Multiturn Rotary Encoders for Compact Servo Motors

HEIDENHAIN's newly developed EBI 1135 encoders are the first generation of inductive multiturn rotary encoders with battery buffering. They are some of the world's smallest absolute rotary encoders and are an ideal solution for highly dynamic servo motors of small size for automation technology and industrial robots. Read more »

PRODUCT SPOTLIGHT

New Magnetic Ring Encoder for the Wind Industry

Leine & Linde's MRI 2000 encoder is designed as a ring segmented into pieces to facilitate installation and service. Its interfaces are designed for long distance transmission, making it ideal for crane applications or turbine designs where the encoder signals need to be transferred from the top of the tower down to the ground. Read more »

NEWS

HEIDENHAIN HISTORY– Part 2
After the DIADUR is Invented

After Wilhelm Heidenhain's 1889 startup of a metal-etching company in...
Berlin, Germany, and subsequent move to Traunreut, Germany during World War II with his son Dr. Johannes Heidenhain, the company began to take on the shape as we know it today. HEIDENHAIN's 1950 invention of the DIADUR production process gave way to the development of precision measurement components never before seen anywhere in the world. Read more »

Trade Show Schedule
HEIDENHAIN is planning to exhibit at eight trade shows in North America in 2013. Trade Shows 2013 »
New Magnetic Ring Encoder from Leine & Linde Offers Speed Feedback for Large Shafts

The constant challenge in the wind industry is to increase the output power of the turbines at the same time as reducing weight. A current trend is to use permanent magnet generators in order to exclude the gearbox and thus decrease the total weight. These solutions often require a speed feedback encoder mounted on the main shaft between the generator and the rotor blades where the shaft dimension is large – sometimes around a meter. For such demands, Leine & Linde has developed a new magnetic ring encoder with many features specially designed for the wind industry.

Called the Leine & Linde MRI 2000, this encoder is designed as a ring segmented into pieces, something that facilitates commissioning and service. As the ring is often mounted on a shaft between other parts in the machinery, it may be difficult to access it, both when first mounting it and when performing service. With a segmented ring, the pieces may be mounted from two sides of the shaft and screwed together. The segments also make handling easier when transporting and storing the ring.

Fixing the ring to the shaft can be made through flange mounting with axial screws or by Leine & Linde's ClampFit solution for simplified commissioning. With ClampFit, the ring segments are screwed together in a way that automatically tightens the ring around the mating shaft. This saves commissioning time and enables fixing to a standard cylindrical shaft without any flange expansion prepared.

The speed pickup unit is available with several market standard interfaces for incremental signals.
interfaces High Current HTL and Optolink have been specially designed for long distance transmission, which makes them extra suitable for crane applications or for turbine designs where the encoder signals need to be transferred from the top of the tower down to the ground.

More information on Leine & Linde's MRI 2000 encoder is available here

To contact HC for more information about this Leine & Linde encoder, click here.
December 2012

New Rotary Encoders from Heidenhain

Battery-Backed Multiturn Encoders for Innovative Servo Motors Offer Optimum Power Density, Efficiency and Precision

Manufacturers of robots and CNC machine tools require precise and compact drives with high power efficiency. To meet these and future demands, STÖBER Antriebstechnik GmbH & Co. KG decided to develop a completely new family of servo motors with three different motor sizes, each available in four different lengths for torque values of 2.8 to 31 Nm in various versions. Thanks to their innovative motor design, the synchronous servo motors of the EZ series provide a very high power density in an extremely compact form. The positioning and speed of the servo motors are controlled with the battery-backed Multiturn Rotary Encoder EBI 1135 likewise newly developed by DR. JOHANNES HEIDENHAIN GmbH.

New manufacturing method

Smaller, lighter, more dynamic and more precise are the common demands made by customers to Heinz Bázner, Head of Cost Center, Motors, at STÖBER. These market demands led to the completely new development of the EZ series of servo motors which have now been on the market since the beginning of 2011 in flange sizes of 98 mm to 145 mm. The synchronous servo motors for speeds of up to 6,000 rpm are extremely short with a high power density. This has been made possible by the innovative method of manufacturing the stator winding.

*All fields required.
*First Name: 
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*Company: 
*Phone: 
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"Previously, with the STÖBER servo motors, we used a complete laminated stator core housing into which the windings were introduced individually," said Heinz Bätzner. "In the case of the EZ motors, however, tooth winding was used, in which the winding was produced as a multi-layer winding (orthocyclic winding). This ensures a very high copper fill factor."

Furthermore, the stator plates are no longer welded or riveted, but are bonded together directly when punched. This means that the plates are placed so closely together that a significantly higher layer factor than with punching or riveting is achieved. This manufacturing method ensures higher stability and thus less vibration, less detent torque and a smoother surface without rivets or welding seams, which in turn prevents eddy currents. The higher layer factor also means less loss in the laminated stator core and a higher power density.

"Another highlight" for Heinz Bätzner is "the encapsulating of the winding in plastic." This ensures even better heat removal. The higher copper fill factor, the new patented procedure for stator plate production and subsequent encapsulating of the winding as well as other measures such as the use of high-energy neodymium iron boron magnets permit the volume to be reduced by about 50 % with the same torque compared with previously manufactured servo motors. "These motors' high efficiency rate of 91 to 95 percent is therefore better than required by the IE4," emphasized Heinz Bätzner. The weight of the motors is also reduced by half thanks to the lower volume. The newly calculated rotor design and optimized rotor gaps also played their part in reducing the moment of inertia and thus improving the dynamics of the motors accordingly.

**Compact motors need compact components**

"The extremely compact design of the motors forced us to solve a number of design problems," said Heinz Bätzner. "For instance, the rotor bearings are deep inside the end winding." For this reason a very small encoder was needed for mounting on the cam. The multiturn rotary encoders with mechanical transmission used previously in the STÖBER servo motors were no longer suitable due to their size.

Heinz Bätzner continued, "We therefore asked HEIDENHAIN, with whom we have enjoyed successful cooperation for many years, whether they had a rotary encoder that can fit into this space and can fulfill our high requirements. Finally, after intensive tests, it became clear that the newly developed inductive rotary encoder EBI 1135 was the optimum solution for our EZ series of servo motors."

"The EBI1135 encoders are the first generation of inductive multiturn rotary encoders from HEIDENHAIN with battery buffering," explained Dr.-Ing. André Schramm from Marketing and Product Management at HEIDENHAIN. "Thus, compared with our other multiturn rotary encoders, all with mechanical transmission, we can achieve comparably high degrees of control and precision with the battery-buffered devices despite their compact dimensions."

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*Figure 2 - Motor cross-section*
"It is just a pity," added Heinz Bätzner with a laugh, "that we did not come across the encoder before we had finished the design phase. Otherwise we could have made the motor another 10 mm shorter." The number of revolutions is generated inductively with this new generation of encoders and buffered with the battery. This means that even if there is a power failure, the current position of the servo motor can always be read out. Here, the battery is mounted externally, as with all encoders with battery buffering, because the temperatures are too high where the encoder is incorporated in the motor. At STÖBER, the battery is mounted in the likewise newly developed Absolute Encoder Support (AES). The AES is installed between the servo controller and the rotary encoder cable. The advantages of this solution are that the battery is easy to access and the absolute position of the servo motor is safely buffered even when the servo controller is replaced.

Small rotary encoder with extraordinary performance data

The EBI 1135 absolute multturn encoder attains a total resolution of 34 bits (singleturn: 18 bits, multturn: 16 bits). Thanks to its modular design without ball bearings and transmission, it is one of the world's smallest absolute rotary encoders with a length of 12.3 mm and outside housing diameter of only 36.83 mm. It is therefore predestined for use in highly dynamic servo motors of small size for automation technology and industrial robots.

The new rotary encoder with battery-buffered revolution counter distinguishes itself in particular with optimized inductive scanning evenly around the circumference together with a sturdy design. This produces a high degree of precision of ± 120", good controller quality and a large permissible axial mounting tolerance of ± 0.3 mm. The large permissible axial mounting tolerance of ± 0.3 mm, the wide voltage range of 3.6 to 14 V and, compared with multturn scanning with a mechanical transmission, the greatly expanded multturn value range of 65,536 distinguishable revolutions increases the reserves in the application available to the customer. The electronic multturn scanning without additional mechanical components also improves the shock and vibration compatibility and ensures low-noise operation.

According to Dr. André Schramm, "The EBI 1135 is the first inductive encoder that is equipped with the EnDat 2.2 interface." This purely serial interface permits fast and secure data transmission at clock-pulse rates of up to 8 MHz for high drive dynamics even in environments with potentially high electromagnetic interference (e.g. welding robots). In addition, the greater voltage range of 3.6 V to 14 V means that there are no longer
any problems with voltage drop in the cable.

The multiturn function of the EBI 1135 is realized through a revolution counter. To prevent loss of the absolute position information during power failure, the multiturn must be driven with an external buffer battery. Compared with the absolute value encoders with battery-buffered revolution counter currently in widespread use in Asia, two features of the EBI 1135 are to be highlighted in particular. One the one hand, the power consumption in battery-buffering mode was lowered to 12 µA (the usual value here is about 25 µA) and a longer battery life of approximately 10 years could be achieved using a buffer battery with 1500 mAh and 3.6 V. On the other hand, the full speed of 12,000 rpm is permissible also in battery-buffering mode (in many cases, devices from the competition greatly reduce the permissible speed in battery-buffering mode).

**Summary and outlook**

The EBI 1135 multiturn rotary encoders are some of the world's smallest. Only thanks to them are such drastic developments possible, as in the case of the EZ series of synchronous servo motors with regard to length and power density. The servo motors are now available in a wide variety of different versions. For example, there are versions with holding brake, with liquid-cooled flange or external fan, or with hollow shaft. In the near future there will then also be servo motors with spindle drives as rotating spindles or spindle nuts—and once again the EBI 1135 will be implemented.
HEIDENHAIN HISTORY

HEIDENHAIN has been in existence for over 100 years, with an illustrious history. Originating in Europe and now with approximately 7,500 employees worldwide, HEIDENHAIN continues to serve as an important and significant force in the precision measurement and motion control industry. This article is the second installment in a series to share its background.

After the DIADUR is Invented

After Wilhelm Heidenhain’s 1889 startup of a metal-etching company in Berlin, Germany, and subsequent move to Traunreut, Germany during World War II with his son Dr. Johannes Heidenhain, the company began to take on the shape as we know it today. HEIDENHAIN’s 1950 invention of the DIADUR production process gave way to the development of precision measurement components never before seen anywhere in the world.

In 1952, HEIDENHAIN introduced its first optical linear (Figure 1) and angle encoders for machine tools. In 1961, its first photoelectric linear (Figure 2), angle and incremental rotary (with 10,000 lines) encoders for position feedback are introduced. All of these products brought exciting advances to the motion control industry.

Then in 1968, HEIDENHAIN introduces its first sealed...
linear encoder with steel tape (40 µm) (Figure 3), as well as its first digital readouts (DROs) for manual machine tools, bringing the ability to monitor and guide measurement movements more accurately than ever before right on the machine shop floor.

With all of these advanced components becoming well established into manufacturing machines all over the world, Dr. Johannes Heidenhain decides in 1970 to put the successful company into a trust for the benefit of its many loyal employees in Traunreut. This trust outlines that the company can never be sold, and establishes itself as a non-profit organization. It also mandates that the HEIDENHAIN board of directors must give a portion of its annual sales to the needy, both for children and adult charitable organizations alike which it continues to do today.

At this juncture, HEIDENHAIN really begins to grow.

*Stayed tuned for more HEIDENHAIN History in the next quarterly newsletter.*

Click here to read HEIDENHAIN History PART 1