SLOVENSKI STANDARD
SIST EN 16602-60-15:2015

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Zagotavljanje varnih proizvodov v vesoljski tehniki - Zagotavljanje sevalne odpornosti komponent EEE

Space product assurance - Radiation hardness assurance - EEE components

Raumfahrtproduktsicherung - Sicherung der Strahlungshärte für EEE-Komponenten

Assurance produit des projets spatiaux - Assurance radiation - Composants EEE

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49.140	Vesoljski sistemi in operacije	Space systems and operations

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EUROPEAN STANDARD

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English version

Space product assurance - Radiation hardness assurance - EEE components

Assurance produit des projets spatiaux - Assurance radiation - Composants EEE

Raumfahrtproduktsicherung - Sicherung der Strahlungshärte für EEE-Komponenten

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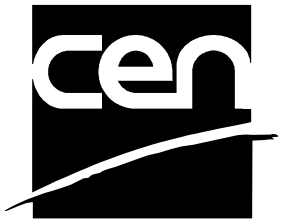

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Foreword

This document (EN 16602-60-15:2014) has been prepared by Technical Committee CEN/CLC/TC 5 “Space”, the secretariat of which is held by DIN.

This standard (EN 16602-60-15:2014) originates from ECSS-Q-ST-60-15C.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by March 2015, and conflicting national standards shall be withdrawn at the latest by March 2015.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association.

This document has been developed to cover specifically space systems and has therefore precedence over any EN covering the same scope but with a wider domain of applicability (e.g. aerospace).

According to the CEN-CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

1
Scope

This standard specifies the requirements for ensuring radiation hardness assurance (RHA) of space projects. These requirements form the basis for a RHA program that is required for all space projects in conformance to ECSS-Q-ST-60. RHA program is project specific. This standard addresses the three main radiation effects on electronic components: Total Ionizing Dose (TID), Displacement Damage or Total Non-Ionizing Dose (TNID), and Single event Effects (SEE).

Spacecraft charging effects are out of the scope of this standard.

In this standard the word "component" refers to Electrical, Electronic, and Electromechanical (EEE) components only. Other fundamental constituents of space hardware units and sub-systems such as solar cells, optical materials, adhesives, polymers, and any other material are not covered by this standard.

This standard may be tailored for the specific characteristic and constrains of a space project in conformance with ECSS-S-ST-00.

2
Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this ECSS Standard. For dated references, subsequent amendments to, or revision of any of these publications do not apply. However, parties to agreements based on this ECSS Standard are encouraged to investigate the possibility of applying the more recent editions of the normative documents indicated below. For undated references, the latest edition of the publication referred to applies.

EN reference	Reference in text	Title
EN 16601-00-01	ECSS-S-ST-00-01	ECSS system - Glossary of terms
EN 16602-10-09	ECSS-Q-ST-10-09	Space product assurance - Nonconformance control system
EN 16602-30	ECSS-Q-ST-30	Space product assurance - Dependability
EN 16602-30-11	ECSS-Q-ST-30-11	Space product assurance - Derating - EEE components
EN 16602-60	ECSS-Q-ST-60	Space product assurance - Electrical, electronic, and electromechanical (EEE) components
EN 16603-10-04	ECSS-E-ST-10-04	Space engineering - Space environment
EN 16603-10-12	ECSS-E-ST-10-12	Space engineering - Methods for the calculation of radiation received and its erects, and a policy for design margins
	ESCC 22900	ESCC Basic Specification: Total dose steady state irradiation test method
	ESCC 25100	ESCC Basic Specification: Single Event Effect Test Method and Guidelines
	MIL-STD-750E method 1080 (20 Nov. 2006)	Test methods for semiconductor devices - Single event burnout and single event gate rupture test
	MIL-STD-750E method 1019 (20 Nov. 2006)	Test methods for semiconductor devices - Steady-state total dose irradiation procedure
	MIL-STD-883G method 1019	Microcircuits - Ionizing radiation (total dose) test procedure

	(28 Feb. 2006)	
	MIL-HDBK-814 (8 Feb. 1994)	Military Handbook: Ionizing dose and neutron hardness Assurance guidelines for microcircuits and semiconductor devices

3 Terms, definitions and abbreviated terms

3.1 Terms from other standards

For the purpose of this Standard, the terms and definitions from ECSS-S-ST-00-01 apply, in particular for the following terms:

applicable document

approval

assurance

derating

EEE component

environment

equipment

failure

information

outage

recommendation

required function

requirement

review

risk

specification

standard

subsystem

system

test

traceability

validation

verification

For the purpose of this Standard, the terms and definitions from ECSS-Q-ST-60 apply, in particular for the following terms:

characterization

commercial component

screening

space qualified parts

For the purpose of this Standard, the terms and definitions from ECSS-E-ST-10-04 apply, in particular for the following terms:

dose

equivalent fluence

fluence

flux

linear energy transfer (let)

For the purpose of this Standard, the terms and definitions from ECSS-E-ST-10-12 apply, in particular for the following terms:

cross-section

displacement damage

LET threshold

multiple cell upset (MCU)

(total) non-ionizing dose, (T)NID, or non-ionizing energy loss (NIEL) dose

NIEL

projected range

radiation design margin (RDM)

sensitive volume (SV)

single event burnout (SEB)

single event dielectric rupture (SEDR)

single event effect (SEE)

single event functional interrupt (SEFI)

single event gate rupture (SEGR)

single event latch-up (SEL)

single event transient (SET)

single event upset (SEU)

solar energetic particle event (SEPE)

total ionizing dose (TID)

3.2 Terms specific to the present standard

3.2.1 component type TIDS

TID level at which the part exceeds its parametric/functional requirements

3.2.2 component type TNIDS

TNID level at which the part exceeds its parametric/functional requirements

3.2.3 enhanced low dose rate sensitivity (ELDRS)

increased electrical parameter degradation of a part when it is irradiated with a lower dose rate

3.2.4 equivalent LET

averaged value of the LET curve inside a sensitive volume

3.2.5 one sided tolerance limit

limit that will not be exceeded with a probability P and a confidence level C, assuming that TID degradation of electrical parameters follow a normal distribution law

NOTE If <delta x> is the mean shift among tested population of n samples, σ is the standard deviation of the shift, and K is the one sided tolerance limit factor, then:

- Delta XL = <delta x > + K σ, for increasing total dose shift
- Delta XL = <delta x > - K σ, for decreasing total dose shift
- K depends on the number of tested samples n, the probability of success P and the confidence limit C. K values are available in MIL-HDBK-814. A 3 sigma (K=3) approach is often used. With 10 samples tested it gives a probability of success P of 90% with a confidence level C of 99%. Table 3-1 gives the values of K as a function of the number of tested samples n for P=0,9 and C=0,9