

1. Title: IC and Advanced Packaging Aging Effects on Second Order Effect Signatures

2. Individual Sponsor:

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3. Academic Area/Field and Education Level: physics, electrical engineering (MS or PhD)

4. Objective: Develop test procedures and analytical models to investigate the effects of aging on signatures collected using second order effect and side channel measurement systems to determine such systems' applicability in lifetime analysis.

5. Description: Reliability of integrated circuits (ICs) and Advanced Packaging is an important area of research, both for commercial applications and within the Department of Defense (DoD) in order to minimize human and economic losses. Second order effect (2OE) measurement systems have been shown to be sensitive to small changes within an IC and the materials used in the advanced packaging methodology (ceramic, plastic, die attach material, wirebond, flip chip, embedded die). As such, this topic aims to investigate whether these 2OE systems are capable of measuring the small physical changes that happen within an IC and advanced package due to aging effects (e.g. hot carrier injection, bias temperature instability, electromigration, etc.). Modeling of the correlation of these signatures to the aging effect type will potentially allow the systems to be used as a way to determine the current lifetime point for a device under test (DUT) or package under test (PUT), and therefore the lifetime left in a DUT or PUT. Knowing where along the lifetime curve a particular part resides will allow more effective preventative maintenance procedures to be put in place. This data will also be useful in training and checking digital twin models of the DUT or PUT or systems in which the DUT or PUT is used.

6: Research Classification/Restriction: CUI/ITAR

7. Eligible Research Institutions: All

Keyword: Second Order Effects, Side Channel Analysis, Reliability, Aging, Digital Twin, Modeling

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