



Interview with Andreas Golf on the new series of highly dynamic servomotors

Servomotor AM8000: Innovation to the power of 3

Dynamic, durable and efficient – these are just a few appropriate words to describe the new servomotor series from Beckhoff. In an interview with Stefan Ziegler, editor-in-chief of Elektro Automation, Product Manager Andreas Golf explains some of the design details, e.g. the bearing selection and one cable technology, and describes the market response since the series introduction at the end of 2011.



Andreas Golf,
Product Manager Drive Technology, Beckhoff

Elektro Automation: How do you rate the response so far since the premiere of the new AM8000 motor series at SPS IPC Drives 2011?

Andreas Golf: The AM8000 series has already become very popular. The feedback we received on the first machines equipped with the new devices has been very positive. One reason is the significantly longer service life of the motor bearings. After all, the ball bearings are the only wear parts in the motor and any failure leads to high repair costs with a direct impact on the lifecycle costs. Another highlight is, of course, our one cable technology, which represents a true innovation and sets new standards.

Elektro Automation: What special advantages does one cable technology have for the user?

Andreas Golf: The development goal was to make use of existing cable cores in order to avoid the need for a feedback line and to extend the remaining line with additional cores. We use a quasi-standard motor cable, which we modified for this purpose. This means the supply voltage as well as the modulated information are transmitted via the two cores of the thermal protection contact. Since we use a data transfer rate of around 10 Mbaud with the one cable technology, we can't use a commercial motor cable and had to design an optimized core and shield structure. However, these modifications have no effect on the cable price, so that we can pass on the entire savings resulting from the removal of the feedback line to our customers. Although the encoder used in our motors with one cable technology is a little more expensive than a resolver, the overall system cost is the same from a cable length of around 5 m; in addition, the user benefits from an electronic name plate and higher resolution. This in turn has a positive effect on the dynamics of the drive axis. Overall, the following applies: The longer the cables, the higher the savings potential with the AM8000 series.

Elektro Automation: And what is the difference compared with the familiar hybrid cables?

Andreas Golf: Hybrid cables contain power lines as well as feedback lines. They are rather expensive and quite inflexible, and also have a significantly larger diameter. In addition, the connectors are much more complex and larger; in addition, hybrid cables are more difficult to assemble, resulting in further additional cost.

Elektro Automation: Thanks to a digital interface, transfer of the motor information is fail-safe and reliable. Did you develop the interface in-house, or do you use a standard interface?

Andreas Golf: The development is based on the principle of supply voltage with modulated information. The transfer is very fail-safe; the EMC tests have been completed with positive results. Analog data are generally more

susceptible to interference. In addition, we are able to omit otherwise required analog evaluation modules, which simplifies the design of the controller electronics.

Elektro Automation: In practice, how significant is the maximum cable length of 100 m and support for the "electronic name plate" and what are the main benefits of one cable technology from your perspective?

Andreas Golf: Although 100 m cable length scenarios are exceptional, the fact that this cable length is possible enables us to explore the reserve capacity of the system. One cable technology offers a high degree of machine development flexibility for the customer, so that their design efforts can focus on the essentials. Today, an electronic name plate is an almost common amenity feature. The user connects the motor to the amplifier and switches it on and the basic parameterization is performed automatically. One cable technology not only saves directly identifiable costs, it also has an effect on the peripheral equipment. Drag chains, for example, can be smaller since a cable is omitted from each drive. In addition, smaller connectors can be used for cable bushings (in control cabinet panels) and spaces allocated for cables can also be smaller. Overall, this makes machines more compact and significantly reduces material consumption. In addition, the thermal state of the motor can be evaluated directly and the winding temperature of the motor can be transferred digitally. In this way remote diagnostics can be implemented right down to the motor.

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Elektro Automation: The AM8000 motors are said to be very dynamic. How do you use this reputation for positioning yourself in the market environment?

Andreas Golf: Although high dynamics requires a low moment of inertia, close attention should be paid to the load moment of inertia. If the motor inertia is too low, a mismatch between load and motor inertia will occur. This in turn results in an axis system that is difficult to control, associated with impaired dynamics of the load/motor system, despite the fact that the motor meets the preconditions for highly dynamic movements. Therefore, if the motor inertia is too low, it will be limited to particular applications or may have to be used in conjunction with a gear unit. With this in mind, our motor development didn't exclusively focus on minimizing the moment of inertia at the expense of stability. Although the inertia of the AM8000 series motors is in the lower range of commercially available motors, the factors described above were carefully considered. After all, the aim for this series was not to address a niche, but a broad market.



One of the highlights of the new servomotors is the one cable technology, which eliminates the need for expensive, inflexible hybrid cables.

Elektro Automation: The special modular design makes mechanical adaptation and implementation of individual customer requirements straightforward. What does this mean in practice?

Andreas Golf: For the series production motors with their standard options, the modular design means that a wide range of motor types can be assembled with a small number of stock components. By reusing identical parts the manufacturing time can be reduced considerably. In addition, the modularity of the system enables us to replace standard components with custom components with little effort. In this way the system can be adapted to the individual requirements of customer applications by changing the motor shaft, adding inertia or modifying the motor flange.

„This is an avalanche effect. The avoided losses are directly converted into deliverable power.“

Elektro Automation: Thanks to the single-tooth winding technology you achieve a high slot fill factor. You say you consistently developed this technological further. What exactly does this mean and what are the improvements compared with conventional versions?

Andreas Golf: The primary benefits of single-tooth winding technology are reduced copper losses due to the short end turns and associated space savings. A special process for inserting these single-tooth coils into the stator slots has already led to high slot fill factors in the past, i.e. higher than with conventional pull-in winding and particularly with needle winding. The logical consequence was to wind the stator teeth directly, which enables the maximum quantity of

copper to be inserted. The process is therefore also referred to as segmented single-tooth winding. The big advantage is a further reduction of losses, with the associated positive effect on the available torque and scope for reducing the size of the end turns further, almost down to the theoretical minimum.

Elektro Automation: Compared with conventional servomotors, the energy efficiency was increased by 10%. Does energy efficiency mean more than reduced power dissipation?

Andreas Golf: This is an avalanche effect. The avoided losses are directly converted into deliverable power. With the same thermal limits, e.g. the overtemperature of the winding, more power can be utilized. Compared with the previous series, performance has improved by 10%. Ultimately this was achieved through a combination of new materials, improved winding techniques and further optimization of the electromagnetic design.

Elektro Automation: What measures did you use to optimize running smoothness and service life?

Andreas Golf: Our devices offer around 30,000 hours service life, which is 50% more than the common value of 20,000 hours. We achieved this through a robust mechanical design, sturdy components and high-quality materials, particularly for the ball bearings. Another important factor is the reduction of vibratory excitation, which is realized through appropriate design of the electromagnetic circuit. In addition, we use a stronger motor shaft in a compact motor design, with a resulting shift in the resonance points towards high frequencies and associated smaller vibration amplitudes and, therefore, reduced load.

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www.wirautomatisierer.de

Further Information:

www.beckhoff.com/AM8000