

Advanced planetary gear head for the most demanding requirements

ebm-papst is further extending the product range of electrical drive systems for industrial applications in a sustainable manner. Gear heads are playing a vital role in this, as they are a necessary part of most customer applications.

For many years, ebm-papst Zeitlauf has been recognized for its expertise in the field of gear technology, particularly in the planetary gear segment (Performax and Noiseless series). These are noted for their exceptional performance and very smooth and quiet operation.

In the industrial drive technology sector, market requirements in terms of engineering are currently developing in two directions. Firstly, the functionality of drive units needs to be extended in order to speed up the design and realization of the customer applications. Secondly, the power output within a given installation space needs to be increased further, particularly in the dynamic range.

In order to be able to achieve this latter requirement, the necessary peak power in each individual module of a drive unit (gear head, motor, and electronics) must be significantly increased.

This means, for electronically commutated internal rotor (ECI) motors, that higher starting torques are required together with simultaneously reduction of rotor inertia moments, in order that the dynamic response is significantly improved.

This is a great challenge, particularly for the gear head. To meet the needs for higher output and mechanical robustness, specialist transmission suppliers place great emphasis on optimized design of the gear toothing and the output shaft bearing, combined with selection of the materials used.

Both in terms of robustness and overload capacity, ebm-papst meets these requirements with the new Optimax series



(Fig. 1). The first size of the series available will be the Optimax 63 gear head with an outer dimension of 63 mm.

This is where the many years of experience in gear tooth design for planetary gear heads really makes a difference. It is not just down to the teeth size (the "modulus") or selection of the teeth ratios, the rolling behavior design of the gearwheels in the gear head is also critical. Due to the possible degrees of freedom in design of a gearing, the development engineer has, at the outset, a virtually unlimited number of potential approaches to a solution at his disposal. The skill lies in the ability to find the perfect "setting" within all these potential options. The focus in the case of the Optimax, was placed on the requirements to withstand high continuous torques and a tolerance to transitory shock loads. In addition, it was also necessary to take a comprehensive view of the Optimax series and to structure it intelligently, both in terms of multiple use of components and a strategically favorable series of gear reductions.



In order to be able to transmit as much power as possible, gear wheels with a very large width are fitted in the Optimax gear heads, which as a result, minimizes the surface pressure and wear on the tooth flanks, despite high torques, and in turn leads to a long service life. Another special feature of the Optimax gear head is the installation of four planetary gears, in a single gear stage, instead of the usual three. This allows some 30% more torque to be transmitted, due to the power distribution over four planetary gears!

The performance capability of a gear head, (i.e., the amount of torque that can be transmitted) will, of course, always be measured relative to its size and space requirement. This has also been taken into account in designing the Optimax gear head: With a near square cross-section, the flange size of 63 mm is best utilized with a large ring gear. The corner regions within the installation space are used for screwing the gear parts together.

The gear head output shaft is mounted in two ball bearings; with particularly large bearing races for radial loads of up to 500 N (for a service life of 20,000 h).

Both flanges engage positively with the ring gear teeth, which ensures both the alignment of components relative to each other, and torque bracing among the casing components (intermediate flange, ring gear and casing flange). The function of the axial screws used, is therefore limited to bracing of the casing parts against each other.

Almost all the parts in the Optimax gear head series are designed for a near net shape manufacturing process. By intelligent use of *sintering*, *zinc die-casting* and *plastic injection molding technology*, it has been possible to manufacture all the components at optimized costs and with the required properties: From noise-absorbing planetary gears made in plastic for the first gear stage, or alternatively high-strength planetary gears in sintered steel for use in the overload range; to a robust, wear-resistant ring gear made of hardened sintered steel

and complex flange and casing geometries made as zinc die-castings with high dimensional stability.

By using near net shape parts and production technology that has been perfected over many years, the gear heads can be offered at fully competitive prices, both for smaller batch sizes and for large series production.

The materials and lubricants used allow operation over a wide temperature range (-20 to + 90°C).

The standard version is offered with protection class IP 50, but higher protection classes up to IP 65 can be implemented by design and can be easily achieved by additional measures.

Despite the high proportion of near net shape parts, a great deal of flexibility is still retained: deviations from the standard design are possible through the use of machined planetary and sun gears. Furthermore, output shafts can be adapted to the customer interface.

The Optimax standard reductions, in the single-stage range, go from 3:1 to 5: 1 (preferred type) and up to 9: 1. The two-stage design is available with reductions of 15:1, 25:1 (preferred type) and 45:1. (Figure 3 Table)

Nenndaten / Getriebedaten							
Typ		63.1			63.2		
Untersetzung / Stufenzahl	i / Anzahl Stufen	3:1 / 1	5:1 / 1	9:1 / 1	15:1 / 2	25:1 / 2	45:1 / 2
Wirkungsgrad	%	≥ 90	≥ 90	≥ 90	≥ 81	≥ 81	≥ 81
Abtriebsdrehmoment (Mab)*	Nm	40 (13)	40 (13)	25 (6)	68 (58)	68 (58)	58 (27)
Kurzzeitdrehmoment (Mmax)*	Nm	120 (39)	120 (39)	75 (18)	150 (150)	150 (150)	150 (81)

* Wert ohne Klammern gilt für Planetenräder (erste Stufe) aus hochfestem Stahl.

Wert in Klammern gilt für Planetenräder (erste Stufe) aus hochfestem Kunststoff.

The robustness and overload capability of the Optimax gear head, allows high acceleration and braking torques to be realized, which enables a significant reduction in cycle times for customer applications.

The Optimax 63 series gear heads can be equipped with powerful, overload capable ECI 63 and ECI 80 series motors.



(Fig. 4) These drive solutions are characterized by high overload capacity and high output performance.

In terms of functionality, compactness, overload capacity and efficiency, a drive unit based on the ECI 63 K4 motor and the Optimax 63 gear head should be more than capable of meeting any customer requirements.

Those interested to learn more can view the documentation for the new drive solutions (technical data, drawings, and 3D models) in the ebm-papst Zeitlauf online portal, and print or download them as required.

Of course, the Optimax 63 preferred types are now included in the online portal and are ready for dispatch within 48 hours from receipt of order. (Fig. 5)

