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ELECTRONIC DEVICE

Abstract

An electronic device includes a card slot, a heat transferrer, a printed wiring board connected to the heat transferrer to allow heat transfer from the heat transferrer, and a contact switch that switches between a contact state and a non-contact state of the card slot and the heat transferrer.

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Background/Summary

TECHNICAL FIELD

[0001] The present disclosure relates to an electronic device.

BACKGROUND ART

[0002] When a memory card is inserted in a card slot and accessed, the memory card generates heat. The memory card may generate excess heat that can possibly cause, for example, an erroneous operation or a failure. An electronic device including a card slot is thus to be designed to dissipate heat generated from the memory card.
[0003] A technique associated with this issue is an electronic device in Patent Literature 1 described below. The electronic device described in Patent Literature 1 includes, on a card, a heat transferrer that deforms to come in contact with a heat receiving portion of a heat dissipator in the electronic device to prevent overheating of the card.
CITATION LIST
Patent Literature
[0004] Patent Literature 1: Unexamined Japanese Patent Application Publication No. 2008-258392
SUMMARY OF INVENTION
Technical Problem
[0005] In the electronic device described in Patent Literature **1**, the heat transferrer deforms and comes in contact with the heat receiving portion each time power is supplied to the electronic device. Thus, heat flows back from the heat dissipator to the card when the temperature of the heat dissipator is higher than the temperature of the card. The heat dissipator is usually used to dissipate heat generated by multiple circuits. Thus, the temperature of the heat dissipator is likely to be higher than the temperature of the card.
[0006] Under such circumstances, an objective of the present disclosure is to provide an electronic device that prevents heat backflow to the card.
Solution to Problem
[0007] To achieve the above objective, an electronic device according to an aspect of the present disclosure includes a card slot, a heat transferrer, a heat dissipator connected to the heat transferrer to allow heat transfer from the heat transferrer, and contact switching means for switching between a contact state and a non-contact state of the card slot and the heat transferrer.
Advantageous Effects of Invention
[0008] The electronic device according to the above aspect of the present disclosure prevents heat backflow to the card.

Description

BRIEF DESCRIPTION OF DRAWINGS
[0009] FIG. **1** is a schematic diagram of an electronic device according to Embodiment 1 of the present disclosure;
[0010] FIG. **2** is a diagram of a contact switch that is switched on in the electronic device according to Embodiment 1 of the present disclosure;
[0011] FIG. **3** is a schematic diagram of an electronic device according to Embodiment 2 of the present disclosure;
[0012] FIG. **4** is a schematic diagram of an electronic device according to Embodiment 3 of the present disclosure;
[0013] FIG. **5** is a schematic diagram of an electronic device according to Embodiment 4 of the present disclosure;
[0014] FIG. **6** is a schematic diagram of an electronic device according to a modification of Embodiment 1 of the present disclosure; and
[0015] FIG. **7** is a schematic diagram of an electronic device according to a modification of Embodiment 1 of the present disclosure.
DESCRIPTION OF EMBODIMENTS
[0016] An electronic device according to one or more embodiments of the present disclosure is

described with reference to the drawings. Like reference signs denote like or corresponding components in the drawings.

Embodiment 1

[0017] An electronic device **1** according to Embodiment 1 is described with reference to FIGS. **1** and **2**. The electronic device **1** can access a memory card **11**. The electronic device **1** includes a card slot **10**, a heat transferrer **20**, a printed wiring board **30**, and a contact switch **40**. The electronic device **1** also includes various electronic components (not illustrated). The electronic device **1** is an example of an electronic device in an aspect of the present disclosure.

[0018] In the state illustrated in FIG. **1**, the card slot **10** and the heat transferrer **20** are not in contact with each other. As described in detail later, when a user operates the contact switch **40**, the heat transferrer **20** deforms and comes in contact with the card slot **10** as illustrated in FIG. **2**. The dot-dash line illustrated in FIG. **2** indicates the heat transferrer **20** before deformation. This allows heat in the card slot **10** to be dissipated to the printed wiring board **30** through the heat transferrer **20**.

[0019] The components of the electronic device **1** are described. The card slot **10** is used for access to the memory card **11**. The memory card **11** is placed in the card slot **10** to allow the card slot **10** to access the memory card **11**. The card slot **10** is an example of a card slot in an aspect of the present disclosure.

[0020] The heat transferrer **20** is connected to the printed wiring board **30** to dissipate heat to the printed wiring board **30**. When the heat transferrer **20** comes in contact with the card slot **10** with operation on the contact switch **40** (described later), the heat transferrer **20** can dissipate heat generated in the card slot **10** to the printed wiring board **30**. The heat transferrer **20** is, for example, a tough metal plate. As illustrated in FIG. **2**, when the contact switch **40** presses down the heat transferrer **20**, the heat transferrer **20** deforms with the toughness to come in contact with the card slot **10**. The heat transferrer **20** is an example of a heat transferrer in an aspect of the present disclosure.

[0021] The printed wiring board **30** electrically connects various electronic components (not illustrated) of the electronic device **1** to the card slot **11**. The printed wiring board **30** is connected to the heat transferrer **20** to allow heat dissipation from the heat transferrer **20**. The printed wiring board **30** connected to the heat transferrer **20** to allow heat dissipation from the heat transferrer **20** functions as a heat dissipator for dissipating heat transferred from the heat transferrer **20**. The printed wiring board **30** also dissipates heat generated by the various electronic components (not illustrated). The printed wiring board **30** is an example of a heat dissipator in an aspect of the present disclosure.

[0022] The contact switch **40** is switched on and off with a user operation. In the state illustrated in FIG. **1**, the contact switch **40** is off. In the state illustrated in FIG. **2**, the contact switch **40** is on. When the contact switch **40** is off, the card slot **10** and the heat transferrer **20** are not in contact with each other as illustrated in FIG. **1**. When the user switches on the contact switch **40** in the off-state, the tip of the contact switch **40** is pressed against the heat transferrer **20** as illustrated in FIG. **2**. The heat transferrer **20** thus comes in contact with the card slot **10**. When the user switches off the contact switch **40** in the on-state, the card slot **10** and the heat transferrer **20** are out of contact with each other as illustrated in FIG. **1**. The contact switch **40** is an example of contact switching means in an aspect of the present disclosure.

[0023] A process for preventing heat backflow from the printed wiring board **30** to the memory card **11** is described. As described above, the electronic device **1** includes various electronic components (not illustrated). Such electronic components generate heat. The generated heat is transferred to the printed wiring board **30**. When the card slot **10** and the heat transferrer **20** are in contact with each other and the temperature of the card slot **10** is lower than the temperature of the printed wiring board **30**, the heat of the printed wiring board **30** is transferred to the memory card **11** through the heat transferrer **20** and the card slot **10**. In other words, the heat flows back from the

printed wiring board **30** to the memory card **11**. Thus, when the card slot **10** and the heat transferrer **20** are in contact with each other, heat may flow back from the printed wiring board **30** to the memory card **11**.

[0024] When heat can possibly flow back from the printed wiring board **30** to the memory card **11**, the user operates the contact switch **40** to be off to place the card slot **10** and the heat transferrer **20** out of contact with each other, thus preventing heat backflow from the printed wiring board **30** to the memory card **11**.

[0025] When, for example, the memory card **11** is not accessed frequently and the processing load of a processor (not illustrated) included in the electronic device **1** is high, the memory card **11** expectedly generates less heat and the processor expectedly generates more heat. In this case, the temperature of the printed wiring board **30** is expected to be higher than the temperature of the card slot **10** with heat generated by the processor. In this state, heat can flow back to the memory card **11** when the card slot **10** and the heat transferrer **20** are in contact with each other. The user can switch off the contact switch **40** to place the card slot **10** and the heat transferrer **20** out of contact with each other, thus preventing heat backflow.

[0026] In contrast, with no possibility of heat backflow from the printed wiring board **30** to the memory card **11**, the user switches on the contact switch **40** to place the card slot **10** and the heat transferrer **20** in contact with each other to dissipate heat from the memory card **11** to the printed wiring board **30**.

[0027] The electronic device **1** according to Embodiment 1 has been described. The electronic device **1** according to Embodiment 1 allows the user to operate the contact switch **40** to switch between the contact state and the non-contact state of the card slot **10** and the heat transferrer **20**. Thus, when heat can possibly flow back from the printed wiring board **30** to the memory card **11**, the user switches off the contact switch **40** to place the card slot **10** and the heat transferrer **20** out of contact with each other, thus preventing heat backflow.

Embodiment 2

[0028] An electronic device **1** according to Embodiment 2 is now described with reference to FIG. **3**. The electronic device **1** according to Embodiment 2 is substantially similar to the electronic device **1** according to Embodiment 1 illustrated in FIG. **1**. The electronic device **1** according to Embodiment 2 differs from the electronic device **1** according to Embodiment 1 in further including a type determiner **50** and including a contact switch **40**A in place of the contact switch **40**.

[0029] The type determiner **50** is connected to the card slot **10** and the contact switch **40**A to communicate with the card slot **10** and the contact switch **40**A. The type determiner **50** communicates with the card slot **10** to determine the type of memory card **11** placed in the card slot **10**. The type determiner **50** transmits a signal indicating the determined type of memory card **11** to the contact switch **40**A. The type determiner **50** is implemented with, for example, an electronic circuit. The type determiner **50** is an example of type determination means in an aspect of the present disclosure.

[0030] The type of memory card **11** refers to, for example, the type of transmission speed of the standard supported by the memory card **11**. When, for example, the memory card **11** is a Secure Digital (SD) memory card, the type of memory card **11** is associated with the maximum transmission speed of the SD memory card, such as Default Speed (DS), High Speed (HS), Ultra High Speed (UHS)-I, UHS-II, and UHS-III.

[0031] The contact switch **40**A is substantially similar to the contact switch **40** in Embodiment 1, except that the contact switch **40**A is not operable by the user, but is switched on and off based on a signal. The contact switch **40**A is switched on and off based on a signal indicating the type of memory card **11** and received from the type determiner **50**. The contact switch **40**A thus switches between the contact state and the non-contact state of the card slot **10** and the heat transferrer **20** based on the type of memory card **11**. The contact switch **40**A is implemented with, for example, an electronic component including an electronic circuit and a mechanical relay. The contact switch

40A is an example of the contact switching means in an aspect of the present disclosure.
[0032] For example, the contact switch **40**A is switched on when the transmission speed of the memory card **11** determined based on the type of memory card **11** is greater than or equal to a predetermined threshold, placing the card slot **10** and the heat transferrer **20** in contact with each other. The contact switch **40**A is switched off when the transmission speed is not greater than the predetermined threshold, placing the card slot **10** and the heat transferrer **20** out of contact with each other. The memory card **11** typically generates more heat at a higher transmission speed. Thus, when the transmission speed of the memory card **11** is greater than or equal to the threshold, the temperature of the card slot **10** that receives heat from the memory card **11** is expected to be higher than the temperature of the printed wiring board **30**. In this state, heat has no possibility of flowing back from the printed wiring board **30** to the memory card **11**. The contact switch **40**A is thus switched on to allow heat from the memory card **11** to be dissipated to the printed wiring board **30** through the card slot **11** and the heat transferrer **20**.
[0033] In contrast, when the transmission speed of the memory card **11** is less than the threshold, the temperature of the card slot **10** that receives heat from the memory card **11** may be lower than the temperature of the printed wiring board **30**. In this state, heat may flow back from the printed wiring board **30** to the memory card **11**. The contact switch **40**A is thus switched off to prevent heat backflow to the memory card **11**.
[0034] The electronic device **1** according to Embodiment 2 has been described. The electronic device **1** according to Embodiment 2 allows the contact switch **40**A to be automatically switched on and off based on the type of memory card **11** placed in the card slot **10**. Unlike in Embodiment 1, this structure prevents heat backflow to the memory card **11** without a user operation.
Embodiment 3
[0035] An electronic device **1** according to Embodiment 3 is described with reference to
[0036] FIG. **4**. The electronic device **1** according to Embodiment 3 is substantially similar to the electronic device **1** according to Embodiment 1 illustrated in FIG. **1**. The electronic device **1** according to Embodiment 3 differs from the electronic device **1** according to Embodiment 1 in further including a temperature detector **60** and including a contact switch **40**B in place of the contact switch **40**.
[0037] The temperature detector **60** detects the temperature of the card slot **10** and the temperature of the printed wiring board **30**. The dashed arrows illustrated in FIG. **4** indicate that the temperature detector **60** detects the temperatures of the card slot **10** and the printed wiring board **30**. The temperature detector **60** is connected to the contact switch **40**B to communicate with the contact switch **40**B. The temperature detector **60** transmits a signal indicating the temperature of the card slot **10** and a signal indicating the temperature of the printed wiring board **30** to the contact switch **40**B. The temperature detector **60** is an example of temperature detection means in an aspect of the present disclosure.
[0038] The contact switch **40**B is substantially similar to the contact switch **40** in Embodiment 1, except that the contact switch **40**B is not operable by the user, but is switched on and off based on a signal. The contact switch **40**B is switched on and off based on a signal indicating the temperature of the card slot **10** and a signal indicating the temperature of the printed wiring board **30** received from the temperature detector **60**. More specifically, the contact switch **40**B is switched on when the temperature of the card slot **10** is higher than the temperature of the printed wiring board **30** and is switched off when the temperature of the card slot **10** is lower than or equal to the temperature of the printed wiring board **30**. The contact switch **40**B is implemented with, for example, an electronic component including an electronic circuit and a mechanical relay. The contact switch **40**B is an example of the contact switching means in an aspect of the present disclosure.
[0039] As described above, when the temperature of the card slot **10** is lower than or equal to the temperature of the printed wiring board **30**, the contact switch **40**B is switched off to prevent heat backflow from the printed wiring board **30** to the memory card **11**. When the temperature of the

card slot **10** is higher than the temperature of the printed wiring board **30**, the contact switch **40**B is switched on to dissipate heat from the memory card **11** to the printed wiring board **30**.

[0040] The electronic device **1** according to Embodiment 3 has been described. The electronic device **1** according to Embodiment 3 allows the contact switch **40**B to be switched on and off based on whether the temperature of the card slot **10** is higher or lower than the temperature of the printed wiring board **30**, and thus prevents heat backflow to the memory card **11** without a user operation, unlike in Embodiment 1. The contact switch **40**B is switched on and off based on whether the temperature of the card slot **10** is higher or lower than the temperature of the printed wiring board **30**, thus more reliably preventing heat backflow to the memory card **11** than in Embodiment 2.

Embodiment 4

[0041] An electronic device **1** according to Embodiment 4 is now described with reference to FIG. **5**. The electronic device **1** according to Embodiment 4 is substantially similar to the electronic device **1** according to Embodiment 1 illustrated in FIG. **1**. The electronic device **1** according to Embodiment 4 differs from the electronic device **1** according to Embodiment 1 in further including a temperature detector **60**A and a notifier **70**. Unlike in Embodiments 2 and 3 described above, the contact switch **40** is the same as in Embodiment 1. More specifically, the contact switch **40** is switched on and off by a user operation.

[0042] The temperature detector **60**A is substantially similar to the temperature detector **60** in Embodiment 3, but differs from the temperature detector **60** in Embodiment 3 in that the temperature detector **60**A transmits a signal indicating the temperature of the card slot **10** and a signal indicating the temperature of the printed wiring board **30** to the notifier **70**. The temperature detector **60**A is an example of the temperature detection means in an aspect of the present disclosure.

[0043] The notifier **70** receives, from the temperature detector **60**A, the signal indicating the temperature of the card slot **10** and the signal indicating the temperature of the printed wiring board **30**. When the temperature of the card slot **10** is higher than the temperature of the printed wiring board **30**, the notifier **70** notifies the user that the contact switch **40**, or a switch, is to be operated to place the card slot **10** and the heat transferrer **20** in contact with each other. When the temperature of the card slot **10** is lower than or equal to the temperature of the printed wiring board **30**, the notifier **70** notifies the user that the contact switch **40**, or the switch, is to be operated to place the card slot **10** and the heat transferrer **20** out of contact with each other. The notifier **70** is, for example, a display that can display information using images. The notifier **70** may notify the user that the card slot **10** and the heat transferrer **20** are to be placed in contact or out of contact with each other using, for example, a lamp or a buzzer. The notifier **70** is an example of notification means in an aspect of the present disclosure.

[0044] As described above, when the temperature of the card slot **10** is lower than or equal to the temperature of the printed wiring board **30**, the notifier **70** notifies the user that the card slot **10** and the heat transferrer **20** are to be placed out of contact with each other. The user switches off the contact switch **40** based on the notification to prevent heat backflow from the printed wiring board **30** to the memory card **11**. When the temperature of the card slot **10** is higher than the temperature of the printed wiring board **30**, the notifier **70** notifies the user that the card slot **10** and the heat transferrer **20** are to be placed in contact with each other. The user switches on the contact switch **40** based on the notification to dissipate heat from the memory card **11** to the printed wiring board **30**.

[0045] The electronic device **1** according to Embodiment 4 has been described. In the electronic device **1** according to Embodiment 4, the notifier **70** provides a notification to the user based on whether the temperature of the card slot **10** is higher or lower than the temperature of the printed wiring board **30**. The user operates the contact switch **40** based on the notification to prevent heat backflow to the memory card **11**. Although such a user operation is performed, the contact switch **40** may be simpler than in Embodiments 2 and 3.

Modifications
[0046] In each of the above embodiments, the printed wiring board **30** functions as a heat dissipator. However, any component other than the printed wiring board **30** may function as a heat dissipator. For example, the housing of the electronic device **1** may be used as a heat dissipator. In this case, the heat transferrer **20** is connected to the housing to transfer heat to the housing.
[0047] In Embodiment 2, the type of memory card **11** is associated with the transmission speed of the memory card **11**. In addition, the type of memory card **11** may be associated with the capacity of the SD memory card, such as SD, Secure Digital High Capacity (SDHC), and Secure Digital eXtended Capacity (SDXC), associated with the shape of the SD memory card, such as SD, miniSD, and microSD, or associated with the standard of the SD memory card, such as SD, MultiMediaCard (MMC), and Secure Digital Input Output (SDIO).
[0048] When the type of memory card **11** is associated with the capacity, the memory card **11** having a larger capacity is expected to generate more heat. The contact switch **40**A may thus be switched on when the capacity determined from the type is greater than or equal to a threshold. In other cases as well, the contact switch **40**A may be designed to be switched on and off based on situations expected to cause more heat generation.
[0049] In Embodiment 1, when the contact switch **40** presses down the heat transferrer **20**, the heat transferrer **20** comes in contact with the card slot **10**. As illustrated in FIG. **6**, for example, the electronic device **1** may include two printed wiring boards **30** arranged perpendicular to each other with a board connector **31** between the two printed wiring boards **30**. In this case, two or more heat transferrers **20** may be connected in a hinge-like manner, and a pivotable portion of the heat transferrers **20** may come in contact with the card slot **10**. In this case, the pivotable portion of the heat transferrers **20** pivots to switch between the contact state and the non-contact state with the card slot **10**, and thus also functions as the contact switch **40**.
[0050] As illustrated in FIG. **7**, for example, the electronic device **1** may include two printed wiring boards **30** parallel to each other with a board connector **31** between the two printed wiring boards **30**. In this case, three or more heat transferrers **20** may be connected in a bellows-like manner to be extendable. A portion of the heat transferrers **20** closest to the card slot **10** may come in contact with the card slot **10**. In this case, the portion of the heat transferrers **20** closest to the card slot **10** switches between the contact state and the non-contact state with the card slot **10**, and thus also functions as the contact switch **40**.
[0051] The foregoing describes some example embodiments for explanatory purposes. Although the foregoing discussion has presented specific embodiments, persons skilled in the art will recognize that changes may be made in form and detail without departing from the broader spirit and scope of the invention. Accordingly, the specification and drawings are to be regarded in an illustrative rather than a restrictive sense. This detailed description, therefore, is not to be taken in a limiting sense, and the scope of the invention is defined only by the included claims, along with the full range of equivalents to which such claims are entitled.
REFERENCE SIGNS LIST
[0052] **1** Electronic device [0053] **10** Card slot [0054] **11** Memory card [0055] **20** Heat transferrer [0056] **30** Printed wiring board [0057] **31** Board connector [0058] **40**, **40**A, **40**B Contact switch [0059] **50** Type determiner [0060] **60**, **60**A Temperature detector [0061] **70** Notifier

Claims

1. An electronic device, comprising: a card slot; a heat transferrer; a heat dissipator connected to the heat transferrer to allow heat transfer from the heat transferrer; temperature detector to detect a temperature of the card slot and a temperature of the heat dissipator; and contact switch to switch between a contact state and a non-contact state of the card slot and the heat transferrer, wherein the contact switch places the card slot and the heat transferrer in contact with each other when the

temperature of the card slot is higher than the temperature of the heat dissipator, and places the card slot and the heat transferrer out of contact with each other when the temperature of the card slot is lower than or equal to the temperature of the heat dissipator.

2.-**5**. (canceled)