

In it from the beginning: Sensors with CANopen

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Introduction

As early as 1996, the German manufacturer Fraba Posital launched an absolute rotary encoder with a CANopen interface. Working with other manufacturers in the CiA special interest group (SIG) for encoders, Posital submitted its encoder profile proposal. The atmosphere among the working group members and within CiA as a whole was so very open and constructive that many parts functions were included in the CiA 406 profile. The final vote was conducted only a few months after the first meeting. Following this success, several parts of the existing CANopen encoder device profile were adopted for DeviceNet a few years later. This was a big advantage saving much effort because it made re-definition and re-implementation unnecessary. Furthermore, the end user gets the same "look and feel" on the device and application sides.

After the first launch of an encoder with a CANopen interface, Posital optimized its products continuously. The first and most pressing concern was price reduction since fieldbus interfaces used to be more expensive than standard interfaces such as SSI or Bit-Parallel. The situation in those early days can be compared to the disparity between fieldbus and Ethernet interfaces as it is today. Very quickly, we offered CAN products at the price of standard interfaces. Presented with such a choice, customers naturally preferred the more robust and flexible CAN network. Very recently, we developed a design for real-time Ethernet systems like Powerlink or Ethercat at costs similar to those for standard CAN interfaces. These systems use many parts of CANopen such as the device and communication profile.

Especially in the first years, customer support was one of our main fields of activity with the fieldbus experts providing help regarding installation, configuration, and diagnosis. Around the year 2000, fieldbuses became more and more popular and the sales volume of CAN connectable encoders increased dramatically. Not only did the number of sensors amplify, the manufacturer also reached a much larger variety of automation applications, for instance cranes, packaging, bottling, robotics, presses, transport, and feeding machines.



Figure 1: The Optocode CA series of optical absolute encoders with CANopen connectivity

New markets and applications

Our next major CAN development was the integration of the encoder profile in the application profile for the lift industry about ten years ago. This development opened up a vital market. Today, many of the company's customers use its CAN encoders in their lift installations. However, our efforts over the last 15 years were not limited to improving the CAN communication side. In addition to the optical measurement principle, the company adopted a new technology and extended its product range to magnetic systems. This enabled us to provide practical solutions for many more applications including mobile or construction machines. These application segments require particularly high ingress protection degrees up to IP69K, high shaft loads up to 300 N, immunity against shock and vibrations, and a wide temperature range. In ad-

dition to that, they are very cost-sensitive. It is noteworthy that CAN was first introduced in the automotive industry and, several years later, was adopted by manufacturers of heavy machinery such as rock drilling machines, mobile cranes, drilling rigs, or pile hammers.

Heavy-duty magnetic encoders

We supply heavy-duty magnetic encoders as a stainless steel model and as a compact, cost-efficient version. Both feature a hardened shaft, providing an optimal contact surface for the shaft seal even at highly dynamic speeds.

This constructive feature ensures IP69K protection on the shaft side throughout the long lifetime of the encoder. The housing, including the connector, is also designed to continuously withstand high-pressure water jets. The sensors are therefore suitable for worldwide use, in remote areas, and under extreme

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Company

Posital is specialized in absolute rotary encoders and inclinometers. The company belongs to the Fraba group, which dates back to 1918, when its predecessor Franz Baumgartner elektrische Apparate GmbH, a producer of relays, was established. Today, the group consists of six independent companies that develop and produce industrial sensor technology and safety equipment.

Product information

Posital manufactures the Optocode line of optical absolute encoders with CANopen interfaces. With a housing measuring 71 mm in length, the encoders are suitable for use in applications with limited installation space. Standard models are equipped with a proven connection cap, which allows for user-friendly configuration by means of a switchable terminating resistor, an integrated T-coupler, diagnosis LEDs and BCD switches for manual adjustment of the bit-rate. Encoders from the Optocode CA series are available with a plug connector or a cable exit. These connection types are especially suited for price-sensitive markets. In addition to the established solid-shaft or blind hollow-shaft models, CA encoders are also available as easy-to-integrate through hollow shaft versions. Like all encoders, the CA models use a tried and tested optoelectronic scanning method to record position values. The single-turn part provides a resolution of 16 bit per revolution. Multi-turn units register a maximum of 16384 revolutions (14 bit), thereby covering an overall 30-bit measuring range.



Figure 2: Graded versions of MCD magnetic encoders for heavy duty



Figure 3: Cost-efficient, robust ACS II inclinometers

environmental conditions. Industrial applications of the high-end model range from the food industry to offshore applications. The compact sister models can be used in various automation applications and in mobile machines. The variants are suitable for high radial and axial shaft loads of up to 200 N and 300 N respectively.

Inclinometer

As a second portfolio segment apart from encoders, we started developing inclinometers. The CAN interface, tested and proven in the encoder design, was retained and extended by two versions of inclination measurement sensor cells. To meet the specific requirements of a wide variety of applications, e.g. high resolution, short response time, immunity against shock or vibrations, we employ both, MEMS (micro-electromechanical systems) technology and the fluid-cell measurement principle.

The Acclens series of IP69K inclinometer is based on MEMS technology and ensures shock resistance up to 100 g and vibration resistance up to 10 g. Since ACS II inclinometers measure inclination values directly, the ultra-compact devices require no mechanical coupling to drive elements, thus generating substantial savings for users. Moreover, a single sensor measuring several axes minimizes the constructive effort compared with other solutions, e.g. by making mounting fixtures and couplings unnecessary. A simple, very robust design allows users to realize cost-efficient sensor solutions for mobile machines. In addition to a CANopen interface, we also offer models with an analog, SSI, or EIA 232 connection.

Safety encoder

A recent highlight in the CAN product family was the development of an optical SIL CL 3 encoder with a CANopen-Safety interface, which was certified by the German testing authority TÜV Rheinland in 2009. Especially in light of the obligations on machine builders by the Machinery Directive, it is advisable to use certified devices which do not require engineering effort, thereby minimizing costs and implementation times. In contrast, standard components often do not cover common cause failures (CCF), forcing users to take special measures, which further increase their costs.

The redundant OCD encoders fulfill the requirements of IEC 61508, EN 62061 (SIL CL 3) and EN ISO 13849 (performance level e) and thus comply with the Machinery Directive. Operated with protective extra low voltage (PELV), they are suitable for use in drive systems, lift applications, mobile machines, construction machinery, and machine tools. The safety encoders support the CANopen-Safety protocol according to EN 50325-5 as well as the CiA 301 CANopen application layer. The single-turn sensors provide a maximum resolution of 16 bit per revolution. Additionally, up to 16384 revolutions (14 bit) can be registered in multi-turn mode, thereby cover-



Figure 4: OCD encoders with redundant design for safety applications

ing a measuring range of up to 30 bit. The encoders are available as solid-shaft, hollow-shaft or synchronous shaft models. They provide IP65 protection on the housing side and IP64 on the shaft side (an optional sealing ensures IP66).

Draw-wire sensors

The Magnetcode draw-wire encoders are designed for medical applications. They use a hall sensor for single-turn, or the Wiegand effect for revolution measurement. They are available as MDW versions with an integrated draw-wire adapter, which makes them ideally suited for medical applications, e.g. in patient positioning and to control or monitor CT scanners or other imaging systems. The compact system provides magnetic, touch-free distance measurement at a 35- μ m resolution. The maximum measurement length of 2 m is sufficient for medical applications. The units feature a serial SSI interface for connection to control systems. Originally developed for industrial applications, the units are especially wear-resistant: stress tests have shown that the absolute accuracy of the distance measurement systems remains the same even after the draw wire has been extended one million times.



Figure 5: Long-life Magnetcode draw-wire encoders for use in medical technology featuring precise distance measurement

the same even after the draw wire has been extended one million times.

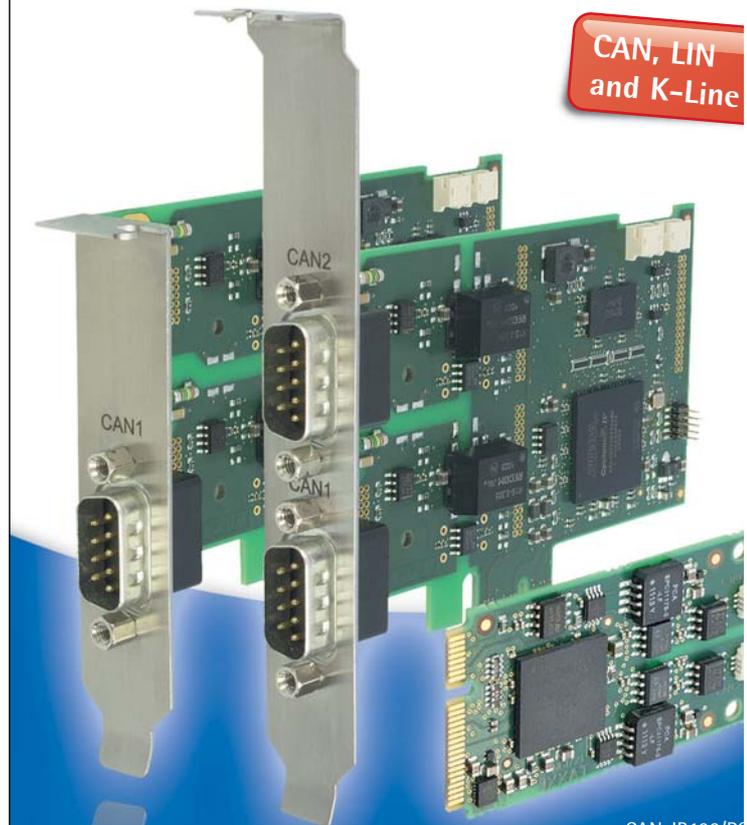
Conclusion

Posital has been integrating CAN interfaces into absolute encoders since the mid-1990s. The company's expertise in bus interfaces has had a major part in the market success of its encoders. Over the last decade or so, optoelectronic scanning has been complemented by magnetic encoder technology, and the product portfolio has grown to include inclinometers and draw wire sensors. Today, the manufacturer supplies suitable models for virtually all possible applications. In the future, Posital will keep on developing dedicated solutions for new applications and as a member of CiA continue its networking and standardization efforts.

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