

SLIP RING / FREQUENTLY ASKED QUESTIONS



HOW DOES A SLIP RING WORK?

A slip ring passes electrical signals and power across a rotating interface using sliding electrical contacts. These contacts are typically a rotating ring and a stationary brush, or wiper, that slides along the ring surface during rotation. Materials and design approaches for these contacts have been optimized to minimize wear and maximize electrical performance.

WHAT MATERIALS DO YOU USE FOR THESE ELECTRICAL CONTACTS?

Since the late 1940s when Moog first started producing instrumentation quality slip rings, a wide range of materials have been utilized in slip ring designs, each with their own beneficial properties. The contacting surfaces are almost always noble metal (typically gold or silver) alloys to minimize surface contaminants and keep contact resistance low.

WHAT SHAPE DO THESE CONTACTS TAKE?

The rings come in two basic configurations: cylindrical (drum) shape or platter (pancake) shape as shown below in figure 1. The best configuration is the one that best fits in your system, i.e., whether your physical constraints are on length or diameter.

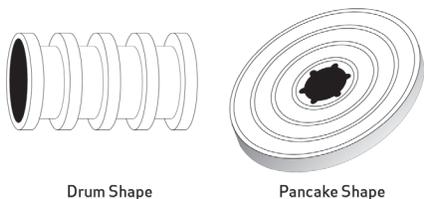


Figure 1: Basic slip ring configurations

The brushes come in several configurations as well, but the three primary ones are as shown in figure 2. The brush selection criteria include size, power requirements, ring configuration, and life requirements. Moog has years of experience applying all these contact designs and materials and will assist in matching the right contacts to your unique requirements.

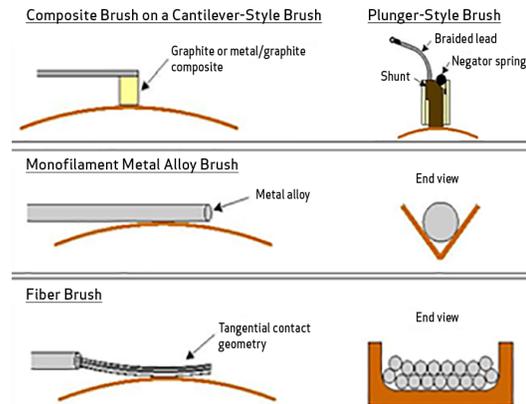


Figure 2: Three primary contact brush configurations

IF SLIP RINGS USE SLIDING CONTACTS, THEY MUST WEAR OUT AT SOME POINT. WHAT IS THE TYPICAL LIFETIME OF A SLIP RING?

Exact contact life values depend on materials, operating speed and design parameters. Wind turbine slip rings for example have a typical life of 100+ million revolutions. The life of typical instrumentation slip rings is usually in the 10s of millions of revolutions range.

IS THERE A ROTATIONAL SPEED LIMITATION ON SLIP RINGS?

Yes, there is a limit to rotation speed at which a slip ring can operate. Moog does have some special designs that can operate up to 20,000 rpm, but the typical limit on operating speed is about 250 - 1,000 rpm although this can vary depending on several parameters such as size, materials, and environment to name just a few.

SLIP RING FREQUENTLY ASKED QUESTIONS

DO THESE SLIDING CONTACTS PASS ELECTRICAL SIGNALS WITHOUT PRODUCING EXTRA NOISE ON THE CHANNEL?

Sliding contacts do produce minimal resistive noise during rotation which is the result of a slight variation in contact resistance, typically about 10-20 milliohms. This resistance variation value produces a low-level voltage variation on an electrical signal, but the value is well below the noise floor for almost all common signals. For low-noise power circuits and low-level analog signals, special design materials and considerations can produce even lower levels of contact noise.

WHAT ARE THE POWER LIMITS ON SLIP RINGS?

The only limitation on slip ring power levels result from physical size constraints. High power requires space for additional insulation (voltage) and large conductors (current). Moog produces slip rings rated up to 25+ KV and others with current ratings that exceed 1,000 amps.

CAN SLIP RINGS TRANSMIT HIGH SPEED DATA?

This has become the most frequently asked question of slip rings. Slip rings have kept up with the new higher speed data formats. Moog has a line of slip rings that have been optimized for 1000 Base-T Ethernet (GigE) as well as HD video (SMPTE 292). Serial data speeds up to about 1.25 Gbps can normally be accommodated in smaller slip rings. Fiber optic rotary joints and non-contacting electrical slip rings can be incorporated in the slip ring in the cases where even higher data speeds are required.

IF MY SYSTEM DOES NOT ROTATE CONTINUOUSLY BUT RATHER OPERATES IN A SCANNING OR LIMITED ROTATION MODE, WILL A SLIP RING WORK?

Moog has years of experience providing slip rings for scanning sensor (radar, electro-optic pods, acoustic sensors). Materials and design selections are important when choosing a slip ring for scanning operation, but slip rings perform very well in full scanning or intermittent scanning mode. By allowing scanning systems to search through a full 360 degrees without returning to zero, slip rings can provide significant performance advantages over flexible cabling.

RIGHT NOW, I USE A CABLE WRAP IN MY SYSTEM. WHY WOULD I USE A SLIP RING INSTEAD?

Cable wraps are often used when continuous rotation is not required. In many cases a slip ring increases performance, improves reliability and maintainability, decreases size and inertia, and improves machine appearance. Moog has provided significant performance improvements in some robotic applications for example by replacing a cable wrap on a joint as seen in figure 3.

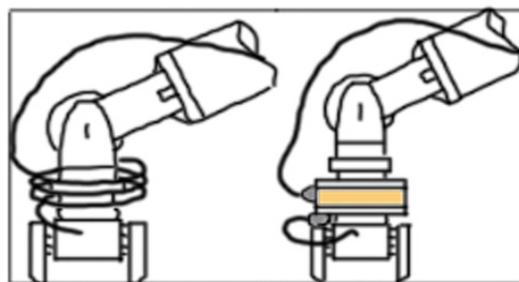


Figure 3: Cable wrap system vs slip ring system

I'M THINKING ABOUT USING FIBER OPTICS FOR DATA COMMUNICATION IN MY ROTATING SYSTEM. WHAT OPTIONS DO I HAVE?

Moog can support this move to fiber optics in two ways:

1. Moog provides an extensive line of fiber optic rotary joints (single and multi-channel as well as single and multi mode) that can be incorporated right into a slip ring.
2. Moog has a line of electronics that assists in combining multiple channels onto a single fiber (multiplexers) as well as converting electrical signals to fiber optic (media converters).

MY SYSTEM IS IN A VERY WET AND DUSTY ENVIRONMENT. HOW DO SLIP RINGS PERFORM IN THIS ENVIRONMENT? AND HOW ABOUT SHOCK AND VIBRATION?

The electrical contacts in slip rings do require protection from environmental extremes (including EMI environment in many cases). Moog provides sealing levels up to IP69 to ensure that the sliding contacts do their job without degrading. And Moog slip rings are designed to handle all levels of shock and vibration experienced in both the industrial and military environments.

I ALSO NEED TO TRANSFER FLUID ACROSS THIS INTERFACE. CAN YOU HELP WITH THAT?

Many of Moog's slip rings incorporate a fluid (oil, gas, air, hydraulic fluid) across the rotating joint. In addition, encoders, resolvers, or other position devices can be incorporated to indicate rotational position.

WHAT STEPS DOES MOOG TAKE TO ENSURE THAT MY SLIP RING WILL MEET PUBLISHED REQUIREMENTS?

Slip rings are typically tested for circuit resistance, variation in contact resistance with rotation (noise), high voltage withstand, and insulation resistance between circuits and all circuits and ground. Critical transmission line parameters are also checked on communication channels such as Ethernet. Additional tests can be performed for specialized applications.

TAKE A CLOSER LOOK

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References

Figure 1	Slip ring configuration photo provided by Moog.
Figure 2	Contact brush configurations photo provided by Moog.
Figure 3	Illustration provided by Moog.

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