

Radiation Tolerant Hermetic Optocouplers From Avago Technologies

The hermetic optocouplers manufactured by Avago may not be characterized as “Rad-Hard”, but have proven to be quite tolerant to most radiation effects. Avago optocouplers utilize integrated photodiode detectors, whereas many optocouplers use phototransistors in their designs. The photodiode design permits shallower diffusion depths and a smaller transistor base area. Phototransistor optocouplers, on the other hand, maximize the base area for increased coupling. This scheme makes the device very susceptible to radiation effects. At the same radiation level, the device with the smaller exposed sensitive area will experience less radiation damage.

Proton-induced single event transients (SET) have a high level of occurrence on high-speed optocouplers such as the Avago 6N134/HCPL-56xx and HCPL-54xx product families. This is not surprising as photodiodes make wonderful particle detectors. The high speed (bandwidth faster than 400 kbps) of some photodiodes allows some transients to induce a transient output, however, there are workarounds (e.g. one may be to increase the Vcc level, or use the optocoupler in inverting mode versus non-inverting mode, whichever appears to be less sensitive). For slower speed or bandwidth applications less highly integrated or simpler optocouplers, such as the 4N55 product family or 6N140A family are recommended. As this family shows a high rate of immunity to SET, it’s an excellent example of the filtering capabilities of the slower speed optocoupler amplifier stage.

Total doses up to 200Krads have been performed on the majority of the hermetic products. These have revealed a high degree of tolerance. With the exception of the “relay” devices (HSSR-711x), we have not experienced any device not meeting datasheet specifications after 200Krads. The MOSFETs utilized in the HSSR-711x family have a low threshold voltage that requires thin oxide for the gates. This design allows for total dose radiation levels up to 30Krads before significant leakage occurs. Over the past several years, Avago has made a concerted effort to amass radiation data on our hermetic optocoupler portfolio. This data, consisting mostly of photon (gamma) and particles (protons and electrons), confirms our belief that the Avago IC design provides high radiation immunity.