

One-Step Production of HMI Components

A Console for the Roof Lining

Electromobility and increasingly autonomous vehicles are changing the car interior. This requires futuristic concepts combining design and functionality, which can be adapted to the occupants' individual requirements. A good example of this is a roof lining console manufactured by Leonhard Kurz. It is particularly interesting for automotive manufacturers and suppliers, since it can be manufactured in only one production step.



The roof-lining console from Leonhard Kurz combines design and functionality in one component. The combination of the two is particularly in demand for electric vehicles. © Leonhard Kurz

In the self-driving car of tomorrow, the car interior will be transformed into a second living room. Design is therefore becoming increasingly important. This trend is also spurred on by electromobility, which is recognized as part of an environmentally aware lifestyle. E-vehicles address this lifestyle in the design: intelligent styling with elegant

forms is replacing the conventional elements of the classical internal combustion vehicle.

To remain competitive, car manufacturers must adapt their strategies to these new requirements. According to a research report by the Institute for Social Science Research (ISF), Munich, Germany, they are transforming into tech

companies [1] to some extent. This will require increasingly smart interfaces between the car occupant and the vehicle. The market for human-machine interface solutions is predicted to show strong growth in the coming years: according to current studies, the revenues obtained globally in this area will grow by over USD 527 million by 2025 [2]. This will demand mainly smart components in which function and decor merge.

Technical Progress thanks to Bundled Competence

An example of this was presented at Fakuma 2021 by the plastics processor Leonhard Kurz, together with several partner companies. In collaboration with the injection-molding machine manufacturer Wittmann Battenfeld, the manufacturer of complex plastic parts Syntech Plastics, the lighting expert Osram Automotive Lighting Systems (AMLS) as well as the Kurz subsidiaries PolyIC and Baier, a prototype for the roof lining was created (**Fig. 1**). The module is characterized by its seamless, completely closed 3D-shaped surface with integrated touch control (**Fig. 1**). This was implemented by means of in-mold electronics processes. Via the module, various functions can be controlled, such as ambient light, reading light and the sliding roof. The unique feature of the component is that almost all the features can be individually adjusted. The integrated light projection allows information and animations to be displayed on various surfaces in the car interior.



Fig. 1. The organic 3D shaping of the surface supports the intuitive operation of the touch buttons. © Leonhard Kurz



Fig. 2. Various designs are possible thanks to IMD manufacturing. A soft-touch function can also be integrated in order to appeal to the sense of touch. © Leonhard Kurz

With the term “HMI,” the first thought is usually of displays for the dashboard or concepts for the center console. But intelligent control, together with attractive styling, can be implemented in all areas of the automotive interior design. The roof lining module clearly shows how modern technologies allow

multiple elements, switches and controllers to be replaced by a single, optically attractive component.

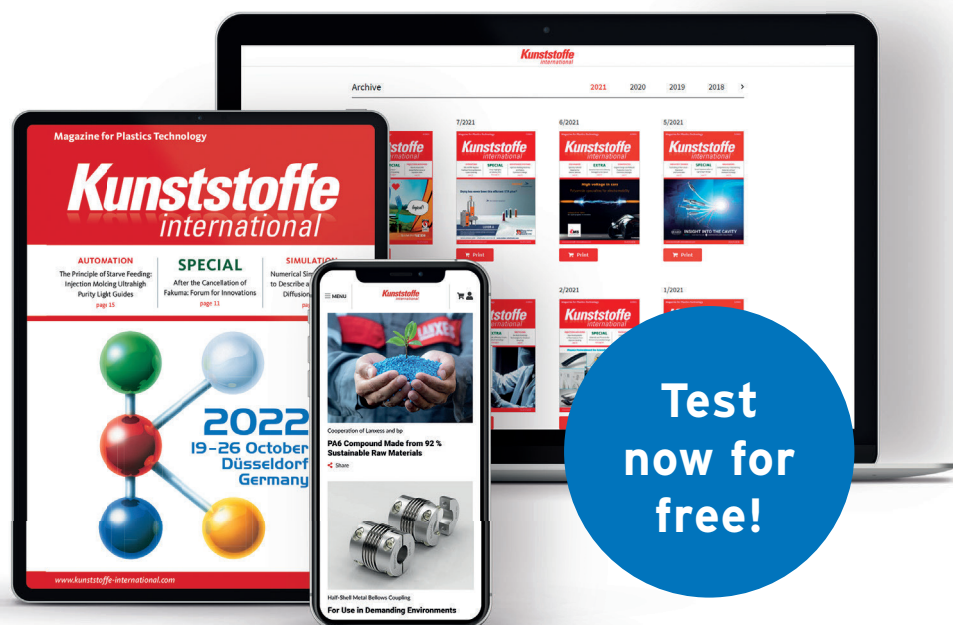
For the implementation, the technical competence of all the companies involved was essential, stresses Christoph Stuhlinger, technical program manager and HMI program manager at Kurz: “We

are already dealing with tomorrow’s technology standards. To realize ambitious, future-proof concepts with perfectly coordinated functions we will need our partners’ in-depth expertise. In the case of the roof-lining console, this was necessary for the 3D-shaped sensors and the integrated projector.” »

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Fig. 3. Matrix LED spots from Osram are used at both sides of the module.

© Leonhard Kurz



Fig. 4. The light structures in the decor illuminate depending on the situation. © Leonhard Kurz

Manufacturing, Decorating and Functionalizing in One Step

The prototype demonstrates several advanced technologies at once, which can be realized by roll-to-roll production and are currently already suitable for mass production. For example, via in-mold decoration (IMD), the console is manufactured, decorated and provided with thin touch sensors in a single one-step process (Fig. 2). For this, a modern injection-molding machine from Wittmann Battenfeld is used. In the injection molding, the plastic compound is combined with the decorative motif. By virtue of the temperature in the machine and the cavity pressure, the design (overall decorative system) is irre-

versibly bonded to the plastics material and is transferred to the surface of the component during the injection-molding cycle. This method allows highly 3D-shaped components to be produced. With the roof-lining component, the decoration at the component edge covers the entire edge radius and the part wall thickness. This also prevents the possibility of light escape in this area.

For car manufacturers, the fact that the production steps are bundled in a single process offers several advantages: first, they reduce resource consumption and, second, the in-mold decoration permits a great deal of design freedom. In the automotive field, there is a sustained trend toward individualization. End customers want a design that suits them – and car manufacturers remain more competitive if they can realize different styling options. However, cost-effective manufacturing is also important. To combine the two – a high degree of individualization plus economical production – the IMD process is very suitable. It permits different options – from high-gloss and matt surfaces, via wood effect, to technical designs and soft-touch effects, which also appeal to the sense of touch.

Intelligent Sensor Integration

A further advantage of IMD manufacturing is that in combination with functional in-mold labeling integration (IML) – i.e., the printing of electronic conductor paths, also known as in-mold electronics (IME) – the process allows three-dimensional parts to be provided with touch sensors. While the

backing material, including decorative coating with light-guide sensors, is positioned by means of the film feeder at one side of the injection mold, which is specific to the combined IMD and IME process, the capacitive touch sensor (IME label) is placed in the opposite cavity.

At Fakuma, Kurz presented a further development of the process, the so-called “tail from the center” sensor integration. “The special feature of this method is the use of a special sliding mechanism, which positions the sensor tail (contact region to the controller) at an angle of 45° to the component, so that the component does not come into contact with the plastic melt,” explains program manager Christoph Stuhlinger. “The intelligent guide permits the sensor to be connected to the controller from the component center and not via the outer edge of the component. This offers an additional advantage, since the decoration is not interrupted at the component edge. In addition, the additional non-stick coating of the sensor tail ensures problem-free connection at the reverse side,” he adds. After injection molding, the entire decorated surface is finally cured by means of UV light in order to meet the highest surface specifications.

Component Cleaning as an Inline Process

This system also incorporated a component cleaning concept from the Kurz subsidiary Baier for the first time, in order to quickly remove residual paint particles

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References & Digital Version

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contactlessly by means of a special nozzle technology in the inline process. Both applications were integrated in one system and in this combination form a compact overall solution.

Wafer-Thin, Transparent, Recyclable

The PolyTC sensors from the Kurz subsidiary PolyIC are used. The very thin sensor films are particularly flexible and robust at the same time. Because of these properties, they are suitable for parts with a curved, shaped surface. The backing material is characterized by another feature: PolyIC uses transparent plastic substrate, to which silver-based metal structures, so-called metal mesh, are added. The metal layers are extremely thin, at a few nanometers, and thus only make up a small proportion. For this reason, the sensors can be added to the recycling process. The same applies to the overall decoration layer on the front side. This results in a crucial advantage of this decorative and functional integration technology as regards sustainability.

Among other things, the roof lining console demonstrates what types of sensor can be integrated into an interior module: besides five capacitive touch sensors with tactile feedback, a touch slider for controlling the ambient and reading light is also integrated. The wafer-thin sensors, invisible to the naked eye, are not only backlit in the direct field of view of the LED light

surfaces but illuminated throughout. This ensures a particularly high degree of transparency. Although specific functions are provided for the individual operating panels, they can also be individually assigned. The option also targets the end customers' desire to adapt the car interior to their own needs.

Lighting the Car Interior Individually

The light in the car interior can also be customized. For the integrated reading light in the roof-lining module, ams Osram AMLS has developed matrix LED spots (**Fig. 3**). The cone size of the reading light can be adapted in different stages and the white tones can be modified to suit the taste of the vehicle occupants. Various lighting scenarios with individual settings can be called up in the desired RGB colors via the ambient lighting – for example as a welcome signal.

Thanks to Shy-Tech design, the prototype does not reveal all its secrets at first glance. The light structures are generally invisible in the decor. But if, for example, a phone call is received, they light up in keeping with the chosen ambient lighting (**Fig. 4**). Another highlight of the prototype is the built-in logo projector from ams Osram AMLS. This allows information and static designs, but also dynamic motifs such as animations, to be transported on various surfaces in the car interior and to project them, for example, on the center console

or dashboard. This function, too, can be adapted to the ambient light and the particular driving situation, as regards design and color choice.

Sustainability throughout the Value-Creation Chain

Individually adaptable functions and a pleasant ambience are important for end customers – as is the efficient production of a component for car manufacturers and suppliers. For both parties, sustainable development also plays an important role. The Overhead Lighting Console is a good example of how automotive interior design can be implemented in an environmentally friendly way.

As the roof liner module, including decoration and sensor integration, is manufactured in a single work step, no further processes are necessary, which has an immediate and noticeable effect on the CO₂ balance (**Fig. 5**). "In the IMD process, we also transfer the decorative layer as a dry-lacquer system. We thereby avoid pollution from wet lacquer. At the same time, we save energy for drying the coating," adds program manager Christoph Stuhlinger.

The process also makes it easy to use recycled material in the injection molding process. In addition, both the component, manufactured and decorated by IMD, and the integrated touch sensors can be completely recycled. The HMI concept module thus shows that an attractive design, sophisticated functionalities and sustainable manufacturing are not mutually exclusive. In order to remain competitive in the automotive industry in the long term, it is essential for manufacturers and suppliers to integrate all three aspects with one another.

Manufacturing Cell at K 2022

The ambitious project with the "Kurz one-step process" as a basic prerequisite placed high requirements on everyone involved – including on the component manufacturer Syntech Plastics. In early 2022, the company finally took over the entire manufacturing cell at its factory in Steinfeld, Germany. The system will be on display live as a show highlight at the Wittmann Battenfeld booth in Düsseldorf, Germany, and presented in the fully automatic series process. ■

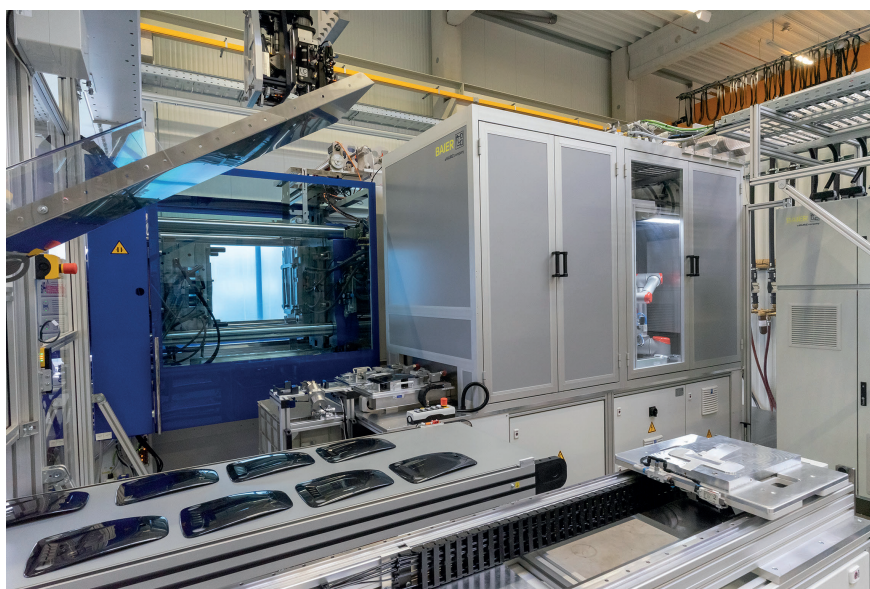


Fig. 5. The roof-liner consoles can be manufactured in one step and equipped with sensors and touch function. © Wittmann Battenfeld