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DESIGN CONSIDERATIONS FOR HIGHER ELECTRICAL POWER SYSTEM VOLTAGES IN AEROSPACE VEHICLES

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Electrical and electronic equipment used in aerospace applications must be designed to operate over a wide range of environmental conditions that include variations in pressure, temperature, and humidity. Electrical power systems for advanced aircraft utilize voltages well above the traditional levels of 12 to 42 Vdc and 115/200 Vac, 400 Hz. Current airborne systems can contain 270 Vdc, and bipolar systems with a 540 V differential are appearing in certain applications. Higher dc potentials create increased probability of arcing and flashover compared to the risks associated with traditional ac or low-voltage dc. The low pressures of high altitude environments only serve only to worsen such concerns.

This paper summarizes the development of a guideline document containing methods of managing higher voltages in aerospace vehicles. Based upon both current and archival work, the design guidance (1) provides a basis for identifying high voltage design risks, (2) defines areas of concern as a function of environment, and (3) illustrates potential risk mitigation methods and test and evaluation techniques. The document is focused on electrical discharge mechanisms including partial discharge and does not address personnel safety. Some of the key areas of concern are power conversion devices, electrical machines, connectors and cabling/wiring, as well as interactions between components and subsystems. The document is intended for application to high voltage systems used in aerospace vehicles operating to a maximum altitude of 30,000 m. (approximately 100,000 ft.), and maximum operating voltages of below 1500 Vrms. Fundamental issues addressing some of the key areas will be presented and discussed

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