LGA Interposer Manual

for

Intel®-specified LGA775 and LGA771 CPU Sockets

manufactured by

Foxconn® Electronics Inc.
www.foxconn.com

and

Tyco Electronics
www.tycoelectronics.com

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http://www.intertesttech.com

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LGA Sockets

Processor Debug Port Access

There are 3 ways in which test access can be provided for µMaster Test and Debug Solutions:

- On-board JTAG or e-JTAG header
- Interposer (placed between CPU and socket to break out debug port lines)
- Fixture (probe access to debug port lines)

This manual describes how to use the Land Grid Array (LGA) interposer for Intel® processors in both LGA775 and LGA771 packages.

LGA Socket Variations (Foxconn & Tyco)

Although the reference designs for the LGA775 and LGA771 CPU sockets were laid down by Intel®, manufacturers implemented these guidelines in different ways. Our LGA775 and LGA771 interposers are designed to accommodate the socket variations of the two foremost manufacturers at the present time:

- Foxconn
- Tyco (AMP)

LGA775 and LGA771 sockets each comprise 4 components:

- Socket Body (Plastic insert containing the land grid array of contacts)
- Load Plate (Stainless steel lid that compresses the CPU onto the LGA contacts)
- Load Lever (Stainless steel lever arm that applies force onto the load plate)
- Socket Body Stiffener (Stainless steel base of the socket)

Each manufacturer uses identical stainless steel components for their own LGA775 and LGA771 sockets. However, the design of those components is unique to that manufacturer. In other words, the Foxconn metalwork for their LGA775 and LGA771 is identical, but the Foxconn LGA775 metalwork is not the same as the Tyco LGA775.

Our LGA interposer attaches to the socket's metalwork, so we have had to create 2 separate clamping mechanisms to support the Foxconn and Tyco sockets. Both of these clamps are supplied with the interposer, and are identified by an "F" for Foxconn and a "T" for Tyco.

Identifying Foxconn & Tyco Sockets

There are a number of ways in which Foxconn and Tyco sockets can be identified:

- Socket part number
- Socket Body Stiffener design
- Load Plate hinge width
- LGA contact design

Only the part number is a reliable differentiating feature because design variations could be eliminated in future. However, where the part number is difficult to read, the design variations are a useful guide for rapid identification.

Socket Part Number

The part number for the LGA sockets is stamped or laser engraved on the side wall of the Socket Body Stiffener (socket base) opposite the Load Lever arm. Intel® specifies that part numbers should include LGA775 or LGA771 for sockets that use eutectic solder balls, and LF-LGA775 or LF-LGA771 for lead free sockets.

Foxconn part numbers include “Foxconn” together with a part number, whereas Tyco sockets only use a part number, as shown in Figure 1.01.

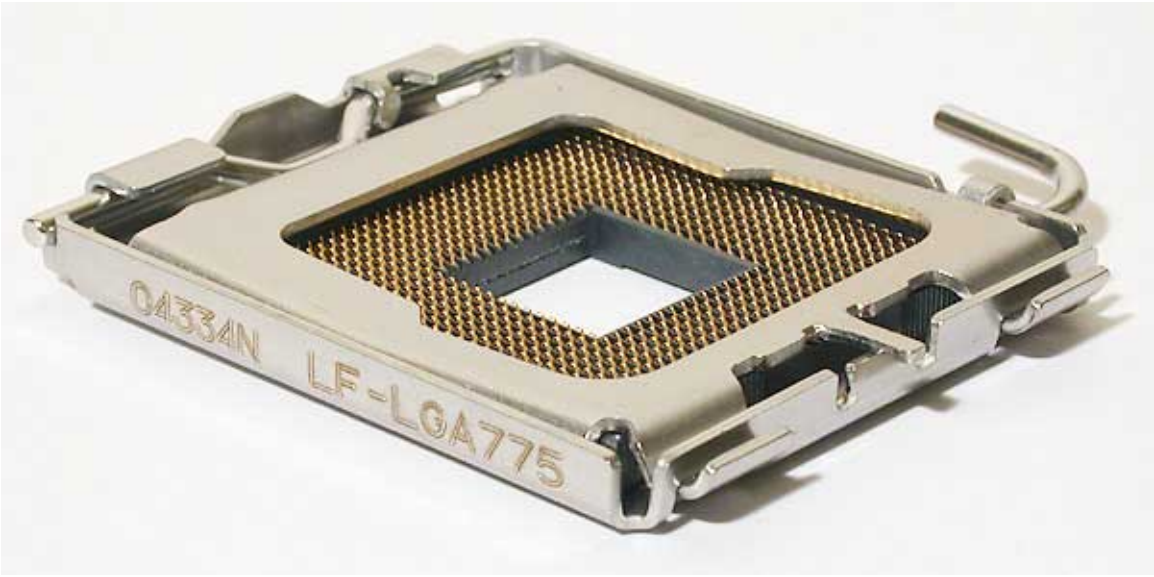

Figure 1.01 Tyco LGA775 socket with lead-free solder balls

Socket Body Stiffener Design

The Socket Body Stiffener (base) of the Tyco socket has a raised metal tab, indicated by the red ring in Figure 1.02. This is designed to limit the travel of the Load Lever when it is fully opened. The Foxconn socket on the right of Figure 1.02 has no raised tab.

Figure 1.02 Tyco sockets (left) have a raised metal tab to limit the travel of the Load Lever – Foxconn sockets don't (right)

Load Plate Hinge Width

The hinges of the Tyco socket (left) Load Plate are more widely spaced than the Foxconn socket, leaving only about 1.5mm of metal outside the hinge.

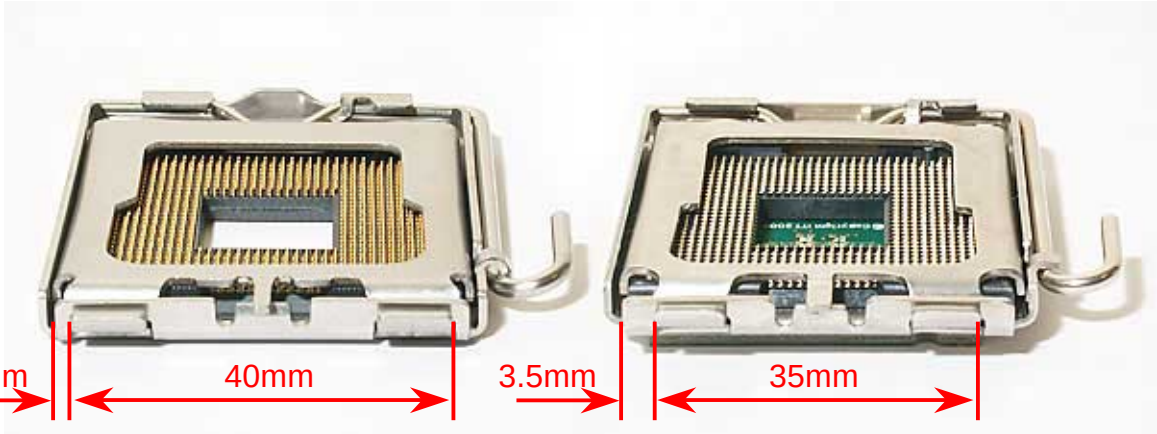

Figure 1.03 The Load Plate hinges on Tyco sockets (left) are further appart than those on Foxconn sockets (right)

LGA Contact Design

The LGA contacts in the Socket Body plastic insert differ between the Foxconn and Tyco sockets. Of course, this design variation could change in the future if these manufacturers decide to use third party suppliers for this component.

The Foxconn contacts depress in a diagonal direction towards pin 1 of the CPU, as shown in Figure 1.04.

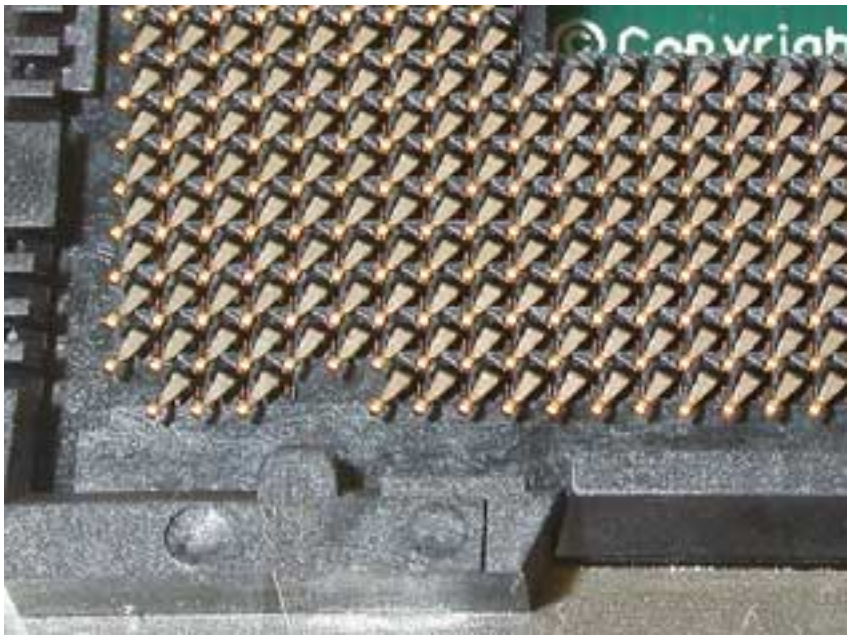

Figure 1.04 Foxconn LGA contact design – contacts depress diagonally

The Tyco contacts depress in a direction parallel to the sidewalls of the socket base, towards the crank in the load lever, as shown in Figure 1.05. Their “S” form prevents them from shorting with the contact in front when depressed.

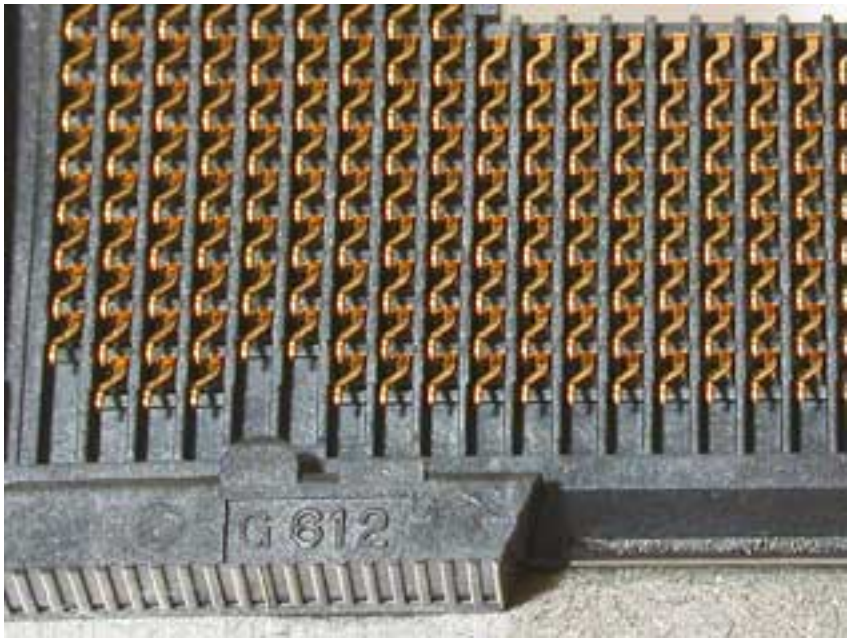

Figure 1.05 Tyco LGA contact design – contacts depress parallel to side walls

LGA Interposers

Interposer Design

The International Test Technologies LGA775 and LGA771 Interposers are designed to overcome the fact that LGA sockets only withstand a relatively low number of CPU insertions (the Intel® reference designs state that a minimum of 20 insertions must be accommodated).

In our design, the known-good, “gold standard” CPU that is used for testing is inserted in a second LGA socket (Figure 2.01). This is an integral part of the interposer, which is piggy-backed onto the on-board LGA socket (Figure 2.02). The known-good CPU remains in this second socket – it does not need to be removed when subsequent boards are tested.

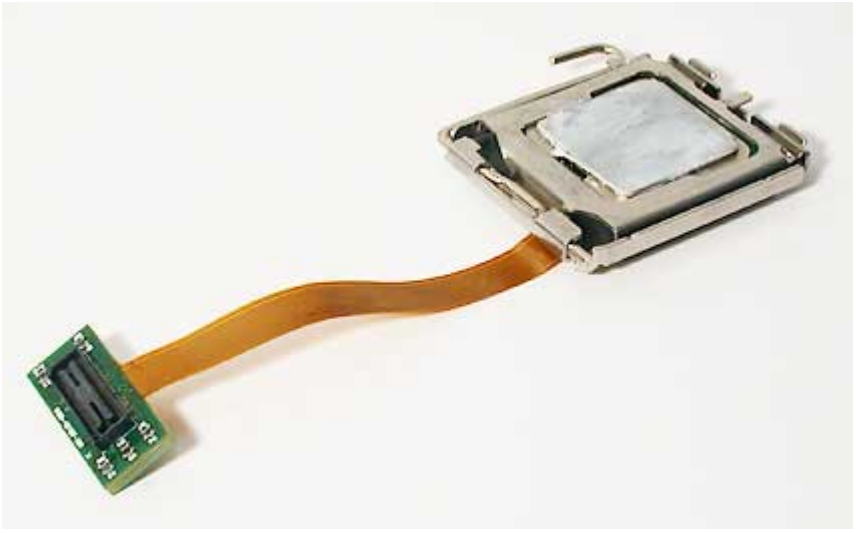

Figure 2.01 CPU held in second LGA socket with XDP connector on flex cable to break out the debug port signals

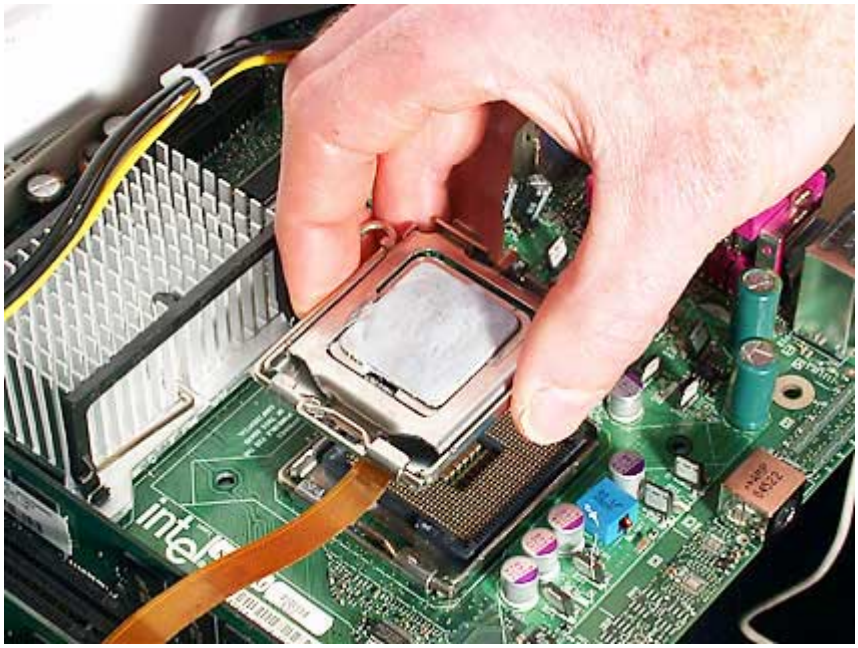

Figure 2.02 Inserting the second LGA socket with CPU installed, into the LGA socket of the board under test

The second LGA socket used in the interposer is soldered to a small PCB that has the same dimensions, land configuration and keying as the CPU itself (Figure 2.03). This PCB locates into the on-board LGA socket. It breaks out the debug port signals onto a flex cable, which terminates in an Intel®-specified XDP connector. The PCB also connects all signals to and from the CPU that is mounted in the interposer. The land configuration and keying of the LGA775 differs from the LGA771, so this part of the interposer is not interchangeable.

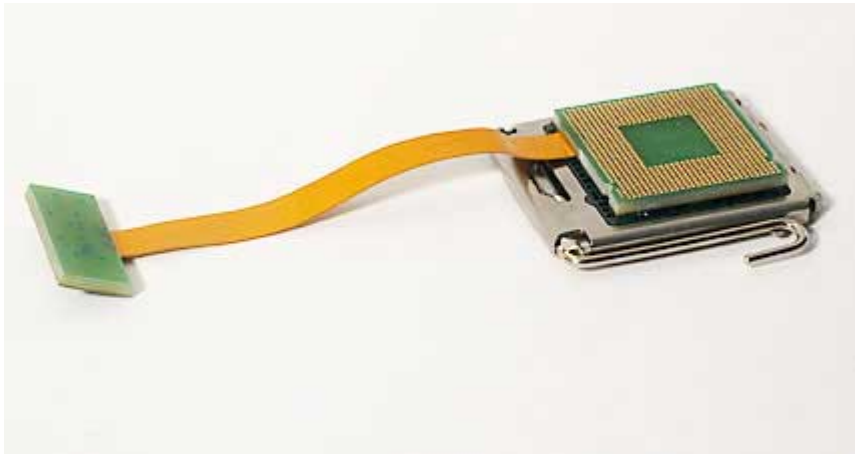

Figure 2.03 Bottom view of the LGA interposer, showing the CPU-shaped PCB that locates into the on-board LGA socket

The LGA interposer is held in place by a clamp (Figure 2.04), which also loads the interposer with the force required to depress the pins in the on-board socket, ensuring good electrical contact. The clamp consists of three parts: End Plate, Top Clamp, and Heat Sink Spacer (Figure 2.04). Two sets of End Plates and Top Clamps are supplied with both the LGA775 and the LGA771 interposers. One set is for use with Foxconn sockets (marked with an “F”) and the other set is for Tyco sockets (marked with a “T”).

Figure 2.04 Interposer clamp, consisting of 1) End Plate, 2) Top Clamp and 3) Heat Sink Spacer

NOTE

The “F” or “T” identifier for Foxconn or Tyco is located on the front of the End Plate and on the top of the Top Clamp, near its connection point with the End Plate. It is important to ensure that the correct interposer clamp parts are used for either Foxconn or Tyco sockets on the board under test. The interposer clamp parts for the Tyco LGA775 can also be used for the Tyco LGA771. Likewise, the clamp parts for the Foxconn LGA775 can be used for the Foxconn LGA771.

Using the LGA775 and LGA 771 Interposers

The LGA775 and LGA771 interposers are identical in operation.

CAUTION

Care must be taken to avoid damaging the LGA socket contacts in either the interposer or the board under test, especially when removing the Load Plate (step 2 below).

The steps to install either LGA775 or LGA771 interposers are as follows:

1. Open the LGA socket on the board under test by releasing and lifting the Load Lever.
2. Remove the Load Plate. This is done by opening the Load Plate so that it is in a vertical position and then exerting a twisting force on the Load Plate so that one of its hinges can be eased out of the hinge slot in the Socket Body Stiffener. Once the first hinge has been removed, the second hinge can be removed by further rotating the Load Plate.
3. If this is the first time the interposer has been used, remove the clip-on plastic cover from the interposer LGA socket. Open this socket by releasing and lifting the Load Lever and opening the Load Plate.
4. Insert a known-good processor, ensuring that the semi-circular keying slots on the processor are aligned with the projecting keys in the socket. The LGA775 is differently keyed from the LGA771 to avoid the wrong processor type from being inserted. Pin (land) 1 of the processor will be towards the right-angle bend in the Load Lever.
5. Close the interposer Load Plate and actuate the Load Lever, clipping it under the retaining hook.
6. Insert the interposer into the LGA socket of the board under test (Figure 2.05). The interposer socket should be inserted in the same orientation as the socket on the board under test. However, there is a slight diagonal offset between the two sockets in the direction of pin (land) 1.

NOTE

The keying slots on the interposer PCB will prevent an LGA775 interposer from being inserted into an LGA771 socket.

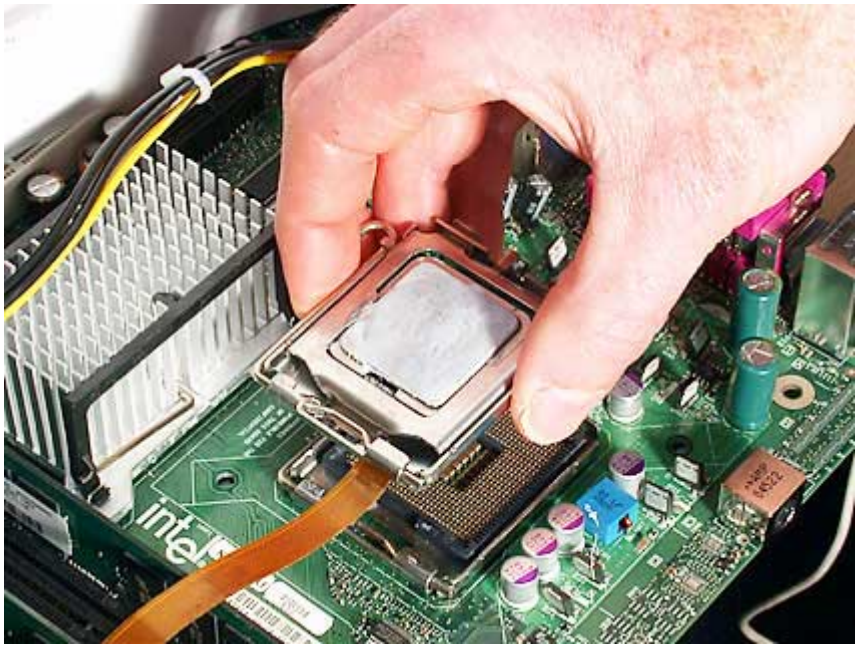

Figure 2.05 Inserting the second LGA socket with CPU installed, into the LGA socket of the board under test

7. Hook the interposer End Plate under the Load Lever of the board under test (Figures 2.06 and 2.07) The flex cable from the interposer PCB passes under a recess in the End Plate. The design of the hooks on the Foxconn and Tyco End Plates differs slightly. A few millimeters of clearance between the on-board socket and surrounding components are required to enable the End Plate to be attached.

Figure 2.06 Hooking the End Plate under the Load Lever

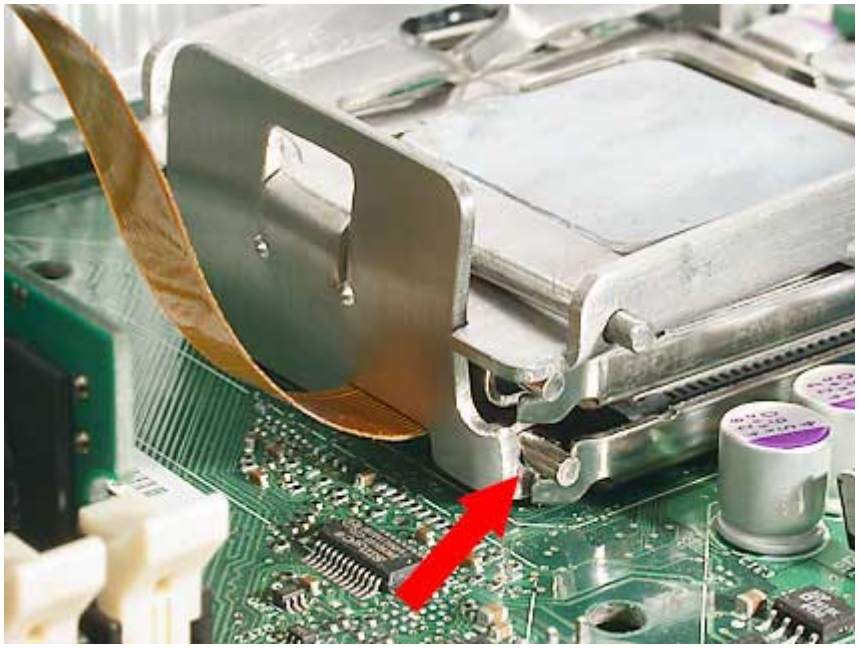

Figure 2.07 Location of the End Plate hooks (Foxconn) under the Load Lever

If the clearance is very small, the interposer can be lifted out of the on-board socket and moved slightly away from the End Plate location point. This will allow the End Plate to be rotated away from the obstructing components so that the space required to engage the End Plate hooks under the Load Lever is minimized. The flex cable must still pass under the recess in the End Plate. The interposer can then be re-inserted in the on-board socket.

NOTE

On the rare occasion where insufficient clearance between the on-board socket and adjacent capacitors or other high components prevents the End Plate from being attached, the LGA interposer cannot be used.

8. Insert the hinges (hooks) of the Top Clamp into the hinge slots of the on-board socket (the Load Plate was removed from these slots in step 2). Ensure that these Top Clamp hinges are fully engaged in the slots (Figures 2.08 and 2.09).

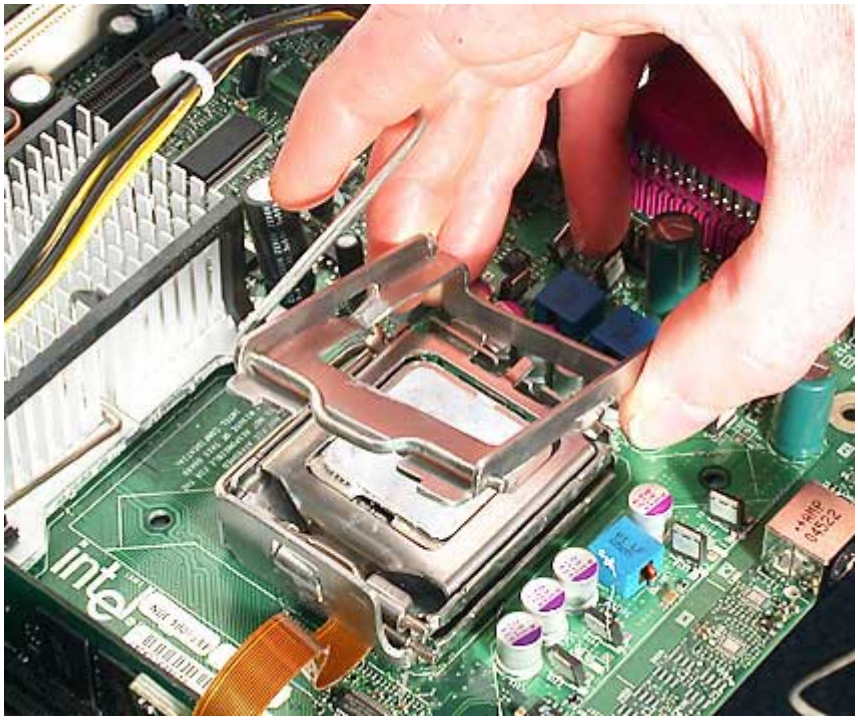

Figure 2.08 Hooking the Top Clamp hinges into the slots of the on-board socket

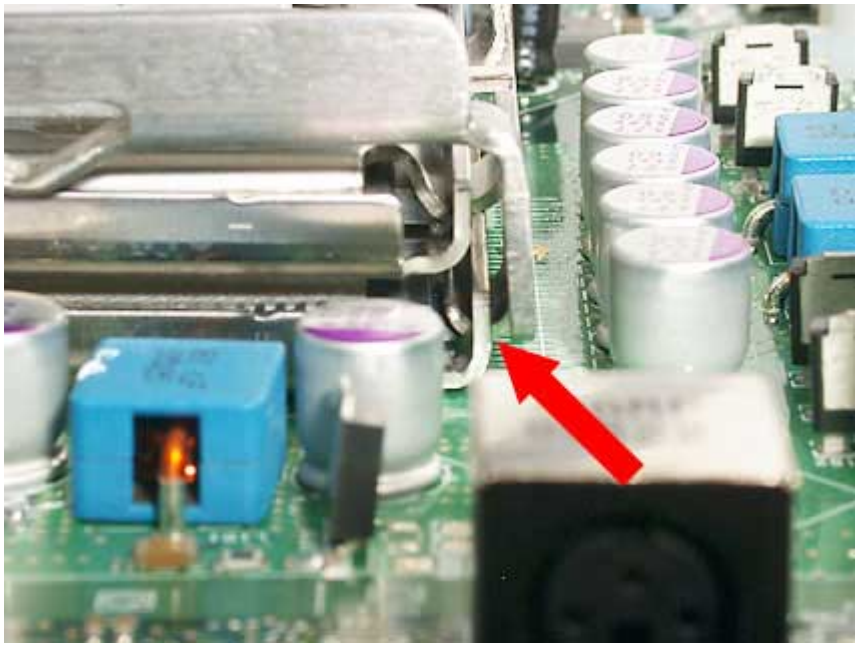

Figure 2.09 Close-up of the Top Clamp hinges in the on-board socket slots

9. Open the Top Clamp Lever.

10. While ensuring that the End Plate hooks are still fully engaged under the on-board socket Load Lever, clip the hook on the End Plate over the top of the Top Clamp Lever. The End Plate should fit into in a slight recess in the Top Clamp (Figure 2.10).

Figure 2.10 Engaging the End Plate hook over the Top Clamp Lever

11. Hold the End Plate against the Top Clamp and actuate the Top Clamp Lever, clipping it under the retaining hook on the side of the Top Clamp (Figure 2.11).

Figure 2.11 Actuating the Top Clamp Lever

12. Apply a small quantity of heat sink compound to the top of the processor and then place the copper Heat Sink Spacer onto the processor. Slide this copper block around to ensure that the heat sink compound is thinly and evenly smeared across the complete top of the processor (Figure 2.12).

Figure 2.12 Inserting the Heat Sink Spacer after applying heat sink compound

13. Apply heat sink compound to the top of the Heat Sink Spacer and then place a combined heat sink and fan on top of it. The standard heat sink and fan intended for the board under test can normally be used on top of the interposer (Figure 2.13).

CAUTION

Ensure that there are no metallic spacers (stand-offs) or fixings attached to the base of the heat sink that could cause shorting of components on the board under test (the heat sink may move during operation). Any projecting metallic parts should be covered with insulation tape.

NOTE

The use of a Heat Sink Spacer slightly reduces the effectiveness of the combined heat sink and fan, so with fast, multi-cored processors, it is important to ensure that the most efficient heat sink and fan available is used (this doesn't necessarily have to be the one designed to fit the board under test). For example, the type of heavy-duty copper-finned heat sink and fan used on server boards should dissipate the heat more effectively. Also, the board under test should be switched off when it is not being tested by µMaster.

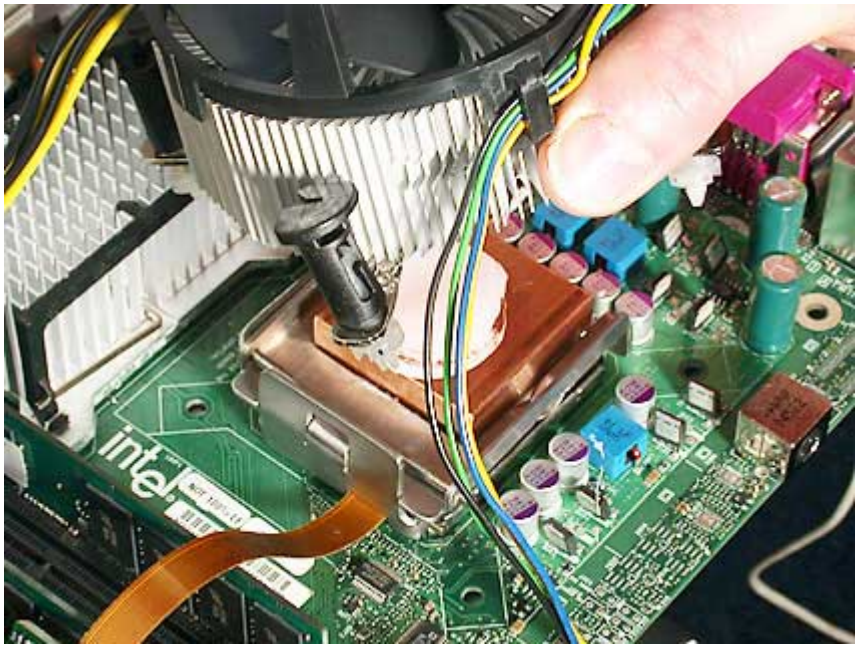

Figure 2.13 Placing the heat sink and fan onto the Heat Sink Spacer

14. Attach an XDP Adapter to the XDP connector at the end of the flex cable.

    NOTE

    Application Note #10 explains the differences between versions 002 and 003 of the XDP Adapter, and also gives details of their configuration with optional resistors. For this application, either version can be used, regardless of its resistor configuration because the interposer flex cable is only connected to port 1 in the XDP connector.

15. Attach the Debug Port Adapter (DPA) to the XDP Adapter (Figure 2.14).

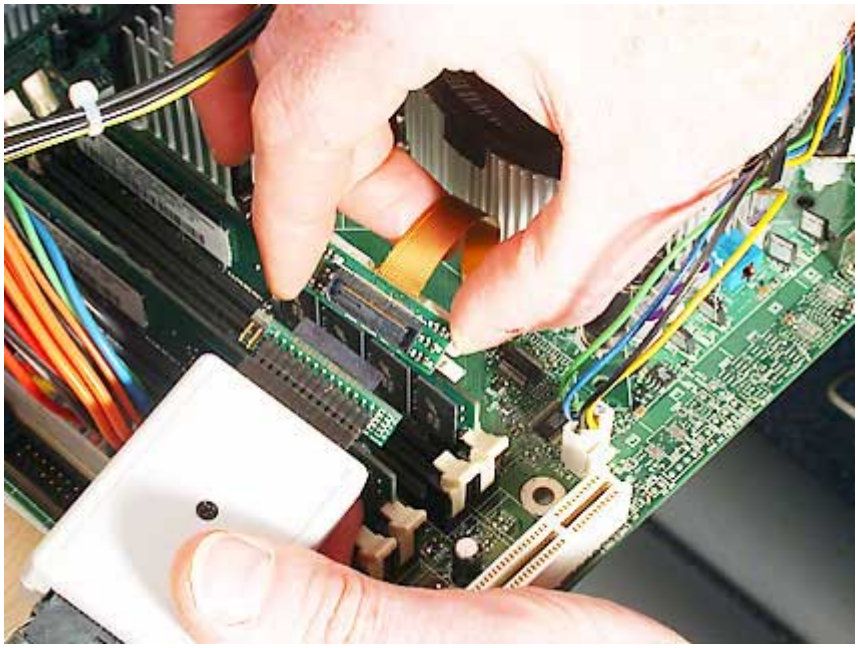

Figure 2.14 Attaching the Debug Port Adapter (DPA). In this photograph, the XDP Adapter is shown attached to the end of the DPA

16. Testing can now commence (Figure 2.15). To minimize heat build-up when using the interposer, avoid leaving the board under test running for long periods when testing is not being carried out.

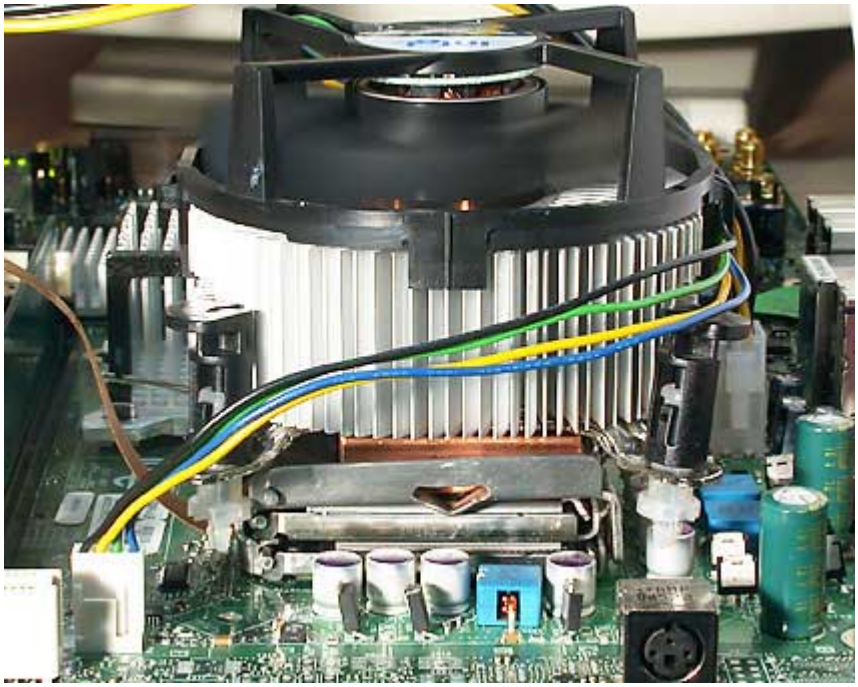

Figure 2.15 The complete LGA interposer configuration