Vehicular Slip Rings

Reliable signal and power coupling in the most rugged battlefield conditions

Description
The increasing complexity of modern military vehicles demands slip rings that provide reliable electrical interfaces between the stationary and rotating parts of these vehicles. Moog Components Group slip rings have been chosen to operate on numerous vehicular programs to meet these challenges. M1 / A2 and M60 tanks, A2 / A3 Bradley Fighting Vehicles, Stryker, Light Armored Vehicles (LAVs), and V150 Commando Vehicles are just a small sample of these vehicular programs.

Technological developments have yielded stabilized gun systems, laser target acquisition and fire control systems, and high bandwidth data communications that create unique demands for vehicular slip rings. We meet all of these challenges effectively and economically. A sampling of our many active vehicular slip ring designs are shown on the following pages, or our engineering department can tailor a slip ring for your vehicular application, often within the existing envelope. Contact us with your requirements.

Features
• Supports modern data communication technologies
• Full environmental sealing capabilities
• EMI shielding available
• Range of operating voltages compatible with any vehicular system
• Hydraulic rotary joint options
• Gold-on-gold contacts for signal and data integrity
• Meets military shock and vibration requirements
• Speed, torque and frequency characteristics designed for specific vehicular applications
• High power capability to support present and future vehicular system needs
• High frequency coax channels available
• Through-bore designs
• Cam-operated microswitches
• Vertical integration with resolvers, fiber optics, fluidic interfaces, hydraulics, pneumatics and motors
• Filtered air transfer for chemical, biological and radiological (NBC) requirements and / or electronics cooling and pneumatic rotary joint options for crew station breathing and electronic cooling
• High speed data capabilities

Typical Applications
• Tanks
• Light armored vehicles
• Armored personnel carriers
• Retrievers
• Armored field artillery vehicles
• Brigade command vehicles
• Reconnaissance vehicles
• Mobile missile launchers
• Independently rotating commander stations
• Forward-Looking-Infra-Red systems (FLIRs) or viewers
VEHICULAR SLIP RING DESIGN CRITERIA

Electrical slip rings are used in vehicles such as tanks, retrievers, light armored vehicles, mobile missile launchers, and armored personnel carriers. A typical vehicle might contain slip rings in the turret, the commander station and the infrared sight. In each of these systems, slip rings have provided reliable signal and power coupling under the most rugged battlefield conditions.

In addition to producing compact slip rings where minimal space is available, we have provided units that combine conventional electrical slip rings with resolvers, encoders, fiber optics, pneumatics and hydraulics rotary joints.

Design
Moog Components Group can offer the most valuable design assistance by being involved early in the development of the vehicle. The internal design of the slip ring capsule will be driven by the circuit requirements and the space available for mounting the slip ring capsule. From our vast product line, we can pull from the following design criteria:

- use of existing designs
- single drum
- concentric drums
- single pancake
- stacked pancakes
- combination of designs
- clear through-bore to allow another device to occupy the centerline
- connectors – case mounted or attached to cables
- mechanical support – on either side of the rotating interface.

Power Circuits
Theoretically, there is no limit to the amount of power that can be transferred by the slip ring capsule. Most hull-to-turret slip ring capsules are capable of transferring 150 amps continuously. It is important that the power duty cycles (including surge currents) be accurately defined as early as possible in the design stage. (Requiring the slip ring capsule to operate at continuous current levels that will not be encountered in the field takes space that could be more effectively used for signal requirements.) If the space available for the slip ring capsule is limited, it may be advantageous to transfer the power at higher voltages and lower currents. The power ground can be made through the case of the slip ring capsule or insulated from case ground.

Signal Circuits
Signal requirements for vehicular slip ring capsules continue to be increasingly demanding. The circuit functions and electrical isolation requirements have a significant impact on the design of the slip ring capsule. A typical vehicular slip ring will include circuits for powering electronic equipment, video circuits, and analog and digital control circuits.

Sometimes it is important that sensitive circuits have additional isolation from other circuits to meet heightened sensitivity requirements. Circuit isolation requirements are more easily addressed early in the design stages.

Slip Ring Expertise
Vehicles such as tanks, retrievers, mobile missile launchers, light armored vehicles and armored personnel carriers pose a variety of challenges. Hydraulically-actuated equipment in the turret may require the combination of conventional electrical slip ring with a hydraulic joint to form an electro-hydraulic slip ring, thereby providing reliable fluidic interfacing. The threat of a NBC environment may require pneumatic channels through the slip ring to provide filtered air to crewmembers’ facemasks. The introduction of an independently rotating commander station or cupola may require a slip ring large enough in diameter to encompass the station, yet very thin in cross section to minimize

Components for Vehicular Systems

- FLIRs and Target Acquisition Systems
  - Slip ring
  - Resolver
  - Cube motor
  - Torque motor
  - Actuator
- Motors, Resolvers and Actuators
  - Electric turret drive
  - Gun elevation
  - Travel lock
- Turret Stabilization
  - Moog Systems Group
- Turret Slip Rings
  - Electromechanical or Electro-optical
  - Hydraulic
  - Pneumatic
- Weapon Station Cupola
  - Slip ring
  - Resolver
  - Motor
  - Actuator
- Optical Data Bus
  - Fiber optic rotary joint
    - On and off axis
    - Single and multi channel
    - Single and multi mode
  - FDDI bypass switches
  - Trunk coupling units
Vehicular Slip Rings

VEHICULAR SLIP RING DESIGN CRITERIA

space requirements. These advances in military technology, plus many others, have challenged the capabilities of the slip ring industry, demanding equally sophisticated solutions for reliable vehicle operation.

Moog Components Group consistently meets these challenges successfully and economically. For more than 50 years we have been involved in the design, development, and production of quality slip rings for many diverse applications. Recognized as leaders in slip ring research and testing, our team of engineers, scientists, and manufacturing personnel have focused their total resources toward one goal—providing you with the best possible product.

To that end, we have:

- Established a complete Research & Development team, conducting numerous on-going studies in such areas as tribology—the science of friction, wear and high bandwidth communication.
- Studied the effect of environmentally-induced contaminants on slip ring contacts and made substantial progress in making slip rings more tolerant of hostile environments.
- Consolidated all of the functions of product design, tool design, manufacturing, and product testing into a well-integrated in-house operation certified to AS9100 Rev. C ISO 9001-2008.
- Combined field-proven slip ring designs with high-volume tooling techniques resulting in high quality hull-to-turret slip rings at attractive unit prices.
- Presented technical papers dealing with the field of electrical contacts and the applications of our technology to a diverse marketplace.

In view of our many years of applications experience and proven performance, it is easy to understand why our slip rings have been chosen to be used on numerous vehicular programs, including:

- APC
- M60 A1 & A2
- HSTV
- M2 & M3 Bradley
- Leopard
- M48
- M728 CEV
- Centurion
- Commando V150
- Stryker
- AAV
- LAV
- Bionix

Vehicular and Turret Slip Ring Specifications

The following table presents a cross-section of our vehicular designs. These products are for reference purposes only. Please contact the factory concerning your requirements. Tooling charges may apply.

<table>
<thead>
<tr>
<th>Vehicular Slip Ring</th>
<th>Power</th>
<th>Signal</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number of Circuits</td>
<td>Cont. Current Rating</td>
<td>Voltage Rating</td>
</tr>
<tr>
<td>AC3497</td>
<td>1</td>
<td>1</td>
<td>150 amps</td>
</tr>
<tr>
<td>AC6033</td>
<td>1</td>
<td>1</td>
<td>150 amps</td>
</tr>
<tr>
<td>VSR-3733</td>
<td>2</td>
<td>200 amps</td>
<td>24 VDC</td>
</tr>
<tr>
<td>VSR-4906</td>
<td>2</td>
<td>200 amps</td>
<td>24 VDC</td>
</tr>
<tr>
<td>VSR-4994</td>
<td>4</td>
<td>200 amps</td>
<td>24 VDC</td>
</tr>
<tr>
<td>VSR-6057</td>
<td>2</td>
<td>250 amps</td>
<td>18 - 32 VDC</td>
</tr>
<tr>
<td>VSR-6772</td>
<td>2</td>
<td>450 amps</td>
<td>28 VDC</td>
</tr>
<tr>
<td>VSR-2000</td>
<td>2</td>
<td>50 amps</td>
<td>250 VDC</td>
</tr>
<tr>
<td>VSR-7001</td>
<td>2</td>
<td>150 amps</td>
<td>20 - 33 VDC</td>
</tr>
</tbody>
</table>
Vehicular Slip Rings

Typical Vehicular Slip Ring Designs

**AC3497**

- 4 MOUNTING HOLES SPACED 3.358 X 3.358 in (85.3 X 85.3 mm)
- 18UNC – BOTH SIDES
- 9.75 in. (247.7 mm)
- 312 in. (7.9 mm)
- 10.64 in. (270.3 mm)

**AC6033**

- 4 MOUNTING HOLES SPACED 3.358 X 3.358 in (85.3 X 85.3 mm)
- 13.2 in. (335.3 mm)
- 7.133 in. (181.2 mm)
- 8.37 in. (212.6 mm)
- 6.0 in. (152.4 mm)

**VSR-3733**

- 375-18UNC-2B X 50 MIN. CP. (DO NOT BREAK THRU)
- 4X 190-24UNC-2B THD. 62 MIN. FULL THD. DEPTH (4.312 +.025)
- 2.27
- 4.54
- 4.88
- 1.31
- 0.345
- 4.00 ± 0.05
- 1.885 ± 0.035
- Ø 1.62 ± 0.03
- Ø 4.50
- 3.75 ± 0.25
- 1.025 ± 0.25

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Typical Vehicular Slip Ring Designs

VSR-4906

VSR-4994

VSR-6057
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VSR-6772

VSR-2000

VSR-7001