

DESCRIPTION

TITLE OF INVENTION: POWER SUPPLY CONTROL DEVICE AND RETROFITTING
ELECTRONIC DEVICE FOR VEHICLE

5 CROSS REFERENCE TO RELATED APPLICATION

[0001]

This application is based on Japanese Patent Application No. 2016-199611 filed on October 10, 2016, the disclosure of which is incorporated herein by reference.

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TECHNICAL FIELD

[0002]

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The present disclosure relates to a power supply control device for controlling a power supply from a vehicle-mounted battery to a predetermined electronic circuit, and to a retrofitting electronic device for a vehicle in which the power supply control device is incorporated.

BACKGROUND ART

[0003]

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An automobile accessory may be added to a vehicle after shipment from a factory by a user, a dealer, or the like. In order to prevent a battery from running out due to the automobile accessory, it is preferable to cut off a power supply from the vehicle-mounted battery to the automobile accessory when the vehicle is parked (in other words, when the vehicle is not used).

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[0004]

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For that reason, as a device (hereinafter referred to as a power supply control device) for controlling the power supply from the vehicle-mounted battery to a predetermined electronic circuit such as an automobile accessory, there are many configurations in which a wire connection to an IG line or an ACC line is required. Further, Patent Literature 1 discloses a power supply control device that supplies the electric power to the automobile accessory and does not cut off energization while a communication with a vehicle-side computer is being carried out, using as a trigger the generation of noise

caused by an engine start or a start of the electric power supply to other vehicle-mounted devices in the battery voltage.

PRIOR ART LITERATURE

5 PATENT LITERATURE

[0005]

Patent Literature 1: JP 2012-148717 A

SUMMARY OF INVENTION

10 [0006]

According to the configuration disclosed in Patent Literature 1, whether or not the vehicle is in use (that is, in use state) is determined without wire connecting to the IG line or the ACC line. However, in the configuration of Patent Literature 1, there is a need to connect the power supply control device to the in-vehicle network in order to cause the power supply control device to communicate with the vehicle-side computer.

[0007]

On the other hand, it is difficult to determine whether the vehicle is in use or not from the presence or absence of noise generated in the battery voltage alone. This is because alternator noise is not generated in an electric vehicle which does not have an alternator, or in a hybrid vehicle which switches a driving unit between an engine and an electric motor. This is also because some engine vehicles have small alter ripples.

20 [0008]

It is an object of the present disclosure to provide a power supply control device and a retrofitting electronic device for a vehicle which enable an appropriate power supply control according to a usage state of the vehicle without requiring a connection to an in-vehicle network.

[0009]

30 According to a first aspect of the present disclosure, a power supply control device includes: a relay switch that switches a supply state of an electric power from a vehicle-mounted battery to a predetermined electronic circuit; a sensor that outputs an output signal functioning as an indicator of

whether or not a vehicle is traveling; a traveling state determination unit that determines whether or not the vehicle has started traveling and whether or not the vehicle has been parked based on a behavior of the output signal of the sensor per predetermined time; and a switch control unit that controls a connection state of the relay switch based on a determination result of the traveling state determination unit.

[0010]

According to the first aspect of the present disclosure, the traveling state determination unit determines whether or not the traveling of the vehicle is started and whether or not the vehicle is parked based on the output signal of the sensor. Determining whether or not the traveling of the vehicle has started and whether or not the vehicle has been parked corresponds to determining whether or not the vehicle is in use by the user (that is, a use state of the vehicle). In other words, the traveling state determination unit described above corresponds to a configuration for determining the use state of the vehicle based on an output signal of the sensor incorporated in the power supply control device.

[0011]

The switch control unit controls the connection state of the relay switch based on the determination result of the traveling state determination unit. The relay switch is a component for switching a power supply state of the electric power from the vehicle-mounted battery to a predetermined electronic circuit. For that reason, the control of the connection state of the relay switch by the switch control unit corresponds to the control of the supply state of the electric power from the vehicle-mounted battery to a predetermined electronic circuit (for example, an automobile accessory). In other words, according to the configuration described above, the power supply control can be realized according to the use state of the vehicle.

[0012]

Further, according to the first aspect of the present disclosure, the communication status with the vehicle side computer is not used in determining the use state of the vehicle. In other words, there is no need to connect to the in-vehicle network for the purpose of communicating the power

supply control device to the in-vehicle computer. In other words, the appropriate power supply control according to the use state of the vehicle can be performed without requiring a connection to the in-vehicle network.

[0013]

5 According to a second aspect of the present disclosure, the power supply control device according to the first aspect of the present disclosure is incorporated in a retrofitting electronic device for a vehicle. The retrofitting electronic device for a vehicle according to the second aspect of the present disclosure also exhibits the same effects as those of the first aspect of the present disclosure.

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BRIEF DESCRIPTION OF DRAWINGS

[0014]

The above and other objects, features and advantages of the present disclosure will become more apparent from the following detailed description made with reference to the accompanying drawings, in which:

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FIG. 1 is a block diagram showing a schematic configuration of a power supply control device;

FIG. 2 is a block diagram showing an example of a schematic configuration of a calculation unit;

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FIG. 3 is a diagram in which (A) to (E) show operation of each unit when the calculation unit detects a start of travel of the vehicle;

FIG. 4 is a diagram in which (A) to (E) show the operation of each unit when the calculation unit detects parking of the vehicle;

FIG. 5 is a flowchart illustrating the operation of the calculation unit;

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FIG. 6 is a diagram showing a modification of the configuration of the calculation unit;

FIG. 7 is a diagram in which (A) to (D) show the operation of each unit when the calculation unit detects the start of travel of the vehicle;

FIG. 8 is a diagram showing a modification of the configuration of the calculation unit;

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FIG. 9 is a diagram in which (A) to (D) show the operation of each unit when the calculation unit detects the start of travel of the vehicle;

FIG. 10 is a diagram in which (A) to (D) show the operation of each unit when the calculation unit detects the parking of the vehicle;

FIG. 11 is a block diagram showing a schematic configuration of a power supply control device;

5 FIG. 12 is a diagram illustrating one control mode of a switch control unit;

FIG. 13 is a diagram illustrating another control mode of the switch control unit; and

10 FIG. 14 is a diagram showing an application example of the power supply control device.

DESCRIPTION OF EMBODIMENTS

[0015]

15 Embodiments of the present disclosure will be described below with reference to the drawings. FIG. 1 is a diagram showing an example of a schematic configuration of a power supply control device 1 according to the present disclosure. The power supply control device 1 is a device for controlling a supply state of an electric power from a vehicle-mounted battery 2 to an automobile accessory 3. In this example, the automobile accessory 3 refers to an electronic device added to a vehicle interior after shipment from a factory.

[0016]

20 As shown in FIG. 1, the power supply control device 1 is provided between the vehicle-mounted battery 2 and the automobile accessory 3 in use. Specifically, the power supply control device 1 includes a positive input terminal, a negative input terminal, a positive output terminal, and a negative output terminal as input/output terminals for power supply, and the positive input terminal is electrically connected to a positive side terminal of the vehicle-mounted battery 2. The negative input terminal is electrically connected to a negative side terminal of the vehicle-mounted battery 2. The positive output terminal is electrically connected to a positive side terminal of the automobile accessory 3. The negative output terminal is electrically connected to a negative side terminal of the automobile accessory 3.

[0017]

The positive input terminal and the positive output terminal in the power supply control device 1 are connected to each other through a relay switch 11. The negative input terminal and the negative output terminal are electrically connected to each other inside the power supply control device 1.

[0018]

The relay switch 11 is a switch whose connection state (that is, ON/OFF) is switched based on a control signal input from a calculation unit 14 (to be described later). When the connection state of the relay switch 11 is set to ON, an output voltage of the vehicle-mounted battery 2 is applied to the positive output terminal, and an electric power of the vehicle-mounted battery 2 is supplied to the automobile accessory 3. When the connection state of the relay switch 11 is set to OFF, the power supply from the vehicle-mounted battery 2 to the automobile accessory 3 is cut off. The automobile accessory 3 corresponds to an electronic circuit described in the claims.

[0019]

As shown in FIG. 1, the power supply control device 1 includes a power supply circuit unit 12, an acceleration sensor 13, and a calculation unit 14 in addition to the relay switch 11. The power supply circuit unit 12 is a circuit module that converts an output voltage of the vehicle-mounted battery 2 (hereinafter referred to as a battery voltage) into a predetermined operating voltage suitable for the operation of the power supply control device 1. In other words, the power supply circuit unit 12 serves as an internal power supply for supplying an electric power from the vehicle-mounted battery 2 to other elements of the power supply control device 1 (for example, the calculation unit 14).

[0020]

The acceleration sensor 13 is a well-known sensor for detecting an acceleration acting on the power supply control device 1. As the acceleration sensor 13, for example, a three-axis acceleration sensor that detects an acceleration in each of three axial directions orthogonal to each other can be employed. In the present embodiment, as an example, the acceleration sensor 13 is an analog three-axis acceleration sensor. The acceleration sensor

13 has three output terminals corresponding to three detection axes, and a voltage signal indicating an acceleration acting in the axial direction corresponding to each of the three output terminals is input to the calculation unit 14 from the output terminal.

5 [0021]

Since the power supply control device 1 is used in the vehicle, an acceleration corresponding to a behavior of the vehicle acts on the power supply control device 1. More specifically, when the vehicle is traveling, an acceleration in a vertical direction caused by unevenness of a road surface or
10 an acceleration in a horizontal direction corresponding to an acceleration and deceleration operation acts on the power supply control device 1. When the vehicle is turning, a centrifugal force acts on the power supply control device 1. When the vehicle includes an engine as a driving source, an acceleration attributable to vibration of the engine acts.

15 [0022]

When the vehicle is traveling on a road as described above, the acceleration sensor 13 detects components other than gravity. In other words, an output signal of the acceleration sensor 13 functions as an indicator of whether or not the vehicle is traveling. Therefore, the acceleration sensor 13
20 corresponds to a sensor defined in the claims.

[0023]

For the sake of convenience, the acceleration acting on a vehicle body due to the unevenness of the road surface will be referred to as a ground vibration component hereinafter. The acceleration acting on the vehicle body
25 by driving the engine is referred to as an engine vibration component. The ground vibration component becomes relatively large when the vehicle is traveling on a road with many irregularities, a bridge, or the like.

[0024]

The calculation unit 14 is a component that determines whether or not
30 the vehicle has started traveling and whether or not the vehicle has been parked based on the output signal of the acceleration sensor 13, and switches ON/OFF of the relay switch 11 according to the determination result. The calculation unit 14 is realized with the use of a CPU 141, a ROM 142, a RAM

143, input/output circuits not shown, and the like.

[0025]

The ROM 142 is a nonvolatile storage medium, and the RAM 143 is a volatile storage medium. The ROM 142 stores a program (hereinafter referred to as a power supply control program) for causing a normal computer to function as the calculation unit 14 in the present embodiment. The calculation unit 14 causes the CPU 141 to execute the power supply control program, thereby causing various functions to be described later to be expressed.

[0026]

It should be noted that the power supply control programs may be stored in a non-transitory tangible storage medium (transitory tangible storage medium). The execution of the power control program by the CPU 141 corresponds to the execution of a method corresponding to the power supply control program.

[0027]

<Functions of Calculation Unit 14>

Next, the function of the calculation unit 14 will be described with reference to FIG. 2. As an example, a description will be given of a mode in which the calculation unit 14 determines whether or not the vehicle has started traveling according to the presence or absence of the ground vibration component and whether or not the vehicle has been parked, and controls the connection state of the relay switch 11 based on the determination result.

[0028]

The calculation unit 14 includes a band-pass filter (hereinafter referred to as a band-pass filter (BPF)) 144, a detection unit 145, a comparator 146, a traveling state determination unit F1, and a switching control unit F2 as functional blocks for realizing the control described above.

[0029]

Although the band-pass filter (hereinafter referred to as BPF) 144, the detection unit 145, and the comparator 146 are shown only one by one, those components are provided for each output terminal of the acceleration sensor 13. Hereinafter, for convenience, each member will be described with respect to a signal output from a certain output terminal among the three output

terminals of the acceleration sensor 13.

[0030]

The BPF 144 is a filter circuit designed to pass ground vibration components included in the output signal of the acceleration sensor 13. A specific range of frequencies in which the ground vibration components may exist (hereinafter, the ground vibration frequency band) may be specified by a test. The BPF 144 passes signals belonging to the ground vibration frequency band, while the BPF 144 attenuates components other than the ground vibration frequency band. The output signal of the BPF 144 is input to the detection unit 145. The BPF 144 corresponds to a vibration component extraction unit defined in the claims.

[0031]

In FIG. 3, (A) and (B) are graphs conceptually representing the operation of the BPF 144 with respect to the output signal of the acceleration sensor 13. (A) of FIG. 3 represents the output signal of the acceleration sensor 13, and (B) of FIG. 3 represents the output signal of the BPF 144. When the output signal of the acceleration sensor 13 is input to the BPF 144, only the ground vibration component is transmitted to the detection unit 145, which is an element of a subsequent stage. In each graph, a horizontal axis represents a time.

[0032]

The detection unit 145 is an analog circuit (so-called envelope detection circuit) for extracting an envelope component of an output signal from the BPF 144. The output signal of the detection unit 145 is input to the comparator 146. (C) of FIG. 3 shows a transition of the output signal of the detection unit 145 with respect to the output signal of the BPF 144 shown in (B) of FIG. 3.

[0033]

As shown in (D) of FIG. 3, the comparator 146 is a component (for example, a circuit) that outputs a high level signal when the output signal of the detection unit 145 is equal to or greater than a predetermined traveling determination threshold Th_d . The comparator 146 outputs a low level signal when the output signal of the detection unit 145 is lower than the traveling

determination threshold Th_d . The fact that the comparator 146 outputs the high level signal means that an amplitude of the ground vibration component becomes equal to or greater than the traveling determination threshold Th_d . The traveling determination threshold Th_d introduced in this example is a threshold for determining that there is a possibility that the vehicle is traveling. A specific value of the traveling determination threshold Th_d may be appropriately designed.

[0034]

The traveling state determination unit F1 is a functional block for determining whether or not the traveling of the vehicle is started and whether or not the vehicle is parked, based on a signal input from the comparator 146. The traveling state determination unit F1 is realized by the CPU 141 executing the power supply control program described above.

[0035]

As another mode, the traveling state determination unit F1 may be realized as hardware with the use of one or more ICs or the like. Further, the traveling state determination unit F1 may be realized by a combination of software execution and hardware. The BPF 144, the detection unit 145, and the comparator 146 described above may also be implemented by analog circuits, or may be implemented digitally by software processing by CPUs, for example.

[0036]

As shown in (D) and (E) of FIG. 3, when a state in which the output level of the comparator 146 is at the high level continues for a predetermined traveling determination time Tr_n or longer, the traveling state determination unit F1 determines that the travel of the vehicle has been started.

[0037]

The traveling state determination unit F1 includes a traveling determination timer as a sub-function for performing the above determination. The traveling determination timer is a timer for measuring an elapsed time after the output signal of the comparator 146 has transitioned from the low level to the high level. The traveling determination timer starts counting with the input of the high level signal from the comparator 146 as a trigger, and

when the count value becomes a value corresponding to the traveling determination time T_{rn} , the traveling determination timer is in an expiration state. However, when the output of the comparator 146 becomes a low level before the timer expires, the traveling determination timer resets the count value. That is, the traveling determination timer expires when the state in which the comparator 146 is outputting the high level signal continues for the traveling determination time T_{rn} or longer.

[0038]

When the traveling determination timer expires, the traveling state determination unit F1 determines that the travel of the vehicle has started, and sets a traveling flag to ON. The traveling flag is a flag for processing, and is set to OFF in a state (hereinafter, an initial state) in which an initialization process, which will be described later) is executed. A setting state (that is, on/off) of the traveling flag is used to determine whether or not the relay switch 11 is turned on.

[0039]

Further, as shown in FIG. 4, when the state in which the output of the comparator 146 is at the low level continues for a predetermined mask time of T_{msk} , the traveling state determination unit F1 determines that the vehicle has been parked. This is because the ground vibration component should be observed when the vehicle is traveling. In other words, the fact that the output of the comparator 146 is at the low level means indirectly that the vehicle may be stopped.

[0040]

A mask time T_{msk} introduced in this example is an element for separating a state in which the vehicle is stopped from a state in which the vehicle is parked. The mask time T_{msk} is designed to be larger than a maximum value of a time assumed as a stop time of the vehicle, for example, an assumed value of a display switching time of a traffic signal, or a value larger than an assumed value of a maximum stop time attributable to traffic congestion. A specific value of the mask time T_{msk} may be appropriately designed. In this example, it is assumed that the mask time T_{msk} is set to 10 minutes as an example.

[0041]

Whether or not the state in which the output of the comparator 146 has been at the low level has continued for a predetermined mask time Tmsk may be determined with the use of a timer (hereinafter referred to as a parking determination timer) that measures the elapsed time since the output of the comparator 146 has been at the low level.

[0042]

The parking determination timer starts counting with a low level signal input from the comparator 146 as a trigger in a state in which the traveling flag is set to ON, and when the count value becomes a value corresponding to the masking time Tmsk, the parking determination timer is in an expiration state. However, when the output of the comparator 146 becomes at the high level before the timer expires, the parking determination timer resets the count value, and the parking determination timer stops the operation until the output of the comparator 146 becomes at the low level. When the parking determination timer expires, the traveling state determination unit F1 determines that the vehicle has been parked, and sets the traveling flag to OFF.

[0043]

Incidentally, in the present embodiment, as an example, three signal processing paths from the BPF 144 to the comparator 146 are provided in accordance with the number of output terminals (in other words, the number of detection axes) of the acceleration sensor 13. In other words, a signal is input from each of the three comparators 146 to the traveling state determination unit F1.

[0044]

When three signal processing paths from the BPF 144 to the comparators 146 are provided as in the present embodiment, the traveling state determination unit F1 executes the determination processing described above for each of the three inputs. If any of the three inputs satisfies the condition that the traveling flag should be set to ON, the traveling state determination unit F1 turns on the traveling flag. When all of the three inputs satisfy the condition for turning off the traveling flag, the traveling state determination unit F1 may turn off the traveling flag.

[0045]

The switch control unit F2 is a functional block for controlling ON/OFF of the relay switch 11 based on the determination result of the traveling state determination unit F1. The switching control unit F2 is realized by the CPU
5 141 executing the power supply control programs described above. As another mode, the switch control unit F2 may be realized with the use of one or more ICs or the like, similarly to the traveling state determination unit F1.

[0046]

The switch control unit F2 determines whether or not the relay ON
10 condition is satisfied based on the determination result of the traveling state determination unit F1. The relay ON condition is a condition for switching the connection state of the relay switch 11 from OFF to ON. As an example, it is assumed that the relay ON condition is determined to be satisfied when it is determined by the traveling state determination unit F1 that the vehicle has
15 started traveling, that is, when the traveling flag has been set to ON.

[0047]

When it is determined that the relay ON condition is satisfied, the switch control unit F2 outputs a control signal (hereinafter referred to as an ON signal) to the relay switch 11 to switch the connection state from OFF to ON.
20 When the relay switch 11 receives the ON signal, the relay switch 11 switches to the ON state.

[0048]

In addition, the switch control unit F2 determines whether or not the relay OFF condition is satisfied based on the determination result of the
25 traveling state determination unit F1. The relay OFF condition is a condition for switching the connection state of the relay switch 11 from ON to OFF. As an example, it is assumed that the relay OFF condition is determined to be satisfied when the vehicle is determined to be parked by the traveling state determination unit F1, that is, when the traveling flag is set to OFF.

[0049]

When it is determined that the relay OFF condition is satisfied, the switch control unit F2 outputs a control signal (hereinafter referred to as an OFF signal) to the relay switch 11 to switch the connection state from ON to

OFF. When the relay switch 11 receives the OFF signal, the relay switch 11 switches to the OFF state.

[0050]

FIG. 5 is a flowchart schematically showing an operating mode of the power supply control device 1. The flowchart shown in FIG. 5 may be started when the power supply control device 1 is connected to the vehicle-mounted battery 2 and the electric power is supplied to the calculation unit 14.

[0051]

First, in Step S1, an operating system (hereinafter referred to as OS) (not shown) of the power supply control device 1 executes an initialization process, and the process proceeds to Step S2. In an initialization process, checking of the RAM 143, reading of programs stored in the ROM 142, reading of initial setting values of parameters for various calculations, and the like are performed. Upon completion of the initialization process, the process proceeds to Step S2.

[0052]

In Step S2, the switch control unit F2 determines whether or not the relay ON condition is satisfied based on the determination result of the traveling state determination unit F1. When it is determined that the relay ON condition is satisfied, an affirmative determination is made in Step S2, and the process proceeds to Step S3. In Step S3, the switch control unit F2 outputs an ON signal to the relay switch 11, and the process proceeds to Step S4. With the execution of Step S3, the relay switch 11 is turned on, and the electric power of the vehicle-mounted battery 2 is supplied to the automobile accessory 3.

[0053]

On the other hand, when the relay ON condition is not satisfied, a negative determination is made in Step S2, and the process returns to Step S2. In other words, the process waits for the relay ON condition to be satisfied. If the power supply to the power supply control device 1 is cut off during the repetitive execution of Step S2, the flow ends.

[0054]

In Step S4, the switch control unit F2 determines whether or not the

relay OFF condition is satisfied based on the determination result of the traveling state determination unit F1. When it is determined that the relay OFF condition is satisfied, an affirmative determination is made in Step S4, and the process proceeds to Step S5. In Step S5, the OFF signal is output to the relay switch 11, and the process proceeds to Step S6. Upon execution of Step S5, the relay switch 11 is turned off, and the power supply to the automobile accessory 3 is cut off.

[0055]

On the other hand, when the relay OFF condition is not satisfied, a negative determination is made in Step S4, and the process returns to Step S4. In other words, the process waits for the relay OFF condition to be satisfied. If the power supply to the power supply control device 1 is cut off during the repetitive execution of Step S4, the flow ends.

[0056]

In Step S6, the OS determines whether or not the power supply is cut off. Whether or not the power supply is cut off may be determined based on the voltage level input to the power supply circuit unit 12. For example, when the voltage level input to the power supply circuit unit 12 becomes equal to or lower than a predetermined threshold value, it is determined that the power supply is cut off. The case where the power supply is cut off is, for example, a case where the power supply control device 1 is detached from the vehicle-mounted battery 2. If the power supply is not cut off, the process returns to Step S1. On the other hand, when the power supply is cut off, the flow ends.

[0057]

In the configuration described above, it is determined whether or not the vehicle has started traveling and whether or not the vehicle has been parked, based on the output signal of the acceleration sensor 13 incorporated in the power supply control device 1. The relay switch 11 is turned on until it is determined that the vehicle has been parked after the determination of start of the drive of the vehicle. When it is determined that the vehicle has been parked, the relay switch 11 is turned off.

[0058]

Further, determining whether the vehicle has started traveling and

whether the vehicle has been parked corresponds to determining whether the vehicle is in use by the user (that is, the use state of the vehicle). In other words, according to the configuration described above, the use state of the vehicle can be determined based on the output signal of the acceleration sensor 13 incorporated in the power supply control device 1, and the power supply control to the automobile accessory 3 according to the use state of the vehicle can be realized.

[0059]

Further, in the configuration described above, signals of an IG line and an ACC line are not used for determination of the use state of the vehicle. Therefore, the power supply control device 1 only needs to be connected to the battery line (so-called "B line"), and does not need to be wire-connected to the IG line or the ACC line of the vehicle.

[0060]

Further, in the configuration described above, the presence or absence of noise generated in the battery voltage is not used in determination of the use state of the vehicle. Therefore, according to the configuration described above, even in a vehicle such as an electric vehicle or a hybrid vehicle in which alternator noise is not superimposed on the battery voltage, or in an engine vehicle in which alternation is small, a supply control of the electric power according to the use state of the vehicle can be realized.

[0061]

Further, in the configuration described above, a communication state with the vehicle side computer is not used in determining the use state of the vehicle. In other words, there is no need to connect to the in-vehicle network for the purpose of communicating the power supply control device 1 with the vehicle-side computer. In other words, the appropriate power supply control according to the use state of the vehicle can be performed without requiring a connection to the in-vehicle network.

[0062]

Although the embodiment of the present disclosure is described above, the present disclosure is not limited to the embodiment and may include the following modifications. Furthermore, various changes may be made in the

present disclosure within the scope not departing from the gist of the present disclosure. For example, plural modifications may be combined.

[0063]

Members having the same functions as the members described in the above embodiment are denoted by the same reference numerals, and description thereof is omitted. Further, when only a partial configuration is described, the configuration of the above-described embodiment can be applied to the other portions.

[0064]

[Modification 1]

In the embodiment described above, the detection unit 145 for performing the envelope detection is provided between the BPF 144 and the comparators 146, but the present disclosure is not limited to the above configuration. For example, as shown in FIG. 6, a configuration without the detection unit 145 may be employed.

[0065]

However, in such cases, the output levels of the comparators 146 may vary in a pulsed manner depending on the output of the BPF 144, as shown in FIG. 7. For that reason, the traveling state determination unit F1 includes a traveling determination timer and a reset timer as sub-functions for determining whether or not the vehicle has started traveling.

[0066]

The traveling determination timer is a timer that measures an elapsed time from the start of the comparator 146 outputting the high level signal, similarly to the embodiment described above. However, the traveling determination timer is not reset immediately even if the output of the comparator 146 becomes at the low level. The traveling determination timer is reset when the reset timer has expired.

[0067]

The reset timer is a timer for measuring a time T_{lw} during which the output of the comparator 146 continues to be at the low level in a state in which the traveling determination timer is started. The reset timer starts counting when the output of the comparator 146 becomes at the low level in a

state in which the traveling determination timer is started. Then, when a count value indicating the time Tlw during which the low level continues becomes a value corresponding to a predetermined low level allowable time Tlmt, the count value becomes in an expiration state. That is, the traveling determination timer according to Modification 1 is reset when a state in which the output of the comparator 146 is at the low level is continued for the predetermined low level allowable time.

[0068]

The low level allowable time Tlmt introduced in this example is a parameter for determining whether or not the driving is started from the output of the acceleration sensor 13 in the configuration in which the output of the comparator 146 varies in a pulsed shape in the same manner as that in the embodiment described above. The specific value of the low level allowable time Tlmt may be determined in accordance with a center frequency of the ground vibration frequency band, an upper limit frequency, a lower limit frequency, and the like. For example, the low level allowable time may be a value obtained by doubling a reciprocal of the center frequency of the ground vibration frequency band. In another embodiment, the low level allowable time Tlmt may be an inverse of the lower limit frequency of the ground vibration frequency band.

[0069]

Whether or not the vehicle is parked may be determined by employing the same determination logic as that in the embodiment described above. This is because when the vehicle is parked, the output of the comparator 146 should stabilize at a low level without vibrating. Such a configuration also achieves the same effects as those of the embodiment described above. In addition, the configuration of the power supply control device 1 can be simplified by omitting the detection unit 145.

[0070]

[Modification 2]

In the embodiment and Modification 1 described above, the mode of determining whether or not the vehicle has started traveling and whether or not the vehicle has been parked based on the presence or absence of the

ground vibration component is disclosed, but the present disclosure is not limited to the above configuration. For example, various states may be determined based on the presence or absence of an engine vibration component. In such a case, a design may be made so that an engine vibration component included in the output signal of the acceleration sensor 13 passes through the BPF 144.

[0071]

The range of frequencies in which the engine vibration component may exist (hereinafter referred to as the engine vibration frequency band) may be specified by an actual test or simulation. For example, the range of the frequencies may be determined in accordance with a distribution range of a rotation speed of the engine. If it is assumed that a rotational speed of the engine is mainly distributed from 1000 rpm to 5000 rpm, the BPF 144 may be designed to pass components of 17 Hz to 84 Hz.

[0072]

The BPF 144 may be designed to pass both of the engine vibration frequency band and the ground vibration frequency band. According to such a configuration, it can be determine whether or not the vehicle has started traveling and whether or not the vehicle has been parked, based on both the ground vibration component and the engine vibration component. For convenience, a component obtained by combining the engine vibration component and the ground vibration component is referred to as a vehicle body vibration component.

[0073]

[Modification 3]

The traveling state determination unit F1 may determine whether or not the vehicle has started traveling and whether or not the vehicle has been parked, using a component derived from the acceleration and deceleration operation of the vehicle, which is included in the output signal of the acceleration sensor 13. In that case, as shown in FIG. 8, the output signal of the acceleration sensor 13 may be input to a comparator 148 through a low-pass filter (hereinafter, referred to as LPF) 147.

[0074]

In this example, the acceleration and deceleration operation of the vehicle will be described on the assumption that the acceleration and deceleration operation is performed by a user as a driver, but the present disclosure is not limited to this example. The acceleration and deceleration operation of the vehicle may be performed by an electronic control device providing a self-driving function. That is, the driver may be an electronic control device.

[0075]

In the following description, in order to distinguish the traveling determination time T_{rn} and the mask time T_{msk} from various parameters to be described later, the traveling determination time T_{rn} and the mask time T_{msk1} will be referred to as a first traveling determination time T_{rn1} and a first mask time T_{msk} , respectively.

[0076]

An LPF 147 introduced in Modification 3 is a filter which passes a component having a frequency lower than a predetermined cutoff frequency and decreases a component having a frequency higher than a cutoff frequency. The LPF 147 is configured to pass signals in a frequency band in which the component derived from an acceleration and deceleration operation of the user (hereinafter, an acceleration and deceleration operation component) can be distributed, but not to pass an engine vibration component and a ground vibration component. The LPF 147 corresponds to an acceleration and deceleration operation component extraction unit defined in the claims.

[0077]

A range of frequencies in which the acceleration and deceleration operation component can be distributed in the output signal of the acceleration sensor 13 (hereinafter referred to as the acceleration and deceleration frequency band) may be specified by a test or the like. It is assumed that a general user does not perform a sudden acceleration and deceleration operation too frequently. Except for the sudden acceleration and deceleration operation, the acceleration components generated by accelerator operation and braking operation are distributed up to several Hz at most. For that reason, it is assumed here that the LPF 147 is configured so as to pass signals up to 3 Hz

(in other words, the cutoff frequency is 3 Hz).

[0078]

5 An output signal of the LPF 147 is input to the comparator 148, and the output signal is compared with a predetermined acceleration and deceleration determination threshold $Th\beta$. The comparator 148 is a component that outputs a high level signal when the output signal of the LPF 147 is equal to or greater than the predetermined acceleration and deceleration determination threshold $Th\beta$. When the output signal of the LPF 147 is lower than the acceleration and deceleration determination threshold $Th\beta$, the comparator 148
10 outputs a low level signal. The high level of the output of the comparator 146 means that the user is performing the acceleration and deceleration operation. A specific value of the acceleration and deceleration determination threshold $Th\beta$ may be appropriately designed.

[0079]

15 Then, as shown in FIG. 9, when the state in which the comparator 148 outputs the high level signal continues for a predetermined second traveling determination time $Trn2$ or longer, the traveling state determination unit F1 determines that the travel of the vehicle has been started, and sets the traveling flag from off to on.

20 [0080]

Further, as shown in, when the condition in which the comparator 148 outputs the low level signal continues for a predetermined second mask time $Tmsk2$ or longer, the traveling state determination time unit F1 determines that the vehicle has been parked and sets the traveling flag to OFF. The various
25 elapsed times may be measured in the same manner as described in the embodiments.

[0081]

The configuration described above also exhibits the same effects as those of the embodiments and various modifications described above.
30 Although the engine vibration and the ground vibration may occur constantly during traveling, there is a possibility that the acceleration and deceleration operation accompanied by the traveling start is not observed after reaching a predetermined speed. For that reason, it is preferable that the second

traveling determination time Trn2 is substantially equal to the first traveling determination time Trn1 or a value equal to or less than the first traveling determination time Trn1. For example, the second traveling determination time Trn2 is preferably set to 3 seconds, 5 seconds, or the like.

5 [0082]

For the same reason, it is preferable that the second mask time Tmsk2 is also set to be longer than the first mask time Tmsk1. For example, the second mask time Tmsk2 is preferably set to a value of about 5 minutes to 30 minutes. The second mask time Tmsk2 is set to a relatively long value, the possibility that the relay switch 11 is erroneously turned off even though the vehicle is traveling at a constant speed can be reduced. Similarly, the possibility that the relay switch 11 is turned off erroneously despite the fact that the vehicle is in use as the first mask time Tmsk1 is longer can be reduced.

10 [0083]

15 However, since the state in which the power supply to the automobile accessory is maintained continues as the various masking times are set to be longer, the remaining power of the vehicle-mounted battery 2 is likely to be lost. In other words, the longer the various masking times are set, the more the amount of electric power of the vehicle-mounted battery 2 consumed by the automobile accessory 3 can be reduced. Incidentally, a state in which the remaining power of the vehicle-mounted battery 2 is lost corresponds to a state in which the battery runs out.

20 [0084]

[Modification 4]

25 The condition in which the traveling state determination unit F1 determines that the vehicle has started traveling may be appropriately designed. For example, it may be determined that the traveling of the vehicle has been started when the traveling determination condition set for the vehicle body vibration component is satisfied and the traveling determination condition set for the acceleration and deceleration operation component is satisfied.

30

[0085]

The traveling determination condition set for the vehicle body vibration component is that the high level signals are continuously output from the

comparator 146 for the first traveling determination time Trn1 or longer. The traveling determination condition set for the acceleration and deceleration operation component means that the high level signal is continuously output from the comparators 148 for the second traveling determination time Trn2 or longer.

[0086]

As another mode, it may be determined that the travel of the vehicle is started when the traveling determination condition set for the vehicle body vibration component is satisfied or the traveling determination condition set for the acceleration and deceleration operation component is satisfied.

[0087]

[Modification 5]

The condition in which the traveling state determination unit F1 determines that the vehicle has been parked may also be designed as appropriate. For example, the traveling state determination unit F1 may determine that the vehicle has been parked when the parking determination condition set for the vehicle body vibration component is satisfied and the parking determination condition set for the acceleration and deceleration operation component is satisfied.

[0088]

The parking determination condition set for the vehicle body vibration component means that the low level signal is continuously output from the comparator 146 for the first mask time Tmsk1 or longer. The parking determination condition set for the acceleration and deceleration operation component means that the low level signal is continuously output from the comparator 148 for the second mask time Tmsk2 or longer.

[0089]

As another mode, it may be determined that the vehicle has been parked when the parking determination condition set for the vehicle body vibration component is satisfied or the parking determination condition set for the acceleration and deceleration operation component is satisfied.

[0090]

[Modification 6]

When it is assumed that the power supply control device 1 is used in the vehicle including the alternator, the power supply control device 1 may control ON/OFF of the relay switch 11 by using both the presence or absence of noise derived from the operation of the alternator (hereinafter referred to as "alternator noise") and the determination result of the traveling state determination unit F 1. The above configuration is shown below as Modification 6.

[0091]

As shown in FIG. 11, the power supply control device 1 in Modification 6 includes a noise detection unit F3 that detects noise superimposed on the battery voltage. The noise detection unit F3 detects a voltage variation caused by driving of the alternator as noise. The noise detection unit F3 may be configured to detect, as noise, a voltage drop generated at the time of starting the engine or a voltage drop attributable to the start of power supply to another vehicle-mounted device, in addition to the alternator noise.

[0092]

A well-known configuration can be applied to the configuration for detecting the alternator noise. As an example, it is assumed that the noise detection unit F3 is realized by the configuration disclosed in Patent Literature 1. When detecting that noise is included in the battery voltage, the noise detection unit F3 outputs a signal indicating that the noise has been detected (hereinafter referred to as a noise detection signal) to the calculation unit 14.

[0093]

The noise detection unit F3 determines the presence or absence of noise in a predetermined detection cycle, and outputs a noise detection signal each time noise is detected. When the alternator is driven, noise is constantly superimposed on the battery voltage. For that reason, when the alternator is driven, the noise detection unit F3 is expected to output a noise detection signal to the calculation unit 14 every detection cycle.

[0094]

The switch control unit F2 manages whether or not an alternator noise is generated depending on whether or not a noise detection signal is input from the noise detection unit F3. Specifically, when the noise detection signal

is input from the noise detection unit F3, a noise flag is set to ON. The noise flag is a processing flag indicating whether or not an alternator noise has occurred, and is set to OFF in an initial state.

[0095]

5 The switch control unit F2 sets the noise flag to OFF when the state in which the noise detection signal is not input continues for a predetermined time (hereinafter, determination holding time) in the state in which the noise flag is ON. In other words, the switch control unit F2 sets the noise flag to OFF when the noise detection signal has not been input for the determination
10 holding time since the last input of the noise detection signal.

[0096]

 The case where the noise detection signal is not input means that there is a possibility that the alternator is in a stopped state. In other words, the state in which the noise detection signal is not input suggests the possibility
15 that the vehicle in which the power supply control device 1 is used is parked. On the other hand, the fact that the alternator has stopped does not necessarily mean that the vehicle has been parked. This is because, in the case where the driver performs idling stop, or in the case where a system that automatically stops the engine while the vehicle is stopped is mounted on the
20 vehicle, the alternator stops along with the engine stop even when the vehicle is stopped.

[0097]

 Similarly to the first masking time Tmsk1, the determination holding time introduced in this example is an element for separating the stop from the parking, and is designed to have a value larger than a maximum value of the
25 expected stop time. The specific value of the determination holding time may be appropriately designed. It is also assumed that the determination holding time is set to a value sufficiently larger than a detection cycle of the noise detection unit F3 (for example, a value of 10 times or more).

[0098]

30 Then, the switch control unit F2 controls ON/OFF of the relay switch 11 based on the determination result of the traveling state determination unit F1 and the detection result of the noise detection unit F3. In other words, the

ON/OFF of the relay switch 11 is controlled based on the respective setting states of the traveling flag and the noise flag.

[0099]

For example, as shown in FIG. 12, when at least one of the traveling flag and the noise flag is set to ON, the switch control unit F2 determines that the relay ON condition is satisfied, and sets the relay switch 11 to the ON state. When both of the traveling flag and the noise flag are set to OFF, it is determined that the relay OFF condition is satisfied, and the relay switch 11 is set to an OFF state.

[0100]

According to the control mode described above, the relay switch 11 is easily set to ON as compared with the embodiment described above and the like. For example, even if the acceleration sensor 13 cannot detect the movement of the vehicle, the relay switch 11 can be set to ON when the alternator noise can be detected. In other words, the possibility that the relay switch 11 remains OFF even though the vehicle is used by the user can be reduced.

[0101]

As another mode, as shown in FIG. 13, only when both of the traveling flag and the noise flag are set to ON, it may be determined that the relay ON condition is satisfied, and the relay switch 11 may be set to the ON state. In that case, when at least one of the traveling flag and the noise flag is set to OFF, it is determined that the relay OFF condition is satisfied, and the relay switch 11 is set to the OFF state.

[0102]

According to the control mode described above, the relay switch 11 is easily set to OFF, and the possibility that the vehicle-mounted battery 2 runs out can be reduced. In any case, with utilization of not only the determination result of the traveling state determination unit F1 but also the presence or absence of the alternator noise for the relay ON condition and the relay OFF condition, more appropriate power supply control according to the use state of the vehicle can be realized.

[0103]

[Modification 7]

In the embodiments described above and the like, the mode in which the acceleration sensor 13 is an analog type acceleration sensor is disclosed, but the present disclosure is not limited to the above mode. The acceleration
5 sensor 13 may be a digital acceleration sensor. In such a case, the respective members such as the BPF 144 may also be realized with the use of digital circuit elements. The functions of the BPF 144, the detection unit 145, the comparators 146, and the like may be realized by the CPU 141 executing the software. The same applies to the LPF 147 and the comparator 148.

10 [0104]

[Modification 8]

Although a configuration in which a signal processing path such as the BPF 144 signal processing path is provided for each of the three detection axes of the acceleration sensor 13 has been disclosed above, the present disclosure
15 is not limited to the above configuration. The three-axis combination acceleration may be calculated from the detection values of the respective axes of the acceleration sensor 13, and the three-axis combination acceleration may be used to determine whether or not the travel of the vehicle has been started and whether or not the vehicle has been parked. In this example, the three-
20 axis combination acceleration is a sum of squares of detection values for each axial direction.

[0105]

The configuration for executing the calculation of the three-axis combination acceleration (hereinafter, the acceleration combination unit) may
25 be disposed immediately after an output stage of the acceleration sensor 13, such as between the acceleration sensor 13 and the BPF 144 or between the acceleration sensor 13 and the LPF 147. According to the configuration described above, the signals input to the traveling state determination unit F1 can be grouped together.

30 [0106]

[Modification 9]

In Modification 6 described above, a mode in which both of the determination result of the traveling state determination unit F1 and the

detection result of the noise detection unit F3 are used in both the relay ON condition and the relay OFF condition is disclosed, but the present disclosure is not limited to the above configuration.

[0107]

5 For example, while both of the determination result of the traveling state determination unit F1 and the detection result of the noise detection unit F3 are used as the relay OFF condition, a control mode in which the determination result of the traveling state determination unit F1 is not used may be adopted as the relay ON condition. In that case, when the noise
10 detection unit F3 detects noise, that is, when the noise flag is switched from OFF to ON, it is considered that the relay ON condition is satisfied, and the relay switch 11 is set to the ON state.

[0108]

15 According to the mode described above, when the relay switch is OFF, since there is only a need to supply the electric power only to the noise detection unit F3, a dark current during parking can be reduced. Specific examples are as follows.

[0109]

20 If a digital acceleration sensor is employed as the acceleration sensor 13 as mentioned in Modification 7, there is a need to constantly supply the electric power also to the CPU or the like. Since the CPU generally consumes a large amount of current, the dark current increases when a digital acceleration sensor is employed as the acceleration sensor 13. In order to cope with such a concern, according to the configuration of Modification 9,
25 since the dark current during parking can be reduced, the possibility that the battery runs out can be further reduced.

[0110]

30 Further, the relay switch 11 can be turned OFF at a more appropriate timing as compared with a configuration in which the determination is made by only the noise superimposed on the battery voltage. Specifically, the possibility that the relay switch 11 is maintained in the ON state even though the vehicle is not in use (that is, parked), or is turned OFF even when the vehicle is in use can be reduced.

[0111]

[Modification 10]

The switch control unit F2 may be configured to switch off the relay switch 11 when a duration of the state in which the relay switch 11 is set to ON reaches a predetermined upper limit time. In this example, the upper limit time is a value determined in accordance with an assumed value of the continuous use time of the vehicle, and may be, for example, 4 hours. It is needless to say that the upper limit time may be another value (for example, 6 hours).

[0112]

According to the above embodiment, even when the ON state of the relay switch 11 continues without the traveling state determination unit F1 or the noise detection unit F3 operating normally, the relay switch 11 may be forcibly turned OFF over time. As a result, the possibility that the battery runs out can be reduced.

[0113]

[Modification 11]

In the above description, a mode in which the power supply control device 1 is provided outside the automobile accessory has been disclosed, but the present disclosure is not limited to the above configuration. As shown in FIG. 14, the power supply control device 1 may be built in the automobile accessory 3 as a power supply control module 1A.

[0114]

The power supply control module 1A is responsible for controlling a power supply state to the other modules 31 included in the automobile accessory 3. The specific configuration and control mode of the power supply control module 1A may employ the embodiments and various modifications described above, and combinations of those embodiments and modifications. The power supply control module 1A described above also corresponds to a power supply control device defined in the claims. In addition, the automobile accessory 3 in which the power supply control module 1A is built-in (in other words, to which the power supply control device 1 is applied) corresponds to a retrofitting electronic device for a vehicle defined in the claims. The module

31 corresponds to an electronic circuit as defined in the claims.

[0115]

According to the mode of Modification 11, the number of devices installed in the vehicle interior space can be reduced, and a space in the vehicle interior can be made clear. In many cases, an acceleration sensor is incorporated in a retrofitting car navigation apparatus. When a power supply control module 1A as the power supply control device 1 is built in the automobile accessory 3 in which such an acceleration sensor is provided in advance, an existing acceleration sensor can be used. For that reason, the cost of introducing the power supply control module 1A can be reduced.

[0116]

[Modification 12]

In the above description, a configuration has been disclosed in which the acceleration sensor is employed as a sensor (hereinafter, an index information sensor) whose output signal functions as an indicator of whether or not the travel of the vehicle is traveling, but the present disclosure is not limited to the above configuration. In addition to the acceleration, a sensor for detecting a physical state amount that changes with the travel of the vehicle, such as an angular velocity, an angular acceleration, an azimuth angle, a vehicle position, or the like, can be employed as the index information sensor. In other words, a gyro sensor, a geomagnetic sensor, a GNSS receiver, or the like may be used as the index information sensor.

[0117]

Even in the case of using a sensor other than the acceleration sensor, there is only a need to determine whether or not the travel of the vehicle has been started and whether or not the vehicle has been parked on the basis of the behavior per predetermined time. When a sensor outputting consecutive values such as a gyro sensor is used, the vehicle body vibration component and the acceleration and deceleration operation component are extracted with the use of a BPF 144 or an LPF 147, and the above determination can be performed with the use of the extracted components.

[0118]

Further, the index information sensor may be a switch element

configured so that the contact state of the movable contact with respect to the fixed contact is changed (in other words, vibrated) by the vehicle body vibration component. The output of such a switch element, when the vehicle is traveling, outputs a pulsed signal because the terminals repeatedly come into contact with and come away from each other due to a vehicle body vibration component or the like. On the other hand, when the vehicle is parked, the contact state between the terminals is stabilized by one of contact and non-contact, so that the pulsed signal is not output. In other words, the switch element described above can also be used as the index information sensor.

[0119]

Although the present disclosure is described based on the above embodiments, the present disclosure is not limited to the embodiments and the structures. Various changes and modification may be made in the present disclosure. Furthermore, various combination and formation, and other combination and formation including one, more than one or less than one element may be made in the present disclosure.

CLAIMS

1. A power supply control device comprising:
 - a relay switch that switches a supply state of an electric power from a vehicle-mounted battery to a predetermined electronic circuit;
 - a sensor that outputs an output signal functioning as an indicator of whether or not a vehicle is traveling;
 - a traveling state determination unit that determines whether or not the vehicle has started traveling and whether or not the vehicle has been parked based on a behavior of the output signal of the sensor per predetermined time;
 - a noise detection unit that detects noise superimposed on an output voltage of the vehicle-mounted battery; and
 - a switch control unit that
 - controls the relay switch from OFF to ON based on a detection result of the noise detection unit without using a determination result of the traveling state determination unit, and
 - controls the relay switch from ON to OFF based on the detection result of the noise detection unit and the determination result of the traveling state determination unit.
2. The power supply control device according to claim 1, wherein the switch control unit
 - sets the relay switch from OFF to ON when the noise detection unit has detected the noise, and
 - sets the relay switch to OFF when the traveling state determination unit determines that the vehicle has been parked and a state where the noise is not detected by the noise detection unit continues for a predetermined determination holding time.
3. The power supply control device according to claim 1 or 2, wherein the sensor is an acceleration sensor,
 - the power supply control device further comprises an vibration component extraction unit that extracts an vibration component generated by traveling of the vehicle from an output signal of the acceleration sensor as the

sensor, and

the traveling state determination unit determines that the vehicle has started traveling when a state in which a magnitude of the vibration component extracted by the vibration component extraction unit is equal to or greater than a predetermined traveling determination threshold continues for a predetermined traveling determination time.

4. The power supply control device according to claim 3, wherein
the traveling state determination unit determines that the vehicle has been parked when a state in which the magnitude of the vibration component extracted by the vibration component extraction unit is less than the predetermined traveling determination threshold continues for a predetermined mask time.

5. The power supply control device according to claim 1 or 2, wherein
the sensor is an acceleration sensor,
the power supply control device further comprises an acceleration and deceleration operation component extraction unit that extracts an acceleration and deceleration operation component from an output signal of the acceleration sensor as the sensor,
the acceleration and deceleration operation component is a component generated when a driver performs an operation of accelerating and decelerating the vehicle, and
the traveling state determination unit determines that the vehicle has started traveling when a state in which a magnitude of the acceleration and deceleration operation component extracted by the acceleration and deceleration operation component extraction unit is equal to or greater than a predetermined acceleration and deceleration determination threshold continues for a predetermined traveling determination time.

6. The power supply control device according to claim 5, wherein
the traveling state determination unit determines that the vehicle has been parked when a state in which the magnitude of the acceleration and

deceleration operation component extracted by the acceleration and deceleration operation component extraction unit is less than the predetermined acceleration and deceleration determination threshold continues for a predetermined mask time.

7. A retrofitting electronic device for a vehicle, the retrofitting electronic device incorporating the power supply control device according to any one of claims 1 to 6.