Titanium SEU Detection Feature

An SEU happens when an environmental factor, such as background radiation, causes a digital circuit to malfunction. For FPGAs, the most frequent (and most worrisome) outcome of an SEU is that a CRAM bit is changed from its programmed value. Designs may not use every CRAM bit in the FPGA, so an SEU may or may not cause the FPGA to malfunction. However, in many situations the safest course of action is to assume that the FPGA's behavior is corrupted until it is reconfigured.

Systems that Need SEU Detection

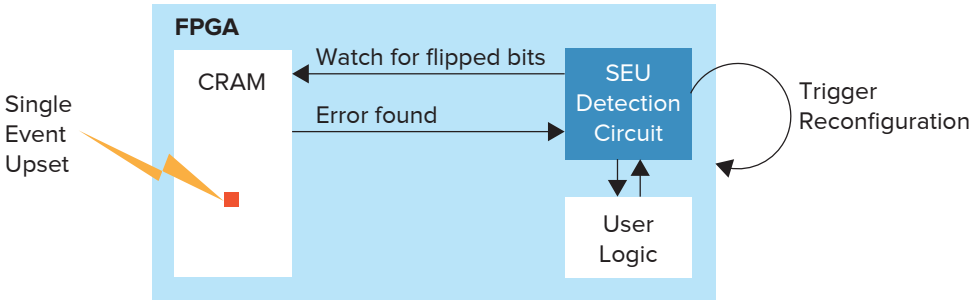
Some systems have stringent uptime requirements and/or a low error tolerance, for example, remotely deployed wireless communications systems or critical industrial applications. You can design your systems so that it can continue to operate with minimal downtime while the FPGA occasionally and randomly reconfigures itself when SEUs occur. For example, you can monitor the number of SEUs as they occur and only trigger reconfiguration when you need to.

Titanium SEU Detection Circuitry

Titanium FPGAs contain built-in circuitry to help detect SEUs. This circuitry periodically monitors the FPGA's CRAM, detects if a CRAM value has changed from the programmed state, and sends status signals to user logic. The user logic can optionally trigger the FPGA to reconfigure using the SEU detection circuitry.

Titanium FPGAs have built-in circuitry to help detect single-event upset.

Figure 1 SEU Detection Circuitry



The SEU detection circuitry can monitor the CRAM while the FPGA is operating normally in user mode. When the circuitry is triggered, it calculates a 32-bit CRC value based on CRAM values and compares it to a CRC computed by the software and stored in the configuration bitstream. If the values are different, the SEU circuit determines an error has occurred and sends an error signal to the user logic.

You can trigger the SEU detection circuitry automatically or manually:

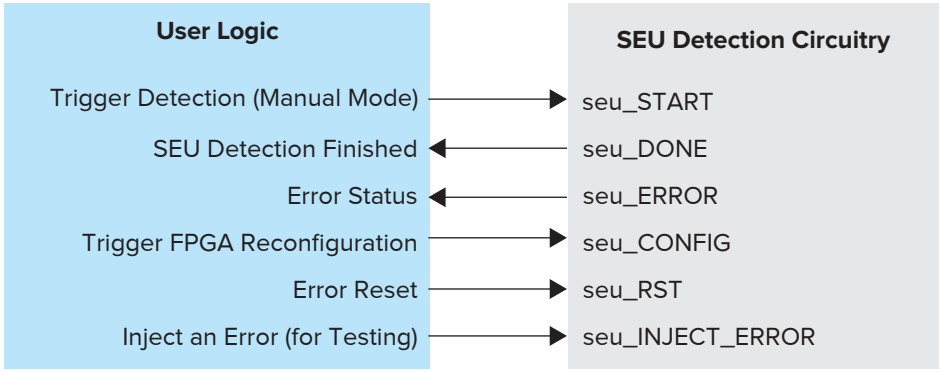
- With *automatic* detection, you choose the interval between detection runs in microseconds.
- With *manual* detection, your user logic triggers the SEU detection circuitry based on factors that you decide. For example, you could use input from a sensor as a trigger.

For testing your application before deployment, you can inject errors into the circuitry to see how the system behaves when an SEU occurs.

Enabling SEU Detection

You enable the circuitry in the Efinity® Interface Designer with the **Enable SEU Detection** option. The Interface Designer adds the SEU signals to your interface, and you connect them to your RTL design. Refer to the Titanium Interfaces User Guide for complete instructions.

Figure 2 SEU Detection Signals



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