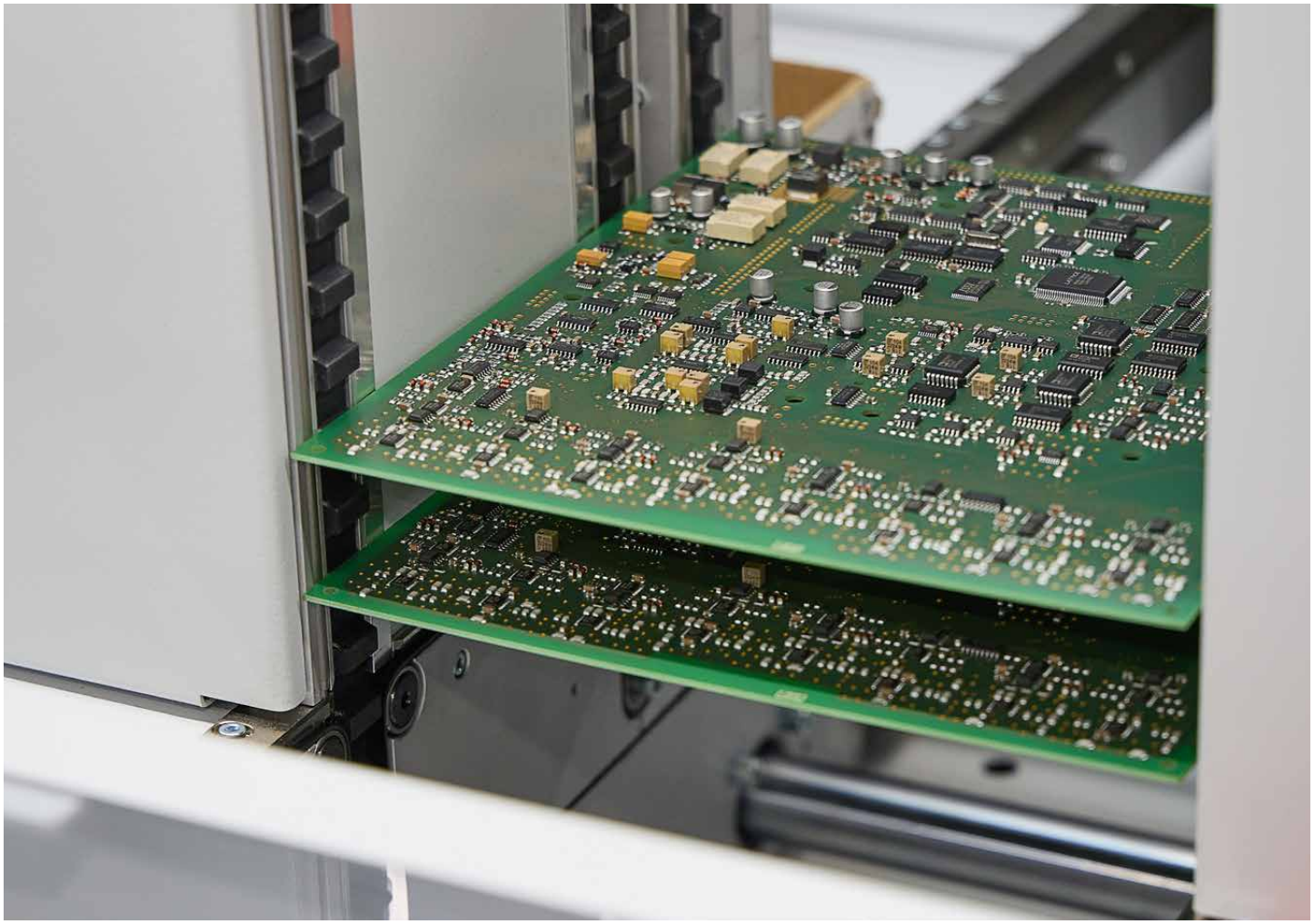
Leuze

How a circuit board is made

Application report

Leuze electronic assembly GmbH, Unterstadion



The Sensor People

EMS expertise: Leuze electronic assembly

A circuit board contains up to 1,500 electronic components. If the customer desires, Leuze electronic assembly also produces complete modules and installs other corresponding components in addition to the circuit board.

To produce a circuit board of the highest quality with up to 1,500 electronic components takes a great deal of know-how. That know-how can be found in Unterstadion, a community of approximately 800 residents in the Alb-Donau district: This is where Leuze electronic assembly GmbH is headquartered. More than 200 employees work in three shifts in the plant, which is over 3,000 square meters in size. The "LEA", a subsidiary of the Leuze electronic group, has existed since 1977. It is one of six Leuze production locations worldwide that is specialized in Electronic Manufacturing Services (EMS) – the production of electronic components.

A reliable partner

Leuze electronic assembly GmbH has continued to consistently and successfully further develop since its founding in 1977. In 2022 sales totaled approximately 64.5 million euros; production has increased an average of 17 percent per year over the past ten years. A success story that is based in part on a special feature of the location, as production manager Georg Denkinger explains: "Two thirds of our production is for the global Leuze group and one third is for external customers. This combination of in-house production and contract production is quite unique. Many competitors attempt this but are not able to succeed at it." According to Denkinger, it requires a different mindset and adapted structures, also with respect to the software that is used. And not least of all, staying power, because it takes a while for some investments to pay off. The customers of Leuze electronic assembly know that they are well served here: "We treat external and internal customers the same. This is easy to say in good times. But it is something that also needs to be demonstrated in challenging times and, of course, means giving an external order priority if the customer has a problem. This is only possible if one is prepared for such situations," explains Georg Denkinger. And Leuze electronic assembly in Unterstadion is, as a glance at the ultra-modern production facilities with three productions lines shows.

Millions of small parts

"Assembling a circuit board is similarly complex as building a modern smartphone", says Georg Denkinger. Leuze electronic assembly processed more than 320 million SMDs (surface-mounted devices) in 2022. These are small, electronic components that are soldered onto the circuit board. In addition to this, there were also some ten million THTs (through-hole technology). These are components with wires that are plugged through the circuit board and are soldered onto its rear side.

„Assembling a circuit board is similarly complex as building a modern smartphone”

Precision required

Circuit board assembly begins with the programming. Here, Leuze uses a machine that programs all types of devices. Well over 500,000 components pass through this step every year. A data matrix code, which contains the part number, order number and serial number, is then laser-etched onto the component. The advantage: Should a component later be determined to be faulty, the code can be used to precisely track everything – for example, when the part was manufactured, which stations it passed through and how it was tested. Once the code has been laser-etched, the component moves on to the SMD line to "Solder Paste Printing": A die is now applied to the empty circuit board as a template. Solder paste is filled into the cavities of the die. "The paste is comparable to the solder wire from past times; it connects the surface-mounted components to the circuit board," says Georg Denkinger. The height of the paste is important – it is very precisely applied to exactly one micrometer. For comparison: The average human hair has a thickness of about 50 to 80 micrometers. A machine measures the circuit board using a 3D scan to determine whether the paste has been correctly applied everywhere.

Production manager Georg Denkinger with a die.
This is used to apply the solder paste on the circuit boards in a targeted manner.

Three lines that can be used flexibly

In the subsequent process, pre-tested rolls with standard components enter an assembler. This removes the components and places them in the respective solder paste depots. Thanks to a "pick-by-light" system, order picking is designed for efficiency and freedom of errors: light signals show the responsible employee exactly where which roll is to be placed next – this is then acknowledged. Another advantage of circuit board assembly at Leuze: All three lines can process all types of components, from small to large. This is controlled via a central line computer from ASYS. Now it's on to the oven: Here, the correct temperature is essential so that the paste melts. The profiling of the temperature trend is performed acc. to J-STD-020, and the soldering takes place under a defined inert gas atmosphere.

The standard electronic components are on rolls. The individual tape rolls are guided into an assembler. This places the components on the circuit board.

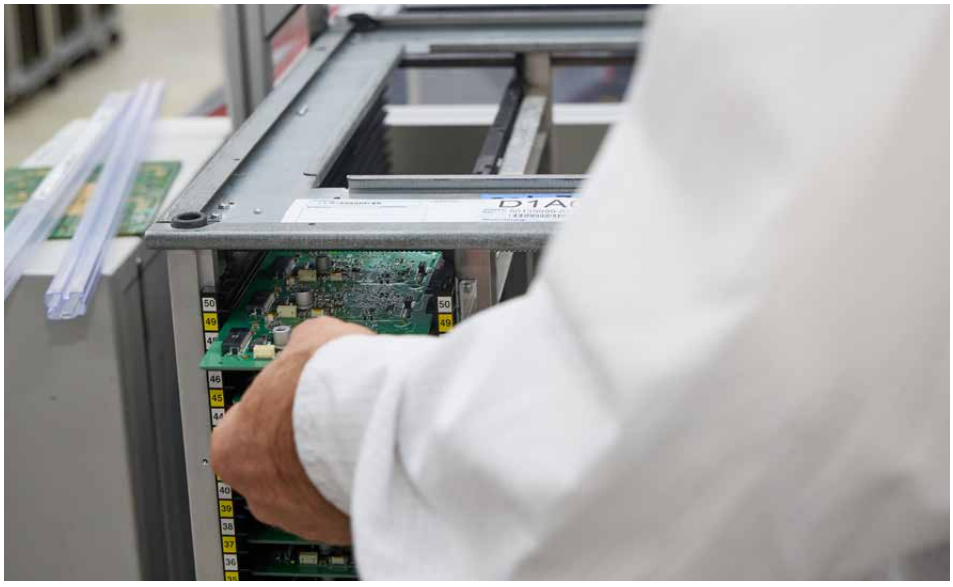
Focus on quality

Next comes an optical inspection of the circuit board – likewise fully automated. High-tech is used here: an Automated Optical Inspection System (AOI-3D) from KohYoung. For this purpose, a laser projects a checkerboard pattern onto the circuit board, thereby facilitating measurement of the surface. In addition, the machine uses image processing to inspect the components. With absolute precision, as Georg Denkinger emphasizes: "Nothing can hide from the system. Whether an electronic component is now missing, was not correctly soldered or if alignment and height are not correct – these and many other possible errors are reliably detected – the plate is then ejected and reprocessed." It takes a maximum of 17 seconds for a circuit board to be inspected in this way. With several hundred, extremely small components, this is quite an accomplishment. For the production manager, AOI-3D is an important step for quality assurance: "We have been using the AOI process since 2007 already. And in 2019, we made the transition to the 3D version. This puts us ahead of many competitors." The customers of Leuze electronic assembly profit from this through maximum operational safety of the electronic assemblies manufactured in Unterstadion.

Quality and functional capability have top priority in every process step and are constantly inspected.

Circuit boards even for harsh environments

In the next step, a machine places diaphragms on the intended sensors – with an accuracy of approximately 15 micrometers. These thereby receive a clear switching threshold from dark to light. Every year, between 600,000 and 700,000 diaphragms are affixed here. This is followed by the flying probe test: A probe with up to eight needles moves over the circuit board. The needles establish contact with the electronic components and test them for functionality. The same occurs on the underside. In addition to this, a needle-bed test system with more than 1,500 needles is available – for the case that the assembly is manufactured in larger quantities. Last but not least, Leuze electronic assembly provides the circuit boards with a protective coating if the customer desires. "A coating is useful in, among other places, environments in which condensation can occur," explains Georg Denkinger. "We produce circuit boards for large mining trucks and snowcats, for example. These need to function reliably even under harsh conditions." With that, the circuit boards are nearly finished: They are now automatically cut out using a milling machine or a laser. If the customer would like complete modules, the employees in Unterstadion install the circuit boards in housings and mount additional components. Programming, parameterization and function tests on the module level round off the process. Such modules are created for devices for blood analysis, for example.



Leuze electronic assembly in Unterstadion can manufacture approximately 1,600 different circuit boards; about 40 different circuit board types are produced every day.

Large demand

With its extensive expertise in EMS production and high quality standards, Leuze electronic assembly GmbH is a reliable partner to its customers. 99.7 percent of the electronic components produced in Unterstadion are error free already on their first process run. With employees who have been trained in the plant, state-of-the-art machines and patents on systems developed in-house, LEA has paved the way for a continued successful future: "We would like to continue to grow and to increase the share of contract manufacturing to approximately 50 percent. There is great potential for this. We are recording a large number of customer inquires," says Georg Denkinger. Thus, the outlook is good for the circuit board specialists in Unterstadion.

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