

POSITAL

FRABA



Ahead Through Absolute Position

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ROTARY ENCODERS

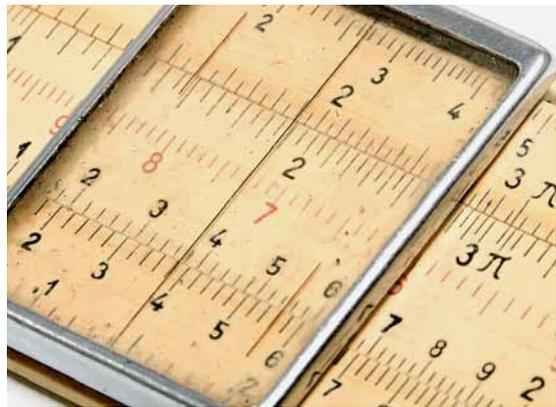


Rotary Encoders

Motion control applications – ranging from factory automation to control systems for construction equipment – require precise, real-time information about the physical location of mechanical equipment. Absolute rotary encoders can provide precise and unambiguous measurements of the angular positions of joints, drive shafts, pulleys, etc. in real time. This makes absolute rotary encoders an ideal way of linking mechanical components to an electronic control system.

Rotary encoders provide high accuracy, excellent dynamic response and consistent precision over a measuring range that can extend beyond 360°.

There are many potential uses for rotary encoders in industry. Integrating these devices into an existing system or a new design can be made much simpler if they have the right combination of mechanical and electronic characteristics. Factors to consider include the kind of motion to be monitored, shaft coupling arrangements, the need for protection from environmental hazards, required resolution and range, and the electronic interfaces required to connect to the control system. POSITAL's modular design philosophy and advanced manufacturing methods mean that we can offer thousands of configurations at highly competitive prices. You can get what you need from POSITAL!



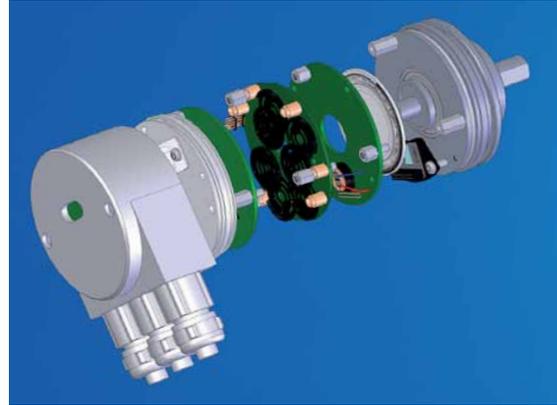
OPTICAL ENCODER TECHNOLOGY



Measuring Principles

A key component of optical rotary encoders is a code disk mounted on the encoder shaft. This is a disk made of transparent material that carries a concentric pattern of transparent and opaque areas. Infrared light from an LED shines through the code disk, onto an array of photoreceptors. As the shaft turns, a unique combination of photoreceptors are illuminated or blocked from light by the pattern on the disk.

For multi-turn models, there is an additional set of code discs arranged in a gear train. As the main encoder shaft rotates, these discs are geared together to turn like the wheels of an odometer. The rotational position of each disc is monitored optically and the output is a count of the net number of rotations of the encoder shaft.

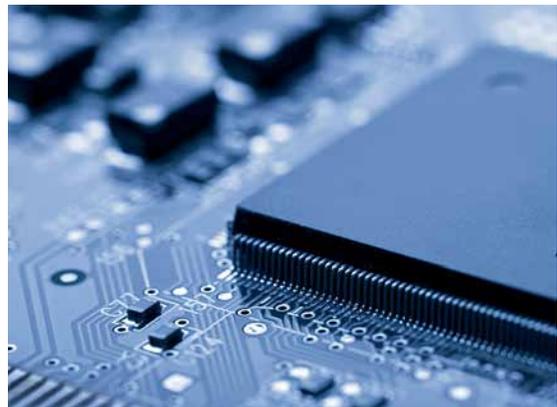


Functionality

POSITAL's OPTOCODE (OCD) absolute rotary encoders use highly integrated Opto-ASICs, providing a resolution up to 16 bits (65,536 steps) per turn, along with incremental signals. For multi-turn models, the measuring range is extended by the mechanically geared code disks to as many as 16,384 (2^{14}) revolutions.

Advantages of Optical Encoders

Optical encoders provide very high resolution and accuracy along with excellent dynamic response and are suitable for use in areas with high magnetic fields. Since the rotation of the code discs is an entirely mechanical process, there is no risk of losing track of their absolute position due to loss of instrument power. No backup batteries are required!



MAGNETIC ENCODER TECHNOLOGY

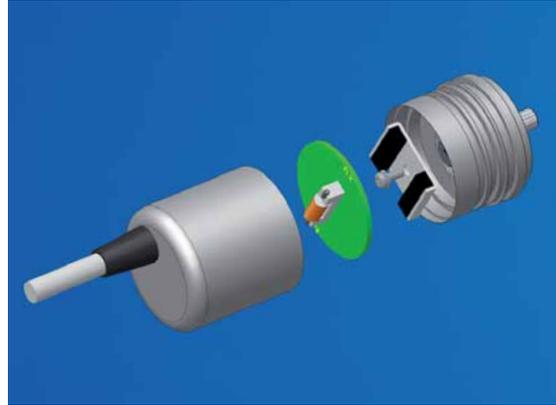


Magnetic Measurement Principles

Magnetic rotary encoders determine angular position using magnetic field sensor technology. A permanent magnet fixed to the encoder's shaft creates a magnetic field that is sampled by a sensor that generates a unique absolute position reading.

Multi-Turn Innovation

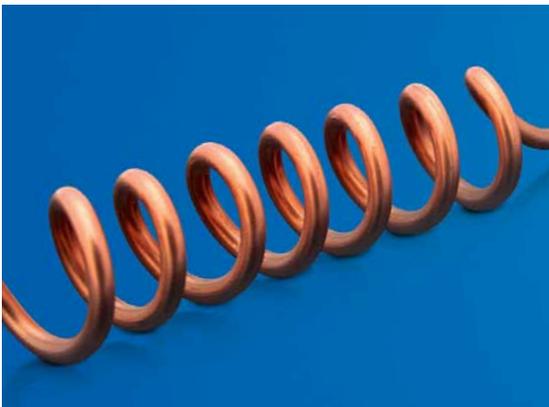
POSITAL multi-turn magnetic rotary encoders use an innovative technology to keep track of the number of rotations that the encoder has experienced, even if the rotations occur when there is no system power. To accomplish this, the encoders generate electrical energy from the rotation of the encoder shaft. The technology is based on the 'Wiegand effect': when a permanent magnet on the encoder



shaft rotates through a certain angle, the magnetic polarity in a 'Wiegand wire' suddenly changes, inducing a brief voltage spike in a coil surrounding the wire. This pulse both marks a rotation of the shaft and powers the electronic circuitry that records the event. The Wiegand effect occurs reliably even with very slow rotations and requires no backup batteries.

Advantages of Magnetic Encoders

Magnetic encoders are robust, durable and compact. They are mechanically simple and cost significantly less than comparable optical encoders. Their compact dimensions mean that they can be used in applications with very limited installation space.



MAGNETOCODE ROTARY ENCODERS



MAGNETOCODE (MCD) Rotary Encoders

POSITAL's MAGNETOCODE (MCD) magnetic absolute rotary encoders offer sturdiness and reliability that make them an excellent solution for many applications. With only one moving part – the shaft/magnet assembly – they are extremely resistant to shock and vibration, while the magnetic measurement technology is virtually immune to dust and moisture. Finally, these devices are very competitively priced.

Maximum resolution for MCD encoders is 4096 increments per revolution (12 bits), while multi-turn models have a range of up to 8192 revolutions (13 bits).



Electronic Interface Options

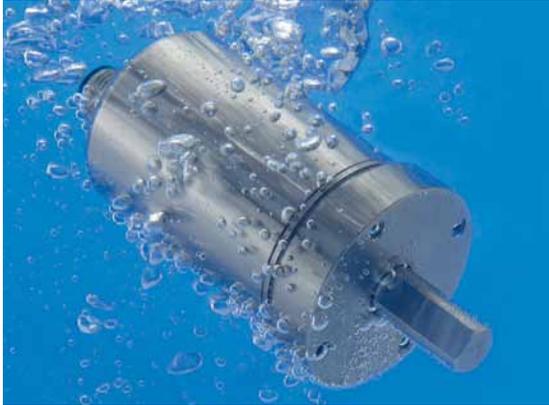
- SSI (serial)
- CANopen
- CANopen lift (elevators)
- DeviceNet
- Analog – voltage or current. (For analog models, sensitivity can be set so that the full range of electrical output precisely matches the range of motion between user-determined end points)

Safety-Related Features

For critical safety-related applications, SIL2-compliant encoders with duplicate redundant sensor components are available. MCD encoders also support CANsafe protocols.



MAGNETOCODE ROTARY ENCODERS



Mechanical Features

MAGNETOCODE absolute rotary encoders are tough! Thanks to their simple robust design, solid shaft, sturdy bearings and rugged casings, they can withstand high shock vibration load, and shaft loads up to 300N (67 pounds force). They are available with casings that provide environmental protection ranging from IP54 to IP66 (IP69K-compliant casings are available for use with mobile equipment). With an outside diameter of only 36.5 mm, MCD encoders are easy to fit into tight spots. For extremely demanding environments, such as offshore or in food processing facilities, MCD encoders are available with rugged stainless steel casings.



Typical Applications

- Trucks, buses
- Construction machinery and mobile equipment
- Mining equipment
- Elevators, escalators
- Industrial valves, water treatment equipment
- Medical equipment
- Wind turbines
- Solar panels



OPTOCODE ROTARY ENCODERS



OPTOCODE (OCD) Rotary Encoders

OPTOCODE optical absolute rotary encoders provide high precision (up to 65,536 or 2^{16} steps per rotation) and outstanding dynamic response. Multi-turn models will measure up to 16,384 (2^{14}) rotations. These encoders are fully capable of operating in rugged industrial settings.

Options and Alternatives

OPTOCODE encoders are highly modular and a wide range of options are available to meet special requirements. This includes models with solid and hollow shafts, stainless steel casings and different levels of environmental protection. Explosion-proof casings that meet ATEX standards are also available.



Electronic Interface Options

- Electronic instrument interfaces available for the OPTOCODE product line include all of the most commonly used connections and protocols:
- Bit parallel
- Serial (SSI)
- CANopen (SSI and CANopen also support incremental output)
- CANopen Lift (elevator)
- DeviceNet
- Profibus
- Industrial Ethernet, including Powerlink, ProfiNet, Ethernet/IP, Modbus and TCP/IP-UDP (OCD encoders were the first devices of this type to receive formal certification for Industrial Ethernet connectivity.)

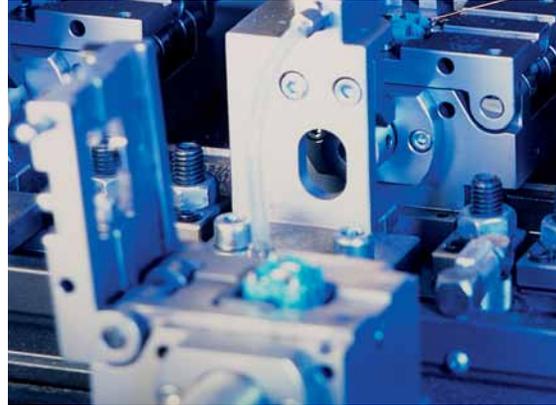


OPTOCODE ROTARY ENCODERS



Safety-Related Features

For safety-critical applications, OPTOCODE rotary encoders are available with safety integrity ratings up to IEC 61508, EN 62061 (SIL CL 3) and EN ISO 13849 (performance level e). These devices feature redundant physical components, including duplicated Opto-ASIC assemblies, and a self-monitoring micro-controller. They can support CANopen safety communications protocols (as specified by DS 304) and CANopen communications protocol (DS 301) simultaneously.



Typical Applications

- Food processing equipment
- Packaging machinery
- Paper industry machinery
- Printing machinery and equipment
- Offshore and marine equipment

Safety-Rated Models

- Chemical processing plants
- Elevators
- Mobile equipment
- Construction machinery
- Stage equipment.



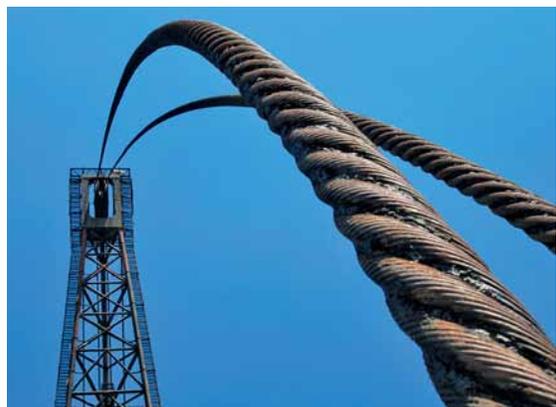
DRAW-WIRE SENSORS



Draw-Wire Sensors

For many applications, translational motions must be monitored for system control or to ensure safety. If the drive mechanism includes a rotating shaft, then a standard rotary encoder connected or geared to the shaft can often be used to measure translational movement. However, where the equipment is positioned manually, or by a pneumatic or hydraulic actuator, it may be necessary to measure the translational movement directly. Here, draw-wire sensors can be very useful.

POSITAL draw-wire sensors are based on rotary encoders. A spool attached to the encoder shaft carries a wire that can be attached to a moveable object. As this object moves, the wire is drawn off the spool, rotating the shaft of the encoder. Because of the inherent accuracy of the encoders, these devices provide extremely precise measurements. They are also highly durable. Tests on POSITAL MDW draw-wire sensors have confirmed reliable performance after over one million draw-rewind cycles.



DRAW-WIRE SENSORS



MDW Draw-Wire Sensors

POSITAL's MDW (Magnetic Draw Wire) series provides an accurate and very cost-effective draw-wire system based on the reliable MCD family of magnetic rotary encoders. Depending on the configuration, the system is capable of measuring distances of up to 5 m (16.4 ft). With a resolution as fine as 30 μm (0.0012 in), these devices are suitable for high precision operations. CANopen, serial SSI and analog electrical interfaces are available.

These devices are an ideal replacement for potentiometer-based systems. With no electrical contact between the shaft-mounted magnet and the magnetic field sensor, these devices do not suffer from the wear that can degrade the accuracy of conventional potentiometers.

MDW sensors are available with analog outputs, in which case, the output can be scaled so that the full output range exactly covers the full range of equipment travel. MDW sensors are also available with digital outputs, which can simplify the interface with digital control systems.

Draw-wire sensors are often less costly than linear displacement sensors and typically require less space to install.

Applications

- Material handling equipment
- Cranes, hoists, fork-lift trucks
- Medical Equipment
- Automatic doors



INCLINOMETERS



Inclinometers

Accurate measurement of the degree of tilt or inclination from a horizontal position can be very important for motion control systems or to ensure safety. Inclinometers offer an easy and efficient way of monitoring spatial orientation without the need for mechanical linkages. This feature, plus the durable packaging of many inclinometers means that these devices can be placed almost anywhere – a real advantage for design engineers! Some inclinometers can measure inclination in two axes simultaneously, which makes these devices even more convenient to use. Inclinometers output an angular measurement directly without the need for recalculation by the control system.

POSITAL's family of inclinometers are designed to be easy to integrate into motion control systems. Built-in electronic processing modules linearize output readings. Internal sensors monitor the temperature and automatically compensate for thermal drift in the measurement units. The digital signal processors allow scaling of the output range to match the full movement range of the mechanism upon which the inclinometer is mounted. Each sensor is individually calibrated to provide unrivalled accuracy for this type of device.



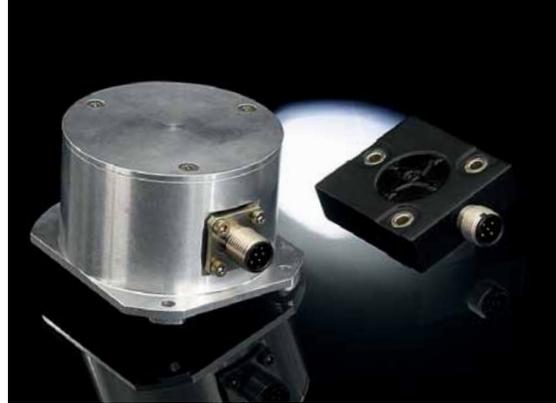
INCLINOMETER TECHNOLOGIES



Micro Mechanics

POSITAL's ACCELENS sensor systems are based on MEMS (Micro-Electro-Mechanical Systems) technology. In these devices, a 'micro mass' is suspended in a flexible support structure. Any movement will induce a displacement of the mass, which will result in a change of the capacitance between the mass and the holding structure. Changes of inclination are calculated from these measured capacitance changes.

These inclinometers have a measurement range of $\pm 80^\circ$ in two axes or 360° in one axis. The devices can withstand shock and vibration loadings of up to 20,000g. They offer excellent dynamic response.



Fluid Cell

Platinum electrodes are deposited in pairs along the base of the sensor cell, parallel to the sensitive axis. The cell is partially filled with an electrolytic liquid. When the sensor tilts, the level of fluid covering the electrodes changes. Applying a voltage across the electrodes causes an electric current to flow through the fluid with the amount of current depending on the level of fluid covering the electrodes. The inclination angle of the instrument is calculated from the measured current.

Fluid Cells are capable of measuring inclinations of up to $\pm 30^\circ$ with a very high level of precision.



ACCELENS INCLINOMETERS



ACCELENS (ACS) Series

The ACCELENS series of inclinometers is based on the groundbreaking MEMS (Micro-Electro Mechanical Systems) technology. These capacitive sensor cells feature a measuring range of up to $\pm 80^\circ$ for two-axis models or a full 360° for single axis versions. Maximum resolution is approximately 0.01° . The sensors provide consistent precision across a temperature range of -40° to $+85^\circ\text{C}$. Software filters can be configured to suppress spurious readings due to vibrations. Packaging options include an aluminum housing or an ultra-compact plastic case. Both offer excellent protection for internal components: IP67 for the aluminum models and IP68 for the plastic.



Electronic Interface Options

- Analog: voltage, current
- SSI
- CANopen

Typical Applications

ACS inclinometers are often used where their combination of durability and low cost meet application needs. This includes:

- Buses, Trucks
- Construction machinery, mobile equipment
- Farm machinery and equipment
- Material handling equipment
- Cranes and hoists
- Medical equipment
- Mining machinery
- Solar panels



ANGUSENS INCLINOMETERS



Precise and High Resolution

POSITAL's ANGUSENS (AGS) inclinometers provide exceptional precision and accurate measurement of tilt angles. Based on fluid cell technology, the ANGUSENS family of sensors offers three measurement ranges: $\pm 5^\circ$, $\pm 15^\circ$ and $\pm 30^\circ$. Angular resolution is as high as 0.001 degree! A rugged three-point mounting on the sensor housing simplifies installation, particularly on uneven surfaces. The combination of full temperature compensation over a range of -40° to $+85^\circ\text{C}$ and sensor housings that provide a high level of protection (up to IP 67) makes these instruments suitable for extreme conditions, including outdoor use.



Electronic Interface Options

- Analog: voltage, current, PWM, switching (in switching mode, the inclinometer acts as a limit switch with user-defined limit angles)
- RS232
- CANopen

Typical Applications

- Trucks, buses
- Construction machinery
- Material handling equipment
- Cranes and hoists
- Positioning of drill holes
- Wind energy
- Aircraft
- Naval applications
- Concrete pumps



POSITAL

FRABA

COMPANY



FRABA Group

FRABAAG is a group of enterprises focused on providing advanced products for the motion control and industrial automation markets. The POSITAL business unit has been a leading manufacturer of absolute rotary encoders for over 30 years. Other FRABA Group subsidiaries include VITECTOR (sensors for safety-assurance applications) and INTACTON (sensors for non-contact velocity measurement).

History

The company was founded by Franz Baumgartner in Cologne in 1918. Until the 1960s, FRABA's main product was mechanical relays. This business was supported by the company's systems engineering division, which was responsible for over 13,000 machine control systems. FRABA developed one of the first absolute rotary encoders in 1973. Today, FRABA companies specialize in innovative products that use advanced technologies to deliver exceptional performance and value.

Service

Absolute rotary encoders are sophisticated devices that can help solve a wide range of technical problems. However, realizing the full potential of these products may require specialized knowledge when selecting the device configuration and programming the operating parameters. To ensure that customers get what they need, POSITAL's development engineers in Germany, the US and ASIA have direct responsibility for customer support. In addition, a growing network of national and international partners are providing expert guidance with knowledge about the local requirements.

Production

FRABA products are manufactured in advanced production facilities located in Europe. The computer-guided semi-automated production system tracks each device from order, through assembly and testing, to final delivery. Even with thousands of unique configurations available, standard products are ready to ship within five working days of receiving an order.



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