EFJohnson®

LTR-NET™ MOBILE SERVICE MANUAL ADDENDUM

984x Series (UHF)
988x Series (800 MHz)
989x Series (900 MHz)

13.6 VDC
Part No. 242-98xx-6xx

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98x3/98x6 SERIES
LTR-NET™ MOBILE RADIO

SERVICE MANUAL ADDENDUM

UHF, 800 MHz, 900 MHz
Part No. 242-98x3-6xx

Transcrypt offers communication solutions in two core areas: land mobile radio products and systems, and information security. EFJohnson land mobile radios and systems provide wireless communication for a variety of markets including government, public safety, and commercial users. Transcrypt's information security devices utilize sophisticated scrambling and encryption techniques to protect sensitive voice and data transmissions.

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SECTION 1 GENERAL INFORMATION

1.1 SCOPE OF MANUAL

This addendum updates current LTR® 9800-series service manuals with information needed to service 9800-series LTR-Net™ transceivers. The LTR service manuals it updates are as follows:

984x Series UHF - Part No. 001-9840-202
988x/989x 800/900 MHz - Part No. 001-9880-200
98xx Series UHF/800/900 MHz - Part No. 001-9800-200 (when available)

1.2 DIFFERENCES BETWEEN LTR AND LTR-NET VERSIONS

The difference between LTR and LTR-Net versions of the 9800-series transceivers is the operating software. All electrical and mechanical components remain the same. Therefore, use this addendum for Operation and Programming information for LTR-Net models, and use the current sections of your service manual for Installation, Circuit Description, Parts List, Schematic Diagram, and PC Board Layout information.

Different software is used to program LTR and LTR-Net versions of this transceiver. The LTR-Net software is a Windows 95/NT program, and the LTR software is a DOS program. Therefore, either Windows 95 or NT 4 or later is required to program an LTR-Net transceiver. The part numbers of this software are shown in Table 1-1.

1.3 TRANSCEIVER IDENTIFICATION

The transceiver identification number is printed on a label that is attached to the chassis. In addition, it is programmed into memory and can be read using the programmer. The information contained in this number is as follows

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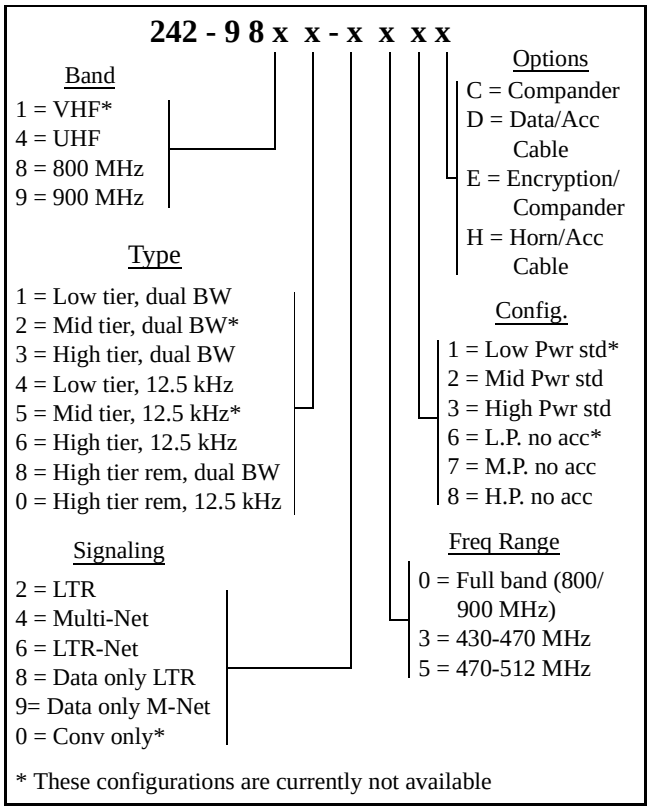
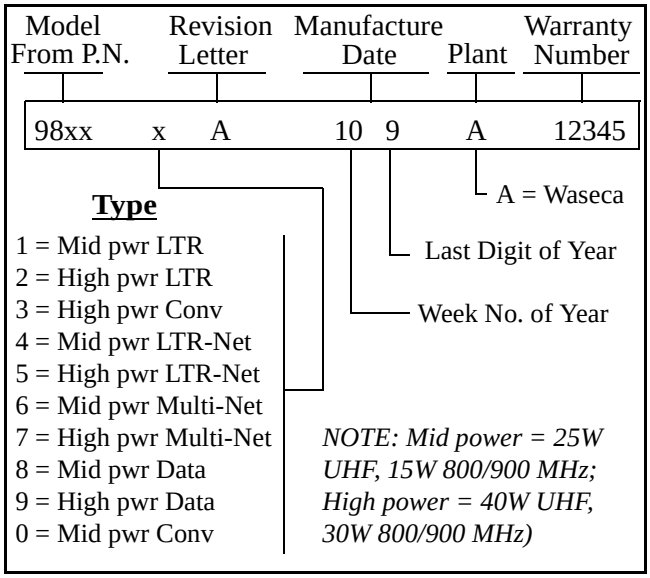


1.4 PART NUMBER BREAKDOWN

The following is a breakdown of the part number used to identify this transceiver.



1.5 MISCELLANEOUS

1.5.1 ACCESSORIES

Table 1-1 is a partial listing of accessories that are available for 9800-series transceivers. Refer to this table in the service manual for other accessories that are available.

Table 1-1 98xx Accessories

Accessory	Part No.
Key Cap Kit (see Section 1.5.3)	587-9840-002
Programming Accessories	
Remote Programming Interface (RPI)	023-9800-000
Cable, RPI to transceiver	597-2002-200
Cable, RPI to computer, 6 ft. (DB9F to DB9M)	597-5900-002
Personality Programming Software, Win 95/NT, 3½", 1.44 M diskette for LTR-Net 98xx mobile models only	023-9998-457
Flash programming software	023-9998-432
Tune software (see Section 1.5.4)	---

1.5.2 AVAILABLE LTR-NET MODELS

Current EFJohnson LTR-Net transceivers are listed in Table 1-2.

1.5.3 KEY CAP KIT

Key Cap Kit, Part No. 587-9840-002, will be included with each transceiver. This kit includes 25 keycaps labeled for the following functions:

FCN*	**SCAN***	**A/D***	**ROAM***	**TEL***
AUX	**MHNG**	**BANK**	**HOME**	**EMER**
HORN	**MON**	**STLH**	**ENCPT**	**C/G**
PAGE	**MCPA**	**RXPA**	**PRI**	**TA**
USR 1	**USR 2**	**CPND**	**(Blank)**	**(Blank)**

The keypads indicated by an asterisk (*) are installed in the front panel at the factory. To remove a key cap, insert a tool with a sharp tip in the slot on the bottom of the cap and carefully pry against the front panel to release the cap. Then simply pull it out.

NOTE: The above key cap kit may not be available until later in 1999. Therefore, early models may be equipped with only the FCN, SCAN, A/D, TA, and AUX key caps.

1.5.4 TRANSCEIVER TUNING

LTR-Net 98xx models are currently not field tunable. If retuning is required, return the transceiver to the factory.

Table 1-2 EFJohnson LTR-Net Transceivers

Model	Freq (MHz)	Localities [1]	Systems [1]	Groups [1]s	Type	Power Output	Other Features
8170	800	14	14	10	Portable	3.0/1.0W	Quick select switch, user sel pwr output
8171	800	14	14	10	Portable	2.0/1.0W	Quick sel sw, sel pwr, Intrin Safe
8172	900	14	14	10	Portable	2.5/1.0W	Quick select switch, user sel pwr output
8173	900	14	14	10	Portable	2.0/1.0W	Quick sel sw, sel pwr, Intrin Safe
9843	400	35	99	99	Mob Dash	25 or 40W	High-tier, up to 16 banks selectable
9883	800	35	99	99	Mob Dash	15 or 30W	High-tier, up to 16 banks selectable
9896	900	35	99	99	Mob Dash	15 or 30W	High-tier, up to 16 banks selectable

[1] With 9800-series high tier transceivers, up to approximately 35 LTR-Net or 60 conventional localities are programmable. However, due to memory limitations, the maximum number decreases as the total number of localities, systems, and groups increases.

SECTION 2 OPERATION

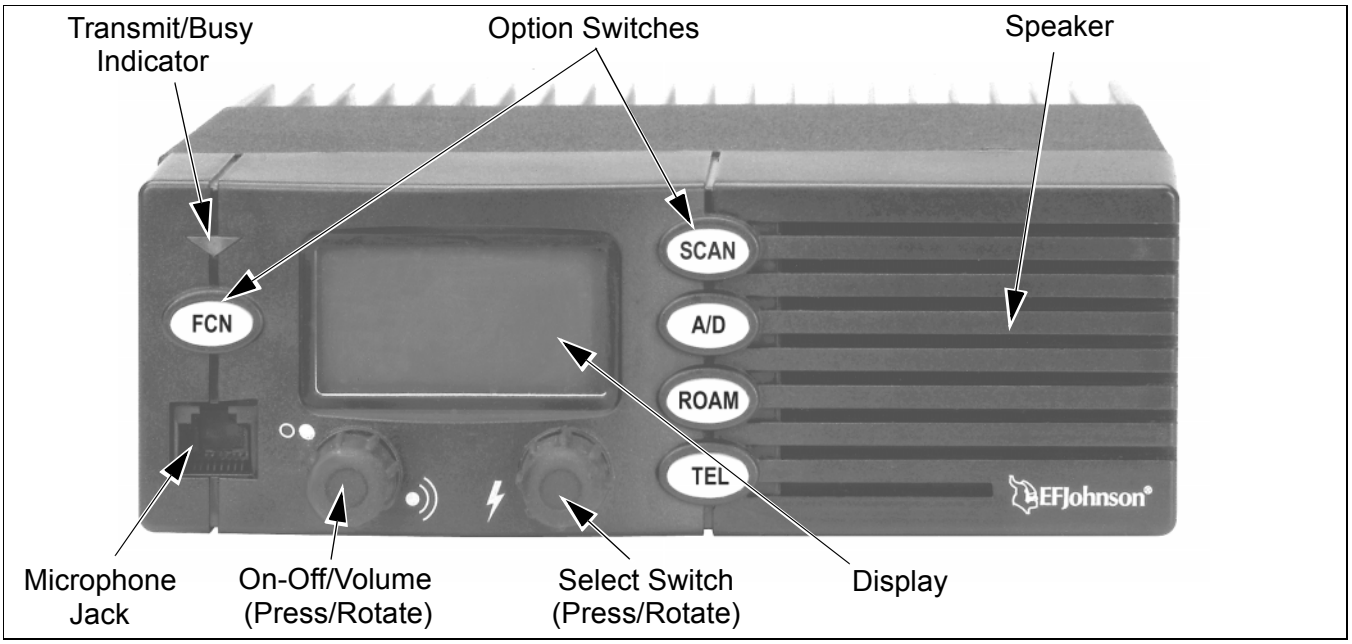


Figure 2-1 Front Panel Controls and Indicators

2.1 FEATURES

2.1.1 INTRODUCTION

The features available are as follows. The LTR-Net features are available when a system programmed for LTR-Net operation is selected and likewise for the LTR and conventional features. Most features can be enabled or disabled by programming.

2.1.2 GENERAL FEATURES

- Up to 35 LTR-Net or 60 LTR/conventional localities (sites) programmable [1]
- Up to 16 banks programmable (a bank is a collection of systems)
- Up to 99 systems per bank and up to 99 groups per system programmable [1]
- Each system selects an LTR-Net, LTR, or conventional locality (site)
- Large 2-line x 8-character liquid crystal display (LCD) with backlight
- Unique 8-character group alpha tags
- Alpha tag or numeric system/group display mode user selectable
- System Scan
- Group Scan
- User programmable scan list(s)
- All five option switches programmable
- Menu mode
- Emergency system/group quick select switch
- Stealth mode to disable LED, tones, and backlight
- Proceed (clear-to-talk) tone
- Time-out timer
- Call indicator
- Companding (optional)
- Two accessory option slots
- One of five preset power output levels programmable for each locality

[1] *Because of memory limitations, the maximum number that can be programmed decreases as the total number of localities/banks/systems/groups increases.*

2.1.3 LTR-NET FEATURES

- Standard, telephone, unique ID, and directed group calls

- Roaming (automatic locality search)
- Queuing of telephone, unique ID, and directed group calls by radio system
- Eight levels of receive priority programmable on each group
- Transmit inhibit

2.1.4 LTR FEATURES

- Standard and telephone calls
- Eight levels of receive priority programmable on each group
- Transmit inhibit

2.1.5 CONVENTIONAL FEATURES

- Each group selects a radio channel
- Channels programmable for tone (CTCSS), digital (DCS) Call Guard, external, or carrier squelch control
- User-adjustable squelch level
- Busy indicator
- Transmit disable on busy
- Monitor mode
- Receive-only channels
- Talk-around

2.2 CONTROLS

2.2.1 FRONT PANEL

The transceiver is shown in Figure 2-1. All of the option switches are programmable, so the function of each switch can vary from those shown. The controls and indicators operate as follows:

On-Off/Volume - Pressing the knob turns power on and off. The vehicle ignition switch may also control power as described in Section 2.5.10. Rotating this knob sets the volume level (see Section 2.4.2).

Select Switch - This switch changes the selected system or group and is also used in the menu mode (see Section 2.6) and other times. When changing the system/group, turning this switch clockwise increases the selected system or group, and turning it counter-clockwise decreases the selected system or group. To switch between system and group select, press this switch. Refer to Section 2.4.5 for more information.

This control also has two alternate functions that are selected by first pressing the FCN option switch. Refer to Section 2.5.6 for more information.

Tri-Color Indicator - Indicates the following conditions:

Red - Transmitter keyed, normal power output
Orange - Transmitter keyed, power reduced by thermal foldback circuit
Green - Busy conventional channel (carrier detected).

Microphone Jack - Connection point for the microphone and also the RPI programming interface when programming the transceiver.

Microphone Push-To-Talk (PTT) Switch - Keys the transmitter.

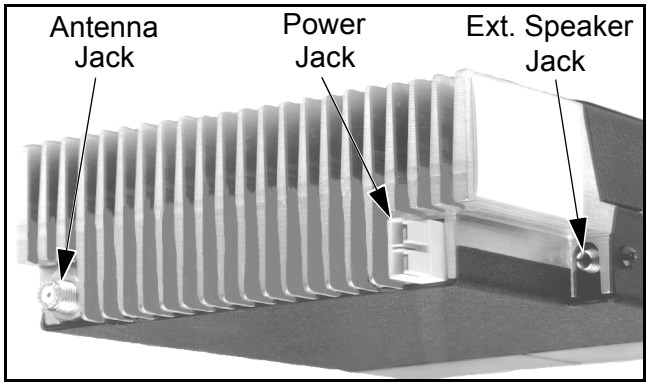
Speaker - A speaker is located behind the grille. An optional speaker can be connected to the external speaker jack described in Section 2.2.2. The internal speaker is disabled when an external speaker is used.

Option Switches - As previously mentioned, all five option switches are programmable. The functions that can be programmed are listed in Table 2-1 on page 2-13. Refer to Section 2.6 for more information on option switch and menu functions:

Function Switch - If this option switch is programmed, it controls the following functions:

Menu Mode Select - Press FCN twice (see Section 2.6.2) or the MENU option switch.
Home System/Group Select - Press FCN and then the Select switch (see Section 2.5.7) or the HOME option switch.
Squelch Level Adjust - In the conventional mode only, press FCN and then rotate the Select switch to adjust the squelch level (Section 2.4.7).

2.2.2 REAR PANEL JACKS AND CONNECTORS



Antenna Jack - Miniature UHF jack for connecting the antenna.

Power Jack - Connection point for a nominal 12-volt, negative ground power source.

Speaker Jack - Connection point for an external 4.7-ohm, 5-watt speaker. The internal speaker is disabled when a speaker is connected to this jack.

Accessory Cable (Not Shown) - This optional pigtail cable installs in the speaker jack opening and is used to connect the ignition sense, horn alert, and other outputs.

Data/Accessory Cable (Not Shown) - This optional cable also installs in the speaker jack opening, and it includes the preceding accessory cable and a data cable with no connector or a female HD DB-15 connector. The data cable is used to connect data equipment such as a modem to the transceiver. Data equipment is not currently supported.

2.3 DISPLAY DESCRIPTION

The display is shown in Figure 2-2, and it indicates the following information.

16-Character Message Area - Indicates the selected system and group (see Section 2.4.4), error conditions, and status information (see Section 2.12.4).

S - Indicates that the displayed system is in the scan list (see Section 2.7.6).

G - Indicates that the displayed group is in the scan list (see Section 2.7.6).

☎ - With LTR-Net operation, indicates that the selected group is programmed for telephone or auxiliary calls (see Section 2.9.1). With LTR operation, indicates that the selected group is programmed for telephone calls.

Z - Indicates that scanning is enabled (see Section 2.7).

▲ - Indicates that the function controlled by the AUX option switch or OPTION menu parameter is enabled (see Section 2.5.9).

C - Indicates that a call has been received on a group programmed for a call indicator (see Section 2.5.2). To turn this indication off, press any key.

◀ - Indicates that the monitor mode is enabled. This mode disables Call Guard squelch and other squelch control features so that all messages are heard on conventional systems (see Section 2.11.1).

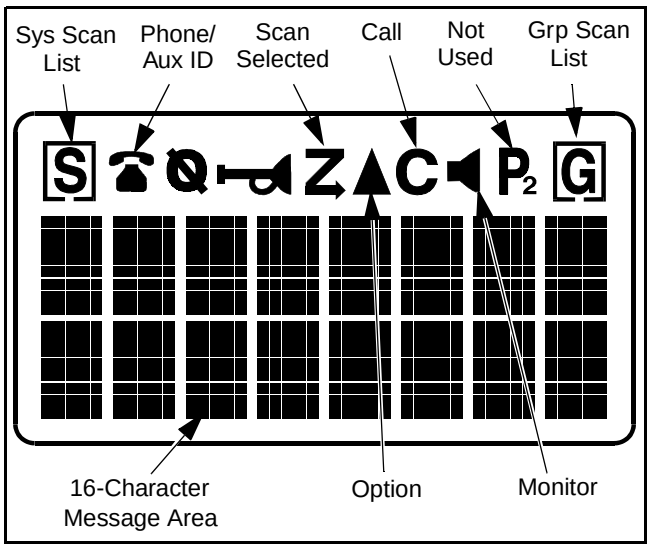


Figure 2-2 Display

2.4 GENERAL OPERATION

2.4.1 POWER-UP SEQUENCE

When transceiver power is turned on by pressing the front panel power switch or turning the ignition switch on, the following start-up sequence occurs:

1. The backlight turns on.

2. All segments of the alphanumeric display are enabled and the last seven digits of the transceiver part number (see Section 1.4) are displayed on the top line very briefly. For example, a 800 MHz, high tier, LTR-Net, 15-watt transceiver is indicated as "9883602". The eighth display digit is reserved for future use and is always "0".

3. If there are unread error codes, the last code that occurred is displayed as "∗ CODE xx" on the bottom line (see Section 2.14).

4. A beeps sounds (if tones are enabled) and the transceiver is ready to be used.

2.4.2 DETERMINING VOLUME LEVEL

The relative volume setting can be determined by noting the position of the index on the volume knob. It may also be possible to enable a reference tone or audio for setting the volume level using one of the following methods:

- If key press tones have been enabled as described in Section 2.5.15, a short tone can be enabled by rotating the select switch or pressing an option switch.

- If a conventional system is selected, take the microphone off-hook to enable the monitor mode (unless off-hook detect is disabled). If someone is talking, audio is then heard. If nobody is talking, the squelch control can also be adjusted as described in Section 2.4.7 and noise should be heard. Refer to Section 2.11.1 for more information on the monitor mode. When an LTR-Net or LTR system is selected, the receiver cannot be manually unsquelched.

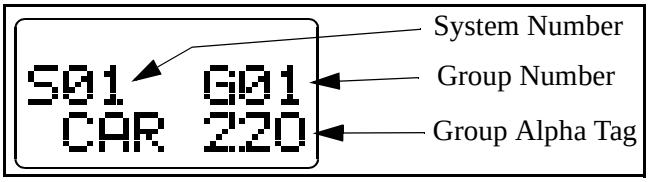
2.4.3 BACKLIGHT OPERATION

The display and keypad backlight can be controlled by the menu BACKLGHT parameter. The three states that can be selected are Bright, Dim, and Off. It is in the selected condition whenever power is turned on. If this menu parameter has been disabled by programming, the backlight is fixed in one of these states.

2.4.4 SYSTEM/GROUP DISPLAY INFORMATION

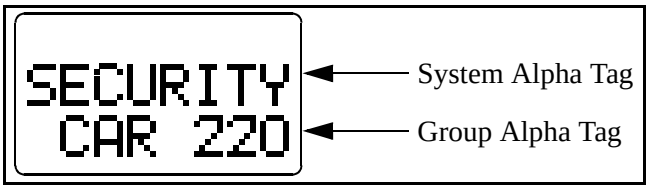
Up to 99 systems and up to 99 groups per system can be displayed. Either a numeric or alpha tag display mode can be selected by the user if the menu S/G DISP menu parameter is enabled (see Section 2.6.2). If not, it is fixed by programming.

When the numeric mode is selected, the system and group numbers are indicated on the top line of the display as Sxx and Gxx, and the group alpha tag (up to eight characters) is displayed on the bottom line (the system alpha tag is not displayed). For example, System 1, Group 1 (CAR 220) is displayed as follows:



Numeric Display Mode

When the alpha mode is selected, the system alpha tag is displayed on the top line, and the group alpha tag is displayed on the bottom line (the system and group numbers are not indicated). For example, a "SECURITY" system and "CAR 220" group are displayed as follows:



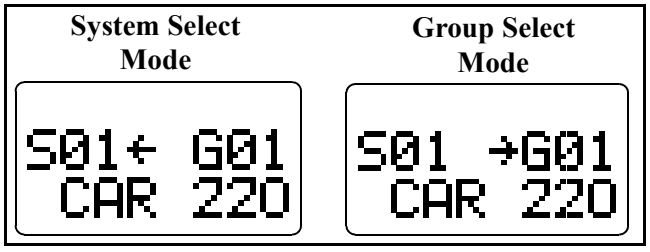
Alpha Display Mode

2.4.5 SELECTING SYSTEMS AND GROUPS

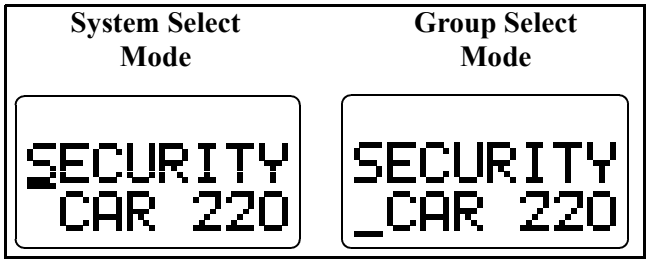
The front panel Select switch is used to change the system and group. Rotating this switch clockwise increases the system or group, and rotating it counterclockwise decreases the system or group. After the highest system or group is selected, wrap-around to the lowest system or group occurs and vice versa. The wrap-around tone sounds when this occurs (if tones are enabled).

Pressing the Select switch toggles between the system and group select modes. With the numeric display mode (see preceding section), the active mode is indicated by an arrow in the display. This arrow points to "Sxx" when the system select mode is enabled, and to "Gxx" when the group select mode is selected (see following example).

If the alpha display mode is selected, the system or group select mode is indicated by an underline in the left-most character position. This underline is on the system alpha tag line when the system select mode is selected and the group alpha tag line when the group select mode is selected (see following example).



Select Mode Indicator (Numeric Display Mode)



Select Mode Indicator (Alpha Display Mode)

The transceiver remains in the selected mode until transceiver power is cycled or normal transceiver operation is interrupted such as by selecting the menu mode. The programmed "Select Knob Default" condition is then selected. A separate return time timer is currently not programmable with LTR-Net models.

Group Tracking

When the selected system is changed, the same group number is selected on the new system if it is programmed. If it is not, the last selected group is selected. The preferred group changes only when another LTR-Net/LTR group is manually selected. For example, assume the following systems and groups are programmed:

System 1 - Group 1 manually selected
System 2 - Groups 2 and 3 (Grp 2 last selected)
System 3 - Groups 1 and 2

If the radio is currently on System 1/Group 1 and System 2 is selected, Group 2 is displayed because there is no Group 1 programmed. If System 3 is then selected without having manually changed the group, Group 1 is selected.

This operation occurs only when selecting other LTR and LTR-Net systems. When selecting a conventional system, the last selected group is always displayed. Manually changing the group with a conventional system selected does not change the preferred LTR-Net/LTR group.

2.4.6 MICROPHONE OFF-HOOK DETECT

Off-hook detection can be disabled on a radio-wide basis by programming. The microphone is then always assumed to be "on-hook" and taking it off-hook does not enable conventional channel monitoring or temporarily disable scanning. One reason for selecting this option may be to prevent scanning from being disabled when the microphone is off-hook. Monitoring can also be disabled on conventional systems on a group-by-group basis as described in Section 2.11.1.

2.4.7 SETTING SQUELCH CONTROL

The squelch level for LTR-Net/LTR operation is set during transceiver alignment and cannot be reset by the user. However, with conventional operation, it can be set if the FCN switch is programmed. If the squelch level cannot be changed by the user (not recommended), a default level is used.

With dual band (12.5/25 kHz) models, separate levels are maintained for each band. Adjusting the squelch with a 12.5 kHz channel selected sets the 12.5 kHz level, and adjusting it with a 25 kHz channel selected sets the 25 kHz level. Proceed as follows:

1. Select a conventional system, and a non-busy group programmed for carrier squelch. If the group is

programmed for Call Guard squelch, the monitor mode described in Section 2.11.1 must also be enabled.

2. Press the FCN switch and then within 8 seconds rotate the Select switch as you would a normal squelch control. Rotate it counterclockwise until noise is heard and then rotate it clockwise slightly past where the noise just mutes. The squelch adjust mode is indicated by "SQUELCH" on the top line of the display, and the relative squelch level is indicated by a bar graph on the bottom line.

3. To select the current level and exit the mode, press the Select switch again. This also occurs automatically 2 seconds after a change is made or 8 seconds after no activity.

NOTE: Some readjustment may be required if weak messages are not heard or unsquelching occurs when no messages are present.

2.4.8 LTR-NET, LTR, AND CONVENTIONAL OPERATING MODES

Introduction

This transceiver can be programmed to operate in the LTR-Net, LTR, and conventional modes. Each selectable system can be programmed to select a locality programmed for one of these modes. The type of operation that is programmed is determined by the type of repeater equipment being accessed. The differences in operation are described in the following information and also noted elsewhere as required.

LTR-Net and LTR Operation

The LTR-Net mode provides the most operating features. Some features available only in the LTR-Net mode include roaming (automatic locality search), unique ID calls, and directed group calls. LTR-Net features are described in Sections 2.8 and 2.9.

Operation in the LTR mode is similar to the LTR-Net mode except that the preceding (and other) LTR-Net features are not available.The types of calls that can be placed in the LTR mode are standard group (mobile-to-mobile) and telephone. LTR features are described in Sections 2.8 and 2.10 and also the LTR Application Note, Part No. 009-0001-020, rev. 8 or later.

Both the LTR-Net and LTR modes provide automatic channel selection (trunking) and monitoring before transmitting. Special tones and display messages indicate busy and out-of-range conditions, and telephone calls can be placed almost as conveniently as with your home telephone.

Selecting a system selects a locality, home repeater, collection of groups, and other information. Likewise, selecting a group selects the call type, transmit and receive ID codes of group calls, call indicator and horn alert operation, and other information. The group call ID codes determine the mobile or group of mobiles being called and what calls are received.

Conventional Operation

In the conventional mode, selecting a system selects a block of up to 99 channels, and selecting a group selects a channel from that block. Each channel (group) can be programmed for a different squelch control technique (CTCSS, CDCS, or carrier) and other parameters. The squelch level must be adjusted as described in Section 2.4.7 to properly receive conventional calls.

With conventional operation, an out-of-range condition is not indicated by a special tone or display message because there is no data handshake with a repeater that allows this condition to be detected. A busy condition is detected automatically if the Transmit Disable On Busy feature is used (see Section 2.11.2). Otherwise, it must be detected manually (see following). Refer to Section 2.11 for more information on conventional operation.

To manually monitor a conventional channel before transmitting to determine if it is being used by someone else, proceed as follows:

Using Busy Indicator - With scanning disabled and the squelch control adjusted as described in Section 2.4.7, note if the indicator on the front panel is lighted green. If it is, a carrier is being detected on the currently selected conventional group (channel). If this

indicator is not lighted, the channel is not busy and the message can be transmitted.

Using Monitor Mode - If scanning, take the microphone off-hook to disable scanning and enable the monitor mode (indicated by ◀ in the display). The monitor mode disables squelch control features so that all messages are heard. If none are heard, the channel is free and the message can be transmitted. Refer to Section 2.11.1 for more information on monitoring.

If off-hook detection is disabled or off-hook monitoring is disabled on the selected conventional group (see Section 2.4.6), taking the microphone off-hook does not enable the monitor mode. The Transmit Disable On Busy feature must then be used to perform monitoring.

2.4.9 LOCALITIES, SYSTEMS, AND GROUPS

When any call is placed, a locality, system, and group are selected. Definitions of each of these terms follows:

Localities

An LTR-Net and LTR locality is a repeater site. The repeaters are typically co-located and interconnected by a common bus to form a trunked channel group. A conventional locality may or may not include repeaters at the same physical site. A locality can include up to twenty repeaters.

Unique locality parameters include the channel frequencies and bandwidth of each repeater at the site. Other information that is programmed includes the status repeater (LTR-Net only), and what repeaters are equipped with telephone interconnect (LTR only) and companding. Up to approximately 35 LTR-Net or 60 LTR/conventional localities can be programmed (the maximum number decreases as the number of banks, systems, and groups increases).

Systems

Systems consist of a collection of groups (see next paragraph) and other unique information. Each system is linked to one of the programmed localities. Up to 99 systems can be programmed.

LTR-Net and LTR systems are programmed with the home repeater number, a collection of groups, and transmit inhibit block of ID codes (see Section 2.8.4). The home repeater number and group ID code form the address for group calls. In addition, it is the repeater that is monitored for incoming call information (the status repeater serves as a backup with LTR-Net operation).

Conventional systems are programmed with a collection of groups, each of which selects a unique radio channel (see following).

Groups

The groups assigned to a system select individual call information. Up to 99 groups can be assigned to each system. With all three types of operation, each group is programmed with a group alpha tag and priority, group scan, and call indicator information. The available group types are as follows.

LTR-Net Group Types

Dispatch - Used to place and receive standard group (mobile-to-mobile) calls. Encode and decode IDs from 1-239 can be specified.

Telco - Used to place telephone calls.

Auxiliary - Used to place unique ID and directed group calls.

Data - Used to place and receive unique ID data calls. This call is currently not available.

LTR Group Types

Dispatch - Used to place and receive standard group (mobile-to-mobile) calls. Encode and decode IDs from 1-250 can be specified when accessing an LTR locality (site). If an LTR-Net locality is being accessed, IDs from 1-239 can be specified.

Telco - Selected to place telephone calls. A RIC (interconnect) ID is also specified. This code is one that has been reserved on the repeater system for telephone calls.

Conventional Group Types

Only dispatch calls can be programmed with conventional operation. Conventional groups select the radio channel, Call Guard squelch, and other information.

2.4.10 PLACING AND RECEIVING STANDARD GROUP CALLS

NOTE: The following procedure applies to all operating modes (LTR-Net/LTR/Conventional).

Standard group (dispatch) calls are between two or more mobile or control station transceivers. Unlike other types of calls, no number is dialed when the call is placed. Proceed as follows to place and receive a group call:

Placing a Group Call

1. Turn transceiver power on and set the volume as described in Sections 2.4.1 and 2.4.2. With conventional operation, also set the squelch as described in Section 2.4.7.

2. Select the system and group of the mobile being called as described in Section 2.4.5.

3. If a conventional call is being placed, monitor the channel manually or automatically as described in the preceding section.

4. The microphone PTT (push-to-talk) switch must be pressed (and held) to talk and released to listen. Operation with the different call types is as follows:

LTR-Net/LTR Operation

- If the proceed tone is enabled, it sounds when the system is successfully accessed. The proceed tone (and other tones) can be disabled if desired by the Tones menu parameter or by programming (see Section 2.5.15).

- If all repeaters are busy, the busy tone sounds (see Section 2.12) and "BUSY" is indicated on the lower line of the display. The PTT switch must then be released and pressed again to make another access attempt.

- If the system could not be accessed because of an out-of-range condition or some other reason, the intercept tone sounds and "NO ACCES" is indicated on the lower line of the display. The PTT switch must then be released and pressed again to make another access attempt. Drive closer to the radio system or away from shielding structures and try again.

- When responding, busy or out-of-range conditions may also occur as when placing a call because the system is accessed for each transmission.

Conventional Operation

- If the channel is busy and the Transmit Disable On Busy feature is programmed, "DSBL BSY" is indicated on the lower line of the display and the transmitter is disabled. Any channel activity is heard while the PTT switch is pressed (see Section 2.11.2).

- Otherwise, busy and out-off-range conditions are not indicated (see Section 2.4.8) and speaking can begin when the PTT switch is pressed. If the proceed tone is enabled, it indicates when speaking can begin but does not indicate that a repeater has been successfully accessed (see Section 2.5.11).

5. When the call is finished, place the microphone back on-hook.

Receiving a Standard Call

1. Turn transceiver power on and set the volume and squelch as described in Sections 2.4.1 and 2.4.2.

2. Select or scan (see Section 2.7) the system and group programmed for the call you want to receive.

3. When the message is received, take the microphone off-hook and press the PTT switch to talk and release it to listen. If scanning, a response may not automatically occur on the group of call. Refer to Section 2.7.8 for more information.

2.4.11 PLACING AND RECEIVING TELEPHONE CALLS

The procedure for placing LTR-Net telephone calls is described in Section 2.9.1, and the procedure for LTR telephone calls is described in Section 2.10.2. If telephone calls can be placed in the conventional mode, the procedure used depends on the specific interconnect equipment being used.

2.5 GENERAL FEATURES

2.5.1 BANK SELECT

Up to sixteen banks can be programmed. Banks are collections of systems that have been set up for operation in a specific geographic area or other uses. For example, one bank could be programmed for operation in Minneapolis and another for operation in Milwaukee. Each bank is identified by a unique alpha tag.

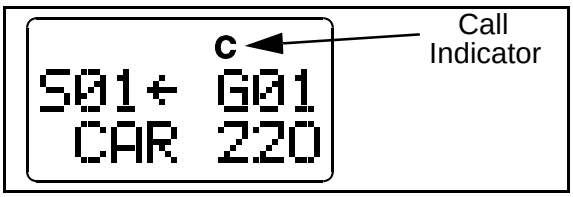
Banks are selected by either the BANK menu parameter or option switch. In the menu mode rotate the Select switch to display "BANK SEL" on the top line, and then press the Select switch to change the bank. The alpha tag of the current bank is displayed on the bottom line. Refer to Section 2.6.2 for more menu mode information. If using the option switch, when "BANK SEL" is displayed on the top line, simply press the Select switch to select the desired bank.

Any programmed system can be assigned to a bank, and the system numbering can be different for each bank. Only the systems in the currently selected bank are selected or scanned, and at least one bank is always programmed. Unique bank parameters include Emergency system/group (see Section 2.5.4), Home system/group (see Section 2.5.7), and the default scan list status of each system.

When a different bank is selected, the last selected system in that bank is displayed, and the displayed group is the last selected group of that system. These are the only user selected functions that are stored on a per bank basis.

2.5.2 CALL INDICATOR

The call indicator is "**C**" in the upper part of the display as shown in the following illustration.



The purpose of this indication is to show that a call was received while the user was away from the vehicle. It is turned off by pressing any button or turning transceiver power off and then on. If scanning and the "last received" configuration is programmed (see Section 2.7.8), the system and group of the last call are displayed. Otherwise, the currently selected system/group is displayed.

Each selectable group can be programmed so that the Call indicator is activated when a call is received. With conventional operation, the Call indicator is activated if the transceiver unsquelches for 2 seconds or longer. Therefore, if Call Guard squelch is programmed, it must also be detected for the call indication to appear (unless it is disabled by the monitor mode).

2.5.3 COMPANDING

The companding feature is optional with this transceiver. It is a separate module that installs in one of the audio/logic board option slots (Option Slot 2 is normally used). Companding improves audio quality by decreasing the amount of noise present in the audio signal. It does this by providing a 2:1 compression of the audio signal on the transmit end and a 1:2 expansion on the receive end. Companding is especially recommended for 12.5 kHz bandwidth channels because audio quality improvement is usually significant.

If this feature is used, it must be utilized in both the transmitting and receiving mobile. The best results are obtained if companding is also used in the repeater; however, improvement also results if it is only used in the mobile and handheld transceivers. With telephone calls, companding must be utilized at the repeater if it is used in the mobile.

Each locality (site) channel can be individually programmed for companding. Then whenever a call is received or transmitted on one of those channels, companding is automatically enabled. Companding is not selectable by the user, and the companding status is not indicated in the display. The control line for this function (Output A or B) must be programmed for "Compand" and active high as described in Section 3.13.

2.5.4 EMERGENCY SWITCH

The Emergency option switch functions as an emergency system/group quick select. Each bank can be programmed for a different emergency system/group.

When the emergency switch is pressed, the emergency system/group is selected and the alpha tag programmed for the emergency group is displayed ("EMERGENCY" is not displayed unless it is the alpha tag). Normal message reception and scanning continue if applicable. The emergency message must be manually transmitted (automatic emergency transmissions do not occur). Another system/group can be selected normally at any time.

2.5.5 ENCRYPTION

Voice encryption is currently not available.

2.5.6 FUNCTION SWITCH

The FCN (function) switch performs the following functions. When the function select mode is active, "FCN" is displayed on the lower line of the display. This mode is automatically exited if no additional activity occurs within 8 seconds.

Menu Mode Select - Pressing FCN twice or the MENU option switch selects the menu mode described in Section 2.6.

Home System/Group Select - Pressing FCN and then the Select switch or the HOME option switch selects the home system/group as described in Section 2.5.7.

Squelch Adjust - Pressing FCN and then rotating the Select switch sets the conventional mode squelch level as described in Section 2.4.7.

2.5.7 HOME SYSTEM/GROUP SELECT

The Home Select feature quickly selects the preprogrammed home system/group. This is done by pressing the Home switch or the FCN switch and then the Select switch (see Section 2.6.1). The home system/group is then displayed and it becomes the selected system/group (it is not temporarily selected). A different home system/group can be programmed for each bank.

If the home system/group is selected while scanning, scanning halts for the programmed scan delay period. If no home system is programmed or the FCN switch is disabled, the home select feature is not available.

2.5.8 HORN ALERT

The horn alert feature is currently not available.

2.5.9 OPTION SELECT

A programmable AUX option switch or the OPTION menu parameter (see Section 2.6) can be used to control some type of dealer-defined accessory such as a DTMF decoder. The enable mode is indicated by ▲ in the display. If the menu mode is used, this indication does not appear until the menu mode is exited.

If this function is used, the I/O line controlling the option (such as the Output D line of accessory connector J101) must be programmed for the Accessory Option as described in Section 3.13. These are CMOS outputs with a 470-ohm series resistance and a typical maximum source and sink current of 2 mA. Therefore, some type of driver circuit may be required.

2.5.10 POWER TURN-OFF DELAY

The transceiver can be installed so that the vehicle ignition switch as well as the front-panel power switch controls transceiver power. This is done by installing the ignition switch cable and removing R170 on the audio/logic board (see Section 2.4.3 of service manual). Turn-off delays of Immediate, 10, 20, 30, 40,

or 50 minutes, 1, 2, 4, 8, 10, 12, or 16 hours or Forever can then be programmed. The delay can be overridden at any time by turning power off using the front-panel power switch or turning the ignition switch back on.

A turn-off delay allows features such as the call indicator to remain active for the programmed delay time after the ignition switch is turned off. At the same time, advantages of ignition switch control can be utilized such as preventing battery discharge that may occur if the transceiver is accidentally left on for an extended period.

2.5.11 PROCEED (CLEAR-TO-TALK) TONE

This is a tone that sounds shortly after the PTT switch is pressed to indicate that the system has been accessed and speaking can begin. It is always enabled on LTR-Net/LTR systems and can be enabled and disabled on all conventional systems by programming. This and other tones can also be disabled by the Tones menu parameter or programming as described in Section 2.5.15.

If the radio system is busy when making an LTR-Net or LTR call, the busy tone sounds instead of the proceed tone and “BUSY” is indicated on the bottom line of the display. If an access attempt is unsuccessful, such as because of an out-of-range condition, the intercept tone sounds and “NO ACCES” is indicated in the display. When either of these conditions occur, the PTT switch must be released and pressed again to make another attempt.

On conventional systems, no data handshake with a repeater occurs, so a busy or out-of-range condition cannot be detected from data. The Transmit Disable On Busy feature can be used to automatically perform monitoring (see Section 2.11.2). If the channel is then busy, the proceed tone does not sound unless the transmitter is keyed by quickly releasing and then pressing the PTT switch. Otherwise, the proceed tone sounds (if enabled) even if the channel is busy.

With conventional operation, if Call Guard squelch is programmed on the group, there is a 0.5-second delay before the proceed tone sounds. This delay gives the receiving mobile time to detect the Call Guard signal which prevents the partial loss of the first word of the transmitted message.

2.5.12 PROGRAMMABLE POWER OUTPUT

One of five levels can be programmed. The actual power output at each of these levels is set during transceiver alignment (see Section 1.5.4). The high power level is factory preset at the rated high power output for the model, and the low power settings are all preset at 10 watts with high power models and 2.5 watts with medium power models. Power output is not user selectable, and the currently selected level is not indicated.

2.5.13 STEALTH MODE

The stealth mode disables the following tones and indicators so that they do not reveal that the transmitter has been keyed or the presence of someone using the transceiver. However, the receive (speaker) audio and display remain enabled.

- All supervisory tones (see Section 2.5.15)
- The front panel tri-color indicator
- Display backlight

The stealth mode is selected by the STEALTH menu parameter (see Section 2.6.2). The above functions are disabled immediately when the switch is pressed, and there is no special indication that this mode is selected. With the menu mode, the tones and indicator are disabled immediately when “ON” is selected, and the backlight remains enabled until the menu mode is exited. If the stealth mode is not selectable by the menu mode, it is fixed in the on or off condition by programming.

2.5.14 TIME-OUT TIMER

General

The time-out timer disables the transmitter if it is keyed continuously for longer than the programmed time. It is programmed in half-minute increments from 0.5 - 5.0 minutes or it can be disabled. If the transmitter is keyed continuously for longer than the programmed time, the transmitter is disabled, “TIME-OUT” is indicated on the lower line of the display, and the conversation time-out tone sounds. The timer and tone are reset by releasing the PTT switch.

One use of this feature is to prevent a repeater from being kept busy for an extended period by an accidentally keyed transmitter. It can also prevent possible damage to the transmitter caused by transmitting for an excessively long period.

2.5.15 TONE SELECT

If the TONES menu parameter is enabled by programming, the user can select the tones that sound. Otherwise, the tone mode is selected by programming. The following choices are available:

SILENT - All tones are disabled.
KEYS - Only the Select switch) and key press tones are enabled.
ALERTS - All tones except the preceding Key Beep tones are enabled.
ALL - Both the preceding Key Beep and Alert tones are enabled.

2.5.16 TRANSMITTER THERMAL FOLDBACK

The temperature of the power amplifier is monitored by the control logic when transmitting. If a temperature is detected that could damage the power amplifier module or other devices, power is automatically cut back to a preset low level. After sufficient cooling occurs, power output returns to the normal level. This provides hysteresis so that power is not cut back again after only a short transmission. When power is cut back, the transmit LED is orange instead of red (no message is displayed).

If temperature continues to increase at the low power setting to the point where more serious damage could occur (this should seldom happen), the transmitter is disabled, a warning tone sounds, and "NO POWER" is displayed. The transmitter remains disabled until temperature decreases to the first temperature limit. Power output is then produced at the preset low setting. The temperature limits and low power level are fixed in software.

The supply voltage applied to the transceiver is also monitored in the transmit mode. If this voltage rises above 18.5 volts DC, the transmitter is disabled and the same indications are produced as described in the preceding paragraph. This prevents possible damage to transistors in the transmitter.

2.6 OPTION SWITCHES AND MENU MODE

2.6.1 USING OPTION SWITCHES

This transceiver has five option switches (see Figure 2-1). All are programmable and the available functions are listed in Table 2-1. A function can be controlled by both the option switch and menu mode parameter if desired. Any switch can also be disabled if desired.

2.6.2 MENU MODE INFORMATION

The menu mode is selected by pressing the FCN option switch twice within 8 seconds or the MENU option switch. If neither of these switches are programmed, the menu mode is not available. The functions that can be controlled by the menu mode are indicated in the "Menu Items" column of Table 2-1. Some functions can also be controlled by programmable option switches (see preceding section). Other highlights of menu mode operation are as follows:

- Programming determines what functions are displayed in the menu mode. Functions can be controlled by both the menu parameter and option switch if available.

- Some functions can be set in a fixed condition by disabling the option switch and menu item and then programming the default condition in the menu for the desired mode. However, if a parameter can be changed by an option switch or menu parameter or

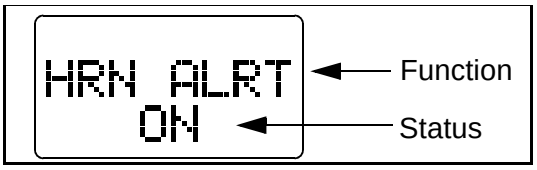
  is automatically changed, the programmed default condition is maintained only until the first time it is changed.

- Calls cannot be received or transmitted while in the menu mode.

2.6.3 USING MENU MODE

To use the menu mode, proceed as follows:

1. To select the menu mode, press the FCN option switch twice within 8 seconds or the MENU option switch. The top line indicates the function being edited, and the bottom line indicates the current status as follows.



Menu Mode Display

2. To display the various functions that are controllable by the menu mode (top line indication), rotate the Select switch. The currently selected status is displayed for each function.

3. To change the selected status, press the Select switch. Information displayed for each menu parameter is shown in Section 2.12.5.

4. To display another menu function, rotate the Select switch. Then change the status if desired as described in the preceding step.

5. The selected configurations for the various functions are saved when the menu mode is exited in one of the following ways:

   - Pressing the FCN or MENU option switch again
   - Pressing the PTT switch
   - Automatically when time-out occurs 2 seconds after a change is made or 8 seconds after no changes are made.

2.7 SYSTEM AND GROUP SCAN

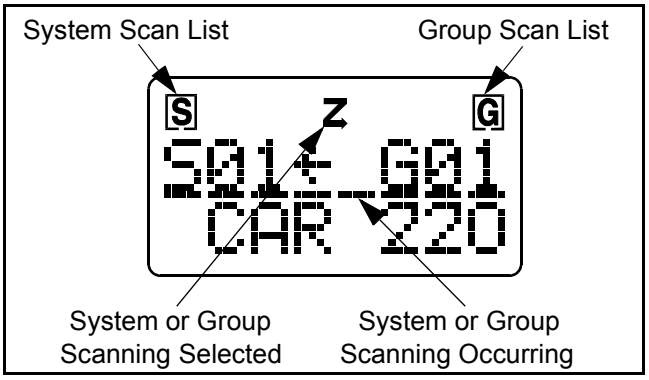
2.7.1 GENERAL

Both system and group scanning are available. Refer to Sections 2.7.3 - 2.7.5 for more information. Both types of scanning are turned on and off by the Scan option switch. When system and/or group scanning is enabled, Z is displayed, and when system or

Table 2-1 Menu Mode and Option Switch Functions

Function	Menu Items	Option Switch	See Section:
Add/delete (scan list programming)		A/D	2.7.6
Backlight adjust	BACKLGHT		2.4.3
Bank select	BANK SEL	BANK	2.5.1
Display mode select	S/G DISPL		2.4.4
Emergency		EMER	2.5.4
Function select		FCN	2.5.6
Home sys/grp select		HOME or FCN then press Sel Sw	2.5.7
Menu mode select		MENU or FCN twice	2.6.2
Option select	OPTION	AUX	2.5.9
Roaming on-off	ROAMING	ROAM	2.9.3
Scan on-off		SCAN	2.7
Scan type select	SCN TYPE		2.7
Scan continue on-off	SCN CONT		2.7.7
Scan list save mode	SCN SAVE		2.7.6
Stealth mode select	STEALTH		2.5.13
Squelch adjust		FCN then rotate Sel Sw	2.4.7
Telephone group select		TEL	2.8.5
Tone type select	TONES		2.5.15
NOTE: Parameters left blank are not available.			

group scanning is actually occurring, a scrolling underline is displayed on the upper line (see following illustration).



Scan Indicators

Other Scan Information

The microphone must be on-hook for scanning to occur (unless off-hook detection has been disabled as described in Section 2.4.6). When a message is detected that the transceiver is programmed to receive, scanning stops and the message is received. Shortly after the message is complete, scanning resumes (unless it has been disabled). The length of this delay is set as described in Section 2.7.7. The selected system and group can be changed in the normal manner while scanning. Scanning resumes shortly after the change is made.

When scanning is occurring (see preceding illustrations), transmissions always occur on the displayed system/group. However, when a message is received, scanning temporarily stops and the display changes to the system/group of the call. A response may then occur on the displayed or selected group as described in Section 2.7.8.

2.7.2 SELECTING SCAN TYPE

The following system and group scan functions are available:

System Scan - This feature detects calls on all systems that are in the scan list (see Section 2.7.6). If system scanning is not used, calls are detected on only the currently selected system.

Group Scan - This feature detects calls on all selectable groups in the selected or scanned systems that are in the group scan list. If group scanning is not used, calls are detected on only the currently selected group (or the last selected group of scanned systems) and higher priority groups.

The type of scanning can be selected by the user if the SCN TYPE menu parameter is enabled. Otherwise, it is fixed by programming. The available types are as follows:

SYSTEMS - Both system and group scanning enabled
GROUPS - Group scanning only enabled
OFF - Both system and group scanning disabled, SCAN switch non-functional

The following configurations can also be programmed:

- If the Scan switch is disabled by programming, the SCN TYPE menu parameter can be used to select one of the three preceding modes.
- If both the Scan switch and menu parameter are disabled, scanning is fixed in the programmed default condition.
- If the SCN TYPE menu parameter is disabled, the user can enable only the type of scanning selected by programming.

2.7.3 LTR-NET MODE SCANNING

When an LTR-Net system is selected, scanning is always the single locality (site) type. Therefore, LTR and conventional systems are not scanned. Calls are detected on all LTR-Net systems in the scan list that are programmed for that locality. LTR-Net systems programmed for other localities are not scanned even if they are in the scan list. Roaming occurs while scanning if it is enabled by the menu parameter or option switch, and priority calls are detected (Section 2.8.1).

If the selected system is an LTR or conventional system, all programmed systems in the scan list are scanned (including LTR-Net), and roaming is disabled.

2.7.4 LTR MODE SCANNING

With LTR mode scanning, the home repeater of each LTR system in the scan list is scanned. Scanning is sequential through all LTR systems in the scan list. If several positions are programmed with the same LTR system, system information is loaded only once. Therefore, there is no delay to change systems which results in very efficient scanning of those positions. Each home repeater is scanned for only as long as necessary to detect all calls. Priority calls are detected on LTR systems while scanning (see Section 2.8.1). LTR systems are not scanned if an LTR-Net system is selected (see preceding section).

2.7.5 CONVENTIONAL MODE SCANNING

With conventional operation, the channels of each conventional system in the scan list are scanned in order. Call Guard squelch is detected if the monitor mode is disabled (see Section 2.11.1). If the monitor mode is enabled, all calls occurring on a scanned channel are received. Conventional systems are not scanned if an LTR-Net system is selected (see Section 2.7.3).

A feature called Adaptive Tone Scan (ATS) is used when scanning conventional channels. If no carrier is detected, the channel is scanned for only 40 ms. If a carrier is detected, searching for Call Guard signaling occurs (if programmed). If the tone type of Call Guard squelch is programmed, the channel is monitored for 180-420 ms. The shorter time is when the tone is outside certain limits, and the longer time is if it is at or near the programmed value. If digital type is programmed, approximately 350 ms is required to determine an invalid code (less time is usually required to detect valid codes).

2.7.6 SCAN LIST PROGRAMMING

NOTES: Calls are always detected on the revert (selected) system/group while scanning even if it is deleted from the scan list.

Deleting LTR-Net systems from the scan list also deletes them from locality searching when roaming even when scanning is disabled (see Section 2.9.3).

The system and group scan lists are user programmable using the A/D (add/delete) option switch. If this switch is not programmed, scan list programming is not available. The scan lists can be programmed even if scanning is not enabled. The displayed system is in the scan list and scanned normally when **S** is displayed, and the displayed group is in the scan list and scanned normally when **G** is displayed (see illustration on page 3-14).

The system/group select mode described in Section 2.4.5 controls if the system or group scan list is changed when the A/D switch is pressed. If this switch is pressed with the system select mode enabled, the status of the displayed system is changed. Likewise, if it is pressed with the group select mode enabled, the status of the group is changed. For example, to change the status of the displayed system, press the Select switch if necessary so that the system select mode is indicated and then press the A/D switch.

Deleting a system only temporarily deletes the groups associated with that system. When a system is added back into the scan list, the original group scan list is again active. Systems and groups can be deleted from the scan list while listening to a message on the system or group by pressing the A/D switch in the normal manner. Scanning resumes shortly after the system or group is deleted.

Saving Current Scan List Changes

The menu SCN SAVE parameter or the default programming of this parameter determines if changes to the system and group scan lists are saved. If “ON” is selected, changes are saved to memory as they are made and the scan list does not change when power is cycled. If “OFF” is selected, changes are not saved and the programmed default status is reselected when power is cycled.

2.7.7 SCAN DELAY AND CONTINUE TIMERS

Receive Delay

When a message is received while scanning, there is a programmable delay of 0-7 seconds before scanning resumes. This delay is called the Receive Delay Time, and it prevents another message from being received before a response can be made. This delay is also in effect if a control is changed while scanning such as selecting another system/group. This timer is reset each time another call is received.

NOTE: Scanning does not resume if it is disabled, such as by taking the microphone off-hook.

Call Delay Time

The receive delay time controls the scan delay until the transmitter is keyed and then the Call Delay Time controls the delay. This time is programmable for 0-7 seconds, and it ensures that a response to your message is heard instead of some other message occurring on another system/group. The Call Delay Timer remains active for the remainder of the conversation, and controls when normal scanning resumes, even if additional responses are received.

Scan Continue Timer

There is also a scan continue timer that can be programmed. This timer controls the maximum time that a call is received before scanning resumes. This prevents scanning from being delayed for long periods by lengthy calls. This time can be programmed for 0-60 seconds in 1-second steps. If "0" is programmed, there is no time limit and the entire message is always received. If the menu SCN CONT parameter is available, this feature can be turned on and off by the user (see Section 2.6.2).

2.7.8 TRANSMITTING IN THE SCAN MODE

When the transmitter is keyed in the scan mode, programming of the "Scan Revert Mode" radio parameter determines if the transmission occurs on the last selected or the received system/group. The display usually indicates the system/group on which a transmission occurs. An exception is when "last selected" is programmed and a call is being received on a system/group other than the selected.

The three programmable Scan Revert Mode configurations are as follows. When an LTR-Net/LTR priority call is received (see Section 2.8.1), this programming also determines if a response occurs on the displayed or selected group, even if scanning is disabled.

Last Selected - Transmissions always occur on the system/group that was last selected by the CHL (low tier) or Select (high tier) switch. To respond to a call not on the selected system/group, one of the following methods can be used:

- Select the system/group of the call manually using the CHL or Select switch.
- Before scanning resumes, exit the scan mode by pressing the SCAN switch. The system/group of the call then becomes the selected system/group and it is not necessary to change it manually.

Last Received - The selected system/group changes to the system/group of a call. Therefore, you can always respond to a call without having to manually change the system/group. To return to the previously selected system/group, the CHL or Select switch must be used to manually select it. This mode may produce undesirable operation with group tracking (Section 2.4.5).

Temporary Last Received - The display changes to the system/group of a call for only the duration of the scan delay period described in Section 2.7.7. Then when the delay expires and scanning resumes (if not disabled, for example, by taking the microphone off-hook), the selected system/group is again displayed. Therefore, you can respond to a call without changing the selected system/group as long as you do so before scanning resumes.

2.8 LTR-NET AND LTR FEATURES

2.8.1 RECEIVE PRIORITY CALLS

This transceiver uses a different receive priority scheme than has been used with other EFJohnson LTR transceivers. Instead of programming one or two fixed priority ID codes, each selectable group is assigned a priority number. That number then determines if a call on that group can interrupt a call on another group in that system.

The following priority information is programmed for each LTR-Net and LTR group:

- Each LTR-Net and LTR group is assigned a priority number from 1-8.
- Each LTR-Net and LTR group can be programmed as interruptible or not interruptible.

The highest priority is programmed by “1” and the lowest priority by “8”. If a call is detected on the selected group or on any group of the selected system with a priority higher than the selected group, it is received. System or group scanning do not need to be enabled for this to occur.

Likewise, if a call is being received on a group programmed as interruptible and a call is detected on a group with a higher priority, the current call is immediately dropped and the higher priority call received.

If calls on certain groups are not to be interrupted by higher priority calls, the group can be programmed as not interruptible. For example, if telephone calls are not to be interrupted, the Telco group can be programmed as not interruptible. This has the same affect as programming the Telco group with a “1” priority. However, if this was done instead of programming it as not interruptible, calls on the Telco group would interrupt all other lower priority calls which may not be desirable.

The transceiver displays the system and group of the priority call while it is being received. The programming of the “Scan Revert Mode” parameter (see Section 2.7.8) determines if the change to the priority group is temporary or permanent and if a transmission occurs on the priority group.

With LTR-Net operation, incoming call information is received on the repeater to which a mobile is trunked as well as the home and status repeaters. Therefore, priority calls are detected when the transceiver is trunked to other repeaters.

With LTR operation, incoming call information is received on only the home repeater. Therefore, priority calls are not detected while trunked to some other repeater. To reach most mobiles with a priority message in this case, the operator can key the transmitter and then not begin speaking for several seconds. This allows trunked-out mobiles time to finish the transmission and return to the home repeater.

This still may not reach mobiles making telephone calls because they hold a repeater for the duration of a conversation (instead of the duration of the transmission as with dispatch calls). Other times when priority calls could be missed are with both types of operation are when some other system not programmed with the priority ID is being monitored and while transmitting.

2.8.2 BLOCK ID CODES AND ACCESS PRIORITY

This transceiver does not use block ID codes. However, with up to 99 groups programmable per system and group scanning, it is usually possible to program the transceiver to receive all desired calls.

Access priority, which controls which transceivers can access the system during busy periods, is not available with this transceiver. The preceding section describes receive priority which controls which calls are received.

2.8.3 STANDARD GROUP CALLS

Standard group (dispatch) calls are between mobiles or groups of mobiles which use the standard group ID codes from 1-239 (LTR-Net) or 1-250 (LTR) that are assignable to each home repeater. LTR-Net and LTR standard calls are very similar and are placed and received using the same procedure. Simply select a group programmed with the ID code of the mobile being called and then press the PTT switch. No number is dialed with a DTMF keypad as with telephone or special calls.

To receive a standard group call, the group programmed with the ID code being transmitted must be selected or scanned. Also, calls with a higher priority than the selected group are always received as described in Section 2.8.1. The procedure used to place and receive these calls is described in Section 2.4.10.

2.8.4 TRANSMIT INHIBIT

This feature prevents the transmitter from keying if the mobile being called is busy with another call. To enable this feature, the LTR-Net or LTR system is programmed with a block of transmit inhibit ID codes that can include up to all 239 or 250. If a code within this block is detected up to 5 seconds before the PTT switch is pressed, the transmitter does not key, the intercept tone sounds, and “TX INHIB” is displayed.

To make another call attempt, the PTT switch must be released and then pressed again. Although the 5-second timer does count down while the PTT switch is pressed, it is not possible to complete the call by holding the PTT switch down until the intercept tone stops sounding.

Another use of this feature is to prevent the accidental interruption of a call in progress. This could happen when the transmitting party unkeys. It can also provide an indication that the mobile being called is busy. A similar Transmit Disable On Busy feature is available on conventional systems.

2.8.5 TELEPHONE SYSTEM/GROUP SELECT

If the Telephone option switch is programmed, it can be used to quickly select the group programmed for telephone calls. When a telephone group or LTR-Net Auxiliary call group is selected, ☎ is displayed. If more than one LTR group is programmed for telephone calls, the first higher numbered telephone group is selected. If there is no telephone group or a conventional system is selected, "NO PHONE" is displayed and an error tone sounds.

2.9 LTR-NET FEATURES

NOTE: For more information on LTR-Net operation, refer to Section 2.4.8.

2.9.1 SPECIAL CALLS

Introduction

Both standard and special calls can be placed and received with LTR-Net operation (standard calls were described in Section 2.8.3). The special calls originated by the mobile include Telephone and Auxiliary (see following information). When a group programmed for either of these calls is selected, ☎ is displayed.

Most other special calls such as Interrogate, Mobile Disable, and Reassignment are originated by the system operator or a dispatcher. Special LTR-Net calls use the special call group ID codes from 240-254. An optional DTMF microphone and special programming are required to place special calls.

Mobile-Originated Special Calls

Telephone (Telco) - These are interconnect calls to or from a mobile made through the Public Switched Telephone Network (PSTN).

Auxiliary - These calls allow a mobile to communicate with specific mobiles or groups at the same locality (site) or another LTR-Net locality (when several LTR-Net repeater systems form a network). Calls to specific mobiles are called Unique ID calls, and calls to specific groups are called Directed Group calls.

Directed Group calls allow communication with groups that are otherwise not accessible because no selectable system has been programmed with the home repeater or group ID of those mobiles. Directed Group calls can be made to any home repeater on any group ID code from 1-239.

Data - This call allows data transmissions to be made to a specific unique ID. This call is currently not available.

Transceiver Programming For Special Calls

To originate a special call and then respond, the selected group must be programmed for the special call being made (Telephone or Auxiliary). The programming software automatically loads the correct ID codes for these calls. Refer to the following chart for more information.

Type of Call	Originating Mobile Encode/Decode ID	Receiving Mobile Decode/Encode ID
Telephone	Telephone	Telephone
Auxiliary		
Unique ID	Auxiliary	Auxiliary
Dir Group	Auxiliary	Group ID

To receive Telephone and Unique ID calls and then respond, one of the selectable groups must be programmed for the applicable call (Telephone or Auxiliary). These calls are received regardless of which group is selected or group scan programming. All that is required is that a group be programmed for the call and the system be selected or scanned. The transceiver temporarily or permanently changes to the

group programmed for the call depending on scan revert programming (see Section 2.7.8).

To receive a Directed Group call and respond, a selected, priority, or scanned group must be programmed for the group ID specified by the originating mobile. This is because the call is converted to a standard group call by the switch.

To receive landside originated telephone calls, the transceiver must be programmed for telephone calls even though the unique ID of the mobile may be specified when placing the call (see "Landside-Originated Calls" which follows).

Special Call Authorization

When a mobile is programmed to make Telephone calls, system authorization is needed before service is available. This authorization is performed by the system operator through the System and Subscriber Manager, and it determines what type of service is available. For example, a mobile may be authorized to dial local numbers only. This authorization is keyed to the mobile's unique ID which is transmitted when any call is made.

Authorization is also required to make auxiliary calls. Unique ID calls can be made to any mobile in the same locality (site) or some other locality that is programmed for Auxiliary calls. The same applies to Directed Group calls except that the mobile receiving the call does not need to be programmed for Auxiliary calls, just the standard group ID being transmitted.

Placing a Special Call

The following is the procedure for placing a special call. An optional DTMF microphone is required to place this call.

1. Select the group programmed for Telephone or Auxiliary calls, whichever is to be made. When a group programmed for either of these calls is selected, ☎ is displayed.

2. Press the PTT switch and when the system is accessed, the proceed tone sounds (if tones are enabled). Release the PTT switch and a dial tone should be heard. Busy conditions and successful and unsuccessful accesses are indicated as described in Section 2.4.10.

3. If a telephone call is being placed, dial the telephone number of the landside party you are calling.

4. If a unique ID or directed group call is being made, a 1-10 digit number is dialed which specifies the destination of the call. This number is entered the same as with telephone calls. The digits dialed for the various types of calls are as follows:

   Unique ID Call (Current Locality)
   1-5 digit unique ID of mobile/dispatcher

   Unique ID Call (Directed Locality)
   3-digit locality ID +
   5-digit unique ID of mobile/dispatcher

   Directed Group Call (Current Locality)
   3-digit home repeater number +
   3-digit group ID

   Directed Group Call (Directed Locality)
   3-digit locality number +
   3-digit home repeater number +
   3-digit group ID

   Unique ID Call (Using Telephone Number)
   10-digit telephone number or mobile being called

   NOTE: Mobile-to-mobile unique ID calls can also be placed by dialing the mobile's telephone number if it has one.

5. Release the PTT switch if it was pressed to dial the number. A beep should then sound which indicates that the number was accepted by the system. If this beep does not sound, an unauthorized number may have been dialed or a dialing mistake may have been made. If a system resource busy condition exists, the call is placed in a queue by the system (see Section 2.9.2).

6. The various types of calls then proceed as follows:

   Telephone Call - The normal landside ringing or busy tone is heard. When the party answers, press the PTT switch to talk and release it to listen as with standard calls.

Unique ID Call - A "ringing" tone is heard which indicates that the mobile is being rung. If there is no answer, ringing stops after several rings or the call can be terminated by pressing the # key. When the party answers, press the PTT switch to talk and release it to listen as with a standard call.

Directed Group Call - A second beep sounds which indicates that the path to the mobile is complete and speaking can begin (no ringing of the other mobile occurs). Press the PTT switch to talk and release it to listen.

NOTE: Since this transceiver operates half-duplex, you cannot hear the other caller while transmitting or speak to the other caller while receiving.

7. When the call is finished, terminate it by pressing the # key. This tells the system that the call is complete and prevents additional billing for the time required by the system to automatically detect the end of the call.

Receiving Special Calls

To receive a special call, all that is required is that the system programmed for the special call be selected (see information at the beginning of this section). When a Telephone or Unique ID call is received, "ringing" is heard. If it is a Directed Group call, only the voice of the calling party is heard because no ringing occurs.

Landside-Originate Special Calls

Calls can be also be made from any landside telephone to specific mobiles (Unique ID calls) or groups (Directed Group calls). Calls can also be placed to other sites similar to when they are mobile dialed.

If the system has DID lines, the landside caller can dial a mobile directly because each mobile that can receive these calls is given its own phone number. If the system has standard trunk lines, the telephone number of the system is dialed. Then when the system answers, a short tone sounds to indicate that the digits specifying the destination of the call should be dialed. The same digits are dialed as described in "Placing a Special Call". The landside telephone must produce standard DTMF tones to dial these digits.

After these digits are dialed, a beep is heard which indicates that the number was accepted by the system. Ringing then indicates that the mobile is being rung unless it is a Directed Group call. With those calls, no ringing of the mobile occurs and another beep is heard which indicates the path is complete and speaking should begin.

After the mobile answers, the landside party should respond in the normal manner. Remember that the mobile is operating half duplex and cannot hear the landside party while transmitting. When the call is finished, it should be terminated by the mobile party. Three beeps indicate that the call has terminated.

2.9.2 BUSY QUEUING/FREE SYSTEM RINGBACK

This transceiver does not have a feature that places a call in a queue if all channels are busy. In addition, it does not have a free system ringback feature that alerts the user when the repeater system is no longer busy.

However, busy queuing may be provided at the system level for telephone, unique ID, and directed group calls (not standard group calls). If this feature is enabled by the System and Subscriber Manager and resources are not available when one of these calls are placed, a voice message informs the user that the call has been placed in a queue. This message occurs when the PTT switch is released after dialing the digits.

If resources then become available, the call is automatically placed and the normal ringing or beep tones are heard. If the call cannot be placed in the allotted time, it is terminated and another voice message informs the user that this has occurred.

2.9.3 ROAMING (AUTO-REGISTRATION)

General

The roaming (auto-registration) feature permits all types of LTR-Net calls to be automatically routed to the LTR-Net locality (site) in which the mobile is operating. To utilize roaming, the following are required:

- An LTR-Net system must be selected.

- Roaming must be enabled by the ROAM option switch, ROAMING menu parameter, or programming (if the option switch and menu parameter are not available).

- Scanning does not need to be enabled. However, if system scanning is enabled, an LTR-Net system must be selected. If an LTR or conventional system is selected, roaming is disabled.

When roaming is enabled or disabled by the option switch, either "ROAM ON" or "ROAM OFF" is momentarily displayed to indicate the current mode. With the menu mode, either "ON" or "OFF" is selected as described in Section 2.6.2. If communication is to be maintained on the current locality regardless of signal strength, turn roaming off.

Registering on a New Locality

When power is turned on with roaming enabled, registration is attempted on the currently selected locality every 5 seconds if there is a free channel. The registration message includes the mobile's unique ID and the home repeater to be used. The registration information is forwarded to the System and Subscriber Manager which then knows its location.

If roaming was disabled when power was turned on and then later enabled, registration on the current system does not occur until a special event such as transmitting, changing systems, or receiving a call occurs. Therefore, the user may want to briefly press the PTT switch after turning roaming on.

If the signal from a locality becomes weak (see "Dropout and Capture Parameters" which follows) or if two consecutive unsuccessful access attempts occur ("NO ACCES" displayed), the transceiver begins automatic locality search. The unsuccessful access counter is reset whenever power is cycled, the selected system is changed, or a successful access occurs.

During locality search, the status channels of other LTR-Net localities in the system scan list are checked (see Section 2.7.6). During the first pass, "HSQ SRCH" (High Squelch Search) is displayed, the locality that was just dropped is not checked, and the Tight Squelch setting programmed for each locality is used (see "Dropout and Capture Parameters" which follows).

If no localities are found on the first pass that have a high enough signal level, the locality that was just dropped is added back into the search list and all localities in the scan list are checked using the Capture setting programmed for each locality. The display indicates "LCL SRCH", and searching continues until a strong enough locality is found. If none are found before the PTT switch is pressed again, the transmission is attempted on the last registered locality, and searching resumes when the transmission ends.

De-Registering

If an LTR-Net system is selected when power is turned off, a de-registration message is automatically sent that tells the system that the mobile is no longer in service. This increases system efficiency by reducing the number of system resources used in trying to reach out-of-service mobiles. Transceiver power is automatically held on until this message is sent. If power to the transceiver is switched off immediately, such as by a relay, this message cannot be sent.

Revert System/Group Selection After Registration

After registration on a new locality occurs, "LCL SRCH" is no longer displayed and the system of the new LTR-Net locality is displayed. The new system is the next higher system with a different locality that could be accessed. For example, if System 3 was selected and System 5 is the next higher system with a different locality number, that becomes the selected system if it can be accessed (wrap-around occurs after the highest system is checked).

The selected group does not change when registration on a new site occurs. This allows registration on a new locality to be nearly transparent to the user. Therefore, when programming the transceiver, the same group programming should be used in all LTR-Net systems that a mobile roams into. If the same group is not programmed in the new system, the last selected group on the new system is selected. A call can be received on the new locality before registration occurs if the call is already active on the new locality.

Dropout and Capture Parameters

The transceiver squelch is used to control when searching for a new site begins and also when registration on a new site occurs. A reference squelch level is

set during alignment as described in the service manual (see Section 1.5.4). In addition, three squelch levels called Dropout, Capture, and Tight Capture Percentage are programmed for each locality (see Table 3-3). These levels automatically tighten the squelch setting in certain operating modes. The tightened amount is the programmed percentage of the difference between the reference level and the maximum tight setting (equivalent to rotating a squelch knob fully clockwise). These squelch levels function as follows:

Dropout Percentage - This is the percentage that squelch is tightened when not in a call. This prevents the transceiver from staying on a weak locality when another stronger locality may be nearby. The default level is 33%, and setting higher levels may cause more missed calls during weak signal periods. If there is no other site nearby, this parameter should be 0%.

Tight Capture Percentage - This is the percentage the squelch is tightened during the first pass when searching for a new site (HSQ SRCH displayed). This parameter should always be greater than or equal to the Capture Percentage which follows, and it ensures that registration occurs on a strong locality if there is one. The default level is 80%.

Capture Percentage - This is the percentage that squelch is tightened on the second and later passes when searching for a new site (LCL SRCH displayed). This parameter should always be greater than or equal to the Dropout Percentage, and it ensures that registration occurs on a stronger site. The default level is 46%.

NOTE: The transceiver uses the value programmed for the locality being sampled, not the value programmed for the locality which was just dropped.

2.9.4 OVER-THE-AIR LOCALITY CHANNEL UPDATES

Localities are initially programmed with the channel numbers of all repeaters currently in use. These are then the channels that the transceiver can access when placing and receiving calls. If new channels are later added to a locality, over-the-air programming is used to update the transceivers with the new channels. This eliminates the need to bring them in for reprogramming. Channel updates occur on only selected repeaters, and they are initiated automatically by the radio system.

2.9.5 TRANSCEIVER DISABLE

If a mobile is lost or stolen or is being used to interfere with communication, it can be temporarily or permanently disabled by the system operator.

A mobile can be temporarily disabled by transmitting the Sleep command to the unique ID of the affected mobile. When a transceiver receives this command, SLEEPING is displayed continuously on the lower line and no calls can be received or transmitted. However, registration on new localities continues normally.The transceiver can be re-enabled again by the system operator by sending an Interrogate message. This is indicated when the display returns to its normal mode.

A mobile can be permanently disabled by sending the Kill command to the unique ID of the affected mobile. The transceiver then responds that it has received this message and then permanently disables itself. It is then totally inoperative and CALL SVC is displayed continuously. It must then be brought back in for reprogramming to make it operational again.

2.9.6 HOME CHANNEL ALIASING

Introduction

The home channel aliasing feature increases the number of standard group calls programmable on a locality. It does this by allowing calls to be programmed on non-existent home repeaters. Therefore, instead of being limited to just the 239 ID codes on each active home repeater, group calls can be programmed on each of the 20 home repeaters allowed per locality (the twentieth repeater is usually the status repeater which is typically not assigned as a home repeater). This permits up to 20 x 239 or 4780 group calls on each locality.

The active repeaters on each locality are designated by locality programming (see Section 3.6.8). Active repeaters are programmed with a frequency and have the Active box checked. Inactive repeaters have the Active box unchecked. If repeaters are later added, they can be added to the locality by over-the-air programming (see Section 2.9.4).

NOTE: Since this feature does not increase system capacity, adding too many users may result in unsatisfactory operation due to frequent busy conditions.

Operation With Home Channel Aliasing

If a system programmed with a non-existent home repeater is selected, the next lower active home repeater is monitored for incoming calls and go-to repeater information. For example, if home repeater 6 is programmed on the selected system and the active repeaters are 1, 10, and 20, repeater 1 is monitored. In addition, all other mobiles on that locality with a selected system programmed for home repeaters 1-9 monitor that repeater.

If a group call is then placed, the home channel of the call is the home channel programmed for the selected system, not the repeater being monitored. The call is detected like any other group call (it is received if a system/group programmed for that home repeater/group ID is selected or scanned).

Repeater Number Programming With Aliasing

Since the next lower numbered repeater is monitored when a system with a non-existent home repeater is selected, a numbering scheme should be used that equalizes, as much as possible, the gaps between the active repeaters. This equalizes the loading on the active channels.

When repeater 1 is reached, wrap-around to repeater 20 occurs. Therefore, the status repeater is always assigned as Repeater 20 and Repeater 1 as an active repeater. This prevents the status repeater from being used as a home repeater which is not desirable because it then has no backup repeater (see Section 4.6). Examples of repeater numbering schemes are as follows:

No. of Repeaters	Numbering
1	20
2	1, 20
3	1, 10, 20
4	1, 7, 14, 20
5	1, 5, 10, 15, 20
10	1, 3, 5, 7, 9, 11, 13, 15, 17, 20

2.10 LTR FEATURES

2.10.1 GENERAL LTR FEATURES

LTR operation is described in Section 2.4.8. The two types of calls that can be placed with LTR operation are Group and Telephone. Standard Group calls and other common LTR and LTR-Net features are described in Section 2.8. LTR telephone calls and other unique LTR features are described in the information which follows.

2.10.2 LTR TELEPHONE CALLS

General

LTR localities which are set up for LTR telephone calls have a block of ID codes reserved for RIC (repeater interconnect) calls. For the transceiver to place and receive telephone calls on those localities, an LTR telephone group must be programed with an ID code from this block. Then when this ID code is decoded (received) or a telephone group is selected to make a call, the transceiver enters the telephone operating mode.

To place an LTR telephone call, a telephone group must be selected; to receive an LTR telephone call, the telephone ID must be selected or scanned or have a higher priority. An optional DTMF microphone is required to dial the telephone number.

Since this transceiver operates half duplex, the PTT switch must be pressed to talk and released to listen the same time as with a dispatch call. Therefore, the mobile user cannot hear the landside caller while transmitting or speak to the landside caller while receiving.

Placing an LTR Telephone Call

1. Turn transceiver power on and set the volume as described in Sections 2.4.1 and 2.4.2.

2. Select the system and group programmed for telephone calls. If equipped with a Telephone option switch, it can be used to quickly select a telephone group (see Section 2.8.5). The telephone symbol ☎ is displayed when a group programmed for telephone calls is selected.

3. Briefly press the PTT switch to obtain a dial tone. A successful access and busy or no access conditions are indicated as described in Section 2.4.10.

4. When a dial tone is heard, enter the number to be called in one of the following ways:

   - Enter it directly using the 0-9 keys. If too much time elapses between digits, the call is terminated.
   - If the microphone has a memory, it may be possible to recall the number from memory and dial it automatically.

5. After the number is sent, landside ringing should be heard (a landside busy condition could also be indicated). When the other party answers, press the PTT switch and respond. The PTT switch must be pressed to talk and released to listen, the same as with standard calls.

6. When the call is finished, press the # key to terminate the call. Three beeps indicate that the call has been terminated. Terminating the call in this manner prevents extra billing that may occur for the time required for the system to automatically detect the end of the call.

Receiving a Telephone Call

1. Turn transceiver power on and set the volume as described in Sections 2.4.1 and 2.4.2.

2. Select or scan the system and group programmed for telephone calls. If equipped with a Telephone option switch, it can be used to quickly select a telephone group (see Section 2.8.5). When a group programmed for telephone calls is selected, the telephone symbol ☎ is displayed).

3. When "ringing" is heard, press the PTT switch and respond. The PTT switch must be pressed to talk and released to listen as with a dispatch call.

4. When the call is finished, it should be terminated as in step 6 of the preceding section.

Placing a Landside-To-Mobile Telephone Call

Calls can be placed from a landside telephone to a mobile transceiver (if the transceiver and radio system have this capability). With most systems, a mobile user can be called directly (each has a unique telephone number). With others, the mobile being called must be specified as follows:

1. Dial the number of the radio system in which the mobile transceiver is operating.

2. When the system answers, a short tone sounds to indicate that the number of the mobile being called should be dialed. This number is usually five digits long and must be dialed using a tone-type telephone. The first two digits are the home repeater number of the mobile, and the last three digits are the telephone ID code of the mobile. With LTR interconnect equipment, the first digit must be dialed within 5 seconds of hearing the tone, and no more than 5 seconds must elapse between digits or the call is terminated.

3. Ringing is then heard by the landside caller while the mobile is being rung.

2.10.3 BUSY QUEUING/FREE SYSTEM RINGBACK

The LTR free system ringback and busy queuing features are not available with this transceiver.

2.10.4 SYSTEM SEARCH

LTR system search is not available with this transceiver.

2.10.5 TRANSPOND

The LTR transpond feature is not available with this transceiver.

2.11 CONVENTIONAL MODE FEATURES

NOTE: For more information on conventional operation, refer to Section 2.4.8.

2.11.1 MONITOR MODE

General

The monitor mode temporarily halts scanning and disables squelch control features such as Call Guard so that all activity on a channel to be monitored. To select

the monitor mode, take the microphone off-hook. The monitor mode is indicated by ◀ in the display.

A conventional system must be selected to enable monitoring. If the microphone is taken off-hook with an LTR-Net/LTR system selected, scanning halts but monitoring is not selected.

Per Group Monitor Enable/Disable

Each conventional group can be programmed so that off-hook monitoring is disabled. It is then always disabled on that group regardless of the current microphone hanger state. Monitoring then must be performed by the Transmit Disable On Busy feature described in the next section. Scanning is still controlled in the normal manner by the hook switch state.

If monitoring is not disabled on a group, it is enabled by taking the microphone off-hook. If off-hook detection is disabled on a radio-wide basis as described in Section 2.4.6, monitoring must be performed by the following Transmit Disable On Busy feature.

2.11.2 TRANSMIT DISABLE ON BUSY

The Transmit Disable On Busy feature automatically disables the transmitter if the channel is busy (carrier present) and it has not been monitored before the PTT switch is pressed. This feature is enabled or disabled on each conventional group by programming.

When the transmitter is disabled by this feature, the busy tone sounds briefly and “DSBL BSY” is indicated on the lower line of the display. The receiver is then enabled while the PTT switch is pressed so that the activity on the channel can be monitored. It is not possible to access a channel by holding down the PTT switch (it must be released to make another attempt).

If this feature is not used or if the channel is being monitored by an off-hook condition as described in the preceding section, the transmitter keys even if the channel is busy. In addition, the transmitter can always be keyed by releasing the PTT switch and then pressing it again within 1 second.

Some repeaters may have delayed drop-out (hang time) which causes this feature to disable the transmitter even though no busy condition exists. If this is a problem, there is the option with this feature to allow transmitting if the correct receive Call Guard tone or code is detected.

2.11.3 RECEIVE-ONLY GROUPS

Conventional groups can be programmed so that transmitting is disabled (monitoring only is allowed). This is done by programming the Tx Option parameter for “Disabled”. If the PTT switch is pressed with one of these groups selected, the intercept tone sounds and “TX DSBL” is displayed.

2.11.4 TALK-AROUND

Normally, all transmissions go through a repeater. However, there may be times when a user is out of range of the repeater system and unable to talk to anyone even though the mobile being called may be only a short distance away. In this situation, the repeater talk-around feature can be used to transmit on the receive frequency so that the transmission does not have to go through a repeater.

Any conventional group can be programmed for talk-around. It is then enabled by simply selecting one of those groups. It is not selectable by an option switch. There is no talk-around indicator unless it is indicated by the group alpha tag.

2.11.5 CALL GUARD SQUELCH

Introduction

Tone, digital, or inverted digital Call Guard squelch can be programmed on each transmit and receive channel in any order desired. There is also an option to disable the reverse burst or turn-off code on transmit channels programmed with Call Guard squelch. The reverse burst and turn-off code are always detected on receive channels programmed with Call Guard squelch (if it is sent).

The Call Guard squelch feature eliminates distracting messages intended for others using the channel. This is done by using a subaudible tone or digital code to control the squelch. This tone or code is unique to a user or a group on that channel. This tone or code is transmitted with the voice signal but is not heard because it is in the subaudible range and is attenuated by a filter. Call Guard squelch must be used in

both the transmitting and receiving transceiver to be functional. When the channel is monitored before transmitting, Call Guard squelch may be temporarily disabled by the monitor mode described in Section 2.11.1.

Tone Call Guard Squelch

Tone-type Call Guard squelch utilizes subaudible CTCSS tones from 67-254.1 Hz. Although there are 42 tones assigned, those above 33 are normally not used because of their close proximity to the voice band which starts at 300 Hz. In addition, tones 11, 39, 40, 41, and 42 are normally not used because they may cause interference with adjacent tones (see Table 3-2). A reverse burst can be transmitted when the push-to-talk switch is released to eliminate the squelch tail (noise burst) in the receiving transceiver. However, both the transmitting and receiving transceiver must be equipped with this feature for it to be utilized. The reverse burst is a 180-degree phase reversal for a period of time determined by the tone frequency.

Digital Call Guard Squelch

Digital Call Guard squelch (CDCSS) uses digital data instead of subaudible tones to control the squelch. This data consists of continuous repetitions of 23-bit words. No bit or word synchronization information is used. When the push-to-talk switch is released, a turn-off code is transmitted which eliminates the squelch tail similar to the reverse burst.

Although there are thousands of possible code combinations with 23 bits, only 83 are unique with the data scheme used. The number specified when the code is programmed is actually a seed for a special algorithm used to generate the 23-bit data word. The data is transmitted at a rate of 134.4 bits per second. Therefore, approximately six words are transmitted each second. When the data is decoded, 23-bit samples are taken and then the bits are rotated to determine if a valid code was received.

Digital Call Guard squelch can be programmed as normal or inverted. The only difference is that the waveform is inverted when “iDCG” is selected. The inverted type may need to be programmed if the signal is inverted by the repeater or another transceiver. If digital Call Guard squelch does not function, try changing to the other type.

2.11.6 EXTERNAL ENCODERS AND DECODERS

External encoders and decoders are not currently supported by the operating software.

2.12 SUPERVISORY TONES AND DISPLAY MESSAGES

2.12.1 GENERAL TONES

The following tones are heard at various times when operating this transceiver. Some or all of these tones can be disabled by the user if the menu “TONES” parameter is available (see Section 2.5.15). If the menu parameter is not available, these tones can be selected only by the programmer.

Busy Tone - This tone is similar to the standard telephone busy tone, and it indicates that the LTR radio system is currently busy. It is produced by turning combined 480 and 620 Hz tones on and off at a 4 Hz rate. This tone sounds with all types of LTR-Net/LTR calls (even if the proceed tone is enabled), and “BUSY” is indicated on the lower line of the display when it sounds. It does not sound on conventional systems.

No more access attempts are made once this tone sounds. The PTT switch must be released and then pressed again to make another attempt. Therefore, it is not possible to access the system by holding the PTT switch down with this tone sounding.

Intercept Tone - This is a siren-like tone (alternating high and low tones) consisting of 700 Hz and 800 Hz tones alternating at approximately a 2 Hz rate. This tone indicates the following no access and error conditions:

- No Access - If this tone sounds 2-3 seconds after pressing the PTT switch and “NO ACCES” is displayed, the data handshake with the repeater could not be completed. The usual cause is an out-of-range condition. Six attempts are made before this tone sounds. No more access attempts are then made until the PTT switch is released and pressed again.

- Time-Out Timer - If this tone sounds after the transmitter has been keyed for an extended period and "TIMEOUT" is displayed, the transmitter has been disabled by the Time-Out Timer feature (see Section 2.5.14). This tone sounds in all operating modes.

- Transmit Inhibit - If this tone sounds as soon as the PTT switch is pressed with an LTR system selected and "TX INHIB" is displayed, the transmitter has been disabled by the Transmit Inhibit feature (see Section 2.8.4).

- Receive-Only Channel - If "TX DSBL" is displayed when this tone sounds, a conventional receive-only channel is selected (see Section 2.11.3).

- Tx While Receiving Call - If the push-to-talk switch is pressed while receiving an LTR call, this tone sounds and "DSBL BSY" is displayed.

Proceed (Clear-To-Talk) Tone - This is a short (700 Hz, 50 ms) tone which sounds after the handshake is complete to indicate when talking can begin (see Section 2.5.11).

Key Press Tone - This is a short (700 Hz, 50 ms) tone that sounds to indicate when an option switch is pressed (in all modes).

Wrap-Around Tone - A 700 Hz, 80 ms tone followed by an 800 Hz, 80 ms tone which indicates that the highest or lowest programmed system or group was displayed and that wrap-around has occurred (see Section 2.4.5).

Error Tone - A 1050 Hz, 80 ms tone followed by a 700 Hz, 80 ms tone which indicates that an error condition occurred.

2.12.2 LTR-NET SPECIAL CALL TONES

NOTE: The following tones are produced by the LTR-Net switch and are heard only when placing special calls.

Confirmation Tone - A short tone which sounds when the number just dialed is accepted by the system.

Call Proceed Tone - With LTR-Net Directed Group calls, ringing does not occur after the number is dialed. Instead, this short tone sounds after the confirmation tone to indicate that the audio path is complete and speaking can begin.

End Call Tone - Three beeps which sound when the end of the call has been detected by the system.

Proceed Dialing Tone - When placing a landside-originate call to a mobile, the caller may dial the number of the system and then when the system answers, a number specifying the mobile being called. This tone sounds to indicate when the number of the mobile should be entered (see Section 2.9.1).

2.12.3 LTR TELEPHONE CALL TONES

The following tones are generated by the LTR interconnect equipment and are heard when making LTR telephone calls.

Reorder Tone - Three beeps which indicate that the call has been terminated by the system.

Return Time Warning Tone - Two beeps which warn that you have not transmitted for an extended period. If you do not transmit within 5 seconds, the call is automatically terminated by the system. The time between transmissions is one of the parameters used by the system to detect the end of a call when the # character is not sent.

Conversation Time-Out Tone - Calls are limited to a certain length by the system. Thirty seconds before this time is reached, a "tick" begins sounding each second. When the 30-second time expires, the call is automatically terminated by the system.

Turn-Around Tone - This is a single beep which may be used to indicate to the landside party when to respond to your transmission. It sounds when you release the PTT switch, and you may partially hear this tone.

Proceed Tone - This tone consists of two beeps and it tells the landside caller when to enter the five-digit number specifying the mobile being called. Dialing of this number must be started within 5 seconds of hearing this tone, and a tone-type telephone must be used.

2.12.4 DISPLAY MESSAGES

The following messages appear in the display to indicate various operating modes and error conditions. Selected system/group information appears in this display during normal operation (see Section 2.4.4).

98xx6xx - On power up, the last seven digits of the transceiver part number (see Section 1.4) are displayed on the top line very briefly. For example, a 800 MHz, high tier, LTR-Net, 15-watt transceiver is indicated as "9883602". The eighth display digit is reserved for future use and is always "0".

∗ CODE xx - Indicates that an error condition has occurred. It is displayed very briefly on the bottom line at power up (see Section 2.14).

BUSY - Indicates that the LTR-Net/LTR radio system is currently busy (see "Busy Tone" in Section 2.12.1).

CALL SVC - Indicates that the transceiver has been totally disabled by an over-the-air message from the system operator. To return the transceiver to service, it must be reprogrammed (see Section 2.9.5).

DSBL BSY - Indicates that the transmitter is disabled by the conventional Transmit Disable On Busy feature (see Section 2.11.2). It also indicates that the transmitter was keyed while receiving an LTR call.

FCN - Indicates that the function select mode is selected by the FCN switch (see Section 2.5.6).

HSQ SRCH - Indicates the transceiver is currently on the first pass while searching for a new locality on which to register (see Section 2.9.3).

LCL SRCH - Indicates the transceiver is currently on the second or later pass while searching for a new locality on which to register (see Section 2.9.3).

NO ACCES - Indicates that the repeater system could not be accessed, perhaps because of an out-of-range condition. Once this indication appears, no more access attempts are made until the PTT switch is released and then pressed again (see Section 2.12.1).

NO PHONE - Indicates that there is no telephone group programmed in the current system when the TEL option switch is pressed (Section 2.8.5).

NO POWER - Indicates that the transmitter temperature is excessive or that the supply voltage is too high and the transmitter has been shut down (see Section 2.5.16).

NOT AUTH - Indicates that an attempt to register was made on a locality where service was not authorized (see Section 2.9.3).

NOT CONV - Indicates that an attempt was made to enable a conventional mode feature on an LTR-Net or LTR system.

NOT LNET - Indicates that an attempt was made to enable an LTR-Net function on an LTR or conventional system.

OUT-LOCK - Indicates that the synthesizer is unlocked. The transceiver is nonfunctional until lock is re-established.

PROG ERR - Indicates an EEPROM read error. Check transceiver programming or the EEPROM if this condition persists (see Section 3.7).

PRG MODE - Indicates that the transceiver is being programmed (see Section 3.7).

SLEEPING - Indicates that the transmitter has been temporarily disabled by an over-the-air message from the system operator (see Section 2.9.5).

SQUELCH - Indicates that the conventional squelch adjust mode is selected (see Section 2.4.7).

TIMEOUT - Indicates that the transmitter has been disabled by the Time-Out Timer (see Section 2.5.14).

TYPE ERR - Indicates that the programming data is incompatible with the transceiver (see Section 3.7).

TX DSBL - Indicates that the selected conventional system is programmed for monitoring only (see Section 2.11.3).

TX INHIB - Indicates that the transmitter has been disabled by the Transmit Inhibit feature (see Section 2.8.4).

2.12.5 MENU MODE MESSAGES

The following messages are displayed in the menu mode that is described in Section 2.6. Enabled or yes is indicated by "ON", and disabled or no by "OFF".

BACKLGT - Backlight
- **BRIGHT**
- **DIM**
- **OFF**

BANK SEL - Bank select
- Alpha tag of programmed banks

OPTION - Option on-off
- **ON** or **OFF**

ROAMING - LTR-Net roaming on-off
- **ON** or **OFF**

SCN CONT - Scan continue on-off
- **ON or OFF**

SCN SAVE - Scan list save
- **ON** = save, **OFF** = not saved

SCN TYPE - Selects type of scanning
- **SYSTEM -** Both system and group
- **GROUPS -** Group scanning only
- **OFF -** Scanning off, switch disabled

S/G DISPL - Sys/grp display mode
- **ALPHA**
- **NUMERIC**

STEALTH - Stealth mode select
- **ON** or **OFF**

TONES - Tone type select
- **SILENT -** No tones sound
- **KEYS -** Only the Select switch and key press tones sound
- **ALERTS -** All tones except preceding Key Beep tones sound
- **ALL -** The preceding Key Beep and Alert tones sound

2.13 TEST MODE

2.13.1 GENERAL

This transceiver currently does not have a test mode that can be selected to perform transceiver testing. To manually control the transceiver, program conventional channels.

2.13.2 DISPLAYING SOFTWARE REVISION NUMBER

To display the software version number, turn power on with the top two switches to right of display pressed. The version number is displayed on the bottom line as "VER x.xx" (see following illustration).

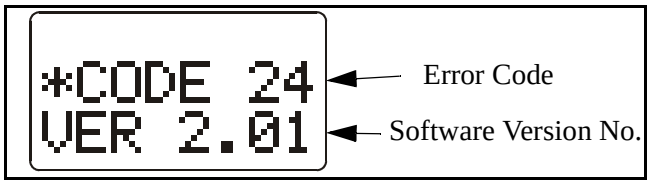
2.14 ERROR CODES

2.14.1 GENERAL

If error conditions occur during operation that interrupt normal program execution, reset occurs which usually restores normal operation, and information on the error condition is stored. Up to 11 error conditions can be stored. If more than 11 occur, the first 10 continue to be stored and only the 11th code is overwritten so it is always the most recent code. An error condition can be caused by such things as a defective memory chip or other hardware problems or software problems.

When power is turned on after an error condition has occurred, "∗ CODE xx" is briefly displayed on the lower line in addition to the transceiver model number on the upper line (see Section 2.4.1). The "xx" indicates the number of the latest unread code.

To display the most recent error code, turn power on with the top two option switches to the right of the display pressed. The error code is indicated on the top line and the operating software version number on the bottom line. For example, error code "24" and software version "2.01" are indicated as follows:



To mark a code as read, press the Select switch. A beep then sounds and the next code is displayed if applicable. Once all stored codes are marked as read, they can no longer be displayed and "∗ CODE xx" is not displayed at power up. However, they continue to be stored and can be read using the programmer (see next section).

2.14.2 READING ERROR CODES

The up to 11 error codes that can be stored can be read out of the transceiver using the personality programming software described in Section 3.

Connect the programming setup and then select File > Read Codes or click the 

icon in the toolbar (see Section 3.5).

The screen shown in Figure 2-3 is then displayed which indicates various information about each stored error code. Contact the Customer Service Department as described in Section 1 of your service manual for additional information on the displayed error codes. To permanently erase the current error codes from the transceiver, click the "Clear ∗ Codes" button at the bottom of the screen.

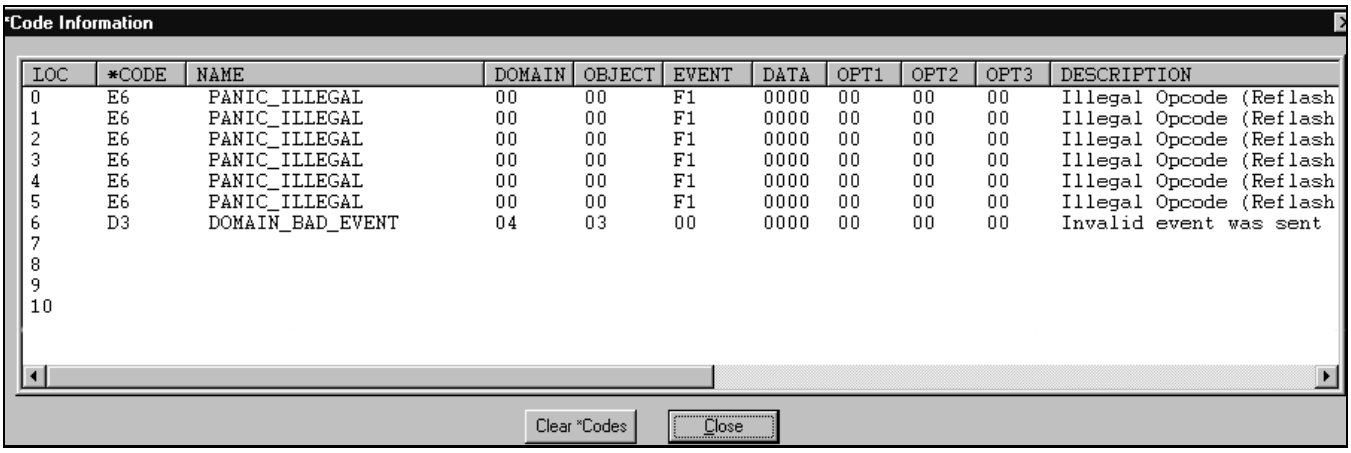


Figure 2-3 Error Code Screen Displayed By Programmer

SECTION 3 PROGRAMMING

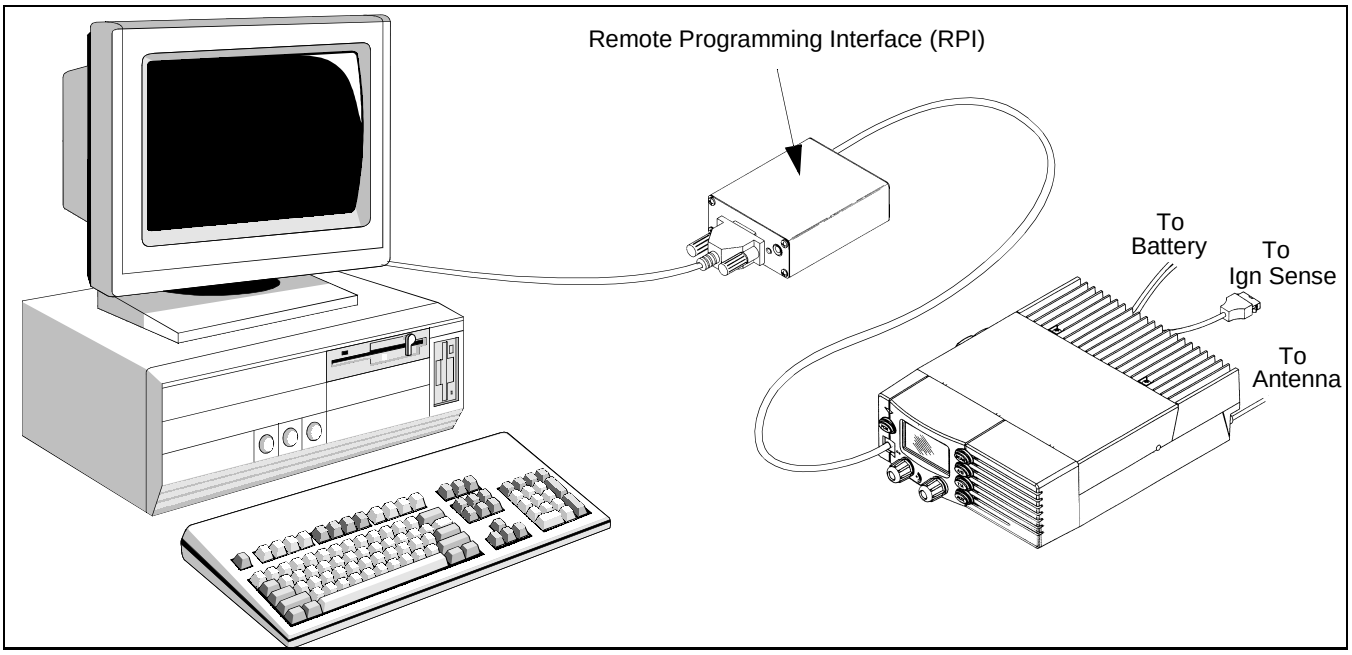


Figure 3-1 Programming Setup

3.1 GENERAL

3.1.1 PROGRAMMING SETUP

The following items are required to program the transceiver. The part numbers of this equipment are shown in Table 1-1 in Section 1. The programming set-up is shown above.

- IBM® PC or compatible personal computer
- EFJohnson Remote Programming Interface (RPI), Part No. 023-9800-000.
- Cables from the RPI to the computer and radio.
- EFJohnson programming software for 9800-series transceiver.

3.1.2 MINIMUM COMPUTER REQUIREMENTS

The programming software is designed to run on an IBM PC or compatible computer that meets the following *minimum* requirements:

- Windows 95/98 or NT 4.0 operating system
- 3-1/2” floppy disk drive
- One unused serial port

The programming software requires a Windows 32-bit operating system such as 95/98 or NT 4.0 to run. Therefore, a 16-bit operating system such as Windows 3.1 cannot be used.

Since the program is relatively small (approximately 500K), it will run properly with the amount of RAM recommended for the operating system. In addition, the data files are relatively small (approximately 15K), so minimal hard disk space is required.

3.1.3 REMOTE PROGRAMMING INTERFACE (RPI)

The RPI provides the required interface between the computer and transceiver. It converts the RS-232 logic levels from the computer to the TTL logic levels required by the transceiver microprocessor and vice versa.

A new RPI (Part No. 023-9800-000) has been designed for this transceiver. This RPI is backward compatible, so it can also be used to program most other EFJohnson transceivers which require an RPI. This new RPI is required for Flash programming

described in Section 3.12, and it has a phone jack for injecting the transmit audio signal during alignment (see Section 7 of service manual). Earlier RPI's, such as Part No. 023-5810-000 or 023-9750-000, can be used to perform the standard personality programming described in most of this section.

When programming this transceiver, the switch on the front panel of the RPI selects either the standard or Flash programming mode. The standard mode is selected when it is away from the LED and the indicator is green, and the Flash mode is selected when it is toward the LED and the indicator is amber. The standard mode should be selected for all but Flash programming.

With remote mount transceivers, this switch is used to turn transceiver power on and off. A separate 9-16 VDC, 200 mA power supply (such as P.N. 563-0001-005) must then be plugged into the RPI power jack to provide power to the RPI.

3.1.4 RPI CABLES

The cables from the RPI to the computer and transceiver are not included with the RPI. The RPI has a female DB9 connector, and most computer serial ports have a male DB9 or male DB25 serial connector. Therefore, either a male DB9 to female DB9 or male DB9 to female DB25 cable is usually required. This is a standard cable available at most electronic and computer supply stores. Suitable cables available from the EFJohnson are listed in Table 1-1.

The cable from the RPI to the transceiver has modular telephone-style connectors on each end and plugs into the microphone jack of the transceiver. The cable for this application is also listed in Table 1-1.

3.1.5 EEPROM DATA STORAGE

Most personality information programmed in the following sections is stored in the Flash memory device (U108). In addition, EEPROM U102 is used to store additional personality information. Other parameters such as alignment settings and current switch settings are stored in an EEPROM that is part of the microcomputer chip. Both Flash and EEPROM devices store data indefinitely without the need for a constant power supply. The transceiver can be removed from the vehicle or even stored on a shelf indefinitely without affecting programming.

If the operating program needs to be updated, reprogramming is performed using special Flash programming software and the same setup used for personality programming. The Flash programming procedure is described in Section 3.12.

3.1.6 HARDWARE HOOKUP

The programming setup is shown in Figure 3-1. The RPI-to-transceiver cable is connected from the modular jack of the RPI to the microphone jack of the transceiver. The RPI-to-computer cable is connected from the serial port of the computer to the DB9 connector on the RPI.

The RPI has a switch which selects standard or Flash modes. Turn on transceiver power and then make sure that the standard mode indicated by a green LED is selected (position away from LED).

If it is the first time the program is run and a port other than Serial Port 1 (COM1) is used, the serial port may have to be selected. Refer to Section 3.9 for more information.

3.2 MISCELLANEOUS PROGRAM INFORMATION

3.2.1 BASIC WINDOWS KNOWLEDGE

With the descriptions which follow in this section, it is assumed that you have a basic understanding of how to use your Windows-based operating system. If you are not familiar with some of the Windows functions described, refer to the Windows Help Screens and any manuals that may have been included with your Windows software.

3.2.2 SOFTWARE INSTALLATION

The programming software is supplied on one 3-1/2" diskette. Install this software as follows:

1. Make sure that there are no other Windows applications open during this installation procedure. Also, make sure that the computer meets the minimum requirements listed in Section 3.1.2.

2. Insert the distribution disk in the disk drive of your computer.

3. Select Start > Settings > Control Panel and double click "Add/Remove Programs". Then click Install and Next. When SETUP.EXE is automatically located on the floppy drive, click Next, select the location for the start-up icon, and enter the name you want to call the program.

4. Follow the instructions displayed by the setup program. The default directory for the program is C:\Program Files\LTR-Net Mobile Programmer. If you wish to use some other directory, click Browse and select it or type the name to create a new one.

Making a Backup Copy

When you receive the programming software, make a backup copy and store the master in a safe place. To make a copy of the distribution disk, select My Computer and then right click the floppy drive icon and select Copy Disk.

3.2.3 STARTING PROGRAM

From Start Menu

The program is started by clicking the shortcut icon for the program. This shortcut is automatically created when the program is installed, and is usually selected by clicking 

> Programs > LTR-Net > Mobile Programmer.

If this icon is not present or you want to create another, select Start > Settings > Taskbar. Then select the Start Menu Programs tab and click the Add button. Click the Browse button and locate the program file called LTRNetMobPgmr.exe where you installed it on your hard drive (see preceding information). Click the program name and continue following the instructions that are displayed.

From My Computer or Windows Explorer

To start the program from My Computer or Windows Explorer, locate the file LTRNetMobPgmr.EXE and then double click it.

3.3 MAIN WINDOW DESCRIPTION

3.3.1 TITLE BAR

The title bar is located at the top of the window (see Figure 3-2) and indicates the following:

-  Clicking this control icon displays the screen on the right which can be used to perform the indicated window control functions.

- Name of the current data file (Johnson_rad.mbl in Figure 3-2).
- Program name (LTR-Net Programmer)
- Window Minimize, Maximize, and Close buttons

3.3.2 MENU BAR

The menu bar (see Figure 3-2) displays the headings for the menus that are used to select program functions. Quick access to the most frequently used menu functions are provided by toolbar buttons. Refer to Sections 3.5 - 3.10 for descriptions of menu functions.

3.3.3 TOOLBAR

The toolbar (see Figure 3-2) provides quick access to the most frequently used menu functions. The toolbar can be turned on and off by selecting View > Toolbar in the menu bar. The function of these buttons and section in which the function is described are as follows:

- Create a new programming file (Section 3.5).

 - Open a disk file (Section 3.5).

 - Save the current file (Section 3.5).

- Create a new locality (Section 3.6.8).

- Edit a current locality (Section 3.6.8).

- Load locality from repeater file (Section 3.6.8).

- Delete a locality (Section 3.6.8).

- Create a new system (Section 3.6.9).

- Edit a current system (Section 3.6.9).

- Copy a system (Section 3.6.9).

- Delete a system (Section 3.6.9).

- Edit a group (Section 3.6.10).

- Create a new bank (Section 3.6.11).

- Edit a current bank (Section 3.6.11).

- Delete a bank (Section 3.6.11).

- Read the programming data from radio (Section 3.7.2).

- Write programming data to a radio (Section 3.7.3).

- Read error code information stored in radio (Section 2.14)

3.3.4 STATUS BAR

The status bar is located at the bottom of the screen (see Figure 3-2), and it indicates the following information. The status bar can be turned on and off by selecting View > Status Bar in the menu bar.

Program Status - When pointing to a function or tool, this area provides a brief description of it. At other times, it indicates the current program status.

Caps Lock - Displays “CAPS” when the keyboard Caps Lock function is enabled.

Num Lock - Displays “NUM” when the numeric keys are enabled.

Special Modes - Normally always blank.

Flash Memory Left - Displays a running total of the amount of space remaining in Flash memory U108 if the transceiver was programmed with the current information. If this number reaches zero before all data is entered, fewer localities/systems/groups/banks must be programmed (see Section 2.4.9).

Reserved - This display is reserved for future use and any number it displays can be ignored.

EEPROM Memory Left - Functions like the Flash memory display just described to indicate the amount of space remaining in EEPROM U102.

3.4 PROGRAMMING PROCEDURE

Introduction

The following is a general procedure that can be used to program a 98xx-series LTR-Net transceiver. Detailed information on the screens mentioned in the procedure is located in Sections 3.5 - 3.10.

Getting Started

1. Start the program as described in Section 3.2.3. The main window shown in Figure 3-2 should be displayed.

2. Choose the data file to be edited using one of the following methods:

   New File - When the program is started, a new file is automatically created that contains program defaults. This file is named “Untitled” until it is saved. A new file can also be created at any time by File > New or clicking 

in the toolbar.

   From Disk File - If a file stored on disk is to be edited or used as a basis for programming another file, open it by selecting File > Open or clicking  in the toolbar.

   Read From Radio - If the data programmed in a radio is to be used as a basis for programming another radio or is to be modified, it can be read into the program. To do this, select Transfer > Read Setup Params or click 

in the toolbar (see Section 3.7).

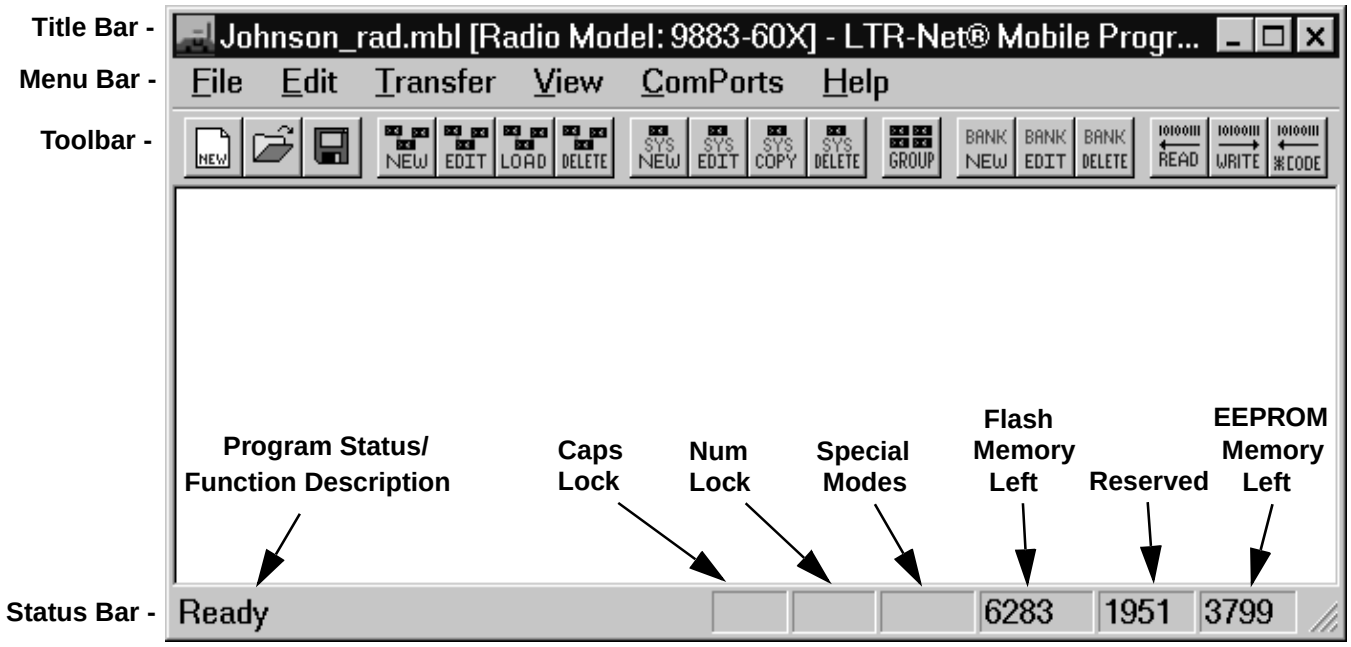


Figure 3-2 Main Window

Programming Main Radio Parameters

The Main Radio Parameters are parameters that are the same regardless of which bank/system/group is selected. They are programmed as follows:

1. Select Edit > Radio Type and the screen that is displayed programs the Type (mobile, portable), Tier (high), Frequency Band (UHF, 800 MHz, 900 MHz), and Bandwidth (narrow 12.5 kHz, dual 12.5 and 25 kHz). See Section 3.6.2.

2. Select Edit > Basic Radio Params (Parameters) to display the screens used to program other radio parameters. The following parameters are programmed by these screens:

   Basic Parameters - Select the Basic Parameters screen by clicking the tab at the top. Choose the desired configuration for each parameter by clicking the arrow button or the check box (Section 3.6.3).

   Timing Parameters - Select the Timing Parameters screen by clicking the tab at the top. Choose the desired configuration for each parameter by clicking the arrow button or the check box (Section 3.6.4).

   Menu Parameters - Select the Menu Items screen by clicking the tab at the top. Placing a check in the box enables the parameter in the menu mode, and the other box programs the default configuration (Section 3.6.5).

   Key Assignment - Select the Key Assignment screen by clicking the tab at the top. Click the key to be programmed and then choose the function for that key by clicking the arrow button to display the drop-down list (Section 3.6.6).

   Input/Output - Parameters in the Input/Output screen need to be programmed only if an internal option such as the compander module is installed or if an option controlled by the AUX option switch is installed (Section 3.13).

3. When all parameters in the Radio Parameters Screens are programmed, click the OK button to save all changes or the Cancel button to exit without saving changes.

Locality Programming

In general, a locality is a repeater site. At least one Locality must be programmed before any Systems can be programmed and so on for Groups and Banks. For example, at least one Locality, System, and Group

must be programmed to program a bank. Proceed as follows to program localities (Section 3.6.8):

Create New Locality - Select Edit > Localities > Create New or click 

in the toolbar.

NOTE: The frequency band is selected in the radio type screen.

Load Locality From Repeater File - Locality information can be loaded from a repeater programming file so that it does not need to be re-entered. These files have the .LNT extension, and are loaded by selecting Edit > Localities > Load From Disk or clicking 

in the toolbar.

Edit Locality - Select Edit > Localities > Edit Existing or click 

in the toolbar.

Delete Locality - Select Edit > Localities > Delete Locality or click 

in the toolbar.

When all parameters in the Locality screen are programmed, click the OK button to save all changes and exit, or click the Cancel button to exit without saving any changes.

System Programming

Each system is linked to one of the localities. Therefore, at least one locality must be created as just described before systems can be created. Groups are added to the systems by group programming described next. Proceed as follows (Section 3.6.9):

Create New System - Select Edit > Systems > Create New or click 

in the toolbar.

Copy System - To copy a system that is already created for use as a basis in programming another, select Edit > Systems > Copy Existing or click 

in the toolbar.

Delete System - Select Edit > Systems > Delete or click 

in the toolbar.

When all parameters in the System screen are programmed, click the OK button to save the changes and exit, or click the Cancel button to exit without saving any changes. Repeat this procedure to add additional systems.

Group Programming

Each group is linked to one of the systems. Therefore, at least one system must be created as just described before groups can be created. Groups program individual call parameters. Proceed as follows (Section 3.6.10):

1. To create a new group or edit a group, select Edit > Groups or click 

in the toolbar.
2. A screen is then displayed which lists all current systems. Select the system to which a group is be added or in which a group is to be edited. Click the OK button to display the groups in that system.
3. In the Group No. box, select the number or the group to be added, edited, or deleted.
4. Program the group with the desired parameters.
5. Click the Add button if adding a new group, the Change button if editing a group, or the Delete button if deleting a group. To exit without saving the current changes, click the Cancel button.
6. Repeat until the system has been programmed with the desired groups. Then click the Done button to exit. Repeat to program other systems if applicable.

Bank Programming

At least one locality, system, and group must be programmed before a bank can be programmed. Banks are collections of systems that may be selected for a unique application such as operation in different geographical areas. System numbering and other parameters can be different for each bank. At least one bank must always be programmed even if bank select is not used.

1. Create, Edit, or Delete a bank as follows:

   Create a New Bank - Select Edit > Banks > Create New or click 

in the toolbar.

Edit Bank - Select Edit > Banks > Edit Existing or click  in the toolbar.

Delete Bank - Select Edit > Banks > Delete or click  in the toolbar.

2. When the bank programming screen is displayed, select the display number of the system to be added, edited, or deleted. Then select the system to be assigned to that number if applicable. Also program default scan list status of the system and other bank information such as alphatag and emergency and home system/group if applicable.

3. To make the selected changes to the system, click the Add, Change, or Delete button, whichever is applicable. To add, edit, or delete other systems, repeat this procedure. When finished programming the bank, click the Done button, or to exit without making any changes, click the Cancel button.

Programming Transceiver

When all the programming described in the preceding sections is complete, the data is ready to be downloaded to the transceiver as follows:

1. Connect the computer to the transceiver as described in Section 3.1.6.

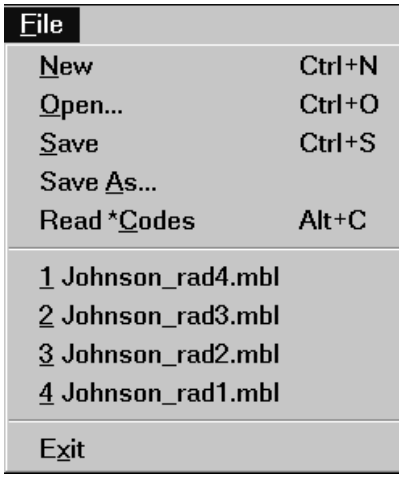
2. Download the data to the transceiver by selecting Transfer > Write Setup Params or click  in the toolbar.

3. Click the Write button in the screen that is displayed. Messages and the data are displayed as programming occurs. Refer to Section 3.7 for more information.

3.5 FILE MENU

The File Menu shown in the following illustration is used to perform these file operations:

 **New -** This menu parameter or toolbar icon creates a new programming data file that contains default parameters. If a file with unsaved changes is currently open, you are asked if you would like to save it before opening the new file. New files are automatically named “Untitled”.



File Menu

 **Open -** This menu parameter or toolbar icon opens a mobile data file that was previously saved to disk. This allows a disk file to be edited or used as a basis for programming another transceiver. If a file with unsaved changes is currently open, you are asked if you would like to save it before opening the new file. This function displays a screen listing all the files in the current directory with the .mbl extension.

 **Save -** This menu parameter or toolbar icon saves the current programming data file to disk. If it is the first time it is being saved, a screen is displayed which allows a file name to be entered (similar to the Save As function which follows). The Save function should be used periodically while editing a file to prevent the loss of data if a power failure occurs or program execution is interrupted for some other reason. Files are automatically given the .mbl extension.

Save As - Same as “Save” except you are prompted to enter a file name. This allows the current file to be renamed and saved to a new file.

 **Read Codes -** This menu item or toolbar icon reads the error code log stored in the radio and displays it. Refer to Section 2.14 for more information.

Recent Files - The file names of the previous files opened by the program are listed. To open one of these files, simply click the name.

Exit - Closes the program. If the current file has unsaved changes, you are asked if you would like to save it before exiting.

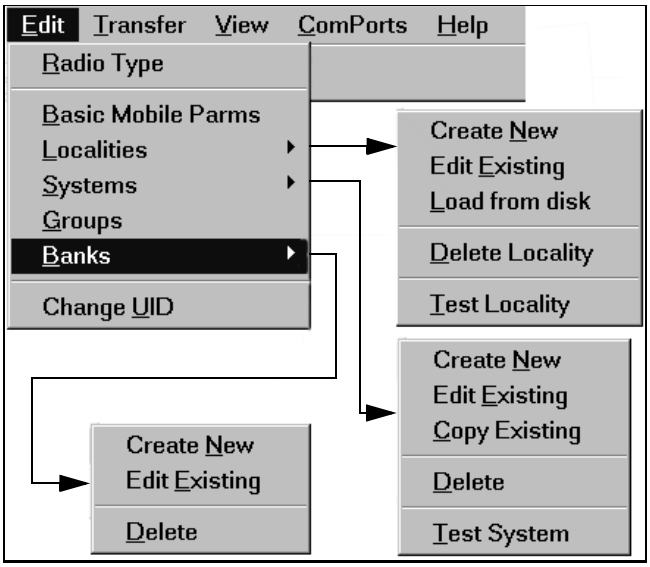


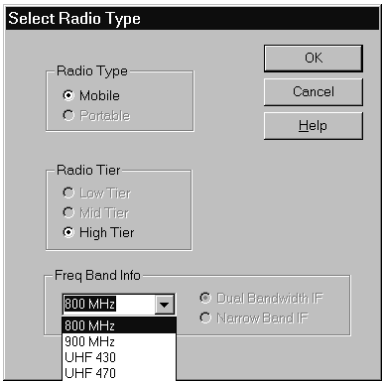
Figure 3-3 Edit Menu

3.6 EDIT MENU

3.6.1 INTRODUCTION

The Edit Menu shown in Figure 3-3 or equivalent buttons in the toolbar select screens that program various transceiver functions. The following information describes the screens selected by the Edit Menu.

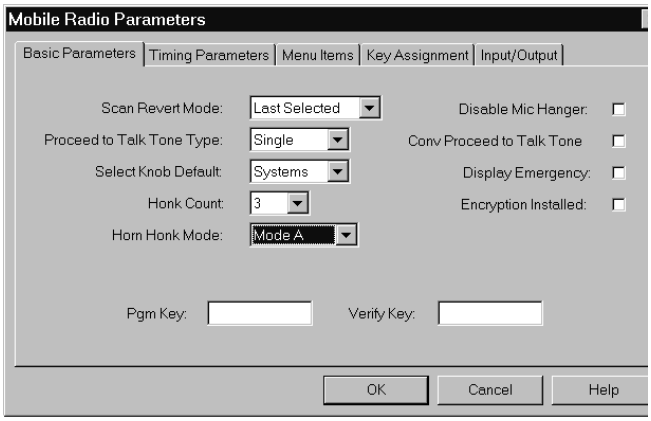
3.6.2 EDIT RADIO TYPE SCREEN



The Radio Type screen shown above selects the type, tier, frequency band, and bandwidth parameters. If you are unsure of what a parameter should be, for example if the transceiver is dual or narrow band, note the model number on the transceiver idenfication label or the number that is briefly displayed when power is turned on. Then refer to Sections 1.3 or 1.4 to determine this information from these numbers.

NOTE: The screens described in Sections 3.6.3 - 3.6.7 which follow are displayed by selecting Edit > Basic Mobile Parms and then clicking the tab at the top.

3.6.3 BASIC PARAMETERS SCREEN



Scan Revert Mode - Selects the system/group on which transmissions occur in the scan mode (Section 2.7.8).

Last Selected - Always on the selected.
Last Received - Always on the last received.
Temporary - On the last received if the transmitter is keyed before scanning resumes.

Proceed-To-Talk Tone - Selects either a single (standard) or double (loud) proceed-to-talk tone. Currently, only the single tone is selectable (Section 2.5.11).

Select Knob Default - Selects if the system or group select mode is enabled when power is turned on and after the menu mode is selected (Section 2.4.5).

Horn Count - Selects the number of times the horn alert sounds when it is enabled. Currently, the horn alert feature is not available (Section 2.5.8).

Horn Honk Mode - Selects horn alert Mode A (manual on-off) or B (automatic on-off). Currently, the horn alert feature is not available (Section 2.5.8).

Disable Mic Hanger - When selected, taking the microphone off-hook does not halt scanning or enable conventional mode channel monitoring.

Conv Proceed-to-Talk Tone - When selected, the proceed-to-talk tone sounds on conventional systems as well as on LTR/LTR-Net systems (Section 2.5.11).

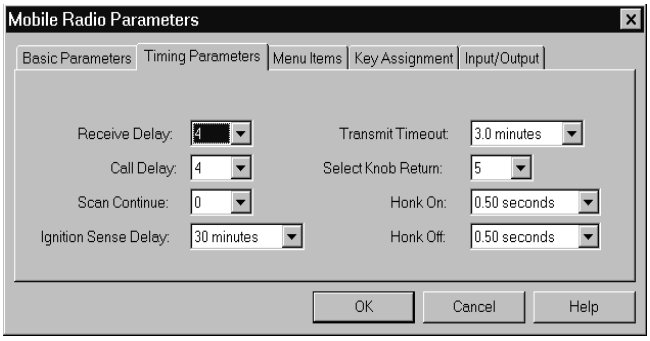
Display Emergency - Currently, this parameter is not used because "EMERGNCY" is always displayed when the emergency switch is pressed (Section 2.5.4).

Encryption Installed - Currently, encryption is not available and this parameter is not used. It is checked if the encryption option is installed. Encryption can then be enabled or disabled on each group (Section 2.5.5).

Pgm (Program) Key - To prevent unauthorized reading or writing of programming data to a transceiver, a code consisting of up to eight keyboard characters can be entered in this box. If this box is left blank, no protection is used (Section 3.11.1).

Verify Key - The exact code entered in the Pgm Key box must be re-entered in this box for it to be accepted as valid code.

3.6.4 TIMING PARAMETERS SCREEN



Receive Delay - Selects the time from 0-7 seconds before scanning resumes after receiving a message (Section 2.7.7).

Call Delay - Selects the time from 0-7 seconds before scanning resumes after transmitting a message (Section 2.7.7).

Scan Continue - Selects the maximum time from 0-60 seconds that a call is monitored before scanning resumes (Section 2.7.7).

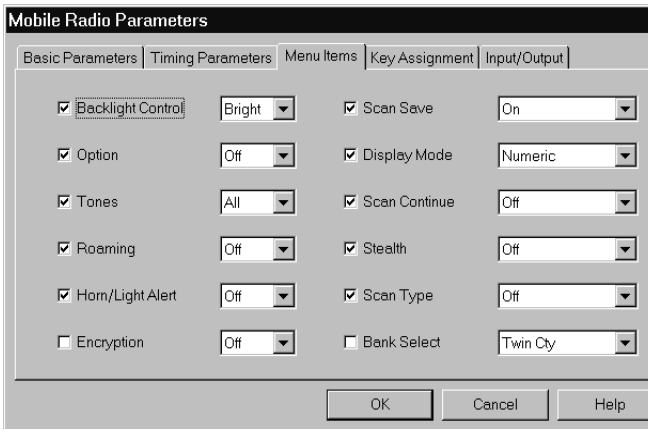
Ignition Sense Delay - Selects a power turn-off delay of Immediate, 10, 20, 30, 40, 50 minutes, 1, 2, 4, 8, 10, 12, 16 hours, or forever (Section 2.5.10).

Transmit Time-Out - Programs the time-out timer (Section 2.5.14).

Select Knob Return - Currently, this parameter is not used. It selects the delay that occurs after the Select switch is used before it returns to the default select mode programmed in the preceding Basic Parameters screen (Section 2.4.5).

Honk On-Off - Currently, the horn alert is not available. This selects the on and off times for each horn alert cycle. The number of cycles are selected in the preceding Basic Parameters screen. Times of 0.25, 0.50, 0.75, or 1.0 second can be programmed (Section 2.5.8).

3.6.5 MENU ITEMS SCREEN



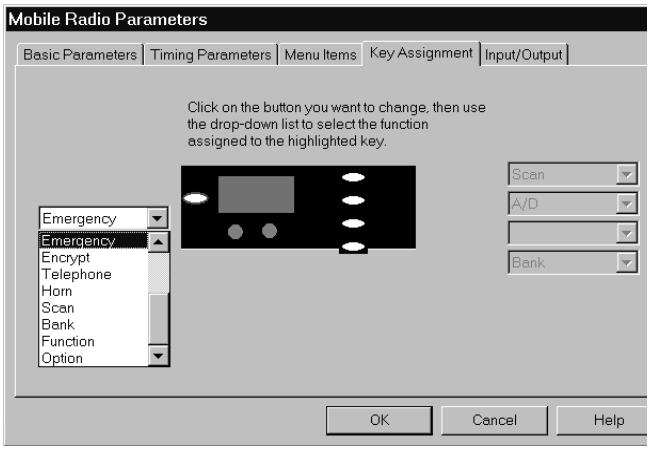
The Menu Items screen programs the parameters that are selectable in the menu mode. It also programs the default status of parameters not controlled by the menu mode or an option switch. Some functions can be controlled by both an option switch and the menu mode.

If a function is programmed as not selectable (no check in the check box), it is fixed in the condition selected in the drop-down list. For example, if "Tones" is not checked and "All" is selected, the Tones menu parameter is not selectable and all tones always sound.

If a menu item is selectable by the menu mode or an option switch, the default condition exists only until the first time that function is changed manually automatically. The last selected and not the default condition is selected when power is turned on. Refer to

Section 2.6 for more menu mode information, and to Table 3-1 for brief descriptions of items programmed in the Menu Items screen.

3.6.6 KEY ASSIGNMENT SCREEN



The Key Assignment screen is used to program the front panel option switches. All five switches are programmable. To program a switch, click it on the front panel and then select the desired function from the drop-down list. When finished, click the OK button to exit and save the changes or Cancel to exit without saving. Refer to Table 3-1 for brief descriptions of the available switch functions.

3.6.7 INPUT/OUTPUT SCREEN

This Input/Output screen programs the various input/output lines on the logic board. Refer to Section 3.13 for information on the parameters listed in this screen.

3.6.8 EDIT LOCALITY SCREEN

The Edit > Localities menu parameter (see Figure 3-3) or equivalent buttons in the toolbar are used to select the screen that sets up and edits localities. As described in “Locality Programming” on page 4-5, a locality is the repeaters at a single location or site. Up to approximately 35 LTR-Net or 60 LTR or conventional localities can be programmed (see Section 2.4.9). The functions that can be selected by Edit > Localities menu are as follows:

Edit > Localities > Create New - Creates a new locality. The screen that is displayed and its parameters are described in Table 3-3. The frequency band is selected on the radio type screen (see Section 3.6.2).

Edit > Localities > Edit Existing - Edits a current locality. The locality to be edited is selected from a list. The screen that is displayed and its parameters are described in Table 3-3.

Edit > Localities > Load From Disk - Loads locality information from the file used to program an LTR-Net repeater site. This eliminates the need to re-enter this information for each mobile. Repeater programming files have the “.LNT” extension.

Edit > Localities > Delete Locality - Deletes a locality.

Edit > Localities > Test Locality - Creates a locality that is used for test purposes. Currently, test localities are not used (see Section 2.13).

3.6.9 EDIT SYSTEM SCREEN

The Edit > Systems menu parameter (see Figure 3-3) or equivalent buttons in the toolbar select the screen that sets up and edits systems. As described in “System Programming” on page 4-6, a system is programmed with one or more selectable groups and other unique information. Up to 99 systems can be programmed (see Section 2.4.9). Groups are added to systems using the group edit function described in the next section. For a system to be selected or scanned, it must be linked to a bank (Section 3.6.11).

The system programming functions that can be selected by the Edit > Systems menu are as follows:

Edit > Systems > Create New - Creates a new system. The screen that is displayed is described in Table 3-4.

Edit > Systems > Edit Existing - Edits a current system. The system to be edited is selected from a list. The screen that is displayed is described in Table 3-4.

Edit > Systems > Copy Existing - Creates a new system by copying one of the current systems. The system to be copied is selected from a list. The screen that is displayed is described in Table 3-4.

Table 3-1 Menu and Option Switch Parameter Descriptions

Parameter	Menu Item	Option Switch	Description
Add/Delete		X	Scan list add/delete switch (Section 2.7.6).
Backlight Control	X		Controls the display and keypad backlight. Bright, Dim, and Off modes can be selected (Section 2.4.3).
Bank Select	X	X	Selects banks when two or more are programmed (Section 2.5.1).
Display Mode Sel	X		Selects the alpha or numeric display mode (Section 2.4.4).
Emergency		X	Selects the emergency system/group (Section 2.5.4).
Encryption On-Off [1]	X	X	Turns optional encryption on and off (Section 2.5.5).
Function Switch		X	Selects menu mode, home sys/grp, and sq adjust (Section 2.5.6).
Home sys/grp sel		X	This switch or FCN Sel displays the home system/group (Section 2.5.7).
Horn alert on-off [1]	X	X	Turns the horn alert on and off if installed (Section 2.5.8).
Menu Mode sel		X	This switch or FCN FCN select the menu mode .
Mic hook sel [1]		X	Select on- or -off-hook mode w/off-hook detect is disabled (Section 2.4.6).
Option select	X	X	Turns a dealer installed option on and off (Section 2.5.9).
Roaming on-off	X	X	Turns roaming on and off (Section 2.9.3).
Scan on-off		X	Turns scanning on and off (Section 2.7).
Scan type select	X		Selects group, system/group, or no scanning (Section 2.7).
Scan continue	X		Turns the scan continue feature on and off. This timer limits the amount of time a message is received while scanning (Section 2.7.7).
Scan list save	X		When “on” is selected, changes to the scan list are saved (Section 2.7.6).
Stealth mode sel	X		Turns stealth mode on and off. This mode disables tones, backlight, etc. (Section 2.5.13).
Squelch adj mode			Selects the conventional squelch adjust mode (Section 2.4.7).
Telephone grp sel		X	Selects a telephone group in system (Section 2.8.5).
Tone type select	X		Selects the tones that sound (All, Alert, Key, Silent). See Section 2.5.15.
[1] These functions are not currently available and so are ignored by the transceiver.			

Edit > Systems > Delete - Deletes a system.

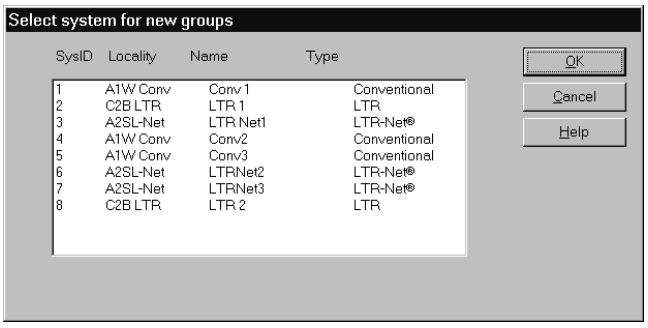
Edit > Systems > Test System - Currently, test systems are not used (see Section 2.13).

3.6.10 EDIT GROUPS SCREEN

NOTE: Refer to Table 3-5 for descriptions of the Edit Group screens.

The Edit > Groups menu parameter (see Figure 3-3) or 

button in the toolbar is used to display the screens that set up and edit the groups assigned to each system. The following screen is displayed to select the system in which groups are to be added or edited. After the desired system is selected, click the OK button and one of the group editing screens in Table 3-5 is displayed. Up to 99 groups can be assigned to each system.



3.6.11 EDIT BANKS SCREEN

The Edit > Banks menu parameter (see Figure 3-3) or equivalent buttons in the toolbar are

used to select the screen that sets up and edits banks. As described in "Bank Programming" on page 3-6, banks are collections of systems that may be selected, for example, for operation in different geographical areas.

Up to sixteen banks can be programmed. System numbering and other parameters can be different for each bank. At least one bank must be programmed even if bank select is not used. The functions that can be selected by the Edit > Banks menu are as follows:

Edit > Banks > Create New - Creates a new bank. The screen that is displayed is described in Table 3-6.

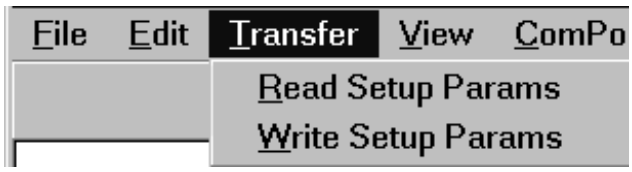
Edit > Banks > Edit Existing - Edits a current bank. The bank to be edited is selected from a list. The screen that is then displayed is described in Table 3-6.

Edit > Banks > Delete - Deletes a bank.

3.6.12 EDIT UNIQUE ID SCREEN

This function displays a screen that can be used to edit the transceiver unique ID codes assigned to each LTR-Net locality. This makes unique ID editing more convenient than selecting each locality individually.

3.7 TRANSFER MENU



3.7.1 INTRODUCTION

The Transfer menu shown above is used to Read (upload) data from the transceiver to the computer and also to Write (download) data from the computer to the transceiver. The Read function can be used to check transceiver programming or to use the data in one transceiver as the basis for programming another. The Write function is used to program a transceiver with the data that has been entered. More information follows:

3.7.2 READING A FILE

To read the programming data contained in a transceiver, proceed as follows.

1. Connect the transceiver to the computer using the RPI as described in Section 3.1.6.

2. Select Transfer > Read Setup Params or click the 

toolbar button.

3. A screen is then displayed which indicates the progress of the read operation. Click the Read button.

4. If the transceiver contains a Program Key, you are prompted to enter this key before the data is read. Refer to Section 3.11.1 for more information.

3.7.3 WRITING A FILE

To write the current programming data to a transceiver, proceed as follows:

1. Connect the transceiver to the computer using the RPI as described in Section 3.1.6.

2. Select Transfer > Write Setup Params or click the 

toolbar button.

3. A screen is then displayed which indicates the progress of the write operation. Click the Write button.

4. If the transceiver was previously programmed with a Program Key, you are prompted to enter this key before the data is transferred. Refer to Section 3.11.1 for more information.

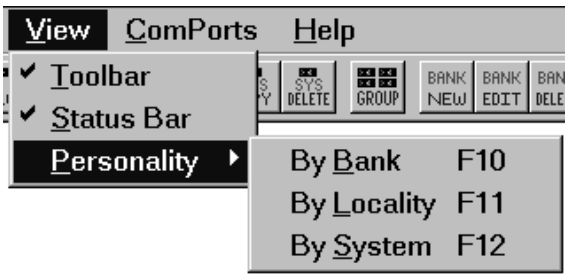
5. The following messages may be displayed by the transceiver:

   PGM MODE - Standard message while programming is occurring.

   TYPE ERR - Indicates that the programming data is incompatible with the transceiver. A possible reason for this is using a version of the programming software that is not compatible with the transceiver software.

PROG ERR - Indicates that an error was detected when verifying the data programmed into the transceiver.

3.8 VIEW MENU

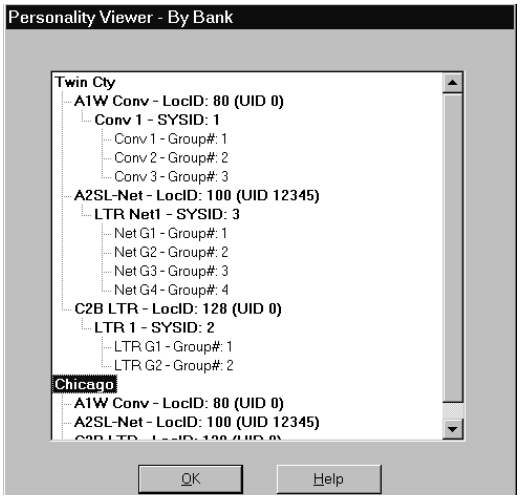


This View menu is shown above, and it is used to select these functions:

View Toolbar - Enables and disables the toolbar (shown behind menu in following screen). Refer to Section 3.3.3 for more information.

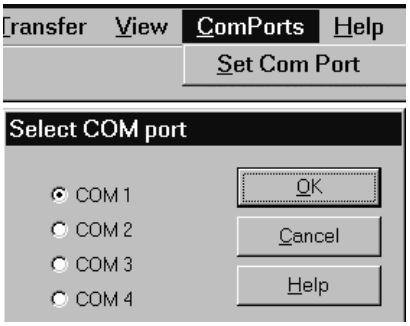
View Status Bar - Enables and disables the status bar at the bottom of the screen (Section 3.3.4).

View Personality - Displays the programmed Bank, Locality, or System hierarchy. An example of a Bank hierarchy follows. To expand or collapse a branch, double click it. Expandable branches are displayed in bold type.



3.9 COMPORTS MENU

The ComPorts menu is shown above, and it is used to select which computer serial port is used by



the RPI (see Section 3.1.3). The default is COM 1. If another port is used, select it using this function. The new port then becomes the default port, so this function only needs to be used when the port is changed.

3.10 HELP MENU

Displays help information on the program. Most screens also have a Help button that can be clicked to display help on that screen.

3.11 ADDITIONAL PROGRAMMING INFORMATION

3.11.1 PROGRAM KEY

An eight-character Programming Key can be entered in the Basic Parameters screen (see Section 3.6.3) to prevent unauthorized reading and writing of transceiver data. If a transceiver is programmed with a data file containing a key in this location, the programming data cannot be read from that transceiver unless the same key is entered. Likewise, the transceiver cannot be reprogrammed without entering this key.

Any keyboard character can be used when entering this key (including spaces), and letter case is considered. For example, entering “A” instead of “a” results in an invalid entry. Characters entered are displayed as asterisks (****). A key must be re-entered in the Verify box to be accepted.

To disable this feature so that no key is required to read or write data to the transceiver, do not enter any characters in the Pgm Key box, or if there already is a code in this box, delete all characters. Then program the transceiver with the data file. A valid key is still required to write over a data file containing key with a file not containing a key. If the key is lost, contact Customer Service as described in Section 1.7 of the service manual for information on what to do.

3.11.2 CHANNEL NUMBER PROGRAMMING

NOTE: Use Programming channel numbers and not FCC channel numbers from the table at the end of this section. Also, if entering channel frequencies instead of channel numbers, be sure to enter the repeater frequency, not the mobile frequency.

The channel frequencies of the repeaters the transceiver can access are programmed on the locality screen shown in Table 3-3. The frequency band is selected in the Radio Type screen before any localities are programmed (see Section 3.6.2). Either channel frequencies or channel numbers can be used depending on which is checked in the Display Mode box of the applicable locality screen.

If channel numbers are used (available only for the 800 and 900 MHz bands), use the Programming channel numbers and not the FCC channel numbers from the table at end of this section. The 800 MHz channels from 1-600 are the same as the FCC channels; however, for channels above 600, a special programming channel number is used because some channels were skipped by the FCC scheme. For channels 1-600, a 12.5 kHz offset band can be selected for operation in near certain U.S. border areas.

The 12.5/25 kHz IF bandwidth parameter applies to only UHF channels and 800 MHz channels 1-600 because the other 800 MHz channels and 900 channels are already 12.5 kHz.

3.11.3 REPEATER NUMBERING

With LTR-Net and LTR repeaters, the repeaters at a locality are assigned a unique number from 1-20. Although these numbers can be assigned arbitrarily, for maximum system efficiency, a scheme should be used which equalizes, as much as possible, the gaps between numbers. For example, a five-repeater system should be numbered 1, 5, 10, 15, and 20. These numbers are programmed in the repeater and also each mobile locality (see Section 3.6.8).

If Home Channel Aliasing is used (see Section 2.9.6), the status repeater should be repeater 20 and repeater 1 should be an active repeater. The other repeaters should then be spaced evenly from 1-20.

3.11.4 SPECIFYING RIC-EQUIPPED REPEATERS

When programming the channel numbers of LTR localities, you specify if the repeater is equipped with an EFJohnson repeater interconnect (RIC) controller. If a system with a transmit ID code programmed for interconnect is then selected, the transceiver will attempt to access only repeaters specified as equipped with this controller. This allows both interconnect and non-interconnect repeaters to be programmed in each locality.

Without this feature, the transceiver may trunk to a repeater not equipped with an interconnect controller when a telephone call is made. No dial tone or other supervision is then returned when the PTT switch is released which may be confusing to the user.

3.11.5 TEST LOCALITY

Currently, the test locality test locality programmed by Edit > Locality > Test Locality as described in Section 3.6.8 is not used. The sixteen channels programmed in this locality are selected by the test mode which is also currently not available (see Section 2.13).

3.12 UPDATING RADIO SOFTWARE

3.12.1 INTRODUCTION

The transceiver operating software (firmware) can be updated in the field without replacing the microcontroller or a memory device such as an EPROM. For example, the radio software may be updated to correct software bugs or add feature enhancements. This is made possible by the use of a reprogrammable Flash memory device.

The same basic hardware setup used to program personality information is also used to update radio software. One requirement though is that only Remote Programming Interface (RPI), Part No. 023-9800-000, can be used. Other RPI's such as the 023-9750-000, 023-5810-000, and 023-5300-000 do not work.

Programming is performed using separate Flash programming software (see Table 1-1). This program is run by typing PLATUPD at the DOS prompt (the DOS mode must usually be used). The program requires a special data file which contains the updated radio software (see next section). Follow the instructions on the screen to perform the actual updating.

3.12.2 DATA FILE

To update the radio software, the data file containing the new radio software is required. The filename of this data file is 98xtsXzz.S19. The "t" is the type number and "s" the signaling type from the transceiver part number (7th and 8th digits, respectively, as described in Section 1.4). The "zz" characters indicate the feature level of the software.

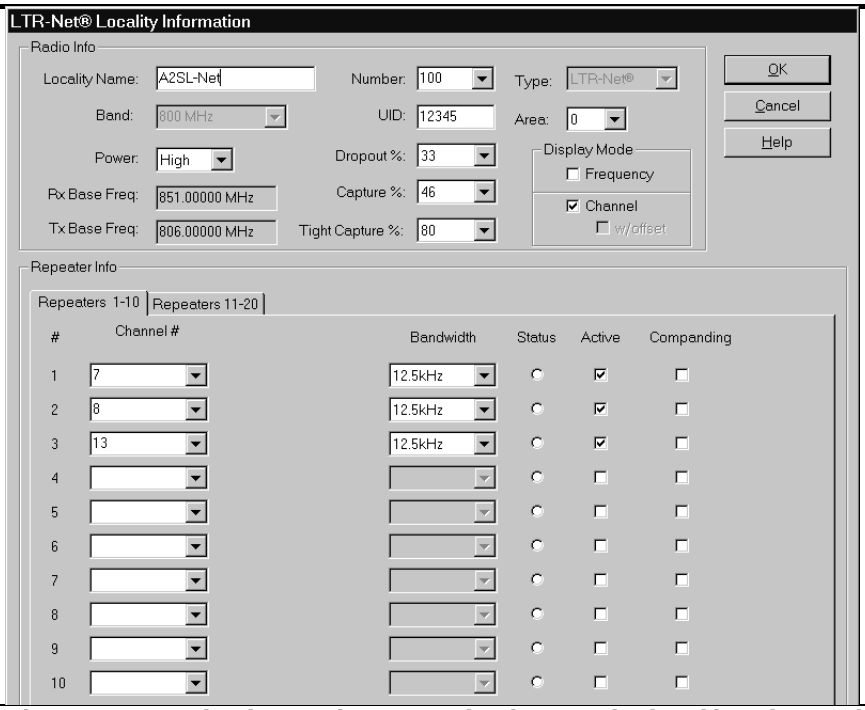
Contact your Customer Service or your sales representative concerning the availability of software updates for this transceiver. They may be available on the EFJohnson ACES® Bulletin Board System for downloading. To access this system, dial toll-free from the U.S. and Canada 1-800-227-3997 (N, 8, 1, ANSI). From other countries, dial 507-835-8607.

If you do not know your login ID or have questions or would like to sign up for service on this system, call 1-800-328-3911, extension 7 (USA and Canada) or 507-835-6222, extension 2100 (international). Once the data file is obtained, it must be copied to the directory containing the program.

Table 3-2 Call Guard Codes and Tones

Recommended Tone Call Guard Codes									
Code	**Freq**	**Code**	**Freq**	**Code**	**Freq**	**Code**	**Freq**	**Code**	**Freq**
00	00.0	09	91.5	18	123.0	27	167.9	36*	233.6
01	67.0	10	94.8	19	127.3	28	173.8	37*	241.8
02	71.9	11**	97.4	20	131.8	29	179.9	38*	250.3
03	74.4	12	100.0	21	136.5	30	186.2	39**	69.3
04	77.0	13	103.5	22	141.3	31	192.8	40**	206.5
05	79.7	14	107.2	23	146.2	32	203.5	41* **	229.1
06	82.5	15	110.9	24	151.4	33	210.7	42* **	254.1
07	85.4	16	114.8	25	156.7	34*	218.1		
08	88.5	17	118.8	26	162.2	35*	225.7		
* These tones normally are not used because of their close proximity to the voice frequencies. ** This tone is normally not used because it may cause interference with adjacent tones.									
Recommended Digital Call Guard Codes									
023	065	131	172	261	346	431	532	654	743
025	071	132	174	263	351	432	546	662	754
026	072	134	205	265	364	445	565	664	
031	073	143	223	271	365	464	606	703	
032	074	152	226	306	371	465	612	712	
043	114	155	243	311	411	466	624	723	
047	115	156	244	315	412	503	627	731	
051	116	162	245	331	413	506	631	732	
054	125	165	251	343	423	516	632	734	

Table 3-3 Locality Programming Screen Description



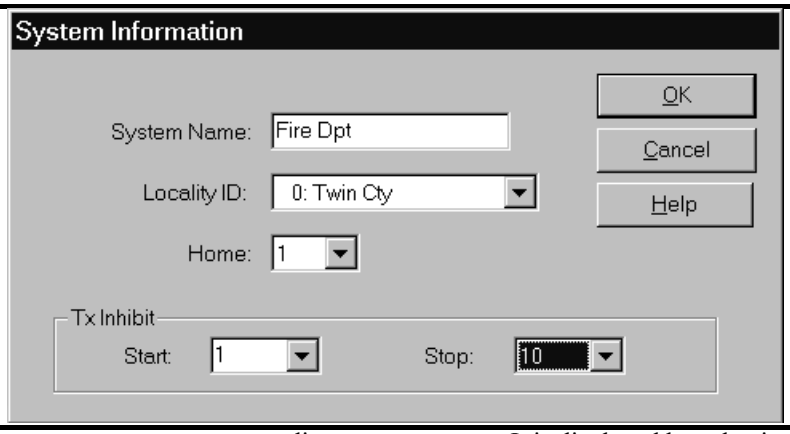
This screen is used to create a new locality or edit a current locality. It is displayed by selecting the Edit > Localities menu (see Section 3.6.8) or clicking one of the EDIT buttons in the toolbar. In general, a locality is a repeater site.

Parameter	Description
Locality Name	This is an eight-character name given to the locality to identify it during programming. It is not displayed by the transceiver.
Number	The number from 1-1023 assigned to LTR-Net localities. Each LTR-Net locality that a mobile can access must have a different locality number, and the same scheme must be used to program the mobiles and repeaters.
Type	Selects the type of locality (LTR-Net, LTR, or Conventional) when new localities are created.
Band	The frequency band in which the locality operates. The frequency band selected when the first locality is created or before any localites are created by the Radio Type screen (see Section 3.6.2). Once a locality is created, the band cannot be changed.
UID	With LTR-Net localities, programs the unique ID of the mobile when it accesses that locality. Numbers from 1-65503 can be programmed.
Area	"0" is usually programmed unless two LTR or LTR-Net localities are close enough to interfere with each other. One locality is then programmed "0" and the other "1".
Rx/Tx Base Frequency	This is a non-editable field shown for reference only. It indicates the base receive and transmit frequency used to derive the frequency of each channel.
Power	Programs the power output that is selected when the transceiver accesses that locality. High, Low 1, Low 2, Low 3, and Low 4 levels can be selected. The power output for each of these levels is set during transceiver alignment (Section 2.5.12).
Dropout Percentage	Programs the percentage that the squelch is tightened when no call is occurring. The higher the percentage, the sooner automatic locality search occurs. The default value is 33%. If there is no other site nearby, this percentage should always be 0% (Section 2.9.3).
Capture Percentage	Programs the percentage that the squelch is tightened after the first pass when searching for a new site ("LCL SRCH" displayed). The higher the percentage, the stronger the signal must be in order to attempt registration on a site. This parameter should always be greater than or equal to the preceding Dropout Percentage. The default value is 46% (Section 2.9.3).
Tight Capture Percentage	Programs the percentage squelch is tightened during the first pass when searching for a new site ("HSQ SRCH" displayed). The higher the percentage, the stronger the signal must be in order to attempt registration on a site. This parameter should always be greater than or equal to the preceding Capture Percentage. The default value is 80% (Section 2.9.3).
Display Mode	With the 800/900 MHz bands, selects if Programming channel numbers or frequency (in MHz) is used to program the channel frequency of each repeater. With the UHF band, only channel frequencies can be used, so "Channel" is not selectable. Channel numbers are shown in the table at the end of this section. It is possible to switch between the channel and frequency display modes until a frequency is changed in the frequency mode.

Table 3-3 Locality Programming Screen Description (Continued)

Parameter	Description
Channel Number	Programs either the channel number or frequency of each repeater at the locality, depending on the Display Mode that was selected by the preceding parameter. If entering channel numbers, use the Programming channel numbers from the tables at the end of this section, not the FCC channel number. Channels 1-920 can be programmed with 800 MHz models, and channels 1-479 can be programmed with 900 MHz models (Section 3.11.2). *NOTE: Repeater frequencies are entered, not the mobile frequencies.*
Bandwidth	This parameter is programmable with UHF and 800 MHz dual bandwidth transceivers only (all 900 MHz models are narrow band). Currently, all UHF and 800 MHz 98xx models are dual bandwidth. Either 12.5 kHz (narrow band) or 25 kHz (wideband) can be selected for each repeater. Then when the transceiver accesses that repeater, it is automatically configured for the proper bandwidth.
Status	With LTR-Net operation only, one of the locality repeaters is designated as the status repeater.
Active	Only repeaters marked as active can be accessed by the transceiver.
Companding	Programs if the repeater is equipped with a compandor. The optional compandor must then be installed, and companding is automatically enabled whenever that repeater is accessed (Section 2.5.3). The output line controlling the compander module must also be programmed for companding (Section 3.13).
RIC	With LTR operation only, programs if the repeater is equipped with a RIC/TIC (interconnect) module. This prevents attempted accesses on non-RIC repeaters to make telephone calls (Section 3.11.4).

Table 3-4 System Programming Screen Description



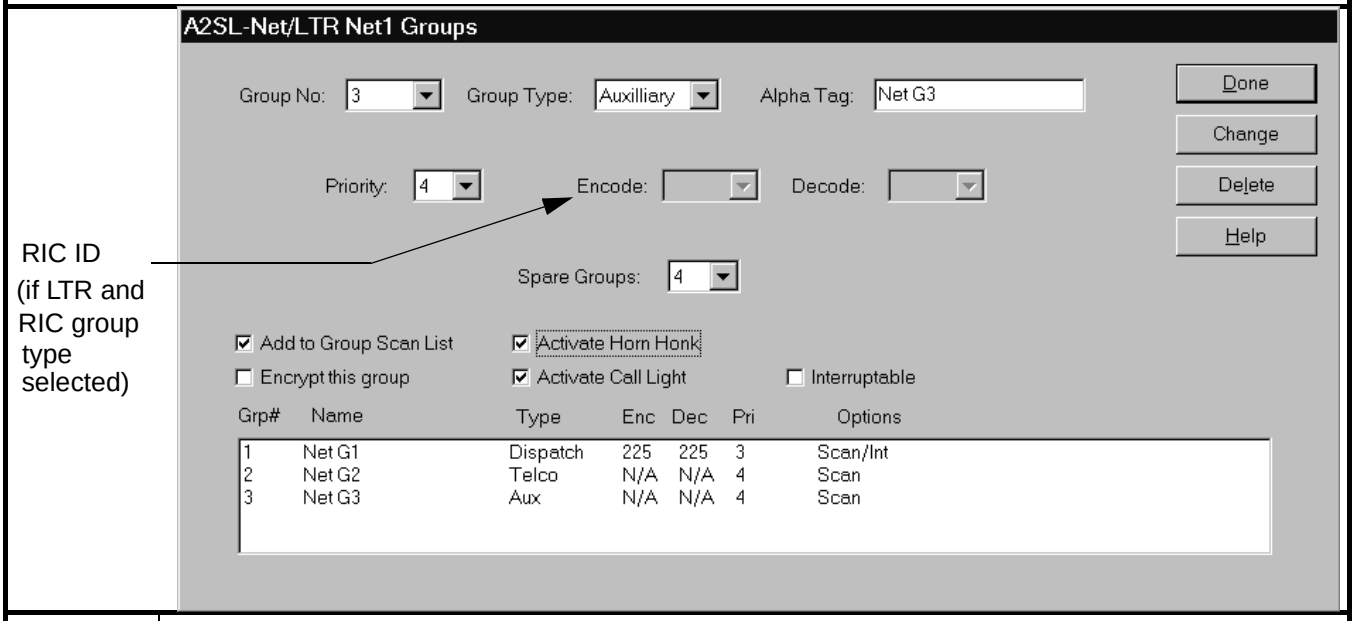
This screen is used to create a new system or edit a current system. It is displayed by selecting the Edit > Systems menu (see Section 3.6.9) or clicking one of the SYS EDIT buttons in the toolbar. Groups are added using the Edit > Groups function. For a system to be selected or scanned, it must be linked to a bank using the bank programming screen described in Table 3-6.

Parameter	Description
System Name	This is an eight-character name given to the system. It is displayed if the alpha display mode is selected (Section 2.4.4). Otherwise, it is used only to identify it during programming.
Locality ID	This drop-down list selects the locality to which the system is linked.
Home	Selects the home repeater when the system is linked to an LTR or LTR-Net locality.
Transmit Inhibit	Selects the block of transmit inhibit ID codes up to all 250 for LTR localities or up to all 239 for LTR-Net localities. If an ID within this block is detected up to 5 seconds before the PTT switch is pressed, the transmitter does not key (Section 2.8.4).

Table 3-5 Group Programming Screen Description

This screen is used to add groups to a system or edit groups already assigned to a system. It is displayed by selecting the Edit > Groups menu or clicking the GROUP button in the toolbar (see Section 3.6.10). In the following screens, first select from the drop-down list or the list at the bottom, the Group No. to be added or edited. Then select the desired parameters and make the changes by clicking the Change button (this is an Add button if adding a Group). To delete a group, select the Group No. and then click the Delete button. When finished programming the system, click the Done button.

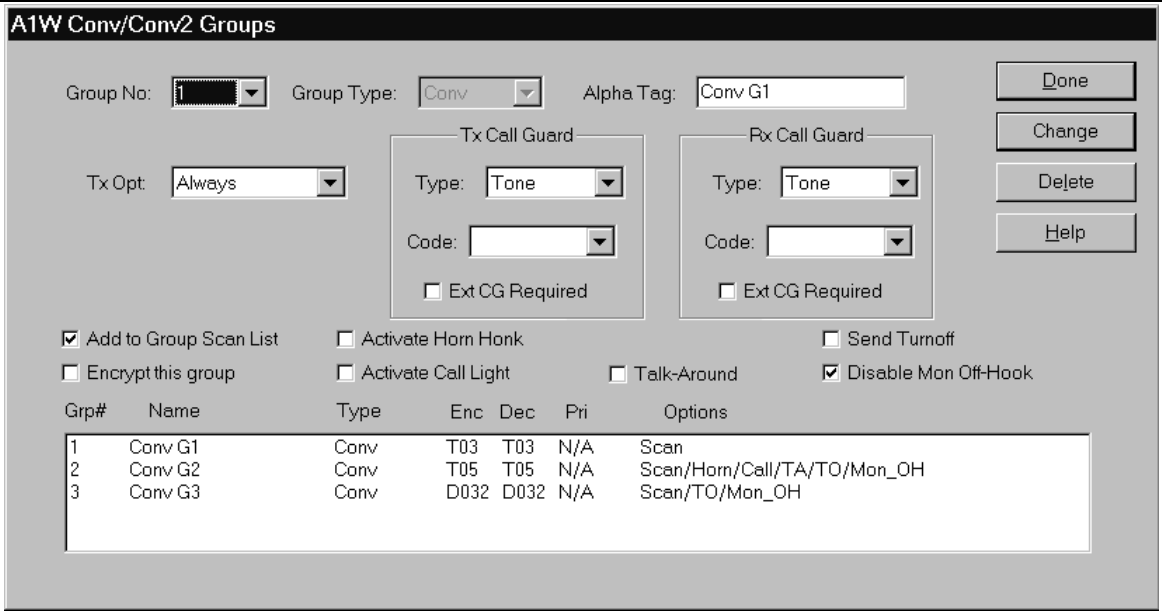
LTR and LTR-Net Group Programming Screen



Parameter	Description
Group No.	This drop-down list selects the group to be added or edited in the screen.
Group Type	This drop-down list selects one of the following call types: **LTR-Net Systems -** Dispatch (standard group call), Telco (telephone call), Auxiliary (unique ID or directed group call), Data. Currently, data calls are not supported by software (Sections 2.8.3 and 2.9.1). **LTR Systems -** Dispatch (standard group call), RIC (telephone call). See Sections 2.8.3 and 2.10.2.
Alpha Tag	This specifies the eight-character alpha tag that is displayed when the group is selected.
Priority	Selects the receive priority of the group. Priority numbers of 1-8 are selectable with LTR-Net and LTR groups (Section 2.8.1).
Encode ID	With dispatch (group) calls, selects the ID code that is transmitted. Codes 1-239 can be programmed with LTR-Net systems, and 1-250 can be programmed with LTR systems (Section 2.8.3).
RIC ID	With LTR RIC groups only, selects the ID code on which a telephone call is received (Section 2.10.2).
Decode ID	Similar to Encode ID except selects the receive code that must be decoded to receive a call on the group.
Spare Groups	With LTR-Net systems only, selects the number of additional groups that can be added to the system by over-the-air programming. This reserves space in memory for the additional groups. If no space has been reserved, additional groups cannot be added. Space for 0-8 groups can be reserved.
Add to Grp Scan List	Selects the default scan list status of the group. This programming can be overridden by the scan list A/D key if available (Section 2.7.6).
Encrypt this Group	Currently, encryption is not available. This selects if encryption is enabled when calls are received and transmitted on the group (Section 2.5.5). Encryption must be selected on the Basic Parameters screen to select this function (Section 3.6.3), and the I/O lines must also be programmed (Section 3.13).
Activate Horn Alert	Currently, the horn alert is not available. If this parameter is checked and the horn alert is enabled, the horn alert sounds when a call is received on the group (Section 2.5.8).
Activate Call Light	Selects if the call indicator is activated when a call is received on the group (Section 2.5.2).
Interruptible	Selects if calls on the group can be interrupted by higher priority calls (Section 2.8.1).

Table 3-5 Group Programming Screen Description (Continued)

Conventional Group Programming Screen

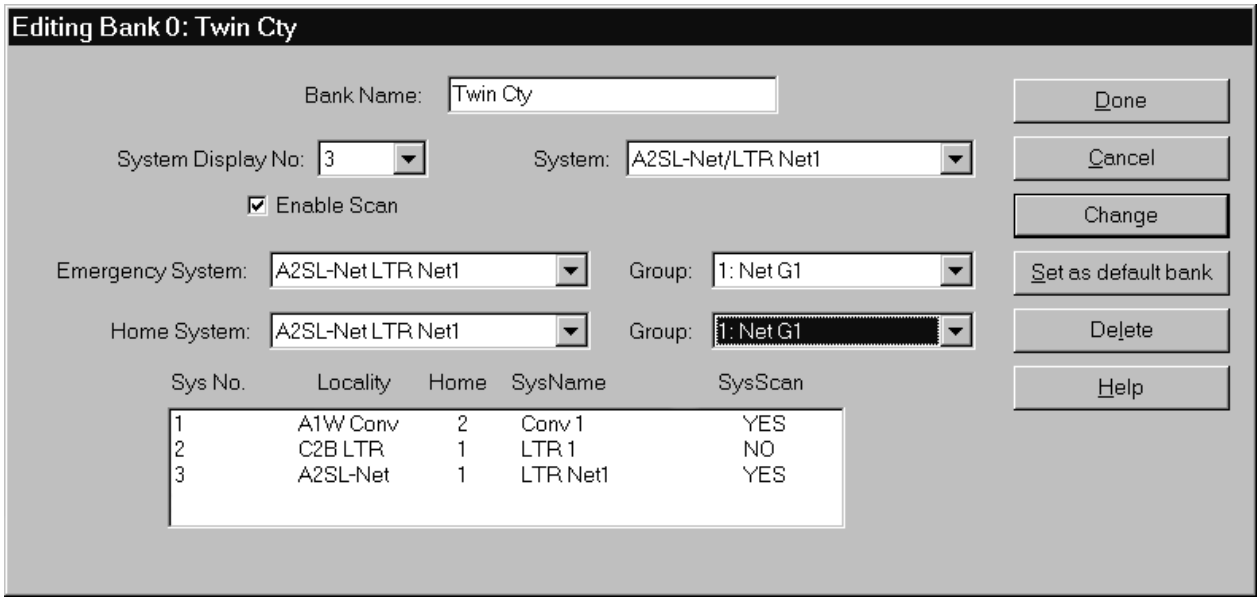


Parameter	Description
Group Number	This drop-down list selects the group to be added or edited in the screen.
Alpha Tag	This specifies the eight-character alpha tag that is displayed when the group is selected.
Tx Option	**Always** = Tx enabled, TDOB (Transmit Disable On Busy) disabled **Disable Busy** = Tx and TDOB enabled, no transmit with carrier even with valid Call Guard **On Valid CG** = Tx and TDOB enabled, transmit allowed with valid CG **Disabled** = Tx disabled (receive-only channel). See Sections 2.11.2 and 2.11.3.
Tx Call Guard Type	Selects the type of transmit Call Guard squelch control as Tone (CTCSS), digital (DCS), inverted digital, or none (carrier). See Section 2.11.5.
Tx Call Guard Code	If tone or digital encode Call Guard squelch was selected above, selects the tone frequency or digital code that is transmitted. These tones and codes are also listed in Table 3-2.
(Tx) Ext CG Required	If this box is checked, both an external encoder and the Call Guard squelch signal are enabled in the transmit mode (Section 2.11.5).
Rx Call Guard Type	Selects the type of receive Call Guard squelch control as Tone (CTCSS), digital (DCS), inverted digital, or none (carrier). See Section 2.11.5.
Rx Call Guard Code	If tone or digital decode Call Guard squelch was selected above, selects the tone frequency or digital code that must be decoded to receive a call. These tones and codes are also listed in Table 3-2.
(Rx) Ext CG Required	If this box is checked, both a detect signal from an external encoder and the Call Guard squelch signal must be detected for the receiver to unsquelch (Section 2.11.5).
Add to Grp Scan List	Selects the default scan list status of the group. This programming can be overridden by the scan list A/D key if available (Section 2.7.6).
Encrypt this Group	Currently, encryption is not available. This selects if encryption is enabled when calls are received and transmitted on the group (Section 2.5.5). Encryption must be selected on the Basic Parameters screen to select this function (Section 3.6.3), and the I/O lines must also be programmed (Section 3.13).
Activate Horn Honk	Currently, the horn alert is not available. If this parameter is checked and the horn alert is enabled, the horn alert sounds when a call is received on the group (Section 2.5.8).
Activate Call Light	Selects if the call indicator is activated when a call is received on the group (Section 2.5.2).

Table 3-5 Group Programming Screen Description (Continued)

Parameter	Description
Talk-Around	Selects if the talk-around mode is selected when transmissions are made on the group (Section 2.11.4).
Send Turn-off	Selects if the Call Guard turn-off code is sent when the PTT switch is released (Section 2.11.5).
Disable Mon Off-Hook	If selected, disables the microphone hanger monitor function on the group. Taking the microphone off-hook then does not enable the monitor mode although scanning is still disabled (Section 2.11.1).

Table 3-6 Bank Programming Screen Description



This screen is used to create a new bank or edit a current bank. It is displayed by selecting the Edit > Banks menu (see Section 3.6.11) or clicking one of the BANK EDIT buttons in the toolbar. In the above screen, select the number of the system to be added or edited in the System Display No. drop-down list and then select the desired parameters. Then make the changes by clicking the Change button (this is an Add button if adding a system). To delete a system from the bank, select it from the drop-down list or in the list at the bottom of the screen and then click the Delete button. When finished programming the bank, click the Done button or click Cancel to exit without saving any changes. At least one bank must be programmed even if bank select is not used.

Parameter	Description
Bank Name	This is an eight-character name given to the bank. It is displayed when banks are selected (Section 2.5.1). Otherwise, it is used only to identify it during programming.
System Display No.	Systems can be assigned unique display numbers in each bank. This drop-down list selects the number that is displayed when the system is selected in the bank.
System	This is a drop-down list of all currently programmed systems that selects the system being added to the bank or edited. Systems being edited or deleted can also be selected by clicking them in the list at the bottom of the screen.
Enable Scan	Selects the default scan list status of the system. This is the only system parameter that can be different for each bank.
Emergency System/Grp	Selects the emergency system/group that is selected by the Emergency switch on the bank (Section 2.5.4).

Table 3-6 Bank Programming Screen Description (Continued)

Parameter	Description
Home System/Grp	Selects the home system/group selected by the Home select switch or function on the bank (Section 2.5.7).
Done Button	Click this button when finished editing the bank to save the changes.
Cancel Button	Click this button to exit the screen without saving any changes to the bank.
Change/Add Button	This is a Change button when editing a system and an Add button when adding a system. It is clicked to make the changes to the selected system.
Set As Default Button	A default bank can be programmed in the Menu Items screen (Section 3.6.5). Clicking this button assigns the current bank as the default without having to select that screen. One use of default banks when the bank menu parameter is disabled is to allow several banks to be programmed and then selectively enable the desired bank on a per transceiver basis. This button is displayed only if two or more banks are programmed.
Delete Button	Deletes the currently selected system from the bank.

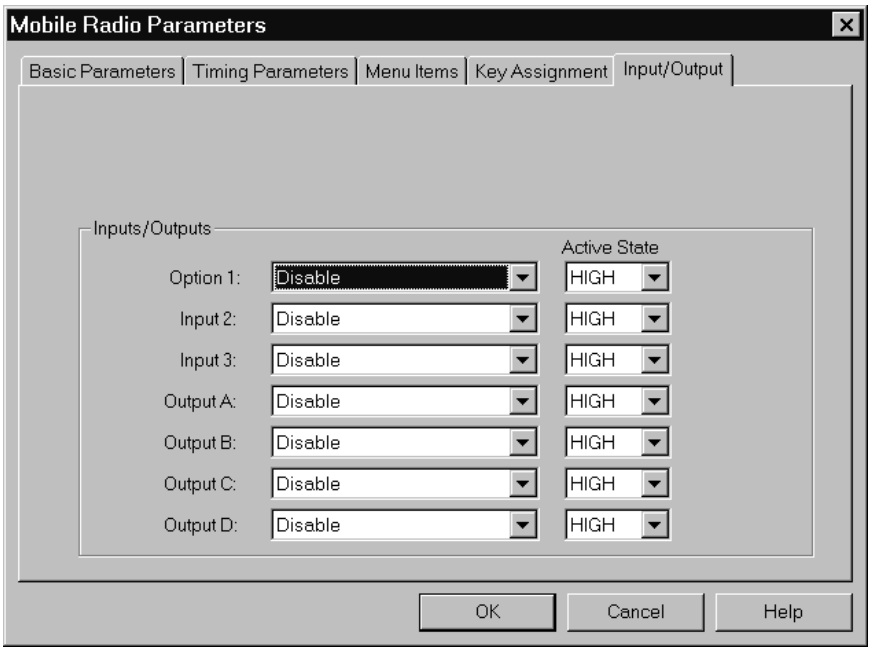


Figure 3-4 I/O Line Programming Screen

3.13 I/O LINE PROGRAMMING

NOTE: External data devices such as modems are not currently supported by software.

3.13.1 INTRODUCTION

The audio/logic board has several input/output lines that are used to control internal options such as the compandor, encryption, and external decoder modules that mount in the Option Slot 1 and 2 wire-outs. In addition, an output line controls Output D of the accessory cable which can be used to control some type of external option. Other input/output lines are brought out of the transceiver by a cable connected to J301 for controlling an external data device such as a modem.

The Input/Output screen used to program these lines is shown in Figure 3-4. It is displayed by selecting the Edit > Basic Parameters menu and then clicking the Input/Output tab.The parameters in this screen

that currently are supported by software are described in the following information.

3.13.2 COMPANDOR PROGRAMMING

When the compandor module option is installed, the locality channels must be programmed for companding as described in Section 3.6.8. In addition, the I/O line which controls the compandor module (Output A or B) must be programmed for "Compand" and active high. Consult the installation instructions included with the compandor and Section 2.5.3 for more information.

3.13.3 ENCRYPTION PROGRAMMING

NOTE: Encryption is currently not supported by software.

When the encryption module option is installed, it must be selected on the Basic Parameters screen described in Section 3.6.3. Then each group on which encryption is to be used is programmed for encryption as described in Section 3.6.10. In addition, the I/O line which controls the encryption module (Output A or B) must be programmed for "Encrypt". Consult the installation instructions included with the encryption module and Section 2.5.5 for more information.

3.13.4 OPTION PROGRAMMING

A dealer installed option of some type may be installed that is controlled by the OPTION menu parameter or AUX option switch programmed for Option Select (see Section 2.5.9). The menu parameter is programmed as described in Section 3.6.5 and the option switch is programmed as described in Section 3.6.6. The output line that controls the option Output A - D/Output 1) must then be programmed in the Input/Output screen for "Accessory Option" and the desired polarity.

800 MHz Channels

Prog Chan. No.	FCC Chan. No.	Repeater Tx Freq.	Repeater Rx Freq
1	1	851.0125	806.0125
2	2	851.0375	806.0375
3	3	851.0625	806.0625
4	4	851.0875	806.0875
5	5	851.1125	806.1125
6	6	851.1375	806.1375
7	7	851.1625	806.1625
8	8	851.1875	806.1875
9	9	851.2125	806.2125
10	10	851.2375	806.2375
11	11	851.2625	806.2625
12	12	851.2875	806.2875
13	13	851.3125	806.3125
14	14	851.3375	806.3375
15	15	851.3625	806.3625
16	16	851.3875	806.3875
17	17	851.4125	806.4125
18	18	851.4375	806.4375
19	19	851.4625	806.4625
20	20	851.4875	806.4875
21	21	851.5125	806.5125
22	22	851.5375	806.5375
23	23	851.5625	806.5625
24	24	851.5875	806.5875
25	25	851.6125	806.6125
26	26	851.6375	806.6375
27	27	851.6625	806.6625
28	28	851.6875	806.6875
29	29	851.7125	806.7125
30	30	851.7375	806.7375
31	31	851.7625	806.7625
32	32	851.7875	806.7875
33	33	851.8125	806.8125
34	34	851.8375	806.8375
35	35	851.8625	806.8625
36	36	851.8875	806.8875
37	37	851.9125	806.9125
38	38	851.9375	806.9375
39	39	851.9625	806.9625
40	40	851.9875	806.9875
41	41	852.0125	807.0125
42	42	852.0375	807.0375
43	43	852.0625	807.0625
44	44	852.0875	807.0875
45	45	852.1125	807.1125
46	46	852.1375	807.1375
47	47	852.1625	807.1625
48	48	852.1875	807.1875
49	49	852.2125	807.2125
50	50	852.2375	807.2375
51	51	852.2625	807.2625
52	52	852.2875	807.2875
53	53	852.3125	807.3125
54	54	852.3375	807.3375
55	55	852.3625	807.3625
56	56	852.3875	807.3875
57	57	852.4125	807.4125
58	58	852.4375	807.4375
59	59	852.4625	807.4625
60	60	852.4875	807.4875
61	61	852.5125	807.5125
62	62	852.5375	807.5375
63	63	852.5625	807.5625
64	64	852.5875	807.5875
65	65	852.6125	807.6125
66	66	852.6375	807.6375
67	67	852.6625	807.6625
68	68	852.6875	807.6875
69	69	852.7125	807.7125
70	70	852.7375	807.7375
71	71	852.7625	807.7625
72	72	852.7875	807.7875
73	73	852.8125	807.8125
74	74	852.8375	807.8375
75	75	852.8625	807.8625
76	76	852.8875	807.8875
77	77	852.9125	807.9125
78	78	852.9375	807.9375
79	79	852.9625	807.9625
80	80	852.9875	807.9875
81	81	853.0125	808.0125
82	82	853.0375	808.0375
83	83	853.0625	808.0625
84	84	853.0875	808.0875
85	85	853.1125	808.1125
86	86	853.1375	808.1375
87	87	853.1625	808.1625
88	88	853.1875	808.1875
89	89	853.2125	808.2125
90	90	853.2375	808.2375
91	91	853.2625	808.2625
92	92	853.2875	808.2875
93	93	853.3125	808.3125
94	94	853.3375	808.3375
95	95	853.3625	808.3625
96	96	853.3875	808.3875
97	97	853.4125	808.4125
98	98	853.4375	808.4375
99	99	853.4625	808.4625
100	100	853.4875	808.4875
101	101	853.5125	808.5125
102	102	853.5375	808.5375
103	103	853.5625	808.5625
104	104	853.5875	808.5875

800 MHz Channels

Prog Chan. No.	FCC Chan. No.	Repeater Tx Freq.	Repeater Rx Freq
105	105	853.6125	808.6125
106	106	853.6375	808.6375
107	107	853.6625	808.6625
108	108	853.6875	808.6875
109	109	853.7125	808.7125
110	110	853.7375	808.7375
111	111	853.7625	808.7625
112	112	853.7875	808.7875
113	113	853.8125	808.8125
114	114	853.8375	808.8375
115	115	853.8625	808.8625
116	116	853.8875	808.8875
117	117	853.9125	808.9125
118	118	853.9375	808.9375
119	119	853.9625	808.9625
120	120	853.9875	808.9875
121	121	854.0125	809.0125
122	122	854.0375	809.0375
123	123	854.0625	809.0625
124	124	854.0875	809.0875
125	125	854.1125	809.1125
126	126	854.1375	809.1375
127	127	854.1625	809.1625
128	128	854.1875	809.1875
129	129	854.2125	809.2125
130	130	854.2375	809.2375
131	131	854.2625	809.2625
132	132	854.2875	809.2875
133	133	854.3125	809.3125
134	134	854.3375	809.3375
135	135	854.3625	809.3625
136	136	854.3875	809.3875
137	137	854.4125	809.4125
138	138	854.4375	809.4375
139	139	854.4625	809.4625
140	140	854.4875	809.4875
141	141	854.5125	809.5125
142	142	854.5375	809.5375
143	143	854.5625	809.5625
144	144	854.5875	809.5875
145	145	854.6125	809.6125
146	146	854.6375	809.6375
147	147	854.6625	809.6625
148	148	854.6875	809.6875
149	149	854.7125	809.7125
150	150	854.7375	809.7375
151	151	854.7625	809.7625
152	152	854.7875	809.7875
153	153	854.8125	809.8125
154	154	854.8375	809.8375
155	155	854.8625	809.8625
156	156	854.8875	809.8875

Prog Chan. No.	FCC Chan. No.	Repeater Tx Freq.	Repeater Rx Freq
157	157	854.9125	809.9125
158	158	854.9375	809.9375
159	159	854.9625	809.9625
160	160	854.9875	809.9875
161	161	855.0125	810.0125
162	162	855.0375	810.0375
163	163	855.0625	810.0625
164	164	855.0875	810.0875
165	165	855.1125	810.1125
166	166	855.1375	810.1375
167	167	855.1625	810.1625
168	168	855.1875	810.1875
169	169	855.2125	810.2125
170	170	855.2375	810.2375
171	171	855.2625	810.2625
172	172	855.2875	810.2875
173	173	855.3125	810.3125
174	174	855.3375	810.3375
175	175	855.3625	810.3625
176	176	855.3875	810.3875
177	177	855.4125	810.4125
178	178	855.4375	810.4375
179	179	855.4625	810.4625
180	180	855.4875	810.4875
181	181	855.5125	810.5125
182	182	855.5375	810.5375
183	183	855.5625	810.5625
184	184	855.5875	810.5875
185	185	855.6125	810.6125
186	186	855.6375	810.6375
187	187	855.6625	810.6625
188	188	855.6875	810.6875
189	189	855.7125	810.7125
190	190	855.7375	810.7375
191	191	855.7625	810.7625
192	192	855.7875	810.7875
193	193	855.8125	810.8125
194	194	855.8375	810.8375
195	195	855.8625	810.8625
196	196	855.8875	810.8875
197	197	855.9125	810.9125
198	198	855.9375	810.9375
199	199	855.9625	810.9625
200	200	855.9875	810.9875
201	201	856.0125	811.0125
202	202	856.0375	811.0375
203	203	856.0625	811.0625
204	204	856.0875	811.0875
205	205	856.1125	811.1125
206	206	856.1375	811.1375
207	207	856.1625	811.1625
208	208	856.1875	811.1875

800 MHz Channels

Prog Chan. No.	FCC Chan. No.	Repeater Tx Freq.	Repeater Rx Freq
209	209	856.2125	811.2125
210	210	856.2375	811.2375
211	211	856.2625	811.2625
212	212	856.2875	811.2875
213	213	856.3125	811.3125
214	214	856.3375	811.3375
215	215	856.3625	811.3625
216	216	856.3875	811.3875
217	217	856.4125	811.4125
218	218	856.4375	811.4375
219	219	856.4625	811.4625
220	220	856.4875	811.4875
221	221	856.5125	811.5125
222	222	856.5375	811.5375
223	223	856.5625	811.5625
224	224	856.5875	811.5875
225	225	856.6125	811.6125
226	226	856.6375	811.6375
227	227	856.6625	811.6625
228	228	856.6875	811.6875
229	229	856.7125	811.7125
230	230	856.7375	811.7375
231	231	856.7625	811.7625
232	232	856.7875	811.7875
233	233	856.8125	811.8125
234	234	856.8375	811.8375
235	235	856.8625	811.8625
236	236	856.8875	811.8875
237	237	856.9125	811.9125
238	238	856.9375	811.9375
239	239	856.9625	811.9625
240	240	856.9875	811.9875
241	241	857.0125	812.0125
242	242	857.0375	812.0375
243	243	857.0625	812.0625
244	244	857.0875	812.0875
245	245	857.1125	812.1125
246	246	857.1375	812.1375
247	247	857.1625	812.1625
248	248	857.1875	812.1875
249	249	857.2125	812.2125
250	250	857.2375	812.2375
251	251	857.2625	812.2625
252	252	857.2875	812.2875
253	253	857.3125	812.3125
254	254	857.3375	812.3375
255	255	857.3625	812.3625
256	256	857.3875	812.3875
257	257	857.4125	812.4125
258	258	857.4375	812.4375
259	259	857.4625	812.4625
260	260	857.4875	812.4875
261	261	857.5125	812.5125
262	262	857.5375	812.5375
263	263	857.5625	812.5625
264	264	857.5875	812.5875
265	265	857.6125	812.6125
266	266	857.6375	812.6375
267	267	857.6625	812.6625
268	268	857.6875	812.6875
269	269	857.7125	812.7125
270	270	857.7375	812.7375
271	271	857.7625	812.7625
272	272	857.7875	812.7875
273	273	857.8125	812.8125
274	274	857.8375	812.8375
275	275	857.8625	812.8625
276	276	857.8875	812.8875
277	277	857.9125	812.9125
278	278	857.9375	812.9375
279	279	857.9625	812.9625
280	280	857.9875	812.9875
281	281	858.0125	813.0125
282	282	858.0375	813.0375
283	283	858.0625	813.0625
284	284	858.0875	813.0875
285	285	858.1125	813.1125
286	286	858.1375	813.1375
287	287	858.1625	813.1625
288	288	858.1875	813.1875
289	289	858.2125	813.2125
290	290	858.2375	813.2375
291	291	858.2625	813.2625
292	292	858.2875	813.2875
293	293	858.3125	813.3125
294	294	858.3375	813.3375
295	295	858.3625	813.3625
296	296	858.3875	813.3875
297	297	858.4125	813.4125
298	298	858.4375	813.4375
299	299	858.4625	813.4625
300	300	858.4875	813.4875
301	301	858.5125	813.5125
302	302	858.5375	813.5375
303	303	858.5625	813.5625
304	304	858.5875	813.5875
305	305	858.6125	813.6125
306	306	858.6375	813.6375
307	307	858.6625	813.6625
308	308	858.6875	813.6875
309	309	858.7125	813.7125
310	310	858.7375	813.7375
311	311	858.7625	813.7625
312	312	858.7875	813.7875

800 MHz Channels

Prog Chan. No.	FCC Chan. No.	Repeater Tx Freq.	Repeater Rx Freq
313	313	858.8125	813.8125
314	314	858.8375	813.8375
315	315	858.8625	813.8625
316	316	858.8875	813.8875
317	317	858.9125	813.9125
318	318	858.9375	813.9375
319	319	858.9625	813.9625
320	320	858.9875	813.9875
321	321	859.0125	814.0125
322	322	859.0375	814.0375
323	323	859.0625	814.0625
324	324	859.0875	814.0875
325	325	859.1125	814.1125
326	326	859.1375	814.1375
327	327	859.1625	814.1625
328	328	859.1875	814.1875
329	329	859.2125	814.2125
330	330	859.2375	814.2375
331	331	859.2625	814.2625
332	332	859.2875	814.2875
333	333	859.3125	814.3125
334	334	859.3375	814.3375
335	335	859.3625	814.3625
336	336	859.3875	814.3875
337	337	859.4125	814.4125
338	338	859.4375	814.4375
339	339	859.4625	814.4625
340	340	859.4875	814.4875
341	341	859.5125	814.5125
342	342	859.5375	814.5375
343	343	859.5625	814.5625
344	344	859.5875	814.5875
345	345	859.6125	814.6125
346	346	859.6375	814.6375
347	347	859.6625	814.6625
348	348	859.6875	814.6875
349	349	859.7125	814.7125
350	350	859.7375	814.7375
351	351	859.7625	814.7625
352	352	859.7875	814.7875
353	353	859.8125	814.8125
354	354	859.8375	814.8375
355	355	859.8625	814.8625
356	356	859.8875	814.8875
357	357	859.9125	814.9125
358	358	859.9375	814.9375
359	359	859.9625	814.9625
360	360	859.9875	814.9875
361	361	860.0125	815.0125
362	362	860.0375	815.0375
363	363	860.0625	815.0625
364	364	860.0875	815.0875
365	365	860.1125	815.1125
366	366	860.1375	815.1375
367	367	860.1625	815.1625
368	368	860.1875	815.1875
369	369	860.2125	815.2125
370	370	860.2375	815.2375
371	371	860.2625	815.2625
372	372	860.2875	815.2875
373	373	860.3125	815.3125
374	374	860.3375	815.3375
375	375	860.3625	815.3625
376	376	860.3875	815.3875
377	377	860.4125	815.4125
378	378	860.4375	815.4375
379	379	860.4625	815.4625
380	380	860.4875	815.4875
381	381	860.5125	815.5125
382	382	860.5375	815.5375
383	383	860.5625	815.5625
384	384	860.5875	815.5875
385	385	860.6125	815.6125
386	386	860.6375	815.6375
387	387	860.6625	815.6625
388	388	860.6875	815.6875
389	389	860.7125	815.7125
390	390	860.7375	815.7375
391	391	860.7625	815.7625
392	392	860.7875	815.7875
393	393	860.8125	815.8125
394	394	860.8375	815.8375
395	395	860.8625	815.8625
396	396	860.8875	815.8875
397	397	860.9125	815.9125
398	398	860.9375	815.9375
399	399	860.9625	815.9625
400	400	860.9875	815.9875
401	401	861.0125	816.0125
402	402	861.0375	816.0375
403	403	861.0625	816.0625
404	404	861.0875	816.0875
405	405	861.1125	816.1125
406	406	861.1375	816.1375
407	407	861.1625	816.1625
408	408	861.1875	816.1875
409	409	861.2125	816.2125
410	410	861.2375	816.2375
411	411	861.2625	816.2625
412	412	861.2875	816.2875
413	413	861.3125	816.3125
414	414	861.3375	816.3375
415	415	861.3625	816.3625
416	416	861.3875	816.3875

800 MHz Channels

Prog Chan. No.	FCC Chan. No.	Repeater Tx Freq.	Repeater Rx Freq
417	417	861.4125	816.4125
418	418	861.4375	816.4375
419	419	861.4625	816.4625
420	420	861.4875	816.4875
421	421	861.5125	816.5125
422	422	861.5375	816.5375
423	423	861.5625	816.5625
424	424	861.5875	816.5875
425	425	861.6125	816.6125
426	426	861.6375	816.6375
427	427	861.6625	816.6625
428	428	861.6875	816.6875
429	429	861.7125	816.7125
430	430	861.7375	816.7375
431	431	861.7625	816.7625
432	432	861.7875	816.7875
433	433	861.8125	816.8125
434	434	861.8375	816.8375
435	435	861.8625	816.8625
436	436	861.8875	816.8875
437	437	861.9125	816.9125
438	438	861.9375	816.9375
439	439	861.9625	816.9625
440	440	861.9875	816.9875
441	441	862.0125	817.0125
442	442	862.0375	817.0375
443	443	862.0625	817.0625
444	444	862.0875	817.0875
445	445	862.1125	817.1125
446	446	862.1375	817.1375
447	447	862.1625	817.1625
448	448	862.1875	817.1875
449	449	862.2125	817.2125
450	450	862.2375	817.2375
451	451	862.2625	817.2625
452	452	862.2875	817.2875
453	453	862.3125	817.3125
454	454	862.3375	817.3375
455	455	862.3625	817.3625
456	456	862.3875	817.3875
457	457	862.4125	817.4125
458	458	862.4375	817.4375
459	459	862.4625	817.4625
460	460	862.4875	817.4875
461	461	862.5125	817.5125
462	462	862.5375	817.5375
463	463	862.5625	817.5625
464	464	862.5875	817.5875
465	465	862.6125	817.6125
466	466	862.6375	817.6375
467	467	862.6625	817.6625
468	468	862.6875	817.6875
469	469	862.7125	817.7125
470	470	862.7375	817.7375
471	471	862.7625	817.7625
472	472	862.7875	817.7875
473	473	862.8125	817.8125
474	474	862.8375	817.8375
475	475	862.8625	817.8625
476	476	862.8875	817.8875
477	477	862.9125	817.9125
478	478	862.9375	817.9375
479	479	862.9625	817.9625
480	480	862.9875	817.9875
481	481	863.0125	818.0125
482	482	863.0375	818.0375
483	483	863.0625	818.0625
484	484	863.0875	818.0875
485	485	863.1125	818.1125
486	486	863.1375	818.1375
487	487	863.1625	818.1625
488	488	863.1875	818.1875
489	489	863.2125	818.2125
490	490	863.2375	818.2375
491	491	863.2625	818.2625
492	492	863.2875	818.2875
493	493	863.3125	818.3125
494	494	863.3375	818.3375
495	495	863.3625	818.3625
496	496	863.3875	818.3875
497	497	863.4125	818.4125
498	498	863.4375	818.4375
499	499	863.4625	818.4625
500	500	863.4875	818.4875
501	501	863.5125	818.5125
502	502	863.5375	818.5375
503	503	863.5625	818.5625
504	504	863.5875	818.5875
505	505	863.6125	818.6125
506	506	863.6375	818.6375
507	507	863.6625	818.6625
508	508	863.6875	818.6875
509	509	863.7125	818.7125
510	510	863.7375	818.7375
511	511	863.7625	818.7625
512	512	863.7875	818.7875
513	513	863.8125	818.8125
514	514	863.8375	818.8375
515	515	863.8625	818.8625
516	516	863.8875	818.8875
517	517	863.9125	818.9125
518	518	863.9375	818.9375
519	519	863.9625	818.9625
520	520	863.9875	818.9875

800 MHz Channels

Prog Chan. No.	FCC Chan. No.	Repeater Tx Freq.	Repeater Rx Freq
521	521	864.0125	819.0125
522	522	864.0375	819.0375
523	523	864.0625	819.0625
524	524	864.0875	819.0875
525	525	864.1125	819.1125
526	526	864.1375	819.1375
527	527	864.1625	819.1625
528	528	864.1875	819.1875
529	529	864.2125	819.2125
530	530	864.2375	819.2375
531	531	864.2625	819.2625
532	532	864.2875	819.2875
533	533	864.3125	819.3125
534	534	864.3375	819.3375
535	535	864.3625	819.3625
536	536	864.3875	819.3875
537	537	864.4125	819.4125
538	538	864.4375	819.4375
539	539	864.4625	819.4625
540	540	864.4875	819.4875
541	541	864.5125	819.5125
542	542	864.5375	819.5375
543	543	864.5625	819.5625
544	544	864.5875	819.5875
545	545	864.6125	819.6125
546	546	864.6375	819.6375
547	547	864.6625	819.6625
548	548	864.6875	819.6875
549	549	864.7125	819.7125
550	550	864.7375	819.7375
551	551	864.7625	819.7625
552	552	864.7875	819.7875
553	553	864.8125	819.8125
554	554	864.8375	819.8375
555	555	864.8625	819.8625
556	556	864.8875	819.8875
557	557	864.9125	819.9125
558	558	864.9375	819.9375
559	559	864.9625	819.9625
560	560	864.9875	819.9875
561	561	865.0125	820.0125
562	562	865.0375	820.0375
563	563	865.0625	820.0625
564	564	865.0875	820.0875
565	565	865.1125	820.1125
566	566	865.1375	820.1375
567	567	865.1625	820.1625
568	568	865.1875	820.1875
569	569	865.2125	820.2125
570	570	865.2375	820.2375
571	571	865.2625	820.2625
572	572	865.2875	820.2875

Prog Chan. No. [1]	FCC Chan. No. [1]	Repeater Tx Freq.	Repeater Rx Freq
573	573	865.3125	820.3125
574	574	865.3375	820.3375
575	575	865.3625	820.3625
576	576	865.3875	820.3875
577	577	865.4125	820.4125
578	578	865.4375	820.4375
579	579	865.4625	820.4625
580	580	865.4875	820.4875
581	581	865.5125	820.5125
582	582	865.5375	820.5375
583	583	865.5625	820.5625
584	584	865.5875	820.5875
585	585	865.6125	820.6125
586	586	865.6375	820.6375
587	587	865.6625	820.6625
588	588	865.6875	820.6875
589	589	865.7125	820.7125
590	590	865.7375	820.7375
591	591	865.7625	820.7625
592	592	865.7875	820.7875
593	593	865.8125	820.8125
594	594	865.8375	820.8375
595	595	865.8625	820.8625
596	596	865.8875	820.8875
597	597	865.9125	820.9125
598	598	865.9375	820.9375
599	599	865.9625	820.9625
600	600	865.9875	820.9875
601	-	866.0000	821.0000
602	601	866.0125	821.0125
603	-	866.0250	821.0250
604	602	866.0375	821.0375
605	603	866.0500	821.0500
606	604	866.0625	821.0625
607	605	866.0750	821.0750
608	606	866.0875	821.0875
609	607	866.1000	821.1000
610	608	866.1125	821.1125
611	609	866.1250	821.1250
612	610	866.1375	821.1375
613	611	866.1500	821.1500
614	612	866.1625	821.1625
615	613	866.1750	821.1750
616	614	866.1875	821.1875
617	615	866.2000	821.2000
618	616	866.2125	821.2125
619	617	866.2250	821.2250
620	618	866.2375	821.2375
621	619	866.2500	821.2500
622	620	866.2625	821.2625
623	621	866.2750	821.2750
624	622	866.2875	821.2875

[1] Use the Programming Channel Number, not the FCC Channel Number

800 MHz Channels

Prog Chan. No. [1]	FCC Chan. No. [1]	Repeater Tx Freq.	Repeater Rx Freq
625	623	866.3000	821.3000
626	624	866.3125	821.3125
627	625	866.3250	821.3250
628	626	866.3375	821.3375
629	627	866.3500	821.3500
630	628	866.3625	821.3625
631	629	866.3750	821.3750
632	630	866.3875	821.3875
633	631	866.4000	821.4000
634	632	866.4125	821.4125
635	633	866.4250	821.4250
636	634	866.4375	821.4375
637	635	866.4500	821.4500
638	636	866.4625	821.4625
639	637	866.4750	821.4750
640	638	866.4875	821.4875
641	-	866.5000	821.5000
642	639	866.5125	821.5125
643	-	866.5250	821.5250
644	640	866.5375	821.5375
645	641	866.5500	821.5500
646	642	866.5625	821.5625
647	643	866.5750	821.5750
648	644	866.5875	821.5875
649	645	866.6000	821.6000
650	646	866.6125	821.6125
651	647	866.6250	821.6250
652	648	866.6375	821.6375
653	649	866.6500	821.6500
654	650	866.6625	821.6625
655	651	866.6750	821.6750
656	652	866.6875	821.6875
657	653	866.7000	821.7000
658	654	866.7125	821.7125
659	655	866.7250	821.7250
660	656	866.7375	821.7375
661	657	866.7500	821.7500
662	658	866.7625	821.7625
663	659	866.7750	821.7750
664	660	866.7875	821.7875
665	661	866.8000	821.8000
666	662	866.8125	821.8125
667	663	866.8250	821.8250
668	664	866.8375	821.8375
669	665	866.8500	821.8500
670	666	866.8625	821.8625
671	667	866.8750	821.8750
672	668	866.8875	821.8875
673	669	866.9000	821.9000
674	670	866.9125	821.9125
675	671	866.9250	821.9250
676	672	866.9375	821.9375
677	673	866.9500	821.9500
678	674	866.9625	821.9625
679	675	866.9750	821.9750
680	676	866.9875	821.9875
681	-	867.0000	822.0000
682	677	867.0125	822.0125
683	-	867.0250	822.0250
684	678	867.0375	822.0375
685	679	867.0500	822.0500
686	680	867.0625	822.0625
687	681	867.0750	822.0750
688	682	867.0875	822.0875
689	683	867.1000	822.1000
690	684	867.1125	822.1125
691	685	867.1250	822.1250
692	686	867.1375	822.1375
693	687	867.1500	822.1500
694	688	867.1625	822.1625
695	689	867.1750	822.1750
696	690	867.1875	822.1875
697	691	867.2000	822.2000
698	692	867.2125	822.2125
699	693	867.2250	822.2250
700	694	867.2375	822.2375
701	695	867.2500	822.2500
702	696	867.2625	822.2625
703	697	867.2750	822.2750
704	698	867.2875	822.2875
705	699	867.3000	822.3000
706	700	867.3125	822.3125
707	701	867.3250	822.3250
708	702	867.3375	822.3375
709	703	867.3500	822.3500
710	704	867.3625	822.3625
711	705	867.3750	822.3750
712	706	867.3875	822.3875
713	707	867.4000	822.4000
714	708	867.4125	822.4125
715	709	867.4250	822.4250
716	710	867.4375	822.4375
717	711	867.4500	822.4500
718	712	867.4625	822.4625
719	713	867.4750	822.4750
720	714	867.4875	822.4875
721	-	867.5000	822.5000
722	715	867.5125	822.5125
723	-	867.5250	822.5250
724	716	867.5375	822.5375
725	717	867.5500	822.5500
726	718	867.5625	822.5625
727	719	867.5750	822.5750
728	720	867.5875	822.5875

[1] Use the Programming Channel Number, not the FCC Channel Number

800 MHz Channels

Prog Chan. No. [1]	FCC Chan. No. [1]	Repeater Tx Freq.	Repeater Rx Freq
729	721	867.6000	822.6000
730	722	867.6125	822.6125
731	723	867.6250	822.6250
732	724	867.6375	822.6375
733	725	867.6500	822.6500
734	726	867.6625	822.6625
735	727	867.6750	822.6750
736	728	867.6875	822.6875
737	729	867.7000	822.7000
738	730	867.7125	822.7125
739	731	867.7250	822.7250
740	732	867.7375	822.7375
741	733	867.7500	822.7500
742	734	867.7625	822.7625
743	735	867.7750	822.7750
744	736	867.7875	822.7875
745	737	867.8000	822.8000
746	738	867.8125	822.8125
747	739	867.8250	822.8250
748	740	867.8375	822.8375
749	741	867.8500	822.8500
750	742	867.8625	822.8625
751	743	867.8750	822.8750
752	744	867.8875	822.8875
753	745	867.9000	822.9000
754	746	867.9125	822.9125
755	747	867.9250	822.9250
756	748	867.9375	822.9375
757	749	867.9500	822.9500
758	750	867.9625	822.9625
759	751	867.9750	822.9750
760	752	867.9875	822.9875
761	-	868.0000	823.0000
762	753	868.0125	823.0125
763	-	868.0250	823.0250
764	754	868.0375	823.0375
765	755	868.0500	823.0500
766	756	868.0625	823.0625
767	757	868.0750	823.0750
768	758	868.0875	823.0875
769	759	868.1000	823.1000
770	760	868.1125	823.1125
771	761	868.1250	823.1250
772	762	868.1375	823.1375
773	763	868.1500	823.1500
774	764	868.1625	823.1625
775	765	868.1750	823.1750
776	766	868.1875	823.1875
777	767	868.2000	823.2000
778	768	868.2125	823.2125
779	769	868.2250	823.2250
780	770	868.2375	823.2375
781	771	868.2500	823.2500
782	772	868.2625	823.2625
783	773	868.2750	823.2750
784	774	868.2875	823.2875
785	775	868.3000	823.3000
786	776	868.3125	823.3125
787	777	868.3250	823.3250
788	778	868.3375	823.3375
789	779	868.3500	823.3500
790	780	868.3625	823.3625
791	781	868.3750	823.3750
792	782	868.3875	823.3875
793	783	868.4000	823.4000
794	784	868.4125	823.4125
795	785	868.4250	823.4250
796	786	868.4375	823.4375
797	787	868.4500	823.4500
798	788	868.4625	823.4625
799	789	868.4750	823.4750
800	790	868.4875	823.4875
801	791	868.5000	823.5000
802	792	868.5125	823.5125
803	793	868.5250	823.5250
804	794	868.5375	823.5375
805	795	868.5500	823.5500
806	796	868.5625	823.5625
807	797	868.5750	823.5750
808	798	868.5875	823.5875
809	799	868.6000	823.6000
810	800	868.6125	823.6125
811	801	868.6250	823.6250
812	802	868.6375	823.6375
813	803	868.6500	823.6500
814	804	868.6625	823.6625
815	805	868.6750	823.6750
816	806	868.6875	823.6875
817	807	868.7000	823.7000
818	808	868.7125	823.7125
819	809	868.7250	823.7250
820	810	868.7375	823.7375
821	811	868.7500	823.7500
822	812	868.7625	823.7625
823	813	868.7750	823.7750
824	814	868.7875	823.7875
825	815	868.8000	823.8000
826	816	868.8125	823.8125
827	817	868.8250	823.8250
828	818	868.8375	823.8375
829	819	868.8500	823.8500
830	820	868.8625	823.8625
831	821	868.8750	823.8750
832	822	868.8875	823.8875

[1] Use the Programming Channel Number, not the FCC Channel Number

800 MHz Channels

Prog Chan. No. [1]	FCC Chan. No. [1]	Repeater Tx Freq.	Repeater Rx Freq
833	823	868.9000	823.9000
834	824	868.9125	823.9125
835	825	868.9250	823.9250
836	826	868.9375	823.9375
837	827	868.9500	823.9500
838	828	868.9625	823.9625
839	829	868.9750	823.9750
840	830	868.9875	823.9875
841	-	869.0000	824.0000
842	-	869.0125	824.0125
843	-	869.0250	824.0250
844	-	869.0375	824.0375
845	-	869.0500	824.0500
846	-	869.0625	824.0625
847	-	869.0750	824.0750
848	-	869.0875	824.0875
849	-	869.1000	824.1000
850	-	869.1125	824.1125
851	-	869.1250	824.1250
852	-	869.1375	824.1375
853	-	869.1500	824.1500
854	-	869.1625	824.1625
855	-	869.1750	824.1750
856	-	869.1875	824.1875
857	-	869.2000	824.2000
858	-	869.2125	824.2125
859	-	869.2250	824.2250
860	-	869.2375	824.2375
861	-	869.2500	824.2500
862	-	869.2625	824.2625
863	-	869.2750	824.2750
864	-	869.2875	824.2875
865	-	869.3000	824.3000
866	-	869.3125	824.3125
867	-	869.3250	824.3250
868	-	869.3375	824.3375
869	-	869.3500	824.3500
870	-	869.3625	824.3625
871	-	869.3750	824.3750
872	-	869.3875	824.3875
873	-	869.4000	824.4000
874	-	869.4125	824.4125
875	-	869.4250	824.4250
876	-	869.4375	824.4375
877	-	869.4500	824.4500
878	-	869.4625	824.4625
879	-	869.4750	824.4750
880	-	869.4875	824.4875
881	-	869.5000	824.5000
882	-	869.5125	824.5125
883	-	869.5250	824.5250
884	-	869.5375	824.5375
885	-	869.5500	824.5500
886	-	869.5625	824.5625
887	-	869.5750	824.5750
888	-	869.5875	824.5875
889	-	869.6000	824.6000
890	-	869.6125	824.6125
891	-	869.6250	824.6250
892	-	869.6375	824.6375
893	-	869.6500	824.6500
894	-	869.6625	824.6625
895	-	869.6750	824.6750
896	-	869.6875	824.6875
897	-	869.7000	824.7000
898	-	869.7125	824.7125
899	-	869.7250	824.7250
900	-	869.7375	824.7375
901	-	869.7500	824.7500
902	-	869.7625	824.7625
903	-	869.7750	824.7750
904	-	869.7875	824.7875
905	-	869.8000	824.8000
906	-	869.8125	824.8125
907	-	869.8250	824.8250
908	-	869.8375	824.8375
909	-	869.8500	824.8500
910	-	869.8625	824.8625
911	-	869.8750	824.8750
912	-	869.8875	824.8875
913	-	869.9000	824.9000
914	-	869.9125	824.9125
915	-	869.9250	824.9250
916	-	869.9375	824.9375
917	-	869.9500	824.9500
918	-	869.9625	824.9625
919	-	869.9750	824.9750
920	-	869.9875	824.9875

[1] Use the Programming Channel Number, not the FCC Channel Number

900 MHz Channels

Prog Chan. No.	FCC Chan. No.	Repeater Tx Freq.	Repeater Rx Freq
1	1	935.0125	896.0125
2	2	935.0250	896.0250
3	3	935.0375	896.0375
4	4	935.0500	896.0500
5	5	935.0625	896.0625
6	6	935.0750	896.0750
7	7	935.0875	896.0875
8	8	935.1000	896.1000
9	9	935.1125	896.1125
10	10	935.1250	896.1250
11	11	935.1375	896.1375
12	12	935.1500	896.1500
13	13	935.1625	896.1625
14	14	935.1750	896.1750
15	15	935.1875	896.1875
16	16	935.2000	896.2000
17	17	935.2125	896.2125
18	18	935.2250	896.2250
19	19	935.2375	896.2375
20	20	935.2500	896.2500
21	21	935.2625	896.2625
22	22	935.2750	896.2750
23	23	935.2875	896.2875
24	24	935.3000	896.3000
25	25	935.3125	896.3125
26	26	935.3250	896.3250
27	27	935.3375	896.3375
28	28	935.3500	896.3500
29	29	935.3625	896.3625
30	30	935.3750	896.3750
31	31	935.3875	896.3875
32	32	935.4000	896.4000
33	33	935.4125	896.4125
34	34	935.4250	896.4250
35	35	935.4375	896.4375
36	36	935.4500	896.4500
37	37	935.4625	896.4625
38	38	935.4750	896.4750
39	39	935.4875	896.4875
40	40	935.5000	896.5000
41	41	935.5125	896.5125
42	42	935.5250	896.5250
43	43	935.5375	896.5375
44	44	935.5500	896.5500
45	45	935.5625	896.5625
46	46	935.5750	896.5750
47	47	935.5875	896.5875
48	48	935.6000	896.6000
49	49	935.6125	896.6125
50	50	935.6250	896.6250
51	51	935.6375	896.6375
52	52	935.6500	896.6500
53	53	935.6625	896.6625
54	54	935.6750	896.6750
55	55	935.6875	896.6875
56	56	935.7000	896.7000
57	57	935.7125	896.7125
58	58	935.7250	896.7250
59	59	935.7375	896.7375
60	60	935.7500	896.7500
61	61	935.7625	896.7625
62	62	935.7750	896.7750
63	63	935.7875	896.7875
64	64	935.8000	896.8000
65	65	935.8125	896.8125
66	66	935.8250	896.8250
67	67	935.8375	896.8375
68	68	935.8500	896.8500
69	69	935.8625	896.8625
70	70	935.8750	896.8750
71	71	935.8875	896.8875
72	72	935.9000	896.9000
73	73	935.9125	896.9125
74	74	935.9250	896.9250
75	75	935.9375	896.9375
76	76	935.9500	896.9500
77	77	935.9625	896.9625
78	78	935.9750	896.9750
79	79	935.9875	896.9875
80	80	936.0000	897.0000
81	81	936.0125	897.0125
82	82	936.0250	897.0250
83	83	936.0375	897.0375
84	84	936.0500	897.0500
85	85	936.0625	897.0625
86	86	936.0750	897.0750
87	87	936.0875	897.0875
88	88	936.1000	897.1000
89	89	936.1125	897.1125
90	90	936.1250	897.1250
91	91	936.1375	897.1375
92	92	936.1500	897.1500
93	93	936.1625	897.1625
94	94	936.1750	897.1750
95	95	936.1875	897.1875
96	96	936.2000	897.2000
97	97	936.2125	897.2125
98	98	936.2250	897.2250
99	99	936.2375	897.2375
100	100	936.2500	897.2500
101	101	936.2625	897.2625
102	102	936.2750	897.2750

900 MHz Channels

Prog Chan. No.	FCC Chan. No.	Repeater Tx Freq.	Repeater Rx Freq
103	103	936.2875	897.2875
104	104	936.3000	897.3000
105	105	936.3125	897.3125
106	106	936.3250	897.3250
107	107	936.3375	897.3375
108	108	936.3500	897.3500
109	109	936.3625	897.3625
110	110	936.3750	897.3750
111	111	936.3875	897.3875
112	112	936.4000	897.4000
113	113	936.4125	897.4125
114	114	936.4250	897.4250
115	115	936.4375	897.4375
116	116	936.4500	897.4500
117	117	936.4625	897.4625
118	118	936.4750	897.4750
119	119	936.4875	897.4875
120	120	936.5000	897.5000
121	121	936.5125	897.5125
122	122	936.5250	897.5250
123	123	936.5375	897.5375
124	124	936.5500	897.5500
125	125	936.5625	897.5625
126	126	936.5750	897.5750
127	127	936.5875	897.5875
128	128	936.6000	897.6000
129	129	936.6125	897.6125
130	130	936.6250	897.6250
131	131	936.6375	897.6375
132	132	936.6500	897.6500
133	133	936.6625	897.6625
134	134	936.6750	897.6750
135	135	936.6875	897.6875
136	136	936.7000	897.7000
137	137	936.7125	897.7125
138	138	936.7250	897.7250
139	139	936.7375	897.7375
140	140	936.7500	897.7500
141	141	936.7625	897.7625
142	142	936.7750	897.7750
143	143	936.7875	897.7875
144	144	936.8000	897.8000
145	145	936.8125	897.8125
146	146	936.8250	897.8250
147	147	936.8375	897.8375
148	148	936.8500	897.8500
149	149	936.8625	897.8625
150	150	936.8750	897.8750
151	151	936.8875	897.8875
152	152	936.9000	897.9000
153	153	936.9125	897.9125
154	154	936.9250	897.9250
155	155	936.9375	897.9375
156	156	936.9500	897.9500
157	157	936.9625	897.9625
158	158	936.9750	897.9750
159	159	936.9875	897.9875
160	160	937.0000	898.0000
161	161	937.0125	898.0125
162	162	937.0250	898.0250
163	163	937.0375	898.0375
164	164	937.0500	898.0500
165	165	937.0625	898.0625
166	166	937.0750	898.0750
167	167	937.0875	898.0875
168	168	937.1000	898.1000
169	169	937.1125	898.1125
170	170	937.1250	898.1250
171	171	937.1375	898.1375
172	172	937.1500	898.1500
173	173	937.1625	898.1625
174	174	937.1750	898.1750
175	175	937.1875	898.1875
176	176	937.2000	898.2000
177	177	937.2125	898.2125
178	178	937.2250	898.2250
179	179	937.2375	898.2375
180	180	937.2500	898.2500
181	181	937.2625	898.2625
182	182	937.2750	898.2750
183	183	937.2875	898.2875
184	184	937.3000	898.3000
185	185	937.3125	898.3125
186	186	937.3250	898.3250
187	187	937.3375	898.3375
188	188	937.3500	898.3500
189	189	937.3625	898.3625
190	190	937.3750	898.3750
191	191	937.3875	898.3875
192	192	937.4000	898.4000
193	193	937.4125	898.4125
194	194	937.4250	898.4250
195	195	937.4375	898.4375
196	196	937.4500	898.4500
197	197	937.4625	898.4625
198	198	937.4750	898.4750
199	199	937.4875	898.4875
200	200	937.5000	898.5000
201	201	937.5125	898.5125
202	202	937.5250	898.5250
203	203	937.5375	898.5375
204	204	937.5500	898.5500

900 MHz Channels

Prog Chan. No.	FCC Chan. No.	Repeater Tx Freq.	Repeater Rx Freq
205	205	937.5625	898.5625
206	206	937.5750	898.5750
207	207	937.5875	898.5875
208	208	937.6000	898.6000
209	209	937.6125	898.6125
210	210	937.6250	898.6250
211	211	937.6375	898.6375
212	212	937.6500	898.6500
213	213	937.6625	898.6625
214	214	937.6750	898.6750
215	215	937.6875	898.6875
216	216	937.7000	898.7000
217	217	937.7125	898.7125
218	218	937.7250	898.7250
219	219	937.7375	898.7375
220	220	937.7500	898.7500
221	221	937.7625	898.7625
222	222	937.7750	898.7750
223	223	937.7875	898.7875
224	224	937.8000	898.8000
225	225	937.8125	898.8125
226	226	937.8250	898.8250
227	227	937.8375	898.8375
228	228	937.8500	898.8500
229	229	937.8625	898.8625
230	230	937.8750	898.8750
231	231	937.8875	898.8875
232	232	937.9000	898.9000
233	233	937.9125	898.9125
234	234	937.9250	898.9250
235	235	937.9375	898.9375
236	236	937.9500	898.9500
237	237	937.9625	898.9625
238	238	937.9750	898.9750
239	239	937.9875	898.9875
240	240	938.0000	899.0000
241	241	938.0125	899.0125
242	242	938.0250	899.0250
243	243	938.0375	899.0375
244	244	938.0500	899.0500
245	245	938.0625	899.0625
246	246	938.0750	899.0750
247	247	938.0875	899.0875
248	248	938.1000	899.1000
249	249	938.1125	899.1125
250	250	938.1250	899.1250
251	251	938.1375	899.1375
252	252	938.1500	899.1500
253	253	938.1625	899.1625
254	254	938.1750	899.1750
255	255	938.1875	899.1875

Prog Chan. No.	FCC Chan. No.	Repeater Tx Freq.	Repeater Rx Freq
256	256	938.2000	899.2000
257	257	938.2125	899.2125
258	258	938.2250	899.2250
259	259	938.2375	899.2375
260	260	938.2500	899.2500
261	261	938.2625	899.2625
262	262	938.2750	899.2750
263	263	938.2875	899.2875
264	264	938.3000	899.3000
265	265	938.3125	899.3125
266	266	938.3250	899.3250
267	267	938.3375	899.3375
268	268	938.3500	899.3500
269	269	938.3625	899.3625
270	270	938.3750	899.3750
271	271	938.3875	899.3875
272	272	938.4000	899.4000
273	273	938.4125	899.4125
274	274	938.4250	899.4250
275	275	938.4375	899.4375
276	276	938.4500	899.4500
277	277	938.4625	899.4625
278	278	938.4750	899.4750
279	279	938.4875	899.4875
280	280	938.5000	899.5000
281	281	938.5125	899.5125
282	282	938.5250	899.5250
283	283	938.5375	899.5375
284	284	938.5500	899.5500
285	285	938.5625	899.5625
286	286	938.5750	899.5750
287	287	938.5875	899.5875
288	288	938.6000	899.6000
289	289	938.6125	899.6125
290	290	938.6250	899.6250
291	291	938.6375	899.6375
292	292	938.6500	899.6500
293	293	938.6625	899.6625
294	294	938.6750	899.6750
295	295	938.6875	899.6875
296	296	938.7000	899.7000
297	297	938.7125	899.7125
298	298	938.7250	899.7250
299	299	938.7375	899.7375
300	300	938.7500	899.7500
301	301	938.7625	899.7625
302	302	938.7750	899.7750
303	303	938.7875	899.7875
304	304	938.8000	899.8000
305	305	938.8125	899.8125
306	306	938.8250	899.8250

900 MHz Channels

Prog Chan. No.	FCC Chan. No.	Repeater Tx Freq.	Repeater Rx Freq
307	307	938.8375	899.8375
308	308	938.8500	899.8500
309	309	938.8625	899.8625
310	310	938.8750	899.8750
311	311	938.8875	899.8875
312	312	938.9000	899.9000
313	313	938.9125	899.9125
314	314	938.9250	899.9250
315	315	938.9375	899.9375
316	316	938.9500	899.9500
317	317	938.9625	899.9625
318	318	938.9750	899.9750
319	319	938.9875	899.9875
320	320	939.0000	900.0000
321	321	939.0125	900.0125
322	322	939.0250	900.0250
323	323	939.0375	900.0375
324	324	939.0500	900.0500
325	325	939.0625	900.0625
326	326	939.0750	900.0750
327	327	939.0875	900.0875
328	328	939.1000	900.1000
329	329	939.1125	900.1125
330	330	939.1250	900.1250
331	331	939.1375	900.1375
332	332	939.1500	900.1500
333	333	939.1625	900.1625
334	334	939.1750	900.1750
335	335	939.1875	900.1875
336	336	939.2000	900.2000
337	337	939.2125	900.2125
338	338	939.2250	900.2250
339	339	939.2375	900.2375
340	340	939.2500	900.2500
341	341	939.2625	900.2625
342	342	939.2750	900.2750
343	343	939.2875	900.2875
344	344	939.3000	900.3000
345	345	939.3125	900.3125
346	346	939.3250	900.3250
347	347	939.3375	900.3375
348	348	939.3500	900.3500
349	349	939.3625	900.3625
350	350	939.3750	900.3750
351	351	939.3875	900.3875
352	352	939.4000	900.4000
353	353	939.4125	900.4125
354	354	939.4250	900.4250
355	355	939.4375	900.4375
356	356	939.4500	900.4500
357	357	939.4625	900.4625
358	358	939.4750	900.4750
359	359	939.4875	900.4875
360	360	939.5000	900.5000
361	361	939.5125	900.5125
362	362	939.5250	900.5250
363	363	939.5375	900.5375
364	364	939.5500	900.5500
365	365	939.5625	900.5625
366	366	939.5750	900.5750
367	367	939.5875	900.5875
368	368	939.6000	900.6000
369	369	939.6125	900.6125
370	370	939.6250	900.6250
371	371	939.6375	900.6375
372	372	939.6500	900.6500
373	373	939.6625	900.6625
374	374	939.6750	900.6750
375	375	939.6875	900.6875
376	376	939.7000	900.7000
377	377	939.7125	900.7125
378	378	939.7250	900.7250
379	379	939.7375	900.7375
380	380	939.7500	900.7500
381	381	939.7625	900.7625
382	382	939.7750	900.7750
383	383	939.7875	900.7875
384	384	939.8000	900.8000
385	385	939.8125	900.8125
386	386	939.8250	900.8250
387	387	939.8375	900.8375
388	388	939.8500	900.8500
389	389	939.8625	900.8625
390	390	939.8750	900.8750
391	391	939.8875	900.8875
392	392	939.9000	900.9000
393	393	939.9125	900.9125
394	394	939.9250	900.9250
395	395	939.9375	900.9375
396	396	939.9500	900.9500
397	397	939.9625	900.9625
398	398	939.9750	900.9750
399	399	939.9875	900.9875
400	400	940.0000	901.0000
401	401	940.0125	901.0125
402	402	940.0250	901.0250
403	403	940.0375	901.0375
404	404	940.0500	901.0500
405	405	940.0625	901.0625
406	406	940.0750	901.0750
407	407	940.0875	901.0875
408	408	940.1000	901.1000

900 MHz Channels

Prog Chan. No.	FCC Chan. No.	Repeater Tx Freq.	Repeater Rx Freq
409	409	940.1125	901.1125
410	410	940.1250	901.1250
411	411	940.1375	901.1375
412	412	940.1500	901.1500
413	413	940.1625	901.1625
414	414	940.1750	901.1750
415	415	940.1875	901.1875
416	416	940.2000	901.2000
417	417	940.2125	901.2125
418	418	940.2250	901.2250
419	419	940.2375	901.2375
420	420	940.2500	901.2500
421	421	940.2625	901.2625
422	422	940.2750	901.2750
423	423	940.2875	901.2875
424	424	940.3000	901.3000
425	425	940.3125	901.3125
426	426	940.3250	901.3250
427	427	940.3375	901.3375
428	428	940.3500	901.3500
429	429	940.3625	901.3625
430	430	940.3750	901.3750
431	431	940.3875	901.3875
432	432	940.4000	901.4000
433	433	940.4125	901.4125
434	434	940.4250	901.4250
435	435	940.4375	901.4375
436	436	940.4500	901.4500
437	437	940.4625	901.4625
438	438	940.4750	901.4750
439	439	940.4875	901.4875
440	440	940.5000	901.5000
441	441	940.5125	901.5125
442	442	940.5250	901.5250
443	443	940.5375	901.5375
444	444	940.5500	901.5500
445	445	940.5625	901.5625
446	446	940.5750	901.5750
447	447	940.5875	901.5875
448	448	940.6000	901.6000
449	449	940.6125	901.6125
450	450	940.6250	901.6250
451	451	940.6375	901.6375
452	452	940.6500	901.6500
453	453	940.6625	901.6625
454	454	940.6750	901.6750
455	455	940.6875	901.6875
456	456	940.7000	901.7000
457	457	940.7125	901.7125
458	458	940.7250	901.7250
459	459	940.7375	901.7375
460	460	940.7500	901.7500
461	461	940.7625	901.7625
462	462	940.7750	901.7750
463	463	940.7875	901.7875
464	464	940.8000	901.8000
465	465	940.8125	901.8125
466	466	940.8250	901.8250
467	467	940.8375	901.8375
468	468	940.8500	901.8500
469	469	940.8625	901.8625
470	470	940.8750	901.8750
471	471	940.8875	901.8875
472	472	940.9000	901.9000
473	473	940.9125	901.9125
474	474	940.9250	901.9250
475	475	940.9375	901.9375
476	476	940.9500	901.9500
477	477	940.9625	901.9625
478	478	940.9750	901.9750
479	479	940.9875	901.9875

[1] Use the Programming Channel Number, not the FCC Channel Number

SECTION 4 LTR-NET OVERVIEW

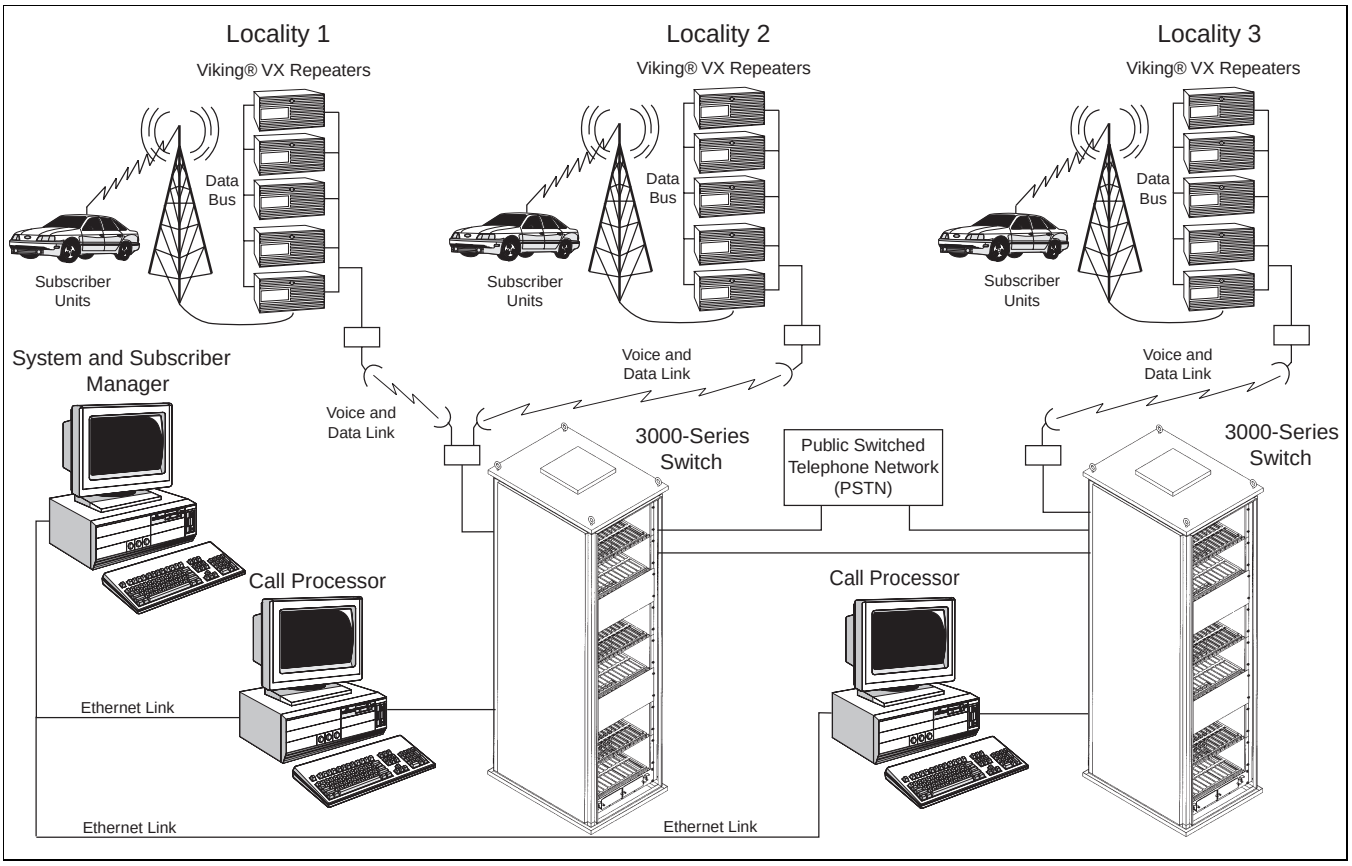


Figure 4-1 LTR-Net System Diagram

4.1 INTRODUCTION

4.1.1 GENERAL

LTR-Net™ is the next generation of LTR® trunked radio signaling. It provides many new enhanced operating features while maintaining compatibility with most current LTR equipment. Some new LTR-Net features include roaming, unique ID calls, and over-the-air reprogramming. Equipment changes include the addition of an LTR-Net 3000-Series switch and System and Subscriber Manager to provide system control. A diagram of an LTR-Net system is shown in Figure 4-1.

4.1.2 COMPATIBILITY WITH LTR

LTR Subscriber Units Operating in LTR-Net Systems

- Standard group calls occur in the normal manner. These calls can be to other LTR subscriber units or between LTR and LTR-Net subscriber units.
- Wide area group calls can be placed and received (see Section 4.4).
- LTR telephone calls can be placed and received in the normal manner.
- Enhanced LTR-Net features such as roaming and unique ID calls are not available.

- Current LTR subscriber units can remain in service and LTR-Net subscriber units added gradually. This makes upgrading to LTR-Net very convenient and less costly.

LTR-Net Subscriber Units Operating on LTR Systems

- LTR-Net subscriber units can be programmed for LTR operation. Therefore, they can place and receive LTR group and telephone calls in the normal manner.

- Enhanced LTR-Net features such as roaming and unique ID calls are not available to LTR-Net subscriber units operating on LTR systems.

4.1.3 LTR-NET FEATURES

Networking

- Multiple LTR-Net and LTR localities may be linked together to provide wide-area coverage.

- LTR-Net subscriber units can roam between LTR-Net localities and register and de-register automatically when entering and exiting.

Calls from one type of subscriber unit can be patched to another type of subscriber unit at another locality. For example, an LTR-Net subscriber unit could talk to a conventional subscriber unit. Calls can even be cross-band, for example, an UHF conventional subscriber unit could talk to an 800 MHz LTR-Net subscriber unit.

Special Calls

- **Unique ID (UID) -** Calls to be placed to specific subscriber units in the same locality or some other locality.

- **Directed Group -** Calls can be placed to any group in the same locality or some other locality.

- **Telephone -** Calls can be placed over the public switched telephone network (PSTN).

- **Data -** Data can be transmitted to specific location selected by unique ID code (not currently available).

System Control

- When new channels are added to a locality, subscriber units can be updated with those channels over the air. This eliminates the need to bring them back in for reprogramming.

- Over-the-air subscriber unit programming allows the ID codes of up to 128 systems and 128 groups to be changed.

- The system/group currently selected by a subscriber unit can be changed over the air.

A temporary UID keyed to the ESN can be assigned to a subscriber unit when it roams to a new radio system (this feature has not yet been implemented).

- Unauthorized subscriber units can be temporarily or permanently disabled.

- A subscriber unit can be interrogated to determine if it is currently in service. It can also be interrogated for its ESN or unique ID code (see following).

Security

- Each LTR-Net subscriber unit is assigned a unique Electronic Serial Number (ESN), and no two subscriber units in existence should have the same ESN. This number can be interrogated as stated above and is used for such things as assigning a temporary UID.

- Over 65,500 unique ID codes can be assigned in each locality. Each subscriber unit in a locality is usually assigned a different unique ID code although more than one can have the same code if desired.

- Unique ID and group validation (by home repeater/group ID) is performed. If an unauthorized ID is detected, the call is terminated.

Miscellaneous

- Home channel backup is provided by the use of a status channel at each locality. The status channel is used for voice traffic the same as normal channels, but is usually not assigned as a home channel.

- Typical access time for group calls is the same as with LTR operation. Access time for unique ID and auxiliary calls is less than 500 milliseconds.

- Priority access, automatic emergency calls, status messaging, and system security keys are not available.

4.1.4 DEFINITIONS

The following are some terms that are used frequently when describing LTR-Net operation:

Group - A subscriber unit has selectable systems and groups. Each system can have several groups. The group selects the call type and the subscriber unit or units which receive the call. Refer to Section 2.4.9 for more information.

Home Repeater - Each selectable system of LTR and LTR-Net subscriber units has one of the locality repeaters assigned as their "home" repeater. This is the repeater from which "free" and "channel-in-use" information is received (see Section 4.6). In addition, with standard group calls, the home repeater number and a group ID form the "address" of the recipient of a call.

Locality - A group of co-located repeaters typically connected by a common data bus. Refer to Sections 4.2.3 and 2.4.9 for more information.

LTR Signaling - This popular EFJohnson radio trunking system provides the basis for the LTR-Net system. For a complete description of LTR trunking, refer to the LTR Application Note, Part No. 009-0001-002, Revision 8 or later.

Mobile - A transceiver mounted in a vehicle. This term may also be used generically to refer to any transceiver, either mobile or portable, since both operate basically the same. See also "Subscriber Unit".

Portable - A small handheld transceiver usually battery powered and carried by a person. See also "Subscriber Unit".

Site - See "Locality".

Status Repeater - The repeater at a locality designated to provide home channel backup. It transmits call information for all subscriber units on that locality. Refer to Section 4.6 for more information.

System, Radio - This refers to the radio equipment and other infrastructure that is accessed when a call is placed.

System, Selectable - A subscriber unit has selectable systems and groups. Each selectable system consists or one or more groups and is programmed with a unique home repeater (see Section 2.4.9 for more information). A radio system refers to the radio equipment that is accessed when calls are placed.

Subscriber Unit - A generic term referring to both the mobile and portable transceivers being used in the radio system.

Trunked Radio System - A radio system which utilizes multiple radio channels and automatic channel switching to allow all users equal access to any channel not in use. This results in minimum waiting to make a call and maximum utilization of the available radio channels.

Unique ID - A unique number from 1-65503 assigned to each subscriber unit. Although this number is assignable on a per locality basis, the same number is typically assigned on each locality a subscriber unit can access.

4.2 SYSTEM ARCHITECTURE

4.2.1 INTRODUCTION

A diagram of a typical LTR-Net system is shown in Figure 4-1. The number or localities, repeaters per locality, number of 3000-series switches, and other system parameters are determined by the requirements of the particular system. The following is more information on the components shown in Figure 4-1.

4.2.2 SUBSCRIBER UNITS

Subscriber units operating in an LTR-Net locality must be the LTR-Net or LTR type. They may be the mounted in a vehicle (mobiles) and or carried (portables). The features available with each type are as follows:

LTR-Net Subscriber Units

These subscriber units are designed for operation in an LTR-Net radio system and therefore have all LTR-Net features. An optional DTMF keypad is required to place telephone, directed group, and unique ID calls. These subscriber units can also be programmed for LTR and conventional operation, so will operate in those types of radio systems. Standard group and also telephone calls can be placed when operating in an LTR system.

LTR Subscriber Units

These transceivers are designed for operation in LTR and conventional radio systems. They can also be used in an LTR-Net radio system to make standard and wide area group calls and telephone calls. Standard group calls are to mobiles in the same locality, and wide area group calls are to mobiles in some other locality. Enhanced LTR-Net features such as unique ID calls and full roaming capability are not available.

4.2.3 REPEATERS

Viking® VX 2000-series repeaters are used in an LTR-Net system. Models are available for the VHF, UHF, 800 MHz, and 900 MHz frequency bands. One repeater is required for each radio channel.

As with standard LTR repeaters, all the signal processing for the channel is performed by the logic unit in each repeater. This is referred to as distributive processing, and it eliminates the need for a separate controller at each locality.

Audio (voice) and data signals are routed from each repeater to a 3000-series switch. This allows the switch to route the call to other localities and also control certain repeater functions. The link to the switch may be a direct connection if the switch is at the same location or some other type such as microwave, fiber optic, RF, or telephone line. The audio interface to the switch is a standard 600-ohm, four-wire path (transmit and receive pair). The data signal can use an RS-232 interface or it can be FSK tones using the same or a different audio path than the voice.

A “locality” refers to repeaters at the same location that are interconnected by a common high-speed data bus. Up to 20 repeaters can be interconnected, so a locality can include up to 20 repeaters. Although more than 20 repeaters could be co-located, they would be considered separate localities because they are not interconnected by the same data bus. A single data bus can be up to 500 feet long.

Standard LTR and conventional Viking VX and 8000-series repeaters can also be connected to the 3000-Series switch. However, since they would not be using LTR-Net software, the only enhanced LTR-Net feature provided would be wide area group calling (see Section 4.4).

4.2.4 3000-SERIES SWITCH

The 3000-Series Switch connects several different forms of communication together to form a communications network. Each switch is controlled by a Call Processor and System and Subscriber Manager (see next sections). A switch can consist of up to three racks, each containing up to eight shelves. Since each shelf has 12-16 device slots, up to 96-128 slots per rack and up to 288-384 slots per switch are available. Many different modules are available for installation in these slots. The exact number and type required is determined by the requirements of each system.

A single 3000-Series Switch can control up to 30 repeaters. Therefore, if a LTR-Net network consisting of several localities has more than 30 repeaters, one switch is required for every 30 repeaters. A switch can be located at one of the repeater localities or it can be at a separate location. An audio and data link connects the switch to each repeater as described in the preceding section.

When a call is made by a subscriber unit in one locality to a subscriber unit in another locality, the switch provides the necessary patch. Likewise, when a telephone call is placed by a subscriber unit, the switch routes it to the Public Switched Telephone Network (PSTN). Calls can also be routed to a PABX (Private Automatic Branch Exchange). The dial access codes and least cost routing facilities of the PABX can then be utilized.

4.2.5 CALL PROCESSOR

The Call Processor is a Windows NT-based personal computer running switch management software. The Call Processor serves as an interface between the switch and the System and Subscriber Manager (see next section). It contains the database used to process calls on the switch and also logs call information from the switch. The Call Processor performs such tasks as processing wide area calls, subscriber unit registration, and Interrogate and Reassign requests. One Call Processor is required per switch, and it is connected to the switch by two 19,200 baud data links.

4.2.6 SYSTEM AND SUBSCRIBER MANAGER

The System and Subscriber Manager (SSM) is also a Windows NT-based personal computer. It runs the software which provides overall system control. One or more SSMs may be used to control the system. This allows, for example, the system administrator to have overall system control and then permit other operators limited control privileges. Access is by password only, and only functions authorized to a particular user can be accessed. This ensures that only authorized personnel can modify and monitor system resources.

Some SSM functions are as follows:

- Set up and authorize auxiliary and telephone interconnect calls on a unique ID basis. Also authorize group calls on a locality/home/group basis.
- Track the location of individual LTR-Net subscriber units by unique ID.
- Control wide area auxiliary calls by unique ID.
- Track wide area group calls by locality/home/group or unique ID.
- Set up command calls such as Reassign, Interrogate, Mobile Disable, and others.
- Monitor and display information on system activity.
- Record information on individual subscriber unit system usage in a standard database format. This information can then be exported and used by billing software to generate customer billing.

4.3 STANDARD GROUP CALLS

Standard group calls are between subscriber units at the same locality and use ID codes 1-239 that are assignable on each home repeater. A group ID can be assigned to one subscriber unit or a group of subscriber units as desired. To place a standard group call, all the user does is select the group programmed for the group being called and press the PTT switch. No number is dialed using a DTMF keypad as with special calls described in Section 4.5.

Selectable groups used to make standard group calls are programmed with a group ID code, and the selectable system is programmed with a home repeater number. This home repeater/ID code form the “address” of the group call. Since each selectable system can be programmed with a different home repeater, standard group calls can be placed to any group in a locality.

Standard group calls hold a repeater for only the duration of a transmission, not for the entire call. This provides maximum system efficiency because the time between transmissions can be used by others.

4.4 WIDE AREA GROUP CALLS

The wide area group calling feature allows standard group calls from LTR or LTR-Net subscriber units to be routed to any locality in the LTR-Net system.

Specific locality/home/group ID combinations can be programmed in the SSM (see Section 4.2.6) for wide area calls. Then when a standard group call is detected on one of these combinations, it is automatically routed to the specified localities as well as occurring on the home locality. The home/group can be different on each wide area locality if desired.

Each wide area locality/home/group involved in a wide area call can be programmed as follows:

- The call is always routed to the specified locality, home, and group (if resources are available).

- The call is routed to a specified locality only if a call on the home/group has been recently detected. This results in more efficient use of system resources.

- The call is routed to a specific locality if a tracked unique ID is registered on that locality.

Wide area group calls can also be made over standard LTR and conventional Viking VX repeaters that are connected to a 3000-series LTR-Net switch. However, no other LTR-Net enhanced features are available with those repeaters.

Wide area group calls continue to be received while registration on a new locality occurs. For example, the transceiver can exit a locality while receiving a call, register on a new locality, and then continue receiving the call on the new locality. In addition, a call can be received on the new locality before registration occurs if the call is already active on the new locality.

4.5 SPECIAL CALLS

4.5.1 GENERAL

LTR-Net subscriber units can place Auxiliary, Telephone, and Data special calls. These calls are not available to LTR subscriber units being used on an LTR-Net system. When a special call is placed, a number is dialed which specifies the recipient of the call. The DTMF keypad used to dial this number may be optional, and it is located on the microphone with mobile subscriber units and on the front panel with portable units. Special calls hold the channel until the entire call is complete, not just until the transmission is complete as with group calls. More information on each special call follows.

4.5.2 AUXILIARY CALLS

Auxiliary calls include Unique ID and Directed Group calls. Unique ID calls allow calls to be selectively placed to an individual subscriber unit in any locality. Likewise, Directed Group calls allow standard group calls allow group calls to be selectively placed to any group in any locality. Refer to Section 2.9.1 for more information on these calls.

4.5.3 TELEPHONE CALLS

Telephone calls allow calls to be placed over the public switched telephone network. After the system is accessed, a dial tone sounds and the telephone number being called is entered using the DTMF keypad. Since most subscriber units are half-duplex (do not transmit and receive at the same time), it is not possible for the mobile user to talk and listen at the same time.

If a unique telephone number has been assigned to subscriber unit, it can be called directly from a land-side telephone. If not, the radio system is called and then the unique ID of the mobile must be overdialed similar to when a unique ID call is placed by a subscriber unit.

If a subscriber unit has been assigned a unique telephone number, that number can also be used for unique ID calls. This allows mobile-to-mobile unique ID calls to be made by simply dialing the telephone number of the desired subscriber unit.

4.5.4 DATA CALLS

NOTE: Data calls are not currently available.

Data calls allow data to be transmitted to a specific unique ID. The audio of the receiving equipment is automatically muted as data is received. Data may be transmitted back and forth several times until the entire data exchange is complete because the channel is held for the duration of the call. To transmit a data call, a group programmed for the data special call is selected and then the unique ID is entered, usually automatically by the data equipment. Data calls are received the same as unique ID calls.

4.6 HOME CHANNEL BACKUP

4.6.1 INTRODUCTION

An LTR-Net repeater locality (site) consists of up to twenty interconnected repeaters (see Section 4.2.3). One of these repeaters is usually designated as status repeater and the others are designated as home repeaters (see following). The subscriber units are programmed with the channel numbers of these repeaters. Data signaling can occur continuously with

voice on any repeater because the data occupies the subaudible frequencies below the voice band.

4.6.2 HOME REPEATERS

The home repeater is used by the subscriber unit as its primary source of incoming call and free repeater information. When not receiving or transmitting a call, it is monitoring this repeater. The home repeater is always used to make a call if it is not busy. In addition, if roaming mobiles searching for a new locality cannot locate a suitable status repeater, the home repeater is monitored (see Section 2.9.3). As previously mentioned, up to 239 group ID codes can be assigned on each home repeater, and the home repeater and ID code form the "address" when making group calls.

4.6.3 STATUS REPEATERS

One repeater at each locality is designated the status repeater. The primary function of this repeater is to provide backup for the other locality repeaters that are assigned as home repeaters. It continuously transmits call information for all calls occurring at that locality. The status repeater is used for voice traffic, but is usually not assigned as a home repeater because there would then be no home channel backup on that repeater. Roaming mobiles searching for a new locality monitor the status repeaters (Section 2.9.3). After registration occurs, the home repeater is then monitored.

4.6.4 BACKUP OPERATION

If subscriber units were limited to only their home repeater to receive update information and that repeater became inoperative, all subscriber units that were assigned to that repeater would then be unable to place or receive calls. To prevent this from happening, the status repeater can also be monitored for call information.

If the signal from the home repeater is lost or falls below a minimum threshold, the subscriber unit automatically begins monitoring the locality status repeater. If a usable signal is detected from the status repeater, it continues to monitor that repeater. If a message is detected that has its home repeater as the "channel-in-use" or "free" repeater, the subscriber unit then returns to monitoring its home repeater.

A roaming subscriber unit also monitors the status repeater in this manner when the home repeater signal drops below the threshold level. However, the status repeater signal level will probably also be below the threshold, so the subscriber unit then begins searching for a new locality.

4.6.5 HOME CHANNEL ALIASING

The LTR-Net Home Channel Aliasing feature increases the number of addresses available on a locality for group calls. It does this by allowing calls to be programmed on non-existent home repeaters.

Each home repeater can be programmed with up 1-239 group ID codes. Assume a locality has four active repeaters and one of these is the status repeater (which is normally not assigned as a home repeater as described in Section 4.6.3). The number a calls that can be programmed are then as follows:

Without Aliasing - 3 x 239 or 717 calls
With Aliasing - 20 x 239 or 4780 calls

When a call is placed on a non-existent home repeater, the subscriber unit automatically uses the next lower numbered active repeater. Refer to Section 2.9.6 for more information.

NOTE: Since this feature does not increase system capacity, adding too many users may result in unsatisfactory operation due to frequent busy conditions.

4.7 OTHER LTR-NET FEATURES

4.7.1 UNIQUE ID CODES

Each LTR-Net subscriber unit in an LTR-Net system is assigned a unique ID (a different unique ID can be programmed for each locality if desired). Up to 65,503 user ID codes are assignable in each locality, and a few other codes are used for system functions. When an LTR-Net subscriber unit places a special call, it transmits its unique ID code along with other information such as the call type. This data is received by the repeater and passed on to the SSM.

Uses of unique ID codes include registering and de-registering on a locality, unit identification, airtime billing, and unique ID calls (see "Unique ID Calls" in Section 4.5.2). A call can also be made to individual

subscriber units using a group call if the group is assigned to only one subscriber unit.

A temporary unique ID code can also be assigned over-the-air. This may be required to allow a full roaming subscriber unit to access a locality that is not part of its network. Temporary unique ID codes are keyed to the ESN of the subscriber unit (see next section). A roaming subscriber unit may also request a temporary unique ID code. If no response is received from the system after three requests, access was denied and the unit must select another locality.

NOTE: The preceding feature has not yet been implemented.

4.7.2 ELECTRONIC SERIAL NUMBER (ESN)

Each subscriber unit, both mobile and portable, is given an electronic serial number at the factory. No two LTR-Net subscriber units should ever have the same ESN. This is a 32-bit number with the first 7 bits reserved for the manufacturer code and the other 25 for the serial number. This allows for up to 128 manufacturers and over 33.5 million serial numbers per manufacturer. The ESN can be interrogated over the air as described next.

4.7.3 ESN AND UNIQUE ID REQUESTS

The system operator can request the Electronic Serial Number (see preceding section) or unique ID (see Section 4.7.1) that is programmed in a subscriber unit. If the ESN is desired, the unique ID code of the subscriber unit is specified, and vice versa. The subscriber unit then responds with the requested information.

4.7.4 INTERROGATE

A system manager can interrogate any subscriber unit in the field to determine if it is in service. The unit is selected by specifying its unique ID code. If it is in service, it automatically responds with an acknowledge message, and this will be indicated on the system manager's screen.

4.7.5 KILL AND SLEEP

If a subscriber unit has been lost or stolen or is being used to interfere with communications, it can be permanently disabled by the kill command or temporarily disabled by the Sleep command. If the Kill command is sent, the unit responds indicating that it has received the message and then it permanently disables itself. It must then be brought back in for reprogramming to make it functional again. If the sleep command is sent instead, the transceiver is disabled until the Interrogate command is sent. Refer to Section 2.9.5 for more information.

4.7.6 OVER-THE-AIR REPROGRAMMING

Any system and group position of a subscriber unit can be reprogrammed over the air. Up to 128 system selections and 128 group selections are allowed. In addition, group alpha tags of up to 16 characters can be reprogrammed if applicable. The subscriber unit to be reprogrammed is selected by specifying its unique ID code. One use of this feature is to allow a subscriber unit to place and receive calls for which it was not originally programmed.

4.7.7 MOVE TO SPECIFIC SYSTEM/GROUP

The system/group currently selected by a subscriber unit can also be dynamically changed over the air. As with reprogramming, the subscriber unit is selected by specifying its unique ID code. When the command is received, the unit automatically changes to the specified system/group. This function may be used, for example, to ensure that the correct system/group is selected to receive an important message.

4.7.8 AUTO-REGISTRATION AND DE-REGISTRATION

LTR-Net subscriber units are programmed with the locality information of all localities they can roam into. This includes the status and home channels and the channel frequencies of the locality repeaters. Roaming must be enabled and an LTR-Net system selected for roaming to occur (it is not necessary to enable scanning).

Normally, a subscriber unit monitors its home channel for incoming call and free channel information. When moving out of range of a locality, the signal from the home repeater decreases below a programmable threshold level. With mobile transceivers, this threshold level is determined by squelch levels (see Section 2.9.3), and with portable trans-

ceivers, it is determined by the percentage of good data messages received over a certain period.

When the home repeater signal strength drops below the threshold, the status channel of that locality is then monitored (see Section 4.6). If its signal strength is also below the threshold, the subscriber unit then begins searching for another locality by checking the status repeater of other programmed localities. If one is located with a signal above the programmed threshold, it will attempt to register on the locality. If no suitable status repeaters could be located, the programmed home repeaters are monitored.

When a new locality is located, the subscriber unit registers on the locality by sending messages indicating its unique ID code and the home channel it will monitor. The system then knows the location of that subscriber unit and will automatically route unique ID calls to the new locality.

Automatic locality search can also be automatically initiated if two consecutive unsuccessful access attempts are made. With mobile transceivers, this feature is always enabled, and with portable transceivers, it can be enabled or disabled by programming.

When a mobile subscriber unit is no longer in service (power is turned off), a de-registration message is automatically sent if possible. This prevents the system from wasting resources trying to reach out-of-service units. Power is automatically held on until this message is sent. De-registration is currently not available with portable subscriber units.

4.7.9 NEW CHANNEL UPDATES

New subscriber units are initially programmed with the channel numbers of all repeaters at each locality. These are then the channels that can be accessed when placing and receiving calls on that locality. If new channels are later added, the subscriber units can be updated with the new channels over the air. This eliminates the need to bring subscriber units back in for reprogramming. Refer to Section 2.9.4 for more information.

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