Ridgetop Group Inc

Ridgetop Semiconductor

Sentinel Silicon Library™

RadCell V_T Prognostic Cell

FEATURES AND BENEFITS

- **The Ridgetop RadCell V_T Prognostic Cell behaves as an early-warning sentinel of an upcoming threshold voltage failure condition due to radiation exposure**
- **Available for various CMOS processes**
- **Power dissipation is approximately 600 µW**
- **Prognostic distance can be adjusted from the nominal 80% point**
- **Simple buffered logic high or low output indicate an impending failure event**
- **Optional IEEE-1149.1 JTAG Bus interface**

DESCRIPTION

Total dose radiation exposure results in charged defect densities in the gate and isolation oxide regions of a MOS transistor. The charged defects degrade device performance by introducing changes in threshold voltage and leakage current. The magnitude of the parametric shift is dependent on operating conditions and environment. The Ridgetop RadCell V_T prognostic cell (Figure 1) accurately senses radiation-induced shift in CMOS transistor threshold voltage and outputs the cumulative degradation result.

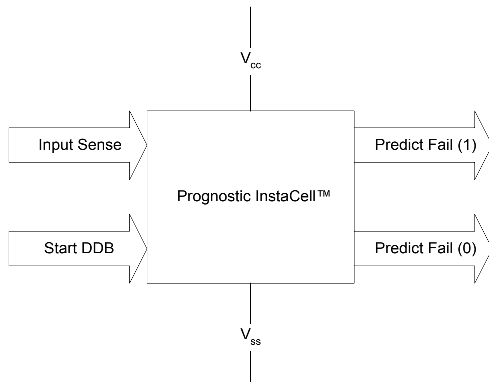

Figure 1: Prognostic Cell Block Diagram

The output is derived from a family of sensor cells, designed and calibrated to trigger at specific values of threshold voltage shift. The RadCell V_T prognostic cells reside on-chip with the host application, and are implemented using the device types and geometries available in the target process. This allows the prognostic cell to identically replicate the transistors used in the host application, and makes the output useful in determining the effects of environmental stress on the application's performance and service life.

RadCell V_T prognostic cells can be used as a diagnostic tool, relating device-level parametric shifts to circuit-level performance, or to allow comparison of ground-based and space-based testing results. The output of the prognostic cell can also be used as the input for an adaptive-bias control circuit. Multiple cells can be combined with calibrated prognostic distances to accurately track cumulative degradation, consistent with the requirements for condition-based maintenance.

Prognostic Distance

The prognostic distance is the time between the prognostic cell warning point and the time of system failure, as shown in Figure 2. The prognostic distance of the RadCell V_T prognostic cell can be adjusted to meet customer needs by trigger point calibration.

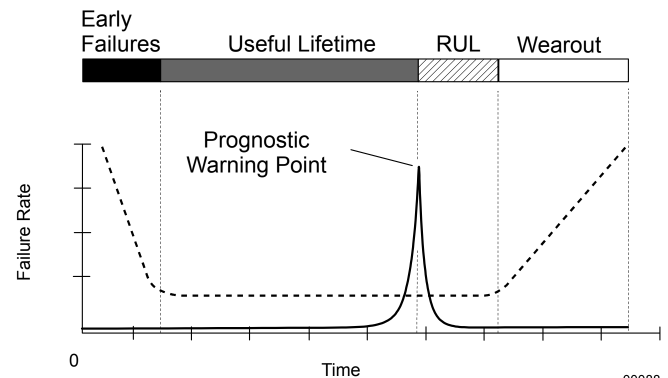

Figure 2: Characteristic System Reliability with Remaining Useful Life (RUL) Indicating Prognostic Distance

Interfacing

The standard RadCell V_T prognostic cell is configured for simple buffered logic high or low output.

Optional Interfacing using the JTAG Bus Structure

Using the JTAG Toolkit, it is also possible to include a register in a chip design that permits an interface using the standard scan test bus that employs IEEE-1149.1. This interface uses four control lines:

TDI - Test Data In
TDO - Test Data Out
TCK - Test Clock
TMS - Test Mode Select

If the JTAG Toolkit is utilized, the prognostic cell uses the TDO and TMS lines. The TDO changes its logic state upon a detected failure event and the TMS is used to invoke a "self-test" function to ensure that the cell is functional.

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