

Maintenance Manual

DUAL FORMAT PCS™ 800 MHz PORTABLE RADIO COMBINATION

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FRONT ASSEMBLY	LBI-38855
REAR ASSEMBLY	LBI-38856
SERVICE SECTION	LBI-38857

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NOTICE!

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SPECIFICATIONS

GENERAL

Dimensions (Less Antenna) H x W x D	
With 1200 maH Battery	7.1 x 2.8 x 1.77 inches 17.8 x 7.2 x 4.5 centimeters
With 1700 maH Battery	8.4 x 2.8 x 1.77 inches 21.3 x 7.2 x 4.5 centimeters
Weight	
Radio (less battery)	14 oz
1200 mAH Battery	9 oz
1700 mAH Battery	13.5 oz
Ambient Temperature Range	-30 to 60 °C (-22 to 140 °F)
Vibration	EIA/USFS/MIL-STD-810E, METHOD 514.4 PROCEDURE 1
Shock	EIA/MIL-STD-810E, METHOD 516.4, PROCEDURE 1,4
Relative Humidity	EIA/MIL-STD-810E, METHOD 507.3, PROCEDURE 2
Altitude	15000 Feet
Construction	
Front	Lexan Polycarbonate
Rear	Die-Cast Aluminum
Battery Drain	
Receive Standby	90 mA
Receive Full Audio	270 mA
Transmit at 3 Watts	2.0 A
Transmit at 1 Watt	1.3 A
Battery Life (Between Charges)	
1200 mAH Battery	
HI Power	6.5 Hours
LO Power	8.0 Hours
1700 mAH Battery	
HI Power	9.2 Hours
LO Power	11.3 Hours
Regulatory Approval	
FCC (USA)	AXA9MX-PCS8
DOT (Canada)	PCS8

SPECIFICATIONS (CON'T)

TRANSMITTER

Frequency Range	806-824 MHz
Talk Around	851-869 MHz
Power Output	
HI Power	3 Watts (806-824)
LO Power	2.5 Watts (851-869)
	1 Watt
Frequency Stability	
NPSPAC	±1.5 ppm
Conducted Spurious	-65 dB (-30 dBm)
Radiated Spurious	-65 dB (-30 dBm)
Deviation	5 kHz
	4 kHz (NPSPAC)
Audio Response	EIA
Hum And Noise	-40 dB
Audio Distortion	5% (max)

RECEIVER

Frequency Range	851-870 MHz
Audio Output	.5 Watt
Sensitivity	-116 dBm (.35 mV)
Frequency Stability	
NPSPAC	1.5 ppm
Selectivity	-65 dB @ 25 kHz
	-20 dB NPSPAC
Intermodulation	-65 dB
Spurious Response	-60 dB
Audio Frequency Response	EIA
Hum And Noise	-40 dB (max)
Conducted Spurious Response	
Canada	-47 dBm

OPTIONS AND ACCESSORIES

<u>OPTION #</u>	<u>DESCRIPTION</u>
PCAC1C	Earphone UDC Connector Only (FM Approved)
PCAC1J	Earphone Without UDC Connector (FM Approved)
PCAE1X*	Speaker MIC (FM Approved)
PCZM1A*	Earphone With UDC Connector (FM Approved)
PCHC1C*	Belt Clip (FM Approved)
PCHC1D*	Swivel Plate (FM Approved)
PCHC5S*	Case With Top Short Battery (FM Approved)
PCHC5T	Case With Strap Short Battery (FM Approved)
PCHC5U	Case With Top Long Battery (FM Approved)
PCHC5V	Case With Strap Long Battery (FM Approved)
PCNC3L*	Antenna Whip 806-870 MHz
PCPA1J*	High Capacity Battery Pack
PCPA1K*	Extra High Capacity Battery Pack
PCPA1L	Extra High Capacity Battery Pack (FM Approved)
PCPS1K	Mobile Charger (Sleeve)
CH1SS1*	Desk Charger 50/60Hz, 120V, 14HR
CH1SS2	Desk Charger 50/60Hz, 230V, 14HR
CH1RS1*	Rapid Desk Charger 50/60Hz, 120V, 1HR
CH1RS2	Rapid Desk Charger 50/60Hz, 230V, 1HR
CH6SS1	Multicharger 50/60Hz, 120V, 14HR
CH6SS2	Multicharger 50/60Hz, 230V, 14HR
CH6RS1	Rapid Multicharger 50/60Hz, 120V, 1HR
CH6RS2	Rapid Multicharger 50/60Hz, 230V, 1HR

* Pictured below.



DUAL FORMAT PCS RADIO PACKAGE NUMBERS

<u>PACKAGE NUMBER</u>	<u>DESCRIPTION</u>
PC8LGS	800 MHz DUAL FORMAT 9 SYS/GROUPS (SCAN, EGE)
PC8LGD	800 MHz DUAL FORMAT 9 SYS/GROUPS (SYSTEM, EGE)
PC8MGS	800 MHz DUAL FORMAT 128 SYS/GROUPS (SCAN, EGE)
PC8MGD	800 MHz DUAL FORMAT 128 SYS/GROUPS (SYSTEM, EGE)
PC8TGS	800 MHz DUAL FORMAT 625 SYS/GROUPS (SCAN, EGE)
PC8TGD	800 MHz DUAL FORMAT 625 SYS/GROUPS (SYSTEM, EGE)
PC8LES	800 MHz DUAL FORMAT 9 SYS/GROUPS (SCAN, ERICSSON)
PC8LED	800 MHz DUAL FORMAT 9 SYS/GROUPS (SYSTEM, ERICSSON)
PC8MES	800 MHz DUAL FORMAT 128 SYS/GROUPS (SCAN, ERICSSON)
PC8MED	800 MHz DUAL FORMAT 128 SYS/GROUPS (SYSTEM, ERICSSON)
PC8TES	800 MHz DUAL FORMAT 625 SYS/GROUPS (SCAN, ERICSSON)
PC8TED	800 MHz DUAL FORMAT 625 SYS/GROUPS (SYSTEM, ERICSSON)

INTRODUCTION

The Dual Format PCS Personal radio is a rugged, lightweight unit which is housed in a molded Lexan Front assembly and an Aluminum Rear casting. The new PCS radio provides reliable service in the 800 MHz band and contains new DUAL FORMAT technology that enables the radio to operate within a GE-MARC trunked system and an EDACS® trunked system. There are two models available, the 3-button SCAN model and the system model (which contains a DTMF keypad and supports DTMF operation).

The radio normally transmit in the 806-825 MHz band and receives from 851-870 MHz. The radio is able to transmit from 851-870 MHz for Talk-Around in the GE-MARC system.

The Dual Format PCS radio is offered with several packages available with respect to the number of systems/groups programmed and the EDACS feature set allowed. The radio is also capable of Conventional operation. See the section on page 6 for a complete description of the Packages available.

The radio is programmed using a Personal Computer and an Interface Box connected to the UDC connector on the side of the radio. This allows the radio to be tailored to meet the requirements of the individual user and of the System(s) it is operating within.

DESCRIPTION

The radio is made up of the front assembly, the rear assembly and the control frame assembly. The RF Board is housed in the Rear Assembly and contains all transmit, receive and synthesizer circuits. The Oscillator stability and Receiver selectivity meets NPSPAC specifications. The Audio Logic Board is housed in the Front assembly and contains all transmit audio and receive audio circuits along with all logic and control circuits. The Control Frame assembly mounts in the radio front cover and provides the following functions:

- Audio Logic board interface
- Microphone and speaker connections
- Houses the Select buttons for selecting Systems/Groups, the Volume up/down buttons, the SHFT/CLR button and the PTT button
- UDC interface to the outside of the radio for external options and customer programming
- Liquid Crystal Display

FEATURES

STANDARD RADIO FEATURES

Carrier Control Timer (CCT)

The CCT is programmable on a per channel basis and prevents unnecessary channel traffic and radio damage if the transmit timer is exceeded. If the programmed timer times out during a transmission the radio will beep and stop transmitting. The beeping tone will continue until the operator released the PTT Button.

Audio Alert Beeps

The PCS radio generates a number of alert tones to indicate various events.

Low Battery Alert

When the battery is low and needs to be recharged, the BT icon will be displayed and a low pitch tone will sound every 130 seconds.

Power Up Self Test

Each time the radio is turned on it will perform a power-up self test. After successful completion of the test, an optional tone will sound and the current System and Group/Channel will be displayed. If the unit does not pass the self test an error message will be displayed.

CONVENTIONAL MODE FEATURES

Channel Guard

Channel Guard provides a means of restricting calls to specific radios through the use of a Continuous Tone Coded Squelch System (CTCSS), or a multi-code Digital Squelch System (DCG). Tone frequencies range from 67 Hz to 210.7 Hz. There are 83 standard programmable digital codes.

Manual DTMF Operation

Telephone interconnect calls can be made using the 12-button keypad. This keypad is enabled when a DTMF programmed channel is selected and PTT Button is pressed.

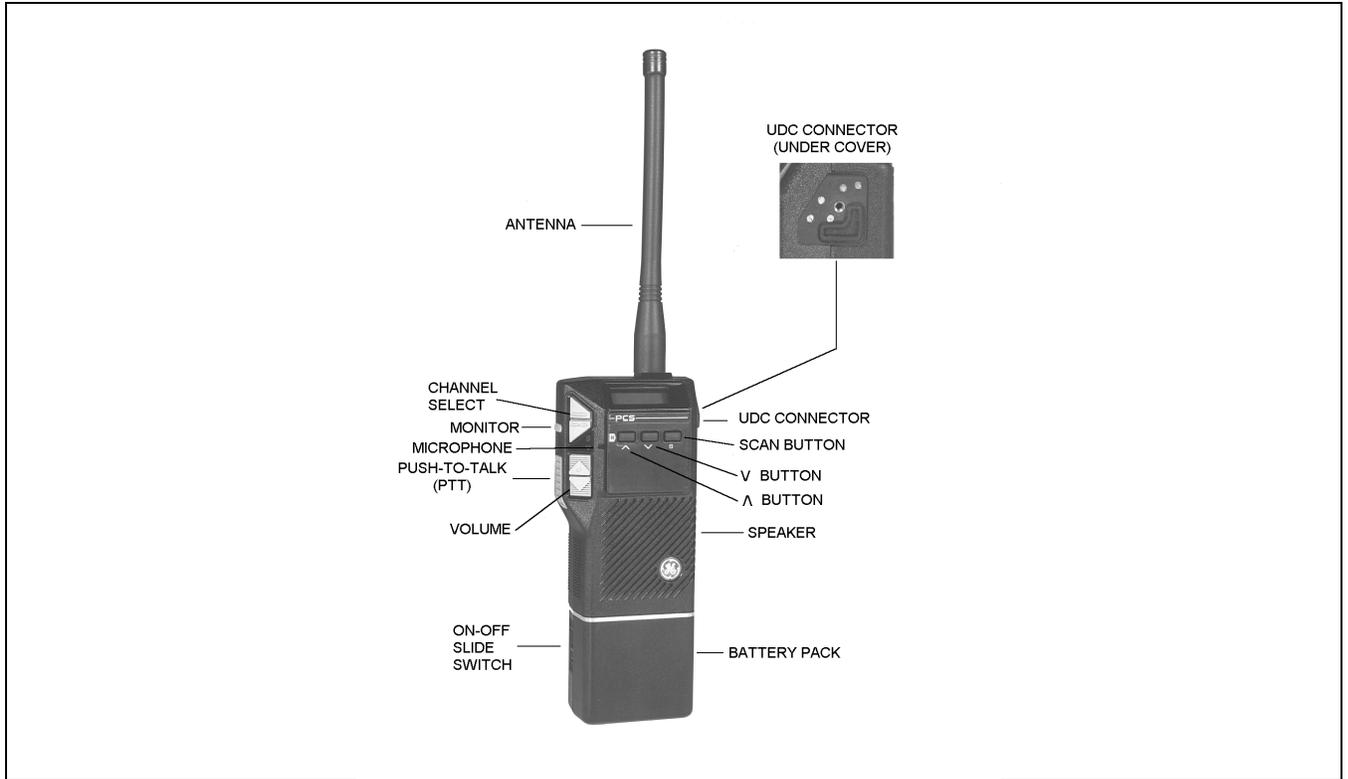


Figure 1 - Dual Format PCS Radio (SCAN)

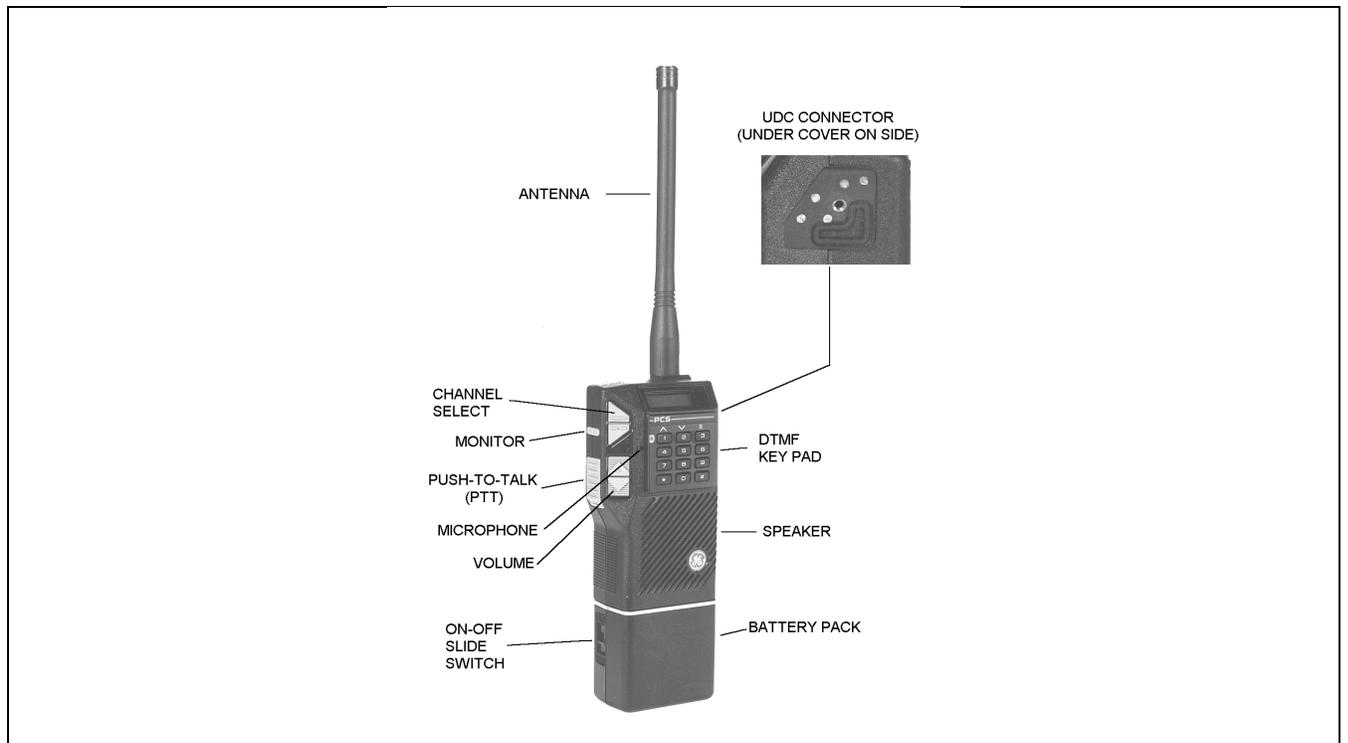


Figure 2 - Dual Format PCS Radio (SYSTEM)

TRUNKED FEATURES (EDACS/GE-MARC)

Preprogrammed DIG/DTMF Numbers

During the PC programming of the radio, the special call list may be programmed with up to 96 numbers for EDACS and 96 numbers for GE-MARC, depending upon available personality space. Using the SPC key, the numbers can be recalled to initiate the special call.

HOME

The radio will automatically select a desired Group and/or System by depressing a single key.

Keypad Lock (System Model Only)

To prevent undesired key presses, the keypad can be locked at any time by depressing the LOCK key (shift 0).

Power Up System/Group

The unit can be PC programmed to automatically select a desired Group and/or System on power up.

Manual Individual Calls (System Model Only)

The System Model radio is capable of making Individual calls which are not programmed into your radio. The Individual Calls are made by manually entering the ID number (EDACS) or Tone Set (GE-MARC) from the radio keypad.

Manual Interconnect (System Model Only)

The System Model radio is capable of making Interconnect calls which are not programmed into your radio. The Interconnect Calls are made by manually entering the telephone number from the radio keypad.

Store

Individual and Interconnect numbers may be entered manually from the radio keypad and stored in any of the 20 memory locations available (10 for EDACS and 10 for GE-MARC).

Recall

Individual and Interconnect numbers may be recalled from a memory location and initiated using the Special Call key and the RCL key (shifted #).

Recall Last Number Send

When entering the Special Call Mode the radio will display the number (0-9) of the last accessed Special Call number.

EDACS (ONLY) FEATURES

Group Scan

The radio monitors the control channel and responds to all group channel assignments associated with the "scan" list. The "priority" group is dictated by the group currently selected. If a call occurs on the "priority" group while monitoring on of the scan groups, the radio will immediately late enter into the "priority" group.

Automatic Login

The radio automatically transmits the "Login" message when the radio roams into a new system, when changing the group selector and when the radio is turned on. The "Login" message includes the Logical ID and the Group ID for the radio.

System/Group Selections

The standard EDACS feature set allows up to 16 systems total, plus group selections. 128 and 625 selection features are also available.

Conventional Failsoft

In the unlikely event of a trunking failure, communications may take place in the Conventional Failsoft mode. The radio will automatically be directed and will switch to a communication channel set up for this purpose.

SCAT

The radio will operate in a Single Channel Autonomous Trunking (SCAT) system.

Base/Mobile Operation

This preprogrammed option is used in some fleets so units can only hear and talk to a base dispatch unit, not to other radios in the group.

Priority System Scan (Optional)

A priority or "home" system is preprogrammed into the radio. The radio unit continually searches (scans) for its

priority system and if found, locks onto it. This improves network efficiency by preventing unnecessary multisited calls.

Emergency (Optional)

An "Emergency" message is initiated by the caller and automatically transmitted by the radio on the control channel. The system automatically assigns the highest priority to the talk group.

Wide Area Scan (Optional)

When the radio unit loses the control channel of the current system, the radio automatically begins searching for a new control channel. The intelligent search algorithm uses a preprogrammed map of adjacent systems to ensure minimum transition time.

Dynamic Regrouping (Optional)

The unit is capable of being reprogrammed over the air while the radio is still active. Multiple talk groups can be added to a radio unit or optionally, the radio can be forced to communicate on designated talk groups.

GE-MARC (ONLY) FEATURES

Talk Around (Direct Mode)

The radio is capable of a direct unit-to-unit short range communication link. It is intended to maintain communications outside the coverage area.

OPERATION

The following section provides a description of the Controls and Indicators for the Dual Format PCS radio. Detailed operating instructions can be found in the Operator's Manual LBI-38823.

CONTROLS

ON/OFF SWITCH

The ON/OFF SWITCH is located on the battery pack. Sliding this switch up to the ON position will supply power to the radio from the battery pack. The radio will beep once after power is applied indicating it is ready for use.

**PTT BUTTON
(Push-To-Talk)**

Pressing the PTT Button on the side of the radio will key the radio's transmitter and perform the necessary steps to acquire a communication channel.

SHIFT/CLR

All alternate key functions are accessed by pressing the SHIFT/CLR button and then pressing the desired function key.

Trunked - Pressing the SHIFT/CLR button twice ("double click") will invoke the CLEAR function which is used to exit the Special Call mode and return to the normal system/group display.

Conventional - Pressing SHIFT/CLR button twice ("double click") will enable MONITORING the channel for activity by un-squelching the receiver. All transmissions will be heard, even if Channel Guard protected.

S

The Select buttons are two momentary (auto ramping) switches used to increment or decrement the current Group/ Channel selection. Pressing the shift button and then the S buttons will increment or decrement the System selection. The Select buttons are also used to increment or decrement the Special Call selection while in the Special Call mode.

V

The Volume buttons are two momentary (auto ramping switches) used to increment or decrement the volume level from the speaker. A tone sounds each time the Volume buttons are pressed, except when a call is in process.

HOME/E

The HOME/Emergency key is used to automatically select a desired Group and/or System by pressing and holding the key for a programmed duration. The HOME/Emergency key is also used to declare emergencies by pressing and holding the key for a pre-programmed duration. Emer-gency

messages may only be issued on EDACS systems.

Group/Channel number. In addition there are 9 status indicators.

SPC Pressing the SPC call key will put the radio in the Special Call Mode. From the Special Call Mode the radio is able to make individual and interconnect calls. This key is active with trunked systems only.

LCD backlighting can be programmed to turn on anytime a button or key is pressed. It will remain on for a programmable length of time after the button or key is released. Backlighting is programmed on a per Group/Channel basis or it may be programmed to remain off at all times. Each radio that is programmed with backlighting may also be programmed to remain on or off when the PTT bar is pressed.

SCAN-A/D The SCAN-Add/Delete key is used to enable the Scan mode and to add or delete Groups/Channel to the Scan list.

System And Group/Channel Indicators

STO The STORe key in combination with the SHIFT/CLR button is used to store Individual Call numbers and Interconnect numbers. This is available on System Model radios and is active with trunked systems only.



The SYStem display indicates the number of the current EDACS, GE-MARC or Conventional system selected.

LOCK The LOCK key in combination with the SHIFT/CLR key is used to lock the keypad. All buttons and keys will be locked except the VOLUME, PTT, HOME/E, SHIFT/CLR and the LOCK (shifted 0). This key is available on System models only.



The GRP (Group) display indicates the number of the current Group in an EDACS or GE-MARC System. The GRP icon is suppressed while operating from a Conventional System, but the field is still used to display the Channel selected.

RCL The RECALL key (shifted #) can be used to recall manually entered individual and interconnect calls in the EDACS and GE-MARC systems. This is available on System model radios and is active with trunked systems only.

Status Indicators

TX The Transmitter flag is on when the radio is transmitting.

BSY The Channel Busy flag is on when the radio receives a call or when a conventional channel is in use. The flag is also on when transmitting on a trunked channel. This flag flashes when a call is queued on a trunked system.

INDICATORS

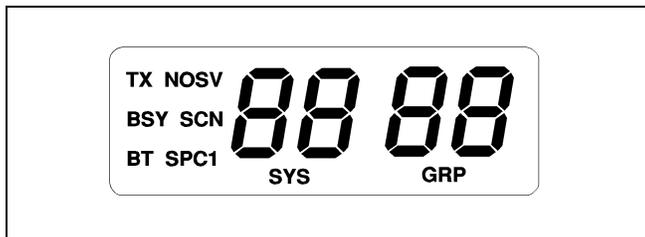


Figure 3 - Dual Format PCS Display

BT The Battery flag is on when the battery power is low and needs charging.

NO EDACS - The NO Service flag is used in conjunction with the Service flag to indicate no service. The illumination of both the NO and the SV flag indicates a no service condition.

The 4-digit LIQUID CRYSTAL DISPLAY (LCD) uses the two digits on the left side to indicate the System number and the two digits on the right side to indicate the

GE-MARC - The NO flag is used in conjunction with the Service flag to indicate an unsuccessful attempt to

access a GE-MARC System. The illumination of both the NO and the SV flag indicates a failed attempt to access a GE-MARC system.

CONVENTIONAL - The NO flag remains off at all times while operating in Conventional mode.

SV EDACS - The Service flag is normally on to indicate service. If a no service condition occurs the "SV" flag and the "No" Service flag will be illuminated.

GE-MARC - The Service flag is normally off. If an unsuccessful attempt is made to access a GE-MARC System, both the "SV" and the "NO" flags will turn on.

CONVENTIONAL - The Service flag remains off at all times while operating in Conventional mode.

SCN The SCAN flag is on when Scan is activated.

S The "S" Flag is used to indicate two conditions. The "S" flag is used in conjunction with the "PC" flag to indicate the radio is in the Special Call mode. The "S" flag is also used to indicate when a trunked group is scan enabled.

PC The "PC" flag is illuminated with the "S" flag to indicate the radio is in the Special Call mode. When the "PC" flag is illuminated without the "S" flag, the radio is in the Program mode.

1 The "1" flag is used only for radio logical ID display. When receiving an individual call, the most significant digit (0 or 1) of the originating radio's ID will be displayed by the (1) flag. When on, the ID of the originating radio begins with a 1.

BATTERY PACKS

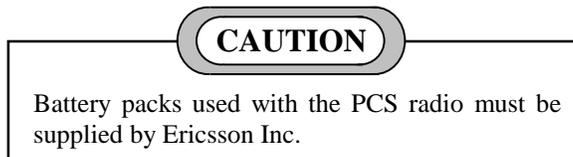
The following battery pack are available for use with the PCS Dual Mode radio:

- | | |
|--------|--|
| PCPA1J | Rechargeable Battery Pack, High Capacity |
| PCPA1K | Rechargeable Battery Pack, Extra High Capacity |

BATTERY PACKS (FM APPROVED)

Only battery packs identified with a green latch shall be used with a portable radio that is rated and labeled as Factory Mutual Intrinsically Safe. Use of nonspecified battery packs voids Factory Mutual approval. The following battery pack option is approved for use in intrinsically safe radios.

- | | |
|--------|---|
| PCPA1L | Rechargeable Battery Pack, Extra High Capacity, (Tall Case) |
|--------|---|



INSTALLING THE BATTERY PACK

1. Ensure the ON/OFF switch on the battery pack is in the off position.
2. Hold the radio and battery pack with the back of them facing you. See Figure 4.
3. Align the grooves on the top of the battery pack with the grooves on the bottom of the radio.
4. Slide the battery pack fully into the radio until the battery release latch clicks into place.



Figure 4 - Installing the Battery Pack

REMOVING THE BATTERY PACK

1. Ensure the ON/OFF switch on the battery pack is in the off position.
2. Press down on the battery release latch and slide the battery pack out in the direction of the release latch. See Figure 5.



Figure 5 - Removing The Battery Pack

CHARGING THE BATTERY PACKS

New batteries or batteries that have been stored for a long period of time, should be fully charged before placing into service. When the battery pack requires charging the "BAT" indicator in the LCD will turn on and the radio will sound a high pitch tone every 130 seconds.

Rechargeable batteries in some applications can develop a condition of reduced capacity, sometimes called "Memory Effect". This condition may occur when:

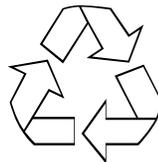
1. The battery is continuously overcharged for long periods of time.
2. A regularly performed duty cycle allows the battery to expend only a limited portion of its capacity.

If the rechargeable battery is only sparingly or seldom used and is left on continuous charge for one or two months at a time, it could experience reduced capacity. This would severely reduce the life of the battery between charges.

The most common method of producing this limited capacity is regularly performing short duty cycles; when the battery is operated so that only a portion (2%) of its capacity is expended. This type of operation can cause the battery to become temporarily inactive and show severe decrease in the ability to deliver at full rated capacity.

Any rechargeable battery showing signs of reduced capacity, should be taken to a qualified Service Technician to be carefully checked before being returned under warranty or scrapped.

Rechargeable Battery Pack Disposal



Ni-Cd

The product you have purchased contains a rechargeable battery. The battery is recyclable. At the end of its useful life under various state and local laws it may be illegal to dispose of this battery into the municipal waste stream. Check with your local solid waste officials for details concerning recycling options or proper disposal in your area. Call Toll Free 1-800-822-9362 for information and/or procedures for returning rechargeable batteries in your state.

Intrinsically Safe Usage

Selected portable radios with appropriate factory installed F4 Options are certified as Intrinsically Safe by the Factory Mutual Research Corporation. Intrinsically Safe approval includes Class I, II, III, Division 1 hazardous

locations in the presence of Groups C, D, E, F and G atmospheres. Non-Incendive approval includes Class I, Division 2 hazardous locations in the presence of Groups A, B, C and D atmospheres.

Hazardous locations are defined in the National Electrical Code. Useful standards NFPA 437A and NFPA 437M for the classifications of hazardous areas can be ordered from the National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.

CHANNEL GUARD ENCODE/DECODE

The radio can be programmed for Channel Guard (CTCSS) encode/decode tone frequencies of Hz to 210.7 Hz, including all of the standard EIA frequencies. Each channel may be programmed for encode/decode, encode only, decode only or for no Channel Guard frequency.

A list of the standard tone frequencies is shown in Table 1. A list of digital Channel Guard codes and their equivalents are shown in Table 2.

Table 1 - CG Tone Frequencies

Standard Tone Frequencies Hz			
67.0	97.4	136.5	192.8
71.9	100.0	141.3	203.5
74.4	103.5	146.2	210.7
77.0	107.2	151.4	
79.7	110.9	156.7	
82.5	114.8	162.2	
85.4	118.8	167.9	
88.5	123.0	173.8	
91.5	127.3	179.9	
94.8	131.8	186.2	
1. Do not use 179.9 Hz or 118.8 Hz in areas served by 60 Hz power distribution systems (or 100.0 Hz or 151.4 Hz in areas supplied with 50 Hz power). Hum modulation of co-channel stations may "false" Channel Guard decoders. 2. Do not use adjacent Channel Guard tone frequencies in systems employing multiple Channel Guard tones. Avoid same-areas co-channel use of adjacent Channel Guard tones whenever possible. As stated in EIA Standard RS-220, there is a possibility of decoder falsing. 3. To minimize receiver turn-on time delay, especially in system using Channel Guard repeaters or receiver voting, choose the highest usable Channel Guard tone frequency. Do not use tones below 100 Hz when it is necessary to meet the receiver response time requirements of EIA Standard RS-220.			

Table 2 - Primary & Equivalent Digital Codes (OCTAL)

PRIMARY CODE	EQUIVALENT CODE	PRIMARY CODE	EQUIVALENT CODE	PRIMARY CODE	EQUIVALENT CODE
023	340, 766	251	236, 704, 742	632	123, 657
025		261	227, 567	565	307, 362
026	566	263	213, 736	654	163, 460, 607
031	374, 643	265	171, 426	662	363, 436, 443, 444
032		271	427, 510, 762	664	344, 471, 715
043	355	306	147, 303, 761	703	150, 256
047	375, 707	311	330, 456, 561	712	136, 502
051	520, 771	315	321, 673	723	235, 611, 671
054	405, 675	331	372, 507	731	447, 473, 474, 744
065	301	343	324, 570	732	164, 207
071	603, 717, 746	346	616, 635, 724	734	066
072	470, 701	351	353, 435	743	312, 515, 663
073	640	364	130, 641	754	076, 203
074	360, 721	365	107	036	137
114	327, 615	371	217, 453, 350	053	
115	534, 674	411	117, 756	122	535
116	060, 737	412	127, 441, 711	145	525
125	173	413	133, 620	212	253
131	572, 702	423	234, 563, 621, 713	225	536
132	605, 634, 714	431	262, 316, 730	246	542, 653
134	273	432	276, 326	252	661
143	333	445	222, 457, 575	255	425
152	366, 415	464	237, 642, 772	266	655
155	233, 660	465	056, 656	274	652
156	517, 741	466	144, 666	325	550, 626
162	416, 553	503	157, 322	332	433, 552
165	354	506	224, 313, 574	356	521
172	057	516	067, 720	446	467, 511, 672
174	142, 270	532	161, 345	452	524, 765
205	135, 610	546	317, 614, 751	454	513, 545, 564
223	350, 475, 750	606	153, 630	455	533, 551
226	104, 557	612	254, 314, 706	462	472, 623, 725
243	267, 342	624	075, 501	523	647, 726
244	176, 417	627	037, 560	526	562, 645
245	370, 554	631	231, 504, 636, 745		

NOTE:
Primary codes in bold are unique Ericsson codes.

EDACS SYSTEM DESCRIPTION

The Dual Format PCS 800 MHz digital trunked portable radio provides fast access to available RF channels and a degree of privacy due to selective signaling. This also eliminates annoyance of other system user's conversations while ensuring that intended calls are not missed.

The system uses 9600 baud high speed digital signaling to identify individual units, user groups, fleets and agencies. Agencies contain multiple fleets and fleets contain multiple user groups simultaneously all the way down to individual users can be accessed. This programming to determine transmit encoded groups and decoded received groups is contained in the personality EEPROM contained in the portable. This information is individually programmed to each users needs via the PC programmer for the radio.

Typical system configuration consists of at least 2 repeater stations (with a maximum number of 25), and the associated portables. One repeater always is a control channel which is dedicated to sending out continuous control data and also to receiving channel request data from the portables. When a portable is first turned on it scans the available list of frequencies programmed in the personality EEPROM for a control channel. When a control channel is found the portable locks onto the frequency and monitors the data for channel assignment (incoming call).

When receiving a channel assignment (incoming call), the monitoring portable immediately switches over to the assigned voice channel and waits for a high speed data confirmation message. Upon receipt of this message the voice paths are unmuted and the user can hear the call.

While on the voice channel, the portable also continuously monitors the low speed, 150 baud (subaudible) data and carrier noise squelch to ensure consistent operation. Upon loss of subaudible data reception (i.e. deep fade, out of range), the portable will return to the control channel frequency.

To initiate a call, the user keys the radio (which is locked to the control channel), and a 30 millisecond high speed data slotted channel request is transmitted to the control channel receiver. The control channel processes the request from the portable and transmits back a voice channel assignment on an unused channel.

When all available voice channels are in use, the control channel will place the portable into a queue, transmit back to the portable a queue message, and will give a channel assignment to the requesting portable as soon as a voice channel is free. If the system is busy and the station queue is filled to capacity, a system busy message will be sent back

to the requesting portable and an alert will be given to the user.

After the initiating portable receives a channel assignment from the control station, it immediately switches frequency over to the assigned voice channel and sends a burst of 9600 baud dotting. The microphone voice paths are then unmuted and the transmission begins. The transmitting portable also continuously sends out a subaudible tone (along with voice) for system reliability. If the station loses this signaling, the voice channel is muted and all receiving portables are sent back to the control channel.

In normal operation, the transmitting portable also sends a phase shift on this subaudible tone to indicate that the user has unkeyed, and to switch listening portables back to the control channel.

GE-MARC SYSTEM DESCRIPTION

The GE MARC™ V•E digital trunked radio system also provides fast access to available RF channels and a degree of privacy due to selective signaling. It also eliminates annoyance of other system user's conversations while ensuring that intended calls are not missed.

Each system has a repeater for each channel (with a 20 channel maximum) and participating portables. The Area/Group switch can address up to 10 systems, 10 combinations of systems and Groups within systems, or even 10 Groups within a single system. An Individual Call would have a dedicated programmed Group encode address.

The system uses tone signaling, with each portable being assigned 2 and/or 4 tone sequences to identify individual units or user groups that can be accessed. Groups of portables are assigned the same tones, so that any unit can talk to all other units in the same group. Programming to determine transmit encoded groups and received decoded groups is contained in the non-volatile Personality EEPROM within the radio, as individually programmed for each user's needs with the PC programmer.

In a GE-MARC V trunked system with a Dual Format PCS System radio, a radio can be programmed to be able to make a Special Call (a telephone interconnect) as an alternative to a programmed dispatch group call for each Area address. Thus for each Area address with its list of channel frequencies, two tone sets can be encoded for transmission, a Group tone set and a Special Call tone set.

For the Direct Mode "Talk- Around" feature a command from the radio's logic circuitry will cause the Voltage Controlled Oscillator (VCO) to switch from the

trunking transmit band to the 851-870 MHz band. This allows direct transmission to another portable without going through a system repeater.

ORIGINATING A CALL

When originating a call, the portable identifies an idle repeater channel and interrogates it with a single burst of "busy" tone, the repeater keys its transmitter and sends a burst of "acquisition" tone back to the portable unit. When the interrogating portable detects the acquisition tone, it then transmits its collect and group tones, which the repeater regenerates for all idle portable units in the system.

The idle portables, which continually scan all channels, will stop on the active channel if any of the programmed collect tones are detected and wait for group tone(s).

If the correct tone sequence is detected, the portables will alert the operator to an incoming call and open their audio circuits. If the correct sequence is not detected, the idle portables will resume scanning the channels. Once the portable is "locked" on a channel, it will remain there until the repeater times out or the operator terminates the call.

OPERATIONAL MODES

The radio will always be in one of three operational modes; idle, wait, or ready. The three operational modes and the conditions that cause the radio to switch from one mode to another are shown in Figure 6.

The radio enters the idle mode when power is turned on and begins scanning channels for incoming calls. The wait mode is entered when the user places a call. The radio remains in the wait mode until a channel is acquired, or if no channel is available. The ready or conversion mode is indicated by an alert tone. A tone signalling Timing Diagram is shown in Figure 7. Sequence Flow Charts for each operational mode are shown in Figures 8, 9 and 10.

Idle Mode (Figure 8)

When the radio is in the Idle Mode, the audio is muted and all channels programmed for call decode are sequentially scanned for an incoming call. An incoming call is identified by detecting one of the collect tones programmed in the area. Upon receipt of a collect tone, the portable looks for a short interval for the group or individual tones, providing that their collect tones are the same. When no valid tone is found, the portable will resume scanning the channels for an incoming call.

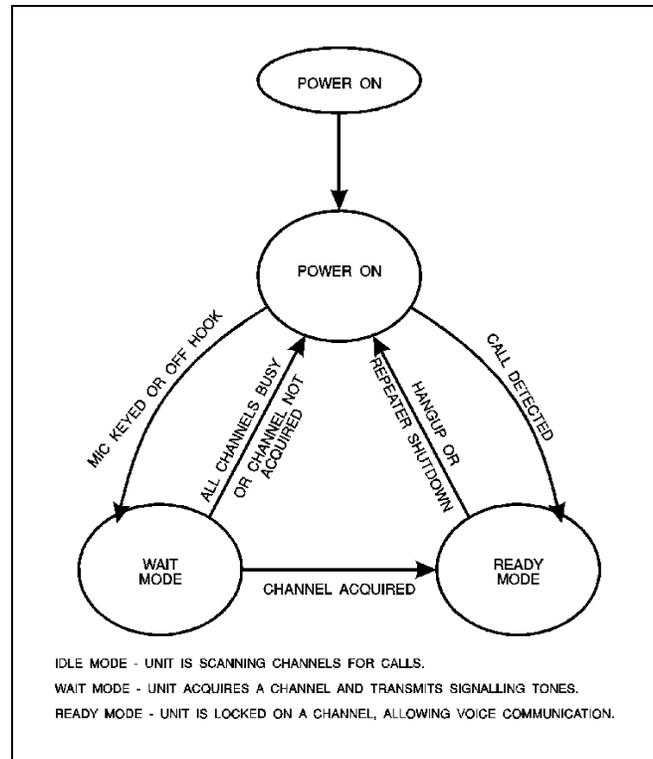


Figure 6 - Operational Modes

If a group (or individual decode) tone is detected the portable then looks for busy tone for a 90 millisecond period. If four tones are properly decoded, the portable will then look for busy tone for 270 milliseconds.

When no valid tones are found, the portable will resume scanning for a call with the next channel. When a busy tone is found, the portable will enter the Ready Mode. If busy tone is not detected, the portable remains in the Idle Mode and continues scanning channels looking for an incoming call. Pressing the PTT switch will cause the radio to enter the Wait Mode.

Wait Mode (Figure 9 on page 19)

When the user enters the Wait mode, the group tone is checked to make sure it is a valid call-originate group. If it is not valid, a high-frequency steady tone is heard in GE-MARC V•E systems only. If valid, the radio will scan the call-originate frequencies for brief intervals until it finds one with no busy tone on it. If no channel is free, the radio will activate the Call Retry state if programmed for this option. This causes the radio to revert to the Idle mode and scan for a call while trying the Wait mode approximately every 20 seconds for a five minute period. If the Retry option is not programmed the portable will sound a low-frequency tone, and then return to the idle mode.

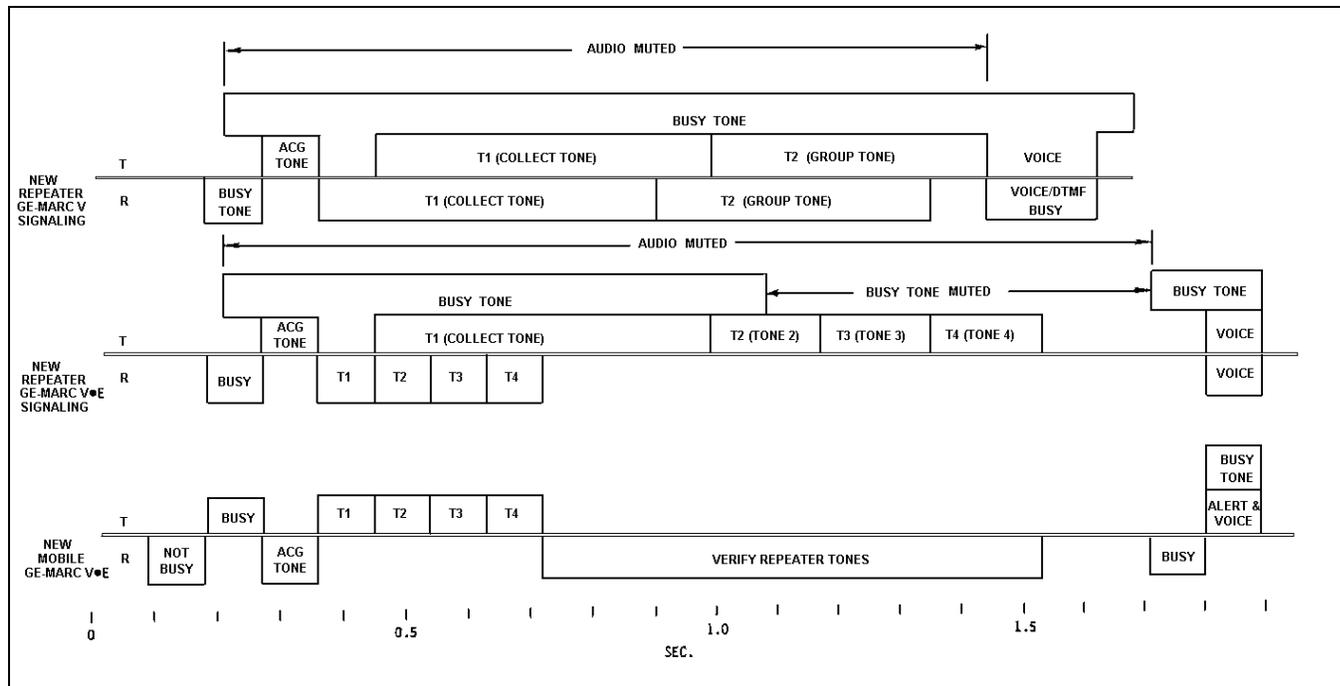


Figure 7 - Tone Signal Timing

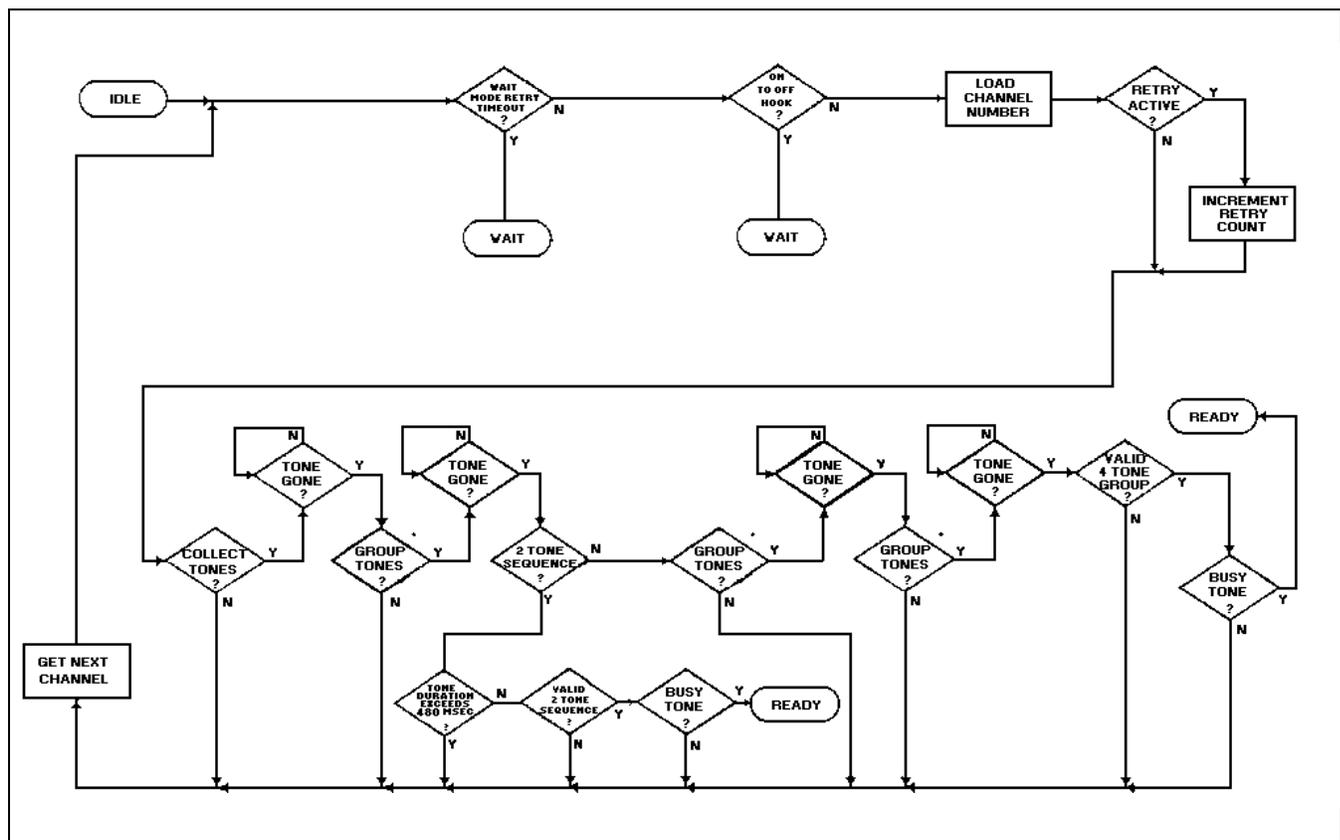


Figure 8 - Idle Mode

If a channel with no busy tone is found, the portable transmits a burst of busy tone to acquire the repeater. The repeater then responds with a burst of acquisition tone. Upon receipt of the acquisition tone, the portable proceeds to transmit the group tones (either two or four tones). If a four tone sequence is sent, the portable must detect all four tones and busy tone before entering the Ready Mode. If a two tone sequence is sent, the busy tone must be present within 90 milliseconds of the last tone in order for the radio to enter the Ready mode. If no busy tone is present, or if the four tone sequence isn't valid, the portable will jump to the next channel in the call originate set and check for busy tone as described above.

READY MODE (Figure 10 On Page 20)

When an incoming call has been detected, or an idle channel has been acquired, the portable enters the Ready mode. In this mode, the audio and push-to-talk circuits are enabled, the speaker is unmuted, and the operator is alerted an alert tone. The radio can then be used in the conventional push-to-talk manner with the radio remaining on the channel until the operator hangs up or the repeater drops the busy tone, causing the unit to revert to Idle mode.

NOTE

If a call is initiated and a sequence of five beeps is sounded, the user cannot access the radio system due to being out of portable receive range or being inoperative. Any subsequent call will be ignored for 20 seconds.

CONVENTIONAL SYSTEM DESCRIPTION

In conventional mode (not trunked) the radio can operate either with tone Channel Guard, digital Channel Guard, or carrier squelch; depending on personality programming. Tone Channel Guard range is 67.0 to 210.7 Hz. Squelch Tail Elimination (STE) is used with tone Channel Guard to eliminate squelch tails at the receiving radio by phase shifting the transmitted Channel Guard tone when the PTT is released.

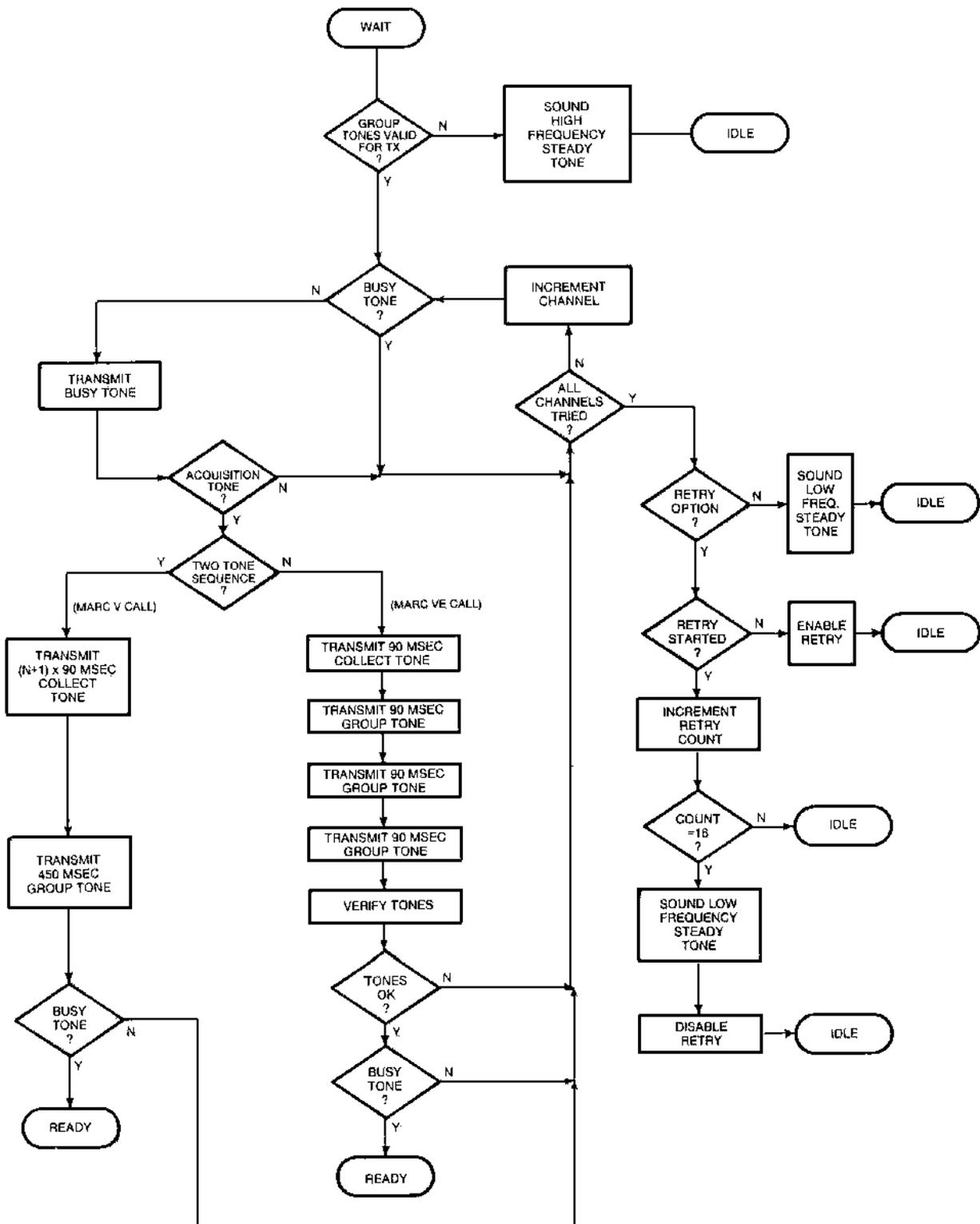


Figure 9 - Wait Mode

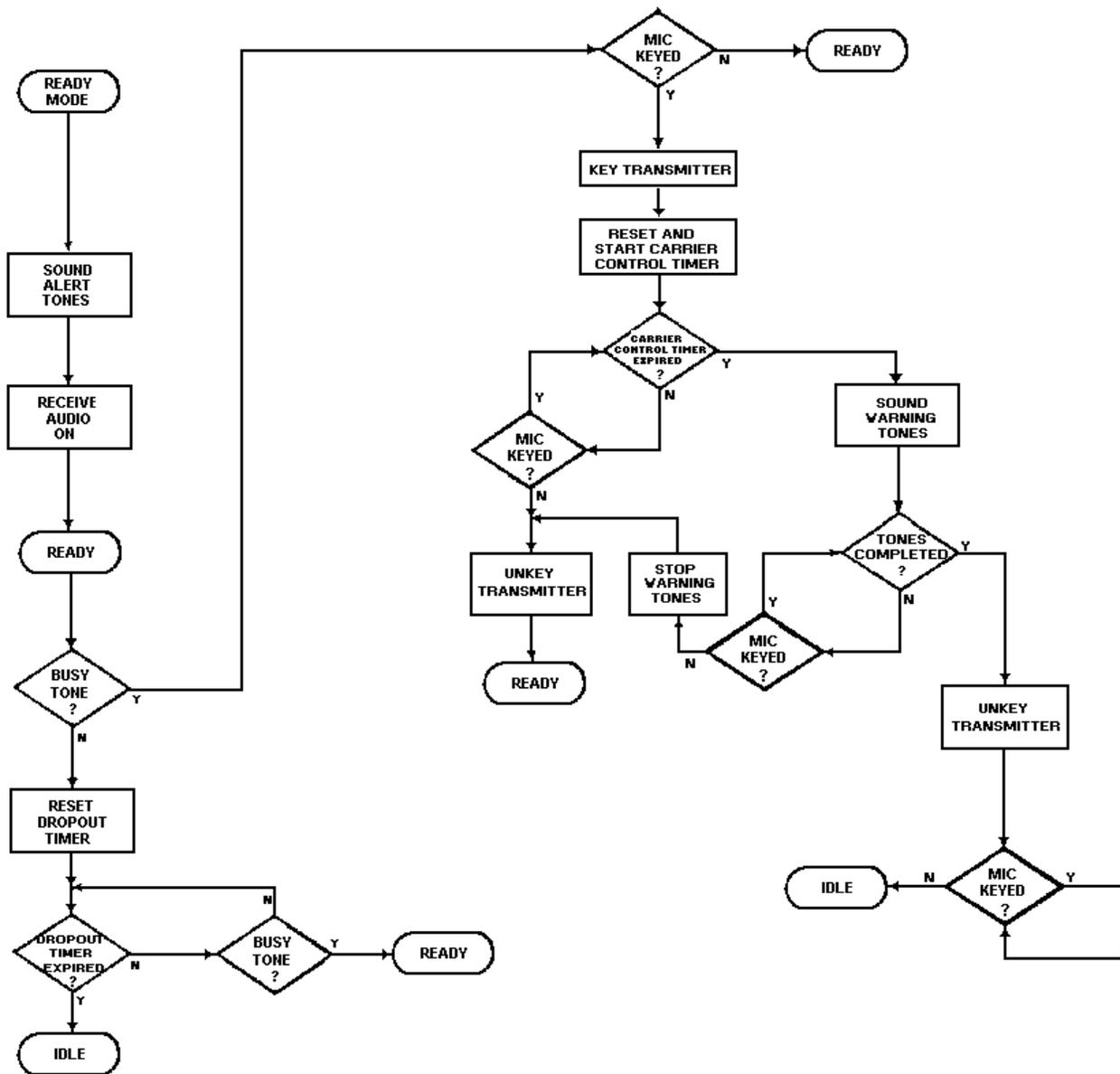


Figure 10 - Ready Mode