

METHOD AND APPARATUS FOR PROGRAMMABLE LOW CELL
ALERT IN A PORTABLE ELECTRONIC DEVICE

Field of the Invention

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This invention relates in general to portable electronic devices, and in particular to a method and apparatus for programmably alerting a user that an energy cell in a portable electronic device is low in stored power.

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Background of the Invention

With the consumer desire for portable electronic devices, many electronic devices have become much smaller and include one or more energy storage cells, called batteries, for storing power to operate the portable electronic device. One such portable electronic device is a portable radio pager which receives paging messages selectively addressed to the pager. After hours of operation on the battery, the stored power becomes depleted and the portable electronic device no longer operates. Typically, the electronic device includes a monitoring system which monitors the stored power of the battery and notifies the user of a "low cell" condition, i.e., the stored power is approaching depletion. This allows the user to remove the battery and replace it with a fresh battery or place the electronic device in a charger to recharge the battery.

Conventionally, the user is notified by activation of a user perceptible alert such as an audible alert or a visual alert or a combination thereof. The visual alert typically takes the form of a predetermined pattern appearing on an output display to indicate the "low cell" condition.

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However, the visual and/or audible alert requires use of the quickly depleting stored battery energy to



notify the user of the "low cell" condition. Typically, the conventional "low cell" alert results in the battery being completely discharged, sometimes before the user has become notified of the "low cell" condition. The user
5 may, for example, be away from his pager at the time the "low cell" alert is activated because he is asleep, he is away from his desk where he left his pager, or he is traveling on business and his pager is left behind.

Thus, what is needed is a more energy efficient and
10 more reliable method and apparatus for notifying the user that a "low cell" condition exists.

Summary of the Invention

15 Accordingly, in one form there is provided a method in an electronic device operated by a battery to alert the user of a low cell condition. The method comprises the steps of monitoring energy output of the battery to determine whether a low cell condition exists, monitoring a real time clock to
20 determine whether time is within a predetermined partial day alert period, and activating a user perceptible alert only if the low cell condition exists and the time is within the predetermined partial day alert period.

In another form there is provided a portable electronic
25 device designed to receive operating energy from a stored energy cell. The portable electronic device comprises a stored energy monitoring circuit for coupling to the stored energy cell to measure the operating energy thereof and for generating a low cell signal if the operating energy falls
30 below a predetermined threshold value. The portable electronic device also comprises a clock for generating a time signal indicative of real time, an output device for providing information to a user, and a controller coupled to the stored energy monitoring circuit and the clock for
35 providing an activation signal to the output device to generate a user perceptible low cell alert in response to



detection of the low cell signal and determination that the time signal is within a predetermined time period.

Brief Description of the Drawing

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FIG. 1 is a block diagram of a portable radio pager in accordance with the preferred embodiment of the present invention.

10 FIG. 2 is a flow chart of the operation of the controller of the portable radio pager of FIG. 1 in accordance with conventional "low cell" alerting capability.

15 FIGS. 3 and 4 are flow charts of the operations of the controller of the portable radio pager of FIG. 1 in accordance with the preferred embodiment of the present invention.

Detailed Description of the Invention

20 Referring to FIG. 1, the portable radio pager 10 receives a paging signal via an antenna 12 for provision to receiver circuitry 14. The receiver circuitry 14 receives and demodulates the signal and provides the demodulated signal to a microprocessor 16.

25 The microprocessor 16 comprises a controller 18, an address correlator 20, a decoder 22, a battery saver circuit 24, and a battery energy monitoring circuit 26. A real time clock 30 is implemented in the controller 18 to supply a time signal indicative of real time for the purposes of registering the time of day.

30 The controller 18 controls the processing of the signal and other functions of the selective call receiver 10 in accordance with information stored in a code plug memory 28. The code plug memory 28 is typically an electrically erasable programmable read only memory (EEPROM) and stores bits of information which define the operational parameters of the portable radio pager 10. In



accordance with the present invention, the code plug memory 28 comprises a bit which is set to "1" if a low cell alert option is enabled or "0" if the low cell alert option is not enabled. A second bit is set to "0" if a
5 full day low cell alert option is enabled or "1" if a partial day low cell alert option is enabled. The operation of the partial day/full day low cell alert option is shown in FIGs. 3 and 4, and is described below.

Referring back to the microprocessor 16 of FIG. 1,
10 the address correlator 20 is coupled to the controller for receiving addresses assigned to the portable radio pager 10 therefrom, the addresses stored in the code plug memory 28 and retrieved therefrom by the controller 18. The address correlator utilizes the addresses for examining
15 the demodulated signal by attempting to correlate the addresses with the signal to determine whether one of the addresses is present therein. If one of the addresses assigned to the portable radio pager 10 is identified, the address correlator 20 signals the controller 18. The
20 decoder 22 decodes the demodulated signal in accordance with a predetermined paging protocol and provides the decoded signal to the controller 18.

When a decoded message is received, the controller 18 provides the decoded message to a display driver 32 for
25 presentation on a visual display device 34 and to a random access memory (RAM) 36 for storage therein. The controller 18 also sends a signal to an alert device 38 to activate a sensible message alert to advise a user that the message has been received and can be presented by
30 activation of user controls 40. The alert device 38 may comprise an annunciator for generating an audible alert, a vibrator for generating a tactile alert, or a visual alert generator for generating a visual alert, or any combination of alert devices.

35 The radio pager 10 is designed to receive operating energy from a stored energy cell 42, such as a battery. The radio pager typically comprises two high power

consuming sections, the receiver circuitry 14 and output devices 44. The battery 42 is coupled to the receiver circuitry 14 via the battery saver circuit 24. The battery saver circuit 24 operates in any of a variety of conventional, protocol-dependent modes under the control of the controller 18 to alternately connect and disconnect the power supplied from the battery 42 to the receiver circuitry 14. The battery 42 is also coupled to output devices 44, including the display 34 and display driver 32 and the alert device 38. The output devices are activated by signals from the controller 18. All other power to the radio pager 10 passes through the controller 18 via the battery energy monitoring circuit 26. In accordance with the present invention, the battery energy monitoring circuit 26 measures the energy output of the battery 42 and provides a signal 46 to the controller 18 indicative of the present value of the energy output of the battery 42. The controller 18 examines the signal 46 to determine if a low cell condition exists.

Referring next to FIG. 2, a flow chart of the operation of the controller 18 in accordance with a conventional low cell alert option is shown. Conventional low cell alert options utilize a single bit in the code plug memory 28. If the bit is set to "0", the low cell alert option is enabled; if the bit is set to "1", the low cell alert option is not enabled.

In accordance with operation of the conventional low cell alert option, after powering up (50) the portable radio pager 10, the controller 16 examines the signal 46 to monitor the battery energy output (52) and determines whether the battery energy output is less than a predetermined threshold (54). If the battery energy output is less than a predetermined threshold (54), the controller 18 examines the code plug memory 28 to determine if the low cell alert option is enabled or not (56).



If the low cell alert option is not enabled (56), the low cell alert option routine is exited (58). If the low cell alert option is enabled (56) and the low cell condition exists (54), the low cell alert is activated (60) by sending a signal to the output devices 44 to present a predetermined output to the user. The low cell alert (60) continues to be activated until the user responds (62). The user's response may be activation of one of the user controls 40 or replacement of the battery 42.

Typically, the predetermined output includes activating the alert device 38 for a predetermined time or until activation of one of the user controls 40, thereby presenting an audible alert to draw the user's attention to the display 34. The predetermined output also typically includes presenting a predetermined message on the display 34 indicating the low cell condition. The predetermined message is ordinarily presented on the display 34 until the low cell condition is remedied by replacement of the battery 42.

The conventional low cell alert option activates the high power consuming output devices 44 without regard to whether the user may be in proximity of the radio pager 10. The already low energy battery 42 is further depleted of stored energy by activation of the low cell alert until a user provides a response. When a user is not near the radio pager when the low cell alert is activated, this could cause the battery 42 to be completely discharged, resulting in total loss of battery power to the radio pager 10. This could result in the loss of messages stored in the RAM 36 and the missing of additional messages, decreasing the reliability of the pager, particularly in some of today's radio pagers which continue to receive messages in a reduced power mode after the user has turned the pager "OFF".

The drawback of conventional low cell alert options as described above has been overcome by the invention as



shown in FIGs. 3 and 4. The present invention realizes that there are times during the day that the user normally is not in proximity of the pager. FIG. 3 describes a process to define a partial day period for enabling the low cell alert in accordance with the preferred embodiment of the present invention, and FIG. 4 describes the partial day low cell alert option of the present invention.

Referring next to FIG. 3, after powering up (70) the portable radio pager 10, the controller 18 examines the code plug memory 28 to determine whether the low cell alert is enabled (72). If the low cell alert option is not enabled (72), the controller 18 determines whether the user has been prompted to enable the low cell alert option (74). If the user has previously been prompted to enable the low cell alert option (74) and the low cell alert option is not enabled (72), the controller 18 exits (76) the routine of FIG. 3.

If the user has not been previously prompted to enable the low cell alert option (74), the controller 18 activates the display driver 32 to display (78) the message "ACTIVATE LOW CELL ALERT" on the display 34. Processing returns to determine if the user has enabled the low cell alert option (72).

If the low cell alert option is enabled (72), the controller 18 examines the code plug memory 28 to determine whether the partial day alert period is enabled (80). If partial day alert period is not enabled (80), the controller 18 determines whether the user has been prompted to select either the full day low cell alert option or the partial day low cell alert option (82). If the user has previously been prompted to select the full day or partial day low cell alert option (82) and the partial day low cell alert option is not enabled (80), the controller 18 exits (84) the routine of FIG. 3.

If the user has not been previously prompted to select the full day or partial day low cell alert option (82), the controller 18 activates the display driver 32 to



display (86) the message "SELECT FULL DAY/PARTIAL DAY ALERT PERIOD" on the display 34. Processing returns to determine if the user has enabled the partial day alert period (80).

5 When the partial day alert period option is enabled (80), the controller 18 activates the display driver 32 to display (88) the message "DEFINE PARTIAL DAY ALERT PERIOD" on the display 34. From information received via the user controls 40, the partial day period is defined (90). The
10 controller 18 then stores (92) the defined partial day period and exits (94) the partial day alert period definition routine of FIG. 3.

 While the partial day alert period definition routine of FIG. 3, describes how the partial day alert
15 period is defined when the radio pager 10 is powered up in accordance with the preferred embodiment of the present invention, other methods could be employed to define the partial day alert period. For example, the partial day alert period could be preset to the most likely fourteen
20 hours of operation between eight a.m. and ten p.m. Also, controller 18 could be prompted to enter the routine of FIG. 3 at regular intervals or in response to a change of the setting of one of the two bits of the code plug memory 28 which control the operation of the low cell alert
25 routine.

 Referring next to FIG. 4, a flow chart of the operation of the controller 18 in accordance with the low cell alert option of the present invention is shown. After powering up (100) the portable radio pager 10, the
30 controller 16 examines the signal 46 to monitor the battery energy output (102) and determines whether the battery energy output is less than a predetermined threshold (104). When the battery energy output is less than a predetermined threshold (104), the controller 18
35 examines the code plug memory 28 to determine if the low cell alert option is enabled or not (106).



If the low cell alert option is not enabled (106), the low cell alert option routine is exited (108). If the low cell alert option is enabled (106), the controller 18 again examines the code plug memory 28 to determine if the full day alert period option is enabled or not (110). If the full day alert period option is enabled (106), the low cell alert is activated (112) by sending a signal to the output devices 44 to present a predetermined output to the user. Since the full day alert period option is selected (110), the low cell alert (112) continues to be activated until the user responds (114).

In accordance with the preferred embodiment of the present invention, if the full day alert period option is not enabled (110), the partial day alert period option is activated. The controller 18 examines the time signal generated by the real time clock 30 and indicative of present time to determine if the time is within the defined partial day period (116). If the battery energy output has fallen below the predetermined threshold (104) at a time during the defined partial day period (116), the low cell alert is activated (112) by sending a signal to the output devices 44 to present a predetermined output to the user and the low cell alert (112) continues to be activated until the user responds (114) or the defined partial day period is exhausted (116).

If the battery energy output has fallen below the predetermined threshold (104) at a time outside the defined partial day period (116), i.e., a time when the user is normally not in proximity to the radio pager 10, the present invention advantageously conserves power by not generating the low cell alert (112). It can be seen that if the battery energy output has fallen below the predetermined threshold (104) at a time outside the defined partial day period (116), the low cell alert (112) will not be generated until the defined partial day period commences (116), thereby conserving battery power by optimally activating the low cell alert (112) when there



is a high probability that the user is in proximity to the radio pager 10 and can thus sense the low cell alert (112) and respond thereto (114) .

Thus, the low cell alert option of the present invention activates the high power consuming output devices 44 only at times defined to be times when the user is normally in proximity to the radio pager 10. The already low energy of the battery 42 is advantageously conserved by activation of the low cell alert at optimally defined times. At times when a user is normally not near the radio pager to the low cell alert is not activated, preventing the battery 42 from becoming totally discharged, and avoiding the loss of messages stored in the RAM 36 and the missing of additional messages. The present invention is particularly beneficial when operating in today's radio pagers which continue to receive messages in a reduced power mode after the user has turned the pager "OFF".

By now it should be appreciated that there has been provided a more energy efficient and more reliable method and apparatus for notifying the user that a "low cell" condition exists.

We claim:





CLAIMS

1. A method for alerting the user of a low cell condition in an electronic device operated by a battery, the
5 method comprising the steps of:

monitoring energy output of the battery to determine whether a low cell condition exists;

monitoring a real time clock to determine whether time is within a predetermined partial day alert period; and

10 activating a user perceptible alert only if the low cell condition exists and the time is within the predetermined partial day alert period.

2. The method of Claim 1 further comprising the step of
15 user selectably defining the predetermined partial day alert period.

3. The method of Claim 1 wherein the step of monitoring the energy output of the battery to determine whether a low
20 cell alert condition exists comprises the steps of:

measuring the energy output of the battery; and

determining that a low cell condition exists if the energy output of the battery is less than a predetermined threshold value.

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4. The method of Claim 1 wherein the step of activating the user perceptible alert comprises the step of activating a visual display device only if the low cell condition exists and the time is within the predetermined partial day alert
30 period.

5. The method of Claim 1 wherein the step of activating the user perceptible alert comprises the step of activating an audible alert device only if the low cell condition exists
35 and the time is within the predetermined partial day alert period.

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6. The method of Claim 1 wherein the step of activating the user perceptible alert comprises the steps of:
activating a visual display device; and
intermittently activating an audible alert device.

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7. The method of Claim 1 further comprising the step of not activating a user perceptible alert if the low cell condition exists but the time is not within the partial day alert period.

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8. A portable electronic device designed to receive operating energy from a stored energy cell, the portable electronic device comprising:

5 a stored energy monitoring circuit for coupling to the stored energy cell to measure the operating energy thereof and for generating a low cell signal if the operating energy falls below a predetermined threshold value;

a clock for generating a time signal indicative of real time;

10 an output device for providing information to a user; and

a controller coupled to the stored energy monitoring circuit and the clock for providing an activation signal to the output device to generate a user perceptible low cell alert in response to detection of the low cell signal and
15 determination that the time signal is within a predetermined time period.

9. The portable electronic device of Claim 8 wherein
20 the output device comprises a visual display device which generates a unique display indicating a low cell condition exists in response to reception of the activation signal.

10. The portable electronic device of Claim 8 wherein
25 the output device comprises an annunciator which generates a unique audible alert indicating a low cell condition exists in response to reception of the activation signal.

11. The portable electronic device of Claim 8 wherein
30 the output device comprises:

a visual display device which generates a unique visual display indicating a low cell condition exists in response to reception of the activation signal; and

an annunciator which intermittently generates a unique
35 audible alert to draw a user's attention to the visual display device.

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12. The portable electronic device of Claim 8 further comprising a memory coupled to the controller for storing information defining the predetermined time period.

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13. A selective call receiver which receives operating power from a battery coupled thereto, the selective call receiver comprising:

5 a stored energy monitoring circuit for coupling to the battery to measure the operating energy thereof and for generating a low cell signal if the operating energy falls below a predetermined threshold value;

a clock for generating a time signal indicative of real time;

10 an output device for providing information to a user; and

a controller coupled to the stored energy monitoring circuit and the clock for providing an activation signal to the output device to generate a user perceptible low cell alert in response to detection of the low cell signal and determination that the time signal is within a predetermined partial day alert period and for conserving power by not providing the activation signal to the output device in response to determining that the time signal is not within
20 the predetermined partial day alert period.

14. The selective call receiver of Claim 13 wherein the output device comprises a display which generates a unique visual display indicating a low cell condition exists in
25 response to reception of the activation signal.

15. The selective call receiver of Claim 13 wherein the output device comprises an alert annunciator which generates a unique audible tone indicating a low cell condition exists
30 in response to reception of the activation signal.





16. The selective call receiver of Claim 13 wherein the output device comprises:

a display which generates a unique visual display indicating a low cell condition exists in response to
5 reception of the activation signal; and

an annunciator which intermittently generates a unique audible tone to draw a user's attention to the visual display.

10 17. The selective call receiver of Claim 13 further comprising a memory coupled to the controller for storing information defining the predetermined partial day alert period.

15 18. The selective call receiver of Claim 16 further comprising:

a code plug memory for storing at least one address assigned to the selective call receiver;

a receiver for receiving and demodulating selective call
20 signals;

an address correlator coupled to the code plug memory and the receiver for correlating the demodulated selective call signal with the at least one address to determine whether one of the at least one address is present in the
25 demodulated selective call signal; and

a decoder for decoding the demodulated selective call signal to derive a message therefrom in response to one of the at least one address being present in the demodulated selective call signal, and

30 wherein the controller activates the annunciator to notify the user that the message has been received and provides the message to the display.

