PRESS RELEASE

Unimicron Germany forces embedding technology with a higher yield and shorter time-to-market

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Page 1 of 5

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In particular, within the field of power electronics, embedding technologies show con-siderable advantages regarding their electrical and thermal performance, for example in the areas of electromobility and photovoltaics. Bonding connections from the chip to the lead frame or soldered connections of the discrete component can be omitted due to integrated power semiconductor chips directly integrated into the PCB, inductive switching losses reduced and switching speeds increased. Simultaneously, power density and thermal properties are improved substantially. Considerably better reliability, the opportunity to use more compact system structures or copy protection provides further advantages for the user.
Based on several years' development, Unimicron Germany offers two different embedding technologies: chip embedding and component embedding.

Chip-Embedding

Unimicron Germany GmbH was able to successfully implement the technical feasibility of so-called chip embedding, i.e. the integration of power semiconductor chips (MOSFETs) into the PCB for various, also in-part State-funded projects, and subsequently prove both improved power properties and increased reliability.

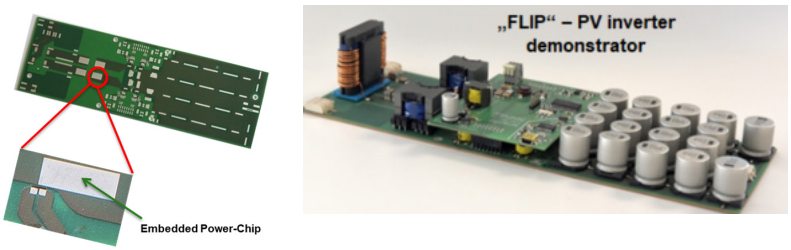

Figure 1:

PV inverter demonstrator (BMBF "Flip" project)

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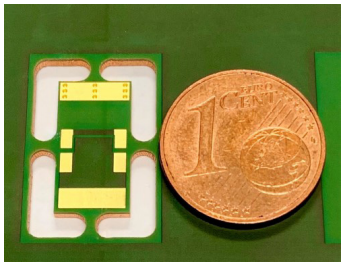

Figure 2:

"Chip embedding" module for the currently running BMBF [German Federal Ministry of Education and Research] "SiCeffizient" project

In addition to its many technical advantages, chip embedding technology also has its downsides. Particularly in chip embedding, apart from issues such as the availability of semiconductor chips with copper-plated connection pads, there is still a fundamental challenge: achieving an economically acceptable yield!

The testing of bare dies before embedding is not practically possible or only with disproportionately high expenses. When producing an embedding assembly group, a correspondingly high scrap factor must be reckoned with. Dependent on the number of embedded semiconductor chips per assembly group, the risk of producing scrap increases exorbitantly. In addition to increased costs, the aspect of sustainability and conservation of resources should be kept track of.

Solving this topic is by no means trivial with a view to power electronics. Despite many years' successful development work, the number of projects currently implemented in series has still remained very manageable.
The "pre-packaging" of the power semiconductor chips in FR4 material offers a solution approach. These "pre-packaged chip" modules can be subjected to an electronic function test before further processing. Although this shifts the yield subject matter towards manufacturing the pre-packages, it provides considerable advantages on profitability and sustainability.

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It must still be observed that each newly generated pre-package is a new component package that requires corresponding qualification work. Embedding chips into the PCB or pre-packages poses specific requirements to the PCB manufacturer's infrastructure. Investments in appropriate equipment for fitting the semiconductors with components, corresponding processes for chip connected to the PCB (gluing, soldering, sintering) as well as extended cleanroom conditions or ESD protection are necessary.

Due to the future technical requirements, the clear advantages of chip embedding and the extremely positive results of the development projects implemented to date, Unimicron Germany has decided to follow this course rigorously. Therefore, the company collaborates closely with customers, component and base material manufacturers to find a solution for the existing challenges.

Component-Embedding

Until chip embedding has achieved economically viable series maturity, Unimicron Germany will force component embedding. The embedding of packaged or pre-packaged power semiconductors already offers the user a variety of advantages and the possibility of rapid implementation in series production.

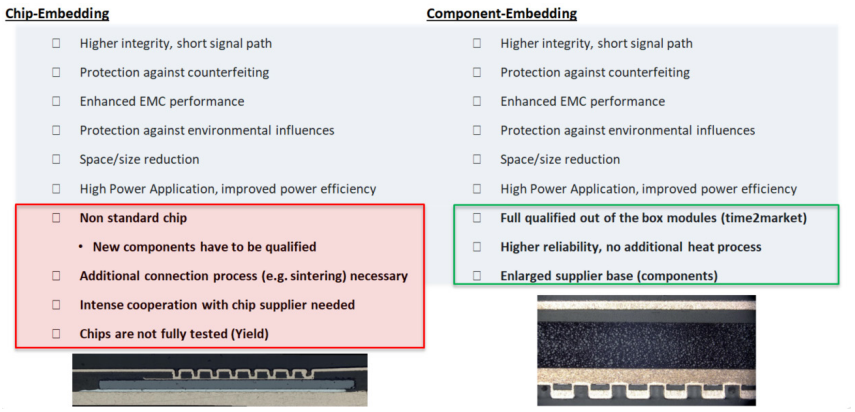

Figure 3:

Comparison of bare die (chip) embedding and component embedding

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Many years of experience in embedding copper moulded parts (busbars) into the PCB provides the basis for component embedding. Here, Cu profiles in nearly all shapes and sizes can be placed in the inner layer core of a multilayer PCB for partial copper cross-section enlargement. The inner layer core is provided with cut-outs at the corresponding locations, which is normally carried out by milling or, for higher packaging densities, using a laser.

The operational process for embedding SMD components is virtually identical to this. Unimicron Germany has developed a process that places and fixes the components without an additional gluing or temperature-afflicted soldering or sintering process. After lamination of the multilayer, the connector pins or surfaces of the respective embedded component are directly connected with drilled and metallised holes.
By this means, a very wide range of available “out of the box” and already qualified standard SMD power semiconductors can be embedded in as far as connector pins or surfaces exist for making the contact.
The standardised operational process and access to standardised components for a wide supplier base have an extremely positive effect on the yield and time-to-market aspects.
Adapted layer constructions and the use of thermally performant basis materials enable the realisation of thermally and/or electrically optimised constructions.

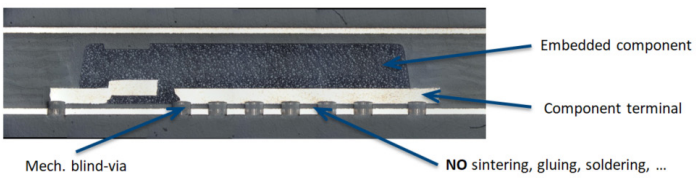

Figure 4:

“Embedded” SMD power semiconductor with mechanically drilled blind-vias to the component connectors

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All the prototypes and test circuits constructed to date show extremely positive results, both concerning the improvement of the thermal properties and on the reliability of the assembly groups constructed with regard to the temperature cycle test and temperature storage.

Currently, further wide-ranging test and examination programmes are running at Unimicron Germany in close collaboration with partners from the customer and component manufacturer sides.

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