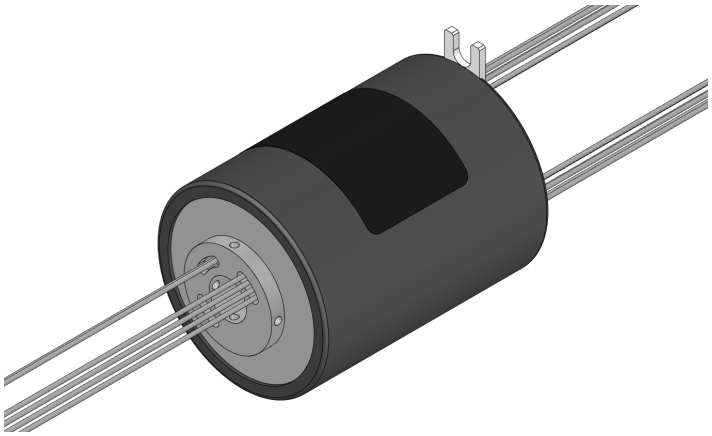
SCHLEIFRING

# Assembly Instruction

Maverick Slip Rings

## 7KCXXXXXX

maverick
by SCHLEIFRING



KEEP FOR
FUTURE REFERENCE

A- • 07.2022

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# Table of Contents

# Table of Figures

# 1 General Information

This assembly instruction contains important safety information and instructions for installing the MAVERICK slip ring.

Read the assembly instruction and observe the product drawing before handling the MAVERICK slip ring.

Follow safety notes and instructions.

**NOTICE**

**Images might differ!**

The MAVERICK slip rings are available in different types and various formats. The illustrations in this assembly instruction are for reference only. They might differ from the individual configuration. For details please visit https://www.schleifringonline.com

## 1.1 Other relevant Documents

The following documents amend this handling instruction:

- Declaration of Incorporation
- Application notes and requirements by standards
- Mechanical and electrical interface drawing 7KCXXXXXX

In order to handle the MAVERICK slip rings correctly, the complete technical documentation is necessary. You will find the complete technical documentation (document 7KCXXXXXX) in the download area on the Schleifring website (shop.schleifring.de/downlaod / shop.schleifring.com/downlaod) with detailed instructions for assembly.

The technical documentation of the MAVERICK slip rings consists of this assembly instruction and the respective product drawing starting with the product number 7KC.

You can find your drawings in the online configurator at shop.schleifring.de/downlaod shop.schleifring.com/download by entering your configuration code 7KCXXXXXX, which you will find on the type plate of your slip ring.

## 1.2 Scope of Delivery

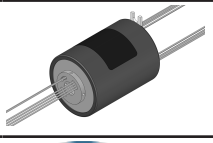
**NOTICE**

**Check Contents of Delivery!**

SCHLEIFRING is not responsible for belatedly reported defects.

- Verify the delivery immediately after receipt.
- Report visible transport damage to the transport company.
- Report visible damage or incomplete delivery immediately to SCHLEIFRING.

The delivery contains:

| Qty. | Scope of Supply | SCHLEIFRING P/N | Image |
|---|---|---|---|
| 1 | Slip ring with additional components | depends on slip ring type 7KCXXXXXX |  |
| 1 | Assembly instruction; valid for all slip ring models purchased online * | 7BC000000 |  |

* The assembly instruction is sent by e-mail and are available online for download in the online configurator. Visit shop.schleifring.de/downlaod / shop.schleifring.com/downlaod and enter your individual Part No., which you will find on the type plate of the slip ring.

## 1.3 Design Versions

**NOTICE**

**Number of Tracks!**

All versions of the MAVERICK slip ring are available with 6, 12, 18 or 24 Tracks.

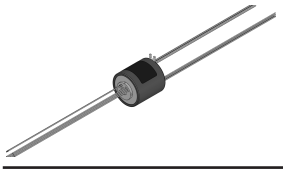
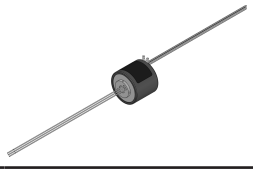
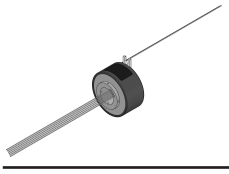
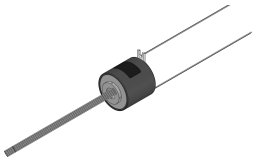
| | |
|---|---|
| 5 A / 250 V | 10 A / 250 V |
|  |  |
| 10 A / 400 V | 15 A / 400 V |
|  |  |

*Table 1:* Design Versions

# 1.4 Symbols and Conventions

The following safety instructions are used in this assembly instruction:

**NOTICE**

**Notice!**

Indicates important information about installing and operating the system.

**NOTE**

**Note!**

Indicates material damage that may occur if safety instructions are not followed.

**CAUTION**

**Caution!**

Indicates dangerous situations that can lead to minor or light injuries if safety instructions are not followed.

**WARNING**

**Warning!**

Indicates dangerous situations that can lead to death or severe injuries if safety instructions are not followed.

**DANGER**

**Danger!**

Indicates dangerous situations that will lead to death immediately if safety instructions are not followed.

# 1.5 Definition of Terms

| Abbreviation | Term |
|---|---|
| AWG | American Wire Gauge |
| AC | Alternating Current |
| DC | Direct Current |
| EMC | Electromagnetic compatibility |
| EMI | Electro-Magnetic Interference |
| ESD | Electrostatic discharge |
| ME | Medical equipment |
| MOOP | Mans of Operator Protection |
| MOPP | Means of Patient Protection |
| PE | Protective Earth |
| PELV | Protective Extra-Low Voltage in a system grounded |
| RH | Relative Humidity |
| RPM | Revolutions Per Minute |
| SELV | Safe Extra-Low Voltage in a system not grounded |
| TT | TT network |
| TN | TN network |

# 2 General Safety Instructions

**NOTICE**

**Trained specialists required!**

Every mechanical and electrical interaction with the system may be exclusively executed by trained specialists. The trained specialists need to cover the following requirements:

- Experience in handling and installation of electrical components.
- Substantial knowledge about safety standards as defined in DIN VDE 0100-100.
- Able to identify potentially dangerous situations and to avoid them.

Read and observe the safety instructions in this assembly instruction carefully. The operator is responsible for protective measures to avoid personal injuries or damage.

| | |
|---|---|
|  | **Risk of electric shock:** Severe injury or death will result due to inappropriate carried out work. Before any interaction with the system: Shut down the system and de-energize it. Secure the system against unintended restart. |
|  | **Risk of getting hit by rotating parts:** Severe injury or death can result by getting hit by or roped-in by rotating parts. Stay away from rotating parts. |
|  | **Risk of getting hit by loose flying parts:** Severe injury or death can result by getting hit by loose flying parts. Fix all parts accordingly to this document. Check for any loose parts manually before commissioning the system. |

## 2.1 Residual Risks

The slip ring system reflects state of the art technology and adheres to commonly accepted safety-related regulations. Nevertheless, hazards may occur.

The slip ring components may only be used in good order and condition. The assembly instruction must be obeyed.

You will find the safety instructions concerning residual risks in the assembly instruction in conjunction with the relevant action steps.

## 2.2 Intended Use

This slip ring is intended to be installed into a system. The slip ring is used for the transmission of electrical power and signals.

The slip ring may only be used under conditions as specified in this document.

## 2.3 Labeling


This label helps you to exactly identify the system.

## 2.4 Reasonably foreseeable Misuse

Misuse may result in personal injury or cause damage to the system.

**NOTICE**

**Misuse forbidden!**

Misuse invalidates the user's warranty entitlements and releases SCHLEIFRING from all such obligations.

- Do not use in corrosive atmospheres.
- Do not use in explosive environment.
- Do not use as lightning protection equipment.
- Do not use as safety component in electrical circuits.
- Do not use as support for mechanical loads.
- Protect the slip ring from liquids, e.g.:
  - silicon,
  - sulfur,
  - oil,
  - water,
  - or other liquids that can accumulate in or near by the slipring.
- Do not use in moving applications.
- Do not modify the system.
- Do not remove or damage the isolation of the housing.
- Do not install damaged components.
- Do not use the slipring when:
  - housing,
  - wires,
  - torque arm fork,
  - mounting flange,

  are visibly damaged.
- Do not apply voltages or currents exceeding the specified values by more that 10%, see type label or chapter Technical Data [▸ 22].
- Do not use MAVERICK slipring for transmission of signals requiring MOPP, do not use for signals of applied parts and endoscopes.
- For more application notes and requirements by standards, see chapter Appendix [▸ 24].

## 2.5 Electromagnetic Compatibility

The system is subjected to directive 2014/30/EU on electromagnetic compatibility (incorporated into the national German EMC legislation).

Compliance with directives, laws and standards on electromagnetic compatibility is the customer’s responsibility after delivery of the system.

# 3 Storage and Transport

**NOTE**

**Damage due to Incorrect Storage or Transport!**

Incorrect storage or transport conditions may damage the system.

- Transport the system exclusively in the original packaging.
- Avoid strong impacts and vibration.
- Protect the system against moisture.
- Avoid high temperature changes.
- Store the system in a dry place.

**NOTICE**

**Rotate the System every 6 Months!**

If the system is shut down for a longer period, rotate the system every 6 months for at least 10 times.

# 4 Slip Ring Overview

## NOTICE

**Mounting material might differ!**

The MAVERICK slip rings are available in different types and various formats. The screws in this assembly instruction are for reference only. They might differ from the individual configuration. For details please visit shop.schleifring.de/ / shop.schleifring.com/

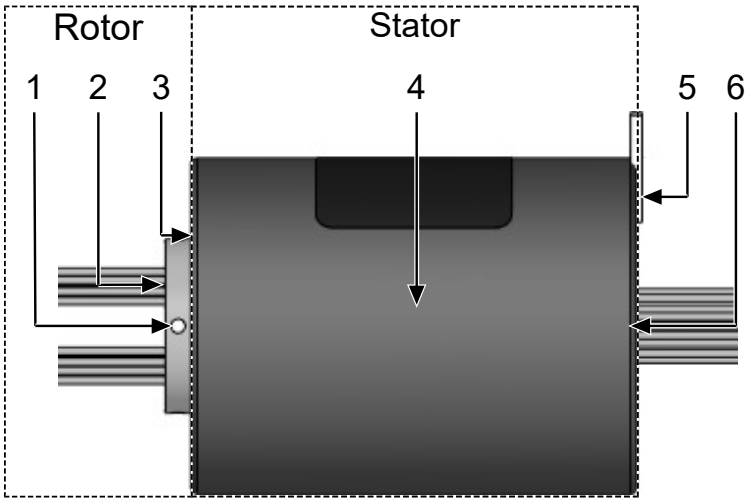



*Illustration 1:* Overview Slip Ring

| | | | |
|---|---|---|---|
| 1 | Allen screws (4 x M3 / M4) | 2 | Rotor (rotating part) with cable outlet and mounting flange |
| 3 | Turning Gap | 4 | Stator (fixed part) |
| 5 | Torque arm fork (two possible positions) | 6 | Cable inlet |

The slip ring consists of a rotating part (rotor) and a stationary part (stator). Between both parts is the turning gap. The slip ring has no drive mechanism. Its sole function is to transfer currents and data between stationary and rotating components.

The rotor has to be fixed to the designated shaft via the mounting flange.

By mounting the torque arm fork on the slip ring, the stator can be connected to the stationary part of the system, this preventing the stator from turning.

The torque arm fork has to be mounted by the customer, see chapter Mounting the slip ring [▶ 14].

Rotor and stator carry the mechanical and electrical connections, which have to be connected to the system during installation.

## NOTICE

For detailed information about mechanical and electrical connections please see the Technical Data and the mechanical and electrical interface drawings. You will find your interface drawings on shop.schleifring.de/maverick-konfigurator / shop.schleifring.com/maverick-configurator by entering your individual number 7KCXXXXXX, which you will find on the type plate of the slip ring.

# 5 Mounting

## 5.1 Installation Requirements

Before installing the slip ring, consider the following:

- Provide enough space and good accessibility to the mounting position.
- Use suitable lifting and handling devices for handling the slip ring.
- Provide a stable and clean placement area before and while mounting the slip ring.
- Mount the components of the slip ring in chronological order according to this document.
- Provide alle necessary fixtures and tools.

## 5.2 Required Tools

Ensure that the following suitable tools are available before you start:

- Torque wrench
- Phillips screwdriver
- Set of allen wrenches
- Suitable mounting screws

## 5.3 Mounting the slip ring

**CAUTION**

**Injury due to Falling Parts!**

Dropping the slip ring can lead to breaking or bruising and may damage the system.

- Secure the slip ring against dropping and tipping over.
- Wear safety shoes.

**NOTE**

**Risk of Damaging the Cable Connections**

Cables can be damaged when installed incorrectly.

- Route cables correctly.
- Do not remove any isolations.
- Avoid sharp bends and tensile load.
- Provide strain relief for cables and connectors.

1. Route rotor and stator cables correctly.
2. Position the slip ring on the shaft of the customer system in mounting position.

3. Tighten the 4 allen screws with their corresponding torque of 0.6 Nm (M3) or 1.4 Nm (M4).

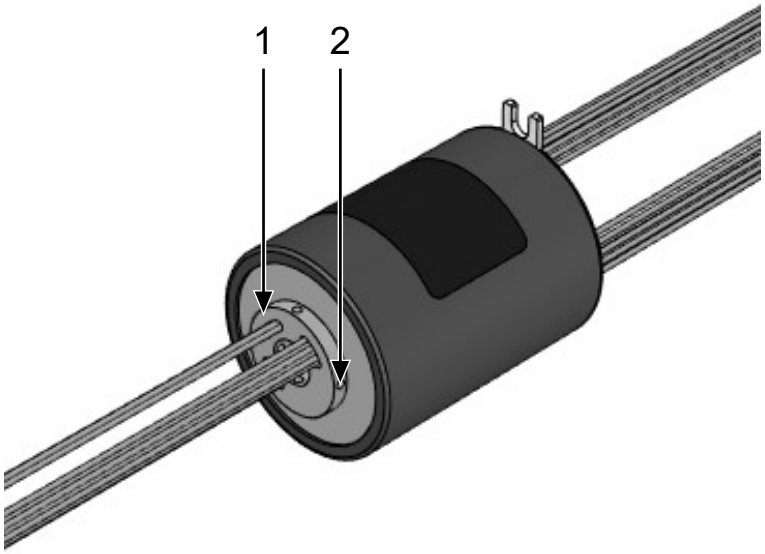



*Illustration 2:* Slip Ring Mounting

| | | | |
|---|---|---|---|
| 1 | Mounting flange | 2 | Allen screws M3 or M4 (4X) depending on the individual Slip Ring |

**CAUTION**

**Risk of Damaging the slip ring isolation**

The isolation of the slip ring can be damaged when installed the torque arm fork incorrectly.

- Only use screws which were delivered with the slip ring.
- Notice the corresponding torque.
- Caution during mounting.

4. Position the torque arm fork (two possible positions) at the stator side of the slip ring.
5. Tighten 2 phillips screws with their corresponding torque of 0.20 Nm (2.2 mm x 6.5 mm) or 0.3 Nm (2.9 mm x 9.5 mm).

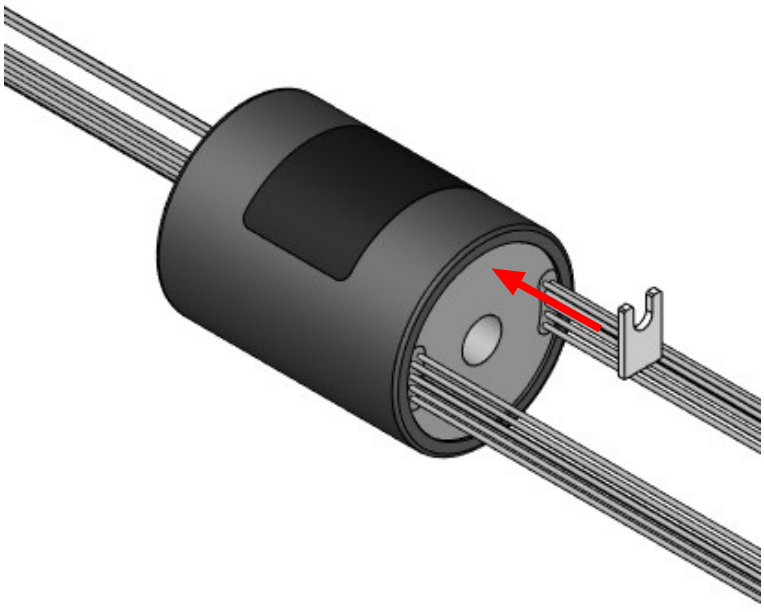


*Illustration 3:* Torque Arm Fork Mounting

6. Ensure, that all fixtures are firmly secured.
7. Mate all fixing materials according to the electrical interface drawing of the slip ring.
8. Prove, that all cables and connectors are intact and tight.

⇨ You have mounted the slip ring to the system.

# 6 Commissioning

Commissioning of the system is prohibited until it is ensured that the system can run securely.

1. Ensure that the slip ring is mounted properly to the system.
2. Ensure that all mechanical and electrical connections are intact.
3. Ensure that all connectors and plugs are plugged-in correctly and that they have the correct polarity.
4. Rotate the slip ring by hand for 5 complete revolutions.

**DANGER**

**Danger to Life due to Electric Shock!**

Severe injury or death will result due to electric shock when inappropriately carried out work or damaged components.

- Ensure that the Protective Earth connections are routed correctly.
- Do not take the system into operation if any component is damaged.

**WARNING**

**Severe Injury due to Rotating Parts!**

Danger of getting squeezed, caught or roped in when the system is in operation.

- Stay away from rotating parts.

5. Switch on the system and let the system rotate slowly.
6. If possible, slightly increase the RPM until max. RPM is reached.

⇨ The system is now running. If you notice irregularities or smoke emission, shut down the system immediately.

For more information regarding electrical integration, see application notes and requirements by standards in chapter Appendix [▸ 24].

# 7 Maintenance

**NOTICE**

**Do not open!**

The system may only be opened by the manufacturer!

No scheduled maintenance is required for the slip ring during specified lifetime.

# 8 Troubleshooting

**DANGER**

**Danger to Life due to Electric Shock!**

Electric shock will lead to death or severe injuries immediately if you do not follow safety instructions.

- Shut down the system.
- De-energize the system.
- Secure the system against unintended restart.
- Wait for at least 300 seconds to ensure that there is no residual voltage left in the system.

| | |
|---|---|
| No passage of current | Check connections.<br>Replace connections if necessary.<br>Check if plug connections are not damaged and that they are firmly seated.<br>Tighten plug connections if necessary. |
| Rough-running rotation, excessive torque | Do not distort system while mounting.<br>Rotor is blocked by a visible foreign object. Remove the foreign object.<br>Secure one of the main assemblies. Allow the other assembly to rotate freely. |
| Short-circuit or fault current | Check the whole system for insulation strength.<br>Check all electrical connections.<br>Check connections.<br>Replace connections if necessary. |
| Unusual noise | Contact SCHLEIFRING. |

For more information regarding electrical integration, see application notes and requirements by standards in chapter Appendix [▶ 24].

If the remedies do not work, contact SCHLEIFRING.

# 9 Dismounting

**DANGER**

**Danger to Life due to Electric Shock!**

Electric shock will lead to death or severe injuries immediately if you do not follow safety instructions.

- Shut down the system.
- De-energize the system.
- Secure the system against unintended restart.
- Wait for at least 300 seconds to ensure that there is no residual voltage left in the system.

1. Ensure that the system is de-energized and secured against unintended restart.
2. Ensure that no residual voltage is left in the system.
3. Remove all electrical connections.
4. Secure the slip ring against dropping down.

**CAUTION**

**Injury due to Falling Parts!**

Dropping the slip ring can lead to breaking or bruising and may damage the system.

- Secure the slip ring against dropping and tipping over.
- Lift the slip ring with at least 2 people.
- Use adequate lifting devices.
- Wear safety shoes.

5. Remove all mechanical fixtures.
6. Remove the slip ring from the system.

⇨ You have removed the slip ring from the system.

# 10 Disposal

Hand out the safety instructions to the disposal company.

This slip ring device is equipped with a gold-plated contact system.

The contact rings are made from a lead (Pb) containing brass alloy (CuZnPb) with a hard gold surface coating. When operating the slip ring beyond the tribological wear limit of the gold contact surfaces or through electric spark load during impermissible operating conditions (e.g. short circuit), contaminated debris containing lead in dispersed form can occur. When opening the housing, this debris can be exposed.

Dispose of worn devices adequately according to the local regulations to avoid environmental damage.

## 10.1 Electric Scrap

Dispose of worn devices adequately according to your local regulations to avoid environmental damage.

Pass the safety instructions on to your waste disposal company.

# 11 Technical Data

**NOTICE**

**Useful Data**

This document contains all relevant Technical Data at a glance that are needed to mount the slip ring securely. For further information please contact SCHLEIFRING.

**NOTICE**

**Number of Tracks!**

All versions of the MAVERICK slip ring are available with 6, 12, 18 or 24 Tracks.

## 11.1 Mechanical Data

| | |
|---|---|
| Maximal rotational speed, short-term | 300 min-[1] |
| Housing material | Aluminium covered with shring tubing |
| Torque | < 2 Nm |
| Lifetime | approx. 50 x 10 [6] revolutions |
| Max. operating attitude (above sea level) | 2000 m |
| Mounting position (rotation axis) | user defined |

*Table 2:* Mechanical Data

| | |
|---|---|
| Operating temperatur | -20 °C to +60 °C |
| Storage temperatur | -30 °C to +70 °C |
| Relative humidity | +10 % to +60 % |

*Table 3:* Environmental conditions

# 11.2 Electrical Data

| Electrical Data | 5A / 250V | 10A / 250V, 10A / 400V & 15A / 400V |
|---|---|---|
| Frequency | 50 / 60 Hz | 50 / 60 Hz |
| Voltage category | OV II *1 | OV II/OV III *1 |
| Isolation resistance (@ 500 VDC) | >500 MΩ | >500 MΩ |
| Protection/Appliance Class II | acc. 60529 | acc. 60529 |
| Ingress protection | acc. IP 50 | acc. IP 50 |

*Table 4:* Electrical Data

*1 see application notes and requirements by standards in chapter Appendix [▷ 24]

- Electrical safety standards to be considered:
  - EN 60664-1:2007
  - EN 20204-1:2018
  - EN 60601-1: 2006 + Cor. :2010 + A1:2013
  - DIN EN 60695-11-10:2014 V0

# 11.3 Flammability rating

## Flammability rating of slipring

- V0 according DIN EN 60695-11-10:2014
- Needle flame test 3 applications of 30sec passed according IEC 60695-11-5:2015

## Flammability rating of wiring

- UL 2556 VW-1

# 12 Appendix

- EE_7KC0000xx.pdf [▶ 25]
- Application notes and requirements by standards.pdf [▶ 26]

maverick
by SCHLEIFRING

# EG - Einbauerklärung / EC - Declaration of Incorporation

**im Sinne der EG-Richtlinie 2006/42/EG über Maschinen (Anhang II B)**
*according to EC directive 2006/42/EC on machinery (Annex II B)*

**Der Hersteller** / *The manufacturer:*

Schleifring GmbH

Am Hardtanger 10, 82256 Fürstenfeldbruck, Germany

**erklärt hiermit, dass die nachstehend beschriebene unvollständige Maschine** / *hereby declares that the partly completed machinery described below*
**Produktbezeichnung** / *Product designation:*

***7KC000 001, 7KC000 002, 7KC000 0xx, ... 7KC000 060 "Maverick-slipring"***

**Baujahr** / *Year of manufacture:* 2022

**die grundlegenden Anforderungen der Maschinenrichtlinie 2006/42/EG erfüllt. Insbesondere Anforderungen gemäß Anhang I** / *is complying with essential requirements of the Machinery Directive2006/42/EC. In particular with the requirements according to Annex I:*
**1.1.5; 1.3.1; 1.3.2; 1.3.3; 1.3.4; 1.3.7; 1.4.1; 1.4.2.1; 1.5.1; 1.5.4; 1.5.5; 1.5.6; 1.6.1; 1.6.3.**

**Es wurden folgende harmonisierte Normen angewandt** / *The following harmonized standards were used:*

| | |
|---|---|
| **EN 60204-1:2018** | Safety of machinery. Electrical equipment of machines. General requirements<br>12.7 Conductor wires, conductor bars and slip-ring assemblies |
| **EN 60664-1:2007** | Insulation coordination for equipment within low-voltage systems. |
| **EN 60601-1:2013** | Medical electrical equipment – General requirement for basic safety and essential performance. |
| **EN ISO 12100: 2010** | Safety of machinery -General principles for design<br>- Risk assessment and risk reduction |

**Die Schutzziele der Richtlinie 2014/35/EU über elektrische Betriebsmittel werden eingehalten.**
*The safety objectives of the Directive 2014/35/EU relating to electrical equipment are observed.*
**Die speziellen technischen Unterlagen gemäß Maschinenrichtlinie 2006/42/EG, Anhang VII, Teil B wurden erstellt.**
*The relevant technical documentation in accordance with Machinery Directive2006/42/EC part B of Annex VII has been compiled*
**Wir verpflichten uns, den Marktaufsichtsbehörden auf begründetes Verlangen die speziellen Unterlagen zu der unvollständigen Maschine in elektronischer Form zu übermitteln.**
*We commit, in response to a reasoned request by the market surveillance authorities, to transmit relevant documents on the partly completed machinery in electronic form.*
**Die unvollständige Maschine darf erst dann in Betrieb genommen werden, wenn ggf. festgestellt wurde, dass die Maschine oder Anlage, in welche die unvollständige Maschine eingebaut werden soll, den Bestimmungen der Richtlinie 2006/42/EG über Maschinen entspricht und die EG-Konformitätserklärung gemäß Anhang II A ausgestellt ist.**
*The partly completed machinery must not be put into service until the final machinery into which it is to be incorporated has been declared in conformity with the provisions of Directive 2006/42/EC on Machinery, where appropriate, and until the EC Declaration of Conformity according to Annex II A is issued.*
**Bevollmächtigt für die Zusammenstellung der relevanten technischen Unterlagen:**
*Authorised to compile the relevant technical documentation:*

**Ort, Datum** / *Place, Date:* Fürstenfeldbruck, 29.04.2022

Horst Knobl
Standardization Representative

# Application notes and requirements by standards

## PE

All tracks have the same current capability, PE can be assigned to any track if marking and assignment rules are observed as described in the subchapters.

If the current carrying capabilities of one track are not sufficient: Use two or more tracks in parallel, also unused tracks can be attached to PE.

Please make sure that marking, track assignment and EMC rules are observed of the subchapters.

Because of protection class II the housing has no PE connection terminal, and none is required.

EN 60204-1 requires means to ensure the continuity of the PE track. Since all tracks are identical this can be achieved by connecting one more track than required by current rating in parallel for PE.

## Marking of cables

According to the standards EN 60601-1 and 60204-1 following signals require a specific marking:

- PE (protective Earth) – green/yellow, please mark the assigned PE wires with green/yellow.
- N (Neutral line) – blue, please mark the assigned N wires with blue shrink tube or use the blue wire. In case your system employs a neutral line make sure that the blue wire is used only for neutral or marked differently to avoid misunderstandings.
- Please make sure that track assignment rules are observed as described in the subchapter.

## Isolation coordination requirements: Track assignment and arrangement

Do not use with shrink tube of Maverick slipring housing removed, cut, or damaged. The Maverick slipring has a protection class II housing, all isolation ratings are valid only with shrink tube installed.

The first priority for assigning the tracks is isolation coordination and single fault prevention, the 2nd priority should be EMC and then only all further rules apply.

Reenforced insulation is required between hazardous potential and accessible parts.

## Single fault safety: Track assignment

Single faults could be a wire break, a short between neighboring brushes/tracks, or a short to the next but one track. To ensure single fault safety also consider an offset of brush to track by one track in one of both directions might be considered to fulfill the single fault condition of the standard. This error is not probable since a barrier of sufficient height between the tracks exists but can not be excluded.

## Overvoltage Category II (OV II) or Overvoltage Category III (OV III): Track assignment

An enforced and double insulation of protection class II is given when the shrink tube housing is undamaged. This includes isolation of tracks against ring and torque bracket.

The insulation coordination differs between 5 A / 10 A type Maverick sliprings and 15 A rated Maverick sliprings:

| | 5A | 10A | 15A |
|---|---|---|---|
| OV II or III / 250 V / basic insulation | Neighboring tracks, every 2nd track | | |
| OV II or III / 250 V / reenforced insulation | Every 3rd track | | Neighboring tracks, every 2nd track |
| OV II or III / 400V 3ph/ basic insulation when marked as 400 VAC | Not possible | Neighboring tracks, every 2nd track | |

## Application examples OVII / OV III track assignment

The bus lines are accessible in this example and need enforced isolation.

The supply is assumed as grounded/earthed single phase or multiphase supply grid. That means it is a TN or TT system not an IT supply system.

## Application examples OVII / OV III track assignment

| OV II / OV III | Track | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 5 A (only OV II) | Single phase 230 VAC*1 | L/N | N/L | PE / Not connected | PE / Not connected | Bus+*2 |
| | | L/N | N/L | PE / Not connected | PE / Not connected | Bus+ |
| 10 A | Single phase 230 VAC*1 | L/N | L/N | PE / Not connected | PE / Not connected | Bus+*2 |
| | 3-Phase 400 VAC*1 | L1 | L2 | L3 | N | PE / Not connected |
| 15 A | Single phase 230 VAC*2 | L/N | N/L | PE | Ground | Bus+ |
| | 3-Phase 400 VAC*2 | L1 | L2 | L3 | PE | Bus+*2 |
| **OV II / OV III** | **Track** | **6** | **7** | **8** | **9** | **-** |
| 5 A | Single phase 230 VAC*1 | Bus-*2 | - | - | - | - |
| | | Bus- | Ground | - | - | - |
| 10 A | Single phase 230 VAC*1 | Bus-*2 | - | - | - | - |
| | 3-Phase 400 VAC*1 | PE | Bus+ | Bus- | Ground | - |
| 15 A | Single phase 230 VAC*1 | Bus- | - | - | - | - |
| | 3-Phase 400 VAC*1 | Bus-*2 | - | - | - | - |

*1 Supply and differential bus

*2 Use PE as Ground reference

## Current carrying capabilities, fuse rating recommended

The wire cross section is dimensioned according to standard requirements or larger.

| Current rating of slipring | Cross section required by standards EN 60601-1 and EN 60204-1 | Recommended fuse rating acc. (60204-1) *IEC 60127-1* | Maverick wire Size, copper |
|---|---|---|---|
| 5 A | 0.75 $mm^2$ | 5 A | AWG17 |
| 10 A | 1 $mm^2$ | 10 A | AWG17 |
| 15 A | 1.5 $mm^2$ | 15 A | AWG14 |

Do not use a fuse in the PE circuit. Fuses protect the slipring when dimensioned as listed or with lower or faster rating. The sliprings were tested at 2x the rated current for all tracks simultaneously, if most tracks are loaded below nominal current some tracks might be loaded at higher currents, this must be tested in the application according standard.

## Risk assessment

A risk assessment considering electrical and mechanical risks in all product life stages as defined in the European machinery directive was made and implemented in this incorporation declaration. A risk assessment according to the medical standard EN 60601-1 was not possible since this product is not medical equipment itself but defined and tested to be integrated as component in an ME system. All information necessary for such a risk assessment was compiled in in this assembly instruction.

## EMC recommendations - Power Supply

Filters in power lines and signal lines that are necessary to fulfill the EMC limits of components need to be installed close to the noise source. For components supplied through the slipring the filter must be installed between slipring and supplied component so that noise is not routed through the slipring. This is especially true when the filters incorporate Y-capacitors.

Also, line input filters required to inhibit EMI like e.g., line surges to disturb your system need to be looped between line input and slipring.

Supply lines must be routed parallel - as near to each other as possible - forming a loop as small as possible, this is valid for extra low voltage supplies as well as for single phase or three phase power supply.

PE must be routed parallel to the supply lines, this is valid for PELV as well as single phase and three phase power supply.

## Shielded cables

If shielded cables are used for signals on rotor or stator the shield must be routed through the slipring on a track close to the tracks connected to the wires of the shielded cable to be effective.

## Bus lines and analog signals

Data Busses should be selected employing differential signal transmission e.g., CAN Bus or RS422 Bus with the Signal Ground also routed in parallel to the signal line. The Ground line can be arranged closer to noisy lines like line supply phases to serve as a shield. Also, distance to noisy signals helps to avoid noise on the bus signals. The same rules apply to analog signals.

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