A planar transformer 100 comprises a planar rectangular frame 10 of insulating material with recessed portions 105 on the top and bottom planar surfaces 101, 102. The frame 10 has a central first opening 104 through the frame and a transverse slot 106 extending from a second opening 103 in a flange 107 on one edge surface of the frame 10 to a blind end at the opposite edge surface of the frame. The second opening 103 is arranged to be in communication with the first said opening 104 and a sheet shaped primary winding 16 is inserted in the transverse slot 106. Sheet shaped secondary winding 18 is arranged on the top and bottom recesses 105 of the frame 10. The frame 10 and the windings 16, 18 are arranged with aligned openings 104, 161 such that the central limb of an E shaped magnetic core member 12 can be inserted through them to link with a plate shaped magnetic core member 14. U-shaped insulators 19 may be clamped on the front and rear edges of the secondary winding 18. The primary winding 16 may be in the form of a printed circuit board (PCB) and the secondary winding 18 may be a copper or PCB winding. The magnetic core 12, 14 may be made of ferromagnetic material. The planar transformer 100 may provide a compact, low-profile transformer with good insulation characteristics.
TITLE: LOW-PROFILE PLANAR TRANSFORMER

BACKGROUND OF THE INVENTION

(a) Technical Field of the Invention

The invention relates to planar transformers and more particularly to a small planar transformer having a lower profile than conventional planar transformer.

(b) Description of the Prior Art

Planar transformers are well known in the art. Planar transformers have advantages of having a compact size, a high efficiency, and a good heat dissipation capability.

Moreover, there have been numerous suggestions in prior patents for planar transformers. For example, U.S. Pat. No. 5,010,314 discloses a type of low-profile planar transformer.

Typically, a small planar transformer is mounted in a compact electronic product (e.g., notebook computer, MP3 player, or the like) for supplying required power thereto. However, typical types of planar transformer have a drawback of having a great clearance distance between core and windings due to safety creepage consideration. Thus, typical planar transformers are still relatively bulky as viewed by the inventor.

It is understood that there is a trend of ongoing reduction in size of
electrical and electronic equipment. Hence, a further reduction in size of planar transformers is desirable.
SUMMARY OF THE INVENTION

The primary purpose of the present invention is to provide a small planar transformer having a lower profile so that insulative clearance and creepage distances required between the primary winding and the secondary winding can be increased to an optimum.

The above and other objects, features and advantages of the invention will become apparent from the following detailed description taken with the accompanying drawings.

The foregoing object and summary provide only a brief introduction to the present invention. To fully appreciate these and other objects of the present invention as well as the invention itself, all of which will become apparent to those skilled in the art, the following detailed description of the invention and the claims should be read in conjunction with the accompanying drawings. Throughout the specification and drawings identical reference numerals refer to identical or similar parts.

Many other advantages and features of the present invention will become manifest to those versed in the art upon making reference to the detailed description and the accompanying sheets of drawings in which a preferred structural embodiment incorporating the principles of the present invention is shown by way of illustrative example.
BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an exploded view of a preferred embodiment of planar transformer according to the invention;

FIG. 2 is a perspective view of the assembled planar transformer; and

FIG. 3 is a top plan view of the planar transformer shown in FIG. 2.
DETACHED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The following descriptions are of exemplary embodiments only, and are not intended to limit the scope, applicability or configuration of the invention in any way. Rather, the following description provides a convenient illustration for implementing exemplary embodiments of the invention.

Various changes to the described embodiments may be made in the function and arrangement of the elements described without departing from the scope of the invention as set forth in the appended claims.

Referring to FIGS. 1 to 3, a planar transformer 100 in accordance with a preferred embodiment of the invention is shown. The transformer 100 comprises the following components as discussed in detail below.

A frame 10 is mounted between a first core 12 and a second core 14. The frame 10 comprises a hollow, rectangular body (not numbered) having a top surface 101, a bottom surface 102, two sides 103, a central, rectangular opening 104 through the top and bottom surfaces 101 and 102, two recessed structures 105 on the top and bottom surfaces 101 and 102 respectively, and a transverse slot 106 having a blind end proximate one side 103 and the other end open to the other side 103, the slot 106 being in communication with the opening 104.

A primary winding 16 is shaped as a rectangular sheet. The primary
winding 16 is implemented as a printed circuit board (PCB). The primary winding 16 comprises a central, rectangular opening 161 through its top and bottom surfaces, and a projection 162 at the other side. The opening 161 is dimensioned to conform to the opening 104. The projection 162 is implemented as a series of conductive contacts (i.e., edge connector) and is adapted to electrically connect to a mating socket (not shown) by plugging thereinto.

A secondary winding 18 is rectangular and is comprised of two spaced, parallel sheets connected together at one side. The secondary winding 18 is implemented as a copper winding or a PCB. The secondary winding 18 has a central opening (not numbered) and a tab (not numbered) at one side. The tab is implemented as a series of conductive contacts (i.e., edge connector) and is adapted to electrically connect to another mating socket (not shown) by plugging thereinto.

A flange 107 is formed on the other side 103 of the frame 10. Both the first core 12 and the second core 14 are made of ferromagnetic core. The first core 12 is E-shaped. The second core 14 is a rectangular plate. Two insulators 19 are formed of a U-shaped insulating sheet.

An assembly of the invention will be described in detail below. First, insert the primary winding 16 into the slot 106 for fastening with only the
projection 162 being exposed. Next, snugly fit the secondary winding 18 on
the top and bottom recessed structures 105 by pushing from one side 103 of
the frame 10 because the secondary winding 18 is dimensioned to conform
thereto. That is, the secondary winding 18 clamps the recessed structures 105.

Next, pushing the insulators 19 onto front and rear ends of the secondary
winding 18 until the bending portions of the insulators 19 are engaged with
and stopped by the front and rear ends of the secondary winding 18

. Next, put the second core 14 on the insulators 19. Finally, insert the central
ridge of the first core 12 through the openings 104 and 161 to cause the first
core 12 to secure to the second core 14 by magnetic attracting force.

The invention has the following advantages. A distance between the
primary winding 16 and the secondary winding 18 is greatly decreased. Hence,
the physical size of the transformer 100 can be reduced significantly. The
flange 107 functions as an insulating member between the primary winding 16
and the secondary winding 18 and thus insulative clearance distances
therebetween can be increased. Moreover, the flange 107 can increase
insulative clearance distances between the primary winding 16 and the first
core 12 and between the secondary winding 18 and the second core 14
respectively. In addition, the flange 107 can increase creepage distances

between the primary winding 16 and the secondary winding 18, between the
primary winding 16 and the first core 12, and between the secondary winding 18 and the second core 14 respectively. As an end, operating safety of the transformer 100 is greatly increased.

It is seen that insulation between the first core 12 and the secondary winding 18 and insulation between the second core 14 and the secondary winding 18 are effected by the provision of the insulator 19. Alternatively, the insulator 19 can be eliminated if insulation is formed on the secondary winding 18 directly. The secondary winding 18 is comprised of a plurality of laminated layers and the number of the layers may vary depending on output power, current, and/or voltage requirements. Moreover, the insulative clearance distance between the primary winding 16 and the secondary winding 18 can be further increased by increasing the peripheral walls or the depths of the recessed structures 105.

It will be understood that each of the elements described above, or two or more together may also find a useful application in other types of methods differing from the type described above.

While certain novel features of this invention have been shown and described and are pointed out in the annexed claim, it is not intended to be limited to the details above, since it will be understood that various omissions, modifications, substitutions and changes in the forms and details of the device
illustrated and in its operation can be made by those skilled in the art without departing in any way from the spirit of the present invention.
I CLAIM:

1. A planar transformer comprising:

   a rectangular frame including two recessed structures on the top
   and the bottom respectively, a central first opening through the top
   and the bottom, a transverse slot having a blind end proximate one
   side and the other end open to the other side, the slot being in
   communication with the first opening, and a flange on the other side;

   a primary winding of sheet shape, the primary winding
   including a central second opening through its top and bottom
   surfaces, the primary winding being adapted to insert into the slot
   with the other side of the primary winding being exposed and the
   second opening being aligned with the first opening;

   a rectangular secondary winding adapted to put on the recessed
   structures;

   two insulating members of U-shaped adapted to clamp the front
   and the rear ends of the secondary winding;

   a first core of E shape; and

   a second core of sheet shape adapted to couple to the first core
   by inserting the central ridge of the first core through the first and the
   second openings with the frame, the primary winding, the secondary
winding, and the insulating members being disposed therebetween.

2. The planar transformer of claim 1, wherein each of the first and the second cores is formed of ferromagnetic material.

3. The planar transformer of claim 1, wherein the primary winding is a printed circuit board (PCB).

4. The planar transformer of claim 1, wherein the secondary winding is either a copper winding or a PCB.

5. A planar transformer comprising:
   a rectangular frame including two recessed structures on the top and the bottom respectively, a central first opening through the top and the bottom, a transverse slot having a blind end proximate one side and the other end open to the other side, the slot being in communication with the first opening, and a flange on the other side;
   a primary winding of sheet shape, the primary winding including a central second opening through its top and bottom surfaces, the primary winding being adapted to insert into the slot with the other side of the primary winding being exposed and the second opening being aligned with the first opening;
   a rectangular secondary winding including two insulating members on the top and the bottom respectively, the secondary
winding being adapted to put on the recessed structures;

a first core of E shape; and

a second core of sheet shape adapted to couple to the first core by inserting the central ridge of the first core through the first and the second openings with the frame, the primary winding, and the secondary winding being disposed therebetween.

6. The planar transformer of claim 5, wherein each of the first and the second cores is formed of ferromagnetic material.

7. The planar transformer of claim 5, wherein the primary winding is a PCB.

8. The planar transformer of claim 5, wherein the secondary winding is either a copper winding or a PCB.
Amendments to the claims have been filed as follows

1. A planar transformer comprising:
   
   a rectangular frame including two recessed structures on the top and the bottom respectively; a central first opening through the top and the bottom, a slot having a blind end proximate one side and the other end open to the other side, the slot being in communication with the first opening, and a flange on the other side;
   
   a primary winding of sheet shape, the primary winding including a central second opening through its top and bottom surfaces, the primary winding being adapted to insert into the slot with the other side of the primary winding being exposed and the second opening being aligned with the first opening;
   
   a rectangular secondary winding adapted to put on the recessed structures;
   
   two insulating members of U-shaped adapted to clamp the front and the rear ends of the secondary winding;
   
   a first core of E shape having a central ridge;
   
   the central first opening and the second central opening extending through the frame and the primary winding for the central ridge of the first core to extend through the central first opening and the central second
opening; and

a second core of sheet shape adapted to couple to the first core by inserting the central ridge of the first core through the first and the second openings with the frame, the primary winding, the secondary winding, and the insulating members being disposed therebetween.

2. The planar transformer of claim 1, wherein each of the first and the second cores is formed of ferromagnetic material.

3. The planar transformer of claim 1, wherein the primary winding is a printed circuit board (PCB).

4. The planar transformer of claim 1, wherein the secondary winding is either a copper winding or a PCB.

5. A planar transformer comprising:

   a rectangular frame including two recessed structures on the top and the bottom respectively, a central first opening through the top and the bottom, a slot having a blind end proximate one side and the other end open to the other side, the slot being in communication with the first opening, and a flange on the other side;

   a primary winding of sheet shape, the primary winding including a central second opening through its top and bottom surfaces, the primary winding being adapted to insert into the slot
with the other side of the primary winding being exposed and the
second opening being aligned with the first opening;

a rectangular secondary winding including two insulating
members on the top and the bottom respectively, the secondary
winding being adapted to put on the recessed structures;

a first core of E shape having a central ridge;

the central first opening and the second central opening
extending through the frame and the primary winding for the central
ridge of the first core to extend through the central first opening and
the central second opening; and

a second core of sheet shape adapted to couple to the first core
by inserting the central ridge of the first core through the first and the
second openings with the frame, the primary winding, and the
secondary winding being disposed therebetween.

6. The planar transformer of claim 5, wherein each of the first and the
second cores is formed of ferromagnetic material.

7. The planar transformer of claim 5, wherein the primary winding is a
PCB.

8. The planar transformer of claim 5, wherein the secondary winding is
either a copper winding or a PCB.
Application No: GB0725329.7  Examiner: Mr John Watt
Claims searched: 1 - 8  Date of search: 15 April 2008

Patents Act 1977: Search Report under Section 17

Documents considered to be relevant:

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<thead>
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<td>EP0933789 A2 (R.G.M.) see figs. 1 - 4 and paragraphs [0001] and [0005].</td>
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<td>US 6522233 B1 (KYOSO ET AL.) see figs. 1 - 16B.</td>
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<td>WO 91/15861 A1 (MULTISOURCE TECHNOLOGY) see figs. 1 - 14 and page 1, lines 4 - 9.</td>
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- **Y** Document indicating lack of inventive step if combined with one or more other documents of same category
- **&** Member of the same patent family
- **A** Document indicating technological background and/or state of the art.
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Field of Search:

Search of GB, JP, WO & US patent documents classified in the following areas of the UKC^X^:

- **HIT**

Worldwide search of patent documents classified in the following areas of the IPC

- **H01F**

The following online and other databases have been used in the preparation of this search report:
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