Long Awaited

Contactless inductive linear position sensor systems were previously restricted to short measuring distances. However, Turck has now further developed its Li series inductive linear position sensors so that they now achieve measuring lengths of up to two meters

Trends have a sell-by date. Initially only a few "early adopters" have the new product. Bystanders continue to look on and some ask a few questions. People in the business world are invited to congresses and podium discussions about the new subject. After some time and depending on the area, the trend becomes standard, main stream or state of the art, or it dies the quiet death of the few good ideas.

A few years ago, the highly dynamic measurement of linear movements over entire ranges of travel could be considered to be a trend in machine building. Today, this has become a standard application. If dynamic movements have to be measured without a large dead time, such as in pick-and-place applications, the position of the moved unit must be known at any time. This can be done indirectly via encoders on the drive or directly on the moved axis with linear position sensors. Immediate position sensing directly on the axis offers high precision and excludes any inaccuracies caused by transfer elements from the drive to the axis as well as any play.

Even with a measuring length of two meters, Turck's inductive linear position sensor system achieves its high linearity values and samples the measured value at a sampling rate of 5 kHz

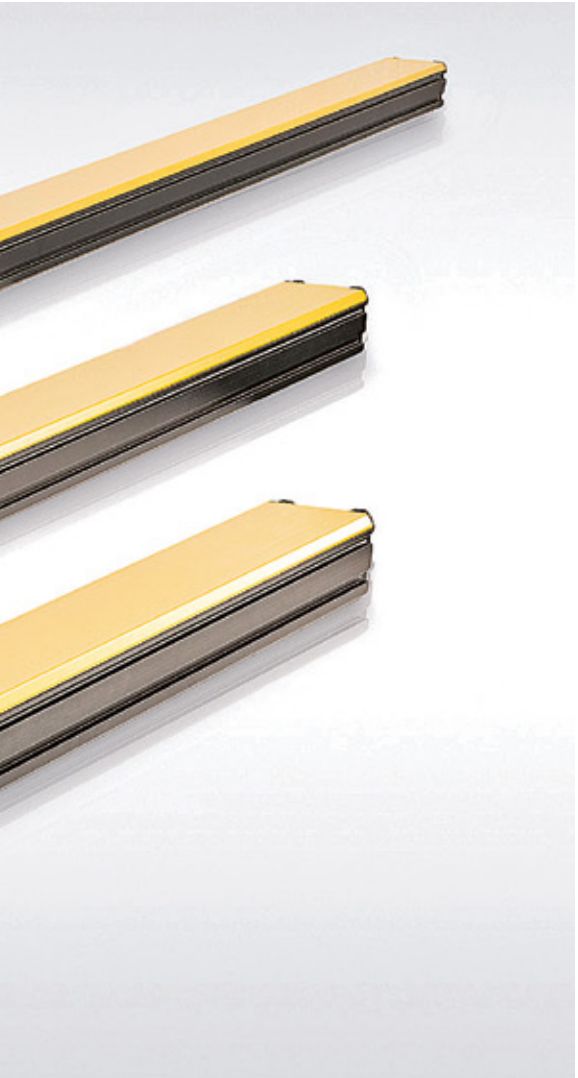
Linear position sensing: potentiometric, magnetostrictive or inductive

Three measuring principles represent the leading methods of measuring linear movements in industrial

automation: The potentiometric, the magnetostrictive and for almost ten years now the inductive measuring principle. Besides these types, magnetically coded or optical measuring systems are also used.

Potentiometric and magnetostrictive measuring systems are the most widely used systems. Like everything else, these also have their benefits and disadvantages. Potentiometers do not have contactless operation. A load-free and play-free coupling between the measuring system and the moved unit to be measured is absolutely essential in order to minimize wear. Too much pressure or too many knocks on the moved unit may considerably increase the wear of the wiper inside the potentiometer. This system therefore requires a lot more care when mounting than with other systems. The mechanical coupling of the slide contact on the conductor can also be a problem if dust or condensation get inside the devices. This becomes increasingly more likely as the sensor seals age and thus also impairs measurement. The characteristics of the sensor change, mostly unnoticed by the operator.

Magnetostrictive systems are designed for contactless operation so that the above disadvantage is excluded; a high level of vibration and severe shock, however, also impair linearity here, and dynamic properties are lost as the measuring length increases.



After all, the further away a measuring point is located from the processor unit, the longer the time required for the measured value to be determined, so that the sampling rate has to be reduced. The installation of this system in the metal industries is not recommended without protection. Metal dust can easily adhere to the magnetic positioning element, causing linearity errors in the sensor. However, it is the ideal solution as a protected mounting inside a fluid cylinder and is offered by Turck as LTX or LTE for mobile applications.

»Turck's Li Sensor provides consistently accurate readings – even with vibrations or shocks up to 200 g«

Inductive measuring principle eliminates disadvantages

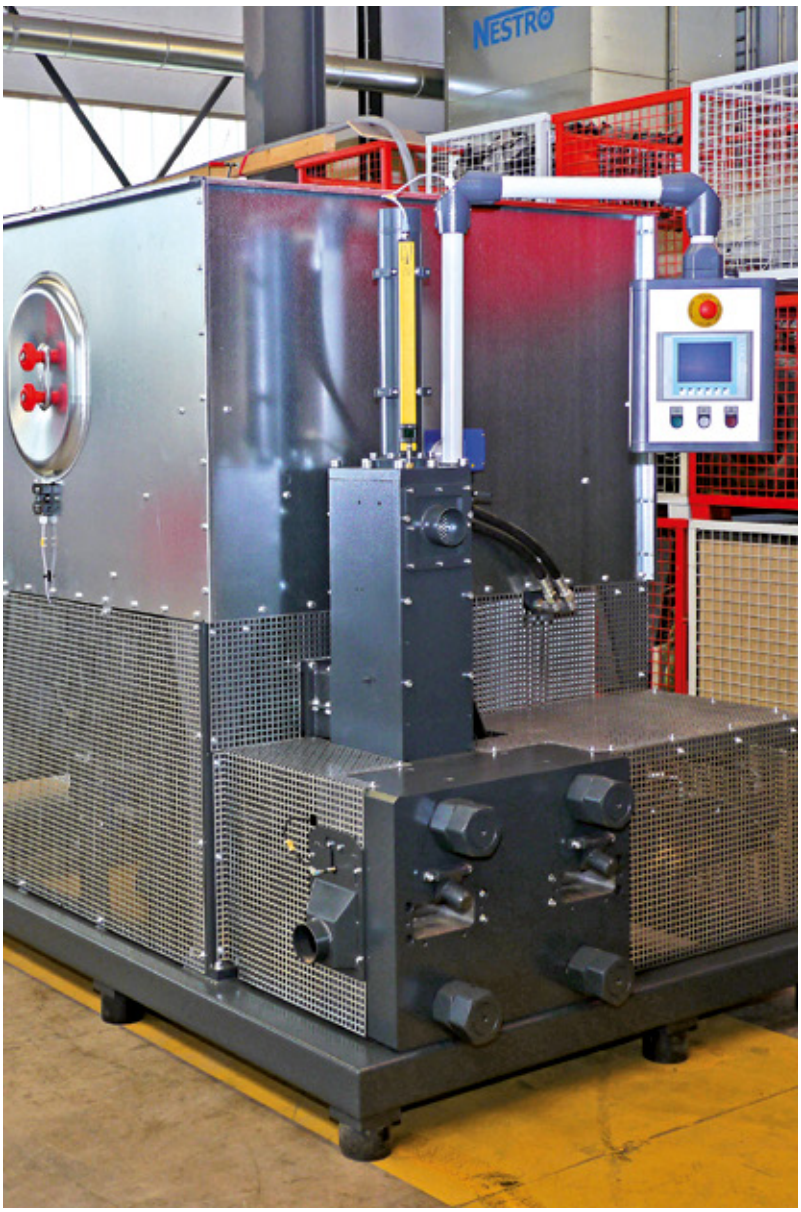
The new generation of inductive linear measurement solutions from Turck eliminates the disadvantages of potentiometric and magnetostrictive sensors and combines their benefits. The Li sensors offer virtually as fast and high resolution operation as potentiometers while being considerably more shock-proof than magnetostrictive systems. This also offers impressive results with a high degree of immunity to magnetic fields, less linearity error and a high repeatability of the measuring signal.

High five kilohertz sampling rate

The Turck automation specialists are the first manufacturers in the world to offer inductive linear position sensors in lengths of up to two meters. The long

QUICK READ

Turck's inductive linear position sensors have been able to offer outstanding performance in many applications, thanks to their combination of robust design, precision, immunity to magnetic fields and high resolution. Turck is now presenting a new generation of the inductive Li linear position sensor series with devices for measuring lengths from 0.1 to 2 meters. The sensor series upgrade also includes an increase in the sampling rate to 5 kilohertz and the shock resistance of the device to 200 g. Alternative measuring principles can no longer compete with these specifications.



The compact briquetting press from Weima has already been operating with an Li sensor for years – models for large measuring distances up to two meters are available

variants are often required by customers who up to now use magnetostrictive systems and have to accept their disadvantages. The reduced sampling rate for long sensors and the resulting non-linearity in particular often led to unsatisfactory solutions such as extrapolated measured values. With measuring lengths over a meter, potentiometers were an unlikely alternative: The production of such a long and precise conductor path, and thus the sensor itself, is very expensive. Whoever can afford it must nevertheless live with the mechanical disadvantages of the potentiometers.

Shock-proof up to 200g

The entire series of the new inductive Li linear position sensors was also improved in other key areas besides the measuring length. All devices now withstand even greater shocks up to 200 g and severe vibrations. However, unlike other systems they also maintain their linearity values even during the shocks and vibrations. With magnetostrictive systems on the other hand, the waveguide in the metal rod buckles at the moment of shock. Its length changes indirectly in relation to the processing unit so that magnetostrictive systems produce a corrupted measured value. If the shock spectrum is on the resonant frequency of the magnetostrictive sensor, measurement is permanently prevented.

The inductive Li sensors benefit from their electromagnetic design. The system tolerates a lateral and horizontal offset of the positioning element to the sensor profile without any loss in the position signal. This function ensures reliable measured values particularly when used on vibrating machines, such as in marking presses.

The sampling rate of the device was also increased to five kilohertz throughout irrespective of the measuring length. This minimizes positioning errors in highly dynamic applications. The measuring principle of magnetostrictive systems prevents them from achieving these sampling rates without interpolation. These become also slower the longer the measuring distance. The torsional wave, which through the measuring principle moves from the positioning element towards the processing unit, is simply too slow compared to the speed of the electrical signal.

16-bit resolution

All Li sensors also now convert a 16-bit resolution digital signal to the appropriate output signal, such as to a 4...20 milliampere analog signal or 0...10 volt signal. Turck has also provided the new devices with an error diagnostic value. If the device does not detect a positioning element, the output signal is set to 22 milliamperes or 11 volts. This function is very useful, particularly for online sensor diagnostics or for detecting mechanical defects on the machine.
The new Li devices are initially available as analog

Inductive linear position sensor system

Turck's inductive linear position sensor system is based on the so-called resonator principle. Unlike magnetostrictive sensors, position sensing is not implemented via a magnetic positioning element, but with a resonator, i.e. an oscillating system consisting of a capacitor and a coil. Operating principle: A transmission coil installed in the IP67 sensor housing generates an alternating field which excites the positioning element. This then induces a voltage in the receiver coils of the sensor. The internal 16-bit processor determines the exact position from the induced voltage.

Potentiometric linear position sensor system

Like any potentiometer, potentiometric linear position sensor systems operate with a resistor with a movable pickup – the slide contact. With linear position sensors the slide contact is the positioning element. Due to their operating principle, non-contact operation is not possible with these systems. However, they are normally designed in housings with a positioning rod, which thus achieve IP67. The seals at the output of the positioning rod are the Achilles heel of the potentiometers. Wear and friction affect them over time. The measuring lengths of linear potentiometers are theoretically unlimited. However, for actual industrial applications there are very few models with measuring lengths over a meter, as this involves much higher manufacturing costs.

variants with a combined voltage/current output. The device is factory set to output both values simultaneously, the voltage value via pin 4 and the current value via pin 2. This enables the user to use a value to operate a control display unit in the field and thus send the other value to the higher-level machine controller. A second position signal is also useful for diagnostic tasks. Correct operation is indicated as long as the absolute position of the output signal on pin 4 equals the signal on pin 2.

Easy-teach for commissioning and mounting

Turck's Easy-teach function enables all Li sensors to be set to the start and end point of a measuring section. The measuring signal can also be inverted, so that the start and end point of the measurement are reversed. The status LEDs on the sensor head indicate to the operator directly whether the Teach operation was successful. This teach process enables the sensor to be adjusted flexibly to the specific requirements at the installation and thus simplifies commissioning.

Linear position sensors for use in large presses

Precise linear positioning with measuring lengths over one meter is particularly required in large machines. Previously it was necessary to use alternative measuring systems here and live with their disadvantages, such as accepting a loss in sensor and machine performance. This is the case, for example, in presses with high shock loads, which nevertheless require precise measurement results.

In wood processing machines, where large measuring lengths are often required, linear position sensors are also subjected to vibration and shock, while sawdust and other dust also play their part. In these types of applications, IP67 protection is mandatory. The new Li Q25 generation meets both requirements and thus raises the bar even higher in terms of linear position sensing.

The sensor withstands vibrations and shocks of up to 200 g and supplies consistently precise measured values

Magnetostrictive linear position sensor system

The sensor unit sends an electronic start pulse along a waveguide. This pulse causes the magnetic positioning element to generate a torsional wave in the waveguide, which runs from the positioning element towards the sensor unit. The elapsed time from the pulse to the detected torsional wave is measured, from which the distance to the positioning element is calculated. The maximum sampling rate of the system is not only limited by the electronic components but also by the time required by the torsional wave. The measuring length of magnetostrictive sensors is virtually unlimited, however, the sampling rate decreases the longer the measuring length.

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