The benefits of slip rings for rotary machinery

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Electrical slip rings allow for the transmission of electricity from a part or device that is stationary to one that is rotary. They replace cables as the electrical connection between these parts and are ubiquitous in machinery that requires power, signal and data connectivity. This type of technology is used in the robotics, plastics, automation, oil and gas, wind energy, and industrial fields to name just a few. Electrical slip rings play an important role in the performance, reliability and operation of the equipment, and in turn the efficiency of entire manufacturing facilities.

Electrically, they are made up of five essential components — stator leadwire, brush block, brushes, conductor rings, rotor leadwire — and, if required, electrical connectors. They work by transferring power, signal or digital data from a stationary side to a rotary side. To achieve this, a precious metal brush slides against a rotary conductor ring. Wires are soldered to both parts to guarantee the most reliable contact in any condition, limiting (as much as possible) the introduction of any additional resistance.

Depending on the type of application and the specifications, slip rings can vary in size from compact solutions (for example in semiconductor applications) to large and complex solutions (like wind energy or packaging, where additional fluid passages can be used). Moreover, the mechanical materials used can vary depending on the application. These materials range from stainless steel in food and beverage to molded plastic for low-cost applications, but also anodized aluminium when corrosion resistance and weight are to be taken into consideration. For the sliding contact system inside the unit, Deublin has always used a combination of precious metals on both the brushes and the conductor rings to maximize performance and minimize the debris inside the unit, even when the required current is high. This can guarantee a unit that operates its entire service life without ever needing maintenance.

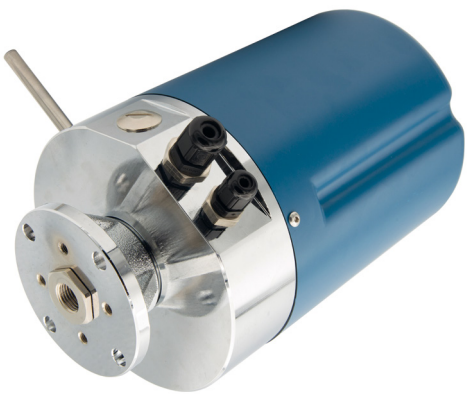

Figure 1: Slip ring solutions can vary vastly in terms of their size and application, depending on the desired specifications. Here is an example of a an SRD-30 slip ring. Source: Deublin

Main applications of slip rings

Slip rings are utilized in a plethora of applications that include a rotary platform or base. Wind turbines, packaging and filling machines, security cameras, automated welders, helicopters, cranes, elevators and generators are all examples of machines and devices that need slip rings to function effectively.

When dealing with applications like cranes, the combination of high power and harsh environment makes it critical to have a robust design that can guarantee the correct contact and prevent uneven wear in the brushes or rings. On applications like offshore wind turbines

Machines operated in the robotics, plastics and automation fields, among others, will no doubt benefit from the reliability and quality of products that Deublin always delivers.

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there are other challenges for power transmission, one of which is the extreme conditions under which the unit must operate. This requires the use of gold-on-gold technology to prevent unwanted corrosion of the contacts in an application where downtime and maintenance are cost prohibitive.

In packaging and filling machines, the reliability of the digital data transmission is more challenging due to the requirement of higher speed protocols. Currently, 100 Mbit/s real-time Ethernet protocols are used all over the industry, with newer and faster protocols up to 1 Gbps already in the market. In these applications the consistency of the connection is critical to ensure that no packet loss happens in the communication. Moreover, the electrical noise in the contact must be reduced to a minimum over the entire range of application, from stationary up to hundreds of revolutions per minute.

Slip ring performance on the front end

Unfortunately, slip rings are not exempt from issues when implemented in the field. Problems with signal, power delivery and data transmission are experienced much too often. There are some common measures that can be undertaken to try to reduce these problems as much as possible.

When dealing with high power, it is critical to prevent the occurrence of sparks (if the contact force is too low) or the excessive wear of the brushes or rings (if the force is too high) during the operation of the slip ring. Otherwise, arc erosion of the contacts can form, significantly shortening the life of the unit.

On the other hand, when dealing with digital data protocols, it is important to have a perfectly electrical noise-free contact as well as a set of design rules that ensure the appropriate protection from external electromagnetic interference (EMI) during operation. For example, the use of STP cables and proper shielding connections and practices are a must to mitigate all external interferences. Otherwise, the reliability of the connection and the data transmitted might be corrupted or packet loss can occur. Especially with high-speed real-time protocols (Ethercat, Powerlink, Profinet to name a few), the contact must be as reliable as possible to prevent errors in the communication, which would lead to machine errors.

There are a multitude of situations that can lead to a fault with a slip ring, which is why it is so important to use a slip ring that is dependable and made to the highest quality. The slip ring supplier must also be competent to provide custom solutions and technical assistance to the customers.

Deublin's unique evolution into manufacturing slip rings

To cope with the main challenges related to slip rings, Deublin has developed a very robust design and materials knowledge. This allows them to choose the most cost-effective and reliable materials in all areas, from the aluminium anodized stator tested to withstand the severe environment required by offshore wind turbines, to cost-effective silver-plated conductor rings where the application is not particularly demanding. This wide range of options enables Deublin to always provide their customer the most appropriate solution in any field of application, from clean room semiconductor machines to on-field cement mixers.

Quality and reliability are Deublin's trademarks, along with understanding and providing for the customer's specific needs, whether they are looking for a slip ring for a new line of machines, or they are unhappy with the slip ring that they are currently using.

Deublin can provide a semi-standard, "off-the-shelf" or a custom solution depending on the project and customer they are working with.

High-quality components from an established manufacturer

Besides slip rings, there are a wide range of rotary union solutions that varies from pneumatic only applications, to hydraulic and pneumatic combinations, to combo options that can fulfil any application of rotary unions with slip rings. These can be designed as separate components that perfectly fit together or as a unique solution integrating the hydraulic or pneumatic passages with all the electrical channels. In the first case, the main advantage is that one supplier can take care of both requirements, reducing time and effort on the customer side as both parts will always be perfectly aligned and compatible. With an integrated solution, it is possible to have a single piece of equipment taking care of all the electrical, hydraulic and pneumatic requirements.

Technical support will be streamlined and convenient as slip rings and rotary unions are integrated and there is only one supplier involved. Moreover, Deublin subsidiaries can provide technicians ready to help customers solve their problems all over the world. All products, both unions and slip rings, must be tested to ensure the highest possible reliability over time and the best service life possible. This is done by using top-of-the-line sources in all areas, from IPC-certified level PCB design to source controlled gold platers, and by using the best available tools for data acquisition and analysis, like Dewesoft dataloggers and Keysight oscilloscopes. The slip rings that are of the highest quality are among the best in class for both technical features and materials used. All the products are designed to endure their entire service life without maintenance thanks to the use of high-quality parts.

Some technical data and information supporting the quality and reliability standards that Deublin provides and the technical specifications of their four main standard slip ring products can be found in Table 1.`

	SRC	SRD	SRH	SRT
Max Speed (RPM)	250 to 1.500	250	60/200	250
Rotational Direction	Bi-Directional	Bi-Directional	Bi-Directional	Bi-Directional
IP Rating	IP55 - IP68	IP55 - IP67	IP55	IP51 - IP68
Mounting Orientation	Horizontal/Vertical	Horizontal/Vertical	Horizontal/Vertical	Horizontal/Vertical
Operating Temp. (°C)	-20 to 80	-20 to 80	-20 to 70	-20 to 80
Storage Temp. (°C)	-40 to 90	-40 to 90	-40 to 80	-40 to 90
Housing Material	Anodized Aluminium	Anodized Aluminium	Aluminium	PA66 Glass Fiber Reinforced
Rotor Material	Anodized Aluminium	Anodized Aluminium	Aluminium/Galvanized Steel	PA66 Glass Fiber Reinforced
Cover Material	Anodized Aluminium	Carbon Graphite Filled PA	Aluminium/Stainless Steel	Aluminium
Conductor Ring	Gold Plated Copper Alloy	Gold Plated Copper Alloy	Bronze (power) - Silver plated (signal)	Silver/Gold Plated Copper Alloy
Brush Contact	Alloy monofilament or polyfilament/ Carbon Brushes	Alloy monofilament or polyfilament/ Carbon Brushes	Alloy monofilament or polyfilament	Alloy monofilament or polyfilament

Table 1. Technical specs of Deublin slip rings. Source: Deublin

These four standard slip ring families manufactured by Deublin have some similar characteristics and features, as can be seen in the table, and their differences determine what specific applications they are used for. Typically, the SRC, SRD, SRH and SRT families are used for packing, automation, rotary tables and wind turbines.

The ATEX-SRX family of slip rings differ from the standard four families as they are designed to operate in environments with combustible dust (Table 2)

Finally, the combo family of products is essentially rotary unions that are meant to be combined with slip rings. These specific rotary unions are designed to mate directly with slip rings with an anti-rotation bracket to ensure that there is no movement between the two components (Table 3). They are also used for packaging, automation and rotary tables.

	ATEX-SRX
IP Rating	IP65
Mounting Orientation	Vertical with Rotor Down
Operating Temp. (°C)	+70 to -20 Celsius
Cover Material	Exterior Material
Nominal Voltage (VAC/VDC)	400
Nominal Current	Up to 34A
Test Voltage	2.5 kV for 1 Min.

Table 2. Specifications for slip rings in harsh environments. Source: Deublin

	Combo
Operating Temp.(c)	50
Housing Material	Carbon Steel/Aluminium with Blackening Coating
Rotor Material	AISI420B
Material	Inert non-flammable compressed gasses, and hydraulic oil
Max. Operating Pressure	10 bar (inert gas) or 250 bar (hydraulic oil)
Max. Line Pressure	12 bar (inert gas) or 300 bar (hydraulic oil)
Test Pressure	15 bar (inert gas) or 450 bar (hydraulic oil)
Max. Environment Temp.	70
Max. Rotational Speed	Refer to Speed Chart

Table 3. Specifications for rotary union and slip ring products. Source: Deublin

Figure 2: Slip ring solutions can vary vastly in terms of their size and application, depending on the desired specifications. Here is an example of a combo solution with an SRD slip ring and a multi-pass soft seal (MPSS). Source: Deublin

Case studies — Deublin Italiana

- A customer wanted to upgrade part of their production line, but it was not possible with a mechanical only setup. So, linear motors were introduced. The customer tested several slip rings from various manufacturers, but with disappointing results, especially for the Ethercat communication. The main reason for failure was in the high number of lost packets during the transmission, leading to machine errors and downtime. With Deublin's polyfilament technology, used in all of the customer's data slip rings to guarantee the highest reliability of the transmission, the line was successfully upgraded.

- A customer was having issues with data transmission due to composite graphite brush debris. This issue caused several downtimes due to communication errors and maintenance operations. Deublin's polyfilament solution with precious metal helped the customer overcome the problem by removing the need for maintenance altogether. Moreover, because of the more reliable transmission there has been no problem in the communication since they switched.

Figure 3: A variation of an SRD30 model designed to fit the customer needs. Source: Deublin

- A German customer was unhappy with the carbon graphite brush slip rings they were using due to high brush debris that disturbed the function of the slip ring. They needed three different designs. Deublin was able to adapt a standard SRD30 model with minimal modifications to fit in the machine. Deublin offered two completely custom solutions with an 80 mm central bore while maintaining an aggressive price level.

Conclusion

Machine builders and design engineers in various fields of industry will be excited to learn that Deublin has brought their reputable expertise, built up over 75 years, to slip rings. Machines operated in the robotics, plastics and automation fields, among others, will no doubt benefit from the reliability and quality of products that Deublin always delivers.

Deublin is the world leader in the manufacture of rotary unions. Their world headquarters is located in Waukegan, Illinois, and they have subsidiaries all over the world, including the U.S., Spain, U.K., Germany, Singapore, Poland, Mexico, Korea, Japan, Italy, China, Brazil and many more.

Their innovative mechanical seal design was a vast improvement on the pressure-type seal that was the standard of the day. Not surprising, this propelled Deublin to the forefront of the rotary machinery industry, and their growth continues today. Deublin is owned by Hoerbiger Group, consisting of companies in over 50 countries around the world, employing almost 7,000 people.

Deublin is gaining traction in the slip ring industry as designers and builders are turning to them for high-quality, dependable slip rings they can trust. Visit their website for more information.

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ABOUT DEUBLIN COMPANY

Deublin Company (a division of Hoerbiger Rotary Solutions) is a leading manufacturer of Rotary Unions and Electrical Slip Rings that are used in a multitude of industrial machinery and manufacturing processes. Rotary Union applications include air clutches, gear boxes, machine tool spindles, rubber & plastic manufacturing machinery, steel continuous casting machines, paper machine calender stacks, steam joints, and siphon systems for paper machine dryer cans. Electrical Slip Ring applications can be found in wind energy, semiconductor, packaging, and oil and gas industries, to name just a few.