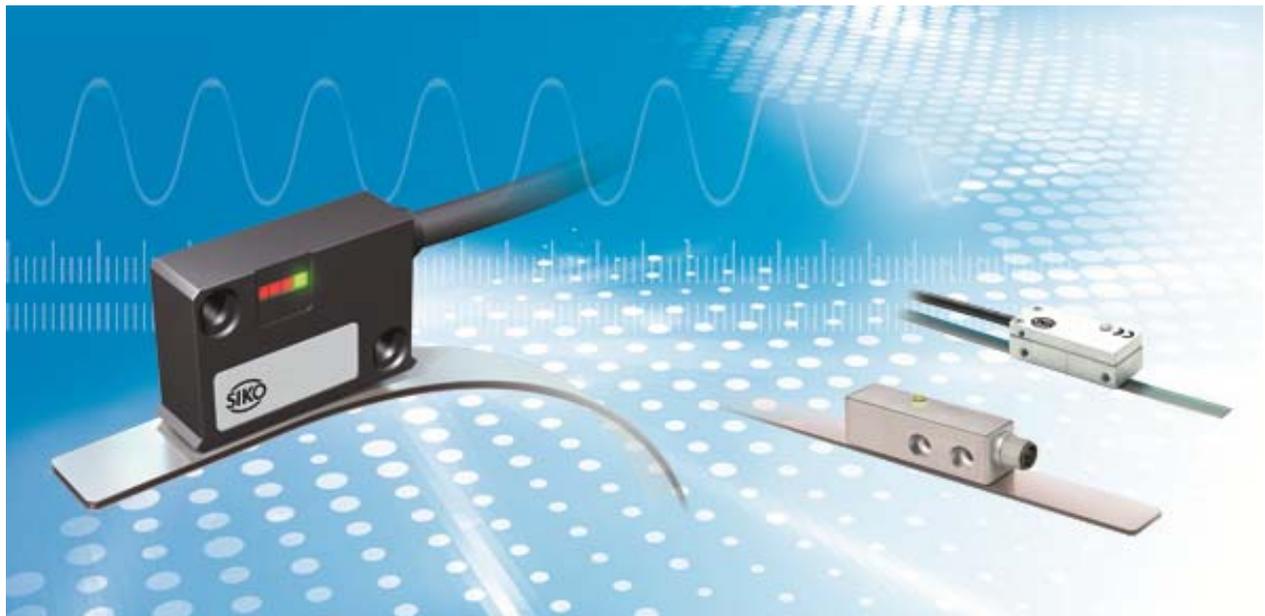




WHITE PAPER

The right sensors for every application

A comparison of optical and magnetic length and angular measurement systems



The requirements of length and angular measurement procedures are highly varied, and consequently a broad product spectrum has emerged in recent years. By clarifying certain key data at an early stage, however, the selection of an appropriate system is made considerably simpler. Using application examples, drawings and images, this white paper offers a clear comparison of the advantages and disadvantages of optical and magnetic sensors. It helps to guide the reader in selecting a tailored system that considers both economic and technological aspects in equal measure.



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1 Introduction

Precise length measurement is a fundamental requirement in industrial production. Yet the specifications of the measurement systems are as varied as the fields of application in which the sensors are used. While it may be necessary to measure distances of up to a hundred meters in cold conditions in a warehouse logistics setting, the biggest challenge faced in mechanical engineering is sufficient precision. Furthermore, contamination caused by ambient media often hampers the measurement process: in a woodworking environment, for example, sensors have to function reliably in spite of high exposure to dust. When used in wet-processing with CNC-controlled milling machines, sensors are constantly exposed to lubricoolants. The function of the measurement systems, or in other words, the reliability of the measurement results, must not be allowed to suffer because of impurities such as swarf or chips flying about, for example.

The capacity of the measurement system to function even under harsh environmental conditions, together with its precision and the economic viability of the system, is one of the main arguments for selecting the appropriate measurement technology. Owing to this diversity of requirements, in recent years a wide product spectrum has been developed. In technological terms, magnetic sensors border on the level of precision of optical systems. There are nevertheless certain applications that demand such high precision that only optical systems can be considered. Compared to magnetic systems, however, these are more sensitive to external influences such as dust or fluids. Encapsulating the sensors can help protect them, say, from harmful emulsions in a CNC milling environment. This is however a costly undertaking.



In choosing a suitable measurement system, then, it is a question of satisfying the requirements of factors such as the necessary precision while minimizing interference from external influences such that an economically viable solution is obtained - a combination of performance and affordability. For the end user, keeping track of what is happening is not easy. Nevertheless, by clarifying certain key data at an early stage it becomes significantly more straightforward to select an appropriate system based on either the optical or the magnetic measurement principle.



Figure1: Operating under difficult conditions: splinters and lubricant in a CNC machine



2 Main considerations for the initial selection of a suitable length measurement process

When selecting an appropriate length measurement process the following factors should be considered first: the higher the required precision, the more important it will be to use an optical measurement process. As regards the operational environment, however, the following basic principle applies: the greater the contamination of the operational environment through dust and liquids, the more obvious are the benefits of magnetic solutions. In the experience of Uwe Frey from the MagLine technical sales team at Black Forest-based measurement technology manufacturer SIKO GmbH, the required precision of the measurement is the key factor when it comes to finding suitable sensors: “The most decisive factor is the level of precision required. If the customer wishes to measure an area with a precision tolerance of ± 5 micrometers, then there is little doubt that an optical system should be used. As for magnetic sensors, these can offer precision of up to ± 10 micrometers.”

However, he also points out how much has changed in the field of magnetic systems in the past. “Even just a few years ago, values less than ± 25 micrometers were unheard of in magnetic systems. For high-precision applications there was no choice but to use optical processes.” The smaller pole pitch of the measuring strips that can be obtained using modern production techniques has meanwhile enabled the accuracy of magnetic measurement processes to be greatly improved.

Since 1963 Siko has established itself as a provider of measurement technology for various tasks such as length, angle and rotational speed measurement and for the measurement of inclination and speed. The Black Forest-based company’s extensive portfolio of magnetic sensors is completed with a range of optical sensors offering exceptional levels of precision.



The 'MagLine' range of magnetic length and angle measurement products has been steadily developed in recent years. The highest level of system and repeatability are obtained in the MagLine Micro product line. The MSK1000 digital magnetic sensor, for example, can output resolutions of down to 0.2 micrometers (200 nanometers) and offers a repeatability of ± 1 micrometer. The magnetic tapes are produced in-house with great care and using high-precision equipment. The manufacturer has developed a special process for coding the measurement tapes. Depending whether the measurement process required is incremental or absolute, one or more magnetic code tracks is attached. Recent product developments have also proved remarkable in terms of repeatability and the axis speeds that can be achieved.

The optical LSC20 sensor and the optical TS20 measuring tape are used to capture lengths and angles using optical principles. This high-precision measurement system can reliably record measuring steps even at high traverse speeds (3 m/s and 1.5 m/s respectively). The TS20 optical rule can be used both as a length measurement system for up to 30 meters length and also as an angle measurement system for measurements below 360 degrees.

3 Optical measurement systems – high precision and insensitivity to magnetic influences

SIKO OptoLine optical systems evaluate information on an optical measuring tape using a laser-based technology. The positional values are forwarded to the downstream electronics as digital counter pulses (A, B, R). The technique makes use of the Talbot effect: Light is distributed at defined spacings in the pattern of a grating. A grating structure is also created behind the sensor head. This grating is now irradiated with monochrome waves, such that a wider light distribution is obtained behind it. This technique allows a comparatively large distance between the sensor and the optical rule. With this technology the sensor head can be made very small. For applications in which dimension is a critical factor, this method is ideal.



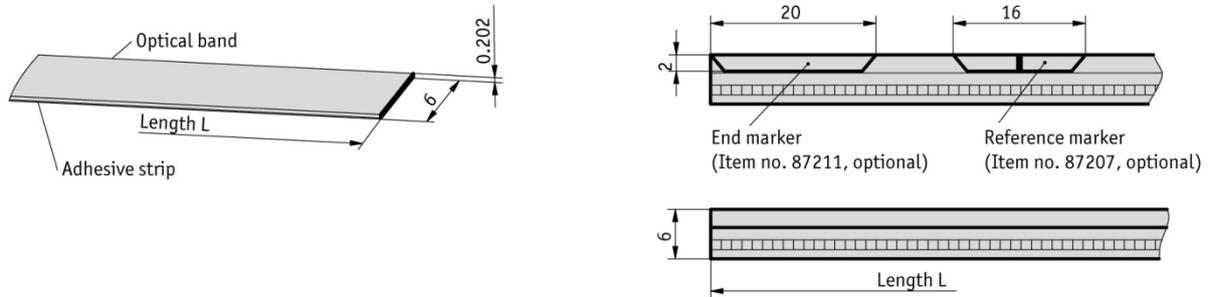


Fig. 2: Basic structure of an optical measuring tape

3.1 Advantages of optical systems

The precision of the LSC20 optical sensor is very high and lies in the range of about ± 5 micrometers. Compared to the magnetic system with its precision of ± 10 micrometers, this represents a doubling in precision. On top of this, the resolution of 0.05 micrometers is greater by a factor of 4 than the 0.2 micrometers currently offered by magnetic systems.

Another advantage of the optical system is its insensitivity to magnetic disturbances. Where linear motors are used, for example, electromagnetic interference can occur in the form of stray magnetic fields that can falsify the position values of a magnetic sensor. Yet linear motors are one of the main areas of application for magnetic sensors at Siko – especially where the motors are used under harsh ambient conditions. This is because the stray magnetic effect of the linear motors is only critical if the sensor head and magnetic tape are positioned too close to the motor. If the user maintains a defined safety clearance between the sensor and the motor or fits a shield, interference can be avoided. The further the motor is from the sensor, the less it affects the sensors. Accordingly, the real benefit of optical sensors becomes evident in situations where space is restricted or very powerful magnetic fields are present. For purely physical reasons, in magnetic systems a hysteresis effect arises in relation to the measured values. No such effect occurs in optical systems since they are not prone to electromagnetic influences.



3.2 Disadvantages of optical systems

By contrast to magnetic systems, optical systems are sensitive to environmental factors such as dust, swarf, oil and grease. In harsh conditions protection is also required for the measurement system against shock and vibration stresses and dirt. The measurement technology is also affected by temperature fluctuations and high air humidity; any formation of condensation on the code strips can result in measurement errors. To avoid this, elaborate housings can be created for protection against the influences described above, but these force the costs of the measurement system upward.

In terms of cost, optical sensors are generally more expensive than magnetic sensors. Optical incremental sensors cost, for the same quantity, roughly twice as much as magnetic sensors. The same is true for the rules: the cost of magnetic tapes is two to two and a half times less than that of optical tapes. A further disadvantage of optical measurement technology is the installation and handling by technical personnel. When sensors are mounted, their mechanical tolerances are dependent on the guide to which they are attached. An optical sensor must be adjusted precisely if the mechanical tolerances are to be offset. The sensors must always be moved exactly equally over the rule in order to obtain accurate values consistently. Dust and dirt must not be allowed to affect the sensor even during installation; measures must be taken to prevent this occurring.



Advantages of optical measurement systems	Disadvantages of optical measurement systems
High precision	Sensitive to dirt
High resolution (0.05 μm)	Non-condensing environment essential (no moisture, no frost)
High system accuracy $\pm 5 \mu\text{m}$	Relatively high cost
High repeatability (0.05 μm)	More involved installation and handling (technical personnel)
Not sensitive to strong magnetic interference	
No hysteresis	
Flexible to use with optical tape	
Rotational measurements below 360 degrees	

Fig. 3: Advantages and disadvantages of optical measurement systems

3.3 Applications ideally suited to optical measurement systems

Optical measurement systems with their high precision and repeatability are frequently required in, for example, pick-and-place automation, production and inspection machinery in the semiconductor industry, positioning and measurement equipment in medical systems and analysis technology. Further areas of application include ultra-precision machines and high-precision equipment, measuring microscopes and other high-precision measurement instruments. Vacuum-based applications can also be realized using measurement systems.



Example applications include:

Pick-and-place automation

High precision is required for automated component placement on printed circuit boards. Individual components such as resistors, capacitors and integrated circuits must be positioned exactly on the PCB before they are soldered in place. The exact positional measurement is provided by optical sensors.

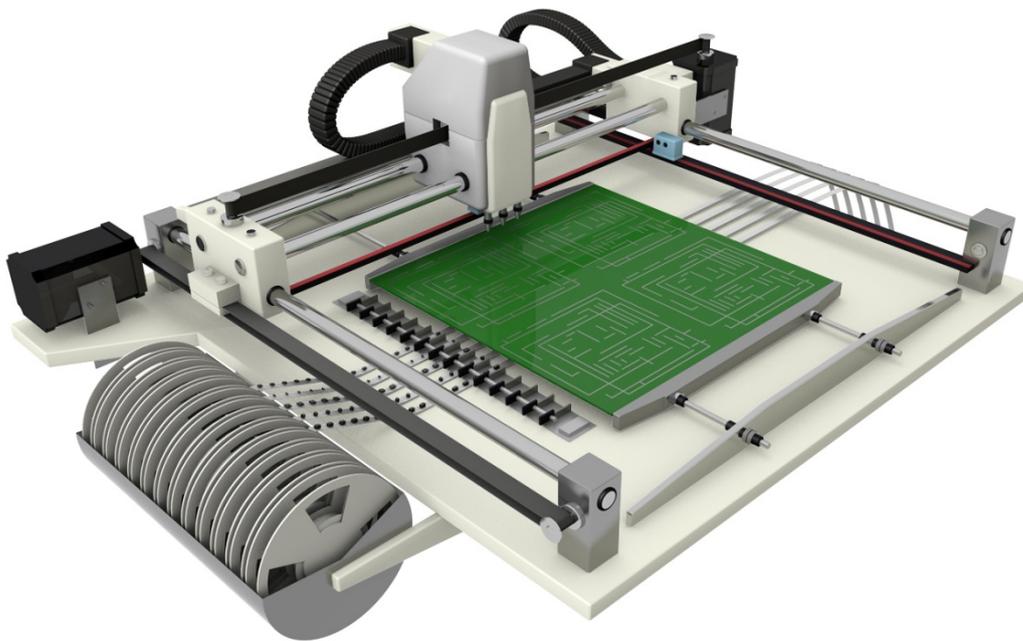


Fig. 4: Compact optical sensors are ideal for capturing positional information in pick-and-place systems.



Semiconductor technology

Optical sensors are used in manufacturing and inspection machines in the semiconductor industry. In clean room conditions the contacts used for chips may be gold or aluminum. Such chips, or integrated circuits, may have their functional electronic components integrated just 1 micrometer below the surface. This then is a process that calls for absolute precision - using optical sensors that are 100% hysteresis-free.

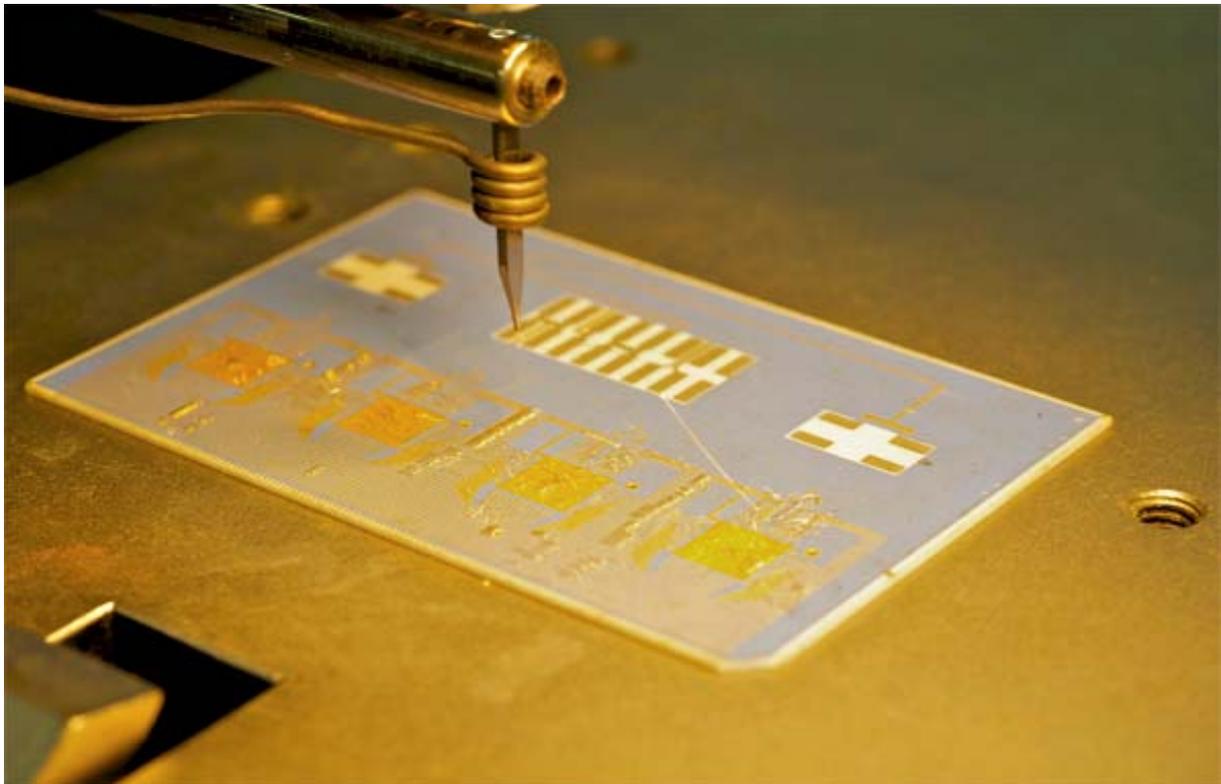


Fig. 5: Wire Bonder

Image credit: Wire Bonder – stock image, istockphoto.com, dolah



Medical and analysis systems

In analysis systems, optical sensors are used in areas such as liquid handling. Pipetting robots are used to collect, transport and dispense liquids from sample stocks in very small and precise quantities and at high speed. A position that has been left must be returned to next time with only the smallest deviation. Since the samples are placed very closely side by side, the pipetting system must be designed to high precision requirements and with high repeatability. Optical systems are ideal for these situations.

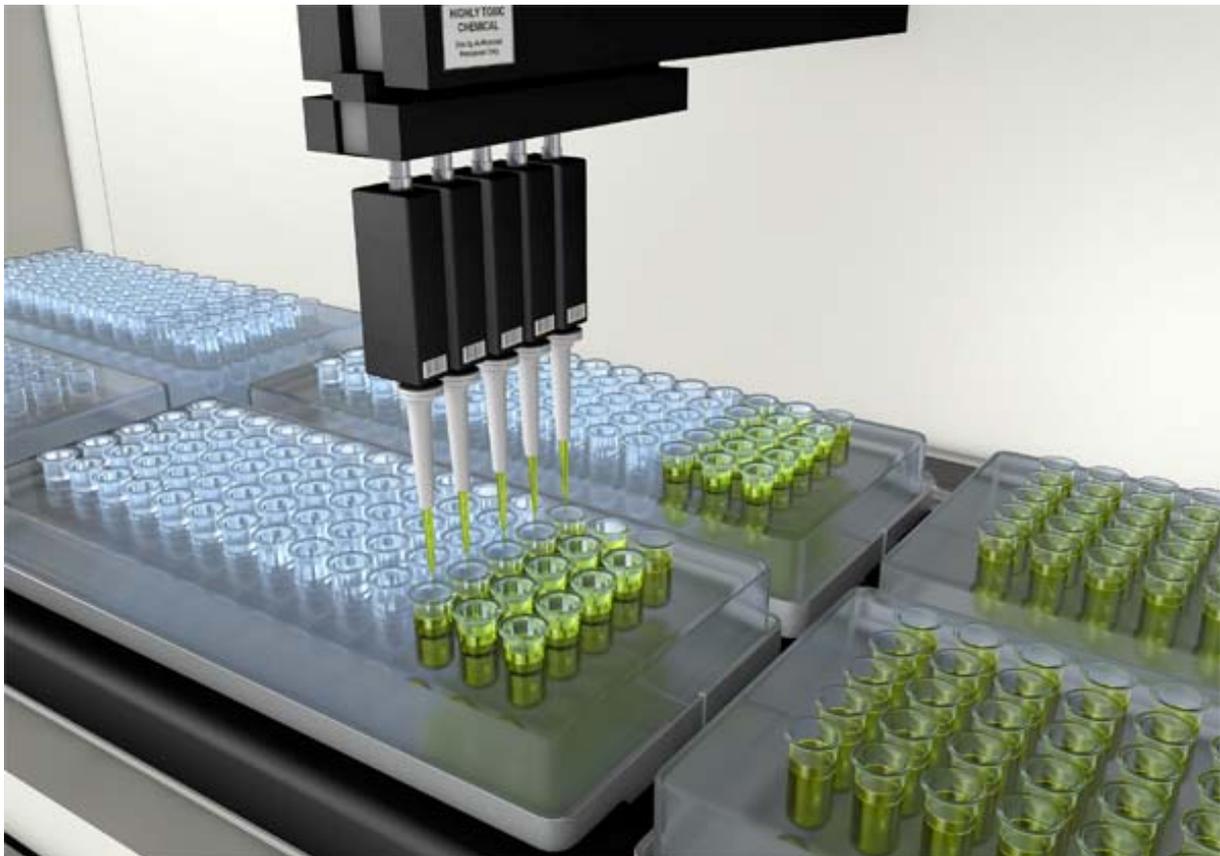


Fig. 6: Path and angle measurement for medical and analysis applications: pipette automation



Linear drive systems

Linear motors are used wherever fast movements must be performed with high reliability. Optical sensors are fitted directly to the motor in order to measure its movements. The tape used in the optical system has very compact dimensions, and the optical sensor head itself also has a small form factor. It is thus easy to integrate optical sensors into the drive unit.

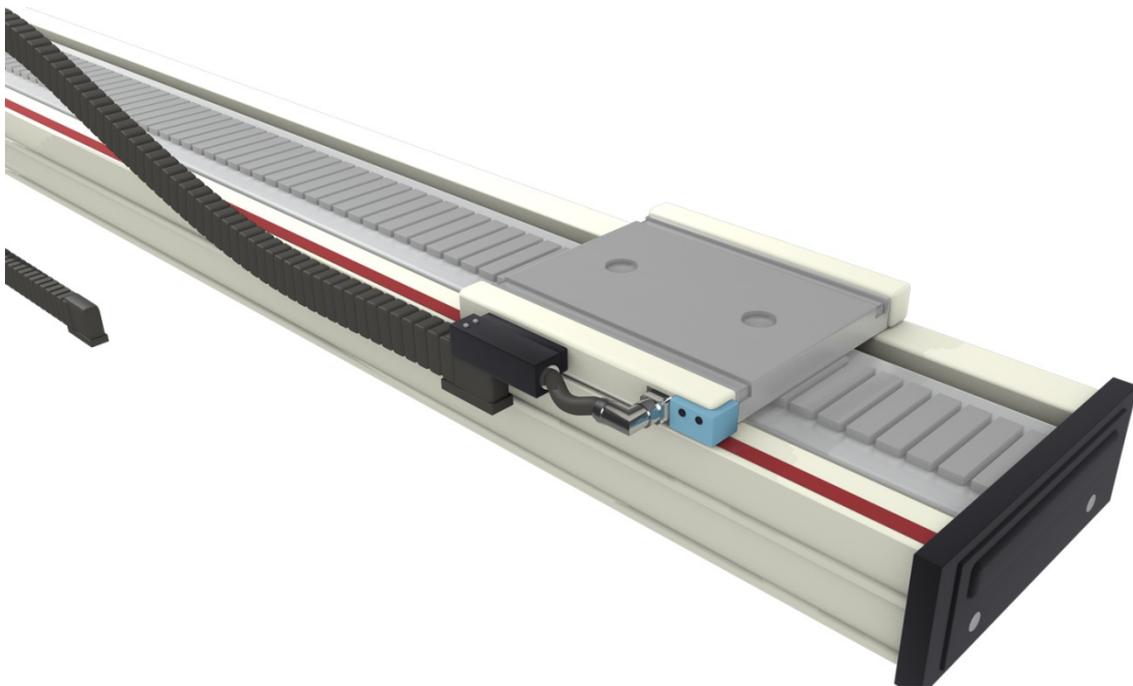


Fig. 7: Optical sensors provide accurate feedback on linear motors



4 Magnetic measurement systems: economically viable and simple to work with

In magnetic measurement systems the sensor travels along a flexible magnetic tape without touching it. The actual magnetic tape is mounted on a 0.3 millimeter thick layer of bearing steel. Magnetization takes place using defined pole pitches. A signal is generated when the magnetic pole is scanned. This is converted into digital square-wave signals, which can then be processed by downstream electronics. The sensors recognize the pitch of the tape and convert the information into high-resolution path information. No direct contact is required in order to read the magnetic field lines. The MSK5000 magnetic sensor, for example, allows a distance of up to 2 millimeters to the measuring surface.

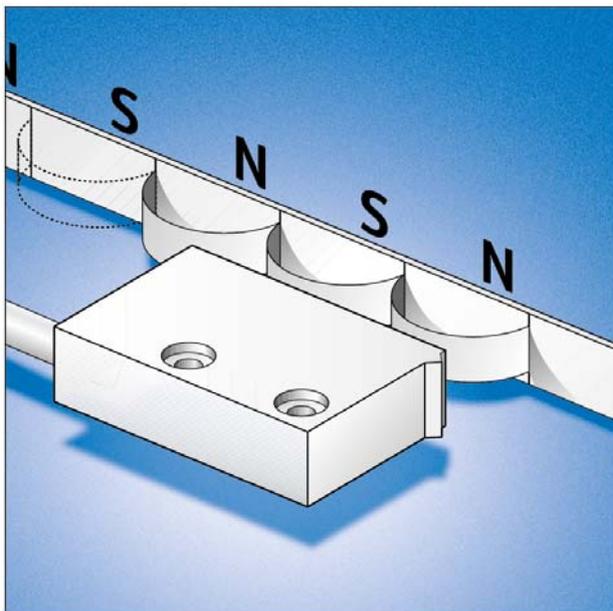


Fig. 8: Schematic illustration of the functioning of a magnetic measurement system





Incremental coding provides robust and cost-efficient all-round solutions. In an **incremental technique** the magnetic tape is magnetized into north and south poles at equal spacings. As the sensor moves over the tape, path information is sent in the form of squarewave signals. The distance covered can then be determined exactly in terms of the number of segments passed through. For the incremental measurement method it is normally necessary to set an absolute reference point. All paths detected are then relative to this defined reference point. This is particularly important where the system is re-energized after a phase without power. Without the magnetic coding of the reference point, fine adjustment must be carried out again in such cases by means of a reference run.

Where the magnetization of the tape is unchanged, such so-called **quasi-absolute techniques** allow the necessity for reference runs to be minimized. This method uses the principle of incremental position measurement. The electronics nevertheless buffers the data using an integrated battery. The reference system is thus retained even when the machine is switched off. Moreover, the use of lowest-power technology allows dependable operation over long periods of time. The sensors can be used for up to ten years without a battery change.

However, if the customer is prepared to invest in a somewhat more cost-intensive system, a system based on **absolute measurement data** can be used: No reference point is required in such systems since the magnetic coding defines unique positional values at every point on the tape. The absolute codings of the magnetic tapes increase measurement reliability, since when they are fitted with appropriate absolute sensors such as the Siko MSA111C they allow positions to be determined even when there is no power. After power outages, for example if the system has been disconnected and reconnected, the true positional value is recorded and converted even if the sensor position has been altered in the meantime. Depending on the design of the machine, this can be of considerable relevance to safety.



4.1 Advantages of magnetic tape length measurement systems

While optical systems are not longer than 30 meters, magnetic systems are available for up to 100 meters. As a rule, applications of this kind, such as warehouse logistics, do not call for extreme levels of precision. Far more important in such situations are mechanical resilience and insensitivity to environmental influences. Magnetic sensors are resistant to dirt, oil and moisture and relatively robust when exposed to shock and vibration. They thus offer the user a wide range of possible applications, such as for plant and equipment used out of doors or on machine tools. Another advantage of the magnetic tape is its flexibility of handling; the user can place the tape in stock as rolled goods and configure it himself.

As well as linear measurement, magnetic measurement systems can be used for rotational measurements of angles greater than 360 degrees (see Section 5: Special features of rotational systems).

4.2 Disadvantages of magnetic measurement systems

Compared to optical systems, magnetic systems generally have lower levels of absolute precision, resolution and repeatability. A magnetic field such as is present in a magnetic sensor can be detrimentally influenced by external ferromagnetic interference. This sensitivity to stray magnetic fields can reduce measurement accuracy. It may be noted that the disadvantages of magnetic measurement technology concerning measurement accuracy and ferromagnetic interference explain the advantages of optical measurement principles.



Advantages of magnetic measurement systems	Disadvantages of magnetic measurement systems
Not sensitive to dirt, oil or moisture	Lower precision
Wide range of applications	Lower resolution
Price advantage	Lower repeatability
Can be used at temperatures down to -40 °C	Sensitive to stray magnetic fields
Relatively insensitive to shock and vibration	
Not affected by condensation	
No need for physical encapsulation	
Up to 20 mm reading distance	
Flexibility in handling of magnetic tape	
Can measure rotations <u>greater than 360 degrees</u>	

Fig. 9: Advantages and disadvantages of magnetic measurement systems compared to optical systems



4.3 Applications of magnetic measurement systems

Magnetic measurement technology is robust and is used for contactless path and angular position measurement. The fields of application of magnetic sensors are many, covering all areas of mechanical engineering and industrial automation. They are used, for example, in linear and rotational drive systems (direct drive systems and motor feedback), in production machinery for furniture and parquet flooring and even in high-tech medical applications such as computer tomography. They are also suitable for extreme applications such as stone processing and glass machining. Magnetic sensors have also proven themselves particularly effective for the mirror tracking systems of solar power collectors and in stage technology, in forklift trucks and in waste and scrap compaction equipment.

Example applications include:

Woodworking

Wherever planing takes place, shavings are created – and this is always so in woodworking. The sensitivity of magnetic systems to such conditions is a crucial factor. Dust, shavings and aggressive lubricants from the machine can be harmful to sensors. Magnetic measurement technology is wholly resistant to these elements, while meeting all the requirements for precision. In industrial parquet manufacturing, an accurate and fast machine is used to ensure a high-quality end product. The parquet panels must fit together without gaps.



The requirements for precision when milling to the individual dimensions and the different profiles of the panels are fulfilled entirely by a magnetic sensor system.



Fig. 10: Autarkic electronic length stop for circular panel saws

Picture credits: Wilhelm Altendorf GmbH & Co. KG



Warehouse systems

In warehouse systems precision is less important than the need for large reading distances, i.e. the distance between the rule and the sensor. During maneuvers with a forklift truck it is essential to detect the exact position of the fork. The exact height of the fork must be known to prevent the vehicle topping forward or approaching the wrong storage space in a high-bay warehouse. Magnetic sensors are ideal for this purpose. Another example from warehouse systems are lifting platform-type elevators capable of delivering large items such as vehicles to the correct position. Here, magnetic measurement technology can be used to position vehicles in a car sales tower, for example.



Fig. 11: Magnetic measurement technology used in warehouse systems



Pick-and-place automation

The electronic components that are fitted to printed circuit boards are very small and must be delivered and positioned precisely by the placement machines. The requirement for precision is very high here. Depending on the specification of the machine, a magnetic sensor may be sufficient as regards precision, e.g. where the packing density of the PCB is not high and economic aspects are a decisive factor.

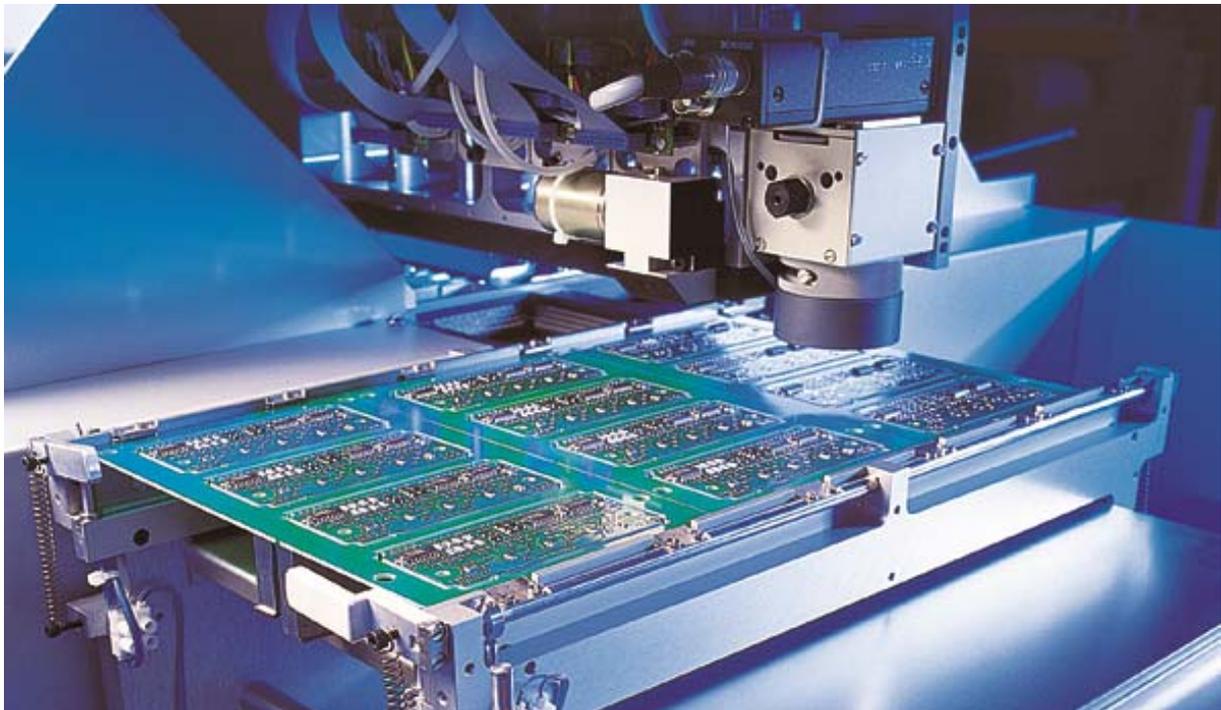


Fig. 12: Accurate PCB placement using magnetic measurement technology



Solar power systems

The comparatively robust magnetic measurement technology is used to determine the positions of solar mirrors and parabolic dishes. In solar tracking systems the solar reflector of one field containing several hundred individual mirrors must be controlled in such a way that the incident solar radiation of the individual mirrors are combined accurately within a heliostat unit. This then acts like a thermal power station to convert the solar energy into heat energy. The more accurately the solar rays are projected into the heliostat, the more efficiently the system operates. The positioning of the solar reflector axes must therefore be as precise as possible. Since the system is however also subjected to weather effects such as temperature fluctuations, moisture, UV radiation and the like, the measurement system should be resistant to these factors. This is a typical application for magnetic sensors.

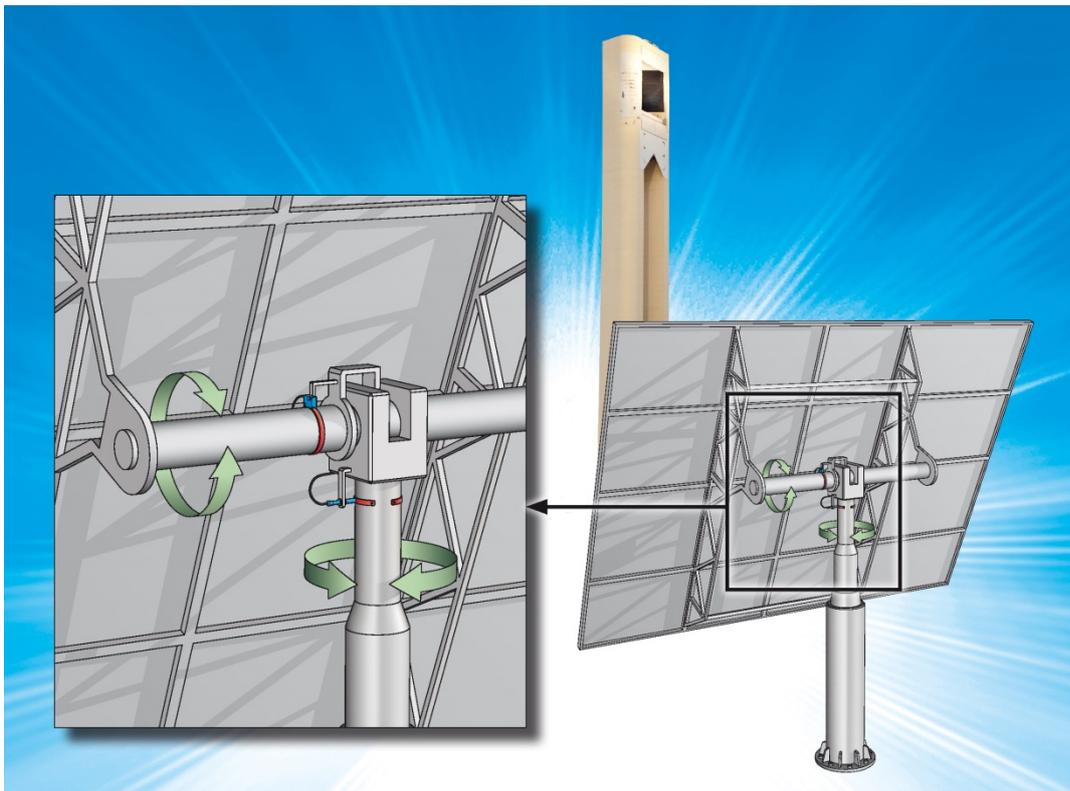


Fig. 13: Precise solar tracking to maximize revenue from solar energy



Linear drive systems

In linear drive applications, both magnetic and optical sensors are commonly used. The deciding factor is the sensitivity of the measurement system to stray magnetic fields, since linear motors can create electromagnetic radiation in their vicinity that has a negative effect on the magnetic sensor. Where the motors are used in harsh conditions, however, magnetic sensors have become the established choice despite their sensitivity to magnetic interference, provided that a defined safety distance is maintained between sensor and motor.



Fig. 14: Magnetic sensors provide the necessary feedback on linear motors



Medical and analysis systems

In medical and analysis systems, the choice between an optical and a magnetic measurement system is determined by the precision level required. Magnetic technology can thus also provide the system required for pipetting systems or centrifuge units. A magnetic measurement system is responsible, for example, for the positioning of the patient table in a computer tomography (CT) unit (height, inclination and position within the unit). The measurement system also captures the position of the patient on the table, which has a direct effect on the precision of the scan.

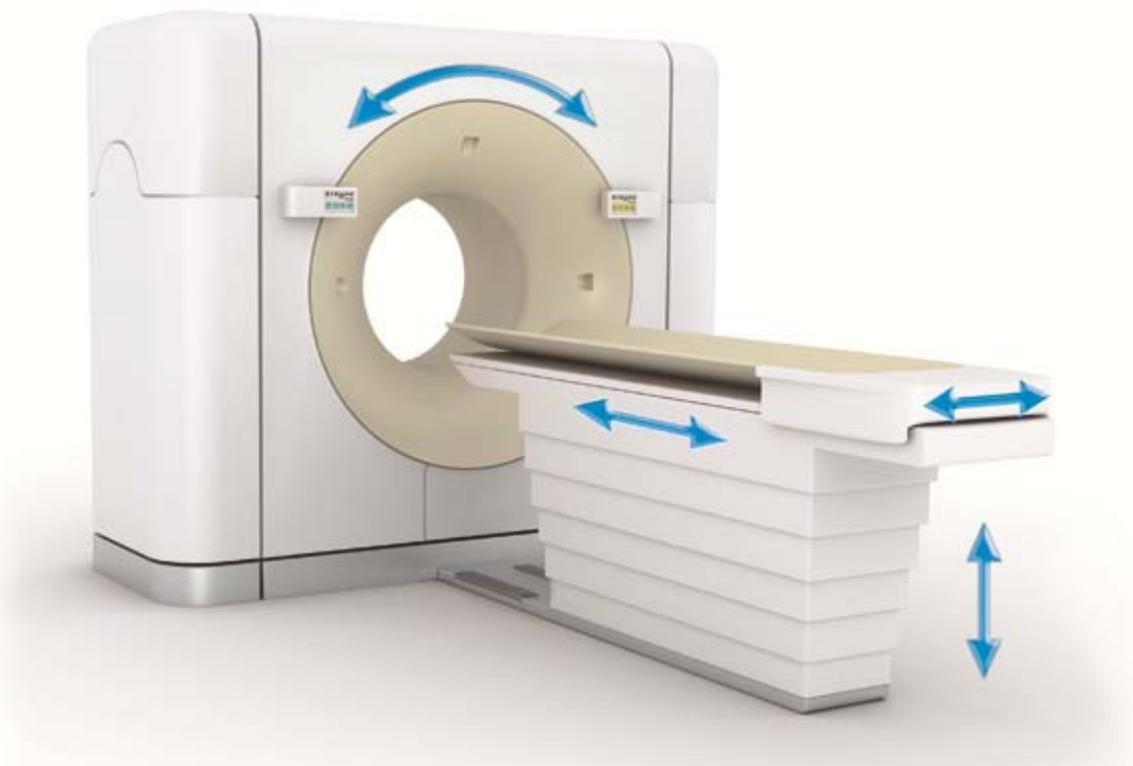


Fig. 15: Rotational and length measurement in a computer tomography unit



Digital printing

In digital printing, dimensions are normally specified in the international unit of inches. Siko measurement technology enables the measurement system parameters to be set exactly in this unit. Thus resolutions can be set not only in terms of metric units but also in terms of the US customary measurement system. For many other measurement systems, this modification entails significant extra expense in making adjustments and reprogramming.



Fig. 16: Digital printing application

Image credit: Ecosolvent printer - stock image, istockphoto.com, Insanet



5 Special features of rotary systems

Path measurements of circular movements bring with them specific challenges. Despite the fact that turning and swiveling are standard operations in mechanical engineering, they nevertheless pose challenges to the designers of measurement systems that should not be underestimated. Siko offers magnetically coded measuring tapes in the form of flexible magnetic rings with no flange or glued with a metallic ring (flange). By attaching the tape to the ring, joints would unavoidably occur that would cause measurement errors. To prevent this, Siko has established its own ring production facility in which the tape is first attached and then coded. This assures a system precision of up to $\pm 0.01^\circ$. In addition to a portfolio of rings in different sizes, Siko also offers custom modifications. From a certain flange diameter upwards, Siko tapes can be fitted by the customer to allow angle measurements below 360 degrees. Where larger quantities are involved, customers also have the option of having their own rings coded by Siko.

For magnetic sensors Siko offers ready finished measurement rings that have such a high quality of manufacture that they can be used for measurements greater than 360 degrees. As for optical sensors, Siko does not offer rings but rather measurement tapes that are affixed to the flange. From a diameter of 50 mm upwards, angle functions below 360 degrees can be measured. The handling of the tapes in rolled form is significantly more demanding in the case of optical systems and must be performed by trained personnel with suitable qualifications. As a consequence, while swiveling axes can be measured using optical sensors in an open construction design, continuous rotational movements cannot. Thus optical sensors can be used successfully with this technique to capture the cutting angle of a saw in mitering operations, while the rotations of the shaft of an electric motor are much more easily recorded using a magnetic system (such as a bearing-free system).



6 The Siko MagLine product family: magnetic length and angle measurement systems

To help the user find his way about the product range Siko has arranged the products by their basic specifications and applications into four product families. These are:

6.1 MagLine Micro

Products in the Micro family have the highest levels of system accuracy and repeatability. They have been developed specially to meet the needs of high-precision and dynamic processing environments. They are thus used particularly in linear and rotational guidance and drive systems. Many applications that would traditionally involve cost-intensive glass scale solutions can instead be equipped with this economical and flexible form of sensor system. Compared to optical methods, magnetic sensor systems demonstrate greater robustness and are less susceptible to interference. The precision of their measurements are not affected by the typical effects of machines - vibrations, oscillations, shocks and so on. When used on machine tools, robust magnetic sensors can withstand the unavoidable contamination (with swarf, lubricants etc.) and mechanical stresses. To minimize the possible sources of mechanical errors, no moving parts are used in the sensors. The electronics are entirely encapsulated. Tough plastic or all-metal enclosures ensure that the sensors continue to function correctly even when in direct contact with liquids or solids within the machine.



Both incremental and absolute measurement systems are available.

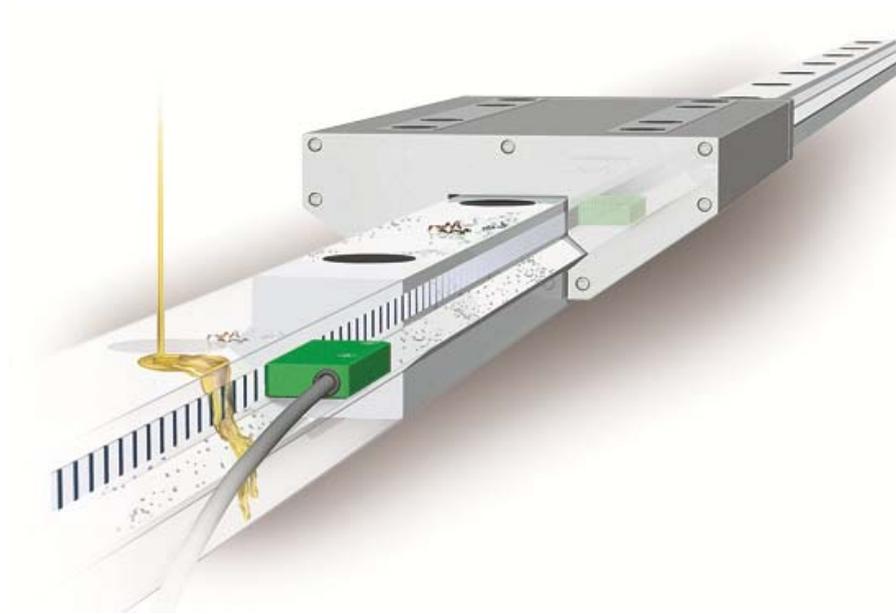


Fig. 17: MagLine Micro with a maximum resolution of 0.2 μm (200 nm)



6.2 MagLine Basic

In the Basic product range the emphasis is on low system cost. These sensor solutions have proven themselves particularly for any application that does not require the highest levels of mechanical precision. Satisfied customers are to be found in fields such as woodworking, metalworking and stoneworking. These systems can also be used in glass or plastics processing machinery. Thanks to the diversity of potential fields of application, the Basic family is also the widest of our product ranges. A very successful part of the Basic family is the Ready-to-Use range - a group of sensors that feature their own display.

These are used in combination with a self-adhesive magnetic tape that can be fitted easily by the user at the measurement point. Thus the length stop of a saw, for example, can be fitted for a minimal outlay.

This product family also offers both incremental and absolute measurement solutions.

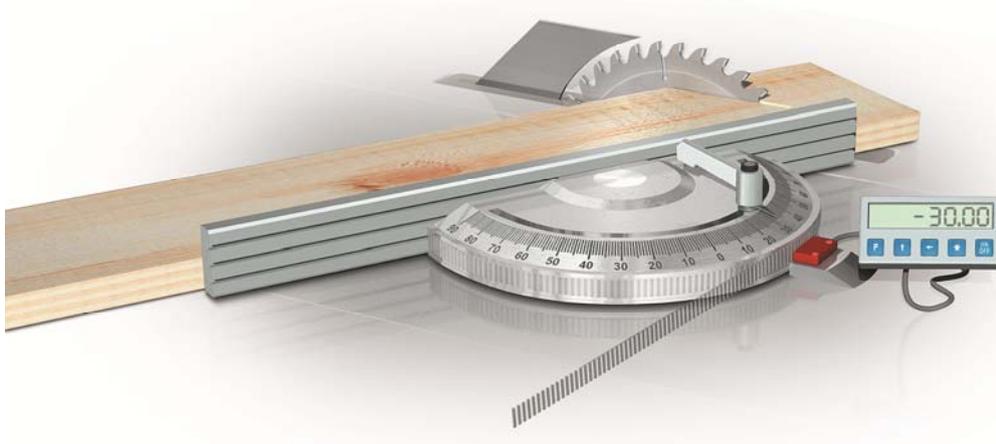


Fig. 18: MagLine Basic with a maximum resolution of 1 μm



6.3 MagLine Macro

The Macro family offers solutions for where long distances are to be measured. This contactless measurement technique enables height differences, which invariably arise above a certain measurement length, to be compensated. For the specific challenges of warehouse and materials handling systems it is a significant advantage that reading distances can be up to 20 mm. In stage and studio technology also, exact position measurement of the order of millimeters together with ease of integration into control systems from various manufacturers is a primary consideration in the purchasing decisions of many customers. In this field, the possibility of measuring the complex interplay of multiple moving parts from a central location to millimeter precision is particularly valued. As with its other product ranges, Siko again places great importance on the physical robustness of its long-distance sensors. They meet the specifications of the international protection class IP 67. This provides such high protection from external influences that they can be used in even extreme environments such as in stoneworking.



Fig. 19: MagLine Macro with a maximum resolution of 0.25 mm



6.4 MagLine Roto

The Roto product range enables the angles and rotations of rotational movements to be measured. These sensors can be used in an open, bearing-free configuration as a low-cost alternative to conventional optical rotary encoder systems. Here again, magnetic systems have the advantage of being capable of reliable operation in harsh environments that would make the use of optical sensors difficult. An example is on wheel balancing machines. The system operates reliably even in an oil bath. The advantage of measurement without moving parts proves itself particularly clearly in elevator systems, where continuous operation unavoidably leads to severe mechanical stresses in measurement systems with direct contact and thus to considerable maintenance outlay and downtimes.

The operating temperature range for magnetic sensors is generally about -10 to $+70$ °C. For special applications such as mobile automation, however, systems are available that operate in the range -40 to $+85$ °C.

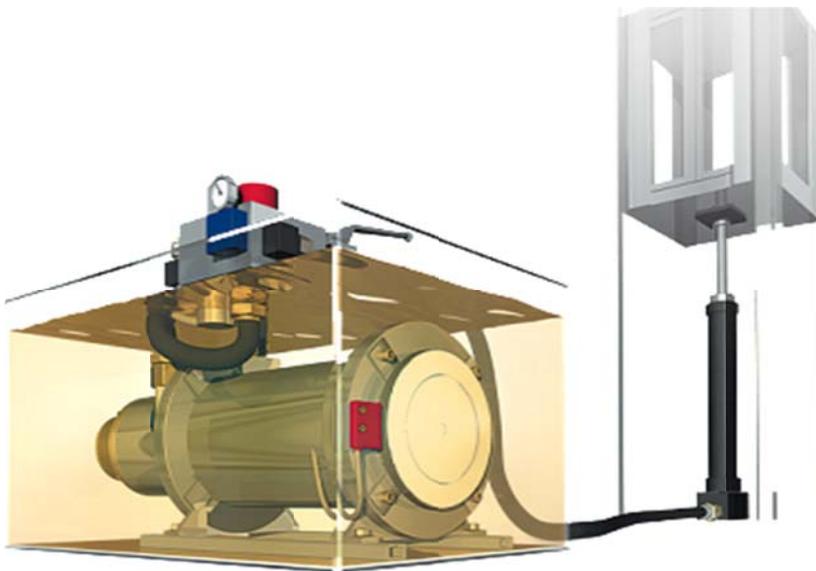


Fig. 20: MagLine Roto with a maximum resolution of 0.001°



7 OptoLine: optical sensors from Siko

The Siko OptoLine product range includes the LSC20 optical incremental sensor and the TS20 optical measuring tape. Both these devices measure lengths and angles using optical principles. As with the MagLine product family, the OptoLine is an open measurement system that is simple to install and requires minimal space. It can thus be flexibly integrated into either new or existing systems.

The LSC20 optical sensing head has the following dimensions: 34.3 mm x 14.3 mm x 11.7 mm. The sensing head accommodates both the sensor and the interpolation circuitry. The mounting tolerances of the device are very high, of the order of 1 mm +/- 0.15 mm. A three-color adjustment LED (green, red or yellow) is fitted to the sensor head. The LED output indicates to the user when the alignment of the optical sensor and the optical tape is correct, even in awkward installation conditions.

Provided with the unit is a 15-pin D-sub plug for connecting on a plug-and-play basis to the DT20 diagnosis tool. The plug contains no electronics, and so the sensor can operate without it, even with an open cable end. The precision of the optical sensors is $\pm 5 \mu\text{m}$, irrespective of the measurement distance. The sensor signals are output in a resolution of either 0.1 or 0.05 μm ; the maximum possible traverse speed depends on which of these is selected. With a resolution of 0.1 μm , this optical sensor issues reliable signals even at 3 m/s.

The TS 20 optical tape consists of a flexible metal strip with etched microstructures of a width of 20 μm . It has a thickness of 0.2 millimeters and a width of 6 millimeters and can be supplied in lengths of up to 30 meters.

Operating temperatures of up to +70 °C are possible. It can be stored at temperatures in the range -20 to +85 °C. While the optical tape is in use, the relative air humidity should be between 10 and 90%.



8 Conclusion

For all fields of application the same rule of thumb applies: the greater the overall length of the unit to be measured, the greater is the price advantage of magnetic over optical solutions.

The market for contact-free and self-finishing measurement systems has become highly differentiated in recent years. Modern production techniques have now made it possible to manufacture measuring tapes for magnetic systems that have largely overcome the earlier weaknesses of this technique. Measurement precision levels of up to ± 10 micrometers mean that these sensors can even be used in high-precision CNC machine tools. The low susceptibility of these sensors to contamination from swarf and lubricants is a significant advantage over the glass scales that were almost exclusively used in the past. Unlike these, magnetic measuring tapes are available in roll form and so offer great flexibility in use.

An interesting compromise between traditional glass rules and magnetic sensor systems has emerged in the form of configurable optical measurement systems. They can also be stored in a warehouse and adapted to suit the object to be measured. They are significantly more precise than the highest-resolution magnetic systems, but this accuracy comes at the cost of increased requirements with regard to ambient conditions. Measurements can be distorted by either heavy contamination or condensation. A major advantage of optical systems is their lack of sensitivity to magnetism, which suits them to use in linear drive systems.

Many factors must be considered when deciding between an optical and a magnetic measurement system. These include the absolute precision and repeatability required, vulnerability to stray magnetic fields and to ambient conditions, and economic aspects in terms of cost efficiency. Here a provider of measurement technology is invaluable who can offer solutions oriented to the customer's specific specifications and can adapt the measurement technology to the exact requirements of the measurement task.





Contact:

SIKO GmbH
Weihermattenweg 2
79256 Buchenbach
www.siko-global.com

MagLine product range

Andreas Wiessler

MagLine division head
Tel.: +49 7661 394-358
E-Mail: andreas.wiessler@siko.de

OptoLine product range

Kerstin Graw

OptoLine product manager
Tel.: +49 7661 394-254
E-Mail: kerstin.graw@siko.de



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