IDDQ testing to improve yield and reliability, 2/2

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Continued from Part 1

IDT to improve yield and reliability

DFT’s main target is to achieve maximum controllability and observability which helps to improve the yield and reliability of design. IDT helps improve the CVY and also the reliability of the design. Before (Deep Submicron Devices) DSM, reliability testing was done by burn-In testing. Now, IDDQ has replaced almost the Burn-In testing. Current testing is more important for the reliability testing. The main challenge for IDT is to select the threshold values. There are many methods available for the selection of threshold values just for IDT. In DSM, the same IDDQ threshold value is used for all the IDDQ strobes, which will not work in VDSM devices. Therefore, separate IDDQ threshold values used in ever different pattern for testing, which will increase reliability screening. The main objective is that if some physical defect is not detected by some pattern, but it will be detected by another, as the threshold value will be changed for each pattern. Experiments have shown that IDT is a good approach to minimize the yield loss and test escape (TE).

When talking about increasing yields, it’s mostly refers to the CVY. IDT is helpful technique for increasing the CVY. Also, the IDT method also helps to decrease the difference between CVY and TY. As CVY increases, so does customer satisfaction. However as devices become more testable, yield is going to be decreased as possibility for detecting faults is increased. In VDSM devices, the DIDDQ (Delta IDDQ) testing method should be preferred for detecting defective devices. In this method, current comparison is done on the basis of previous pattern current measurement. The pass/fail decision will take on the basis of comparing the IDDQ current for two different consecutive vectors. This approach will reduce the affordability for calculating the IDDQ threshold value. As die to die and vector to vector IDDQ variations occur, delta IDDQ is a more preferable method. IDDQ is complementary and overlapped with a traditional Stuck-at based scan approach as it increases the visibility and allows detecting defects that are not detectable through the scan chain.

Most IM (Infant Mortality) related failures are due to defects such as gate-oxide shorts, pinholes, partial open, resistive bridging, etc., which may not cause a functional error at the time of testing, but decrease quality and lifetime. The exact motivation is explained through popular bathtub curve for reliability. Figure (2) provides, two views of the bathtub curve to illustrate the impact of IDT based screening of early failures. Figure (2) indicates that circuit reliability is not increased but we can get failure within short application time period. Figure (2) illustrates that similar time savings can be obtained over burn-in by IDT based screening of the infant mortality failures. That is if IDT is used to supplement a reduced burn-in flow (for example only 24 hours instead of 1200 hours in
qualification testing or 24 hours instead of 190 hours in production reliability screening), whatever time is reduced shortens time to market.

As discussed before, selection criteria for burn-In patterns require tricky methods. IDDQ patterns can be converted to burn-in patterns for burn-in testing. Burn-in test patterns require more toggle coverage by using less number of patterns, IDT is also doing the same. Therefore, IDT is almost replacing the burn-in testing. Figure (3) shows the effectiveness of the IDT compared to burn-in testing. Figure (3) shows that, the defects which can be detected by IDT are the same as those that
can be detected after the burn-in process.

**Conclusion**

Based upon above discussion, IDT is helpful for detecting the faults which are not detected by Structural testing which will improve the CVY yield. IDT can effectively screen physical failures and used to reduce Burn-In testing time, increase the reliability by detecting early life time failures.

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