Intentional Grounding Solutions

CFG – Carbon Fiber Grounding for industrial applications

schunk-carbontechnology.com

Full range supplier

Our grounding systems are at the technological forefront in their field of use worldwide. Schunk materials can be deployed in a wide range of applications, from offshore wind energy systems to high-speed trains and array of electric motors. With a range of materials that have earned the trust of OEMs and aftermarket. With various grades of carbon brushes, the high versatility of our Carbon fiber material and 100 years of current transmission know how, Schunk Carbon Technology is your full range supplier for shaft grounding solutions.

Schunk intentional grounding benefits:

- Materials designed to ground your unique electrical signal
- Excellent protection of drivetrain & system components
- Minimized system downtime and repair expenditure
- Reliable common ground point
- OEM Trusted and validated
- Extremely long service life
- Extensive design and development expertise
- Ease of use and maintenance

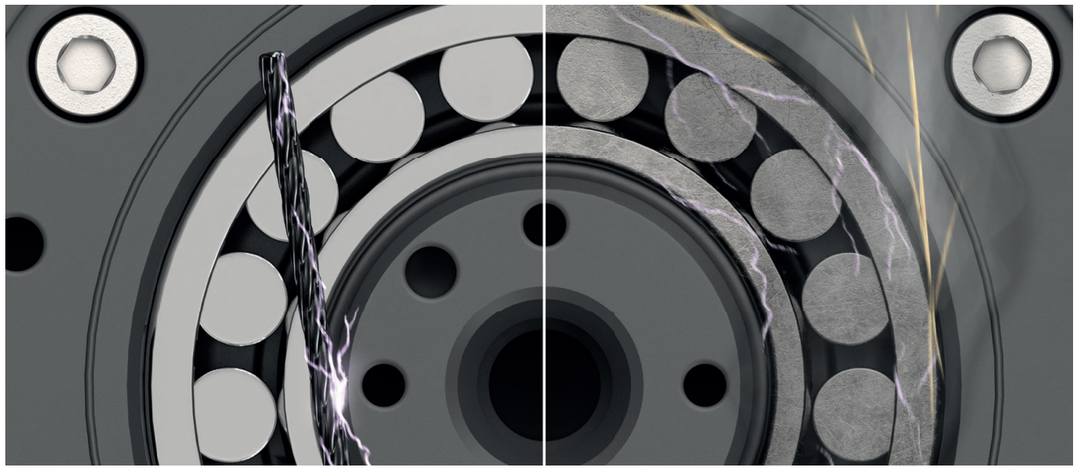
Along with normal ground signals, stray shaft voltage and noise are undesirable yet unavoidable for most rotating machines. Effective materials for grounding these currents include metal graphites, carbon fibers filaments and metallic fiber contacts. Each of these materials has an ideal range of operation. These materials can be used in combination or as stand alone solutions based on the electrical signal/s needing grounded.

The need for Schunk CFG

Electromagnetic static, system harmonics and modern day power electronic that are used in combination with motors and generators can cause unwanted high frequency currents. These currents often circulate through the entire system looking for a proper path to ground.

Problems created from these currents can lead to:

- Bearing issues
- Ground loop feedback
- System communication noise
- Damage to larger system electrical circuitry



Bearing failure due to microwelding from built up high frequencies are the most common issue with ungrounding currents

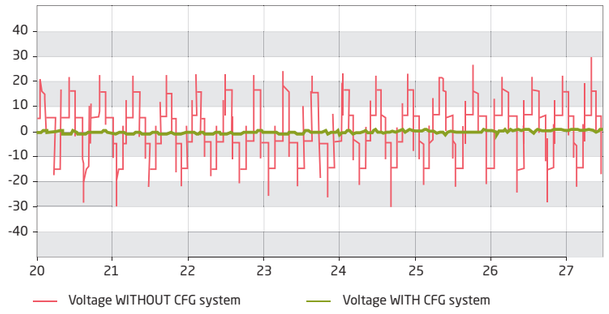
Our solution

Schunk's innovative Carbon Fiber Grounding (CFG) material has been designed to effectively ground high frequency noise and parasitic currents.

Unlike other options in the industry, our material is easily installed, can overcome shaft contaminants and performs on bidirectional shaft rotations. Additionally, the material grounds all high frequency system noise, not just the signals from the power electronics making them more effective in mitigating root causes than filters and other conducting solutions.

Specific Proof
Schunk has tested the materials effectiveness along side our industry partners and can provide specific operational performance data with a few of the highilghts below.

System noise with and without Schunk CFG system in place. In operation testing graph largest USA transit authority.

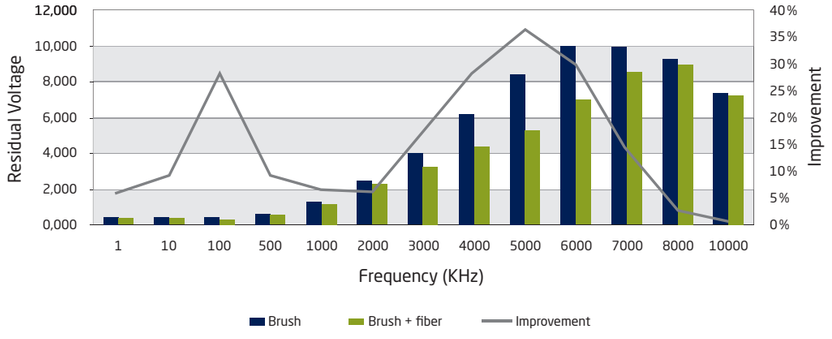


CFG systems from Schunk reliably reduce shaft voltage

Field measurements show:
CFG systems from Schunk reliably dissipate vagrant. Shaft voltage, generally at levels of >+/-20 V, can be reduced to a non-critical level of 4 V by using a CFG system on the affected shaft.

Improved reliable of common ground point for brushed systems.

Common ground point improvement when CFG added to system with existing carbon brush ground solution



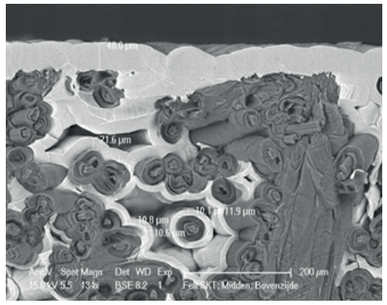
Showing higher range of grounding with CFG when in combo with a brush

The Carbon Fiber Grounding material

Material (picture of graphite on the right)
Schunk's CFG material is designed to engage thousands of individual contact points along a rotating shaft. The is achieved by small graphene layers infiltrated with a patented coating process creates this technical innovation that has ideal electrical properties to overcome the (skin effect) and provide an excellent path to ground for high frequency. The tangential contact and gas infiltrated coating help to overcome any contact surface containments and promote operational lifetime.

Providing the following benefits:

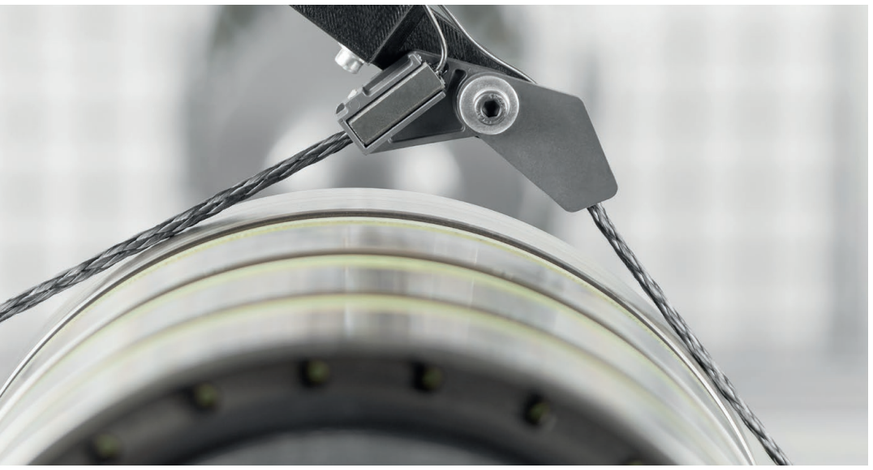
- Protection of bearing from stray currents
- Reduced noise on communication sensors and drives
- Improved common ground point
- Reduction to noise and damage of in line electronic control boards
- Lower maintenance cost
- Overall improve system availability and uptime



Schunk CFG under a microscope shows our patented conductive coating penetrating the carbon materials.

Designs

Schunk CFG is highly adaptive. Our standard designs can be retrofit into most applications and the material can be formed to fit the more unique systems.



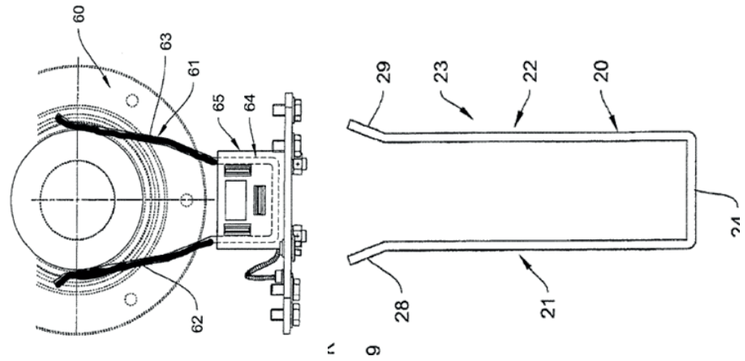
Schunk universal design for industrial motors. Can fit a large range of shaft diameters.

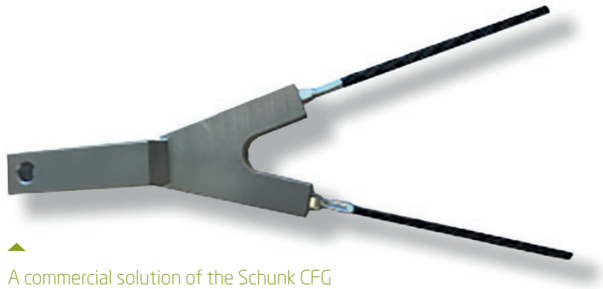
Replaceable CFG contacts make a maintenance a breeze.

Schunk offers custom soltuions for OEMs and high volume partners

The Schunk CFG has been patented in a number of contact positions as the potential layouts are truly infinite.

Drawing from one of many US Patents for the CFG material
Refernce US Patent
10,141,702
10,485,083
15,521,826





A commercial solution of the Schunk CFG for a common wind turbine platform.

Common interchangeable rods can be used to fit several different application designs, but not limited to straight contacts as the material can be shaped to fit any system with ease.

There is typically no application we can't design for:

- OEM – ring design
- Aftermarket – stick design
- Universal retrofit – your design and Vblock

The CFG is part of our Intentional Grounding portfolio, designed to recommend ideal grounding solutions for your specific system needs.

Grounding product selection guide

Use the matrix below to identify your needed grounding material type

		Carbon Brush Grounding	Carbon Fiber Grounding	Metal Fiber Grounding
Application Range	Frequency range	DC application and low frequency AC application	High- to ultra high-frequency AC application kHz, MHz range	-
	Grounding current	> 0 A	< 10 A	< 5 A [max. 10 A for < 30 s]
	Peripheral speed	< 90 m/s	< 120 m/s	< 90 m/s
	Peripheral speed	kHz, MHz range	-	< 90 m/s
	Interface requirement for installation	¬ Recommended surface roughness Ra 0.8 - 1.2 µm, Rz 5-8 µm ¬ Slight oil influence possible	¬ Shaft made of steel ¬ Metallically bright ¬ Low resistance to vehicle ground ¬ Max. surface roughness Ra 0.8, Rz 4	¬ Shaft made of steel ¬ Stainless ¬ Shaft diameter 100-1500 mm ¬ Max. surface roughness Ra 1.6, Rz 7
	Current industries served	¬ Wind ¬ Transit ¬ Ship ¬ Industrial motors ¬ Electrical motors in Automotive	¬ Wind ¬ Transit ¬ Industrial motors	¬ Turbo and Hydro generators
Material Properties	Material specification	Various graphite grades available	With pyrolytic carbon coating	Soft metal with stainless metal wires
	DC-resistance	0.1 -30 µOhm	<0.1 mOhm	µOhm to mOhm
	Bi-directional rotation	Yes, not S13/F19	Yes	Yes
	Key advantages	¬ S13/F19 sandwich design - most popular earthing brush ¬ Big grade portfolio available - adaptable to all conditions ¬ Brush holders with micro switch wear indicator ¬ *Automotive application: work at shaft voltage frequency up to 50 MHz with low wear rates	¬ Transfer of high frequency current (MHz range) ¬ Low wear and high du rability ¬ Dust free operation without contamination of surrounding area ¬ High conductivity even under tough conditions ¬ Designs with microswitch available	¬ Micro switch status indicator ¬ Various arm lengths available

CFG is just one solution in our Intentional Grounding Portfolio, while it is a good option for grounding high frequency current, it might not always be the best grounding solution.

Carbon Brush Grounding

Why / when to use:

1. Grounding using traditional carbon brushes should be utilized to suppress electrical currents with < 100 kHz and higher than 10 Amps.
2. Schunk has a number of brush grades and holder designs to fit any applications along with a universal solution series to help protect most motor shaft systems.

Why / when not to use:

With brushes providing only a single surface contact, high frequency currents can become subjected to the "skin effect" phenomenon which allow only the outermost 1 - 5 % of the conductor surface area to be used. Additionally, carbon brushes are designed to carry high current loads. Unloading carbon brushes for an extended period of time can lead to performance issues.

Carbon Fiber Grounding "CFG"

Why / when to use:

In using AC drives and convertor systems to alter power controls in modern drivetrains, come the problem of high frequency parasitic currents. These currents can be a pest on traditional grounding systems, with bearings and expensive power electronic PC boards usually being the victims of their constant search of a path to ground. Schunk CFG material is used in a variety of configurations to help suppress these high frequency electrical signals. Cuts through system contaminants and operates on reversing motors with no concerns of losing continuity.

CFG Options:

1. Universal-drop in solutions for in-service use motors that affix and ground directly to motor/system housings.
2. OEM integration - Ideal for high volume system integration and available to be molded or configured to fit any requirement (1000+ pcs).
3. Application retrofits - Schunk can support a housing design to fit your unique system retrofit using our threaded CFG stick system... (typically 100+ pcs).

Why / when not to use:

Application with nominal current of 10 amps +. Material CFG can stacked in parallel to handle peak voltage spikes of over 10 amps. Recommendation is one 4 mm rod per witnessed 10 amp spike. i.e. if peak voltage discharge can reach 30 amps, use three 4 mm diameter CFG rods for proper grounding.

Metal Fiber Grounding

Why / when to use:

Precious Metal Fiber Bristle brushes offer a unique ground solution to suppress static buildup for turbo machinery and other applications. With the ability to conduct a wide range of currents & a number of existing installations in the turbo machinery world, Schunk replacement bristle brush heads and systems are an easy drop in to keep equipment safe.

Why / when not to use:

High amperage +10 amp applications, smaller applications, difficult to monitor and access applications.

Need a combination?
We can create parallel paths to ground with combinations of our systems to help solve your unique grounding needs.