BS IEC 62396-4:2013

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# Process management for avionics — Atmospheric radiation effects

## Part 4: Design of high voltage aircraft electronics managing potential single event effects

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The UK participation in its preparation was entrusted to Technical Committee GEL/107, Process management for avionics.

A list of organizations represented on this committee can be obtained on request to its secretary.

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# INTRODUCTION

This industry-wide international standard provides guidance and requirements to design high voltage aircraft electronics for electronic equipment and avionics systems. It is intended for avionics system designers, electronic equipment manufacturers, component manufacturers and their customers to manage the single event effects produced in semiconductor devices operating at high voltage (nominally above 200 V) by atmospheric radiation. It expands on the information and guidance provided in IEC 62396-1:2012.

The internal elements of semiconductor devices operating at high applied voltage will be subject to high voltage stress. The incident radiation causes ionisation charge within the device, and the high voltage stress may cause a large increase (avalanche) in this charge, which may be destructive. Within this part of IEC 62396 two effects are considered: single event burnout (SEB), and single event gate rupture (SEGR).

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# PROCESS MANAGEMENT FOR AVIONICS – ATMOSPHERIC RADIATION EFFECTS –

## Part 4: Design of high voltage aircraft electronics managing potential single event effects

## 1 Scope

This part of IEC 62396 provides guidance on atmospheric radiation effects and their management on high voltage (nominally above 200 V) avionics electronics used in aircraft operating at altitudes up to 60 000 ft (18,3 km). This part of IEC 62396 defines the effects of that environment on high voltage electronics and provides design considerations for the accommodation of those effects within avionics systems.

This part of IEC 62396 provides technical data and methodology for aerospace equipment manufacturers and designers to standardise their approach to single event effects on high voltage avionics by providing guidance, leading to a standard methodology.

Details are given of the types of single event effects relevant to the operation of high voltage avionics electronics, methods of quantifying those effects, appropriate methods to provide design and methodology to demonstrate the suitability of the electronics for the application.

## 2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 62396-1:2012, *Process management for avionics – Atmospheric radiation effects – Part 1: Accommodation of atmospheric radiation effects via single event effects within avionics electronic equipment*

## 3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 62396-1:2012 apply.

## 4 Potential high voltage single event effects

An N-channel power MOSFET can have two different types of destructive effects induced by the deposition of charge from a single energetic particle, single event burnout (SEB) and single event gate rupture (SEGR). Different tests performed on several devices show that is difficult to induce SEB in P-channel MOSFET [1], [2][1]. In addition to this kind of power MOSFET, other power devices, such as insulated gate bipolar transistors (IGBTs), bipolar power transistors and diodes, which have large applied voltage biases and high internal electric fields, are susceptible to SEB.

In SEB, the penetration of the source-body-drain region by the deposited charge can forward bias the thin body region under the source. If the bias applied to the drain exceeds the local

[1] Numbers in square brackets refer to the Bibliography.

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