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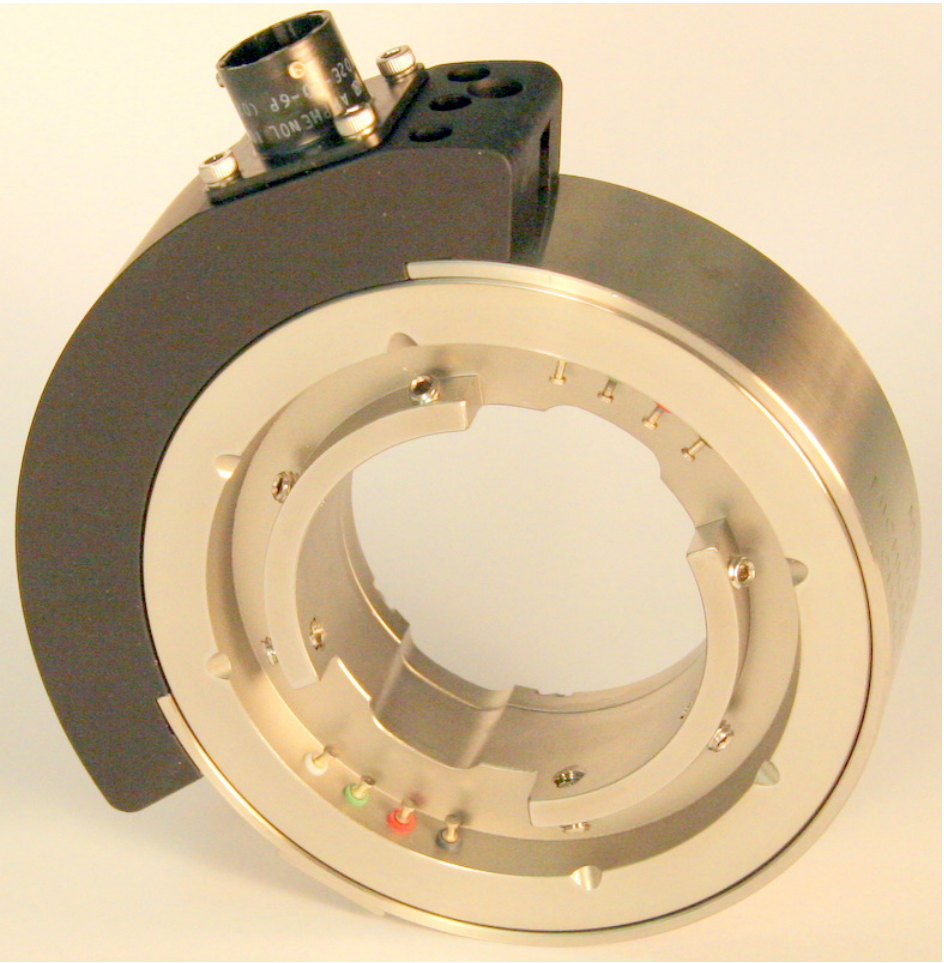
MODEL B4-2
SLIP RING ASSEMBLY

OPERATOR'S MANUAL



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Introduction

The Model B4-2 Slip Ring Assembly is ideal for applications that require the slip ring to be mounted directly on a rotating shaft. It is designed to fit on shafts up to two inches (50.8 mm) in diameter and make electrical connection to strain gages, thermocouples, or other sensors that have been installed on rotating equipment. The slip ring brushes and rings are made of precious metals which minimize noise and enable the assemblies to be used for low level instrumentation signals. Connections are made through color coded solder terminals located on the slip ring rotor and a connector on the slip ring stator. The compact design of these assemblies makes them ideal for applications where limited space is available

Features

- 4 circuit slip ring.
- Compact design.
- Mounts on shafts up to 2” [50.8 mm] in diameter.
- Permanently lubricated bearings.
- Rugged construction, utilizing stainless steel and anodized aluminum on all external parts.
- Instrumentation quality rings and brushes.

Specifications

Slip Ring	
Circuits	4
Current Capacity per Circuit	1 Amp
Temperature Range	-40℉ to 250℉ (-40℃ to 121℃)
RPM Rating	7000 RPM
Maximum Peak Noise*	0.1 Ohm
Width	1.060 in (26.92 mm)
Weight (with encoder option)	2.0 lbs (0.9 Kg)
Output Connector	Bendix PT02E-10-6P
Mating Connector	Bendix PT06E-10-6S(SR)
*Resistance variation across slip ring contact.	

Operation

General Operation

Slip Ring Assemblies allow for electrical connections to be made between rotating and stationary portions of an application. For many applications no additional equipment would be required that is not required for a stationary application. We specialize in instrumentation type slip ring assemblies, which are designed to carry signals across rotating junctions.

The most common sensors used with slip rings are strain gages and thermocouples. These sensors have outputs in the microvolt to millivolt range. By using the correct circuits and installation techniques these small signals can be brought through the slip ring with minimal distortion.

Because of the large diameter of the rings used in tubular assemblies relative to the end of shaft assemblies, the surface speed of the ring surfaces relative to the brushes is much higher. To deal with the higher surface speeds and to maintain good signal quality, we use silver alloy rings and silver-graphite brushes in all of our tubular assemblies. The contacts are somewhat sacrificial in nature; they tend to wear out more quickly than the rest of the assembly. Under ideal conditions, the contacts tend to last ~100 million revolutions.

Many factors can affect the life of the contacts, including temperature, humidity, rotational speed, amperage, vibration, etc. It is a good idea to occasionally check the condition of the contacts until you become familiar with the rate of wear for a particular application. This procedure is described in the “Maintenance” portion of this document.

This assembly uses permanently lubricated bearings and solid silver alloy rings (rather than plated). If the contacts are not allowed to wear completely away during use, the rest of the assembly will typically last through several sets of contacts. If the contacts are allowed to completely wear away, severe damage can result to the brush assembly and ring surfaces.

Technical Considerations

As mentioned earlier, the most common sensors used with slip rings are strain gages and thermocouples. These sensors have outputs in the microvolt to millivolt range. By using the correct circuits and installation techniques these small signals can be brought through the slip ring with minimal distortion.

Strain gages are usually configured as a Wheatstone bridge which is very sensitive to their small resistance changes. The full bridge should be located on the rotating side of the application so the small resistance variations at the slip ring are not inside the bridge. This results in the signal rings being in series with a high input resistance instrument like a recorder, readout, or oscilloscope. Small resistance variations at the signal rings will not distort the signal. The effects of using different wiring methods are discussed, and recommended wiring diagrams are included in the “Technical Notes” portion of our website (www.michsci.com/tech_notes.htm).

The use of slip ring assemblies with thermocouple circuits is also discussed in the “Technical Notes” section of our web site. There is potential for error when slip ring assemblies are used with thermocouples. If possible, the slip ring assembly should be kept at a uniform temperature because it is not thermocouple material. If, for example, the rotor terminals are 5F hotter than the stator terminals, a 5F error will be introduced into the measurement.

For tubular assemblies thermocouple measurements are more difficult because the slip ring bearings and brushes can generate significant heat, making the formation of a temperature gradient more likely. This potential increases with rotational speed. We tested a model B6-2 tubular slip ring. At 5000 rpm the error was 40F.

With an instrumentation slip ring assembly there is another minor source of error called the thermoelectric effect. Heat from the slip ring bearings and sliding brush contacts cause small temperature gradients inside the slip ring assembly. The gradients create thermoelectric voltages between rings. In small assemblies with a few rings this is insignificant and can be ignored. Assemblies with many or large diameter rings have more thermoelectric voltage. For example, a 36 connection end of shaft assembly or a tubular slip ring may have voltages of 80 to 150 microvolts at higher speeds. The sensitivity of a type J thermocouple is about 28 microvolts/F (50 microvolts/C) and for type K it is about 22 microvolts/F (39 microvolts/C). So an error of a few degrees can result. The solution is to minimize the error by using adjacent rings for a given thermocouple.

For any thermocouple application, the above considerations can be transcended by using rotating thermocouple amplifiers. Also, other temperature sensors could be considered, such as an RTD.

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Installation

This assembly has a 2.000 inch (50.8 mm) bore. If the shaft the slip ring assembly will be mounted to is a smaller diameter, an adapter bushing will need to be made to make up the difference. For best results, the assembly should be mounted as square and as concentric as possible with the axis of rotation of the shaft. For low rotational speeds this is not as critical. As rotational speeds increase, it becomes much more important. For high speed use, we recommend axial and radial run-out to be held to .001 TIR, if possible.

The slip ring assembly is secured to the shaft with six 8-32 set screws. It is best if the adapter is made of aluminum or other soft metal, so that the set screws can provide a good grip. We strongly recommend that you dental drill, grind or machine small recesses or flats in the surface of the adapter or shaft that align with the set screws; this will help make sure the rotor is secured adequately to the shaft. This is particularly helpful in very dynamic applications and/or if the shaft or adapter is made of a harder metal.

The method for restraining the stator of the assembly from rotating should allow for some flexibility. If the rotor of the assembly is rigidly secured to the shaft and a rigid rotational restraint is applied to the stator housing, any run-out in the application would impose large loads on the slip ring assembly as the application rotates. Small cables, springs or wire ties work well as rotational restraints. Typical operational torque for these assemblies is ~30 inch-ounces. It is best if the stator cable is not used as the restraint.

Electrical connections to the slip ring rotor are made using solder terminals. It is best to use small stranded lead wire (24 AWG maximum). Be careful when attaching and removing lead wires so the terminals are not broken by excessive force or heat. The solder iron should be no more than about 30 watts or 500F if the temperature controlled type. Once the leads are soldered to the terminals secure them to the rotating shaft to prevent the leads from fatiguing off or damaging the terminals.

If the leads are thermocouples it is necessary to use the correct flux. Contact Michigan Scientific for flux and instructions. 28 or 30 AWG wire is recommended.

After the electrical connections are made, it is important to apply a protective coating to the exposed wires and terminals. Several coatings are available. We recommend using electronics grade RTV silicone sealant.

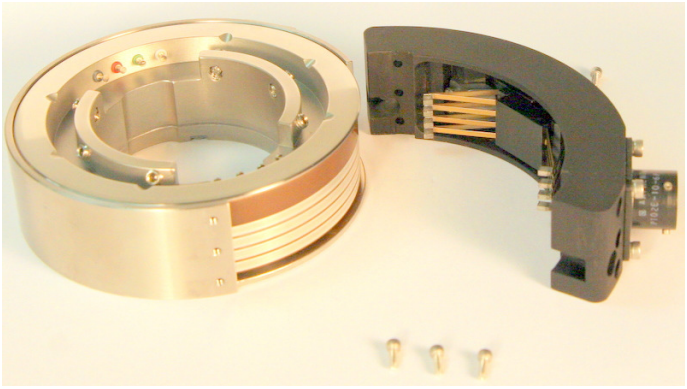
Maintenance

The Model B4-2 Slip Ring Assembly is designed to require very little maintenance during normal use. It is highly recommended that assemblies that appear to be malfunctioning be returned to Michigan Scientific Corporation for evaluation and repair. One part that can be inspected and maintained by the user fairly easily is the Brush Assembly.

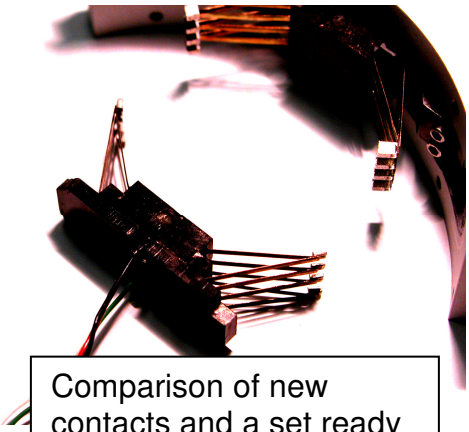
Because of the relatively high speed of the ring surfaces in relation to the electrical contacts, sacrificial contacts are used in this assembly. These contacts wear at a much higher rate than the rest of the assembly. This rate of wear can be affected by many environmental factors (i.e. temperature, humidity, etc.) so contact life can vary from application to application. As the contacts wear the debris from the contacts builds up within the slip ring housing. Since this debris is conductive, over time it can build up to the point where it can cause shorting between rings, affecting signal quality. Experience and testing has shown that this wear debris does not typically cause any ill affects during the useable life of the contacts. As the contacts near the end of their useable life, the signal quality tends to degrade at a rapid rate. It is important to service the slip ring assembly if it is determined that the slip ring assembly is causing a degradation of signal quality. If the contacts are allowed to wear away completely the rings and brushes in the slip ring assembly can become severely damaged. As long as the contacts are serviced as needed, the rest of the assembly should last through several sets of contacts.

The brush assembly on the Model B4-2 Slip Ring Assembly is the anodized aluminum part with the connector installed on the outer diameter of the slip ring assembly. Use care when removing the housing, as it is easy to damage the contacts and leaves. Hold the housing in place with one hand and remove the six 2-56 x 1/4" socket head cap screws that attach it to the Slip Ring Assembly. The Brush Housing can then be carefully removed from the assembly. Do not throw this away. It is less expensive to rebuild this assembly than to buy a new one.

Remove wear debris that has accumulated in the brush assembly by spraying an appropriate precision cleaning solvent or contact cleaning solution on the contacts and leaves to flush away the debris. If such solvents are not available the debris can be removed by using a soft flux brush and clean isopropyl alcohol to gently brush the debris away. Remove the solvents by spraying the assembly with clean air. The air must be very clean, either filtered air or "bottled air" used for cleaning electronics. Do not use air from shop compressors, since it often contains oil and/or water, either of which would contaminate the slip ring assembly.



Brush Assembly separated from rest of assembly.



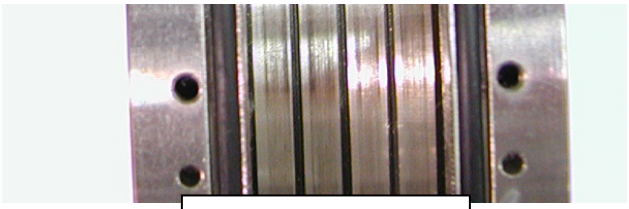
Comparison of new contacts and a set ready for replacement.

Once the brush assembly is clean inspect the contacts and wipers for damage and wear. If the leaves or contacts are damaged or if the contacts are significantly worn, the assembly must be returned to Michigan Scientific Corporation for service.

New contacts are 0.135” (3.5 mm) in length. If any contact has less than 0.040” (1 mm) of material left on the leaf it is time to have the contacts replaced.

It is important to remove the excess wear debris from the slip ring assembly housing when the brush assembly is serviced. Wear debris can be removed from the interior of the slip ring assembly simply by placing the nozzle of a shop vac near the opening in the housing where the Brush Assembly was installed. Vacuum away the debris as the assembly is slowly rotated. Do not wipe the rings since this can force wear debri between the rings and could cause shorting. Do not clean the rings with solvent. It is actually good to leave a fine dusting of debris on the rings since it acts as a contact lubricant.

While cleaning the assembly you may notice that the contacts have worn shallow grooves or “tracks” in the rings. This is normal. Do not attempt to polish the tracks out of the rings. If the grooving is severe return the assembly to MSC for service.



Normal “tracks”.

The exterior of the slip ring assembly can be cleaned by wetting a cloth with clean isopropyl alcohol or other appropriate solvent and wiping the surfaces. Do not spray solvents on the housing

Examples of appropriate cleaning products for the brush assembly.

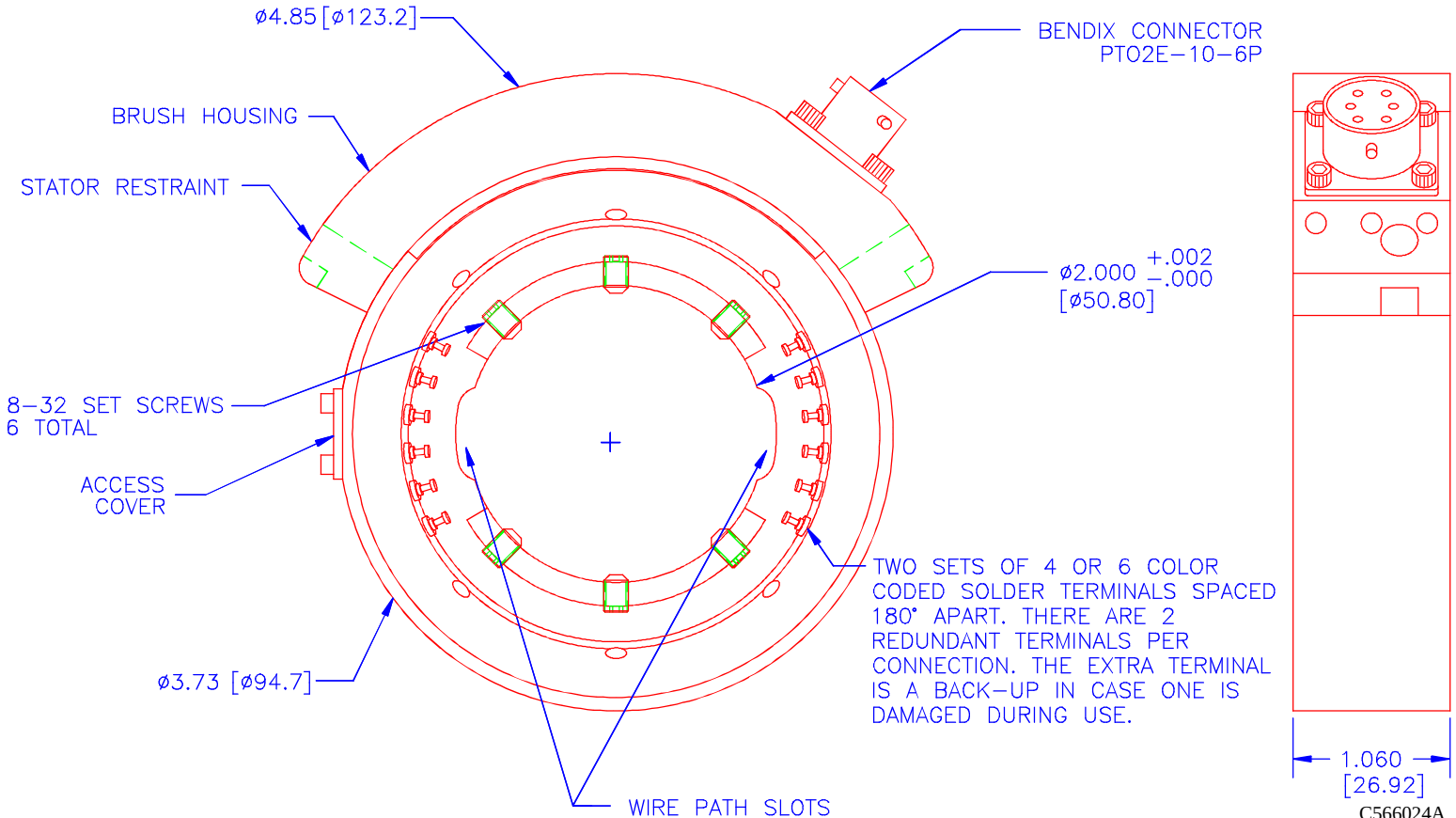
since solvents can enter and contaminate the assembly.

Occasionally the wear debris can cause signal problems before the contacts are completely worn away. If the contacts are in good condition the brush assembly can be reinstalled and the assembly returned to service. Contact life expectancy can be estimated by carefully measuring the length of the shortest contact. The contacts are approximately 0.135" long when new. The percentage of contact length left is a good indicator of the percentage of useable life left. If the contacts are worn away return the assembly to MSC for contact replacement. It is best if the entire slip ring assembly is returned, but if this is not desirable or possible just the brush assembly can be returned. Use care when packaging to protect the brush assembly during shipping. To avoid possible delays in long term testing customers occasionally purchase spare brush assemblies to install on the slip ring assembly while the original is being serviced.

The easiest way to install the Brush Housing to the Slip Ring Assembly is to lay both pieces on a smooth tabletop and carefully slide them together. The Brush Housing can be replaced on a Slip Ring Assembly that is still installed on a shaft as long as care is taken to maintain proper alignment of the two pieces as the Brush Housing is moved into position. It is possible to do this by visually aligning the pieces but you may find the use of a flat, smooth piece of material that can be placed against the side of the assembly to be very useful.

The Brush Housing must be installed so that it is oriented as shown in the above photos. It is possible to install this assembly in the wrong orientation. If the assembly is installed incorrectly, leaves, contacts and ring surfaces can be severely damaged when the assembly is rotated. First carefully move the housing into position. Install a screw in each end of the Brush Housing and tighten until snug. The unit can now be lifted from the table. Verify that the Brush Housing is installed correctly and that it is aligned with the Slip Ring Assembly. If it is slightly out of alignment loosen the screws and adjust it. Install the rest of the screws. The housing is held on with 6 2-56 x 1/4" socket head cap screws. Be careful not to use longer screws, since doing so would severely damage the rings. Install the rest of the screws. Assembly is now complete.

Appendix



DIMENSIONS ARE INCH[mm]

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