

**Translation of application incorporating the
amendments made under Chapter II of PCT**

10 **Conductor path structure, in particular for a lead frame for a smart card ap-
plication, with at least two superimposed conductor path planes**

Description

15 The invention relates to a conductor path structure, in particular for a lead frame
for a smart card application, which comprises at least one first conductor path
plane with several first conductor paths and at least one second conductor path
plane with several second conductor paths, whereby superimposed conductor
path planes are separated by an insulator, whereby at least one first conductor
20 path of the first conductor path plane comprises at least one bond opening ex-
tending through it **and the insulator comprises a through opening arranged
below the bond opening**, through which a bond wire can be led and can be
brought in electric contact with a **first** conductor path of the second conductor
path plane, and whereby at least ~~two adjacent conductor paths of the first conduc-~~
25 ~~tor path plane~~ **said first conductor path of said first conductor path plane and
the conductor path of the first conductor path plane adjacent to it** are sepa-
rated by ~~a slots and at least two adjacent conductor paths of the second conduc-~~
~~tor path plane~~ **said first conductor path of said second conductor path plane
and the conductor path of the second conductor path plane arranged adja-**
30 **cent to it** are separated by **a further slots**.

Such a conductor path structure is known and is commonly used for the manufac-
ture of electronic devices, in particular for smart card applications. For this pur-
pose, an electronic component, in particular a chip for a smart card, is put in or on
35 the first conductor path plane. The contacting of this electronic component with

the conductor paths of the first and/or of the second conductor path plane is then achieved in a manner known per se and therefore not described in greater detail via bonding wires which originate from the electronic component. In order to electrically connect a bonding wire of the electronic component with a contact area of a conductor path of the second conductor path plane, so called vias are used, that is to say bond openings, which traverse the first conductor path plane and the insulator arranged between the first conductor path plane and the second conductor path plane. In particular in so-called "dual-interface-applications" it is required in a number of cases to lead the bond wire through a bond opening of a conductor path of the first conductor path plane in order to electrically contact via the bond wire the conductor path of the second conductor path plane lying under the bond opening. In this case, the problem arises that, when bonding or later on, the bond wire touches the edge of the bond opening, whereby an electric contact between the bond wire and the conductor path of the first conductor path plane comprising the bond opening is established. This can lead to a short circuiting or to other undesired functional impairments. In order to avoid these problems, it is provided in the known conductor path structures that at least the conductor paths of the first conductor path plane having bond openings and the corresponding conductor paths of the second conductor path plane are separated by mechanical slots, so that adjacent conductor paths of the first conductor path plane and the second conductor path plane respectively are electrically insulated by the slots arranged between them. Known conductor path structures have the disadvantage that each of the slots separating adjacent conductor paths of the first conductor path plane are arranged above the slots separating two adjacent conductor paths of the second conductor path plane. This adversely affects the mechanical rigidity of such a conductor path structure, since the cohesion between the first conductor path plane and the second conductor path plane in the areas of said slots is only achieved by the insulator arranged between these two conductor path planes, which is usually a foil made of insulating material having a thickness of a few microns.

5 **EP 0 891 603 A1/WO98/28709** discloses a non-conductive substrate forming
a band or panel on which a plurality of support elements, in particular for
incorporation into a chip card, is provided. One side of the substrate has
conductive contact surfaces and the other side is provided with conductive
structures. Recesses are provided in the substrate, through which, for test-
10 ing purposes, an access to coil connections of the semi-conductor chip
from the side of the contact surface is possible, as long as the carrier ele-
ment is in the band or panel. The recesses are formed as through contacts
being connected with the conductor structures. On the side opposite to the
contact surface the recesses are each covered by a conductive area being
15 connected with the conductor structures. In this way slots separating adja-
cent conductor paths of the contact side forming a first slots on the second
side substrate are formed.

EP 0 992 065 A1/WO 99/53545 discloses a film used as a substrate for inte-
20 grated circuits, which has got the shape of an elongated film strip with edge
perforations and has conductor paths acting as a carrier for a plurality of
integrated circuits for mounting, in particular in chip cards. The conductor
paths are stamped out of a metal foil and are glued on a plastic film having
only stamp openings or through openings. On both sides of the plastic foil
25 metal foils having a different conductor path pattern are glued, whereby the
metal foils on both sides furthermore are provided with additional breaks in
addition to the conductor path pattern, in order to reduce the cross section
of the metal foils vertically in relation to the longitudinal direction of the film
at short intervals.

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It is the object of the present invention to further improve a conductor path struc-
ture of the type mentioned at the beginning so that an improved mechanical stabil-
ity is achieved.

5 This problem is solved according to the invention in that the **at least one** slot ~~or the slots separating adjacent conductor paths~~ of the first conductor path plane and ~~the slot or the slots separating adjacent conductor paths of the second conductor path plane are arranged offset from each other~~ **is arranged offset in relation to said at least one further slot of the second conductor path plane.**

10 By virtue of the staggered arrangement of the slots separating adjacent conductor paths of the first conductor path plane and the further slots separating adjacent conductor paths of the second conductor path plane provided according to the invention, in an advantageous manner an improved mechanical stability of the
15 conductor path structure is achieved, since at least one slot separating two adjacent conductor paths of the first conductor path plane is offset in respect to the corresponding further slot which is provided in the second conductor path plane being arranged under the first conductor path plane, and is not any longer, as it is provided in the known conductor path structures, arranged above the correspond-
20 ing slot of the second conductor path plane, but is offset relative to it. Preferably a plurality or, more preferably, all slots of the first conductor path plane are arranged offset in respect to the further slots of the second conductor path plane in such a way. In this way in an advantageous manner it is achieved that in the areas of co-
operating or associated slots of two conductor path planes the cohesion between
25 these two conductor path planes is not only effected by the insulating foil arranged between these two conductor path planes.

According to an advantageous embodiment of the invention it is preferably provided that at least one slot of the first conductor path plane passes through the
30 associated bond opening. In this way in an advantageous manner a favorable arrangement as well as manufacturability of the slots arranged offset according to the invention is achieved.

A further advantageous embodiment of the invention provides that at least in a
35 part of the edge region of the first conductor path plane substantially no electrical-

ly conductive material is present. It is preferred that the edge region or the edge regions of the first conductor path plane and/or of the second conductor path plane are substantially free of electrically conductive material in those regions in which the risk of an unwanted contacting between the first conductor path plane and the second conductor path plane exists. By these measures it is achieved that the risk, that, in a separation process for separating the conductor path structures according to the invention, as a result of a mechanical impact by a separating tool on one edge region or edge regions of one of the conductor path planes, e. g. of the first conductor path plane, electrical conductive material of this edge regions is pressed to the surface of the further conductor path plane being arranged under said conductor path plane or – in the case of a structure having two or more layers – to the further conductor path planes being arranged below said first mentioned conductor path plane, is eliminated or at least reduced. The risk of functional impairment and/or malfunctions due to such an unwantingly produced electrically conductive connection between two or more conductor path planes is counteracted in a very simple manner. Such a measure in particular has advantages for the user of such conductor path structures, in particular manufacturers of smart cards, as the manufacturing process of such a smart card can be simplified in an advantageous manner, since the smart card manufacturer can perform the separation process required for the separation of conductor path structures without having to pay particular attention to the fact that, when separating in two individual conductor path structures from the carrier receiving them in the process required for said separation, e. g. a stamping or cutting, no unwanted contacting between two or several conductor path planes can occur through stamping and/or cutting residues.

A further advantageous embodiment of the invention provides that the insulator separating the conductor path planes is formed as an electrically insulating foil, and that said foil is provided preferably on both sides with an adhesive layer. Such a measure has got the advantage that in this way in a particular simple manner the two conductor path planes can be assembled to the conductor path structure

- 5 according to the invention, in that the first conductor path plane is glued with the first surface of the insulating foil and the second conductor path plane being arranged under the first conductor path plane is glued with the second surface of said double-sided adhesive insulating foil.
- 10 Further advantageous developments of the invention are the subject matter of the dependent claims.

Further advantages of the invention are disclosed in the exemplary embodiment, which is described in the following with reference to the figures. They show:

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- Figure 1 an embodiment of a conductor path structure having two superimposed conductor path planes in a view from their chip side,
- Figure 2 the embodiment of Figure 1 in a view from the chip side,
- Figure 3 the embodiment of Figure 1 in a bottom view from a contact side,
- 20 Figure 4 a top view on an embodiment of an insulator arranged between the two conductor path planes,
- Figure 5 an enlarged view of a section along line A-A of Figure 1,
- Figure 6 a strip of an electrically conductive material having a plurality of first conductor path planes, and
- 25 Figure 7 a strip of an electrically conductive material having a plurality of second conductor path planes.

- In figures 1 to 5 an exemplary embodiment of a conductor path structure 1 comprising two superimposed conductor path planes 10, 20 is shown, whereby figure
- 30 1 shows a view on the conductor path structure 1 from its so-called chip side. The conductor path structure 1 comprises, in the embodiment described, said first conductor path plane 10 (see figure 2) and said second conductor path plane 20

5 (see figure 3), which – as it can be best seen from the cross section of figure 5 –
are separated by an insulator 30 (see figure 4), which is formed, in the described
embodiment, as a foil made of an insulating material 31. For the sake of clarity,
the structures of the second conductor path plane 20 are shown in figure 1 by
dashed lines and the insulator 30 is shown in a transparent manner in order to
10 show the spatial relationships between the conductor paths 11 and 21 of the first
conductor path plane 10 and the second conductor path plane 20 respectively.

A number of conductor paths 11 of the first conductor path plane 10 comprise
bond openings 12a-12e, which traverse the respective conductor paths 11. The
15 insulator 30 being arranged below the first conductor path plane 10 comprises –
as it can best be seen from figure 4 – a number of through openings 32a-32e be-
ing arranged below the corresponding bond openings 12 of the first conductor
path plane 10, so that so-called vias are formed, which allow to connect an elec-
tronic component (not shown) being arranged on or in the first conductor path
20 plane 10, in particular a chip for a smart card, by means of associated bond wires
(not shown) with contact areas of a corresponding number of conductor paths 21
of the second conductor path plane 20. Such a design of a conductor path struc-
ture 1 is known and hence needs not to be described further in detail. It is appar-
ent for a person skilled in the art from the following description that the basic
25 structure of the conductor path structure 1 described here is merely exemplary in
nature and does not limit the generality of the following considerations. In particu-
lar, it is possible to provide more than two superimposed conductor path planes
10, 20 made of an electrically conductive material, wherein individual conductor
path planes are separated by an insulator 30.

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Figure 2 now shows a top view on the first conductor path plane 10. One recog-
nizes the conductor paths 11a-11f, the bond openings 12a-12e as well as slots
13a-13i, which separate the respective conductor paths 11a-11f from each other
and hence isolate them. The conductor path 11a is separated by slots 13a and
35 13d from conductor path 11b. In a corresponding manner, the slots 13b and 13c

5 separate conductor path 11c and the afore-mentioned conductor path 11b. The
conductor path 11d and the conductor path 11e are separated by the slots 13e
and 13h, whereas the conductor paths 11f and 11e are separated by the slots 13f
and 13g. A slot 13i starting from the – in figure 2 left – edge 10a of the conductor
10 path plane 10 and running to its right edge 10b separates conductor paths 11b
and 11e. As it can be seen from the figures, it is preferred that the respective slots
13a-13h are not led around the bond openings, as it is provided in known conduc-
tor path structures, but pass through them. For example, slot 13a starting from the
lower edge 10c of the first conductor path plane 10 ends in the bond opening 12a,
slot 13d starts from bond opening 12a and runs to the first edge 10a of the first
15 conductor path plane 10. The slots 13d and 13c co-acting with bond opening 12c
are provided accordingly, as well as the slots 13e and 13h co-acting with the bond
opening 12d. The slot 13f starting from the upper edge 10d of the first conductor
path plane 10 runs to the fourth bond opening 12e and the further slot 13d starts
therefrom and runs to the first edge 10a of the first conductor path plane 10.

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It is preferred that the individual slots 13a, 13d or 13b and 13c or 13e and 13h or
13d and 13f respectively as well as the corresponding bond openings 12a or 12c
or 12d or 12e are not formed separately, but as a contiguous structure, so that
they can be formed – as described below – by means of a single operation, in par-
25 ticular a stamping operation, from a carrier material 2 (see figure 6) being used for
the manufacturing of the first conductor path plane 10.

Figure 2 further shows that the conductor path plane 10 comprises areas 14 along
the edges 10a-10d which are free or substantially free of electrically conductive
30 material. As it will be explained below, such a measure serves to avoid an un-
wanted electrically contacting of the first conductor path plane 10 and the second
conductor path plane 20 or to at least reduce the risk of such an electric contact-
ing.

Figure 3 shows the second conductor path plane 20. It comprises conductor paths 21 corresponding to the conductor paths 11 of the first conductor path plane 10, wherein individual conductor paths 21a-21f are separated by corresponding slots 23a-23f. The statements made in respect to the separation of the conductor paths 11 by the slots 13 of the first conductor path plane 10 apply here accordingly, so that it is sufficient to refer to the representation of figure 3 from which it is apparent which slots 23a-23f separate certain conductor paths 21a-21f. It only shall be noted that for the second conductor path plane 20 it is not required, as for the first conductor path plane 10, that each individual slot 23 has got to be provided individually. For example the slots 23a, 23b and 23c of the second conductor path plane 20 form sections of a slot 23' starting from the – in figure 3 left – edge 20a of the second conductor path plane 20 and running to the upper edge 20d. In a corresponding manner the slots 23d, 23e and 23f form sections of a slot 23'' starting from the left edge 20a and running to the lower edge 20c of the second conductor path plane 20.

One can see from figure 3 that the second conductor path plane 20 has got areas 24 along the edge region 20a-20d too, which are free or at least substantially free of an electrically conducting layer.

For manufacturing the conductor path structure 1 consisting, in the embodiment described, of the two conductor path planes 10 and 20 and the insulator 30, which is arranged between the two conductor path planes 10 and 20, here a foil 31 of an insulating material, the first conductor path plane 10, the insulator 30 and the second conductor path plane 20 arranged above each other, as it will be described below, wherein – as it can be seen from figure 5 – the insulator 30 is arranged between the two conductor path planes 10 and 20. This yields the structure shown in figure 1.

It is essential that – as it can be seen from the afore-mentioned figure 1 as well as the cross section of figure 5 – that the slots 13 of the first conductor path plane 10

5 and the slots 23 of the second conductor path plane 20 are arranged offset to each other. It can be seen from figures 1 and 5, that the slot 13a of the first conductor path plane 10 is arranged farther outwardly than the slot 23a of the second conductor path plane 20. In a corresponding manner the slot 23b of the second conductor path plane 20 is provided farther inwardly than the slot 13b of the first conductor path plane 10. The slot 13e of the first conductor path plane 10 is closer to the edge 10b of the first conductor path plane 10 than the slot 23e of the second conductor path plane 20 is provided distant from the second edge 20b. The slot 23f of the second conductor path plane 20 is farther spaced from its first edge 20a than slot 13f of the first conductor path plane 10 is spaced from its first edge 10a.

By said staggered arrangement of corresponding slots 13a, 23a or 13b, 23b as well as 13e and 23e or 13f, 23f, respectively, in an advantageous manner an improved mechanical stability of the conductor path structure 1 formed by the two conductor path planes 10 and 20 as well as the insulator 30 arranged between them is achieved, since – in contrast to known conductor path structures – slots 13 and 23 respectively separating adjacent conductor paths of the respective conductor path planes 10 and 20 respectively are now no longer – in a top view on the plane of the conductor path structure 1 – arranged above each other, but are offset in a direction orthogonal thereto. This is in particular apparent from the sectional view of figure 5. In this way in an advantageous matter the mechanical stability, in particular the torsional rigidity, of the conductor path structure 1 formed by the conductor path planes 10 and 20 and the insulator 30 arranged between them is improved.

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The manufacturing of the afore-described conductor path structure 1 is explained with reference to the figures 6 and 7. It is preferably done by a so-called “reel-to-reel”-process. For this purpose, in a way known per se and hence not described in details corresponding structures are formed in a carrier material being rolled on a reel and having an electrically conductive layer.

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In the carrier material 2 of figure 6, from which the first conductor path planes 10 are manufactured, the slots 13 and the bond openings 12a-12e are formed, too. In the carrier material 3 of figure 7, from which the second conductor path planes 20 are manufactured, correspondingly slots 23 are formed. The working of the carrier materials 2 and 3 respectively for forming the conductor path planes 10 and 20 respectively is preferably done by a stamping or another method suited for the manufacturing of such conductor path planes 10 and 20 respectively.

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The correspondingly processed carrier materials 2 and 3 respectively are then rolled again on another reel. This is known too and hence needs not to be described in detail.

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For the formation of conductor path structures 1 the first conductor path plane 10 and the second conductor path plane 20 are arranged one above the other in a correct position, wherein between these two conductor path planes 10 and 20 the insulating foil 31, hence the insulator 30, was arranged. The carrier material 2, the insulator 30 as well as the carrier material 3 are then connected with each other, so that – in the case described here – a three-layer structure is formed. It is preferred that the insulator 30, in the embodiment described here the foil 31 of insulating material, is provided as a foil which is adhesive on both sides. This has got the advantage that in a simple manner the lower surface 2' of the first carrier material 2 can be connected with the upper surface 30' of the insulator 30 and the upper surface 3' of the second carrier material 3 can be connected with the lower surface 30'' of the insulator 30. In this way the here described three-layer structure, formed by the carrier material 2, the insulator 30 and the carrier material 3, is formed, from which lateron individual conductor path structures 1 can be separated out. This is done by means of an appropriate separation technique, in particular by a stamping process, so that a plurality of conductor path structures 1, as shown in figure 1, can be separated out thereof. In figure 6 and 7 the outer contour of a conductor path structure 1 (the conductor path structure 1 shown in fig-

5 ures 6 and 7 at the left top) following a separation operation is illustrated by a dashed line S.

When performing such a separation process for separating out the conductor path structures 1 there is the risk that, as a result of a mechanical impacting of the edge areas 10a-10d of the first conductor path plane 10 by a separating tool, electrically conductive material of said edge area can be pressed to the surface of the second conductor path plane 20 arranged below it, so that in this way an electrically conductive connection between the two conductor path planes 10 and 20 is generated, which can lead to functional impairments and malfunctions. In order to counteract this, or to at least reduce the risk of such an unwanted electrically contacting of the two conductor path planes 10 and 20, in the described embodiment it is provided, as already addressed before, that – as it can be best seen from figure 1 and the cross section of figure 5 – the edge areas 10a-10d of the first conductor path plane 10 are substantially free of electrically conducting material, since there respective areas are provided. From the top view of figure 1 one can see an edge region 33 protruding above the edges 10a-10d of the insulating foil 31 being arranged between the first conductor path plane 10 and the second conductor path plane 20.

25 As it also has been addressed before, the second conductor path plane 20 has got in its edge regions 20a-20d areas 24 being free of an electrically conductive material.

By this design of the first conductor path plane 10 and/or of the second conductor path plane 20 with areas 14 and 24 respectively it is preferably effected that from the carrier material 2, from which – as described before – a number of first conductor path planes 10 are formed, further areas 40 can be separated out of the electrically conductive layer of this carrier material 2.

- 5 The areas 14, 24 are formed in such a way that from the carrier material 2 and 3, respectively, the areas 40 and 41, respectively, are stamped out or made in another way free of electrically conductive material.

10 In summary, it is to be mentioned that by the measures described a conductor path structure 1 is provided, which is characterized in that by the staggered arrangement in individual planes of the slots 13 and 23 respectively separating adjacent conductor paths 11 and 21 of conductor path planes 10 and 20 respectively an increased mechanical stability, in particular an enhanced torsional rigidity, of the conductor path structure 1 provided as described is achieved. By further optional providing that – which is a method of individual patentability – at least this
15 edge areas 10a-10d of the first conductor path plane 10, this is to say the one of the two conductor path planes 10, 20, from which the separation process by means of a separation tool starts, is made at least substantially free of insulating material, an unwanted contacting between one or several conductor paths 11 of
20 the first conductor path plane 10 and at least one conductor path 21 of the second conductor path plane 20 is counteracted in an advantageous way.

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Claims

1. Conductor path structure, in particular for a lead frame for a smart card application, comprising at least one first conductor path plane (10) having several first conductor paths (11; 11a-11f) and at least a second conductor path plane (20) having several second conductor paths (21; 21a-21f), wherein superimposed conductor path planes (10, 20) are separated by an insulator (30), wherein at least one first conductor path (11; 11a, 11b, 11c, 11d, 11f) of the first conductor path plane (10) has got at least one bond opening (12; 12a-12e) traversing it **and the insulator (30) comprises a through opening (32a-32e) being arranged below the at least one bond opening (12; 12a-12e)**, through which a bond wire can be led and can be brought in electric contact with a **first** conductor path (21; 21a-21f) of the second conductor path plane (20), and wherein ~~at least two~~ **said first conductor path of the first conductor path plane (10) and the** adjacent conductor paths (11; 11a, 11b, 11c, 11d, 11e, 11f) of the first conductor path plane (10) are separated by a slot (13; 13a-13i) and ~~at least two~~ **said first conductor path of the second conductor path plane (20) and the** adjacent conductor paths (21a, 21b; 21b, 21c, 21d, 21e; 21e, 21f) are separated by a further slot (23, 23a-23e), characterized in that ~~the said slots (13; 13a-13i) separating adjacent conductor paths (11; 11, 11a, 11b, 11c, 11d, 11f) of the first conductor path plane (10) and further slots (13; 13a-13i, respectively 23; 23a-23e) of the second conductor path plane (20) are arranged offset to each other~~ **is arranged offset in relation to said at least one further slot (23; 23a-23e) of the second conductor path plane (20).**
2. Conductor path structure according to claim 1, characterized in that at least one slot (13; 13a-13h) passes through a bond opening (12a-12e), ends in it or starts from it.

- 5 3. Conductor path structure according to one of the previous claims, characterized in that the insulator (30) arranged between adjacent conductor path planes (10, 20) is provided as an electrically insulating foil (31) having at least one through opening (32a-32e) for a bond wire.
- 10 4. Conductor path structure according to claim 3, characterized in that the foil (31) is provided with an adhesive layer at least on one side and preferably on both sides.
- 15 5. Conductor path structure according to one of the previous claims, characterized in that at least one conductor path plane (10; 20) of the conductor path structure (1) is provided at least in a partial area (14; 24) of its edge area (10a-10d; 20a-20d) at least substantially free of the electrically conductive material.
- 20 6. Electronic device, in particular smart card, having a conductor path structure (1) for receiving an electronic component, in particular a chip, which can be inserted or set upon the conductor path structure (1) and can be connected with at least one bond wire with the conductor path structure (1), characterized in that the conductor path structure (1) is provided according to one of the claims 1 to 5.
- 25 7. Method for manufacturing a conductor path structure according to one of the claims 1 to 5, characterized in that in a carrier material (2; 3) slots (13; 23) for separating adjacent conductor paths (11, 21) are provided.
- 30 8. Method according to claim 7, characterized in that for forming non-conductive edge areas (10a-10d) of the conductor path plane (10) recesses (40) are provided.