Failure Analysis and Resolution of an Electrochemical Corrosion Degradation Process Caused By Pop-corning/Flux Ingress on a GaAs pHEMT -- Arrested Through Moisture Starvation

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Several GaAs MMICs in near hermetic QFN packages failed after being operated for approximately 1000 hours in a non-stressful moisture environment. The packages contained an air cavity with a GaAs MMIC inside. Failure analysis was performed to understand the root cause of the failures. Optical inspection showed that the organic bondline between the lid and the package body was compromised on some devices. Review of the manufacturing steps used pointed to a 'pop-corning' event during IR reflow when the QFNs were attached to printed circuit boards De-lidding and internal visual examination showed evidence of significant corrosion on several FETs on the MMIC for several failed and non-failed devices.

Isolation and probing showed that shorted and/or leaky FETs were closely associated with areas of maximum corrosion. SEM, STEM, and EDS showed the presence of bromine, which accelerated the corrosion process. The bromine appeared to have entered the package cavities after the bondline was breached (post-IR reflow), during an aqueous wash step to remove the solder flux from under the QFNs. A low humidity stress-test was run on a device that showed significant corrosion in optical inspection, and was reported as a failure on the board. This device had a compromised bondline. Stress-testing showed that starving the contaminated area for moisture fully arrested any further progression of electrolytic corrosion.