



Contract SMT and Microelectronics Assembly in One

Modern manufacturers have to deal with both SMT and Micro-E services because assemblies require mixed interconnect technologies. The application, required processes, thermal considerations, and particular board all must be considered.

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Throughout the history of electronic manufacturing, there have been distinct boundaries between those that assemble SMT components and those that assemble microelectronics (Micro-E). In today's market, it is difficult to identify a U.S. source for low-volume prototype services that offers both disciplines.

A detector manufacturer was looking for a company to provide prototyping/low-volume sourcing and assembly services for a PWB panel that required multiple assemblies and depanelization to fit in a handheld monitor. The project entailed both surface mount and Micro-E assembly services, which rarely are offered together. A solution was available from an unexpected source: a manufacturer of automated precision wire-bonding and die-attach equipment.

Contract surface mount services and microelectronic chip and wire services are not usually found in one location. OEMs generally have to deal with two different companies; that is, if they can find a company able to provide microelectronic prototype and manufacturing support. Although these two fields almost always have been separate, more manufacturers have to deal with both SMT and Micro-E services because many boards and assemblies today require mixed technologies. These include hybrids or chip on board (COB), where customers integrate wire bonding directly on the board. The application, required processes, thermal considerations, and particular board all must be considered in determining which procedures involve SMT, which involve Micro-E, and in which order these processes should occur.

SMT Working with Micro-E

Traditional Micro-E assemblies require a class 100,000 cleanroom for most operations and some of the processes require class 10,000 (**Figure 1**). Expertise is expected in process engineering, die attach, wire bonding, and custom deliverable parts. Most companies looking to outsource these processes want someone with 15 to 20 years of experience in building Micro-E parts.



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Figure 1. Microelectronics assembly requires anywhere from class 100,000 to 10,000 cleanrooms.

SMT assembly uses solder, flux, and other contaminants that affect the microassembly process negatively, and people performing these services usually are experts in the areas of solder, reflow, pick-and-place, screen printing, and other steps of electronics assembly and test. Facilities generally require a class 300,000 cleanroom (**Figure 2**).



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Figure 2. SMT assembly brings more contaminants into the manufacturing process than microelectronics assembly alone.

Taking into account and planning the two processes — SMT and Micro-E — simultaneously has many advantages. Simultaneous production planning enables those involved to look at the total product rather than at one board or view it in isolation. Temperature plays a large part in determining the order of assembly; maximum temperature requirements for wire bonding can be different than for other components. Working together enables an evaluation of which part needs what processes, and at what temperature profile, so as not to destroy the component or the wire bonds.

A schedule is set up and cost analysis done for the entire project, sourcing occurs for both parts at the same time, documentation covers the complete process, and quality control and testing are ensured. It also establishes accountability for the project and process flow, simplifies scheduling, streamlines costs, and reduces risk.

Package- and Die-level Interconnect

It is rare for equipment manufacturers to offer contract assembly services. However, depending on the type of equipment, equipment manufacturers often are in the best position to understand and perform assembly processes. They know how to use their equipment, reconfigure it for many unique applications, and have experienced engineers dedicated to fine-tuning customers' processes and products on the equipment. The equipment already is in place at their showrooms and testing facilities.

For a designer and manufacturer of automated high-precision wire bonders and component placement systems, positioning the company to support the scalable production of complex microelectronic devices at its own facility was a natural progression. Equipment providers boast expertise, equipment, processes, and facilities already in place. With proper planning, they can take a product from design to volume production at a lower cost, in a shorter time, and at less risk than a company not specialized in these technologies trying to do the prototyping, manufacturing, and test on its own.

Micro-E assembly processes include advanced wire bonding, gold ball bumping, and precision component placement for semiconductor packages, high-power LEDs, MEMS devices, microwave and RF components, optoelectronic packages, multichip modules (MCMs), and hybrids.

Starting a contract microelectronics business can be highly synergistic and offer positive returns to an existing equipment business, because it ensures that the company is providing the most cost-effective and flexible designs, production services and equipment — such as this company's bonders — specifically suited to a customer's end application. In many cases with this contract business, after the product has reached volume assembly, the customer or EMS provider chosen for volume manufacturing will purchase the equipment. The needed machines already have been tooled for the particular application, and training and process transfer can be done for volume manufacturing.

Concerns may arise about equipment suppliers competing with their own EMS customers. Equipment suppliers performing assembly will not be reaching the manufacturing volumes generally accepted by EMS companies, and because many of these customers later transfer the process and equipment to the high-volume EMS, that concern is reduced.

SMT

Micro-E assembly for EMS and OEM customers falls short of the full range of electronics assembly, namely, SMT-level steps. Partnering with a nearby electronic design and manufacturing service provider added complementary technical capabilities to the equipment supplier's microelectronics assembly business. When a customer proposed an application that required a total SMT/Micro-E solution, a partnership between EMS provider and packaging business was born. Together, these assembly companies provide prototyping, sourcing, and low- to mid-volume assembly and test services for complex microelectronic packages and assemblies.

Case History of a Detector Panel

Following the path of the detector manufacturer illuminates the advantages of the Micro-E/SMT assembly collaboration. In need of wire bonding services for a 10 × 8" panel with 12 assemblies, the handheld detectors OEM approached the microelectronics assembly service business of the bonder company. They were seeking quick-turn prototype development and package assembly support. Consultation revealed that SMT and chip and wire support were needed.

As is usually the case, the customer had PWB drawings; materials already were purchased. Over time, much of the procurement responsibilities were transferred to the assembly partners. A JIT inventory system was set up to categorize materials and provide inventory control. Documentation using work order flow tags for the entire process, down to details for each lot, was adopted.

A prototype was made using the same automated assembly equipment that would eventually be used for volume manufacturing. The panel initially started production in the SMT facility, where passive components were attached. Most of the control functions had to be placed on the board first because of the difference in process temperatures required before and after wire bonding. The Micro-E provider took over: epoxy was dispensed, parts wire bonded then encapsulated. The panels then returned to the SMT facility for installation of higher-level discrete components and final mechanical assembly. Each panel went through test, and then depanelization. Acceptable ones went to final assembly and were integrated into the handheld monitors.

Conclusion

Bringing low-volume prototype manufacturing services into an equipment supplier's offering provided a solution for companies in need of rapid prototyping and assembly of precision microdevices. Collaboration with an SMT-focused EMS provider, created a single source for SMT and Micro-E. The collaborations extend further, with the addition of qualified vendors to offer specialized processing such as plating, sputtering, wafer dicing, and LED repackaging. These partnership-based services align with several key market segments including

photonics products, LEDs, and solar cells for solar concentrators.

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