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In this work, large array and fine pitch WLP drop test data are examined through drop test and FE modeling with ANSYS software. The drop test method is specified by JESD22-B111[1]. The methodology of drop test modeling with FE is described in previous work[13]. In the following sections, overall failure rates of different component groups are presented. Effect of mounting screws is investigated and a criterion for WLP drop test reliability comparison was established. Failure mechanism, crack map after drop test, crack initiation and its propagation are investigated through failure analysis (FA) and FE modeling. Effect of design and material parameters are then studied. These parameters include: PCB pad design, WLP structures, array size, ball pitch, and solder ball alloy. Conclusions are made at the end.

NOMENCLATURE

WLP: Wafer Level Package
FFT: Fast Fourier Transform
IMC: Intermetallic Compound
BGA: Ball Grid Array

JEDEC DRO

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corner components (group A) see the highest stress and should fail first. Groups F and E are the next ones to fail. And B, C, and D have lower failure rates.
To verify this rating, drop test failure data for all six groups are plotted in Figure 9. Total of 10 test boards are considered in this ca

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It should be pointed out that component placements different from JEDEC specification are employed metonitfeem JEe Cot Ge onoeeeo0

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EFFECT OF WLP STRUCTURE CHIOCE

In this study three different WLP structures are considered. They are labeled as WLP A, B, and C. The CL comparison of these WLP structures is shown in Figure 15. It is seen that WLP B and C have approximately the same CL. While WLP A has the best solder joint reliability at drop with approximately 2.5x CL compared to WLP B and C.

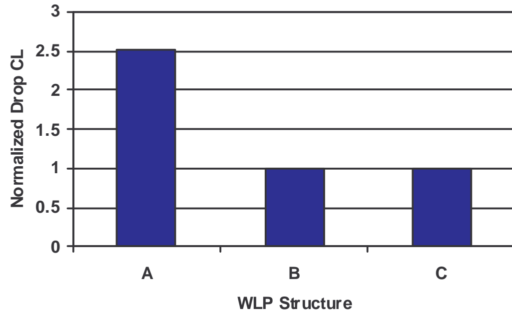

Figure 15. Drop test life comparison among three different WLP structures.

EFFECT OF WLP BALL PITCH

Drop test CL of 12x12 array 0.5 and 0.4 mm pitch WLP are shown in Figure 16. The results incorporate the test results for multiple WLP structures. For a given ball array, 0.4 mm pitch WLP CL is reduced by 14% compared to 0.5 mm pitch. The CL drop is probably due to the reduction of UBM side and solder joint diameter reduction.

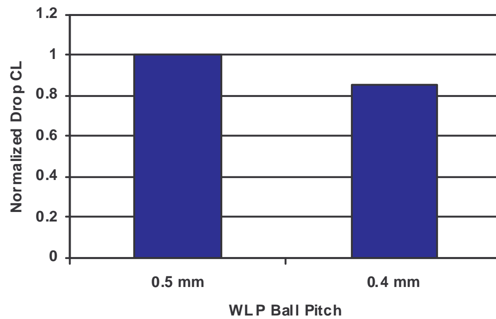

Figure 16. Drop test life comparison between 0.5 and 0.4 mm pitch WLP.

EFFECT OF BALL ARRAY SIZE

The comparison among n Figurop

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2. For a given WLP, corner balls always fail first during drop test. The crack initiates at inner side of the solder joint and propagate towards the opposite side.
3. NSMD PCB pad gives better drop test reliability than SMD pad.
4. WLP structure A gives the best drop reliability. Choice of WLP structure makes visible difference.
5. With a given ball array, WLP with smaller pitch has worse drop reliability.
6. Drop reliability significantly decreases with array size increase.
7. Solder ball alloy choice makes significant difference in drop reliability. Solder alloy A give the best drop reliability among the three considered.

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