NexLogic Technologies, Inc.
2075 Zanker Road
San Jose, CA 95131
P: (888) 639-5644
P: (408) 436-8150
F: (408) 436-8156
www.NexLogic.com

Understanding PCB Prototypes

There is a vast difference between PCB production and PCB prototypes. Characteristics of a prototype line differ in several respects from those of a production line. Prototype line traits include quick turn capabilities, flexibility, easy GUI, quick changeover adaptability, higher technology level, proactive and trained staff, equipment, and capacity levels.

Standard turn, also known as extended turnaround time, refers to the time between order entry and customer ready prototype, and it differs among contract manufacturers (CMs) and EMS providers. Some advertise one week as their standard turn; others, two to three weeks. Time factors are of prime concern because an OEM customer can incur extra costs and loss of time-to-market by naively relying on three weeks delivery, when in reality, the time extends out to six to eight weeks.

A prototype line must be flexible in terms of accepting different sizes of boards and different complexity levels. Prototyping for both PCB fabrication and assembly is, in effect, R&D since a product is not yet mature. It deals with a number of design changes involving specifications, features, and countless product aspects. For instance, a re-programmable FPGA's power and ground pin-outs may change to comply with different power and voltage requirements on a PCB. Or strip planes between analog and digital sections may need to be changed, depending on the impedance control requirements on the board.

By its nature, a prototype incurs constant change, even on the last day when it is ready to be shipped. The OEM may change a resistor or capacitor value, for example, just before the product is shipped out. Flexibility should be embedded in the process and procedures from design to assembly. At times, 100 percent review may not happen due to time constraints, and the OEM skips intermediate steps to rush the product ship out the door.

An easy-to-use GUI is important for helping the technical staff to quickly re-program prototype line systems. In doing so, the EMS provider can easily and quickly execute a changeover to a new prototype job. Re-programming should take no more than a few hours, not days, so that multiple jobs can be executed on the same prototype line on any given day. Easy prototype programming is important because prototyping requires quick format changes to maintain a steady and smooth flow of other incoming jobs.

As for technology level, a prototype line demands the latest technology available to include automatic optical inspection (AOI). If a fabrication shop is involved, it's important to know the kind of inner layer inspection and lamination registration and verification tools and capabilities this shop will be using during the fabrication process. It's also important to know how many layers they're capable of building for multi-layer boards and how complex boards can be manufactured.

A proactive sales team plays a major role in a highly successfully prototype line because it acts as an early warning system to advise the OEM of possible pending issues, concerns, or questions. Being alert to any possible problems assures that a prototype project stays on track and on schedule. This alertness is particularly valuable to avoid thousands of dollars of extra cost and inordinate time delays.

Multi-tasking technicians complement a proactive sales team by maintaining a smooth prototype line moving expeditiously from one project to the next. When the prototype SMT

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machine is running one job, technicians are already offline programming the next job or a technician may be changing the feeder on the second line, while the first line is operating at the same time. Hence, a set of two SMT machines operators are working at multiple jobs in tandem.

Lastly, successful prototype lines require the right kind of equipment to support the latest technology prototype projects. This includes an SMT line that is easy to program, an AOI machine for checking and inspecting defects, a paste height inspection system, a flying probe tester and BGA/CSP installation capability. Equipment like this ensures that jobs can be efficiently and successfully performed. Along this line, it's important to know the level of capacity an EMS provider offers and its limitations.

PROTOTYPE FABRICATION

The ideal prototype fabrication shop turns product around within 24 to 48 hours, if extra fast turn around is required. It possesses current technology to effectively handle components like fine pitch BGAs and CSPs and turns out cutting edge PCBs with finer capabilities. This means fabricating boards with 3 mil trace spacing and 3 mil air gaps between traces, plus making a BGA with 0.5 mil pitch, which is difficult to fabricate.

Also, this prototype fab house uses laser drilling technology for smaller drill sizes. It continues to use mechanical drills for up to eight to 10 mil holes. However, laser drills are used for the smaller four to five mil holes. As for surface finishes, the prototype customer has a full selection readily available to include immersion silver, immersion gold, OSP, and hot air solder level (HASL). Moreover, the prototype fab shop should be capable of producing hybrid boards with mixed layers of FR4, Rogers, polyimide, and / or Teflon materials.

Special considerations like sequential lamination and control depth drilling are equally as important. This calls for special tools and techniques to comply with prototype needs specific to different industries and applications. Sequential lamination, for instance, involves laminating board layers in pairs, one pair after another, rather than laminating them all at once. Control depth drilling deals with drilling the holes in the PCB's that drill from top layer to a specific length that does not go through all the way to the bottom side of the board.

Flying probe tester's speed is another important aspect. Does the prototype fab shop have a four- or eight-header tester? Is it one- or two-sided flying probe tester? Testing speeds are crucial to prevent bottlenecks so that the fab shop can churn out multiples of products at a time. Further, is the technology available for catching and inspecting inner layer registrations? This is especially vital for multi-layer, let's say 10 or more layer boards. It's important to inspect and evaluate internal layer registration to prevent mis-aligned layers.

PROTOTYPE ASSEMBLY

Selection criteria for prototype assembly includes capabilities for efficiently handling fine pitch BGA and CSP devices, hand loading to avoid programming charges, especially for smaller one to 10 quantities, ability to do consigned versus turnkey assembly, exemplary inventory management control, top-notch test capabilities, component procurement capability for smaller and larger BOMs, as well as the ability to cross reference the parts, which may include hard to find and obsolete items.

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Flexibility to do machine loading versus hand loading is also important. That's because the project may deal with small quantities involving moderate technology. Hence, it may be easier and faster to hand load the project. A prototype assembly shop should be flexible enough to do turnkey versus consigned assembly jobs because different projects and different customers have different needs, hence flexibility comes in handy to support them.

For further information and a complimentary consultation on PCB Design, Fabrication, Assembly, Material Management, or RoHS and Pb-Free considerations call us at **1-888-NexLogic (639-5644)**, email us at info@nexlogic.com or visit our website: www.nexlogic.com.