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POWER SUPPLY PROTECTION

The present invention relates to paging receivers, and more particularly to power supplies thereof.

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Generally, a paging receiver is called a "pager", and it has a buzzer, a vibration motor, a lamp and a liquid crystal display circuit, etc, as devices which notify a user of received data when the data are received. The pager receives and demodulates the data when data are applied thereto as radio signals. Then the pager notifies a user of a call by driving the buzzer or the vibration motor, etc, when the data are confirmed as a call to the user's own paper and simultaneously produces the received data on the liquid crystal display circuit. Therefore, when the buzzer or the vibration motor is driven, the user notices the call by confirming the liquid crystal display circuit. Further, a paging receiver or system usually has a battery as a power supply source and checks whether or not its voltage maintains a reference value by sensing the battery voltage at all times.

Figure 1 of the accompanying diagrammatic drawings is a flow chart for checking the battery voltage in a prior art pager system.

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The flow chart in Figure 1 is performed in a central processing unit (hereinafter referred to as CPU) of the pager system which is located in an external memory.

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The CPU performs a normal operation in a step 2a, checks the battery voltage in a step 2b and, if the battery voltage is lower than a predetermined reference value after checking the battery voltage in the step 2b, generates a

low voltage alert and displays its state on a liquid crystal display circuit in a step 2c. The CPU checks the battery voltage by periodically repeating the operation from step 2a to step 2c.

5 Meanwhile, the paging receiver has two modes for notifying a user of received data, when the data are applied thereto. One is a normal mode in which the user notices the received data as an audible signal through a buzzer, and the other is a memory mode in which the user notices the received data by physically sensing a vibration caused by driving of a vibration motor.

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 However, if the battery voltage of the paging receiver is in low state, currents of about 70 mA or 100 mA are typically consumed when the buzzer or the vibration motor in the normal mode or the memory mode is operated, so that the battery voltage may drop greatly. In this case, the paging receiver
15 may be disabled or reset, thereby causing messages being received and previously received and stored to be erased.

 However, a method such as is illustrated in the flow chart of Figure 1 could not solve problems occurring in the memory mode or the normal mode,
20 because it detects the low voltage state only when data are received.

 Preferred embodiments of the present invention aim to provide a method for preventing the loss of received data even if a power source voltage, e.g, a battery voltage, falls below a predetermined reference value.

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 According to a first aspect of the present invention, there is provided a method for protecting message data in a paging receiver in case of a low power supply state, the method comprising the steps of:

checking whether a power supply is in a low power supply state, during a normal state of operation;

5 de-energizing a buzzer, a vibration motor and a lamp included in said paging receiver during said low power supply state, thereby to reduce current flow in the receiver; and

10 displaying said low power supply state on display means and then returning to said power supply checking step.

According to a second aspect of the present invention, there is provided a method for protecting message data in a paging receiver having normal and memory modes of operation, in case of low power supply state, the method comprising the steps of:

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checking whether a power supply is in a low power supply state, during a normal state of operation;

20 de-energizing first alarm means or second alarm means included in said paging receiver in response to said respective modes, during said low power supply state, thereby to reduce current flow in the receiver; and

25 displaying said low power supply state on display means, and then returning to said power supply checking step.

Preferably, said first alarm means comprises a vibration motor.

Preferably, said second alarm comprises a buzzer and a lamp.

Preferably, said de-energizing step comprises the steps of:

checking said modes of operation;

5 generating a buzzer and lamp disable signals when said paging receiver is in said normal mode of operation, thereby to de-energize said buzzer and lamp; and

10 generating a motor disable signal when said paging receiver is in said memory mode, thereby to de-energize said vibration motor.

The invention also extends to a paging receiver provided with power supply checking and control means adapted to operate in accordance with a method according to any of the preceding aspects of the invention.

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For a better understanding of the invention and to show how the same may be carried into effect, reference will now be made, by way of example, to Figures 2 to 4 of the accompanying diagrammatic drawings, in which:

20 Figure 2 is a block diagram of one example of a paging receiver embodying the present invention;

Figure 3 is a flow chart for illustrating an example of a first method according to the present invention; and

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Figure 4 is a flow chart for illustrating an example of a second method according to the present invention.

Referring to Figure 2, a low voltage detection and radio frequency circuit 10 receives a radio frequency signal through an antenna 1, and restores data by amplifying, filtering, demodulating and frequency-converting the received signal, and then detects whether a power supply source is in a low voltage state. An auxiliary control circuit 20 receiving the received data 6 and a low voltage detection signal 7, output from the low voltage detection and radio frequency circuit 10, performs preamble detection and word synchronization detection, etc, and generates a lamp control signal 5, a buzzer control signal 4 and a motor control signal 3. The reference numerals 8 and 9 indicate a battery save control signal and a quick charge control signal respectively. A driving circuit 30, receiving the lamp control signal 5, the buzzer control signal 4 and the motor control signal 3, amplifies currents of these control signals to supply a lamp 33, a buzzer 32 and a vibration motor 31, respectively. A main control circuit 40 supplies data to the auxiliary control section 20, is supplied with data therefrom, and controls each of a number of circuits, and a memory 50 generates data under the control of the main control circuit 40 in a state that a cap code, etc, is previously stored. A display circuit 60 displays received data under the control of the main control circuit 40. A mode switching circuit 70 assigns a normal mode or a memory mode to the main control circuit 40, and a power source stabilizer 80 supplies the main control circuit 40 and the auxiliary control circuit 20 with operation voltage by controlling a battery 90 voltage in order to operate the main control circuit 40 and the auxiliary control circuit 20. The power regulator 80 may be implemented with SCI7661, single chip, available from Seiko Epson Co.

Referring to Figure 3, the flow chart includes the steps of checking whether or not the battery voltage is low state in a state of a normal operation

performance, reducing current consumption by cutting off the control signals of the buzzer, the vibration motor and the lamp if the battery voltage state is low state as a result of checking the voltage state, displaying low voltage state on the display circuit after performing the current consumption reduction process, and then returning to the voltage checking step.

This embodiment of the present invention will become more apparent from the following description given with reference to the Figures 2 and 3.

10 The main control circuit 40 operates the paging receiver normally in a step 3a and periodically checks whether or not the voltage of the battery 90 is low state in a step 3b. If the voltage of the battery 90 is low state, the main control circuit 40 advances to a step 3c, and, if the voltage is not low state, the main control circuit 40 returns to the step 3a. In the step 3b, there
15 is no problem when the voltage of the battery is not low state, but if it is low state, the main control circuit 40 disables the buzzer 32 and the vibration motor 31, etc, which may consume a current of about 70mA or 100mA, in order not to consume excessive current. In other words, the main control circuit 40 provides the auxiliary control circuit 20 with predetermined data,
20 and the auxiliary control circuit 20 disables the buzzer control signal 4, the motor control signal 3, etc, thereby causing the buzzer 32 and the vibration motor 31 not to be operated.

25 On the other hand, generally, the selection mode switch of a paging receiver includes a normal mode producing a buzzer tone to notify a user when data are received; a memory mode in which a user senses vibration by the vibration of a vibration motor; and an off mode which turns power off.

Figure 4 shows another embodiment which checks the battery voltage state and differentiates subsequent control to take into account the above-described modes.

5 In Figure 4, the same steps as those shown in Figure 3 are designated by like reference numerals and otherwise they are designated by different reference numerals. The steps having different reference numerals will be mainly described because the steps having the same reference numerals have the same function as before.

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 If the voltage of the battery 90 is determined as a low voltage state in the step 3b, it is followed by a step 4a where it is checked whether or not the mode switch circuit 70 assigns a normal mode to the main control circuit 40. If the normal mode is assigned to main control circuit 40, the main control
15 circuit 40 cuts off the buzzer control signal 4 and the lamp control signal 5 in a step 4c. If the normal mode is not assigned to the main control circuit 40 in the step 4a, the main control circuit 40 advances to the step 4b to disable the vibration motor control signal 3. After performing the steps 4b and 4c, the lamp 33, the buzzer 32 and the vibration motor 31 are disabled so that the
20 lamp 33, the buzzer 32 and the vibration motor 31 can not operate as they are not supplied with driving current from the driving circuit 30. Accordingly, even though data is received when the voltage of the battery 90 is a low state, there is no sudden power consumption due to activation of the alarms. Therefore, it does not occur that the main control circuit 40 is reset. After
25 performing the steps 4b or 4c, the main control circuit 40 notifies the liquid crystal display circuit 60 that data have been received and also displays a low-voltage state message in the step 3d as shown in Figure 3, and then returns to the step 3a.

Thus, in the above-described example of a method of the present invention, the main control circuit controls the buzzer, the vibration motor and the lamp having significant current consumption in response to the mode selection switch, even if data are received when the battery which is a main power source is in a low voltage state, thereby preventing their operation. Thus, the main control circuit may be prevented from being reset by a sudden drop of the battery voltage.

Further, loss of data can be prevented even if there exists previously received data.

CLAIMS:

1. A method for protecting message data in a paging receiver in case of a low power supply state, the method comprising the steps of:

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checking whether a power supply is in a low power supply state, during a normal state of operation;

de-energizing a buzzer, a vibration motor and a lamp included in said
10 paging receiver during said low power supply state, thereby to reduce current flow in the receiver; and

displaying said low power supply state on display means and then returning to said power supply checking step.

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2. A method for protecting message data in a paging receiver having normal and memory modes of operation, in case of low power supply state, the method comprising the steps of:

20 checking whether a power supply is in a low power supply state, during a normal state of operation;

de-energizing first alarm means or second alarm means included in said
paging receiver in response to said respective modes, during said low power
25 supply state, thereby to reduce current flow in the receiver; and

displaying said low power supply state on display means, and then returning to said power supply checking step.



3. A method as claimed in claim 2, wherein said first alarm means comprises a vibration motor.

4. A method as claimed in claim 2 or 3, wherein said second alarm
5 comprises a buzzer and a lamp.

5. A method as claimed in claim 2, 3 or 4, wherein said de-energizing step comprises the steps of:

10 checking said modes of operation;

generating a buzzer and lamp disable signals when said paging receiver is in said normal mode of operation, thereby to de-energize said buzzer and lamp; and

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generating a motor disable signal when said paging receiver is in said memory mode, thereby to de-energize said vibration motor.

6. A method of checking power supply state in a paging receiver and
20 controlling operation of the receiver in response to such checking, the method being substantially as hereinbefore described with reference to Figures 2 and 3 or Figures 2 and 4 of the accompanying drawings.

7. A paging received provided with power supply checking and control
25 means adapted to operate in accordance with a method according to any of the preceding claims.

