IEC 62435-1

Edition 1.0 2017-01

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Electronic components – Long-term storage of electronic semiconductor devices –
Part 1: General

Composants électroniques – Stockage de longue durée des dispositifs électroniques à semiconducteurs –
Partie 1: Généralités

IEC 62435-1:2017-01(en-fr)

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

COMMISSION ELECTROTECHNIQUE INTERNATIONALE

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

Part 1: General

FOREWORD

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International Standard IEC 62435-1 has been prepared by IEC technical committee 47: Semiconductor devices.

This standard cancels and replaces IEC/PAS 62435 published in 2005. This first edition constitutes a technical revision.

The text of this standard is based on the following documents:

FDIS	Report on voting
47/2326/FDIS	47/2349/RVD

Full information on the voting for the approval of this standard 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 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 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

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

INTRODUCTION

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

This is a document 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 can be more than 12 months for product scheduled for long duration storage. While intended to address the storage of unpackaged semiconductors and packaged electronic devices, nothing in this standard 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, selecting 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;
- preventive 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 standard 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 its individual parts. This puts the user in a situation requiring careful and adequate storage of such parts to maintain the as-received solderability and 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 may 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.

For storage of devices that are moisture sensitive but that do not need to be stored for long periods of time, refer to 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 is useable after storage. Particular attention should be paid to storage media surrounding the devices together with the local environment.

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 guide to methods of long-duration storage of electronic components where this is intentional or planned storage of 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 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[1] are specific to the type of product being stored. It is intended that the product specific part should be read alongside the general requirements of Parts 1 to 4.

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

The structure of the IEC 62435 series as currently conceived is as follows:

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

1 Under preparation.

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

Part 1: General

1 Scope

This part of IEC 62435 on long-term-storage covers the terms, definitions and principles of long-term-storage that can be used in as an obsolescence mitigation strategy. Long-term storage refers to a duration that can be more than 12 months for products scheduled for long duration storage. Philosophy, good working practice, 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*

3 Terms definitions and abbreviated terms

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

3.1.1
storage environment
specially controlled storage area, with particular control of temperature, humidity, atmosphere and any other conditions depending on the product requirements

3.1.2
long-term storage
LTS
planned storage of components to extend the life-cycle for a duration with the intention of supporting future use

Note 1 to entry: Allowable storage durations will vary by form factor (e.g., packing materials, shape) and storage conditions. In general, long-term storage is longer than 12 months.

3.1.3
electronic device
packaged electrical, electronic, electro-mechanical (EEE) item, or assemblies using such items

3.1.4
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 IEC60749-20-1 for packaging of moisture sensitive products.

3.1.5
humidity indicator card
HIC
card printed with a moisture sensitive chemical (cobalt bromide) that changes from blue to pink in the presence of water vapour

3.2 Abbreviations

ESD electro-static discharge

4 Purpose of long-term storage

4.1 General

LTS is intended as any device storage for more than 12 months but typically much longer. Annexes A to E provide useful lists and tools for documentation and later use during and after long-duration storage. While most stock is purchased for immediate production requirements, some product is stored for the following reasons:

- bulk purchase for incremental production;
- cost reasons, justified by price breaks or minimum purchase quantities;
- last-time buy, required for future production;
- special, bespoke components;
- product stored for a customer for their future production;
- product stored for anticipated future orders;
- spares for in-service repair.

LTS stock shall not be stored alongside products for immediate planned production. It is recommended that products destined for future production be segregated and stored in a long-term storage facility in order to guard against:

- unintended mixing of stored components and use of components in immediate production that were intended for future production use;
- selling or disposal of stock which has been stored longer than expected in production stores and is erroneously assumed to be no longer required;
- inventory review and reduction with unintended disposal of components;
- unintended and repeated opening of cabinets containing LTS products.

4.2 Storage decision criteria

4.2.1 Advantages

4.2.1.1 Technical simplicity – Rapidity

When the various steps of the storage process are finalized and validated, the creation of a stock is a simpler, faster and technically less hazardous solution than developing or modifying electronic boards.

Storage can also be a temporary solution enabling equipment maintenance during modification or development of electronic boards.

4.2.1.2 Solution durability

Any equipment changes based on the use of new electronic components will be faced, eventually, with the obsolescence of these new components. Storage can resolve obsolescence problems until the end of the operating life of the equipment.

4.2.1.3 Preventive storage

Preventive storage (i.e., before the component becomes obsolete) presents several additional advantages compared with remedial storage (i.e., when the component has already become obsolete). This can be advantageous for a number of different reasons including the following:

- the component price has not become prohibitive as in the case of specific obsolete components that have become very rare;
- the quality level is ensured if the component can be purchased directly from the manufacturer or franchised distributor;
- the likelihood of being supplied counterfeit, fraudulent or recycled components is very unlikely when purchasing directly from the manufacturer or franchised distributor. However, when a component has been obsolete for a long time, it is possible that it could only be found at suppliers who specialise in purchasing, storage and resale of obsolete components, where the chance of receiving counterfeit components is increased. For more information, refer to IEC TS 62668-1 and IEC TS 62668-2. In this case, no component reliability guarantee is likely to apply.

For more information, refer to IEC 62402.

4.2.2 Hazards

4.2.2.1 General

There are a number of hazards related to the storage of components that should be taken into account in long-term storage. These are listed in the following Table 1 and referenced paragraphs, as well as in IEC 62435-2.

Table 1 – Storage hazards

Hazard	Reference	Description	Mitigation
General aging	4.2.2.2	Components, when stored, have natural aging mechanisms which can cause the component to deteriorate.	Ensure that component deterioration mechanisms have been assessed and storage conditions minimise these effects.
Poor stock dimensioning	4.2.2.3	Underestimation of the number of components required for storage. Can lead to future shortages.	Ensure that correct methods are used to calculate the number of components required for storage.
Control during storage	4.2.2.4	Variable or uncontrolled storage conditions may cause components to deteriorate rapidly.	Storage conditions should be controlled to pre-determined limits and monitored for out of control events.
Freezing of equipment design and functionality	4.2.2.5	The design and function of equipment may be required to be upgraded during the life of the equipment.	Components stored for future use imply that the design should be frozen.

4.2.2.2 Generic aging hazard

Components when stored do not remain in a pristine condition and will have a natural aging characteristic(s). This effect can be mitigated by investigating the deterioration mechanisms for any component type that is being stored and to design the storage conditions to minimise any likely deterioration. See IEC 62435-2 for more information.

4.2.2.3 Poor stock dimensioning

The calculation of the volume of components to be stored may be based on feedback (operational failure rate) and/or on theoretical models (predictive failure rate). Calculation using feedback is only valid if the sample is big enough (significant population of components installed, operation for several years, high number of failures evidenced). Predictive calculations do not generally take into account the extrinsic parameters of the components (defects caused by printed-board handling and repair, systematic replacement of the components (including functional components) during repairs, improper use of the components, etc.). Therefore, the stock volume can be improperly assessed.

Underestimating the stock can lead to a lack of components to repair printed boards, which will ruin the stock strategy. Overestimating it will lead to the purchasing and conditioning of components which will not be used, adding significant costs.

4.2.2.4 Control during storage

Storage conditions shall be precisely defined, controlled and auditable. In addition, it is important to check the quality of the components to be stored.

4.2.2.5 Freezing of equipment design and functionality

Storing components to ensure equipment maintenance over a long time implies that equipment design be frozen. A long-duration storage solution is therefore not compatible with the desire to upgrade equipment and functionalities.

4.2.3 Storage cost

In order to assess the cost of a storage solution, various items should be taken into account, such as:

- component purchasing;
- validation/test of purchased component batches;

- conditioning and de-conditioning;
- stock management;
- maintenance of installations dedicated to storage by means of manufacturing tests and/or repair;
- staff ensuring storage, maintenance operations, etc.;
- financial cost of tied-up stocks.

4.2.4 Decision criteria

The following criteria should be taken into account:

- planned storage time;
- stock dimensioning;
- dimensioning reliability index;
- life of test means;
- life of manufacturing means and/or printed boards;
- competence traceability and related documentation;
- industrial consequences of under-dimensioning or a component failure at the end of storage;
- confidence level in the knowledge of potential component failure mechanisms;
- cost compared with other solutions;
- impact of accepting new product orders using the LTS components;
- audit/inspection schedule and standards used.

4.3 Reasons and methodology

Many electronic components have a shorter life-cycle than the design and manufacturing cycle time of the equipment in which they are used. This is especially true for equipment that is designed for military, space, automotive, medical or other high-reliability products, which have an extended design cycle or planned period of manufacturing. Some components, therefore, become obsolete before the manufacturing cycle is complete. Cost for long-term storage is ultimately taken into account by suppliers and customers as part of the business contract terms and conditions.

When a component becomes obsolete, the users have the choice of either upgrading/redesigning the product during their manufacturing cycle, for which there is a cost penalty, or they may choose to make a life-time buy for all the production and maintenance requirements.

Additional costs related to testing and type approval for the redesign shall be factored in when making this choice. This cost for long-term storage shall take account not only the upfront cost of purchasing the components and the costs for storage, but also costs associated with periodic checking or qualification of the stored components. There is also risk associated with either strategy and this needs to be taken into account.

Assuming that components have been purchased ahead of planned production, then these components need to be stored in a carefully predetermined manner. Assuming that the components will be beyond the manufacturer's stated shelf-life at the time of production, then consideration shall be given as to how they are packed or re-packed prior to storage including testing and qualification to ensure that only good components are stored. Refer to 5.5 for more information.

4.4 Market forces

Market forces determine when it is uneconomical to continue to manufacture a component and it is declared end-of-life or obsolete. Occasionally, a manufacturer can be persuaded to restart the manufacturing of an obsolete component, but normally this will require a significant investment.

It is not always possible to predict when the end-of-life will occur for a particular component, and the manufacturer itself may not be able to give advanced warning or last-time-buy. It is therefore not recommended to assume that there will always be an opportunity to make a last purchase towards the end of the production cycle of a particular component.

4.5 Risk mitigation and insurance

Whether long-term storage is used or not, there is risk involved in the future availability of components for a particular design. Analysing and calculating the risk involved, including the financial costs involved, is beyond the scope of this document. However, there are many specialist consultancies who specialize in risk analysis and management.

One factor to consider in storing components is the insurance cost should the worst happen and the components cannot be used after storage. Generally, the insurance value is likely to increase during the life of storage. At the start of storage, while replacement components could be obtained from the manufacturer, the insurance value may represent just the cost of these replacements. As the storage time continues, the cost of replacing the components will increase up to the maximum costs for redesign and qualification should the components be unusable.

However, there are various risk mitigation methods such as using multiple storage locations, which helps to reduce the storage risk and associated insurance costs. The effective use of monitoring, checking and qualification during storage should help to reduce the risk of damage occurring during storage.

4.6 Obsolescence mitigation

The risks associated with obsolescence should be considered as early in the design cycle as possible in order to guard against using components that are more likely to become obsolete sooner with no viable alternative available. Care should be taken when designing advanced electronics using components originally designed for a mass-market product such as a mobile phone, since these components tend to have an extremely short life cycle. Likewise, memory products tend to have short manufacturing cycles where frequent die shrinks and rapid increases in memory density lead to early obsolescence. It should not be assumed that a larger capacity memory can always replace an obsolete memory component. Refer to IEC 62402 and GEIA/SAE STD-0016. Consideration should also be given to the obsolescence of test equipment and programmes.

5 Logistics

5.1 Procurement requirements

5.1.1 List of components

A appropriate list of the components used shall be established for units under long-term storage. It should include the part number, specifications, manufacturers and the corresponding trade references.

The list shall be cross-referenced to the next higher level assembly.

The purpose of this list is to