Industrial Electronics

The 5 Approaches for Producing Radiation Hardened Solutions

Radiation hard devices have been used successfully to realize other components and systems for radiation hard applications. These are the key components that enable the operation of electronic systems in harsh environments. In addition, the semiconductor devices and systems are highly susceptible to damage and malfunctions caused by ionizing radiation. This environment may be encountered in high altitude flight and in outer space, as well as in the vicinity of nuclear reactors or accelerators. To ensure the reliable operation of electronic systems subjected to such environments, a variety of techniques can be employed to make them radiation tolerant. This article will highlight the value of the various radiation tolerance techniques available.

Red Hot by Design Components

Traditionally, it has often been necessary to use components that are red hot by design of the semiconductor design to create radiation-tolerant electronics. The radiation hardening of these components is accomplished by exposing electronic components incorporating integrated circuit technology to high temperature for extended periods of time. High temperature exposes the devices to high internal stresses. This process is performed in an atmosphere of inert gas, such as nitrogen or argon, to minimize the impact of the stress on the device. After the high-temperature process, the components are tested to ensure that they still function correctly. This process produces electronic components that are radiation tolerant.

Space Shielding

Space shielding involves adding radiation shielding material to the package of individual electronic components in order to protect the components from the radiation in the spacecraft. This approach takes advantage of the fact that the largest commercial electronics can be used and the shielding effectiveness can be tailored to the environment. For instance, DOD offers radiation-tolerant microelectronics devices utilizing its patented NetRAID® packaging technology (Figure 2) that includes an integrated high-density radiation shielding in the microcircuit package, providing a total dose capability of 100 Krads or higher. This provides a solution that is lightweight and takes advantage of the shield’s radiation hardness to extend its in-orbit life.

Error-Correction Code (DCC) Memory

Protons, cosmic rays, and solar flare rays can cause a single bit to be corrupted. To prevent these errors, a redundancy code is used to protect the data. The code is capable of detecting and correcting errors in the data. This process is performed in an atmosphere of inert gas, such as nitrogen or argon, to minimize the impact of the stress on the device. After the high-temperature process, the components are tested to ensure that they still function correctly. This process produces electronic components that are radiation tolerant.

Figure 1. Red Hot devices for radiation tolerance

Figure 2. Space shielding packaging technology

Figure 3. Error-Correction Code (DCC) Memory

For commodity silicene, a silicon-based material, the radiation hardness of the component can be improved through the use of oxide layers. Using this technique, the radiation hardness of the component can be improved by up to 50%. The use of oxide layers can be useful in reducing the radiation hardness of the component.

Figure 4. Space Shielding

Figure 5. Error-Correction Code (DCC) Memory

Commercial Off-The-Shelf Components

Radiation tolerance in the semiconductor industry makes it possible to use commercial off-the-shelf (COTS) components, since the performance of radiation-tolerant alternatives often eclipses that of COTS parts. The radiation hardening of COTS devices is achieved through the use of oxide layers. The use of oxide layers can be useful in reducing the radiation hardness of the component. In addition, the use of oxide layers can be useful in reducing the radiation hardness of the component.

Figure 6. Commercial Off-The-Shelf Components

Space-Qualified Designers & Manufacturers

Space-qualified design and manufacturing facilities, the design of Device Data Component (DDC) devices can assist electronic system designers and engineers in the development of radiation-tolerant and radiation-hardened components. These devices are designed with radiation tolerance in mind, allowing for the use of oxide layers. The use of oxide layers can be useful in reducing the radiation hardness of the component. In addition, the use of oxide layers can be useful in reducing the radiation hardness of the component.