ARDENT CONCEPTS
Signal Integrity is our Passion

APPLICATION NOTE

Document # AE-AN-SK-003

High Performance BGA/LGA Socket Use and Maintenance

RC Spring Probe™ Test Sockets

2 Piece Insulator System

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INTRODUCTION

Ardent BGA and LGA sockets are composed of a metal guide plate, plastic interposer subassembly, stiffener assembly, and mounting hardware. Guide plates and board stiffeners are either stainless steel or green anodized aluminum. The DUT interface is a plated screw-machined beryllium copper contact element shaped as a reduced four point crown and the PCB interface is a plated beryllium copper wireform wire lead .003" in diameter. To protect the board side of the socket, the socket is shipped with a Lexan plate bolted between the socket and the stiffener assembly. **This plate should be installed when transporting, shipping and handling of the socket.** This plate also doubles as a vacuum manifold assembly fixture. The stiffener assembly can be comprised of a single metal plate with support posts or the metal plate and a detachable plastic stiffener pad.

SOCKET ASSEMBLY DRAWING EXPLODED VIEWS AND DETAILS

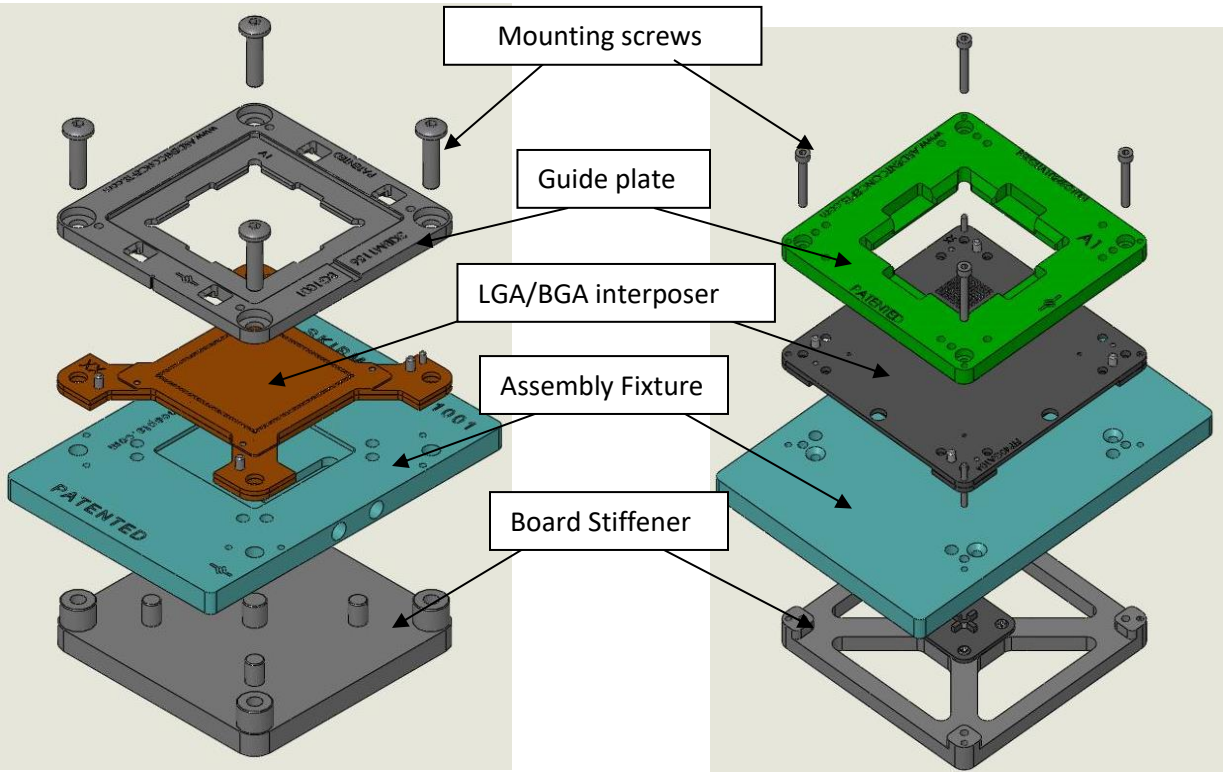


Figure 1: BGA and LGA socket anatomy

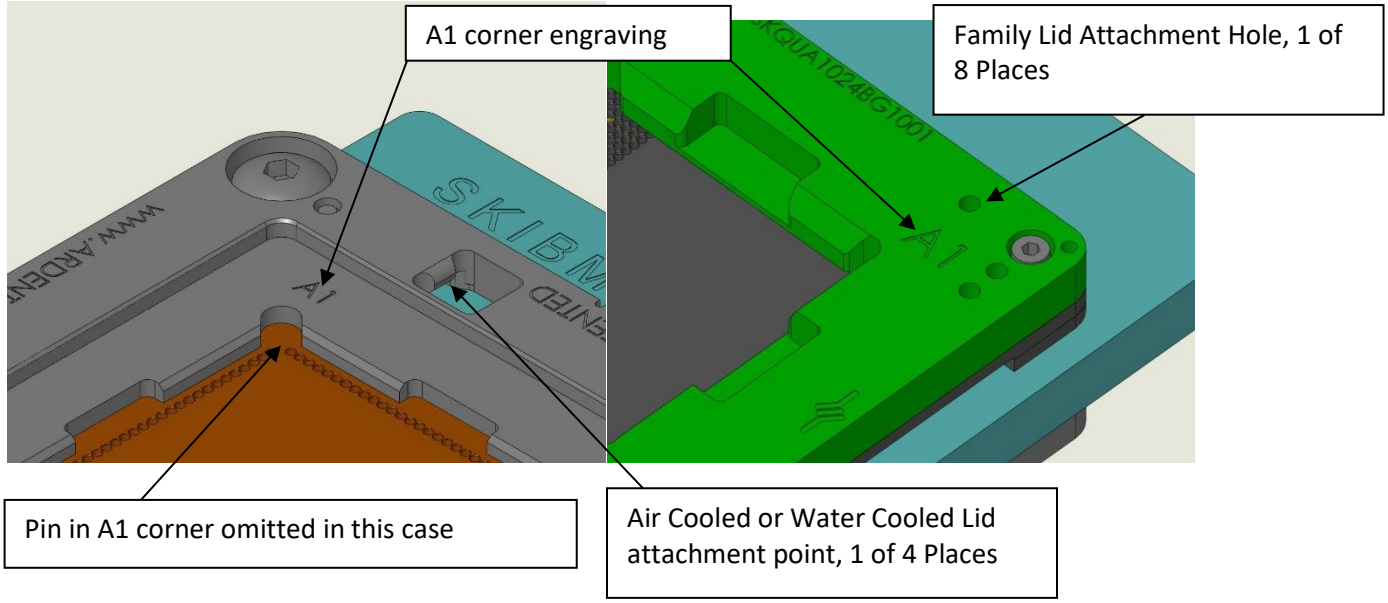


Figure 2: The A1 corner is indicated with an engraving or an omitted pin. Lids can be hooked on or bolted down.

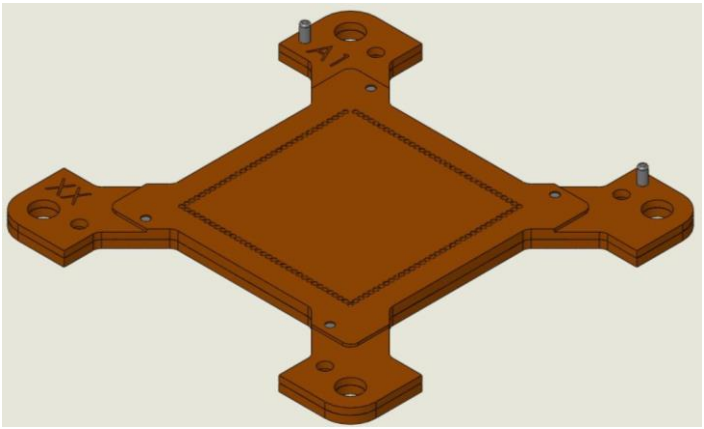


Figure 3: BGA or LGA Interposer Subassembly with press fit alignment dowels pins. This is the modular component of the Ardent socket system which can be easily cleaned, repaired and replaced.

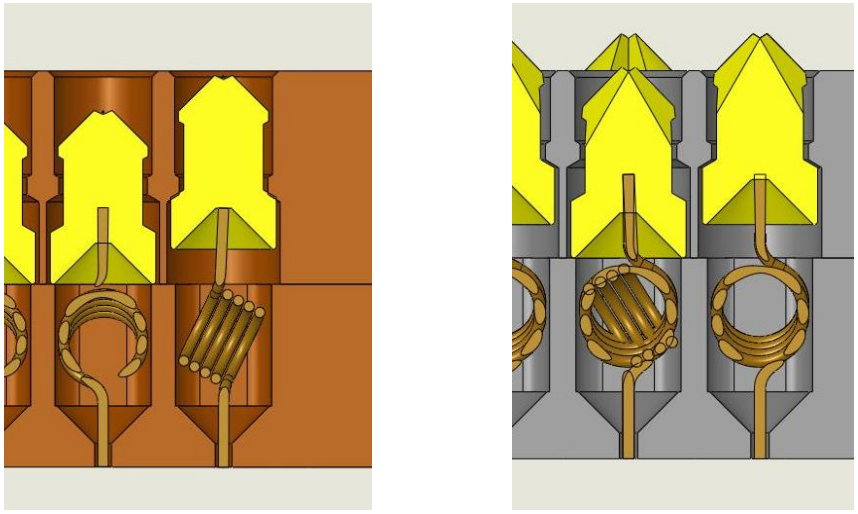


Figure 4: Interposer Sub-Assembly BGA cross section (left) and LGA cross section (right).

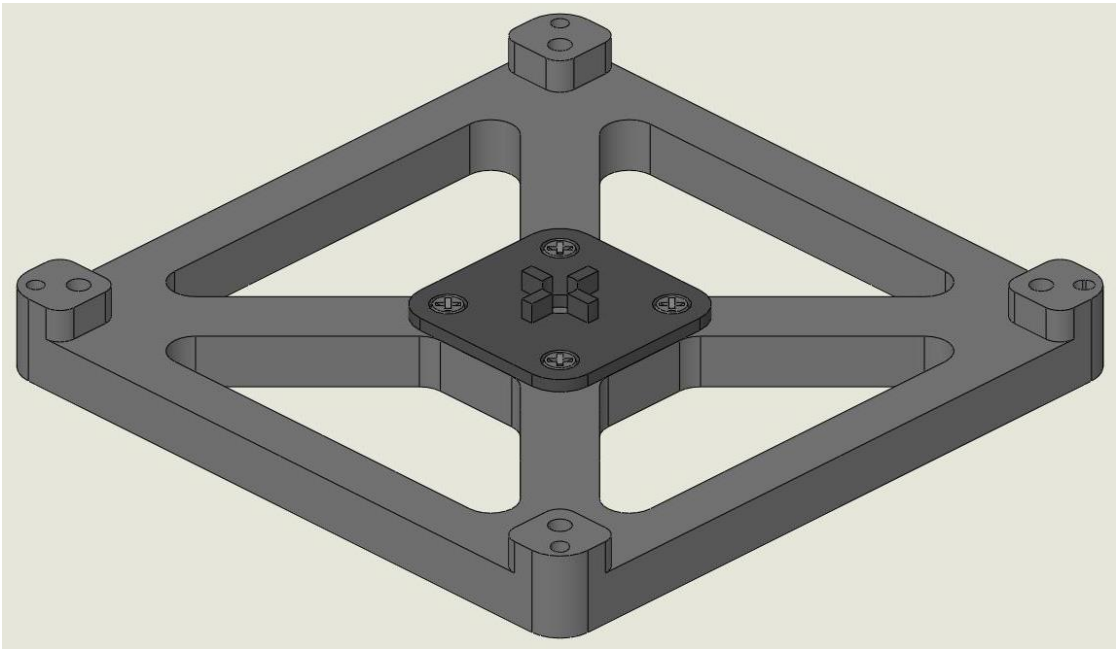


Figure 5: Typical Socket Stiffener assembly.

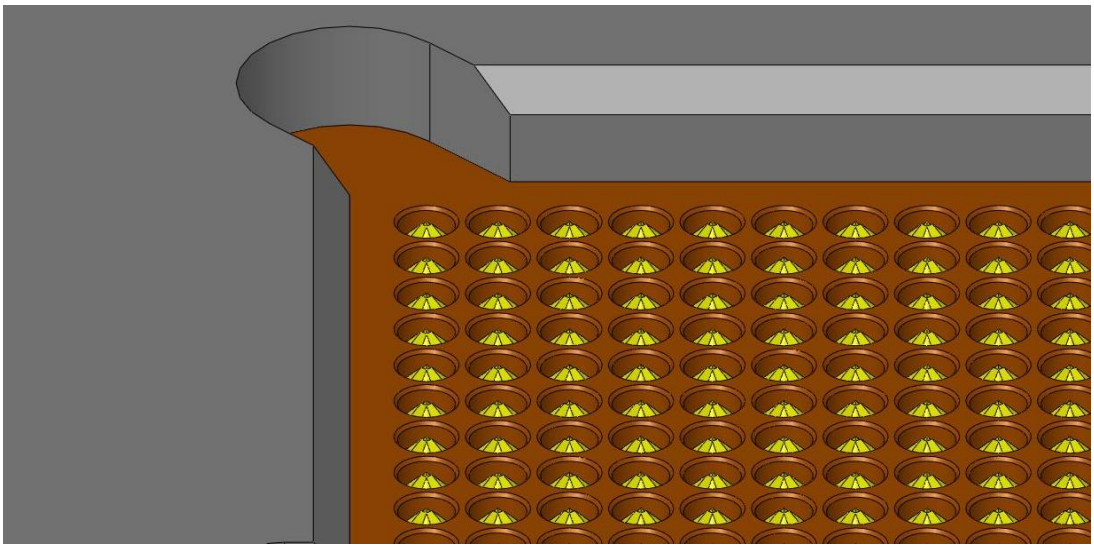


Figure 6: Socket Topside View (BGA), also referred to as the DUT side.

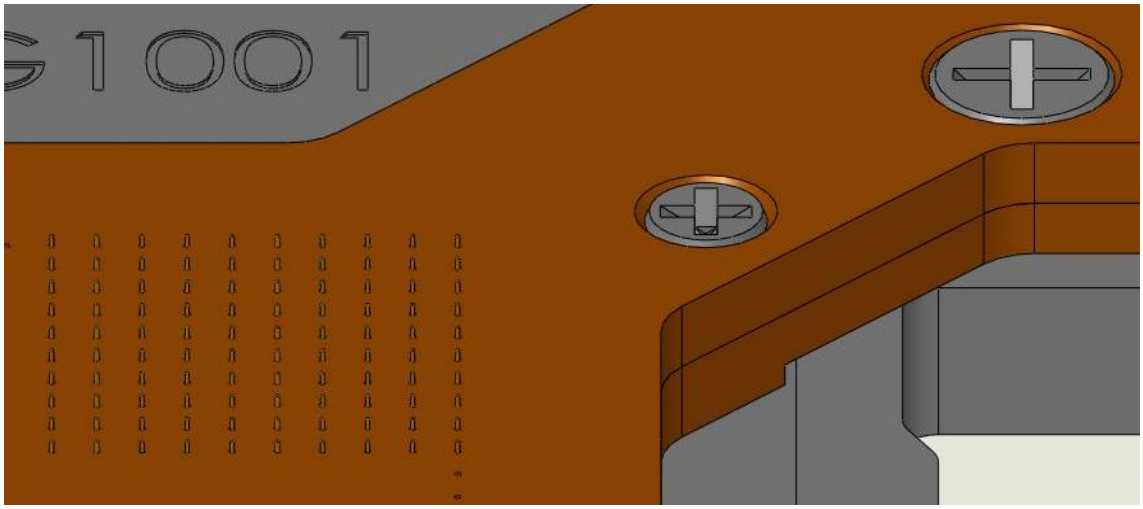


Figure 7: Countersunk #0 and M2 assembly screws on the bottom side of the socket.

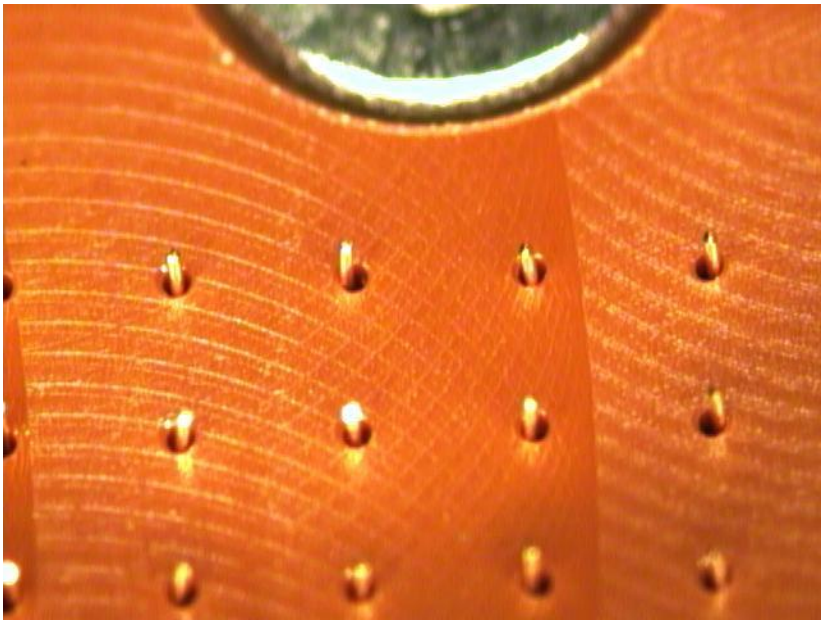


Figure 8: Socket Bottom Side View

THIS IS THE MOST CRITICALLY SENSITIVE COMPONENT OF THE ARDENT SOCKET SYSTEM. CARE SHOULD BE TAKEN TO NOT SUBJECT THE BOTTOM SIDE OF THE SOCKET TO CONTAMINANTS OF ANY KIND. THE SOCKET SHOULD NEVER BE PLACED ON A BENCH OR EXPOSED TO ANY SURFACE OTHER THAN THE PCB PADS OR THE SOCKET SHIPPING COVER'S FLAT SURFACE.

ONCE THE SOCKET IS PROPERLY MOUNTED ON THE PCB, THE RC SPRING PROBE PINS ARE SECURELY PRELOADED AND THE SYSTEM IS MUCH MORE STABLE.

SOCKET LIDS/ACTUATORS

BGA and LGA sockets are paired with several kinds of lids depending on the application. When there are no heat transfer requirements, a jack screw lid is used. This lid is sized according to the DUT ball count. For DUTs with 20x20 ball grid arrays and below, the 20GA lid is used. For DUTs with grid arrays between 20x20 and 50x50, the 50GA lid is used.

When heat transfer considerations have to be taken into account, the sockets can be paired with water and air cooled lids. Air lids use 60mm square 12V DC fans with or without PWM control. Both air and water cooled lids can be supplied with thermocouples as well as Peltier thermoelectric modules.

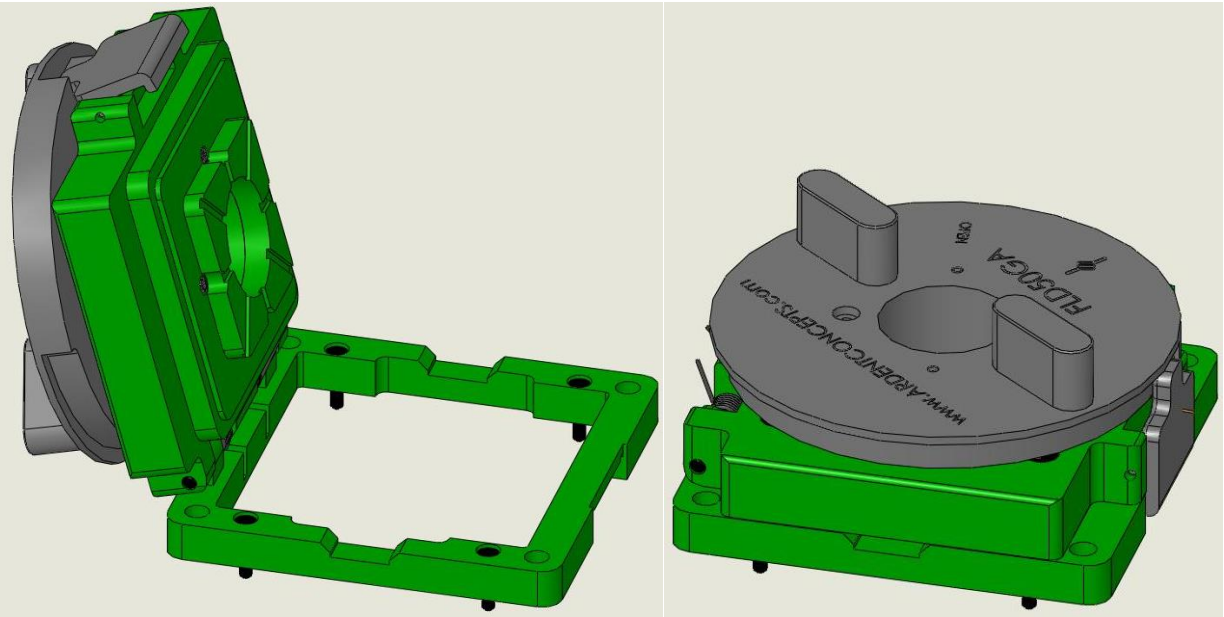


Figure 9: Family 50GA Lid in open and closed positions.

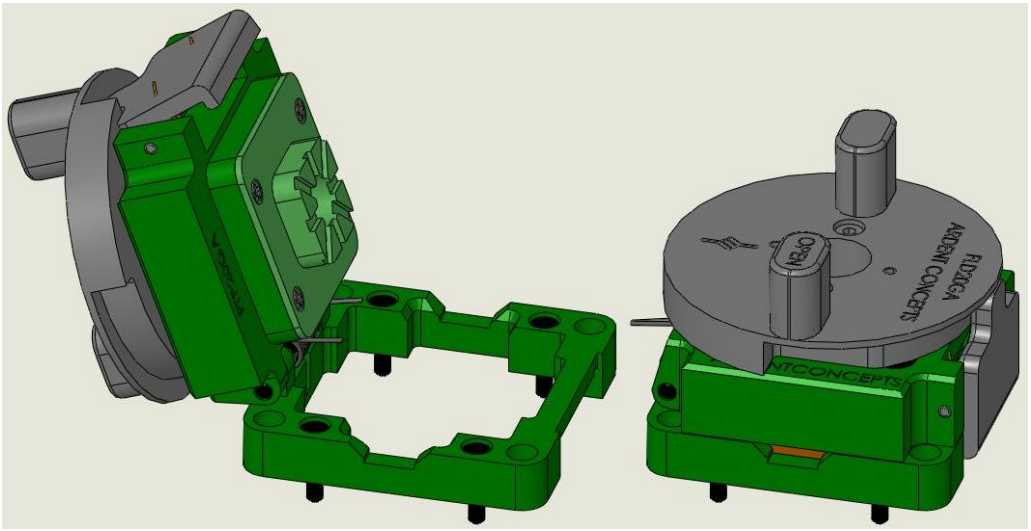


Figure 10: Family 20GA Lid in open and closed positions.

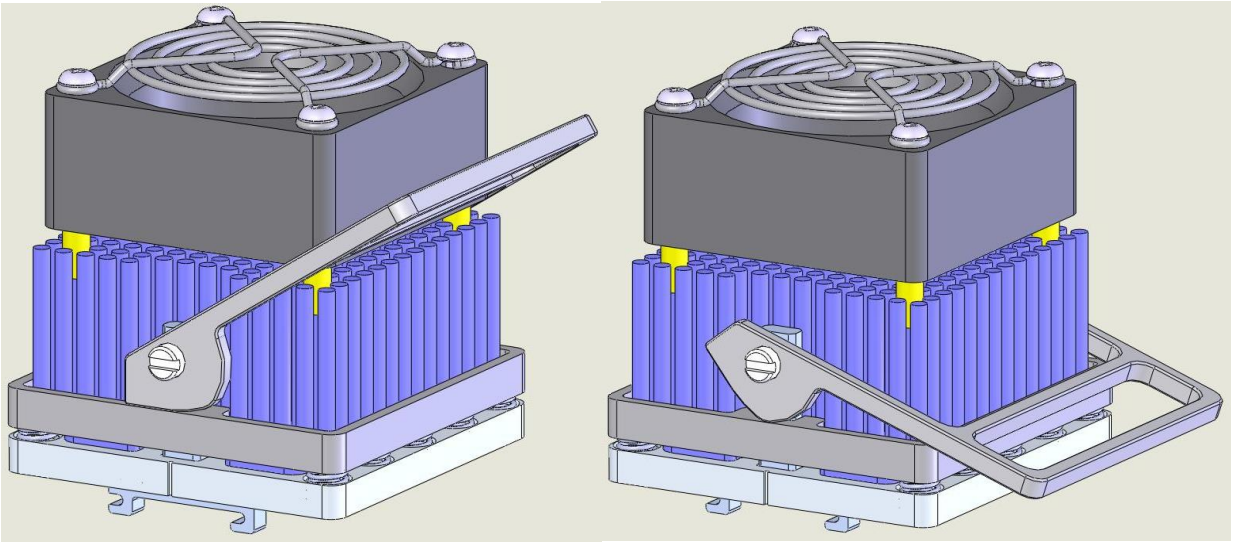


Figure 11: Air Cooled Lid in open and closed positions.

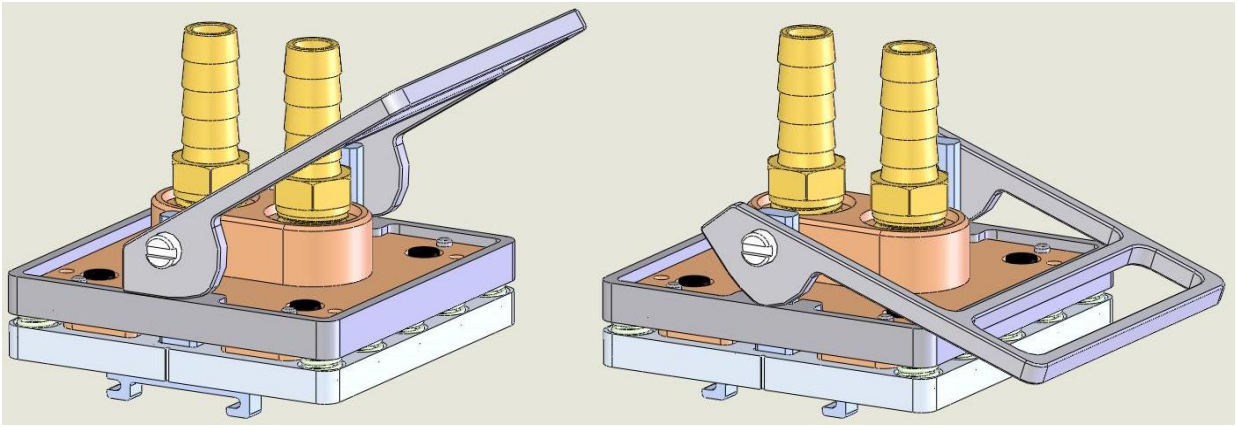


Figure 12: Water Cooled Lid in open and closed positions.

SOCKET PACKAGING

BGA and LGA sockets are shipped from the factory mounted onto the flat side of their assembly fixtures with fasteners and stiffeners. Figure 13 shows the two sides of the fixture and Figure 14 shows a typical shipping assembly.

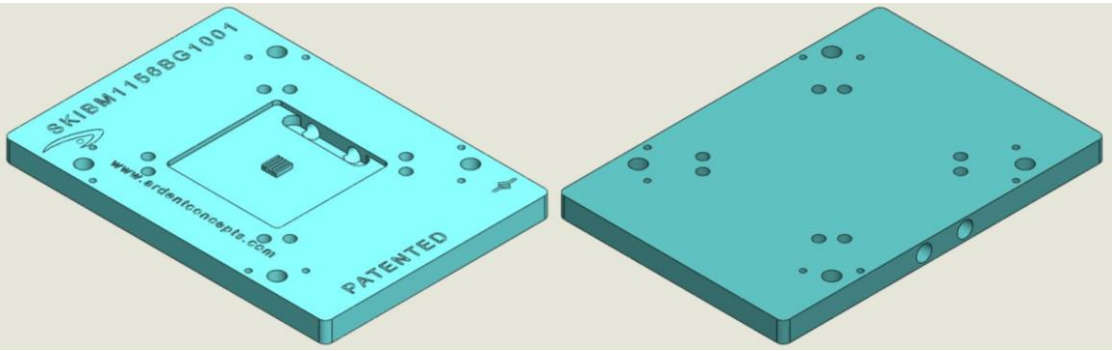


Figure 13: Cavity and flat sides of the assembly fixture. This part is made of clear ESD Lexan and doubles as a shipping cover. This is an important part of your socket and should be kept as a protected covering for the board side of the socket anytime it is not mounted on a PCB. If the socket ever needs to be returned to the factory, it should be shipped on flat side of this fixture mounted with fasteners and with a stiffener assembly.

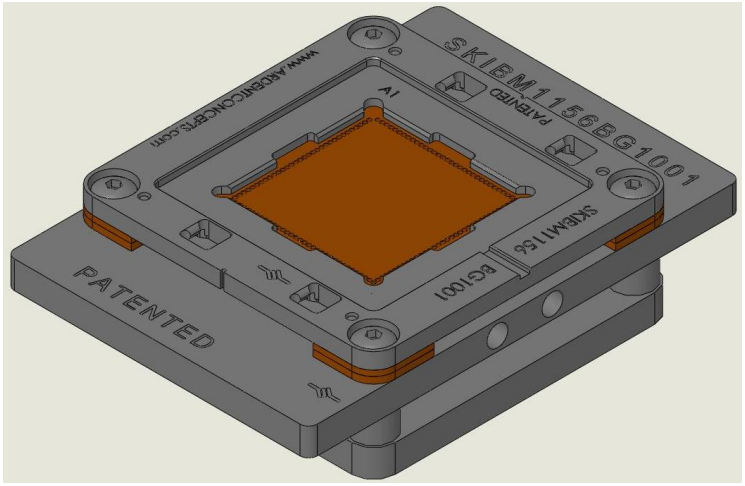


Figure 14: Typical shipping configuration for LGA and BGA sockets.

Sockets are shipped in a membrane box to protect them from drops during shipping and handling. Lids are typically packaged separately, inside an antistatic bag, bubble wrapped, and in a cardboard box.

Figure 15: Socket, Lid, and Shipping materials.

SOCKET INSTALLATION

Before You Begin

Ensure the following items have been shipped to you. Contact the factory if anything is missing or damaged.

- Socket Lid/Actuator
- Socket (assembly fixture and stiffener assembly attached)
- Spare mounting hardware

Consult the factory if the socket is to be used on boards with pads other than hard gold or if the socket is to be installed on a board that has had a BGA device soldered on it before.

Clean the bench top surfaces where you will be handling the socket to remove any dust, debris, or residue.

Board Preparation

Check the condition of the pads on your PCB under at least 7X magnification with a stereoscope at an angle with plenty of light. They should be clean and free of solder and solder paste resin. The entire pad array should be flat. To clean the pads, use 99% isopropyl alcohol or equivalent and a short-haired acid brush (McMaster-Carr p/n 7431T92, or equivalent) to brush away any contaminants.

If any solder rework needs to be done to the PCB in the area around the socket on the primary or secondary side of the board, complete that work before the socket is installed. After work is complete, inspect the contact pads on the primary side of the board thoroughly for solder or flux residue. Clean off solder until the gold underneath is exposed or until the pad is flat again. Scrub any resin off with alcohol and a brush.

Figure 16: Examining the board under a stereomicroscope.

Figure 17: Cleaning the board pads with alcohol and brush.

Mounting

Follow these steps to install the socket:

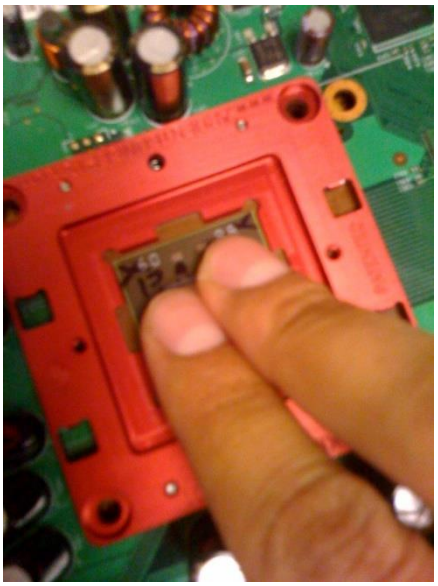
1) Remove the mounting screws that fasten the socket to the board stiffener using the appropriate hex wrench.
2) Lift the socket off its assembly fixture, position it over the board in the correct A1 orientation, and lower it slowly until the alignment dowels go into the dowel holes on the board. **Do not allow the board side of the socket to come in contact with any protruding components on the board.**
3) Drop the mounting screws into the counter-bored holes on the guide plate corners.
4) While holding the socket firmly against the PCB, position the board stiffener on the backside of the board so that the screws align with the tapped holes on the stiffener.
5) Turn the mounting screws on all four corners until they are hand tight.
6) If using a family lid, position the lid on top of the guide plate such that the handle does not interfere with board components in its open position.
7) Turn the lid mounting screws until hand tight.

SOCKET USE

Insertion and removal of BGA and LGA devices should be performed with vacuum pens.

IT IS CRITICAL THAT THE DEVICE BE PROPERLY SEATED IN THE SOCKET BEFORE THE LID IS ACTUATED.

TO ENSURE PROPER SEATING, PUSH DOWN ON THE CENTER OF THE DEVICE WITH YOUR INDEX AND MIDDLE FINGERS AND WIGGLE THE DEVICE SIDE TO SIDE OR IN A CIRCULAR MOTION WHILE PRESSING DOWN. THIS CHECK WILL TELL YOU IF THE BALLS ON THE DEVICE ARE PROPERLY ENGAGED IN THEIR CONTACT HOLES.



If using a Family lid, close the lid and turn the handle to its stopping point and begin testing.

If the resulting lid pressure is too much or not enough, lid adjustment will be necessary. See Family GA - Lid Adjustment Procedure AE-AN-SK-005 for more information.

If using an Air or Water Cooled lid, plug the fan connector, if supplied, into its plug on the board. Plug in the thermocouple and/or Peltier module leads to the board. Attach the water hoses to the water cooler lid fittings with appropriate hose clamps.

Slide the lid onto the socket so that its anchor hooks engage with the slots on the guide plate and until all the vertical faces of the lid base align with the vertical faces on the guide plate. At that point, the vertical grooves on the socket base will align with the grooves on the guide plate. Push the lever to its down position and begin testing.

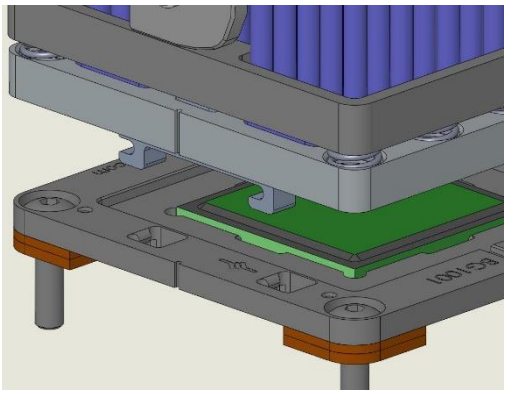


Figure 18: Air and Water cooled lids have four hooks on the bottom that engage with four slots on the guide plate. To fully seat the lid with the socket, the lid is lowered to engage the hooks then pushed back until the vertical grooves line up.

SOCKET MAINTENANCE

Work area must be clean – no debris from solder work, no contaminants from electrical tape, epoxy, or other adhesives and no solder paste residue, for example. Figure 19 below shows some common maintenance tools.

Figure 19: Stereoscope, ultrasonic bath, isopropyl alcohol, and short haired brushes.

Light Duty Cleaning

Many common airborne particles can cause opens, such as clothes fibers, skin flakes, and a variety of other contaminants that come with the devices from the factory. Figure 20 shows some of these particles. These can be removed from the socket with clean, dry, pressurized air as frequently as necessary. The air supply must be free of moisture and oil particles.

If air is readily available, it is good practice to do this before every insertion. If not, cleaning every 500 insertions is sufficient. This kind of simple cleaning should be done with the socket still installed on the PCB.

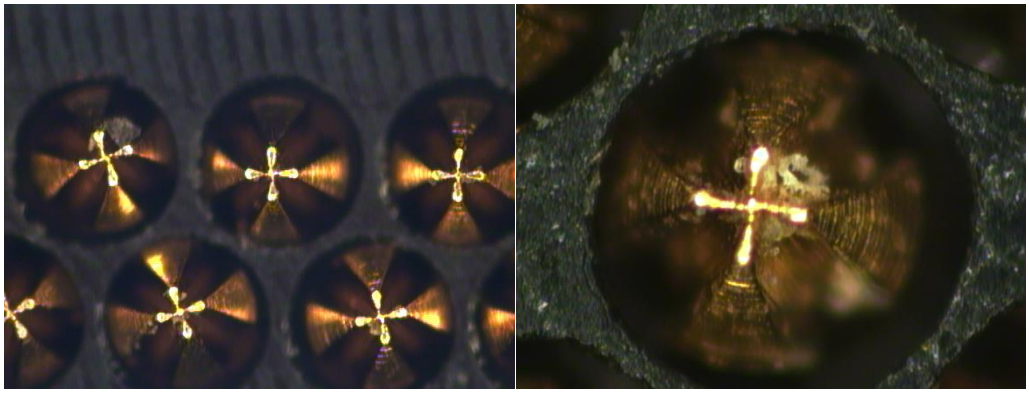


Figure 20: Particles that cling to the contact element side of the socket that can be removed with light cleaning.

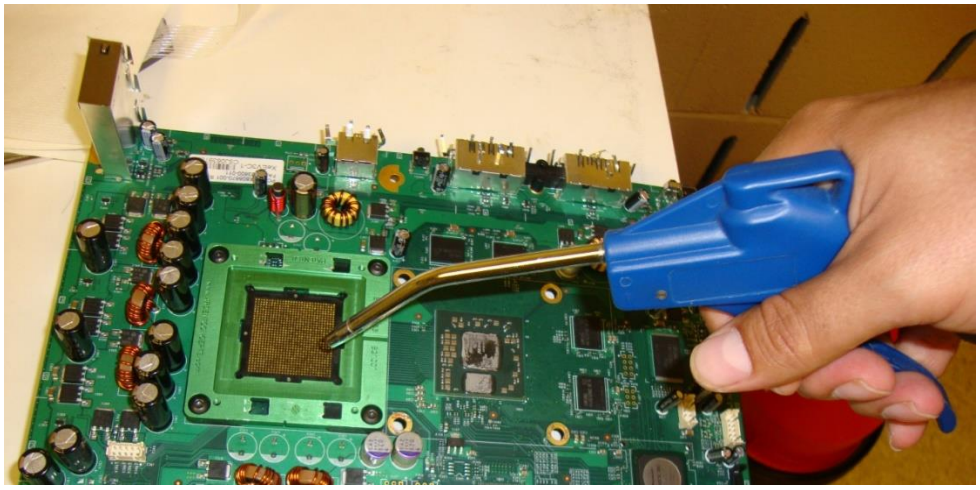


Figure 21: Socket being blown off while installed on PCB

Lever Lids Inspection and Lubrication

Lever lids parts are lubricated wherever rubbing occurs to prevent premature wear. This kind of wear is marked by a grainy feel to the lever when it is actuated, metal particles around the wear spots, and decrease in lid pressure. Periodic reapplication of lubricant prevents this from occurring. The factory recommends lubing every 500 cycles with Magnalube G high temperature grease (http://www.magnalube.com/magnalubeg.html), or equivalent.

The picture below shows where wear can occur. Grease should be applied at the contact points between the lever cam lobes and pressure foot shoulders.

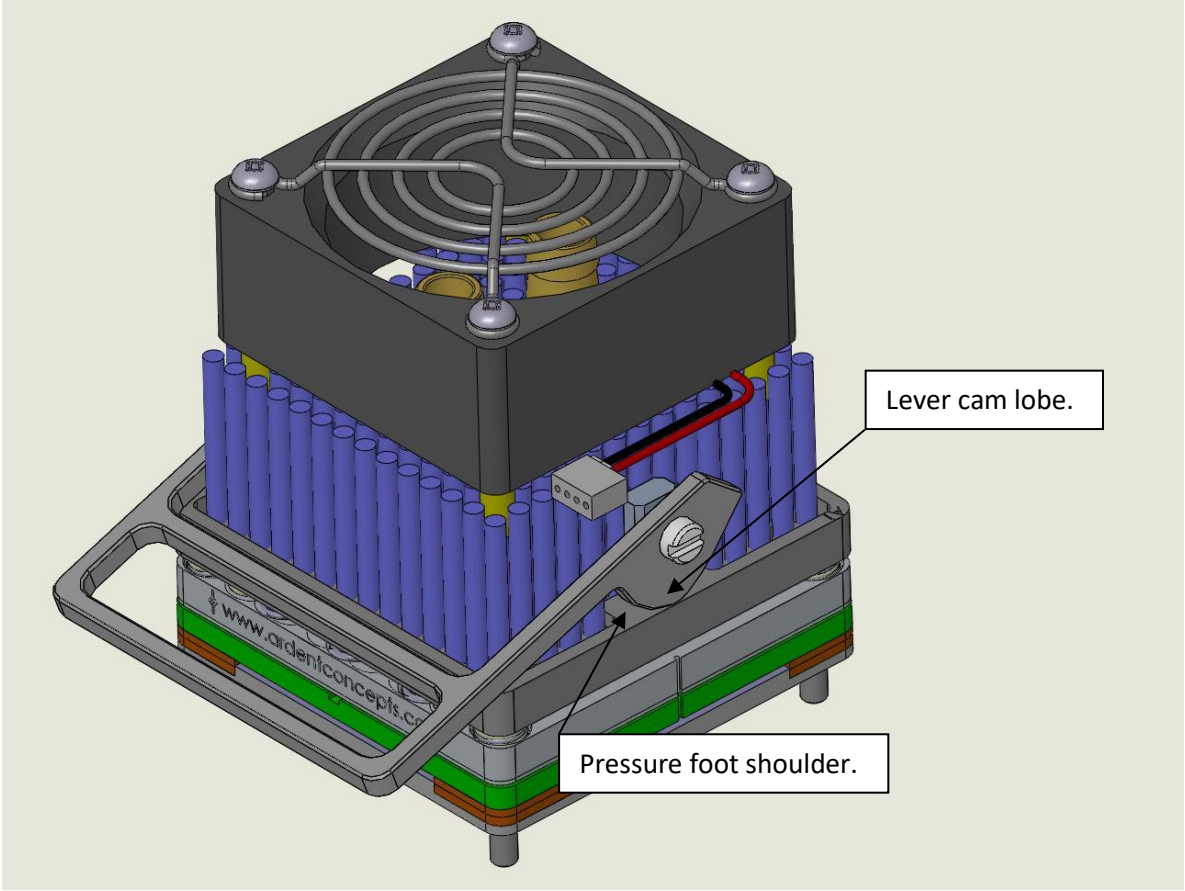


Figure 22: Places to look for wear in lever lid systems.

Medium Duty Cleaning

There are a few contaminants that will stick to the socket contact elements and to the top and bottom socket surfaces that cannot be readily removed with pressurized air alone. Examples are finger oils, skin lotion, solder flux resin, heat transfer paste, solder mask particles, and plastic wear debris.

This kind of cleaning requires that the socket be removed from the board and should be performed as needed, or at every 1,000 insertions.

While the socket is off the board, this is also a good time to check for more serious problems with the socket like bent or burnt pins, molten plastic, or shorts between the board and the socket fasteners.

Before starting work, be sure the work areas on the bench top are clean and free of any debris.

Detaching the Socket from the Board

If using a family lid, loosen the four lid mounting screws until they disengage from the threads on the guide plate but do not remove them from their counter-bored holes. Lift the lid off the socket, close it, and turn the handle to activate the latch. This will ensure the lid mounting screws are not lost.

Support the board stiffener assembly while the four mounting screws are removed from the top of the socket. Set the mounting screws and stiffener assembly aside.

Remove the socket from the board and mount it on the flat side of its assembly fixture. Do not touch the pin field on the board side of the socket.

Inspecting for Contamination

Under at least 7X magnification at an angle with plenty of light, inspect the entire contact element field for signs of contamination. Make note of any heavily soiled areas so that cleaning can be concentrated there.

Take the socket off its fixture, turn it upside down, and place it on a clean bench top. Check again under magnification for contamination.

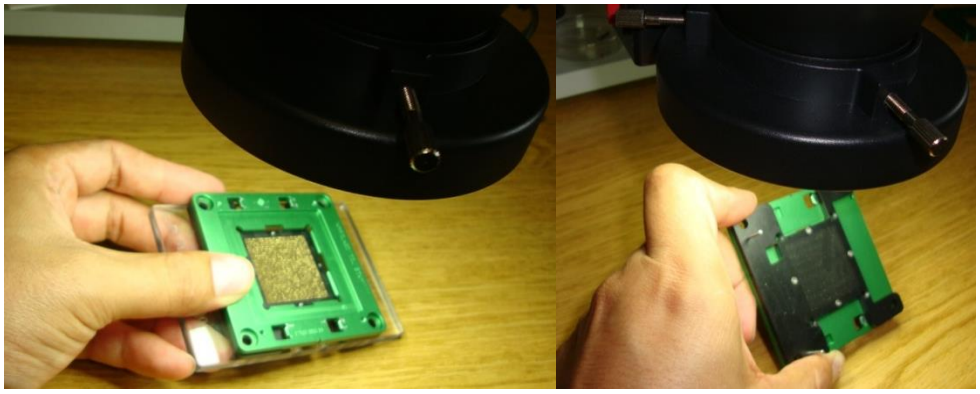


Figure 23: Socket being inspected under microscope with light on and at an angle.

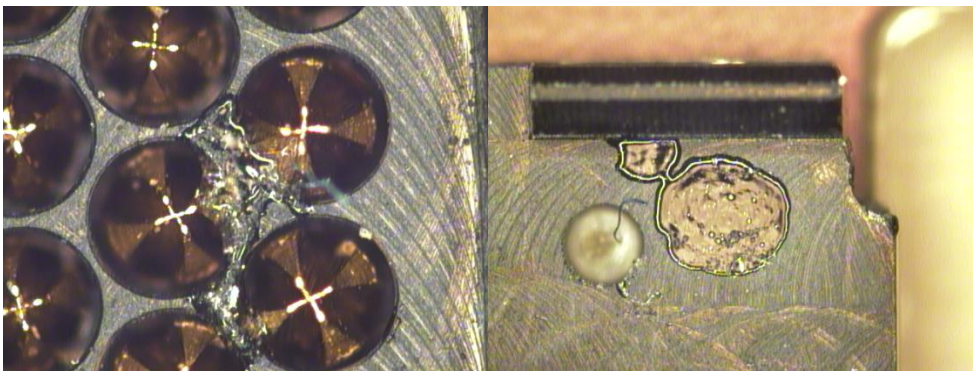


Figure 24: Pictures of substances that stick to the socket parts that will not come off with pressurized air alone.

Checking for Damage

Mount the socket on the flat side of its assembly fixture and inspect once more under the microscope, at an angle and with plenty of light. Check for bent pins or signs of heat damage.

Take the socket off its fixture, turn it upside down, and place it on a clean bench top. Ensure that the countersunk fasteners are relieved sufficiently in their holes at that they have not caused any shorts.

If any damage is found, stop work and contact the factory to initiate an RMA. Use the following pictures as examples of low elements, bent pins, and heat damage.

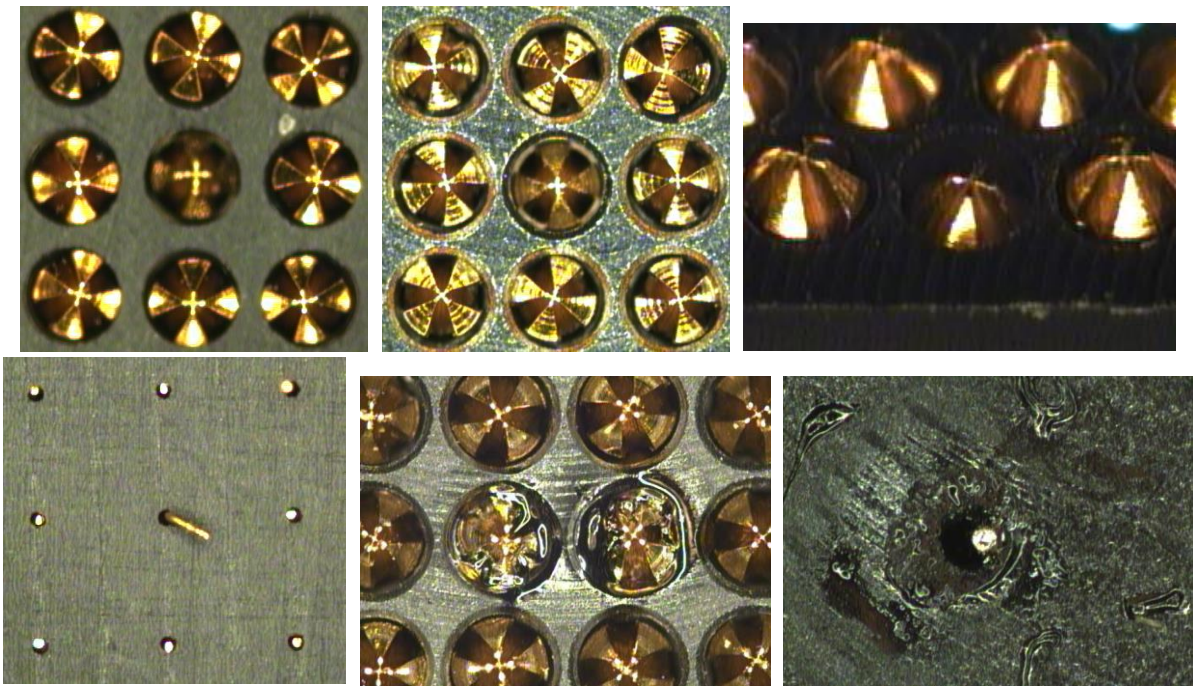


Figure 25: The two upper left pictures show low elements when viewed under magnification directly from the top of the socket. The low elements are out of focus. The upper right picture shows a low element when viewed at an angle. The lower left picture shows the bent tip of an RC Spring Probe on the board side of the socket. The two lower right pictures show heat damage to the top and bottom sides of the socket.

Cleaning

If there are no signs of damage, the socket can be cleaned. Remount the socket on the flat side of the assembly fixture and place the socket and fixture on a clean, sturdy surface. Dip the bristles of a short-haired acid brush into a dish of isopropyl alcohol and firmly scrub the contact element side of the socket in a side-to-side motion. Special attention should be paid to heavily soiled areas. Use clean, dry, pressurized air to blow off any residual alcohol. Remove the socket from its assembly fixture and blow off the board side of the socket as well being careful not to touch the pin field with the tip of the air gun. The board and DUT side of the socket may need to be blown off repeatedly in alternating fashion to completely remove any alcohol that may have seeped into the pin cavities. When the socket is dry, place the socket back on its assembly fixture and inspect once more under at least 7X magnification. Check the heavily soiled areas in particular to ensure the contact elements are now cleaned. Repeat the process as necessary. Once clean and dry, install the socket as before.

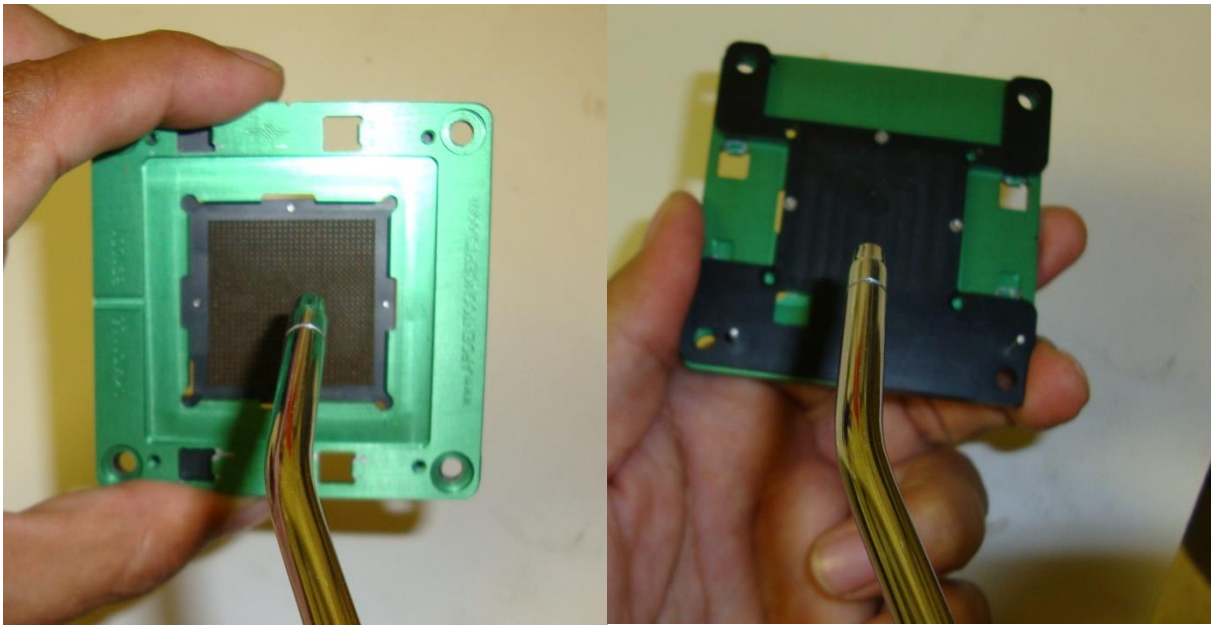


Figure 26: Socket top and bottom sides being blown off.

Heavy Duty Cleaning

After long-term exposure to temperatures above 50°C or below 10°C for hours or days at a time, intended or accidental high current use (greater than 3 amps), exposure to moisture from condensation or water leaks, or every 10,000 insertions, the socket needs to be removed from use and thoroughly inspected for damage. At this stage in socket use, the tips of the contact elements start to accumulate significant (visible without magnification) tin oxides from the balls on BGA devices. Also, guides may start to show wear from device insertion. Condensation may leave discolored stains on the socket plastic parts and on the contact elements. Anodized and plated surfaces also begin to wear.

Before starting work, be sure the work areas on the bench top are clean and free of any debris.

If there is any evidence of exposure to moisture, contact the factory to initiate an RMA for socket and/or lid. Any such damage observed on the socket will most likely appear on the board as well. Inspect the board under at least 7X magnification, at an angle, and with plenty of light. Thoroughly clean the board as described before, or per established procedures.

To inspect the socket, remove the lid as described above and dismount the socket from the board. Do not touch the pin field on the board side of the socket. Place the socket on its assembly fixture and inspect under at least 7X magnification at an angle with plenty of light. Make note of any particularly soiled areas. If there are any low pins or gross damage to the socket's plastic surfaces, stop work and contact the factory to initiate an RMA.

Remove the socket from the assembly fixture and place it upside down on a clean bench top surface. Inspect under magnification again and look for bent pins, heat damage, debris, or staining.

There are two sets of flat head screws that hold the socket together; the smaller screws hold the interposer subassembly together and are commonly #0 screws, and the larger screws fasten the interposer subassembly to the guide plate and are commonly #2 or M2 screws.

Unscrew the larger #2 or M2 screws with a fine-tipped Phillips-head screw driver (#0 tip, McMaster-Carr part number 52985A18 or equivalent) and set aside. Do not unscrew the #0 screws. Be careful not to damage the board side pin field with the screw driver tip. Detach the interposer subassembly from the guide plate and set the guide plate and screws aside.

Fully immerse the interposer, board-side up, into an isopropyl ultrasonic bath to soak the interposer thoroughly. Remove the interposer from the bath and use a clean, short haired acid brush to firmly scrub the DUT side of the interposer while holding the interposer along its edges with one hand and brushing side-to-side with the other. Do not brush the board side. Return the brushed socket to the bath and clean for an hour minimum. Care must be taken not to allow the pins on the board side of the interposer to touch anything in the bath.

Remove the interposer from the bath and blow dry it with clean, dry, pressurized air blowing on DUT and board side in alternating fashion. It may take several repetitions to remove all the alcohol since the pin cavities trap liquid easily.

Once dry, place the interposer, board-side-down, on its assembly fixture. Under at least 7X magnification, at an angle, and with plenty of light verify that the cleaning has succeeded. Tin oxide will most likely still be present. Other, more troublesome residues should now be removed.

Place the guide plate set aside earlier upside-down on a clean bench top surface. Remove the interposer subassembly from its assembly fixture and place it back onto the backside of the guide plate being careful to orient the A1 corners correctly, if so marked. Screw the #2 or M2 flat head screws back into place being careful not to damage the board-side pin field with the tip of the screw driver. Screws only need to be tightened to hand tight.

Install the socket on a clean board as previously described.

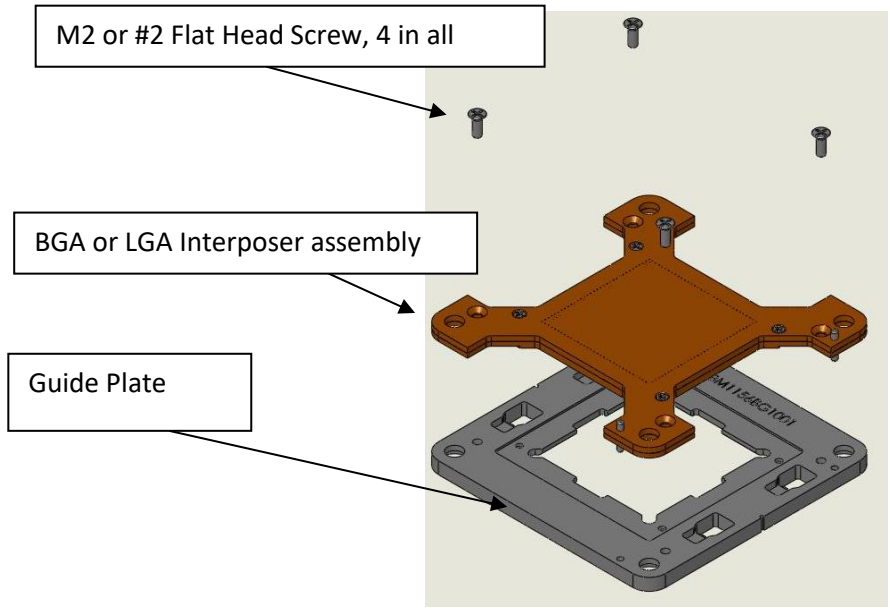


Figure 27: Interposer coming off its guide plate.

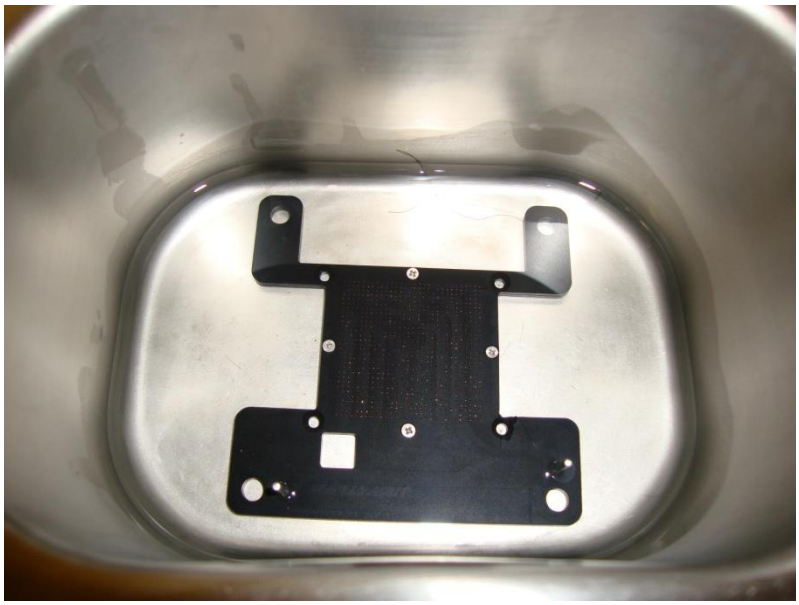


Figure 28: Interposer inside ultrasonic bath.

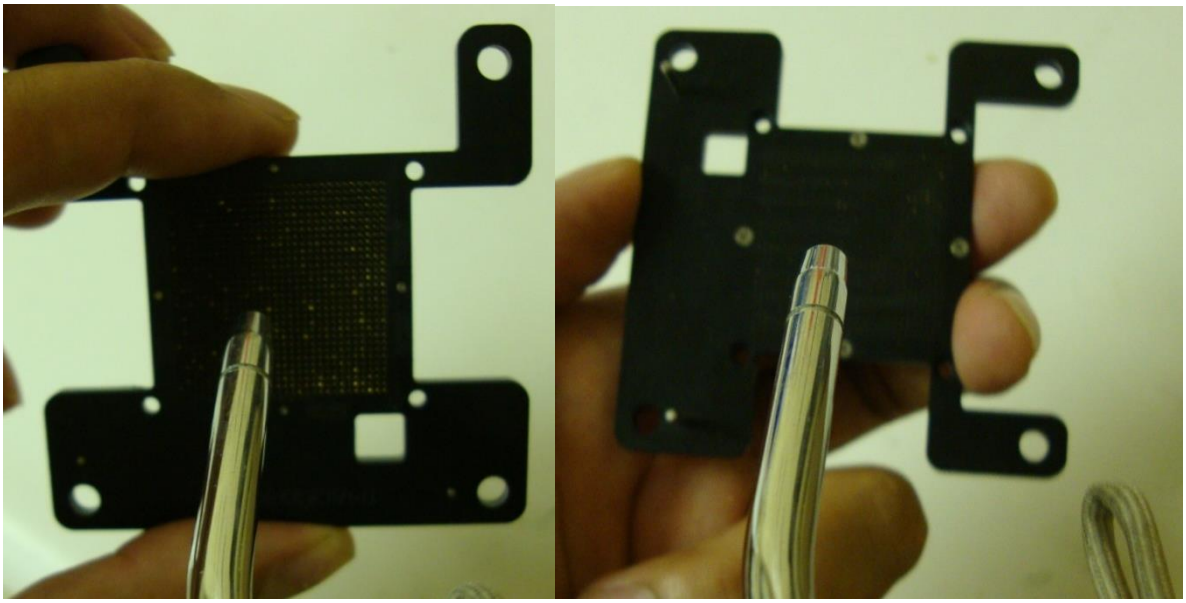


Figure 29: How to hold interposer while blowing off alcohol with pressurized air.

EXTREME WEAR

When regular cleaning is not enough to restore the socket, a more serious approach is needed. At this point, the socket should be taken out of service and thoroughly examined as described above. Signs of gross damage to any and all socket parts should be noted. This include deformation of the plastic plates that make up the interposer assembly, signs of excessive wear on guide walls and on rubbing surfaces were air and water lids mount, loss of spring tension in die springs that go into the water and air lids, and dulling of contact element tips. The picture below is an example of these symptoms. If these are observed, contact the factory to initiate an RMA.

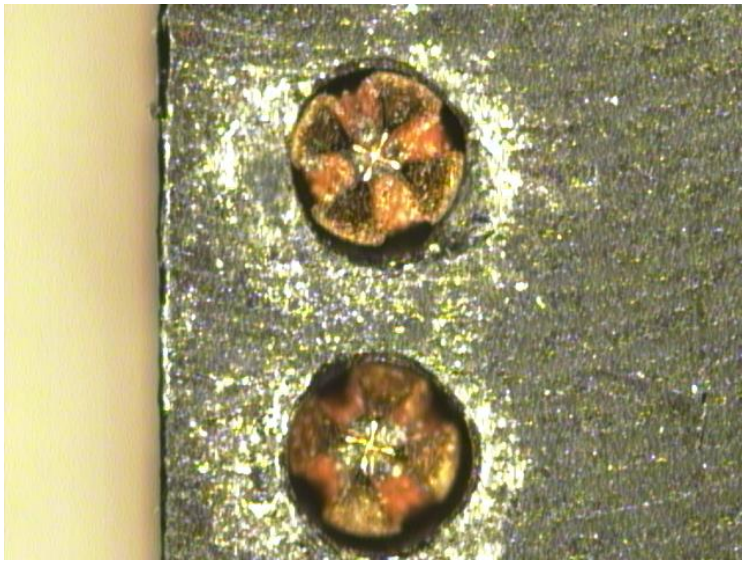


Figure 30: Example of extreme wear and damage that requires factory intervention.

SPARE PARTS, QUESTIONS, RMAs

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Who Is Ardent Concepts?

Ardent Concepts, Inc. is a leading designer and manufacturer of high performance multicoax and coaxial assemblies, connectors, and sockets used in the development of next generation semiconductors and electronics systems. Our core technology is the smallest, fastest, most electrically efficient compression mount connector technology worldwide. As data rate requirements increase and devices and systems shrink, Ardent's products deliver superior signal integrity in a dense footprint that can be reusable across programs to maximize cost savings.