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Innovative and Robust Application of Automation for Unit Level Traceability on Dual Die configuration of Micro Electromechanical System Products

Cheryl Jallorina [a], Mary Grace Tapia [a] and Jerome J. Dinglasan [a*]

[a] STMicroelectronics, Inc., Calamba City, Laguna, 4027, Philippines.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Strip mapping for unit level traceability on die attach process of semiconductor companies provide quality driven impression for end users on the market. On processing of Micro electromechanical system packages, strip map generated by operators manually, certain errors and discrepancies are encountered and inevitably experienced by the production line. This causes misleading analysis on manufacturing problems and may lead to inappropriate and incorrect solutions hurting the process line. The application of modern technology and internet of things have been considered as an improvement. This is to eliminate human intervention errors caused by manual practice and promoted fool proof design of procedures. Having a user-friendly application with integration of modern technology drives significant improvement provide benefits to both supplier and customer of the manufacturing world.

Keywords: Strip mapping; micro electromagnetic systems; traceability; Die attach process; substrate.

1. INTRODUCTION

Applying modern technology on semiconductor business became one of the leading advantages of manufacturing plants all over the world. Innovation to achieve process efficiency and high-end quality of products drive our people to explore new ideas combining engineering

**Corresponding author: Email: jerome.dinglasan@st.com;*

discipline and industrial automation. These solutions as discussed on [1-5] to resolve unwanted problems has been very effective because of this growing and fast-moving technology. Different techniques to perform process troubleshooting determine the effectiveness of the corrective and preventive actions generated and applied. Traceability comes to be one of the vital elements in troubleshooting. It provides fundamental details of the product after it was processed and shows initial data of the process. Without this data, it will be hard to trace back the process sequence, determine the configuration of the units processed, and logs recorded before, during and after the process.

In manufacturing of semiconductor products like MEMS or Micro electromagnetic systems with dual die package configuration, recording activities on die attach process are performed for traceability purposes. Die attach is where singulated silicon die are picked and placed on a substrate or on top of another die and oven cured at a specific oven curing parameters. Operators who processed the products will provide a recording of the die attached units or what we called “strip mapping”, showing the whole image of substrate with unit quantity of good and bad units and other details. Strip mapping is defined as the performance of semiconductor products on a substrate is represented by a “map” projecting the processed units. this activity has been applied on most of manufacturing plants of semiconductor in front end (wafer testing) and back-end (assembly). Simply put, strip mapping is recording of processed units, its condition and their location after the die attach process. For wafer testing, a representation of wafer map as seen on Fig. 1 is produced after testing process, showing different colors of tested units or what we call “bins”. For back-end assembly, a substrate or strip map is used from die attach going to the next process. This will be included on the documents of the product until it has completed on the downstream processes. As seen on Fig. 2 a sample of strip map format provided for traceability of processed units at die attach process. Included are:

1. Lot vehicle details (package, device, date, operator, shift, total strips processed)
2. Quantity of good units
3. Quantity of bad
4. Location of good and bad units
5. Type of defects
6. Image of strip and its details
7. Serialize unit numbering
8. Strip number

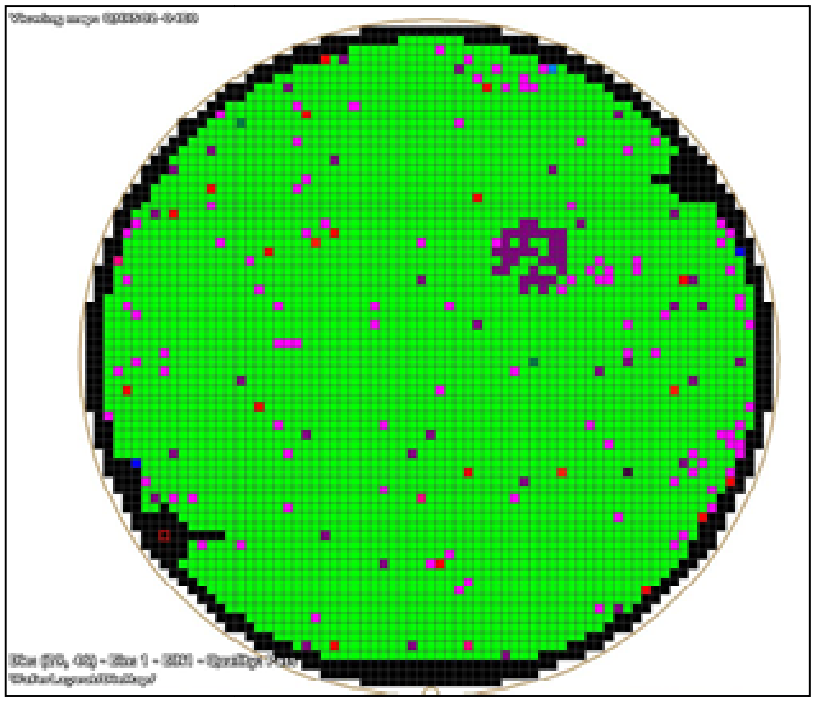

Fig. 1. Substrate mapping on front-end wafer testing

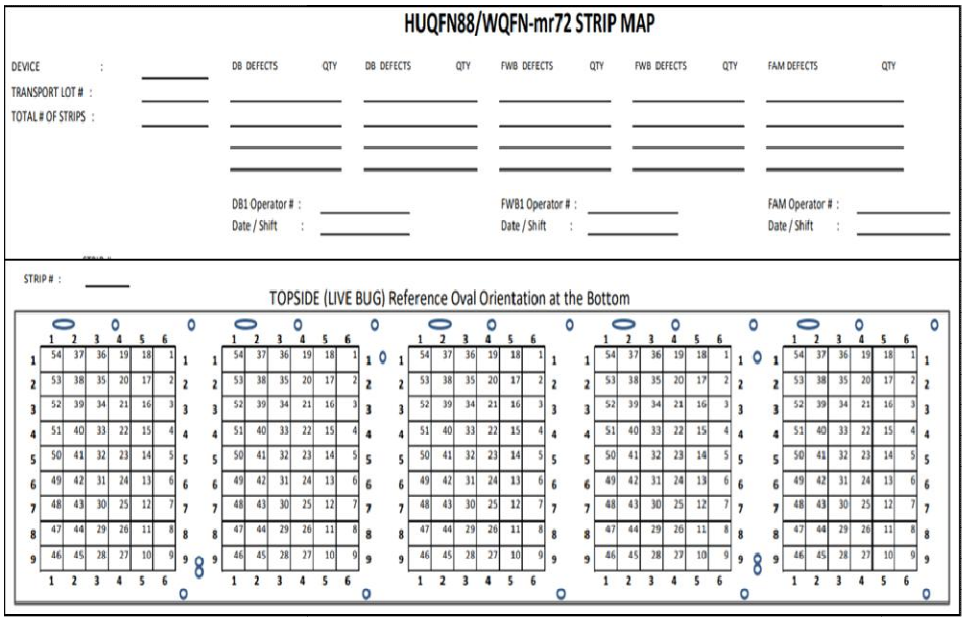

Fig. 2. Strip map format used on Die attach process

Strip map will be completed by the operator, showing marks of good and reject units, and other details of the product. This is accomplished after every completion of die attach process and will be used by next process for traceability purposed of units including total quantity, total good and rejected units and other necessary details.

Creation of strip map on die attach is manual, using strip map format printed on a paper. Most die attach machines present on manufacturing plants have limited to no capability on having a strip map feature for traceability. With this kind of practice, the said activity is seldomly not performed by operators, or it was not created robustly. Missing data, incorrect unit markings and other human related errors are encountered. As a result, investigation during process troubleshooting is compromised and often mislead to have the correct actions. This paper will introduce an innovation for die attach process strip mapping activity wherein modern technology and automation are applied. Reducing or eliminating manual intervention to perform this activity will be a great advantage for every manufacturing plant to achieve process robustness and introduce industry modernization.

2. IMPROVEMENT OF THE PROCESS AND METHODOLOGY

Applying the technology of internet of things and automation, this manuscript will introduce the electronic strip mapping software. It is an application created for MEMS package with multiple die configuration and utilizes strip and wafer mapping of die attached units. this application is practically applicable on Die attach machine with network capability and barcode that can read 2D codes engraved on the substrate. Instead of manual strip mapping on a paper that is filled up by operators, this will be the replacement that will be generated automatically. As seen on Fig. 3, Outstanding benefits are noted using this application such as:

1. Electronic strip mapping can provide single device tracking (SDT), or per die traceability for multiple die configuration.

2. Promotes paperless process, eliminating non-value-added activities by this paper-based records, and especially to zero out human errors in providing required data.

3. Increase machine capacity on the next process by eliminating PRS (pattern recognition system) on those rejected units from the previous process.

4. Real time monitoring of die attached units and will be projected on the die attach machine during operation.

5. Innovation from manual to automated software-based process of having a traceability of units build.

6. Modernization of process that boost up customers confidence in having a real time and systematic unit level traceability.

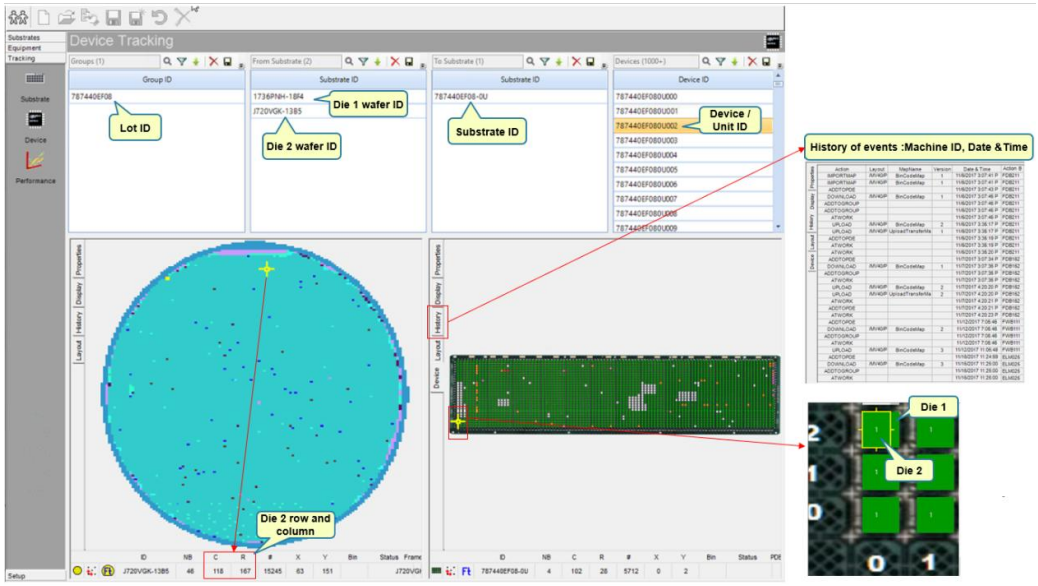

Fig. 3. Electronic strip mapping with Single Device Tracking

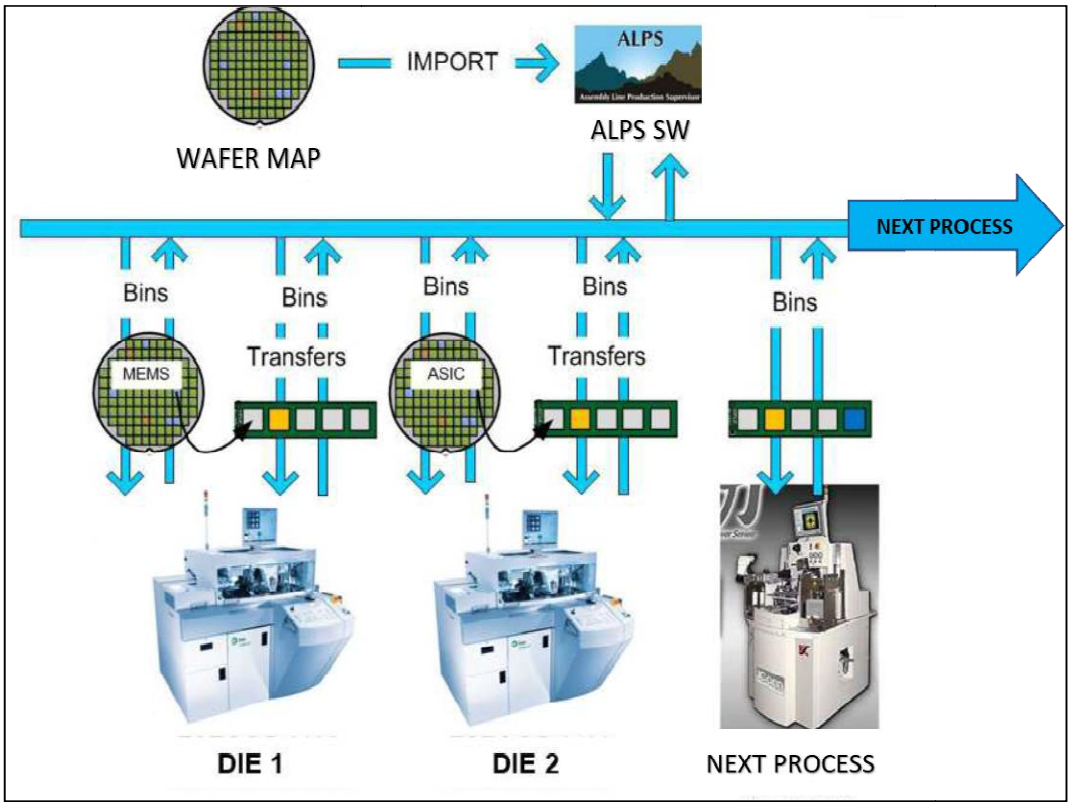

Fig. 4. Architecture flow of Electronic Strip Mapping Software connection to die attach machine

Electronic strip mapping software enables machine operator and technicians to have real time and robust strip mapping, automatically generated by the software during and after lot processing. Setting up this software is done by engineers and software experts starting with hooking up the network from the PC server to the machine. Configurations are made on the link through cables and IP addresses provided, and necessary set up on machine's connectivity menu. Then the product's configuration set up on the electronic strip mapping software will be performed to capture the products structure including number of dice per unit and its location on the substrate. Basic architecture of the link from Die attach machine to the electronic strip mapping software is seen on Fig. 4, showing the flow of data to have unit traceability on die attach strip map. In this case, MEMS product is shown that undergo 2 die attach processes. Wafer map from Front End (wafer testing) will be uploaded to the Die attach machine with electronic strip mapping software. During the process of die attach 1, real time data of the attached unit on substrate is recorded and sent to the electronic strip mapping software.

After completion of die attach 1, data of processed units will be uploaded to the electronic strip mapping software to be used on the next process which is die attach 2. Strip map recorded on the previous process will appear on the server and machine screen in a strip form, showing number of quantities on each substrate, location of bad units, and visual image of the substrate via electronic strip mapping software as seen on Fig. 5. After Die attach 2 process, same procedure will run through going to the next process until the assembly process is completed.

3. RESULTS AND DISCUSSION

Application of this electronic strip mapping software had promoted efficiency of the process during die attach. Unit level traceability was automatically provided and real time monitoring of processed units at die attach was observed. Operators will never have to provide strip map of processed units manually by recording it on the paper with strip map format. With this feature the process had eliminated the manual activity and improved by 8%, eliminating the activity of operators to generate strip maps manually every lot they process. Good and reject units scanned during die attach process were recorded automatically and stored on the application and will be transmitted on the next process. Furthermore, human related errors and discrepancy caused by manual intervention have been eliminated, since the application performs almost all the strip mapping procedure and records all data from units processed. Whether single or multiple die configuration, ALPS strip mapping application can handle complex and precise unit level traceability design for modern age of technology and automation.

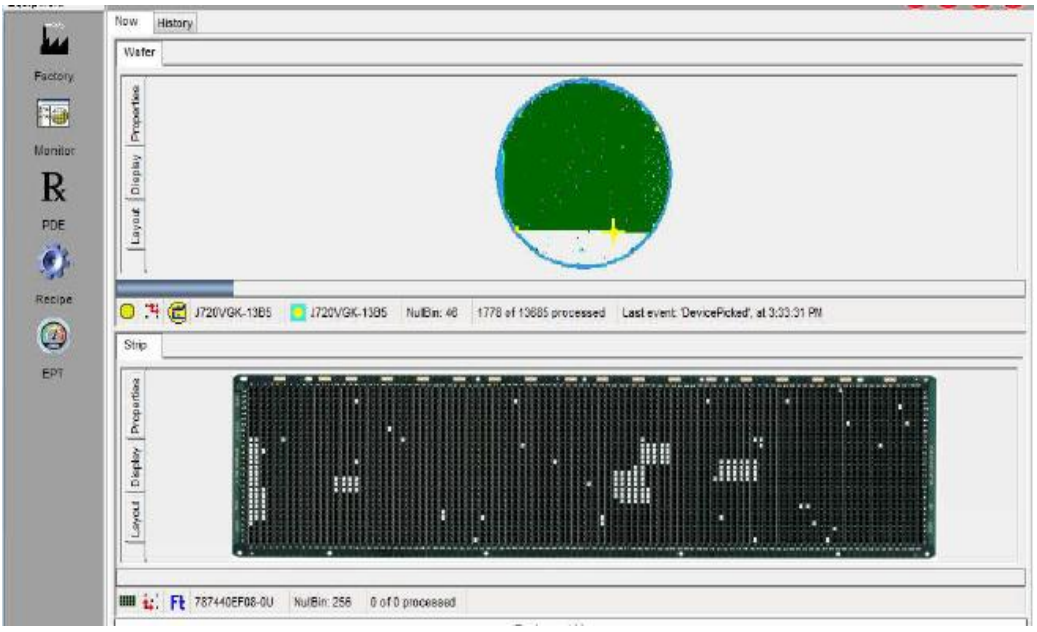

Fig. 5. Completed strip at die attach showing good and bad units

4. CONCLUSION AND RECOMMENDATION

Having this advance application for die attach process, the use of this electronic strip mapping software for automated unit level traceability of processed units have been a breakthrough on manufacturing. Promotion of efficiency improvement, lean and error free manufactuing through this improvement become an edge to the competitive world of semiconductor industry. More advantage on related and same application is projected, and recommended to be applied on other manufacturing. Enhancement of the improvement is possible, as learnings are available on references cited specifically on [6-10] and can be cobined and evaluated on current process.

DISCLAIMER

The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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