Effective DPPM improvement programs require test program qualification and post-probe data analysis.

The need for quality improvement in semiconductor manufacturing processes has continued to be driven by customer demands for improved product reliability. Sort test yield impacts have made it apparent to the semiconductor IDM's that DPPM improvement programs must comprehend effectiveness and efficiency when employing outlier detection methodologies. Competitive pressure for suppliers to improve both cost and quality is now being driven from broader markets than the traditional automotive markets. It is realized that cross departmental sort test functions must leverage joint efforts in order to implement the most effective solutions. Combined data analysis strategies in both device test program development and manufacturing post-test data analysis are elemental in this solution.

Historically it has been proven that post processing of sort test data is the most effective way of identifying outlier devices, since this gives the most accurate and comprehensive view of parametric and spatial characteristics. However, any form of data analysis aimed at DPPM improvement is inherently dependent on the quality or integrity of the data being analyzed. Before exploring the concepts of maximizing the effectiveness of the post data analysis, you must first analyze the test environment to ensure that the data produced at sort for outlier detection is in fact optimized to represent the performance of the device, and is free from second-order effects caused by non-ideal aspects of the test process. These include, for example, multimodal distributions as a result of site-to-site variation, which will limit the effectiveness of outlier detection techniques. The presence of tester alarms or poor results resolution due to DSP instrumentation or techniques may be indications of incorrect setup or measurements for a given test. Incorrect test limit settings can affect outlier detection, which is normally performed on the Good Bins population. There are many other indications of potential problems either in the setup or measurement aspects of a given test, which can have a negative impact on the effectiveness of DPPM reduction, and should result in some form of corrective action. The outcome of this corrective action should actually have a positive impact on the overall testing process, improving the quality of the data generated, and perhaps even addressing causes of yield reduction during testing.

Additionally, a comprehensive analysis of the test environment itself, through interpretation of the data it produces, can give valuable insights into maximizing the efficiency of the post test data analysis in the production environment. Tests that exhibit a higher outlier density can be identified and given special consideration. Highly correlated pairs of tests can be identified as good candidates for linear-regression based detection techniques, which allow identification of outliers within the main population which do not conform to the underlying relationship between the two datasets.

Manual identification of these corrective actions, and tests that can play a key role in maximizing DPPM reduction efficiency, is a lengthy, tedious and error-prone process. Automating the data analysis effort provides the obvious benefit of allowing the analysis of all the data regardless of magnitude. It is clear that a standardization of automated test data analysis is an effective leveling opportunity to ensure department compliance to desired programming quality standards and will significantly reduce test program development time and improve time to market. An automated, user-configurable framework will be described that can achieve these goals, quickly and in a repeatable manner.

It is recognized that each wafer represents a unique processing demographic as a result of modern wafer fabrication processing methods. Post-processing of sort test data using adaptive outlier detection techniques analyze the data on a per-wafer, per-test basis. This methodology comprehends any type of data population distribution and applies the appropriate detection algorithms. Quality risk devices are then determined based on user defined classification logic accumulating both magnitude and frequency of the identified anomalies across all parametric tests.

This defined framework of automated test program data analysis is then highly leveraged with adaptive automated in-line outlier detection, increasing test efficiencies and improving overall manufacturing yield while reducing DPPM.

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