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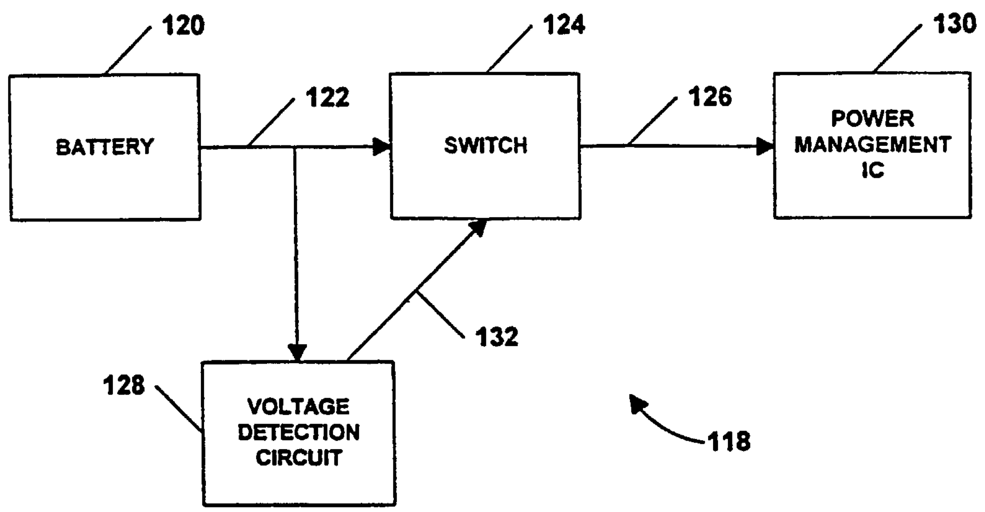
(54) Title: AUTOMATIC POWER-ON FEATURE FOR WIRELESS COMMUNICATION DEVICE



(57) Abstract: A wireless communication device includes an automatic power-on function. The function is implemented by a voltage detection circuit (128) or software that detects a change in voltage level provided by a power source (120) from a low level to a high level. This voltage level change usually indicates a battery change. Upon detection of a voltage level change from low to high, the wireless device is powered on automatically, eliminating the need for a user to manually power on the device. The voltage detection circuit controls switching means (124) between the power supply (120) and processor (130), and causes the switch to connect the power source (120) to the processor (130) on detecting the voltage level change. The switching means (124) is a capacitor that creates a voltage spike that is detected by the detection circuit (128).

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AUTOMATIC POWER-ON FEATURE FOR WIRELESS COMMUNICATION DEVICE

Field of the Invention

The present invention relates generally to radio or wireless communications and, more particularly, relates to an automatic power-on function after exchange of a battery in a wireless communication device.

Background of the Invention

The advent of wireless personal communications devices has revolutionized the telecommunications industry. Cellular, PCS and other services provide wireless personal communications to businesses and individuals at home, in the office, on the road, and any other locations the wireless network reaches. Wireless telephone subscribers no longer have to use pay telephones along the road, or wait until they return home or to the office to check messages and return important business calls. Instead, wireless subscribers carry out their day to day business from their cars, from the jobsite, while walking along the airport concourse, and just about anywhere their signals are accessible.

Thus, it is no surprise that since the introduction of the cellular telephone service, the number of wireless telephone subscribers has increased steadily. Today, the number of wireless telephone subscribers is staggering and still growing rapidly. In fact, many households have multiple wireless telephones in addition to their conventional land-line services.

With a market of this size, there is fierce competition among hardware manufacturers and service providers. In an attempt to lure customers, most providers offer handsets with desirable features or attributes such as small size, light weight, longer battery life, speed dial, and so forth. Many recent additions to the marketplace include multi-functional handsets that even provide pocket-organizer functions integrated into the wireless handset. Most manufacturers, however, are still scrambling to add new features to their communication devices to snare a portion of this booming market.

Wireless devices typically include a battery that supplies power to the device. When the battery has expired or is low, the user of the device must exchange the old battery for a new one. Usually, this battery exchange is performed at a time when the user wants to use the device. Current wireless devices, however, require the user to power on the device after exchanging an old battery for a new one.

Summary of the Invention

The present invention is directed toward an automatic power-on function after exchange of a battery in a wireless communication device.

In one embodiment of the invention, a wireless communication device is provided. It includes a processor for directing the overall operation of the device and a transceiver for transmitting and receiving data over a wireless communication network. Power management circuitry is provided for managing power distribution in the device, and a battery supplies a voltage level to the power management circuitry. Switching means coupled between the power management circuitry and battery connects the battery to the power management circuitry during a power-on state and disconnects the battery from the power management circuitry during a power-off state. Voltage detection means detects a change in the voltage level from low to high and causing connection of the battery to the power management circuitry, automatically powering on the device.

In another embodiment of the present invention, a method for powering on a wireless device after a battery change is provided. According to the method, the level of the supply voltage is monitored. If a change of voltage level from low to high is detected, the phone is powered on automatically.

Objects and advantages of the present invention include any of the foregoing, singly or in combination. Further objects and advantages will be apparent to those of ordinary skill in the art, or will be set forth in the following disclosure.

Brief Description of the Drawings

The present invention is described with reference to the accompanying drawings. In the drawings, like reference numbers indicate identical or functionally similar elements, and

Figure 1 is a diagram illustrating an example wireless communication device.

Figure 2 is a block diagram of a wireless communication system including an automatic power-on function according to the present invention.

Figure 3 is a schematic diagram of a voltage detection circuit implementing an automatic power-on function according to the present invention.

Figure 4 is a flowchart of a method for automatically powering on a wireless device according to the present invention.

Detailed Description of Preferred Embodiments

1. Example Environment

Before describing the invention in detail, it is useful to describe an example environment in which the invention can be implemented. One example environment is a handset or communication device operating within a wireless communication network such as, for example, a cellular, GSM, PCS or radio communication network. Wireless communication devices embodying the present invention can be implemented in various configurations and architectures. Typically, a wireless communication device will include a keypad for control of the device and data entry, and a display for displaying relevant information.

An example wireless communication device 100 is illustrated in **Figure 1**. Communication device 100 is presented for illustrative purposes only; implementation of the invention is not dependent on any particular device architecture or communication network.

Device 100 includes a processor 104, a speaker 106, a display 108, a keypad 110, a transceiver 112, a memory 114, a microphone 116, a power source 118 and an antenna 120. Device 100 is typically a mobile device such as a handheld handset or an integrated vehicle phone. It is configured to communicate with other communications devices such as base station 112. Base station 112 is typically within a geographic area known as a "cell" and handles communications for all wireless devices within the cell.

Processor 104 directs the overall operation of device 100. A computer program or set of instructions is typically coded or otherwise implemented on the processor to enable the processor to carry out the device operation. Memory 114 interfaces with processor 104 and may store program code and provide storage space for data useful in executing the program code and carrying out the device functions. Memory 114 may be implemented as ROM, RAM or any other convenient memory format. The features and functionality of the invention described below may be implemented using hardware, software, or a combination thereof, and such software can run on a processor such as processor 104 and be stored in a memory such as memory 114.

Transceiver 112 includes a transmitter that transmits voice and data information via antenna 120 to a recipient communication device such as, for example, base station 112. Transceiver 112 also includes a receiver that receives voice and data information from another communication device (e.g., base station 112). The received voice and data information is provided to the user or used to facilitate device operation.

User interface features include speaker 106, display 108, keypad 110, and microphone 116. Microphone 116 accepts voice or other audio information from the user and converts this information into electrical signals that can be transmitted by transceiver 112. Likewise, speaker 106 converts electrical signals received by transceiver 112 into audio information that can be heard by a user of device 100. Display 108 displays information such as call information, keypad entry information, signal presence and strength information, battery life information, or any other information useful to the user. Display 108 preferably takes the form of a liquid crystal display (LCD), which have low power consumption characteristics, but could also be implemented as a light emitting diode (LED) display or any other appropriate visual indicator. Keypad 110 typically includes an alphanumeric keypad and may also include special function keys. In one embodiment, keypad 110 is backlit to permit viewing of the keys in low light or dark conditions. Device 100 may also include a flip panel (not shown) that can be closed to conceal some or all of the keypad.

Power source 118 provides power to the various components of device 100. Any suitable power source may be utilized, but a rechargeable lithium ion battery is preferable. In one implementation, the battery is implemented as an easily removable and exchangeable battery pack. Power may also be provided by an external cable that plugs in to a mating slot in device 100, either to recharge the battery or to act independently as a power source.

2. Automatic Power-On Feature

Figure 2 is a block diagram of a power source 118 implementing an automatic power-on feature according to the present invention. Power supply 118 is implemented in a wireless communication device, such as handset 100 of **Figure 1**, and includes a battery 120 and a power management circuitry 130. In one implementation, the circuitry 130 is a power management IC (PMIC). Battery 120 supplies a required voltage level to device 100. Typically, the required voltage level is in the range of 3.6 – 8.4 volts. As noted above, battery 120 is preferably implemented as a lithium ion rechargeable battery.

PMIC 130 is essentially a DC/DC converter. It takes the voltage level supplied by battery 120, and converts into the particular voltages required by the various elements of device 100 (i.e., processor 104, transceiver 122, etc.).

Switch 124 is coupled between battery 120 and PMIC 130. A power supply line 122 extends between battery 120 and switch 124, and a power supply line 126 extends between switch 124 and PMIC 130. In a power-on state, switch 124 connects voltage supply line 126 to battery 120 and, in a power-off state, switch 124 disconnects battery 120 from PMIC 130.

Voltage detection circuit 128 is coupled to voltage supply line 122 and detects changes in voltage level from low to high. Circuit 128 also controls the state of switch 124 via a control line 132. When detection circuit 128 detects a change in voltage level from low to high on line 122, circuit 128 causes switch 124 to connect battery 120 to PMIC 130, thereby powering on the device.

Typically, a voltage level change from low to high will occur when a fresh battery is substituted for battery 120. Hence, when a battery change is made, device 100 is automatically powered on without need for the user to manually power on the device.

Figure 3 is a schematic diagram of a circuit implementation 140 of the power source 118 depicted in **Figure 2**. A battery having a voltage in the range of 3.6 – 8.2 volts is connected to a battery voltage input 142. In a preferred embodiment, the battery is a two cell lithium ion battery. Of course, the battery could also be one cell or any other suitable configuration. An external voltage input 144 is also provided for connection of an external power source such as a power or charging cord or cable. Isolation diode 146 isolates the voltage inputs 142 and 144 and prevents a battery connected to input 142 from back-driving an external power source connected to input 144.

Power management circuitry 160 accepts the input voltage and manages power distribution for the entire wireless device. In a preferred embodiment, circuitry 160 takes the form of a power management IC (PMIC). PMIC 160 is a DC/DC converter that converts and controls the supplied voltage (i.e. 3.6 to 8.2 volts) to other voltage levels for supply to the various elements of the wireless device requiring power (i.e., the processor, transceiver, display, etc.).

The power supply path from voltage inputs 142 and 144 extends to PMIC 160 along lines 148, 150 and 152. When line 152 is high, the input supplied to the PMIC Enable input is high and the device is powered on. A capacitor 154 is interposed in the power supply path between lines 148 and 150. Capacitor 154 is initially in a discharged state. When an old battery is exchanged for a fresh battery, the voltage level changes from a low level to a high level, and a voltage spike occurs on the negative (line 150) side of capacitor 154. Hence, the voltage level on lines 150 and 152 changes or switches to a high level.

The system operating software detects this change in level and sets the power supply hold (PS_HOLD) line 156 to high in order to keep line 152 high, thereby keeping the device powered on. The system operating software may be present on the processor 104 or stored in memory 114, and interfaces with the power source as shown in **Figure** 1. A set of isolation diodes 158 is coupled between lines 150 and 152 in order to keep the current flowing from the battery to the PMIC, rather than in the reverse direction.

Other features of circuit 140 will be only briefly described, as they are not essential to the automatic power-on feature. The device may also be powered on when a user depresses the power on key 162. Switch 164 (which is also connected to the battery) closes, thereby applying the battery voltage level to line 152 and turning on the device. An additional external voltage input 166 is also provided. Typically, this input will be used to recharge the battery. The IGN_SN line 166 senses whether an external power source is applied to input 166. When the external power source is disconnected, the voltage level drops on line 166 and the system software automatically turns off the phone. The software could be reprogrammed, however, such that the phone is turned on rather than off after disconnection of the external power source.

Figure 4 is a flowchart depicting a method 200 for automatically powering on a wireless device 100. The supply voltage level of a battery 118 is monitored at step 202. If no voltage level change is detected (decision node 204), the method loops back and continues to monitor the voltage level. If a voltage level change from low to high is detected, the phone is automatically powered on at step 206. In one implementation, the power on is effected by activating a switch that supplies the battery power to the central processor. After the automatic power-on, the method returns to step 202 and again monitors for a voltage level change. In one embodiment, this method is implemented as shown in **Figure 3**.

While particular embodiments of the present invention have been described above, it should be understood that they have been presented by way of example only, and not as limitations. The breadth and scope of the present invention is defined by the following claims and their equivalents, and is not limited by the particular embodiments described herein.

Claims

1. A wireless communication device comprising:

a processor for directing the overall operation of the device;

a transceiver for transmitting and receiving data over a wireless communication network;

power management circuitry for managing power distribution in the device

a battery for supplying a voltage level to the power management circuitry ;

switching means coupled between the power management circuitry and battery to connect the battery to the power management circuitry during a power-on state and disconnecting the battery from the power management circuitry during a power-off state; and

voltage detection means for detecting a change in the voltage level from low to high and causing connection of the battery to the power management circuitry to automatically power on the device.

2. A wireless communication device as claimed in claim 1, wherein the battery is a lithium ion battery.

3. A wireless communication device as claimed in claim 1, wherein the power management circuitry comprises a DC/DC converter.

4. A wireless communication device as claimed in claim 1, wherein the switching means comprises a capacitor interposed between the battery and power management circuitry that creates a voltage spike upon a change in voltage level from low to high.

5. A wireless communication device as claimed in claim 1, wherein the voltage detection means comprises system operating software.

6. A wireless communication device comprising:

a processor for directing the overall operation of the device;

a transceiver for transmitting and receiving data over a wireless communication network;

a battery for supplying a voltage level to the device;

means for detecting the voltage level supplied by the battery; and

means for automatically powering on the device when the detected voltage level changes from a low level to a high level.

7. A method for automatically powering on a wireless communication device comprising the steps of:

monitoring a voltage level provided to the device by a power source; and

powering on the phone when a change in the voltage level from a low level to a high level is detected.β

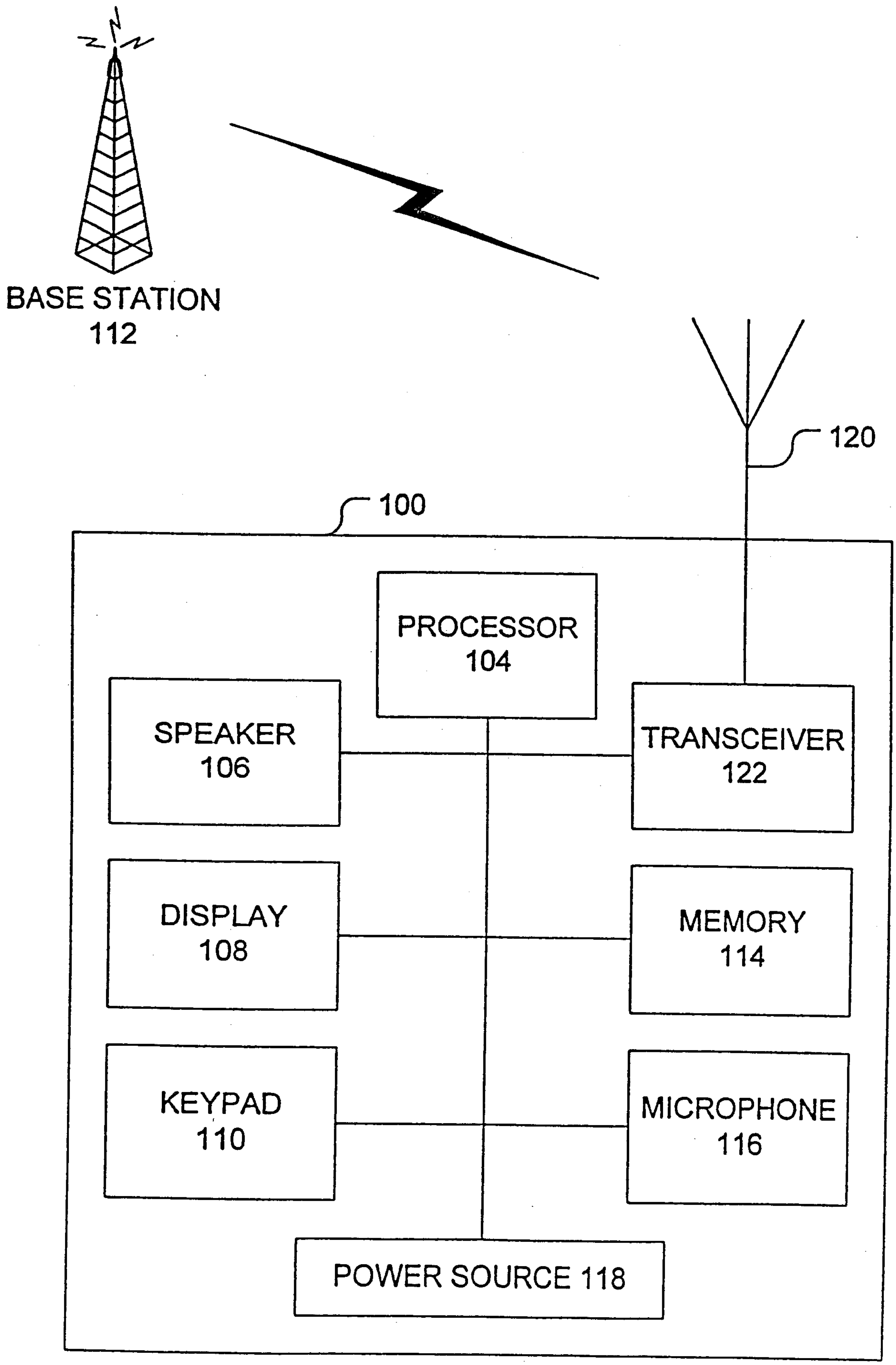
BASE STATION
112
120
100
PROCESSOR
104
SPEAKER
106
TRANSCEIVER
122
DISPLAY
108
MEMORY
114
KEYPAD
110
MICROPHONE
116
POWER SOURCE 118

Fig. 1

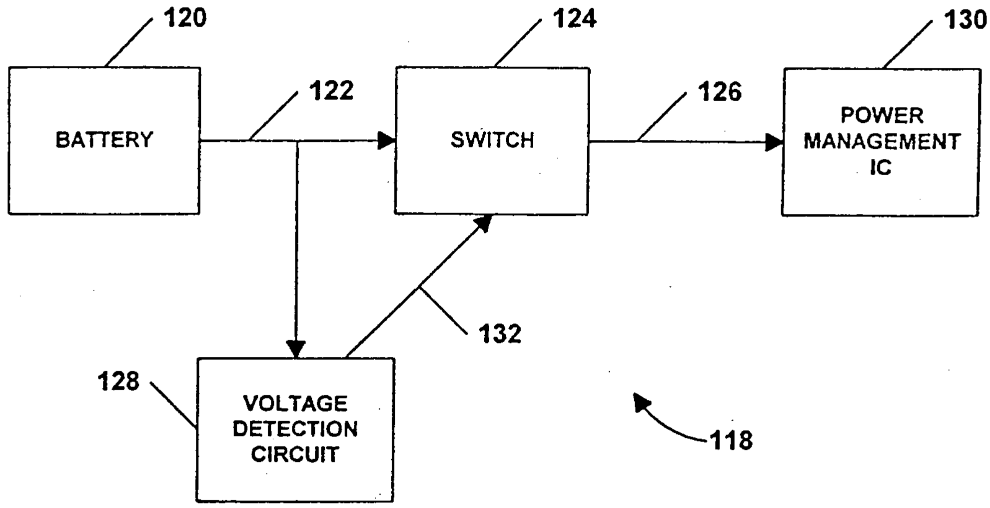
120
124
130
122
126
BATTERY
SWITCH
POWER MANAGEMENT IC
132
128
VOLTAGE DETECTION CIRCUIT
118

Fig. 2

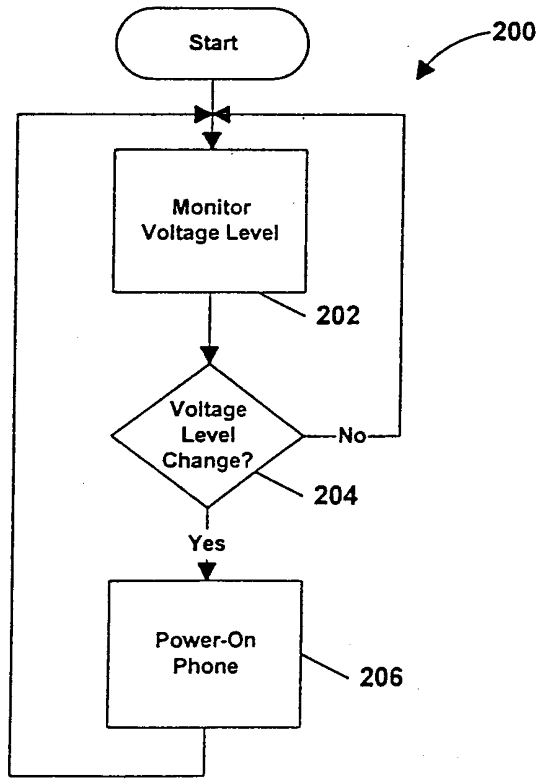
Start
200
Monitor Voltage Level
202
Voltage Level Change?
No
204
Yes
Power-On Phone
206

Fig. 4

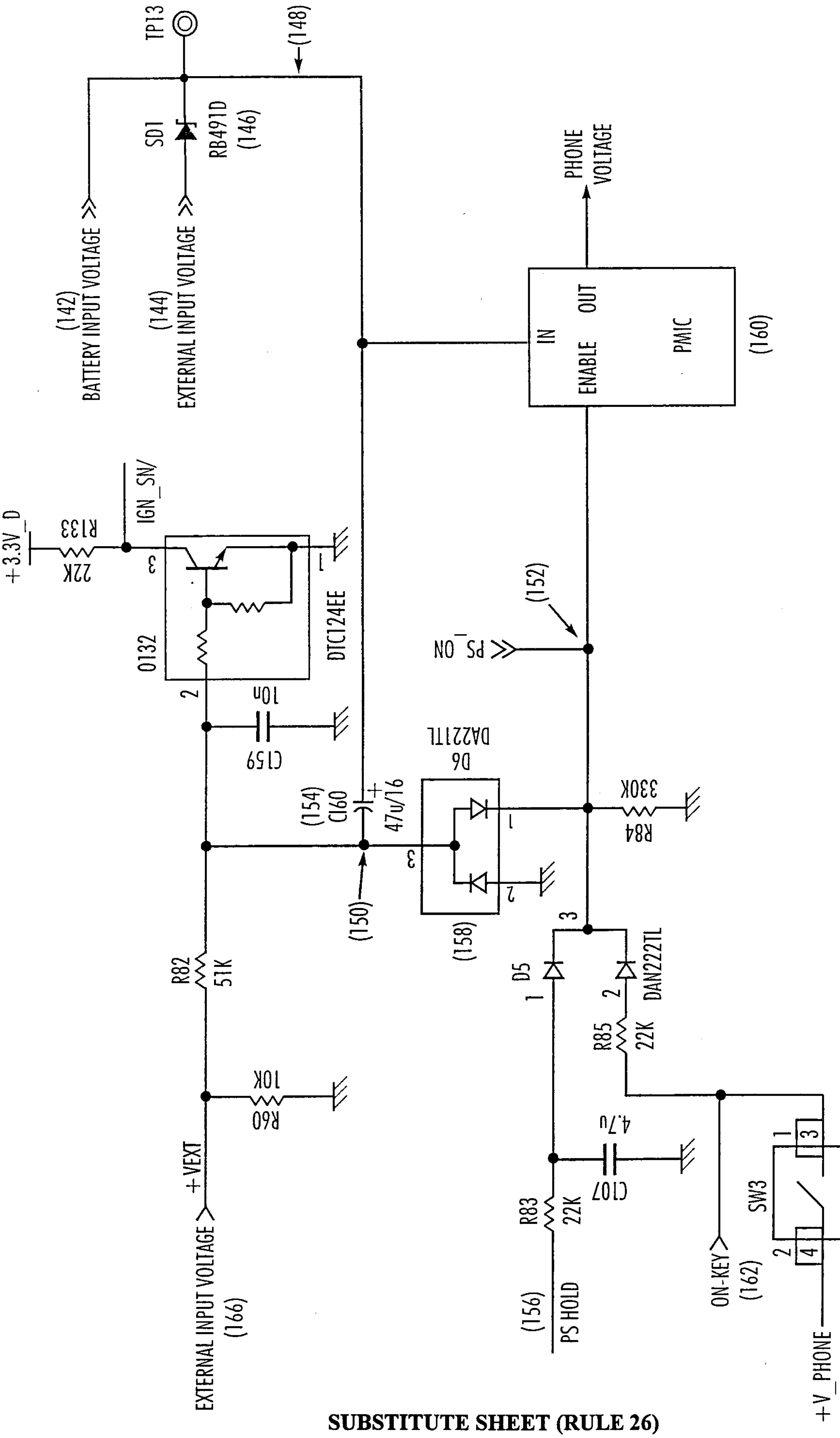
TP13
(148)
SD1
RB491D
(146)
(142)
BATTERY INPUT VOLTAGE
(144)
EXTERNAL INPUT VOLTAGE
PHONE VOLTAGE
IN
OUT
ENABLE
PMIC
(160)
+3.3V_D
R133
22K
IGN_SN/
Q132
DTC124EE
(152)
PS_ON
C159
10n
(154)
C160
47u/16
D6
DA221TL
330K
R84
(150)
(158)
R82
51K
D5
DAN222TL
R85
22K
10K
R60
+VEXT
4.7u
C107
R83
22K
SW3
EVQ-PU802K
POWER
(164)
EXTERNAL INPUT VOLTAGE
(166)
(156)
PS HOLD
ON-KEY
(162)
+V_PHONE

Fig. 3

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US00/22813

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) :Please See Extra Sheet.
US CL : 455/472,573,38.2, 38.3
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 455/472,573,38.2, 38.3;323/901;363/49

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

West

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5,870,685 A (FLYNN) 09 FEBRUARY 1999, Fig. 4 items 112, 116, col. 8 lines 8-10, abstract, col. 14 lines 43-63 and lines 30-43.	1-7
Y	US 5,926,013 A (BRANDT) 20 JULY 1999, abstract	1-7
A	US 5,929,776 A (WARBLE et al.) 27 JULY 1999, ALL	1-7
A	US Re.36,056 A (NONAMI) 19 JANUARY 1999	1-7
A	US 5,668,462 A (HANSSON et al.) 16 SEPTEMBER 1997, ALL	1-7
A,P	US 6,044,069 (WAN) 28 MARCH 2000, ALL	1-7

[X] Further documents are listed in the continuation of Box C. [ ] See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be of particular relevance		
"E"	earlier document published on or after the international filing date	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed	"&"	document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
12 OCTOBER 2000	16 NOV 2000

Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231	Authorized officer YEMANE WOLDEYAPIOS
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Form PCT/ISA/210 (second sheet) (July 1998)★

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5,465,392 A (BAPTIST et al.) 07 NOVEMBER 1995, ALL	1-7

A. CLASSIFICATION OF SUBJECT MATTER:
IPC (7):

HO4Q 9/02