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(54) SECONDARY BATTERY PROTECTION DEVICE

(75) Inventor: **Takashi Kashine**, Chino-shi (JP)

Correspondence Address:
OLIFF & BERRIDGE, PLC
P.O. BOX 19928
ALEXANDRIA, VA 22320 (US)

(73) Assignee: **SEIKO EPSON CORPORATION**, Tokyo (JP)

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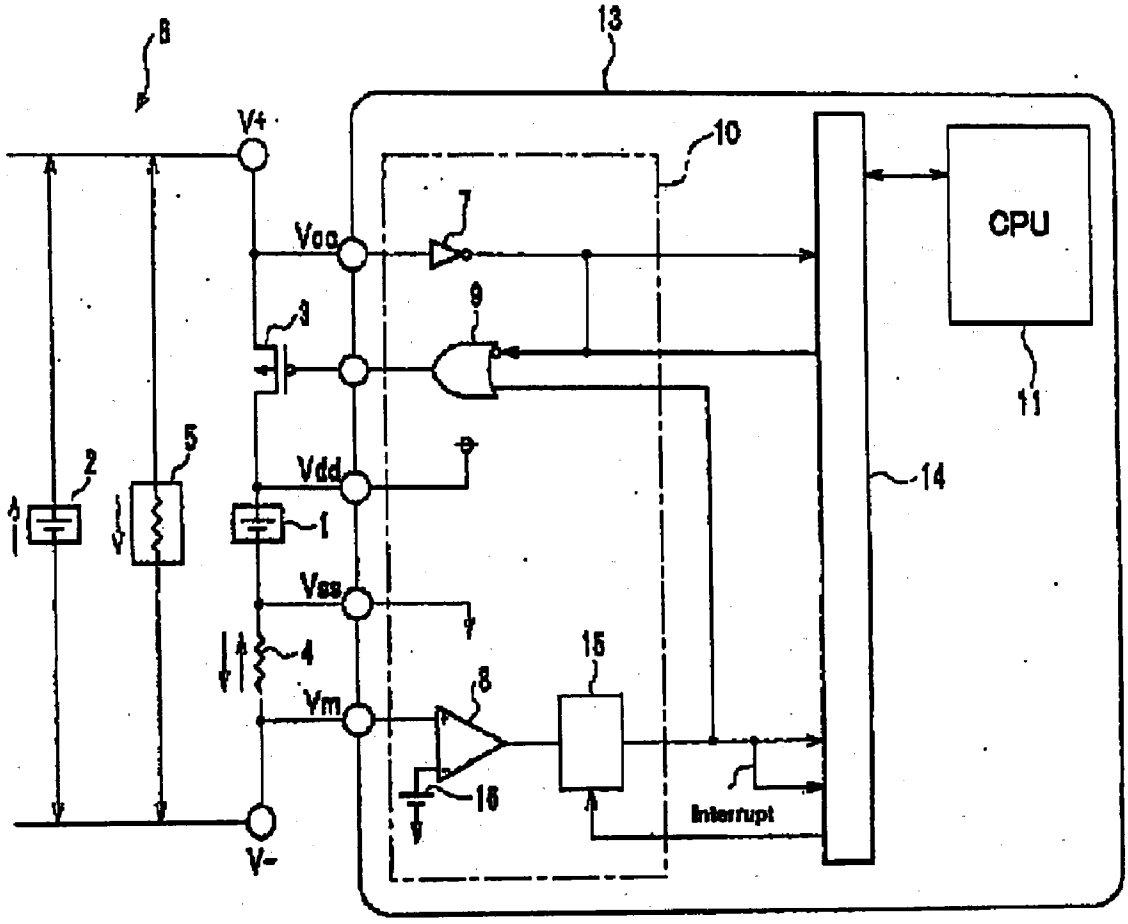
(57) ABSTRACT

Device miniaturization is made possible by building a battery protection circuit in a microcomputer. A secondary battery protection device comprises a voltage detection means **7** that detects a voltage of a power supply circuit **6** including a secondary battery **1,** a current detection means **8** that detects a current of the power supply circuit, and a battery protection circuit **10** that shuts off the power supply circuit **6** based on a signal representing a detection made by the voltage detection means **7** or the current detection means **8** of an excess current that is generated in the power supply circuit **6,** wherein the protection circuit **10** is built in a microcomputer **13.**



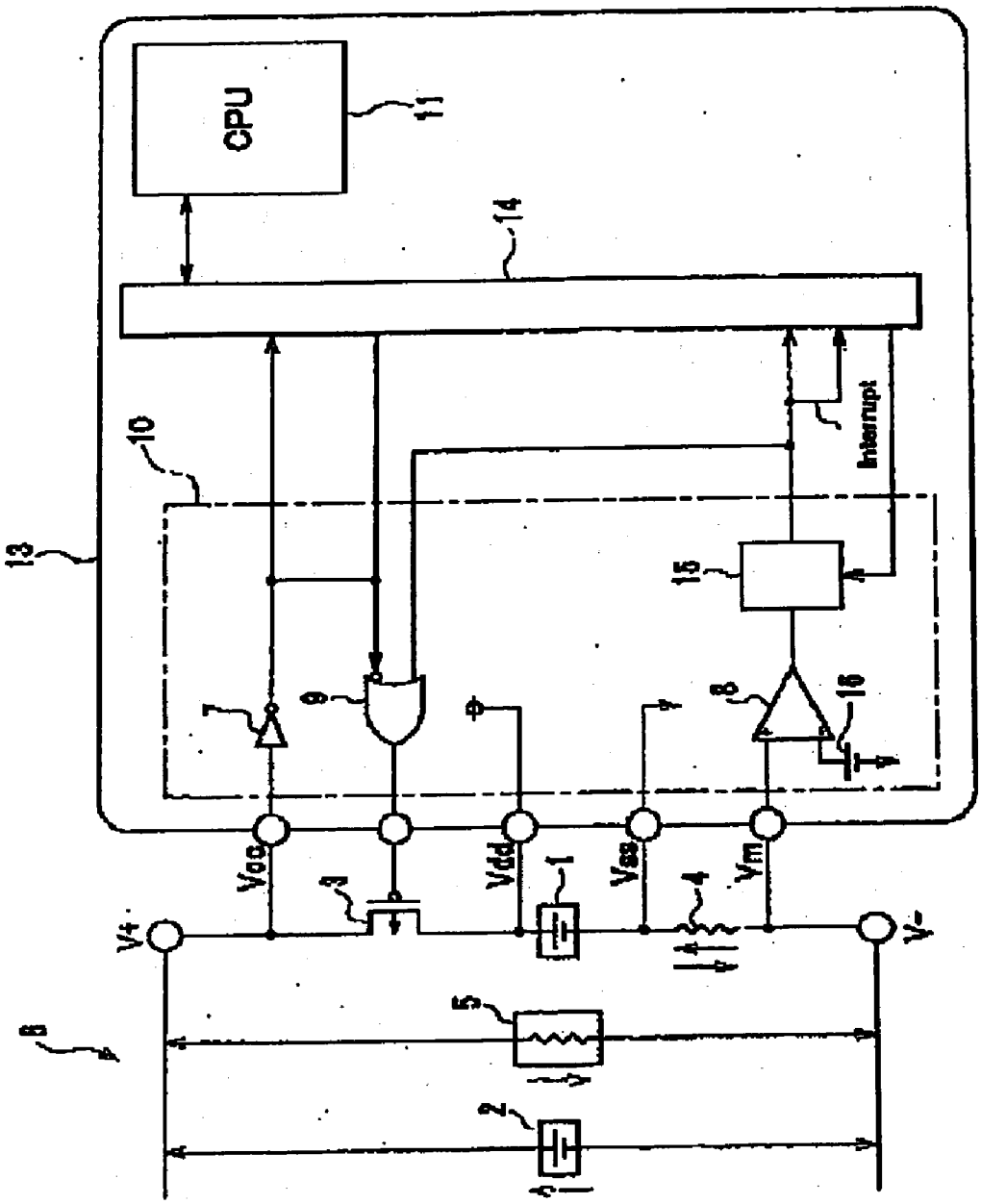


Fig. 1

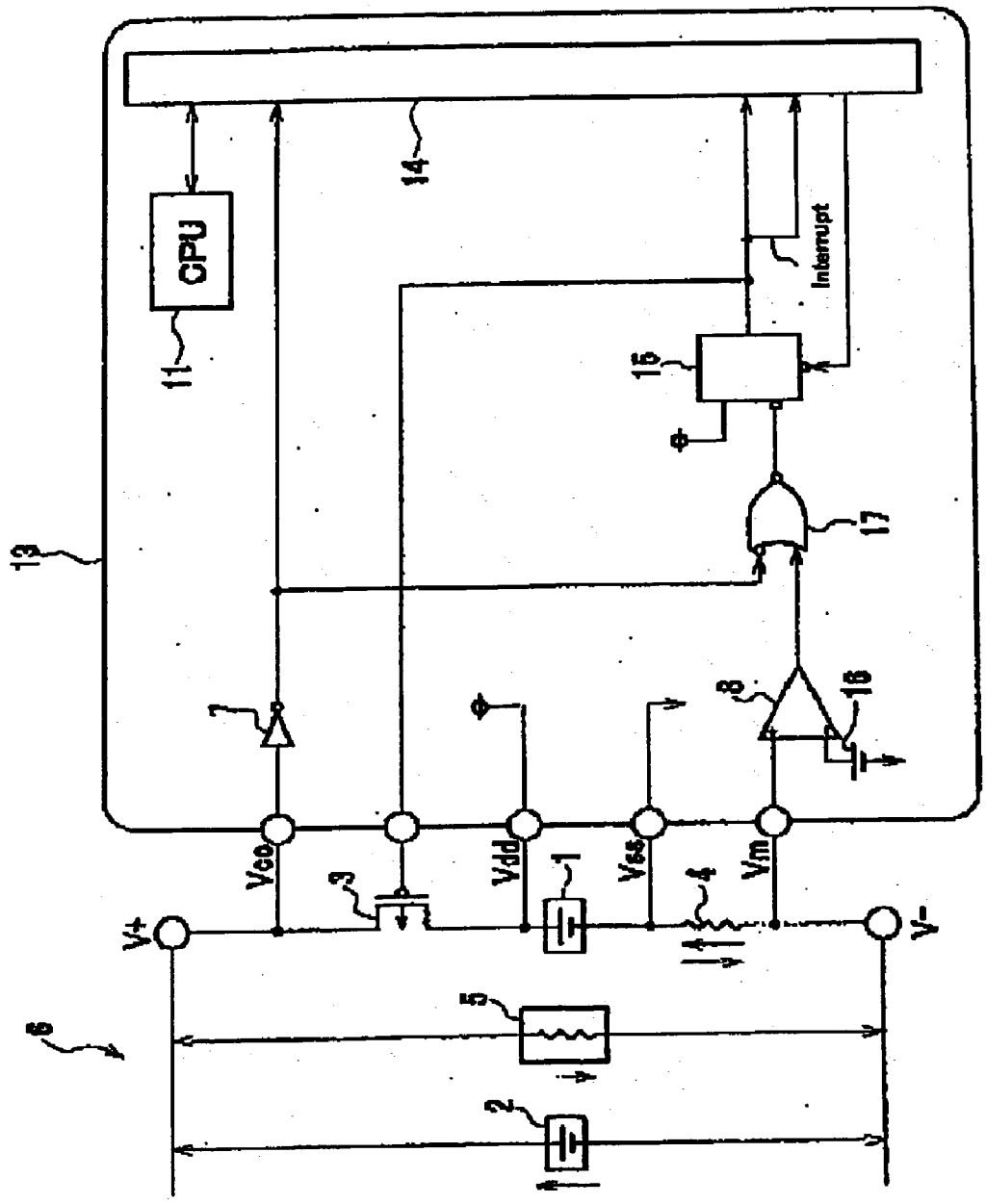


Fig. 2

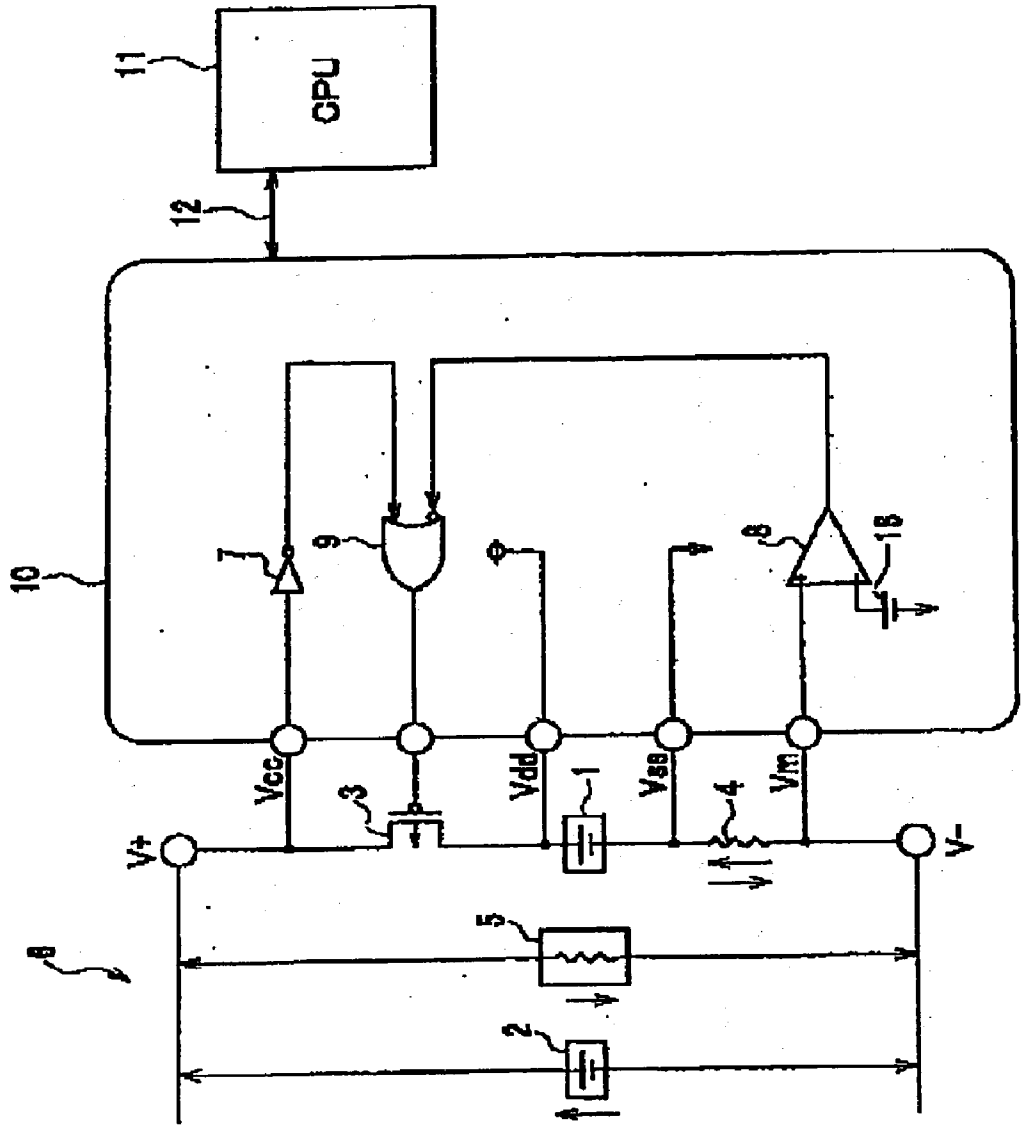


Fig. 3
(Prior Art)

SECONDARY BATTERY PROTECTION DEVICE

BACKGROUND OF THE INVENTION

[0001] 1. Field of Invention

[0002] The present invention relates to a secondary battery protection device that detects an excessive current and shuts off a power supply circuit of a secondary battery.

[0003] 2. Description of Related Art

[0004] **FIG. 3** shows an example of a conventional secondary battery protection device.

[0005] The figure shows a secondary battery **1**, a charger **2**, a switching element **3** such as an FET, a resistance for detecting an excessive current **4**, and a load resistance **5**; and these circuit elements composes a power supply circuit **6**. A battery protection circuit **10** is equipped with a sense amplifier **7** that is connected to a positive side of the secondary battery **1**, a sense amplifier **8** that is connected to a downstream side of the resistance **4**, and an OR circuit **9** that takes an OR of outputs of the sense amplifiers **7** and **8** to turn off the switching element **3**. The sense amplifier **8** connects to a battery **16** for providing a reference voltage. The battery protection circuit **10** is independent of a microcomputer, and exchanges signals with a CPU **11** of the microcomputer through a signal line.

[0006] Next, operations are described. A voltage on the positive side of the secondary battery **1** is always detected by the sense amplifier **7**, and a current that flows through the resistance **4** is detected by the sense amplifier **8**. When an excess current is generated in the power supply circuit **6** for the secondary battery **1**, an output that indicates an abnormality is generated in a voltage detection means by the sense amplifier **7** or a current detection means by the sense amplifier **8**, the switching element **3** is turned off by an output from the OR circuit **9** to shut off the power supply circuit **6**, such that the secondary battery **1** is protected.

[0007] However, a circuit such as the one described above in which an output of the voltage detection means **7** or the current detection means **8** is directly inputted in the battery protection circuit **10** has a problem. If a current or a voltage that is inputted in the battery protection circuit **10** is close to a threshold value, an output of the battery protection circuit **10** becomes unstable, such that the switching element **3** frequently turns on and off, which leads to a trouble in protecting the secondary battery **1**.

[0008] Furthermore, since the battery protection device **6** is independent of the microcomputer, their circuit space becomes large and the size of the apparatus becomes large.

[0009] The present invention is made in view of the problems described above, and its object is to provide a secondary battery protection device that enables miniaturizations through building a battery protection circuit in a microcomputer.

[0010] Another object of the present invention is to provide a secondary battery protection device in which a power supply circuit does not frequently turn on and off even when a current or a voltage inputted in a battery protection circuit is close to a threshold value.

SUMMARY OF THE INVENTION

[0011] To solve the problems described above, in accordance with the present invention, in a secondary battery protection device comprising a voltage detection means that detects a voltage of a power supply circuit including a secondary battery, a current detection means that detects a current of the power supply circuit, and a protection circuit that shuts off the power supply circuit based on a signal representing a detection made by the voltage detection means or the current detection means of an excess current that is generated in the power supply circuit, the secondary battery protection device is characterized in that the protection circuit is built in a microcomputer.

[0012] Also, the present invention is characterized in further comprising a latch that holds an input signal from the current detection means or the voltage detection means as is.

[0013] Furthermore, the present invention is characterized in that an output of the latch defines an interrupt request flag to the microcomputer.

[0014] Also, the present invention is characterized in that an output of the voltage detection means or the current detection means is directly inputted in an I/O register of the microcomputer to conduct an on-operation of the power supply circuit based on a judgment of the microcomputer.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] **FIG. 1** shows a circuit diagram of a secondary battery protection device in accordance with a first embodiment of the present invention.

[0016] **FIG. 2** shows a circuit diagram of a secondary battery protection device in accordance with a second embodiment of the present invention.

[0017] **FIG. 3** shows a circuit diagram of a conventional secondary battery protection device.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0018] Secondary battery protection circuits in accordance with embodiments of the present invention are described below with reference to the accompanying drawings. It is noted that members and functions that are the same as those indicated in **FIG. 3** are assigned the same reference numerals.

[0019] **FIG. 1** shows a first embodiment of the present invention. The figure shows a microcomputer **13** that is equipped with a CPU **11** and a system bus **14**. A battery protection circuit **10** is built in the microcomputer **13**. The battery protection circuit **10** is equipped with sense amplifiers having the same functions as those indicated in **FIG. 3**, in other words, a sense amplifier **7** for voltage detection and a sense amplifier **8** for current detection that is connected to a downstream side of a resistance **4**. An output side of the sense amplifier **7** is connected to the system bus **14**, and an output side of the sense amplifier **8** is connected to a latch **15**. Also, there is provided an OR circuit **9** which takes an OR of an output signal of the sense amplifier **7** and an output signal of the latch **15** to turn off a switching element **3** of a power supply circuit **6**.

[0020] Next, operations are described.

[0021] A voltage (Vcc) on the positive side of a secondary battery **1** is always detected by the sense amplifier **7**, and a current that flows through the resistance **4** is detected by the

sense amplifier **8**. When an excess current is generated in the power supply circuit **6**, an output that indicates the excess current is generated in a voltage detection means by the sense amplifier **7** or a current detection means by the sense amplifier **8**. In accordance with the present embodiment, an output of the sense amplifier **8** is inputted in the latch **15**, and its state is held there. An output of the latch **15** is inputted in an Logic circuit **9**, and an output from the Logic circuit **9** turns off the switching element **3** to thereby shut off the path of the secondary battery **1**.

[**0022**] In this manner, through inputting an output of the sense amplifier **8** in the latch **15** and holding its state, the discharge path of the secondary battery **1** is prevented from frequently turning on and off even when the level of an input to the sense amplifier **8** is close to a threshold value.

[**0023**] As shown in **FIG. 1**, it is possible to input an output of the latch **15** in the system bus **14** as an interrupt request flag. By so doing, an excess current detection state provided by the sense amplifier **8** can be promptly notified to the CPU **11**. Also, a state after the discharge path of the secondary battery **1** is shut off may be judged by software, so that the time required for a succeeding operation to restore the discharge path can be shortened.

[**0024**] Furthermore, in accordance with the present embodiment, an output of the sense amplifier **7** may be directly connected to an I/O register through the system bus **14**, such that an input voltage can be detected by the CPU **11** in real time without passing through a latch. In this manner, an input state can be detected by the CPU **11** in real time without being held. Therefore, for example, if a charger **2** is connected after the switching element **3** has been shut off, the CPU **11** can make a judgment as to if the voltage (Vcc) rapidly increases, and can immediately turn on the switching element **3** based on the judgment. Also, the CPU **11** may read an input state multiple times, such that noises can be removed in a pseudo manner by the software, and the interval and the number of input state judgments can also be set optionally by the software.

[**0025**] **FIG. 2** shows a second embodiment of the present invention.

[**0026**] In this embodiment, an Logic circuit **17** is provided in a preceding stage of the latch **15**; an output side of the sense amplifier **7** is connected to the system bus **14**, and also inputted in the Logic circuit **17**; and an output of the sense amplifier **8** is also inputted in the Logic circuit **17**. An OR of output signals of the sense amplifiers **7** and **8** is inputted in the latch **15**, and the switching element **3** is operated by an output of the latch **15**. It is noted that this embodiment is the same as the previous embodiment in that an output of the latch **15** is inputted in the system bus **14** as an interrupt request flag, an output of the sense amplifier **7** is directly connected to an I/O register through the system bus **14**, and an input voltage is detected in real time by the CPU **11**.

[**0027**] In this embodiment, both of a voltage input from the sense amplifier **7** and a current input from the sense amplifier **8** are held by the latch **15**, such that the discharge path of the secondary battery **1** is prevented from frequently turning on and off even when the levels of inputs to the sense amplifier **7** and the sense amplifier **8** are close to threshold values.

[**0028**] As described above, the present invention is effective in that, because the battery protection circuit is built in the microcomputer, a further device miniaturization can be achieved compared to the one in which they are structured independently from one another; and also, because a signal of the battery protection circuit can be inputted in the microcomputer, a judgment result provided can be used for on-off operations of the power supply circuit.

[**0029**] Also, the present invention is effective in that, because the latch is provided to hold an input signal from the voltage detection means or the current detection means as is, the discharge path of the secondary battery is prevented from frequently turning on and off even when the level of an input to the voltage detection means or the current detection means is close to a threshold value.

[**0030**] Also, the present invention is effective in that, because an output of the latch is used as an interrupt request flag to the microcomputer, an excess current detection state provided by the sense amplifier can be promptly notified to the CPU; and a state after the discharge path of the secondary battery is shut off may be judged by software, so that the time required for a succeeding operation to restore the discharge path can be shortened.

[**0031**] Also, the present invention is effective in that, because an output of the voltage detection means or the current detection means is directly inputted in an I/O register of the microcomputer, and on-operations of the power supply circuit can be conducted based on judgments by the microcomputer, the CPU can make a judgment as to if the charger is connected after the power supply circuit has been shut off, and can immediately turn on the switching element based on the judgment.

What is claimed is:

1. A secondary battery protection device comprising: a voltage detection means that detects a voltage of a power supply circuit including a secondary battery; a current detection means that detects a current of the power supply circuit; and a protection circuit that shuts off the power supply circuit based on a signal representing a detection made by the voltage detection means or the current detection means of an excess current that is generated in the power supply circuit, the secondary battery protection device characterized in that the protection circuit is built in a microcomputer.

2. A secondary battery protection device according to claim 1, characterized in further comprising a latch that holds an input signal from the current detection means or the voltage detection means as is.

3. A secondary battery protection device according to claim 1, wherein an output of the latch defines an interrupt request flag to the microcomputer.

4. A secondary battery protection device according to claim 1, wherein an output of the voltage detection means or the current detection means is directly inputted in an I/O register of the microcomputer to conduct an on-operation of the power supply circuit based on a judgment of the microcomputer.

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