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(54) **PCB FOR AEROSOL GENERATION DEVICE**

(57) The present invention relates to a printed circuit board assembly for an aerosol generation device, comprising: a printed circuit board substrate having a plurality of electrical transmission lines for electrically connecting components thereon, a heating module configured to heat a consumable, for generating an aerosol, and connected to the printed circuit board substrate via terminals; a switching module having a first terminal electrically coupled to a power source and a second terminal electrically coupled to a first terminal of the heating module, wherein a conductive heat-dissipation area arranged on the printed circuit board substrate is electrically coupled between the second terminal of the switching module and the first terminal of the heating module.

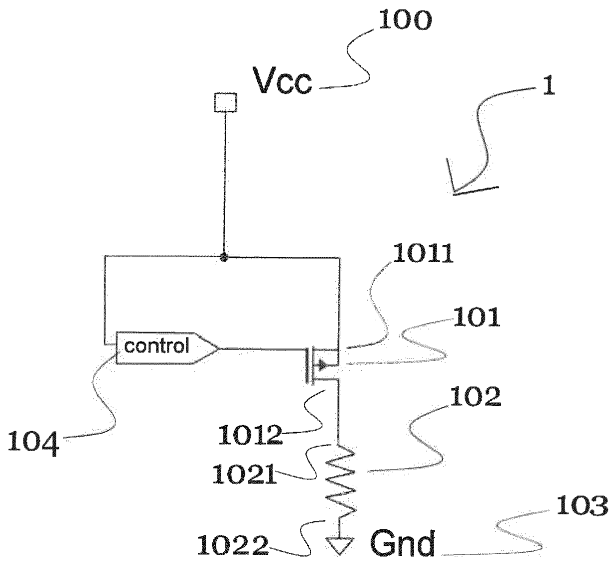

Fig. 1

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Description

TECHNICAL FIELD

[0001] The present invention is directed to a printed circuit board for an aerosol generation device, and the aerosol generation device using the printed circuit board.

BACKGROUND

[0002] An aerosol generation device, or E-cigarette, is now a mainstream product to simulate a traditional tobacco cigarette. There are many types of aerosol generation devices, and the one which still has tobacco or volatile substrate inside is one of the most popular types. By heating but not burning the consumable, one type of the aerosol generation device does not release the by-products of combustion such as tar and carbon monoxide. The operation method of the aerosol generation device is to contain an aerosol generation carrier inside and to heat it, but not to its burning point. There is also another type of E-cigarette, the operation method of which is to evaporate liquid to form smoke. For both types of aerosol generation devices, especially the one with the substrate inside, a high-quality heating section is important.

[0003] The heat from the heater (load) is typically regulated by regulating the supply of electrical power to the heater. A current control switch is typically configured to control the duty cycle of the heater on and off. This provides pulses of electrical current, and by adjusting the duty cycle of current control switch, the temperature of the heater can be controlled.

[0004] A low-side switching is typically configured to control the heater. However, the configuration of low-side switching may cause an unaccounted-for voltage across the transistor, which makes voltage measurements across the heater inaccurate for use. Besides, a low-side switching for high-currents directly to the ground of a circuit may cause instability. To solve the problems, a high-side switch is used for a more stable operation and a more accurate measurement, since the heater is referenced to true ground, measurements across it provide accurate information. However, a high-side switch is also not ideal, since different voltages across Vds during use require a big size FET for safety, which occupies too much space in the device and makes it unportable. The heat from the heater may also affect the function of the MOSFET.

[0005] US2017303595 A discloses a method of controlling an electric heater in an electrically heated smoking system, which contains both a high side switching and a low side switching.

[0006] The complex circuit design in the prior art not only has the above problems but also increases the cost of the aerosol generation device.

SUMMARY OF THE INVENTION

[0007] The present invention provides a smoking article for an aerosol generation device, which solves some of or all of the above problems.

[0008] A 1st embodiment of the invention is directed to a printed circuit board assembly for an aerosol generation device, comprising:

- a printed circuit board having a plurality of electrical transmission lines for electrically connecting components thereon,
- a heating module configured to heat a consumable, for generating an aerosol, and connected to the printed circuit board via terminals, and
- a switching module having a first terminal electrically coupled to a power source and a second terminal electrically coupled to a first terminal of the heating module;

wherein a conductive heat-dissipation area arranged on the printed circuit board is electrically coupled between the second terminal of the switching module and the first terminal of the heating module.

[0009] With the high-side switching and the conductive heat-dissipation area, the safety of the device is improved, and greater reliability and a more efficient use of space is achieved. According to a 2nd embodiment, in the 1st embodiment, the conductive heat-dissipation area corresponds to at least 10%, preferably at least 30%, more preferably at least 50%, even more preferably at least 70%, and most preferably at least 90% of the area of a layer of the printed circuit board.

[0010] With a larger heat dissipation area, a better heat dissipation effect can be achieved for the switch.

[0011] According to a 3rd embodiment, in any one of the preceding embodiments, the average length of the conductive heat-dissipation area corresponds to at least 10%, preferably at least 30%, more preferably at least 50%, even more preferably at least 70%, and most preferably at least 100% of the distance between the first terminal of the switching module and the first terminal of the heating module and/or the average width of the conductive heat-dissipation area corresponds to at least 10%, preferably at least 30%, more preferably at least 50%, even more preferably at least 70% and most preferably at least 90% of the average width of the printed circuit board.

[0012] According to a 4th embodiment, the average length of the conductive heat-dissipation area is at least 10%, preferably at least 30%, more preferably at least 50%, even more preferably at least 70%, and most preferably at least 90% of the length of the printed circuit board.

[0013] According to a 5th embodiment, in any one of the preceding embodiments, a distance between the first terminal of the switching module and the first end of the printed circuit board is less than 40 %, preferably less than 30%, more preferably less than 15%, even more preferably less than 10%, and most preferably less than 5% of the length of a long side of the printed circuit board, and a distance between the first terminal of the heating module and the second end of the printed circuit board is less than 40%, preferably less than 30%, more preferably less than 15%, even more preferably less than 10%, and most preferably less than 5% of the length of the long side of the circuit board.

[0014] According to a 6th embodiment, in any one of the preceding embodiments, the conductive heat-dissipation area comprises or is a pad of a copper-clad foil.

[0015] According to a 7th embodiment, in the preceding embodiment, the conductive heat-dissipation area comprises or is a polygon applied on the printed circuit board substrate.

[0016] According to an 8th embodiment, in any one of the preceding embodiments, the conductive heat-dissipation area is arranged on an outmost surface of an outmost layer of the printed circuit board.

[0017] According to a 9th embodiment, in any one of the preceding embodiments, the heating module has a second terminal coupled to a signal ground of the printed circuit board assembly.

[0018] With this arrangement, a more accurate measurement of the heater (load) is achieved.

[0019] According to a 10th embodiment, in any one of the preceding embodiments, the conductive heat-dissipation area is arranged on an outmost surface of the printed circuit board.

[0020] According to an 11th embodiment, in any one of the preceding embodiments, the MOSFET is a P-channel FET.

[0021] According to a 12th embodiment, in any one of the preceding embodiments, the first terminal of the switching module is a source terminal of the P-channel FET, and the second terminal of the switching module is a drain terminal of the P-channel FET.

[0022] According to a 13th embodiment, in any one of the preceding embodiments, at least a part of the circuit board is formed by a flexible printed circuit board.

[0023] With this arrangement, a possible heat dissipation area is expanded, and the heat dissipation area makes the flexible circuit more rigid and solid providing extra support.

[0024] A 14th embodiment of the invention is directed to an aerosol generation device, comprising a printed circuit board assembly according to any one of the preceding claims.

[0025] According to a 15th embodiment, in the preceding embodiment, a first end of the printed circuit board in a longitudinal direction of the printed circuit board is at a first end of the aerosol generation device in a longitudinal direction of the aerosol generation device, and a second end of the printed circuit board is at a second end of the aerosol generation device.

[0026] According to a 16th embodiment, in the preceding embodiment, the first end of the printed circuit board has a distance to the first end of the aerosol generation device corresponds to less than 40 %, preferably less than 30%, more preferably less than 15%, even more preferably less than 10%, and most preferably less than 5% of the length of a longitudinal direction of the aerosol generation device, and a second end of the printed circuit board has a distance to the second end of the aerosol generation device corresponds to less than 40 %, preferably less than 30%, more preferably less than 15%, even more preferably less than 10%, and most preferably less than 5% of the length of the longitudinal direction of the aerosol generation device.

[0027] According to a 17th embodiment, in the preceding embodiment, the average length of the conductive heat-dissipation area in the longitudinal direction, the distance between the second terminal of the switching module and the first terminal of the heating module, and/or the distance between the second terminal of the heater and the electrical ground have a relation of proportionality with the average width of the conductive heat-dissipation area such that they reduce the resistance of the conductive heat-dissipation area to substantially 0 Ohm.

[0028] The benefit of the 17th embodiment is that the power loss is reduced, and the power efficiency is increased.

[0029] Preferred embodiments are now described, by way of example only, with reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0030]

Figure 1:	is a schematic illustration of a circuit of an aerosol generation device according to an exemplary embodiment of the present invention;

Figure 2: shows a schematic view of a printed circuit board of the aerosol generation device according to an exemplary embodiment of the present invention;

Figures 3a and 3b: show schematic views of the aerosol generation device with the printed circuit boards therein according to exemplary embodiments of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0031] Preferred embodiments of the present invention are described hereinafter and in conjunction with the accompanying drawings.

[0032] As used herein, the term "aerosol generation device" or "electronic cigarette" may include an electronic cigarette configured to deliver an aerosol to a user, including an aerosol for smoking. "Printed circuit board" or "PCB" are well-known terms for the skilled person, which supports and uses etched conductive tracks (trace, lines), pads and other features, to electrically connect electrical or electronic components. Herein, "PCB" may also mean Printed Circuit Board Assembly (PCBA), which means the substrates of the PCB board and the components thereon. The illustrated embodiments of the aerosol generation system and the PCB therein are schematic, and it is also possible to combine some of the parts to single units or elements, which will be apparent to a person skilled in the art. Herein, "coupled" or "connected" may mean "electronically coupled" or "electronically connected", wherein the connection may be via other components such as transistors or capacities for purposes known to the skilled person. "circuit board body", "printed circuit board body", "printed circuit board substrate" and/or "printed circuit board" may refer to the printed circuit board per se, namely the combination of the unconducive substrate layer and the copper layer, which makes the circuit board, or the unconducive substrate layer per se, without the components mounted or soldered thereon. A length of the printed circuit board 1 means the length of the printed circuit board 1 along the direction from the switching module described below to the heater, and a width of the printed circuit board 1 means the width of the printed circuit board 1 along the direction substantially perpendicular to the length direction of the printed circuit board.

[0033] In Fig. 1, a schematic illustration of an embodiment of a circuit 1 of an aerosol generation device 2 is shown in a simplified manner. Other parts of the circuit 1 not relevant for the understanding of this embodiment have been omitted for simplicity. The elements of the electrically heated aerosol-generating device 2 are not drawn to scale in FIG. 1.

[0034] The heater 102 is connected to electrical ground 103, and to other parts of the circuit, which include an electrical power supply, such as a lithium ion battery, providing the battery voltage Vcc, through a high side switch 101, also referred to as the switching module 101 herein.

[0035] During normal operation of the aerosol generation device, the switching module 101 is switched on, allowing current to flow from the electrical power supply to the heater 102 and then to electrical ground. The on-and-off of the switching module 101 is controlled by the controller 104, for example, with a particular duty cycle, so as to change or maintain the temperature of the heater 102. The controller 104 can be any controller, such as an operator or a CPU known in the prior art, together with, for example, some resistors (not shown) for limiting the current into the gate, holding the gate near the power voltage A voltage measuring circuit (not shown) may also be coupled to the heater 102 and configured to measure the voltage of the heater 102 in operation.

[0036] More specifically, the switching module 101 is a P channel MOSFET with the source 1011 connected to the electrical power supply 100 and the drain 1012 connected to the heater 102. The gate is connected to the controller.

[0037] By using a high-side switch, the device 2 can have a more stable operation, and since the heater 102 is referenced to true ground, measurements of the heater provides more accurate information.

[0038] In Fig.2, a schematic view of a printed circuit board 1 of the aerosol generation device 2 is shown. It is noted that FIG. 2 does not accurately depict the relative scale of elements of the circuit or the circuit board body, and elements, such as conductive tracks, are omitted for simplicity. The parts with slashes are those where some of the electrical or electronic components (such as the heater, MOSFET, transistor, capacitors) are located on (soldered to) the PCB. The part with dots is a conductive area 103 on the PCB for heat dissipation (conductive heat dissipation surface, conductive heat dissipation module, conductive heat dissipation unit) for the switching module 101. The printed circuit board 1 comprises the heat dissipation area 103. With this heat dissipation area 103, a larger safe-operating-area (SOA) of the FET defined by the different voltages across the transistor/FET Vds during use is obtained. As a function of heat dissipation, a larger safe-operating-area requires a larger FET, which is not ideal for the aerosol delivery device. In contrast, with the heat dissipation area 103 for the MOSFET, a small and low power MOSFET can be used, which makes the heater (load) switch 101 more stable, safe, compact and accurate for measuring.

[0039] The PCB body 10 is double-sided or multi-layer, and with the components being soldered on one side, namely a first surface of the PCB, and the conductive heat dissipation area 103 being arranged on another outmost surface of the outmost layer of the PCB, namely the second surface. A through-hole component (via), namely a copper-plated hole, connects the drain 1012 of the MOSFET 101 and the conductive heat dissipation area 103 through the insulating substrate of the PCB body 10. In other words, the drain 1012 of the MOSFET 101 is soldered on the PCB body 10 to directly connect with the conductive heat-dissipation area 103. Another through-hole component connects the conductive heat dissipation area 103 and a terminal 1021 of the heater 102, and the heater 102 (shown in dotted lines) further connects with the signal ground or the electronic ground of the PCB by another terminal 1022 thereof. More specifically, according to this embodiment, a pogo pin 1021 is soldered on the PCB and connected with the conductive heat dissipation area 103 via a conductive through-hole, and another pogo pin 1022 is soldered on the PCB connecting the electronic ground, herein the polygon pour, on the first surface, on which the components are soldered. The heater 102 is mounted on the PCB body 10 through the pogo pins 1021 1022. Herein, the conductive heat-dissipation area 103 is electrically coupled between the second terminal 1012 of the switching module 101 and the first terminal 1021 of the heating module 102, which means that the conductive heat-dissipation area 103 is electronically coupled with the second terminal 1012 of the switching module 101 and the first terminal 1021 of the heating module 102, but is not physically located or set between the second terminal 1012 of the switching module 101 and the first terminal 1021 of the heating module 102. In other words, a length of the heat-dissipation area 103 can be shorter or exceed the distance between the second terminal 1012 of the switching module 101 and the first terminal 1021 of the heating module 102.

[0040] According to this embodiment, the conductive heat dissipation area 103 is a pad of the copper-clad laminate on the outer surface of one of the outmost layers of the PCB board. Herein, "copper", "copper clad", "copper-clad laminate", "copper-clad foil", "copper foil" or "copper layer" means the conductive tracks (trace, lines), pads and other features etched from one or more sheet layers of copper laminated onto and/or between sheet layers of the non-conductive substrate body of PCB. Preferably, the pad of the copper-clad foil on the second surface has a polygonal shape, preferably a roughly rectangle shape, and takes substantially a big area on the surface. More specifically, the average length of the conductive heat-dissipation area 103 (pad) corresponds to at least 10%, preferably at least 30%, more preferably at least 50%, even more preferably at least 70%, and most preferably at least 100% of the distance between the source 1011 of the switching module 101 and the first terminal (1021) of the heating module and/or the average width of the conductive heat-dissipation area 103 corresponds to at least 10%, preferably at least 30%, more preferably at least 50%, even more preferably at least 70% and most preferably at least 90% of the width of the circuit board body (10). Most preferably, the conductive heat-dissipation area 103 is arranged on almost the entire second surface by means of the polygon pour. The polygonal shape above may also be arranged on the PCB body (10) by the means of the polygon pour. "Polygon", "polygon pour" and "copper pour" is a well-known terminology in PCB technology, which mean the solid or hatched (lattice) areas of the copper pour that completely cover the remaining area outside the tracks, pads, and stand-off regions of the other components. In other words, the polygon copper is hatched or applied around existing objects, and connects only to the objects (components) on the same net as the polygon pour, herein the drain 1012 of MOSFET 101 and one pogo pin 1021 of the heater 102. The conductive heat-dissipation area 103 applied on the second surface of the PCB by the polygon pour means corresponds to at least 10%, preferably at least 30%, more preferably at least 50%, even more preferably at least 70%, and most preferably at least 90% of the area of the second surface of the PCB. With a larger heat-dissipation area, a relatively small size MOSFET 101 can be used on the circuit board 1. In this embodiment, practically the entire second surface corresponds to the conductive heat-dissipation area, while avoiding and insulating from the other tracks and components, connects and conducts with the drain 1012 of the MOSFET 101 and one of the terminals of the heater 102 in the polygon pour means. More specifically, since the surrounding area of the second surface is already full with the conductive tracks connecting other components, a roughly rectangular copper foil on the second surface is connected to the soldered MOSFET 101 on the first surface via the conductive through-hole of which the average length corresponds to substantially 90% of the distance between the source 1011 of the switching module 101 and the first terminal (1021) of the heating module and/or the average width of the conductive heat-dissipation area 103 corresponds to substantially 70% of the width of the circuit board body (10), and corresponds to roughly 70% of the area of the second surface of the PCB. Preferably, the electronic ground of the PCB body (10) is also formed in the manner of polygon copper pour on the first surface but insulated from the heat dissipation area 103 of the second surface.

[0041] For a better heat dissipation effect for the PCB, the electronic components, especially the high-power components, are arranged close to the ends of the circuit board body (10), which has an elongated shape so as to fit into the elongated body of the aerosol generation device. The elongated shape of the PCBA has a lateral side (direction) and a longitudinal side (direction), and the longitudinal side has a greater dimension than the lateral side. In the preferred embodiments, the average length of the longitudinal side of the PCBA is at least 30 mm, preferably at least 35 mm, more preferably at least 40 mm, even more preferably at least 45 mm, and most preferably at least 50 mm, and/or at most 80 mm, preferably at most 70 mm, more preferably at most 65 mm, even more preferably at least 60 mm, and most preferably at least 55 mm. The average length of the lateral side of the PCBA is at least 3.0 mm in the preferred embodiments, preferably at least 3.5 mm, more preferably at least 4.0 mm, even more preferably at least 4.5 mm, and most preferably at least 5.0 mm, and/or at most 8.0 mm, preferably at most 7.0 mm, more preferably at most 6.5 mm, even more preferably at least 6.0 mm, and most preferably at least 5.5 mm. Correspondingly, the average length of the longitudinal side of the conductive heat-dissipation area 103 or the copper foil in the preferred embodiments is at least 20 mm, preferably at least 25 mm, more preferably at least 30 mm, even more preferably at least 35 mm, and most preferably at least 40 mm, and/or at most 70 mm, preferably at most 60 mm, more preferably at most 55 mm, and even more preferably at least 50 mm, and most preferably 45 mm. Correspondingly, the average length of the lateral side of the conductive heat-dissipation area 103 or the copper foil in the preferred embodiments is at least 2.0 mm, preferably at least 2.5 mm, more preferably at least 3.0 mm, even more preferably at least 3.5 mm, and most preferably at least 4.0 mm, and/or at most 7.0 mm, preferably at most 6.0 mm, more preferably at most 5.5 mm, even more preferably at least 5.0 mm, and most preferably at least 4.5 mm. The copper foil has a thickness of at least 0.15 um in the preferred embodiments, preferably at least 0.18 um, more preferably at least 0.20 um, even more preferably at least 0.23 um, and most preferably at least 0.26 um, and/or at most 0.38 um, preferably at most 0.35 um, more preferably at most 0.32 um, even more preferably at most 0.30 um, and most preferably at most 0.28 um on one side or one layer of the PCBA. As two of the highest power components, the MOSFET 101 and the heater 102 are arranged on the opposite end of the circuit board 1, so that a distance between the source 1011 of the switching module 101 or the drain 1012 and the first end of the circuit board body (10) is within 40 %, preferably within 30%, more preferably within 15%, even more preferably within 10%, and most preferably within 5% of the length of a long side of the printed circuit board 1, and a distance between the pogo pin 1022 of the heater 102 connecting the heat dissipation area 103 of and the second end of the circuit board body (10) is within 40 %, preferably within 30%, more preferably within 15%, even more preferably within 10%, and most preferably within 5% of the length of the long side of the printed circuit board 1. Accordingly, the average length of the conductive heat-dissipation area 103 is at least 10 %, preferably at least 30%, more preferably at least 50%, even more preferably at least 70%, and most preferably at least 90% of the length of the printed circuit board 1. In this preferred embodiment, both the MOSFET 101 and the heater 102 are close to the long ends of the circuit board body (10), and the distances to the respective ends are within 10% of the length of a long side of the printed circuit board 1, and the average length of the conductive heat-dissipation area 103 corresponds to at least 95% of the length of the printed circuit board 1, and the average width of the conductive heat-dissipation area 103 corresponds to at least 70% of the width of the circuit board body (10). When arranging the dimensional relationship between the PCBA and the copper foil, if the length of the conductive heat-dissipation area 103 (the copper foil), the distance between the second terminal 1012 of the switching module 101 and the first terminal 1021 of the heating module 102, and/or the distance between the first terminal 1022 of the heating module 102 and the ground of the PCBA are increased, the width of the conductive heat-dissipation area 103 (the copper foil) may have to be increased proportionately as well, in order to reduce the resistance as close to zero Ohm as possible. In other words, the average length of the conductive heat-dissipation area in the longitudinal direction, the distance between the second terminal of the switching module and the first terminal of the heating module, and/or the distance between the second terminal of the heater and the electrical ground have a relation of proportionality with the average width of the conductive heat-dissipation area. In the present embodiment of the invention, the average length of the conductive heat-dissipation area in the longitudinal direction is arranged in the way that it has a proportional relation with the average width of the conductive heat-dissipation area, with a proportionality constant of 10 (40 mm x 4 mm). With the linear relationship, the power loss caused by the copper foil is reduced, and the power efficiency is increased.

[0042] Alternatively, the single-side PCB can also be used with a polygon pour copper on the first layer, having the same size as above, and insulated from the ground. In some embodiments, while all the components and routes assigned to the first surface, an entire surface of copper-clad laminate or plane without any routes going through on the second surface is distributed to the heat-dissipation area 103, similar to a power plane. In yet another embodiment, the heat-dissipation area 103 may be a metal board mounted or soldered on the PCB having the same features as above. Although a P-channel MOSFET 101 is preferred and used in the above embodiments, other types of switches, such as N-channel MOSFET is used, may also be used.

[0043] Fig. 3a and 3b show schematic views of the printed circuit board 1 (shown in slash shadows) configured in in the aerosol generation devices according to preferred exemplary embodiments of the present invention. The heater 102 is mounted with heating chamber 3 (shown in dotted lines) on a first surface, which the mouthpiece end or the upper end surface when the aerosol generation device 2 is set perpendicular to the ground with the aerosol outlet on the top. One end of the circuit board 1 is arranged with the heater 102 adjacent to the upper surface, another end of the circuit board 1 is arranged with the MOSFET 101, and possibly also the other components, adjacent to the opposite end surface of the aerosol generation device 2 or, the bottom end or the lower surface of the aerosol generation device. With such an arrangement, the heat from the components of the device 2 is evenly dissipated, and the heat from the components does not affect the function of other components. For an even better heat dissipation result, at least a part of the circuit 1 is formed by a flexible printed circuit 1 (Flexi). In the embodiment of Fig. 3b, the entire circuit 1 is a flexible printed circuit 1, which provides an even larger surface for the heat dissipation area 103, which is arranged on the second surface facing towards the inner surface of the housing of the aerosol generation device 2 and curves as a "U" shape inside the housing, while the first surface having the MOSFET 101 and the heater 102 with the pogo pins 1021 1022 is arranged on the other side surface of the circuit board 1. More specifically, a first end of the circuit 1 having the heater 102 is adjacent to a front long-side surface, and preferably also the upper end surface of the device, and a second end of the circuit 1 having the MOSFET 101 is adjacent to an opposite back long-side surface, and preferably the bottom end surface of the device, so as to be substantially adjacent to the inner surface of the housing of the aerosol generation device 2. More specifically, the first end of the circuit board body 10 has a distance to the first end of the aerosol generation device 2 corresponding to less than 40%, preferably less than 30%, more preferably less than 15%, even more preferably less than 10%, and most preferably less than 5% of the length of a longitudinal direction of the aerosol generation device 2, and a second end of the circuit board body 10 has a distance to the second end of the aerosol generation device 2 corresponds to less than 40%, preferably less than 30%, more preferably less than 15%, even more preferably less than 10%, and most preferably less than 5% of the length of the longitudinal direction of the aerosol generation device 2.

[0044] In the embodiments, a smaller P-channel FET 101 is used but the drain is arranged into a polygon that runs along with the enclosure from the main PCB, where the MOSFET is located, at the back surface of the device to the front surface of the device where the heating element is connected. This reduces the track resistance and conducts heat out of the P-channel FET, which gives a greater SOA. Also, the otherwise flimsy length of the flexible circuit board 1 is made more solid and rigid.

Claims

1. A printed circuit board assembly (1) for an aerosol generation device, comprising:

   - a printed circuit board (10) having a plurality of electrical transmission lines for electrically connecting components thereon,
   - a heating module (102) configured to heat a consumable, for generating an aerosol, and connected to the printed circuit board (10) via terminals (1021, 1022), and
   - a switching module (101) having a first terminal (1011) electrically coupled to a power source (100) and a second terminal (1012) electrically coupled to a first terminal (1021) of the heating module;

   wherein a conductive heat-dissipation area (103) arranged on the printed circuit board (10) is electrically coupled between the second terminal (1012) of the switching module (101) and the first terminal (1021) of the heating module (102).

2. The printed circuit board assembly (1) according to any one of the preceding claims, wherein the conductive heat-dissipation area (103) corresponds to at least 10%, preferably at least 30%, more preferably at least 50%, even more preferably at least 70%, and most preferably at least 90% of the area of a layer of the printed circuit board (10).

3. The printed circuit board assembly (1) according to any one of the preceding claims, wherein the average length of the conductive heat-dissipation area (103) corresponds to at least 10%, preferably at least 30%, more preferably at least 50%, even more preferably at least 70%, and most preferably at least 100% of the distance between the first terminal (1011) of the switching module and the first terminal (1021) of the heating module and/or the average width of the conductive heat-dissipation area (103) corresponds to at least 10%, preferably at least 30%, more preferably at least 50%, even more preferably at least 70% and most preferably at least 90% of the average width of the printed circuit board (10).

4. The printed circuit board assembly (1) according to any one of the preceding claims, wherein the average length of the conductive heat-dissipation area (103) is at least 10%, preferably at least 30%, more preferably at least 50%, even more preferably at least 70%, and most preferably at least 90% of the length of the printed circuit board (10).

5. The printed circuit board assembly (1) according to any of the preceding claims, wherein a distance between the first terminal (1011) of the switching module and the first end of the printed circuit board (10) is less than 40 %, preferably less than 30%, more preferably less than 15%, even more preferably less than 10%, and most preferably less than 5% of the length of a long side of the printed circuit board (10), and a distance between the first terminal (1021) of the heating module and the second end of the printed circuit board (10) is less than 40 %, preferably less than 30%, more preferably less than 15%, even more preferably less than 10%, and most preferably less than 5% of the length of the long side of the printed circuit board (10).

6. The printed circuit board assembly (1) according to any one of the preceding claims, wherein the conductive heat-dissipation area (103) comprises or is a pad of a copper-clad foil.

7. The printed circuit board assembly (1) according to any one of the preceding claims, wherein the conductive heat-dissipation area (103) comprises or is a polygon applied on the printed circuit board (10).

8. The printed circuit board assembly (1) according to any one of the preceding claims, wherein the conductive heat-dissipation area (103) is arranged on an outmost surface of an outmost layer of the printed circuit board (10).

9. The printed circuit board assembly (1) according to any one of the preceding claims, wherein the heating module has a second terminal (1022) coupled to a signal ground (103) of the printed circuit board (1).

10. The printed circuit board assembly (1) according to any one of the preceding claims, wherein the switching module (101) comprises a MOSFET.

11. The printed circuit board assembly (1) according to the preceding claim, wherein the MOSFET (101) is a P-channel FET, the first terminal of the switching module is a source terminal (1011) of the P-channel FET, and the second terminal of the switching module is a drain terminal (1012) of the P-channel FET.

12. The printed circuit board assembly (1) according to any one of the preceding claims, wherein at least a part of the circuit board (1) is formed by a flexible printed circuit board.

13. An aerosol generation device (2), comprising a printed circuit board assembly (1) according to any one of the preceding claims.

14. The aerosol generation device (2) according to the preceding claim, wherein a first end of the printed circuit board (10) in a longitudinal direction of the printed circuit board (10) is at a first end of the aerosol generation device (2) in a longitudinal direction of the aerosol generation device (2), and a second end of the printed circuit board (10) is at a second end of the aerosol generation device (2).

15. The aerosol generation device (2) according to the preceding claim, wherein the first end of the printed circuit board (10) has a distance to the first end of the aerosol generation device (2) corresponds to less than 40 %, preferably less than 30%, more preferably less than 15%, even more preferably less than 10%, and most preferably less than 5% of the length of a longitudinal direction of the aerosol generation device (2), and a second end of the printed circuit board (10) has a distance to the second end of the aerosol generation device (2) corresponds to less than 40 %, preferably less than 30%, more preferably less than 15%, even more preferably less than 10%, and most preferably less than 5% of the length of the longitudinal direction of the aerosol generation device (2).

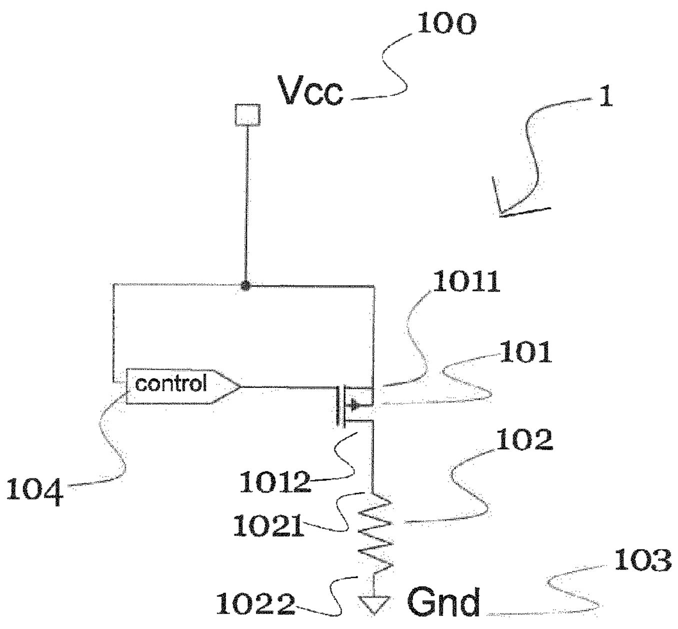
100
Vcc
1
1011
101
control
104
1012
102
1021
103
1022
Gnd

Fig. 1

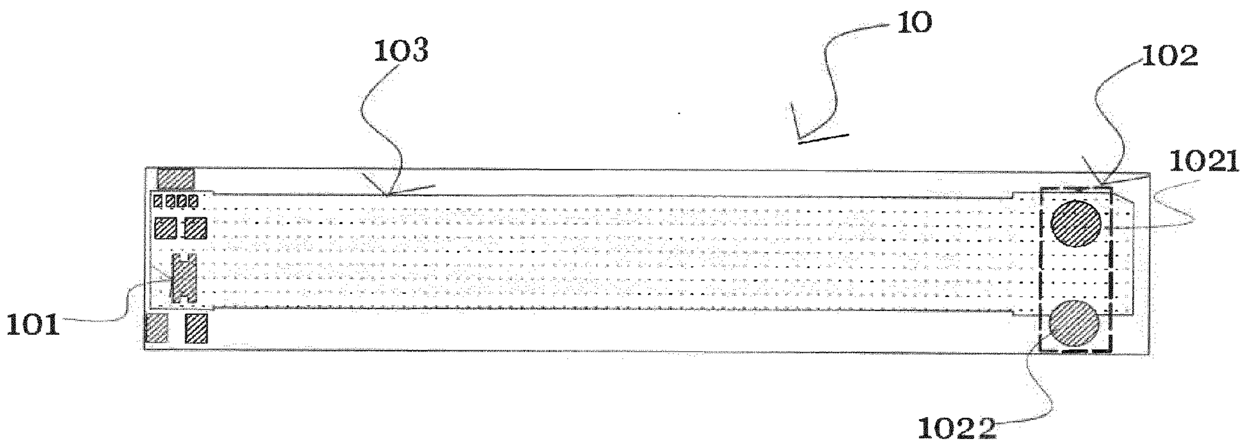
10
103
102
1021
101
1022

Fig. 2

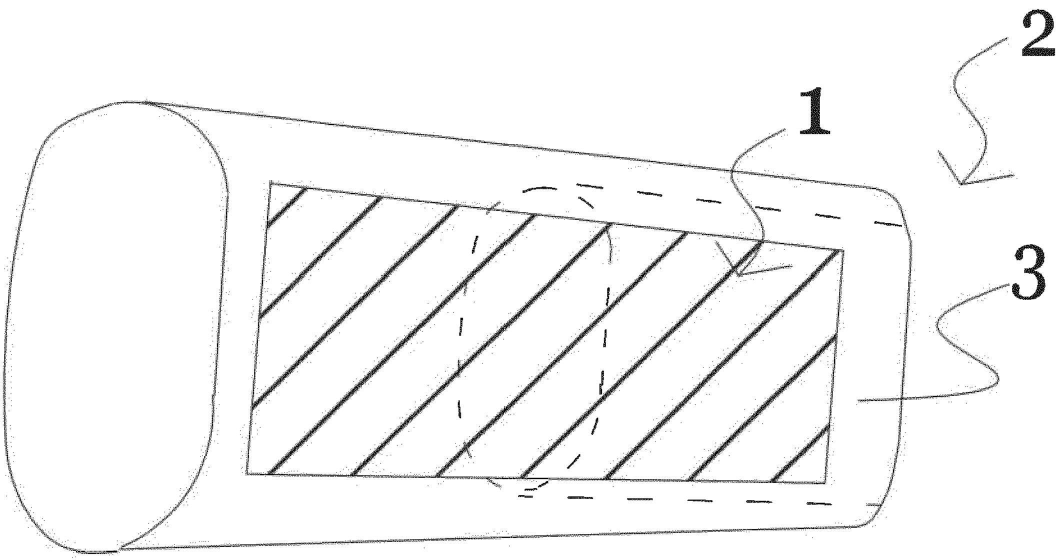

Fig. 3a

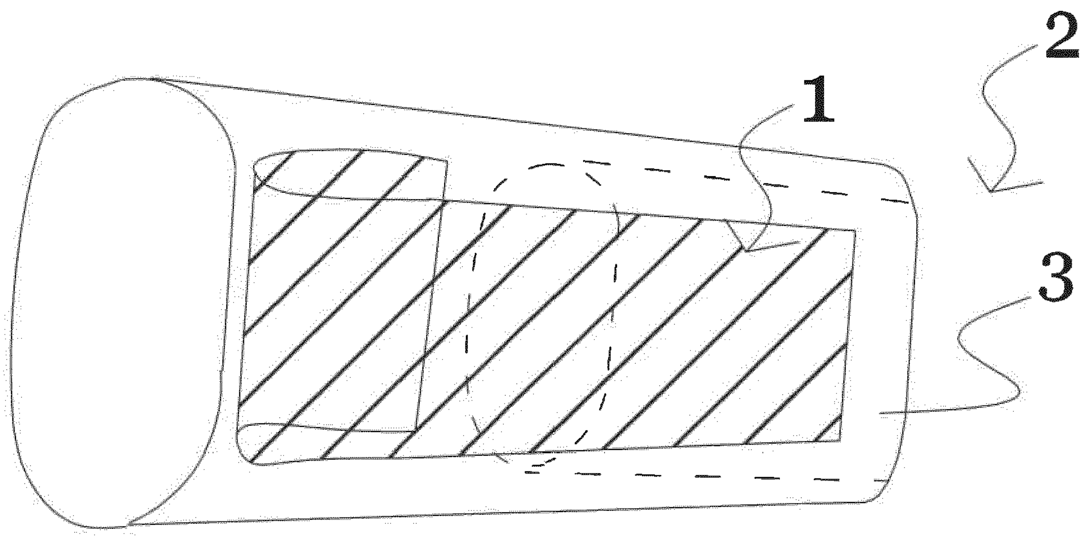

Fig. 3b

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EUROPEAN SEARCH REPORT

Application Number
EP 20 21 4557

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	WO 2015/100361 A1 (PAX LABS INC [US]) 2 July 2015 (2015-07-02)	1-5, 8-11,14, 15	INV. H05B1/02
Y	* abstract * * paragraphs [0079], [0171], [0181], [0211], [0274] * * claims 90-92,130-136 * * figures 6b,6d,7b * -----	6,7,12	
Y	EP 3 451 480 A2 (COMPUTIME LTD [HK]) 6 March 2019 (2019-03-06) * abstract * * paragraphs [0031], [0032] * * figure 9c * -----	6,7	
Y	CN 111 050 579 A (KT & G CORP) 21 April 2020 (2020-04-21) * abstract * * figures 4-6 * -----	12	
A	CN 206 852 029 U (CHANGZHOU PAITENG ELECTRONIC TECH SERVICE CO LTD) 9 January 2018 (2018-01-09) * abstract * * figure 10 * * paragraphs [0107] - [0110] * -----	1-15	TECHNICAL FIELDS SEARCHED (IPC): H05B A24F A61M
A	WO 2019/002329 A1 (PHILIP MORRIS PRODUCTS SA [CH]) 3 January 2019 (2019-01-03) * abstract * * page 12, lines 3-13 * -----	1-15	

1

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	7 May 2021	de la Tassa Laforgue

CATEGORY OF CITED DOCUMENTS

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L : document cited for other reasons

& : member of the same patent family, corresponding document

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 20 21 4557

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07-05-2021

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2015100361 A1	02-07-2015	AU 2014369867 A1	16-06-2016
		AU 2019246867 A1	31-10-2019
		CA 2933906 A1	02-07-2015
		CN 106028846 A	12-10-2016
		CN 110269282 A	24-09-2019
		CN 110638106 A	03-01-2020
		CN 110638107 A	03-01-2020
		CN 110638108 A	03-01-2020
		CN 110638109 A	03-01-2020
		CN 110664011 A	10-01-2020
		CN 110664012 A	10-01-2020
		CN 110664013 A	10-01-2020
		CN 110710714 A	21-01-2020
		CN 110710715 A	21-01-2020
		CN 110710716 A	21-01-2020
		CN 110710727 A	21-01-2020
		DE 202014011205 U1	13-09-2018
		DE 202014011221 U1	13-09-2018
		DE 202014011232 U1	13-09-2018
		DE 202014011257 U1	07-11-2018
		DE 202014011258 U1	08-11-2018
		DE 202014011260 U1	13-11-2018
		DE 202014011261 U1	13-11-2018
		DE 202014011264 U1	06-12-2018
		DE 202014011265 U1	06-12-2018
		DE 202014011267 U1	06-12-2018
		DE 202014011292 U1	01-02-2019
		DE 202014011294 U1	07-02-2019
		DE 202014011295 U1	07-02-2019
		DE 202014011296 U1	08-02-2019
		DE 202014011297 U1	13-02-2019
		DE 202014011309 U1	29-03-2019
		DE 202014011310 U1	29-03-2019
		DE 202014011311 U1	29-03-2019
		DE 202014011313 U1	29-03-2019
		DK 3086671 T3	21-01-2019
		DK 3491948 T3	08-02-2021
		DK 3504991 T3	01-03-2021
		DK 3508080 T3	01-03-2021
		EP 3086671 A1	02-11-2016
		EP 3430921 A1	23-01-2019
		EP 3491948 A1	05-06-2019
		EP 3498115 A1	19-06-2019
		EP 3504989 A1	03-07-2019
		EP 3504990 A1	03-07-2019
		EP 3504991 A1	03-07-2019

EPO FORM P0459

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO.

EP 20 21 4557

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

07-05-2021

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
		EP 3508080 A1	10-07-2019
		EP 3513673 A1	24-07-2019
		ES 2703823 T3	12-03-2019
		GB 2538424 A	16-11-2016
		GB 2558804 A	18-07-2018
		GB 2558805 A	18-07-2018
		GB 2558806 A	18-07-2018
		GB 2558807 A	18-07-2018
		GB 2559506 A	08-08-2018
		GB 2559507 A	08-08-2018
		GB 2560465 A	12-09-2018
		GB 2560606 A	19-09-2018
		GB 2560607 A	19-09-2018
		GB 2560651 A	19-09-2018
		GB 2560652 A	19-09-2018
		GB 2560653 A	19-09-2018
		GB 2560660 A	19-09-2018
		HK 1257275 A1	18-10-2019
		HK 1257276 A1	18-10-2019
		HK 1257277 A1	18-10-2019
		HK 1257278 A1	18-10-2019
		HK 1257279 A1	18-10-2019
		HK 1257280 A1	18-10-2019
		HK 1257281 A1	18-10-2019
		HK 1257282 A1	18-10-2019
		HK 1257283 A1	18-10-2019
		HK 1257284 A1	18-10-2019
		HK 1257285 A1	18-10-2019
		HK 1257286 A1	18-10-2019
		HU E042629 T2	29-07-2019
		IL 246404 A	30-05-2019
		JP 6653432 B2	26-02-2020
		JP 2017501805 A	19-01-2017
		JP 2020072700 A	14-05-2020
		KR 20160102293 A	29-08-2016
		KR 20190130072 A	20-11-2019
		KR 20190130073 A	20-11-2019
		KR 20190130074 A	20-11-2019
		KR 20190130075 A	20-11-2019
		KR 20190130076 A	20-11-2019
		KR 20190130667 A	22-11-2019
		KR 20190130668 A	22-11-2019
		LT 3086671 T	11-02-2019
		PL 3086671 T3	31-05-2019
		PT 3086671 T	23-01-2019
		PT 3491948 T	28-01-2021

EPO FORM P0459

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 20 21 4557

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The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

07-05-2021

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
		PT 3504991 T	01-03-2021
		PT 3508080 T	02-03-2021
		US 2015208729 A1	30-07-2015
		US 2018064174 A1	08-03-2018
		US 2018070643 A1	15-03-2018
		US 2018070647 A1	15-03-2018
		US 2018092405 A1	05-04-2018
		US 2018092406 A1	05-04-2018
		WO 2015100361 A1	02-07-2015
EP 3451480 A2	06-03-2019	AU 2018214046 A1	21-03-2019
		CN 109428247 A	05-03-2019
		EP 3451480 A2	06-03-2019
		JP 2019047717 A	22-03-2019
		TW 201917989 A	01-05-2019
		US 2019067883 A1	28-02-2019
CN 111050579 A	21-04-2020	CN 111050579 A	21-04-2020
		WO 2019088559 A2	09-05-2019
CN 206852029 U	09-01-2018	NONE	
WO 2019002329 A1	03-01-2019	BR 112019021706 A2	12-05-2020
		CN 110800372 A	14-02-2020
		EP 3646667 A1	06-05-2020
		JP 2020524982 A	27-08-2020
		KR 20200019856 A	25-02-2020
		PH 12019502098 A1	09-03-2020
		US 2020163386 A1	28-05-2020
		WO 2019002329 A1	03-01-2019

EPO FORM P0459

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Patent documents cited in the description

- US 2017303595 A **[0005]**