

MOUNTINGS FOR LEADLESS CHIP CARRIER

This invention relates to mountings for leadless chip carriers for use during testing and burn-in as well as for mounting leadless chip carriers on circuit boards or other substrates for use in

5. circuit applications.

As large scale integration (LSI) techniques are applied to integrated circuit and hybrid circuit development, the density of circuit functions which may be performed by a single circuit chip becomes

10. limited, not by the electronic functions which can be performed by the circuit chip, but by the packaging used to house the chip and the leads required for interconnecting the chip with other circuitry.

Integrated circuits are conventionally housed in 15. flat packs or dual in-line package (DIP) structures wherein interconnection leads are arranged in parallel rows extending from opposite sides of the chip housing. However, as the chip functions are

expanded to require greater numbers of interconnection

20. leads, standard DIP configurations pose serious limitations. For example, a sixty-eight pin array in conventional DIP packaging would require a DIP over three inches long. Because of impedance of the long leads required, such arrangements are

25. unsuitable for high speed devices. Furthermore, such packages would consume an inordinate amount of circuit board area and pose problems in maintenance or replacement.

In response to the need for high density packaging 30. for LSI devices, the industry has developed standard LSI chip carrier housings known in the art as leadless

chip carriers. Conventionally, the leadless chip carrier comprises a substantially flat rectangular ceramic base piece with a centrally located cavity in one face thereof. The chip is mounted on the

5. floor of the cavity and the cavity enclosed and hermetically sealed with a ceramic cover. Terminal lands are arranged on one or both sides of the base piece adjacent each of the four edges of the base piece and electrical communication between the
10. terminal lands and the enclosure housing the chip is provided by gold-plated leads or the like extending from the terminal lands to the cavity. The terminal lands may be on the front side (the major face of the base piece which carries the enclosure cover) or
15. the back side (the side of the base piece opposite the enclosure cover) or both, depending on the design of the leadless chip carrier. Furthermore, the location and arrangement of the terminal lands may vary depending on the size of the carrier and the
20. number of terminal lands.

Conventionally, leadless chip carriers as described above are mounted in mounting means for electrical interconnection with a circuit board or the like. Since the terminal lands must contact

25. means for forming electrical communication between the circuit elements on the printed circuit board and the terminal lands, means must be provided in the mounting housing to accurately position and align the terminal lands with respect to such contact
30. means.

- While various leadless chip carrier sizes and configurations as generally described above have been adopted as industry standards for various pin connection arrangements, the means used for inter-
5. connecting such leadless chip carriers with circuit boards or the like and thus provide electrical communication between the terminal lands of the leadless chip carrier and the circuit board varies with the particular circuit application, the
10. functions to be performed by the particular chip and other considerations. Thus no standard means has been adopted for mounting leadless chip carriers on circuit boards or the like.

- Obviously various designs of leadless
15. chip carrier interconnection means have been devised, each with its own unique characteristics and designed to satisfy certain requirements. Ordinarily, however, all prior mounting housings rely on registration of the mounting housing and
20. leadless chip carrier by reference to an edge of the ceramic base piece to align the contact means of the mounting housing with the terminal lands on the leadless chip carrier. Since the position of the contact means with respect to the mounting housing is
25. fixed, the position of the lands with respect to the edge of the base piece must be precisely fixed to insure that the contact means are in proper registry with the lands. Furthermore, the contact means are usually arranged to extend in a direction
30. transverse to the plane of the lands, thus project upwardly and/or downwardly from the mounting housing and/or the mounting housing cover, thus contacting the lands on the broad surfaces thereof.

22

.4.

Unfortunately, the ceramic base piece of many leadless chip carriers is not machined to provide precision edges. Instead, the base piece is formed from a larger sheet of ceramic material by forming

5. a plurality of precisely aligned holes in the sheet and/or scribing the sheet on one or both faces and breaking the sheet along the scribe line or aligned series of holes. Obviously, the break line which forms the edges of the base piece may or may not
10. be precisely aligned with the holes or scribe line. However, the terminal lands are formed on the base piece at precise locations with reference to the holes or scribe line, not the actual edge of the body. Thus, where the actual edge of the body does not
15. precisely coincide with the scribe line or line defined by the centres of the holes, and where the contact means carried by the mounting housing is aligned to contact the terminal lands by reference to the actual edge of the base piece,
20. misalignment between the contact means and the terminal lands often occurs. This results in failure to form proper electrical contact between the contact means and the terminal lands.

In accordance with the present invention, a

25. mounting for a leadless chip carrier comprises a support for the chip carrier, a plurality of conductive pins extending from the support with edges of the pins defining a cavity for the leadless chip carrier, the edges which define the cavity each comprising

30. a portion which converges slightly towards the cavity with increasing distance from the support, and a spreader arranged to act against the edges which define the cavity to spread the ends of the pins to permit the insertion of a leadless chip carrier between them into the cavity and onto the support.

The invention enables rapid mounting and de-mounting of a leadless chip carrier by deflecting the contact pins away from the cavity, and allowing them to return after insertion or removal of the carrier.

5.

If terminal lands on the chip carrier are positioned at holes used to define the desired edge of the ceramic base piece, those holes may constitute precision reference points on the base piece, for precisely locating the conductive pins on the terminal lands. Furthermore, where the land is formed with reference to the holes, the land material usually extends into the hole. The conductive pins may thus actually engage the lands in the semicylindrical portions of the holes formed to define the edges of the base piece. Thus, precise registration between the land and the contact means is achieved using the only precision reference points on the base piece.

10.

15.

20.

In a preferred embodiment, the conductive pins are resilient metal pins with outwardly sloping inner camming surfaces which mate with the spreader to uniformly and simultaneously spread the pins and to permit insertion and removal of the leadless chip carrier from the housing.

25.

The invention may be carried into practice in various ways, and two embodiments will now be described by way of example with reference to the accompanying drawings in which:-

30.

FIGURE 1 is a top plan view of a twenty pin version of the preferred embodiment of the invention;

FIGURE 2 is a sectional view of the apparatus of FIGURE 1 taken through section lines 2-2;

5. FIGURE 3 is a sectional view of a portion of the apparatus of FIGURE 1, taken through section lines 2-2 illustrating the action of the spreader to open the contact means; and

10. FIGURES 4 and 5 are sectional views of the same portion of the apparatus as shown in FIGURE 3 illustrating an alternative embodiment of the contact means.

15. In FIGURE 1 a typical twenty pin leadless chip carrier 10 is shown having five terminal lands 11 on the top surface of each edge thereof. Since the arrangement of the semiconductor chip within the cavity of the carrier and the interconnection of the chip with the lands 11 form no part of the invention, these details of the leadless chip carrier are not
20. illustrated. However, the base portion of the leadless chip carrier in the embodiment shown is characteristic of ceramic base pieces formed by breaking the ceramic along a line of small holes. Therefore the edge of the base piece has semicylindrical depressions
25. 12 vertically traversing each lateral edge thereof. The lands 11 positioned on one or both faces of the leadless chip carrier 10 are indexed to the depressions 12 and usually extend into the depressions 12.

30. The structure of the mounting housing is most clearly illustrated in FIGURE 2. In the preferred

embodiment, the housing comprises a base support 15; an intermediate support housing 16 which co-operates with the base support 15 to hold and position contact pins 20; and a spreader cup 40. The assembly is

5. secured together by a plurality of studs 18 (shown in FIGURE 1). The studs 18 secure the base support 15 and intermediate support housing 16 rigidly together and extend through the spreader cap 40 permitting the spreader cap to move with respect to the remainder of the

10. assembly as explained hereinafter.

In the preferred embodiment, the contact pins 20 are substantially flat axially elongated resilient electrically conductive bodies such as stainless steel coated with a suitable electrically

15. conductive coating or beryllium copper alloys or the like formed with a pair of parallel arms or blades 20a and 20b extending from a common base 20c. Each pin 20 has one pin shank 20d and one index stud 20e extending from the base 20c in the direction

20. opposite the blades 20a and 20b. The contact pin 20 is symmetrical about its longitudinal (vertical as shown in FIGURE 2) axis except that the shank 20d is substantially longer than the index stud 20e.

The base 20c fits within a recess 25 in base support 15 with shank 20d extending through aperture 26 and index stud 20e fitted within indexing recess 27.

25. Thus, shank 20d extends vertically through the base support 15 to provide electrical connection with a substrate such as a circuit board or burn-in board

30. or other socket or support means. It will be observed that aperture 26 and indexing recess 27 may be arranged in alternately reversed positions so that a

plurality of shanks 20d project from the bottom surface of the base support 15 in parallel rows with the positions of the shanks 20d in each row staggered with respect to the shanks in the other row.

5. Alternatively, aperture 26 and recess 27 may be identical apertures. Thus, shanks 20d may be alternately reversed or all arranged in the same row.

- The depth of recess 25 in the base support 15 is substantially equal to the vertical height of the base 20c of the pin member 20 so that the intermediate support housing 16 when mated with base support housing 15, locks the base 20c within the recess 25. The intermediate support housing 16 has outer lateral dimensions substantially conforming to the outer lateral dimensions of the base support 15 and has vertical channels 30 extending therethrough which align with the recess 25. However, channels 30 are not as wide as the recesses 25, thus, the shoulders 31 of the intermediate support 16 extend over the base 20c and secure the contact pin body within the housing. The internal surfaces of the channels 30 are provided with parallel slots 32 (most clearly shown in FIGURE 1) aligned with the recesses 25 and apertures 26 to receive the blades 20a and 20b of the pin, thus supporting the pins 20 vertically and parallel with each other. It will thus be observed that with intermediate support housing 16 mated with base support 15, the pins 20 are secured vertically and parallel to each other in groups aligned in four rows defining a central rectangular area on the top surface of the intermediate support member 16.

In the preferred embodiment, the base support 15 and the intermediate housing support 16 have aligned apertures 34 extending vertically therethrough at each corner. The intermediate support 16 also

5. has a post 33 on the top surface thereof surrounding each aperture 34. The base support 15 and intermediate support housing 16 are held firmly together by studs 18 passing through the apertures 34.

A spreader cap 40 having outer lateral dimensions

10. substantially conforming to the outer lateral dimensions of the base support 15 and intermediate support housing 16 is mounted for vertical reciprocal movement on the posts 33. Preferably, the spreader cap 40 has apertures in the corners thereof in registry

15. with the posts 33 and thus rides on the posts. The studs 18 have enlarged ends 41 for retaining the spreader cap on the assembly. The spreader cap 40 has a central rectangular cavity 42 which is larger than the rectangular area defined by the top ends of

20. the pins 20. However, the top surface of the spreader cap 40 has an inwardly and downwardly projecting lip 43.

As most clearly illustrated in FIGURES 2 and 3, the pin 20 is forked at about its mid-section to form

25. blades 20a and 20b which project above the surface of the intermediate support housing 16. The outer edge of each blade 20a and 20b also diverges outwardly from the vertical axis of the pin 20 to a point near the top free end thereof and then diverges inwardly.

30. The inwardly and downwardly projecting lip 43 is

adapted to mate with and rest on the inwardly diverging edge 50 of each pin 20. It will thus be observed that as the spreader cap 40 is moved downwardly (as illustrated by the arrow in FIGURE 3)

5. the lip 43 acts as a camming surface against the edges 50 of the pins, thus bending the blades 20b toward the central axes of the pins 20 and outwardly with respect to the central cavity defined by the blades 20b. As the spreader cap 40 is uniformly pressed
10. toward the support 16, all the inner blades 20b of the pins 20 are urged outwardly from the central cavity, thus aligning the otherwise inwardly inclined edges 51 vertically or nearly so. Since the central opening in the spreader cap 40 is slightly larger than
15. the leadless chip carrier 10, and since the pins 20 are spread outwardly by the spreader cap 40, a leadless chip carrier may be inserted through the spreader cap 40 into the central cavity to rest on the top surface of the intermediate support 16 or on a seat
20. carried on it. When downward pressure on the spreader cap 40 is released, the inner blades 20b return to their relaxed position (see FIGURE 2) and engage the edges of the leadless chip carrier.

- Where the terminal lands 11 are aligned with and
25. extend into the semicylindrical depressions 12 on the edges of the leadless chip carrier base piece (as illustrated in FIGURE 1), and where the pins 20 are spaced to likewise mate with the depressions 12, the inclined edges 51 of the blades 20b are urged
 30. into the depressions 12 to form physical and electrical contact with the lands 12. Furthermore, since the edges 51 are inclined inwardly from the vertical the blades 20b securely lock the leadless chip carrier within the mounting housing.

The above described embodiment is particularly suitable for use in connection with leadless chip carriers wherein the ceramic base piece is formed by drilling holes therein and breaking the ceramic

5. wafer along the line of holes. In such cases, the lands 11 are usually formed in registry with the semi-cylindrical depressions 12 formed by the breaking hole and thus the blades 20b are automatically aligned with the lands 11 and engage the lands
10. within the semi-cylindrical depressions 12. Note that in this arrangement the contact means (the blades 20b) are indexed with the lands by reference to the semi-cylindrical depressions 12 which are the only Precision-located points on the ceramic base piece.
15. Since the electrical conical means 20b are not indexed with reference to any other portion of the ceramic base piece, precision and accurate indexing is always achieved.

- Some leadless chip carriers are not formed by
20. drilling holes in the ceramic base piece. Therefore semi-cylindrical depressions 12 are not present and can not be used to index the lands 12. In such cases, the lands 12 may be formed only on one surface, on both surfaces, or actually wrapped around the lateral
25. edges of the base piece. However, if the lands are wrapped around the edges, the above embodiment performs equally well since electrical contact is made between the portion of the land wrapped around the edge of the ceramic base and blade 20b. If,
30. however, the ceramic base piece of the leadless chip

carrier has no semi-cylindrical depression 12 to act as an indexing means and the land 11 does not extend around the edge of the ceramic base piece, the blades 20b may be modified as illustrated in FIGURES

5. 4 and 5.

In the embodiment of FIGURES 4 and 5, the outwardly divergent edge 51 of blade 20b is modified to include an outwardly and downwardly extending barb 51a. Thus, when the spreader cap 40 is depressed
10. the blades 20b are withdrawn laterally to permit the leadless chip carrier to be positioned within the cavity. However, when the spreader cap 40 is released the blades 20b move inwardly urging barbs 51a inwardly and downwardly into contact with the top surface of the
15. lands 11. Since the barbs 51a move both laterally and downwardly when the blades 20b are released, the barbs 51a scrape the surface of the lands 11 to remove any oxidation therefrom and thus form good electrical contact with the lands 11 while also acting
20. to retain the leadless chip carrier within the cavity.

It should be noted that the structure of the embodiment described is extremely simple and may be readily fabricated from available materials. For example, the housing may be made from three pieces
25. of insulating material such as moulded or machined plastic or the like. The pins 20 are symmetrical about their longitudinal axes (except for the lengths of shanks 20d and studs 20e), thus may be all identical and simply alternately reversed during assembly
30. to provide parallel rows of pins. Furthermore, a centrally located aperture 13 may be provided in the base support 15 to permit cooling of the leadless

- chip carrier by convection or by a heat sink attached to the leadless chip carrier and projecting into the cavity. Likewise, since the top of the housing is open, a heat sink may be attached to the top side
5. of the leadless chip carrier 10 and project through the central opening in the spreader cap 40.

- It will be noted that no special tools are required to insert the leadless chip carrier into the housing of the invention. The leadless chip carrier
10. is simply inserted within the opening in the central portion of the spreader cap 40 and the spreader 40 pressed toward the intermediate support 16. As the blades 20b retract laterally, the leadless chip carrier 10 simply drops into position on the top
15. surface of the intermediate support housing. When the spreader cap 40 is released, the blades 20b automatically align with and form electrical contact with the lands 11.

- Removal of the leadless chip carrier 10 from the
20. housing is accomplished with similar ease. By pressing the spreader cap 40 toward the intermediate support housing 16, the blades 20b are retracted and the leadless chip carrier may be withdrawn from the housing by simply inverting the structure; by
25. inserting a plunger or other suitable instrument through the aperture 13; or by other suitable simple and convenient means.

- It should be noted that the housing of the invention is extremely compact and has no moving
30. closure lid or the like. Thus, the housing may be

inexpensively manufactured and occupies minimum space on a mounting substrate. Furthermore, the housing can be designed to accommodate leadless chip carriers of various configurations without modification of the basic design of the housing.

5.

Because of the simplicity of design and the ease with which leadless chip carriers may be inserted into and withdrawn from the housing of the invention, the housing has particular applicability and suitability

10.

for use in connection with burn-in boards wherein large numbers of leadless chip carriers are mounted in housings on a burn-in board and tested and stressed under adverse conditions. The housing is

15.

likewise applicable for use as a housing or mounting socket for end use circuit applications. Accordingly, while the invention has been described with particular reference to specific embodiments thereof, it is to be understood that the forms of the invention shown and described in detail are to be taken as

20.

preferred embodiments of same, and that various changes and modifications may be resorted to without departing from the spirit and scope of the invention as defined by the appended claims.

25.

30.

CLAIMS

1. A mounting for a leadless chip carrier comprising a support for the chip carrier, a plurality of conductive pins extending from the support with edges of the pins defining a cavity for the leadless chip carrier, the edges which define the cavity each comprising a portion which converges slightly towards the cavity with increasing distance from the support, and a spreader arranged to act against edges of the pins which define the cavity to spread the ends of the pins to permit the insertion of a leadless chip carrier between them into the cavity and onto the support.

2. A mounting as claimed in Claim 1 in which the pins extend from the support substantially perpendicularly.

3. A mounting as claimed in Claim 1 or Claim 2 in which the conducting pins pass through the support to define external connections on the side remote from the cavity.

4. A mounting as claimed in any of the preceding claims in which the pins tend to spring back towards the inserted chip carrier after the spreader has been removed.

5. A mounting as claimed in any of the preceding claims in which the pins are disposed along the four sides of a rectangle.



6. A mounting as claimed in any preceding claim wherein each of said conductive pins comprises a substantially flat elongated conductive body with a centrally located base portion, a shank and an index stud extending parallel in a first direction from said base portion and a pair of blades extending parallel in the opposite direction from said base portion, said conductive pin body being substantially symmetrical about its central axis except for the relative lengths of said index stud and said shank, one of the blades carrying the said cavity defining edge.

7. A mounting as claimed in Claim 6 wherein the support includes a plurality of recesses adapted to mate with and receive the base portions of the pins to support said pins with their axes parallel and normal to a major face of the support.

8. A mounting as claimed in Claim 6 or Claim 7 wherein said contact means are arranged in said support housing in alternately reversed positions so that the shanks project through apertures in the support in parallel rows with location of the shanks alternately staggered in each row.

9. A mounting as claimed in any preceding claim wherein the inwardly inclined edge of each pin includes an inwardly projecting barb.

30.



10. A mounting as claimed in any preceding claim wherein the support comprises a first base support means including recesses for receiving base portions of the pins and an intermediate support housing
5. mating with the first base support means and having a plurality of channels passing therethrough, said channels each having slots in the walls thereof for receiving the edges of the pins.
10. 11. A mounting as claimed in Claim 10 including studs passing through the first base portion, the intermediate support housing and the spreader; the studs securing the first base portion and intermediate support housing together, while permitting
15. the spreader to move reciprocally axially of the studs.
12. A mounting as claimed in any preceding claim wherein the spreader comprises a body adapted for
20. reciprocal movement parallel with the axes of the pins and having a central opening greater in lateral dimensions than the lateral area of the cavity defined by said pins and including camming means for mating with the ends of said pins to urge the free
25. ends of said pins outwardly with respect to the cavity as the spreader is moved axially with respect to the pins.
13. A mounting as claimed in Claim 12 in which the
30. edges of the ends of the pins further from the support than the converging parts have edges which diverge away from the cavity and which, together with an inclined surface of the spreader, constitute the camming means.



14. A mounting as claimed in any preceding claim including a centrally located aperture in the support.
15. A mounting for a leadless chip carrier
5. constructed and arranged substantially as herein specifically described with reference to FIGURES 1-3 or 1, 4 and 5 of the accompanying drawings.
16. A mounting as claimed in any of the preceding
10. claims including a leadless chip carrier positioned on the support within the cavity, and with terminal lands in contact with the edges of the pins.
15. 17. A mounting as claimed in Claim 16, in which the conductive pins are located in depressions in the edges of the leadless chip carrier.