

# TECHNICAL SPECIFICATION

**Process management for avionics – Electronic components for aerospace,  
defence and high performance (ADHP) applications –  
Part 1: General requirements for high reliability integrated circuits and discrete  
semiconductors**



## THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2015 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester. If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

IEC Central Office  
3, rue de Varembe  
CH-1211 Geneva 20  
Switzerland

Tel.: +41 22 919 02 11  
Fax: +41 22 919 03 00  
[info@iec.ch](mailto:info@iec.ch)  
[www.iec.ch](http://www.iec.ch)

### About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

### About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigenda or an amendment might have been published.

#### IEC Catalogue - [webstore.iec.ch/catalogue](http://webstore.iec.ch/catalogue)

The stand-alone application for consulting the entire bibliographical information on IEC International Standards, Technical Specifications, Technical Reports and other documents. Available for PC, Mac OS, Android Tablets and iPad.

#### IEC publications search - [www.iec.ch/searchpub](http://www.iec.ch/searchpub)

The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee,...). It also gives information on projects, replaced and withdrawn publications.

#### IEC Just Published - [webstore.iec.ch/justpublished](http://webstore.iec.ch/justpublished)

Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and also once a month by email.

#### Electropedia - [www.electropedia.org](http://www.electropedia.org)

The world's leading online dictionary of electronic and electrical terms containing more than 30 000 terms and definitions in English and French, with equivalent terms in 15 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

#### IEC Glossary - [std.iec.ch/glossary](http://std.iec.ch/glossary)

More than 60 000 electrotechnical terminology entries in English and French extracted from the Terms and Definitions clause of IEC publications issued since 2002. Some entries have been collected from earlier publications of IEC TC 37, 77, 86 and CISPR.

#### IEC Customer Service Centre - [webstore.iec.ch/csc](http://webstore.iec.ch/csc)

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: [csc@iec.ch](mailto:csc@iec.ch).

# TECHNICAL SPECIFICATION

**Process management for avionics – Electronic components for aerospace,  
defence and high performance (ADHP) applications –  
Part 1: General requirements for high reliability integrated circuits and discrete  
semiconductors**

INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

ICS 03.100.50; 31.020; 49.060

ISBN 978-2-8322-2645-2

**Warning! Make sure that you obtained this publication from an authorized distributor.**

## CONTENTS

FOREWORD.....	6
INTRODUCTION.....	8
1 Scope.....	9
2 Normative references .....	9
3 Terms, definitions and abbreviations .....	10
3.1 Terms and definitions.....	10
3.2 Abbreviations .....	12
4 Technical requirements .....	14
4.1 General.....	14
4.2 Procedures .....	14
4.2.1 General .....	14
4.2.2 Product discontinuance .....	14
4.2.3 ESD protection during manufacture .....	14
4.2.4 Specification control .....	15
4.2.5 Traceability including anti-counterfeit measures .....	15
4.3 Product or process change notification (PCN) .....	15
4.3.1 General .....	15
4.3.2 Notification .....	15
4.3.3 Notification details .....	15
4.3.4 Notifiable changes .....	16
4.4 Shipment controls .....	16
4.4.1 General .....	16
4.4.2 Shipping container and date code marking .....	16
4.4.3 Date code remarking .....	16
4.4.4 Inner container formation.....	16
4.4.5 Date code age on delivery .....	17
4.4.6 ESD marking .....	17
4.4.7 MSL.....	17
4.4.8 Lead-free marking .....	17
4.4.9 Labels .....	17
4.5 Electrical.....	18
4.5.1 General .....	18
4.5.2 Electrical test.....	18
4.5.3 Electrical parameter assessment .....	18
4.5.4 SDRAM memories .....	18
4.5.5 Logic families .....	19
4.5.6 Power MOSFETs .....	19
4.5.7 Silicon rectifier diodes .....	19
4.6 Mechanical .....	19
4.6.1 General .....	19
4.6.2 Device marking.....	19
4.6.3 Small packages .....	19
4.6.4 Moisture sensitivity .....	19
4.6.5 Robustness of hermetic seals .....	19
4.6.6 Termination finishes .....	20
4.7 Audit capability .....	20

4.7.1	General .....	20
4.7.2	Internal quality audits .....	20
4.7.3	Subcontract manufacturing .....	20
4.8	Quality assurance .....	21
4.8.1	General .....	21
4.8.2	Quality system .....	21
4.8.3	Sampling plans .....	21
4.8.4	Failure analysis support .....	21
4.8.5	Outgoing quality .....	21
4.9	Supplier performance monitoring by the user .....	22
4.9.1	General .....	22
4.9.2	Lot acceptance .....	22
4.9.3	Suspension of deliveries .....	23
4.9.4	Loss of approval .....	23
4.9.5	AQL figures .....	23
4.9.6	100 % screening .....	23
4.9.7	Termination determination .....	23
4.10	Qualification .....	23
4.10.1	General .....	23
4.10.2	Methodology .....	24
4.10.3	Test samples .....	25
4.10.4	Qualification categories .....	26
4.10.5	Maintenance of qualification standard .....	26
4.10.6	In-process test results .....	26
4.10.7	Product monitor results .....	30
4.10.8	References .....	30
4.10.9	Qualification report .....	30
4.10.10	Archiving .....	30
4.10.11	Qualification by similarity .....	30
4.10.12	Similarity assessment .....	30
4.11	Reliability .....	31
4.11.1	General .....	31
4.11.2	Operating reliability .....	31
4.11.3	Failure criteria .....	31
4.11.4	Corrective action .....	32
4.11.5	Warranty .....	32
4.11.6	Suspension of certification .....	32
4.11.7	Single event effects (SEE) .....	32
4.12	Product monitor .....	32
4.12.1	General .....	32
4.12.2	Monitor programme .....	32
4.12.3	Problem notification .....	33
4.12.4	Data reporting .....	33
4.12.5	Samples .....	33
4.12.6	Corrective action .....	33
4.12.7	Product monitor results .....	33
4.12.8	Accumulated test data .....	33
4.13	Environmental, health and safety (EHS) .....	34
4.13.1	General .....	34

4.13.2	EHS compliance .....	34
4.13.3	Device handling .....	34
4.13.4	Device materials .....	34
4.14	Shipping containers .....	34
4.14.1	General .....	34
4.14.2	ESD requirements .....	34
4.14.3	Magazine reuse .....	36
4.14.4	Tubes .....	36
4.14.5	Trays .....	36
4.14.6	Tape and reel .....	37
4.15	Compliance with internal standards .....	37
Annex A	(informative) Test code (TC) information .....	38
A.1	General .....	38
A.2	TC1 – Autoclave (AC) .....	38
A.3	TC2 – Bond strength, internal (BS) .....	38
A.4	TC3 – Die shear strength (DS) .....	38
A.5	TC4 – Electromigration (EM) .....	38
A.6	TC5 – Electrostatic discharge (ESD) .....	39
A.7	TC6 – Electrical test (ET) .....	39
A.8	TC7 – Electrical distributions (ED) .....	39
A.9	TC8 – Flammability (FL) .....	40
A.10	TC9 – Hot carrier injection (HCI) .....	40
A.11	TC10 – Hermeticity (HE) .....	40
A.12	TC11 – High temperature bake (HTB) .....	40
A.13	TC12 – High temperature blocking bias (HTBB) .....	41
A.14	TC13 – High temperature gate bias (HTGB) .....	41
A.15	TC14 – High temperature reverse bias (HTRB) .....	41
A.16	TC15 – High temperature operating life (HTOL) .....	41
A.16.1	General .....	41
A.16.2	Qualification conditions .....	41
A.16.3	Test results assessment .....	41
A.16.4	Temperature acceleration factor .....	42
A.16.5	Supply voltage acceleration factor .....	42
A.17	TC16 – Latch-up (LU) .....	43
A.18	TC17 – Lead integrity (LI) .....	43
A.19	TC18 – Lid torque (LT) .....	43
A.20	TC19 – Mechanical sequence (MS) .....	43
A.20.1	General .....	43
A.20.2	Constant acceleration .....	44
A.20.3	Vibration (variable frequency) .....	44
A.20.4	Mechanical shock .....	44
A.21	TC20 – Marking permanency (MP) .....	44
A.22	TC21 – Non-volatile memory operating life (NVL) .....	44
A.23	TC22 – Time dependent dielectric breakdown (oxide integrity) (OI) .....	45
A.24	TC23 – Package dimensions (PD) .....	45
A.25	TC24 – Power cycling (PTC) .....	45
A.26	TC25 – Resistance to solder heat (RSH) .....	45
A.27	TC26 – Solder preconditioning (PC) .....	45
A.28	TC27 – Solderability (SD) .....	46

A.29	TC28 – Soft error rate (SER).....	46
A.30	TC29 – Steady state operating life (SSOL).....	47
A.31	TC30 – Temperature cycling (TC) .....	47
A.32	TC31 – Temperature humidity reverse bias (THRB) .....	47
A.33	TC32 – Temperature humidity bias (THB or HAST) .....	48
A.34	TC33 – Terminal strength (TS).....	48
A.35	TC34 – Thermal resistance (thermal impedance) (TR) .....	48
A.36	TC35 – visual inspection (VI) .....	48
A.36.1	TC35a – External visual inspection .....	48
A.36.2	TC35b – Internal visual inspection .....	49
A.37	TC36 – Water vapour content, internal (WV) .....	49
A.38	TC37 – X-ray inspection (XR) .....	50
A.39	TC38 – Moisture sensitivity level (MSL) .....	50
A.40	TC39 – Ball shear test (BST) .....	50
A.41	TC40 – Negative bias temperature instability (NBTI) .....	50
A.42	TC41 – Accelerated tin whisker test .....	50
Annex B (informative) Cross-reference to STACK Specification S/0001 revision 14 .....		51
Bibliography.....		58
Table 1 – Label requirements.....		18
Table 2 – Internal quality audit requirements.....		20
Table 3 – Outgoing quality .....		22
Table 4 – Incoming test.....		23
Table 5 – Technology/family qualification and device qualification .....		27
Table 6 – Product monitor tests .....		34
Table A.1 – Conditions of the DC over voltage stress method of JP001.01 or IEC 62416 test.....		40
Table A.2 – Examples of temperature acceleration factors.....		42
Table A.3 – Dip and look test references.....		46
Table A.4 – Parameter values for consideration .....		46
Table A.5 – Test conditions.....		47
Table A.6 – Test methods .....		48

# INTERNATIONAL ELECTROTECHNICAL COMMISSION

## PROCESS MANAGEMENT FOR AVIONICS – ELECTRONIC COMPONENTS FOR AEROSPACE, DEFENCE AND HIGH PERFORMANCE (ADHP) APPLICATIONS –

### Part 1: General requirements for high reliability integrated circuits and discrete semiconductors

#### FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

The main task of IEC technical committees is to prepare International Standards. In exceptional circumstances, a technical committee may propose the publication of a technical specification when

- the required support cannot be obtained for the publication of an International Standard, despite repeated efforts, or
- the subject is still under technical development or where, for any other reason, there is the future but no immediate possibility of an agreement on an International Standard.

Technical specifications are subject to review within three years of publication to decide whether they can be transformed into International Standards.



IEC TS 62686-1, which is a Technical Specification, has been prepared by IEC technical committee 107: Process management for avionics.

This second edition cancels and replaces the first edition, published in 2012. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition.

- a) adoption and modification of STACK Specification S/0001 revision 14 notice 3, *General requirements for integrated circuits and discrete semiconductors*;
- b) update of IEC semiconductor test methods;
- c) update of JEDEC semiconductor test methods; including addition of JEP148A, based on the Physics of Failure Risk and Opportunity assessment;
- d) update of Annex A with additional JEDEC and IEC test information;
- e) revision of lead-free termination finish requirements.

The text of this technical specification is based on the following documents:

Enquiry draft	Report on voting
107/248/DTS	107/259/RVC

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

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

A list of all the parts in the IEC 62686 series, published under the general title *Process management for avionics – Electronic components for aerospace, defence and high performance (ADHP) applications*, can be found on the IEC website.

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

- transformed into an International standard,
- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

A bilingual version of this publication may be issued at a later date.

## INTRODUCTION

This part of IEC 62686 includes all the requirements of STACK Specification S/0001 revision 14 notice 3 and contains revisions for alternative IEC qualification test methods and additional test information.

This Technical Specification complements IEC TS 62564-1 which is used for ADHP applications when additional manufacturer's data is required beyond the publicly available manufacturer published data sheets (e.g. when additional thermal performance data is required for thermally challenging applications or when additional verification data are needed, for example to comply with the requirements of RTCA DO-254/EUROCAE ED-80 for complex components for flight critical applications, etc.).

This Technical Specification can also be used to comply with the typical qualification requirements of IEC TS 62564-1. Further guidance is given in IEC TS 62239-1.

NOTE With the adoption of the STACK Specification S/0001 revision 14 notice 3 it will be possible for all existing STACK certified manufacturers to be audited by IECQ under the new STACK-IECQ joint venture.

# **PROCESS MANAGEMENT FOR AVIONICS – ELECTRONIC COMPONENTS FOR AEROSPACE, DEFENCE AND HIGH PERFORMANCE (ADHP) APPLICATIONS –**

## **Part 1: General requirements for high reliability integrated circuits and discrete semiconductors**

### **1 Scope**

This part of IEC 62686, which is a Technical Specification, defines the minimum requirements for general purpose "off the shelf" COTS (commercial off-the-shelf) integrated circuits and discrete semiconductors for ADHP (aerospace, defence and high performance) applications.

This Technical Specification applies to all components that can be operated in ADHP applications within the manufacturers' publicly available data sheet limits in conjunction with IEC TS 62239-1. It may be used by other high performance and high reliability industries, at their discretion.

ADHP application requirements may not necessarily be fulfilled by this specification alone. ADHP OEMs (original equipment manufacturers) may need to consider redesigning their products or conducting further testing to verify suitability in ADHP applications using their IEC TS 62239-1 ECMP procedures. Alternatively a component in accordance with IEC TS 62564-1 may be more suitable.

### **2 Normative references**

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 9001, *Quality management systems – Requirements*

ISO TS 16949, *Quality management systems – Particular requirements for the application of ISO 9001:2008 for automotive production and relevant service part organizations*

ANSI/EIA-556, *Outer Shipping Container Bar Code Label Standard*

ANSI/ESD S541, *Packaging Materials Standards for ESD Sensitive Items*

AS/EN/JISQ 9100, *Aerospace series – Quality management systems – Requirements for aviation, space and defense organisations*

IPC/JEDEC J-STD-020, *Moisture/Reflow Sensitivity Classification for Nonhermetic Solid State Surface Mount Devices*

IPC/JEDEC J-STD-033, *Handling, Packing, Shipping and Use of Moisture/Reflow Sensitive Surface Mount Devices*

IPC/JEDEC J-STD-609, *Marking and Labeling of Components, PCBs and PCBA's to Identify Lead (Pb), Lead-Free (Pb-Free) and Other Attributes*

JEDEC/IPC/ECIA J-STD-048 Notification Standard for *Product Discontinuance*

JEP130, *Guidelines for Packing and Labeling of Integrated Circuits in Unit Container Packing*

JESD46, *Customer Notification of Product/Process Changes by Solid-State Suppliers*

JESD471, *Symbol and Label for Electrostatic Sensitive Devices*

TL 9000, *Quality management system*<sup>1</sup>

### 3 Terms, definitions and abbreviations

For the purposes of this document, the following terms, definitions and abbreviations apply.

#### 3.1 Terms and definitions

##### 3.1.1

##### **calendar days**

continuous days, including weekends and holidays

##### 3.1.2

##### **container**

outer shipping container consisting of one or more inner containers

##### 3.1.3

##### **customer user**

original equipment manufacturer (OEM) which purchases electronic components, including integrated circuits and/or semiconductor devices compliant to this technical specification and uses them to design, produce, and maintain systems

##### 3.1.4

##### **data sheet**

document prepared by the manufacturer that describes the electrical, mechanical, and environmental characteristics of the component

##### 3.1.5

##### **deviation**

user agreement to allow the delivery of a shipping lot which does not fully meet the requirements of this specification

Note 1 to entry: Considered equivalent to concession for the purposes of this document

##### 3.1.6

##### **device specification**

document written by a user and agreed by the supplier or OCM

##### 3.1.7

##### **form**

shape, arrangement of parts, visible aspect, mode in which a part exists or manifests itself, and the material an item is constructed from

<sup>1</sup> For the telecommunications industry.