

WCSP Handling Guide



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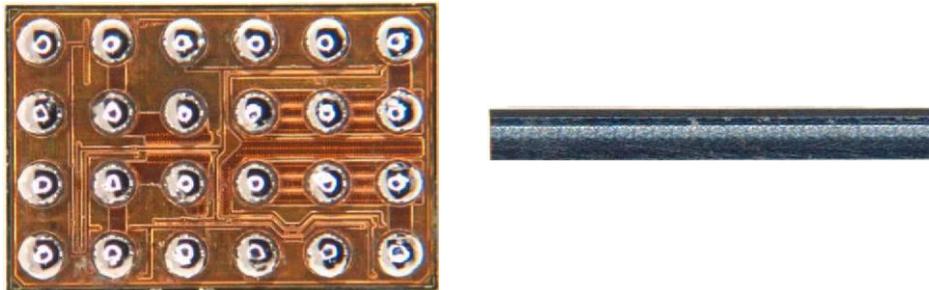
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WCSP Information

What is WCSP?

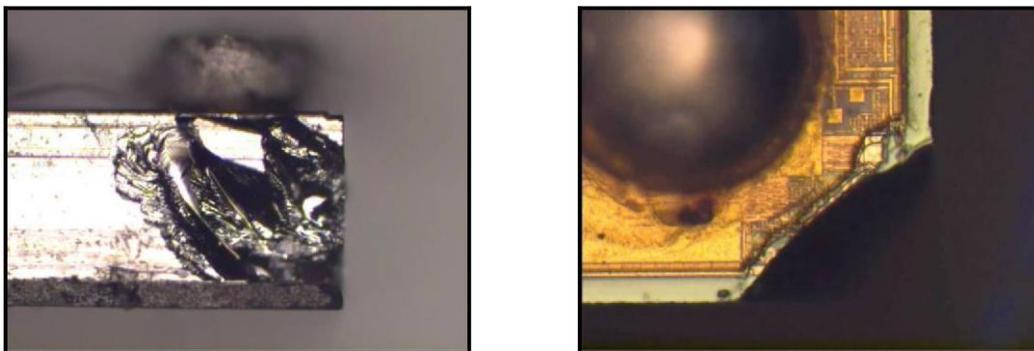
Wafer Chip Scale Package (WCSP) is the term used to describe fully assembled units that remain of the form the bare die. Rather than placing a singulated die in a protective hermetic package, such as is done with QFN or QFP packages, WCSP units are ready for application by placing a Ball Grid Array (BGA) and ReDistribution Layer (RDL) directly onto the die.



Images of a representative WCSP device

Why is handling important?

The nature of WCSPs means that when handling the device, the user is essentially handling a bare die. Die are built upon a crystalline silicon structure which, if handled improperly, can result in cracks developing in the silicon which can easily propagate through the crystal lattice further into the device, potentially reaching the active surface of the die and irrecoverably affecting device operation. Proper handling techniques can limit such damage.



Examples of severe mechanical damage to WCSP device

WCSP Information

When is a die handled?

For the most part, WCSP handling is performed by machine processes. This includes the flow from fabrication to initial device testing to transit and board application at the customer site for production units. However, there are cases in which manual handling is required, at which times the WCSP devices are at the highest risk for accidental handling damage.

Manual handling is often required when the device undergoes procedures as a single unit rather than as part of a batch. For evaluation of singulated units off of the assembly line, manual handling is performed during Automated Test Equipment (ATE) characterization. For units returned from customer sites, a greater amount of handling is required in order to remove the units from their PCB application, for reball work, and for ATE testing. A significant amount of manual handling also occurs during Failure Analysis (FA), which includes inspection and destructive techniques. Mishandling during any of these procedures can irreversibly damage the WCSP device.

Handling Techniques

Battery-Powered Vacuum System

The preferred method for manual handling involves utilizing a vacuum pen system. A vacuum system uses moderate suction power to lift and manipulate the WCSP device, preventing compression or shearing mechanical damage to the silicon bulk edges.

This vacuum system solution works best with smaller WCSP devices for which the device is light enough for the vacuum to maintain a satisfactory hold. To best accomplish this, interchangeable vacuum pen tips with inner diameters within a certain range are necessary. If the opening is too small, the surface area of the die that is exposed to the vacuum may not be large enough to maintain a strong hold as even a slight jarring effect on the die could dislodge the tip. Too large, and the tip may not be able to grasp onto a continuous flat surface. An inner diameter size of 250um has worked well for this purpose. Tip material often comes in Delrin thermoplastic for normal use, or Torian polyimide for high-heat applications.



Example of battery-powered vacuum pen kit



Delrin vacuum pen tip

Handling Techniques

ESD-safe plastic tweezers

Some WCSP devices are large enough that the vacuum pen system is ineffective – the devices are too massive for the moderate vacuum to maintain a sufficient hold. In these cases, tweezers must be used. However, the types of tweezers used for this task are critical. Only plastic, ESD-safe, tweezers are permitted for manual handling of large WCSP devices. The plastic will flex when in contact with die edges, limiting localized stress to the silicon lattice while still allowing a firm grip. The user must still take care to hold the device firmly enough that the die does not come loose during handling, but not strongly enough to cause damage to the die. The firmness required should become evident with practice. Curved, precision-tip, ESD-safe plastic tweezers are a good choice for manual handling of large WCSP devices.



ESD-safe precision-tip plastic tweezers

DO NOT USE: metal tweezers

In no event should metal tweezers ever be used when handling WCSP devices or bare die of any kind. The rigid nature of metal tweezers means that they do not flex when coming into contact with the surface it is intended to grasp, thus the force of the tweezers transfers directly to highly localized surfaces on the die edges, easily causing chips and fractures in the silicon crystal lattice.



Transportation Method

ESD-safe foam boxes

For transport of individual devices, or a small group of devices, foam ESD-safe boxes are an effective solution. However, the foam inserts must exhibit small voids only, or the WCSP devices (if they are small enough) could fall partially into the voids causing unnatural die stress when closed. 2"x2" ESD-safe boxes have been found to work well.



Small ESD-safe box with foam inserts

Transportation Method

ESD-safe waffle grid boxes

In the event that a significant number of devices must be transported, waffle-pack grid boxes are a preferred option. In foam ESD-safe boxes; devices may relocate when the box is opened, and potentially permitting a mix-up of unlabeled units. The grid will keep units separated during transport. However, it must be noted that the grid size of the waffle-pack boxes must be close to the size of the devices to be transported. If too much room is allowed, the device could become damaged by forceful contact with the grid edges during movement since there is no foam to keep the devices rigidly in place.

Note that the waffle pack grids, like the example shown below, will require covers and clips to completely enclose and secure the units to be transported.



Waffle pack bottom grid

Transportation Method

ESD-safe gel surface boxes

If neither foam nor waffle grid ESD boxes are desired, a final transport option are ESD-safe boxes incorporating a gel material placed onto an interior surface of the package. If gel of an acceptable adhesion quality is chosen, the device will remain adhered in place, but still be loose enough to allow removal and manipulation without excessive force being required. The gel surface box solution is not without risk, however, as jarring force to the box, such as dropping it, can dislodge devices.



ESD-safe gel surface box

Transportation Method

ESD-safe ant-static bags

No matter what ESD-safe box is chosen to contain the WCSP devices for transport, the box must be secured in an undamaged ESD-safe static shielding bag. Since the ESD-safe boxes are not completely sealed, paths still remain for outside electrical charges to affect the devices inside. Securing the box in an ESD-safe static shielding bag adds an extra layer of protection. These bags also permit easy transportation, and can help prevent loss of or damage to the devices in case the boxes open during transit.

Take care that the bags to be used are not perforated by tears or holes, as damage to the bags will break the anti-static protection. If a bag must be stapled to documentation for transit, a good recommendation would be to use zip-top bags like those shown below, and staple only the lip of the bag to the documentation. The body of the bag will still be able to protect the box inside since the zipper creates a properly-closed seal.



ESD-safe static shielding bags

Transportation Method

DO NOT USE: masking or carbon tape

At no time should masking, carbon, or any other type of tape be used to restrain units in an ESD box. One major issue with this method is that the tape is likely fully highly conductive or insulated, which can readily cause ESD damage to the devices. Another problem is that the high adhesive quality of these common types of tape can make it very difficult to separate the units, enabling mechanical damage, and adhesive residue can transfer onto the units.

DO NOT USE: ESD-safe bag singularly

Placing WCSP units into an ESD-safe bag without first securing them in an ESD-safe box permits mechanical damage from numerous sources during transportation. An ESD-safe box should always be used to transport WCSP units, and the box placed into an ESD-safe static shielding bag.

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