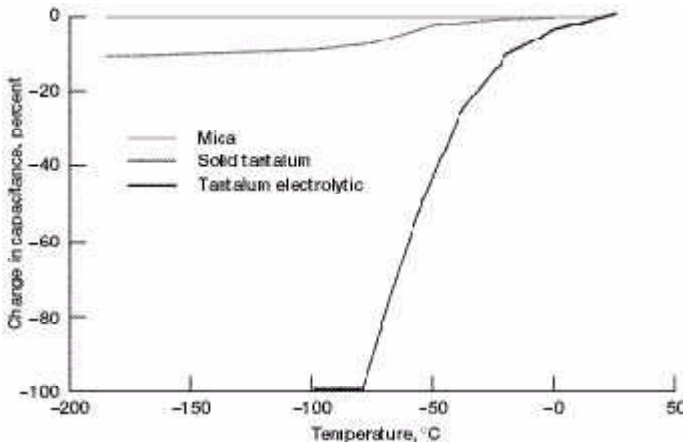
Electronics for Low-Temperature Space Operation Being Evaluated

Electronic components and systems capable of low-temperature operation are needed for many future NASA missions where it is desirable to have smaller, lighter, and cheaper (unheated) spacecraft. These missions include Mars (-20 to -120 °C) orbiters, landers, and rovers; Europa (-150 °C) oceanic exploratory probes and instrumentation; Saturn (-183 °C) and Pluto (-229 °C) interplanetary probes.

At the present, most electronic equipment can operate down to only -55 °C. It would be very desirable to have electronic components that expand the operating temperature range down to -233 °C. The successful development of these low-temperature components will eventually allow space probes and onboard electronics to operate in very cold environments (out as far as the planet Pluto). As a result, radioisotope heating units, which are used presently to keep space electronics near room temperature, will be reduced in number or eliminated. The new cold electronics will make spacecraft design and operation simpler, more flexible, more reliable, lighter, and cheaper.

Researchers at the NASA Glenn Research Center are evaluating potential commercial off-the-shelf devices and are developing new electronic components that will tolerate operation at low temperatures down to -233 °C. This work is being carried out mainly in-house and also through university grants and commercial contracts. The components include analog-to-digital converters, semiconductor switches, capacitors, dielectric and packaging material, and batteries. For example, the effect of low temperature on the capacitance of three different types of capacitors is shown in the graph. Using these advanced components, system products will be developed, including dc/dc converters, battery charge/discharge management systems, digital control electronics, transducers, and sensor instrumentation.

The Low Temperature Electronics Program at Glenn collaborates with other Government agencies, industrial and aerospace companies, and academia. It supports missions and development programs at the Jet Propulsion Laboratory, the NASA Goddard Space Flight Center, and the NASA Langley Research Center.



Change in capacitance due to low temperature for mica, solid tantalum, and liquid electrolytic tantalum capacitors.

Find out more about this research at http://www.grc.nasa.gov/WWW/epbranch/ephome.htm.

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