Definitions

Definitions (1)

Single Event Upset (SEU) is a change of state or transient induced by an ionizing particle such as a cosmic ray or proton in a device. This may occur in digital, analog, and optical components or may have effects in surrounding circuitry. These are "soft" bit errors in that a reset or rewriting of the device causes normal behavior thereafter. A full SEU analysis considers the system effects of an upset. For example, a single bit flip, while not damaging to the circuitry involved, may damage the subsystem or system (i.e., initiating a pyrotechnic event).

Single Hard Error (SHE) is an SEU which causes a permanent change to the operation of a device. An example is a permanent stuck bit in a memory device.

Definitions (2)

<u>Single Event Functional Interrupt (SEFI)</u> is a condition where the device stops operating in its normal mode, and usually requires a power reset or other special sequence to resume normal operations. It is a special case of SEU changing an internal control signal. One example would be a DRAM entering the test mode defined by JEDEC. Another example is a microcircuit with IEEE 1149.1 JTAG circuitry leaving the TEST_LOGIC_RESET state and loading an unintended instruction into the instruction register (IR). Like other SEUs, the system effects must be properly analyzed. For example, a JTAG upset can cause the device to draw high currents or turn inputs into an output. The latter could, for example, drive a clock line to ground; thus, an independent clock signal should be used for the TCLK pin on devices without the optional TRST* pin.

Definitions (3)

Single Event Latchup (SEL) is a potentially destructive condition involving parasitic circuit elements forming a silicon controlled rectifier (SCR). In traditional SEL, the device current may destroy the device if not current limited and removed "in time." A "microlatch" is a subset of SEL where the device current remains below the maximum specified for the device. A removal of power to the device is required in all non-catastrophic SEL conditions in order to recover device operations.

Single Event Burnout (SEB) is a highly localized burnout of the drain-source in power MOSFETs. SEB is a destructive condition.

Definitions (4)

Single Event Gate Rupture (SEGR) is the burnout of a gate insulator in a power MOSFET. SEGR is a destructive condition.

Linear Energy Transfer (LET) is a measure of the energy transferred to the device per unit length as an ionizing particle travels through a material. The common unit is MeV-cm^2/mg of material (Si for MOS devices).

LET threshold (LET_{TH}) is the minimum LET to cause an effect. The JEDEC recommended definition is the first effect when the particle fluence = 10^7 ions/cm^2.

Definitions (5)

Cross section (sigma) is the device SEE response to ionizing radiation. For an experimental test for a specific LET, sigma = #errors/(ion fluence). The units for cross section are cm^2 per device or per bit.

Asymptotic or saturation cross section (sigmasat) is the value that the cross section approaches as LET gets very large.

Sensitive volume refers to the device volume affected by SEE-inducing radiation. The geometry of the sensitive volume is not easily known, but some information is gained from test cross section data.