Wirebond Process Improvement with Enhanced Stand-Off Bias Wire Clamp and Top Plate

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ABSTRACT

New design for a certain issue in semiconductor industry is another way to modify the standard configuration into specified limit or to make a possible solution of the problem. This paper presents a new modified design for wirebond top plate with a bias platform structure that will maintain a consistent second bond into a leadframe leads with half-etch configuration on quad-flat no-leads (QFN) packages especially in wirebond process. This paper used a side by side comparison to proof that the new design is better than the older design. With the new specialized wire clamp and top plate design, parts per million (PPM) level performance is improved by almost 90 %.

Keywords: Wire clamp and top plate, quad-flat no-leads, non-stick on leads, ball aspect ratio, integrated circuit.

1. INTRODUCTION

Wirebonding (or simply wirebond) is one of the challenging process in semiconductor industry for integrated circuit (IC) assembly, responsible in attaching the wires to provide electrical connections through combination of heat, pressure and thermosonic energy. With the design of new leadframe with half-etch leads configuration, a big challenge exists to run or process this type of technology especially in wirebond process. Nevertheless, the paper presents a solution to successfully process this leadframe technology in IC assembly manufacturing by using a specialized wire clamp and top plate (WCTP) design with a bias stand-off platform. The leadframe leads would overlap on the bias stand-off platform to prevent bouncing effect during wirebonding process. To guarantee its integrity during production run, wirebond process is incorporated with a multiple of criteria such as ball size, ball height, ball aspect ratio (BAR), wire pull test, ball shear test, stitch pull test, loop height, intermetallic compound (IMC) and contact angle. The wirebond criteria is performed after machine conversion or set-up to ensure that the product is reliable when subjected to a reliability test. Fig. 1 shows a representation of a wirebonded unit.

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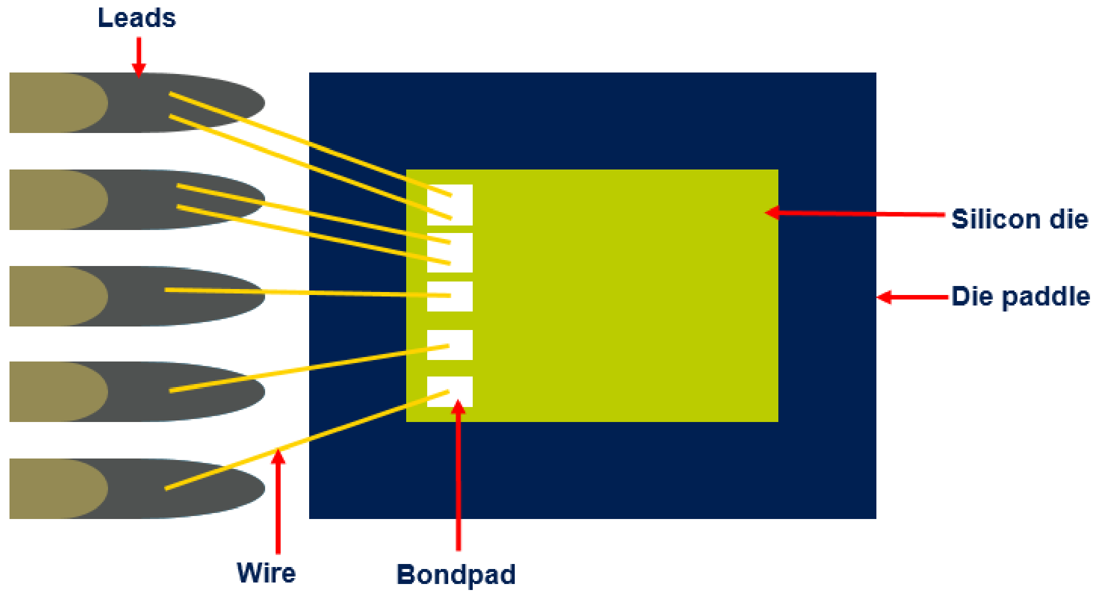

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39 **Fig. 1. Package design diagram.**
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2. LITERATURE REVIEW AND PROBLEM IDENTIFICATION

42
43 A complete process flow for a standard QFN package starting from pre-assembly to back-
44 end assembly until test and finish and packing is depicted in Fig. 2.
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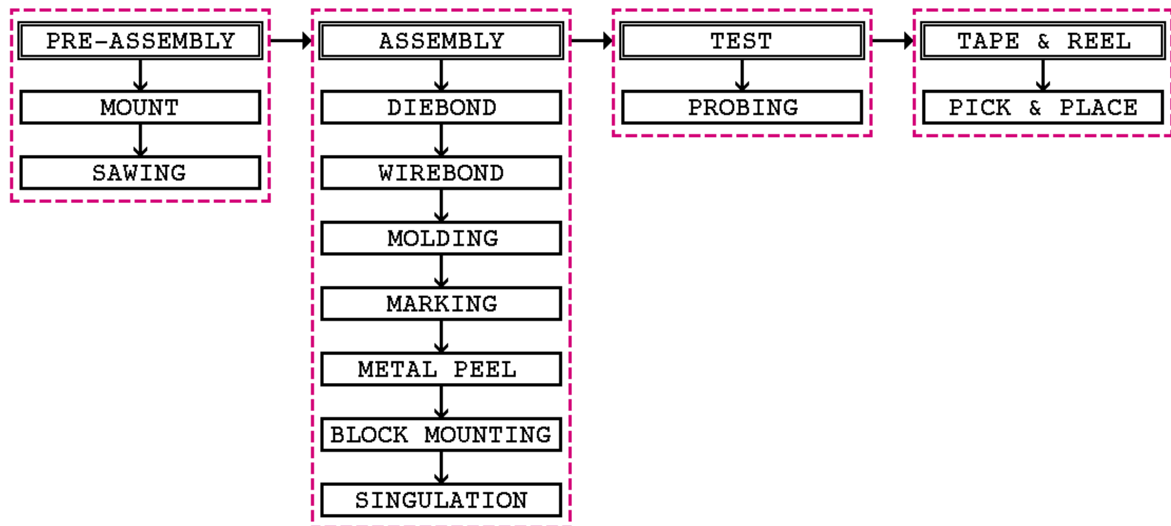

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48 **Fig. 2. Assembly process flow**
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50 Non-stick on leads (NSOL) is the top major assembly rejects in wirebonding process and this
51 was seen during the development stage of the package. This NSOL is caused by a
52 wirebonding clamp and insert with panel-type as shown in Fig. 2A. The panel-type wire
53 clamp and top plate is to grip and handle the leadframe into panel during the attaching of
54 wires into the silicon die and leads of a leadframe. Unluckily, this type of leadframe has an

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55 half-etch design with the result of major assembly rejects particularly NSOL and indicates
56 that the 2nd bond wire was unable to stick on the leadframe leads as shown in Fig. 2B.
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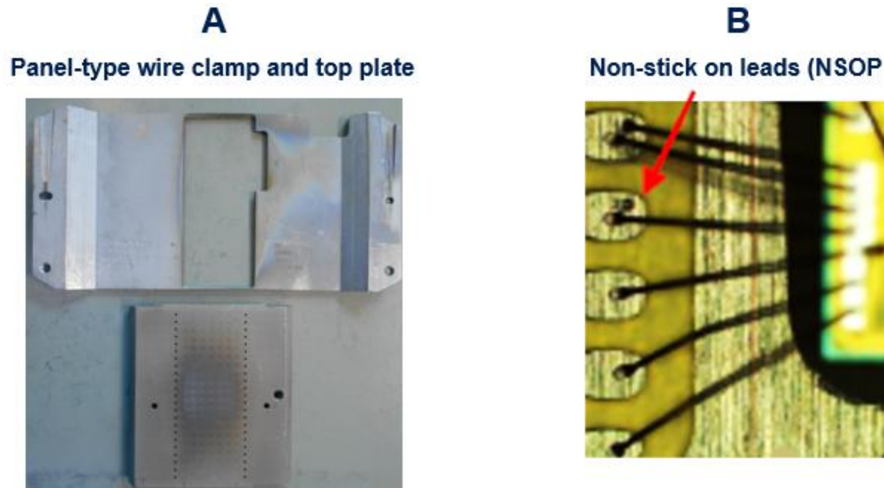

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60 **Fig. 2. A) Panel-type wire clamp and top plate, B) Non-stick on leads**
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62 3. PROCESS DEVELOPMENT SOLUTION AND DISCUSSION OF RESULTS

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64 With an improve wire clamp and top plate design was mature for quad flat no-leads QFN
65 with half-etch leadframe packages, especially in wirebond process. With an individual
66 clamping alignment per pad column, the new wire clamp and top plate will have resolved the
67 assembly rejects issue occurrence of non-stick on leads NSOP during production run in wire
68 bonding process. Fig. 3A illustrated the new wire clamp and top plate design and Fig. 3B is
69 the actual stitch formation, with a significant difference on stich formation compared to the
70 panel-type wire clamp and top plate.
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74 **Fig. 3. A) New wire clamp and top plate design, B) Actual stitch formation**
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76 After completing the two lots using the panel-type window clamp and top plate for lot A and
77 new wire clamp and top plate for lot B. Results are significantly improving about 90 percent
78 (%) by using the new wire clamp and top plate.
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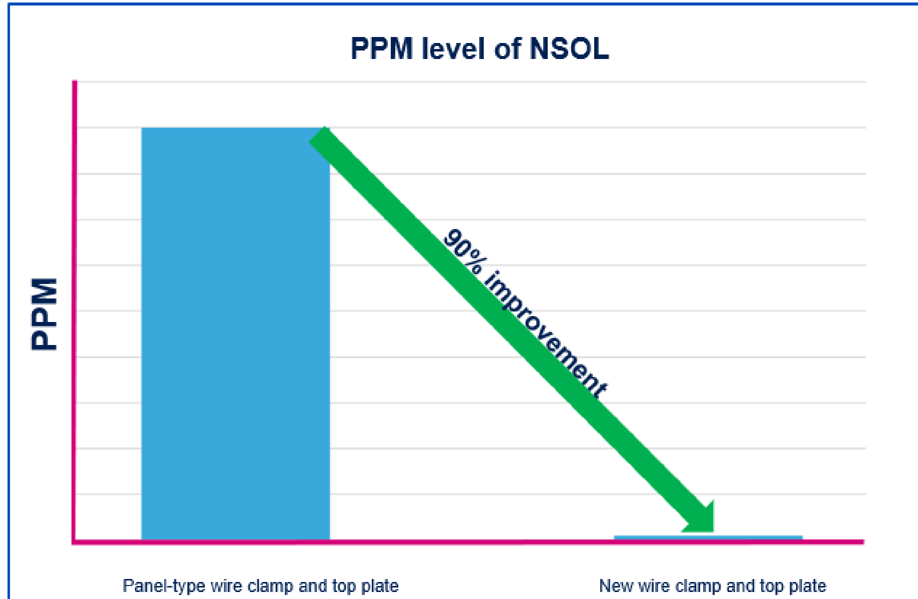

Fig. 4. PPM level performance for NSOL

4. CONCLUSION

This paper presented a process solution and improvement with the improved wire clamp and top plate, which significantly resolved the assembly reject occurrence of NSOL during wire bonding process. The new wire clamp and top plate design offered a better stitch formation that is properly bonded in a half-etch leadframe and provided good reliability test.

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