



BSI Standards Publication

## Process management for avionics – Atmospheric radiation effects

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

## National foreword

This Published Document is the UK implementation of IEC TR 62396-8:2020.

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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Published by BSI Standards Limited 2020

ISBN 978 0 580 96566 1

ICS 03.100.50; 31.020; 49.060

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This Published Document was published under the authority of the Standards Policy and Strategy Committee on 31 May 2020.

### Amendments/corrigenda issued since publication

Date	Text affected
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# 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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ICS 03.100.50; 31.020; 49.060

ISBN 978-2-8322-8010-2

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CONTENTS

FOREWORD..... 5

INTRODUCTION..... 7

1 Scope..... 8

2 Normative references ..... 8

3 Terms, definitions, abbreviated terms and acronyms ..... 8

    3.1 Terms and definitions..... 9

    3.2 Abbreviated terms and acronyms ..... 10

4 Technical awareness ..... 12

    4.1 Basic knowledge of atmospheric secondary particles ..... 12

    4.2 Four typical hierarchies of faulty conditions in electronic equipment: Fault – error – hazard – failure ..... 15

    4.3 General sources of radiation ..... 18

        4.3.1 General sources of terrestrial radiation ..... 18

        4.3.2 Atmospheric radiation particles ..... 19

        4.3.3 Spectra at the avionics altitude ..... 22

    4.4 Particle considerations ..... 25

        4.4.1 General ..... 25

        4.4.2 Alpha particles ..... 25

        4.4.3 Protons ..... 26

        4.4.4 Muons and pions ..... 30

        4.4.5 Low-energy neutrons ..... 32

        4.4.6 High-energy neutrons ..... 33

    4.5 Conclusion and guidelines ..... 43

Annex A (informative) CMOS semiconductor devices ..... 45

Annex B (informative) General description of radiation effects ..... 48

    B.1 Radiation effects in semiconductor materials by a charged particle – Charge collection and bipolar action ..... 48

    B.2 Radiation effects by protons ..... 49

    B.3 Radiation effects by low-energy neutrons ..... 51

    B.4 Radiation effects by high-energy neutrons ..... 52

    B.5 Radiation effects by heavy ions ..... 53

Bibliography..... 54

Figure 1 – Cosmic rays as origin of single event effects ..... 13

Figure 2 – Initial stage of secondary particle production..... 14

Figure 3 – Differential high-energy neutron spectrum at sea level in NYC ..... 14

Figure 4 – Long-term cyclic variation in neutron flux measured at Moscow Neutron Monitor Center..... 15

Figure 5 – Differential proton spectra originating from solar-minimum sun, from big flares on the sun, and from the galactic core..... 15

Figure 6 – Typical hierarchy of fault conditions: Fault-error-failure ..... 18

Figure 7 – Sources of atmospheric ionizing radiation: Nuclear reactions and radioactive decay..... 19

Figure 8 – Differential flux of secondary cosmic rays at avionics altitude (10 000 m) above NYC sea level ..... 22

Figure 9 – Differential flux of terrestrial radiation at NYC sea level..... 23

Figure 10 – Measured differential flux of high-energy neutrons at NYC sea level and at avionics altitudes (5 000 m, 11 000 m and 20 000 m).....	24
Figure 11 – Cumulative flux of terrestrial radiation at avionics altitude above NYC sea level.....	25
Figure 12 – Comparison of measured cross section of memory devices irradiated by high-energy protons and neutrons.....	27
Figure 13 – Simplified scheme of muon/pion irradiation system .....	30
Figure 14 – Nuclear capture cross section of cadmium isotopes .....	32
Figure 15 – Neutron energy spectra of monoenergetic neutron beam facilities .....	35
Figure 16 – Neutron energy spectra from radioisotope neutron sources .....	35
Figure 17 – Simplified high-energy neutron beam source in a quasi-monoenergetic neutron source.....	37
Figure 18 – Neutron energy spectra of quasi-monoenergetic neutron beam facilities .....	38
Figure 19 – Conceptual illustration of cross section data obtained by (quasi-) monoenergetic neutron sources and fitting curve by Weibull fit .....	39
Figure 20 – Simplified high-energy neutron beam source in a spallation neutron source .....	41
Figure 21 – Neutron energy spectra of spallation neutron sources and terrestrial field .....	42
Figure A.1 – Basic substrate structure used for CMOSFET devices with the stripe structure of p- and n-wells and cross sections of triple and dual wells.....	45
Figure A.2 – SRAM function and layout.....	46
Figure A.3 – Example of logic circuit.....	46
Figure A.4 – Example of electronic system implementation.....	47
Figure A.5 – Example of stack layers in an electronic system .....	47
Figure B.1 – Charge collection in a semiconductor structure by funnelling .....	48
Figure B.2 – Bipolar action model in a triple well n-MOSFET structure.....	49
Figure B.3 – Charge deposition density of various particles in silicon as a function of particle energy.....	50
Figure B.4 – Total nuclear reaction cross section of high-energy proton and neutron in silicon .....	50
Figure B.5 – Microscopic failure mechanism due to spallation reaction of high-energy neutron and proton in a SRAM well.....	51
Figure B.6 – $(n, \alpha)$ reaction cross section of low-energy neutrons with $^{10}\text{B}$ .....	52
Figure B.7 – Calculated energy spectra of Li and He produced by neutron capture reaction with $^{10}\text{B}(n, \alpha)$ reaction .....	52
Figure B.8 – Kanges of typical isotopes produced by nuclear spallation reaction of high-energy neutron in silicon .....	53
Figure B.9 – Calculated energy spectra of elements produced by nuclear spallation reaction of high-energy neutrons in silicon at Tokyo sea level.....	53
Table 1 – General modes of faults .....	17
Table 2 – Properties of atmospheric radiation particles .....	19
Table 3 – Selected data sources for spectra of atmospheric radiation particles .....	22
Table 4 – Non-exhaustive list of methods for alpha-particle SEE measurements.....	26
Table 5 – Non-exhaustive list of facilities for proton irradiation.....	27
Table 6 – Non-exhaustive list of facilities for muon irradiation.....	31
Table 7 – Non-exhaustive list of facilities for thermal/epi-thermal neutron irradiation.....	33

Table 8 – Non-exhaustive list of facilities for low-energy neutron irradiation.....	36
Table 9 – Non-exhaustive list of facilities for quasi-monoenergetic neutron irradiation .....	40
Table 10 – Non-exhaustive list of facilities for nuclear spallation neutron irradiation .....	42

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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**

## FOREWORD

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IEC TR 62396-8, which is a Technical Report, has been prepared by IEC technical committee 10. 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*

#### 3 Terms, definitions, abbreviated terms and acronyms

For the purposes of this document, the terms, definitions, abbreviated terms and acronyms given in IEC 62396-1 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>