

How Space Enhanced Products Address Challenges in low Earth orbit Applications



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One of the more exciting aspects of the emerging new space market is the launch of high-volume low Earth orbit (LEO) satellites that are small and economically feasible, but also radiation-tolerant and reliable. These satellites enable expanded communication and connectivity around the world. Unlike the traditional satellite market, where the majority of missions are in geosynchronous orbit up to 22,236 miles from Earth and expected to last more than 10 years, LEO satellites orbit much closer to Earth, not more than 1,300 miles away. Because they're relatively easy to replace, they generally have mission lives for less than seven years.

The major challenges in electronic design for LEO satellites – all while meeting strict budgets and maintaining competitiveness – are:

- Using smaller, more integrated components to reduce board size.
- Finding devices with short lead times for quick-turn designs.
- Having electronic components capable of enduring the harsh conditions in space.

For designers new to the space market, there are specific challenges in space that products designed for terrestrial markets do not address, including:

- Radiation performance.
- Controlling process and material variations typical in commercial off-the-shelf (COTS) devices.
- Thermal cycling as satellites experience extreme temperature fluctuations as they move around Earth.
- Outgassing from plastic packages, which are not hermetically sealed.

TI's Space Enhanced Product (EP) qualification process addresses these challenges and removes the need for high-risk and resource intensive upscreening methods sometimes used for this market. Upscreening is the practice of testing a part electrically or environmentally for use outside of datasheet specifications. While upscreening can help classify a device's performance for space, there are still numerous risks and without a full understanding of the "recipe" of a device and its test vectors, this can lead to field failures and a false sense of security that the satellite will function for the mission duration.

How Radiation-tolerant Plastic Devices Reduce Risk

TI's certified space products enable designers and component engineers to design and qualify their boards without worrying about the specific considerations of satellites in a LEO space environment. Some of the considerations that Space EP products address are:

- A controlled baseline flow. TI manufactures each Space EP device at a single fabrication facility, assembly site and test site in order to control site-to-site variations between material set, radiation tolerance and electrical specifications.
- Radiation lot acceptance testing. Space EP devices are at minimum tested for total ionizing dose (TID) assurance to 20 krad (Si) for each wafer lot, with higher rated testing for devices capable of meeting higher TID ratings, removing any risk of radiation variation from lot to lot. The devices are typically characterized from 30 to 50-krad(Si) TID during qualification for extra radiation performance. (For programs that require a higher level of TID performance, TI's traditional QMLV space products are generally rated to 100 krad(Si) or higher.)
- Gold wire. Space EP devices use only gold bond wires, eliminating the bond integrity and reliability issues possible with copper given tighter tolerance requirements.
- No risk of tin whiskering. Tin whiskering, even when using a conformal coating, is a concern because of the harsh conditions in space. To avoid this risk, Space EP products do not use terminations with high tin content. Instead, finishes are either nickel-palladium-gold or 63% tin/37% lead.
- Extended temperature range. Space environments typically require a temperature tolerance of -55°C to 125°C. Qualifying Space EP parts to this temperature range eliminates the need to upscreen for an extended temperature range, which would invalidate TI's warranty and potentially harm devices used in flight.
- Harsh environment qualifications. Space EP products receive additions to the flow specific to the space environment with extended high accelerated stress testing, temperature cycling on every device and an enhanced material set, to meet the NASA-driven American Society for Testing and Materials E-495 outgassing specification.

For more detailed information on TI's Space EP qualification, read our application note: ["Reduce the risk in low Earth orbit missions with Space Enhanced Plastic products."](#)

Accelerate Launch Timelines

The quality and reliability in TI Space EP devices enables designers to spin and qualify new designs faster. Within the device product folder on TI.com, we provide all radiation data for the device, optimized for LEO requirements, as well as outgassing data and reliability reports. Using our detailed reports can be a huge cost saver since a significant investment is made in radiation testing, upscreening and accounting for low yield when using COTS products in LEO satellite applications.

Our reports include:

- A radiation report provided for TID, including characterization data from 30-50 krad(Si) and radiation-hardness assured data from 20-50 krad(Si).
- A radiation report for single-event effects, a single-event latchup report to 43 MeVcm²/mg and additional destructive single event and single-event transient characterization for power-management products.
- An outgassing and reliability report that provides information about product flow, reliability data, traceability and outgas testing. The information in this report helps expedite board qualification and reduces the need for external qualification efforts, minimizing risk when selecting new products and giving you confidence that the devices will work from the beginning.

TI continues to invest and release more Space EP qualified products. For a full list of available devices, see the [Space EP parametric table](#).

The harsh environment of space requires an enhanced level of reliability to ensure the safety of your system. In addition to these challenges, launch cycles and project timelines are continuing to accelerate. Save time and reduce risk in your next launch with our Space EP portfolio of devices.

Additional Resources

- Keep up to date with newly released radiation-tolerant and radiation-hardened space products with the "[TI Space Products Guide](#)."
- Choose the right device to meet your mission's quality requirements with our [space device classifications diagram](#).

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