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FLEX TAPE ASSEMBLY FOR USE IN BGA PACKAGING

FIELD OF THE INVENTION

The present invention relates generally to the field of packaging of ball grid array (BGA) assemblies, and in particular, to a flex tape assembly to facilitate easy handling of flex tape during BGA packaging process.

BACKGROUND OF THE INVENTION

Integrated circuit (IC) are well known to those skilled in the art. Because IC chips must communicate with other IC chips in a circuit through an input/output (I/O) system of interconnects, and also because the IC chip and its embedded circuitry are delicate, the packaging of the IC must serve multiple functions. Particularly, the electronic packaging must carry and protect the IC chip; provide a path for the electrical current that powers the circuits on the IC chip; distribute the signals onto and off the IC chip; remove the heat generated by the circuits; and support and protect the IC chip from hostile environments.

As the trend toward higher I/O, higher performance, and higher printed circuit board (PCB) manufacturing yield continues, ball grid array (BGA), chip-scale package (CSP), and flip chip become the package of choice. For these packages, the solder joints are only mechanical means of attaching them to the printed circuit board (PCB).

Presently, a lot of focus has been put into advance IC packaging. For BGA package built in strip form, substrate material used is BT resin.

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Substrate thickness used commonly varies from 0.36 to 0.56 mm. Another type of material that has been developed is the flex tape. This material is polymide with the copper routed finely around the area.

Flex tape has many advantages over the current substrates. One, it has fine pitch capability as 50 micron lines and spaces are standard with at least some flex tape circuitry. Second, it has higher I/O density. Third, it has superior electrical properties in that the fine line capability allows the wirebond fingers to be brought in very close to the die, thereby minimizing inductance of the wire. Fourth, flex tape is more extendible. As wirebond capability continue to improve, flex circuitry offers the extendibility necessary to suit the needs of finepitch bonding. Fifth, with the ability to position the wirebond fingers closer to the die, it enables the die manufacturers to continue to shrink the die size while keeping the wires reasonably short. Shrinking the dies enables more die per wafer providing significant reduction in the die cost. Lastly, using flex tape will reduce the overall thickness of the final package.

While the advantages are many, one of the main difficulties faced in the manufacturer of a BGA using flex tape in a strip form is the handling. Because the tape is extremely thin (typically around .080 mm), and is prone to bending, warping, and waving when heated, there currently is no easy way to package a chip using flex tape as the substrate using the existing process.

OBJECT OF THE INVENTION

It is therefore an object of the present invention to provide a flex tape assembly which can be used in the current BGA packaging process to facilitate the use of flex tape as a substrate without requiring a substantial modification to the existing process which utilises BT resin or other substrates.

SUMMARY OF THE INVENTION

To allow the current BGA systems to be able to handle the very flexible flex tape, some rigidity is provided to the flex tape through the use of stiffeners. A top stiffener strip is placed on the top side of the flex tape, and a bottom stiffener strip is placed on the bottom side of the flex tape. The stiffener strips should be made the same size and shape as the flex tape strip and should be made of a relatively rigid material which preferably has a similar physical characteristics as the flex tape.

The top stiffener strip includes a contour opening to receive a die which will be eventually placed onto the flex tape and then molded. The top stiffener also includes a push rod hole, snap fit hole, and a top pre-locating hole. The push rod hole is used during the stripping process where the bottom strip is removed from the flex tape (as explained more fully below). The snap fit hole and the top pre-locating hole are used during the lamination process where the top and bottom strips are placed onto the bottom side of the flex tape.

The bottom stiffener strip includes an embossed cap for snap fitting with the snap fit hole during the lamination process. Also used during the lamination process is the bottom pre-locating hole which is used in

conjunction with the top pre-locating hole of the top strip to properly align the top and bottom strips.

The lamination process will generally occur early in the BGA processing, preferably right after the flex tape has been cut into a strip form, and before the die attach. The top and bottom pre-locating holes and are aligned such that the top and bottom strips are properly matched. In the correct position, the embossed cap is directly below the snap fit hole so that when the lamination occurs, the cap is snugly mated with the snap fit hole. The stiffener strips are secured to the flex tape solely by the mating of the embossed cap into the snap fit hole, and the fitting of the contour opening around the molded package. No adhesive is used to adhere the stiffeners to the flex tape.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 shows the top stiffener strip which is placed on the top side of a flex tape.

FIG. 1a shows the flex tape which is adapted to be used in the present flex tape assembly.

FIG. 2 shows the bottom stiffener strip which is placed on the bottom side of a flex tape.

FIG. 3 shows the present flex tape assembly which already has the molded packaged placed onto it.

FIGS. 4, 5, and 6 illustrate the stripping process for removing the bottom stiffener from the flex tape assembly.

DETAILED DESCRIPTION OF THE INVENTION

The process for handling of BGA packages employing a rigid PCB or BT resin substrate is well known to those skilled in the art. This process, however, cannot easily be applied to BGAs employing flex tape because flex tape does not provide the necessary rigidity and is difficult to handle. By employing the present flex tape assembly, a flex tape substrate can be used without substantial modification to the current BGA systems.

To allow the current BGA systems to be able to handle the very flexible flex tape, some rigidity is provided to the flex tape through the use of stiffeners as shown in FIGS. 1 and 2. FIG. 1 shows the top stiffener strip 10 which is placed on the top side of the flex tape, and FIG. 2 shows the bottom stiffener strip 20 which is placed on the bottom side of the flex tape. The stiffener strips should be made the same size and shape as the flex tape strip and should be made of a relatively rigid material which preferably has a similar physical characteristics as the flex tape. It has been shown that copper alloy is one material which has worked well as a stiffener.

Now referring to FIG. 1, the top stiffener strip 10 includes a contour opening 11 to receive a die which will be eventually placed onto the flex tape and then molded. The dimensions of the opening 11 should be such that the edges 11a of the opening fit snugly around the eventual molded package. The top stiffener 10 also includes a push rod hole 12, snap fit hole 13, and top pre-locating hole 14. An identical set of these holes 12, 13, and 14 are placed at fixed intervals at each side of the strip. The push

rod hole 12 is used during the stripping process where the bottom strip 20 is removed from the flex tape (as explained more fully below). The snap fit hole 13 and the top pre-locating hole 14 are used during the lamination process where the top and bottom strips 10, 20 are placed onto the top and bottom side of the flex tape. Of course, these holes are only one way to achieve the purposes stated herein.

Now referring to FIG. 2, the bottom stiffener strip 20 includes an embossed cap 21 for snap fitting with the snap fit hole 13 during the lamination process. Also used during the lamination process is the bottom pre-locating hole 22 which is used in conjunction with the top pre-locating hole 14 of the top strip 10 to properly align the top and bottom strips. A slot 23 is provided which is used during the stripping process, the purpose of which will become clear below.

Now referring to FIG. 1a, the flex tape 40 has the identical set of holes as the top stiffener strip 10 in the identical positions, and serve the same function as the holes from the top stiffener. So the flex tape push rod hole 12a correspond to the push rod hole 12; the flex tape snap fit hole 13a correspond to the snap fit hole 13; and the flex tape pre-locating hole 14a correspond to the top pre-locating hole 14.

Now referring to FIG. 3, the figure shows the flex tape assembly 30 where the top and bottom stiffener strips 10 and 20 are laminated onto the flex tape 40 with the molded package 50 placed on the flex tape 40. The lamination process will generally occur early in the BGA processing, preferably right after the flex tape has been cut into a strip form, and before the die attach (though for illustration purposes FIG. 3 shows the assembly 30 with the molded package).

The top, bottom, and flex tape pre-locating holes 14, 22, and 14a, respectively, are aligned such that the top and bottom strips are properly matched with each as well as with the flex tape 40. In the correct position, the embossed cap 21 is directly below the snap fit hole 13 and the flex tape snap fit hole 13a so that when the lamination occurs, the cap 21 is snugly mated with the snap fit hole 13 and the flex tape snap fit hole 13a. Also note that the edges 11a of the contour opening 11 fit snugly around the molded package 50. The stiffener strips 10 and 20 are secured to the flex tape solely by the mating of the embossed cap 21 into the snap fit hole 13 and 13a, and the fitting of the contour opening 11 around the molded package 50. No adhesive is used to adhere the stiffeners to the flex tape.

For the present flex tape assembly to be used optimally in the existing BGA process, certain dimensional requirements should be met. Generally, the bottom stiffener 20 will be thicker than the top stiffener 10 as the bottom stiffener must be thick enough for the embossed cap to have sufficient height to reach into the snap hole 13. Obviously, the stiffeners must be thick enough to provide some rigidity. Preferably, the combined thickness for all of "a", "b", and "c" should be in the range of .36 to .56 mm as this is the range of thickness for the BT resin substrate currently being used. By keeping the overall thickness as close as possible to the thickness of the current substrates, any modification to the current BGA handling process is minimized. However, some deviation from this range is possible without requiring substantial modification.

At some point in the BGA encapsulation process, the bottom stiffener 20 must be removed from the flex tape assembly 30 to place the solder balls on the package. Preferably, the removal of the bottom stiffener, called

the stripping process, should be done immediately before the solder balls are placed. FIGS. 4, 5, and 6 illustrate the stripping process.

Referring now to FIG. 4, a vacuum suction 60 and 61 is provided for the molded package 50 and the bottom stiffener 20. A support bar 65 is inserted into the slot 23 (better shown in FIG. 2) to support the flex tape 40 and the top stiffener 10. A punch bar 66 is positioned immediately above the embossed cap 21 which has been fitted inside the snap fit hole 13. A push rod 67 is positioned inside the push rod hole 12.

Now referring to FIG. 5, to separate the bottom stiffener 20 from the flex tape assembly, the suction 61, push rod 67 and the punch bar 66 simultaneously move downward. As the embossed cap 21 is cut from the bottom stiffener 20, the bottom stiffener 20 is released from the flex tape 40. FIG. 6 shows the assembly after the removal of the bottom stiffener 20. The top stiffener 10 remains intact to provide the necessary support during ball placement, and is naturally removed when the molded package is singulated.

Besides providing the necessary rigidity for the flex tape, the bottom stiffener plays another important function. The bottom side of the flex has gold pads which are the contact points for the solder balls to attach. In order for the solder balls to attach properly, the surface of the gold pads must not be contaminated with foreign material. This is very important as even one failed attachment results in the rejection of the entire unit. The bottom stiffener, by covering the bottom side of the flex tape, helps to minimise any contamination to the gold pads.

The present invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. For

instance, although the present invention has been described in reference to BGA packages, the present flex tape assembly may be applied to other types of packages such as flip chip and chip scale packages. The presently disclosed embodiments are, therefore, to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims and all changes which come within the meaning and range of equivalency of the claims are, therefore, to be embraced therein.

CLAIMS

We Claim:

1. A flex tape assembly for use in BGA packaging comprising:

a flex tape having a top side, a bottom side, a flex tape snap fit hole, a flex tape pre-locating hole, and a flex tape push rod hole;

a top stiffener placed on the top side of the flex tape, said top stiffener having an opening to receive a molded package, a snap fit hole, a top pre-locating hole, and a push rod hole; and

a bottom stiffener placed on the bottom side of the flex tape, said bottom stiffener having an embossed cap, a bottom pre-locating hole, and a slot;

wherein said embossed cap is fitted inside said snap fit hole and flex tape snap fit hole, said flex tape push rod hole and push rod hole on said top stiffener are aligned with each other, and said top and bottom pre-locating holes and the flex tape pre-locating holes are adapted for aligning the top and bottom stiffeners and the flex tape.

2. The flex tape assembly as recited in claim 1 wherein a total thickness of said assembly is in the range between 0.36 mm and 0.56 mm.