

WIND TURBINE ROTARY DATA AND POWER SOLUTIONS

High reliability slip rings and fiber optic components for onshore and offshore wind turbines



Wind turbines require delivery of power and data signals to the rotating hub by a reliable slip ring assembly. These high-performance units must operate continuously in harsh environments, often in remote locations, where regular maintenance and monitoring are difficult and expensive. Moog provides rotary products that are designed to operate reliably in these rugged environments.

The most common use for slip rings is to provide electrical signals and power for blade pitch control systems. Moog provides solutions for both electric and hydraulic systems and can integrate position feedback devices such as encoders as well as fluid swivels, fiber optic rotary joints, and electronics such as media converters and multiplexers.

Moog's slip ring solutions designed for the demanding wind turbine environment incorporate the latest design technology, and product features are based on years of proven performance in numerous demanding applications. These wind power solutions have standard, flexible configurations that allow quick configuration to meet each customer's unique set of requirements. The use of standard pre-engineered modules allows cost effective, field-proven and yet customized solutions.

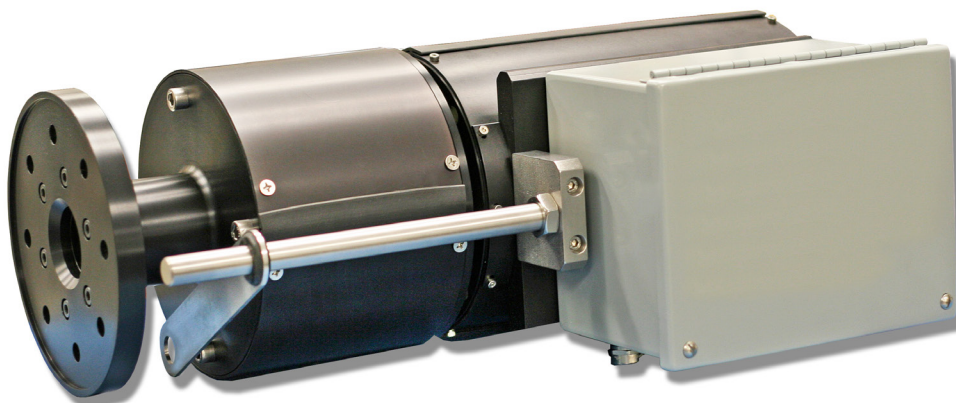
Moog's low maintenance slip rings utilize several reliable contact material technologies allowing our engineers to select the optimum material combination for every application. Robust power and low noise data transfer are features of Moog's reliable slip ring assemblies. More detail on contact materials can be found in *High Reliability Slip Ring Design for Wind Turbines White Paper*, visit www.moog.com.

ADVANTAGES

- High reliability slip rings with 100+ million revolution life
- Low maintenance slip rings utilizing advanced materials
- Flexible design with modular slip ring configuration
- Field proven designs
- Complete solutions for wind applications integrating position feedback, fiber optics, fluid and electronics

APPLICATIONS

- Onshore wind turbines
- Offshore wind turbines
- Floating offshore platforms
- Small and mid-size wind turbines



Direct Replacement Wind Turbine Pitch Control Slip Ring

MOOG SLIP RING AND FIBER OPTIC SOLUTIONS FOR WIND TURBINES

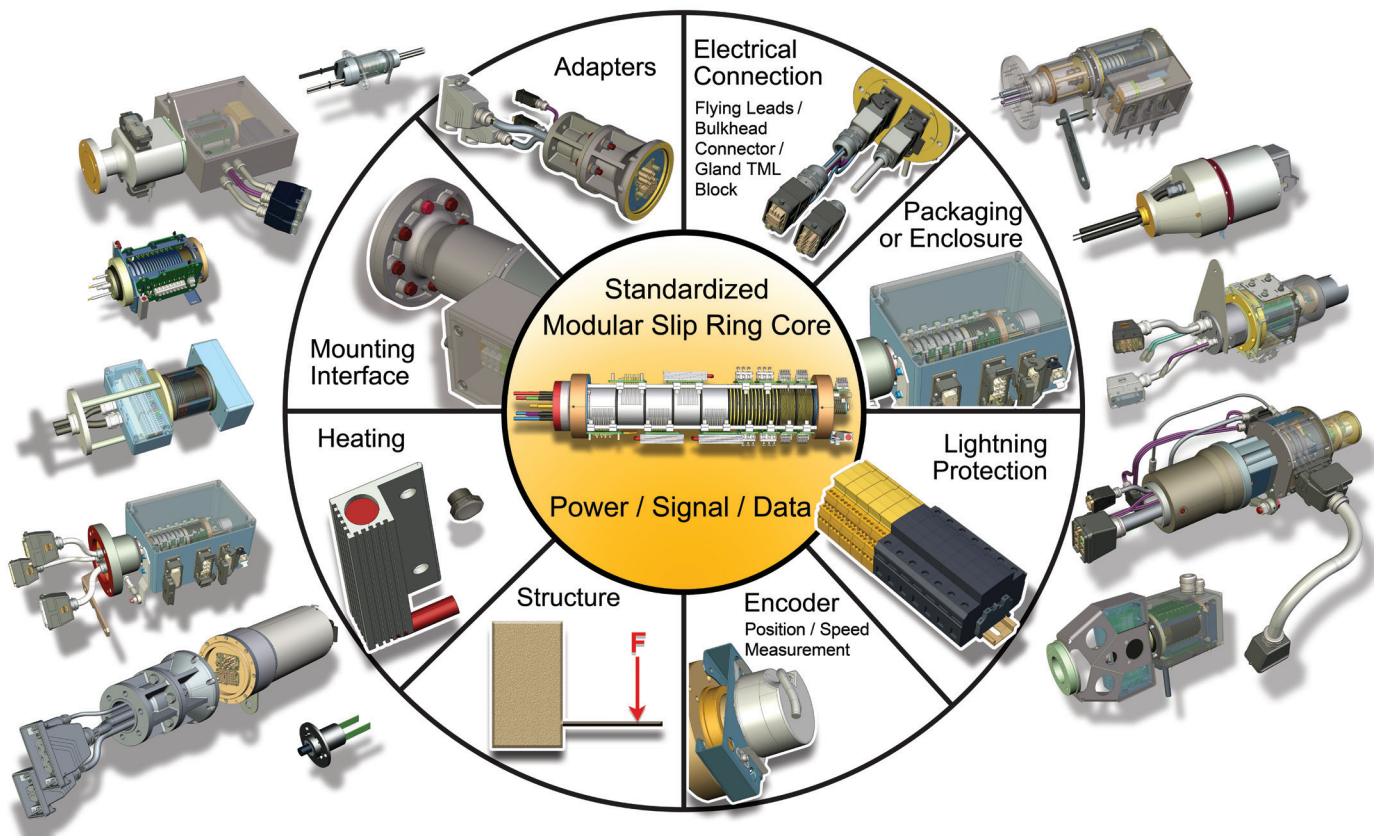
Flexibility

Moog has established a modular system for developing and manufacturing its slip rings. System building blocks can be matched to meet each customer's specifications to provide field-proven, cost effective solutions. It is this modular core construction along with a vast range of custom features that provide the ultimate system solution.

- Up to 500 A continuous current capability
- Discrete signal circuits, Ethernet, RS serial buses, CAN bus and CAN open options available
- Fiber Optic Rotary Joint (FORJ), Fluid Rotary Unions (FRU) and encoders can be integrated
- Optimum electrical contact material options
- High reliability and low maintainability
- Environmentally robust (temperature, humidity, vibration)
- 100+ million revolutions operational life
- Customized mechanical and electrical interface features
- Other elements can be integrated as required such as lightning protection or heaters
- Fiber optic multiplexers or media converters can be integrated into new or existing systems to transfer multiple real-time Ethernet (e.g. EtherCAT®) serial and diagnostics data via single fiber cable

Solution Oriented

Special techniques are required in these rotary assemblies to ensure the reliable operation of each of the specific functional components including multiplexer and media conversion electronics. Moog will provide a fully tested and qualified assembly. Key diagnostics can also be integrated to ensure reliable operation.



Moog Modular Wind Turbine Slip Ring

FOCUS ON RELIABILITY

Reliable slip ring assemblies start with the optimization of the contact materials and design strategies of the power and data modules themselves. But bearing selection, housing construction and sealing, and internal wiring are just a few examples of other critical reliability decisions.

Reliable Power Transfer

The most common reliability problem in slip ring assemblies for wind turbine applications is found in the power transfer capability. Poor selection of contact materials and inappropriate design parameters can often result in accelerated wear debris generation in the power section which in turn results in a breakdown in dielectric isolation between phases, circuits, or circuits and ground leading to short circuits. Moog contact materials and matching design parameters provide several options for long-lived, reliable power transfer, including a patented fiber brush technology and a carbon/metal composite brush that was custom designed for the requirements of wind turbine power transfer.

Reliable Data Transfer

Contacting: There are several sound options for reliable data transfer in wind turbine slip rings. Contacting signal and data slip rings normally incorporate noble metals for the contacts themselves. Gold and silver are the most common contact materials, but there are other noble metals that provide advantages in some environments. Moog designs incorporate the right material to meet the most demanding bit error rate (BER) requirements of communication data.

Non-contacting: Another option for electrical signal transfer is contactless data transmission using Moog's High Speed Data Link (HSDL) technology. This technology uses capacitive coupling or near field RF coupled designs to couple data from rotor to stator without sliding contacts. These designs can handle data up to 1 Gbps and can be configured to provide multiple data channels.

Fiber optic data transmission is available to increase data reliability. Optical data transmission is available using a complete line of Fiber Optic Rotary Joints (FORJ) integrated into the final rotary union solution. The high bandwidth capability of fiber provides an opportunity to reduce the number of circuits and minimize the number and size of signal cables - reducing cost and weight and improving reliability and EMI performance. Fiber optic communication electronics can be used to multiplex multiple copper Ethernet and serial data signals along with link diagnostics onto a single optical fiber.

Aftermarket / Retrofit Wind

Wind turbine operators use Moog pitch slip rings to replace low reliability, high maintenance designs in existing turbines. These models are developed as direct replacements in major wind turbine models. There are a number of designs for existing turbines and new designs are always in process. Moog's high reliability slip rings make the turbine owners life easier.

- Direct form, fit, function replacement
- Easy installation
- Maintenance free

MOOG WIND TURBINE PRODUCT MATRIX

The chart below shows some of Moog's solutions for wind turbine slip ring applications and is intended to show the range of solution offerings. With our modular construction approach we can easily configure a solution for any power or data rotary transfer problem.

Product	Model	Features / Advantages
	WP 7286 GE Wind Slip Ring	<ul style="list-style-type: none"> - Direct replacement models to fit various GE turbines - High power capacity - Heavy duty bearing - No maintenance
	F 7010 Gamesa Slip Ring	<ul style="list-style-type: none"> - No lubrication - Compact size - Direct replacement - No maintenance - IP 65 sealing
	F 5784 X Wind World India	<ul style="list-style-type: none"> - High power capacity - Corrosion proof - Five years maintenance free, no lubrication - Long lifetime 200 M+ rotations - Integrated encoder for rpm measurement
	CF 9013 Sany Slip Ring Assembly	<ul style="list-style-type: none"> - Five years maintenance free, no lubrication - Long lifetime - Compact size - High power capacity
	197S Fiber Optic Rotary Joint	<ul style="list-style-type: none"> - Single pass, multimode fiber optic rotary joint - Ruggedized for harsh environments - Low insertion loss and low back reflection - Common wavelengths (850/1310, 1310/1550 nm) - Sealed design (IP67) - Bulkhead ST connectors - 316 stainless steel
	F 7070 High Speed Data Link	<ul style="list-style-type: none"> - Non-contacting, electrical data transfer - Capacitively coupled - Low noise, high life, high reliability
	920-EDM Ethernet and Data Fiber Optic Multiplexer	<ul style="list-style-type: none"> - Combines multiple channels in single interface box to single bidirectional fiber - Reduces system cost and space - Low and deterministic latency for real-time Ethernet applications - Link condition monitoring using open standard Ethernet based protocols
	Fluid Rotary Union	<ul style="list-style-type: none"> - Low leak rates - Can be integrated with slip ring and fiber optic rotary joint - Offers a total rotary system solution
	High Current Brush Holder	<ul style="list-style-type: none"> - Used for lightning protection - High power capacity up to 1000 A

Moog has offices around the world. For more information or the office nearest you, contact us online.

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