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RTMP

BATTERY POWERED DEVICE

BACKGROUND TO THE INVENTION

The present invention relates to a battery powered electronic device and particularly, but not exclusively, to battery-powered cellular telephones, and methods of operating cellular telephones and cellular telephone networks.

In designing consumer electronics products - such as cellular telephones, other communications or data processing equipment or audio-visual equipment such as camcorders - there is a general need to provide improved performance and additional operational features so as to enhance the attractiveness of the product to the consumer. On the other hand, for each such product there is usually a sector of the market which is extremely price sensitive. For this part of the market there is a need to strip out all but the most essential features in order to minimize the price. These conflicting needs can be met by providing different designs for the different market sectors, but then there is a loss of the economies of scale which might otherwise be obtained.

Another important design factor in the manufacture of battery-powered products is the need to maximise battery life. Particularly in relation to cellular telephones, the maximum standby time, that is the time for which the telephone can be left not in active communication but in readiness to receive a call, is an important performance parameter. It is, for example, one of the most frequently quoted parameters in comparative reviews of such phones. Despite the practical and commercial importance of this parameter, it has not hitherto proved possible to extend the standby time for a typical ETACS phone much beyond 24 hours using a 600 mAHr battery.

SUMMARY OF THE INVENTION

According to a first aspect of the present invention, there is provided a battery-powered portable electronic device including an interchangeable battery pack fitted to a main unit of the device, characterised by an auxiliary functional unit

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contained within the battery pack and arranged to communicate data bidirectionally with circuits within the main unit of the device, the auxiliary functional unit thereby performing the auxiliary function in conjunction with the said circuits within the main unit of the device.

By an auxiliary function is meant a function which adds to or enhances the primary functioning of the device and not merely charge management or other functions of the type conventionally associated with battery packs.

This aspect of the present invention takes advantage of the fact that the battery-powered electronic device necessarily has at least one interchangeable module and associated interface, namely that of the battery pack itself. By providing auxiliary functional units which fit within the battery pack, and using the enhanced battery pack interface, the invention makes it possible for the same basic unit to provide different levels of function for different sectors of the market, while maintaining maximum economies of scale. All this is achieved without adding significantly to the size, complexity or cost of the base-level model, since no additional interface is required.

In the case of a cellular telephone, the auxiliary functional unit might comprise, for example, an answering machine, a silent vibrating alarm, a cordless phone or a pager as discussed below in relation to the other aspects of the invention. The unit may provide two or more such functions in combination, for example both an answering machine and a pager.

Preferably the main unit of the device includes a user input device and is arranged to communicate control signals to the auxiliary functional unit in response to a user input. The user input device might be, for example, the keypad of a cellular telephone and may be used to program and control the auxiliary functional unit via the battery pack interface.

Preferably the interface for the battery pack includes a connection for the transmission of power from the main unit to the auxiliary functional unit.

Although the auxiliary unit is located adjacent the battery power supply, it is found to be advantageous for many purposes if it is not directly connected to the batteries, but receives its power via the main unit. This reduces the need for power switching or control circuitry within the auxiliary unit.

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This aspect of the invention also encompasses a battery pack incorporating an auxiliary functional unit.

According to a second aspect of the present invention, there is provided a cellular telephone, characterised by a pager module powered independently of the primary telephony circuits of the telephone and arranged to power-up the said telephony circuits when a paging signal is received.

This aspect of the invention takes a novel approach to the problem of extending the standby time of a cellular telephone. Instead of attempting to enhance the batteries or to reduce the power drain of the telephony circuits, the present inventors have added to the telephone a pager module able to "wake-up" the phone on receipt of a pager signal. This allows the main circuits to be turned OFF and so reduces the battery drain from the 20 to 40 mA conventionally associated with standby mode to a much lower level, typically around 0.1 - 0.4 mA, associated with the drain current of the pager in standby. By using the pager to provide the standby function, the inventors have been able to extend the standby lifetime of the phone from around 24 hours to as long as 3 weeks, thereby doing away with the need for daily recharging of the batteries.

Preferably the pager module is arranged to communicate caller line identification (CLI) data to the primary telephony circuits.

Preferably the primary telephony circuits are arranged to display to the user the CLI data received from the pager module.

Preferably the primary telephony circuits are arranged to make a registration with the cellular network automatically after powering-up in response to a paging signal.

It is found to be particularly advantageous to have the pager use CLI data to ready the telephone to make a return call to the caller at the press of a button, should the user wish to do so.

The pager is preferably fitted within a battery pack, in accordance with the first aspect of the invention. In this case, preferably the pager is arranged to communicate data bidirectionally with the primary telephony circuits via the connection between the battery pack and the main unit of the telephone.

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The phone may be arranged so that the user can choose between one mode in which, after the completion of the call, the primary telephony circuits are powered down again, or a second and alternative mode, in which at the completion of the call the telephony circuits remain powered, giving the user the option of making a further call.

According to a third aspect of the present invention, there is provided a method of operating a cellular telephone including placing the telephone in a standby mode to reduce power consumption, characterised in that in standby mode power to the primary telephony circuits is turned OFF and power to a pager module remains ON, and in that the pager module, on subsequently receiving a pager signal, switches ON power to the primary telephony circuits.

Optionally, at the end of the conversation upon detection of mobile/network release, cellular phone primary circuit power may be switched OFF, and power to the pager remains ON, ready for the next incoming call.

According to a fourth aspect of the present invention, there is provided a method of operating a cellular telecommunications network characterised by transmitting a pager signal from the network to a cellular telephone, receiving the pager signal in a pager module in the cellular telephone while the primary telephony circuits of the cellular telephone are powered-down, switching ON power to the primary telephony circuits in response to the pager signal, and subsequently establishing a connection between the said primary telephony circuits and the network.

Preferably the method further comprises receiving at the network exchange a destination telephone number from a call originator; and

only when the destination cellular telephone is determined to be not registered, then outputting from the network exchange a pager signal, and otherwise establishing a connection directly with the primary telephony circuits of the destination cellular telephone.

Preferably the network exchange stores a record of destination numbers and corresponding pager numbers, and when the destination cellular telephone is determined to be not registered then retrieves the corresponding pager number for use in signalling the pager module.

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The present invention's approach to extending cellphone standby time can be implemented simply using existing telephone and pager networks. This however requires the caller to have both the telephone number and pager number of the destination. This can be avoided, and the invention implemented in a manner transparent to the user, if the network exchange logs when a given phone is not registered, and then retrieves and uses the corresponding pager number from a database to transmit it on the pager network thereby switching ON the phone and enabling a connection to be made.

BRIEF DESCRIPTION OF THE DRAWINGS

Embodiments of the invention in its different aspects will now be described in further detail, by way of example only, with reference to the accompanying drawings in which:

Figure 1 is a block diagram which shows schematically a device embodying the present invention;

Figures 2A and 2B are a front elevation and side elevation respectively of the device of Figure 1;

Figure 3 is a sectional view of a battery pack incorporating a pager;

Figure 4 is a sectional view of a battery pack including an answering machine;

Figures 5A to 5B are circuit diagrams for the pager of Figure 3 and 5C shows the interface for the pager or other AFU;

Figure 6 is a diagram illustrating a first method of operation for a network; and

Figure 7 is a diagram for a second method of operation for a network.

DESCRIPTION OF EXAMPLES

A battery-powered portable electronic device, in the present example a hand-held cellular telephone or "handphone" 1 includes an interchangeable battery pack 2, which is fitted to the main body of the handphone 1 and is electrically connected to the handphone 1 via an interface 3. The handphone 1 includes a power management circuit 4, a control microprocessor 5 and telephony transmission/

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reception circuits 6. A key pad 7 acts as a user input device, serving both the dialling of numbers, and also for programming of the different functions of the handphone 1. The number dialled, and other indications relating to the functioning of the phone are displayed on an LCD 8. These primary circuits within the handphone 1 are all conventional in construction, and so will not be described in further detail here.

Figures 2A and 2B show the external features of the handphone 1 and battery pack with AFU 2. As is conventional with handphone battery packs, the battery pack when fitted to the phone is normally held rigidly to the body of the device with a connection established to the circuits of the handphone 1 using a pin and contact arrangement. However, the pack may be released when, for example, it is decided to recharge the batteries.

In the present example the handphone uses a transmit frequency band from 872 MHz to 905 MHz and a receive frequency band from 917 MHz to 950 MHz. It operates in power class 4 with duplex spacing of 45 MHz and channel spacing of 25 KHz. The phone can access 1320 channels. It communicates using FM modulation with FSK Manchester coding. In this example, the phone has physical dimensions of 149 x 55 x 26.5 mm. It includes a 2 x 12 dot-matrix supertwist LCD with back lighting.

For conventional operation, in which the battery packs serves only to provide power to the handphone 1, then the pack may contain conventional AA (NiCd) batteries. Alternatively, as in the example illustrated, prismatic NiMH or NiCd batteries may be used. In this case, the battery pack holds in addition to the batteries an auxiliary functional unit (AFU) 10.

The batteries 9 supply power to the handphone 1 via the interface 3. The AFU 10 receives power from the handphone 1 via the interface and communicates data bidirectionally with the handphone 1 via the interface. It may be programmed and controlled via the keypad 7 and microprocessor 5 in the handphone 1. In a first example illustrated in further detail in Figures 3 and 5A-D, the AFU is a pager. As will be described in further detail below, this functions in combination with the circuits in the handphone 1 to extend greatly the standby time of the handphone.

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As seen in Figure 3, the casework for the battery pack 2 is divided at approximately half its height by an internal wall 31. A PCB 32 mounted on one side of the dividing wall 31 provides the circuits of the pager. Four prismatic batteries 33a to d are contained in the pack below the dividing wall 31 and are electrically connected to the pack output pins 34 via contact pads 35. The pack includes a thermistor 36 (SEMITEC 103 AT-2) and a poly-switch 37 (RAYCHEM SRP200). These both serve as safety devices to protect against overheating of the pack when charging. A ferrite antenna 38 mounted directly on the PCB picks up the paging signal transmitted by the paging network to the pager.

The output pins from the pack are shown in further detail in Figure 3f. It comprises 10 pin contacts having a pitch of 2.54 mm. The battery ground and battery positive contacts are located at the extreme ends. This is found to give better electrical performance. The pin labelled Pwr-to-Acc provides a power input signal to the accessory pack. The AFU electronics therefore only get the power when the pack is mounted on the main electronics. This therefore provides an interlock mechanism for the powering-up of the AFU. Select line 1 and 2 are logic inputs to the main electronics indicating the type of AFU being operated. The transmit data and receive data pins communicate signals carrying proprietary protocol information between the main electronics and the AFU electronics and provide data transactions in respect of the pager, answering machine or other AFU.

The interface between the battery pack including the AFU and the main electronics, i.e. the main circuits of the handphone in the present example, uses a proprietary serial protocol designed to provide maximum flexibility and ease of communication. It has two basic data formats. One to carry messages from main electronics to enhancement (i.e. AFU) electronics, the other in the reverse direction. The protocol defines message type fields, device identification code fields, and longitudinal redundancy check (LRC) fields, in addition to data fields. It provides a mechanism for acknowledgement of data transactions between the main electronics and the enhancement (AFU) electronics.

In a second example shown in Figure 4, the AFU 10 contained within the battery pack 2 is an answering machine. As in the previous example, the electronics

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for the answering machine are provided as a PCB 42 mounted on a dividing wall 41 of the battery pack.

A variety of other options are possible for the AFU. For example, it may comprise a silent vibrating alarm to be used when desired in place of the usual audio ringing tone of the handphone 1. The operation of the answering machine is described in further detail below.

CORDLESS PHONE

A further option is that the AFU may enable the handphone to function as a cordless phone. In this case the AFU contains circuits for providing a relatively low power radio frequency link between the phone and a cordless phone base unit connected to a telephone line. The AFU the allows the AF circuits of the handphone to be used in making a conventional telephone call via the telephone line. While in use in this manner the handphone is not in registered with the cellular network and does not incur charges from that network.

ANSWERING MACHINE

The answering machine is described in detail in Annex B. It includes a Solid State memory for recording messages and includes an option for recording an ongoing conversation between the handphone user and a called or calling party.

SERIAL BUS PROTOCOL

The serial bus provides means to establish point-to-point communication between the Handset and the Auxiliary Functional Unit (AFU). There are three types of messages transacted:

- Command messages
- Respond messages
- Status Messages

Either device i.e. the Handset or AFU may issue and respond to a set of commands. All messages are binary based (with the exception of monitor status where its data is ASCII-based for ease of monitoring). All messages are single word.

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Physical Layer Specifications

Type	:	Full Duplex
		Asynchronous
		Point-to-point link
Speed	:	9600 BPS
Data bits	:	8
Parity	:	None
Stop bits	:	1

Command Messages: At the link level each command message will be ACKed or NACKed by the receiving party according to the reception of the message. For some commands, the requested operation of the command will be responded by a separate response message.

The following is the list of commands that are applicable to the AFU providing a functionality of either a Pager or an Answering Machine.

Commands Relating to an Answering Machine

1. Turn off the Auxiliary Functional Unit
2. Play back the Slot No. x
3. Play back current slot
4. Record Slot No. x
5. Record Current slot
6. Stop Play back/Record
7. Turn off the Auxiliary Functional Unit
8. Program 'Decoder'

Commands Relating to Pager

1. Set Time
2. Read Time
3. Wake-up Enable/Disable
4. Read Page
5. Delete Page
6. Any Unread Page
7. Lock Page
8. Unlock Page

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In response to the command set the AFU reply with appropriate response along with its Device Identification Codes (DIC). Status messages from the AFU indicate certain conditions are satisfied, hence action can be originated by the main unit. For Pager AFU these are:

1.	Page Alert	:	In response to an external page reception.
2.	Out of Range	:	When the received messages exceeds the maximum number of allowed locations in the Pager.
3.	Real Time Clock Tick	:	Generated once in a minute.
4.	Low Battery	:	When the current battery value goes below the preset LOW value.

EXTENDING STANDBY TIME

The use of a pager in combination with a handphone to extend the standby time of the handphone will now be described in further detail. The pager is preferably, but not necessarily, provided as an AFU within a battery pack, as described above.

Four modes of operation may be defined for a cellular phone:

(A) Full-OFF, battery not attached. In this state there is zero current drain from the battery. The phone cannot originate a call, and cannot terminate a call.

(B) Battery attached, "Pagullar" standby. In this state there is a small current drain and current going to the pager. The phone is in OFF state. Only the wake-up circuits in the phone are powered to detect ON/OFF key press, or wake-up signals from the pager module.

(C) Switched on, conventional standby mode. Here the cellular phone is not in an act of conversation with the base station but is "registered" and ready to receive a call from the cellular base station. The battery drain is significant, in the range 20 - 50 mA.

(D) Switched on, call in progress mode. Here the cellular phone is in active communication with a cellular base station. The battery drain in this mode is very high, typically 500 to 700 mA.

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Modes A, C and D are conventional. Mode B is provided by phones embodying the present invention, and provides an alternative standby mode, termed by the inventors "Pagullar standby" which enables a greatly increased standby time. The battery standby time is the time duration in which the cellular phone can be in standby mode with a fully charged battery of pre-defined capacity measured in mAHr. As already discussed, typically for ETACS type handphones, a standby time of about 24 hours is achievable. In this example of the present invention, the standby time is greatly extended through the use of a pager incorporated in the handphone. The pager is connected to the circuits of the handphone by an interface of the type described above and is independently powered from the batteries via the handphone. When in "Pagullar standby" mode the main circuits of the handphone are switched off. The pager however remains in a standby state in which it has a small current drain of around 0.1 - 0.4 mA. When a call is to be made to the switched-off handphone, then a paging signal is sent to the pager which in turn transmits a control signal via the interface to the handphone to turn the handphone ON. Two scenarios for making or terminating a call will now be described by way of example.

Scenario A: This is a simple solution which can be implemented immediately using existing networks and without requiring co-operation between the pager and mobile phone networks. Following this scenario, the call originator uses the pager number to make a page to the pager options pack indicating that he wants to make contact with the cellular phone. On receipt of a paging signal, the caller's number is captured by the pager using caller line identification CLI. The pager then transmits a control signal to wake-up the phone and communicates the CLI information to the cellular phone via the interface. The caller's number is displayed on the handphone display automatically. Simultaneously, the handphone makes registration with the cellular network. Should the handphone user choose to return the call, then he or she presses the SEND key, the cellular phone dials the CLI number, and hence is able to return the calling party's telephone call. This approach has the advantage of not requiring any modification to existing network. However it does require the caller to know both the telephone number and the pager number

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of the destination. On return of the call, the cellular phone is the initiator of the call and hence has to pay that portion of the cost for the call.

Scenario B: This uses a modified mode of operation for the networks to make the process more friendly to the user. It is however more complex to implement. It requires the co-operation of the cellular and pager network operators to include intelligence in the network management software. Following this scenario, the call originator makes a call to the cellular phone number. The cellular phone network knows that the phone is switched off and hence not registered. The cellular network then looks up in a database the equivalent pager number matched to the cellular phone number. Transparently to the calling party, the cellular phone network initiates a paging call through the paging network to wake-up the cellular phone, awaits registration, and completes the call when the freshly awoken cellular phone is registered with the network.

In this way, the caller does not need to know if the cellular phone is switched on, or if it has a pager option. The caller makes a "normal" call and the method of operation is transparent both to the caller and the called party. The cellular phone and the pager network do the signalling automatically. While the operation of the phone appears conventional to the user, the ability to switch off the main circuits and leave just the pager in standby reduces a greatly increased standby time which may be as long as 3 weeks.

Figure 6 illustrates scenario A discussed above, and Figure 7 scenario B.

In the following appendices, Appendix A describes in further detail the plug-in pager module, Appendix B describes the plug-in answering machine and Appendix C describes the proprietary serial data protocol.

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APPENDIX A

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1. Introduction

This document attempts to describe the objective features and ergonomics of the optional plug-in pager for the 2nd Generation AMPS/TACS handphone from the end user point of view.

It is envisioned that the pager will be housed in the battery compartment. Other than incorporating the control into the keypad and display panel of the handphone, no extra switch and display will be provided by the plug-in pager. This document includes descriptions on the host handphone LCD display, usage of the keys, user selectable options and modes of operations. However, it will not cover user requirements on mechanical and performance parameters (such as receiver sensitivity, battery life etc).

Listed below is the summary of the features:

- ◊ Pager on/off (independent of the handphone)
- ◊ Paging Format: POCSAG
- ◊ Alphanumeric
- ◊ Real-Time Clock
- ◊ Time-Stamped Message
- ◊ Store 16 message. Each with 20 characters max.
- ◊ Audible / Silent Alert Option (p.s. w/o vibrator)
- ◊ Unread Message Indication
- ◊ Duplicated Message Indication
- ◊ Out-of-Range Indication
- ◊ Wake-Up Handphone Option

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2. Features Review

INDEPENDENT PAGER ON/OFF

- ◊ The plug-in pager can be turned on or off via the handphone's Accessory Menu.
- ◊ While the plug-in pager is powered down, only the built-in real time clock will function.
- ◊ Once the pager is turned on, the handphone can be switched on or off without affecting the state of the pager.
- ◊ If the phone is turned off and the wake-up option is disabled (see description below), the pager will not give alert upon reception of good page. The incoming page will be stored in the receive buffer, which can be accessed by the user once the phone is turned on (notification will be shown).

PAGING FORMAT

- ◊ POCSAG

REAL-TIME CLOCK

- ◊ The Real-Time Clock is always running, even if the pager is turned off.
- ◊ The clock is used for :
  1. Time-stamping all incoming pages
  2. Display the current time on the handphone, even if the pager is turned off.
- ◊ The clock and time stamp will be displayed in 24-hour format.
- ◊ Set the time via sub-menu under the Accessory Menu.

INCOMING PAGES

- ◊ Holds up to 16 alphanumeric messages.
- ◊ Each message can be 20 characters long max.
- ◊ The receive buffer is numbered with buffer #1 holding the latest page.
- ◊ If the buffer is full, any new message will replace the oldest un-locked one in the buffer.
- ◊ User may access the receive buffer by scrolling through via the Mailbox Mode.
- ◊ If the currently accessed message is a phone number, user may use One-Touch Dialing to initiate a callback.
- ◊ Messages stored in the buffer can be deleted either individually or altogether.

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SOURCE INDICATION

◊ Source identifier: `[A]`,`[B]`,`[C]` or `[D]` will be displayed together with the incoming message to indicate its source.

LOCKING / UNLOCKING MESSAGES

◊ Messages in the received buffer can be locked or unlocked individually.
◊ Locked messages cannot be deleted unless they have been unlocked.

MEMORY RETENTION

◊ Only unread messages and locked messages in the received buffer are retained when the pager is turned off.

ALERT OPTIONS

◊ User may choose either alert tone or silent alert only (blinking LED only, no vibrator option is offered).
◊ The LED on the top facia of the handphone will also blink when there is an incoming page.
◊ Regardless of the alert tone/silent setting, "`NEW PAGE`" message and the time-stamped received message will be shown for 20 seconds.
◊ If the phone is powered down, there will not be any alert tone or blinking LED indication.
◊ If a page is received while the phone is on a voice channel, there will be "soft" beeping tone sounded in the earpiece regardless of the alert tone/silent setting.

UNREAD MESSAGE INDICATION

◊ An unread icon will always be turned on until the all the messages are read at least once. (This icon is dedicated to the plug-in pager and it is not utilised by the handphone)
◊ While the received buffer is being scrolled through, the unread icon will be turned on only if the currently displayed page is unread.

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DUPLICATED MESSAGE

◊ If a new paging message is identical to a previous one already stored in the received buffer, the time stamp will be updated and the message will be placed in buffer #1.
◊ "DUP PAGE" message will be shown instead of "NEW PAGE" for 20 seconds.

OUT-OF-RANGE INDICATION

◊ An inverse video message "OUT" will be shown when the pager is out-of-range. (The message will temporarily be suppressed if the phone enters into any display modes, such as Menu mode, Alpha mode etc.)

WAKE-UP HANDPHONE OPTION

◊ The user may choose whether or not an incoming page will automatically turn on the handphone.

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3. Man-Machine Interface

Since the plug-in pager is sharing the display (LCD panel and the top LED) and the keypad with the handphone, the ergonomics of the pager are designed to be as consistent as possible to that of the handphone.

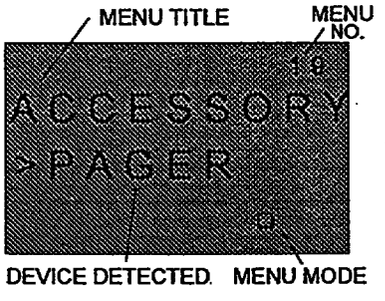
Many of the icons and buttons are shared between the handphone and the pager. However, there are certain buttons and icons dedicated for the plug-in pager only:

Icon	Button
ACC	MAIL BOX (✉)
UNREAD	
📼	

The Mail Box Mode (thru' which the user may access paging messages) will be cancelled when there is an incoming phone call. To make incoming call to have highest priority is consistent to the basic ergonomics of the handphone.

MENU OPERATION

- ◊ Power on/off and configuration of the plug-in pager are accomplished through the Accessory Menu (Menu #19).
- ◊ The phone detects the presence of the device, and displays it as follows:



- ◊ Press STO to get into the sub-menu of the Accessory Menu. The structure of the sub-menu is depicted below:

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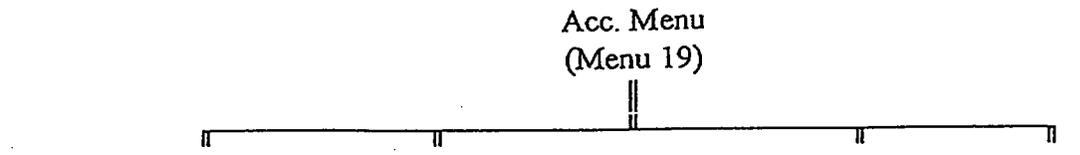


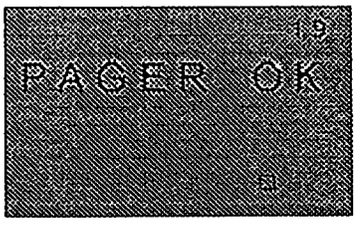
Sub-Menu:	Power (Menu 19.1)	Wake-Up (Menu 19.2)	Alert Option (Menu 19.3)	Set Clock (Menu 19.4)

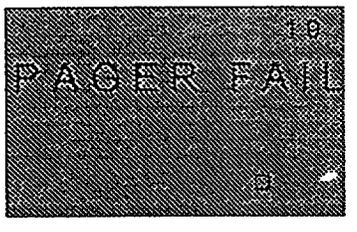
POWER ON/OFF & SELF-TEST

◊ Enter Menu mode and go to Power Sub-Menu 19.1.

MENU:	19.1	
FUNCTION:	PAGER ON/OFF	
DISPLAY 1:	POWER	Press STO
DISPLAY 2:	>{current_option}	↵
OPTIONS:	ON	
	OFF	← default

◊ Use ∧ or ∨ button view the other option and press STO to select/store the option.
◊ If the plug-in pager is removed from the handphone's battery compartment, the pager shall be powered down automatically
◊ During power up an internal power up self-test of the pager will be done. If the test is passed, a good key chirp will sound and a message will be shown for 5 seconds. The phone will quit Menu mode automatically.
◊ There is also a short-cut to turn on the plug-in pager when there is any pending unread message(s). Please refer to the section on *UNREAD MESSAGES*.





◊ During power off, the following message will be shown for 2 seconds before quitting the Menu Mode altogether. The ACC icon disappears indicating the plug-in is off.

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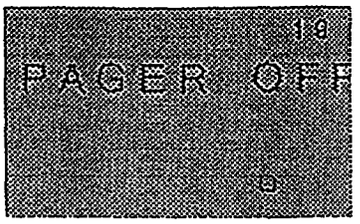
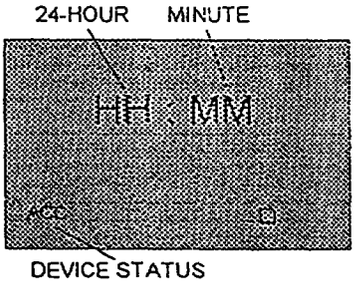


STANDBY

◊ After a successful power up, the display will show a Real-Time-Clock and the ACC icon will be turn on.

◊ The Real-Time-Clock display stays even if the pager is turned off. However, the RTC display will be temporarily suppressed under the following circumstances:

1. Menu Mode
2. Alpha Mode
3. Retrieving Phone Memory
4. Mailbox Mode
5. Phone is operating on voice channel
4. Displaying a pop-up message in line 1



RECEIVING A PAGE

◊ There are 4 different types of audio/visual alert:

1. LCD display
2. LED on the top facia of the phone
3. Paging Tone (user selectable on/off)
4. Paging Beeps in the Earpiece.

◊ *LCD DISPLAY*

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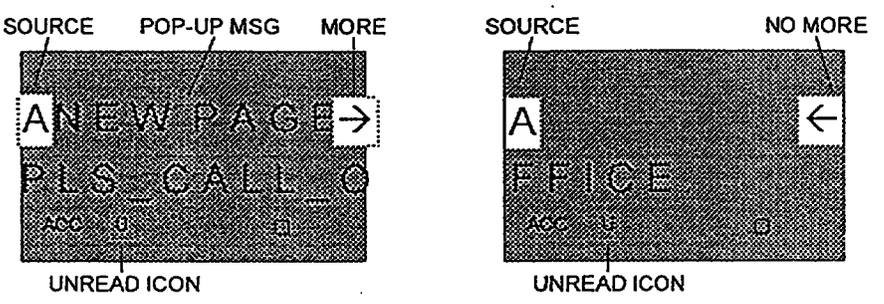
- Only applicable if the phone is powered on when the page is received or the Wake-Up option has been enabled.
- The paging message will be displayed for 15 seconds unless RCL is pressed. Pressing this button will reset the 15 seconds. However, **UNREAD** icon will always stay on.



- Source identifier (preferably in inverse video) indicates one of the 4 possible RIC.
- Pop-Up message: **NEW PAGE** or **DUP PAGE** (if message is identical to a previous one)
- More indicator (→)(preferably in inverse video) indicates a long message (more than 10 characters). Press RCL the number of times required to view the next 10 characters, and so on. When the end of the message is reached, press RCL shows the beginning again.
  → indicates the message has more character to the right
  ← indicates the display has reached the end of this message

◊ *LED ON THE TOP FACIA OF THE PHONE*
- Slow blinking for 15 seconds unless cancelled by user. User can easily distinguish it from the case of incoming phone call.
- Cannot be disabled by user option.

◊ *PAGING TONE*
- Sounds for 15 seconds or cancelled by user explicitly.
- May be disabled via Alert Option.
- Even if it is enabled, it can be suppressed when:
  1. The phone is operating in voice channel.
  2. The phone is ringing.

◊ *PAGING BEEPS IN THE EARPIECE*
- Only works when the phone is operating in voice channel.
- Cannot be disabled by user option.

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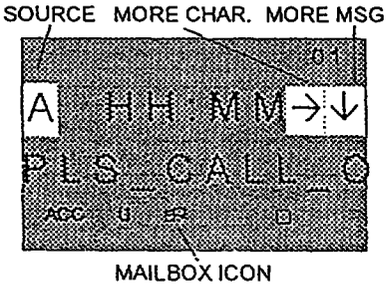
CANCEL AN ALERT

◊ While the audio/visual alert is on-going, press any key once to stop the alert (exception: POWER, END and volume keys).
◊ Paging tone and blinking LED will be cleared, but the message shown in display will remain till the end of the 15 seconds.

RETRIEVE A MESSAGE

◊ Press MAIL BOX (✉) key to enter into Mailbox mode. The most recent message (buffer #1) will be displayed by default. If the received buffer is empty, "NO MSG" message will be shown.



◊ Source identifier (preferably in inverse video) indicates one of the 4 possible RIC.
◊ Pop-Up message shows the time stamp.
◊ More character indicator (→) (preferably in inverse video) indicates a long message. Press RCL to view the rest.
◊ More message indicator (↓) (preferably in inverse video) indicates that there are more messages (both read or unread) in the received buffer. The indicator will not light when displaying the last message. Press ↓ key to scroll down the buffer. "NO MORE" message will be displayed when end of the buffer is reached.
◊ If the message is a duplicated one, a blinking block cursor (▒) will appear in the left most position of line 2.

INITIATE A CALL-BACK

◊ If the currently retrieved message is a telephone number, the user may just press SEND to initiate a callback. Upon completion of the call (successful or not), the phone will quit Mailbox mode.

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◊ The unit assumes that the displayed message must be a numeric string. It is up to the user to determine if the numeric message is a valid telephone number.

LOCK / UNLOCK A MESSAGE

◊ Each message in the received buffer can be locked or unlocked individually.
◊ Only locked messages and unread messages will be retained when the pager is turned off.
◊ Press STO as a toggle switch to lock and unlock the currently displayed message.
◊ Locked messages will appear in inverse video.

DELETE MESSAGE(S)

◊ Press and hold CLR for 1 second to clear the currently displayed message (which must not be locked). A good key chirp will sound as a confirm tone. If the message is locked, a bad key chirp sounds.
◊ While staying at the end of the received buffer, press and hold CLR for 1 second to clear all read and unlocked messages. A confirmation message "CLEAR ALL?" will be shown for 10 seconds. Press CLR once to confirm. Press any other key or wait for message to disappear to abort the operation.
◊ After the delete operation, the phone will quit Mailbox mode.

UNREAD MESSAGE(S)

◊ If the handphone is turned off while there is any unread paging message(s), a reminder message "NEW PAGE" will be shown upon the power up of the handphone.
◊ In order to allow the user to retrieve the unread paging message(s) quickly if the pager has not been turned on yet, MAIL BOX (✉) button can be used.
◊ Pressing MAIL BOX (✉) once will:
  1. Turn on the plug-in pager.
  2. Enter into mailbox mode.

BATTERY LEVEL & LOW BATTERY ALERT

◊ Share with the handphone.

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4. Customization

All the settings described in this chapter are stored in the non-volatile memory of the pager. The data will be retained when the plug-in pager is turned off.

SETTING WAKE-UP OPTION

◊ Enter Menu mode and go to Sub-Menu 19.2 of the Accessory Menu.

MENU:	19.2	
FUNCTION:	WAKE UP OPTION	
DISPLAY 1:	WAKE-UP	Press STO
DISPLAY 2:	>{current_option}	↵
OPTIONS:	ENABLE	
	DISABLE	← default

◊ Use ∧ or ∨ button view the other option and press STO to select/store the option.

SETTING ALERT OPTION

◊ Enter Menu mode and go to Sub-Menu 19.3 of the Accessory Menu.

MENU:	19.3	
FUNCTION:	PAGING ALERT OPTION	
DISPLAY 1:	ALERT OPT	Press STO
DISPLAY 2:	>{current_option}	↵
OPTIONS:	PAGE TONE	← default
	SILENT	

◊ Use ∧ or ∨ button view the other option and press STO to select/store the option.

SETTING THE CLOCK

◊ Enter Menu mode and go to Sub-Menu 19.4 of the Accessory Menu.

MENU:	19.4
FUNCTION:	SET REAL TIME CLOCK

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DISPLAY 1:	SET CLOCK	Press STO
DISPLAY 2:	HH : MM	⌟
CURSOR:	▒	

◊ A blinking cursor appears on the 10's hour digit. Press any digit key and the cursor will move to the right.

◊ May use ∧ or ∨ button to move the cursor position. Press STO to store the setting or CLR to abort and quit.

SETTING THE PAGING TONE VOLUME

◊ The volume of the paging tone is identical to that of the handphone's ringing tone, which can be selected via Menu 10.

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APPENDIX B

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1. Introduction

This document attempts to describe the objective features and ergonomics of the optional plug-in answering machine for the 2nd Generation AMPS/TACS handphone from the end user point of view.

It is envisioned that the solid-state plug-in answering machine will be housed in the battery compartment. Other than incorporating the control into the keypad and display panel of the handphone, no extra switch and display will be provided by the plug-in device. This document includes descriptions on the host handphone LCD display, usage of the keys, user selectable options and mode of operations. However, it will not cover user requirements on mechanical and performance parameters (such as audio levels, battery life etc.).

Listed below is the summary of the features:

- ◊ Menu-Driven Power On/Off
- ◊ 90 Seconds Playback/Record Capacity
- ◊ Personalized Outgoing Message (OGM) Recording (15 seconds max)
- ◊ Factory Pre-recorded OGM (non-recoverable)
- ◊ Security Code for Personalized OGM Recording
- ◊ OGM Playback
- ◊ Incoming Message (ICM) Recording for 5 Messages (each 15 seconds max)
- ◊ Automatic Disable When Memory Full
- ◊ Unread Message Indication
- ◊ Allow User To Pick-Up Call While Recording ICM
- ◊ CLI-Tagged Recorded Voice Message Allows One-Touch Callback
  (Only for TACS systems supporting CLI functions)

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2. Features Review

POWER ON/OFF

- ◊ The plug-in answering machine can be turned on or off via the handphone's Accessory Menu.
- ◊ When the handphone is turned off, the answering machine will also be turned off automatically (only unread and locked voice messages are retained).
- ◊ When the handphone is turned on, the answering machine will still remain power off by default. This feature avoids the accidental use of the machine when it is not intended to.
- ◊ Once turned on, the answering function of the machine is not affected by neither imposing access control nor activating keyguard features of the handphone.
- ◊ A shortcut is also available. When there is any unread messages and the answering machine is turned off, the user may use **MAIL BOX (✉)** key to turn on the machine and retrieve the message.

PLAYBACK/RECORD CAPACITY

- ◊ 90 seconds in total (Recording chip may be cascaded if required in the future).

PERSONALIZED OUTGOING MESSAGE

- ◊ All units are shipped with a non-recoverable factory pre-recorded OGM, which the user may override with his personalized OGM later.
- ◊ 15 seconds max.
- ◊ User access to OGM recording is controlled by the lock code of the phone.
  (The lock code is the same as the one used for access control of the handphone.)
- ◊ The recorded OGM can be previewed.

INCOMING MESSAGES

- ◊ The remaining 75 seconds of the built-in voice recording capacity is hard-partitioned into 5 slots with 15 seconds duration each.
- ◊ Each of the voice messages is also tagged with CLI, which will also be displayed when the voice message buffer is being scrolled through.
  (TACS system with CLI support is required)

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◊ When the voice message slots is full, the answering machine will not answer any incoming calls at all.

MONITOR INCOMING MESSAGES

◊ The user may choose (option accessed via menu mode) to monitor all the incoming calls even if the answering machine is enabled.
◊ This feature makes the plug-in device functionally compatible to the majority of the conventional desktop answering machines, where the user can monitor calls from the speaker.

USER INTERRUPT ANSWERING PROCESS

◊ The user may interrupt the machine's automatic answering process at any time after the phone is ringing.
◊ It does not matter whether or not the answering machine has already picked up the call, playing back the OGM or recording the caller's ICM.
◊ Once the user presses **SEND**, any of the above on-going activities will be aborted. If there is any incomplete recorded message, it will be discarded.

UNREAD MESSAGE INDICATION

◊ An unread icon will always be turned on until the all the voice messages are read at least once. (This icon is dedicated to the plug-in answering machine and it is not utilised by the handphone)
◊ While the received voice message slots are being scrolled through, the **UNREAD** icon will be turned on only if the currently playback message is unread.

LOCKING / UNLOCKING MESSAGES

◊ Messages in the voice message slots can be locked or unlocked individually.
◊ Locked messages cannot be deleted unless they have been unlocked.

MEMORY RETENTION

◊ Only unread messages and locked messages in the received buffer are retained when the answering machine (or handphone) is turned off. This helps to avoid out-dated/unnecessary

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messages of occupying valuable voice memory, which may prevent the machine from answering new calls.

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3. Man-Machine Interface

Since the plug-in answering machine is sharing the display (LCD panel and the top LED) and the keypad with the handphone, the ergonomics of the machine are designed to be as consistent as possible to that of the handphone as well as other accessories.

Many of the icons and buttons are shared between the handphone and the answering machine. However, there are certain buttons and icons dedicated for the plug-in device only:

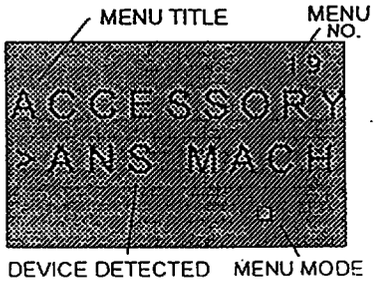
Icon	Button
ACC	MAIL BOX (✉)
UNREAD	
🖃	

The Mail Box Mode (thru' which the user may access the recorded voice messages and the accompanying CLI if available) will be cancelled when there is an incoming phone call. To make incoming call to have the highest priority is consistent to the basic ergonomics of the handphone.

MENU OPERATION

◊ Power on/off and configuration of the plug-in answering machine are accomplished through the Accessory Menu (Menu #19).

◊ The phone detects the presence of the device, and displays it as follows:



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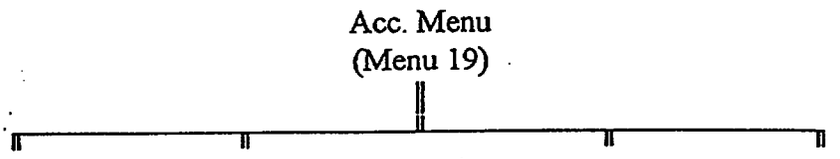
◊ Press **STO** to get into the sub-menu of the Accessory Menu. The structure of the sub-menu is depicted below:



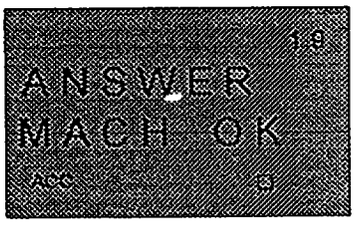
Sub-Menu:	Power (Menu 19.1)	Record OGM (Menu 19.2)	Playback OGM (Menu 19.3)	Monitor (Menu 19.4)

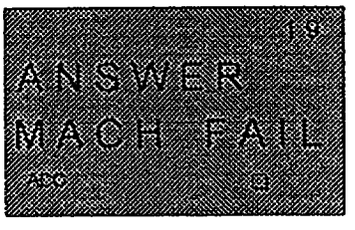
POWER ON/OFF & SELF-TEST

◊ Enter Menu mode and go to Power Sub-Menu 19.1.

MENU:	19.1	
FUNCTION:	ANSWERING MACHINE ON/OFF	
DISPLAY 1:	POWER	Press **STO**
DISPLAY 2:	>{current_option}	↵
OPTIONS:	ON	
	OFF	← default

◊ Use ∧ or ∨ button view the other option and press **STO** to select/store the option.
◊ If the plug-in answering machine is removed from the handphone's battery compartment, the device should be powered down automatically
◊ During power up, an internal self-test of the answering machine will be done. If the test is passed, a good key chirp will sound and a message will be shown for 5 seconds. The phone will quit Menu mode automatically.
◊ There is also a short-cut to turn on the answering machine when there is any pending unread message(s). Please refer to the section on *UNREAD MESSAGES*.





◊ During power off, the following message will be shown for 2 seconds before quitting the Menu Mode altogether. The ACC icon disappears indicating the plug-in is off.

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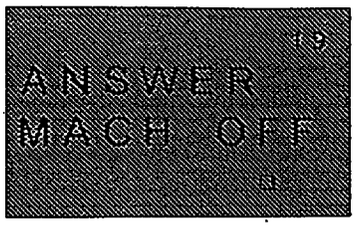


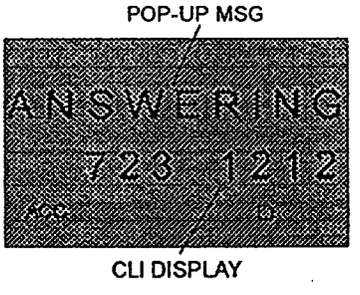
STANDBY

◊ After a successful power up, the ACC icon will be turned on.
(P.S. Since there is no time stamping of voice messages, there will not be any built-in Real-Time-Clock.)

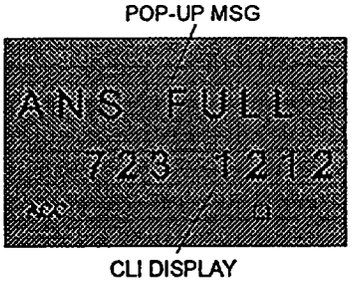
ANSWERING A CALL

◊ With the plug-in device in place, the audio/visual indications of receiving incoming calls are identical to those of the basic handphone.

◊ *GOING OFF-HOOK*
- If the voice message slots are not full, the answering machine will answer the call within a pre-defined (factory/dealer programmable) number of rings.
- If the voice message slots are full, the machine will not answer the call. After the elapsed of the pre-defined number of rings, a message will be displayed as follows.



Voice Message Slots Not Full



Voice Message Slots Full

◊ *PLAYING BACK THE OGM*
- Monitoring of the on-going OGM playback is not allowed.
- A message will be displayed as follows:

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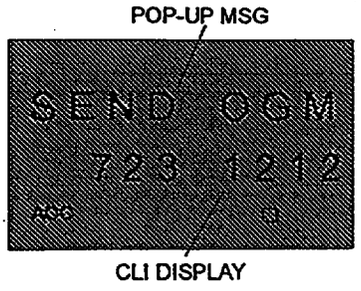
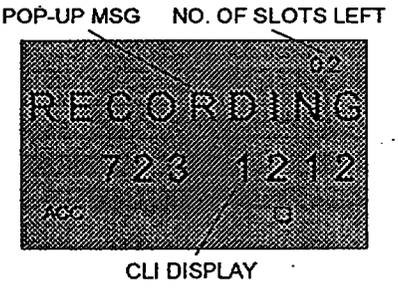


◊ *RECORDING THE ICM*

- One second after the completion of the OGM playback, the caller will be given a 1-second long start tone.
- Recording of ICM will commence immediately after the end of the start tone.
- Monitoring of the ICM is allowed as an option. The audio out will be connected to the earpiece or to the speaker (if the hands-free car kit is used).
- At the 12th second, a short (say, 800msec) warning tone sounds to alert the caller to finish his/her message.
- At the 15th second, the recording stops and a continuous warning tone sounds to inform the caller of the end of the recording session. The **UNREAD** icon will then be turned on.
- The answering machine will initiate an on-hook after 1 second.
- While the message is being recorded, the remaining number of voice message slots (including the current message) will be shown.
- If there is no voice message slot available, the handphone will display a reminder message "**ANS FULL**" upon the power up of the handphone. It serves to remind the user that the answering machine will not answer any further calls unless old message(s) are removed.



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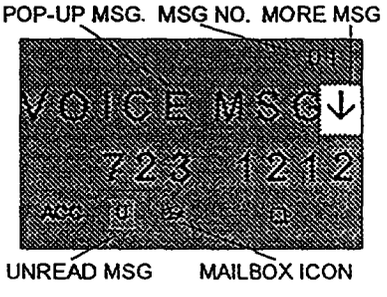
RECORDING OF OGM

◊ Accessed via the sub-menu under the Accessory Menu to record personalized OGM.
◊ The recording is controlled by the lock code.
◊ The recording is guided by start tone and end tone sounded from the buzzer.

RETRIEVE A MESSAGE

◊ Press **MAIL BOX (✉)** key to enter into Mailbox mode. The most recent message (slot #1) will be played back by default. If the message slots are empty, "NO MSG" message will be shown.



◊ Pop-Up message shows a standard message.
◊ More message indicator (↓) (preferably in inverse video) indicates that there are more messages (both read or unread) in the message slots. The indicator will not light when displaying the last message. Press ↓ key to "skip" to other messages (i.e. scrolling down the buffer). "NO MORE" message will be displayed when end of the slots is reached.
◊ CLI display depends on the support of the TACS system.
◊ The UNREAD message icon will disappear when the voice message has been played back.
◊ After the message number (and CLI) has been displayed for 2 seconds, a short confirmation tone will sound. This will be followed by the playback of the message.
◊ When the playback of the current message is completed, the audio output will be muted. The machine will display the next available message (read or unread).
◊ The playback sequence will continue in a similiar manner until the end of the message slots is reached. "NO MORE MSG" message will be displayed.
◊ During the playback of any message, the user may use ↓ or ↑ key to skip to the next message or re-start the current message respectively.

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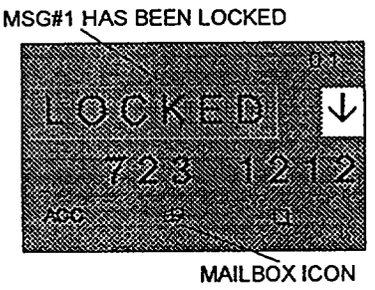
INITIATE A CALL-BACK (FOR CLI ONLY)

- ◊ If the currently retrieved message contains a CLI, the user may just press **SEND** to initiate a callback.
- ◊ When **SEND** is pressed, it does not matter whether the playback of the message has begun or not. The playback will be aborted before the call is initiated.
- ◊ Upon completion of the call (successful or not), the phone will quit Mailbox mode.

LOCK / UNLOCK A MESSAGE

- ◊ Each message in the received message slots can be locked or unlocked individually.
- ◊ Only locked messages and unread messages will be retained when the answering machine (or the handphone) is turned off.
- ◊ Press **STO** as a toggle switch to lock and unlock the currently displayed message.
- ◊ Locked messages will appear in inverse video as follows.



DELETE MESSAGE(S)

- ◊ Only unlocked or read voice messages can be deleted.
- ◊ Press and hold **CLR** for 1 second to clear the currently displayed (and/or played back) message. A good key chirp will sound as a confirmation tone.
- ◊ While staying at the end of the message slots (where "`NO MORE MSG`" message is being displayed), press and hold **CLR** for 1 second to clear all the voice messages. A confirmation message "`CLEAR ALL?`" will be shown for 10 seconds. Press **CLR** once to confirm. Press any other key or wait for message to disappear to abort the operation.
- ◊ After the delete operation has been completed, the phone quits Mailbox mode.

UNREAD MESSAGE(S)

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- ◊ If the handphone (together with the answering machine) is turned off while there is any unread message(s), a reminder message "NEW VOICE MSG" will be shown upon the power up of the handphone. (P.S. The answering machine is still powered off.)
- ◊ In order to allow the user to retrieve the unread message(s) quickly, **MAIL BOX (✉)** button can be used.
- ◊ Pressing **MAIL BOX (✉)** once will:
  1. Turn on the answering machine.
  2. Enter into mailbox mode.

BATTERY LEVEL & LOW BATTERY ALERT

- ◊ Share with the handphone.

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4. Customization

All the settings described in this chapter are stored in the non-volatile memory of the answering machine. The data will be retained when the device is turned off.

RECORDING OUTGOING MESSAGE (OGM)

◊ Enter Menu mode and go to Sub-Menu 19.2 of the Accessory Menu.
◊ The access of Menu 19.2 is controlled by the lock code.

MENU:	19.2	
FUNCTION:	RECORD OUTGOING MESSAGE	
DISPLAY 1:	RECORD OGM	Press **STO**
DISPLAY 2:	ENTER CODE	↵
DISPLAY 3:	* * * *	Press {lock_code} **STO**
DISPLAY 4:	START AFTER	↵
	BEEP	
	....	
	(Recording ...)	
	....	Press **STO** when completed
DISPLAY 5:	REC DONE	↵
		Exit back to Menu 19
		after 3 seconds

◊ The buzzer will sound briefly after the correct lock code has been entered. The recording will commence immediately after the end of the tone.
◊ The recording of OGM ends when either the user presses **STO** again, or the 15 seconds interval has elapsed. In the later case, the *End Recording Tone* will sound for 3 seconds.

PLAYING-BACK OUTGOING MESSAGE (OGM)

◊ Enter Menu mode and go to Sub-Menu 19.3 of the Accessory Menu.

MENU:	19.3	
FUNCTION:	PLAYBACK OUTGOING MESSAGE	
DISPLAY 1:	P'BACK OGM	Press **STO**
DISPLAY 2:	PLAYING ...	↵
	....	

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(Playing back ...)
....
(Exit back to Menu 19)

[Press **STO** to abort any time]
↵

◊ When **STO** is pressed, a beep will sound in the earpiece (assuming there is no car kit) briefly after a 2-second delay. The playback will commence immediately after the end of the tone. (P.S. The delay is to allow the user to position the handphone onto his ear.)

SETTING ICM MONITOR OPTION

◊ Enter Menu mode and go to Sub-Menu 19.4 of the Accessory Menu.

MENU:	19.4	
FUNCTION:	MONITOR OPTION	
DISPLAY 1:	MONITOR	Press **STO**
DISPLAY 2:	>{current_option}	↵
OPTIONS:	ENABLE	← default
	DISABLE	

◊ Use ∧ or ∨ button view the other option and press **STO** to select/store the option.

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APPENDIX C

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1. INTRODUCTION

- Elite bus provides a basic means of point-to-point communications between the followings:

  I. Handset <----------> Lab Tester ❶
  II. Handset <----------> Factory Tester ❷
  III. Handset <----------> Radio Servicing Software / Field Programmer ❸
  IV. Handset <----------> Plug-in Pager ❹
  V. Handset <----------> Plug-in Answering Machine ❺

- Each of the above device is assigned an device identifcation code (see Section 2 for details), which needs to be sent in every commands and responses.

- There are 3 categories of messages defined:
  - Command Message
  - Response Message
  - Status Message

- Each of the above device ❶ to ❺ may issue and respond a set of commands. Section 5, 6 and 7 indicates which messages are applicable to each device. The Lab Tester is an exception where all defined messages are applicable.

- All messages are binary-based (with the exception of monitor status message which its data is ASCII-based for easy monitoring). Each message word comprises of one or more bytes. All messages are single-word.

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2. DEVICE IDENTICATION CODE

- The parameters field in the table refers to any additional data other than *Device Identication Code* that needs to be sent in the message. The *Device Identication Code* is used by the handset to determine if the response is applicable.

• Handset	-	No code is required.
• Lab Tester	-	0xB0 (derived from 0xA1 XOR 0x11)
• Factory Tester	-	0xA3 (derived from 0xB2 XOR 0x11)
• Radio Servicing Software	-	0xD2 (derived from 0xC3 XOR 0x11)
• Plug-In Pager	-	0xC5 (derived from 0xD4 XOR 0x11)
• Plug-In Answering Machine	-	0xF4 (derived from 0xE5 XOR 0x11)

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3. PHYSICAL LAYER SPECIFICATIONS

Type:	Full Duplex Asynchronous Point-to-Point link
Speed:	9600 bit per sec
Data Bits:	8
Parity:	None
Stop bits:	1

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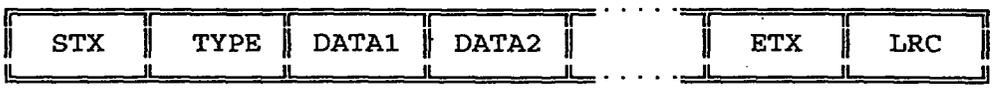
4. MESSAGE STRUCTURE & FLOW CONTROL

- General Message Word Structure:

Message From Handset:



Message To Handset:

STX	-	Start of Transmission (0x02).
TYPE	-	Message type field.
DIC	-	Device Identification Code as defined in Section 2.
DATA	-	(See description of individual messages).
ETX	-	End of Transmission (0x03).
LRC	-	Longitudinal Redundancy Check. LRC is computed by XOR all the characters from TYPE field up to ETX character inclusively. See the following paragraphs: Sentinel(s) is not included in the calculation. Original special characters (not "quoted" characters) are used in the calculation.

- Flow Control: ACK (0x06) / NACK (0x15) protocol:

SENDER:

- Should not continue to send additional message word until the its last sent message has been acknowledged (ie. ACK received). ***TIMEOUT = 1 second.***
- Sender should retry ***UP TO 3 TIMES*** when there is no response (ACK or NACK) or NACK'd. The time interval between retries should be ***1 to 2 second.***.

RECEIVER:

- Message word with non-zero calaculated LRC should be NACK'd; otherwise, the incoming message should be ACK'd ASAP.

- Provisions for Full Duplex Operation:

- Special Characters:

STX	-	0x02
ETX	-	0x03
SENTINEL	-	0x88
ACK	-	0x06
NACK	-	0x15

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- In full duplex operation, it is possible that any of the above special characters may be embedded into an on-going incoming message word (as well as the LRC). These flow control characters is meant for a previously sent message in the opposite direction.

- When a party needs to respond with a ACK or NACK while it is also sending its own message, it should send ACK or NACK immediately (the ACK/NACK character shall not affect the LRC calculation of the message being sent). The other party should recognize 0x06 or 0x15 as flow control characters (not part of the message).

- A SENTINEL (0x88) is defined to notice the receiving party that the byte that follows immediately has been be "quoted" (XOR with 0x11) before sending out. For example,

  Original Word:

02	20	31	06	03	LRC

  LRC = 0x00 XOR 0x20 XOR 0x31 XOR 0x06 XOR 0x03
  = 0x14

  Word To Be Sent:

02	20	31	88	17	03	LRC

  Sentinel 0x06 XOR 0x11

  LRC = 0x14

- The transmitted LRC field is calculated with the "pre-quoted" character (i.e. 0x06 in the above example). Similiarly, the received LRC should be calculated with "recovered" character.

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5. COMMAND MESSAGE

At link level, each command message will be ACK or NACK by the receiving party. For some commands, the requested operation of the command will be responded by a separate response message.

- Listed below is the summary all the defined commands. The parameters field in the table refers to any additional data other than *Device Identication Code* that needs to be sent in the message. The *Device Identication Code* is used by the handset to determine if the command is applicable.
-

TYPE	Command	Parameters (if any)	Response	Direction
ACCESSORIES - PLUG-IN ANSWERING MACHINE (Available during Normal Mode Only)				
0x00[†]	Turn Off Plug-In Device (for Ans Mach or Pager)	NONE	Ans Mach Status (w/ Ready indication)	Hset ⓪,⓪>> ⑥
0x50	Play Back	Slot No (0 to 5)	Ans Mach Status (w/ Slot no. indication) ... Ans Mach Status (w/ EOM indication)	Hset ⓪,⓪>> ⑥
0x51	Play Back Current Slot	NONE	Ans Mach Status (w/ Slot no. indication) ... Ans Mach Status (w/ EOM indication)	Hset ⓪,⓪>> ⑥
0x52	Record	Slot No (0 to 5)	Ans Mach Status (w/ Slot no. indication) ... Ans Mach Status (w/ Overflow indication)	Hset,⓪,⓪>> ⑥
0x53	Record Current Slot	NONE	Ans Mach Status (w/ Slot no. indication) ... Ans Mach Status (w/ Overflow indication)	Hset,⓪,⓪>> ⑥
0x54[†]	Stop PlayBack/Record	NONE	Ans Mach Status (w/ Ready indication)	Hset,⓪,⓪>> ⑥

† In order to turn on the answering machine, a 10ms low pulse needs to be generated.

† During recording, Stop PlayBack/Record Command should be issued to the device before the 15 second time slot elapsed. Otherwise, the answering machine will issue an Overflow Response and the recording will be stopped immediately.

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ACCESSORIES - PLUG-IN PAGER (Available during Normal Mode Only)

0x00†	Turn Off Plug-In Device (for Ans Mach or Pager)	NONE	Pager Status (w/ Ready indication)	Hset,❶,❷>> ❶

† In order to turn on the pager, a low pulse (500 usec minimum) needs to be generated.

0x60	Program Decoder	EEPROM Array No. Address/Data (5 bytes)	Pager Status (w/ Ready indication)	❶❷❸>>❶
0x61	Read Time	NONE	Current Time (hh:mm:ss)	Hset❶❷❸>>❶
0x62	Set Time	Time (hh:mm:ss)	Pager Status (w/ Ready indication)	Hset❶❷❸>>❶
0x63	Handset Power	Handset PWR ON/OFF Wake-up Enable/Disable	Pager Status (w/ Ready indication)	Hset❶❷❸>>❶
0x64	Any Unread Page	NONE	Pager Status (returns no. of unread msg)	Hset❶❷❸>>❶
0x65	Read Page	[Latest | Current | Prev]	Page Record	Hset❶❷❸>>❶
0x66	Delete Page	[Prev | All]	Pager Status (w/ Ready indication)	Hset❶❷❸>>❶
0x67	Lock Previous Page	NONE	Pager Status (w/ Ready indication)	Hset❶❷❸>>❶
0x68	Unlock Page	NONE	Pager Status (w/ Ready indication)	Hset❶❷❸>>❶
0x69	Load Decoder	EEPROM Array No.	EEPROM Array No. Address/Data (5 bytes)	❶>>❶❷❸

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6. RESPONSE MESSAGE

- Listed below is the summary all the defined responses. The parameters field in the table refers to any additional data other than *Device Identication Code* that needs to be sent in the message. The *Device Identication Code* is used by the handset to determine if the response is applicable.

TYPE	Response	Parameters (if any)	Corr. Command	Direction
GENERAL - Available in all Modes				
0x80	Command Status	OK or INVALID	Any commands	Hset>>❷❸❹❺
MONITORING - Available during Monitor Mode Only				
0x81	Channel Status	*See Below	Monitor Mode	Hset >> ❶ ❷
(Not Implemented Yet. Until further notice)				
*	AIR-INTERFACE State, Channel Number, SAT, Transmit Power Level and total number of BCH errors since last command. Response sent whenever any of the above parameters changes.			
TESTING - LOAD (Available during Test Mode Only)				
0x82	PSIM Data	See Section 8	Load PSIM	Hset >>❶ ❷ ❸
0x83	NAM Data	See Section 8	Load NAM	Hset >>❶ ❷ ❸
0x84	UPO Data	See Section 8	Load UPO	Hset >>❶ ❷ ❸
0x85	Emergency Numbers	See Section 8	Load Emergency Numbers	Hset >>❶ ❷ ❸
0x86	Tuning Values	**See below	Load All Tuning Values	Hset >>❶ ❷ ❸
**	All attenuator values (A1-A7) in APROC PWM values corresponding to AMPS/TACS PL0-7			
0x87	EEPROM Data	Data Bytes	Read EEPROM	Hset >>❶ ❷
TESTING - DPROC (Available during Test Mode Only)				
0x89	DPROC Status	Status Reg	Read DPROC Status Reg	Hset >>❶ ❷ ❸
ACCESSORIES - PLUG-IN ANSWERING MACHINE (Available during Normal Mode Only)				
0x8A	Ans Mach Status	† Status Byte † Indications Power OFF Ready Slot No.	See Below Plug-In Power (OFF) Plug-In Power (ON) OR Stop PlayBack/Record OR Device Internal Reset Play Back OR Play Back Current Slot OR Record OR	❺ >>Hset ❶ ❷

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			Record Current Slot	
		EOM	Play Back & Voice Msg Ended,	
		Overflow	Record & Time Slot Exceeded	

ACCESSORIES - PLUG-IN PAGER (Available during Normal Mode Only)

0x8B	Pager Status	†† Status Byte	See Below	❾>>Hset❶❷❸
		†† Indications		
		POWER OFF	Plug-In Power (OFF)	
		READY	Plug-In Power (ON) OR Program Decoder OR Set Time Device Internal Reset	
		UNREAD MSG	Any Unread Message	
0x8C	Unread Pages	No. of Unread Pages	Any Unread Pages cmd	❾>>Hset❶❷❸
0x8D	Page Record	Data & Ctrl Bits	Read Page	❾>>Hset❶❷❸
0x8E	Current Time	hh:mm	Read Time command	❾>>Hset❶❷❸
0x8F	Decoder Data	EEPROM Array No. Address/Data (5 bytes)	Load Decoder command	❾>>❶❷❸

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7. STATUS MESSAGE

Status messages are sent spontaneously when a determinant condition occurs.

- Listed below is the summary all the defined responses. The parameters field in the table refers to any additional data other than *Device Identication Code* that needs to be sent in the message. The *Device Identication Code* is used by the handset to determine if the status is applicable.

TYPE	Status Msg	Parameters (if any)	Condition	Direction
MONITORING - Available during Monitor Mode Only				
0xA0	Channel Status	See Below	Any Parameter Changes Value	Hset >> ❶ ❷
(Not Implemented Yet. Until further notice)				
	Same as Type 0x80. Parameters include AIR-INTERFACE State, Channel Number, SAT, Transmit Power Level and total number of BCH errors since last command.			
ACCESSORIES - PLUG-IN PAGER (Available during Normal Mode Only)				
0xA1	Pager Alert	Repeated Call indication	Page Received	❹ >>Hset ❶ ❷
0xA2	Out Of Range	NONE	See Decoder Specs	❹ >>Hset ❶ ❷
0xA4	RTC Tick	Current Time (hh:mm)	Every Minute (unless Wake-Up-Handset command has been rcvd)	❹ >>Hset ❶ ❷
0x8B	Pager Status	Buffer Full	All available msg slots are occupied.	❹ >>Hset ❶ ❷

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TURN OFF PLUG-IN DEVICE 0x00

MESSAGE TYPE: COMMAND

DESCRIPTION: Turn off the plug-in devices (including the Answering Machine and the Pager). Note that the power control of the plug-in vibrator has not been defined yet.

MESSAGE FORMAT:

STX	00	ETX	LRC

PARAMETERS: None

EXPECTED RESPONSE: PAGER/ANS MACHINE STATUS MESSAGE (0x8A)

PLAYBACK 0x50

MESSAGE TYPE: COMMAND

DESCRIPTION: Direct the plug-in answering machine to playback at the selected slot once. The playback continues until either "Stop Playback/Record "command is sent or the voice mail ends. After the playback, the answering machine will advance to next slot (but it will not wrap-around back to slot 0 if slot 5 is selected).

MESSAGE FORMAT:

STX	50	SLOT	ETX	LRC

PARAMETERS:

SLOT Select the slot number (0 to 5) of the voice message to playback.

EXPECTED RESPONSE: ANSWERING MACHINE STATUS MESSAGE (0x8A)

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PLAYBACK CURRENT SLOT 0x51

MESSAGE TYPE: COMMAND

DESCRIPTION: Direct the plug-in answering machine to playback at the currently selected slot once. The playback continues until either "Stop Playback/Record "command is sent or the voice mail ends. After the playback, the answering machine will advance to next slot (but it will not wrap-around back to slot 0 if slot 5 is selected).

MESSAGE FORMAT:

STX	51	ETX	LRC

PARAMETERS: NONE

EXPECTED RESPONSE: ANSWERING MACHINE STATUS MESSAGE (0x8A)

RECORD 0x52

MESSAGE TYPE: COMMAND

DESCRIPTION: Direct the plug-in answering machine to record at the selected slot. The recording shall commence shortly (say, within 100ms) after the Answering Machine sends a positive status message. The recording continues until either "Stop Playback/Record "command is sent or the voice mail time slot expires. After the recording, the answering machine will advance to next slot (but it will not wrap-around back to slot 0 if slot 5 is selected).

MESSAGE FORMAT:

STX	52	SLOT	ETX	LRC

PARAMETERS:

SLOT Select the slot number (0 to 5) of the voice message to record.

EXPECTED RESPONSE: ANSWERING MACHINE STATUS MESSAGE (0x8A)

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RECORD CURRENT SLOT 0x53

MESSAGE TYPE: COMMAND

DESCRIPTION: Direct the plug-in answering machine to record at the currently selected slot. The recording shall commence shortly (say, within 100ms) after the Answering Machine sends a positive status message. The recording continues until either "Stop Playback/Record "command is sent or the voice mail time slot expires. After the recording, the answering machine will advance to next slot (but it will not wrap-around back to slot 0 if slot 5 is selected).

MESSAGE FORMAT:

STX	53	ETX	LRC

PARAMETERS: NONE

EXPECTED RESPONSE: ANSWERING MACHINE STATUS MESSAGE (0x8A)

STOP PLAYBACK/ RECORD 0x54

MESSAGE TYPE: COMMAND

DESCRIPTION: Direct the plug-in answering machine to stop playing back or recording. The answering machine will advance to next slot (but it will not wrap-around back to slot 0 if slot 5 is selected).

MESSAGE FORMAT:

STX	54	ETX	LRC

PARAMETERS: NONE

EXPECTED RESPONSE: ANSWERING MACHINE STATUS MESSAGE (0x8A)

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PROGRAM DECODER 0x60

MESSAGE TYPE: COMMAND

DESCRIPTION: Program the eeprom array that resided in the plug-in pager's POCSAG decoder PCF5001T. (There are 3 eeprom arrays of 38 bits each in the decoder, please refer to its specs for definition. Certainly bits in the command may be ignored by the pager which will be defined later.)

MESSAGE FORMAT:

bit39 bit0

PARAMETERS:

ARRAY#	Select one of the 3 eeprom arrays in the decoder. 0x00 - Array 1, 0x01 - Array 2, 0x02 - Array 3
Bit 39, 38	Not used
Bit 37 - 0	As per PCF5001T specs

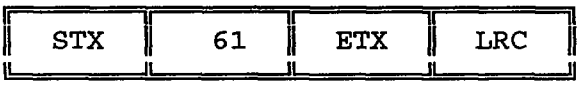
EXPECTED RESPONSE: PAGER STATUS MESSAGE (0x8B)

READ TIME 0x61

MESSAGE TYPE: COMMAND

DESCRIPTION: Read the current time maintained by the built-in real time clock in the plug-in pager.

MESSAGE FORMAT:



PARAMETERS: NONE

EXPECTED RESPONSE: CURRENT TIME MESSAGE (0x8E)

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SET TIME 0x62

MESSAGE TYPE: COMMAND

DESCRIPTION: **Set the current time of the built-in real time clock in the plug-in pager. Second will be set to zero.**

MESSAGE FORMAT:

STX	62	HOUR	MINUTE	ETX	LRC

PARAMETERS:

HOUR — 24-hour format (0 to 23). Ten's and one's digits are BCD-coded.

MINUTE — 0 to 59. Ten's and one's digits are BCD-coded. For example, 11:32 pm will be represented as:

```
02 62 23 32 03 LRC
```

EXPECTED RESPONSE: PAGER STATUS MESSAGE (0x8B)

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HANDSET POWER 0x63

MESSAGE TYPE: COMMAND

DESCRIPTION: Inform the pager of power status of the handset.

MESSAGE FORMAT:

STX	63	PWR	WAKEUP	ETX	LRC

PARAMETERS:

PWR
- 0 - Handset is going to power down. Pager to suspend RTC Tick message (0xA4).
- 1 - Handset has been powered up. Pager to resume RTC Tick message (0xA4). Reset any WAKEUP option in the previous 0x63 command.

WAKEUP *Ignore this byte if PWR = 1*
- 0 - Do not wake up the handset even if a valid page has been received.
- 1 - Wake up the handset via the serial bus if a valid page has been received.

EXPECTED RESPONSE: PAGER STATUS MESSAGE (0x8B)

ANY UNREAD PAGE 0x64

MESSAGE TYPE: COMMAND

DESCRIPTION: Interrogate the number of unread pages in it's page memory.

MESSAGE FORMAT:

STX	64	ETX	LRC

PARAMETERS: NONE

EXPECTED RESPONSE: PAGER STATUS MESSAGE (0x8B)

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READ PAGE 0x65

MESSAGE TYPE: COMMAND

DESCRIPTION: Request for a page record as indicated. (P.S. After sending the record, the pager should automatically advance its internal pointer to the next record or null (if it's the last one)).

MESSAGE FORMAT:

STX	65	LOC	ETX	LRC

PARAMETERS:

LOC	0x00	-	Send the **LATEST** page
	0x01	-	Send the **CURRENT** page
	0x04	-	Send the **PREVIOUS** page

EXPECTED RESPONSE: PAGER STATUS MESSAGE (0x8B)
(indicating BUFFER IS EMPTY or END OF BUFFER), OR
PAGE RECORD MESSAGE (0x8C)

DELETE PAGE 0x66

MESSAGE TYPE: COMMAND

DESCRIPTION: Request for a page record or all of them to be deleted from the pager's memory.

MESSAGE FORMAT:

STX	66	OPT	ETX	LRC

PARAMETERS:

OPT	0x00	-	Delete the **PREVIOUS** page only.
	0x01	-	Delete all pages except those that are marked as unread or locked.

EXPECTED RESPONSE: PAGER STATUS MESSAGE (0x8B)

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LOCK PREVIOUS PAGE 0x67

MESSAGE TYPE: COMMAND

DESCRIPTION: Lock the previous page record. Locked page will not be deleted by the pager when it goes power down. Unlike "Read Page" command, the pager **should not** advance its internal page record pointer.

MESSAGE FORMAT:

STX	67	ETX	LRC

PARAMETERS: NONE

EXPECTED RESPONSE: PAGER STATUS MESSAGE (0x8B)
(with READY, EMPTY or END OF BUFFER indication)

UNLOCK PAGE 0x68

MESSAGE TYPE: COMMAND

DESCRIPTION: Unlock the previous page record.

MESSAGE FORMAT:

STX	68	ETX	LRC

PARAMETERS: NONE

EXPECTED RESPONSE: PAGER STATUS MESSAGE (0x8B)
(with READY, EMPTY or END OF BUFFER indication)

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PAGE ALERT 0xA1

MESSAGE TYPE: SPONTANEOUS STATUS

DESCRIPTION: Sent when there is a valid page has been received.

MESSAGE FORMAT:

STX	A1	DIC	DUP	ETX	LRC

PARAMETERS:

DUP	0x00	The latest page is not a Duplicated one
	0x01	The latest page is a Duplicated one. (P.S. The pager shall replace the timer stamp of the old page with the new one, and place the page to the top of its buffer.)

OUT OF RANGE 0xA2

MESSAGE TYPE: SPONTANEOUS STATUS

DESCRIPTION: Sent the paging receiver goes out of range or back in range.

MESSAGE FORMAT:

STX	A2	DIC	STATUS	ETX	LRC

PARAMETERS:

STATUS	0x01	Out-Of-Range
	0x00	In Range

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RTC TICK 0xA4

MESSAGE TYPE: SPONTANEOUS STATUS

DESCRIPTION: Same as message 0x8E every minute unless "Handset Power" message with power down indication has been received.

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CLAIMS

1. A battery-powered portable electronic device (1) including an interchangeable battery pack (2) fitted to a main unit of the device, characterised by an auxiliary functional unit (AFU) (10) contained within the battery pack and arranged to communicate data bidirectionally with circuits within the main unit of the device, the auxiliary functional unit (10) thereby performing the auxiliary function in conjunction with the said circuits within the main unit (1) of the device.

2. A device according to claim 1 in which the physical interface (3) between the battery pack (2) and the main unit (1) comprises a multiplicity of contact pins arranged in a linear array with a battery ground contact pin at one end of the array, a battery +ve contact pin at the other end of the array, and at least one data pin between the said battery contact pins and connected to the auxiliary functional unit.

3. A device according to claim 2 in which the interface (3) includes 2 data pins, one carrying data unidirectionally from the AFU to the main unit, and the other carrying data unidirectionally from the main unit to the AFU.

4. A device according to claim 1, 2 or 3 in which the main unit of the device includes a user input device (7) and is arranged to communicate control signals to the auxiliary functional unit (10) in response to a user input.

5. A device according to any one of the preceding claims in which the interface (3) for the battery pack includes a connection for the transmission of power from the main unit to the auxiliary functional unit (10).

6. A device according to any one of the preceding claims, in which in a standby mode of the device only the auxiliary functional unit (10) is powered, and the auxiliary functional unit is arranged subsequently to switch ON power to the main unit.

7. A device according to claim 6, in which the auxiliary functional unit (10) switches ON the main unit in response to a signal received from a source external to the device.

8. A device according to any one of the preceding claims, in which the device (1) is a cellular telephone.

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9. A device according to claim 8, in which the auxiliary functional unit (10) is a pager.

10. A device according to claim 8, in which the auxiliary functional unit (10) is an answering machine.

11. A device according to claim 8, in which the auxiliary functional unit (10) is a vibrating silent alarm.

12. A device according to claim 8, in which the auxiliary functional unit (10) is a cordless phone.

13. An interchangeable battery pack (2) arranged to be fitted to the main unit of a portable electronic device, characterised by an auxiliary functional unit (10) contained within the battery pack and arranged to communicate data bidirectionally with circuits within the main unit of the device, the auxiliary functional unit thereby performing the auxiliary function in conjunction with the said circuits within the main unit of the device

14. A cellular telephone, characterised by a pager module powered independently of the primary telephony circuits of the telephone and arranged to wake-up the said telephony circuits when a paging signal is received.

15. A cellular telephone according to claim 14, in which the pager module is arranged to communicate caller line identification (CLI) data to the primary telephony circuits.

16. A cellular telephone according to claim 15, in which the primary telephony circuits are arranged to display to the user the CLI data received from the pager module.

17. A cellular telephone according to any one of claims 14 to 16 in which the primary telephony circuits are arranged to make a registration with the cellular network automatically after powering-up in response to a paging signal.

18. A cellular telephone according to any one of the preceding claims, in which the pager is contained in an interchangeable battery pack fitted to the phone.

19. A cellular telephone according to any one of the preceding claims, in which the pager is arranged to communicate data bidirectionally with the primary telephony circuits via the connection between the battery pack and the main unit of the telephone.

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20. A method of operating a cellular telephone including placing the telephone in a standby mode to reduce power consumption, characterised in that in standby mode power to the primary telephony circuits is turned OFF and power to a pager module remains ON, and in that the pager module, on subsequently receiving a pager signal, switches ON power to the primary telephony circuits.

21. A method according to claim 20, in which the pager module receives caller line identification (CLI) data and communicates the said CLI data to the primary telephony circuits.

22. A method according to claim 21, in which the primary telephony circuits display the CLI data received from the pager module.

23. A method according to any one of claims 20 to 22, in which the telephony circuits make a registration with the cellular network automatically after waking-up in response to a paging signal.

24. A method of operating a cellular telecommunications network characterised by transmitting a pager signal from the network to a cellular telephone, receiving the pager signal in a pager module in the cellular telephone while the primary telephony circuits of the cellular telephone are powered-down, switching ON power to the primary telephony circuits in response to the pager signal, and subsequently establishing a connection between the said primary telephony circuits and the network.

25. A method according to claim 24, further comprising:

receiving at the cellular network exchange a destination cellular telephone number from a call originator; and

only when the destination cellular telephone is determined not to be registered with the cellular network then outputting from the network exchange a pager signal, and otherwise establishing a connection directly with the primary telephony circuits of the destination cellular telephone.

26. A method according to claim 25, in which the network exchange stores a record of destination numbers and corresponding pager numbers, and when the destination cellular telephone is determined to be not registered powered-down then retrieves the corresponding pager number for use in signalling the pager module.

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