SRI International®

MICROCIRCUIT EMULATION CENTER
PRINCETON, NJ

AME GEM

Microcircuit Emulation: Electrical Testing

The Microcircuit Emulation Center at SRI International in Princeton, NJ maintains capabilities to perform electrical testing to validate the wafer fabrication process is executed correctly, and functional testing to verify the microcircuit operates as per the required specification. MIL-PRF-38535 qualification and screening tests are preformed to ensure the emulated microcircuit meets performance requirements for use in military systems. See Figure 1 as reference.

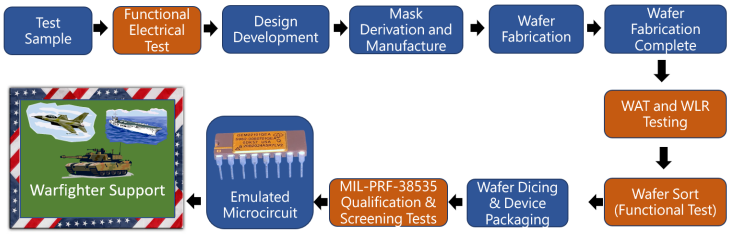

Figure 1. Electrical Testing Overview.

FUNCTIONAL ELECTRICAL TESTING

The functional test group performs tests several times during the manufacturing process to ensure product integrity and QML quality compliance. The functional test program development begins with the electrical reverse engineering using a sample part. The measured data is compared to the procurement specification. Characteristics which are critical to the correct operation or design of the microcircuit but are not specified in the original documentation are also measured. The collected data is used by the design team to create the emulated microcircuit.

ELECTRICAL TESTING TO VALIDATE WAFER FABRICATION

Wafer level testing and reliability screening are performed in compliance with MIL-PRF-38535 procedures to determine product suitability for assembly and packaging of the die. Wafer Acceptance Testing (WAT), also known as Process Control Monitoring or the Parametric Monitor, is performed to measure the characteristics of the devices and determine uniformity across a wafer. WAT verifies wafer processing has been executed properly and validates that the transistor characteristics are within the accepted range for a given process. The parametric measurements taken include threshold voltage, sheet resistance, contact resistance, transistor gain, and breakdown voltage. Between 100 to 500 parameters are measured from each test site.

Wafer Level Reliability (WLR) testing is performed on the Technology Characterization Vehicle (TCV), which is a structure to obtain measurements that provide the lifetime expectations of the products based on susceptibility to intrinsic failure or wear-out mechanisms. This ensures that all wafer processing produces acceptable levels of reliability. Measurements are taken to analyze structures for metal electromigration, hot carrier degradation, oxide integrity, and other indicators performance over time.

WAT and WLR tests are performed in a climate controlled micro-chamber providing the added capability to perform parametric testing over the full mil-spec temperature range (-55 °C to +125 °C).

WAFER SORT (FUNCTIONAL) ELECTRICAL TESTING

After the wafer manufacturing process in has been completed, wafer sort testing is performed to verify functional performance of the microcircuit. Following assembly of production devices into packages, each microcircuit is tested over the full operating range to ensure that it is fully compliant to the required specification.

Automated Test Equipment (ATE) systems are used to perform both digital and analog testing. The ATE systems use of customized test programs and dedicated test fixture hardware.

MIL-PRF-38535 QML QUALIFICATION TESTING

SRI maintains capabilities to perform MIL-PRF-38535 qualification and screening tests with DLA issued lab suitability in conformance to the requirements for military grade microcircuits (MIL-STD-883 Test Methods).

With on-site mechanical, environmental and package test screening equipment we routinely perform test methods shown in the inset Table. These tests are performed to ensure full conformance to MIL-PRF-38535 and MIL-STD-883. All devices are fully screened, including Wafer lot acceptance, visual inspection, temp cycling, constant acceleration, fine leak, gross leak, pre-burn-in and post burn-in electrical tests. Additional test methods are performed as per MIL-PRF-35835 to verify suitability of the microcircuit.

Moisture Resistance	1004
Steady State Life Test	1005
Salt Atmosphere	1009
Temperature Cycling	1010
Thermal Shock	1011
Seal	1014
Burn In	1015
Constant Acceleration	2001
Mechanical Shock	2002
Solderability	2003

Lead Resistance	2004
Vibration, Variable freq.	2007
External Visual	2009
Resistance to Solvents	2015
Physical Dimensions	2016
Lid Torque	2024
Adhesion, Lead Finish	2025
Resistance Solder Heat	2036 (8)
ESDS Classification	3025
Electrical Test	Device Specification

Table 1 – MIL-STD-883 Test Methods supported at SRI

Our Story

In the late 1980s, DLA recognized that microcircuit obsolescence threatened the readiness of many American defense systems. Numerous systems in the armed forces were designed and developed in the 1960s and 1970s. For example, the U.S. Air Force began flying the F-15 Eagle tactical fighter in 1972, and the U.S. Navy first tested the Aegis phased-array radar at sea in 1973. Because of continued advancements in semiconductor technology, the original suppliers stopped manufacturing the microelectronic components used in these and other systems. In 1987, DLA contracted with SRI to begin research and development on how to best replace obsolete microcircuits with standardized, modern integrated circuits (IC). DLA and SRI collaborated to develop the GEM Program. Using its on-site Trusted semiconductor foundry and deep knowledge of IC design/development, SRI produces on-demand, Class Q microcircuits matching the Form-Fit-Function-Interface (F3I) criteria of the required microcircuit. DLA is developing the next generation of F3I microcircuit Emulation capability through the AME Program to further alleviate growing IC obsolescence issues caused by the continued rapid advancements in technology. The new capabilities developed by AME are utilized by the GEM Program to ensure the Emulation Programs continue to meet weapons systems wide-ranging requirements. SRI's semiconductor foundry is accredited as a Department of Defense (DoD) Trusted Foundry supplier, and our manufacturing processes are qualified to MIL-PRF-38535.