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Redwire's Rad-Hard Sun Sensors Enabling Historic Mission to Jupiter's Moon Europa

Credit: NASA

For millennia humanity has pondered whether we are alone in the universe, and recently NASA launched a mission meant to gather information that moves us closer to answering that question. On October 14, 2024, the Europa Clipper lifted off from NASA's Kennedy Space Center in Florida. The spacecraft will spend the next several years traveling the vast distance from Earth to Jupiter and its moon Europa, which is thought to have a large, subsurface ocean that may be hospitable to life.

Redwire is proud to have delivered a radiation-hardened Digital Sun Sensor (DSS) system to support the Europa Clipper. The DSS system will supply the mission with crucial sun angle data to enable precise orientation of the spacecraft. However, this mission has brought additional challenges for the DSS system that Redwire engineers had to overcome.

Artist's concept of NASA's Europa Clipper spacecraft in orbit around Jupiter. Credit: NASA/JPL-Caltech

The most significant challenge of the Europa Clipper DSS is the intense radiation in the Jupiter environment, which is among the highest in the entire solar system. All of the components in the DSS Electronics processor are rated to a minimum of 300 krad, making this the most radiation hardened sun sensor processor ever devised by Redwire. However, these radiation hardened components could not withstand Jupiter's radiation on their own. To handle the extreme radiation levels, all of the Europa Clipper's vital electronics like the spacecraft's onboard computers and the DSS electronics processor are contained in a vault inside the spacecraft. This vault structure consists of 9.2 mm thick walls of aluminum-zinc alloy that shield sensitive hardware from radiation.

NASA's Europa Clipper spacecraft at JPL just after delivery in early June 2022. Credit: NASA/JPL-Caltech

Another challenge lies in the high dynamic range of the Sun's signal during the Europa Clipper's journey. The DSS system will need to handle not only the relatively weak signal of the Sun when it arrives at Jupiter, but also deal with stronger sunlight when the spacecraft flies around Mars and Earth to pick up a speed assist from those planets' gravitational fields. This required Redwire engineers to set up multiple gain settings in the DSS systems amplifiers to compensate, while still maintaining immunity from albedo from Europa and other sources.

Redwire's high performance digital sun sensors have flown on over 100 missions in rad hard environments, some performing in flight for more than 20 years. The DSS system on Europa Clipper is the latest in a line of Redwire sun sensors that have been a part of multiple missions and spacecraft. Redwire sun sensors have enabled Juno, NASA's previous mission to Jupiter, as well as NASA's Double Asteroid Redirection Test, Parker Solar Probe, and a variety of Mars missions, including the Perseverance rover. By supporting this latest deep space scientific mission, Redwire is continuing to build on its heritage of spaceflight expertise.

Learn more about the Redwire DSS system that supported NASA's DART mission here.

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