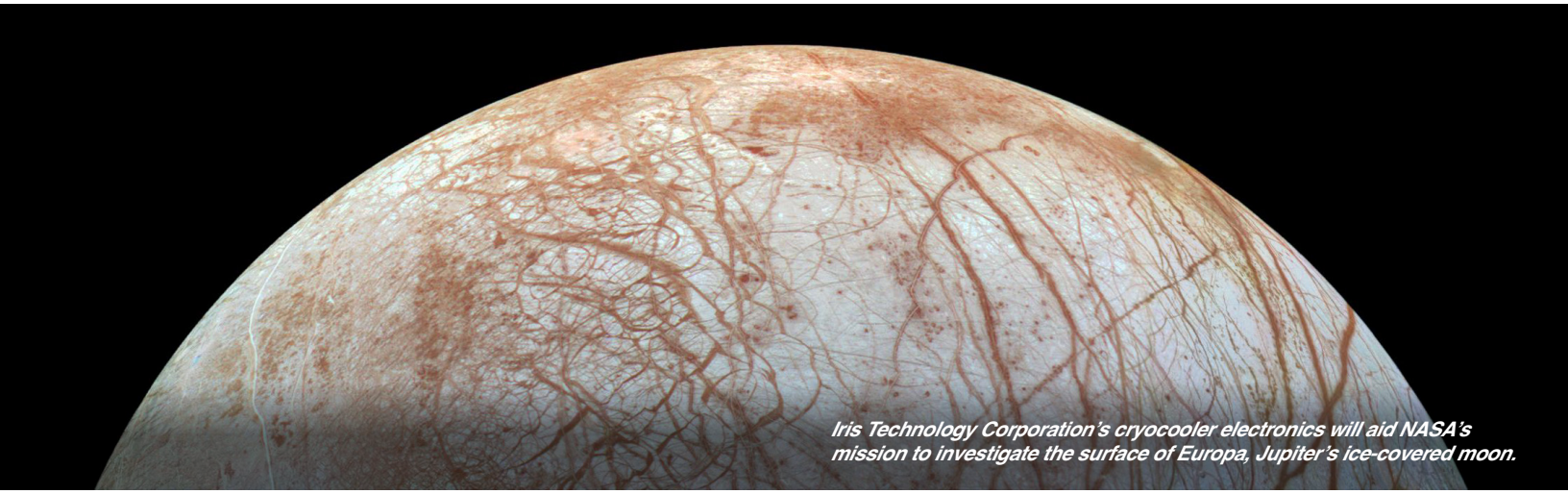
National Aeronautics and Space Administration



Iris Technology Corporation's cryocooler electronics will aid NASA's mission to investigate the surface of Europa, Jupiter's ice-covered moon.

Cryocooler Electronics Enable Thermal Imaging of Planetary Objects in Deep Space

Challenge

Thermal imaging cameras use infrared waves instead of visible light to capture images. Because infrared waves have longer wavelengths than visible light and can pass through dense regions of gas and dust in space with less scattering and absorption, many of NASA's space missions require thermal imaging systems to capture data.[1] It is important for the focal point of a thermal imaging system to maintain stable cryogenic temperatures—at an operating temperature between 160 K to 0 K, or -171 °F to -460 °F—so that the temperature of the focal point does not interfere with the detection of the infrared waves that are being imaged.

NASA sought a cost-efficient system that could maintain control of the cryocooler of a thermal imager within a fraction of a degree Kelvin. In addition, the system needed to be radiation hardened to resist the high radiation in deep space that can cause electronics to damage or malfunction. A thermal camera that meets these requirements could help us better understand the existence of water, and therefore possible life, beyond Earth.

Solution

Iris Technology Corporation is a small business located in Irvine, CA with a track record of manufacturing electronics that control and stabilize the temperatures of cryocooler technologies. NASA became familiar with Iris after the company received Air Force SBIR Phase I and II awards in 2011

[1] science.nasa.gov/ems/07_infraredwaves

Project

Low Cost Cryocooler Electronics and Deep Space Cryocooler System for thermal imaging

Mission Directorates

Science

Follow-on Success

More than $13.6 million in contracts with NASA JPL and the Air Force as well as commercialization income

Snapshot

Iris Technology Corporation received NASA SBIR awards to advance its cryocooler electronics, which control mechanical cryocoolers that enable thermal imaging systems to capture data to improve our knowledge of water and possibly life in space. Originally partnering with the Air Force SBIR program, Iris has since won several contracts to provide its cryocooler electronics on NASA missions— including a mission to examine the surface of Jupiter's moon Europa—and on a satellite mission with the Air Force.

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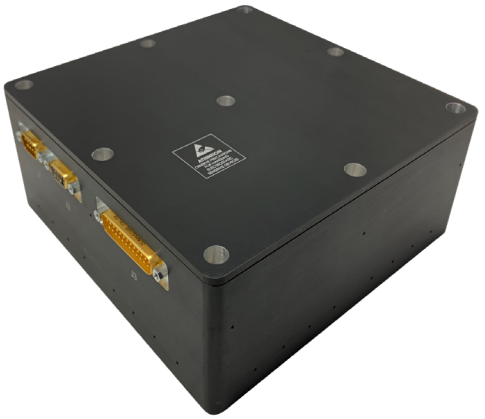
to develop its Low Cost Cryocooler Electronics (LCCE). The LCCE was designed to support a broad range of mechanical cryocoolers, control the power, and control the temperature within a fraction of a degree Kelvin.

While cryocooler control technology was already available for the government through acquisition channels, Iris sought to offer more affordable radiation-hard cryocooler electronics. NASA's Jet Propulsion Lab (JPL) located in Pasadena, CA, became familiar with the progress Iris had made with the Air Force and encouraged the firm to submit a proposal to the NASA SBIR/STTR program. In 2012, the company received Phase I and II NASA SBIR/STTR awards for the second generation of LCCE (LCCE-2), building from the advancements made with the Air Force to include input power ripple filtering and active vibration cancellation technology. Because the cryocooler operates as a single frequency audio speaker, it generates a vibration when in use. Iris designed the electronics to cancel out the cryocooler movement, which is vital to ensuring that the vibration does not interfere with capturing a high-resolution image.



Iris' HP-LCCE support mechanical cryocoolers by controlling temperature within a fraction of a degree Kelvin

In 2016, Iris also received SBIR Phase I and II awards to develop its Deep Space Cryocooler System (DSCS) to advance the state of the art in cryocooler systems. The key objective of this effort was to demonstrate cryogenic cooling technologies for smaller spacecraft, such as CubeSats and miniature satellites. Both LCCE and DSCS would go on to impact NASA and Air Force missions.

Business Impact

In total, Iris attributes more than $13.6 million in contracts and related revenue to technology developed through the NASA SBIR/STTR program. The progress Iris made with LCCE-2 led to a $2.7 million subcontract with JPL as the prime to create a radiation hard set of cooler drive electronics for the Mapping Imaging Spectrometer (MISE), scheduled to launch in 2024 on the Europa Clipper to examine the surface of Europa, one of Jupiter's moons. Iris also delivered electronics for another instrument on the Europa Clipper, the Mass Spectrometer for Planetary Exploration. Building on LCCE-2 further, JPL awarded Iris a separate subcontract to develop a high power (HP) LCCE for several JPL instruments including the Earth Surface Mineral Dust Source Investigation, scheduled to launch to the International Space Station in 2022. Iris has since earned $6.9 million in commercial sales of the HP-LCCE for additional space flight instruments.

The progress made with DSCS led Iris to receive a contract with JPL to support the High-resolution Volatiles and Minerals Moon Mapper (HVM3), which aims to map water ice located in permanently shadowed craters on the Moon. Lockheed Martin is a partner with Iris and JPL in this effort; George Steiner, Senior Manager of Aerospace Business Development at Iris, remarks on how the SBIR/STTR program opens avenues for small and large businesses to be at the same level.

"I was impressed with the opportunity for the small businesses to compete with the large aerospace companies," Steiner says. "It really gives small businesses an entry."

Steiner also acknowledges how the initial partnership with Air Force contributed to Iris' work with NASA, noting that "working with one program might gain you access to another agency." Iris' progress with the NASA SBIR/STTR program has also opened more opportunities with Air Force as the Defense agency works with Iris to add functionality to DSCS for a satellite mission. The thermal imaging technology enabled by Iris' instruments aims to capture data that can improve science and our understanding of water and potential life on other planetary bodies.

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>
> – George Steiner
> Senior Manager of Aerospace Business Development at Iris Technology Corporation