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(71) Applicant (for all designated States except US): **OSRAM GESELLSCHAFT MIT BESCHRÄNKTER HAFTUNG** [DE/DE]; Hellabrunner Str.1, 81543 München (DE).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **CHEN, Xiaomian** [CN/CN]; Oversea Chinese Town 5F, Hantang Building OCT, Shenzhen, Guangdong 518053 (CN). **LI, Hao** [CN/CN]; Oversea Chinese Town 5F, Hantang Building OCT, Shenzhen, Guangdong 518053 (CN). **YANG, Canbang** [CN/CN]; Oversea Chinese Town 5F, Hantang Building OCT, Shenzhen, Guangdong 518053 (CN). **YUAN, Haiping** [CN/CN]; Oversea Chinese Town 5F, Hantang Building OCT, Shenzhen, Guangdong 518053 (CN).

(74) Common Representative: **OSRAM GESELLSCHAFT MIT BESCHRÄNKTER HAFTUNG**; Postfach 22 16 34, 80506 München (DE).

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(54) Title: AN ELECTRONIC HEATING MODULE AND A METHOD FOR MANUFACTURING THE SAME

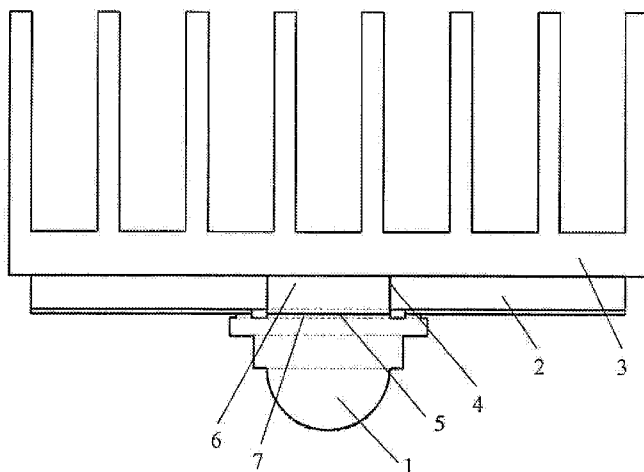


FIG. 2

(57) Abstract: The present invention relates to an electronic heating module, comprising an electronic heating body (1), a substrate (2) and heat sinks (3), the electronic heating body (1) being arranged on the substrate (2), wherein, in the substrate (2) provided is a unique via (4) in which a slug (6) conducting heat is mounted, the slug (6), at its one side, comes into contact with the electronic heating body (1), and at its other side, with the heat sinks (3). The electronic heating module according to the present invention obtains good heat dissipation effect, can use the thermoelectric separate assembly and the integrated thermoelectric-type assembly, and is easy to be assembled and produced. Moreover, the present invention also relates to a method for manufacturing the electronic heating module of the above type



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Description

AN ELECTRONIC HEATING MODULE AND A METHOD FOR MANUFACTURING THE SAME

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Technical Field

The present invention relates to an electronic heating module and a method for manufacturing the same.

Background Art

10 In the current luminaire structure, the LED assembly is usually placed on the MCPCB board (Metal Core Printed Circuit Board) in order to quickly transfer the heat generated by the LED assembly itself to the heat sinks. The MCPCB board has a good thermal conducting performance, but it is expensive. In the LED luminaire structure, the cost of the MCPCB board can be up to around 10%-30% of the total cost. Compared with the cost of the MCPCB board, the cost of the FR4
15 printed circuit board is only around 20%-35% of its cost. If the FR4 printed circuit board is applied to the luminaire structure, the total cost of the luminaire structure can be reduced by 6.5%-24%. But the low thermal conductivity (0.2-0.5W/m*k) of the FR4 material brings the limitation to the thermal management of the luminaire
20 structure.

In order to improve the thermal conducting performance of the printed circuit board using the FR4 material, the heat dissipation vias carried by the FR4 printed circuit board are usually injected with the material itself having a high thermal conductivity, such as copper. These heat dissipation vias can transfer a portion of the heat
25 generated by the LED assembly itself to the heat sinks arranged on the other side of the FR4 printed circuit board. However, these heat dissipation vias usually have a very small size and cannot be used for well conducting the heat. Moreover, the structure of this type also is merely adapted to the thermoelectric separate electronic assembly, but is not applicable to the thermoelectric integrated electronic
30 assembly.

Summary of the invention

Therefore, the objective of the present invention is to provide an electronic heating module that improves the heat dissipation performance, which can use both the thermoelectric separate electronic assembly and the thermoelectric integrated electronic assembly. Moreover, the present invention also relates to a method for manufacturing the electronic heating module of the above type.

The first objective of the present invention is accomplished by an electronic heating module. The electronic heating module comprises an electronic heating body, a substrate and heat sinks, the electronic heating body being arranged on the substrate, wherein, in the substrate provided is a unique via in which a slug conducting heat is mounted, the slug, at its one side, comes into contact with the electronic heating body, and at its other side, with the heat sinks. In the solution according to the present invention, since the via is mounted with the slug conducting heat therein instead of the heat dissipation vias with a very small size carried by the FR4 board as in the prior art, it is possible to embed the slug conducting heat with a big size. Moreover, only a unique via and the slug are provided, therefore, it is possible to obtain the biggest contact area between the slug and the heat sinks and between the slug and the thermal pad of the electronic heating body, so as to be capable of quite effectively transferring the heat of the electronic heating body itself to the heat sinks, thereby to accomplish the objective of improving the heat dissipation effect.

According to a preferable solution of the present invention, the electronic heating body comprises the thermal pad in contact with the slug the size of which is bigger than or equal to that of the thermal pad. Due to this solution, the whole surface of the thermal pad can completely come into contact with the slug, so as to render the biggest contact area between the slug and the thermal pad for effectively transferring the heat.

According to a preferable solution of the present invention, between the slug and the thermal pad provided is a thermal interface material, for instance, thermal silicon elastomer, which further improves the heat transfer efficiency between the slug and the thermal pad.

According to a preferable solution of the present invention, the slug is mounted in the via by press fit, which prevents the slug from sliding from the via to a great

extent, and simplifies the manufacturing technology.

Preferably, the slug is manufactured by Cu, Fe, Au, AlN, Al₂O₃ or graphite. The above materials have good thermal conducting performance, which further improves the heat transfer efficiency between the electronic heating body and the heat sinks.

Preferably, when the electronic heating module according to the present invention uses the thermoelectric integrated electronic assembly, the slug is designed to be a conductor, for instance, Cu, Fe and Au. Thereby, the slug can be used not only as a heat conductor but also as a conductive portion of the thermoelectric integrated electronic assembly.

Preferably, in the technical solution of the integrated thermoelectric type, between the substrate and the heat sinks provided is an electric insulation layer, so as to effectively form the electric insulation therebetween, wherein, the electric insulation layer is manufactured by the thermal synthetic material having a thickness of 0.1-0.15mm.

According to the solution of the present invention, the substrate is designed to be the FR4 printed circuit board. Due to the low cost of the FR4 material, the cost of the entire electronic heating module is also greatly reduced.

The other objective of the present invention is accomplished by a method for manufacturing the luminaire module. The method comprises the following steps: a) providing a unique via in a substrate, b) mounting a slug conducting heat in the via, and c) mounting an LED assembly and heat sinks of the luminaire module at both sides of the substrate, respectively, to make the slug come into contact with the LED assembly and the heat sinks, respectively. The present invention, by embedding the slug conducting heat in the substrate after manufacturing the substrate, makes it possible to embed the slug conducting heat with a big size and to obtain the biggest contact area between the slug and the heat sinks and between the slug and the thermal pad of the electronic heating body. The luminaire module manufactured by the method according to the present invention improves the heat dissipation performance, can use the thermoelectric separate LED assembly and the thermoelectric integrated LED assembly, and is easier to be assembled and produced.

Preferably, the slug has a size bigger than or equal to that of the thermal pad. By means of this solution, the thermal pad completely comes into contact with the slug, so as to render the biggest contact area between the slug and the thermal pad for effectively transferring the heat.

- 5 According the method of the present invention, prior to the step c) it is further included providing a thermal interface material such as thermal silicon elastomer between the slug and the thermal pad, which further improves the heat transfer efficiency between the slug and the thermal pad.

- 10 Preferably, when using the thermoelectric integrated LED assembly, between the substrate and the heat sinks provided is an electric insulation layer, so as to effectively form the electric insulation therebetween.

Below is the comparison table describing the heat dissipation efficiency of the electronic heating module according to the present invention and the solution in the prior art.

Number	Substrate Type	LED Temperature	Thermal Conducting Performance	Cost
1	Traditional FR4 Board	88°C	Poor	Low
2	FR4 Board with Heat Dissipation Vias	70°C	Middle	Low
3	MCPCB	57°C	Good	High
4	Structure with a Single Via and a Slug according the Present Invention	57°C	Good	Low
5	Structure with an Additional Insulation Layer according the Present Invention	60°C	Good	Middle

- 15 It should be understood that all the general descriptions above and the detailed

descriptions below are illustrative, aiming at providing further explanation to the present invention claimed.

Brief Description of the Drawings

5 The drawings constitute a part of the present Description and help in further understanding the present invention. The drawings illustrate the examples of the present invention and explain the principle of the present invention together with the Description. The same part in the drawings is represented by the same reference sign. In the drawings:

10 Figure 1 shows the LED luminaire module according to the prior art, which has a plurality of heat dissipation vias,

Figure 2 is a scheme of the first example of the electronic heating module according to the present invention, and

Figure 3 is a scheme of the second example of the electronic heating module according to the present invention.

15 Detailed Description of the Embodiments

Figure 1 shows the LED luminaire module according to the prior art. The module comprises an LED assembly 1, a substrate 2 and heat sinks 3, wherein, the substrate 2 has a plurality of heat dissipation vias 4 that have a quite small size, and the heat dissipation thermal vias in the substrate 2 are injected with the material itself having a high thermal conductivity, for instance, copper. From the figure it can be seen that, since the vias for conducting heat have a quite small size, the contact area between these vias and the thermal pad of the LED assembly 1 is also quite small. Therefore, these vias cannot be used for well conducting the heat. Moreover, such solution can only be applied to the thermoelectric separate LED assembly, but is not applicable to the thermoelectric integrated LED assembly.

Figure 2 shows the electronic heating module according to the present invention, comprising an electronic heating body 1 which is designed as an LED assembly 1 of the thermoelectric separation type, a substrate 2 and heat sinks 3. The LED assembly 1 is arranged on the substrate 2, wherein, in the substrate 2 provided is a unique via 4 in which a slug 6 conducting heat is mounted by press fit, the slug 6, at

its one side, comes into contact with the LED assembly 1, and its other side, with the heat sinks 3. In the present example, the slug 6 can be manufactured by Cu, Fe, Au, AlN, Al₂O₃ or graphite.

5 The LED assembly 1 comprises a thermal pad 5 of the LED assembly in contact with the slug 6 that has a size bigger than or equal to that of the thermal pad 5, such that the whole surface of the thermal pad 5 can completely come into contact with the slug 6, so as to render the biggest contact area between the slug 6 and the thermal pad 5 for effectively transferring the heat.

10 Moreover, it can be seen from Figure 2 that between the slug 6 and the thermal pad 5 further provided is a thermal interface material 7, for instance, thermal silicon elastomer, which further improves the heat transfer efficiency between the slug 6 and the thermal pad 5.

15 Figure 3 is a scheme of the second example of the electronic heating module according to the present invention. It is different from the example shown in Figure 2 in that the electronic heating module uses an LED assembly 1 of the integrated thermoelectric type, wherein, the slug 6 is manufactured by the conductive metal materials such as Cu, Fe and Au, and between the heat sinks 3 and the substrate 2 an electric insulation layer 8 is additionally coated, so as to insulate the heat sinks 3 from the substrate 2.

20 The above-mentioned is only to illustrate the preferred examples of the present invention but not to limit the present invention. For the person skilled in the art, the present invention may have various alterations and changes. Any modification, equivalent substitution, improvement, etc., within the spirit and principle of the present invention, should be within the protection scope of the present invention.

List of reference signs

- 1 electronic heating body (LED assembly)
- 2 substrate
- 5 3 heat sinks
- 4 via
- 5 thermal pad
- 6 slug
- 7 thermal interface material
- 10 8 electric insulation material

Claims:

1. An electronic heating module, comprising an electronic heating body (1), a substrate (2) and heat sinks (3), the electronic heating body (1) being
5 arranged on the substrate (2), characterized in that, in the substrate (2) provided is a unique via (4) in which a slug (6) conducting heat is mounted, the slug (6), at its one side, comes into contact with the electronic heating body (1), and at its other side, with the heat sinks (3).
- 10 2. The electronic heating module according to Claim 1, characterized in that, the electronic heating body (1) comprises a thermal pad (5) in contact with the slug (6) the size of which is bigger than or equal to that of the thermal pad (5).
- 15 3. The electronic heating module according to Claim 2, characterized in that, between the slug (6) and the thermal pad (5) provided is a thermal interface material (7).
- 20 4. The electronic heating module according to Claim 1, characterized in that, the slug (6) is mounted in the via (4) by press fit.
5. The electronic heating module according to Claim 1, characterized in that, the slug (6) is manufactured by Cu, Fe, Au, AlN, Al₂O₃ or graphite.
- 25 6. The electronic heating module according to any one of Claims 1-5, characterized in that, the slug (6) is a conductor.
7. The electronic heating module according to Claim 6, characterized in that, between the substrate (2) and the heat sinks (3) provided is an electric
30 insulation layer (8).
8. The electronic heating module according to Claim 7, characterized in that, the electric insulation layer (8) is a thermal synthetic material having a
35 thickness of 0.1-0.15mm.
9. The electronic heating module according to any one of Claims 1-5, characterized in that, the substrate (2) is designed to be an FR4 printed circuit board.
- 40 10. A method for manufacturing a luminaire module, characterized by comprising the following steps:
a) providing a unique via (4) in a substrate (2),
b) mounting a slug (6) conducting heat in the via (4), and
45 c) mounting an LED assembly and heat sinks (3) of the luminaire module at both sides of the substrate (2), respectively, to make the slug (6) come into contact with the LED assembly and the heat sinks (3), respectively.
11. The method according to Claim 10, characterized in that, the slug (6)
50 has a size bigger than or equal to that of a thermal pad (5) of the LED assembly.

12. The method according to Claim 10, characterized by, prior to the step c), further including providing a thermal interface material (7) between the slug (6) and the thermal pad (5).

5

13. The method according to Claim 10, characterized in that, between the substrate (2) and the heat sinks (3) provided is an electric insulation layer (8).

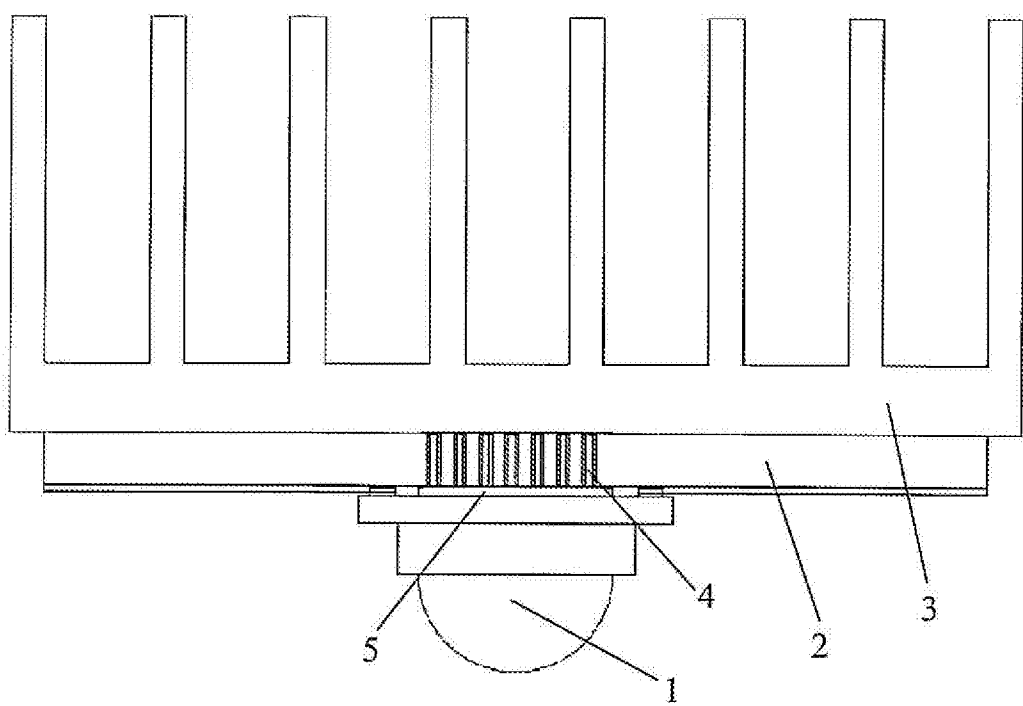


FIG.1

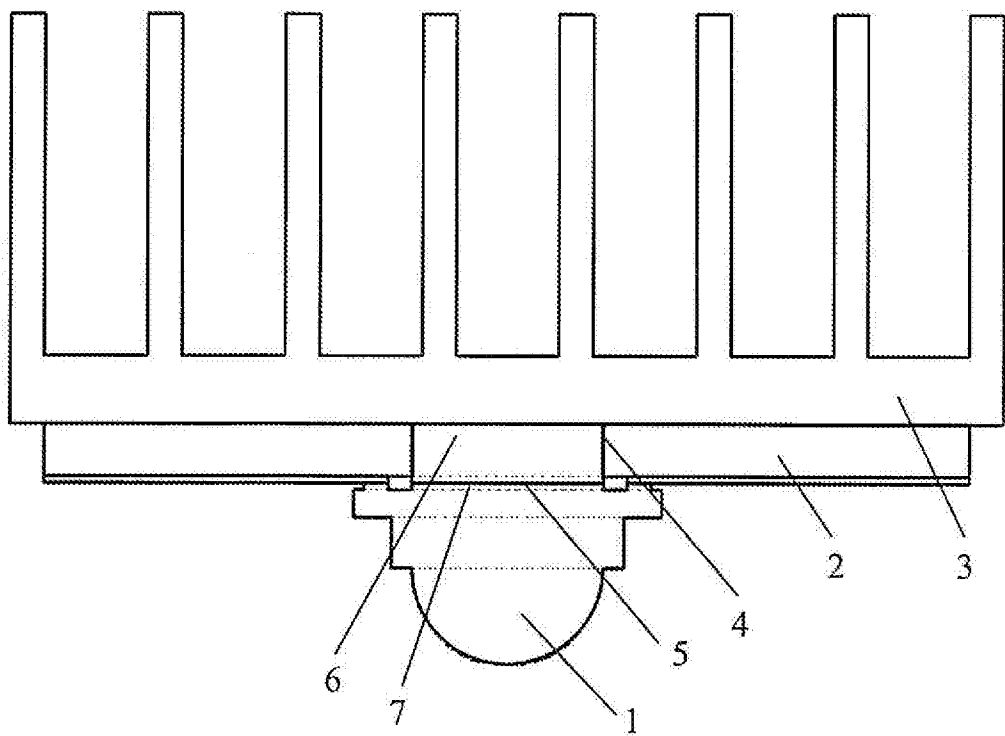


FIG.2

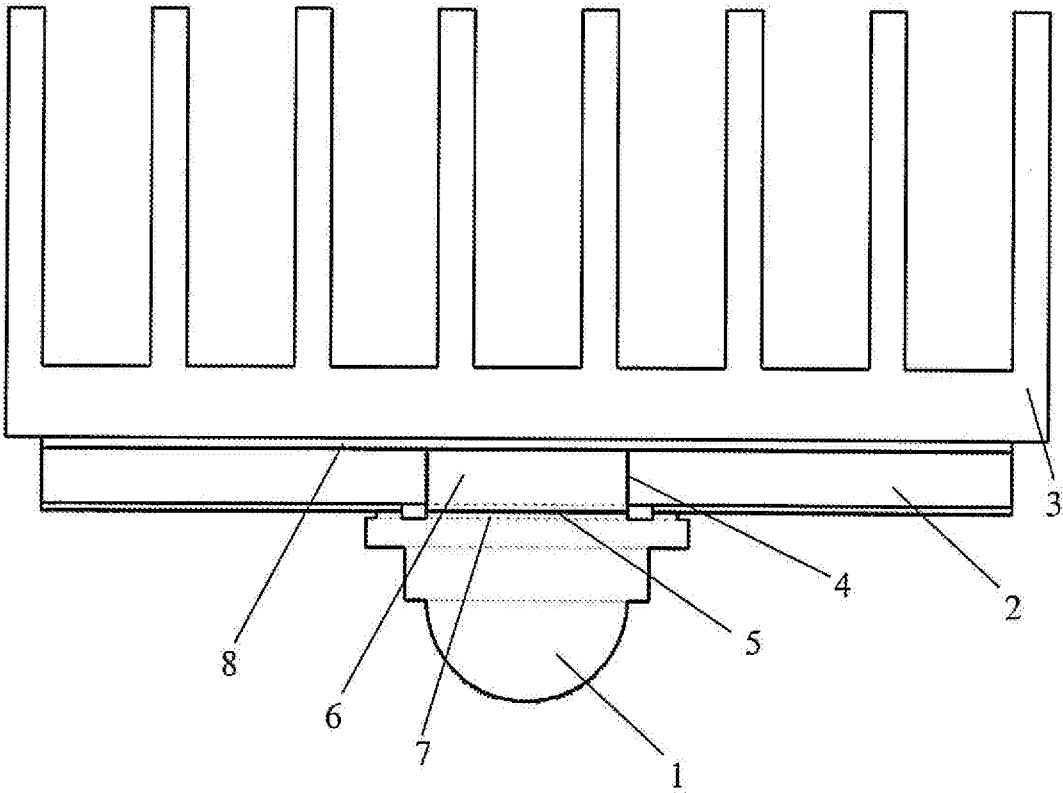


FIG3

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2011/062375

A. CLASSIFICATION OF SUBJECT MATTER
INV. H05K1/02
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
H05K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EP0-Internal

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☒ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

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Date of the actual completion of the international search

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Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040,
Fax: (+31-70) 340-3016

Authorized officer

Baur, Christoph

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2011/062375

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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Information on patent family members

International application No

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