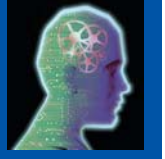

On the Forefront

Phil Zarrow

The Oddity of Automated Odd-Form Insertion

"Domo arigato, Mr. Roboto." Styx

In the early days of surface mount, some prophesized that, eventually, through-hole components would disappear. Well, we are 25 years into surface-mount technology and through-hole technology persists. Certainly, the majority of integrated circuits (ICs) and passives are available in surface-mount packaging. In fact, you would be hard-pressed to find many such components in through-hole configuration—the demand for them has declined so much that component manufacturers rarely supply them. In many cases, this conundrum has pushed a design from through hole to surface mount. However, most printed circuit board assemblies (PCBAs) being manufactured are still "mixed tech" because they contain through-hole parts.

Which Through-Hole Components Persist?

The through-hole components typically found on modern assemblies are connectors and headers. Granted, an incredible variety of surface-mount connectors are available. However, many applications require the mechanical robustness that only a through-hole interconnection can give. This requirement is particularly true of connectors that interface to the external portions of a product and may see stress induced by frequent plugging and unplugging of interconnections.

I fondly recollect a conversation I had back in 1982 with a design engineer at Apple Computer. While working on an iteration of the Apple 2C, he mentioned to me that not only did he foresee only using through-hole D-type connectors for the joystick interface, but that he was seriously considering using a mil-spec one at that. That particular interconnection had to survive the force of a nine-year-old repeatedly plugging and unplugging that joystick cable.

A plethora of other through-hole parts reside on modern PCBAs. Sockets, switches, light-emitting diodes (LEDs), heatsinks, radio-frequency (RF) shielding and larger passive power components still have to be inserted and soldered. What's the best way to do this? If you have a low volume of total parts to be inserted, you might hand insert and solder them. If you have a high-volume of parts and are assembling in China—where the typical assembler is getting $0.50 an hour—you will probably hand insert them. If you fall between these two extremes, automated solutions—such as robotics—can come to the rescue.

How to Insert Through-Hole Components: The Old Days

In days of yore, through-hole components were automatically inserted with machines built by companies like Universal Instruments, USM-Dynapert, Panasonic, TDK and Fuji. Machine centers were dedicated to radial components, axial components and dual-inline packages (DIPs). Automated robot cells inserted or placed other types of components on the board. The automation ranged from robot arms configured into cells dedicated to placement, like those from Adept and Seika, to insertion of a specific type of component. Usually, the cells required a long de-bug time and were costly.

Eventually, the surviving configurers evolved robot cells to do sophisticated assemblies. Robodyne, for example, has designed cells for complete final assembly of PCMCIA cards—attaching the surface-mount connector to the card and inserting the card/connector into the assembly housing—all on one cell. But most assemblers just have a few through-hole components to mount on the PCBA.

Some flexible pick-and-place machines could be configured to insert a limited number of through-hole components. The type and variety of component and parameters vary by manufacturer and machine model, but this capability is demonstrated on the Universal GSM, Fuji QP-3 and Mydata MY-11, as well as machines from Yamaha/Essemblion, Siemens, Samsung, Panasonic and Juki. But be warned: The variety of components that can be inserted with a pick-and-place machine comprises a very narrow band and strict PCB hole specifications must be met.

How to Insert Through-Hole Components: These Days

Some machines on the market are specifically designed to address the through-hole minority popula-

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tion on PCBAs. One interesting approach is a machine manufactured by ATS. Their system combines a robotic means of picking up a through-hole component, inserting it and using an on-board laser soldering system mounted below the PCB level, soldering the leads to the board with solder supplied by a wire-solder feeder. The components are mounted and soldered on a single machine center.

A comprehensive approach addressing the high volume of PCBAs and the large number of through-hole components on them has been developed by Universal Instruments. The Polaris assembly cell is a viable solution to odd-form placement. Using interchangeable servo-gripper head technology, the machine can deal with a variety of through-hole components including sockets, connectors, transformers, large passives and RF shielding.

The assembly cell concept lends itself to a number of soldering options, such as intrusive reflow soldering. In such a process, the PCB is printed with solder paste, and surface-mount components (SMCs) are mounted prior to the assembly cell. Following odd-form mounting, the entire board would pass through the reflow oven, completing soldering of the SMCs and the through-hole components. Of course, a number of through-hole components cannot pass through a reflow thermal excursion. A few other reasons sometimes mean that intrusive soldering is not suitable. In such cases, reflow soldering of both sides of the assembly would precede the assembly cell. A selective soldering system complements the assembly cell perfectly, particularly in an in-line, automated configuration. Lacking that, the board could always be wave-soldered, palletized to prevent previously reflowed SMCs from being exposed to the wave.

Conclusion

The old assembly cell has gone a long way in 25 years. The advantage of cost-effective, accurate and repeatable component insertion, coupled with versatility and easy changeover, offers advantages over hand insertion just as automated soldering trumps hand soldering. Perhaps that Chinese assembly line person might graduate to an assembly cell operator after all. But don't count on a raise in pay. Remember, we're all in this together. ■