IEC 62435-4

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INTERNATIONAL STANDARD

NORME INTERNATIONALE

Electronic components – Long-term storage of electronic semiconductor devices –
Part 4: Storage

Composants électroniques — Stockage de longue durée des dispositifs électroniques à semiconducteurs
Partie 4: Stockage

IEC 62435-4:2018-06(en-fr)

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

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ELECTRONIC COMPONENTS – LONG-TERM STORAGE OF ELECTRONIC SEMICONDUCTOR DEVICES –

Part 4: Storage

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.
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International Standard IEC 62435-4 has been prepared by IEC technical committee 47: Semiconductor devices.

This bilingual version (2018-11) corresponds to the monolingual English version, published in 2018-06.

The text of this International Standard is based on the following documents:

FDIS	Report on voting
47/2469/FDIS	47/2486/RVD

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

The French version of this standard has not been voted upon.

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

A list of all parts in the IEC 62435 series, published under the general title *Electronic components – Long-term storage of electronic semiconductor devices*, 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.

INTRODUCTION

This standard applies to the long-term storage of electronic components.

This is a standard for long-term storage (LTS) of electronic devices drawing on the best long-term storage practices currently known. For the purposes of this document, LTS is defined as any device storage whose duration may be more than 12 months for products scheduled for long duration storage. While intended to address the storage of unpackaged semiconductors and packaged electronic devices, nothing in this document precludes the storage of other items under the storage levels defined herein.

Although it has always existed to some extent, obsolescence of electronic components and particularly of integrated circuits, has become increasingly intense over the last few years.

Indeed, with the existing technological boom, the commercial life of a component has become very short compared with the life of industrial equipment such as that encountered in the aeronautical field, the railway industry or the energy sector.

The many solutions enabling obsolescence to be resolved are now identified. However, selection of one of these solutions should be preceded by a case-by-case technical and economic feasibility study, depending on whether storage is envisaged for field service or production, for example:

- remedial storage as soon as components are no longer marketed;
- preventative storage anticipating declaration of obsolescence.

Taking into account the expected life of some installations, sometimes covering several decades, the qualification times and the unavailability costs, which can also be very high, the solution to be adopted to resolve obsolescence should often be rapidly implemented. This is why the solution retained in most cases consists in systematically storing components which are in the process of becoming obsolescent.

The technical risks of this solution are, a priori, fairly low. However, it requires perfect mastery of the implemented process and especially of the storage environment, although this mastery becomes critical when it comes to long-term storage.

All handling, protection, storage and test operations are recommended to be performed according to the state of the art.

The application of the approach proposed in this document in no way guarantees that the stored components are in perfect operating condition at the end of this storage. It only comprises a means of minimizing potential and probable degradation factors.

Some electronic device users have the need to store electronic devices for long periods of time. Lifetime buys are commonly made to support production runs of assemblies that well exceed the production timeframe of their individual parts. This puts the user in a situation requiring careful and adequate storage of such parts to maintain the as-received solderability and to minimize any degradation effects to the part over time. Major degradation concerns are moisture, electrostatic fields, ultra-violet light, large variations in temperature, air-borne contaminants and outgassing.

Warranties and sparing also present a challenge for the user or repair agency, as some systems have been designated to be used for long periods of time, in some cases for up to 40 years or more. Some of the devices needed for repair of these systems will not be available from the original supplier for the lifetime of the system, or the spare assembly can be built with the original production run but then require long-term storage. This document was developed to provide a standard for storing electronic devices for long periods of time.

The storage of devices that are moisture sensitive but that do not need to be stored for long periods of time is dealt with in IEC TR 62258-3.

Long-term storage assumes that the device is going to be placed in uninterrupted storage for a number of years. It is essential that it be useable after storage. It is important that storage media and the local environment are considered together.

These guidelines do not imply any warranty of product or guarantee of operation beyond the storage time given by the manufacturer.

The IEC 62435 series is intended to ensure that adequate reliability is achieved for devices in user applications after long-term storage. Users are encouraged to request data from suppliers to applicable specifications to demonstrate a successful storage life as requested by the user. These standards are not intended to address built-in failure mechanisms that would take place regardless of storage conditions.

These standards are intended to give practical guidance on methods of long-duration storage of electronic components, where this is intentional or involves planned storage of a product for a number of years. Storage regimes for work-in-progress production are managed according to company internal process requirements and are not detailed in this series of standards.

The overall standard series is split into a number of parts. Parts 1 to 4 apply to any long-term storage and contain general requirements and guidance, whereas Parts 5 to 9 are specific to the type of product being stored.

Electronic components requiring different storage conditions are covered separately starting with Part 5.

The structure of the IEC 62435 series as currently planned consists of the following:

Part 1 – General

Part 2 – Deterioration mechanisms

Part 3 – Data

Part 4 – Storage

Part 5 – Die and wafer devices

Part 6 – Packaged or finished devices

Part 7 – MEMS

Part 8 – Passive electronic devices

Part 9 – Special cases

ELECTRONIC COMPONENTS – LONG-TERM STORAGE OF ELECTRONIC SEMICONDUCTOR DEVICES –

Part 4: Storage

1 Scope

This part of IEC 62435 specifies long-term storage methods and recommended conditions for long-term storage of electronic components including logistics, controls and security related to the storage facility. Long-term storage refers to a duration that may be more than 12 months for products scheduled for long duration storage. The philosophy of such storage, good working practices and general means to facilitate the successful long-term storage of electronic components are also addressed.

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 60749-20-1, *Semiconductor devices – Mechanical and climatic test methods – Part 20-1: Handling, packing, labelling and shipping of surface-mount devices sensitive to the combined effect of moisture and soldering heat*

IEC TR 62258-3, *Semiconductor die products – Part 3: Recommendations for good practice in handling, packing and storage*

IEC 61340-5-2, *Electrostatics – Part 5-2: Protection of electronic devices from electrostatic phenomena – User guide*

JEDEC J-STD-033, *Standard for handling, packing, shipping, and use of moisture/reflow sensitive surface mount devices*

MIL-PRF-27401, *Propellant pressurizing agent nitrogen*

MIL-PRF-81705, *ESD Materials, Bags and Performance Specification*

3 Terms and definitions

For the purposes of this document, the following terms and definitions 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

3.1
storage environment
specially controlled storage area, with particular control of temperature, humidity, atmosphere and any other conditions depending on the product requirements

3.2
moisture sensitivity level
MSL
rated and verified moisture sensitivity level assigned to a component that defines the maximum safe equilibrium moisture exposure for a specific encapsulated device prior to reflow assembly or rework

3.3
long-term storage
LTS
planned storage of components to extend the life-cycle for a duration with the intention of supporting future use

3.4
LTS storeroom
area containing components that have additional packaging for storage to protect from moisture or from mechanical impact or for ease of identification or handling

3.5
moisture-sensitive device
MSD
device that has moisture absorption or moisture retention and whose quality or reliability is affected by moisture

3.6
electronic device
packaged electrical, electronic, electro-mechanical (EEE) item, or assemblies using such items

[SOURCE: IEC 60050-551:1998, 551-14-01, modified]

3.7
desiccant
hygroscopic substance used to remove moisture from an atmosphere

3.8
moisture barrier bag
MBB
storage bag manufactured with a flexible laminated vapour barrier film that restricts the transmission of water vapour

Note 1 to entry: Refer to IEC 60749-20-1 for packaging of moisture sensitive products.

3.9
humidity indicator card
HIC
card printed with a moisture sensitive chemical that changes from blue to pink in the presence of water vapour

3.10
water vapour transmission rate
WVTR
measure of permeability of MBBs to water vapour

3.11
electrostatic discharge
ESD
transfer of electric charge between bodies of different electrostatic potentials in proximity or through direct contact

[SOURCE: IEC 60050-561:2014, 561-03-06]

4 Purpose of storage (facility)

4.1 General

Successful long-term storage is dependent upon sustained control of the environment and its physical and data security. Costs associated with handling, maintaining traceability, physical accounting and environmental conditions should be accounted for from the outset of long-term storage.

4.2 Cost of ownership

Cost will be determined by type of storage facility, cabinet, continuous nitrogen flow or inert gas flow and periodical examination on a representative sample.

4.3 Security

Access to controlled areas should be limited to a small number of persons to ensure adequate security. Controlled areas shall be secure from theft, tampering and environmental disturbances.

4.4 Location and ambient environment

The LTS storeroom should be located away from any vibration, electromagnetic fields, ultraviolet rays and other strong light. Consideration should be given to any catastrophic events likely to occur near or at the physical locale of the storage facility. For example, seismically active locations may have building safety and control mitigation measures in place.

4.5 Incorrect control of reliability during storage

Storage conditions should be precisely defined and controlled, to ensure the reliability of the components (see Clause 5).

Component integrity may be reduced by improper storage conditions. Potential causes of storage risk are related to poor control of environmental conditions. Proper control should consider temperature, humidity, moisture, pressure, atmospheric gases, electrostatic field charge, applied physical forces, handling (shock, vibration, impacts, etc.), contamination or other applied stress factors. Degradation mechanisms that are induced with moisture may occur if the integrity of the dry storage (cabinet or MBB) is violated. Verification of moisture exposure includes, but is not limited to, examination of the HIC for any change in colour, chamber humidity monitoring and the use of recording devices that indicate moisture exposure. Different materials can absorb moisture at different rates and should be evaluated based upon exposure time. For other degradation mechanisms that require oxygen, radiation, electrical exposure or mechanical impact, the LTS environment should be evaluated to prevent contributing to failure concerns.

Packing materials used in LTS should be evaluated for moisture absorption and release. The packing requirements of IEC 60749-20-1 or J-STD-033 should be followed for LTS unless otherwise indicated in this publication.

5 Storage

5.1 General

The following 5.2 to 5.6 describe storage environments and practices within the storage facility.

5.2 Type of environment

Various types of storage environments exist, such as:

– air without any monitoring;
– “dry”-air (relative humidity lower than 7 % – 25 %), with or without active desiccant, which may be in a sealed moisture barrier bag;
– low-oxygen; typically nitrogen (racks, bags, tubes, etc.) where a nitrogen or oxygen detector is recommended;
– vacuum in fully evacuated chamber (with precautions to prevent part-crushing damage or bag foil damage if used).

The selection of a solution shall be made on the basis of the intended storage time, the application of the technology and the accepted risks. For long-term storage, a dry-air, nitrogen or vacuum solution is recommended.

5.3 Storage identification – traceability

Storage of part manufacturing data, unit level traceability and various other data that is recorded during storage should be maintained and archived. Data storage practices and requirements are planned to be addressed in IEC 62435-3[1]. Data to be stored coincident with the environment should include:

– the component manufacturer's name and part number;
– the procurement source;
– the date-code;
– the storage history;
– the validation test identification or program version performed.

The purpose of this data is to accurately identify the components stored, to ensure the traceability and enable tracking of components.

When there are periodic checks, the following data should be recorded and compared to the previous checks: date, nature of the checks, components tested, results.

5.4 Initial packaging

Initial packaging may not be suitable for long-term storage, and consideration should be made as to the method of packing for storage, in particular, re-packing devices in special protective material that will not degrade or out-gas during storage. ESD controls and protection guidelines are found in IEC TR 61340-5-2 and recommendations for ESD protective materials are found in IEC 61340-5-3.

If packaging fails, the components should be assessed for further handling and additional storage, and if necessary the components should be repackaged. This type of operation can only be performed in exceptional circumstances during storage because the components could be degraded or damaged.

Re-package all devices in accordance with the specified storage environment. Parts should be exposed to ambient air for as limited a time as possible. If re-packing is required it should be completed within 8 h or less. Care should be taken to avoid part contamination through foreign material by segregating component bag opening and storage preparation areas. Containers may be reused, as long as they are visibly inspected and show no damage. Where desiccant is required, fresh or refreshed desiccant should be used for initial storage and for every subsequent re-packaging.

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1 Under preparation. Stage at the time of publication: IEC/PCC 62435-3:2018.