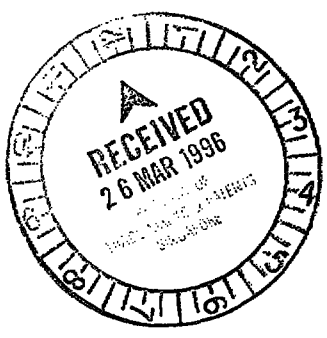
Contactless Data Carrier and Process for the Manufacture Thereof

The invention concerns a contactless data carrier and a process to manufacture a contactless data carrier with laminated layer structure, consisting of a chip disposed in a package, of core films provided with openings for the package, of covering films and an antenna.
The invention is preferably usable for contactless smart cards. However, it is also suitable for data carriers in which a package-disposed chip is connected to an antenna. Such arrangements can be used for example to protect goods against theft or as payment means with electronic protection in the form of coin-like constructions.

In the prior art, it is known to realise the data and energy transfer between contactless data carriers and the write and read stations by means of inductive coupling, microwave, or capacitive coupling. Transmitting and receiving means are antennas or metallic areas connected to the chip. To fulfil the existing dimensional standards and the mechanical stability requirements of the data carriers, the mechanical forces that occur during use must not damage



the semiconductor chip, the electrical leads or the transmitting and receiving means, hereinafter called antenna.

Arrangements are known whereby the chips are affixed to a flexible conductive film, which also carries or constitutes the antenna, by means of bonding. Further it is known to mount the chips by means of direct bonding method. With these methods, the chip and the contact leads between chip and circuit card are protected mechanically by a hardenable casting or covering substance. Guard rings, fabric plates and similar materials or arrangements are used for the mechanical protection of the chip and to simplify assembly.

The disadvantage of these arrangements and methods is that the data carriers and/or the antenna are laminated layer-asymmetrically in a plastic card, which leads to increased tensile stress on the conductors in the event of bending. Similarly it is disadvantageous that the chip lies not precisely centric in the laminate. In the event of bending of and torsional strain upon the plastic card, mechanical stress spikes occur, owing to material and constructional non-homogeneities, which can lead to the destruction of certain materials and thus to failure of the entire plastic card. A further disadvantage is that a data carrier structured asymmetrically in layer and material tends to sag.

In the state of the art it has been attempted to partially circumnavigate these disadvantages through use of very flat miniature packages.

The object of this invention is to specify an arrangement and a process for the manufacture of contactless data carriers, which enable favourably priced manufacture, whereby mechanical tensions are largely avoided, which enable an undisturbed laminate surface of high design quality in the region of the chip, and which are distinguished through high flexural resistance.

In accordance with the invention this task is solved therein in that

- an antenna is disposed between the core films,
- the package consists of two equal-sized package halves symmetrical in relation to the plane of division, which are provided with a bevel edge and a radius,
- the package is disposed layer-symmetrically in the core films with a press fit, and
- the package has at least two leads in the plane of symmetry, which are connected to the antenna.

Further advantageous embodiments of the design according to the invention are specified in claims 2 to 10.

The data carriers pursuant to the invention are distinguished by a number of advantages:

1. Owing to the pressing of the package into the core films, the package is securely affixed before lamination. It can remain on the film for various operations, it enables secure connection with the antenna contacts through press contact or soldered or bonded contact points.
2. Owing to the small gap between core film and package, there is a stable core film bond, which prevents air traps during lamination and subsequent bend tears.
3. Owing to the rounded package edges, the laminate films flow more easily during lamination. Furthermore, the roundings reduce mechanical tensions in the laminate.
4. Owing to the bevelling of the package, the laminate is strengthened across the package edges, which also contributes to the stability of the laminate, especially under bending loads, and reduces the mechanical tensions across the package edges.
5. The layer-centric exit of the leads facilitates a fully symmetrical laminate structure, which advantageously affects the flexural strength of the card and the card quality. The card can also be manufactured fully flat.

Further important advantages are the very favourably priced package manufacture, the possibility to facilitate a very high level of design of smart card, high reliability owing to the optimum arrangement of the package in the opening and the card position, and the favourable manufacture of the lamination packet.

In pursuance to the process to manufacture the data carriers according to this invention, the antenna is positioned on a core film, a package half is pressed into the opening of the core film and the antenna connected conductively to the package leads.

Thereby it is practical to dispose the core films on the package halves in such a way that the punching burr resulting from the punching of the core film points away from the package.
This facilitates self-centering during assembly of the package and an optimum fit of the package contours and the hole contour is achieved, which guarantees a neat embedding of the package in the laminate without significantly disturbing the covering films carrying the design.

The invention is explained in greater detail using the embodiments. In the associated drawing, there is shown:

Figure 1	a side elevation of the package according to the invention,
Figure 2	the associated top plan view,
Figure 3	a package pressed into core films,
Figures 4 to 6	arrangement examples of the package in a data carrier,
Figure 7	a thermoplastic two-part package,

and Figure 8 a thermoplastic package with alignment pins.

The package 1 represented in Figures 1 and 2 is almost layer-symmetrical in structure.

In the described example, it has the following dimensions:

- the thickness of package 1 is less than or equal to 570 μm, and the thickness of the outer package leads 4.1 is 40 to 80 μm,
- the thickness of package 1 is designed to be about 10 to 50 μm greater than the sum of the thicknesses of core films 10, 11 and where necessary of antenna films 15 in laminated condition,
- the package top halves 32 and bottom halves 33 have conical bevelling in edge region 6, whereby bevelling is disposed on a width of 0.5 mm to 1 mm at an angle of 5° to 10° between package top side 2 and bottom side 3 and the respective edge surfaces,
- the package side areas 7 outside of the layer plane of package leads 4.1, 4.2 are bevelled and extend conically pointed in the direction of package top side 2 and bottom side 3 at an angle of 85° to 70° to package top side 2 and bottom side 3,
- the package edges 8 are provided with a radius greater than or equal to 50 μm.

Figure 3 shows package 1 pressed into core films 10, 11.

During the assembly of the data carrier, package 1 is pressed into core films 10, 11 similar to a double-sided, very flat alignment pin. In the example described, package 1 has a round cross-section in which external leads 4.1 project out of package 1 layer-centrically. For usual applications two leads are sufficient. In the event of a plurality of leads, these are distributed advantageously with equal separation on the package edge. Package side areas 7 have a pointed conical package edge bevelling, which enables a simple, self-centering assembly of package 1 in core films 10, 11. The top and bottom circular package areas 2,3 are bevelled conically in edge region 6. Owing to the dimensionally adapted designs of core film openings 12 and of package 1, an embedded disposal of package 1 in core films 10,11 is possible. The package area in the centre of package thickness 5 is greater than or equal to the hole diameter of openings 12 in core films 10,11, while the package area of package top side 2 and bottom side 3 is less than the hole diameter of core film openings 12. Package 1 is received through core films 10,11 to the thickness of each package half 32, 33. The thickness of core films 10,11 and where necessary the antenna film 15 corresponds to, after laminating, the sum of the package thickness at the package edge. Assembly is effected by pressing package halves 32, 33 into core films 10, 11 and subsequent

lamination of core foils 10, 11 and the covering foils. Thereby antenna circuits 9 in the represented example are on one of core films 10,11. It is also possible to lay the antenna on a separate antenna film 15 or as flat wire coiling between core films 10,11. Corresponding embodiments are shown in Figures 4 to 6.

An advantageous embodiment results therefrom that the size of opening 35, for the insertion of package halves 32, 33 through antenna film 15, is some 0.4 to 1 mm larger in width than the package area in package layer centre 5, so that between the edge of antenna film opening 35 and package 1 an antenna film-free edge region 18 results. Thus during laminating a stable bond of core films 10,11 among one another is achieved directly around package 1.

Figures 4 to 6 explain arrangements of package 1 in interaction with antenna 15, 34.
Figures 4 and 5 show an embodiment in which film antenna 15 lies on a bottom core film 10 and in which opening 35 is disposed in such a way through antenna supporting film 15 that package 1 lies in the middle of conductor arrangement 9 of antenna 15. Package 1 can therefore be provided with relatively short external leads 4.1 and disposed in a relatively flexurally neutral zone of the card. Thereby package opening 35 is disposed proximate to a corner of the data carrier.

Package leads 4.1 or contact points 16 of antenna 15 are disposed usefully in the direction of the card diagonals. Package 1 and leads 4 are thus optimally positioned under flexural loading of the card. Figure 6 shows an embodiment in which a wire antenna 34 is used.

Figures 5 and 6 show practical examples of connecting package leads 4.1 to antenna 15, 34. For this purpose, antenna supporting film 15 can be covered with a temperature and pressure resistant, electrically insulating material 17.1 in the region in which external leads 4 of package 1 cross antenna circuits 9. This allows antenna 15 to be produced in a metal plane.
Package 1 can consist of plastic, ceramics and similar materials. Leads 4 are made of metal, preferably copper, iron or iron nickel and the like. They can also be realised in anodised form (gold, silver, etc.). Especially suitable are packages 1 of hard elastic material. The base films for film antennas 15 are preferably produced from polyester, polyimide, circuit board material and similar. PVC, polycarbonate and ABS plastics are preferably used for core films 10, 11.
To improve the design quality of the data carriers, it is advantageous to print package top side 2 and bottom side 3 of package 1 in the colour of core films

10,11. This prevents differently coloured package areas 2, 3 from shining through the covering films, which can particularly disturb in the case of dark packages 1.

Figure 7 shows an embodiment where package 1 consists of two package shells 12, 13 of electrically isolated plastic glued to each other. On bottom package shell 19 a supporting strip is disposed in such a way that in the glued state it is the bonding plane.
The module film required in the state of the art is no longer needed. During the chip assembly process package bottom shells 19 are part of an endless substrate strip and are therefore easily and simply transportable. Furthermore, the automatic bonder lines known in the state of the art can be used for processing.
Because the very flat, thin substrate strip is at the same level as the bonding plane of package shell 19, package shell 19 can easily be separated from lead 42 during handling processes.
For localisation, leads 4.1, 4.2 have, at least in the region of bottom package shell 19, a dovetailed cross-section in order to hold better internal lead 4.2 in the plastic. Moreover, internal lead 4.2 has interlocking holes to improve dovetailing.

A further advantageous arrangement is represented in Figure 8. In this embodiment alignment pins 30 are disposed in bottom package shell 19 and

alignment holes 29 in top package shell 20. This enables vertical and horizontal displacements of housing shells 19, 20 during adhesive or resin hardening to be avoided.

Thereby it is advantageous that, through plastic deformation of the tips of alignment pins 31, top package shell 20 is pressed onto bottom package shell 19. This causes top and bottom shell 19, 20 to remain in a defined position during the period of resin hardening, whereas in known methods resin 28 presses shells 19, 20 apart owing to wetting forces. In the state of the art this is compensated for by use of weights, which, however, requires very expensive production processes.

In the case of the arrangement according to the invention, the use of weights can also be avoided in that package shells 19, 20 can be secured in position during resin hardening by depositing fast bonding glue on the tip of alignment pin 30 and immediate bond soldering.

Further, it is possible to achieve, by using a casting resin 28 with a filler grain diameter that is somewhat larger than the gap alignment pin 30 to alignment hole 29 and by jamming the pin to the alignment hole wall by the filler body, an exact vertical localisation of package shells 19, 20.

It is furthermore practical to reduce the load upon the contact points and to stabilise the position of micro lead 23 by realising a wire support boss between

contact area 24 of internal lead 4.2 and semiconductor chip 21.

DRAWING REFERENCE LIST

1. Chip package
2. Package top side
3. Package bottom side
4.1 External lead
4.2 Internal lead
5. Package layer centre
6. Conically bevelled edge region of a package side
7. Package side area
8. Edge radius
9. Antenna conductor
10. Bottom core film
11. Top core film
12. Core film opening
13. Core film punching burr
14. Rounding of core film opening
15. Film antenna
16. Contact point
17.1 Insulating enamel for crossing insulation
17.2 Insulating enamel to locate lead end
19. Package bottom shell
20. Package top shell
21. Chip
22. Chip bonder
23. Micro lead
24. Internal contact area
25. Chip surface

26. Cavity in package bottom shell
27. Cavity in package top shell
28. Casting resin
29. Alignment hole
30. Alignment pin
31. Plastic deformed alignment pin tip
32. Top package half
33. Bottom package half
34. Wire antenna
35. Opening through antenna film



PATENT CLAIMS

1. Contactless data carrier with laminated layer structure, having a chip (21) disposed in a package, having core films (10, 11) provided with openings for the package, having covering films and an antenna, **wherein**

- the antenna is disposed between said core films (10, 11),
- the package consists of two equal sized package halves (32, 33), which outside are symmetrical in relation to the plane of division and have a bevelled edge and a radius,
- the package is disposed layer-symmetrically in core films (10, 11) with a press fit, and
- the package has at least two leads (4.1, 4.2) in the plane of symmetry which are connected to said antenna.

2. Data carrier according to claim 1, **wherein** top and bottom side of package halves (32, 33) have a blunt conical bevelling in the edge region.

3. Data carrier according to claim 1 or 2, **wherein** the sum of the core film thicknesses and where necessary of the antenna film thicknesses after lamination is somewhat less than the maximum package thickness.

4. Data carrier according to one of claims 1 to 3, **wherein** said antenna is

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disposed on an antenna film (15) arranged between core films (10, 11).

5. Data carrier according to one of claims 1 to 3, **wherein** one of core films (10, 11) is designed as antenna film (15).

6. Data carrier according to one of claims 1 to 5, **wherein** the opening in antenna film (15) is larger than the dimensions of the package in the package layer centre.

7. Data carrier according to one of claims 1 to 6, **wherein** said package is disposed centrically to the antenna arrangement.

8. Data carrier according to one of claims 1 to 7, **wherein** the data carrier is rectangular and the package is disposed proximate to a corner of the data carrier.

9. Data carrier according to one of claims 1 to 8, **wherein** package halves (32, 33) are glued to each other and a substrate strip is disposed in bottom package half (33) in such a way so that in a bonded state it is in the bonding plane of both package halves (32, 33).

10. Data carrier according to claim 9, **wherein** on one of the two package halves (32, 33) alignment pins (30) are disposed and on the other package half alignment holes.

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11. Process to manufacture contactless data carriers with laminated layer structure, having a chip (21) disposed in a package, having core films (10, 11) provided with openings for the package, having covering films and an antenna, wherein said antenna is positioned on a core film (10, 11), one package half (32, 33) is pressed into the opening of the core film (10, 11), and the antenna is connected conductively to package leads.

12. Process according to claim 11, wherein the core films are disposed on said package halves (32, 33) in such a way that punching buff (13) caused by core film punching points away from the package.