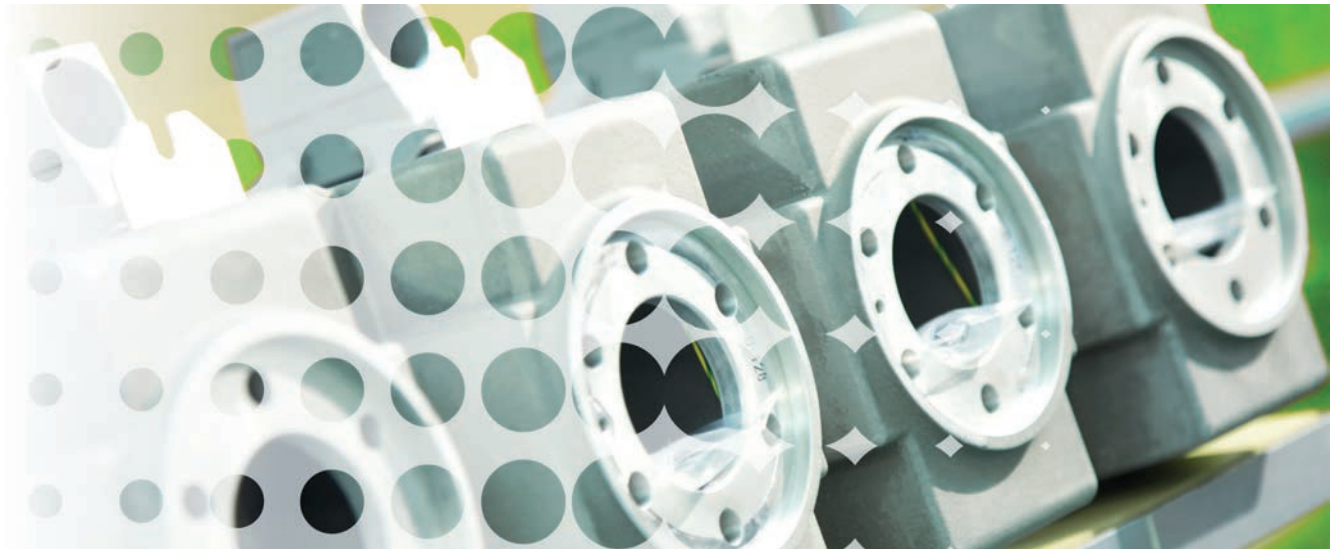
SCHLEIFRING

Slip Ring Solutions | **Wind Energy**



SCHLEIFRING Headquarters in Fürstenfeldbruck, Germany

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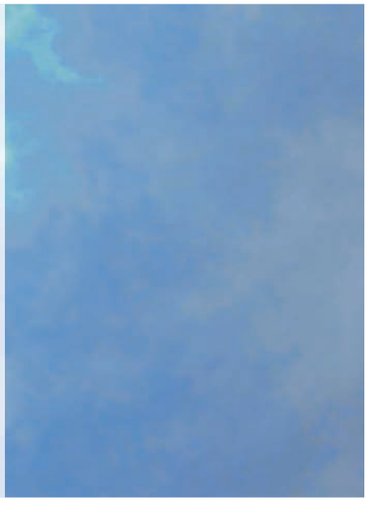
About SCHLEIFRING



As the market leader, SCHLEIFRING meets the complex and demanding requirements for sophisticated electrical rotary joints and slip ring systems throughout the world.
More than 3,000 customers rely on SCHLEIFRING solutions. Our products lead the field in wind energy, aerial and space surveillance, and medical applications such as CT-Scanners.

In virtually all high-tech industries, our solutions have been successfully providing the rotating interface behind the process for almost 40 years now.
The outstanding quality of our precision products is highly regarded by OEMs and operators alike, and is firmly linked to our philosophy and to the name SCHLEIFRING.

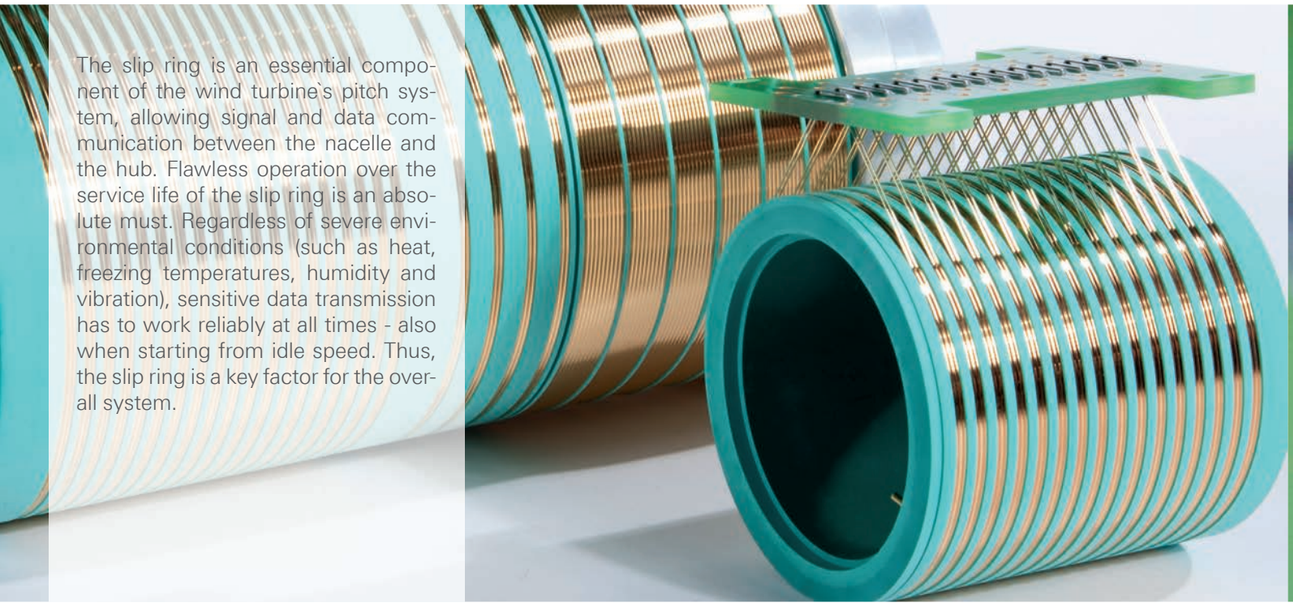
SCHLEIFRING maintains a global network to provide its customers with local sales, service and logistic capabilities.

Schleifring und Apparatebau GmbH | Germany

Headquarters Fuerstenfeldbruck — Plant Kaufbeuren

- **Schleifring North America, LLC** — Elgin, IL | USA
  - **Schleifring Medical Systems, LLC** — Elgin, IL | USA
- **Schleifring Systems Ltd.** — Newbury | UK
- **Xring Technologies GmbH** — Fuerstenfeldbruck Germany
- **Schleifring Transmission Technology (Beijing) Co. Ltd.** — Beijing | China

Contacting Transmission | **Signal & Data**



The slip ring is an essential component of the wind turbine's pitch system, allowing signal and data communication between the nacelle and the hub. Flawless operation over the service life of the slip ring is an absolute must. Regardless of severe environmental conditions (such as heat, freezing temperatures, humidity and vibration), sensitive data transmission has to work reliably at all times - also when starting from idle speed. Thus, the slip ring is a key factor for the overall system.

Gold-Wire Signal & Data Transmission e.g. safety chain, Profibus, Profinet, EtherCAT

SCHLEIFRING's gold-wire technology allows excellent signal and data transmission:

- Extremely low electrical noise and contact resistance
- Long service life with low maintenance
- High contact reliability
- Crosstalk isolation
- Reliable operation under shock loading, vibration and extreme temperatures
- Transmission of all common bus systems up to 100 Mbit/s (100BaseT)

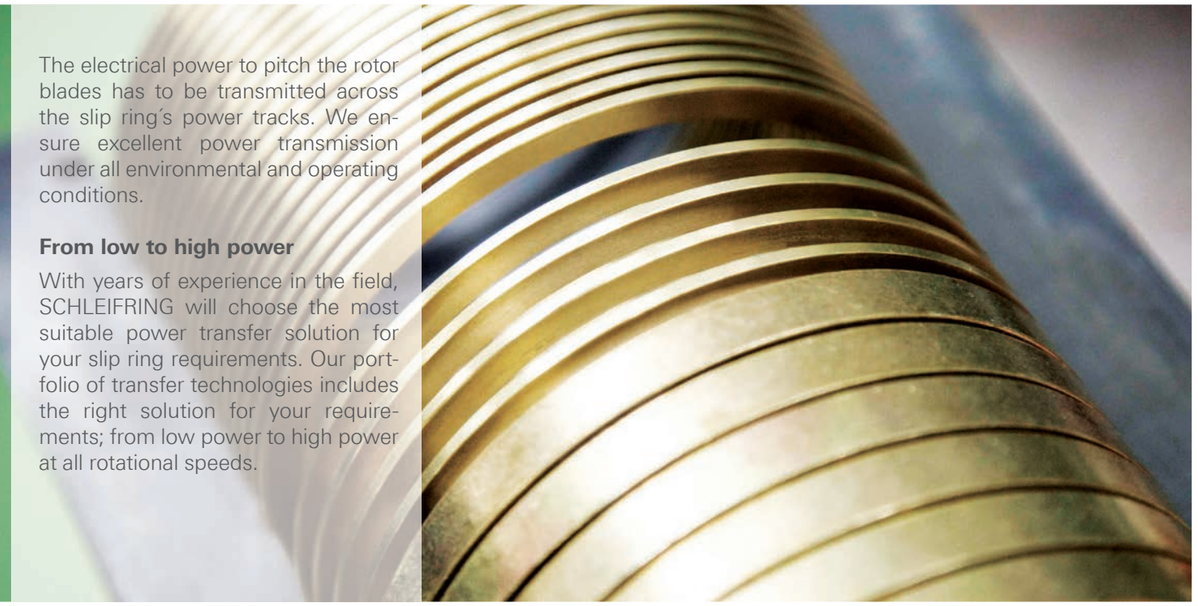
Fast Ethernet

Ethernet/IP | EtherCAT | Profinet | Powerlink

Fieldbus

Interbus | Profibus | Devicenet | CAN

Contacting Transmission | **Power**



The electrical power to pitch the rotor blades has to be transmitted across the slip ring´s power tracks. We ensure excellent power transmission under all environmental and operating conditions.

From low to high power

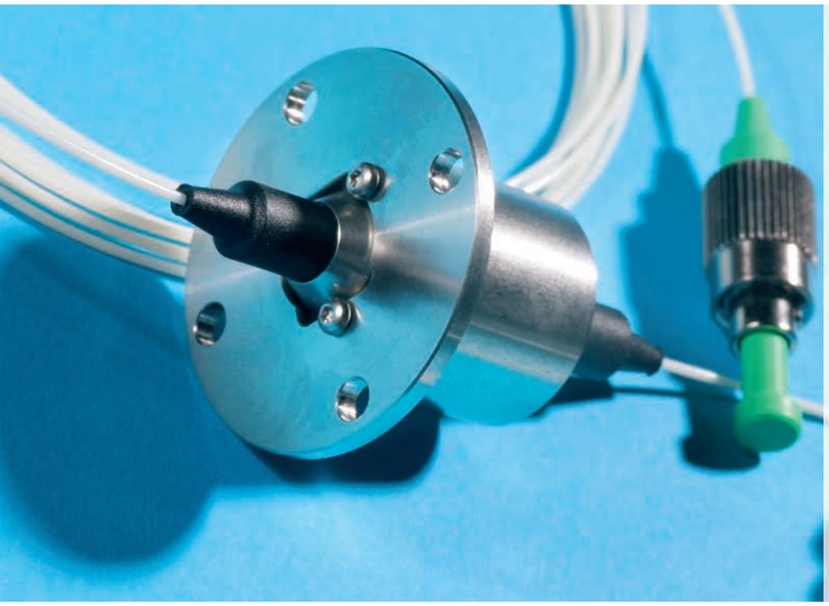
With years of experience in the field, SCHLEIFRING will choose the most suitable power transfer solution for your slip ring requirements. Our portfolio of transfer technologies includes the right solution for your requirements; from low power to high power at all rotational speeds.

SCHLEIFRING is your technology expert for contacting materials in power transmission. We choose the most appropriate technology to meet your requirements. (e.g. **multi-fiber technology**, **precious-metal technology**, **carbon technology**)

We focus on meeting the following requirements:

- Design and materials adapted to your specific power transmission requirements
- Transmission technology for optimal maintenance intervals
- Optimized heat dissipation characteristics
- Robust design for all rotating modes (from idle to max.)
- Long service life

Contactless Data Transmission | **Fiber-Optic Rotary Joints**



For about 20 years now SCHLEIFRING has been developing and manufacturing state-of-the-art FORJs, and is technology leader in the field of single- and multi-channel FORJs which work reliably day in day out in various applications all over the world.
In today's wind turbines the use of fiber optics is common practice. Particularly control and condition-monitoring systems are linked optically with the nacelle and the switchboard gallery of the wind park. Slip rings with integrated fiber-optic rotary joints (FORJs) extend this optical infrastructure, allowing high-speed data transfer and reliable, wear- and maintenance-free communication between the nacelle and the hub. SCHLEIFRING offers the possibility to integrate FORJs into customized solutions.

Optical Data Transmission:

- Data rates of 10 Gbit/s or higher
- EMC: Immune against any kind of electromagnetic interference
- Temperature range: -40 °C to +85 °C
- Bidirectional communication via BiDi transceiver or wavelength-division multiplexer (WDMs)
- Single-mode or multi-mode fibers
- No maintenance

Gigabit Ethernet

Ethernet 1000BaseT

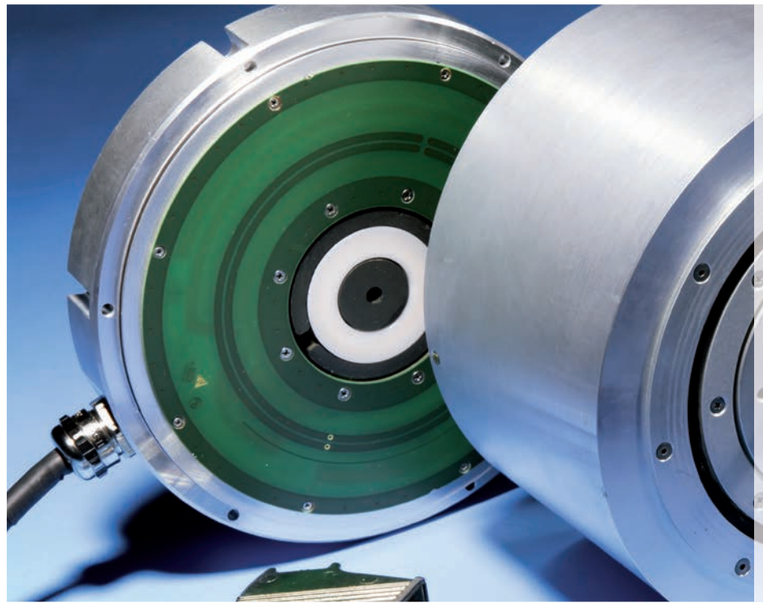
Fast Ethernet

Ethernet/IP | EtherCAT | Profinet | Powerlink

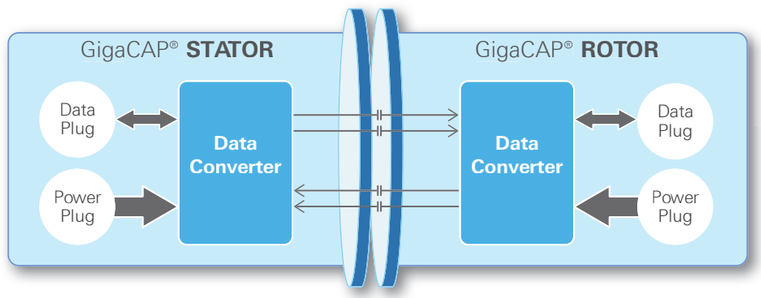
Fieldbus

Interbus | Profibus | Devicenet | CAN

Contactless Data Transmission | **Capacitive Data Link** GigaCAP®



SCHLEIFRING's GigaCAP® capacitive data link is maintenance-free, even at high rotational speeds, without the use of brushes running on metallic surfaces. The system allows full duplex communication and transfer of high data rates, combining high noise immunity and excellent EMC shielding.
The integration of a slip ring with a GigaCAP® has no impact on data transfer and the network infrastructure of the pitch system.



GigaCAP® **Data Transmission:**

- Data rate up to 10 Gbit/s
- No maintenance
- High reliability: BER < 10^{-12}
- Temperature range: -40 °C to 65 °C
- Full duplex
- Reliable operation under shock loading and vibration
- Real-time capability

Gigabit Ethernet

Ethernet 1000BaseT

Fast Ethernet

Ethernet/IP | EtherCAT | Profinet | Powerlink

Fieldbus

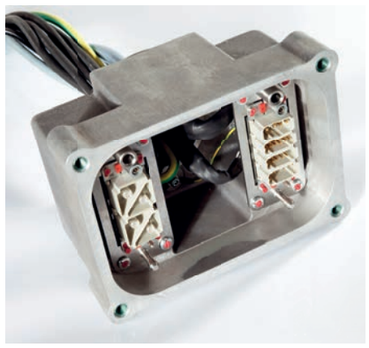
Profibus | CAN

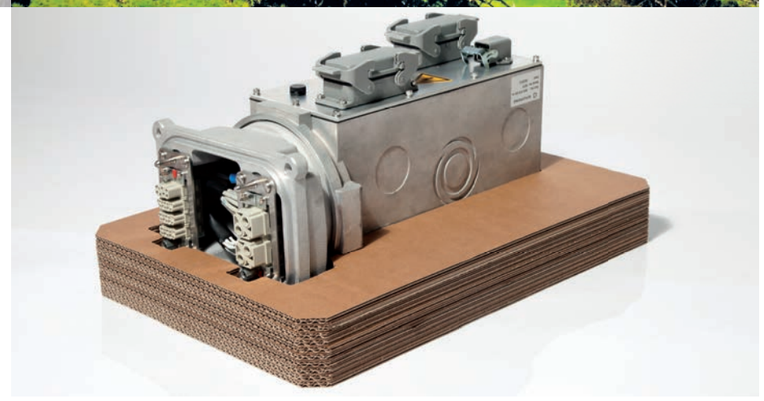
In Quality and Performance | **Onshore**

SCHLEIFRING manufactures thousands of slip rings every year and has been setting quality standards in wind turbines for more than 20 years.

Quality in:

- Customer consulting
- Product development
- Product qualification
- Product realization
- Supply chain management
- After-sales service





In Quality and Performance | **Offshore**

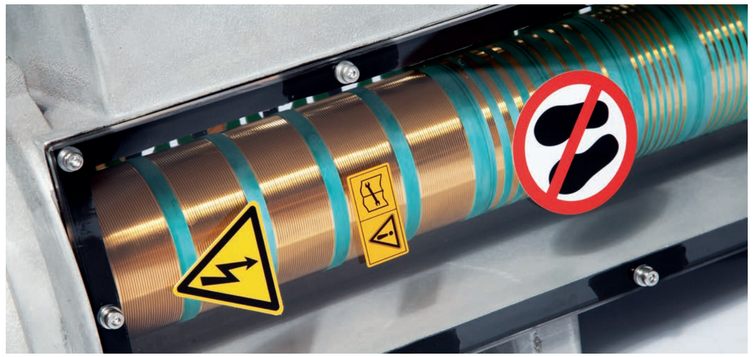
As an experienced supplier of slip ring systems for offshore oil and gas exploration, SCHLEIFRING has been supplying slip rings for offshore wind applications to most European manufacturers right from the word go.

Our slip ring designs set performance standards for turbine sizes between 2 and 7 MW. They are designed to fulfill the most demanding requirements of OEMs, operators and service crews.

The Allrounder

The Demanding World of Pitch-Control Slip Rings

SCHLEIFRING has combined the experience of the past 10 years with market requirements. We have designed a slip ring system which covers typical pitch system concepts for wind turbines with a gearbox in the range from 500 kW to 5 MW. The result is a slip ring system that fulfills high quality and performance standards by combining cost efficiency and short time to market. The versatility of this system allows more than 500 hardware combinations and 36 connector configurations. It is also suitable as a substitute system to operate turbines in the field that were not initially equipped with our slip rings.



Specify your desired functionality:

Key features:

- 5-pitch power tracks up to 80 A / 400 VAC (690 VAC)
- Up to 32 tracks
- Industrial connectors
- Easy maintenance
- No extra heating element required
- Adaptable to suit direct-drive turbines

Operating range:

Temperature range:	-40 °C to +70 °C
Working humidity:	0 - 95 % rH
Working altitude:	Up to 4000 m
Operational speed:	0 - 30 rpm
Shock/Vibration:	Up to 5g
Corrosion protection:	C4
Protection class:	IP65

Optional:

- Incremental or absolute encoder for speed measurement and/or blade position
- Adapter/connector flange
- Cables and cable harnesses

...leaves nothing to be desired.

Customized Solutions

SCHLEIFRING offers tailored solutions for all special requirements.

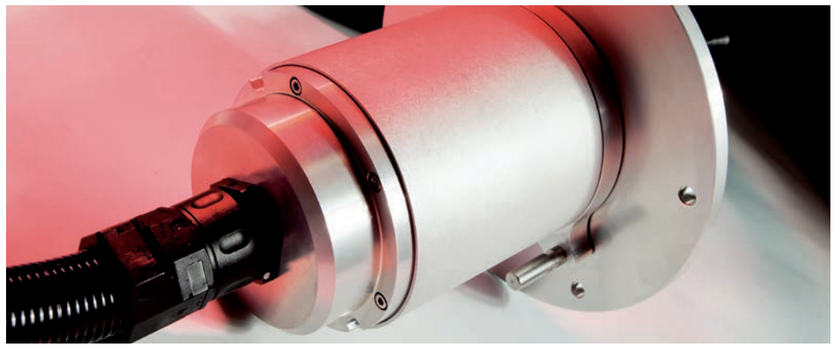
If your requirements are non-standard, SCHLEIFRING creates tailored slip ring designs for any given wind turbine application. Whether compact or heavy-duty, onshore or offshore, with electrical or hydraulic pitch control, conventional or leading-edge transmission technology – we engineer your customized solution.

Cable and sealing

- EMC cable glands
- Multi-cable sealing
- High-temperature cables
- Cable harnesses

Encoders

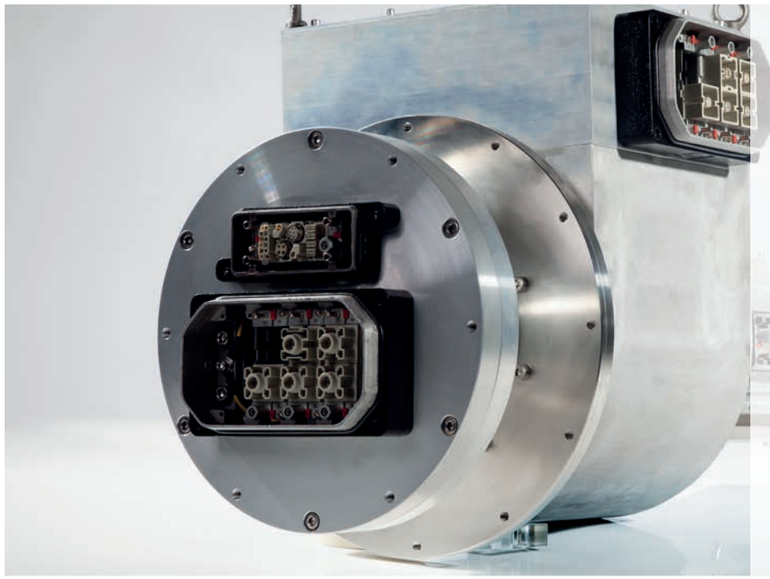
- Integrated and externally mounted encoders



Let us know your needs ...

Wind Applications

Customized Solutions



Flange designs, housing and interface

- Low-weight/compact slip ring systems
- Electrical slip ring for hydraulic pitch control systems with a selection of individually adapted media rotary joints
- Robust cast aluminum enclosures
- Sheet-metal enclosures
- Industrial or heavy-duty connectors
- Terminal boxes
- Sand-cast for individual design
- Permanent-mold cast for high quantities
- Seawater-resistant paintwork

Transmission technologies

- Up to 250 A power transmission
- Hybrid solutions combining contacting and contactless transmission technologies

... we design your tailor-made slip ring.

Customized Slip Rings | **Customized Service**

Our global service department is made up of a team of highly qualified service engineers. Systematic support and maintenance by our experts solves potential problems before they arise.

We support our clients throughout the entire service life of the product right up to its disposal.

SCHLEIFRING

Life-Cycle Management

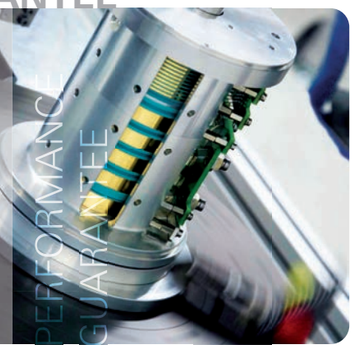
DEVELOPMENT SUPPORT

We offer our customers expert advice and services on all questions concerning products and development.

We accompany OEMs and design engineers from the early concept stages through prototyping and product qualification.

PERFORMANCE GUARANTEE

SCHLEIFRING makes a huge effort to guarantee the performance and reliability of each product line by performing environmental and endurance tests in our own well-equipped test laboratories.



LIFE CYCLE MANAGEMENT

SCHLEIFRING

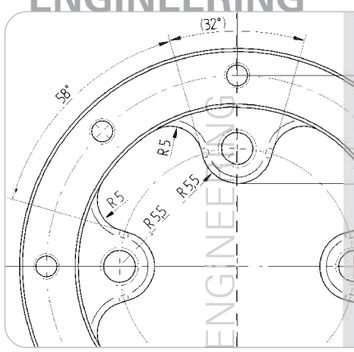
TECHNICAL SUPPORT

Our engineers provide competent technical support throughout the entire service life of the slip ring system. We also offer packages for comprehensive installation and maintenance training in-house and on-site. When solving technical issues together, even on-site, we always take your concerns, requirements and wishes into consideration.

DOCUMENTATION

We offer precise documentation of all important development steps, control of all documents and certificates, as well as installation and maintenance manuals to guarantee a trouble-free service life.

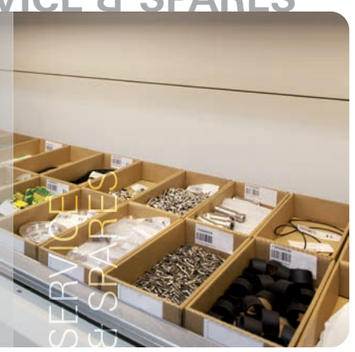
ENGINEERING



All our slip ring units are individually customized according to customer specification by our highly skilled engineering team.
We put a high priority on retaining our most precious asset, our knowledge, by developing and producing all core components in-house, in order to produce the best results to your satisfaction.

SERVICE & SPARES

The availability of spare parts during the entire service life of the wind turbine is indispensable. Our competent service engineers provide in-house maintenance and overhaul of used slip rings to extend their operational lifetime. Furthermore SCHLEIFRING will ensure that spare parts will be available throughout the service life of the turbine.



Wind Applications

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