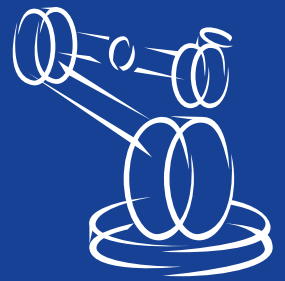


# Application Report



## Highly automated production of several million connectors



## Intelligently linked and consistently automated

How does one cope with the constant increase in demand for plastic hybrid components in spite of space restrictions and personnel constraints? An international automotive supplier has opted for an intelligent linked system with two injection molding machines and six robots – and it is going quite well.

With around 3,000 employees worldwide, KE Elektronik is one of the most valued suppliers for the automotive and aviation industries. With production sites in Germany, the Czech Republic, Slovakia, northern Macedonia, China, and Mexico, the company belongs to the American Amphenol Corporation – a leading manufacturer of connectors.



This 300 people strong manufacturer, headquartered in Kressberg-Marktustenau, has built engine fan connectors that are used in both hybrid and internal combustion engine vehicles. These connectors are so-called plastic hybrid components in which four metal contacts are over-molded with three different plastics.

“The production of these connectors is a relatively complex process that involves numerous testing stages as well as complete traceability. To be able to meet the constantly increasing demand given the shortage of skilled workers, an intelligent automation solution was required,” says Jens Gradenegger, Team Leader Injection Molding Automation at KE Elektronik.

## An extremely challenging project

KE Elektronik turned to EGS Automation GmbH to take on the task of automating and interlinking two punching and bending units as well as two Arburg injection molding machines in such a way that the resulting manufacturing station could reach an output of several million connectors per year. “Our previous experience of working with EGS was positive, so we were sure they’d be able to offer us a reliable solution in this case as well,” says Jens Gradenegger.

EGS would not be EGS if it wasn’t able to come with a perfect automation solution to do this complex job. “We like to prove ourselves by taking on challenging projects – and this one certainly gave us plenty of opportunity to do so. In close cooperation with KE, we succeeded in designing a 15 x 6-meter manufacturing station that meets all requirements, including six Yaskawa Motoman robots, lots of handling and testing technology, and a SUMO Ecoplex2 palletizing system,” says EGS project manager Hartmut Pfalzgraf.

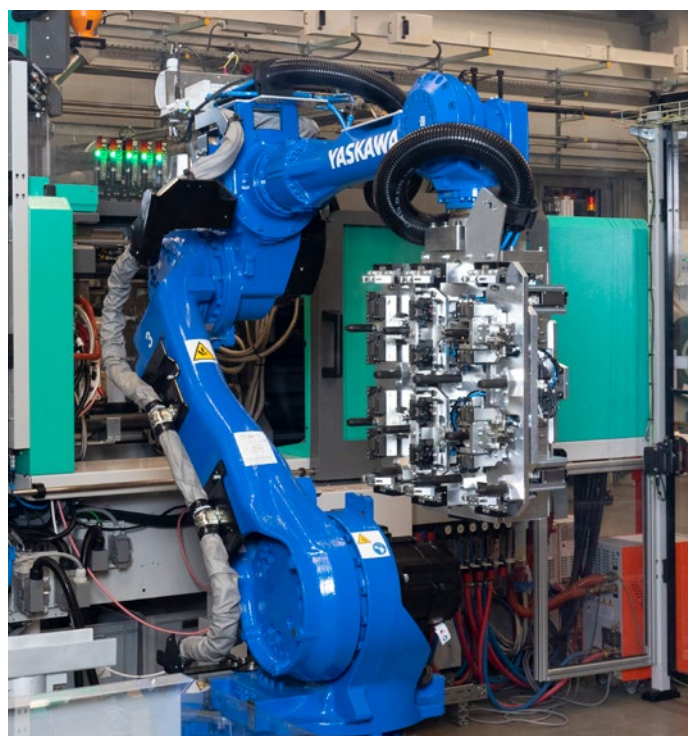
The complete production line is clearly divided into four modules – and the transparency of the layout is impressive. To guarantee the cycle time requirement of ten seconds or less per connector as well as maximum accessibility, only the highest quality components were used. Close attention was paid to good availability for all parts of the system as well. This is what the system looks like in the real world:

### Module I: Provision of the connector pins

Two punch-bend units ensure continuous supply of the connector contacts. While one line produces signal pins, the other produces power pins. A MOTOMAN GP7 with mechanical gripper – equipped with integrated sensor technology and tilted 25 degrees – is installed on each punch-bend unit. “The inclined position of the robot allowed us to achieve the required rotation from the removal to the insertion position entirely via the S-axis, thereby reducing the cycle time to a minimum,” says Hartmut Pfalzgraf – an ingenious piece of engineering that reflects EGS’ experience of over 2,000 robot installations.



ters and a payload of 50 kg, the robot is perfectly suited to this task. The task spectrum of the 6-axis robot is highly complex. The robot first must unload the SGM before it can fit it with new contacts. To do this, the robot must remove the finished overmolded connector plugs from the lower mold, transfer the pre-molded parts from the upper mold to the lower mold and finally fit the now empty upper mold with the 4x4 stamped and bent contacts from the workpiece carrier of Module 1.



The two 6-axis robots each remove two contacts from their line and position them in a workpiece carrier with four receptacles, each of which in turn must be fitted with four contacts. After four work cycles, the two 6-axis robots have completely loaded the four receptacles and the workpiece carriers reach their unloading position, where they are received by the MOTOMAN GP50 on Module II.

### Module II: Complex handling processes with the GP50

The heart of Module II is an Arburg 2K injection molding machine which processes two plastics simultaneously. In the first shot, an overmold is applied with the upper portion of the Injection molding machine to fix the contacts precisely in the desired position. The resulting contact carriers are then overmolded to a connector plug in the second shot by means of the lower injection mold.

“In order to be able to achieve the required precision when gripping, the robot docks onto the molds by means of a centering gripper prior to the actual handling. To keep the mold open time as short as possible, we make full use of the GP50’s exemplary dynamics,” says Jens Gradenegger.

Finally, the overmolded connectors are placed on another workpiece carrier in the assembly line. With a total of eight connectors, the workpiece carrier is transferred from Module II to Module III via a transfer system.

All loading and unloading processes of this SGM are completed with a Yaskawa MOTOMAN GP50 6-axis robot, which uses a 36 kg triple gripper system. With a reach of 2,061 millime-

### Module III: Special Liquid silicone rubber (LSR) overmolding

The essential step in Module III consists of LSR

overmolding of the connectors, which is also carried out on an Arburg injection molding machine. The advantage here is that by overmolding the connectors with a silicone lip, a separate seal is not required. This means there is no need for an additional component that might cause problems during assembly.

Module III also uses a MOTOMAN GP50, but its job is not quite as complex as that of its colleague in Module II. Here, the robot removes the 2x4 connectors from the workpiece carrier and checks their temperature by holding them in front a thermal imaging camera. Only when the temperature is within the defined window are the parts suitable for the next injection molding process and the robot then places them in the mold.

The first step before loading the injection molding machine is to remove the eight finished parts. The GP50 then loads a 2-fold shuttle which takes a total of 16 parts to the last module.



#### Module IV: Test, test, test

Another MOTOMAN GP7 is used in Module IV. It's task is to pick up the finished parts and move them to a revolving transfer unit. "On this revolving transfer unit there are various test stations and an assembly station equipped with a MOTOMAN SG650 Scara robot. Here we've successfully integrating a really large number of processes in an extremely compact space," says Jens Gradenegger.

This module is all about quality assurance. The first step is a continuity and high-voltage test,

followed by a pin position check with a triangulation laser, and then a camera inspection of the LSR overmolding. The component is then given a data matrix code by a marking laser, thereby ensuring one hundred percent traceability. Subsequently, the Data Matrix Code is tested, too.

Once the component has passed the entire test marathon, the final step is the torque-controlled assembly of a protective cap, which is performed by the SG 650 Scara robot. "The fact that Yaskawa has been offering 4-axis robots for some time now has proven to be a great advantage here. This allowed us to fit the entire plant with robots made by a single manufacturer and stay with Yaskawa controls," says Jens Gradenegger.

The Scara robot is not pushed to its limits, but the situation is quite different with the MOTOMAN GP7: "The 6-axis robot is critical in terms of the time cycle because it not only loads the rotating transfer unit, but also finalizes the process by placing the finished parts into trays in a SUMO Ecoplex2 – the top seller among the EGS palletizing systems.



We had to pull out all the stops here so as not to jeopardize our cycle time targets. Among other things, the robot is fitted with a 2+2 gripper system to reduce the number of movements," says Hartmut Pfalzgraf.

The plant has been running three shifts since

September 2021 and fully meets KE's expectations, as Jens Gradenegger assures us: "EGS really did an excellent job – from planning right through to commissioning. We were able to benefit from the expertise of the EGS designers in all kinds of detailed solutions. An added bonus is the reliability of Yaskawa robots, which we particularly value here at KE."

### Contact

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