



# TECHNICAL REPORT



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**Process management for avionics – Atmospheric radiation effects –  
Part 8: Proton, electron, pion, muon, alpha-ray fluxes and single event effects  
in avionics electronic equipment – Awareness guidelines**

INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

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## INTERNATIONAL ELECTROTECHNICAL COMMISSION

### PROCESS MANAGEMENT FOR AVIONICS – ATMOSPHERIC RADIATION EFFECTS –

#### Part 8: Proton, electron, pion, muon, alpha-ray fluxes and single event effects in avionics electronic equipment – Awareness guidelines

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IEC TR 62396-8, which is a Technical Report, has been prepared by IEC technical committee 107: Process management for avionics.

The text of this Technical Report is based on the following documents:

Draft TR	Report on voting
107/355/DTR	107/365/RVDTR

Full information on the voting for the approval of this Technical Report can be found in the report on voting indicated in the above table.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all the parts in the IEC 62396 series, published under the general title *Process management for avionics – Atmospheric radiation effects*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "<http://webstore.iec.ch>" in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

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## INTRODUCTION

Atmospheric radiation can be responsible for causing single event effects (SEEs) in electronic equipment. Beside neutrons and protons, there are other atmospheric radiation sources (for example electrons, pions and muons), which are currently regarded as minor sources, which can also affect electronics in avionics and terrestrial applications. This is currently a new emerging topic with a limited amount of test data and supporting information.

This document, as part of the IEC 62396 series, provides awareness on this new emerging topic in order to inform avionics systems designers, electronic equipment manufacturers and component manufacturers and their customers of the kind of ionising radiation environment that their electronic devices can be subjected to in aircraft and the potential effects this radiation environment can have on those electronic devices.

This awareness is unavoidable due to the aggressive scaling of electronic semiconductor devices to smaller and smaller transistor feature sizes where the impact of these radiation sources can become visible or even significant in the future. For example, some evidence of muon effects has appeared in the literature, in which the impact of muons seems to be negligible at present. This document gives a comprehensive survey on the nature of these particles, atmospheric spectra, induced phenomena and possible testing facilities with their radiation sources; it also provides orientation in order to prepare avionics in the future.

## PROCESS MANAGEMENT FOR AVIONICS – ATMOSPHERIC RADIATION EFFECTS –

### Part 8: Proton, electron, pion, muon, alpha-ray fluxes and single event effects in avionics electronic equipment – Awareness guidelines

#### 1 Scope

This part of IEC 62396 is intended to provide awareness and guidance with regard to the effects of small particles (that is, protons, electrons, pions and muon fluxes) and single event effects on avionics electronics used in aircraft operating at altitudes up to 60 000 feet (18 300 m). This is an emerging topic and lacks substantive supporting data. This document is intended to help aerospace or ground level electronic equipment manufacturers and designers by providing awareness guidance for this new emerging topic.

Details of the radiation environment are provided together with identification of potential problems caused as a result of the atmospheric radiation received. Appropriate methods are given for quantifying single event effect (SEE) rates in electronic components.

NOTE 1 The overall system safety methodology is usually expanded to accommodate the single event effects rates and to demonstrate the suitability of the electronics for application at the electronic component, electronic equipment and system level.

NOTE 2 For the purposes of this document the terms "electronic device" and "electronic component" are used interchangeably.

Although developed for the avionics industry, this document can be used by other industrial sectors at their discretion.

#### 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 62396-1:2016, *Process management for avionics – Atmospheric radiation effects – Part 1: Accommodation of atmospheric radiation effects via single event effects within avionics electronic equipment*