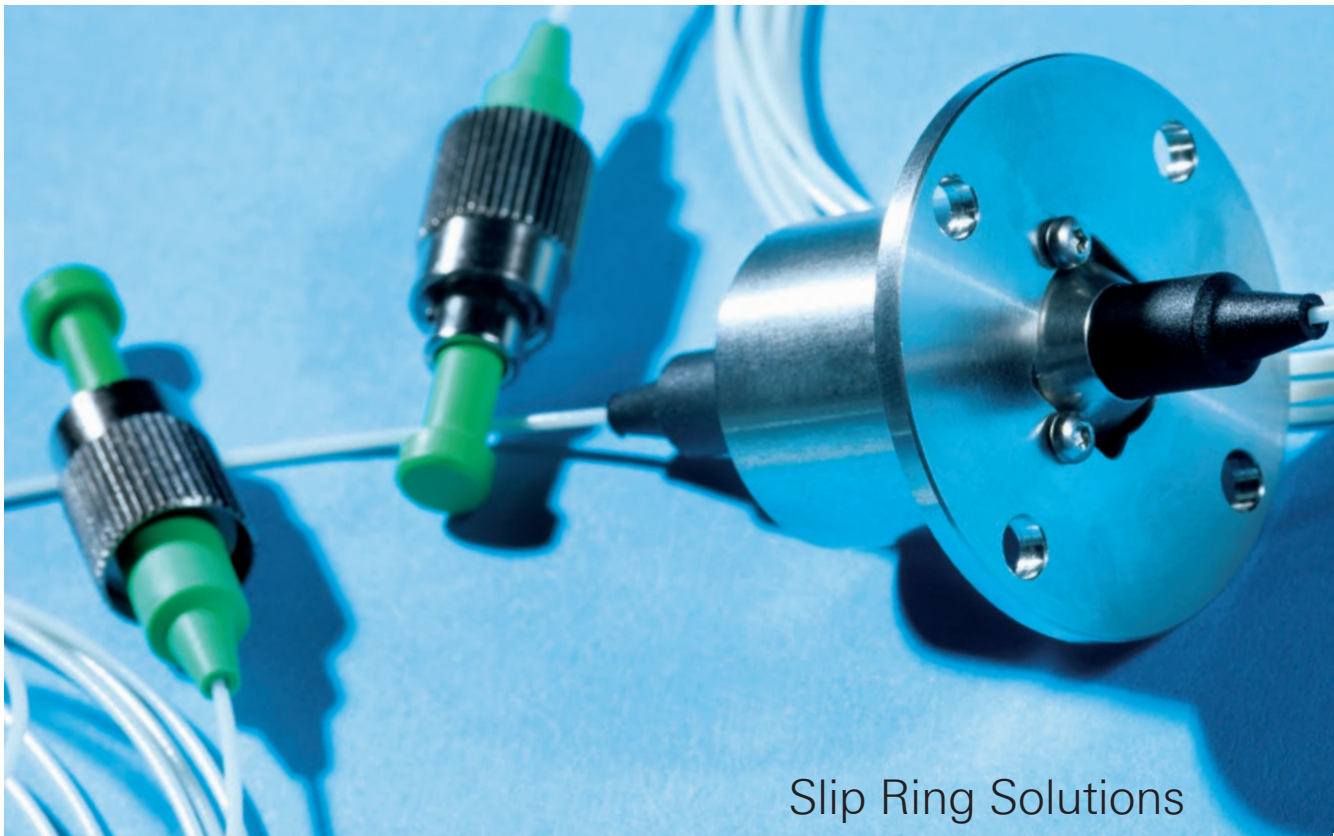




**SCHLEIFRING**



Slip Ring Solutions

**Fiber Optics**

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## About SCHLEIFRING



### Company Name

Slip rings are our business. That is why we called our company SCHLEIFRING. This is the German word for slip ring.

### Foundation

1974

### Company Philosophy

This is what we stand for:

- highly innovation-based products
- sustainable quality
- fair competition

### Certified Management System

We fulfill the requirements of DIN EN ISO 9001:2008

### Employees

More than 650 and we are growing steadily.

### Research & Development

More than 15% of our employees work in R&D in 9 different laboratories.

### Patents

More than 230 in the last ten years. And the number is still increasing.

### Corporate Video

Learn about all our miscellaneous applications in our corporate video and experience our technologies.



### Worldwide Network

#### SCHLEIFRING GmbH, Germany

Headquarters and plant  
Production plant  
XRing Technologies GmbH

#### SCHLEIFRING Group worldwide

Schleifring North America, LLC  
Schleifring Medical Systems, LLC  
Schleifring Systems Ltd.  
Schleifring Transmission Technology (Tianjin) Co. Ltd.

Fuerstenfeldbruck, Germany  
Kaufbeuren, Germany  
Fuerstenfeldbruck, Germany

Chelmsford, MA, USA  
Elgin, IL, USA  
Newbury, UK  
Tianjin, China



## Fiber Optics In General

Optical fibers transmit high data rates reliably over long distances.

SCHLEIFRING offers fiber-optic rotary joints which can be connected directly to optical fibers. FORJs transmit every kind of digital or analog optical signal irrespective of the data protocol used.

### Highlights:

- Temperature range: -40 °C to 85 °C
- Capacities up to 60 fibers
- Not affected by EMI
- Long service life through by contactless technology

### Classic applications:

- Ground and marine radar systems
- Offshore industry
- Unmanned aerial vehicles (UAV)
- Mining industry



### Combining FORJs with rotary components to create hybrid assemblies

Typically, fiber-optic rotary joints are part of a more comprehensive rotary interface. Hybrid FORJs combine an electrical slip ring with a fiber-optic rotary joint, allowing electrical, power and optical signals to be transferred through a single rotational joint. All devices can be ordered as "stand-alone" solution.

### Dependable expertise

For more than 35 years we have been engaged in the development, design and production of fiber-optic rotary joints for a wide range of applications worldwide.

## Fiber Optics Different Fiber Types

### Single-Mode (SM) Fiber:

A small-core optical fiber limits the light to only one mode of propagation. The typical core diameter is 9 microns. SM fibers are the best choice for long-haul links and high data rates >10 Gbit/s. The standard wavelengths are 1310 nm and 1550 nm. SM fibers offer optimum signal quality.

### Multimode (MM) Fiber:

Due to its large core, this type of optical fiber allows the transmission of light using different parts (multiple modes) along the link. The high number of modes limits the maximum link length at high data rates. Typical core diameters are 50 or 62.5 microns. MM fibers are commonly used for short-haul links at data rates up to 10 Gbit/s. Typical wavelengths are 850 nm or 1310 nm.



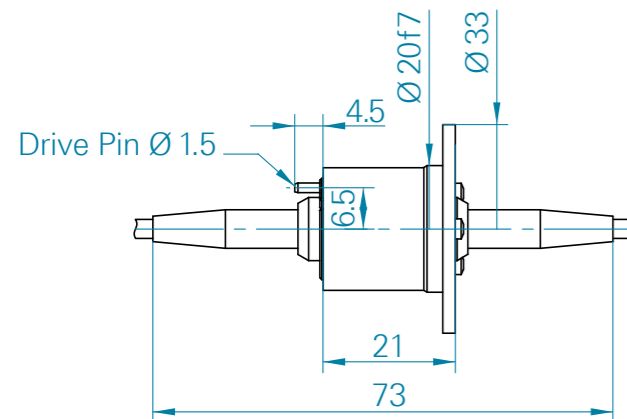


## Optical Rotary Joints Single-Channel

These rotary joints achieve optimum insertion and return loss figures due to the use of high-quality collimators aligned in four axes. Precision ball bearings being the only moving parts, high rotational speeds in combination with a long service life can be attained.

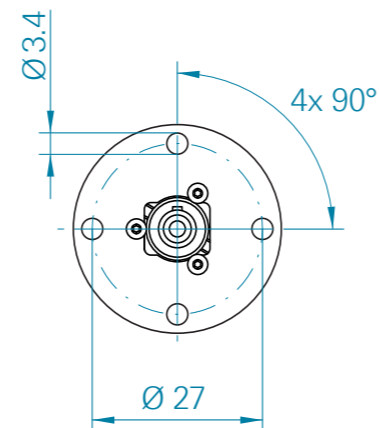
Technologies such as bi-directional (BiDi) transceivers or Coarse Wavelength Division Multiplexing (CWDM) bundle up to 16 channels in one fiber. This type of system combines the advantage of compactness with a large number of channels. The overall size and the layout of the mounting holes and the drive coupling are the same for single-mode and multimode fiber rotary joints.

### Single-Channel Single-Mode and Multi-Mode FORJ:



#### Special characteristics:

- Small size
- High rotational speeds
- Identical mechanical interface for single-mode and multi-mode units

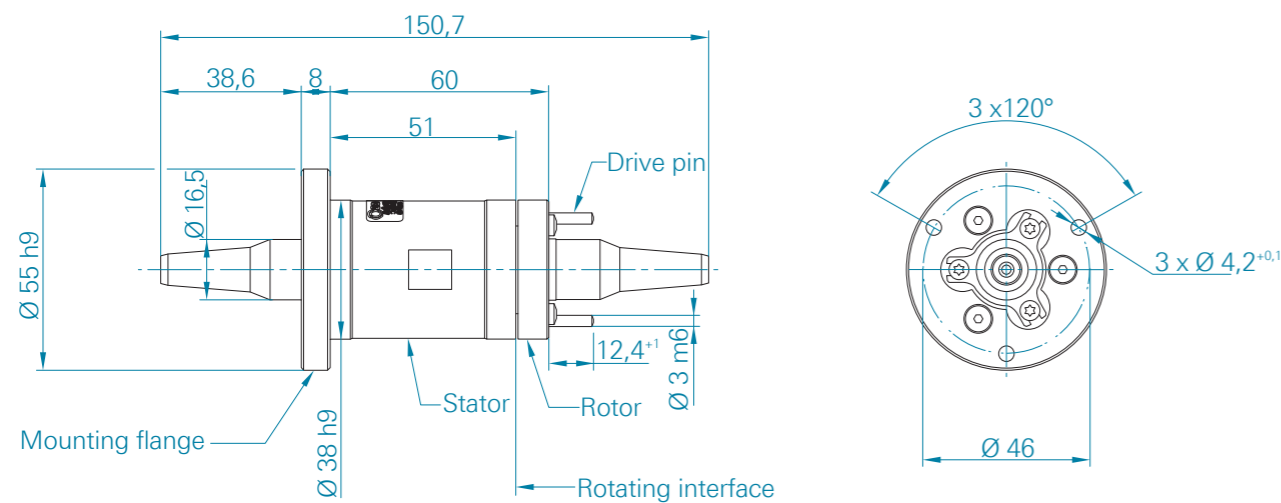


## Technical Data Single-Channel

Interface	1-CH SM	1-CH MM
<b>No. of optical channels</b>	1	1
Fiber type	Single-Mode G.657.A1 9 μm / 125 μm	Multimode 50 μm / 125 μm (OM4) 62.5 μm / 125 μm (OM1)
Fiber jacket	900 μm jacket or cable	900 μm jacket or cable
Preferred connectors (for further connectors see page 16)	FC/PC	ST/PC
Weight	~60 g	~60 g
Diameter	20 mm	20 mm
Length	19.5 mm	19.5 mm
<b>Optical Performance</b>		
Wavelength range	1260 nm ... 1625 nm	820 nm ... 880 nm and 1280 nm ... 1350 nm
Wavelengths used for specifications	1310 nm and 1550 nm	850 nm and 1310 nm
Max. insertion loss	1.5 dB	2.0 dB
Max. insertion loss variation (during rotation)	0.5 dB	0.5 dB
Min. return loss	55 dB	25 dB
Max. optical power handling (up to)	27 dbm / 500 mW	27 dbm / 500 mW
<b>Mechanical characteristics</b>		
Rotational Speed	2,000 rpm (up to 16,000 rpm with balanced version)	
Service life	200 million revolutions	
<b>Environmental characteristics</b>		
Operating temperature	-40 °C ... 85 °C	
Storage temperature	-40 °C ... 85 °C	
Max. temperature gradient	2 °C/min	
Humidity (non-condensing)	27 °C / 98 % rel. hum. 35 °C / 74 % rel. hum.	
Shock	Typ. 30 g, 11 msec	
Vibration	Typ. 3.85 g rms, 5 Hz ... 500 Hz	
Protection Class	IP 40	

## Optical Rotary Joints 2-Channel Multimode

Optical rotary joints may be more complex than multi-channel transmitters, but they enable two channels to be completely separated physically for optimum full-duplex transmission without additional electronics. Using a lens system, the optical signals are transmitted 100 % passively in the highest quality.



## Technical Data

Interface	2-CH MM
<b>No. of optical channels</b>	2
Fiber type	Multimode 50 μm / 125 μm (OM4) 62.5 μm / 125 μm (OM1)
Fiber jacket	900 μm tight buffer
Preferred connectors (for further connectors see page 16)	LC / PC
Weight	~ 500 g
Diameter	38 mm (55 mm incl. removable flange)
Length	150 mm incl. cable boots
<b>Optical Performance</b>	
Wavelength range	820 nm ... 880 nm or 1280 nm ... 1350 nm
Wavelengths used for specifications	850 nm or 1310 nm
Max. insertion loss	5.5 dB
Max. insertion loss variation (during rotation)	2.0 dB
Min. return loss	18 dB
Crosstalk	50 dB
Max. optical power handling (up to)	27 dbm / 500 mW
<b>Mechanical characteristics</b>	
Rotational Speed	1000 rpm
Service life	200 million revolutions
<b>Environmental characteristics</b>	
Operating temperature	-40 °C ... 85 °C
Storage temperature	-40 °C ... 85 °C
Max. temperature gradient	2 °C/min
Humidity (non-condensing)	27 °C / 98 % rel. hum. 35 °C / 74 % rel. hum.
Shock	Typ. 30 g, 11 msec
Vibration	Typ. 3.85 g rms, 5 Hz ... 500 Hz
Protection Class	IP 40

## Optical Rotary Joints Multi-Channel

Optical rotary joints with up to 60 independent single-mode fibers or up to 28 multimode fibers.

The micro-optics patented by SCHLEIFRING offer important advantages over conventional technology with individual collimators.

Micro-optics provide for the highest number of channels in the smallest possible area. The overall size and the interface dimensions are the same for single-mode and multimode units irrespective of the number of channels.

### Wavelength spectrum — Dove prism:

A dove prism is used to display the rotating side as a stationary image. Due to the refraction inside the prism, the FORJ performs best within the wavelength range from 1260 nm to 1625 nm.

Find a choice of possible plug connectors on page 16.

### Innovative Single-Mode Optical Fiber 60 Channels

The product platform developed by SCHLEIFRING for multi-channel optical rotary joints offers further potential i.a. with regard to a higher number of channels.

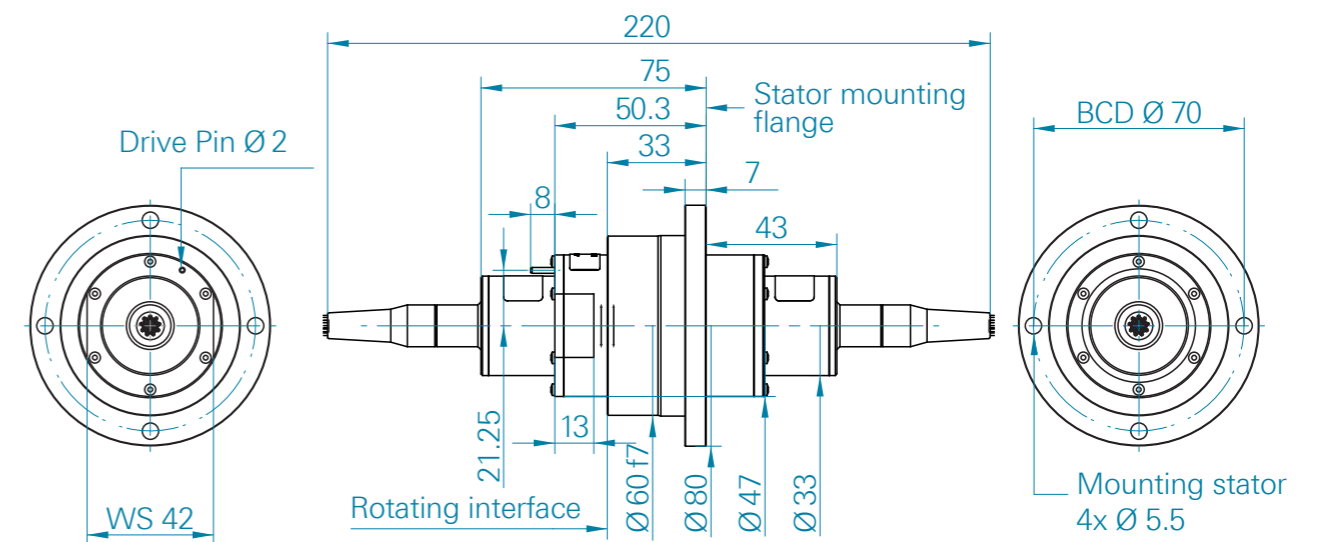
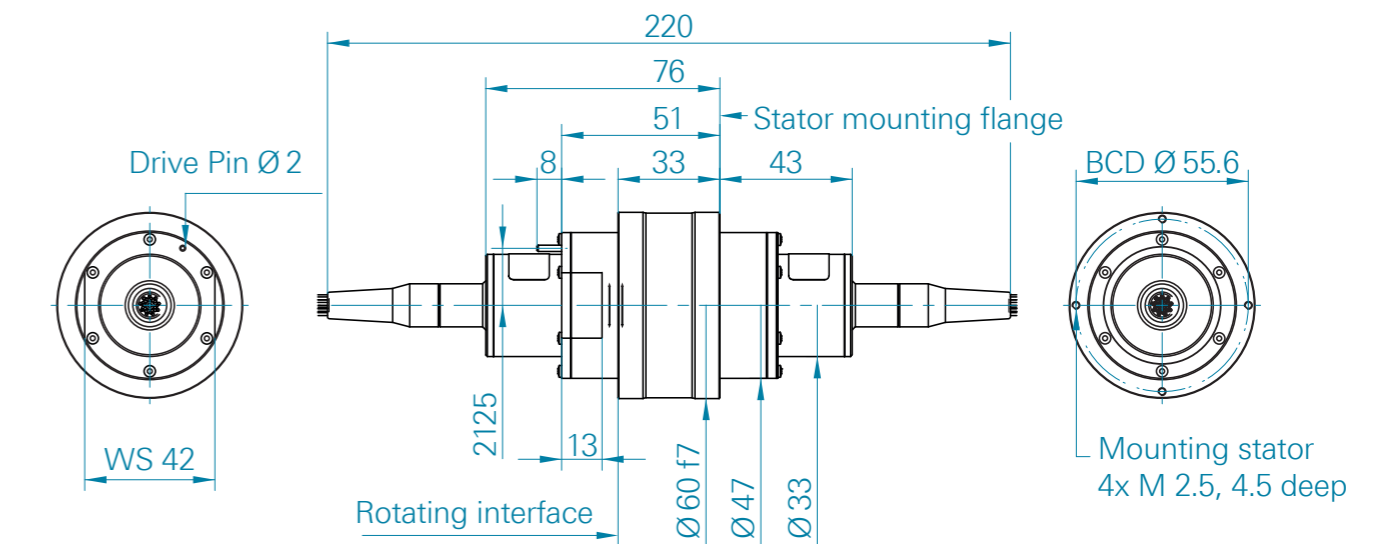
By continuously investing in R&D, SCHLEIFRING opens up new possibilities for this technology. SCHLEIFRING has improved the structural design and joining technologies and optimized the design of the micro-optics to suit the manufacturing technology.

Due to the use of micro-optic technology, rotary joints with 60 channels or more have the same housing size as earlier generations.

Due to the number of channels, each 10 channels at a time are combined in one ribbon fiber and one MPO connector.

## Optical Rotary Joints Multi-Channel

### Multi-channel FORJ:



Technical Data  
Multi-Channel Single-Mode

Interface	Multi-Channel SM
<b>Preferred no. of optical channels</b>	4, 8, 12, 16, 20, 24, 28, 32, 60
Fiber type	Single-Mode 9 µm/ 125 µm G.657.A1 ribbon fiber
Fiber jacket	900 µm tight buffer, flame-retardant PVC 60-channel ribbon fiber
Cable length	from 1 m to 2 m
Preferred connectors (for further connectors see page 16)	FC/ PC (60 ch with MTP/ APC)
Weight	~1.5 kg
Diameter	60 mm
Length	220 mm incl. cable boots
<b>Optical performance</b>	
Wavelength range	1260 nm... 1625 nm
Selected wavelength	1310 nm/ 1550 nm
Max. insertion loss	3.5 dB
Max. insertion loss variation	1.5 dB
Min. return loss	40 dB
Max. crosstalk	-50 dB
Optical damage threshold of each fiber Max. continuous optical power handling per fiber	20 dBm ± 100 mW 10 dBm ± 10 mW
<b>Mechanical characteristics</b>	
Rotational speed	150 rpm
Service life	200 million revolutions
<b>Environmental characteristics</b>	
Operating temperature	-40 °C ... 85 °C
Storage temperature	-40 °C ... 85 °C
Max. temperature gradient	2 °C / min
Humidity (non-condensing)	27 °C / 98 % rel. hum. 35 °C / 74 % rel. hum.
Shock	Typ. 30 g, 11 msec
Vibration	Typ. 3.85 g rms, 5 Hz ... 500 Hz
Protection Class	IP 50

Technical Data  
Multi-Channel Multimode

Interface	Multi-Channel MM
<b>Preferred no. of optical channels</b>	4, 8, 12, 16, 20, 24, 28
Fiber type	Multimode 50 µm / 125 µm (OM3) Multimode 62.5 µm / 125 µm (OM1)
Fiber jacket	900µm tight buffer, flame-retardant PVC Color: OM3 - aqua / OM1 - orange
Cable length	from 1 m to 2 m
Preferred connectors (for further connectors see page 16)	ST/PC
Weight	~1.5 kg
Diameter	60 mm
Length	220 mm incl. cable boots
<b>Optical performance</b>	
Wavelength range	820 nm ... 880 nm; 1280 nm...1350 nm
Optimized wavelength	850 nm / 1310 nm
Max. insertion loss	3.5 dB
Max. insertion loss variation	1.0 dB
Min. return loss	30 dB
Max. crosstalk	-40 dB
Optical damage threshold of each fiber Max. continuous optical power handling per fiber	20 dBm ± 100 mW 10 dBm ± 10 mW
<b>Mechanical characteristics</b>	
Rotational speed	150 rpm
Service life	200 million revolutions
<b>Environmental characteristics</b>	
Operating temperature	-40 °C ... 85 °C
Storage temperature	-40 °C ... 85 °C
Max. temperature gradient	2 °C / min
Humidity (non-condensing)	27 °C / 98 % rel. hum. 35 °C / 74 % rel. hum.
Shock	Typ. 30 g, 11 msec
Vibration	Typ. 3.85 g rms, 5 Hz ... 500 Hz
Protection Class	IP 50



## Connectors

SCHLEIFRING offers a possible choice of different plug connectors for FORJs listed below.

Further customized solutions and designs on request.

Connector Type	Single-Mode	Multimode
FC/PC	•	•
FC/APC R-type narrow key	•	
ST/PC	•	•
SC/PC	•	•
SC/APC	•	
LC/PC	•	•
LC/APC	•	
E-2000/PC	•	•
E-2000/APC	•	
M29504/04 /05	•	•
M29504/14 /15	•	•
LuxCis/PC (ARINC 801)	•	•
LuxCis/APC (ARINC 801)	•	
MPO (only 60 channels)	•	

## Multiplexer, Power Splitters & BiDi Transceivers

The intelligent application of multiplexing devices such as WDM and CWDM, power splitters and couplers can greatly enhance the capacity of each fiber pass.

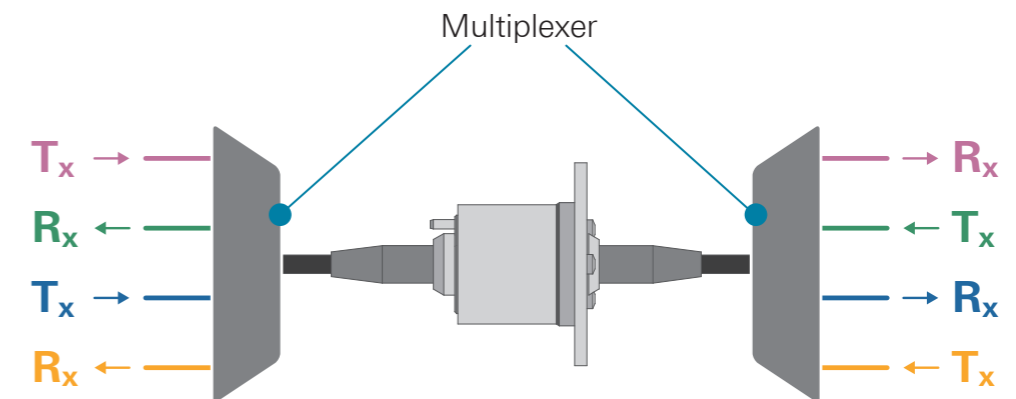
### Wavelength division multiplexing (WDM):

Wavelength-division multiplexing feeds several signals (with different wavelengths) into one optical fiber.

### Coarse wavelength division multiplexing (CWDM):

Coarse wavelength division multiplexing components allow up to 18 independent signals to pass through one optical fiber.

Both multiplexing techniques can be used separately or together to simplify optical transmission systems and reduce cost, improve reliability, reduce weight and improve performance.



### Bidirectional fiber optic transceiver (BiDi):

BiDis and multiplexers include both a transmitter and a receiver in one component. BiDis use only one single fiber for the bidirectional transmission.

## Hybrid Solutions



In many instances, SCHLEIFRING is called upon to incorporate various transmission technologies – such as contacting slip rings for power and signal transmission and contactless rotary joints for data transmission and positioning systems – into one slip ring assembly: highly reliable hybrid systems built to withstand strong vibrations and harsh environments.

### **Transmission principles individually combined into a single rotary joint:**

Electrical slip rings in gold-wire technology apply:

- Fiber optical rotary joints for data and signal transmission up to 10 Gbit/s
- Contactless GigaCAP data link for high data transfer rates up to 10.3 Gbit/s per channel
- Contactless rotary joints for combined power and signal transmission
- Media rotary joints for fluids and gases up to 2000 l/min.
- RF rotary joints, digital/ analog, up to 15 channels, DC - 94 GHz

### **A commitment to progress**

SCHLEIFRING carries out intensive and systematic research with methods that have been perfected in the course of many application-oriented projects over the years. With our commitment to innovation, we are constantly pushing back the limits of technical feasibility for our customers. The expertise of our development and manufacturing specialists provides the users of our systems and technologies significant competitive advantages.

## Manufacturing Excellence

We design for demanding conditions. Rigorous testing is performed by specialists in our own environmental testing chambers and testing facilities.

SCHLEIFRING stands for absolute precision and reliability based on the expertise, enthusiasm and many years experience of our specialists. We solve signal and data transmission challenges even in the world's harshest environments with innovative, high-performance fiber-optic rotary joints.

In order to be able to meet our customer's special requests, no matter what the application, we have made expert advice and technical progress our core business.





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