

Application Information

Handling, Storage, and Shelf Life of Semiconductor Devices

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Introduction

Electronic devices are available in many package types and can contain semiconductors (integrated circuits), magnets, capacitors, and resistors. This application note provides guidelines for the handling and storage of Allegro devices with regards to functionality and shelf life. Precautions against ESD (electrostatic discharge), moisture, and contaminants need to be considered for electronic devices.

There are several areas of possible concern with electronic devices regarding handling, shelf life, and storage conditions:

- Handling considerations involve ESD and environmental protections.
- Shelf-life considerations involve solderability, MSL, and open-bag floor-life conditions.
- Storage considerations involve proper bagging and environment.

Applicable Documents

The documents listed below provide further background information and guidance, and are required reading. Within each document are listed applicable documents which must also be referenced.

International standards:

Moisture/Reflow Sensitivity Classification for Nonhermetic Solid State Surface Mount Devices, IPC/JEDEC J-STD-020D.1

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

Requirements for Handling Electrostatic-Discharge-Sensitive (ESDS) Devices, JEDEC JESD625

Allegro application notes (at Allegromicro.com):

Soldering Methods for Allegro Products (SMD and Through-Hole), AN26009

Chemical Exposure of Devices, 295047-AN

Guidelines for Designing Subassemblies Using Hall-Effect Devices, 27703.1-AN

Guidelines for Leadforming Using Back-Biased Hall-Effect Devices, 296080-AN

Handling

Allegro product is generally shipped in sealed bags containing tape-and-reel product, devices in shipping tubes, or wafer jars. These shipping materials are antistatic and can also be conductive, depending on product and configuration. The customer must be fully aware of and fully implement the ESD precautions detailed in JEDEC JESD625 (*Requirements for Handling Electrostatic-Discharge-Sensitive (ESDS) Devices*). This includes the mandatory use of ESD gloves, grounded and ESD protected table surfaces, and directed air ionizers, as needed for the configuration of the customer's incoming inspection, assembly line stations, and finished goods inspection and packing areas.

When using tape-and-reel packaged devices, the cover tape should be removed at a rate of 10 mm/s or less and at an angle of 165 to 180 degrees from the carrier-base plastic in order to minimize ESD generation.

Other environmental protections should be used. The protection of product in shipping bags, and after the opening of these bags, should prevent contamination by the ambient environment from dust, corrosive materials, humidity/water, or other chemicals (containing chlorine or phosphates).

Specifically, electronic devices should not be handled with bare hands, or exposed to unmasked personnel. Although finger cots can be used, it is important to ensure their proper use and immediate replacement if contaminated (i.e. use sterile technique to prevent transfer contamination from one surface to another). Gloves are a better choice to prevent contamination.

Face masks to prevent spittle and discharge from talking should be used. Smocks or gowns should be used as well. Finally, protective footwear is desirable to maintain a clean work environment.

Note that Allegro uses fully gowned personnel—from head to foot, including full head covering, eye shields, face mask, gloves, full suit, and booties—in all areas of assembly, from start to finish, in a clean-room-class environment. Therefore, customer-returned parts with corrosion may be from the customer's assembly or the end application, as determined by Allegro failure analysis. See Allegro application note, *Chemical Exposure of Devices*, for details.

Shelf Life and Floor Life

Surface-Mount Devices (SMD) and Moisture Sensitivity Level (MSL)

SMD product can be sensitive to picking up moisture within the molding compound of the package and, when undergoing board solder reflow, can have delamination occur between the molding compound and the leadframe. MSL classification (J-STD-020D.1) gives a rating to each SMD package type, from MSL 1 to MSL 3, at a reflow temperature of 260°C or a lower temperature for some packages (as noted on the Caution Label on the shipping box). MSL 1 classification means that the package is very robust and not susceptible to moisture influences at reflow; thus, the “floor life” (the time parts can be exposed to ambient temperatures and humidities) is unlimited for MSL 1 ($\leq 30^{\circ}\text{C}/85\% \text{RH}$). For MSL 2 parts, the floor life is 1 year at $\leq 30^{\circ}\text{C}/60\% \text{RH}$ and MSL 3 is 168 hours (7 days) at $\leq 30^{\circ}\text{C}/60\% \text{RH}$.

The customer need only be aware of MSL 3 devices in regards to floor life. For example, if the customer uses only part of tape-and-reeled product rated MSL 3 and the remaining product is thus exposed to ambient temperature and humidity, one must refer to the Floor Life table 7-1 in J-STD-033C to determine actual floor life on the part. Thus an exposure at 30°C/60% RH for 7 days is the maximum floor life if reflow is at 260°C (all tables in J-STD-033C are based on 260°C reflow, as are MSL classifications, unless otherwise noted by Allegro). If reflow is at 245°C, the maximum floor is much greater and may be unlimited (no data is available at this time for all devices). If exposure is less than 30°C/60% RH and reflow is at 260°C, then the floor life is much greater, and unlimited at 50% RH. Most customers use a reflow temperature of 230°C to 245°C (max.) and have an environment

of 25°C and 60% to 70% RH, and therefore would not need to be concerned about floor life for MSL 3 devices.

Note that through-hole devices and devices which will be welded, crimped, or hand-soldered are exempt from MSL considerations, because the package body does not exceed the reflow profile temperatures found in board soldering.

Solderability and Long-Term Storage

- Solderability of components after long-term storage, such as for replacement parts inventory or “last-time buy” parts, is a question that some customers have.
- Parts are supplied in moisture-barrier bags (MBB) for parts labeled as MSL 2 or MSL 3 and contain desiccant (optional with MSL 1 devices). The MBB offer protection of the units from environmental factors. While this is recommended for parts that are to be reflow-soldered to prevent “popcorn” delamination within the package body, the solderability of the leads is not affected.
- Allegro parts have their terminations plated with 100% tin or nickel-palladium-gold (NiPdAu).
- 100% tin-plated parts are subject to minor levels of oxidation from exposure to humidity and temperature. The levels of oxidation accumulated from such exposure does not affect the solderability quality of the parts, as seen by Allegro standard testing procedure of preconditioning parts for 8 hours with a steam chamber and wetting balance testing, as shown below. See Allegro application note, *Soldering Methods for Allegro Products (SMD and Through-Hole)*, for more information. The study below shows that tin plating is good for 10 years storage at ambient.

A solderability study was done with parts stored openly in a drawer at ambient conditions for up to 10 years. Included were samples that were preconditioned with 8 hour steam. All parts soldered very well. This shows that long-term storage at ambient conditions does not affect solderability and therefore storage in a sealed bag is more than adequate.

- These wetting balance curves show the wetting force versus time with immersion into SAC 305 alloy using a 0.5% mildly activated flux on SG package parts (4-pin SIP package with integrated back-biasing magnet). All show excellent final wetting force (which is anything above 0.1 mN/mm) after 3 second immersion.
- The top three curves are on virgin units stored exposed to ambient conditions for 5, 6, and 10 years, respectively.
- The bottom three curves are on 8 hour steam-aged units stored exposed to ambient conditions for 4, 9, and 10 years, respectively.
- The gold coating on the leads of NiPdAu parts prevents any oxidation or degradation of the leads under environmental exposure of humidity and temperature and therefore the shelf life is unlimited and no special precautions are needed.

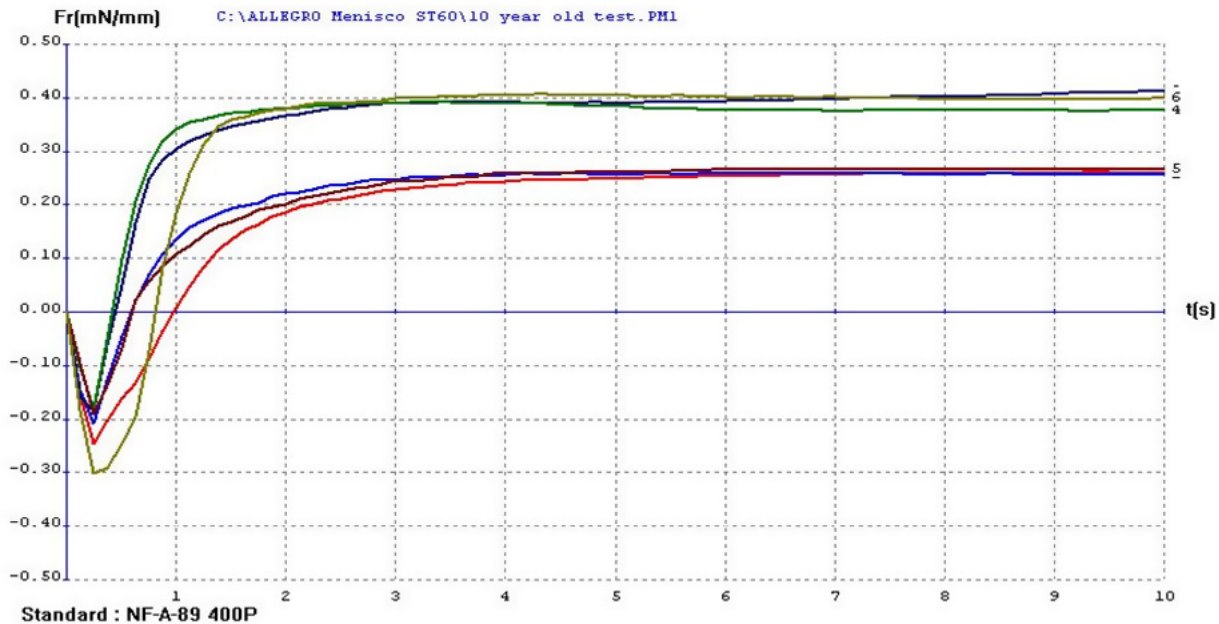
Storage Life

All Allegro packages, whether SMD or not, have a minimum shelf life of 5 years.

For an unopened bag, packaged in a sealed MBB with desiccant, the shelf life of SMD is greater than 5 years for MSL 3 parts and unlimited for MSL 1 and MSL 2. This assumes that the MBB remains intact; therefore, double-bagging is recommended for extremely long-term storage. Note that MSL 1 parts do not actually require a MBB, but it is recommended for long-term storage.

As previously noted, solderability is not affected by storage up to 10 years.

Storage of die or wafers also exceeds 5 years in MBB and double-bagging is recommended for longer than 5 year storage. Recommended ambient storage conditions are usually <25°C and <60% RH.



Revision History

Number	Date	Description
–	March 30, 2016	Initial release
1	August 11, 2016	Updated Storage Life section
2	September 12, 2018	Minor editorial updates
3	September 17, 2019	Minor editorial updates

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