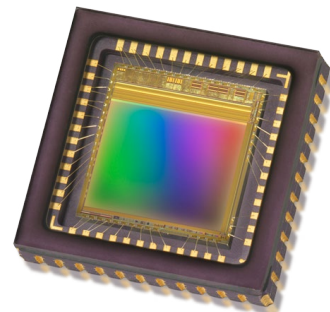


Ruby® 1.3 MP USV: A Robust Imaging Solution for Space Radiation Environments.

October 2026



As space missions continue to multiply and diversify, the demand for reliable, high performance imaging technologies capable of operating in harsh radiation environments has never been greater. From Earth observation and situational awareness to platform monitoring and scientific payloads, image sensors are expected to deliver consistent performance throughout increasingly demanding mission profiles. In this context, Teledyne e2v's Ruby® 1.3 MP USV (Upscreened for Space) image sensor offers a well balanced solution, combining industrial grade imaging performance with demonstrated radiation robustness validated through dedicated test campaigns.



The Ruby USV image sensor is based on a 1.3 megapixel global shutter CMOS architecture that has been widely adopted in demanding industrial and scientific applications. Building on this strong foundation, Teledyne e2v has adapted the technology for space use with some specific layers added in the CMOS process, that enhance the robustness of component under irradiation. This approach enables Ruby USV to sit between fully space qualified components and commercial off the shelf devices, providing enhanced reliability without the cost or lead time constraints associated with traditional space qualification.

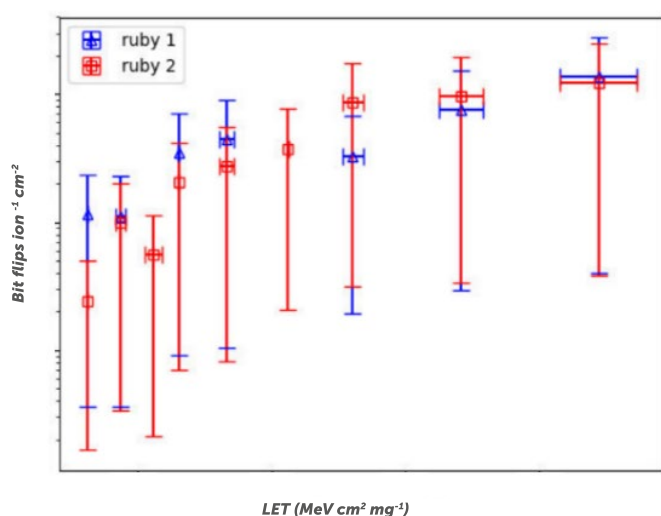


Figure 1 – Ruby 1.3 MP USV Single-Event Upset (SEU) cross section versus LET, showing register bit-flip sensitivity for two devices under test.

Radiation remains one of the primary challenges facing spaceborne imaging systems. During a mission, image sensors are exposed to cumulative Total Ionizing Dose effects as well as single event phenomena caused by energetic particles. These effects can lead to functional disruptions, parametric drifts or, in the worst cases, permanent damage. For this reason, the Ruby USV sensor has undergone thorough extensive radiation evaluation, including heavy ion, total ionizing dose and characterization, in order to help mission designers properly dimension their systems under representative conditions.

Heavy ion testing was carried out to characterize the sensor's sensitivity to single-event effects, including single-event latch-up (SEL) and single-event upsets (SEU) affecting configuration registers. Figure 1 presents the measured SEU cross section as a function of linear energy transfer (LET) for two devices under test.

The heavy-ion campaign showed that SEU events, observed as temporary bit flips in the sensor's configuration registers, occurred from an LET of approximately 32 MeV·cm²·mg⁻¹. This threshold is slightly below the SEL threshold reported during the same campaign.

The measured upsets were recoverable: affected registers could be rewritten with their expected configuration values, with no permanent functional impact identified. At system level, this predictable behavior can be managed through standard mitigation measures such as periodic register readback, verification and refresh.

In parallel, SEL testing confirmed that latch-up occurred only at higher LET levels. The observed SEL events were non-destructive and could be cleared by power cycling, complementing the SEU results with a controlled and recoverable single-event response.

Long term radiation endurance was assessed through a dedicated total ionizing dose test campaign. Flight model Ruby devices were irradiated up to a cumulative dose representative of typical short to medium duration space missions, followed by detailed electrical and electro optical characterization and annealing. Post irradiation measurements confirmed that all devices remained fully functional and compliant with their specifications.

The observed parametric variations were limited and in line with expected CMOS behavior under ionizing radiation (cf. Figure 2). These included small increases in dark signal and modest changes in power consumption, with a slight reduction in dynamic range primarily driven by dark current evolution. Above all, no functional degradation was detected, and no physical or structural damage was observed during post test inspections. Even after ageing, the sensors continued to operate well within acceptable margins, demonstrating their suitability for space missions with moderate radiation exposure.

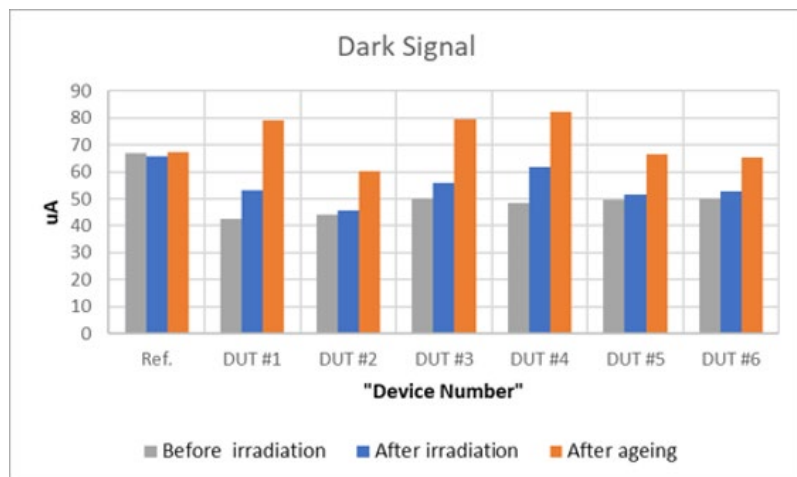


Figure 2 – Evolution of dark signal before irradiation, after irradiation, and after ageing, illustrating limited parametric drift following TID exposure.

Beyond the individual test results, the overall radiation behavior of Ruby USV is characterized by clarity and predictability[PF2.1]. Rather than seeking absolute radiation immunity, Teledyne e2v has designed and validated the sensor to respond in a controlled and reversible manner when exposed to extreme conditions. This philosophy aligns well with current spacecraft design practices, where system level mitigation strategies play a key role in ensuring mission reliability.

As a result, Ruby 1.3 MP USV is particularly well suited to low Earth orbit and medium Earth orbit missions, including New Space constellations, technology demonstrators, and institutional programs requiring dependable imaging performance with controlled risk. Its global shutter architecture makes it ideal for capturing moving scenes without distortion, while its radiation robustness provides confidence over the duration of the mission. By combining a proven industrial imaging core with targeted process choices and comprehensive radiation testing, Teledyne e2v offers, with Ruby USV, a pragmatic and reliable imaging solution for space. The sensor delivers a compelling balance between performance, availability, and robustness, enabling mission designers to meet their imaging objectives while managing radiation risk effectively.

With decades of experience in space imaging and a long track record of flight heritage, Teledyne e2v continues to support a wide range of space programs worldwide. The Ruby 1.3 MP USV image sensor exemplifies this expertise, providing a dependable pathway for missions seeking high quality imaging in challenging radiation environments.

For more information on the Ruby 1.3 MP USV image sensor and the extensive radiation test campaign highlighted in this article, or to access the full detailed report, please do not hesitate to contact the Teledyne e2v team. Our experts will be pleased to provide comprehensive technical insights, detailed data, and tailored support to help address your specific application requirements.



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