Military Performance Specifications

19500 – General Specification for Semiconductor Devices

38534 – Performance Specifications for Hybrid Microcircuits

38535 – General Specification for Intregrated Circuits (Microcircuits) Manufacturing

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Military Handbooks

The following **Military Handbooks** can be obtained from the Department of Defense (DoD) Single Stock Point for Specifications and Standards, 700 Robbins Avenue, Building 4, Section D, Philadelphia, PA 19111-5094. Or call 215-697-2667 or fax at 215-697-1462. The web address is http://www.dodssp.daps.mil.

339 – Custom Large Scale Integrated Circuits Development and Acquisition for Space Vehicles

814 – Ionizing Dose and Neutron Hardness Assurance Guidelines for Microcircuits and Semiconductor Devices

815 – Dose Rate Hardness Assurance Guidelines

816– Guidelines for Developing Radiation Hardness Assured Devices Specifications

817 – System Development Radiation Hardness Assurance

1547 – Electronic Parts, Materials, and Processes for Space and Launch Vehicles

1766 – Nuclear Hardness & Survivability Program Guidelines for ICBM Weapon Systems & Space Systems (being drafted)

Service Documents

The following **Service Documents** may be obtained from the DoD Single Stock Point for Specifications and Standards, 700 Robbins Avenue, Building 4, Section D, Philadelphia, PA 19111-5094. Or call 215-697-2667 or fax at 215-697-1462. The web address is http://www.dodssp.daps.mil.

DNA-H-93-140 – Military Handbook for Hardness Assurance, Maintenance and Surveillance (HAMS)

DNA-H-95-61 – Transient Radiation Effects on Electronics Handbook

Military Test Methods

The following **MIL-STD-750** standards provide testing information for the irradiation of parts. These standards may be obtained from the DoD Single Stock Point for Specifications and Standards, 700 Robbins Avenue, Building 4, Section D, Philadelphia, PA 19111-5094. Or call 215-697-2667 or fax at 215-697-1462. The web address is http://www.dodssp.daps.mil. They can also be viewed and downloaded at DSCC's web site at http://www.dla.mil/programs/milspec/default.asp.

MIL-STD-750, Method 1017 – Neutron Irradiation

MIL-STD-750, Method 1019 – Ionizing Radiation (Total Dose) Test Procedure

MIL-STD-750, Method 1032 – Package-Induced Soft Error Test Procedure (Due to Alpha Particles)

MIL-STD-750, Method 1080 – Single Event Burnout and Single Event Gate Rupture

MIL-STD-750, Method 3478 – Power MOSFET Electrical Dose Rate Test Method

MIL-STD-750, Method 5001 – Wafer Lot Acceptance Testing

The following **MIL-STD-883** standards provide testing information for the irradiation of parts. These standards may be found in their entirety on the DSCC web site. Or contact the DoD Single Stock Point for Specifications and Standards, 700 Robbins Avenue, Building 4, Section D, Philadelphia, PA 19111-5094 (215-697-2667, fax 215-697-1462, www.dodssp.daps.mil).

MIL-STD-883E, Method 1017 – Neutron Irradiation

Purpose: The neutron irradiation test is performed to determine the susceptibility of semiconductor devices to degradation in the neutron environment. the tests described herein are applicable to integrated circuits, transistors, and diodes. this is a destructive test. Objectives of the test are: (1) to detect and measure the degradation of critical semiconductor device parameters as a function of neutron fluence, and (2) to determine if specified semiconductor device parameters are within specified limits after exposure to a specified level of neutron fluence.
www.dscc.dla.mil/V/Va/docs/MIL-STD-883/std883_1000.pdf

MIL-STD-883E Notice 1, Method 1019 – Ionizing Radiation (Total Dose) Test Procedure

Purpose: This test procedure defines the requirements for testing packaged semiconductor integrated circuits for ionizing radiation (total dose) effects from a cobalt-60 (^{60}Co) gamma ray source. In addition this procedure provides an accelerated annealing test for estimating low dose rate ionizing radiation effects on devices. this annealing test is important for low dose-rate or certain other applications in which devices may exhibit significant time-dependent effects. This procedure addresses only steady state irradiations, and is not applicable to pulse type irradiations. This test may produce severe degradation of the electrical properties of irradiated devices and thus should be considered a destructive test.
www.dscc.dla.mil/V/Va/docs/MIL-STD-883/std883_not1.pdf

MIL-STD-883E Notice 1, Method 1020 – Dose Rate Induced Latchup Test Procedure

Purpose: This test procedure defines the detailed requirements for performing latchup testing of microcircuits to identify susceptibility to dose rate induced latchup.
www.dscc.dla.mil/V/Va/docs/MIL-STD-883/std883_1000.pdf

MIL-STD-883E Notice 1, Method 1021 – Dose Rate Upset Testing of Digital Microcircuits

Purpose: This test procedure defines the requirements for testing the response of packaged digital integrated circuits to pulsed ionizing radiation. A flash x-ray or linear accelerator is used as a source of pulses of ionizing radiation. The response may include transient output signals, changes in the state of internal storage elements, and transient current surges at inputs, outputs, and power supply connections. The dose rate at which logic or change-of-state errors first occur is of particular interest in many applications.
www.dscc.dla.mil/V/Va/docs/MIL-STD-883/std883_1000.pdf

MIL-STD-883E Notice 1, Method 1023 – Dose Rate Response and Threshold for Upset of Linear Microcircuits

Purpose: This test procedure defines the requirements for measuring the dose rate response and upset threshold of packaged devices containing analog functions when exposed to radiation from a flash X-ray source or from a linear accelerator. This procedure addresses the measurement of dose rate response characteristics of a linear circuit, excluding latchup which is addressed in MIL-STD-883 Test Method 1020.
www.dscc.dla.mil/V/Va/docs/MIL-STD-883/std883_1000.pdf

MIL-STD-883E Notice 1, Method 1032 – Package-Induced Soft Error Test Procedure (Due to Alpha Particles)

Purpose: This test method defines the procedure for testing integrated circuits under known test conditions for susceptibility to alpha induced errors. This test was specifically designed to measure the device's ability to withstand alpha particle impact. In addition, the procedure will determine the effectiveness of a "die-coating" shield. This test objective is to determine the rate that failures are induced due to alpha radiation sourced from the device package, die and die-coat material.
www.dscc.dla.mil/V/Va/docs/MIL-STD-883/std883_1000.pdf

MIL-STD-883E Notice 1, Method 5004 – Screening Procedures

MIL-STD-883E Notice 1, Method 5005 – Qualification and Quality Conformance Procedures

MIL-STD-883E Notice 1, Method 5010 – Test Procedures for Complex Monolithic Microcircuits

ASTM Standards

ASTM Standards may be obtained from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959 (610-832-9585).

The following are test and measurement standards. They are under the oversight of ASTM Subcommittee F1.11, Quality and Hardness Assurance (Chairman, William Alfonte, Jr.; 410-326-6044).

F448 – Test Method for Measuring Steady-State Primary Photocurrent

F526 – Test Method for Measuring Dose for Use in Linear Acceleration Pulsed Radiation Effects Tests

F528 – Test Method of Measurement of Common-Emitter D-C Current Gain of Junction Transistors

F615 – Practice for Determining Safe Current Pulse Operating Regions for Metalization on Semiconductor Components

F616 – Test Method for Measuring MOSFET Drain Leakage Current

F617 – Test Method for Measuring MOSFET Linear Threshold Voltage (Metric)

F676 – Test Method for Measuring Unsaturated TTL Sink Current

F744 – Test Method for Measuring Dose Rate Threshold for Upset of Digital Integrated Circuits

F769 – Test Method for Measuring Transistor and Diode Leakage Current

F773 – Practice for Measuring Dose Rate Response of Linear Integrated Circuit

F980 – Guide for the Measurement of Rapid Annealing of Neutron-Induced MOSFET Threshold Voltage Shift into Components Due to Oxide Trapped Holes and Interface States Using the Subthreshold Current-Voltage Characteristics

F996 – Test Method for Separating an Ionizing Radiation-Induced MOSFET Threshold Voltage Shift into Components Due to Oxide Trapped Holes and Interface States Using the Subthreshold Current-Voltage Characteristics

F1190 – Practice for Neutron Irradiation of Unbiased Electronic Components

F1192 – Guide for the Measurement of Single Event Phenomena (SEP) Induced by Heavy Ion Irradiation of Semiconductor Devices

F1262– Guide for Transient Radiation Upset Threshold Testing of Digital Integrated Circuits

F1263 – Test Method for Analysis of Overtest Data in Radiation Testing of Electronic Parts

F1467 – Guide for Use of an X-Ray Tester (= 10keV Photons) in Ionizing Radiation Effects Testing of Semiconductor Devices and Microcircuits

F1892 – Guide for Ionizing Radiation (Total Dose) Effects Testing of Semiconductor Devices

F1893 – Guide for the Measurement of Ionizing Dose-Rate Burnout of Semiconductor Devices

The following are radiation dosimetry standards. They are under the oversight of ASTM Subcommittee E10.07 (Chairman, Dr. Dave Vehar; 505-845-3414).

E265 – Test Method for Measuring Reaction Rates and Fast-Neutron Fluences by Radioactivation of Sulfur-32

E496 – Test Method for Measuring Neutron Fluence Rate and Average Energy from $^{3}H(d,n)^{4}$ He Neutron Generators by Radioactivation Techniques

E665 – Practice for Determining Absorbed Dose Versus Depth in Materials Exposed to the X-Ray Output of Flash X-Ray Machines

E666 – Practice for Calculating Absorbed Dose from Gamma or X Radiation

E668 – Practice for Application of Thermoluminescence Dosimetry Systems for Determining Absorbed Dose in Radiation-Hardness Testing of Electronics

E720 – Guide for Selection of a Set of Neutron-Activation Foils for Determining Neutron Spectra Used in Radiation-Hardness Testing of Electronics

E721 – Method for Determining Neutron Energy Spectra with Neutron-Activation Foils for Radiation Hardness Testing of Electronics

E722 – Practice for Characterizing Neutron Energy Fluence Spectra in Terms of an Equivalent Monoenergetic Neutron Fluence for Radiation-Hardness Testing of Electronics

E763 – Method for Calculation of Absorbed Dose from Neutron Irradiation by Application of Threshold-Foil Measurements

E1026 – Methods for Using the Fricke Dosimeter to Measure Absorbed Dose in Water

E1249 – Practice for Minimizing Dosimetry Errors in Radiation Hardness Testing of Silicon Electronic Devices Using Co-60 Sources

E1250 – Test Method for Application of Ionization Chambers to Assess the Low Energy Gamma Component of Cobalt-60 Irradiators Used in Radiation-Hardness Testing of Silicon Electronic Devices

E1854 – Practice for Assuring Test Consistency in Neutron-Induced Displacement Damage of Electronic Parts

E1855 – Method for Use of 2N2222 Silicon Bipolar Transistors as Neutron Spectrum Sensors and displacement Damage Monitors

E1894 – Guide for Selecting Dosimetry Systems for Application in Pulsed X-Ray Sources

The following are fiber optic test standards. They are under the oversight of ASTM Subcommittee E13.09, Optical Fibers for Molecular Spectroscopy (Chairman, Dr. Tuan Bo-Dinh; 423-574-6249).

E13.09 – Optical Fibers for Molecular Spectroscopy; Chairman, Dr. Tuan Bo-Dinh, 423-574-6249

E1614 – Guide for Procedure for Measuring Ionizing Radiation-induced Attenuation in Silica-Based Optical fibers and Cables for Use in Remote Fiber-Optic Spectroscopy and Broadband Systems

E1654 – Guide for Measuring Ionizing Radiation-Induced Spectral changes in Optical Fibers and Cables for Use in Remote Raman Fiber-Optic Spectroscopy.

Commercial Test Methods and Guides

The following EIA/JEDEC standards also provide testing information for the irradiation of parts. For a copy of these procedures, contact the Global Engineering Documents, 15 Inverness Way East, Englewood, CO 80112-5704, U. S. A. In the U. S. A. and Canada, call 1-800-854-7179. Other locations should call 303-397-7956.

EIA/JESD57 – Test Procedures for the Measurement of Single-Event Effects in Semiconductor Devices from Heavy Ion Irradiation

Purpose: This test method defines the requirements and procedures for Earth-based single-event effects (SEE) testing of integrated circuits.
Goal of SEE Testing: For SEU and SEL, the end product of the test is a plot of the SEE cross-section versus effective LET (linear energy transfer). This plot should extend from the threshold LET (onset of upset or latchup) to the maximum cross-section that can be obtained. This data can be combined with the predicted heavy ion environment of the intended space application in order to predict an expected SEE rate for the DUT. For SEB and SEGR, the end product is to establish safe operation limits.

JEP-133 – Guideline for the Production and Acquisition of Radiation-Hardness Assured Multichip Modules and Hybrid Microcircuits

EIA/TIA-455-64, FOTP-64 – Procedure for Measuring Radiation-Induced Attenuation in Optical Fibers and Optical Cables

IEEE Standard P1156.4 – Standard for Environmental Specifications for Spaceborne Computer Modules

ESA Test Methods and Guides

ESA/SCC Basic Specification No. 22900 – Total Dose Steady-State Irradiation Test Method

ESA/SCC Basic Specification No. 25100 – Single Event Effects Test Method and Guidelines

ESA PSS-01-609 – The Radiation Design Handbook

Most of the information compiled in this section was compiled by Harvey Eisen for the Space Parts Working Group, Hardness Assurance Committee. Please send any comments/corrections to him at heisen9929@aol.com or fax him at 301-493-4096. This information is posted and maintained on the committee's web site at www.spwg-hac.org.