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Traceability on the Line

Compiled by SMT

This article looks at ways in which traceability is implemented and maintained during the electronics assembly process from the perspectives of pick-and-place, reflow equipment, and screen printer manufacturers; as well as barcode scanner and software companies.

Traceability means many things to different facets of the electronics assembly market. To the capital equipment manufacturer, it often means incorporating value-added proprietary software capabilities that recognize, scan, and verify components on the assembly line. For EMS providers and contract manufacturers (CMs), it offers the ability to locate and troubleshoot failures before and after they hit the field. It may also lead to gaining additional customers in higher-reliability fields. For the OEM, traceability can reduce recalls and field failures, strengthening the bottom line.

Years ago, traceability focused mainly on high-reliability electronics — military, aerospace, defense, and medical applications. Not surprisingly, manufacturers of other products, such as high-end telecom applications that are expensive and performance-critical, have gained interest in tracking products on the line. "In our industry, the margins are so tight for CMs that, typically, they do only what is absolutely required by their customers — no more, no less," says Francois Monette, co-president of marketing, Cogiscan, a tracking and traceability solutions provider. "And OEMs have been in a cost-reduction mode as well, which is evident in the migration of manufacturing to China." Solid traceability during a product build can save costs down the line. This has been witnessed in recent costly product recalls of laptop batteries, cell phones, and game consoles. Having good traceabilty data frees manufacturers to recall only a limited number of products from the field if there's a problem. "You have to invest a little bit more to gather the data during the manufacturing process, and you have to store the data," adds Monette, "but if something goes wrong, you will recover your investment by having a limited recall. That can be very significant." According to Monette, it's all a matter of dollars and cents — and not if there will be a recall, but when. Thorough traceability data will help to pinpoint the root cause of reliability problems.

"Traceability, traditionally, was necessary when manufacturing devices for government and medical; relatively low-volume, very sophisticated products," says Michael Foster, GM, Dynatech/Samsung. Recently, adds Foster, automotive manufacturers have become more concerned with traceability as in-car electronics become more robust. "They're getting out of their traditional thinking — simply setting up lines and punching out radios — to run somewhat flexible lines that manufacture a variety of products." High-volume electronics are becoming more expensive to manufacture, meaning that mistakes are not indispensable anymore. "Losses weren't as big in the past if they had a yield problem," notes Foster. Automotive electronics manufacturers haven't backed away from the volume requirement, but they're doing smaller lot numbers with more changeover, and a lot more accountability and traceability.

Lead-free manufacturing was another significant driver in acquiring and maintaining traceability data and tighter process control. Manufacturers need traceability, and they need lead-free process verification for due diligence documentation — being able to prove and document that, to the best of their knowledge, they have manufactured a product with lead-free solder and parts according to the RoHS legislation.

Process Control

Just as vital as product traceability is process control — determining that your process is in spec and will generate a reliable product. During the screen printing process, for example, if a low solder condition existed that later manifested into a short or open in the field, you can examine the data collected for that process and trace it back. "You could review the post-print inspection data, and at least come to a confident conclusion that, for that lot of boards, the inspection data shows that there was sufficient solder on that particular board," said Chris Wild, product manager, printers, Speedline Technologies. "Then you can take it down to the device level on a per-board basis and tie that to a barcode-specific board." Process control during printing encompasses the ability to scan materials: stencil, squeegee, paste medium, and work holder to verify that they are all the correct materials for that particular process program; it also tracks print speed and board schematics.

Process control also became more critical with the move to lead-free manufacturing because the solderability of lead-free alloys is more difficult than tin/lead alloys. Lead-free alloys must be reflowed at higher temperatures than leaded alloys, which may be too high for a particular component on the board. Before a board enters the reflow oven, the operator must verify that the process is in spec for alloys, components, and boards being used. You must verify that the board and the "current recipe" are a match, said Richard Burke, product manager, reflow, Speedline Technologies. "If a board is coming down the line to reflow, we're going to see that the board with this particular bar code matches the existing recipe. If it doesn't, the reflow oven will take action before that board goes in, and will change parameters automatically." This additional step can help prevent using leaded solder on a lead-free board, or vice versa; and can save lower-temperature-requirement components from damage. Automatic process control also removes some human interaction (read: opportunity for mistakes) in setting up and verifying that the correct reflow profile is used for the correct board — saving money in the long run. "It's more costly on the back-end to put leaded paste into a lead-free process than it is to spend a couple more minutes using a handheld barcode scanner," added Burke. "If you're able to tie the process back to the product and verify that you're within process controls, it helps drive this technology."

Pick-and-Place Traceability

Tracking and tracing component placement on the line is required in low-mix/high-volume (LMHV) lines as well as high-mix/low-volume lines (HMLV), making the pick-and-place machine the perfect outlet for acquiring traceability data. Each placement machine manufacturer handles this a bit differently. For Samsung, it means putting the process and the controls in place in the materials section of a customer facility, not in the production floor where people are trained and know how to run machines. Putting the control further back in the warehouse to where people are trained to manage materials means that tracking begins the moment a reel of components comes into a customer facility, comments Dynatech/Samsung's Mike Foster. At this point, each tray or stick is given a unique barcode label. When the reel reaches the manufacturing floor, the operator simply needs to scan it; when the feeder is loaded into the setup station, the bar code is scanned. "This marries the feeder to the bar code on the reel, and there's nothing that operator can do to break the marriage," said Foster. From that point on, a manufacturer will know where that reel of components is, regardless of on what machine it lands.

Many pick-and-place vendors integrate add-on traceability features to their machines. Samsung wrote the software and developed the hardware to make its systems somewhat intelligent from both a feeder standpoint and from a lot-tracking and traceability standpoint. But Samsung's SM platform let the company start with a "blank piece of paper — a brand new system that uses existing machine technology, but allowed us to start from the ground up with things like lot tracking and feeder-setup verification, sophisticated software tools, and sophisticated component presentation tools," said Foster. The company also developed this on an open architecture that uses an Oracle database. Therefore, if a customer wants to build product and generate reports, then import those reports into their MRP system, for example, it uses simple, non-proprietary ASCII text. Importing these reports into a company's MRP system enables full traceability, says Foster, which alerts the stockroom to component replenishment needs, and orders supplies automatically. Foster isn't seeing many North American manufacturers going for full traceability yet. "We have several customers that are running the closed-loop traceability, letting the system keep track of data, and knowing that, if they need it, it's in the Oracle database," said Foster. "Not too many have gone to the extreme to import that into their MRP system, and I think that's because the inventory guys want to be able to control this. Inventory is money, and the system, for all its automation and sophistication, can't really predict what you're going to build next month." Because several EMS providers and CMs ramp up production for seasonal builds, they may be trying to ramp down, while the machine automatically alerts the system to buy more components and materials.

Samsung's closed-loop traceability system uses barcode labels with an electronic feeder that has its own intelligence; however, some third-party systems have an RFID label on the feeder, which can be easy to implement on such systems. But there can be some downfalls in this method, notes Foster. "We like that fact that the feeder talks to the machine through a hard connection because we're writing information to the feeder," comments Foster. "We have bi-directional communication with the feeder because it is, in many ways, the most important part of the machine. But each system has its pros and cons, and no one can have a "one-configuration-fits-all" type of approach to traceability.

RFID and Future Traceability

Most traceability systems in the field today are based on barcode technology only, says Monette. Barcode technology, while it has been around for a long time and is proven, has some limitations. Doing a lot of traceability and tracking a multitude of material in your facility means that you must take a barcode scanner and scan each individual item manually. "This can be a lot of overhead of human interaction and transactions, which can slow down your line setup and production," says Monette. It also introduces the possibility for human error. "One of the problems with barcode data is that sometimes humans make mistakes, and they will forget to scan a reel or bypass the system because they were in a rush, and you end up with missing or inaccurate data in your database." RFID is not operator-dependent, making it error-proof in this respect, allowing you to replace barcode scanning and make the process seamless and transparent to the operators. "You simply move things around on the manufacturing floor, and the RFID system takes care of data acquisition automatically in the background," comments Monette.

But not everything lends itself to using RFID cost effectively. The technology is suitable for use on applications that are well-established in an electronics assembly environment, such as asset tracking of stencils, pallets, and other items typically confined in the factory, because it is a closed-loop environment. Applying it to the supply chain is still tricky. "First, you have to get all of the members of that supply chain to agree on a standard method of doing things," says Monette. Enter the chicken-and-the-egg scenario: There's no value in putting tags on reels of components if manufacturers can't read those tags because they lack the proper infrastructure. Monette believes that Cogiscan's patented RFID technology offers a solution to this conundrum, making RFID a viable solution in factory automation. Cogiscan currently partners with several pick-and-place vendors, including Juki, Sony, and Panasonic Factory Solutions Company of America (PFSA).

RFID has had its problems in the past with signal interference, and the production floor does not alleviate these issues. "They have changed the bandwidth and settled on an area that's less problematic," says Chris Wild, Speedline. But what you would use to track the reel must be different than what you would use to track other parts. "If you take the tag that we use on the reel and put it on the feeder, we wouldn't be able to use it because the feeder is made out of metal," adds Wild. "We need a very close-proximity, high-accuracy solution there; it's a different type of device in a different environment." Wild notes that a low-frequency signal would be better suited in this environment. Therefore, it's important to know which particular RFID solution best fits each application. Cost is also another prohibitive factor of using RFID for traceability. It's simply a more costly method than printing labels and being able to shop for one of 14 or 15 barcode suppliers.

Conclusion

Experts agree that process control, traceability, and material tracking are essential to help prevent failures and field recalls, ultimately reducing costs. The small investment that a manufacturer must make in establishing such a process on the line is worth it down the line. Most also agree that RFID is the future of traceability and tracking, especially in relation to component placement. Traceability and process control most likely will only get tighter in the electronics assembly environment. But it's difficult to predict how this will affect the industry. "As it becomes more hands-off, maybe some of the manufacturing will come back from China," speculates Foster. "I do think that more companies are seeing diminishing returns having products built in China, especially very large, expensive-to-ship products. Driving yields down may, in fact, drive some more work back to North America." Considering that traceability on the line is strongest right now in Europe, Japan, and North America, that doesn't sound too far off the radar screen. **SMT**

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