

The present invention relates to a portable connectable electronic system. This system can be used in applications where portable and connectable electronic devices are employed. It may, however, also be used for repair purposes where the integrated connector thus invented may allow components to be interchanged more easily.

The various new applications of smart cards show that such a card is required to perform more and more complex functions if it is desired to extend the scope of its applications. This then leads to the necessity to use larger and larger surfaces of chips to be integrated in these cards in order to obtain these functions. This is the case for example with two known applications of smart cards, namely telephone cards and bank cards. The chip of the telephone card is a simple memory. It occupies a surface of the order of mm^2 . The chip of the bank card is a processor integral to the memory and the application. It occupies a surface of about 20 mm^2 .

It should be noted briefly that a smart card is a relatively thin plastic card in which a semiconductor chip and a grid of conductors are encased within the thickness of the card. The chip is attached to an upper surface of the grid, for example by adhesion. Conductive wires are then soldered on the one hand to the output terminals of the chip and on the other hand to metallized regions of the grid. This is the technology for assembling chip cards called "chip on board" in English publications. A lower surface of the grid is flush with one of the two surfaces of the card and constitutes the connection for the smart card. When this card is inserted in the reader, it is this connector which is connected to the reader.

However, the conventional support in a smart card is not very suitable for a chip with a large surface area. Although the support is flexible the chip itself is in fact very rigid. There is a risk that the conductive wires will break. The larger the chip, the more sensitive it is to deformations and the greater the chance that it will be damaged. The effect of this is to decrease the reliability of the smart card when

it incorporates a large chip. This limits the possibility of extending the field of utilisation of smart cards, in particular to new applications.

Various known techniques have been used to overcome this problem. In particular an attempt has been made to reduce the amplitude of the deformations at the level of the chip and the wires which join it to its connector grid. For example, the known use of a cobalt plate placed beneath the substrate of the chip to make the chip more rigid may be cited. In another example, the process of forming a recess in the card to receive the chip has been modified so as to make the surroundings of the chip more rigid. However, these solutions do not make it possible to assemble, in this technology of smart card assembly, chips having large surface areas: greater than 20 mm² for example. Furthermore, in the case of such surface areas a number of problems occur, in particular that of the reliability of the chip thus assembled.

Moreover, the plastic material which forms the card is not sealed against various inorganic and organic contaminations to which the chips in the integrated circuit are very sensitive. The deterioration of the reliability induced is more serious the larger the chip is. This constitutes a third technological limitation.

The technology used for assembling is of the hybrid type. It is not optimised in terms of production. In practice, when assembling semiconductors a line is used to manufacture a standard product which is produced in very great volume. This product consists of one or more chips assembled in a standard casing and is called an electronic component. These chips are or are not interconnected with one another. Besides these electronic components produced in large volume there are also specific products such as, for example, a smart card. This specific product is manufactured in a much smaller volume. Furthermore it also requires a specific production line. This increases considerably the production costs and the amortization costs of this line relative to the production lines for standard products. Moreover the rejection rate of this specific product is much higher than that for standard products because of the

technology used. In practice, in the manufacture of smart cards, the fixing of the conductive wires is a delicate operation, the reliability of which directly affects the final product. A specific protection of these wires is necessary to guarantee they are not damaged.

In order to avoid these difficulties, in another connection an attempt has been made in a technique known as "tape automatic bonding" to connect, in particular by heat transfer, tail ends of metal tracks of the grid to terminals of the chip. However, this technology also suffers from the manufacturing precision which it necessitates. It, too, does not result in a sufficient reliability of assembly.

The aim of the invention is to overcome these disadvantages and to allow the development of the smart card for new, more complex applications, which are not constrained and limited by the prior uses of magnetic card readers, for example applications which might use an electronic key in the sense of using an electronic function and using the shape of the object.

It employs electronic casings equipped with standard connection pins in which the function to be obtained is integrated in one or more chips; it is known to interconnect several chips on a printed circuit and to integrate the complete assembly in a standard casing. The electronic component obtained has a much greater reliability than the chips on account of the casing which mechanically protects the chip or chips in the electronic component from various inorganic and organic contaminations, and on account, too, of the technology of assembling chips in a casing, this being a well controlled standard technology. It is therefore possible to provide complex functions. Nevertheless, such a component is not connectable in the sense of the invention: for example a component for assembling by surface mounting has pins which are too small to provide a sure and reliable contact on the connector of a reader. Likewise, a component for assembling by insertion cannot be inserted thousands of times in a connector; the pins would become bent or even break, and anyway the operation of insertion is delicate in this case.

The object of the invention therefore is a connection system, comprising a reader, of an electronic chip held in a portable covering support, characterized in that this chip is itself contained in a casing of the electronic component type comprising output pins which can be connected by surface mounting, the casing comprising for this purpose connection pins for placing and soldering on metallic contacts of an upper surface of a connection means, and in that the system comprises a connector for connecting the chip to the reader, the connector being constituted by metallic contacts of a lower surface of the connection means, metallic contacts of the upper surface being opposite and connected to the metallic contacts of the lower surface and vice versa, the connection means being held flush with the said covering support.

The characteristics of a system in accordance with the invention are described in the following description with reference to the attached figures. This description and these figures are given solely by way of non-limiting illustration of the invention.

Figure 1a is a perspective view of the upper part of a system in accordance with the invention.

Figure 1b is a view from above of the lower part of a system in accordance with the invention.

Figure 1c shows three views in cross-section, a, b, and c, of a connectable electronic module made using different covering techniques.

Figure 1a is a perspective view of a system in accordance with the invention. In the region A the system is constituted by a connection means MC. This connection means comprises in the example an insulating support 1. An upper surface 10 of the insulating support 1 comprises a first and a second row, 3 and 4, of metallic contacts 30 and 40. The two rows 3 and 4 are parallel. The metallic contacts 30 of the first row 3 are aligned with the metallic contacts 40 of the second row 4. The two rows 3 and 4 contain the same number of metallic contacts. The connection

spacing P , which is the distance between the centres of two consecutive contacts 30 and 31 is, in the example, the same in the case of both rows. The metallic contacts 30 and 40 are flat and, for example, rectangular. An electronic component 2 is fixed on the upper surface 10 of the insulating support 1 using surface mounting technology for assembling. The free ends of pins 20, 21, 22 and 23 of the electronic component are placed on metallic contacts (20, 22) or on the insulating support (21, 23). They are fixed, for example by hot soldering on the metallic contacts (pins 20, 22) and by adhesion on the insulating support (pins 21, 23).

Facing each metallic contact 30 and 40 of the upper surface 10 there is a metallic contact 50 and 60 on the lower surface 11 of the insulating support 1 (Figure 1b). Two facing metallic contacts, for example 40 and 60, are connected for example (in Figure 1b) by a metallized hole 7.

The complete set of metallic contacts 50 and 60 of the lower surface 11 of the insulating support 1 constitute the connector 8 of the system. The complete set of metallic contacts of each of the upper and lower surfaces and the insulating support 1 form, in this example, the connection means MC.

The metallic contacts 50 and 60 of the lower surface 11 are flat and in this example rectangular. These metallic contacts 50 and 60 each occupy in the example a lower surface which is included within the surface occupied by the metallic contact 30 and 40 which corresponds to it on the upper surface: in other words they are face to face. The surfaces of the contacts could be equal in another example.

In practice such a support 1 comprising metallic contacts 30, 50 which correspond with one another on the upper 10 and lower surfaces 11 is produced, for example, as follows: holes 7 are pierced in an insulating support 1 at the future sites of metallic contacts 30, 40. Metal is applied on both the upper and lower surfaces of the insulating

support 1 and is etched chemically using well known processes to obtain the metallic contacts 30 and 50. Because each hole 7 is contained within each of the surface areas of the metallic contacts which correspond with one another, 30 and 50, 40 and 60, the hole is metallized and provides the connection between the two regions 30 and 50, 40 and 60. The insulating support 1 may be, for example, a polyimide film or a printed circuit or any other insulating material.

The shape of the metallic contacts 30 and 40 on the upper surface 10 is imposed by the electronic component 2. It has been mentioned that the component is assembled by surface mounting on the support.

In a known (standard) manner, so that the reliability of the assembly is optimal in manufacturing terms, it is necessary that the metallic contacts 30 and 40 should be sufficiently large. In practice it should be possible to tolerate a component put on askew or slightly offset in relation to the metallic contacts. This tolerance is associated with the automatic assembling machines. It is also necessary to respect the minimal connection spacing in order to avoid problems due to electrical disturbances. This latter constraint also affects the shape of the regions of contact 50 and 60. This shape should allow the maximum reliability of contact with the connector of the reader.

Furthermore there are several standard casings for electronic components. A given electronic function may therefore be proposed in various catalogued packagings: plastic casing, ceramic, square, rectangular, having pins in two rows or pins over all the periphery of the casing, a given connection spacing, pins curved in towards the interior of the casing or towards the outside - and this list is not exhaustive.

Consequently a shape and distribution of connection regions 30 on the upper surface 10 is chosen which conform with the type of packaging (casing) and connection (outputs of the casing) selected. In the example shown in Figure 1a this is a rectangular casing 24 having pins 26 distributed in two rows and 40 in number.

The choice of a component for surface mounting is related to the use of the connector 8 of the system. It should be remembered that the connector 8 consists of the metallic contacts 50 and 60 of the lower surface 11 of the insulating support 1 (Figure 1b). If an electronic component is used for mounting by insertion, the pins of this component pass through the support 1 and protrude from lower surface of the support. The disadvantages which this entails can be seen immediately: on the one hand to the touch, since the lower surface is dotted with the ends of the pins; on the other hand for insertion and connection in a reader of the system. In the following, when an electronic component is referred to it is, by default, for surface mounting.

It has been seen that, corresponding to the standard electronic components for surface mounting, the connection regions may have various shapes, round, rectangular etc., but their number and distribution are well known depending on the type of casing chosen and consequently on its connection. The connection in this case is adapted for electronic purposes.

However, there are also connectors, standard or not, such as those of a smart card, which do not correspond with the standards imposed by the standard packagings and connections considered. This is because these connectors have not been designed for such components. These connectors are designed for the reader of a portable and connectable electronic system. They are defined in shape, number, distribution of the connection regions, positioning in the reader etc. It is important to be able to use these readers because they exist. In such cases the electronic device will therefore be adapted to the connection.

A good example of an existing reader is the smart card reader of the public phone type. The well known connector of a smart card is standardised: the connection spacing is 2.54 mm; it comprises two rows of 4 metallic contacts; the rows are spaced about 8 mm apart. This connector is on the lower surface of the support. On the upper surface there are corresponding, facing metallic contacts. However the shape of each region

on the upper surface may differ from that of the metallic contacts of the connector. They may be larger for example.

One known standard for electronic components defines a connection spacing of 1.27 mm. If this standard is chosen with a casing comprising 16 pins, of which one pin in two is connected to the electronic function device incorporated in the casing, it can be seen that the connection spacing of the pins connected to the electronic function device becomes 2.54 mm. It is possible to assemble such a component on a support the connector of which is that of a smart card. The pins not connected to the electronic function device then serve for the mechanical holding of the electronic component on its support.

In order to adapt the width of the casing and the shape of the pins to the connection regions on the upper surface of the support it suffices, for example, to make the metallic contacts wider towards the interior of the two rows in the case of a narrow casing or in the case of pins curved in under the casing. In the case of a wide casing or in the case of pins curved out towards the outside of the casing the opposite arrangement is made: for example, metallic contacts wider towards the outside of the rows are provided which extend beyond the casing.

A slightly different example has been chosen for description in Figure 1a. In fact in the example shown in Figure 1a, an electronic component 2 has been shown of which only one pin 20 in three successive pins 20, 21, and 22 is connected to the electronic function device integrated in the casing. This is to show the diverse possibilities of adaptation of an assembly consisting of an electronic component and a given type of connector, according to the invention.

In this example the component 2 is mounted on the support in such a manner that each of the output pins of the electronic function devices integrated in the casing 24 is fixed to a metallic contact 30 of the upper surface 10. It is clear that the number of pins of electronic outputs is less than or equal to the number of metallic contacts. In this

example there are two pins 20, 22 fixed to the same conductive region. However, only one pin, 20, is an electronic output. Between each successive metallic contact one pin of the casing is fixed to the insulating support. This arrangement is derived from the ratio of the connection spacings of the connector and of the component.

In this example, the casing is longer than the connection surface on the support. This is why the pins 23 outside the connection region are in this example fixed to the insulating support. In this example the connection region is the totality of the metallic contacts on the same surface.

It will be recalled that the pins 21, 22 and 23 here only serve to mechanically hold the electronic component 2 on its support, as has already been said in the description. It is obvious that the pins which are electronic outputs are preferably facing on the two rows 3 and 4, such as the pins 20 and 27 in Figure 1a.

It has therefore been shown that it is possible to use any standard electronic component casing for surface mounting, the number of pins of the casing and the type of casing being determined on the one hand by the complexity of the electronic function device or devices to be integrated and, on the other hand, by the number of outputs of these devices and the type of connector 8 of the system.

It is therefore possible to produce a complex electronic function device having a small number of outputs, by means of chips integrated in casings which protect them mechanically and which improve very substantially the reliability of the electronic function device. Some of the pins may serve only to hold the standard electronic component thus formed on its support mechanically.

Advantageously, in accordance with a second embodiment shown in cross-section in Figure 1c, the connection means comprise only metallic contacts. The facing and connected metallic contacts 30 and 50 in the

preceding example here coincide. They serve on the upper surface 10 side of the connection means MC for interconnection with the component 2 for surface mounting, and on the lower surface 11 side of the connection means MC as the connector 8. In this case there is no longer an insulating support. This is possible because the component is solid and rigid and there is no risk of contamination. It is then possible, for example, to mount the component on a grid of contacts short-circuited with one another and then to cut the contacts. This operation is simple and reliable. The metallic contacts may be provided thick enough to increase the rigidity of the module. It is always possible to deposit insulation on the pins or under the component, although in this method of producing a connectable connection this would not be obligatory. As in the first embodiment some pins of the component may not be connected. They are not electronic outputs of the component. They have only a mechanical role. Thus they facilitate the hooking on for example of a previously moulded plastic material which forms the covering of the connectable component. These pins may also be mounted on a metallic contact. For example there may be two pins on the same contact. Only one of the pins is an electronic output in this case, but the two pins increase the rigidity of the connection.

Figure 1c shows a covering E of the electronic component 2 made connectable in accordance with the invention. This covering may be made of a dielectric material, dissipative or conductive. In the case where it is conductive, an insulation must be provided for example in the cavity before inserting the component. The component may very well be made flush with the external surface of the covering material. The covered system may have any shape, the only constraint being that the connector 8 must be accessible to a reader. The covering may be attached by adhesion (section a) or else be welded on by ultrasound. In the latter case the covering comprises an excess of material x (section b) near the contacts, which allows the attachment of the covering on the contacts by ultrasound. The covering may be riveted on (section c). This latter method is particularly useful in the case of covering with a dissipative material (that is to say weakly conductive). The contacts and the

covering are then in practice at the same equipotential and this favours the absorption of electrostatic charges emitted close to the contacts. The dissipative character of the covering still allows the normal operation of the component. The contacts are then no longer short-circuited. The advantage can be seen of such a covering which allows both the normal operation of the circuit and electrostatic protection.

It is also possible to have another electronic element connected to that which has just been described. An example of this is shown in region B of Figure 1a.

In Figure 1a the metallic contacts 30 and 40 of the upper surface 10 of the support 1 are extended by conductive wires 300 and 400 to the region B. Preferably the conductive wires 300 and 400 do not pass under the casing 24 of the electronic component 2. In the region B they constitute a connection layer in the support 9. The support 9 is in this example multi-layered. It consists of a plurality of connection layers 900 stacked on and interconnected with one another. On the upper surface 90, electronic components 92 and 93 are surface mounted on standard metallic contacts 94. These components 92 and 93 are interconnected for example by the connection layers 900 of the support 9. They are also interconnected with the electronic component 2 by the connection layer 901 comprising the conductive wires 300, 400 which prolong the metallic contacts 30 and 40.

The electronic components 92 and 93 are here compatible with surface mounting. They could also be in this case components for mounting by insertion. In fact in this example these components do not have to be connectable in the sense of the invention. They could well be so, for example if it was desired to have a plurality of electronic function devices in the same system, independent of one another and each connectable in the sense of the invention.

The connection regions 94 are standard with respect to the types of electronic components 92 and 93, since no external restriction on

the connection has to be taken into account. The components 92 and 93 could very well be mounted on the lower surface 91, or even on the two surfaces, lower 91 and upper 90, of the support 9. It can thus be seen that many combinations are possible. For example the lower surface 11 and the lower surface 91 may be the same.

The support 9 may be composed of only a single connection layer which then comprises only the conductive wires 300 and 400. The support 9 may then be quite simply the support 1.

In the region A the conductive wires 300 and 400 are in the example on the upper surface 10 of the support 1. They could be in a median plane, that is to say between and parallel to the lower 11 and upper 10 surfaces of the support 1.

It remains to cover the system with a material. The system may have any shape whatsoever which is adapted to the reader. The only constraints are therefore:

Firstly, if the system is not inserted completely in the reader, the part not inserted must not comprise electrical connections which are not insulated electrically. In practice there would otherwise be electrical or electrostatic disturbances which would affect the operation of the system.

Secondly, the connector 8 must be flush with a surface of the system so that the reader can connect onto it.

Furthermore, the shape of the system must allow easy insertion, partially or completely, and a reliable connection of the reader on the system.

Finally, if the covering material is not a dielectric material provision must be made to insulate all the connection with the covering material.

A well known possible form is a card. It may also possibly be a key or have any other form, provided that it satisfies the criteria set out hereinabove.

In the system described the reliability of the electronic function is considerably improved relative to that obtained with the conventional technology of chip cards. In practice a casing, for example made of plastic or ceramic, of an electronic component is rigid. It is also sealed, in particular to various attacks by inorganic or organic compounds. It is the casing which improves the reliability. In conclusion, in the invention there is consequently sufficient reliability to produce devices for complex applications in the field of portable connectable electronic systems, in particular banking applications. This could not be envisaged with the conventional technology used for chip cards for reasons explained already.

The choice of the type of casing is also varied. What is important is the manufacturing cost of the module. This depends on the density of integration necessary for the application envisaged, the cost of production and the rejection rate in each of the various technologies.

The manufacturing cost aspect is in fact very important in the field of smart cards. The target purchase price for the users is in fact very low. For this reason, as has been seen already, the production cost and the amortization costs incurred by the use of a specific production chain in the conventional technology used for chip cards is a major disadvantage of this technology from the point of view of manufacturing costs. Added to that there is a high rejection rate, greater than that which occurs in the conventional technology used for semiconductors. The use of electronic components overcomes all these disadvantages. In practice the production lines are then standard semiconductor assembly lines. Moreover, in the invention, when the electronic components are assembled, for example on a printed circuit, if the final test is unsatisfactory it is possible to unsolder a defective component and replace it by another assembled on the same connector. It is also possible to change a defective printed circuit and thus keep the component. The module is not completely discarded. This is a big advantage in relation to a smart card. If the latter is defective nothing can be saved.

In summary, the invention makes it possible to obtain a portable and connectable electronic system adapted to all new complex applications. In particular, the scope of the invention includes any electronic system comprising at least one component for surface mounting which is or is not connected to another electronic element in the system and which is connectable in the sense of the invention, that is to say surface mounted:

- either on metallic contacts on the surface of an insulating support, these contacts being arranged facing one another and connected to other metallic contacts on the opposite surface of the insulating support which form the connector,

- or, advantageously, on metallic plates forming on one side the interconnection with the component and, on the other side, the connector. The invention considerably improves the reliability of the electronic part. It reduces the manufacturing costs and the amortization costs, by use of an electronic element made using standard technology only the application being specific, relative to a conventional smart card the electronics of which are specific both with regard to the application and to the manufacturing technology.

CLAIMS

1. A connection system, comprising a reader, of an electronic chip held in a portable covering support (E), characterized in that this chip is itself contained in a casing of the electronic component (2) type comprising output pins which can be connected by surface mounting, the casing comprising for this purpose connection pins (930) for placing and soldering on metallic contacts (30) of an upper surface (10) of a connection means (MC), and in that the system comprises a connector (8) for connecting the chip to the reader, the connector being constituted by metallic contacts (50) of a lower surface (11) of the connection means (MC), metallic contacts (30) of the upper surface being opposite and connected to the metallic contacts (50) of the lower surface and vice versa, the connection means being held flush with the said covering support.

2. A system as claimed in claim 1, characterized in that the metallic contacts (30) of the upper surface (10) coincide with the metallic contacts (50) of the lower surface and themselves constitute the connection means (MC) by thus making, on the upper surface (10) side, the interconnection with the electronic component (2) and, on the lower surface (11) side, the interconnection with the connector (8).

3. A system as claimed in claim 1, characterized in that the metallic contacts (30, 50) of the upper surface (10) and the lower surface (11) of the connection means (MC) are etched on one side and on the opposite side of an insulating support (1), the connection means (MC) then being constituted by an insulating support (1) having upper (10) and lower (11) surfaces and comprising metallic contacts (30, 50) on these surfaces.

4. A system as claimed either in claim 2 or claim 3, characterized in that the metallic contacts are extended by conductive wires (300, 400) to form one layer (901) of a multi-layer interconnection support (9) so as to interconnect one or more other electronic components (92, 93) with the electronic component (2).



5. A system as claimed in claim 4, characterized in that the other electronic components (92, 93) are also interconnected with one another.

6. A system as claimed in any one of the preceding claims, characterized in that the electronic component (2) comprises a casing (24) in which one or more semiconductor chips are integrated.

7. A system as claimed in claim 2, characterized in that the electronic component (2) and its metallic connection contacts (30, 50) are set by riveting in the covering support (E).

8. A system as claimed in claim 7, characterized in that the covering support is dissipative.

