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PATENT SPECIFICATION

DRAWINGS ATTACHED

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COMPLETE SPECIFICATION

Header for a Semiconductor Device

We, TEXAS INSTRUMENTS INCORPORATED, a Corporation organised according to the laws of the State of Delaware, United States of America, of 13500 North Central Expressway, Dallas, Texas, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to headers suitable for semiconductor devices and more particularly to headers in which one lead-wire is attached to the header eyelet and at least two other lead-wires pass through the eyelet.

In the manufacture of headers for semiconductor devices, it is often desirable to have one of the leads bonded to the header while the other leads are sealed in a glass or ceramic to insulate them from the header eyelet. In this manner the header may be grounded or, if the device is mounted directly to the header, the header and the lead bonded thereto serve as one of the connections to the device. Since the header may serve as a heat sink for the device, transistors and other semiconductor devices are frequently bonded directly thereto requiring that the header and an attached wire serve as one of the lead wires.

Attaching the lead wire to the header usually involves one or more steps separate from the other steps used in manufacturing the header. The lead is bonded in some manner to the inside of the header and extended in a direction generally parallel to the other lead-wires connected to a device mounted on the header.

According to the present invention, a method of constructing a header suitable for a semiconductor device, comprises the steps of locating a plurality of electrical lead-wires in a header eyelet, one lead having at least an end portion coated with an electrically conductive fusible material and being positioned with that end portion in contact with the eyelet, at least two other lead-wires extending through the

eyelet. The eyelet is heated to fuse electrically insulating material therein and to fuse the coating on the said one lead-wire to seal the insulating material to said other electrical lead-wires and to the eyelet and to bond and electrically connect the said one lead-wire to the header eyelet.

Suitably, the insulating material may be glass and preferably has a thermal coefficient of expansion compatible with that of the eyelet. Suitably the coating of the lead-wire to be attached to the eyelet is a braze solder which may be in the form of a body of braze solder fused to the lead-wire. Alternatively, for example, the lead-wire may be plated with braze solder.

In a specific embodiment of the invention, an electrical lead-wire is provided with a region of braze material at one thereof and a glass preform, the braze coated lead-wire and at least two additional lead-wires are located in a header eyelet with the braze coated lead extending through the preform with the braze material abutting the eyelet and each additional lead-wire extending through both the glass preform and the eyelet. The eyelet is then heated to fuse the glass preform and the braze material to form a bond and electrical connection between the braze coated lead-wire and the eyelet and also to seal the glass to the lead-wires and to the eyelet.

It will be appreciated that in carrying out the invention, the lead-wires are sealed in the eyelet at the same time that the coated lead is attached to the header eyelet.

By way of example, embodiments of the invention will be described in greater detail with reference to the accompanying drawings, in which:

Figure 1 illustrates one method of applying a braze material to the end of a lead-wire by placing the lead wire and a ball of braze material in a furnace to bond the material to one end of said wire;

Figure 2 shows a semiconductor header eye-

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let having several lead-wires and a preform of insulating material placed therein in a graphite carrier prior to bonding the parts together; and

5 Figure 3 shows a cross-sectional view of a completed transistor header with a wire brazed to the underside of the header eyelet and two other wires held in place by an insulating material fused within the header eyelet.

10 Referring to the drawing, there is shown in Figure 1 a method for applying braze material to one end of an electrical lead-wire. Wire 1 and ball 2 of braze material are placed in a suitable fixture (not shown) so that the ball 2 is in contact with the wire. The fixture with the wire and braze material therein is placed in opening 6 of furnace 4 which is heated by electrical coil 5. The furnace is brought up to a temperature of about 1000°C to fuse the braze material to the wire. The wire with the braze material on one end is shown at 3. The braze material may be applied to the wire by other convenient means. For example the braze material may be plated or electrodeposited on to one end of the wire.

25 The wire and the braze material may be of any suitable material, for example, the wire may be of a nickel-iron-cobalt alloy, for example, one commonly referred to by the trade name Kovar (registered Trade Mark). The braze material may be of any suitable brazing alloy, for example, a silver alloy of about 90% silver and 10% copper or even pure silver. In some instances it may be desirable to nickel plate the lead-wire before the material is applied to improve the bonding of the braze material to the lead-wire.

30 Figure 2 shows a graphite carrier 14 having a header eyelet 11 positioned therein. The header eyelet rests in the bottom of the graphite carrier 14 with flange 12 of the eyelet resting upon ledge 14a. Glass preform 10 is placed within the header with holes 28 and 29 in the preform aligned with holes 19 and 20 in the eyelet. Two lead-wires 16 and 15 respectively extend through the holes 28 and 29 in the glass preform 10 and openings 19 and 20 in the header eyelet so that the wires extend into openings 17 and 18 in the carrier. Lead-wire 1 with braze material thereon is inserted into opening 30 in glass preform 10 and placed in an abutting relationship with the header eyelet at surface 21. With the three lead-wires and the glass preform positioned within the header, it is ready to be placed into a furnace such as the one shown in Figure 1 to fuse the braze material of lead-wire 1 to the header eyelet at 21 and fuse the glass to the leads and to the inside of the header eyelet. The entire assembly within the boat is placed in the furnace and heated to about 1000°C.

65 Figure 3 is a cross-sectional view of the completed header after the glass is fused. The glass is fused to the inside of the header eyelet and to the lead-wires, and a small amount of

the glass extends downward at 25 due to capillary action of the glass along the lead-wires. Lead-wire 1 is brazed to the inside of the header eyelet with the braze material 2, thereby making a good electrical contact thereto. Lead-wires 15 and 16 are held in place and insulated from the header by the glass 10.

The level of the glass 10 is shown at 26. This level is established to keep the glass from extending onto the flange 12. If the glass did extend onto the flange, it probably would be broken during subsequent sealing operations on the header. Often times a groove (not shown) is extended around the inner periphery of the header eyelet, above the glass, to prevent the glass from extending onto the flange. Such a groove is described in United States Patent No. 3,193,443 issued July 6, 1965.

In practice, the three leads and the header are gold plated. Gold plating of the braze material inhibits oxidation of the braze alloy. Headers for semiconductor devices are usually gold or even nickel plated before the devices are mounted thereon, since these metals are not reactive with various etch and cleaning solutions used in the manufacture of semiconductor devices.

The glass material may be any sealing glass; however, it is preferable that it be a glass which has a thermal coefficient of expansion similar to the coefficient expansion of the material used in the header eyelet. A glass matching the coefficient of expansion of the nickel-iron-cobalt alloys which are generally used is Corning (registered Trade Mark) No. 7052 which is a boro-silicate glass. However, any suitable glass may be used.

Although the present invention has been shown and illustrated in terms of a specific preferred embodiment, it will be apparent that changes and modifications are possible without departing from the invention as defined in the appended claims.

WHAT WE CLAIM IS:—

1. A method of constructing a header suitable for a semiconductor device comprising the steps of locating a plurality of electrical lead-wires in a header eyelet, one lead having at least an end portion coated with an electrically conductive fusible material and being positioned with that end portion in contact with the eyelet, at least two other lead-wires extending through the eyelet, and heating the eyelet to fuse electrically insulating material therein and to fuse the coating on the said one lead-wire to seal the insulating material to said other electrical lead-wires and to the eyelet and to bond and electrically connect the said one lead-wire to the header eyelet.

2. A method according to Claim 1, the insulating material having a thermal coefficient of expansion compatible with that of the eyelet.

3. A method according to Claim 1, or Claim 2, the insulating material being glass.



let having several lead-wires and a preform of insulating material placed therein in a graphite carrier prior to bonding the parts together; and

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25 to one end of the wire. The wire and the braze material may be of any suitable material, for example, the wire may be of a nickel-iron-cobalt alloy, for example, one commonly referred to by the trade name Kovar (registered Trade Mark). The braze material may be of any suitable brazing alloy, for example, a silver alloy of about 90% silver and 10% copper or even pure silver. In some instances it may be desirable to nickel plate the lead-wire before the material is applied to improve the bonding of the braze material to the lead-wire.

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The level of the glass 10 is shown at 26. This level is established to keep the glass from extending onto the flange 12. If the glass did extend onto the flange, it probably would be broken during subsequent sealing operations on the header. Often times a groove (not shown) is extended around the inner periphery of the header eyelet, above the glass, to prevent the glass from extending onto the flange. Such a groove is described in United States Patent No. 3,193,443 issued July 6, 1965.

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Although the present invention has been shown and illustrated in terms of a specific preferred embodiment, it will be apparent that changes and modifications are possible without departing from the invention as defined in the appended claims.

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2. A method according to Claim 1, the insulating material having a thermal coefficient of expansion compatible with that of the eyelet.

3. A method according to Claim 1, or Claim 2, the insulating material being glass.

4. A method according to Claim 1, the coating material being a braze solder.
5. A method according to Claim 4, in which a body of braze solder is fused to an end portion of the lead-wire to be coated.
6. A method according to Claim 4, in which the braze solder is plated on the lead-wire.
7. A method of constructing a header suitable for a semiconductor device, comprising the steps of providing a region of braze material on one end of an electrical lead-wire, locating a glass preform, the braze coated lead-wire and at least two additional electrical lead-wires in a header eyelet with the braze coated lead-wire extending through the preform with the braze material abutting the eyelet and each additional lead-wire extending through both the glass preform and the eyelet, heating the eyelet to fuse the glass preform and the braze material forming a bond and electrical connection between the braze coated lead-wire and the eyelet and sealing the glass to the lead-wires and to the eyelet.
8. A method according to Claim 3 or Claim 7, in which the eyelet is heated to substantially 1000°C to fuse the glass and the coating on the coated lead-wire.
9. A method according to any one of Claims 4—8, the braze solder being a silver alloy and the coated lead-wire being composed of an iron-nickel-cobalt alloy.
10. A method according to any one of the preceding claims, the lead wires and the eyelet being gold plated.
11. A method according to any one the preceding claims, in which the eyelet and the said contents thereof are mounted in a graphite carrier during the heating step.
12. A method of manufacturing a header suitable for a semiconductor device, substantially as described herein with reference to and as illustrated by the accompanying drawings.
13. A header suitable for a semiconductor device manufactured by a method according to any one of the preceding claims.

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