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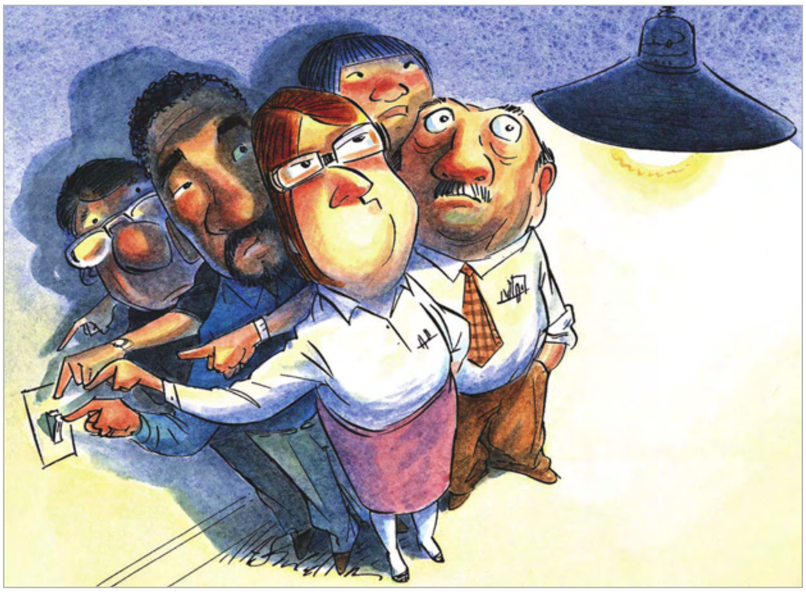
# Shedding light on radiation testing



DANIEL VASCONCELLOS

We recently designed a 2-kW, more-than-93%-efficient power converter for a manned space application. The design uses the latest generation of 500 and 200V power MOSFETs, which are available as commercial encapsulated plastic parts, for both converter-drive and synchronous rectification. For several reasons, including cost, schedule, volume, weight, and—most important—ease of connection, we opted to use the FETs in this form, rather than purchase die and have them mounted in hermetic headers—thereby making them "special" parts. We devised a set of screening tests and procured parts for sample testing. The parts did well in parametric testing over the full military-temperature range, even though they weren't specified for it. They also met all of the DPA (destructive-physical-analysis), outgassing, and other materials requirements. The only additional set of tests required was radiation-susceptibility testing.

The program preference was for heavy-ion testing, so that's what we did. Because heavy ions do not readily penetrate the encapsulant, it was necessary to subject the radiation-test articles to a plastic stripping process to expose the die. After successfully completing the stripping process, we subjected the parts to room-temperature parametric tests; they passed. We developed test fixtures that use high-value resistors in the drain circuit, pulled up to an adjustable power supply, and used a biasing circuit to apply the appropriate reverse bias on the gate, simulating the application's gate bias. During testing, the high value of drain resistance reduces both the available current and the destructive energy available during radiation-induced turn-ons of the parasitic bipolar within the FET structure, allowing the device to recover. In turn, we could sneak up on the drain potential at which these events first began to happen and record the frequency of these events versus drain voltage. To save time, we checked out the fixtures in parallel with the stripping of the actual test articles by using encapsulated parts. Our test engineer, who would conduct the testing, then shipped the test articles and the fixtures to the test site.

Shortly after testing was to have begun, our test engineer found that all of our test articles had excessive drain-to-source leakage before he had subjected them to any radiation! The parts had passed parametric tests at room temperature, based on data-sheet maximums, but no one had compared the measurements one-to-one with the test data collected on the same parts before stripping.

The need to considerably reduce the drain resistance to run the tests made more current and energy available, which limited the resolution of the sensitivity data. After the fact and after some head-scratching, we found the problem was due to room light impinging on the exposed FET die. The resulting photo current in the FET body diode drastically increased the measured saturated drain-to-source current. Turning off the lights could have solved the problem ... and made the microammeter unreadable. (Whatever works!) EDN

*Charles Clark, a member of EDN's Editorial Advisory Board, is a Technical Fellow at The Boeing Company.*

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