

CARRIER TAPE FOR ELECTRONIC COMPONENTS

Technical Field

5 The disclosure generally relates to carrier tapes, particularly carrier tapes for electronic components.

Background

As electronic equipment become miniaturized, it has become desirable to design and manufacture electronic components, such as integrated circuit (IC) chips, to be lighter in weight and smaller in size. 10 Methods for storing and/or transporting such components have evolved over the years. One such method is use of a carrier tape. Carrier tapes are used to store and transport electronic components (such as resistors, capacitors, or integrated circuits) from a component manufacturer to a different manufacturer that assembles the components carried within the carrier tape. These electronic components are mounted onto a printed circuit board (PCB) or other substrate during assembly of electronic equipment, or sub-assemblies 15 that will be used later to build the electronic equipment.

Summary

In some aspects of the disclosure a flexible carrier tape for transporting a plurality of components includes a flexible substrate extending along a longitudinal direction of the carrier tape. Pluralities of spaced 20 apart first and second pockets are formed in the flexible substrate and arranged along the longitudinal direction of the carrier tape. At least each of the first pockets is configured to receive one of the components therein. Each of the first and second pockets include a pocket opening for receiving the component therethrough and into the pocket. A bottom wall includes a major inner surface facing the pocket and an opposing major outer surface lower than the substrate. The major inner and outer surfaces are spaced apart 25 from the pocket opening by respective pocket height and pocket thickness. The pocket heights and thicknesses of the first pockets are smaller than the respective pocket heights and pocket thicknesses of the second pockets.

In some other aspects of the disclosure a flexible carrier tape for transporting a plurality of components include pluralities of spaced apart pockets and protrusions arranged alternately along a 30 longitudinal direction of the carrier tape. Each of the pockets is configured to receive one of the components therein and includes a pocket opening for receiving the component therethrough and into the pocket, and a bottom wall. The protrusions extend beyond the bottom walls of the pockets and so shaped that when a carrier tape assembly is formed by disposing one of the components in each of the pockets and bonding a cover tape to the carrier tape to seal the components in the pockets; and the carrier tape assembly is wound 35 around a carrier reel to form a plurality of concentric loops of the carrier tape assembly, for each pair of adjacent inner and outer loops: the bottom walls of the pockets in the inner loop do not make physical

contact with the cover tape in the outer loop; and the protrusions in the inner loop do not push any portion of the cover tape in the outer loop into any of the pockets in the outer loop.

Other aspects of the disclosure relate to a carrier tape assembly for transporting a plurality of components. The carrier tape assembly includes a carrier tape according to one or more embodiments of the disclosure. Each one of first pockets of the carrier tape have one of the components disposed therein. A cover tape is bonded to a top surface of the carrier tape to seal the first and second pockets.

Brief Description of Drawings

The various aspects of the disclosure will be discussed in greater detail with reference to the accompanying figures where,

FIG. 1 schematically shows a flexible carrier tape having a plurality of spaced apart pockets according to some embodiments of the disclosure;

FIGS. 2 and 3 schematically show the cross sectional views of the flexible carrier tape according some aspects of the disclosure;

FIG. 4 schematically shows the top view of the flexible carrier tape with spaced apart first and second pockets;

FIG. 5 schematically shows a carrier tape assembly including a flexible carrier tape according to some embodiments of the disclosure;

FIG. 6a schematically shows a carrier tape wound around a carrier reel according to some embodiments of the disclosure;

FIG. 6b schematically shows a cross sectional view of a carrier tape with anti-nesting features wound around a carrier reel according to some embodiments; and

FIGS. 7a-7g schematically show different designs of the pockets formed on the flexible carrier tape.

The figures are not necessarily to scale. Like numbers used in the figures refer to like components. However, it will be understood that the use of a number to refer to a component in a given figure is not intended to limit the component in another figure labelled with the same number.

Detailed Description of Illustrative embodiments

In the following description, reference is made to the accompanying drawings that form a part hereof and in which various embodiments are shown by way of illustration. It is to be understood that other embodiments are contemplated and may be made without departing from the scope or spirit of the present description. The following detailed description, therefore, is not to be taken in a limiting sense.

Flexible carrier tapes according to the present disclosure are generally used in combination with components, particularly electronic components including memory chips, integrated circuit chips, resistors, connectors, processors and the like. Carrier tapes include a number of pockets formed within the carrier tape at regular intervals. The pockets have a geometry that is compatible with the components to be carried

and the components rest within the defined pockets. The pockets of the carrier tape carrying the electronic components generally have an upper opening sealed, for example with a cover tape such as a pressure sensitive adhesive cover tape, for instance, and the carrier tape is wound around a core or reel for storage or delivery. Due to the winding tension, a top layer pocket bottom wall may press against a component in a bottom layer pocket causing the component to stick onto the cover tape during unloading in the PCB assembly process. Embodiments described herein address these and other challenges.

Referring to FIGS. 1-5, a flexible carrier tape (200) may include a flexible substrate (20) extending along the longitudinal axis (x-axis) of the carrier tape (200). The flexible carrier tape (200) may be configured to store and/or transport a plurality of components (10). A plurality of spaced apart pockets (30, 40), arranged along the longitudinal direction of the carrier tape (200), may be formed in the flexible substrate (20). The flexible carrier tape (200) may have a unitary construction. The flexible carrier tapes according to the present disclosure may have dimensions suitable for use with particular desired electronic components, and the pockets (30, 40) may be spaced apart from each other as suitable for the specific application. Each of the pockets (30) may be configured to receive one of the components (10) therein. For instance, each of the pockets (30) may include a pocket opening (31) for receiving the component (10) therethrough and into the pocket (30). In some instances, the pockets (30) may have a size of less than 1mm.

Carrier tapes (200) of the present disclosure may be made of any suitable material including, for example, thermoplastic polymeric materials, cardboard, and/or metal foil. In addition, the materials that may be used for carrier tape (200) may be dimensionally stable, durable, and readily formable into the desired configuration. Preferably, the material includes a thermoplastic polymeric material that has a sufficient thickness and flexibility to permit it to be wound about the hub of a storage reel. Suitable thermoplastic polymeric materials include, but are not limited to, polyesters (e.g., glycol-modified polyethylene terephthalate, or polybutylene terephthalate), polycarbonate, polypropylene, polystyrene, polyvinyl chloride, acrylonitrile-butadiene-styrene, amorphous polyethylene terephthalate, polyamide, polyolefins (e.g., polyethylene, polybutene, or polyisobutene), modified poly (phenylene ether), polyurethane, polydimethylsiloxane, acrylonitrile-butadiene-styrene resins, and polyolefin copolymers. In some embodiments, the material may have a melt temperature in the range of about 400°F (204°C) to about 630°F (332°C). The carrier tape may be optically clear, pigmented or modified to be electrically dissipative. In the latter case, the carrier tape may include an electrically conductive material, such as carbon black or vanadium pentoxide, either dispersed within the resin material or coated onto the surface(s) of the formed carrier tape. The electrically conductive material may help dissipate an electric discharge that may occur during removal of the cover film or unwinding of the carrier tape assembly from a storage spool thus helping to prevent damage to the electronic components contained within the pockets of the carrier tape. In addition, dyes, colorants, pigments, UV stabilizers, or other additives may be added to the resin material before forming the carrier tape.

In some embodiments, as best shown in FIGS. 2 and 3, the plurality of spaced apart pockets may include a plurality of spaced apart first pockets (30) and a plurality of spaced apart second pockets (40). In some aspects, the plurality of spaced apart first (30) and second (40) pockets may be formed in a row in the flexible substrate (20). In some aspects, the first (30) and second (40) pockets may be arranged alternately along the longitudinal direction (x-axis) of the carrier tape (200). In other aspects, each of the first pockets (30) may be disposed between two of the second pockets (40) along the longitudinal direction (x-axis) of the carrier tape (200). In some aspects, at least each of the first pockets (30) may be configured to receive one of the components (10) therein. In some aspects, the second pockets (40) may be dummy pockets not configured to receive any one of the components therein.

In some embodiments, each of the first pockets (30) may include a pocket opening (31) for receiving the component (10) therethrough and into the pocket (30), and a bottom wall (32). Each of the second pockets (40) may include a pocket opening (41) and a bottom wall (42). The bottom wall (32) of each of the first pockets (30) may include a major inner surface (33) facing the first pocket (30) and an opposing major outer surface (34) lower than the substrate (20). The bottom wall (42) of each of the second pockets (40) may include a major inner surface (43) facing the first pocket (40) and an opposing major outer surface (44) lower than the substrate (20).

In some embodiments, second pockets (40) may have opposing sidewalls (45, 46) as shown in FIG. 4. The opposing sidewalls (45, 46) of the second pockets (40) generally extend along a lateral direction (y-axis) orthogonal to the longitudinal direction (x-axis) of the carrier tape (200). In some instances, in a top plan view (xy-plane), the side walls (45, 46) may be substantially straight and orthogonal to the longitudinal direction.

As shown in FIG. 3, the major inner surface (33) of the bottom wall (32) of each of the first pockets (30) may be spaced apart from the pocket opening (31) by a pocket height (h1) and pocket thickness (t1). The major inner surface (43) of the bottom wall (42) of each of the second pockets (40) may be spaced apart from the pocket opening (41) by a pocket height (h2) and pocket thickness (t1). In some aspects, the pocket height (h1) and pocket thickness (t1) of each of the first pockets (30) may be smaller than the respective pocket height (h2) and pocket thickness (t2) of each of the second pockets (40).

In some embodiments, the flexible carrier tape (200) may include pluralities of spaced apart pockets (30) and protrusions (80) arranged alternately along a longitudinal direction (x-axis) of the carrier tape (200) as best seen in FIG. 2. In some aspects, the plurality of spaced apart pockets (30) may be formed in a row in the flexible substrate (20). Each of the pockets (30) may include a bottom wall (32) and the protrusions (80) may extend beyond the bottom walls (32) of the pockets (30). Each of the protrusions (80) may define a dummy pocket (40) therein. The dummy pocket (40) may include a pocket opening (41) at a top surface (21) of the flexible carrier tape (200) and may not be configured to receive any one of the components therein.

A plurality of optional sprocket through holes (60) may be provided in the flexible substrate (20) of the carrier tape (200) to facilitate mechanical handling of the carrier tape. The sprocket through holes (60) may be spaced apart along the longitudinal direction of the flexible carrier tape. In some embodiments, other structures (e.g., notches or printed indicia) may be used in place of, or in addition to, sprocket through holes (60). The sprocket through holes (60) may be disposed, for example, along one or both longitudinal edges of the carrier tape (200). The sprocket through holes (60) can engage with teeth on a sprocketed drive (not shown) as may be present in the drive assemblies of a precision placement equipment used to remove the components from the pockets of the carrier tape. The sprocket through holes (60) may be used to advance the carrier tape (200) to a prescribed location such that the component (10) can be placed in or removed from the pocket (30) of the carrier tape (200).

A carrier tape assembly (300) for transporting a plurality of components (10) according to some embodiments is illustrated in FIG. 5. The component (10), in some instances, may have a thickness of about 0.05 mm to about 0.15 mm. In some instances, the component (10) may be an electronic component, including memory chips, integrated circuit chips, resistors, connectors, processors and the like. The assembly (300) may include the carrier tape (200) according to one or more embodiments of this disclosure. Each one of the first pockets (30) of the carrier tape (200) may have one of the components (10) disposed therein. In some aspects, none of the second pockets (40) has any of the components (10) disposed therein. A cover tape (70) may be bonded to a top surface (21) of the carrier tape (200) to seal the first (30) and second (40) pockets. The cover tape (70) may be a pressure sensitive adhesive (PSA) tape such as 3M™ Pressure Sensitive Cover Tape 2698, 3M™ High Shear Pressure Sensitive Cover Tape 2668, or the like.

The carrier tape (200) may be used to transport electronic components to be assembled onto a printed circuit board using, say, surface mount technology. For instance, the electronic components are retained within the pockets (30) in the carrier tape (200) and continuous lengths of the carrier tape (200) with electronic components are wound around a carrier reel as a supply roll. As shown in FIGS. 6a and 6b, in some aspects, the carrier tape may be wound around a carrier reel (50) to form a plurality of concentric loops (51) including pairs of adjacent inner loop (51a) and outer loop (51b). For each of the concentric loops (51), the pocket openings (31, 41) face the carrier reel (50) and the bottom walls (32, 42) face away from the carrier reel (50).

In some embodiments, the protrusions (80) extending beyond the bottom walls (32) of the pockets (30) are so shaped that, when the carrier tape assembly (300) is formed by disposing one of the components (10) in each of the pockets (30) and bonding the cover tape (70) to the carrier tape (200) to seal the components in the pockets, and when the carrier tape assembly (300) is wound around the carrier reel (50) to form the plurality of concentric loops (51) of the carrier tape assembly (300), for each pair of adjacent inner (51a) and outer (51b) loops, the bottom walls (32) of the pockets (30) in the inner loop (51a) do not make physical contact with the cover tape (70) in the outer loop (51b). Further, the protrusions (80) in the inner loop (51a) do not push any portion of the cover tape (70) in the outer loop (51b) into any of the pockets (30) in the outer loop (51b).

In some other embodiments, as best seen in FIG. 6b, when the carrier tape (200) is wound around the carrier reel (50) to form the plurality of concentric loops (51) of the carrier tape, the pluralities of first (30) and second (40) pockets are so arranged along the longitudinal direction (x-axis) of the carrier tape and the pocket openings (31, 41) and the bottom walls (32, 42) are so sized and shaped that, for each pair of adjacent inner (51a) and outer (51b) loops the major outer surfaces (34) of the bottom walls (32) of the first pockets (30) in the outer loop (51b) do not make physical contact with the substrate (20) of the carrier tape in the inner loop (51a). Further, the major outer surfaces (44) of the bottom walls (42) of the second pockets (40) in the outer loop (51b) do not penetrate the pocket openings (31, 41) of either the first (30) or the second (40) pockets in the inner loop (51a). According to the illustrated embodiments, nesting of pockets in the carrier tape between adjacent inner and outer loops may largely be prevented when the carrier tape is wound around the carrier reel.

The second pockets (40) with anti-nesting features may have different designs. FIGS. 7a-7g illustrate some examples of designs of the second pockets (40a-40g) of the carrier tape (200a-200g) with anti-nesting features.

According to the embodiments illustrated in FIG. 7a and 7b, the second pockets (40a, 40b) have opposing sidewalls (45a, 46a; 45b, 46b) generally extending along a lateral direction (y-axis) orthogonal to the longitudinal direction (x-axis) of the carrier tape (200a, 200b). In a top plan view (xy-plane), the side walls (45a, 46a; 45b, 46b) may be substantially parallel and straight and not orthogonal to the longitudinal direction (x-axis).

According to the embodiment illustrated in FIG. 7c, the second pockets (40c) have opposing sidewalls (45c, 46c) generally extending along a lateral direction (y-axis) orthogonal to the longitudinal direction (x-axis) of the carrier tape (200c). In a top plan view (xy-plane), at least portions of the side walls (45c, 46c) may be curved and convex toward each other.

According to the embodiment illustrated in FIG. 7d, the second pockets (40d) have opposing sidewalls (45d, 46d) generally extending along a lateral direction (y-axis) orthogonal to the longitudinal direction (x-axis) of the carrier tape (200d). In a top plan view (xy-plane), the side walls may have middle portions (45d', 46d') that may be substantially straight and orthogonal to the longitudinal direction (x-axis). The middle portions (45d', 46d') of the side walls (45d, 46d) may be spaced apart by a distance d_1 . The side walls may further have end portions (45d'', 46d'') on each opposing lateral end of the side walls (45d, 46d) that may be substantially straight and orthogonal to the longitudinal direction (x-axis) and spaced apart by a distance d_2 , where $d_2 > d_1$.

According to the embodiments illustrated in FIGS. 7e and 7f, the second pockets (40e, 40f) have opposing sidewalls (45e, 46e; 45f, 46f) generally extending along a lateral direction (y-axis) orthogonal to the longitudinal direction (x-axis) of the carrier tape (200e, 200f). In a top plan view (xy-plane), the side walls (45e, 46e; 45f, 46f) may be curved and substantially parallel.

According to the embodiment illustrated in FIG. 7g, the second pockets (40g) have opposing sidewalls (45g, 46g) generally extending along a lateral direction (y-axis) orthogonal to the longitudinal direction (x-axis) of the carrier tape (200g). In a top plan view (xy-plane), the side walls (45g, 46g) may have meandering shapes.

- 5 Various modifications and alterations will be apparent to those skilled in the art and it should be understood that this scope of this disclosure is not limited to the illustrative embodiments set forth herein.

Claims

1. A flexible carrier tape for transporting a plurality of components and comprising a flexible substrate extending along a longitudinal direction of the carrier tape, and pluralities of spaced apart first and second pockets formed in the flexible substrate and arranged along the longitudinal direction of the carrier tape, at least each of the first pockets configured to receive one of the components therein, each of the first and second pockets comprising:
- 5 a pocket opening for receiving the component therethrough and into the pocket; and
- a bottom wall comprising a major inner surface facing the pocket and an opposing major outer surface lower than the substrate, the major inner and outer surfaces spaced apart from the pocket opening by
- 10 respective pocket height and pocket thickness;
- wherein, the pocket heights and thicknesses of the first pockets are smaller than the respective pocket heights and pocket thicknesses of the second pockets.
- 15 2. The flexible carrier tape of claim 1, wherein the first and second pockets in the pluralities of spaced apart first and second pockets are arranged alternatingly along the longitudinal direction of the carrier tape.
3. The flexible carrier tape of claim 1, wherein the pluralities of first and second pockets are so arranged along the longitudinal direction of the carrier tape and the pocket openings and the bottom walls are so
- 20 sized and shaped that when the carrier tape is wound around a carrier reel to form a plurality of concentric loops of the carrier tape so that for each of the concentric loops, the pocket openings face the carrier reel and the bottom walls face away from the carrier reel, then for each pair of adjacent inner and outer loops:
- the major outer surfaces of the bottom walls of the first pockets in the outer loop do not make physical contact with the substrate of the carrier tape in the inner loop; and
- 25 the major outer surfaces of the bottom walls of the second pockets in the outer loop do not penetrate the pocket openings of either the first or the second pockets in the inner loop.
4. The flexible carrier tape of claim 1 having a unitary construction, and wherein the second pockets are dummy pockets not configured to receive any one of the components therein.
- 30 5. The flexible carrier tape of claim 1, wherein the second pockets have opposing sidewalls generally extending along a lateral direction orthogonal to the longitudinal direction of the carrier tape, and wherein in a top plan view, the side walls are substantially parallel and straight and not orthogonal to the longitudinal direction.

35

6. The flexible carrier tape of claim 1, wherein the second pockets have opposing sidewalls generally extending along a lateral direction orthogonal to the longitudinal direction of the carrier tape, and wherein in a top plan view, at least portions of the side walls are curved and convex toward each other.
- 5 7. The flexible carrier tape of claim 1, wherein the second pockets have opposing sidewalls generally extending along a lateral direction orthogonal to the longitudinal direction of the carrier tape, and wherein in a top plan view, the side walls have middle portions that are substantially straight and orthogonal to the longitudinal direction and spaced apart by a distance $d1$, and end portions on each opposing lateral end of the side walls that are substantially straight and orthogonal to the longitudinal direction and spaced apart
10 by a distance $d2$, $d2 > d1$.
8. A carrier tape assembly for transporting a plurality of components, comprising:
the carrier tape of claim 1;
each one of the first pockets having one of the components disposed therein; and
15 a cover tape bonded to a top surface of the carrier tape and sealing the first and second pockets, wherein none of the second pockets has any of the components disposed therein.
9. A flexible carrier tape for transporting a plurality of components and comprising pluralities of spaced apart pockets and protrusions arranged alternately along a longitudinal direction of the carrier tape, each
20 of the pockets configured to receive one of the components therein and comprising a pocket opening for receiving the component therethrough and into the pocket, and a bottom wall, the protrusions extending beyond the bottom walls of the pockets and so shaped that when:
a carrier tape assembly is formed by disposing one of the components in each of the pockets and bonding a cover tape to the carrier tape to seal the components in the pockets; and
25 the carrier tape assembly is wound around a carrier reel to form a plurality of concentric loops of the carrier tape assembly, for each pair of adjacent inner and outer loops:
the bottom walls of the pockets in the inner loop do not make physical contact with the cover tape in the outer loop; and
the protrusions in the inner loop do not push any portion of the cover tape in the outer loop into any of the
30 pockets in the outer loop.
10. The flexible carrier tape of claim 9, wherein each of the protrusions defines a dummy pocket therein comprising a pocket opening at a top surface of the flexible carrier tape, the dummy pocket not configured to receive any one of the components therein.

35