

Focused not “Complete Recall”

Lonny Plummer

Kinesys Software Inc.

6 C Street, Petaluma, CA 94952

Phone: 215-651-0661, URL www.Kinesyssoftware.com

Abstract

There have been several high profile product recall stories in the press recently that involve electronic device failures. We may think of electronic devices as non-critical consumer items like your phone or iPod but increasing these devices are part of a complex system that can and does threaten human life when they fail. It may seem comforting that, for the most part, the companies involved act swiftly and responsibly with a total recall of all affected devices, but complete recall hides a deeper problem that should be addressed.

The reason the number of products recalled is high is not because that many parts are actually affected. It is because the parts are made in large batches or lots. When a defect is identified the only choice is to recall the whole lot. As manufacturing moves offshore the batch size increases so the problem is getting worse. The impact on a car owner is an inconvenient and unnecessary trip to the service center. The impact on a patient with an implanted medical device is a visit to the operating table with all the attendant risks. What is needed is focused recall which identifies precisely the affected products. If manufacturers had this level of insight into their manufacturing processes it is likely that they will be able to, not only limit the recall count, but also resolve the root cause of the problem and take steps to prevent a recurrence.

Clearly the device manufacturers would benefit both financially and from a public relations viewpoint if they could contain their recalls and prove that the affected devices had been accurately identified. So why don't they do so. The reason is that, until recently, it has not been possible to trace the manufacturing process precisely enough to perform effective “commonality analysis”. SEMI, an industry standards body, has recently published a standard that enables single device tracking (SDT) and software products integrated with the manufacturing line; such as ALPS from KINESYS Software are emerging that make this a reality. There is no longer an excuse and manufacturers of devices that affect our health and safety would be well advised to deploy single device tracking at the offshore manufacturing facilities.

Key Words: SDT, Focused, Recall, E-142, Complete

Focused Not Complete Recall

Product recall stories involving health, consumer safety, high value, or mission critical applications often receive high profile press coverage. In today's market a manufacturer's response must be comprehensive, "let's recall all of them", is often the final result.

But there is a price to this *complete recall* approach for those recalled products that are not faulty, e.g.

- For an embedded medical application, the patient must return to the operating table.
 - The cost to the manufacturer
 - The risk to the patient
 - The liability risk
- For an Automotive application, the car must return to a service center.
 - Service visit cost covered by manufacturer
 - Inconvenience to the customer
- The cost to replace the defective product

All of the above run the real risk of a public relations disaster for the manufacturer and the final reseller of the product. The cost to recall is great and multileveled.

The question must be asked – Why are good or unaffected parts or product recalled?

- Without SDT the only option is to recall the whole lot of devices or products linked to a specific wafer lot if it is determined that the failure is related to the die or assembly process.
- Many of today's products are assembled or processed off-shore for costing benefits, this exacerbates the

recall problem and decision process because –

- Lot sizes are larger
- Any in-house tracking procedures with the IDM's are often not portable to the Sub-con

What is needed is *Focused Recall not Complete Recall*. If the manufacturer had the ability to:

- Identify precisely the affected device or product will greatly reduce the cost and the long term risk and exposure of a complete recall
- With focused data on product failure the manufacturer can gain insight into improving every aspect of the Fab and assembly process.
- SDT data offers concrete data points into the decision making process when it comes to both a recall situation and how to prevent such an event from reoccurring.

What is Single Device Tracking (SDT)?

(See Figure 1.) SEMI has developed a standard for SDT called, Semi E142; which defines the device as follows "the unit to which the device status or code in the map is assigned including, but not limited to: die on a wafer, multichip module, and package. The ability to identify the specific die throughout its assembly process is key for any form or SDT. The process must clearly track the wafer and die from the test and probe environment, to the pick and place process, through the assembly process steps to final test and or singulation. The Goal of SDT is to identify the final device with a unique mark

or code and to be able to map and identify all the die and assembly processes within a specific device and to track all back to the original wafer or lot entering the assembly process.

The market currently has very strong traceability and process documentation within the Front end Fab / wafer process, but to date most assembly processes end the tracking information flow of the die and its relationship to the individual wafer. One noted exception is found within the Memory and Microprocessor market where the actual die has a unique ID embedded into the die that can be read after it is assembled. This form of Unit Tractability is used by some large IDM's and is propriety to their specific process.

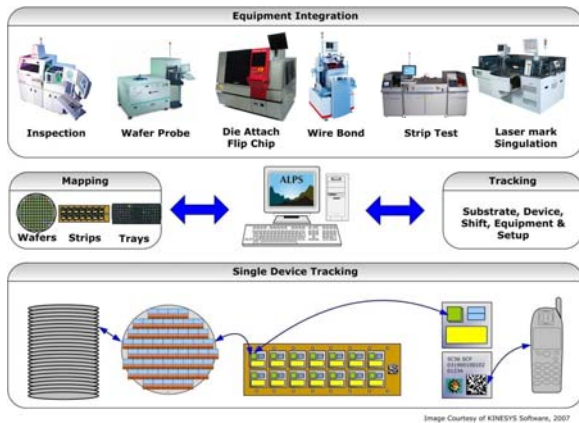


Figure 1. SDT Process Flow and Equipment Integration overview

Why has SDT not been implemented before? Effective "commonality analysis" requires a comprehensive SDT deployment and that all of the assembly equipment be configured to collect and process both Strip and wafer maps and that the system can track its placement and process steps within the process. Without SEMI E142 this was only done on a custom and limited basis. With Semi E142 the industry now has a common standard to follow that will allow

this data collection in the assembly environment.

Another roadblock to SDT was the availability of a comprehensive server and client software that would allow the use of different OEM equipment into an open data collection environment that would allow the tracking of various x/y transfer maps and the storage and efficient recovery of this data throughout the entire assembly process. The leading software package now on the market that is in compliance with the new E142 standard is ALPS Net, supplied by KINESYS SOFTWARE.

Today the market has both equipment and open software that will allow SDT and several key semiconductor markets are moving to SDT for their high value products, notably Medical, Automotive, Military and Microprocessor IDM's are expanding into SDT to gain additional focus and data when confronted with a fields failure situation.

What makes SDT work and what is required?

SDT requires that all the machines in the assembly process be connected to an E142 or compatible Data Mart environment and that the equipment have the ability to read and process the unique wafer / strip and or device ID. As stated before this equipment cost and availability has to date been an issue, but in 2008 several of the major equipment OEM's have product offerings that meet SDT requirements and most of the others will have a solution that meets E142 within 2009.

- A unique ID mark on the strip / substrate or tray is a requirement. This ID must correlate to an X/Y location on the strip / substrate or tray. (see figure 2.)
- The Die attach process must upload the wafer to Strip ID + X/Y transfer data.
- Each die in the package is identified by the wafer ID + X/Y information
- The Final device must have an ID mark – this ID will allow the manufacturer to look up the tracking data based on the ID and a complete history can be reported.

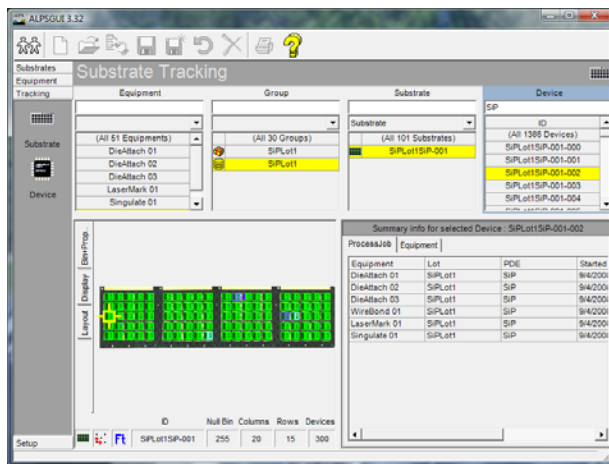


Figure 2. An SDT Enabled Factory / Tracking Screen from ALPS NET

The Data generated and collected within an SDT factory will give the manufacturer real-time and historical data as it relates to the device history throughout the assembly process. This data is stored in a data mart server environment for an unlimited time allowing the manufacturer to reference this data when a recall decision is being considered, or process improvements are warranted.

The ability to track and to compare wafer and lot processing and to overview the flow of one lot against another allows the manufacturer solid tools to document and then correct production line or equipment differences. (See figure 3.)

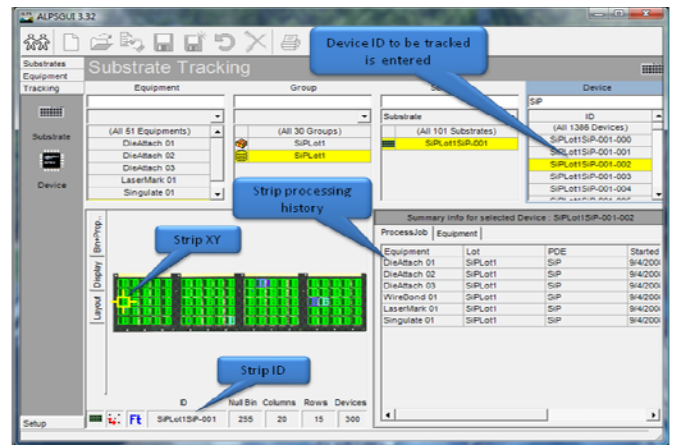


Figure 3. Tracking to the Assembly Process

Response to Failure in an SDT environment is an empowered decision process.

- Analysis of SDT data reveals correlation with a single wafer and the die that were processed from it.
- Review of failure data will allow improved focus on the true cause of the failure, be it assembly or wafer fab related.
- Correlation of data within the failure scope can be refined to identify a specific cluster on the wafer, a bulls eye area on the wafer, a recital or other pattern on the wafer thereby reducing the recall count.

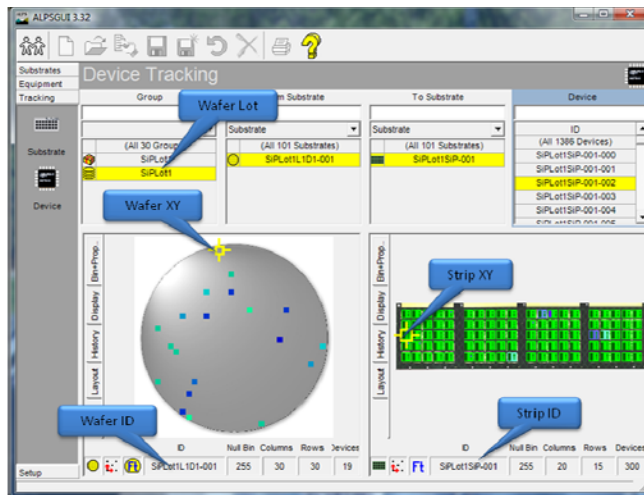


Figure 4. X/Y Transfer Map from Wafer to Strip for MCM product

- Additional correlation can also be related to the assembly process rather than the wafer, that would yield valuable data on a specific machine or assembly process cell failure

The goal of SDT is adding real data into the decision making process that will further empower management when called upon to make a complete recall or a focused one.

Case Study

- Embedded medical product
- Assembly lot size – 5,000 MCM Units
- Product includes die from 3 wafer types
 - o W1 with 100 die per wafer / 50 wafer lot size
 - o W2 with 1500 die per wafer / 4 wafer lot size
 - o W3 with 2500 die per wafer / 3 wafer lot size

- Recall cost is 5,000.00 USD per Product

The response to a failure under this case study was greatly improved and cost was reduced with using SDT – How?

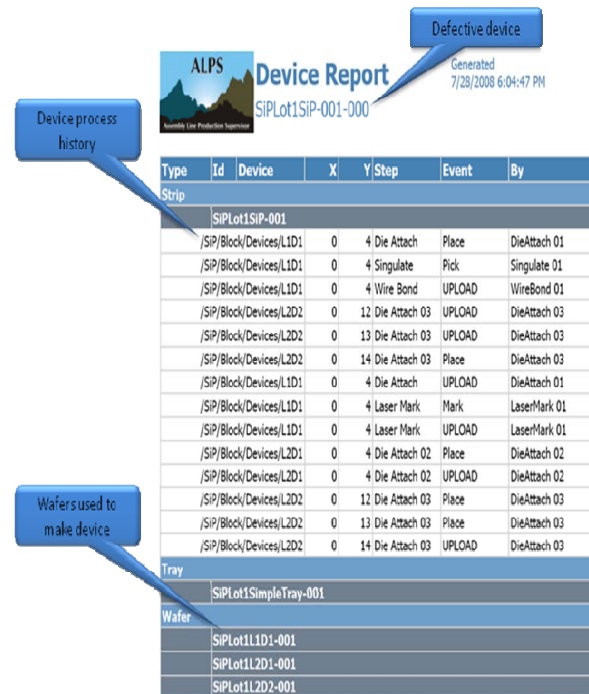


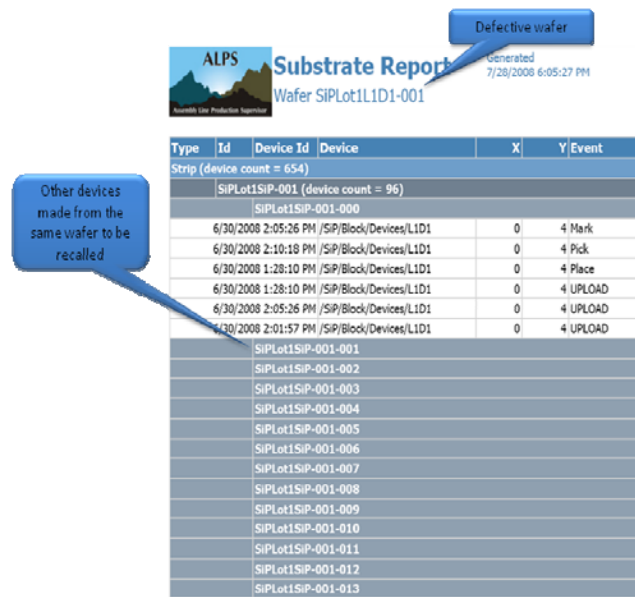
Figure 5. The Device Report

The above report allows management to identify that the failure came from W1, only.

With further evaluation and correlation of the data mart information collected from the assembly process and the X/Y strip information identified what strips and what strip locations were populated with W1 die. A focused recall could be developed.

- Recall issued within 2 days on 100 products at a cost of 500,000 USD
 - o SDT identified a Wafer handling problem that was corrected.

- Without SDT – Recall delayed by 2,5 weeks and all 5,000 products were recalled with a cost of 25,000,000 USD
 - o The wafer handling issue was not identified as the root cause.



Type	Id	Device Id	Device	X	Y	Event
Strip (device count = 654)						
SiPlot1SIP-001 (device count = 96)						
SiPlot1SIP-001-000						
	6/30/2008 2:05:26 PM	/SIP/Block/Devices/L1D1		0		4 Mark
	6/30/2008 2:10:18 PM	/SIP/Block/Devices/L1D1		0		4 Pick
	6/30/2008 1:28:10 PM	/SIP/Block/Devices/L1D1		0		4 Place
	6/30/2008 1:28:10 PM	/SIP/Block/Devices/L1D1		0		4 UPLOAD
	6/30/2008 2:05:26 PM	/SIP/Block/Devices/L1D1		0		4 UPLOAD
	6/30/2008 2:01:57 PM	/SIP/Block/Devices/L1D1		0		4 UPLOAD
SiPlot1SIP-001-001						
SiPlot1SIP-001-002						
SiPlot1SIP-001-003						
SiPlot1SIP-001-004						
SiPlot1SIP-001-005						
SiPlot1SIP-001-006						
SiPlot1SIP-001-007						
SiPlot1SIP-001-008						
SiPlot1SIP-001-009						
SiPlot1SIP-001-010						
SiPlot1SIP-001-011						
SiPlot1SIP-001-012						
SiPlot1SIP-001-013						

Figure 6. The Substrate Report

The savings under this case study was substantial as was the insight into where the failure originated. Without SDT a Focused Recall Decision could not be reached.

Conclusion

SDT is not for every market and or product type, but in selected markets it is becoming a requirement. Complete process and Unit monitoring has been embraced in the front end for the past 10 years and now with the availability of new tools and software its benefits can be realized in the assembly backend of the semiconductor process.

KINESYS Software Inc

Petaluma CA