Application Note
Moisture Sensitivity

June 2019

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1 Revision History

The revision history describes the changes that were implemented in the document. The changes are listed by revision, starting with the most current publication.

1.1 Revision 5.0

Revision 5.0 was published in June 2019. The following is a summary of changes.

- Updated the Moisture Sensitivity Levels for Microsemi Packages (see page 5) table.
- Revised Conclusion (see page 6) section.

1.2 Revision 4.0

Revision 4.0 was published in March 2011. The following is a summary of changes.

- Moisture Sensitivity Levels for Microsemi Packages (see page 5) were revised.

1.3 Revision 3.0

Revision 3.0 was published in January 2009. The following is a summary of changes.

- CS289 and QN68 data were added to Moisture Sensitivity levels for Microsemi Packages (see page 5).

1.4 Revision 2.0

Revision 2.0 was published in November 2008. The following is a summary of changes.

- CSG 281 level 2 was removed from Moisture Sensitivity level for Microsemi Packages (see page 5).

1.5 Revision 1.0

Revision 1.0 was published in June 2008. It was the first publication of this document. The following is a summary of changes.

- Updated Moisture Sensitivity Levels for Microsemi packages (see page 5)table.
- Updated Microchip FPGA Division's package list and MSL classification.
- Deleted criteria after reflow, and added note to refer to J-STD-020 for criteria after reflow of component.

2 Introduction

Microsemi tests and classifies all semiconductor devices for moisture sensitivity to ensure long-term reliability. This document describes the moisture-related failure modes, preventative test procedures, and the moisture sensitivity of Microsemi FPGAs. Microsemi tests all its packaged devices in accordance with the procedures outlined by JEDEC (IPC/JEDEC JSTD-020 and JESD22-A113).

3 Moisture-Induced Manufacturing Failures

Improper storage, handling, or packaging of plastic encapsulated semiconductor devices can introduce moisture. Moisture trapped inside the plastic encapsulated package can cause damage during soldering, as the moisture vaporizes and tries to expand. This internal vapor pressure can cause separation of the plastic package from the semiconductor chip or lead frame, internal or external cracks, and cause damage to thin films and wire bonds. In severe cases, soldering may cause an integrated circuit package saturated with moisture to bulge and/or explode.

It is important to handle the moisture barrier bag (dry pack bag) carefully to prevent the plastic packages from absorbing moisture. Microsemi strongly recommends adhering to the following guidelines when handling the devices (see IPC/JEDEC STD-033 for more information).

1. Moisture barrier bags are sealed after electrical test by Microsemi or by its contracting electrical test facility. These bags are handled with care to avoid puncture or tearing of the bag’s material.
2. Upon receipt, moisture barrier bags should be inspected for punctures or holes of any kind. If openings in the bag are found and the maximum humidity indicator is exceeded, Microsemi recommends baking the parts according to the conditions specified in Moisture Sensitivity Levels for Microsemi Packages.
3. Bags should remain sealed until the parts are ready to be used.
4. Inspect the humidity indicator card (HIC) immediately after opening the package and evaluate the color of the dots according to the guidance written on the HIC.
5. Proper handling of storage, board mounting assembly, and rework is critical to avoid over-exposure of the package to moisture.

4 Moisture Sensitivity Range

JEDEC defines a moisture sensitivity classification that is universally regarded as the standard for definitions in this area. The purpose of this standard is to identify the moisture sensitivity level at a fixed reflow temperature as listed in the following table, so that the user properly stores and handles the devices and to avoid subsequent thermal/mechanical damage during the assembly reflow attachment and/or repair operations.

The present moisture sensitivity standard contains seven levels. The lower the level, the longer a device's floor life. The goal of all package manufacturers is to have their packages reach level 1, which is an unlimited floor life.

Table 1 • JEDEC Standards Qualification Levels

Level	Description	Preconditioning Followed by Three Cycles of Reflow Temperature Exposure	Expected Floor Life (at ≤ 30 °C/60 % RH)
1	Not moisture sensitive	168 hours at 85 °C/85 % RH	Unlimited
2	Limited moisture sensitive	168 hours at 85 °C/60 % RH	One year
2a	Limited moisture sensitive	696 hours at 30 °C/60 % RH	4 weeks
3	Moisture sensitive	192 hours at 30 °C/60 % RH	168 hours
4	Moisture sensitive	96 hours at 30 °C/60 % RH	72 hours
5	Highly moisture sensitive	72 hours at 30 °C/60 % RH	48 hours
5a	Highly moisture sensitive	72 hours at 30 °C/60 % RH	24 hours
6	Extremely moisture sensitive	Time on label 30 °C/60 % RH	Time on label

Typically, most packaged ICs are certified at level 3. This means that they have a floor life of 168 hours before they need to be re-baked.

5 Moisture Test Method

Consistent with JEDEC recommendations, Microsemi's tests follow the latest revision of IPC/JEDEC J-STD-020 (consult JEDEC for the full profile).

Table 2 • Moisture Sensitivity Levels (MSL) for Microsemi Packages

Package		Maximum Exposure Time (hour) to Ambient prior to Surface Mount Reflow	Bake Time (hour) at 125 °C	MSL
Type	Pin Count			
BG/BGG	272/329/456	168	8	3
FG/FGG	144/256/324 /484/676/896 /1152	168	8	3
VF/VFG	100/256/400	168	8	3
CS/CSG	49/81/121/128 /180/196/201/ 281/288/289 /325	168	8	3
FCS/FCSG	158/325/536	168	8	3
UC/UCS	36/81	168	8	3
QN/QNG	48/68/100[1]/108[1]/132[1]/180[1]	168	8	3
PQ/PQG	100/144/160 /208/240[1]	168	8	3
TQ/TQG	64/100/144 /176	168	8	3
VQ/VQG	80/100/128 /144/176	168	8	3
PL/PLG	44/68/84	168	8	3
RQ/RQG	208[1]/240[1]	72	8	4
FC/FCG	484/784/1152 /1657	72	24	4
FCV/FCVG	484	72	24	4

Note: 1. Discontinued.

6 Conclusion

Moisture trapped inside the plastic packages can damage them during soldering. Microsemi tests all plastic packaged FPGAs for moisture sensitivity according to procedures outlined by JEDEC. Microsemi's plastic packages are rated at a moisture sensitivity level (MSL) of 3 or 4. If a user stores any device beyond the floor life at or above recommended temperature relative humidity, Microsemi recommends the user adhere to JEDEC guideline and perform a bake-out before reflow soldering.

Microsemi Headquarters
One Enterprise, Aliso Viejo,
CA 92656 USA
Within the USA: +1 (800) 713-4113
Outside the USA: +1 (949) 380-6100
Sales: +1 (949) 380-6136
Fax: +1 (949) 215-4996
Email: sales.support@microsemi.com
www.microsemi.com

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