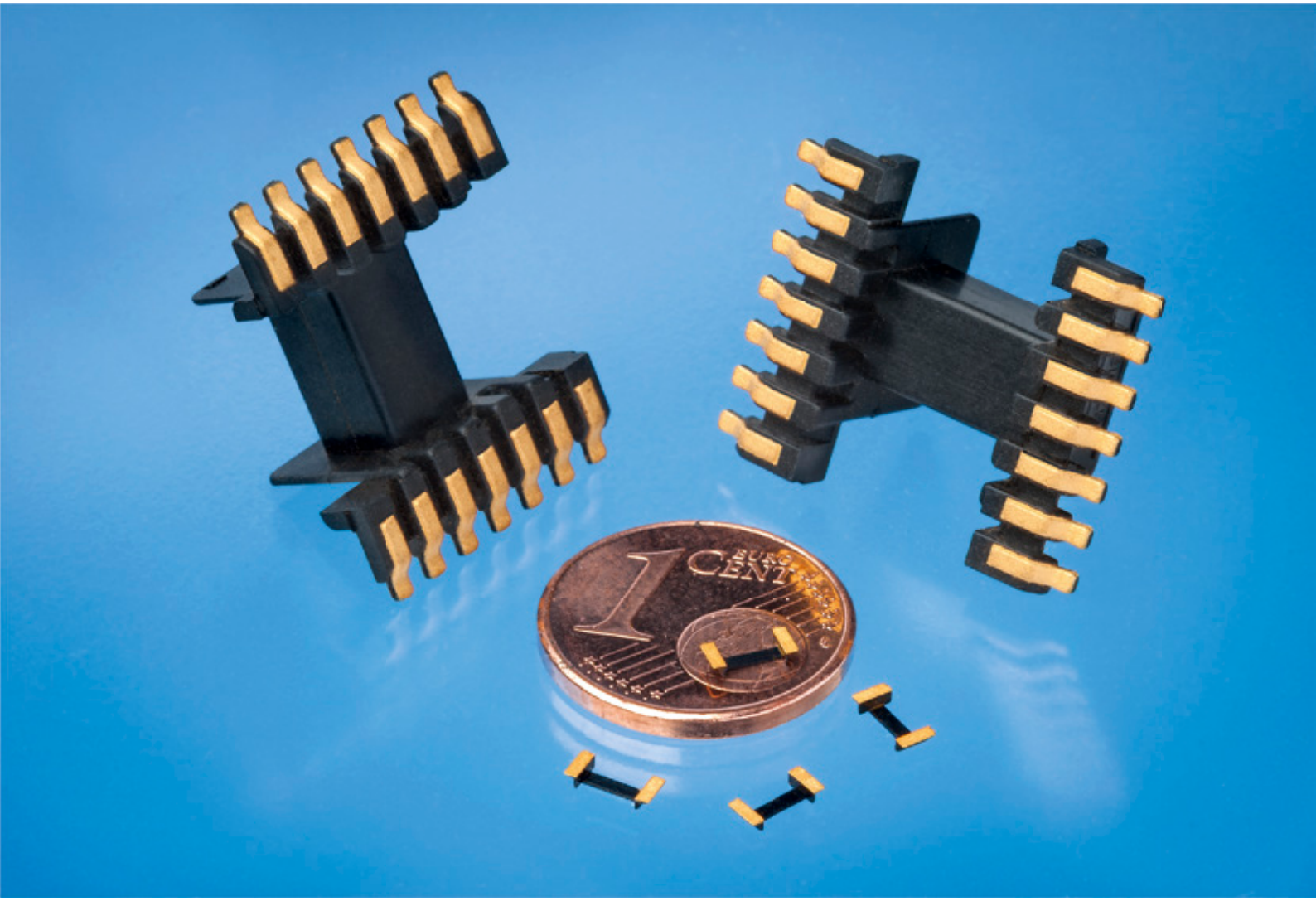
Advanced Technology and Materials

NORWE relies on LDS for innovative coilformers



3D coilformers in LDS technology

Glass fiber reinforced cross-linked PTS Creamid LDS promises production advantages

They are in transformers, computers and automobile electronics: coils and their basic elements, the coilformers. Inconspicuous, but indispensable – and with very specific requirements for their development and manufacturing. Because as coils are wound ever tighter and packing density increases, innovative processes become crucial. The coilformer specialist NORWE utilizes LDS technology and the material expertise of LPKF and LaserMicronics in its joint development of new and optimized products.

25,000 coilformers for various applications

NORWE GmbH (derived from the name of the company's founder, Norbert Weiner) is one of the leading specialists worldwide in the development and production of coil formers and their accessories. The company started in 1956 as a producer of electrical devices in the North Rhine-Westphalian town of Bergneustadt. The product portfolio today includes around 25,000 coilformers for the most varied areas of use. Every year, ca. 100 NORWE employees produce up to ca. 120 million items. Among its customers in 40 countries worldwide are suppliers of medical technology, automotive technology, alternative energy technology and aerospace as well as manufacturers within these industries. The export share is approx. 50%. National and international companies in various areas rely on the NORWE standard, i.e., certified quality according to DIN EN ISO 9001:2008, UL746D and environmental management certification according to DIN EN ISO 14001:2009. At the same time, NORWE constantly strives for innovative processes and new technologies and secures new developments through its own patents.

One part of NORWE's extensive machinery: ca. 120 million coilformers were manufactured on the injection molding machines in the past year.

Coilformers and contacts

Coilformers have a broad application in electronic components. A classic example is transformers integrated in power supply units that convert AC voltage using coils. Further areas of application for coils are power electronics, sensors and security electronics. The coilformers take up the winding, provide the necessary connection technology and are available in the most varied designs, depending on the application. They have to withstand mechanical, electrical and thermal stresses in harsh environments every day.

NORWE produces coilformers in a plastic injection molding process. NORWE uses over 120 different materials.

The electrical contacts are pressed into the plastic former or assembled in a further operation. They are for attaching the coil wires and for soldering the finished coils onto the circuit boards.

Engineer Michael Kruszinski is responsible for quality assurance at NORWE. He works out the test criteria in the individual manufacturing stages to establish suitability for serial production.

Coplanarity – a quality criterion

The requirements for coilformers increase rapidly with smaller installation sizes. Especially with SMD or surface-mountable components, so-called coplanarity is a decisive quality criterion. An uneven distance of the soldered contacts to the circuit board impairs the soldering result. Pressing the wire contacts in is a mechanical procedure that can cause cracks in thin-walled coilformers if not done properly.

This limitation within mechanical assembly (critical soldering results, difficult positioning of contacts) as winding qualities become ever smaller led NORWE to seek out innovative technologies. The company thus became interested in the LPKF Laser & Electronics process of laser direct structuring (LDS) and made contact with the production service provider LaserMicronics.

Another development aspect is the target solderability of components over 400 °C. The liquid crystalline polymers (LCPs), which are much used and well-suited for production, have the disadvantage that they are not suitable for the high temperature range required here.

Coplanarity

Coplanarity is a technical term in geometry. Several points are called coplanar if they lie along the same plane.

For coilformers, this means that all connections must lie along the same plane for reliable soldering.

New product characteristics through teamwork

Ultimately a joint project was started between NORWE GmbH, LaserMicronics GmbH and PTS Plastic Technology Service, the Adelshofen specialist for high-performance polyamides that can be cross-linked by irradiation. LaserMicronics, with locations in Garbsen and Fürth, specializes in micro-material processing with the laser. The LaserMicronics range of offerings includes feasibility studies, process development and optimization – from prototype production to series production – and especially the process of laser direct structuring (LDS).

This innovative technology combines electronic and mechanical functions in one component. The process can be quickly explained. First, shaped parts are formed with single-component injection molding from a thermoplast provided with additives. Then a laser beam inscribes the course of the strip conductors to be formed on the plastic. With this laser activation, a micro-rough surface forms on which the copper is firmly anchored during the subsequent metallization. A copper layer up to 10 µm thick builds up in the currentless metallization bath. Nickel as a barrier layer and a razor-thin gold finish are attached on top of this for better solderability.

Siblings Marlene Weiner and René Weiner are the second generation to manage NORWE GmbH. The subsidiary NORWE Inc. in the USA, with their brother Peter Weiner as manager, serves the market in the USA, Canada and Asia. They supply customers with coilformers in 40 countries worldwide each year.

Irradiation cross-linking

With irradiation cross-linking, chemical reactions are triggered in additivized plastics by beta or gamma rays – a cross-linking of molecules. That prevents the typical molecular motion with heating.

The cross-linking takes place with components that have already been completed. The effect: the plastic can be processed in thermoplastic fashion and behaves in an extremely temperature-stable manner after cross-linking.

Soldering temperatures up to more than 400 °C

The basic idea was to modify a suitable base plastic through irradiation cross-linking so that the required resistance to temperature influences could be achieved.

In the joint pilot project, initially the plastics to be used were chosen and the influencing factors of irradiation cross-linking on their LDS capability were investigated. Plates made of cross-linked and un-cross-linked PTS Creamid LDS were produced for removal tests according to an exactly defined test matrix and provided with conductor structures. Creamid LDS is high-temperature polyamide cleared by LPKF and is

suitable for laser direct structuring of 3D molded interconnect devices.

The irradiation cross-linked Creamid can be soldered with block tin alloys and a soldering temperatures higher by ca. 20 – 30% is necessary for this. In plain language: soldering temperatures over 400 °C for up to three seconds are no problem for irradiation cross-linked components.

Specialists at LaserMicronics GmbH structured and metallized the Creamid test plates. On the basis of the measurement data ascertained, credible statements could be made on the required laser and metallization parameters for adhesion of the metal layers on the plastic and for the general suitability of the process for production of coilformers. The LPKF LDS development center under the direction of Dr. Wolfgang John was also involved in the design of the process and the additivation.

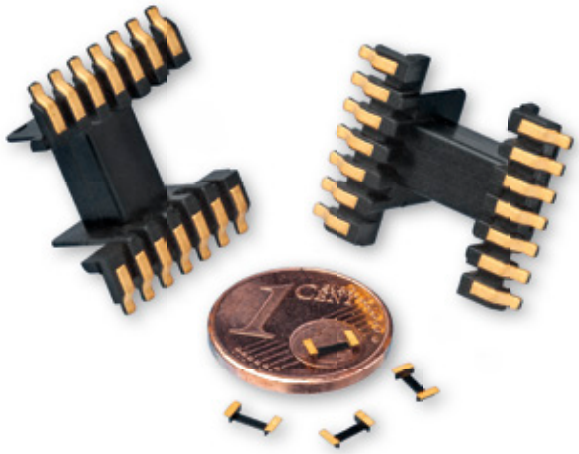
It is now certain: the pilot project has led to a valuable material qualification that benefits the other product innovations of NORWE.

The qualified LDS process has now entered series production at NORWE. The first step was the substitution of an existing component by its LDS counterpart. Tiny coil formers were produced as LDS variants with an existing injection mold and metallized.

Connection technology with the best soldering characteristics

After a successful launch, implementation on other components started. The completely newly developed and patented SMD3 coilformer series from a glass fiber reinforced, cross-linked polyamid PA 6.6 with 0.1 µm gold finish has been successful in the first customer applications and is ready for series production. Thanks to the LDS process, the coilformers no longer need metallic solder contacts, so no clamping of the component and no pressing the contacts in. The required contact and winding surfaces come about through laser processing and chemical metallization.

“The advantages at all levels have convinced us,” says René Weiner, managing partner at NORWE GmbH. “Reduction of components, lower item weight, simplified connection technology, outstanding soldering characteristics, optimal coplanarity and the option of small and medium-size series without a large assembly outlay – LDS technology still offers much potential for coilformers.”



Very small or very big: at the time of printing, two LDS coilformers have made it into series production – and others will follow.

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For around 60 years, NORWE has been developing coil-formers for the electronics industry. With distributors worldwide and a branch in the USA, the medium-size company serves customers in Germany, Europe and worldwide.

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LPKF Laser & Electronics AG produces machinery and laser systems that are used in electronics manufacturing, medical technology, the automotive industry and in the manufacture of solar cells. Operating worldwide, the company combines expertise in laser technology and optics, drive and control technology with extensive experience in laser micro-material processing.