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Interview with Thomas Bliem, VP R&D at ASMPT SMT Solutions

The right machine at the right time

With continuing advances in smartphones, smartwatches, autonomous vehicles and medical technology, electronic products are becoming smaller, more complex, and more powerful. This is made possible by a key technology called system-in-package, or SiP, which combines semiconductor chips, conventional SMT components, sensors and even antennas in a single housing. For manufacturing, this means that the semiconductor and SMT worlds are converging. At the upcoming Productronica trade fair, ASMPT SMT Solutions, the market and technology leader in electronics manufacturing equipment, will be showcasing the SIPLACE CA2 for the first time in Europe. The hybrid platform places dies directly from the wafer and SMDs from the reel in a single machine. This makes SiP production suitable for high-speed and large-scale production. We spoke with Thomas Bliem, VP R&D at ASMPT SMT Solutions, about technology, benefits, and prospects.

productronic: Mr. Bliem, why are system-in-package modules currently in such high demand and where are they used?

Thomas Bliem: Because SiP significantly shortens development cycles and enables a wide range of variants. Instead of developing a new monolithic SoC (system-on-chip), you can combine proven existing dies with passive/active SMDs, sensors and antennas in a single package. This results in compact designs, short signal paths, and calculable costs right through to volume production. The range of applications is correspondingly broad: RF front ends and connectivity modules for 5G, wearables such as smartwatches and fitness trackers, computing and sensor modules for AR/VR, IoT gateways and edge controllers in industry, as well as power and control devices in vehicles, and even implantable or wearable medical devices. For manufacturers, this means that SiP is becoming a standard component requiring integrated processes that seamlessly combine die handling and SMT. We have been focusing on this trend for a long time and have directed our development activities accordingly. The result proves us right: The SIPLACE CA2 is the right machine at the right time.

productronic: You are presenting the SIPLACE CA2 for the first time at this year's Productronica. What is so special about it?

Thomas Bliem: The SIPLACE CA2 is a true hybrid platform that combines two worlds in one machine: conventional SMT placement and pioneering advanced packaging. For the first time, users can combine SMDs from tapes and dies directly from sawn wafers in a continuous process. It doesn't matter whether the dies are processed using the die attach or flip chip method — both are possible without retooling. The big difference between this and previous approaches is that we eliminate the entire die taping process and also make dedicated die bonders unnecessary. For customers, this not only means one less process step, but also less investment in machinery, a significantly more compact line, and, above all, a decisive gain in speed. It is precisely this combination of productivity, flexibility, and process integration that makes the SIPLACE CA2 so special.

productronic: How powerful is this new platform in terms of productivity and precision?

Thomas Bliem: Very — in both aspects. The key lies in the intelligent buffer system with its integrated flip module. It decouples the sensitive removal of the dies from the carrier foil from the actual placement process. While the dies are removed from the wafer and temporarily stored in the buffer, the placement operations continue without interruption. This ensures uniform clocking and unprecedented speed. Specifically, this means that the SIPLACE CA2 can handle up to 51,000 components per hour in flip-chip mode, 54,000 in die attach mode, and 76,000 conventional SMDs — all within a single machine. This closes the gap between backend process speed and modern SMT production. Precision is equally important: we achieve a placement accuracy of up to ±10 micrometers at 3 σ. In other words, 1 σ corresponds to around ±3.3 micrometers — meaning that around 68 percent of all components are already within this extremely narrow tolerance. We are now bringing a level of precision that was previously known only in the semiconductor world into the SMT cycle. This combination of high speed and high precision sets a new benchmark compared to specialized die bonders, which simply cannot keep up in this performance class.

productronic: Wafer handling certainly presents a particular challenge. What was the biggest technical hurdle?

Thomas Bliem: Definitely the gentle removal of the dies from the carrier foil. After being sawed, the individual chips sit on a foil from which they must be removed before placement. To do this, the die is lifted slightly from below with a fine needle, while at the same time the foil is pulled in the opposite direction using negative pressure. This process is technically very demanding because many dies are extremely fragile. In conventional machines, this is the bottleneck that slows down the entire process speed. Our solution was to take a completely new approach with an intelligent buffer with 16 nozzles that temporarily stores the detached dies, combined with a four-nozzle turner for flip-chip components. This means that detaching and placing run in parallel and no longer sequentially. While the placement head works, new dies are being prepared in the background. This ensures a continuous supply without wait times and with full process reliability. This is the decisive step toward bringing wafer handling up to SMT cycle times.

productronic: Apart from performance, what advantages does the SIPLACE CA2 offer users?

Thomas Bliem: There are several points that are crucial for our customers:

- Traceability: For the first time, we offer full end-to-end single die level traceability. Each individual die is clearly documented from the original wafer to its final position in the end product. This is indispensable today, especially in the automotive industry or in other safety-critical applications.

- Costs & environment: The elimination of die taping means two things: On the one hand, the investment and operating costs for this entire process step are eliminated. On the other hand, there are no more tapes that would have to be disposed of afterwards. In a typical high-volume line, the cost savings add up to several million euros per year, while at the same time hundreds of kilometers of plastic waste are avoided.

- Flexibility: With the Wafer Exchange Unit, up to 50 different wafers can be kept in the system. While one wafer is being processed, the next one is already being prepared. The actual changeover then takes only 13 seconds. This means that even complex products with multiple chip types can be manufactured without any slowdown. In addition, the machine can of course be combined with tape & reel feeders. This offers maximum flexibility in the smallest of spaces.

- Space requirements: Last but not least, the SIPLACE CA2 is extremely compact despite its performance. It requires only 2.56 by 2.50 meters of floor space.

productronic: How do you ensure process stability with this level of complexity?

Thomas Bliem: In the SIPLACE CA2, several high-end vision systems take on this task. One example is a new high-speed camera that tracks the sensitive die removal process at up to 200 frames per second and automatically adjusts its frame rate to the relevant process steps. This allows potential challenges in the die removal process to be identified at an early stage and specifically remedied with appropriate corrective measures. At the same time, we have once again doubled the resolution of the PCB camera to reliably detect even the finest structures. This combination of real-time control and precise image processing ensures that the SIPLACE CA2 operates with maximum process reliability even at the highest speeds.

productronic: What does a typical production line with the SIPLACE CA2 look like?

Thomas Bliem: The line setup is conventional: first a DEK Galaxy solder paste printer, followed by an SPI system. Then fast SMT placement machines such as our SIPLACE TX micron take over, which can place up to 93,000 components per hour and are designed for maximum precision with conventional SMDs. At the end of the line is the SIPLACE CA2, which additionally places the dies directly from the wafer, thus bringing together the worlds of SMT and advanced packaging. The result is a continuous high-speed SiP line that, despite its enormous performance, requires only around ten meters of shop floor space before the oven and is thus significantly more compact and efficient than conventional setups, in which separate die bonders have to be operated away from the line. With the SIPLACE CA2, this previously outsourced process is now seamlessly and resource-efficiently integrated into a classic SMT line setup for the first time.

productronic: Powerful hardware is one thing — how important is software integration?

Thomas Bliem: Extremely important. Integrated hardware and software solutions are the key to our concept of data-driven, intelligent manufacturing. With the SIPLACE CA2, we are also opening up the entire WORKS software suite for die processing directly from the wafer for the first time. This means consistent planning, efficient material logistics, setup optimization, setup verification, and even automated program changes — all without operator intervention. With these automation and optimization functions, our customers achieve a whole new level of productivity and process reliability. Another advantage is that the user interface is identical for SMT and advanced packaging applications.

productronic: Sustainability and resource efficiency are a must in manufacturing. What contribution does the SIPLACE CA2 make?

Thomas Bliem: One very significant contribution is the elimination of die taping. In conventional processes, dies first had to be taped in an additional step, which not only incurred costs but also generated enormous amounts of plastic waste. With the SIPLACE CA2, this step is completely eliminated. In high-volume production environments, this can save several million euros per year and at the same time avoid up to 800 kilometers of plastic tape. Added to this is a reduction in what we internally refer to as "material tourism". In many production facilities, die bonders are located outside the SMT line, which requires additional transport, energy, and time. With the SIPLACE CA2, SMDs and dies are processed inline in a continuous process. This not only saves space and reduces transport distances, but also reduces energy consumption.

productronic: How flexible is the platform?

Thomas Bliem: The SIPLACE CA2 has a deliberately modular design and can be tailored very precisely to the requirements of each customer. For example, users can choose between dual or single conveyor systems. This makes it possible to process conventional PCBs as well as very large substrates measuring up to 620 × 700 millimeters and wafers with diameters of up to 300 millimeters. In addition, we support various dip process solutions, such as our Linear Dipping Unit, which allows flux and other auxiliary materials to be applied with high precision and process reliability — even for components made of tape and wafer. The Wafer Exchange Unit offers additional flexibility It can hold up to 50 different wafers, with the next wafer being prepared while another one is processed. This means that the actual changeover takes only 13 seconds. This variety of options makes the SIPLACE CA2 a platform that can be used for everything from wafer to panel-level packaging, giving users the flexibility to adapt their line to new requirements in stages.

productronic: How can customers get started with this new technology?

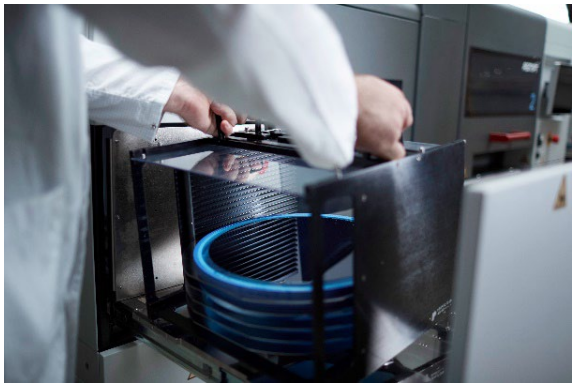
Thomas Bliem: Of course, we don't leave our customers to fend for themselves with this new technology — we support them very closely throughout the entire process. This begins with feasibility studies, in which we analyze specific products and requirements. This is followed by pilot projects, which we implement together with our customers in our global Centers of Competence. This allows us and our customers to test and optimize processes under real-world conditions before going into series production. Another important component is the training we provide for operators and process engineers so that the teams can work confidently with the new platform right from the start. Our experience shows that those who gain experience early on quickly build up expertise and can reap the benefits of system-in-package technology in large-scale production applications. Initial customers report that an investment in the SIPLACE CA2 will pay for itself after around a year in 24/7 production — a strong argument for getting started with this technology.

productronic: In your opinion, where is system-in-package technology heading?

Thomas Bliem: You can already find several dozen SiP modules in a modern smartphone today. But that's just the beginning. We expect significant growth potential in the coming years that goes far beyond consumer applications. Edge AI, AR/VR, networked medical technology and electronics for autonomous driving will massively increase the demand for SiP solutions. What all these markets have in common is that they require compact and powerful modules that can be produced economically. For electronics manufacturers, this means that investing in the right technology now will secure a clear competitive advantage for them. With the SIPLACE CA2, we are closing the gap between backend and SMT and enabling SiP production with SMT cycle times. This is a decisive step toward bringing this technology into large-scale production environments.

Thomas Bliem, VP R&D at ASMPT SMT Solutions (Image credit: ASMPT)

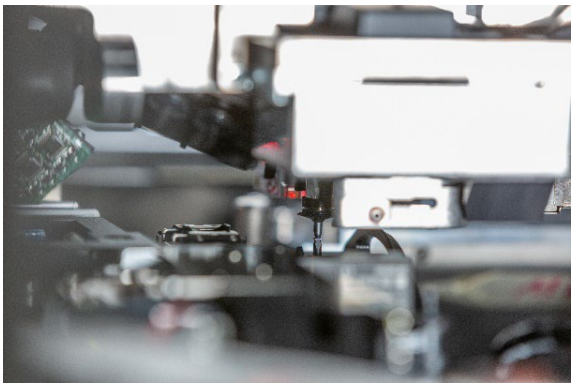
The hybrid SIPLACE CA2 brings two worlds together in one machine: conventional SMT assembly and pioneering advanced packaging in a footprint of just 2.56 by 2.50 meters (L x W).
(Image credit: ASMPT)



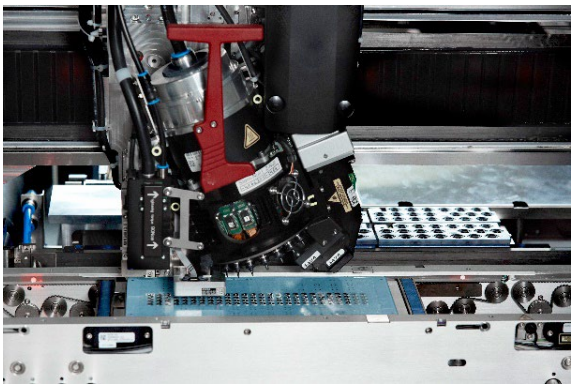
Feeding a film frame magazine into the wafer exchange unit, which can accommodate up to 50 different wafers, with wafer changes taking only 13 seconds.
(Image credit: ASMPT)

Supplied via a feeder, the SIPLACE CA2 also processes classic SMT components such as resistors, capacitors, transistors and diodes at speeds of up to 76,000 cph.
(Image credit: ASMPT)

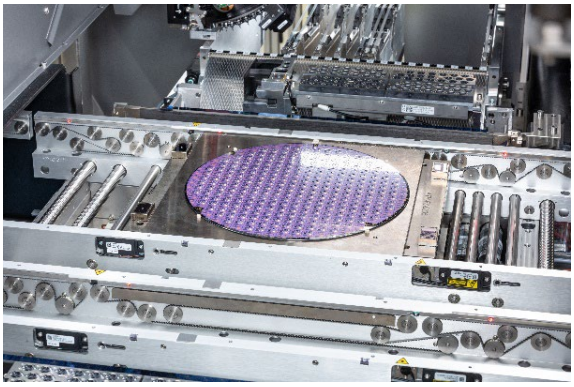
A continuous high-speed SiP production line: A DEK Galaxy solder paste printer followed by the Process Lens SPI system, fast SIPLACE TX micron placement machines and the hybrid SIPLACE CA2 at the end of the line, which also places dies directly from the wafer.
(Image credit: ASMPT)



Flip chip unit: Four flip nozzles detach the dies from the wafer's carrier foil and transfer them to a buffer system. This process, which runs parallel to the placement process, increases the processing speed significantly.
(Image credit: ASMPT)



The trace data of each individual die can be tracked seamlessly, from the original wafer to its exact position on the substrate.
(Image credit: ASMPT)



Placement on a glass wafer (WLSiP) with an accuracy of up to ±10 µm (3 σ), supported by a wafer chuck that holds the wafer flat, stable, and vibration-free during processing.
(Image credit: ASMPT)