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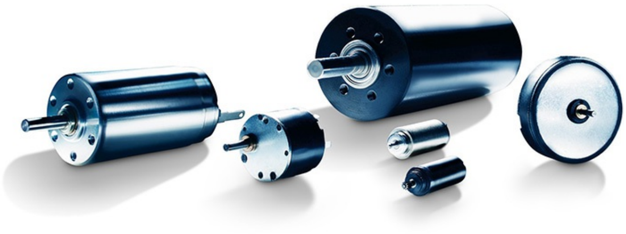
Matching CANopen drives for DC micro-motors

Small and powerful DC-motors are critical to the development of highly-integrated systems. Making the right choice is fundamental for reliable operation.

The complete article is published in the December issue of the CAN Newsletter magazine 2021. This is just an excerpt.



Micro-motors have especially stringent requirements on motion controllers (Source: Faulhaber)

The DC micro-motors are a driving technology in many different sectors, from medical and laboratory technology to aerospace, robotics, optics, and photonics as well as industrial machinery and equipment in general. But the small motors only mature to an application-relevant drive or positioning system when combined with other components, such as gearheads, encoders, and motion controllers. Making the right choice is fundamental for reliable operation. All components must be compatible with the motor and meet its requirements. In the worst case, selecting the wrong controller can destroy a motor in no time.

Fundamental questions

When selecting a suitable motion controller for a drive system, it is important to answer a few questions first. For example, the movements that are to be carried out must be established, and it must be defined what this means in terms of motor control requirements. Is the drive working continuously or in start-stop mode? Is precise positioning required? What type of load will the drive be moving? What are the load cycles? Is a gearhead required? Which motor is best suited for the application? The motion controller is then selected based on the answers. And it may get interesting, because not every motion controller suits every motor. DC-micro- motors in particular have unique requirements due to their design.

At the heart of the DC miniature and micro-motors is the patented, self-supporting, coreless rotor coil with skew-wound design, which rotates around a fixed magnet (Source: Faulhaber)

Risk of overheating

At the heart of the DC miniature and micro-motors from Faulhaber is the patented, self-supporting, core-less rotor coil with skew-wound design and brush commutation, which rotates around a fixed magnet. This motor is also often referred to as a bell- type armature motor due to its look. Its design not only has many practical benefits, it also influences the selection of the motion controller.

No cogging torque forms due to the symmetrical air gap, which enables precise positioning and excellent speed control. The ratio of load to speed, current to torque, and voltage to speed is linear. And as almost the entire motor diameter can be used for the winding, the motors achieve higher power and torques for their size and weight compared with conventional designs. The rotor's low inertia also guarantees an extremely low electrical time constant. The motors can thus be operated very dynamically and heavily overloaded. Triple continuous torque in overload mode is quite common and easily possible for servo applications, as long as the temperature of the motor winding is monitored. But motors with a diameter of only 22 mm or less do not have an integrated temperature sensor. There simply is not enough space. So, if just any controller is connected to a micro-motor, in the worst case the coil may be completely burnt up before any heat is even noticed on the outside.

Possible solution

Such problems can be avoided with motion controllers from Faulhaber, which were developed for the requirements of mini- and micro-drives and tested under real operating conditions. They estimate the winding temperature for the respective motor type using models of varying complexity. This means that the full dynamic range of the motor can be exploited, for example for fast positioning processes. The current is also limited before the winding overheats. The parameters required are transmitted to the drive controller with the “Motor selection dialogue” of the company's Motion Manager software.

Additional information about thermal integration in the application can be used in the models that are stored in the controllers for further improvement. How well is the motor cooled? Is it necessary to limit power due to high ambient temperatures? Is a gearhead and encoder used? With such additional information, maximum motor power can also be used with, e.g. a drive that works cyclically in a climatic chamber, in that the motor controller keeps track of the ambient temperature parameters from the climatic chamber control within the models stored. The same applies if the load cycles are known. The motor can then often be smaller in design, which is an advantage especially when used in mobile devices.

If you would like to read the full article, you can download it free of charge or you download the entire magazine.

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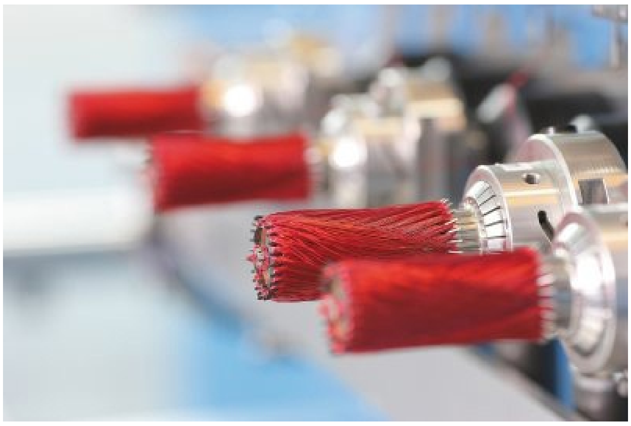

Motors with a diameter of 22 mm or less do not have an integrated temperature sensor. Without a matching motion controller, the coil may be burnt up before any heat is noticed on the outside. (Source: Faulhaber)