Lead Guide Press

Field of the Invention

[0001] The present invention relates to an integrated circuit (IC) test apparatus. In particular, the invention relates to a lead-press for a lead guide system for the IC test apparatus.

Background

[0002] In integrated circuits (IC) manufacturing, the ICs are required to be tested for testing their functionalities. The IC testing is performed by bringing a device under test (DUT) in contact with a test socket. In high speed IC testing, leads of the DUT are not required to be inserted and secured on the test socket as long as the leads are electrically in contact with the test socket. To ensure that the leads are properly in contact with the test socket, a lead-press is often used to press the leads of the DUT against the test socket during IC testing.

[0003] FIGs. 1a-c show a DUT **150**, a test socket **190** and a conventional lead-press **100**. In FIG. 1a, the DUT **150** has a row of gull wing leads **152** extended from body of the DUT **150**. The test socket **190** includes two rows of contacts **192** which are adapted to mate with to leads **152** of the DUT **150**. A cavity **194** is defined between the two columns of contacts **192** for receiving a protruded portion of the DUT **150** when the leads **152** of the DUT **150** are in contact with the contacts **192** of the test socket **190**. The lead-press **100** has an elongated flange **105** adapted for pressing a row of the leads **152** against the contacts **192**. In FIG. 1a, only one lead press **100** is shown for simplicity, though two are required for pressing the rows of the leads **152** on each side of DUT **150**. FIG. 1b is an enlarged view of FIG. 1a showing that the flange **105** of the lead press **100**

is adapted to maintain contact between the lead **152** of the DUT **150** with the contact **192** of the test socket **190** when performing IC testing.

[0004] FIG. 1c shows a typical vertical test handler **180** having the DUT **150** loaded thereon. Two lead presses **100** mounted on a lead guide **180** in an opposing manner where the flange **105** of each lead press **100** are supporting the gull wing of the leads **152** of the DUT **150** on each side. In operation, the lead guide **120** moves toward the test socket **190** and when the leads **152** are in contact with the corresponding contacts **192**, the lead-press **100** helps to ensure that all the leads **152** are in proper contact with the contacts **152**.

[0005] The IC test is often performed in three temperature stages, i.e. cold environment (about -50 ~ 0°C), ambient environment and hot environment (about 50 ~ 200°C) (herein after referred to as "tri-temperature stages"). Thus, it is important that material used for the lead-press **100** is thermally sustainable under the tri-temperature stages. Also, it is also preferred that the downtime for IC testing under the tri-temperature stages is minimized, or preferably, zero downtime.

[0006] It is also required that the lead-press **100** is made of electrically non-conductive material so that the leads **152** are not short circuited during the testing. Further, it is preferred that the lead-press **100** has a good wear resistance, low friction, good impact resistant, and non-deformable and non-stick characteristics.

[0007] One of the common materials used for making lead-press **100** is hard plastic. However, hard plastic lead presses require replacement after about every 3,000 IC test cycles, and it requires cleaning after every few hours of operation. Further, hard plastic wears out relatively easy, which may cause contact problems with the leads **152** in operation.

[0008] Ceramic and sapphire, for example, are suitable candidates for making the lead press **100**. Besides the good performance in the tri-temperature stages, and non-conductive, they are durable, and there is almost no downtime in operations when working with these two materials.

[0009] US5,172,049 discloses an IC test equipment having a lead press that is made up of sapphire. Such material has a good thermal conductivity. However, due to the hard and durable characteristics, it is difficult to fabricate into a shape required for the specific type of test handler and it may be scraped during while manufacturing the same. Further, the cost for using sapphire is relatively high.

[0010] It would be ideal that the lead-press **100** be made of two different types of materials. Specifically, at least the contact (with the leads **152**) portion of the lead-press **100**, i.e. the flange **105**, uses the material having good hardness and high durability, and the body of the lead-press **100** uses a material that is easy to fabricate or mold into a configuration that holds the contact portion on the test handler. For example, the contact portion of the lead-press **100** is made of ceramic and the body of the lead-press **100** is made of stainless steel.

[0011] Such combination provides the advantages over the lead-press **100** that is made with only one material. However, it is difficult to attach the body and the contact portion together firmly for working in the tri-temperature stages.

[0012] Adhesives may be used to join the body and the contact portion. However, such adhesives often produce residues that require additional cleaning processes during the IC testing.

Summary

[0013] In accordance with one embodiment, the present invention provides a lead press of a test apparatus for testing a device under test (DUT), the lead press comprises a contact member defining a contact portion and a mating profile, wherein said contact portion is adapted for contacting with at least one lead of the DUT; and a holder having another mating profile adapted for holding the contact member, wherein an internal and substantially narrowing channel is defined at the another mating profile of the holder for securing resiliently the mating profile of the contact member.

[0014] In accordance with an alternative embodiment, the mating profile of the contact member and the another mating profile of the holder may define a dovetail join. Further, the mating profile of the contact member defining a dovetail insert and the another mating profile of the holder may define a groove adapted for receiving the dovetail insert.

[0015] In accordance with another alternative embodiment, the mating profile of the contact member may define a groove and the another mating profile of the holder may define a dovetail insert for inserting to the groove.

[0016] In accordance with a further alternative embodiment, the contact member may be made of an electrically non-conductive material. The non-conductive material may be ceramic or sapphire or any materials with suitable properties.

[0017] In accordance with yet another alternative embodiment, the contact member may be made up of an material different from that of the body. The body may be made up of stainless steel.

[0018] It is desired for the present invention to provide a lead press for a test apparatus for testing a device under test (DUT). The lead press may include a contact

member for pressing leads of the DUT and a holder for holding the contact member on the test apparatus. The holder is operable to hold the contact member with a dovetail join. The holder has a channel cuts into the body of the holder from the dovetail join.

Brief Description of the Drawings

[0019] This invention will be described by way of non-limiting embodiments of the present invention, with reference to the accompanying drawings, in which:

[0020] FIG.1a illustrates a configuration of a test socket, a device under test and a conventional lead press;

[0021] FIG. 1b is an enlarge figure of the FIG. 1a;

[0022] FIG. 1c illustrates a top view of a conventional vertical test handler;

[0023] FIGs. 2a-b illustrate a lead press in accordance with one embodiment of the present invention;

[0024] FIG. 3 illustrates an IC test handler in accordance with one embodiment of the present invention; and

[0025] FIG. 4 illustrates a lead press in accordance with another embodiment of the present invention.

Detailed Description

[0026] In line with the above summary, the following description of a number of specific and alternative embodiments are provided to understand the inventive features of the present invention. It shall be apparent to one skilled in the art, however that this invention may be practiced without such specific details. Some of the details may not be described at length so as not to obscure the invention. For ease of reference, common reference numerals will be used throughout the figures when referring to the same or similar features common to the figures.

[0027] FIG. 2a illustrates a perspective view of a lead press **200** in accordance with one embodiment of the present invention. The lead press **200** is adapted for mounting on a lead guide of an IC test handler (not shown). The lead press **200** comprises a contact member **250** for pressing leads of a device under test (DUT) and a holder **210** for supporting the contact member **250**.

[0028] The contact member **250** is configured into an elongate L-shape bar having an insert member **252** and a flange member **254**. The insert member **252** is an elongated bar having a dovetail cross-section with one end defining a stopper **256**. The flange member **254** is a rectangular shaped bar making a corner to the insert member **252**. A protrusion **258** is provided at a distal end of the flange member **254** relative to the position of the stopper **256**. The protrusion **258** is used as a stopper for aligning the leads of the DUT on the lead guide of the IC test handler.

[0029] The holder **210** is a trapezoid block having a shorter side **212** and a longer side **214** parallel to each other. Two round notches **216**, spaced part, are provided along an edge of the shorter side **212** and a clamp plate **217** is further defined by the bottom of each of the round notches **216** for receiving bolts or fasteners for securing the holder **210** on the guide arm. The longer side **214** of the holder **210** defines a longitudinal groove

218 configured to dovetail with the insert member **252** of the contact member **250**. The longitudinal groove **218** has two inwardly inclined surfaces forming a dovetail slot for receiving the insert member **252**. A channel **220** is defined at a corner between one of the inclined surfaces **217** and a bottom surface **219** of the longitudinal groove **218**. The channel **220** cuts into the holder **210** towards the shorter side **212** making the adjacent wall (with the inclined surface **217** at top) a relatively resilient part to the holder **210** that is structurally self-compliant during the tri-temperature stages testing. Among one of the incline surfaces of the holder **210** by the edge of the bottom surface **219**, there is provided a slit **215** for receiving the stopper **256** of the contact member **250**.

[0030] FIG. 2b shows the lead press **200** with the contact member **250** attached to the holder **210**. The contact member **250** is attached to the holder **210** by inserting the insert member **252** into the longitudinal groove **218**. To prevent free movement, the insert member **252** and the longitudinal groove **218** are fabricated to have tight engagement when the contact member **250** and the holder **210** are dovetailed with each other. In addition, the insert member **252** is inserted into the longitudinal groove **218** by aligning an end of the insert member **252**, where the protrusion **258** is defined, with the end of the longitudinal groove **218**, where the slit **215** is defined, and push the insert member **252** through the longitudinal groove **218** until the stopper **256** is parked into the slit **215** to stops the contact member **250** from moving further. The two inwardly inclined surface of the longitudinal groove **218** serves as a gripping arm for securing the contact member **250** on the holder **210**. When the contact member **250** is attached on the holder **210**, the flange member **254** defines a flange **255** for contacting with leads of the DUT when performing the IC testing. For a vertical test handler, the flange **255** may further serve as a support for loading gull wing leads of a DUT.

[0031] Most IC test handlers are required for performing IC testing in the tri-temperature stages, accordingly the lead press **200** is required to withstand under the tri-temperature stages testing. Further, the contact member **250** is required to be made by an

electrically non-conductive material while the holder **210** can be made by any material which can be fabricated for adapting the contact member **250** on the guide arm. During the tri-temperature stages testing, the contact member **250** and the holder **210** changes the physical properties at different rates as they are made in different materials. Such changes are however compensated by the channel **220** provided between the two gripping arms. Accordingly, the contact member **250** is properly attached to the holder **210** without any adhesive. As mentioned earlier, the used of adhesive for two-parts lead press produces residue during IC testi ng, which requires additional cleaning steps during the IC testing. Further, the adhesive attaching the contact member **250** on the holder **210** may give way under the tri-temperature stages testing.

[0032] The channel **220** is a narrow gap or slit defined within the holder **210** for providing a relatively resilient gripping arm for firmly gripping the contact member **250**, while compensating the differential changes during the tri-temperature stages. Further, the channel **220** allows the contact member **250** to properly position and align on the holder **210**. The channel **220** may be created by an electrical discharge machining (EDM) process such as a wire-cut EDM process, through the longitudinal groove **218**. However, it is to be appreciated to a person skill in the art that any known industrial processes, such as laser cutting or moulding, can also be used for making the holder **210** defining the channel **220** depending on the material used and the configuration of the holder **210**.

[0033] FIG. 3 shows an IC test handler **300** in accordance with another embodiment of the present invention. The IC test handler **300** comprises a guide arm **310** having a suction tube **320** and two lead presses **350**, and a test socket **380** having contact **381**. Each of the lead press **350** has a T-shape member **355** attached thereto with a contact portion **351** protruding from the lead press **350**. The slot of each lead press **350** defines a channel **359** suitably extends into the body of the lead press **350**. The two lead presses **350** are attached to each side of the guide arm **310** with the contact portion **351**

pointing downward. When the guide arm **310** picks up a DUT **390** having leads **391** with the suction tube **320**, the contact portion **351** of the lead presses **350** are substantially in contact with the leads **391**. When the IC test handler **300** is performing IC testing, the contact portion **351** pressing the leads **391** of the DUT **390** against the test contacts **381** of the test socket **380**.

[0034] FIG. 4 shows a lead press **400** in accordance with an alternative embodiment of the present invention. The lead press **400** comprises a contact member **450** and a holder **410**. The contact member **450** has a contact portion **459** for operationally pressing leads of a DUT against contacts of a test socket. The contact portion **459** is a flange defined at a side of the contact member **450**. The holder **410** is adapted to hold the contact member **450** via a reversed dovetail join. The reverse dovetail join has an insert member **412** defining on the holder **410** and a groove **451** defining on the contact member **450**. The insert member **412** and the groove **451** are configured to couple with each other, and when the insert member **412** is inserted into the groove **451**, the contact member **450** is firmly held on the holder **410**. A channel **415** is defined longitudinally across the insert member **412** of the holder **410**, which makes the insert member **412** relatively resilient.

[0035] It is to be appreciated to a person skilled in the art that it is possible to configure the contact members to provide a mating profile in any configuration for coupling with anther mating profile defined on the holder. For example, for a dovetail join, mating profile of the contact member is configured to a dovetail insert, where the another mating profile of the holder is configured to a groove for receiving the dovetail insert, and vice versa for a reverse dovetail join.

[0036] It is understood that the lead press may not be a discrete component for mounting on a guide arm of an IC test handler. It may be configured to formed part of

the guide arm of the IC test handler adapted for receiving contact members for pushing leads of the DUT against contacts of the test socket.

[0037] In accordance with one embodiment of the present invention, a lead press comprises a stainless steel body and a ceramic contact. The advantages of using ceramic material for the contact member includes, less build up of solder which improves overall equipment effectiveness, lower wear and high impact resistance which gives longer lifetime, less residue and easier to clean which results in lesser downtime. In addition, high finishing ceramic contact provides lower friction resulting in lesser machining jams. It was tested that the good hardness and durability of the ceramic contact may provide more than 5 millions DUT test cycles before replacement of a new ceramic contact is required. The lead press body is required to be self-compliance under impact of coefficient of thermal expansion during the tri-temperature stages IC testing, while it can be easily configured for securing the contact member for different type of test handler. Stainless steel can easily be configured into a shape that securing the ceramic contact onto a guide arm. The lead press requires only mechanical means for securing the ceramic contact thereon. As no adhesive required for attaching the ceramic contact onto the stainless steel body, there is no further cleaning step required during the IC test.

[0038] While specific embodiments have been described and illustrated, it is understood that many changes, modifications, variations and combinations thereof could be made to the present invention without departing from the scope of the invention. For example, the present invention is suitable for used in a pick and place handlers for Quad Flat Packages (QFP) which require four lead presses, for pressing leads at each side of the QFP. Further, the shapes of the components, such as the T-shaped member and the L-shaped bar, are provided wherewith for illustrations only. It is understood that these components may be configured into other suitable shapes as required.

Claims

1. A lead press of a test apparatus for testing a device under test (DUT), the lead press comprising:

a contact member defining a contact portion and a mating profile, wherein said contact portion is adapted for contacting with at least one lead of the DUT; and

a holder having another mating profile adapted for holding the contact member, wherein an internal and substantially narrowing channel is defined at the another mating profile of the holder for securing resiliently the mating profile of the contact member.

2. The lead press according to claim 1, wherein the mating profile of the contact member and the another mating profile of the holder defining a dovetail join.

3. The lead press according to claim 2, wherein the mating profile of the contact member defining a dovetail insert and the another mating profile of the holder defining a groove adapted for receiving the dovetail insert.

4. The lead press according to claim 2, wherein the mating profile of the contact member defining a groove and the another mating profile of the holder defining a dovetail insert for inserting to the groove.

5. The lead press according to claim 1, wherein the contact member is made of an electrically non-conductive material

6. The lead press according to claim 2, wherein the contact member is made of ceramic.

7. The lead press according to claim 2, wherein the contact member is made of sapphire.

8. The lead press according to claim 2, wherein the contact member is made up of an material different from that of the holder.

9. The lead press according to claim 2, wherein the holder is made up of stainless steel.

10. The lead press according to claim 2, wherein the holder is made up of metal.