Application Note Abstract
This application note describes methods for handling, storing, and cleaning image sensors. It also describes the precautions to take when handling and cleaning image sensors.

Introduction
Integrated circuits, including image sensor products are sensitive to Electrostatic Discharge (ESD).

ESD events can cause immediate damage to a device so that it is no longer functional. The effect may also not be noticed until a considerable time has passed, with the unit operating to specifications for some time. ESD events also show up as shifts in device characteristics.

ESD events occur by improper handling of the image sensor. Improper handling includes any operation that creates an electrostatic discharge; for example, handling the device without a wrist strap. Environmental conditions also contribute to the likelihood of ESD event.

The cost of an appropriate ESD control program is well offset by the savings achieved in avoiding damaged devices (see references 1 and 2).

This application note discusses some recommended procedures to minimize the occurrence of an ESD event when handling image sensors. The recommendations in this application note follow JEDEC Standard JESD625-A. Cypress recommends that our customers become familiar with and follow the procedures in JEDEC Standard JESD625-A3.

Disclaimer
Cypress Semiconductor is not responsible for damage caused by improper handling or cleaning of the device after it is received by the customer.

Rating
Cypress CMOS image sensors, unless stated otherwise in the product data sheet, are rated as follows for ESD sensitivity according to the JESD22 classification method:

- Human Body Model: JESD22-A114 Class 2
- Charged Device Model: JESD22- C101 Class III

Glossary of Terms and Definitions
For the purpose of this application note, the following definitions apply:

- **Air ionizer**: A source of charged air molecules (ions).
- **Antistatic material**: Refers to the property of material that inhibits tribo-electric charging.
- **Conductive material**: A material that has a surface resistivity less than $10^5$ ohms per square or a volume resistivity less than $10^4$ ohm centimeter.
- **Electrostatic discharge (ESD)**: The transfer of electrostatic charge between bodies or surfaces that are at different electrostatic potentials.
- **Electrostatic discharge susceptibility [sensitivity] (ESDS)**: The lowest level of ESD that produces changes in device characteristics such that the device fails to meet its specified characteristics.
- **ESD-protective packaging**: A packaging system that provides electrostatic protection and limits tribo-electric charging to levels that do not result in device damage.
- **ESD-protective work-surface**: A table top or other surface on which to work that has a resistance to ground of less than $10^9$ ohms.
- **Insulation material**: A material having a surface resistivity of at least $10^{12}$ ohms per square or volume resistivity of at least $10^{11}$ ohm centimeter.
- **Static dissipative material**: A material having a surface resistance between $10^5$ ohms and $10^{11}$ ohms or a volume resistivity between $10^5$ ohm centimeters and $10^{11}$ ohm centimeters.
- **Static electricity**: Electrical charge at rest. The electrical charge is due to the transfer of electrons within a body (polarization) or from one body to another.
Minimum Requirements for ESD Protected Areas, Workstations, and Tools

The following are the recommended minimum requirements when handling image sensors.

ESD Protective Work Surface

When unprotected ESD sensitive (ESDS) devices are handled, a grounded static protective work surface with a resistance to ground of less than $10^3 \Omega$ should be used.

ESD Protective Flooring or Floor Mats

Grounded flooring or floor mats are only required when personnel or mobile ESD protective workstations use floor grounding methods.

Personnel Grounding

Each person, handling or within 12 inches of unprotected ESDS devices, must be grounded using either of these:

- Wrist straps:
  - Provide a continuous electrical path directly from the user to ESD ground.
  - Have an integral resistance at the wrist band end that limits current to less than 0.5 mA at the highest voltage level that an ESD may be encountered.
  - Be worn by operators handling unprotected ESDS devices when seated.

- ESD protective footwear (heel straps, toe straps, or shoes). These should:
  - Provide a direct continuous electrical path from the user to the ESD protective flooring or floor mat.
  - Be worn on both feet.
  - Limit current to less than 0.5 mA through the specific path to ground at the highest power supply voltage that may be encountered.
  - Not be relied upon for grounding of seated personnel.

- Static generating sources and charged surfaces.
  - Non-essential and personal items should not be placed on ESD protective work surfaces that are in use.
  - No item with an electrostatic potential greater than ±1000 volts should be closer than 12 inches from unprotected ESDS devices.
  - Operations, equipment, or clothing generating electrostatic potential greater than ±1000 volts within 12 inches of unprotected ESDS devices should be neutralized or reduced to less than ±1,000 volts.
  - Charged items must not contact ESDS devices.

Note that the above personnel grounding recommendations are intended to protect ESDS devices and not the personnel handling them. Safety of personnel is outside the scope of this document and is not the responsibility of Cypress.

ESD Protective Smocks

When ESD protective smocks are worn, they should cover all personal garments above the waist, except at the neck area.

Air ionizers can be used to reduce electrostatic potentials to less than ±1000 volts within 12 inches of unprotected ESDS devices if those voltages are not controlled by other means.

ESD Protected Area and Workstation Identification

ESD caution signs must be posted at each ESD protected workstation or at the entrances of defined ESD protected areas.

ESD Precautions for Device Handling

Methods to Minimize Static Charging

Static charge preventive actions should be used at ESD protected areas and workstations where electrostatic potentials greater than ±1000 volts are measured and unprotected ESDS devices are within 12 inches of the charged sources.

Charge prevention and neutralization methods include, but are not limited to, antistatic solution treatments, relative humidity control, air ionizers, sleeve protectors, and ESD protective clothing.

- Antistatic Solution
  Antistatic chemicals (solutions) can be used to prevent static charge generation on static generating or charging materials in the work or storage areas. During application of any antistatic chemical, consider the following:
    - Choose the antistatic solutions to avoid contamination of ESDS devices.
    - Avoid any contact of the solution with the sensor glass lid.
    - Do not apply antistatic spray or solutions in any form to energized electrical parts, assemblies, panels, or equipment.
    - Do not apply antistatic solutions when devices and packages are directly exposed to spray mists.
    - The need for initial application and frequency of reapplication can only be established through routine electrostatic field measurements during normal operations using an electrostatic field meter.

- Relative Humidity Control
  Relative humidity has a significant impact on the generation of static electricity and its control is recommended, where applicable. The recommended humidity is between 30% R.H and 60% R.H.

- Air ionizers, when used, should conform to the following:
  - Table ionizers should be positioned so that the devices at the ESD-protected workstations are within the ionizer manufacturer’s specified coverage area.
The ionizer should be aimed at the devices and operator's hands rather than at the operator.
- Ceiling ionizers should be oriented in relation to the work surfaces in keeping with the ionizer manufacturer's instructions.
- Devices should not be brought closer to the ionizer than specified by the ionizer manufacturer.
- There should be an unrestricted, straight line air flow between the ionizers and the unprotected devices.
- Ionizer balance (positive and negative ions) should be verified according to Table 2 of the JEDEC Standard JESD625-A.
- Ionizer charge decay performance should be verified using the method described in EOS/ESD-S3.1 according to Table 2 of the JEDEC Standard JESD625-A.

- ESD Protective Smocks: When worn, ESD protective smocks must accomplish the following:
  - The ESD protective smocks must be buttoned (except for the collar) whenever the wearer is at an ESD protected workstation or in a designated ESD protected area.
  - The ESD protective smock manufacturer's cleaning instructions should be followed to gain maximum effectiveness and utility from the smocks.
- Gloves: Only static dissipative Nitrile gloves are used when handling ESDS devices.

Device Handling
This is a general guideline. Imaging sensors must be handled in an ESD safe area. A ground strap is required when handling the sensors in a non-ESD safe area. ESD safe gloves must be used.

While handling imaging sensors:
- Wear mouth protection (face mask) to minimize the risk of contaminating the glass lid through saliva or other particles.
- Wear gloves that are ESD safe. The gloves must be clean. Contaminated or dirty gloves need to be changed or cleaned.
- Finger tips of the gloves should be tight to reduce the risk of contaminating the glass lid.
- Always handle image sensors at the package; never touch the glass lids.
- Handle the pin grid package (PGA package) carefully to avoid bending the pins.

Static charge can be generated during in-process assembly and testing. The devices should be allowed to slowly discharge any potential charge buildup generated during unpacking the devices or when removing devices from test sockets. Allow the charge to dissipate in an ionized air stream before shorting the leads together.

Cover Glass Cleaning

Purpose of Cleaning the Cover Glass
The packaging of image sensors requires high levels of cleanliness. High quality glass windows are used instead of typical ceramic or plastic encapsulation methods. In some sensors, special coating is placed on the glass to control spectral properties.

Special handling precautions are required to prevent scratching, chipping, and particulate or other contamination of the glass and/or coatings.

In particular, electronic module assembly processes involving image sensors can expose the sensor cover glass to particles or contaminants. Cypress recommends that all handling and assembly processes be audited and modified to reduce the risk of exposure to particles or contaminants. In the event that such exposure cannot be completely eliminated, it may be necessary to clean the cover glass. The following are Cypress recommendations for proper cleaning of the glass.

Procedure for Cleaning the Cover Glass
Perform the cleaning in an ESD safe protected workstation. Always wear an ESD wrist strap. Do not touch the cover glass with fingers or anything other than a cleaning paper as recommended in this section. Finger grease can etch optical coatings and cause permanent damage. The gloves should be static and powder free. Gloves should be static dissipative Nitrile gloves.

Materials:
- Clean compressed nitrogen
- IPA, preferably extra pure, or VLSI grade
- ESD protective Wipe: recommended type S1091PRT from Puritech or RTMKC002 from distributor Hans J. Michael GMBH
- ESD protective gloves for example: Nitrile Glove, NiProTect CC529

Method A: Blow Off
This method is applicable for loose particle contamination. This is the only method that guarantees no residues such as drying spots.

- Remove particles from the glass by blowing with an ionized-N2 gun.
- Do not blow towards the other parts. If you work under a flow box, try to blow out of the box.
Method B: Isopropyl Alcohol (IPA) Clean

- Use only wet wipes, lay it on the sensor, and pull it from one side to the other. Ensure that the wipe is wet over the whole sensor.
- Wipe very gently, do not rub the surface because many cover glasses have a coating that is sensitive to damage (especially AR-coatings). Be careful when rubbing close to the glass edges.
- Never use the original IPA bottle to dip the wipe. This might contaminate the whole bottle.
- Cleaning with fluid might leave staining. Use less IPA to reduce the residue, but use enough IPA to not damage the surface because the wipe is too dry.

Caution on Cleaning Agents

- Use IPA only to clean the image sensor lid glass. Other solvents can contaminate the glass, attack the resin and sealant, and degrade reliability of the package.
- Do not use acetone because it attacks the resin that glues the cover glass to the package.
- Do not use methanol due to its toxicity and low quality cleaning properties.

If the surface is not clean, repeat these procedures. If the contaminant is not removed in two or three wipes, it is possible that the cover glass is permanently damaged. Inspect the device in optical microscope for permanent damage.

Sensor Mounting and Soldering Considerations

Mounting for SMD

- Image sensors require special considerations when soldering to printed circuit boards. Image sensors with filter arrays (CFA) and micro-lens are especially sensitive to high temperatures. Prolonged heating at elevated temperatures may result in deterioration of the performance of the sensor.
- The cover glass, with or without coatings, is sensitive to contamination. Avoid spilling solder flux on the cover glass and particularly glass with coatings. Avoid mechanical or particulate damage to the cover glass.

Pin Grid (Hand Soldering)

When a soldering iron is used to solder devices to a through-hole board, the following conditions should be followed:

- Use a soldering iron with temperature controlled tip (30-80W).
- The soldering iron tip temperature should not exceed 350°C.
- The soldering period for each pin should be less than three seconds.

Pin Grid (Wave Soldering)

Preferably, place image sensors in a PGA package in a socket, where the socket, and not the image sensor, is subjected to the mounting reflow procedures such as IR, convection, or wave soldering.

CAUTION

- Do not place the image sensor in the socket during the reflow process.
- Do not mount PGA packages using IR or convection solder reflow. Wave soldering is preferable for mounting PGA packages, if a socket is not used.

CSP (BGA) Handling

For Chip Scale Packaging assembly process, follow J-STD’s number 7 and IPC standards number to prevent failure.

Solder Paste and Flux

Solder Paste should be compatible with the BGA’s solder. For details refer to data sheet number. The flux type should be no-clean and Halide-free (no corrosive residue is allowed).

Reflow Profile

In general, reflow profile considerations rely upon PCB material, solder paste manufacturer recommendations and the other electronic components on the same board. The package thickness and volume can affect the reflow profile requirement. Refer to the package dimensions on the product data sheet and the Jedec Standard JSTD020D6 Table 4-1 and Table 4-2.

IS parts may be moisture sensitive; use proper handling and baking techniques according to the moisture sensitivity classification.

Storage of Image Sensors

Cypress Semiconductor sells a variety of image sensors in die and wafer form as well as in packages, including both sealed and unsealed cavity packages and chip scale packages.

The following recommendations are for seal cavity and chip scale packages. In the case of sensors provided in a wafer die or unsealed packages, contact Cypress directly for storage instructions.

With sealed cavity packages, the cover glass sealant is typically an organic resin which is permeable to moisture. Long term exposure to high humidity environments should be avoided. Devices should be carefully stored in dry air or nitrogen environments.
In the case of surface mount devices, the sensor should be stored and baked prior to mounting in accordance to moisture sensitivity level of the device (refer to JDEC standard). Image sensors should be stored in their first-level packing container, in a dark, dust-free, enclosed environment with the following conditions:

- Temperature 20°C to 40°C
- Relative humidity between 30% and 60%

**CAUTION**

Avoid exposure to the following storage conditions:

- Direct sunlight: Carriers (tubes, trays, or single unit carriers) may deform or color filter arrays may fade.
- Corrosive gases: Leads and pins may oxidize or corrode.
- Excessive mechanical loads: Devices may be damaged if heavy objects are stacked on packing boxes.
- Ionizing radiation: Imaging defects may be induced.
- Electromagnetic fields: Imaging defects may be induced.
- Static electricity: Device may suffer catastrophic damage.

**References**


2. White paper: *A Case for Lowering Component Level HBM/MM ESD Specifications and Requirements*.

3. IPC/JEDEC JESD625-A (December 1999) Requirements for handling electrostatic discharge sensitive (ESDS) devices.

4. IPC/JEDEC Standard No. 22-C101B.01.

5. IPC-7095L: Chapter 6: Printed Circuit assembly design considerations and Chapter 7: Assembly of BGA on printed circuit boards.


8. IPC-610C: Acceptability of electrical assemblies.
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