The subject of the present invention is a device providing hermetic encapsulation of components forming an electronic circuit.

As is known, the problem of the suppression or, failing that, of the limitation of humidity in housings for electronic components is an acute problem. It is known that the contaminant having the most important and the most harmful role in the context of the reliability of a discrete component or of an integrated circuit is the water content of the ambient environment. In fact, humidity is especially capable of corroding the connection pads of the circuits; it also allows ions to dissolve, which promotes corrosion. This effect is very noticeable on integrated circuits, and is all the more so as the scale of integration is larger, that is to say as the connection pads are smaller.

For high-performance applications in a severe environment, such as the military or space applications, it is known to use housings for components whose base is made of ceramic and whose cover is made of metal, hermetically sealed on to the latter, an outgassing being generally carried out before mounting the housing. One drawback of this solution is its cost price, which is very high.

Furthermore, encapsulation housings made of a plastic material are known, whose cost is much lower, but which exhibit the drawback of not being hermetic. In fact, in the first place, the plastic materials themselves do not prohibit the passage of water molecules from the outside to the inside of the housing. Moreover, in the second place, the accumulation of water capable of being produced under the encapsulated components induces cracks in the plastic material forming the housing, during the mounting on the card, the operation of the component and the heating which thereby results. This drawback renders them unusable for high-performance applications.

The subject of the present invention is a hermetic encapsulation for components used in electronic circuits, such as semi-conductor chips, which is of a lower cost price than that of the ceramic-metal housings and which provides hermetic protection for the components, when they are mounted operationally in an item of equipment as well as during maintenance operations on the latter.

To this end, the components are each encapsulated in a non-hermetic housing, produced for example in a plastic material, then the housings are mounted on a printed circuit card, provided with means for electrical connection and with a cover sealed on to the card so as to enclose all of the housings in a second enclosure such as to be hermetic, the means of connection being left outside the second enclosure.

More precisely, the subject of the invention is a device such as is defined by Claim 1.

In that way, the chips can be easily mounted on the card by way of their housings, the hermetic integrity is provided by the second enclosure and the whole is of a relatively low cost, the plastic housings being inexpensive and the second enclosure encapsulating the whole of the card in a single operation. Moreover, since maintenance operations take place on site by replacement of cards, the protection of the latter remains fully operational both during replacement and during storage of spare parts.

Other objects, characteristics and results of the invention will emerge from the following description, given by way of non-limiting example and illustrated by the attached drawings which represent:

- Figure 1a, a diagrammatic view of a first embodiment of the device according to the invention;
- Figure 1b, a top view of this same device;
- Figure 2, another embodiment of the device according to the invention.

In these various figures, on the one hand the same reference numerals refer to the same elements, and, on the other hand, the actual scale has not been followed for reasons of clarity of explanation.

Thus in Figures 1a and 1b, a first embodiment of the device according to the invention is diagrammatically represented, seen respectively in section and from above.

An electronic circuit is represented, constituted by an assembly of components, especially of semiconductor chips, encapsulated in housings 3 and arranged on a substrate (or card) 1, carrying a printed circuit, traditionally providing the mechanical fixing of the housings and their electrical interconnection by use of conducting tracks 41, arranged on the surface of the card 1.

Conventionally also, the printed circuit card 1 comprises a connector 4, arranged at one of its extremities and substantially along its whole length. This connector comprises contacts 40 coming to rest on the tracks 41 of the card 1 and thus providing the electrical connection.

The device further comprises a cover 2 substantially covering the whole of the surface of the card 1, except the means of connection 4, whose periphery is fixed in a leakproof way on to the card 1. According to the invention, around the housings 3 there has thus been formed a second enclosure, indexed 6, whose function is to provide the hermetic integrity of the whole of the electronic circuit.

The hermetic integrity is provided by the choice of the materials forming the second enclosure. To this end, the printed circuit card 1 must be produced in such a way as not to permit the passage of water molecules; it can be entirely produced in such a material (for example a ceramic such as alumina); it can also be produced in a material which is not in itself capable of fulfilling the function, such as a printed circuit card in epoxy glass, but covered on its outer (lower and side) faces by a

layer prohibiting the passage of water molecules, such as a metal layer (copper for example). In the same way, the cover must be produced in, or comprise a layer of, a material which does not permit the passage of water molecules, metal or ceramic for example. In the case of a ceramic card and a metal cover, the hermetic sealing 5 is constituted for example by a soldered joint. It should be noticed that the alloy used for the soldered joint must have a melting temperature greater than the maximum storage temperature of the card, which must not exceed 150°C, but, preferably, less than the reflow temperature of the alloy used for mounting the components on to the card, in general lead-tin whose melting temperature is close to 183°C. In the contrary case, the heating necessary for the soldered joint must be produced with the aid of means permitting it to be localised. It should also be noted that the soldered joint must be produced not directly on the card 1 and the interconnection tracks 41 but on a layer of electrically insulating material, deposited in advance on the assembly 1-41 and not represented in the figures. Since the housings 3 have no hermetic integrity function, they can be produced in any material, plastic for example.

Figure 2 represents, diagrammatically and seen in section, a second embodiment of the device according to the invention.

In this figure are again found the housings 3 for encapsulation of electronic components mounted on to the card 1, which carries the connector 4 at one of its extremities. The card is covered by a cover which is, in this embodiment, flat and indexed 20; it is mounted on to the card 1 by the use of a frame 50.

The hermetic integrity is here again provided by the choice of the materials forming the second enclosure (6); thus the card 1 is, for example, made of ceramic, the cover 20 is, for example, metal and the frame 50 is made of a ferronickel alloy.

The benefit of the frame 50 is that this can be fixed, by soldering for example, on to the card 1 before the mounting of the housings 3; this for example permits it to be soldered at high temperature, that is to say at a temperature greater than the reflow temperature of the soldered joint used for mounting the housings 3. The cover 20 can then be sealed on to the frame 50 by reflow, with the conditions mentioned for the embodiment described in Figure 1, or by other means avoiding these difficulties: laser soldering, electric soldering, etc.

0374007

CLAIMS

1. Hermetic encapsulation device for electronic components, the components each being encapsulated in a non-hermetic housing (3), the housings being mounted on a substrate (1) carrying a printed circuit providing the interconnection of the housings in an electronic circuit, the device being characterised in that the substrate (1) comprises means (4) for electrical connection to the outside, linked to the printed circuit, and a cover (2, 20) sealed on to the substrate so as to form a second enclosure (6) encapsulating the whole of the substrate, except the means of connection, in a single operation, the hermetic integrity of the whole of the electronic circuit being provided by the choice of each of the materials forming the substrate, the cover and the sealing of the cover on to the substrate and constituting the second enclosure (6).

2. Device according to Claim 1, characterised in that the substrate (1) is made of ceramic.

3. Device according to Claim 1, characterised in that the substrate (1) is covered on its outer faces by a layer of a material providing hermetic integrity.

4. Device according to one of the preceding claims, characterised in that the cover (2) is made of metal or ceramic.

5. Device according to one of the preceding claims, characterised in that the sealing of the cover on to the substrate is constituted by a soldered joint.

6. Device according to one of the preceding claims, characterised in that the cover is sealed on to the substrate by the use of a frame (50).

7. Device according to Claim 5, characterised in that the frame (50) is constituted by a ferronickel alloy.