3 General Safety Precautions and Usage Considerations

This section is designed to help you gain a better understanding of semiconductor devices, so as to ensure the safety, quality and reliability of the devices which you incorporate into your designs.

3.1 From Incoming to Shipping

3.1.1 Electrostatic Discharge (ESD)

When handling individual devices (which are not yet mounted on a printed circuit board), be sure that the environment is protected against electrostatic electricity. Operators should wear anti-static clothing, and containers and other objects that come into direct contact with devices should be made of anti-static materials and should be grounded to earth via an 0.5- to 1.0-MΩ protective resistor.
Please follow the precautions described below; this is particularly important for devices which are marked "Be careful of static.".

3.1.1.1 Work Environment

(1) When humidity in the working environment decreases, the human body and other insulators can easily become charged with static electricity due to friction. Maintain the recommended humidity of 40% to 60% in the work environment, while also taking into account the fact that moisture-proof-packed products may absorb moisture after unpacking.

(2) Be sure that all equipment, jigs and tools in the working area are grounded to earth.

(3) Place a conductive mat over the floor of the work area, or take other appropriate measures, so that the floor surface is protected against static electricity and is grounded to earth. The surface resistivity should be 10^4 to 10^8 Ω/sq and the resistance between surface and ground, 7.5×10^5 to 10^8 Ω

(4) Cover the workbench surface also with a conductive mat (with a surface resistivity of 10^4 to 10^8 Ω/sq, for a resistance between surface and ground of 7.5×10^5 to 10^8 Ω) . The purpose of this is to disperse static electricity on the surface (through resistive components) and ground it to earth. Workbench surfaces must not be constructed of low-resistance metallic materials that allow rapid static discharge when a charged device touches them directly.

(5) Pay attention to the following points when using automatic equipment in your workplace:

(a) When picking up ICs with a vacuum unit, use a conductive rubber fitting at the end of the pick-up wand to protect against electrostatic charge.

(b) Minimize friction on IC package surfaces. If some rubbing is unavoidable due to the device's mechanical structure, minimize the friction plane or use material with a small friction coefficient and low electrical resistance. Also consider the use of an ionizer.

(c) In sections that come into contact with device lead terminals, use a material that dissipates static electricity.

(d) Ensure that no statically charged bodies (such as work clothes or the human body) touch the devices.

(e) Make sure that sections of the tape carrier which come into contact with installation devices or other electrical machinery are made of a low-resistance material.

(f) Make sure that jigs and tools used in the assembly process do not touch devices.

(g) In processes in which packages may retain an electrostatic charge, use an ionizer to neutralize the ions.

(6) Make sure that CRT displays in the working area are protected against static charge, for example by a VDT filter. As much as possible, avoid turning displays on and off. Doing so can cause electrostatic induction in devices.

(7) Keep track of charged potential in the working area by taking periodic measurements.

(8) Ensure that work chairs are protected by an anti-static textile cover and are grounded to the floor surface by a grounding chain. (Suggested resistance between the seat surface and grounding chain is 7.5×10^5 to 10^{12} Ω/sq.)

(9) Install anti-static mats on storage shelf surfaces. (Suggested surface resistivity is 10^4 to 10^8 Ω/sq; suggested resistance between surface and ground is 7.5×10^5 to 10^8 Ω/sq.)

(10) For transport and temporary storage of devices, use containers (boxes, jigs, bags) that are made of anti-static materials or of materials that dissipate electrostatic charge.

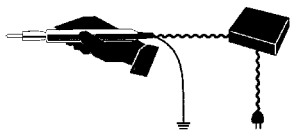
(11) Make sure that cart surfaces which come into contact with device packaging are made of materials that will conduct static electricity, and verify that they are grounded to the floor surface with a grounding chain. (The suggested resistance between the cart surface and grounding chain is 7.5×10^5 to 10^{10} Ω/sq.)

(12) In any location where the level of static electricity is to be closely controlled, the ground resistance level should be Class 3 or above. Use different ground wires for all items of equipment which may come into physical contact with devices.

3.1.1.2 Operating Environment

(1) Operators must wear anti-static clothing and conductive shoes (or a leg or heel strap).

(2) Operators must wear a wrist strap grounded to earth via a resistor of about 1 MΩ.



(3) Soldering irons must be grounded from iron tip to earth, and must be used only at low voltages (6 V to 24 V).

(4) If the tweezers you use are likely to touch the device terminals, use anti-static tweezers and in particular avoid metallic tweezers. If a charged device touches a low-resistance tool, rapid discharge can occur. When using vacuum tweezers, attach a conductive chucking pat to the tip, and connect it to a dedicated ground used especially for anti-static purposes (suggested resistance value: 10^4 to 10^8 Ω).

(5) Do not place devices or their containers near sources of strong electrical fields (such as above a CRT).

(6) When storing printed circuit boards which have devices mounted on them, use a board container or bag that is protected against static charge. To avoid the occurrence of static charge or discharge due to friction, keep the boards separate from one other and do not stack them directly on top of one another.

(7) Ensure, if possible, that any articles (such as clipboards) which are brought to any location where the level of static electricity must be closely controlled are constructed of anti-static materials.

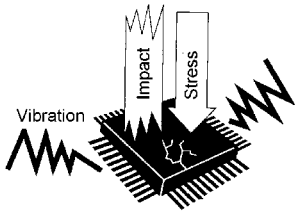
(8) In cases where the human body comes into direct contact with a device, be sure to wear anti-static finger covers or gloves (suggested resistance value: 10^8 Ω or less).

(9) Equipment safety covers installed near devices should have resistance ratings of 10^9 Ω or less.

(10) If a wrist strap cannot be used for some reason, and there is a possibility of imparting friction to devices, use an ionizer.

(11) The transport film used in TCP products is manufactured from materials in which static charges tend to build up. When using these products, install an ionizer to prevent the film from being charged with static electricity. Also, ensure that no static electricity will be applied to the product's copper foils by taking measures to prevent static occuring in the peripheral equipment.

3.1.2 Vibration, Impact and Stress



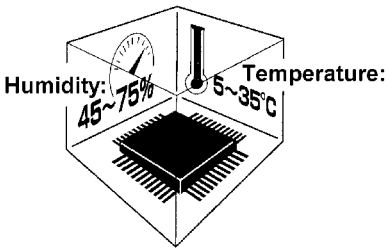
Handle devices and packaging materials with care. To avoid damage to devices, do not toss or drop packages. Ensure that devices are not subjected to mechanical vibration or shock during transportation. Ceramic package devices, and devices in canister-type packages which have empty space inside them, are subject to damage from vibration and shock because bonding wires are secured only at their ends. Plastic molded devices, on the other hand, have a relatively high level of resistance to vibration and mechanical shock because their bonding wires are enveloped and fixed in resin. However, when any device or package type is installed in target equipment, it is to some extent susceptible to wiring disconnections and other damage from vibration, shock and stressed solder junctions. Therefore when incorporating devices into the design of vibration-prone equipment, the structural design of the equipment must be thought out carefully.
If a device is subjected to especially strong vibration, mechanical shock or stress, the package or the chip itself may crack. In products such as CCDs which incorporate window glass, this could cause surface flaws in the glass or cause the glass connection to separate.
Furthermore, it is generally known that stress applied to a semiconductor device through the package changes the resistance characteristics of the chip because of piezoelectric effects. In analog circuit design, attention must be paid to the problem of package stress as well as to the dangers of vibration and shock as described above.

3.2 Storage

3.2.1 General Storage

(1) Avoid storage locations where devices will be exposed to moisture or direct sunlight. (Be especially careful during periods of rain or snow.)

(2) Do not place device cartons upside down. Stack cartons on top of one another in an upright position only; do not place cartons on their sides.



(3) The storage area temperature should be kept within a temperature range of 5°C to 35°C, and relative humidity should be maintained at between 45% and 75%.

(4) Do not store devices in the presence of harmful (especially corrosive) gases, or in dusty conditions.

(5) Use storage areas where there is minimal temperature fluctuation. Rapid temperature changes can cause moisture to form on stored devices, resulting in lead oxidation or corrosion. As a result, the solderability of the leads will be degraded.

(6) When repacking devices, use anti-static containers.

(7) Do not allow external forces or loads to be applied to devices while they are in storage.

(8) If devices have been stored for more than two years, their electrical characteristics should be tested and their leads should be tested for ease of soldering before they are used.