

GEM 325**A METHOD OF MANUFACTURING A CONTACTLESS CARD WITH WOUND ANTENNA**

5 The invention concerns the manufacturing of chip cards, particularly cards capable of operating without contact by means of an antenna integrated into the card. Under this name "contactless cards", there are envisaged on the one hand cards which can communicate with the outside only through the antenna, and also and in
10 particular mixed cards which can communicate with the outside either by means of the antenna or by means of standardised conventional contacts.

15 Such cards are intended to perform various operations such as, for example, banking operations, telephone communications, identification operations, operations of debiting or reloading units of account, all kinds of operations which can be performed either by inserting the card into a reader or remotely by electromagnetic
20 coupling (in principle of the inductive type) between a

sending/receiving terminal and a card placed in the zone of action of this terminal.

5 Contactless cards must preferably have standardised dimensions identical to those of conventional smart cards provided with contacts. This is obviously particularly essential for mixed cards, and is desirable for cards operating solely without contacts.

10 The usual standard ISO 7810 defines a card 85 mm long, 54 mm wide and 0.76 mm thick. The contacts are flush at clearly defined positions on the surface of the card.

15 These standards impose severe constraints in manufacture. The very small thickness of the card is in particular a major constraint, more severe still for contactless cards than for cards simply provided with contacts, since it is necessary to provide for the
20 incorporation of an antenna in the card.

The technical problems which are posed are problems of positioning the antenna with respect to the card, since the antenna occupies almost an entire surface of the
25 card, problems of positioning the integrated-circuit module (comprising the chip and its contacts, which provides the electronic functioning of the card), and problems of precision and reliability of the connection between the module and the antenna; finally,
30 constraints of mechanical strength, reliability and manufacturing cost must be taken into account.

The aim of the invention is to propose a manufacturing method which best resolves the different constraints of sizing, manufacturing precision, mechanical strength,
5 and more generally reliability, cost and efficiency in manufacturing the card.

For this purpose, according to the invention, a method of manufacturing a chip card with contactless
10 transmission is proposed, principally characterised in that an integrated-circuit module and an antenna made from flat-wound wire is produced, the antenna ends are fixed to connection areas of the module, the antenna/module assembly is temporarily fixed against a
15 plate made of plastics material having an opening which can serve as a housing for the module, another plate of plastics material is placed on the antenna/module assembly, and the two plates are connected, enclosing the antenna and module.

20 The temporary fixing of the antenna/module assembly is preferably effected by bonding an adhesive sheet to the first plate and the module is applied against the adhesive face of this sheet inside the opening which serves as a housing for the module. The adhesive sheet
25 is subsequently detached. If the card is a mixed card, the access contacts are bared when the sheet is removed, since they are flush with the bottom of the opening serving as a housing for the module.

30

This method is simple and inexpensive and reliably and precisely resolves the problem of contact between the chip module and the antenna: the electrical connection is made before fitting the assembly in a plastic card.
5 The module is correctly placed in the card, and the antenna also.

The plastic film provided with metallic parts, on which the integrated circuit is placed in order to constitute the module, can in practice be in particular of two
10 kinds: double-face printed-circuit film or metallic grille covered with an insulated plastic film, but in practice the solution with a double-face printed-circuit film is clearly preferably since it makes it
15 possible to fix the antenna ends exactly flat on the connection areas, whilst the other solution would make it necessary to fix the antenna ends in insulating-film openings, the thickness of the insulating film around these openings impeding the fixing.

20 In the case of a module produced from a double-face printed circuit, the chip is fixed on one side (the front face of the film) and connected by soldered wires to metallic connection areas situated on this side.
25 The antenna is also welded to connection areas on this side. The rear face has metallic parts cropped to the format of the standardised contacts of a smart card (for a mixed card), conductive vias being provided between the metallic parts of the front face and those
30 of the rear face in order to establish the necessary

electrical connections between the external contacts of the rear face and the inputs/outputs of the chip.

Conventionally, the chip is immersed in a protective resin before the module is inserted in the card.

The two plates of plastics material of the card can be connected by hot or cold lamination, a resin being able to be interposed between the two plates, in order to serve as a binder between them and as a sealing product in order to isolate the module and antenna from the outside.

In practice, the manufacturing method includes the following steps:

- there is produced an integrated-circuit module which can be inserted in a card, comprising an integrated-circuit chip mounted on a plastic film provided with metallic parts, the metallic parts comprising on the one hand connection areas allowing a connection with the chip and on the other hand two connection areas for connection with an antenna, these two latter areas being at a given distance from each other and also being connected electrically to connection areas permitting connection with the chip;

- a flat-wound antenna wire is produced, having two ends situated substantially at the same predetermined distance from each other;

- the antenna ends are fixed to the two corresponding connection areas;

5 - the antenna/module assembly is bonded against a plate made of plastics material having an opening which can serve as a housing for the module, so that the antenna/module assembly is held in place against the plate during the subsequent operations;

10 - another plate made of plastics material is placed on the antenna/module assembly;

- the two plates are connected, enclosing the antenna and module.

15 Other characteristics and advantages of the invention will emerge from a reading of the following detailed description which is given with reference to the accompanying drawings, in which:

20 - Figure 1 depicts an antenna made from a wound wire produced in a format which can be incorporated in a smart card;

25 - Figure 2 depicts a module in front view, rear view and a view in section, in an embodiment on a double-face metallised film;

30 - Figure 3 depicts the assembled antenna/module assembly;

- Figure 4 depicts the fitting of the antenna/module assembly against a plastic plate in the format of the card, provided with an adhesive sheet;

5 - Figure 5 depicts the fitting of another plastic plate in order to cover the module assembly;

- Figure 6 depicts the finished card, at the stage of removal of the adhesive sheet and ready to be used.

10

The antenna A depicted in Figure 1 is a simple wire 10 wound flat, the stiffness inherent in the wire being sufficient for the antenna to be able to be manipulated during the operations of insertion in the card, keeping
15 its overall flat shape. This antenna represents an inductance allowing communication at a distance by electromagnetic coupling of the inductive type.

The wire can be covered with an insulant preventing
20 contact between adjacent turns. In any event an insulant is provided if the turns intersect (the case where there are several turns). However, the ends of the wire are bared with a view to their electrical connection to an integrated-circuit module.

25

The dimensions of the antenna are, for reasons of electromagnetic efficiency, very close to the outside dimensions of the chip card, and it is also one of the reasons why the positioning of the antenna in the card
30 must be carried out precisely.

The ends 12 and 14 of the antenna are at a predetermined distance D from each other, and are preferably turned towards the inside of the turns, so that the electronic module can be placed on the inside
5 of the turns, the perimeter of the antenna then coming as close as possible to the perimeter of the smart card in which it is to be embedded.

The module M of Figure 2 comprises an insulating film
10 20, a front-face metallisation, a rear-face metallisation, and conductive vias connecting the front-face metallisations to the rear-face metallisations. The relative scale of the dimensions, particularly in thickness, is not complied with, in
15 order for the figures to be be legible.

The metallisation of the rear face is cut out into contacts 21 in a standardised format for smart cards; these contacts will be flush on the smart card at the
20 end of manufacture.

A chip 22 is soldered to a central area 23 of the front-face metallisation; soldered wires 24 connect the chip to connection areas 25 of the front-face
25 metallisation (other connection methods can be envisaged, for example a direct connection in the case of turned-over chips in "flip-chip" mode).

Two connection areas 26 and 27 are reserved for fixing
30 the ends of the antenna A. These areas are electrically connected to connection areas 25 serving

to receive wires of a chip. In practice, the areas 26 and 27 constitute extensions of two connection areas 25, these extensions being sufficiently separated from the central area to which the chip is fixed: the chip
5 22 is covered with a drop of protective resin 28, but the connection areas 26 and 27 are sufficiently distant from the central area for the resin not to cover them.

The connection areas 26 and 27 are situated on the film
10 20 at a distance from each other corresponding substantially to the distance D between the ends of the antenna wire A, so that these ends can be soldered easily to the areas 26 and 27.

Figure 3 depicts, in lateral section, the antenna/module assembly, after the operation of soldering the antenna ends to the areas 26 and 27; it also depicts a plate made of plastics material 30
20 (which can already be in the format of a smart card or which will be subsequently cut to this format). The plastics material can be polyvinyl chloride (PVC) or another plastics material.

This plate constitutes a part of the body of the smart
25 card. It has an opening 32 which can serve as a housing for the module M, this opening passing through the entire thickness of the plate. The dimensions of the openings are at least equal to those of the module M. If possible these dimensions are accurately
30 adjusted with respect to the dimensions of the modules. The position of the openings with respect to the format

of the plate corresponds to the standardised position of the contacts of a smart card.

5 The rear face of the plate is covered with an adhesive sheet 34, the adhesive face of which is applied against the plate. This sheet covers the opening 32 so that it constitutes a base for the housing formed in the card by the opening 32. This base is adhesive.

10 Figure 4 depicts the fitting of the antenna/module assembly against the plate 30, the module being inserted in the opening 32 and being bonded by the adhesive material against the sheet 34.

15 The housing and the adhesive material keep the antenna/module assembly in precise position during the subsequent operations, which introduce mechanical stresses. The assembly can be coated at this stage with a thick resin which improves the holding in place
20 and which will serve as a binder and sealing substance protecting the antenna and module.

Another plate 10 made of plastics material cut to the format of the smart card (except if the format is
25 defined subsequently) is applied against the top face of the assembly thus produced, that is to say on the same side as the antenna rather than the adhesive sheet (Fig 5). The plastics material can be polyvinyl chloride (PVC) or other.

A cold or hot lamination operation is performed in order to connect the plates whilst enclosing the antenna/module assembly. For cold lamination, the insertion of a bonding resin (which can be the resin mentioned above) is necessary.

Figure 5 depicts the chip card at this stage, with the plate 30 and 40 on each side of the antenna/module assembly, and the binding resin 30 immersing the assembly between the plates.

The last operation (Figure 6) consists of removing the adhesive sheet 34, then revealing the bared contacts 21 of the smart card.

The method which has just been described would also be applicable in the case of a module produced not from a double-face metallised film but from a grille cut out to the shapes of necessary contacts and covered with an insulating film cut so as to bare a chip fixing area, connections areas for the chip wires, and connection areas for the antenna wire. It would however be less easy to solder the antenna wire in the latter areas because of the thickness of the insulating film.

**CLAIMS**

1. A method of manufacturing a smart card with contactless transmission, characterised in that an integrated circuit module and an antenna made from flat wound wire is produced, the antenna ends are fixed to connection areas of the module, the antenna/module assembly is temporarily fixed against a plate made of plastics material having an opening which can serve as a housing for the module, another plate of plastics material is placed on the antenna/module assembly, and the two plates are connected, enclosing the antenna and module.
2. A method according to Claim 1, characterised in that the temporary fixing of the antenna/module assembly is effected by bonding an adhesive sheet (34) to the first plate and the module is applied against the adhesive face of this sheet inside the opening (32) which serves as a housing for the module, the adhesive sheet being detached after connection of the two plates.
3. A method according to one of the preceding claims, characterised in that the smart card is a mixed card having access contact (21), and in that the module is inserted in the opening so that the contacts are flush with the bottom of the opening.
4. A method according to Claim 3, characterised in that the module is produced from a film with front-face



metallisations and rear-face metallisations, antenna connection areas (26, 27) being situated on the front face and the contacts (21) for access to the smart card being situated on the rear face.

5

5. A method according to one of Claims 1 to 4, characterised in that the chip (22) is immersed in a protective resin (24) before the module is inserted in the card, this protective resin not covering connection areas intended for the antenna.

10

6. A method according to one of Claims 1 to 5, characterised in that the two plastic plates of the card are connected by hot or cold lamination.

15

7. A method according to one of Claims 1 to 6, characterised in that a bonding and sealing resin (50) is deposited on the antenna/module assembly before pressing of the second plate.

20

8. A method of manufacturing a contactless transmission smart card comprising the following operations:

25

- there is produced an integrated-circuit module (M) which can be inserted in a card, comprising an integrated-circuit chip (22) mounted on a plastic film (20) provided with metallic parts (21, 25, 26, 27), the metallic parts comprising on the one hand connection areas (23, 25) allowing a connection with the chip and on the other hand two connection areas (26, 27) for

30



connection with an antenna (A), these two latter areas being at a given distance from each other and also being connected electrically to connection areas permitting connection with the chip;

5

- a flat-wound antenna (A) wire is produced, having two ends (12, 14) situated substantially at the same predetermined distance from each other;

10 - the antenna ends are fixed to the two corresponding connection areas (26, 27);

- the antenna/module assembly is bonded against a plate made of plastics material (30) having an opening (32) which can serve as a housing for the module (M), so that the antenna/module assembly is held in place against the plate during the subsequent operations;

15 - another plate made of plastics material (40) is placed on the antenna/module assembly;

20 - the two plates are connected, enclosing the antenna and module.

25 9. A manufacturing method according to Claim 8, characterised in that the chip card is a mixed card having access contacts (21), and in that the module is inserted in the opening so that the contacts are flush with the bottom of the opening.

30