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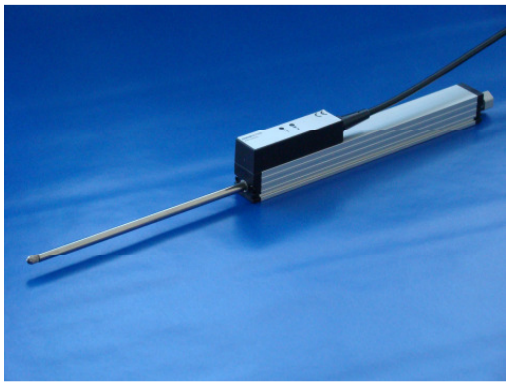

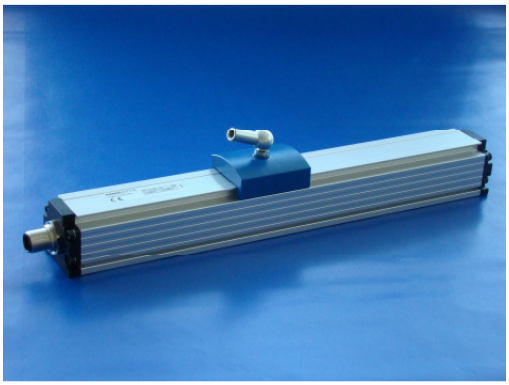

Inductive and magnetostrictive linear transducers of a new generation:

Contactless measurement principles in the fast lane

If linear movements are to be recorded, users today often prefer contactless principles, where basically no mechanical wear is present. Depending on the demands of the application, the choice then frequently falls on inductive or magnetostrictive linear transducers. The latest developments in both types of sensors will strengthen this trend even further.

The sensor specialist Novotechnik has recently developed two new series of linear transducers, which will include new application areas for contactless linear travel measurement. The LS1 series of inductive linear transducers, intended for measurement areas from 25 to 200 mm, are appropriate as wear-free alternatives to practically every standard market small linear potentiometer with a square cross-section (illustration 1). Because of their size, these are completely compatible with the T-series potentiometers from the same manufacturer. The same applies to the new TP1 series of magnetorestrictive linear transducers, which are offered for measurement areas from 50 mm to 4,500 mm (illustration 2). They are mechanically compatible with the previous models of the TLM series. However, this new development offers a very high measurement accuracy of up to 10 µm, and thanks to many mechanical and electronic improvements it delivers very stable signals even in unfavorable environmental conditions.

Inductive linear transducers: Teach-In functionality directly on the linear transducer

The contactless inductive linear transducers have a very compact cross-section of 18 x 18 mm. They are available both as instruments with a integrated resetting spring for measurement areas between 25 and 100 mm and as linear transducers with a ball coupling without play for pulling and pushing applications intended for measurement areas between 25 and 200 mm. The integrated signal processing makes the measured value available as an absolute current or voltage signal at the end. The integrated teach-in function with LED status display is practical for many application types. A push button directly on the linear transducer enables the user to define zero and end points of the measurment, invert the measurement output slope, or set the desired signal amplitude. Unlike potentiometers, a separate measurement transformer is not necessary; the higher control is thus simplified and the user does not have to get involved in the control program.

The linear transducers are almost maintenance and wear-free due to the contactless inductive measurement principle (see text box 1), and are very impressive with their high-level repeatability (better than 0.025% of the measured area), high resolution (12 or 13 bits), and high linearity (up to +/- 0.05%). The update rate of the output signal is specified to approximately 1 kHz, which is more than sufficient for most applications. It is also very advantageous for many applications that the inductive linear transducer is completely unaffected by magnetic fields.

Magnetostrictive linear transducers: highly exact and immune to interferences

Linear transducers that work according to the magnetostrictive principle are offered for long measurement areas (see text box 2). The new TP1 series from Novotechnik is available for measurement areas between 50 and 4500 mm, optionally with movement-free or guided position displays. The linear transducers are very robust and serially fulfill the requirements of ingression protection type IP67 or IP68 over the entire lifetime, even in critical applications. Due to the contactless measurement principle, the average life is from a mechanical standpoint virtually unlimited.

The mechanical elements, the measuring elements, and the evaluation electronics of the new generation of linear transducers were improved in order to achieve as high a level of interference immunity as possible. The results speak for themselves. Even with surrounding interference fields, machine vibrations or

shocks, the measurement receivers deliver stable output signals with linearity values of up to 10 µm. The resolution is independent of the measurement length and for all digital variants uniformly amounts to 1 µm, something that can be a decisive criterion particularly for large measurement ranges .

Special attention was paid to the integrity of the internal measurement evaluation preparation in the linear transducers and to the data output with an update rate of 16 kHz. The electronics calculate the position value from the value of the digitized measurement time and the known speed of the wave guide. The determined position value is checked for plausibility, linearized, and then treated and linearized in accordance with the interface. In addition to analog current and voltage interfaces, Start-stop, SSI, and DyMoS interfaces are available. The DyMoS interface transfers the current measurement value for the speed as well as the position value. For linear movements designs with incremental or quadrature interfaces are suitable as substitutes for expensive RPM counter solutions.This product is often the choice as well for a more robust alternative to glass encoder systems, since for many applications the exactness of the magnetostrictive linear transducers is quite sufficient. Many interesting areas of application have hereby been opened up for magentorestrictive measurement technology.

Text box 1: The NOVOPAD inductive measurement principle

Covering the whole measurement range, sinusodial and cosinusodial traces forming loops are printed on a circuit board and supplied with alternating currents with a phase-shift of 90 deg.

In this way alternating fields are generated perpendicularly to the conducting plate, while their strength over the measurement range is also sinusoidal or cosinusoidal. Based on the trigonometric addition theorem the following relationship applies to the site-dependent sum of both fields:

$H * \sin(x) * \cos(\omega t) + H * \cos(x) * \sin(\omega t) = H * \sin(\omega t + x)$

where “H” describes the magnetic field strength, “x” the travel information and “ωt” describes the periodic time dependence of the signal sum. This generates a signal, whose phase shift is directly proportional to the path. The position indicator, designed as a oscillating circuit, “floats” over the signal conducting plate (illustration 3). Its resonance frequency is tuned to the emitting frequency of the two signal feeds. The oscillating circuit is stimulated by them and then emits its alternating field back to the conducting plate. The rectangular receiving spool that is integrated into the signal conducting plate receives this signal and sends it to the evaluation electronics. There the received signal is compared with the

sent signals. The resulting phase information is then transformed by the evaluation electronics into an analog position information, which is linear over the measurement range.

Text box 2: The NOVOSTRICTIVE magnetostrictive measurement principle

The measurement process (illustration 4) is triggered by a short impulse current, which creates a circular magnetic field around the wave guide. The field lines of the position indicator run perpendicular to this field, and the position indicator marks the measurement position in the wave guide. An elastic deformation, the magnetostriction, occurs in the wave guide, where the two magnetic fields superimpose. The reversible dimension change triggers a mechanical impulse, which is transmitted in the wave guide as a torsional wave with a speed of about 2,800 m/s. At one end of the wave guide the torsion wave is transformed into an electric signal, while it is dampened at the other end so that there are no interferences with subsequent measurements. The time of flight from the origin point to the inductive pickup is directly proportional to the distance between the position indicator and the inductive pickup.

Illustration 1: The contactless inductive linear transducers have a very compact cross-section of 18 x 18 mm and as such are suitable as contactless alternatives for many potentiometers with the same cross-section.

Illustration 2: The robust magnetostrictive linear transducers are available in effective lengths up to 4,500 mm. Even under unfavorable environmental conditions they deliver a stable output signal with linearity values of up to 10 µm.

Illustration 3: Text box 1: The NOVOPAD inductive measurement principle

Illustration 4: The NOVOSTRICTIVE magnetostrictive measurement principle

All illustrations: Novotechnik

About Novotechnik

Novotechnik with headquarters in Ostfildern in Swabia, Germany has been a leader in the development of measuring technology for more than 60 years. In Germany alone over 200 employees work at peak performance. This results in high-performance travel and angle sensors, that are today indispensable for production, control and measurement technology as well as automobiles around the world. The very wide product line includes travel and angle sensors of vari-

ous functional principles, special solutions for the automotive area, measuring transducers, and measuring devices. These cover practically all the imaginable tasks; custom-made solutions are available for special application needs.

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Text (nov171) and illustrations on the Internet: http://pool.rbsonline.de
Text (without picture caption and box texts): Approx. 5300 strokes
Text box 1 “Das induktive Messprinzip” approx. 1400 strokes
Text box 2: “Das magnetostriktive Messprinzip” approx. 1000 strokes
“Über Novotechnik”: Approx. 700 strokes

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