

Electrical Devices and Circuits for Low Temperature Space Applications

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Abstract

The environmental temperature in many missions, such as deep space probes and outer planetary exploration, is significantly below the range for which conventional commercial-off-the-shelf electronics is designed. Presently, spacecraft operating in the cold environment of such deep space missions carry a large number of radioisotope or other heating units in order to maintain the surrounding temperature of the on-board electronics at approximately 20 °C. Electronic devices and circuits capable of operation at cryogenic temperatures will not only tolerate the harsh environment of deep space but also will reduce system size and weight by eliminating or reducing the heating units and their associate structures; thereby reducing system development cost as well as launch costs. In addition, power electronic circuits designed for operation at low temperatures are expected to result in more efficient systems than those at room temperature. This improvement results from better behavior in the electrical and thermal properties of some semiconductor and dielectric materials at low temperatures. An overview of the program will be presented in this paper. A description of the low temperature test facilities along with selected data obtained from in-house component testing will also be discussed.