Duplicate Exact from the Stencil Perspective

Duplicate Exact. Sounds redundant, doesn't it? Somewhat like "déjà vu all over again." Semantics aside, however, the concept of "duplicate exact" has many facets that correspond directly to efficient and effective surface mount assembly. It can be instrumental in positively influencing assembly yields, reducing ramp up costs in high-volume manufacturing (HVM), cutting lead times, and cost reduction in sustaining manufacturing.

Today's realities of rapid new product introduction (NPI) and shorter life cycles require that products flow from NPI to HVM in a flawless manner. This is especially true with multinational manufacturing, where the transition to HVM takes place around the globe in multiple facilities. Because of this, SMT manufacturers are faced with numerous questions.

When NPI is released to HVM, is the process completely reengineered at the HVM site? When HVM is moved from one facility to another, a common occurrence in today's volatile global economy, how much reengineering of the process is required? When an OEM turns over NPI to an EMS provider for volume production, is reengineering necessary? Is the contract manufacturer open to transferring the process as well as the product, or do they want to adapt it to their own methods?

Fortunately, duplicate exact can help address these issues. Duplicate exact can apply to equipment, materials, tools, and processes in SMT assembly. Although we will examine just one aspect, the stencil tool for printing, it is easy to see how the concept can transfer throughout the manufacturing operation.

When a new product comes to the EMS facility, the process engineer often has little influence over the PCB design, including pad layouts. Usually, “it is what it is.” The board may have chip pads designed to work for either 0402s or 0603s. It may have QFN devices with a full ground plane. Without special aperture edits, both of these devices will present defect opportunities; tombstoning in the first case, and floating the QFN during reflow in the second case. Given the likely time constraints, and the almost certain pressure for zero defects, the process engineer must scramble to accommodate this scenario and meet production requirements.

The best approach would be to address manufacturability before release of the new product (design for manufacturing, DfM, is used for this), prove out the process, and facilitate the duplicate exact concept at all points of manufacture. Since this isn’t always possible, a winning scenario is to send the Gerber data file to the stencil supplier and have them design the stencil apertures per an established aperture design library that has been developed jointly with the EMS customer. This takes into account the EMS manufacturing capabilities in conjunction with sound manufacturing principles. Some stencil houses have stencil aperture libraries that have been proven out for hundreds of unique PCB pad designs that are customer specific. The area ratio calculator, a process development tool offered by some vendors, can aid the stencil/aperture design process. This tool helps define stencil thickness and stencil technology compatible with the particular area ratio. In some cases, a step stencil may be required, to best meet the area ratio guideline. In other cases, an electroformed stencil may be necessary.

By maintaining these customer-specific data files on-site at the stencil vendor, the “duplicate exact” printing process is facilitated. Both the library and the stencil Gerber file are archived, including all of the aperture edits, steps if required, and stencil technology used. This has great value when an assembly goes from NPI to HVM. The HVM location can order an exact duplicate of the NPI stencil proven out in early production.

The stencil design library is not a static, but rather a dynamic tool with a variety of inputs from the OEM, stencil house, initial EMS introduction site, and the ongoing EMS volume manufacturing facilities. It is not uncommon for conference calls to be performed on a routine basis with some or all of the above involved. A “duplicate exact” stencil includes the aperture design, as well as the stencil technology type (laser or electroform) and stencil thickness including any step designs. In effect, the stencil has become a purchased part that can be duplicated with the same consistency that the EMS provider would find in procuring board components.

Just as the EMS company strives to duplicate manufacturing capability throughout the organization, the duplicate exact stencil forms an important cornerstone in replicating the process.

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