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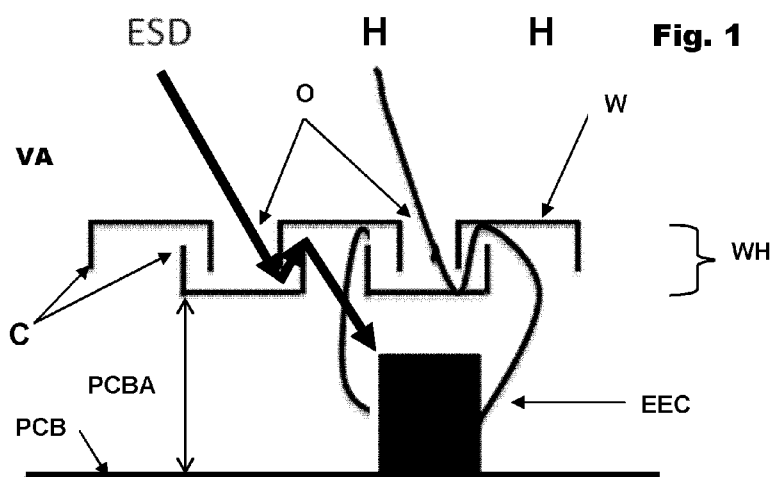
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(54) Title: HOUSING FOR AN ELECTRIC OR ELECTRONIC CIRCUIT



(57) Abstract: A housing for an electric or electronic circuit arranged in the housing for protecting the electric or electronic circuit from physical or electrostatic damage and drawing off heat from the electric or electronic circuit is recommended. The housing comprises a wall in sandwich structure of two face sheets comprising an air vent being provided by chicanes of the face sheets directed in a direction of a chicane of the other face sheet for creating an U-profile with legs each invasive into a separate groove formed by an U-profile of the face sheet located opposite to the U-profile formed by chicanes of the other face sheet. Advantageous of the housing are e.g. that comparable electrostatic discharge requirements and thermal requirements are realized with less expenditure as less wall thickness and a smaller distance between wall and the electric or electronic circuit as well as an improved protection which avoids a contact with the electric or electronic circuit by small pieces. The housing is preferably a nonmetallic housing for a residential gateway, a DSL modem or a set top box.

HOUSING FOR AN ELECTRIC OR ELECTRONIC CIRCUIT

The invention relates to a housing, especially a nonmetallic housing for an electric or electronic circuit arranged in the housing for protecting the electric or electronic circuit from physical or electrostatic damage and drawing off heat from the electric or electronic circuit.

10 Background of the invention

In the development of nonmetallic housings for electric or electronic circuits as e.g. modems and gateways frequently conflicts exist between electrostatic discharge requirements below also abbreviated as ESD and thermal requirements of the nonmetallic housing for the electric or electronic circuit. On the other hand, there is in addition a demand of development of more cost effective housings and higher demands on look and feel of the products.

With regard to plastic housings there are conflicts how to solve the issues regarding ESD and thermal requirements. In general, if a housing with an ESD compliant to 15kV shall be designed, it has to be ensured that metal components being not arranged closer then 15mm from a venting area in the outside wall of the nonmetallic housing or the wall of the housing has to be a wall without openings.

On the other hand, to design a housing that passes the thermal test, it has to be ensured that there is sufficient venting to evacuate heat from the electric or electronic circuit or product within the housing. These two opposite requirements often result in a big and quite expensive housing construction or require additional means to cool the device.

Summary of the Invention

35 It is an aspect of the invention to provide a nonmetallic housing for an electric or electronic circuit with combined

functionality with regard to electrostatic discharge requirements and thermal requirements although there is a conflict between electrostatic discharge distance and thermal requirements.

5 The problem is solved by a nonmetallic housing for an electric or electronic circuit to be disposed in an electrical or electronic device. The nonmetallic housing is configured such that it has a wall according to a sandwich structure comprising three layers as two face sheets and
10 one core. The face sheets are an inside face sheet and an outside face sheet of the wall being interrupted by an air vent. The face sheets are connected via the core in other regions of the wall of the housing to support the face sheets in a region of an air vent. Both face sheets have a
15 chicane directed to a chicane of the other face sheet for extending a distance via air from the outer face sheet to said electric or electronic circuit in said housing and for reducing a distance between said electric or electronic circuit and the inside face sheet of the housing. That
20 means in other words that a housing for an electronic circuit with a printed circuit board is provided, wherein the housing comprises a top cover, a bottom cover and side covers, wherein at least a first one of the covers comprises venting holes, being provided by a first and a
25 second plate or shell resembling chicanes for ESD by still allowing venting for cooling of a printed circuit board. According to an exemplarily embodiment of the invention, said chicanes of the face sheets are formed by legs projecting from a face sheet at the edges of a ventilation
30 opening for creating an U-profile with legs each invasive into a groove formed by an U-profile face sheet located opposite to the U-profile without being connected with the other face sheet. Said U-profile face sheets and the arrangement thereof extend a distance via air from the
35 outer face sheet to said electric or electronic circuit in said housing and makes it possible to arrange the electric

or electronic circuit closer to the wall of the nonmetallic housing without losing protection against electrostatic damage. Furthermore, the chicanes still allow venting of the electric or electronic circuit. According to an
5 embodiment, in addition an air guide assembly is arranged in the housing to improve the cooling of the electric or electronic circuit in certain areas, by guiding the air or using the chimney effect. The chimney effect also known as the stack effect is the tendency of heated air or gas to
10 rise in a duct or other vertical passage, due to its lower density compared to the surrounding air and a greater difference in pressure with the rest of the interior space accelerates the air movement and consequently increases the efficiency of air extraction.

15 The nonmetallic housing according to the invention is reduced in size and expenditure and nevertheless complies with the ESD compliant and is compliant to thermal requirements. Further, the U-profile structure better withstands impacts according to Steel Ball test
20 requirements. The wall thickness of the housing can be reduced due to a stronger rigidity of the U-profile structure and the inventive housing requires less space due to a reduced distance of electric or electronic circuits to the wall of the housing so that a cost effective and
25 ecological housing is provided. In addition, the electric or electronic circuit is better protected from physical damages as the invasive U-profile of the face sheets avoids that the electric or electronic circuit can be contacted in a straight line by small pieces through a vent opening in
30 the wall of the housing. Such an arrangement also can be applied to a metallic housing.

The specific nature of the invention as well as other objects, advantages, features and uses of the invention will become evident from the following description of a
35 preferred embodiment taken in conjunction with the accompanying drawings.

Brief Description of the Drawings

Exemplary embodiments of the invention are described with reference to the accompanying drawings, which show in:

- 5 Fig. 1 a schematic representation of a cross-sectional view illustrating a wall of a non-metallic housing for electric or electronic circuits in accordance with the invention;
- Fig. 2 a schematic representation of a cross-sectional
10 view illustrating a known nonmetallic housing for electric or electronic circuits;
- Fig. 3 a schematic representation of a cross-sectional view illustrating a non-metallic housing for electric or electronic circuits with an air guide
15 assembly in accordance with the invention.

Description of the Invention

Like numerals and characters designate like elements throughout the figures of the drawings.

- 20 Reference is initially directed to Fig. 1 illustrating a schematic representation of a cross-sectional view of a wall W of a non-metallic housing for electric or electronic circuits EEC in accordance with the invention. The electric or electronic circuit EEC is arranged in the housing for
25 protecting the electric or electronic circuit EEC from physical or electrostatic damage ESD and drawing off heat H from the electric or electronic circuit EEC as illustrated in Fig. 1. The electric or electronic circuit EEC is e.g. arranged on a printed circuit board PCB, a circuit part, an
30 integrated circuit IC or in general a conductive component like a metal up to the venting areas or an air vent O. Electric or electronic circuits EEC generate heat H which in a housing has to be removed from the electric or electronic circuit EEC to avoid overheating and a damage of
35 the electric or electronic circuit EEC. Therefore, at least a first one of the covers comprise venting holes or as

illustrated in Fig. 1 to 3 an air vent O. According to the invention, the air vent O is provided by a first and a second plate or shell resembling chicanes for ESD by still allowing venting for cooling a printed circuit board. That means that a wall W for the housing for an electric or electronic circuit EEC arranged in the housing is recommended which in a sandwich structure of two face sheets comprises an air vent O provided by chicanes C of the face sheets. The chicanes C of the face sheets are directed in a direction of a chicane C of the other face sheet for creating an U-profile as shown in Fig. 1 and Fig. 3. That means in other words that a first one of the covers of the recommended housing comprises a first plate comprising holes as openings and U-like bridges in a two-dimensional raster and a second plate comprising holes as openings and U-like bridges in a two-dimensional raster or that said chicanes C of the face sheets are directed in a direction of a chicane C of the other face sheet for creating an U-profile with legs each invasive into a separate groove formed by an U-profile of the face sheet located opposite to the U-profile formed by chicanes of the other face sheet. Space between said legs and to a face sheet forms an air vent O.

According to an embodiment of the invention, the U-profile has a web two times the length of the legs or in other words the U-like bridges have a length two times the length of the holes. That means that the housing according to the invention is configured such that it has a wall W according to a sandwich structure comprising three layers as two face sheets and one core being removed in some areas to form an air vent O. Said face sheets are an inside face sheet and an outside face sheet of the wall W. The face sheets are interrupted by an air vent O and in other regions connected via a core to form a wall W in sandwich structure. That means that the wall W has also regions not illustrated in the drawings where inside face sheet and an outside face

sheet of the wall W are connected with each other to support the chicanes C and face sheets in an area where the face sheets are interrupted by an air vent O or in other words the air vent O is formed by chicanes C of the face sheets. As illustrated in Fig. 1 and Fig. 3, chicanes C of the face sheets are arranged in such a way that legs of an U-profile formed by chicanes C of a face sheet each are invasive into a separate groove formed by an U-profile of the face sheet located opposite to the U-profile formed by chicanes C of the other face sheet to provide an air vent O. The chicanes C of the face sheets extend a distance via air from the outer face sheet to the electric or electronic circuit ECC in the housing. Said extended distance via air is advantageously used to reduce a distance between said electric or electronic circuit ECC and the inside face sheet of the recommended wall W of the housing according to the invention. The recommended housing makes it possible to arrange the electric or electronic circuit EEC closer to the wall W of the nonmetallic housing without losing protection against electrostatic and mechanical damage. Consequently also a distance PCBA to the printed circuit board PCB requires less space and contributes to a smaller housing which is manufactured with less expenditure.

The invention is carried out by using an inexpensive material for ESD protection. The preferred material is a nonmetallic polystyrene however the housing also can be manufactured from metallic material to realize some advantageous aspects disclosed here especially in view of a nonmetallic housing as e.g. the a stronger rigidity of the U-profile structure or an improved protection which avoids that the electric or electronic circuit EEC can be contacted in a straight line by small pieces through the air vent O in the wall W of the housing as it is illustrative by a comparison between Fig. 1 and Fig. 2.

The chicanes C are arranged with space to each other and form an air vent O which still allows venting of the

electric or electronic circuit EEC. In addition, as shown in Fig. 3, an air guidance assembly AGA is arranged in the housing to improve the cooling of the electric or electronic circuit EEC in certain areas by guiding the air or using the chimney effect. The air guidance assembly AGA is used to reduce a space to the electric or electronic circuit EEC and as air has a behavior like a gas GAS neither liquid nor solid, said reduced space accelerates the air movement and consequently increases the efficiency of air extraction for cooling the electric or electronic circuit EEC. Further advantageous of the recommended housing are that the wall thickness WH of the housing can be reduced due to a stronger rigidity of the U-profile structure and the housing requires less space due to a reduced distance of electric or electronic circuits ECC to the wall of the housing so that due to less expenditure a cost effective and ecological housing is provided.

Nevertheless, the housing according to the invention as illustrated in Fig. 1 and Fig. 3 complies with the ESD compliant and is compliant to thermal requirements in comparison to a known housing for an electric or electronic circuit EEC arranged in the housing for protecting the electric or electronic circuit EEC from physical or electrostatic damage and drawing off heat H from the electric or electronic circuit EEC as illustrated in Fig. 2. Reference is therefore directed to Fig. 2 which illustrates the basic features of a known nonmetallic housing for electric or electronic circuits EEC. The known nonmetallic housing for electric or electronic circuits ECC comprises a wall W forming a protective casing having at least in a part of the casing an air vent O drawing off heat from the electric or electronic circuit EEC and protecting the electric or electronic circuit EEC from physical or electrostatic damage. However, as air vents O provide a straight access to the electric or electronic circuit EEC, the electrostatic discharge requirements as an

ESD compliant to 8 or 15kV requires a certain distance CD to conductive components of the electric or electronic circuit EEC, which has been reduced by a chicane C according to the invention.

5 A Z-structure of the wall W is less rigid in comparison to an U-profile, so that the U-profile structure better withstands external impacts. Also the sandwich structure of the housing according to the invention withstand better to impacts. Furthermore, said rigidity of the wall W allows
10 the use of a housing with reduced wall thickness WH. The outer shell of the housing has a minimum of different features, so that it is easier to achieve requirements related to a visual aspect of the housing due to less impact of sink marks, weld lines and thinner wall
15 thickness. Inside shells of the housing contain the most of the features to form a device as snappers, ribs and other structures and can also support the outer shell. That means that a housing is provided being effective with respect to expenditure and ecology as a so called ECO-housing. Since
20 the outer shell is mainly responsible for the cosmetic look of the product and is made thinner it reduces the necessary amount of material. The inner shell of the housing contains the most of the technical features and since elements inside are not visual from the outside the technical
25 product inside the housing has less design requirements due to the fact that there is less need to avoid parting lines and sink marks and the material requirements do not have to comply to a certain color and UV resistance. In view of the above it has to be considered that the housing according to
30 the invention provides a nonmetallic housing for an electric or electronic circuit EEC with combined functionality with regard to electrostatic discharge requirements and thermal requirements although there is a conflict between electrostatic discharge distance and
35 thermal requirements. The housing is preferably a

nonmetallic housing for a residential gateway, a DSL modem or a set top box.

5 It is understood that the invention is not limited to this exemplary embodiment and that specified features can also expediently be combined or modified without departing from the scope of the claims.

What is claimed is:

1. A housing for an electric or electronic circuit (EEC) arranged in the housing for protecting the electric or electronic circuit (EEC) from physical or electrostatic damage and drawing off heat (H) from the electric or electronic circuit (EEC), wherein the housing comprises: a wall (W) in sandwich structure of two face sheets comprising an air vent (O) being provided by chicanes (C) of the face sheets directed in a direction of a chicane (C) of the other face sheet for creating an U-profile with legs each invasive into a separate groove formed by an U-profile of the face sheet located opposite to the U-profile formed by chicanes (C) of the other face sheet.
2. Housing according to claim 1, wherein the housing comprises a top cover, a bottom cover and side covers, wherein at least a first one of the covers comprise venting holes, being provided by a first and a second plate or shell resembling chicanes for ESD by still allowing venting for cooling of a printed circuit board.
3. Housing according to claim 1, wherein the electric or electronic circuit comprises a printed circuit board.
4. Housing according to claim 2, wherein the first one of the covers comprises a first plate comprising holes as openings and U-like bridges in a two-dimensional raster and a second plate comprising holes as openings and U-like bridges in a two-dimensional raster.
5. Housing according to claim 2 or 3, wherein the first and the second plates are an outer and an inner plate with regard to the housing, the holes of the first and second plates have same dimensions and the U-like bridges of the first and second plates have same dimensions, the first

plate and the second plate are placed one over the other, such that the U-like bridges of one plate are arranged above the holes of the other and vice versa, and the width of the U-like bridges having two times the length of the
5 holes.

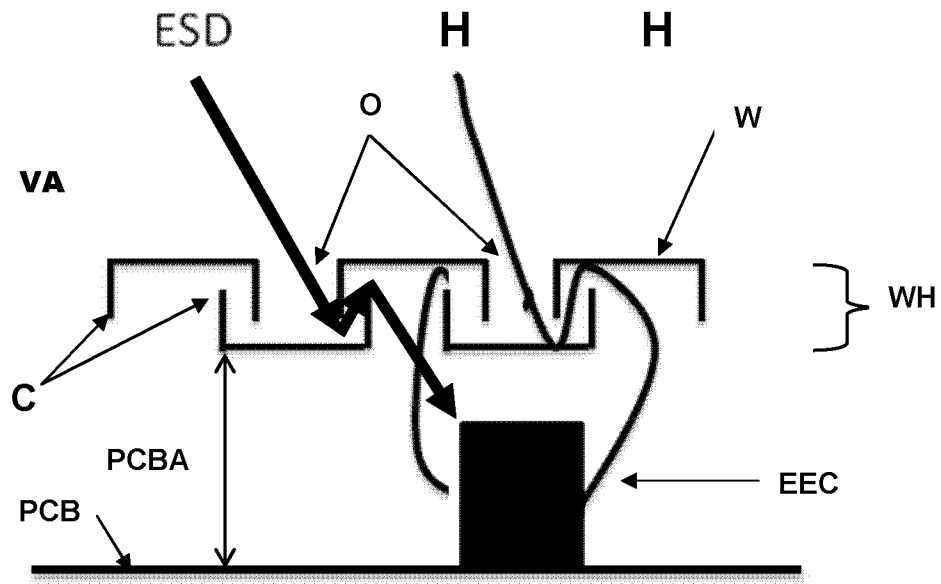
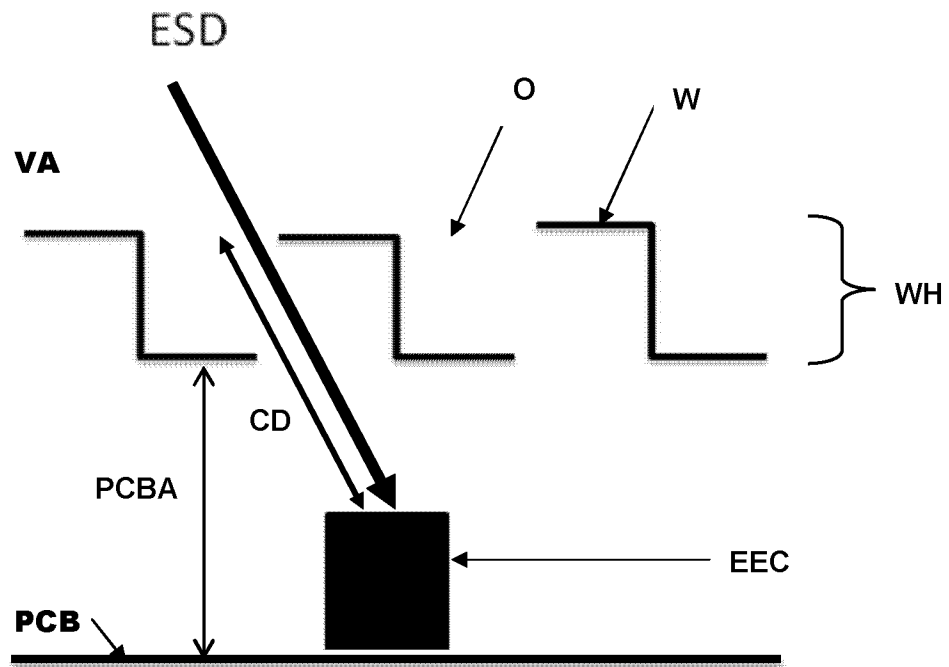
6. Housing according to claim 2, 3 or 4, wherein the first one of the covers with the venting holes is made of a plastic material.

10

7. The housing according to claim 1, wherein the chicanes (C) are arranged in a certain distance to form an air vent (O).

15 8. The housing according to claim 1, wherein the legs of the U-profile extend halve of a web connecting the legs of the U-profile.

9. The housing according to one of the claims 1 to 8
20 wherein the electric or electronic circuit (EEC) is a residential gateway, a DSL modem or a set top box.

**Fig. 1****Fig. 2 Prior Art**

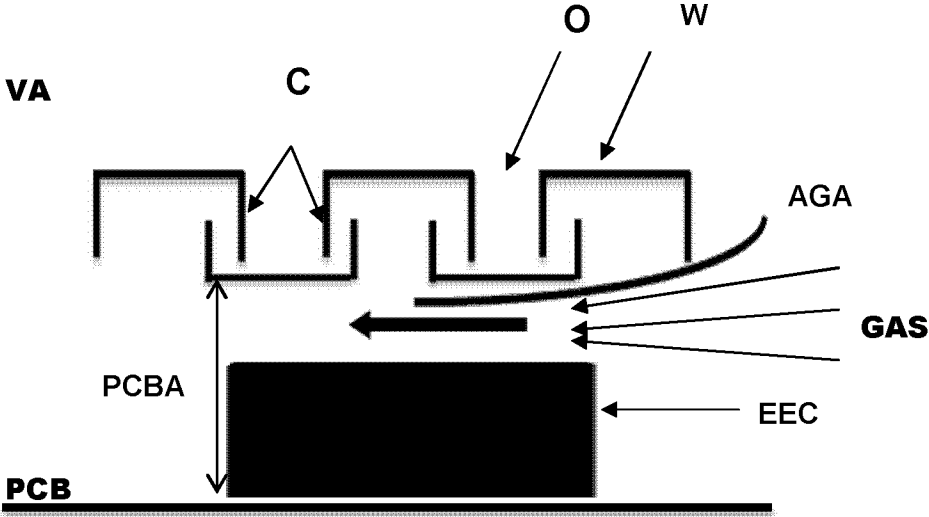


Fig. 3