

# SLIP RING AND ROTARY SOLUTIONS FOR MARINE APPLICATIONS



Reliable transfer of power, data, liquid, gases  
and more for rugged marine environments

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## CERTIFICATION

Moog's marine solutions are certified under various IACS member associations, ensuring our products meet critical quality and industry standards across the globe. Our dedicated project teams, knowledge on marine rules and established contacts to various associations make certification a commodity.

Testing of components and full products can be challenging, which is why Moog has built substantial internal testing capabilities and collaborate with long time proven partners for special testing and simulation to certify under the demanding requirements (especially vibration and shock).

Moog's philosophy is to deliver full rotary systems consisting of the mentioned products in this brochure and certify them as a whole so that single component certification by the customer becomes redundant. We cooperate with all IACS member organizations.

## TRADEMARKS

**PROFINET**® is a registered trademark of PROFIBUS Nutzerorganisation e.V.

**EtherCAT**® is a registered trademark and patented technology licensed by Beckhoff Automation GmbH

**POWERLINK**™ is a trademark of Ecessa Corporation

**MECHATROLINK III**® is a registered trademark of the MECHATROLINK Members Association

**Sercos III**® is a registered trademark of sercos® international e.V.

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**DeviceNET**™ is a trademark of ODVA, INC

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## ABOUT MOOG

Moog Inc. is a worldwide designer, manufacturer and integrator of precision control components and systems. Moog Industrial Group designs and manufactures highly reliable products, solutions and services using innovative motion control and power/data technologies. We combine world class technologies with expert consultative support in a range of applications such as energy, industrial machinery, marine, and simulation and test industries, to name a few. We help performance driven companies design and develop their next generation equipment.

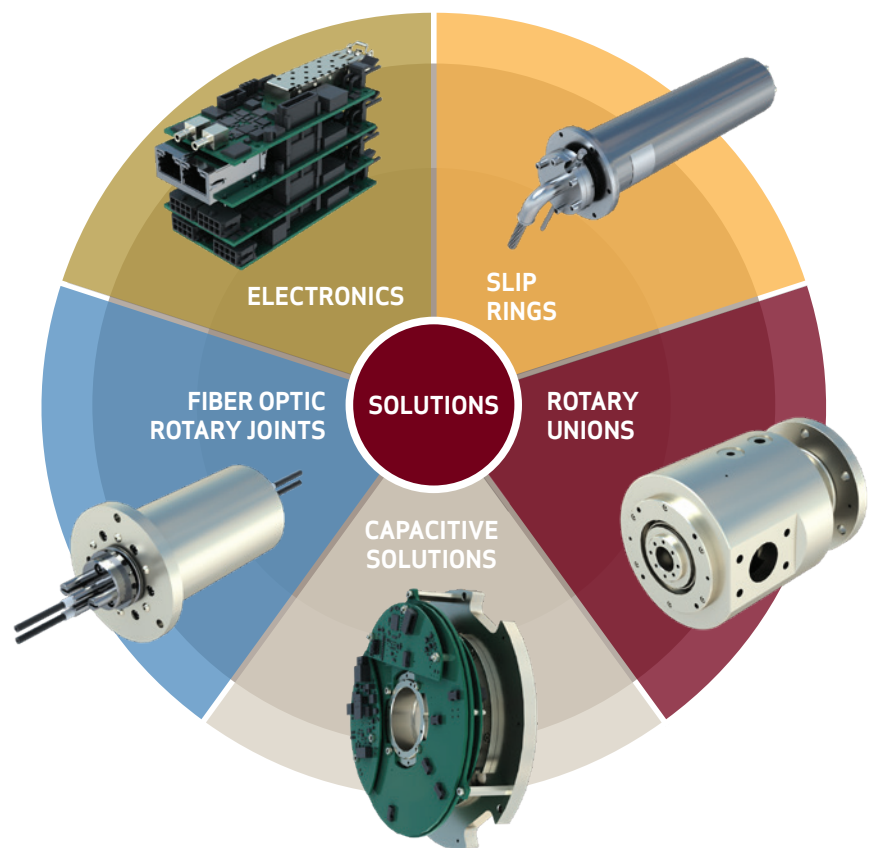
Moog's standard and customized products have a long service life with minimal to no maintenance applications, ideal for demanding requirements in harsh environments. As a market leader, we use innovative engineering to combine and integrate our products, delivering the best solutions to our customers.

## THE POWER OF MOOG: COMPLETE ROTARY SOLUTIONS

Moog's slip rings have been successfully performing in commercial and industrial applications for over 70 years. Our products consistently perform in the world's harshest environments, delivering trusted technology products to maritime industries, including offshore petroleum, oceanographic, seismic and shipbuilding. We also offer products for marine renewables and subsea infrastructure, such as cabling and piping.

As the world market leader for slip rings, we provide superior rotary solutions for even your most complex application needs. Our systems can transmit power and data signals, as well as transfer different mediums such as oil, water, gas, coolant and more to fit specific needs.

This allows us to provide leading edge custom solutions and services that set the pace in today's rapidly changing global markets.



## MOOG'S SLIP RING & MARINE BRANDS

Moog's global brands deliver a broad range of technologies and rotary data and power transfer products. Our global brands include Focal, GAT, and Rekofofa, which work together to engineer the best possible solution for your marine and subsea requirements.

**FOCAL**™

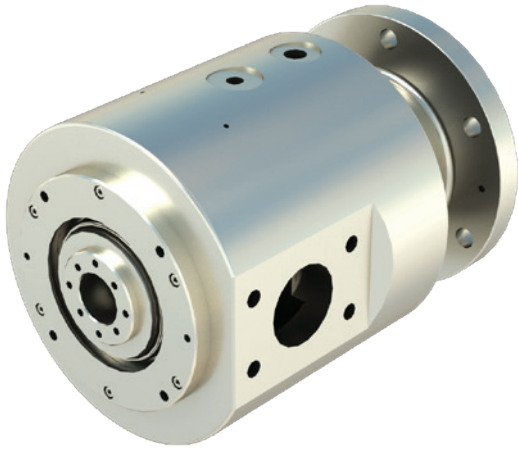


**GAT**®

**REKOFA**

## ROTARY UNIONS

Moog's rotary unions are used around the world to ensure reliable transmission of all kinds of mediums. Various sealing technologies are available and are selected based on chemical compatibility, design pressure, design temperature, required service life and acceptable leakage rate. Moog provides a wide range of standard rotary unions as well as tailor made system solutions.



### TECHNICAL INFORMATION

- For the transmission of mediums such as oil, water, grease, air, gas, vacuum from the stationary part to the rotating part of the machine for almost all industries
- Standard and customized solutions for small quantities as well as serial production
- Pressures up to 1,000 bar (14,500 psi)
- Rotating speeds up to 20,000 rpm
- Transfers various mediums types with up to 30 channels
- Seawater resistant with aluminum or stainless steel housing
- Compact design
- Available sealing technologies (optional):
  - **Non-contacting gap seal technology:** for high speeds, high flow rates and high pressures. Provides low friction and extremely long service life
  - **Contact sealing system:** for high pressures, low speeds and leakage-free performance. Suitable for any medium
  - **Mechanical sealing system:** for single channel and high speeds; high pressures can be achieved
  - **Features:** hydrostatically relieved, robust design, suitable for dry running

### FEATURES AND ADVANTAGES

- Combined systems: hydraulic + pneumatic + electric
- Low turning torque at simultaneously high pressures
- Simultaneous use of different mediums without component exchange
- Suitable for aggressive mediums, protects sealing material from damage
- High production due to less maintenance and down times thanks to durable products
- Increased production rates through innovative, advanced technology

## SLIP RINGS

Moog has delivered trusted technology products and services to the offshore petroleum, oceanographic, seismic and maritime industries since 1983. Our marine slip rings are designed to function in extreme environments such as subsea oil fields and offshore wind platforms. Moog has a large selection of standard slip rings for a variety of applications and also offers custom engineering solutions to adapt to our customer's unique needs.



### TECHNICAL INFORMATION

- Hybrid technology: power, data and mediums transmission in one design
- Compact, protected housing (up to IP68)
- Current rating: up to 120 A per pass, parallel passes are used to support higher currents
- Voltage rating: up to 7.2 kV AC or higher if required
- Quantity of circuits as required by application (up to several hundreds)
- Analog video, CANbus, PROFIBUS®, DeviceNET™, 10BASE-T Ethernet, SHDSL, RS-485, Drive CLIQ™, TSN, etc up to 2 GBit/s
- Contacting technologies: composite brush, gold/gold contact, fiber brush and silver rivet
- Temperature range: -50 °C to 100 °C

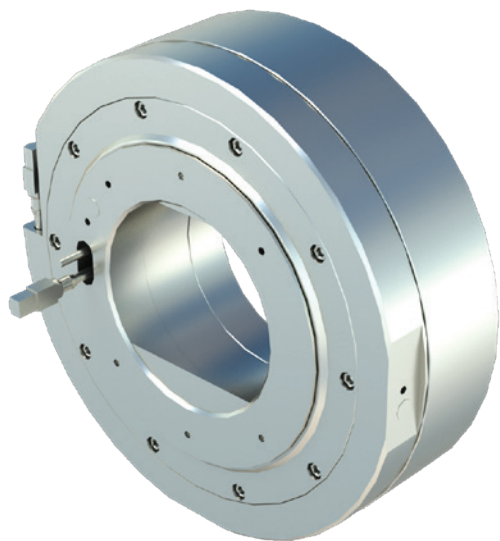
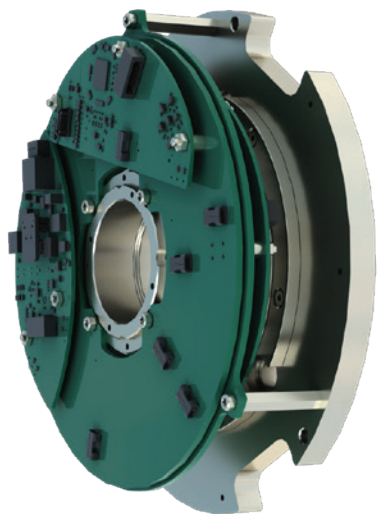
### FEATURES AND ADVANTAGES

- Low maintenance
- Integration with FORJ, capacitive transmission (ROTOCAP) and rotary unions to provide a complete rotating interface solution
- Standard models and customized solutions available
- Hazardous area certification available
- Condition monitoring provides performance and maintenance data
- Equipment thoroughly tested to ensure reliable performance at surface and challenging subsea environments
- Compliance with the highest quality standards for design, manufacturing and testing
- Compatible with encoders



## CAPACITIVE TRANSMISSIONS (ROTOCAP)

Moog's ROTOCAP system offers seamless high speed data transmission using contactless capacitive transmission technology. The system's maintenance free technology delivers uninterrupted performance, with the most reliable data transmission for 100 Mbit/s Fast Ethernet (100BASE-TX). All corresponding transmission protocols, such as PROFINET® Class C (IRT), Sercos III®, POWERLINK™, EtherCAT® and MECHATROLINK-III® can be used. The modular design of the ROTOCAP provides flexibility in very small internal diameters with the ability to extend to 400 mm. Additional transmission technologies can be integrated into the ROTOCAP system. Special solutions and certifications according to UL/CSA regulations are also available by request.



### TECHNICAL INFORMATION

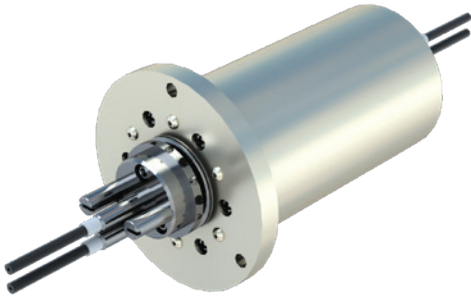
- Meets industrial electromagnetic compatibility (EMC) standards, IEC 61000-6-2 and IEC 61000-6-4
- Bit error rate: 10E-12
- External power supply: 12 VDC / 24 VDC
- Provides safe solution for applications, especially those with demanding operating modus, requiring continuous high speed with vibrations
- Transmission type: electric power, analogue signals and digital data
- Data transmissions rates of up to 2.5 Gbit/s
- Standard models include Fast Ethernet (100BASE-TX), Gigabit-Ethernet (1000BASE-T) and various optical data
- Inner diameters of up to 400 mm (other diameters on request)
- Max. speed: 1,000 rpm (depending on slip ring system)

### FEATURES AND ADVANTAGES

- Can be combined with most of Moog's slip ring systems
- Reliable transmission in continuous noise and challenging environments
- Small failure and error rate throughout lifetime
- Can be integrated with our complete portfolio of rotary solutions
- Different sealing technologies available
- Several ROTOCAP modules can be combined for extremely high data, multichannel transmission
- Free through bore with high data transmission at the same time
- Integrated data converter processes and data signal clean up
- Complex combinations of rotary unions with different sealing techniques possible
- Seal diameters can be significantly reduced with rotary unions combinations

## FIBER OPTIC ROTARY JOINTS (FORJ)

A Fiber Optic Rotary Joint (FORJ) transmits data and signals optically instead of electrically. Moog's FORJs come in surface and subsea configurations and have practically unlimited bandwidth. Subsea FORJs are volume compensated for operation at varying depths and temperatures. While the number of physical channels has a limit that varies by type, time division and wave division multiplexing (see our Electronics page #8) significantly expands the number of effective channels.



### TECHNICAL INFORMATION

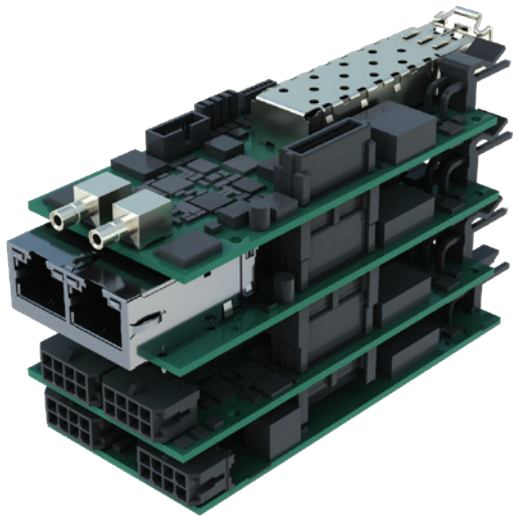
- Surface and subsea configurations: volume compensated up to 10,000 psi (69,000 kPa)
- Singlemode, multimode and combination singlemode + multimode units available
- Passive and bidirectional
- 1 to 52 physical channels available as standard catalog product; more channels available in custom configuration
- Full compatibility with our time division and wave division multiplexing products, enabling many more effective channels
- Standard wavelengths (850 nm, 1,300 nm, 1,310 nm, 1,550 nm, etc.) as well as custom and division multiplexing wavelengths are available
- Operating temperature range of -40 °C to 60 °C standard; extended ranges available
- Solutions for LED, VCSEL and laser sources
- Array of fiber types and sizes (OM1 – OM4, SMF - 28, etc.)
- Up to IP65 available in surface configurations
- Service life of over 100 million revolutions for certain models

### FEATURES AND ADVANTAGES

- Can be integrated with Moog's slip rings, fluid rotary unions and / or IP rated housings
- Stainless steel construction and proven ruggedized field designs
- Fiber pigtails designed to custom specifications, including connectors or integrated junction boxes
- Standard and military grade connector options
- High performance data transmission via low insertion, rotational variation and return loss specifications
- High crosstalk and interference resistance
- Various mounting and drive coupling options
- Extended temperature range and environmental qualifications available
- Stackable individual segments provide greater redundancy for improved reliability

## ELECTRONICS

Moog's industry standard electronics products are centered around converting multiple copper signals to a reduced number of fiber optic links, also known as multiplexing. A major benefit to multiplexing is reducing the number of fiber optic cables or fiber optic rotary joint passes. Two types of multiplexing are used, Time Division Multiplexing (TDM) and optical multiplexing. TDM uses high speed Field Programmable Gate Array (FPGA) and optical transceivers, whereas optical multiplexing uses passive optical filters. There is a surface side and a pressure tolerant submerged subsea side. Condition monitoring is built into most Moog electronics assemblies to assist in preventative maintenance and quickly diagnose problems, reducing downtime.



### TECHNICAL INFORMATION

- Fiber optic rates up to 10 Gbit/s
- Copper signals:
  - HD video
  - Analog video
  - Ethernet
  - Serial (RS232/485/422)
  - EtherCAT
  - PROFINET® RT/IRT
  - Other signals
- Wide variety of standard product offerings, configured and fully custom options
- Optical multiplexing up to 16-to-1
- Optical redundancy with splitter and auto switching
- Oil compatible up to 6,000 psi
- Options for enclosures
- Condition monitoring:
  - Optical performance
  - Voltage rails
  - Copper signal performance and activity
  - On-board temperature
  - Software included
  - Diagnostics

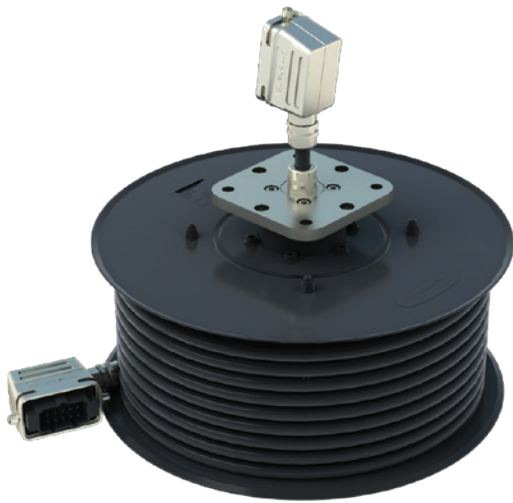
### FEATURES AND ADVANTAGES

- Long support life
- High reliability in harsh environments
- Built in condition monitoring improves installation, troubleshooting and preventative maintenance
- Compact design provides space saving stackable configuration; fully tested for easy installation
- Reduces FORJ channel count
- Can be integrated with all Moog FORJs



## SPRING DRIVEN CABLE REELS

The spring driven cable reels from Moog are designed for harsh environments and are used in harbor and ship deck cranes. To guarantee high level of quality, Moog spring driven cable reels use Moog standard slip ring technologies.



### TECHNICAL INFORMATION

- Current rating:
  - Power circuits: up to 50 A
  - Signals: mA & data transmission
- Voltage rating: up to 500 VAC / 750 VDC
- Temperature range: -40 °C to 80 °C
- Contact material: coated metal
- Protection class (slip ring): up to IP67/IP69K
- Data transfer:
  - up to 400 MBit/s with contacting slip rings
  - up to 2 GBit/s with contactless transmission

### FEATURES AND ADVANTAGES

- Sea water, UV and oil resistant
- Maintenance free, for more than 10 million revolutions (significantly more than 100,000 cycles)
- Very flat design where the slip ring is assembled in the spring
- Housing is designed for difficult environmental conditions
- Compatible with additional sensors like an angle encoder
- Customized fixing flanges, torque arms and connectors

## AIR GUN COMBINATION UNITS

Moog's slip ring and rotary union combinations were specially developed to meet the requirements of the seismic industry and air gun applications. The unique slip ring design ensures reliable transmission of gun control signals and sensor signals from the hydrophones with very low noise. For the rapidly increasing frequency bandwidth, a multichannel optical rotary joint with single mode fiber is integrated. The compact design allows easy integration into various types of winches. The robust housing ensures a reliable operation in rough conditions and most extreme environments on a vessel deck. All of our product solutions are focused on enabling our customers to effectively run their seismic vessels.



### TECHNICAL INFORMATION

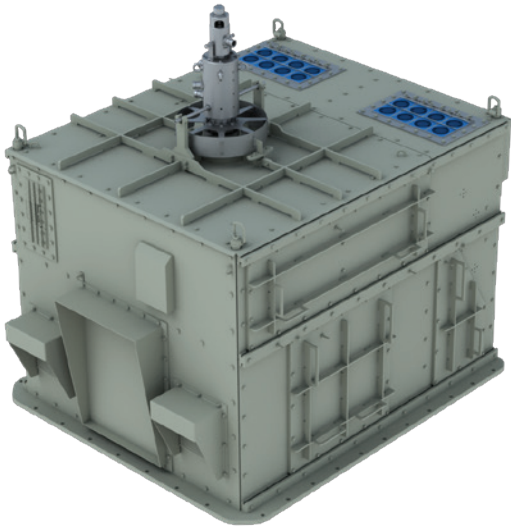
- Combination of Rotary Union, Slip Ring and FORJ with high protection class up to IP65
- Contact material: gold/gold
- Speeds of up to 20 rpm
- Up to 150 ways
- Voltage rating: 350 volts AC/DC
- Current rating: 20 amps per way
- Up to 8 optical lines
- Data bus: nearly all data busses up to 1 Gbit/s
- Air pressure: up to 250 bar (3,625 psi)

### FEATURES AND ADVANTAGES

- Compact design
- Customized fixing flanges, torque arms and connectors
- Sea water and UV resistant
- Long lasting and maintenance free
- Ethernet:
  - Option 1: via gold plated contact rings
  - Option 2: via Rotocap
  - Option 3: via FORJ (fiber optic cable)
- High data transmission rate possible with copper cable
- Very robust non-optical components/cables

## POD PROPULSION COMBINATION UNITS

Moog has integrated slip rings into pod propulsion systems, supporting electrification needs while delivering increased efficiency and game changing maneuverability when compared to traditional propulsion solutions. In fully electric pods, rotary transmission systems provide connection between the ship and the free turning pod to power the main propulsion motors and transmit signals. The systems also transfer network data and mediums such as lubrication, while pumping away pod leakage.



### TECHNICAL INFORMATION

- Slip Rings: up to 25 MW pods
- Current rating: >6,000 amps per way
- Voltage rating: mV up to 20,000 volts AC/DC
- Hybrid technology: current, data and mediums in one compact and protected housing (up to IP54)
- Contact material: brass, copper, silver, rhodium or gold plated
- Condition monitoring: vibration, shock, arc flash, temperature, humidity
- Data transmission
- Encoder position referencing
- Vibration certified: 4g up to 100 Hz
- Forced or natural cooling possible

### FEATURES AND ADVANTAGES

- Complex rotary transmission system from a single source supplier
- IACS certified
- Compact design
- 40 year lifespan for most operation profiles
- Robust design - high vibration resistance, high reliability, suitable for icebreaker ship classes
- Oxidation and fungus resistant materials and coating
- Optimized temperature behavior for all steering positions
- Full power available in every steering position
- Internal component accessibility for easy maintenance
- Maintenance and repair service offered worldwide

## FLOATING PRODUCTION SYSTEMS (FPS) SWIVELS

Moog provides a complete product line of rotary and electro-optical equipment for the swivel stacks of Floating Production Systems (FPS). Floating Production Systems include FPSO, FSO, FLNG, FSRU, FSU, FPU, Loading Towers, CALM buoys and similar marine installations that weathervane. The swivels we supply are typically combination units, including fiber optic swivels, toroidal fluid swivels, electrical swivels, wavelength converters, multiplexers and ancillary equipment. We have successfully completed over 210 FPS swivel projects since 1986.

Moog offers various configurations of FPS swivels designed to minimize stack cost, height and weight, while maximizing performance. We have developed design methods and tools that allow us to quickly consider space requirements through the bores, cable de-rating due to high temperatures, signal and optical data transmission, mechanical loading and various other parameters. We also maintain a team of offshore trained and certified technicians and engineers that ensure the correct installation of our swivels on your FPS projects, protecting your investment.

Decisions during the design stage are not always obvious with many factors determining where components are best placed. Having supplied and integrated most components in swivel stacks, Moog is ideally positioned to help optimize those variations. Contact a Moog expert early in your project, when planning how your turret will stack up, to save time and costs.



### TECHNICAL INFORMATION

- Hazardous Area Protected (Ex d, Ex p, Ex e)
- Multiple marine certifications available (ABS, DNV, LR, etc.)
- Ingress protection rated up to IP68
- Stainless steel housing exterior
- Suitable for harsh offshore environments
- Low maintenance and long design life
- Power: up to 1,600 A per pass
- Voltage: up to 36 kV (170 kV ready)
- Optical passes: up to 61 single mode passes
- Electrical signal passes: 300+
- Hollow through bore: up to  $\varnothing 2,400$  mm
- Fluid pressure: up to 1,000 bar

### FEATURES AND ADVANTAGES

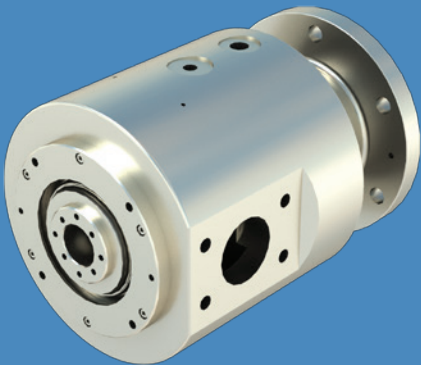
- Complete rotary transmission system from a single source supplier
- IACS certified
- FPS market leader for swivels with long term field experience
- Project support from design to end of life
- High level of customization to meet customer requirements
- Robust design, suitable for all types of FPS installations
- Worldwide service





## ROTARY UNION

for the rotary transmission of mediums such as oil, water, grease, air, gas, vacuum

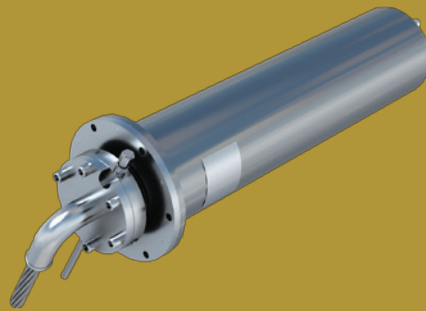


0-100 rpm → Contact Sealing

50-20,000 rpm →  
Contactless Sealing

## SLIP RING

for the rotary transmission of currents, signals and data



Carbon Brushes

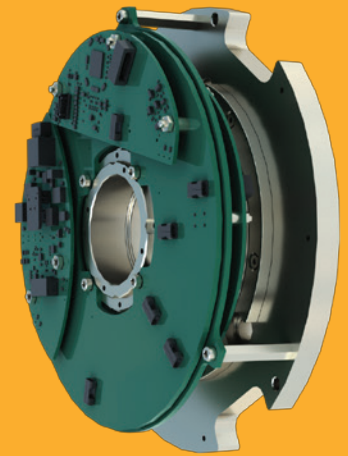
Fiber Brushes

Gold/Gold

Silver Rivet

## ROTOCAP

for the rotary transmission of high bandwidth data in electrically harsh environments when through bores are required



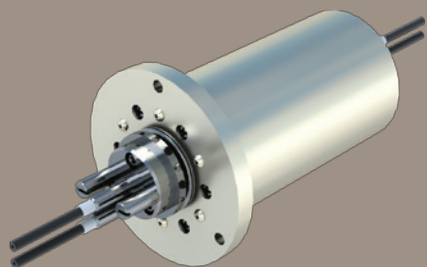
Contactless Capacitive  
Transmission Technology

## THE POWER OF MOOG: COMPLETE ROTARY SOLUTIONS

All the above products are available as standalone solutions or can be integrated in various combinations to create limitless, off-the-shelf and highly customized solutions. As the world market leader of integrated solutions, Moog has the ability to combine products to meet our customer's most challenging and unique rotary transfer needs; we call this the *The Power of Moog: Complete Rotary Solutions*.

## FORJ

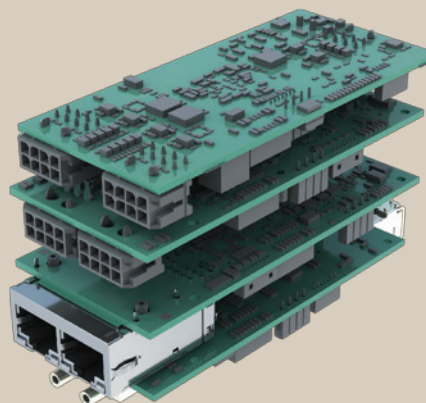
for the cost efficient rotary transmission of high band width data in electrically harsh environments when many channels required



Fiber Optic Rotary Joints

## ELECTRONICS

for the transmission, amplification and consolidation of fiber optic and electrical signals and data



Multiplexers  
Repeaters  
Switches

### EXAMPLES OF WAYS TO BUILD AND COMBINE



Rotary union plus slip ring



Slip ring and high speed data transmission



Rotary union with slip ring and high speed data transmission



FORJ with multiplexers and sensors

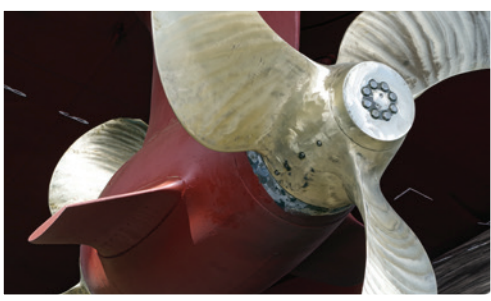


Complete rotary transmission solution with electronics support



## FPS

[More Info:](#)



## POD PROPULSION

[More Info:](#)



## MARINE CONTROLS

[More Info:](#)



## SEISMIC

[More Info:](#)





## OFF SHORE WIND TURBINES

[More Info:](#)



## WINCHES & CABLE REELS

[More Info:](#)



## OIL RIG & BOP

[More Info:](#)



## TIDAL TURBINES

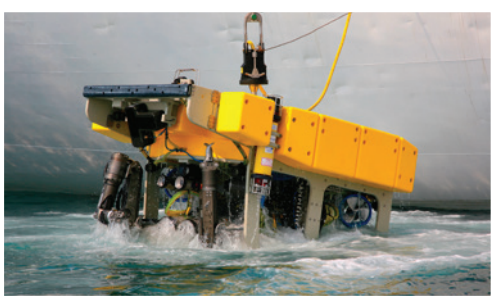
[More Info:](#)





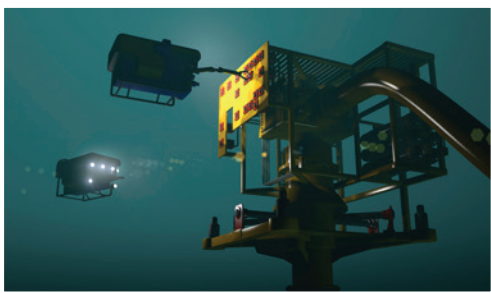
## SEA PUMPS

[More Info:](#)



## ROV

[More Info:](#)



## WELLHEAD CONTROLS

[More Info:](#)



## BOP / IWOC

[More Info:](#)







## INFARED MAMMAL MITIGATION

[More Info:](#)



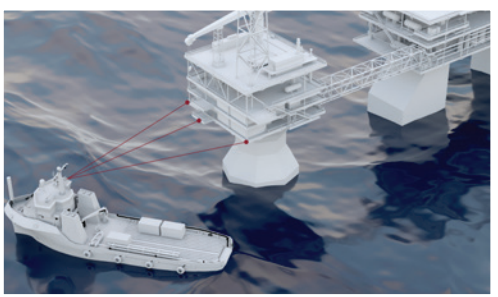
## CRANES

[More Info:](#)



## SEA KITES

[More Info:](#)



## LASER POSITIONING

[More Info:](#)



# TAKE A CLOSER LOOK

Learn more about Moog's slip ring and rotary solutions for your specific application. Visit our web site for more information.

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Slip Ring And Rotary Solutions For Marine Applications

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For product information, visit

**[www.moog.com](http://www.moog.com)**

This technical data is based on current available information and is subject to change at any time. Specifications for specific systems or applications may vary.