



Contactless or hybrid contact-contactless smart card with reinforced connection of the electronic module

Technical field

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This invention concerns contactless or hybrid contact-contactless smart cards and particularly a smart card of this type with reinforced connection of the electronic module.

10 **Background art**

The contactless smart card is a system being used increasingly in various sectors. For example, in the transport sector, smart cards have been developed as a means of access. The same holds true for the electronic
15 **purse. Many companies have also developed identification systems for their personnel using contactless smart cards.**

The exchange of information between a contactless card and the associated reader is accomplished by remote electromagnetic coupling
20 **between an antenna housed in the card and a second antenna located in the reader. For developing, storing and processing the information, a chip is placed inside the card on a support on which it is connected to a screen-printed antenna.**

25 **Hybrid contact-contactless smart cards also exist which can operate as conventional smart cards or as contactless smart cards. These cards comprise an electronic module made up of a chip and a double-sided circuit, one face of which has contact areas that are flush with the surface of one of the faces of the card body.**

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A number of manufacturing processes exist for hybrid or contactless



smart cards. A first type of card is a monobloc card in which the antenna support, made of plastic material, is inserted between two layers made of plastic material (PVC, PET, PC, acrylonitrile-butadiene-styrene (ABS) etc.) which form the upper and lower card bodies and which are then heat-
5 bonded by hot-lamination under pressure. The module is connected to the antenna by a conductive glue or equivalent which enables ohmic contact to be established.

This type of card features a high overall rigidity. As a result, when the
10 card is subjected to mechanical bending and/or twisting stresses, these stresses are immediately transmitted to the chip and especially to the bonding spots which make the chip/antenna or module/antenna connections. These stresses, applied intentionally or unintentionally, may cause connections to rupture and thus may result in card malfunction
15 without the card being marked.

This characteristic proves to be the major disadvantage for hybrid or contactless smart cards. It is, in fact, relatively easy for a dishonest user to destroy the card as cleanly as possible by repeated intensive bending.
20 When the card is sold with credit (telephone cards, public transport cards, highway toll station payment cards) and this credit is exhausted or almost exhausted, this allows the individual to have the card exchanged or reimbursed by the card issuer without it being possible to prove the intent to commit fraud afterwards.

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In order to offset this major drawback, screen-printing the antenna on a paper-type fibrous material support placed between two card bodies made of at least one layer of plastic material has been considered. A hot-lamination under pressure step enables the various layers to be welded
30 together, the fluidized PVC of one of the card bodies trapping the screen-printed ink of the antenna.

The paper support has the advantage of giving the card the ability to delaminate when bent at the location where the stresses generated by said bending are exerted, which highlights any act of deliberate damage a posteriori, as the card retains the traces of the bending.

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However, this type of card has the drawback that the connection of the electronic module is weak. Indeed, if the paper antenna support offers the advantage of "memorizing" the bends of the card, it also results in the card lacking internal cohesion, thus rendering the card susceptible to delamination of the paper after multiple bending under the glue joint(s) that hold the module onto the card and therefore vertical to the thinnest part of the card body, thereby resulting in disconnection of the electronic module and the antenna.

15 Disclosure of the invention

It is for this reason that the aim of the invention is to provide a hybrid or contactless smart card with an antenna support made of a fibrous, paper-type material enabling a reinforced connection of the module in order to withstand disconnection and pulling out in case of intensive bending.

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Another aim of the invention it to provide a contactless smart card with reinforced connection of the electronic module, simply by contact between the chip and the antenna, without using conductive glue.

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The object of the invention is thus a contactless or hybrid contactless smart card including an antenna on a support made of fibrous, paper-type material, two card bodies on each side of the support each made up of at least one layer of plastic material having a relatively low fluidizing temperature, and an electronic module including a chip connected to the antenna, the assembly formed by the antenna support

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and the two card bodies being welded together by hot-lamination under pressure. The support made of fibrous material includes at least one recess such that the plastic material layers of the card body come into close contact owing to the recess during the lamination operation, the
5 recess thus filled forming a weld between the card bodies thus reinforcing the connection of the module.

Brief description of the figures

10 The aims, objects and characteristics of the invention will become more apparent from the following description when considered in conjunction with the accompanying drawings in which:

Figure 1 represents the antenna support of a hybrid contact-contactless
15 smart card according to the invention,

Figure 2 represents a cross-sectional view of the smart card represented in Figure 1, along the axis A-A,

20 Figure 3 is a front view of the recesses and the location of the module in the antenna support for the card represented in Figure 1,

Figure 4 represents the antenna support of a contactless smart card according to the invention,
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Figure 5 is a cross-sectional view of the smart card, represented in Figure 4, along the axis B-B, and

Figure 6 represents a cross-sectional view of the smart card, represented
30 in Figure 4, along the axis C-C.

Detailed description of the invention

The hybrid contact-contactless smart card comprises an electronic module made up of an electronic chip and a double-sided circuit 10, one face of which is flush with one of the faces of the card. The card's antenna, generally screen-printed on a support made of fibrous material 12, comprises a number of turns 18 made of conductive ink and two bonding pads 11 and 13 designed to be connected to the chip, and thus to the electronic module. The antenna support comprises two recesses 14 and 16 which are preferably made after the antenna screen-printing operation. The shape of the recesses as well as their location are described in detail in the description that follows.

According to Figure 2, representing a cross-section along axis A-A of a part of the card shown in Figure 1, the card is made up of several layers throughout its thickness. In a preferred embodiment, the antenna support 12 is inserted between a lower card body, made up of layers 22 and 23, and an upper card body, made up of layers 24 and 25. The upper and lower card bodies are made of plastic material of polyvinyl chloride (PVC), polyester (PET, PETG) or polycarbonate (PC) type or even acrylonitrile-butadiene-styrene (ABS) type. According to a preferred embodiment, the card bodies are made of PVC and are each made up of an external layer of rigid PVC 22 or 24 and an internal soft PVC layer 23 or 25. The PVC making up the soft PVC layer, in contact with the antenna, has a Vicat point (the temperature at which the PVC is transformed from a rigid state to a rubbery state) lower than the Vicat point of the layer forming the rigid PVC layer.

The assembly of the card layers is made using a hot-lamination process at a specific temperature and under pressure. Under the combined action of heat and pressure, the external PVC only softens while the internal layer,

made of a PVC having a lower Vicat point, is fluidized. The thus fluidized PVC of layer 25 traps the antenna in the mass, and enters into close contact with the fluidized PVC of layer 23 through the recesses 14 and 16 made previously in the antenna support 12, thus creating two welds
5 between the upper and lower card bodies via the close contact of the two internal layers 23 and 25.

After assembly of the various layers which make up the card, a cavity is pierced in the card, generally by a milling operation, in order to house the
10 electronic module made up of the electronic chip 26 and the double-sided circuit 10. The shape of the cavity is such that it includes a smaller central part designed to receive the chip 26 and an larger external part made in a part of the thickness of layer 22 of the card body in order to receive the double-sided circuit.

15 The electronic module is inserted into the cavity and secured by gluing in the largest part of the cavity. In this manner, the double-sided circuit of the electronic module and the external layer 22 of the card body are linked together by two spots of cyanoacrylate-type glue 34 and 36, placed over
20 recesses 14 and 16 previously made in the antenna support 12. The glue spots 34 and 36 are thus positioned vertical to the thinnest part of the card body 22 and thus are located vertical to recesses 14 and 16 filled with PVC and forming two welds between the upper and lower card bodies, thereby reinforcing the connection of the module to its support.

25 The connection of the chip to the antenna pads 11 and 13 is ensured by the use of conductive glue, not represented in the figure, and applied before the electronic module is inserted into its cavity.

30 According to Figure 3, the location of the recesses 14 and 16 on the antenna support is such that they are situated on either side of the

bonding pads 11 and 13 and preferably in the middle of the face 30 of the
 double-sided circuit 10 intended to be glued onto the card and
 represented in the figure in grey dotted effect. However, the recesses may
 be slightly offset in relation to the position shown in the figure while
 5 remaining superposed on the face 30 of the electronic module without
 deviating from the scope of the invention. In all cases, the width of the
 recesses must not be excessive. In this respect, the surface area of the
 recesses must not exceed the surface area of the face 30 of the module to
 be glued so that the recesses are totally filled with the fluidized PVC of
 10 layers 23 and 25 during the lamination of the card bodies between them.

As the electronic module is placed symmetrically on either side of the
 bonding pads 11 and 13, the recesses 14 and 16 are preferably
 symmetrical in relation to the bonding pads 11 and 13 and are preferably
 15 identical in shape. In addition, in order to improve the connection of the
 module to the card, the outside contour of recesses 14 and 16 matches
 the outside contour of the glue spots 34 and 36 insofar as possible.

When the invention is applied to a contactless smart card, the antenna
 20 support 38 is presented as shown in Figure 4. As seen previously, the
 electronic module 40 is connected to an antenna 42 which is screen-
 printed onto support 38 by two bonding pads 44 and 46. The antenna
 support also features two recesses 48 and 50 which are preferably made
 after the antenna screen-printing operation.

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According to Figure 5 representing the cross-section along axis B-B of
 the card shown in Figure 4, the contactless card is made up of several
 layers. In a preferred embodiment, the antenna support 38 is inserted
 between a lower card body made up of layers 52 and 54, and an upper
 30 card body made up of layers 56 and 58. As in the previous case, the card
 bodies are made of PVC, polyester, polycarbonate or acrylonitrile-

butadiene-styrene (ABS). As above, each of the external layers 52, 58, preferably made of PVC, is rigid whereas each of the internal layers 54, 58 is preferably made of soft PVC. These layers in contact with the antenna support 38 have a Vicat point which is lower than the Vicat point of the external layers made of rigid PVC. As can be seen in the figure, the external layers are thinner than the internal layers contrary to the hybrid card in which the external layers are generally thicker than the internal layers.

10 The electronic module 40 is placed in a recess of the support 38 and secured to the layer 54 of the lower card body by a layer of glue 60. The chip's bonding pads (not shown) are thus in contact with the antenna bonding pads 62 and 64. Ohmic connection may be made using a conductive glue or without glue by means of a simple contact as explained below.

If the cross-section of the support along axis C-C, represented in Figure 6, is considered, the two recesses 48 and 50 which are located in the antenna support 38 on each side of the module 40 can be seen.

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As above, the layers are assembled by a hot-lamination process and under pressure. Under the combined action of heat and pressure, the external layer of PVC 52 or 56 softens while the internal layer 54 or 58 is fluidized. The fluidized PVC of layer 58 traps the antenna in the mass and enters into close contact with the fluidized PVC of layer 54 via the recesses 48 and 50. This creates two welds between the upper and lower card bodies through the close contact of the two internal layers 54 and 58.

Unlike the electronic module of the hybrid contact-contactless smart card, the electronic module of the contactless card is trapped between the two bodies of the card. Owing to the hot-lamination process enabling the

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welds of the two layers to be made through the recesses 48 and 50 as presented above, the pressure exerted by the module on the bonding pads 62 and 64 of the antenna is maintained after the lamination step. This pressure thus enables ohmic contact between the chip and the antenna to
5 take place without it being necessary to provide a layer of conductive glue between the chip's bonding pads and those of the antenna.

As previously, the recesses may be more or less distant from the module without being excessively far from it such that the connection of the
10 module is reinforced. The size of the recesses must not be too small so as to ensure a strong link between the two internal layers of the card bodies. The recesses are preferably situated symmetrically in relation to the module and are preferably of the same shape. While in the embodiment illustrated in Figures 4 and 6, the recesses are circular in shape, any other
15 shape may be used without deviating from the scope of the invention.

Whether for a contactless card or for a hybrid card, the recesses must not have sharp corners, for several reasons, one of these being that recesses without sharp corners facilitate the cut-out operation. Indeed, cutting out
20 recesses with sharp corners may create points which retain the paper to be removed on its support, while cutting out recesses with rounded corners never presents this type of problem. In addition, when the card body is printed with solid tone, the cut-outs are exposed during the lamination operation due to the printed dots which are located above the
25 recesses coming closer together, resulting in a darker tone at the location of the recesses. As a result, a rounded shape seen through the transparent PVC is more aesthetic than a shape with sharp corners.

Although it is preferable to have two recesses on each side of the module
30 to reinforce its mechanical connection as described above, it is possible to have only one recess, or more than two recesses, without deviating

from the scope of the invention.

CLAIMS

1. A smart card including an antenna (18 or 42) on a support made of paper type fibrous material (12 or 38), two card bodies on each side
5 of said support each made up of at least one layer of plastic material having a low fluidizing temperature, and an electronic module (26 or 40) housed in a cavity made through one of said card bodies and said antenna support (12) and including a chip connected to the antenna, the assembly formed by the antenna
10 support and the two card bodies being welded together by hot-lamination under pressure;

said card being characterised in that said support made of fibrous material includes recesses (14, 16 or 48, 50) located such that they
15 are superposed on the glue spots (34, 36) securing said module to the other card body such that the plastic material layers (23, 25 or 54, 58) of said card bodies come into close contact via said recesses during the lamination process, said recesses thus filled forming a weld between the card bodies thereby reinforcing the
20 connection of the module.
2. The smart card according to Claim 1 in which the outside contour of said recess(es) (14, 16) has the same shape as the outside contour of the glue spot(s) (34, 36).
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3. The smart card according to Claim 2, in which the chip of said electronic module (26) is connected to the antenna by two bonding pads (11, 13) on said antenna support (12), the latter comprising two recesses on each side of said bonding pads.
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4. The smart card according to Claim 3, in which said two recesses

(14, 16) are identical in shape and are symmetrical in relation to the bonding pads (11, 13).

5. The smart card according to Claim 4, in which said recesses (14, 16)
5 are round in shape.
6. The contactless-type smart card according to Claim 1, in which said
electronic module (40) is placed in a cavity of the antenna support
before hot-lamination under pressure and is secured to one of said
10 card bodies (54) by a layer of non-conductive glue (60).
7. The smart card according to Claim 6, in which the chip of said
electronic module (40) is connected to said antenna (42) by means
of two bonding pads (62, 64) via simple ohmic contact without
15 conductive glue, said ohmic contact being made by pressure
between the layers of said card bodies (54, 58) in close contact due
to said recesses (48, 50) forming a weld after hot-lamination.
8. The smart card according to Claim 6 or 7, in which said antenna
20 support (38) comprises two recesses (48, 50) located on each side
of said electronic module (40).
9. The smart card according to Claim 8, in which said recesses (48, 50)
are symmetrical in relation to said electronic module (40).