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English version

Space product assurance - Techniques for radiation effects mitigation in ASICs and FPGAs handbook

Ingénierie spatiale - Guide sur les techniques de durcissement des ASICs et FPGAs vis-à-vis des effets des radiations

Raumfahrtproduktsicherung - Handbuch zu Minderungsmethoden von Strahlungseffekten auf ASICs und FPGAs

This Technical Report was approved by CEN on 22 November 2021. It has been drawn up by the Technical Committee CEN/CLC/JTC 5.

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Table of contents

European Foreword	14
1 Scope	15
2 References	16
3 Terms, definitions and abbreviated terms	17
3.1 Terms from other documents	17
3.2 Terms specific to the present document	17
3.3 Abbreviated terms	19
4 Radiation environment and integrated circuits	25
4.1 Overview	25
4.2 Radiation environment in space	25
4.3 Radiation Effects in ICs	26
4.3.1 Overview	26
4.3.2 Cumulative effects	26
4.3.3 Single Event Effects (SEEs)	27
4.3.3.1 Overview	27
4.3.3.2 Non-destructive SEE	28
4.3.3.3 Destructive SEE	29
4.3.3.4 Summary	30
5 Choosing a device hardening strategy	31
5.1 The optimal strategy	31
5.2 How to use this handbook	32
6 Technology selection and process level mitigation	35
6.1 Overview	35
6.2 Mitigation techniques	36
6.2.1 Epitaxial layers	36
6.2.2 Silicon On Insulator	37
6.2.3 Triple wells	40
6.2.4 Buried layers	42
6.2.5 Dry thermal oxidation	43
6.2.6 Implantation into oxides	45

6.3	Technology scaling and radiation effects	46
7	Layout.....	49
7.1	Overview	49
7.2	Mitigation techniques	50
7.2.1	Ringed or Enclosed Layout Transistor.....	50
7.2.2	Contacts and guard rings	52
7.2.3	Dummy transistors	55
7.2.4	Transistors Gate W/L ratio sizing	57
8	Analogue circuits	58
8.1	Overview	58
8.2	Mitigation techniques	59
8.2.1	Node Separation and Inter-digitation.....	59
8.2.2	Analogue redundancy (averaging)	63
8.2.3	Resistive decoupling	64
8.2.4	Filtering	67
8.2.5	Modifications in bandwidth, gain, operating speed, and current drive	68
8.2.6	Reduction of window of vulnerability	71
8.2.7	Reduction of high impedance nodes	75
8.2.8	Differential design	77
8.2.9	Dual path hardening.....	80
9	Embedded memories	85
9.1	Overview	85
9.2	Mitigation techniques	86
9.2.1	Hardening of individual memory cells.....	86
9.2.1.1	Overview.....	86
9.2.1.2	Resistive hardening.....	86
9.2.1.3	Capacitive hardening.....	87
9.2.1.4	IBM hardened memory cell	89
9.2.1.5	HIT hardened memory cell	91
9.2.1.6	DICE hardened memory cell	92
9.2.1.7	NASA-Whitaker hardened memory cell	94
9.2.1.8	NASA-Liu hardened memory cell	95
9.2.2	Bit-interleaving in memory arrays	97
9.2.3	Data scrubbing	99
9.3	Comparison between hardened memory cells	100
10	Radiation-hardened ASIC libraries	101
10.1	Introduction.....	101
10.2	IMEC Design Against Radiation Effects (DARE) library	102

10.3	CERN 0,25 μm radiation hardened library	103
10.4	BAE 0,15 μm radiation hardened library	103
10.5	Ramon Chips 0,18 μm and 0,13 μm radiation hardened libraries.....	103
10.6	Cobham (former Aeroflex) 600, 250, 130 and 90 nm radiation hardened libraries.....	104
10.7	Microchip Atmel MH1RT 0,35 μm and ATC18RHA 0,18 μm CMOS and ATMX150RHA 0,15 μm SOI CMOS radiation hardened libraries	104
10.8	ATK 0,35 μm radiation hardened cell library	105
10.9	ST Microelectronics C65SPACE 65 nm radiation hardened library	105
10.10	RedCat Devices radiation hardened libraries	105
11	Digital circuits.....	106
11.1	Overview	106
11.2	Mitigation techniques	107
11.2.1	Spatial redundancy	107
11.2.1.1	Description of the concept.....	107
11.2.1.2	Duplex architectures.....	108
11.2.1.3	Triple Modular Redundancy architectures	109
11.2.1.3.1	General.....	109
11.2.1.3.2	Basic TMR	109
11.2.1.3.3	Full TMR.....	110
11.2.2	Temporal redundancy	113
11.2.2.1	Description of the concept.....	113
11.2.2.1.1	Overview.....	113
11.2.2.1.2	Triple Temporal Redundancy combined with spatial redundancy.....	114
11.2.2.1.3	Minimal level sensitive latch	115
11.2.3	Fail-safe, deadlock-free finite state machines.....	117
11.2.4	Selective use of logic cells, clock and reset lines hardening.....	121
12	System on a chip	123
12.1	Overview	123
12.2	Mitigation techniques	124
12.2.1	Error Correcting Codes	124
12.2.1.1	Introduction to multiple options	124
12.2.1.1.1	General.....	124
12.2.1.1.3	Cyclic Redundancy Check.....	126
12.2.1.1.4	BCH codes	127
12.2.1.1.5	Hamming codes.....	127
12.2.1.1.6	SEC-DED codes.....	128
12.2.1.1.7	Reed-Solomon codes	128
12.2.1.1.8	Arithmetic codes	128
12.2.1.1.9	Low Density Parity Codes.....	129
12.2.2	Mitigation for Memory Blocks	130
12.2.3	Filtering SET pulses in data paths.....	131
12.2.4	Watchdog timers	133
12.2.5	TMR in mixed-signal circuits	135
13	Field programmable gate arrays	138

13.1 Overview	138
13.2 Mitigation techniques	140
13.2.1 Local Triple Modular Redundancy	140
13.2.2 Global Triple Modular Redundancy	142
13.2.3 Large grain Triple Modular Redundancy	144
13.2.4 Embedded user memory Triple Modular Redundancy	146
13.2.5 Additional voters in TMR data-paths to minimise DCE	148
13.2.6 Reliability-oriented place and Route Algorithm (RoRA)	151
13.2.7 Embedded processor protection	153
13.2.8 Partial reconfiguration or Scrubbing of configuration memory	155
13.2.8.1 Description of the concept	155
13.2.8.1.1 Overview	155
13.2.8.1.2 Full scrubbing	156
13.2.8.1.3 Partial scrubbing	156
13.2.8.1.4 Partial reconfiguration	157
14 Software-implemented hardware fault tolerance	160
14.1 Overview	160
14.2 Mitigation techniques	161
14.2.1 Redundancy at instruction level	161
14.2.2 Redundancy at task level	167
14.2.3 Redundancy at application level: using a hypervisor	171
15 System architecture	174
15.1 Overview	174
15.2 Mitigation techniques	175
15.2.1 Shielding	175
15.2.2 Watchdog timers	179
15.2.3 Power cycling and reset	180
15.2.4 Latching current limiters	180
15.2.5 Spatial Redundancy	181
15.2.5.1 Overview	181
15.2.5.2 Duplex architectures	181
15.2.5.2.1 Description of the concept	181
15.2.5.2.2 Lockstep	182
15.2.5.2.3 Double duplex	183
15.2.5.2.4 Double Duplex Tolerant to Transients	183
15.2.5.3 Triple Modular Redundant system	185
15.2.6 Error Correcting Codes	187
15.2.7 Off-chip SET filters	187
16 Validation methods	188
16.1 Introduction	188
16.2 Fault injection	188

16.2.1	Fault injection at transistor level	188
16.2.1.1	Overview.....	188
16.2.1.2	Physical level 2D/3D device simulation.....	189
16.2.1.3	Transient fault injection simulations at electrical level	190
16.2.2	Fault injection at gate level.....	190
16.2.3	Fault injection at device level	191
16.2.3.1	Overview.....	191
16.2.3.2	Fault injection in processors.....	191
16.2.3.3	Fault injection in FPGAs.....	193
16.2.3.4	Analytical methods for predicting effects of soft errors on SRAM-based FPGAs	195
16.2.4	Fault injection at system level	195
16.3	Real-life radiation tests	196
16.3.1	Overview.....	196
16.3.2	Tests on-board scientific satellites.....	196
16.3.3	On-board stratospheric balloons	196
16.3.4	Ground level tests	196
16.4	Ground accelerated radiation tests	197
16.4.1	Overview.....	197
16.4.2	Standards and specifications	197
16.4.3	SEE test methodology.....	198
16.4.4	TID test methodology	200
16.4.5	TID and SEE test facilities.....	202
16.4.5.1	Overview.....	202
16.4.5.2	Total ionizing dose	203
16.4.5.3	Single event effects	204
16.4.6	Complementary SEE test strategies.....	207
16.4.6.1	Overview.....	207
16.4.6.2	Laser beams SEE tests.....	207
16.4.6.3	Ion-Microbeam SEE tests.....	209
16.4.6.4	Californium-252 and Americium-241 SEE tests.....	210
Annex A (informative) Vendor/institute-ready solutions that include mitigation or help to mitigate		211
Bibliography.....		212

Figures

Figure 4-1: Schematic showing how galactic cosmic rays deposit energy in an electronic device, after Lauriente and Vampola [321]	27
Figure 4-2: Two upsets in the same word induced by a single particle (MBU)	29
Figure 4-3: Two upsets in the different words induced by a single particle (MCU)	29
Figure 5-1: Different abstraction levels where mitigation techniques can be applied and naming convention for this Handbook.	33
Figure 6-1: Example of epitaxial layer in CMOS technology	36

Figure 6-2: a) Conventional bulk NMOS transistor, b) Partially depleted SOI, c) Fully depleted SOI	38
Figure 6-3: a) single-well technology, b) twin-well technology, c) triple-well technology implementing a deep n-well to isolate the p-well forming the NMOS from the substrate	41
Figure 6-4: Schematic view of a P-type buried layer in a P-well.....	42
Figure 6-5: Radiation-induced back channel threshold voltage shifts for different SOI substrates types, SOI layer thickness and hardening process conditions [1].....	45
Figure 7-1: Gate oxide and STI oxide in CMOS technology.....	49
Figure 7-2: a) Conventional two edge NMOS, b) Enclosed Layout Transistor NMOS ..	50
Figure 7-3: Two examples of NMOS transistor layout eliminating radiation-induced leakage current between source and drain.....	51
Figure 7-4: Parasitic thyristor responsible for SEL (top), introduction of P+ guard ring around NMOS transistor (bottom).....	53
Figure 7-5: CMOS transistors with guard rings	54
Figure 7-6: RHBD technique using dummy transistors. (a) The circuits, (b) the layouts (layout1 on the left, layout2 on the right), after J. Chen [286].....	56
Figure 8-1: Cross-section of two adjacent NMOS devices in a bulk CMOS technology (From [109])	60
Figure 8-2: (a) Upset sensitivity data for basic DICE topology implemented in 90 nm CMOS at three angles of incidence [114] and (b) measured upset cross-sections as a function of azimuth angle for the Kr ion (LET of approximately 30 MeV*cm ² /mg) in improved DICE implementing nodal spacing [114].....	60
Figure 8-3: Charge collected on an adjacent transistor for a) PMOS and, b) transistors as a function of the distance separating them ([112])	61
Figure 8-4: (a) Comparison of collected charge for the active and passive NMOS devices following laser-induced charge deposition at the active device. (b) Collected charge for passive NMOS devices verifies the charge sharing effect and shows a nodal spacing dependence for the passive device charge collection ([95])	61
Figure 8-5: Analogue averaging through the use of N identical resistors. A perturbation (ΔV) due to a particle strike on any one copy of the circuit is reduced to $\Delta V/N$	63
Figure 8-6: (a) A standard current-based charge pump configuration for phase-locked loop circuits. (b) Single-event hardened voltage-based charge pump configuration	64
Figure 8-7: (a) A standard LC Tank Voltage-Controlled Oscillator (VCO) and (b) Single-event hardened configuration utilizing decoupling resistor R_3 (From [118]).....	65
Figure 8-8: Brokaw bandgap reference circuit with an output low-pass filter for improved noise, isolation, and transient suppression (From[128]).	67
Figure 8-9: Transient PLL error response as a function of PLL bandwidth.....	70
Figure 8-10: Simulated windows of vulnerability over one data conversion cycle in a 2-bit flash ADC (From [130]).....	72

Figure 8-11: The number of errors with respect to cycle time following laser-induced charge deposition in a phase-locked loop (From [131]).	72
Figure 8-12: Simulated windows of vulnerability over one data conversion cycle for unhardened and hardened 2-bit flash ADCs (From [132])	73
Figure 8-13: Simplified view of the auto-zeroed comparator (From [134])	73
Figure 8-14: (a) Simplified schematic of a typical LC Tank VCO and (b) an experimentally observed transient resulting from laser-induced charge injection on transistor M1 (From [135])	75
Figure 8-15: Schematic of RHBD CMOS LC Tank VCO (From [134])	76
Figure 8-16: Two-dimensional slice of three PMOS transistors depicting the electrical signal and the charge-sharing signal caused by an ion strike, i.e. pulse quenching (From [142]).	78
Figure 8-17: Basic differential pair	78
Figure 8-18: Differential pair including devices A and B before and after DCC layout for maximizing charge sharing (From [143])	79
Figure 8-19: Charge collected by a single transistor for single (left) and parallel (right) transistor configuration, is shown in the top row. Differential charge is shown in the bottom row for single (left) and parallel (right) transistor configuration (From [143])	79
Figure 8-20: (a) The switched-capacitor comparator operates in two phases: (b) reset phase and (c) evaluation phase (From [142])	81
Figure 8-21: Simplified circuit schematic of the differential amplifier showing the split input paths (From [142])	81
Figure 8-22: The switched-capacitor comparator with split differential amplifier input paths to harden the floating nodes against single-event upsets (From [142])	82
Figure 8-23: Simulated output error voltage versus deposited charge of a sample and hold amplifier with and without dual path hardening (From [141])	82
Figure 8-24: Simulated deposited charge required to generate a SEU at the output of the comparator for various differential input voltages for the (a) unhardened design, (b) the design with increased capacitors (2x), and (c) the design implementing dual path hardening (From [142])	83
Figure 9-1: Resistor memory cell	86
Figure 9-2: Hardened SRAM cell using a capacitor (SRAM-C cell)	88
Figure 9-3: The SRAM-tct cell	88
Figure 9-4: IBM hardened memory cell (after original picture in [177])	90
Figure 9-5: HIT memory cell	91
Figure 9-6: DICE hardened cell structure	93
Figure 9-7: NASA-Whitaker hardened memory cell	94
Figure 9-8: NASA-Liu hardened memory cell (after original picture in [186])	96
Figure 9-9: Standard memory topology	98
Figure 9-10: Example of memory topology with scrambling	98
Figure 10-1: Hardened 2 input NOR gate	102

Figure 11-1: Block diagram of the spatial redundancy architecture.....	108
Figure 11-2: (a) SET and (b) SEU detection with a duplex architecture	108
Figure 11-3: Fault detection by a duplex architecture	109
Figure 11-4: Hot backup (a) and duplication with backup (b) approaches.....	109
Figure 11-5: SET (a) and SEU (b) detection with a TMR architecture.....	110
Figure 11-6: Fault detection and correction in the full TMR architecture	111
Figure 11-7: SEU-tolerant latch based on DMR (CE1 and CE2) and a Muller-C element (CE3)	112
Figure 11-8: Typical topology for a sequential circuit	114
Figure 11-9: Temporal sampling using delays on clocks and TMR	114
Figure 11-10: Temporal sampling using delays on data.....	115
Figure 11-11: Minimal temporal sampling latch replicating itself in time	115
Figure 11-12: 4 states FSM bubble-diagram showing legal and illegal states, and states transitions.....	119
Figure 12-1: Example of a CRC computation on a binary message “1101011011”	127
Figure 12-2: An arithmetic function using an arithmetic code as error detection mechanism.....	129
Figure 12-3: Logical masking of a transient in two logical gates	131
Figure 12-4: Electrical masking along a path in combinatorial logic	132
Figure 12-5: Temporal masking	132
Figure 12-6: SET Filter proposed by Actel Corporation for their Flash-based FPGAs, as per S. Rezgui et al. in [329]	132
Figure 12-7: Watchdog Timer	134
Figure 12-8: Functional block diagram of the IS139ASRH SEE-hardened voltage comparator.....	135
Figure 12-9: Signal-to-noise (SNR) ratio improvement when increasing use of Comparator TMR in a 10-bit pipelined ADC	136
Figure 13-1: High-level description of an FPGA structure	138
Figure 13-2: Schematic representation of the two layers composing an FPGA.....	139
Figure 13-3: Local TMR – single combinatorial logic but triplicated registers	140
Figure 13-4: RTAX-S/SL/DSP R-cell Implementation of D Flip-Flop Using Voter Gate Logic	141
Figure 13-5: Global TMR implemented in an FPGA.....	143
Figure 13-6: Physical implementation of global TMR inside an FPGA	143
Figure 13-7: Large grain TMR	145
Figure 13-8: Physical implementation of a large grain TMR inside an FPGA	145
Figure 13-9: BRAM TMR	147
Figure 13-10: Routing defect within the same module	149
Figure 13-11: Domain Crossing Event as a consequence of routing defect affecting two different modules	149

Figure 13-12: Inserting voters reduces the risk of domain crossing events	150
Figure 13-13: RoRA's design flow	152
Figure 13-14: Hybrid architecture using a fault detection-oriented I-IP	154
Figure 13-15: Organization of the configuration memory for the Xilinx Virtex family ...	156
Figure 13-16: Simple configuration and SEU correction design	156
Figure 14-1: Temporal redundancy at instruction level	162
Figure 14-2: Optimized architecture for temporal redundancy applied at instruction level	164
Figure 14-3: Example of code.....	164
Figure 14-4: Example of code with instruction level redundancy.....	165
Figure 14-5: Task-level redundancy	168
Figure 14-6: Architecture for temporal redundancy applied at task level.....	168
Figure 14-7: DMT architecture.....	169
Figure 14-8: Scheduling and fault detection in DMT architecture.....	170
Figure 14-9: Time redundancy at application level.....	172
Figure 15-1: TID for the L1 orbit with indication of the typical shielding range and the failure regions of commercial and semi-hard components (after [315])....	176
Figure 15-2: Typical annual mission doses (spherical Al shield) for various orbits, from ECSS-E-10-04A	176
Figure 15-3: Example of a dose depth curve (C. Poivey, NSREC 2002 short course).....	177
Figure 15-4: Figure Contributions of protons, electrons, and bremsstrahlung to total dose as a function of aluminum shielding. The data were taken after a 139-day exposure during the Explorer 55 space mission. (After [313]).....	178
Figure 15-5: Block diagram of a LCL	180
Figure 15-6: Block diagram of a duplex architecture	182
Figure 15-7: Lockstep architecture	182
Figure 15-8: UCTM-C/D architecture	183
Figure 15-9: DT2 hardware architecture	184
Figure 15-10: Triple Modular Redundancy.....	185
Figure 15-11: Full Triple Modular Redundancy	186
Figure 16-1: Flow chart for fault injections in FPGAs	194
Figure 16-2: Flow chart of a typical static test.....	199
Figure 16-3: Flow chart for a typical dynamic test.....	200
Figure 16-4: Example of TID proposed test flow of test vehicle	202
Figure 16-5: Neutron fluxes in NY City and at LANL	205
Figure 16-6: Californium-252 fragments energy spectrum (left) and LET spectrum (right)	210

Tables

Table 4-1: Summary of single event effects (SEE) as a function of component technology and family.....	30
Table 6-1: Summary of mitigation techniques at manufacturing process level and the radiation effects they address.....	35
Table 6-2: Summary of key characteristics for epitaxial layers.....	37
Table 6-3: Summary of key characteristics for silicon on insulator.....	40
Table 6-4: Summary of key characteristics for triple wells	42
Table 6-5: Summary of key characteristics for buried layers.....	43
Table 6-6: Impact of thermal oxidation process parameters on TID hardness	44
Table 6-7: Summary of key characteristics for dry thermal oxidation	45
Table 6-8: Summary of key characteristics for implantation into oxides	46
Table 7-1: Summary of mitigation techniques at physical layout level and the radiation effects they address	50
Table 7-2: Summary of key characteristics for enclosed layout transistor	52
Table 7-3: Summary of key characteristics for contacts and guard rings	55
Table 7-4: Summary of key characteristics for dummy transistors	57
Table 7-5: Summary of key characteristics for large W/L ration transistors.....	57
Table 8-1: Summary of mitigation techniques at analogue design circuit architecture level and the radiation effects they address.....	59
Table 8-2: Summary of key characteristics for node separation and inter-digitation.....	62
Table 8-3: Summary of key characteristics for analogue redundancy	64
Table 8-4: Summary of key characteristics for resistive decoupling	66
Table 8-5: Summary of key characteristics for filtering	68
Table 8-6: Summary of key characteristics for modifications in bandwidth, gain, operating speed and current drive	71
Table 8-7: Summary of key characteristics for reduction of window of vulnerability	75
Table 8-8: Summary of known issue for reduction of high impedance nodes.....	77
Table 8-9: Summary of key characteristics for differential design	80
Table 8-10: Summary of key characteristics for dual path hardening.....	84
Table 9-1: Summary of mitigation techniques for embedded memories and the radiation effects they address.....	85
Table 9-2: Summary of key characteristics for resistive hardening	87
Table 9-3: Summary of key characteristics for capacitive hardening.....	89
Table 9-4: Summary of key characteristics for IBM hardened memory cell.....	91
Table 9-5: Summary of key characteristics for HIT hardened memory cell	92
Table 9-6: Summary of key characteristics for DICE hardened memory cell.....	94
Table 9-7: Summary of key characteristics for NASA-Whitaker hardened memory cell	95
Table 9-8: Summary of key characteristics for NASA-Liu hardened memory cell.....	97
Table 9-9: Summary of key characteristics for bit-interleaving in memory arrays.....	99

Table 9-10: Comparison between state-of-the-art SEU hardened memory cells	100
Table 11-1: Summary of mitigation techniques at digital design circuit architecture level and the radiation effects they address	107
Table 11-2: Summary of key characteristics for spatial redundancy	113
Table 11-3: Summary of key characteristics for temporal redundancy	116
Table 11-4: Summary of key characteristics for fail-safe, deadlock-free finite state machines	120
Table 11-5: Summary of key characteristics for selective use of logic cells	121
Table 12-1: Summary of mitigation techniques at System-on-Chip level and the radiation effects they address	123
Table 12-2: Error detection and correction capability for some ECC	125
Table 12-3: Examples of parity check applied to a 7-bit word	126
Table 12-4: Example of commonly used CRCs	126
Table 12-5: Summary of key characteristics for error correcting codes	130
Table 12-6: Summary of key characteristics for filtering SET pulses in data paths	133
Table 12-7: Summary of key characteristics for watchdog timers	135
Table 12-8: Summary of key characteristics for TMR in mixed-signal circuits	137
Table 13-1: FPGAs characteristics and representative manufacturers	139
Table 13-2: Summary of mitigation techniques for FPGAs and the radiation effects they address	139
Table 13-3: Summary of key characteristics for local Triple Modular Redundancy	142
Table 13-4: Summary of key characteristics for global Triple Modular Redundancy ..	144
Table 13-5: Summary of key characteristics for large grain Triple Modular Redundancy	146
Table 13-6: Summary of key characteristics for embedded user memory Triple Modular Redundancy	148
Table 13-7: Summary of key characteristics for additional voters in TMR data-paths to minimise DCE	151
Table 13-8: Summary of key characteristics for reliability-oriented place and route algorithm	153
Table 13-9: Summary of key characteristics for embedded processor protection	155
Table 13-10: Summary of key characteristics for scrubbing of configuration memory	159
Table 14-1: Summary of effects versus mitigation techniques	161
Table 14-2: Summary of key characteristics for redundancy at instruction level	166
Table 14-3: Summary of key characteristics for redundancy at task level	171
Table 14-4: summary of key characteristics for redundancy at application level	173
Table 15-1: Summary of mitigation techniques at electronic system level and the radiation effects they address	175
Table 15-2: Summary of key characteristics for shielding	179
Table 15-3: Summary of key characteristics for latching current limiters	181

Table 15-4: Summary of key characteristics for double duplex architecture.....	185
Table 15-5: Summary of key characteristics for Triple Modular Redundant system ...	187
Table 16-1: The different radiation test methods and guidelines.....	197
Table 16-2: Main features of the radiation sources available for TID testing	203
Table 16-3: Non-exhaustive list of worldwide Gamma ray facilities.....	204
Table 16-4: Non-exhaustive list of worldwide heavy-ion facilities.....	204
Table 16-5: Non-exhaustive list of worldwide proton facilities	205
Table 16-6: Non-exhaustive list of worldwide laser test facilities.....	209
Table 16-7: Summary of the characteristics of laser and microbeams	209

European Foreword

This document (CEN/TR 17602-60-02:2021) has been prepared by Technical Committee CEN/CLC/JTC 5 "Space", the secretariat of which is held by DIN.

It is highlighted that this technical report does not contain any requirement but only collection of data or descriptions and guidelines about how to organize and perform the work in support of EN 16602-60.

This Technical report (CEN/TR 17602-60-02:2021) originates from ECSS-Q-HB-60-02A.

Attention is drawn to the possibility that some the elements of of this dmocuent 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 TR covering the same scope but with a wider domain of applicability (e.g.: aerospace).

1

Scope

This ECSS-Q-HB-60-02 handbook provides a compilation of different techniques that can be used to mitigate the adverse effects of radiation in integrated circuits (ICs), with almost exclusive attention to Application Specific Integrated Circuits (ASICs) and Field Programmable Gate Arrays (FPGAs) to be used in space, and excluding other ICs like power devices, MMIC or sensors.

The target users of this handbook are developers and users of ICs which are meant to be used in a radiation environment. Following a bottom-up order, the techniques are presented according to the different stages of an IC development flow where they can be applied. Therefore, users of this handbook can be IC engineers involved in the selection, use or development of IC manufacturing processes, IC layouts and ASIC standard cell libraries, analogue and digital circuit designs, FPGAs, embedded memories, embedded software and the immediate electronic system (printed circuit board) containing the IC that can experience the radiation effects.

In addition, this handbook contains an overview of the space radiation environment and its effects in semiconductor devices, a section on how to validate the good implementation and effectiveness of the mitigation techniques, and a special section providing some general guidelines to help with the selection of the most adequate mitigation techniques including some examples of typical space project scenarios.

The information given in this ECSS Handbook is provided only as guidelines and for reference, and not to be used as requirements. ECSS Standards provide requirements that can be made applicable, while, ECSS Handbooks provide guidelines.

References

EN Reference	Reference in text	Title
EN 16601-00-01	ECSS-S-ST-00-01	ECSS system - Glossary of terms
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 effects, and a policy for design margins
TR 17603-10-12	ECSS-E-HB-10-12	Space engineering - Calculation of radiation and its effects and margin policy handbook
EN 16602-60	ECSS-Q-ST-60	Space product assurance - Electrical, electronic and electromechanical (EEE) components
EN 16602-60-02	ECSS-Q-ST-60-02	Space product assurance - ASIC and FPGA development
EN 16602-60-15	ECSS-Q-ST-60-15	Space product assurance - Radiation hardness assurance - EEE components
	ESCC 22900	ESCC Basic Specification: Total dose steady-state irradiation test method
	ESCC 25100	ESCC Basic Specification: Single event effects test method and guidelines
	JEDEC JESD57	Test Procedures for the Management of Single-Event Effects in Semiconductor Devices from Heavy Ion Irradiation
	JEDEC JESD89A	Measuring and Reporting of Alpha Particle and Terrestrial Cosmic Ray-Induced Soft Errors in Semiconductor Devices
	MIL-STD-883/ 1019	Test Method Standard Microcircuits / Ionizing radiation (total dose) test procedure