

After a quick installation, going on one's way-without a caretaker

Versatile wheelchair drive powered by EC-motors

Hubert Goetjes
Head of Advertising Department
Contact for editorial stuff
Phone +49 7724 81-1208
Fax +49 7724 81-1459
H.Goetjes@de.ebmpapst.com

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St. Georgen

Those who use a wheelchair due to illness or handicap often require assistance from others to get around. This is especially true of children, older people and those who have coordination difficulties or too little strength in their arms and hands. Today's state-of-the-art technology helps to overcome this, enabling individuals to get around without assistance. The ideal drive solution for these wheelchairs is to use maintenance-free, energy-saving, electronically commutated direct current motors. Together with drive electronics and an operating device adapted to the degree of disability, this allows any wheelchair to be powered without cables. Thanks to the powerful drive motors, a retrofitted drive unit with battery pack permits ranges of up to 15 and slopes up to 20%. It is no longer necessary to have a caretaker go along. The intelligent technology not only gives people in wheelchairs mobility, it makes them independent.

Despite great advances, as a way for people to get around, the wheelchair still is lacking in many aspects of mobility. Naturally, a person cannot do as much work with their arms as they could with their legs. When we consider that without training, a person is only capable of putting out 60 to 100 W of power on an enduring basis, any additional performance impairments quickly become burdensome when using a wheelchair. For this reason, AAT Alber, the drive specialist for transport and rehabilitation technology, has developed a new electric drive that can be retrofitted onto almost any manual wheelchair. To optimize the drive in the most professional manner possible, the company is cooperating with fan and drive specialist ebm-papst of St. Georgen, Germany. The result is the compact, powerful and energy-saving "max-e" drive, which is based on electronically commutated DC motors (EC motors). The drive conforms to EC Directive 93/42/EEC for medical products and is recognized by health insurance companies as a medical aid.

Strength in functional design

The drive itself has to meet all the requirements specific to wheelchairs. For example, vehicles with wheels on both sides normally require a differential to compensate for the difference in curve radius between the two wheels. The developers cleverly bypassed this fact by providing a separate drive motor for both the left and right wheel. Thus the electronic control system regulates the necessary wheel slip without costly mechanical components.

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Instead of large curve radii like those of separate pushing or pulling aids attached in front of or behind the chair, the compact drive allows turning and maneuvering in the tightest spaces. Like the movement of the chains in a chain-driven vehicle, one wheel rotates forwards, the other backwards. This allows 360-degree turns, just as in manual operation.

So that the drive can be installed universally, installation kits are available for all common wheelchairs with a seat width of 28 cm or more. This allows the drive to be installed and removed easily. The battery pack can also be exchanged if necessary, and the operating device removed (Figure 1). The operating device, which is wirelessly connected to the electronic control system, features a variety of ergonomically shaped operating levers such as softballs, golf balls, forks for tetraplegics etc., ensuring optimum control of the wheelchair at all times. With its compact dimensions and light weight, the drive unit fits on almost any manual wheelchair. Since it is installed without changing the chair's geometry, the familiar movement characteristics remain intact.

Because each motor can provide effective power of up to 90 W, slopes up to 20 % and a total weight of drive module, wheelchair and occupant of up to 200 kg are no problem. Though the drive packs 180 W of power, in normal operation, the battery capacity lasts for a total distance of about 15 km. At 6 km/h, the forward speed equals a brisk walking pace; the reverse speed is 3 km/h, and both are continuously adjustable. All parameters can be programmed via an interface. The drive itself consists of the actual motor with electromagnetic brake, a reduction, and a pneumatic engagement and disengagement system. The extendable drive shafts transmit the power from the motor to the wheel. Each drive shaft end has a drive pinion that meshes with a geared ring fastened to the wheelchair wheel (Figure 2). This guarantees a safe, non-slip, positive locking drive.

Maintenance-free power source

The drives used are maintenance-free internal rotor motors. Thanks to the electronic commutation, there are no mechanical wear parts other than the ball bearings of the anchor. This allows multiple tens of thousands of operating hours to be attained with no problem. Thanks to the continuous rotary axis with outlets on both sides, the reduction and mechanical brake can be flange-mounted separately, yet in a compact manner (Figure 3). Despite the drives' sturdy design and high dynamics, they are quite small, with a diameter of 56 mm and a length of 103 mm. The precision ball bearings ensure minimal operating noise, and the

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aluminum housing provides fast heat dissipation, even at full load. At a nominal speed of 3000 rpm, the drive provides a torque of 290 mNm-more than enough to reliably conquer slopes. Three integrated Hall sensors detect the rotor position and signal it to the electronic control system, which, in turn, specifically controls the current impulses for the stator winding. Thus the drive always works in the optimum range and reaches high efficiency.

Thanks to the electronic control system, the drive can also be operated in what is known as generator mode. In this mode, the drive works like a bicycle dynamo, braking the wheel and thus generating power that be fed back to the battery. This improves the range and, more importantly, relieves the mechanical brakes during long brake operation when going downhill. Because the EC motors brake without any wear, this clever trick reduces the maintenance effort. For the same reason, modern commercial vehicles also use this type of wear-free electrical sustained-action brake. Now, thanks to the EC drive and intelligent control, they are also used for the wheelchair drive and, as a welcome side effect, improve the energy balance of the drive system.

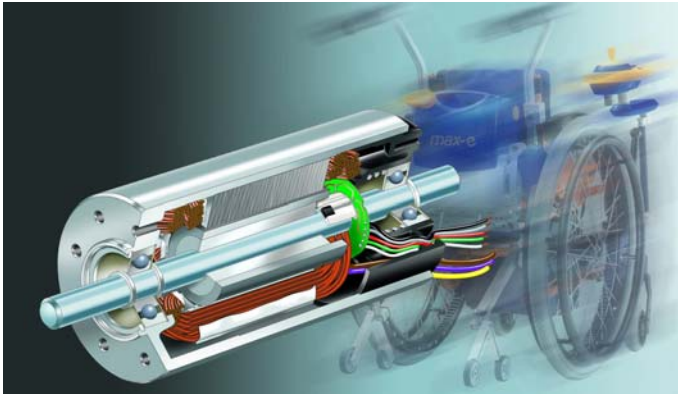
Modern EC small drives offer previously undreamed-of possibilities. Today, the only limit is the developers' imagination, not the technology. This allows great forward leaps and innovations to be made in development, particularly for technical aids for the medical field. Close cooperation of the user and drive specialist from the early development stage on results in high-performance solutions that would have been unimaginable just a few years ago. In the case of the wheelchair drive and other related aids, this means more individual freedom for those with handicaps.

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Introduction: EC motor in cross section

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Image 1: Compact drive, as easy to switch out as the rechargeable battery pack and operating device

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EPS_07-008_image2a.jpg



EPS_07-008_image2b.jpg



Image 2a + 2b: Positive locking drive per gear improves safety and service life

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EPS_07-009_image3.jpg



Image 3: Compact ECI motor, high output, high efficiency, small design