

## Press news

**Durable, sturdy, reliable:**

### **EC motors, the ideal vehicle actuators**

In modern vehicles more and more processes are being controlled by electronics. This sector accounts for approx. 30 % of the development expenditure. As in automation, the trend in the automobile industry is towards on-site intelligence that is underlined today by decentralized control devices for brake assistants, motor management, air conditioning, chassis stabilization etc. However, this concept can only be implemented when the actuator is located directly on site. V-belt transmission and hydraulic control are antiquated means, modern electronically commutated (EC) DC motors offer completely new possibilities as actuators in vehicles.

The car is an extremely demanding workplace for mechanical and electronic equipment. All components must function smoothly under constantly changing conditions e.g. heat, vibration, water etc.

### **Demanding assignment in vehicles**

Both the interior and periphery of vehicles place varying demands on the EC motors. In the passenger compartment, what counts is „inaudible, invisible“, in other words: A motor should neither be seen nor heard. The demands on a quiet-running motor are particularly high and the extremely strict specifications of the automobile industry as regards resistance to vibration and shock (minimum 4 g load) do not exactly facilitate the design of a „quiet rotor“.

As far as the exterior is concerned, e.g. under the hood matters are even more difficult. The drives have to permanently withstand shock and vibration loads of over 10g and other environmental influences such as a wide temperature range (-40 to +120 °C) or temperature shock (120 °C warm, and cooling down in 4 s with cold water of 4 °C).

The chemical and mechanical resistance is also of major importance. Salt spray test, impermeability to the influence of vapour jets or fuels are basic requisites for use in a car. Just how complex this topic is, can be seen from the brief list of fluids that car components are tested for: Motor oil, diesel, RME and gas play just as important a role in these tests as cooler fluids, windshield cleaners or battery acids. If an electric motor has successfully passed these tests, the final hurdle is still to come – the EMC test. The highly complex interaction of many components in the automobile is only successful when based on „mutual consideration“. Low noise radiation and tolerance towards interference from external sources are just as important as mechanical and chemical resistance and in this respect the brushless EC motors are at advantage; brush sparking and noise radiation are unknown to them. Incoming disturbing pulses can be easily extracted by filtering thanks to the integrated electronics.

### EC motors, external rotors

With external rotor motors, the rotating rotor is on the outside above the field winding. The advantage of this location is a high torque and simultaneously excellent constant velocity (Fig. 1). The freely accessible rotor is ideally suitable e.g. as a fluid drive for carrying different blades. With this in mind, the motor and fan specialist ebm-papst produces a wide range of fans specially for the automobile sector. However, it is important to make a distinction between versions for the consumer or PC sector and products for the automobile industry. The wide operating temperature alone means that the storage and service life lubrication as well as the control electronics have to be specially adapted. In addition to the strict EMC requirements in the vehicle, anti-blocking protection of the electronics is required to prevent blowing. The control of motors via integrated interfaces has already become standard. For the passenger compartment an extremely low, virtually inaudible running noise is equally state of the art as excellent speed control.

If one compares these motor requirements with those for PCs or consumer devices, one soon comes to the conclusion that both types of drive are not comparable. A PC stays put. A navigation device with radio and CD changer in the vehicle also requires cooling air and constant drive as does the PC but a simple PC fan or drive motor would soon fail. Although external rotor motors are

also ideally suitable for other drive requirements with comparably high torque and low demands on dynamic, the internal rotor motor is the right choice for dynamic requirements.

### Dynamic EC internal rotors

Function drives require dynamic motors so that control commands can be realized quickly and in this respect internal rotor motors fare considerably better than external rotor motors. The lower moment of inertia of the smaller internal rotor enables speed and direction to be changed quickly. Thanks to the use of choice materials and miniaturized electronics, an extremely high power density is possible (Fig. 2). These motors offer a wide range of applications for booster and auxiliary generating sets. The most well known example is the ECI motor (Fig. 3) for the steering aid in the car. The characteristics of this motor demonstrate the requirements that need fulfilling in the automobile:

Speeds between 0 and 6.000 r.p.m. are achieved during the entire service life. The discreet steering aid requires not only the same delicate activation as is virtually required by a stepping motor but also the quick change of direction and dynamic run-up. The motor is continuously loaded in the vehicle in 4-quadrant operation. The ebm-papst solution therefore, is based on the principle of the three-phase, excited permanent magnet, synchronous internal rotor motor with sinusoidal current. A specific air gap extension in the rotor surface modulates the sine-wave form of the voltage. This means that a very low idle click point of the motor is achieved and a high uniform torque when under current.

Modern EC DC motors open up new possibilities for vehicle designers. Preset positions for drive units as is the case with V-belts or toothed belts are no longer necessary. Reliability increases drastically. High power density in minimum space enables unlimited aerodynamic shapes – the actuators fit the chassis and not vice-versa. The maintenance-free motors enhance the comfort and lower the maintenance costs for the vehicle owner. Inspection intervals can be prolonged and normal driving becomes safer and more reliable.

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Fig. Intro: Product family EC motors, the internal and external rotor characteristics complement one another

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Fig. 1: Compact external rotor motor.

A fixed stator and integrated electronics ensure high motoring refinement

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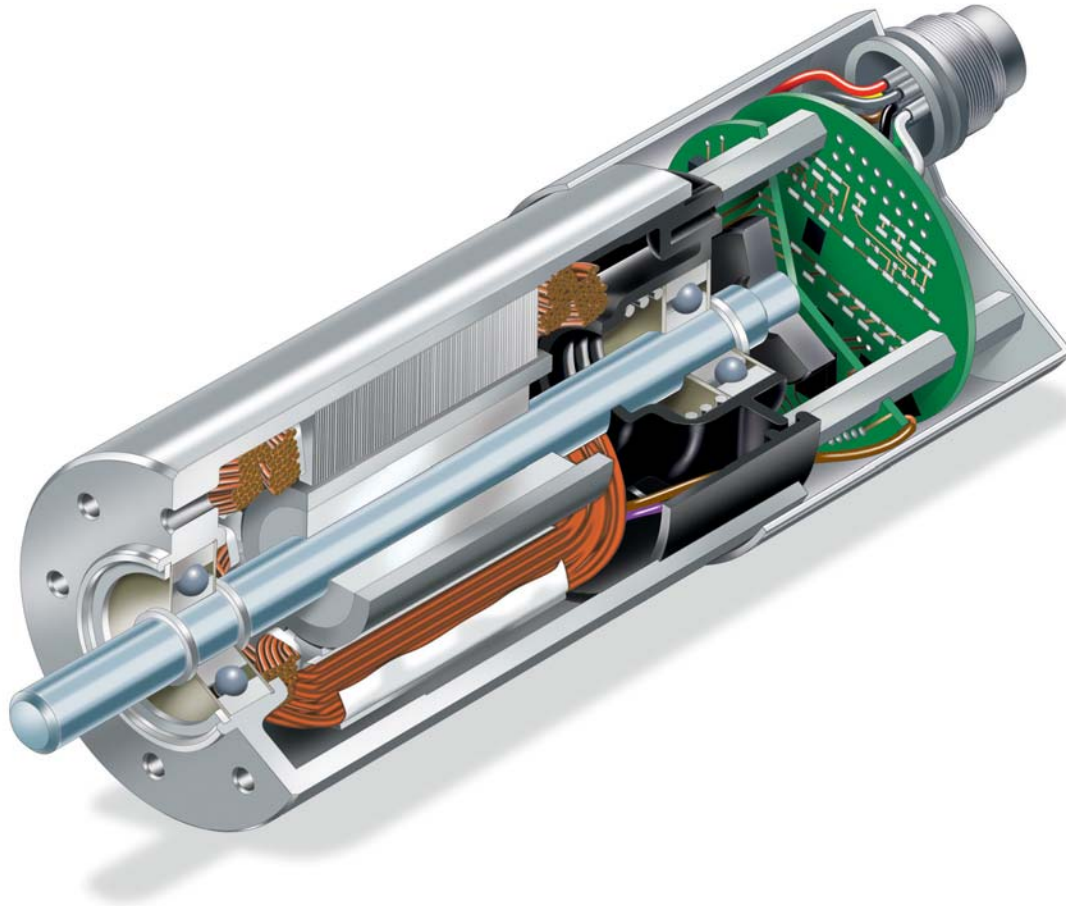


Fig. 2: Internal rotor motor, a dynamic power pack with integrated electronics

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Fig. 3: The ECI steering aid defies all environmental influences under the bonnet

Text and photos/graphics can be found on the CD supplied.

Print-offs are available from ebm-papst St. Georgen on request.

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