*Journal of Engineering Research and Reports*

*19(2): 16-19, 2020; Article no.JERR.62940*
*ISSN: 2582-2926*

# Elimination of Crumpled Leadframe Defect through Machine Sensor Enhancement

**Jonathan C. Pulido[1*], Edwin M. Graycochea Jr.[1] and Frederick Ray I. Gomez[1]**

*[1]New Product Development & Introduction, STMicroelectronics, Inc., Calamba City, Laguna, 4027 Philippines.*

***Authors' contributions***

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

***Article Information***

DOI: 10.9734/JERR/2020/v19i217226
Editor(s):
(1) Dr. Hamdy Mohy El-Din Afefy, Pharos University, Egypt.
Reviewers:
(1) Alemu Gurmessa Gindaba, Jimma College of Teachers Education, Ethiopia.
(2) Mahmoud Hamid Mahmoud Hilo, Sudan University of Science and Technology, Sudan.
Complete Peer review History: http://www.sdiarticle4.com/review-history/62940

***Original Research Article***

***Received 02 September 2020***
***Accepted 07 November 2020***
***Published 28 November 2020***

## ABSTRACT

The paper focused on the improvement done in quad-flat no-leads (QFN) leadframe package assembly to address the quantity of rejection of crumpled leadframe during handling at wirebond process station. Overload sensor at the output magazine handler was found out to be defective, hence a new sensor was installed. With the improvement done, crumpled leadframe strip occurrence was ultimately eliminated.

*Keywords: Assembly; crumpled leadframe; QFN; wirebonding.*

## 1. INTRODUCTION

As the semiconductor technology continues on growing, the demand for new packages increases with efficiency, cost and reliability coinciding with the modern technological development. Quad-flat no-leads (QFN) leadframe technology is the most popular integrated circuit (IC) package in semiconductor assembly industry. The fast pace growth on this package provides the need for every industry to come up with more innovative packaging solution to stay competitive in the semiconductor market. New technologies have a given manufacturability issues encountered during lot processing and one of the process mostly affected is the wirebonding process [1-4]. Wirebonding process is responsible in attaching the wires to provide

**Corresponding author: Email: jonathan.pulido@st.com;*

electrical connections through combination of heat, pressure and thermosonic energy. This paper presents a solution and improvement done to process this type of assembly reject which is crumpled leadframe by replacing a new overload sensor at the output magazine handler. Overload sensor is a type of sensor that senses or detect an object and to push the leadframe on the output magazine. To guarantee its integrity during the processing, wirebond process is incorporated with a multiple of criteria such as, ball size, ball height, ball aspect ratio, wire-pull test, ball shear test, stitch-pull test, loop height, intermetallic coverage, contact angle, visual inspection and indexer planarity at output magazine. These wirebond criteria are performed after machine conversion or setup to ensure the product is reliable and robust. Fig. 1 shows the defect manifestation of crumpled leadframe at the output magazine.

## 2. PROBLEM IDENTIFICATION

A process macro map for QFN device in focus is illustrated in Fig. 2. Highlighted is the process mostly affected with the assembly issue of crumpled leadframe. Important to note that assembly manufacturing process flow differs with the technology and hence the product [5-7]. As mentioned earlier, with continuing technology development and breakthroughs, challenges in assembly manufacturing are unavoidable.

Crumpled leadframe is the top major assembly reject during handling ejection of leadframe onto the output magazine at wirebond process station. The problem was identified to be caused by a defective overload sensor that senses the leadframe if it is already ejected. Parameter adjustment was done to address the crumpled leadframe strip, but it did not eliminate the reject occurrence. To isolate the main root cause, the overload sensor was replaced with a new one. Fig. 3 shows the defective overload sensor and crumpled leadframe

## 3. PROCESS IMPROVEMENT AND RESULTS

With the improved and enhanced process solution on QFN package handling during wirebonding process by replacing the overload sensor to a new one, crumpled leadframe issue was ultimately resolved. The leadframe used in this device is usually either a roughened or a standard pre-plated leadframe. Again, with the improvement done, no crumpled leadframe occurrence was observed during wirebonding process. Fig. 4 shows the actual newly replaced overload sensor.

Visual inspection during ejection of leadframe is not anymore needed, thus saving resources and time. Furthermore, faster delivery of units and business movement could be realized. A 100% improvement shared in Fig. 5 was achieved, with the crumpled leadframe occurrence successfully eliminated. Actual parts per million (ppm) is purposely not disclosed due to confidentiality.

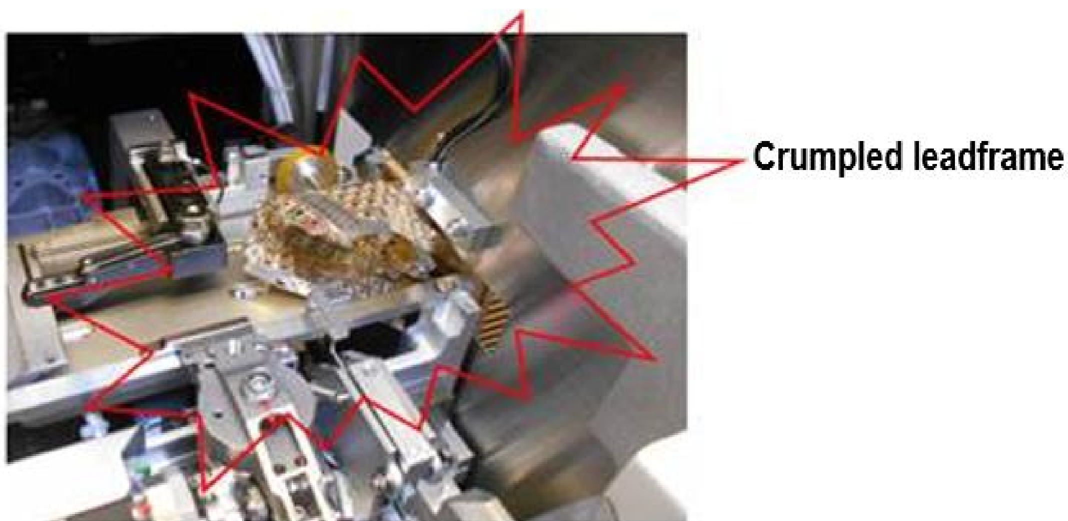


**Fig. 1. Actual defect manifestation of crumpled leadframe strip**

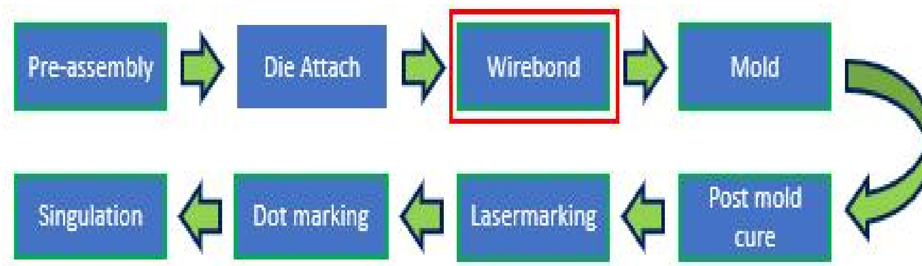


**Fig. 2. QFN assembly process flow**

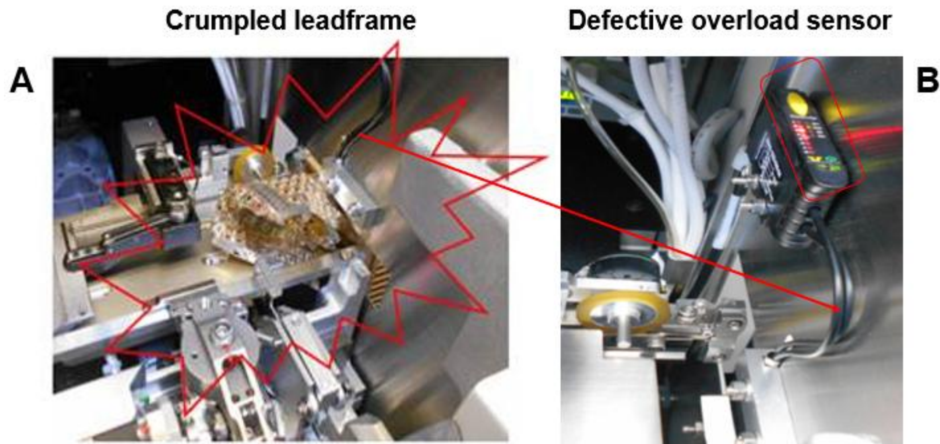


**Fig. 3. Actual photo of the crumpled leadframe occurrence**

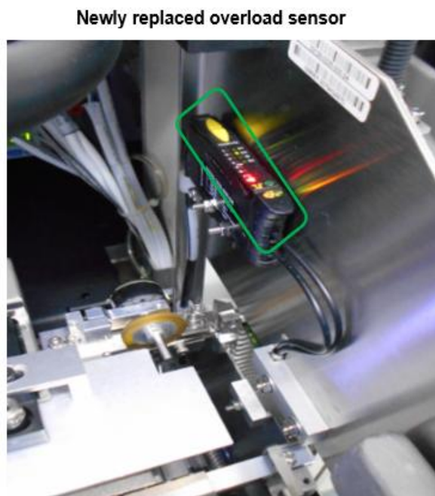


**Fig. 4. New overload sensor**

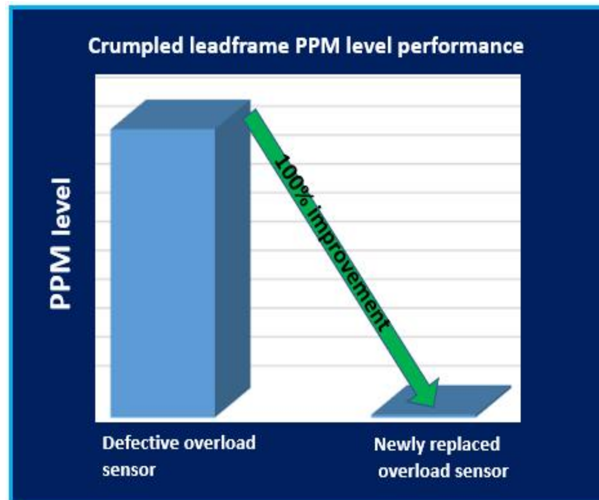


**Fig. 5. Crumpled leadframe strip occurrence performance**

## 4. CONCLUSION AND RECOMMENDATIONS

The paper discussed a process solution and improvement in addressing the crumpled leadframe strip during leadframe handling or ejection at the output magazine handler at wirebond process. By replacing the overload sensor, crumpled leadframe occurrence on wirebond process was successfully mitigated.

For succeeding works, the machine configuration or setup could be used on packages with similar construction. Works and learnings discussed in [1,3,8-11] are helpful to improve the assembly processes focused on the front-of-line processes including wire bonding process.

## ACKNOWLEDGEMENT

The authors are thankful the New Product Development & Introduction (NPD-I) team and the Management Team for the solid support.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

## REFERENCES

1. Tan CE, et al. Challenges of ultimate ultra-fine pitch process with gold wire & copper wire in QFN packages. 36th International Electronics Manufacturing Technology Conference, Malaysia; November 2014.
2. Yeap LL. Meeting the assembly challenges in new semiconductor packaging trend. 34th IEEE/CPMT International Electronic Manufacturing Technology Symposium (IEMT), Malaysia. 2010;1-5.
3. Lall P, et al. Reliability of copper, gold, silver, and PCC wirebonds subjected to harsh environment. IEEE 68th Electronic Components and Technology Conference, San Diego, California, USA; May 2018.
4. Liu Y, et al. Trends of power electronic packaging and modeling. 10th Electronics Packaging Technology Conference, Singapore; December 2008.
5. May GS, Spanos CJ. Fundamentals of semiconductor manufacturing and process control. 1st ed., Wiley-IEEE Press, USA; May 2006.
6. Geng H. Semiconductor manufacturing handbook. 2nd ed., McGraw-Hill Education, USA; September 2017.
7. Harper C. Electronic packaging and interconnection handbook. 4th ed., McGraw-Hill Education, USA; October 2004.
8. Moreno A, et al. Specialized wirebond process configuration on advanced multi-die package. Journal of Engineering Research and Reports. 2020;12(4);1-5.
9. Pulido J, et al. Lead scratch resolution through wirebonding process optimization on qfn packages. Journal of Engineering Research and Reports. 2020;15(1):29-33.
10. Sumagpang Jr. A, Rada A. A systematic approach in optimizing critical processes of high density and high complexity new scalable device in MAT29 risk production using state-of-the-art platforms. Presented at the 22nd ASEMEP Technical Symposium, Philippines; 2012.
11. Rodriguez R, et al. Implementing single-row process plate design for pre-encapsulated lead frame.

*© 2020 Pulido et al.; This is an Open Access article distributed under the terms of the Creative Commons Attribution License (http://creativecommons.org/licenses/by/4.0), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.*

*Peer-review history:*
*The peer review history for this paper can be accessed here:*
*http://www.sdiarticle4.com/review-history/62940*