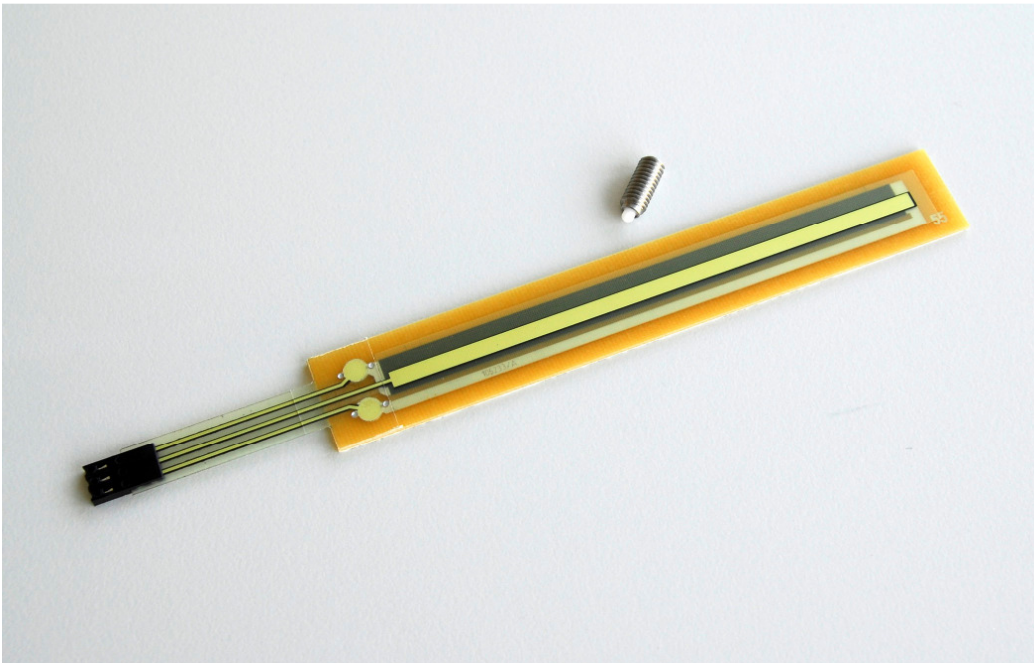


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**Precise Measurements, Durable Design, and Longevity**

## **Next Generation Membrane Potentiometers – And What They Can Do**

### **Short Version**

With its LFP line, the Novotechnik portfolio now also includes membrane potentiometers for linear position detection whose linearity and life expectancy closely match those of the known potentiometer standards. The traditional wiper of the membrane potentiometer is replaced with a membrane that is connected to the resistive track by way of a pin. Apart from this, the FR4 printed circuit board substrate technology permits the utilization of the standard procedures of potentiometer technology. Trusted screen printed resistive inks ensure high life expectancy (more than 25 million cycles). A subsequent linearization process provides excellent linearity over the entire product life (e.g., typically +/- 0.4% at a defined electrical travel of 50mm or +/- 0.3% at 500mm). The membrane potentiometers are hermetically sealed, comply with the requirements of class IP67 ingress protection and are suitable for environmental temperatures up to a maximum of +257°F (+125°C). The component series is offered in standard lengths of 50mm to 500mm. In addition to linear models, rotary systems can be manufactured as well. Applications range from integrated actuator systems in car and truck seats, window lifts, convertible car covers, and mirror systems to the positioning systems of solar panels, robotic systems, actuators, or for medical and space technology applications. The trouble-free function of the membrane potentiometers even in explosion-proof classified areas should also make them in-

teresting options for many applications.

**Long Version:**

*Potentiometer-based sensors are still the means of choice for many automotive, mobile, and industrial applications requiring path and angle measurements. After all, comparable measuring speeds, linearity values, hysteresis values, and temperature ranges would otherwise require significantly larger investments. New membrane potentiometers could now expand the range of applications for potentiometer solutions.*

In recent years, mostly manufacturers of membrane keyboards have started to apply their membrane technology expertise to path and angle sensing. However, this has tended to yield solutions that do not come anywhere near the accuracy of standard potentiometers. Specializing in sensor technology, Novotechnik (see box) has now turned to this technology and, jointly with a partner, developed solutions that closely match the linearity and life expectancy of the known standard in conventional potentiometers.

**Trusted Screen Print Resistive Inks and Subsequent Linearization**

The basic principle of the series LFP linear membrane potentiometers is easy to comprehend (Figures 1a, b): They consist of an FR4 printed circuit board substrate (epoxy-saturated fiber glass sheet) and a collector membrane, separated by the spacer. The resistance track is applied to the FR4 printed circuit board substrate by way of a screen printing process. Printed on the membrane on the opposite side, i.e. on the collector membrane, is a low-resistance collector circuit. The collector membrane consists of an FR4 prepreg of high mechanical durability. Mechanical pressure, usually applied via a simple spring-loaded pressure piece, serves to join the collector membrane with the resistance track. Collector membrane and spring loaded pressure piece thereby replace the classic wiper system and achieve a signal that is proportional to the distance even with membrane solutions.

The described membrane potentiometer structure offers several practical advantages at once: The FR4 printed circuit board substrate technology allows the utilization of standard procedures in potentiometer technology. Trusted screen printed resistive inks ensure long life of more than 25 million cycles - twice as many as existing membrane potentiometers typically deliver. The linearization

that follows the printing process with appropriate layer thickness levels also provides for typical linearity values of e.g., +/- 0.4% at a defined electrical travel of 50mm or +/- 0.3% at 500mm. In terms of accuracy, new membrane potentiometers are therefore no longer put in the shade by standard potentiometer solutions.

### **Durable and Suitable for High Temperatures**

The membrane potentiometers feature tight hermetical seals for protection against the ingress of dirt, dust, or moisture. This complies with the requirements of class IP67 ingress protection (excludes the connector). Since the collector membrane is made of highly durable FR4 prepreg and applied over the resistive layer like a protective membrane, there are no worries of damaging the sensor, e.g. during assembly. At the same time, the membrane potentiometer is suited for applications with environmental temperatures of up to +257°F (+125°C). The polyester-membrane-based solutions in today's market do not measure up in this regard either. In addition, the measuring system structure with its rigid FR4 substrate offers the advantage that slightly uneven surfaces or, e.g., dust particles do not interfere with test results. This is not the case with today's economical models featuring membrane-on-membrane design, where even the tiniest dust particles on the surface can cause membrane rifts, resulting in linearity errors or even short circuits.

The new membrane potentiometers are offered in standard lengths of 50 to 500mm. In addition to linear models, rotary systems can be manufactured as well, affording a broad spectrum of applications. Similar to wiper potentiometers, they are suitable, for example, as integrated actuators in car and truck seats, window lifts, convertible car covers, and mirror systems, but also for positioning systems of solar panels, robotic systems, actuators, or for medical and space technology applications. Their trouble-free function even in explosion-proof classified areas should also make them interesting options for many applications. In addition to the model described here, which features a mechanical positioning component, a magnetic version, where the positioning component consists of a magnet, is also possible. This version is currently being developed by Novotechnik with the aim of serial production.

Figure 1: The replacement of the classic wiper system with a collector membrane (a) that is pressed against the resistance track by a mechanical

pin (b) likewise yields an output signal that is proportional to the distance or angle.

Figure 2: The linearization following the screen printing process with appropriate layer thickness levels provides for excellent linearity values.

Text: Dr. Tobias Eckert (Figure 3), Leiter Technologiezentrum Potentiometer at Novotechnik, and Ellen-Christine Reiff, M.A., PR firm Redaktionsbüro Stutensee (Figure 4)