Both Economical and Flexible

**Engel and MMS Offer Modular System Solutions for Metal/Plastic Hybrid Components**

Highly specialized production cells, tailored precisely to the respective product, are used to produce connectors, switches or contacts in an efficient way. The cells integrate the various work processes, from metalworking to plastics injection molding. With product variance rising while batch sizes fall, manufacturers are increasingly looking for more flexible production options.

**Linear Production Line on a Compact Footprint**

Thermal switch housings were produced at the Engel booth. From the punching of the contacts to the inspection and labeling of ready-to-use electronic components, all work steps are fully automated in the highly integrated production cell (Fig. 1). The raw material for the brass carrier plates is fed directly from a reel and pre-punched including a thread in-line. The thread is servo-electrically tapped before the carrier plates – still on the strip – are overmolded with glass-filled nylon on an Engel insert 60V/35 single vertical injection molding machine.

Quality control happens also within the production process. In addition to the camera inspection, high voltage testing is integrated into the tool, thus already guaranteeing 100% short-circuit inspection during production. In order to ensure seamless traceability, the good quality parts are labeled by laser before the sprue and carrier tabs are removed and the components are separated from the strip. Eight ready-to-install electronic components leave the production cell every 20 s.

Thermal switches, such as those used for monitoring electric motors in automobiles or in domestic appliances, are traditionally produced in a complex, multi-stage process. Typically the metal components are punched and overmolded even at different locations. This not only requires a considerable logistics overhead, but also uses large amounts of material because two independent processes need to be ramped up. This is a considerable cost factor, especially where non-ferrous metals are used, that can be avoided through the highly integrated process.

**Safely Managing Complexity**

Thanks to the modular design of the MMS systems, additional processing modules...
Metal/Plastic Hybrid Components

The raw material for manufacturing thermal switch housings is fed directly from the reel and pre-punched, including thread tapping, in-line. (© Engel/MMS)

Radial Arrangement with Rotary Table Machine for Short Cycle Times

In contrast, radial or transfer systems are used where the hybrid components must not be attached to a carrier strip, or the metal parts are significantly smaller than the plastic components. The core of these production lines are injection molding machines equipped with a multi-station rotary table that allow the overmolded finished parts to be removed and new metal inserts to be placed in the mold at the same time.

Usually the preparatory machining modules are arranged to the left of the injection molding machine, and the modules for the downstream processes such as quality assurance and marking are arranged to the right. The handling system is located in between. Linear robots – also with multiple x- or z-axes – keep the layout particularly clear. Depending on the application and product, Scara and articulated robots are often used. The radial arrangement allows the modules upstream and downstream of the injection molding step to be quickly converted or supplemented.

Manufacturing of four-pin plug inserts, for example (Fig. 3), requires a radial system concept. The pre-punched and galvanized strip with gold-plated contact area is unwound from a coil by means of an automatic swivel winder. The swivel winder supports replacement of the strip during operation. The coil can be changed within a very short time without damaging the plastic material thermally.

In the cam-controlled punching and bending module, the connecting webs are cut and the contacts bent. Subsequent joining and sealing in the injection mold requires a particularly high degree of precision, which is ensured by feeding the parts on a carrier strip. In addition, bending the parts immediately before overmolding has the advantage that stress fluctuations in the strip can still be compensated for.

The total of 32 contacts (4 x 8) are separated in the punching tool and inserted into the injection mold by an robot in Scara design (Engel easix). The Engel insert 60V/35 XS injection molding machine has two bottom mold halves on the rotary table for inserting the next set of contacts while the parts are being overmolded. Parallel operation reduces the cycle time and avoids energy losses, as the clamping unit only needs to be opened briefly each time.

Eight plug inserts are produced per shot, and then removed by an Engel vi-
stacked. Reject moldings are automatically separated.

**Highest Machining Precision Enables Complete Automation**

Manufacturing contact elements is another example of a production cell with a radial arrangement (Fig. 4). Due to the complexity of the conducting paths and restricted space in the component, the lead frame in this application must be divided into two strips. Here too, the pre-punched and galvanized strips are fed to the injection molding machine from the left. The two feeding and bending stations have an identical layout. The strips are unwound by a swivel winder, while the strip is fed into the line via servo-electric gripper feeders.

In the cam-controlled punching and bending module with its six independent slide units, the contacts are exposed by cutting before bending and separating. With the aid of a moving cutting plate and two servo handling systems, the lead frames are transferred and placed in the correct positions in the injection mold. Before overmolding, the contacts are bent in a further bending module. The target of 90° must be precisely adhered to as the upper mold half must slot in over the contacts for overmolding. The position of the contacts is checked with the aid of a camera before the left-hand robot of the two easix articulated robots picks up the contacts and inserts them correctly into the 2-cavity injection mold.

In this application, too, the insert vertical machine is equipped with a rotary table to implement all of the handling steps for overmolding. The easix articulated robot mounted to the right of the clamping unit removes the finished contact elements and deposits them in a blister tray.

The handling concept with two articulated robots, each located to the side of the clamping unit, ensures excellent accessibility of the mold area. In addition, parallel operation of two robots in this application reduces the cycle time, considering that the injection molding step does not require a long cooling time due to the small component surfaces. ■

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Fig. 3. Radial plant layouts are used where the hybrid components must not be attached to a carrier strip. This is the case, for example, in the production of four-pin plug inserts (© MMS)

Fig. 4. Due to the complexity of the conducting paths and restricted space in the component, the lead frame in the manufacture of contact elements has to be divided into two strips (© MMS)