A tray having three dimensionally adjustable sized pockets for holding a plurality of electronic components. A rectangular tray base has a cavity with a flat bottom, and four sides configured with wall notches for receiving and captivating ends of elongated transverse and longitudinal dividers. Each divider has a plurality of notches spaced along a length. The notches are configured to allow each transverse divider to interlock with a plurality of longitudinal dividers to form a rectangular array. The array is positioned in the tray base cavity, forming a plurality of rectangular pockets. The lengths and widths of the pockets are adjustable by selecting a particular divider notch for intersection of each longitudinal and lateral divider. A rectangular top frame of selected thickness is positioned over the wall notches to retain the dividers, and to define a height of each pocket upon placing a lid over the tray.
UNIVERSAL MATRIX TRAY FOR ELECTRONIC DEVICES

FIELD OF THE INVENTION

[0001] The present invention relates generally to trays for storing, transporting and processing electronic devices and more particularly to a tray that has adjustable sized component pockets.

DESCRIPTION OF THE PRIOR ART

[0002] Most trays, including JEDEC sized trays, are hard tooled, meaning that a separate tool is required for each different tray size or configuration. The design and manufacture of such a hard tooled tray is both costly and time consuming. For example, it may take several weeks to build tooing for injection molding a tray. Once a tray is constructed, it is only usable for one size of component. Present tray designs are not capable of properly storing a mixture of component sizes.

SUMMARY

[0003] It is an advantage of this invention in that it provides a custom component tray that can be quickly assembled from stock parts.

[0004] It is a further advantage of this invention in that it provides a tray that can be adjusted to fit a desired component size.

[0005] It is a still further advantage of this invention in that it provides an adjustable tray that can simultaneously accommodate different sizes of electronic components.

[0006] In one embodiment of the present invention, there is provided a tray having three dimensionally adjustable sized pockets for holding electronic components. A plastic injection molded rectangular tray base has a cavity with a flat bottom and a four sided wall configured with wall notches for receiving and captivating ends of elongated lateral and longitudinal dividers. Both the lateral and longitudinal dividers have a plurality of notches spaced along a length of each divider and extending substantially half way through. The notches are configured to allow each lateral divider to interlock with a plurality of longitudinal dividers, to form a rectangular array with a plurality of rectangular four sided enclosures. The array is positioned in the tray base cavity, and each of the four sided enclosures and the bottom of the cavity form a pocket. The length and width of a pocket is adjustable by selecting particular divider notches for intersection of longitudinal and transverse dividers. A rectangular top frame approximating the contour of the wall, and of a selected thickness is positioned over the top of the wall to cover the wall notches for retaining the dividers with the frame height selected to define the height of the pockets for limiting movement of a component in a pocket upon placing a lid over the tray.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] FIG. 1A is a perspective view of an embodiment of a tray according to the present invention;

[0008] FIG. 1B is a perspective view of the tray of FIG. 1A without the dividers;

[0009] FIG. 2 is an exploded section view of a portion of FIG. 1A to more clearly illustrate the assembly of the tray;

[0010] FIG. 3 is a cross-sectional view of a stack of two trays;

[0011] FIG. 4A illustrates an alternate embodiment of a tray wherein smaller wall notches provide a larger selection of pocket sizes;

[0012] FIG. 4B illustrates details of a lateral divider shown in FIG. 4A;

[0013] FIG. 4C illustrates details of a longitudinal divider shown in FIG. 4A;

[0014] FIG. 4D shows an alternate construction of a reduced width end portion of a divider;

[0015] FIG. 5 illustrates use of a partition to form more than one section in a tray;

[0016] FIG. 6 illustrates an alternate JEDEC dimensioned tray with adjustable dividers, and

[0017] FIG. 7A illustrates an alternate divider configuration;

[0018] FIG. 7B is an enlarged partial view of a wire divider shown in FIG. 7A; and

[0019] FIG. 8 illustrates a cover apparatus for filling space between a tray cover and components or dividers.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0020] While the present invention will be described herein with reference to particular embodiments thereof, a latitude of modifications, various changes and substitutions are intended, and it will be appreciated that in some instances some features of the invention will be employed without a corresponding use of other features without departing from the spirit and scope of the invention as described with respect to the preferred embodiments set forth herein.

[0021] An embodiment of the adjustable tray of the present invention is shown in the perspective view of FIG. 1A. The tray 10 includes a rectangular tray base 12 having a cavity 14 defined by a flat tray base bottom 16 and four walls including side walls 18 and 20 and end walls 22 and 24. Each of the walls 18,24 has a plurality of wall notches 26 for captivating end portions of longitudinal dividers 28 and lateral dividers 30 positioned in the cavity 14 as shown. The lateral dividers 30 each have a plurality of lateral divider notches 32, and upon assembly, selected lateral divider notches 32 are positioned and engaged with corresponding selected longitudinal divider notches 34 as shown by example in FIG. 1A, and which will be more clearly illustrated in reference to FIG. 2.

[0022] The installation of a plurality of longitudinal and lateral dividers 28 and 30 in the cavity 14 results in the formation of a plurality of pockets 36. In another embodiment, only one set of opposing walls have wall notches 26. For example, if end walls 22 and 24 have notches, side walls 18 and 20 in this embodiment do not have notches. Similarly, when side walls 18 and 20 have notches, end walls 22 and 24 do not have notches. In this alternate embodiment, the notches in one set of opposing walls and in the dividers
adequately retain the desired matrix of pockets 36. The size of a pocket 36 is determined by the particular selection of notches 32 and 34 for intersection between the lateral and longitudinal dividers. For example, if a particular one of dividers 30 such as item number 38 is positioned so as to engage with the row of notches 34 located closer to end wall 24 as indicated by line 40, the pockets 42 would be smaller, and pockets 44 would be larger. The longitudinal dividers 28 can similarly be moved to any available lines of notches 32 to enlarge or reduce the size of particular rows of pockets.

[0023] With the dividers 28 and 30 installed to form the pocket dimensions in longitudinal and transverse directions as required, a frame 46 is secured with fasteners 48 over the wall notches 26. The frame 46 completes the captivation of end portions of the dividers, securing the dividers in position. The height 50 of the frame 46 is selected/designed to achieve a required pocket 16 height. The pockets are therefore adjustable, according to the above description of the tray, in the three dimensions of length, width and height.

[0024] FIG. 1B shows the tray base 12 of FIG. 1A without the dividers 28 and 30, and without the frame 46 in order to show the cavity 14 more clearly. As an alternate embodiment, numbers 51 are placed on the top surfaces 53 of the walls 18-24, referencing the locations of the recesses 26 for aiding in locating the desired positions for the dividers in the notches and therefore in the cavity 14. The use of notch location indicating marks avoids tedious manual counting of notches 26. The layout of numbers shown in FIG. 1B shows a zero reference at an approximate center of each of the four walls 18-24. Other arrangements are also included in the spirit of the present invention. The present invention also includes other types of locating indicators for aiding in positioning the dividers, such as a combination of numbers or letters and scale index lines.

[0025] FIG. 2 is an exploded sectional view “A” from FIG. 1A for more clearly describing the construction of the tray 10. The tray base 12 side wall structures 18 and 20 are visible in FIG. 2, and the notches 26 are clarified. The walls 18 and 20, and also walls 22 and 24 shown in FIG. 1A, have a first height “h₁” from the base 16. A lateral divider 30 is shown and has a height “h₂” preferably equal to or slightly less than height h₁ of the notches 26. An end portion 52 of the divider 30 is placed in a selected notch 26 in wall 18 as indicated by the dashed lines. Similarly, a longitudinal divider 28 is shown positioned/orthogonal to divider 30, and has a height h₃, and has an end portion 54 which is placed in a selected one of the notches 26 in wall 20, for example the placement illustrated by dashed lines. The longitudinal divider 28 notches 34 are constructed to have a width w₁ for clearance over the width w₂ of the lateral divider 30. Similarly, the width w₂ of the notches 32 of the lateral divider 30 are constructed for clearance over the width w₁ of the longitudinal divider 28. The height h₁ of the notches 32 and 34 is constructed to equal or exceed half the height h₁ of the dividers so as to allow a full engagement/alignment of the lateral and longitudinal dividers as shown in FIG. 1A.

[0026] The frame 46 is secured to sidewalls 18, 20 or end walls 22, 24, or both side walls 18, 20 and end walls 22, 24. Although screws are shown as fasteners 48 in FIG. 1A, the frame 46 can alternatively be secured to walls 18-24 with any type of fastener or adhesive method that maintains the frame in place. For example, the frame may be secured to walls 18-24 with glue, adhesive tape, ultrasonic welding, plastic welding or snaps. The frame 46 interfaces with surface 56 and covers the tops of the notches 26 so as to captivate the dividers 28 and 30 in the notches 26 upon securing the frame 46 with fasteners 48 to the walls 18-24. The total height of the pockets is effectively the sum of the height h₁ of the walls 18-24 plus the height h₃ of the frame 46. With a cover on top of the tray, a component will therefore be secured in a pocket, assuming that the height of the component is greater than the height h₁ of the frame. If the height of the component is less than h₁, or the gap between the top of the dividers and the top of the frame, the component could migrate between pockets. Since the height of the frame is selectable, this problem is avoided by proper selection of the frame height according to the present invention. Suitable materials to use for fabricating the frame include metal, plastic, rubber, gasket material or any combination thereof. As an alternate embodiment, the dividers can be configured with a height that is higher in the area within the inner border of the frame so as to avoid migration of components of smaller size. In this case, the ends of the dividers would be of a reduced height relative to the height of the divider within the inner border of the frame. This alternate embodiment applies to all of the dividers disclosed herein. These and other variations for securing the dividers in place and adjusting the pocket sizes that will be apparent to those skilled in the art upon reading the present disclosure are also included in the spirit of the present invention.

[0027] FIG. 3 is a cross sectional view of two trays 10 stacked one on the other. The cross section of each tray 10 is taken for example, along a line such as B-B in FIG. 1A. FIG. 3 shows more clearly the height of a pocket 36 as h₃, which is equal to the sum of h₁ and h₂ shown in FIG. 2. Note that the height of the dividers 28 and 30 is less than the total height of each pocket. A component placed in a pocket 36 will be captivated sufficiently if the component height is greater than the height h₁ of the frame. Preferably, the component height is only slightly less than h₁ in order to avoid undesirable component movement in a pocket. Similarly, the width and length of a pocket is preferably adjusted to be only slightly greater than the corresponding dimensions of the electronic component to be placed therein, in order to minimize component movement.

[0028] FIG. 4A illustrates an alternate tray embodiment that provides a “finer”, more accurate adjustment of the width and length of the component pockets. The tray base 64 has a cavity 77 with the cavity bottom indicated by item number 76. In order to accomplish the finer adjustments, notches 57 in the walls 58, 60, 62 and the wall at the opposite end (not shown) of the tray base 64, are made more narrow, and spaced closer together, for example than the notches 26 shown in FIG. 1A. In order to preserve strength in the lateral dividers 66 and longitudinal dividers 68, only end portions 70 of the dividers are made narrow enough to fit in the notches 57. In order to allow lateral and longitudinal movement of the dividers at intersections 72, elongated divider notches 74 and 75 are provided in the lateral and longitudinal dividers respectively.

[0029] FIG. 4B is a perspective view of a lateral divider 66, and FIG. 4C is a perspective view of a longitudinal divider 68, for more clearly illustrating the ends 70 and elongated slots 74 and 75.
FIG. 4D is an alternate section “C”, corresponding to section “C” of FIG. 4A, showing an alternate tray base 79 having an alternate embodiment of an end portion 78, corresponding to the end portion 70 of FIG. 4A. FIG. 4D shows a support 80 attached to a reduced width portion 82. In order to accommodate the thickness “t” of the support portion 80, the level of a top surface 83 of a wall 84, corresponding to wall 88, is reduced over the notch area 86 by an amount “t” equal or slightly more than the thickness “t” of the support 80.

A further alternate embodiment is illustrated in FIG. 5. In this embodiment a partition divider 87 is provided with notches 88 on both sides. The partition divider 87 separates the base cavity 90 into two main sections 92 and 94. The partition 87 makes it possible to space longitudinal dividers differently in the two sections 92 and 94 as shown. FIG. 5 illustrates for example, smaller pockets 96 in section 92 and larger pockets 98 in section 94. Although FIG. 5 shows one lateral partition 87, the present invention also includes any number of partitions, and they can be either longitudinally or laterally oriented, or they can be interconnected to intersect each other as separate dividers or integrated in one unit to provide any number of sections in which pockets of various sizes can be arranged. The wall notches and divider notches can be configured to allow the dividers to be placed in various ways, including those described above in reference to FIG. 1A and FIG. 4A. Such variations in the construction and assembly will be apparent to those skilled in the art upon reading the present disclosure, and these are to be included in the spirit of the present invention.

As a still further alternate embodiment of the present invention, the trays as described above in reference to FIGS. 1A-5 can have dimensions conforming to JEDEC standard dimensions for trays used to contain semiconductor devices.

Another tray embodiment 100 of the present invention is shown in FIG. 6, which embodiment is similar to that described in reference to FIG. 1A, except that the wall notches 26 of FIG. 1A are omitted. In order to vertically captivate the dividers 28 and 30, a frame 102 is provided that extends inward past the wall 104 and over the top of each end of dividers 28 and 30. As an alternate embodiment, the tray 100 is designed to have length “L” and width “W” dimensions that conform to JEDEC standard dimensions. Various alternative ways of retaining the dividers 28 and 30 in a tray base will be apparent to those skilled in the art upon reading the present disclosure, and these are to be included in the spirit of the present invention. For example, the dividers 28 and 30 of FIG. 6 could be retained by extending the lateral frame end wall portions 106 and 108 over the ends of the longitudinal dividers 28, and not overlapping the ends of the lateral dividers 30 by longitudinal frame wall portions 110 and 112. Even a single lateral bar extending over the matrix of dividers from the frame wall 110 to wall 112 and positioned for example half way along the length L of the tray could serve to retain the dividers 28 and 30 with the longitudinal dividers positioned so as to hold the lateral dividers as shown in FIG. 6. In a further alternate embodiment, only the frame lateral end walls 106 and 108 could be configured to extend over the ends of the longitudinal dividers 28 for captivating the dividers 28 and 30. In this case with the longitudinal dividers 28 holding down the lateral dividers 30, the frame positions 110 and 112 need not extend over the lateral dividers 30. These and other variations that will be apparent to those skilled in the art upon reading the present disclosure, and they are to be included in the spirit of the present invention. In a still further alternate embodiment of the present invention, the frame as described in the present disclosure can be omitted. In this case, in a method according to the present invention, a cover is placed over the matrix of dividers, which will hold the dividers in place. For example, a cover can be placed over the assembly of FIG. 7A.

The present invention includes other designs of dividers, as well as the designs described above. FIG. 7A illustrates an alternate tray and divider embodiment with a tray base 118, similar to base 12 of FIG. 1A, but having wall notches 120 configured to retain longitudinal 122 and lateral 124 dividers constructed of wire. The wire as shown in FIG. 7A is configured in the form of a sine wave. It can alternatively be a saw tooth, square wave or other configuration that serves to allow the interleaving of longitudinal and lateral dividers to form a plurality of component pockets 126 with walls that are effective for retaining components in the pockets 126. For description in the claims, the wire dividers will be described as meandering wire dividers. In this case, the term “meandering” is defined to describe a controlled, planned/divider configuration as described above for the purpose of forming straight walls, and does not imply an uncontrolled or unplanned meandering, which is another dictionary definition of the term which is not relevant to this application. Referring to the enlarged partial view of FIG. 7B of a meandering wire divider, the space 128 between downward and upward excursions 130 of the wire serve as divider notches, allowing longitudinal and lateral dividers to be interleaved as shown in FIG. 7B.

FIG. 8 illustrates another embodiment of the present invention. In this embodiment, cavity cover apparatus 132 is provided for filling or partially filling the space between the bottom 134 of a base 136 of an upper tray 138, or the bottom of a tray cover (not shown), and the top of the dividers 28 and 30, or the tops of a component 140 (indicated by dashed lines), whichever is higher. The cover apparatus 132 can be any of various structures for covering the pockets and also for filling the cavity space that will be apparent to those skilled in the art upon reading the present disclosure. The cover apparatus 132 serves to restrict movement of components 140 in the pockets in which they are placed. FIG. 8 shows a cover plate 142 that is placed directly on top of the pockets 36 and rests on either the dividers or the components, again depending on which is higher. An adjustable spacer 144 is also provided for filling the space. The spacer can be fabricated for example of metal, plastic or a compressible material such as rubber or gasket material, or any combination of materials. The spacer can be custom selected/adjustable, or it can be a compressible material in order to fill the space. The cover length and width are configured to substantially cover the pockets 36, i.e., to substantially occupy the space within the frame 46. The spacer 144 can be of various configurations for serving the purpose of holding the cover plate 142 in place. For example, it can be a single piece in the form of a plate as shown, or it can be any of various configurations, including more than one piece, such as a plurality of compressible disks attached or placed on the cover plate 142. As a further alternate embodiment, the cover apparatus 132, including
spacer and cover plate can be attached to the bottom side of the tray cover or bottom side of an upper tray to be stacked on a lower tray. As a still further embodiment, referring again to FIG. 8, a spacer can be placed between the bottom of a first tray base and a frame on a second tray on which the first tray is placed. For example, a spacer can be placed in the gap 146 of FIG. 8. For ease of illustration, a spacer 148 is shown placed on the bottom 150 of tray base 152 for filling a gap between the bottom 150 of tray base 152 and the top of a frame similar to frame 46 on a lower tray upon which the tray base 152 may be placed. The lower tray for example could be of the same design as tray 138.

[0036] While the present invention has been described herein with reference to particular embodiments thereof, a latitude of modifications, various changes and substitutions are intended in the foregoing disclosure, and it will be appreciated that in some instances some features of the invention will be employed without a corresponding use of other features without departing from the spirit and scope of the invention as set forth in the appended claims.

1. A tray for holding semiconductor components comprising:

a tray base including

a bottom support structure;

a wall including first and second opposing side walls, and first and second opposing end walls, said wall extending from said bottom support structure to form a cavity in said tray base, said wall having a wall top and wall notches formed on a side of said wall facing inward to said cavity;

a plurality of lateral dividers for placement in said cavity, each lateral divider having a plurality of lateral divider notches and having end portions for placement in selected wall notches;

a plurality of longitudinal dividers for placement in said cavity, each having a plurality of longitudinal divider notches configured for engagement with lateral divider notches to form a matrix of pockets upon placement of said lateral and longitudinal dividers in said cavity; and

a frame placed on said wall top and attached to said base for captaining said lateral and longitudinal dividers in said wall notches.

2. A tray for holding semiconductor components comprising:

a tray base, said base having a tray bottom and a wall structure forming a cavity in said tray base;

an adjustable matrix of dividers wherein said dividers can be positioned to adjust sizing of a plurality of pockets formed by said tray bottom and said dividers; and

a frame for captaining said dividers in said cavity.

3. A tray as recited in claim 2 wherein said wall structure includes

first and second opposing side walls; and

first and second opposing end walls.

4. A tray as recited in claim 3 wherein said dividers include

a plurality of longitudinal dividers each having a plurality of longitudinal divider notches; and

a plurality of lateral dividers each having a plurality of lateral divider notches for engaging with corresponding said longitudinal divider notches.

5. A tray as recited in claim 4 wherein each of two opposing walls include a plurality of wall notches for captaining ends of corresponding dividers.

6. A tray as recited in claim 2 wherein said frame includes a frame height selected to limit movement of a component in a pocket when a tray cover is placed over said tray.

7. A tray as recited in claim 3 wherein each of two opposing walls include a plurality of wall notches for captaining ends of corresponding dividers.

8. A tray as recited in claim 7 wherein said dividers are configured as meandering wire.

9. A tray as recited in claim 7 wherein each said divider includes first and second opposing end portions that are narrowed for insertion in said wall notches.

10. A tray as recited in claim 9 wherein said dividers include

a plurality of longitudinal dividers, each having a plurality of elongated longitudinal divider notches; and

a plurality of lateral dividers, each having a plurality of elongated lateral divider notches, wherein said lateral and longitudinal notches are configured to provide clearance for continuous movement of a lateral divider relative to a longitudinal divider within a length of a said notch.

11. A tray as recited in claim 3 wherein said dividers include

at least one section divider, each section divider for partitioning off sections in said cavity;

a plurality of longitudinal dividers configured for each said section; and

a plurality of lateral dividers configured for each said section.

12. A tray as recited in claim 11 wherein said walls have a plurality of wall notches for captaining end portions of said lateral, longitudinal and section dividers, and said section dividers have a plurality of section divider notches on two sides for captaining end portions of lateral and longitudinal dividers in two sections.

13. A tray recited in claim 11 wherein each of two opposing walls include a plurality of wall notches for captaining ends of corresponding dividers.

14. A tray as recited in claim 1 wherein each said lateral and longitudinal divider has a reduced width portion on each of two opposing ends for placement in said wall notches, for achieving a finer adjustment of position of said dividers.

15. A tray as recited in claim 13 wherein said lateral and longitudinal divider notches are each elongated to provide continuous movement of said dividers relative to one another at a point of crossover of a lateral and longitudinal divider, for the purpose of accommodating smaller incremental position selection from one wall notch to another.

16. A tray as recited in claim 1 further comprising at least one section divider for dividing said cavity into sections, whereby said lateral and longitudinal dividers in one section are independently adjustable relative to adjustment of lateral and longitudinal dividers in another section.
17. A tray as recited in claim 1 wherein a plurality of said longitudinal and lateral dividers are formed as a meandering wire, and wherein said divider notches are defined by space between downward and upward excursions of said wire.

18. A tray as recited in claim 2 further comprising a cover plate for placement within an inner perimeter of said frame.

19. A tray as recited in claim 18 further comprising a spacer for placement over said cover plate.

20. A tray as recited in claim 19 further compressing a tray cover.

21. A tray as recited in claim 20 wherein end spacer and said cover plate are attached to an underside of said tray cover.

22. A tray as recited in claim 21 wherein said tray cover is a second tray placed on said tray.

23. A method of adjusting a tray for holding semiconductor components, said tray including a tray base having a cavity with a bottom and a wall structure including first and second opposing side walls and first and second opposing end walls, said wall structure extending from said bottom, wherein said cavity is divided into a matrix of pockets, the method comprising:

    inserting at least one first divider within said cavity;

    placing at least one second divider transverse to said first divider within the cavity by interlocking the second divider with the first divider to form a matrix of pockets; and

    attaching a frame to said tray base for retaining said dividers in said cavity.

24. The method of claim 23 further comprising placing a tray cover on said tray.

25. The method of claim 23 wherein said matrix of pockets includes pockets of different sizes.

26. The method of claim 24 further comprising placing a cover plate within an inner perimeter of said frame.

27. The method of claim 26 further comprising providing a spacer on said cover plate.

28. The method of claim 27 wherein said spacer is configured so that said spacer is in contact with an underside portion of said tray cover.

29. The method of claim 28 wherein said spacer and cover plate are attached to an underside of said tray cover.

30. The method of claim 28 wherein said tray cover is a second tray stacked on said tray.

31. The method of claim 23, wherein a said first divider is repositioned to adjust at least one pocket size within the matrix of pockets.

32. The method of claim 23 wherein a said second divider is repositioned to adjust at least one pocket size within the matrix of pockets.

33. The method of claim 23, wherein a said first divider and a said second divider are repositioned to adjust at least one pocket size within the matrix of pockets.

34. The method of claim 24, wherein said tray cover is a second tray that is placed on said tray.

35. The method of claim 23, comprising securing end portions of said first divider to said wall structure with notches in said opposing end walls.

36. The method of claim 35, further comprising securing end portions of said second dividers to said wall structure with notches in said opposing side walls.

37. A tray comprising:

    a tray configured for holding semiconductor components including

    a tray base, said base having a tray bottom and a wall structure forming a cavity in said tray base; and

    an adjustable matrix of dividers for placement in said cavity, wherein said divider can be positioned to adjust a size of a plurality of pockets for holding semiconductors, said pockets formed by said tray bottom and said dividers.

38. A tray as recited in claim 37 wherein said wall structure includes

    first and second opposing side walls;

    first and second opposing end walls; and

    wherein said dividers include a plurality of longitudinal dividers each having a plurality of longitudinal divider notches;

    a plurality of lateral dividers each having a plurality of lateral divider notches for engaging with corresponding said longitudinal divider notches, and

    wherein each of said opposing walls include a plurality of wall notches for captivating ends of corresponding dividers.

* * * * *