



# APPLIED MEASUREMENTS LTD.

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MICRO-EPSILON



## More Precision.

wireSENSOR applications





### wireSENSOR measurement principle

Draw-wire displacement measurement is classified as a contact measurement method. Every draw-wire sensor consists of the basic wire elements, drum and spring motor (combined as mechanics) and a potentiometer or encoder for the measurement signal generation. Draw-wire sensors are ideal for applications with large measuring ranges, small sensor dimensions and when a low cost solution is required.

Depending on the sensor design, the wire is normally an extremely thin steel wire, which is sheathed with polyamide. The wire is around 0.8mm thick on average, depending on the type of stress forces involved.

### From the movement to the electrical signal

With a draw-wire sensor, a linear movement is transformed into a rotary movement.

The free end of the wire is attached to the movable body. An optional eyelet at the free end of the wire can be screwed onto or attached to the measurement object. The rotary movement produced by drawing out the wire is converted into an electrical signal using a rotary encoder.

A spring motor provides sufficient pre-tension of the wire. The spring motor is a coil spring with torque load, similar to those used in mechanical watch mechanisms. The further the wire is drawn out, the higher the tensioning force of the spring. In horizontal mountings, this has the benefit of minimising wire sag.

### Benefits of draw-wire sensors

- Very compact design compared to the measuring range
- Telescopic measurement principle
- Very robust sensors
- Measuring wire can be deflected using deflection pulleys



### Possible types of output

#### Analogue connection

There are basically three different types of precision potentiometer used in draw-wire sensors from Micro-Epsilon: wire potentiometers, hybrid potentiometers and conductive plastic potentiometers.

Conductive plastic or hybrid potentiometers are usually used for standard products. For high volume production applications, selection is made based on the required specifications for the application in order to achieve an optimum price/performance ratio for the customer.

#### Digital connections

Compared to analogue potentiometers, encoders have a significantly longer service life and better linearity. Incremental or absolute encoders are available depending on the application. Both types of encoder are fundamentally different from each other. Incremental encoders are used where the relative position displacement should be measured. In contrast, an absolute encoder assigns a unique position value to each measured value.

## Applications in medical engineering

### Position measurement on X-ray machines

X-ray machines must provide high quality images in different positions. Previously, an X-ray cassette with film had to be manually aligned with the X-ray tubes. Today, this is performed digitally and is fully automatic.

Modern equipment functions with a camera that digitalises the recordings directly. This saves time and development costs. The camera must be exactly aligned with the X-ray tubes so that high-resolution recordings are produced for digital equipment. The cameras, the X-ray tubes, the table and the wall stands can be moved on several axes, providing as much flexibility as possible.

Draw wire sensors measure five different positions in an X-ray machine.

This parallel running means that the best possible focussing of the X-ray tubes for the camera is achieved.



- ① Height position of the camera
- ② Height position of the X-ray tubes
- ③ Horizontal table position
- ④ Vertical table position
- ⑤ Horizontal camera position



#### Benefits to the customer:

- Simple mounting
- Telescopic sensor
- Favourable price performance ratio
- Durability

### Monitoring of Training exercises on rehabilitation and therapy machines

"Ideal design costs and performance" are important requirements when it comes to the conceptual design, physical form and carrying out of rehabilitation measurements. As well as the most modern devices, an intelligent method data recording, control and documentation is also needed for implementing these requirements. Information about the performance of training exercises can be provided to a trainer by using a network or chip card. The medically-ideal performance of exercises can be monitored, therefore avoiding both the under-challenging and overworking of the patient. In this way, optimum efficiency with regard to the medical success of the therapy and the best possible economic utilisation of the equipment can be achieved.

In order to provide this information to the trainer, sensors that measure the execution of mo-

vements on the machine are required. As well as force sensors, displacement measurement sensors can also be installed, which measure and output the displacement and chronological progress of movements.

Due to the installation size and favourable price/performance ratio, MK30 and MK46 series draw-wire sensors are ideally suited for these applications. Depending on customer requirements, analogue potentiometer-based outputs or digital encoder-based incremental signals are available.



#### Benefits to the customer:

- Simple mounting
- Telescopic sensor
- Favourable price performance ratio

## Angle measurement in SoloAssist®

SoloAssist gives surgeons a helping hand by reducing the cost per operation and improving quality

The device resembles an arm and can be moved in several degrees of freedom, whilst noting and maintaining its position. Starting from a calibrated zero point, the device automatically performs the required incremental movements in order to traverse a complete specified movement. An endoscopic camera is guided by the robot arm thereby achieving a 360-degree view with up to 80-degree incline from the perpendicular of the endoscope.

The arm is largely designed to be MR- and X-ray neutral, which is why sensors are not used in the area directly above the operating table. For this reason, direct measurement of the turning movements of the arm with angle sensors is not possible.

The angle of rotation is therefore determined indirectly by using draw-wire sensors, which are installed underneath the operating table. A total of three MK30 Series sensors are installed, which measure the rotation movements shown in Picture 1. Due to the compact size of the installation, mounting is easier and reliability improved, Micro-Epsilon's draw-wire sensors are ideal in meeting customer requirements .

The sensors provide a displacement or angle proportional output signal (potentiometer). Alternatively, digital incremental output signals are also possible.



### Benefits to the customer:

- Measurement outside the actual arm
- Very compact design
- Easy integration of the sensor

## Position measurement in Computer Tomography (CT)

In the latest CT equipment, the most effective diagnoses are determined by how precise and fast the measurement systems are (speed and resolution), as well as their cost effectiveness. Irrespective of whether spiral, helical or dual source apparatus is used, the requirements are continuing to increase.

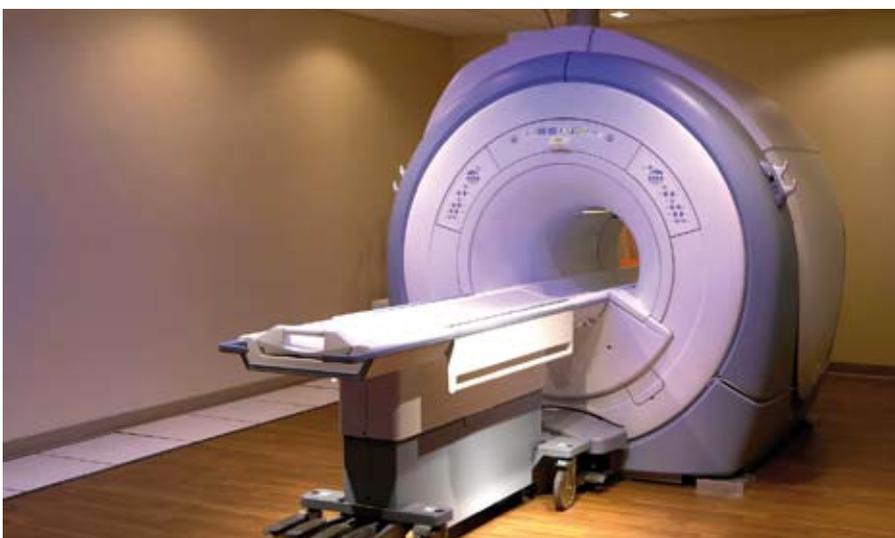
In particular, this also concerns the length measurement equipment for the horizontal reclined position. In order to obtain the best possible overall image of the target, the individual X-ray sections, which normally travel through the object, have to be measured with smaller and smaller spacing. To do this, the sections are compiled in a 3D reconstruction to obtain vo-

xels (volumetric and pixel). Based on this complete volume data set, any 3D views or sectional planes can be produced (see 3D image).

In order to correctly assign the sections, the horizontal position of the couch has to be measured precisely. Therefore, a measuring system with very high resolution and long measuring range is required.

In this application, draw-wire sensors from Micro-Epsilon achieve a resolution of up to 0.001% of the measuring range; this is combined with maximum reliability, long service life and a very favourable price/performance ratio.

A number of different sensor designs and signal outputs (analogue, incremental digital or absolute digital) are available which means the sensors can be adapted easily to individual customer requirements.



### Benefits to the customer:

- High reliability
- Long sensor service life
- Simplified mounting
- Attractive price/performance ratio

## Positioning of operating tables

Utilisation and cost efficiency are playing a more important role in modern medical operating procedures. This is also true for the operating tables. The latest operating tables offer numerous functions for precise handling

of the patient and are also efficient and cost-effective.

The tables are modular in design and provide multiple adjustment options for precise positioning of the patient during an operation. As well as the height of the table, the horizontal position

and several angle functions, e.g. for the head, torso and legs, can also be adjusted. Complete patient profiles can be pre-programmed for certain positions or can be created by the user and then called up with a single press of a button. Important personnel and cycle times can be saved using this function.

However, in order to facilitate the precise positioning of the adjustable elements of the operating table, suitable measuring technology is required.

Draw-wire sensors from Micro-Epsilon are ideally suited to this task. With regard to the measuring range, these sensors combine a compact design with high precision and long service life.

In addition, the sensors can be easily integrated to the operating table and provide an excellent price/performance ratio. Draw-wire sensors are usually used for vertical and horizontal table positions. However, the sensors can also be used for (indirect) angle measurements in certain cases, since angle sensors often cannot be installed on the rotational axes due to restricted space.

This means that up to five draw-wire sensors can be used on an operating table.



### Benefits to the customer:

- Long sensor service life
- Very compact design

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## Available sensor series

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### wireSENSOR MK30/MK77/MK120

The MK series is available in the measuring ranges between 50mm and 7500mm. The sensors are characterised by a robust plastic housing and a very compact design. Potentiometer and incremental encoder outputs are available. MK sensors have a particularly long service life, a high protection class and high precision.



### wireSENSOR MPM/MPW

The MPM / MPW series with measuring ranges from 50mm to 1000mm are used for particularly challenging ambient conditions. This means that the wire acceleration can be very fast; the service life is not affected by accelerations of up to 100g. Despite the robust metal housing, the sensor has a surprisingly compact design. The mounting flange contributes to the sensor's high flexibility. This is tightly fastened and the sensor remains freely rotatable on it.



### wireSENSOR P60/P96

A very high number of applications can be solved using the P60 series, which has measuring ranges between 100mm and 1500mm, with the P96 offering even higher measuring ranges of 2000mm and 2500mm. These sensors are extremely robust due to their metal housing and can be easily installed using the mounting rails.



### wireSENSOR P115

The P115 series is available for larger measuring ranges. Also with mounting grooves, metal housing and high spring force, the P115 series is comparable to sensors in the P96 and P60 series. Measuring ranges between 3m and 15m are used. All common field bus and analogue outputs are provided for the connection of the sensor.



### wireSENSOR P200

The P200 sensors are used for extremely large measuring sections such as those in lifts or elevators for example. Their measuring range reaches up to 50m and therefore represents the upper limit of measuring ranges that can be achieved using draw-wire sensors. Nevertheless, the compact design and flexibility of use due to mounting grooves opens up a wide range of potential applications.



### wireSENSOR Mechanics

Many different draw-wire mechanisms with up to 15m measuring range are provided for customer-specific encoders or potentiometers. These mechanisms consist of the complete sensor, but without the electronics component. Using a special adapter, the customer can install almost every encoder on the mechanism.

### Specific Sensors

Despite the range of wireSENSOR models available, application-specific modifications to the sensor are often required to suit a specific application. For high volume production, Micro-Epsilon can modify the sensor according to customer requirements. Modifications are often made to the length and design of the measuring wire, the tensioning force of the spring package or different output types.

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