Still common these days: a touch panel below the display area. *Source: Kurz*

Vanishing Buttons

Electrical appliances are currently changing in appearance. Slowly but surely the mechanical knobs, buttons and switches of old are disappearing from panel surfaces. Touch sensors, like touch screens for display applications or simple touch buttons, which are suitable for semi-transparent or non-transparent surfaces, are replacing them. There is also the possibility of contactless gesture control.

Touch fields are often still being combined with mechanical controls. Washing machines will continue to have rotary knobs because users are very used to this system. Electric stoves will still come with on and off switches because they offer a sense of security. A trend towards removing all buttons and switches is nevertheless discernible.

More and more premium appliance lines are being equipped with novel design concepts, for example the dead front effect. When the appliance is switched off, the user sees a uniform front surface, for example in a brushed metal look, and a control panel only becomes visible when backlighting is activated. New sensor technologies cater to these trends efficiently and with a high level of design freedom.

New design possibilities for buttons

Washing machines, refrigerators and electric stoves with touch panels have been on the market for several years now. In earlier appliances, the conductive connection between the operating panel and the electronic circuit board was established by means of springs. The current sensor technology completely eliminates all bulky mechanical components. New sensor foils are being employed in the washing machine models from BSH Hausgeräte GmbH. The sensor technology that BSH has implemented in series production offers a high level of design freedom, and not just as a result of space savings. Thanks to the use of capacitive sensors, every position on the display can be functional. This opens up a multitude of design possibilities in the display area because the touch buttons can be positioned anywhere. This advantage can be utilized, for example, to posi-

Design freedom for touch panels thanks to innovative sensor and decoration technologies.

by johannes schad and martin hahn

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tion all switches and buttons directly on the touch display. Currently the controls are usually placed in the off-screen area, i.e. outside the actual display area.

Cost-efficient production creates scope for sophisticated design

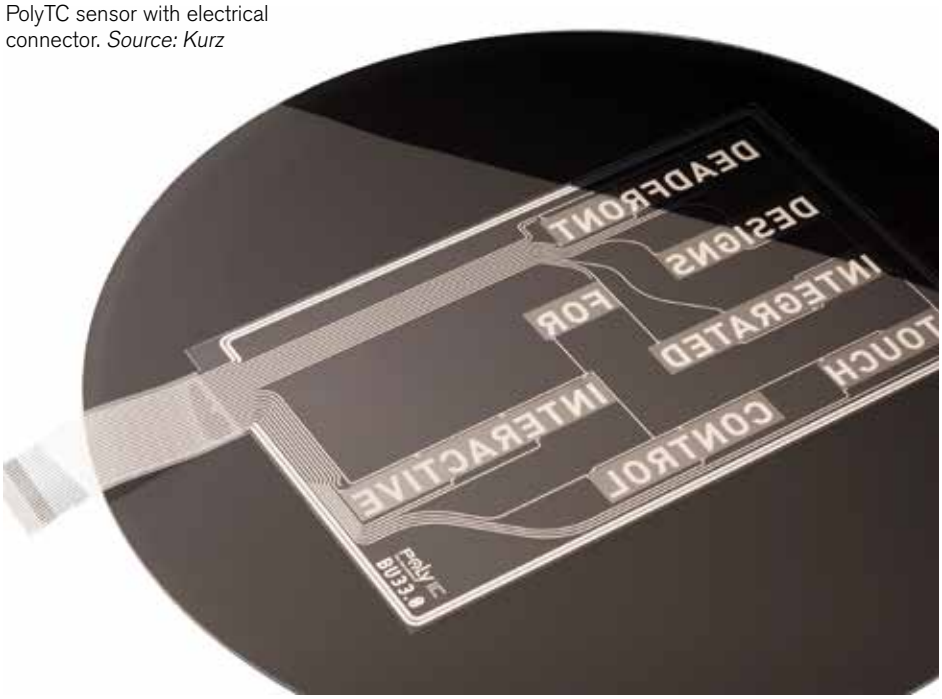
New sensor designs are manufactured in high volumes in an efficient roll-to-roll process. This cost advantage opens up scope for designing a sophisticated display. The ability to efficiently integrate the sensor decreases the costs further. The sensor film can be applied to the rear of the plastic front panel using one of several fast industrial processes. These sensor foils can be integrated not only in an adhesive-based laminating process, but also by means of IML (In-Mold Labeling) or in a process similar to hot stamping (Functional Foil Bonding).

In contrast to ITO sensors, the electrical connector (tail) is integrated directly during the printing process and only needs to be connected to the controller, whereupon the sensor is immediately functional.

Sensors conform to special front panel geometries

This freedom of design extends not only to the buttons but also to the geometry of the plastic front panels. These new sensor foils are comprised of high-resolution conductive metallic structures (metal mesh) on a PET substrate. These thin functional foils are mechanically robust and elastic. This enables them to be integrated not only in flat but also curved plastic components, which differentiates them from the ITO-coated sensor foils that are predominantly used. ITO is a brittle material that is unable to withstand this kind of deformation, and therefore cannot be integrated into curved components.

PolyTC sensor with electrical connector. *Source: Kurz*



Thanks to the use of highly conductive, silver metal mesh structures, these new sensors have several advantages over ITO. Their electrical conductivity is up to ten times higher. This ensures reliable touch recognition even through several millimeter thick plastic front panels (cover lenses). Additional time-consuming calibration of the touch system, from touch controller to touch sensor, is also eliminated when using metal mesh sensors.

Series production touch panel on a curved plastic front panel using a PolyTC sensor foil. *Source: Kurz*

A clean solution: contactless gesture control

Anyone who cooks and bakes knows the situation: your fingers are greasy or covered in dough, so you wish you could switch on the stove or open the fridge without physically touching it. This functional requirement can be fulfilled by contactless control panels. This capacitive sensor technology enables not only simple proximity switches but also intuitive gesture control systems to be integrated directly into the display area. Capacitive gesture control is the perfect choice for applications where cleanliness or hygiene is an issue and where a high-quality display design is required.

Visual enhancement through invisible function buttons

Manufacturers can give their electrical appliances a distinctive appearance by incorporating sophisticated control panel layouts and upmarket styling into the front panel. An especially exclusive appearance can also be achieved using a dead front effect, whereby the buttons remain hidden while the backlighting is inactive. An electrical appliance with a consistent front panel design gives the appearance of a fine piece of furniture—an effect that is in great demand given the current trend for open-plan living.

Decoration technologies based on the hot stamping process

Flexible capacitive sensors offer significant design freedom with regard to the layout of the control panel and the geometry of the

Dead front effect: Uniform metallic-finish front panel with non-visible control panel. *Source: Kurz*

Backlit control panel activated via a PolyTC touch sensor. *Source: Kurz*

front panel. The hot stamping, IMD (In-mold decoration) and insert molding decoration technologies offer freedom in surface design. Whether it is for surface designs with a metallic, carbon, piano lacquer, marble or wood look, for printed or backlit symbols, for permanently visible control panels or a dead front effect: as a coating specialist, we employ the aforementioned, continuously-developing decoration technologies to achieve a wide variety of designs. Which process to use for a given decoration project depends primarily on the geometry of the plastic front panel.

The hot stamping process, which serves as the basis for all of the technologies, requires a polyester carrier foil coated either with colored lacquer, or a true metal applied by vapor deposition. The decorative layer of the foil is transferred to the plastic substrate through the application of heat and pressure. Classical hot stamping using either the vertical or roll-on process is suitable for applying continuous designs to flat or minimally curved surfaces. Components with a slightly 3D geometry, such as the BSH panel described above, can be decorated by IMD during the injection molding process. We have further developed this process to enable it to be used to produce a wide variety of designs. This includes not only continuous designs, but also printed and backlit single images that can be applied with high registration accuracy. Tactile structures and soft touch effects can also be produced by means of the IMD process. The insert molding process is suitable when strong three-dimensional deformation is required. The design is applied to an ABS foil, which is then vacuum-formed and trimmed to size. The insert created in this manner is positioned within the mold cavity and back injected. This process can be used to produce a wide variety of continuous designs as well as accurately positioned single images.

Special requirements on the surface coating

The dead front effect requires a special coating structure. To present a homogeneous, opaque decorative front panel during daylight, and function buttons or an illuminated design when backlit, it is necessary to combine lacquer or metallized layers of different thicknesses to create these opaque and semitransparent areas. Specialist coating know-how is required to produce these variations in layer thickness. Even in the opaque areas, the layer thickness is so small that only around one to two grams of lacquer are required per square meter. The challenge lies in precisely varying such small thicknesses, if necessary achieving different levels of translucency, and applying the layers uniformly and consistently in the required thicknesses. Applying small, opaque symbols or lettering of a homogeneous thickness is especially difficult to achieve.

Combining touch and gesture control with metallic designs also places special requirements on the coating, as the metallized decorative layers can interfere with the capacitive fields. To ensure reliable functioning, we have developed NCVM (non-conductive vacuum metallized) foils that can be used with any combination of metallic decoration and sensor panel.

Brushed metal design with touch panel, implemented using an NCVM coating. *Source: Kurz*

Conclusion

Front panel design for appliances is undergoing significant changes. The trend is towards control panels with an elegant touch or gesture control interface, in the off-screen area as a first step, then directly integrated into the touch display. Suitable decoration and sensor technologies are available to reliably implement these designs and functional features. These can accommodate special requirements like partially translucent or non-conductive coatings. A number of initial successful series production applications have demonstrated that these innovative layouts are not only technically, but also economically, feasible. ■

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