Product Data Sheet

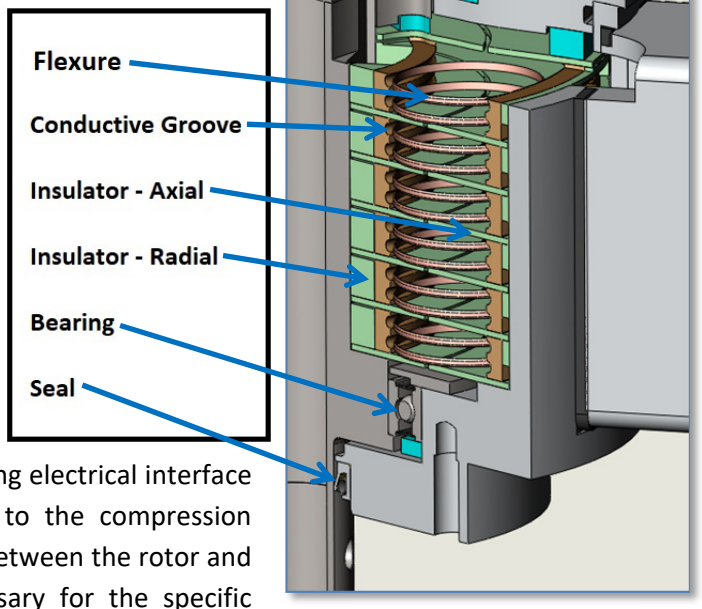
Introduction

Roll-Rings® were invented over forty years ago to solve slip-ring related performance issues for mission critical applications such as gyroscopes for F-14 fighter aircraft. The development of Roll-Rings led next to winning the bid to build rotary Power and Data Transfer Devices (PDTD) for NASA for the solar arrays on the International Space Station.

Today Roll-Rings are also found operating in mission critical applications such as the SPS-48E radar system aboard aircraft carriers and the AN/APX-134 Big Look airborne radar aboard EP-3E aircraft for the US Navy, in the Patriot Missile System, in military helicopter rotors, and in military and civilian Air Traffic Control radar systems in twenty-four countries around the globe. With maintenance-free operation and lower cost of ownership Roll-Rings can solve slip-ring related performance issues for a wide variety of mission critical applications.

Design

The benefits of the Roll-Ring solution are a direct result of its simple yet rugged design. Flexures are rings of spring copper plated with gold which roll between two gold plated concentric coplanar grooves. In the design pictured at the right two flexures are used per circuit and there are six circuits total. Each circuit is separated by insulators in the axial and radial directions. Rotor and stator are precisely aligned with bearings to ensure proper rotation for long life. The rolling electrical interface is made shock and vibration tolerant due to the compression otherwise known as pre-load of the flexure between the rotor and stator grooves. Seals are added as necessary for the specific application environment.



6 Channel Roll-Ring

Product Data Sheet

Capabilities

Current	10 amperes per standard two Flexure circuit, higher currents possible
Voltage	Up to 1,000 volts
Dynamic Noise	2-5 milliohms
Channel Count	Unlimited
Rotational Speed	1,200 rpm
Shock	Up to 180G, all three axes
Vibration	Excellent
Temperature	-60 °C to 115 °C
Space Qualified	Heritage: International Space Station
Data Rate	100 MB/s
Coax Signal	64 MHz @ 1.15 VSWR
Environmental	IP 65
Diameter	3.0” (76.2mm) over clear bore
Axial	0.180” (4.6mm) per channel plus mechanicals (RF and Data circuits are larger)
Connectors	Flying Leads or Mil Spec connectors

Maintenance-Free

With military budgets facing significant reductions and with military personnel tasked with increasing scope of responsibilities, designing, operating and maintaining systems with components that require periodic maintenance where effective maintenance-free alternatives are available put the Warfighter and the Department of Defense at a disadvantage. Roll-Rings eliminate field maintenance by employing a proven design that produces extremely little wear over a very long operating life. The maintenance-free benefit enables cost reductions in parts, personnel, training and technical support while improving operational readiness. The Roll-Ring design delivers the additional unique benefit of reducing the potential for sabotage as no maintenance access port is provided.

Long Life

A standard Air Traffic Control Roll-Ring unit was placed on test at 200 rpm for over two and a half years to simulate 30 years of continuous duty. The unit logged 240 million revolutions before the test was concluded. All circuits were found to be within specification at the end of the test. The vast majority of Roll-Rings supplied for mission critical applications today will survive long past the anticipated service life of the system in which they are installed. The long operating life of a Roll-Ring has the potential to reduce the total cost of ownership for the system they are designed into.

Product Data Sheet

Low Resistance

A 600 Amp test circuit using 3” diameter Roll-Rings measured 0.81 mΩ under rotation. The International Space Station UTA assembly tested at 1.9 milliohms at ambient conditions with two circuits in series including the loop-back connector at the rotating end. The gold on gold rolling interface allows for very low resistance for all Roll-Ring devices. This has the benefit of reducing power loss for power, signal and data circuits and reducing heat transfer management requirements.

Surge Capacity

The Bets Gimbal Roll-Ring Sub-System (BGRRS) module for the International Space Station, with each crossing designed for a nominal 113A, was required to survive a 1 millisecond in-rush fault current pulse of 4500A. With the unit stationary at ambient temperature and pressure an in-rush current of 5000A was applied across two crossings in parallel peaking at approximately 0.27 ms with a 1.0 ms period. The BGRRS modules measured no increase in resistance between pre and post test measurements and disassembly showed no detectable damage by the application of the fault current. Roll-Rings have the proven capability for high current handling.

Static Operation

Wind turbines on Black Island in Antarctica operate for months at gale force winds with no change in direction. This is a problem for slip-rings as once the wind finally shifts the balance of the ring surface is not clean and thus creates overheating and other issues requiring maintenance in an expensive to access location. Roll-Rings are capable of indefinite operation in a fixed position without reducing the capability of the unit for low resistance electrical transfer once rotation has resumed. This benefit is available to Roll-Ring units designed to handle 10 amps per circuit as well as units designed for 1,200 amps per circuit and beyond.

Data Rates

15 MBit/s at 30 MHz on an IntelliBus network was successfully demonstrated with a six channel Roll-Ring unit running 900+ hours at 1,200 rpm with a 0.006” displacement. The application requirement was to transfer on-blade performance and operating measurements for a rotary wing aircraft during flight tests. The incumbent slip ring caused expensive delays in the flight test schedule due to its relatively short life span, about 100-150 hours, before wear debris increased data error rates to unacceptable levels. The 15 MBit/s data rate was the upper limit for IntelliBus network for this application but was not the upper bit rate for the Roll-Ring.

Using a Bit Error Rate Tester the same helicopter tail rotor design was tested at 100 MB/s and experienced zero drops. Over a significantly larger clear bore a design was developed for a satellite application to allow for LVDS signal transfer at 10 MB/s at 20 MHz. This design later tested at 100 MB/s.

Product Data Sheet

Temperature range

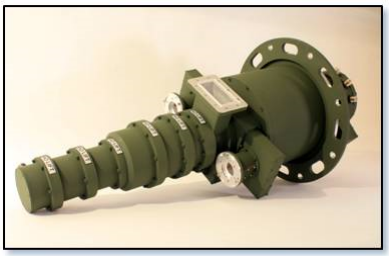
Roll-Rings operating now on the International Space Station successfully tested at temperatures ranging from -55°C to 80°C at sea level atmospheric conditions as well as under the perfect vacuum of outer space. Roll-Rings are in service today as part of the Patriot Missile System as well as in service for the Navy's shipboard SPS-48E air search radar system proving suitability for land and sea applications.

Shock

A twelve channel Roll-Ring installed around a Diamond Antenna & Microwave rotary joint successfully survived a three axis 180g shock load as part of US Navy qualification testing. The Roll-Ring devices used for the International Space Station successfully passed a 300g shock load test. The comparative light weight of a flexure, the concentric conductive grooves that it rides in and the relatively high compressive load the flexure is under while installed in the groove enables a Roll-Ring device to survive extreme shock loads.

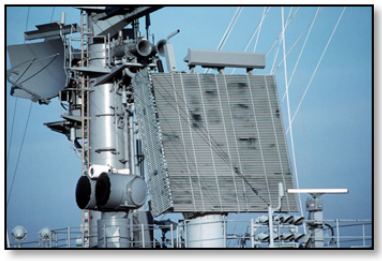
Conclusion

A number of significant military equipment customers chose Roll-Rings for their mission critical applications. NASA, the US Navy, Airbus and others have subjected Roll-Rings to full qualification testing and in each case Roll-Rings have passed. Roll-Rings deliver mission critical performance by offering advanced capabilities and lower cost of ownership as compared to slip rings. Roll-Rings can be adapted for most applications. The RFQ section of the website is the best way to start the conversation with a Roll-Ring Engineer to see if Roll-Rings are the answer for your mission critical application.

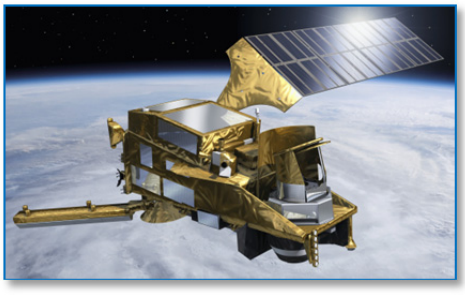


Diamond Antenna & Microwave
6 Channel Rotary Joint
with an integrated Roll-Ring

Patriot Missile System
with a cable reel Roll-Ring



US Navy SPS-48E Radar
with an integrated Roll-Ring



European Space Agency
MetOp2 Satellite
Including a 32 Channel Roll-Ring PDTD
(Power & Data Transfer Device)