7780 **Series**

SMARTNET™/SMARTZONE® PORTABLE

778x (800 MHz)

SMARTNET™/SmartZone®/Conventional
7.5 VDC, 1 and 3 Watts
806-824 MHz Transmit
851-870 MHz Receive
Part No. 242-778x-50x

Full Keypad (15-Key) Model   **Limited Keypad (3-Key) Model**

EFJohnson®

First Printing
November 1999

7780-SERIES
SMARTNET™/SMARTZONE®/CONVENTIONAL
FM TWO-WAY
PORTABLE RADIO

7.5 VDC
806-824 MHz Transmit, 851-870 MHz Receive
1-Watt (Low Power), 3-Watts (High Power)
Part No. 242-778x-50x

EFJohnson®

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SECTION 1   GENERAL INFORMATION

1.1 SCOPE OF MANUAL

This service manual contains operating, programming, alignment, and service information for the E.F. Johnson 7780 800 MHz portable transceiver.

1.2 EQUIPMENT DESCRIPTION

1.2.1 INTRODUCTION

The 7780 800 MHz portable transceiver is available in limited keypad (3-key) and full keypad (15-key) models. In addition, standard and intrinsically safe versions are available (see Section 1.2.3). With all versions, up to 16 zones can be programmed, and each zone can contain up to 16 channels resulting in up to 256 total channels. The rotary switch on the top panel provides channel select, and an option switch provides zone select if applicable.

The 7780 is an 800 MHz transceiver which operates on the 920 channels from 806-824 MHz (mobile transmit). The receive channels are 45 MHz above these frequencies from 851-869 MHz. All models can be programmed for both narrow and wide band operation. With narrow band operation, the channel spacing is 12.5 kHz and maximum deviation 2.5 kHz; with wideband operation, the channel spacing is 25 kHz and maximum deviation is 5 kHz. On NPSPAC channels, maximum deviation is 4 kHz (see Section 1.2.5).

1.2.2 OPERATING PROTOCOLS

The 7780 operates on analog channels utilizing the following operating protocols:

- Conventional (non trunked)
- SMARTNET II/SmartZone (trunked)

1.2.3 INTRINSICALLY SAFE MODELS

NOTE: Contact your sales representative to determine the availability of intrinsically safe models.

The intrinsically safe versions of the 7780 (see Section 1.3) meet Factory Mutual standards for operation in certain flammable atmospheres. Basically, the same service information used to service standard

models is also used to service these models. Refer to Section 1.10 for more information on the intrinsically safe rating and additional requirements for servicing intrinsically safe models.

1.2.4 SYSTEMS, CHANNELS, AND ZONES

A zone and channel are selected to place and receive calls. The following describes the relationship between systems, channels, and zones.

Systems

A system as used with this transceiver is a collection of channels (talk groups) belonging to the same repeater site. A system defines all the parameters and protocol definitions required to access a site. Up to 1 conventional system and 15 SmartNet/SmartZone systems can be programmed (16 total). Systems are used for programming purposes only and are not selectable by the user.

Channels

A channel selects a radio channel or talk group in a system as follows:

Conventional Mode - A channel selects a specific radio channel, Call Guard (CTCSS/DCS) squelch coding, and other parameters unique to that channel.

SmartNet/SmartZone Mode - A channel selects a specific talk group, announcement group, emergency group, and other parameters unique to that channel.

As previously described, a maximum of up to 256 channels can be programmed with the preceding modes. The conventional system can be programmed with up to 256 channels, and each SmartNet/SmartZone system can be programmed with up to 256 talk groups (channels).

Therefore it is theoretically possible to program any combination of these systems that produces up to 256 total channels. However, the maximum number may be limited by the available memory. For example, since more memory is required to program a SmartNet system than a conventional system, the total number

of channels decreases as the number of SmartNet systems increases. The programming software displays a bar graph which shows the amount of available memory space that is used by the current data. Refer to Section 3.1.9 for more information.

Zones

A zone is a collection of up to 16 channels of any type (conventional or SmartNet/SmartZone). For example, a zone could include 12 conventional channels and 4 SmartNet channels. Zones are similar to banks used in other EFJohnson transceivers. One use of zones may be to program the channels used for operation in a specific geographical area. Up to 16 zones can be programmed.

1.2.5 NPSPAC MODELS

All 7780 models meet the stricter specifications established by NPSPAC (National Public Safety Panel Advisory Committee) for public safety frequencies from 821-824 and 866-869 MHz. Maximum deviation on NPSPAC channels is 4 kHz, and it is automatically changed to the level set for NPSPAC channels when one of these channels is selected (see Section 6.4).

1.2.6 PROGRAMMING

The transceiver is programmed using a PC-compatible computer, the EFJohnson Remote Programming Interface (RPI), and the PCTrunk™ programming software (see Table 1-1). Programming is described in Section 3. Cloning (programming one transceiver with another) is not available. The operating software is Flash upgradable if required.

1.2.7 TRANSCEIVER ALIGNMENT

Transceiver alignment is performed using the same computer and RPI used to perform programming (see preceding section) and special PCTune™ software. Only two adjustments are made manually and the rest are made electronically using the PCTune software. The transceiver can usually be tuned without disassembling the transceiver to access internal adjustments. Refer to Section 6 for more information.

1.3 PART NUMBER BREAKDOWN

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

2 4 2 - 7 7 8 x - x 0 x

8 - 800 MHz

0 - Standard
1 - Intrin. Safe

3 - SMARTNET/Conv
5 - SMARTNET/SmartZone/Conv

2 - W/accessories, limited (3-key) keypad
3 - W/accessories, full (15-key) keypad
7 - W/o access, limited (3-key) keypad
8 - W/o access, full (15-key) keypad
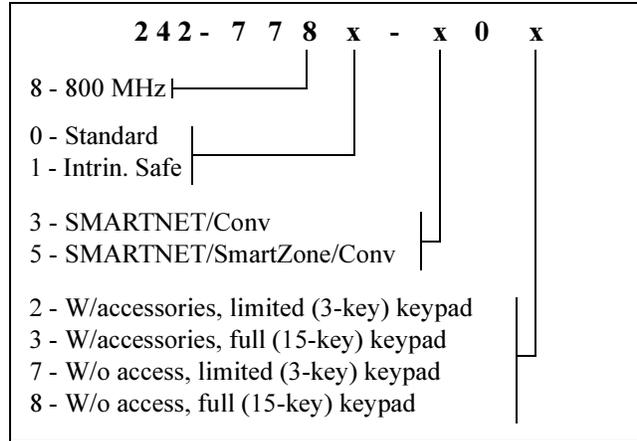
1.4 TRANSCEIVER IDENTIFICATION

The transceiver identification number is printed on a label that is affixed to the back cover. The information in this number is as follows:

Model	Revision Letter	Manufacture Date	Plant	Warranty Number
778 x x	A	419	J	12345

Week No. of Year

J - Japan
Last Digit of Year

3 - SMARTNET
5- SMARTNET/SmartZone

See Section 1.3
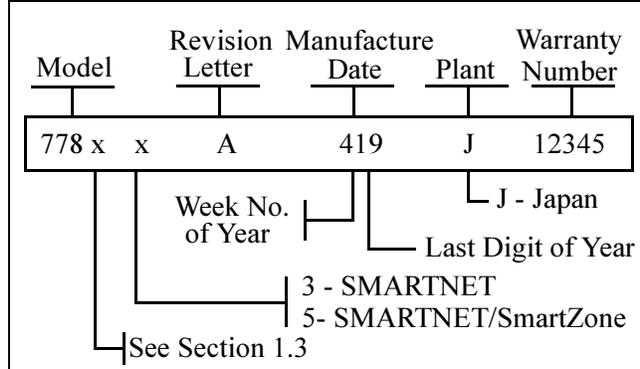
1.5 ACCESSORIES

The accessories that are available for this transceiver are listed in Table 1-1.

1.6 FACTORY CUSTOMER SERVICE

The Customer Service Department of EFJohnson provides customer assistance on technical problems and the availability of local and factory repair facilities. Regular Customer Service hours are 7:30 AM. - 5:30 PM. Central Time, Monday - Friday. The

Customer Service Department can be reached using one of the following telephone numbers:

Toll-Free: (800) 328-3911
(From within continental United States only)

International: (507) 835-6911

FAX: (507) 835-6969

E-Mail: First Initial/Last Name@efjohnson.com
(You need to know the name of the person you want to reach. Example: jsmith@efjohnson.com)

NOTE: Emergency 24-hour technical support is also available at the 800 and preceding numbers during off hours, holidays, and weekends.

When your call is answered at the E.F. Johnson Company, you will hear a brief message informing you of numbers that can be entered to reach various departments. This number may be entered during or after the message using a tone-type telephone. If you have a pulse-type telephone, wait until the message is finished and an operator will come on the line to assist you. When you enter some numbers, another number is requested to further categorize the type of information you need.

You may also contact the Customer Service Department by mail. Please include all information that may be helpful in solving your problem. The mailing address is as follows:

E.F. Johnson Company
Customer Service Department
299 Johnson Avenue
P.O. Box 1249
Waseca, MN 56093-0514

1.7 FACTORY RETURNS

Repair service is normally available through local authorized EFJohnson Land Mobile Radio Service Centers. If local service is not available, the equipment can be returned to the factory for repair. However, it is recommended that you contact the Customer Service Department before returning equipment because a service representative may be able to suggest a solution to the problem so that return of the equipment would not be necessary.

Table 1-1   Accessories

Accessory	Part No.
Battery Pack, NiMH 1400 mAH	
Standard	587-8150-135
Intrinsically safe [1]	587-8150-136
Antenna, flexible half-wave 800 MHz [1]	585-5000-053
Antenna, 800 MHz	501-8100-001
Speaker-microphone, w/360° swiv clip [1]	589-0015-040
Speaker-microphone, heavy duty	589-0015-047
Earphone adapter [1]	585-5000-051
Earphone, standard (for -040/-051) [1]	589-9003-004
Earphone, heavy duty w/coil cord	250-0881-003
Carrying Accessories	
D-swivel for back of transceiver	250-5810-123
Leather case with D-swivel	585-5000-052
Leather belt loop with D-swivel	023-8790-130
Belt Clip, plastic spring loaded [1]	585-5000-054
Battery Chargers	
Single-unit rapid base	585-5020-020
120 VAC power supply for -020 base	585-5020-021
230 VAC power supply for -020 base	585-5020-022
Programming Accessories	
Remote Programming Interface (RPI)	023-9800-000
Cable, RPI to transceiver	597-2002-123
Cable, RPI - computer, 6 ft. (DB9 F - DB9 M)	597-5900-002
PCTrunk programming software, 3.5"	023-9998-453
PCTune tuning software, 3.5" diskette	Contact Cust Serv
SMA to BNC M-F antenna jack adapter	515-3102-060
[1] Factory Mutual approved for use on intrinsically safe models.	

Be sure to fill out a Factory Repair Request Form #271 for each unit to be repaired, whether it is in or out of warranty. These forms are available free of charge by calling Customer Service (see Section 1.6) or by requesting them when you send a unit in for repair. Clearly describe the difficulty experienced in the space provided and also note any prior physical damage to the equipment. Then include a form in the shipping container with each unit. Your telephone number and contact name are important because there

are times when the technicians have specific questions that need to be answered in order to completely identify and repair a problem.

When returning equipment for repair, it is also a good idea to use a PO number or some other reference number on your paperwork in case you need to call the repair lab about your unit. These numbers are referenced on the repair order and it makes it easier and faster to locate your unit in the lab.

Return Authorization (RA) numbers are not necessary unless you have been given one by the Field Service Department. RA numbers are required for exchange units or if the Field Service Department wants to be aware of a specific problem. If you have been given an RA number, reference this number on the Factory Repair Request Form sent with the unit. The repair lab will then contact the Field Service Department when the unit arrives.

1.8 REPLACEMENT PARTS

Replacement parts can be ordered directly from the Service Parts Department. To order parts by phone, dial the toll-free number as described in Section 1.6. When ordering, please supply the part number and quantity of each part ordered. EFJohnson dealers also need to give their account number. If there is uncertainty about the part number, include the designator (C512, for example) and the model number of the equipment the part is from.

You may also send your order by mail or FAX. The mailing address is as follows and the FAX number is shown in Section 1.6.

E.F. Johnson Company
Service Parts Department
299 Johnson Avenue
P.O. Box 1249
Waseca, MN 56093-0514

1.9 INTERNET HOME PAGE

EFJohnson has a site on the World Wide Web that can be accessed for information on the company and such things as products, systems, and regulations. The address is http://www.efjohnson.com.

1.10 INTRINSICALLY SAFE INFORMATION

NOTE: Contact your sales representative to determine the availability of intrinsically safe models.

1.10.1 INTRODUCTION

Intrinsically safe 7780 transceivers have been approved by the Factory Mutual Research Corporation for operation in certain flammable atmospheres. The specific atmospheres in which operation is approved are shown in Section 1.10.5 and also on the label on the back cover of the transceiver.

WARNING

When servicing an intrinsically safe transceiver, these rules must be followed to maintain intrinsic safety:

- Service can be provided only by the factory or by service centers specifically authorized by the Factory Mutual Research Corporation to service E.F. Johnson intrinsically safe transceivers. Contact Factory Mutual at the following address for information concerning their auditing procedure. Contact the E.F. Johnson Customer Service Department as described in Section 1.6 if you have questions.

  Factory Mutual Research Corporation
  1151 Boston-Providence Turnpike
  P.O. Box 9102
  Norwood, Massachusetts 02062
  Phone: (617) 762-4300

- Replace the battery pack only with Intrinsically Safe Battery Pack, Part No. 587-8150-136.

- Do not make any modifications to the circuitry.

- When replacing a part, use only the exact replacement part listed in the service manual parts list.

- Do not install any accessory that is not specifically approved for use with intrinsically safe 7780 models.

1.10.2 DEFINITIONS

Intrinsically Safe - This is a fire rating given to these transceivers by the Factory Mutual Research Corpora-

tion. When electrical equipment is given this rating, the equipment is considered incapable of releasing sufficient electrical and thermal energy under normal operation or specified fault conditions per the testing standard to cause ignition of a specific flammable or combustible atmosphere in its most easily ignited concentration. In other words, this transceiver should not cause a fire or explosion when used in certain flammable atmospheres.

Fault - A defect or electrical breakdown of any component, spacing, or insulation which alone or in combination with other faults may adversely affect the electrical or thermal characteristics of the intrinsically safe circuit (for example, a shorted transistor).

1.10.3 POSSIBLE IGNITION SOURCES

When a transceiver is checked by Factory Mutual, possible sources of ignition are checked. These sources may be electrical (spark) or thermal (heat). The following could be sources of spark ignition:

- Discharge of a capacitive circuit by a fault such as a short circuit.
- Interruption of an inductive circuit.
- Intermittent making or breaking of a resistive circuit.
- Hot-wire fusing.

The following could be sources of thermal ignition:

- Heating of a small-gauge wire or PC board trace.
- High surface temperature of components.

1.10.4 INTRINSICALLY SAFE AND NONINCENDIVE RATINGS

This transceiver is rated intrinsically safe for some types of hazards and nonincendive for other types of hazards. An intrinsically safe rating applies to operation in Division 1 areas, and a nonincendive rating applies to operation in Division 2 areas (see next section). The difference between these ratings is as follows:

The intrinsically safe rating is a higher rating because more severe conditions must be met. To be approved for this rating, the transceiver must not cause

ignition of a particular atmosphere if two of the faults specified in the testing procedure occur. In other words, it must be able to withstand two simultaneous unrelated breakdowns without causing ignition. To receive a nonincendive rating, the transceiver needs to withstand only a single fault without causing ignition of a particular atmosphere.

1.10.5 CLASSIFICATION OF HAZARDOUS AREAS AND ATMOSPHERES

Introduction

This transceiver has been submitted for approval to operate in the following hazardous atmospheres and areas. Contact your sales representative or refer to the label on the back of the transceiver to determine the specific atmospheres and areas for which approval was obtained.

Intrinsically Safe - Class I, II, and III, Division 1, Groups C, D, E, F, and G.

Nonincendive - Class I, Division 2, Groups A, B, C, and D.

Temperature Code - T3C

The meanings of these Class, Division, and Group designations are as follows.

Atmosphere Classification (Class/Group)

For the purposes of testing and approval, various atmospheric mixtures have been grouped on the basis of their hazardous characteristics. Equipment is approved for a class of material and also for the specific gas, vapor, or dust in that class. Class I materials include gases and vapors, and Class II materials include combustible dusts. The various classes and some specific groups of gases in each are shown in Table 1-2.

Area Classification (Division)

Areas are either Division 1, 2, or 3 as shown in Table 1-3. Since a Division 1 area is considered the most hazardous, a transceiver approved for a specific Division 1 area can also be used in the same Division 2 Class/Group.

Table 1-2   Material Classification

Typical Hazard	Group	Class
Acetylene	A	I
Hydrogen	B	I
Ethylene, ethyl ether, cyclopropane	C	I
Gasoline, naphtha, butane, propane, alcohol, acetone, benzol, natural gas	D	I
Metal dust including aluminum, magnesium, and their alloys	E	II
Carbon black, coal, or coke dust	F	II
Flour, starch, or grain dusts	G	II
Ignitable fibers/flyings such as rayon or cotton	-	III

Table 1-3   Area Classification

Division	Area
1	An area where there is or could be an explosive atmosphere most of the time in normal operation
2	An area where an explosive atmosphere exists only as a result of a fault (something going wrong)

1.11 ACCESSING PC BOARDS

1.11.1 INTRODUCTION

The RF unit is located under the back cover and the logic unit is located under the front cover. These boards connect together using a 30-pin connector on the bottom side. Since both boards have numerous parts on the bottom (hidden) side, the board may need to be removed to replace components. To operate the transceiver with the RF unit removed, a special extension test cable is required.

Also inside the transceiver are display and keypad boards. These boards are mounted to the inside of the front cover. Proceed as follows to remove the RF and logic unit board from the transceiver.

1.11.2 REMOVING TRANSCEIVER CASE

To access the internal parts in the transceiver, the plastic case must first be removed. Proceed as follows:

1. If you have not already done so, remove the battery by pressing the release button upward and then sliding it off the transceiver. If the belt clip is mounted on the back, it must also be removed.

2. Remove the three screws in the back and two in the bottom end that are indicated in Figure 1-1. Slide the case off.

3. Removing the two screws in the end also allows the front panel to be removed. Simply lift it outward if desired. If you do not want to remove the front panel, temporarily replace one of the end screws.

CAUTION

Excessive flexing of the ribbon cables may result in broken traces.
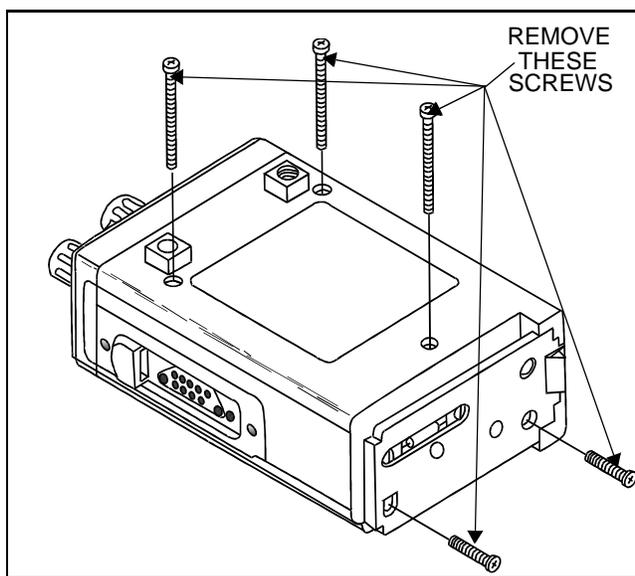
Figure 1-1   Removing Case Screws

1.11.3 UNPLUGGING FLEX CABLES

The flex cable to the front panel and also the accessory jack and PTT switch flex cables to the logic board are inserted into a locking-type connector. To release the cable so that it can be removed from the connector, the locking tangs must be pulled out as shown in the following illustration.

LOCK

UNLOCK
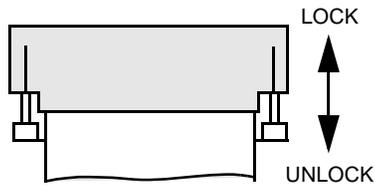
1.11.4 REMOVING RF UNIT

1. Remove the five screws attaching the shield to the PC board.

2. Remove the two screws securing the RF power module to the chassis. Then remove the four stand-offs attaching the RF board to the chassis.

3. Unsolder the antenna connector from the PC board by removing the solder at the locations shown in the following illustration.

SOLDER

WIRE IN
PC BD

ANTENNA
CONNECTOR
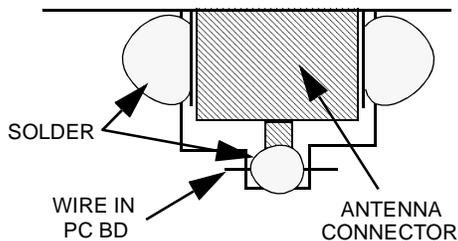
4. Remove the PC board by lifting it upward. The RF-to-logic board connector under the IF board must unplug, so some resistance may be encountered. Do not pull on the IF or PLL board assemblies because they can be easily damaged.

1.11.5 REMOVING LOGIC UNIT

1. Remove the top panel knobs. Then remove the spanner nuts on the quick select and on-off/volume switches. Remove the plastic top panel.

2. Unplug the flex cables from the front panel, accessory connector, and PTT switch as described in Section 1.11.3.

3. Unsolder the DC power flex circuit attached to the logic unit near the accessory flex circuit connector.

4. Remove the four screws attaching the logic unit to the chassis.

5. Remove the logic unit by carefully lifting it outward. The RF-to-logic board connector under the IF board must unplug, so some resistance may be encountered. There is a pry hole (indicated by an arrow) on the lower left edge of the PC board.

7780 SPECIFICATIONS

The following are general specifications intended for use in testing and servicing the transceiver. For current advertised specifications, refer to the 7780 product information sheet available from your E.F. Johnson sales representative. Specifications are subject to change without notice.

GENERAL

Operating Mode	SMARTNET/SmartZone (trunked) and conventional (non-trunked)
Frequency Range	806-824 MHz transmit (SMARTNET/SmartZone/conventional standard)
	851-869 MHz transmit (conventional talk-around)
	851-869 MHz receive
Zones Programmable	Up to 16
Channels Programmable	Up to 16 per zone (256 total)
Transmit/Receive Separation	45 MHz standard, 0 MHz conventional talk-around
Channel Spacing	12.5 kHz - 2.5 kHz maximum deviation
	25 kHz - 5 kHz max deviation standard, 4 kHz NPSPAC
Frequency Stability (tx and rx)	1.5 PPM –22° to +140° F (–30° to +60° C)
Dimensions (with battery and controls)	6.5" H x 2.2" W x 1.2" D
	166 mm H x 56 mm W x 30 mm D
Weight (with battery)	18 oz. (515 g)
Power Source	7.5 VDC nickel metal-hydride (NiMH) battery pack, 1300 maH
Typical Battery Life (5-5-90)	7.5 hours (high power), 8.6 hours (low power)
Compliance	FCC parts 15 and 90
Circuit Protection	3-ampere fuse

RECEIVER

Sensitivity	0.35 µV (12 dB SINAD)
Selectivity	–65 dB at 25 kHz
Spurious and Image Rejection	–60 dB at 25 kHz
Intermodulation	–65 dB at 25 kHz
Audio Output Power	Internal Speaker - 0.5 watt (16-ohm load)
	External - 1.5 V rms (680-ohm load)
Audio Distortion	Less than 5% at rated power (0.5 watt)
Audio Response	+1, –3 dB at 6 dB per octave de-emphasis characteristic
Channel Spread	18 MHz
Current Drain	Standby (squelched) - 92 mA maximum
	Rated Audio Output - 300 mA maximum

TRANSMITTER

High RF Power Output	
Standard Models	3.0 watts (standard mode)
	2.5 watts (conventional talk-around mode)
Intrinsically Safe Models	2.0 watts at less than 1.55 A (standard mode)
	1.8 watt at less than 1.60 A (talk-around mode)
Low RF Power Output	1.0 watt (all models and modes)
Spurious and Harmonic	–60 dB at 25 kHz
FM Hum and Noise	–40 dB at 25 kHz
Audio Distortion	5% maximum at 1 kHz
Audio Frequency Response	+1, –3 dB from a 6 dB per octave pre-emphasis characteristic
Audio Modulation	11K0F3E, 16K0F3E, 14K0F3E
Channel Spread	18 MHz (no degradation); 63 MHz (talk-around)
Current Drain (maximum)	Low Power - 1.3 ampere
	High Power Standard Models -1.75 ampere (2.0 ampere talk-around)
Load Impedance	50 ohms
Duty Cycle (6-6-48 seconds)	5% (Transmit-Receive-Standby)

SECTION 2   TRANSCEIVER OPERATION

2.1 FEATURES

2.1.1 GENERAL FEATURES

- 16 zones with home zone select
- 16 channels per zone (256 channels total)
- Radio-wide scan
- Time-out timer
- LCD 8-character alphanumeric display with 12 status annunciators

2.1.2 CONVENTIONAL FEATURES

- Channel scan with three user programmable scan lists
- Priority channel sampling
- Busy channel lockout (transmit disable on busy)
- Monitor mode
- Call Guard® (CTCSS/DCS) squelch control
- Penalty timer
- Conversation timer
- Repeater talk-around
- DTMF/ANI signaling
- User selectable power output
- Selectable channel display mode

2.1.3 SMARTNET™ II FEATURES

- Group, Enhanced Private Conversation™, Private Conversation II™, and telephone calls
- Call Alert™ (paging)
- Emergency calls
- Messaging
- Priority monitor scanning
- Failsoft operation
- Dynamic regrouping

2.1.4 SMARTZONE® FEATURES

- Site trunking
- Site search
- Site lock/unlock

2.1.5 LIMITED/ENHANCED KEYPAD FEATURES

Limited (3-key) and Enhanced (15-key) models of this transceiver are available. Most features avail-able with the enhanced keypad model are also avail-able with the limited keypad model. The features not available with the limited (3-key) model are as follows:

- Since the DTMF keys are not available, it is not possible to dial telephone numbers or manually send DTMF tones. However, telephone calls can still be placed using prestored numbers.

- With conventional standard scanning, only one scan list is available and it is not user programmable.

- With SMARTNET/SmartZone operation, direct entry of unit ID numbers is not available when making private calls or sending pages. However, these calls can still be made by recalling the ID from a prestored list.

2.2 CONTROLS AND DISPLAY
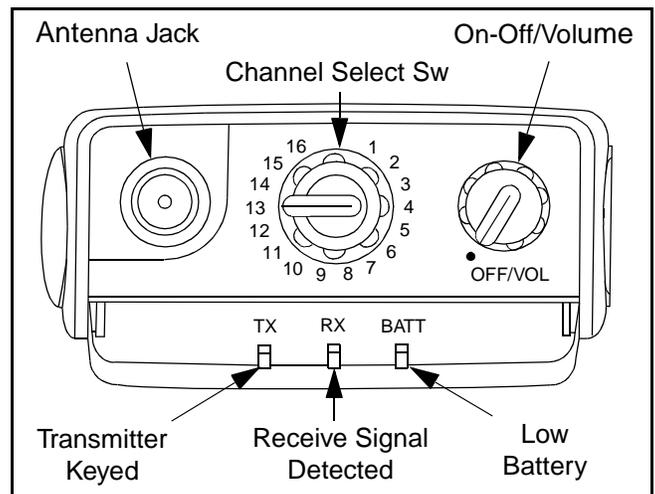
2.2.1 TOP PANEL CONTROLS

On-Off Volume - Turning this knob clockwise turns power on and sets the volume level. Turning it coun-terclockwise to the detent turns power off.

Channel Select Switch - Selects up to 16 prepro-grammed channels. The selected channel is also indi-cated in the display.

Antenna Jack - Connection point for the antenna.
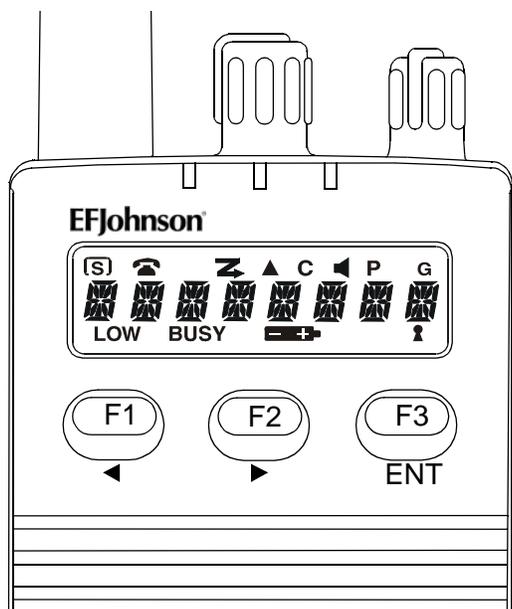
Figure 2-1   Limited Keypad Model
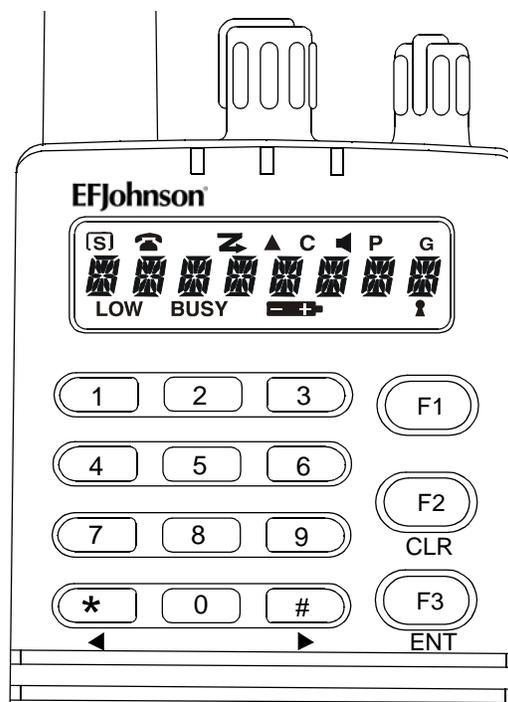
Figure 2-2   Full Keypad Model

2.2.2 TOP PANEL INDICATORS

TX Indicator (Red) - Indicates when the transmitter is keyed.

RX Indicator (Green) - Indicates that the channel may be busy because a carrier is being detected.

Battery Release
Button

Low-Battery Indicator (Amber) - Indicates that the battery charge is getting low and recharging will soon be required.

2.2.3 SIDE CONTROLS

AUX (Auxiliary) - This is a dealer programmable switch that can control various functions (see Section 2.3.4). With the limited keypad (3-key) version, it is also the CLR key.

PTT (Push-To-Talk) - This switch is pressed to key the transmitter. The red TX indicator on the top panel lights when the transmitter is keyed.

FCN (Function) - This is a dealer programmable switch that can control various functions (see Section 2.3.4).

Battery Release Button - Pushing this spring-loaded button upward releases the battery so that it can slide off the radio for recharging or replacement. Turn power off before removing the battery.

Accessory Connector (not shown) - This connector is on the opposite side of the transceiver, and it is the connection point for optional accessories such as a speaker-microphone.

2.2.4 FRONT PANEL KEYS (LIMITED KEYPAD MODEL)

The following keys are located on the front panel shown in Figure 2-1:

F1, F2, F3 - Each of these keys can be dealer programmed to control a specific function (see Section 2.3.4). These keys are also used in menus to scroll left (◄), scroll right (►), and for the Enter (**ENT**) function. The top key on the side (**AUX**) functions as a CLR key in menus.
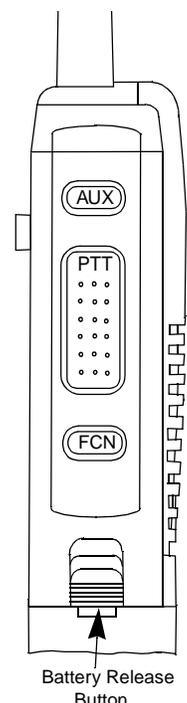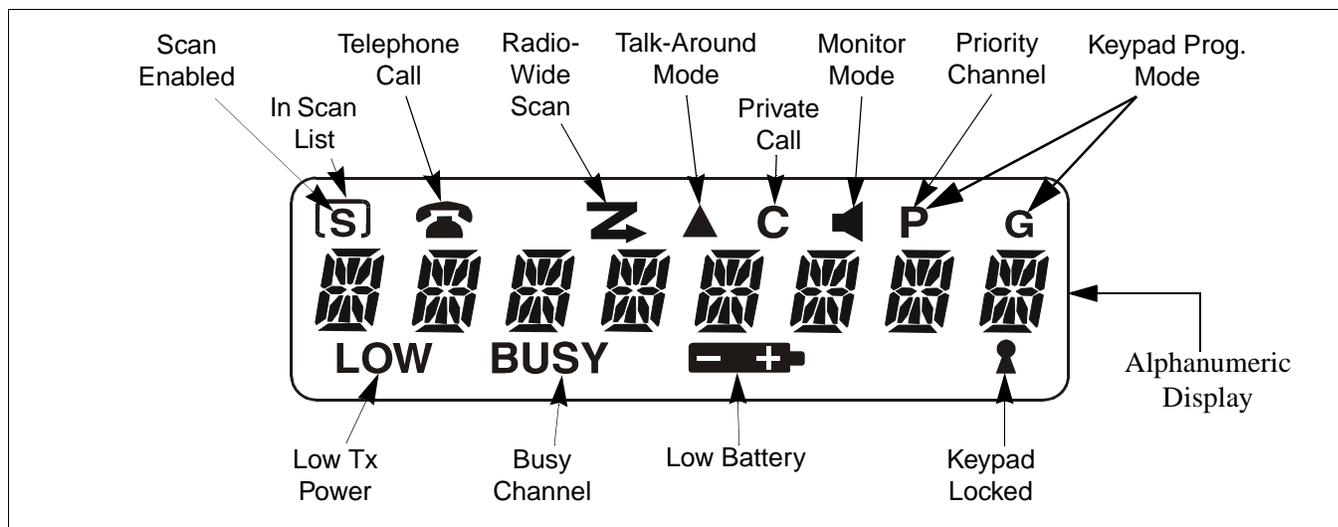
Figure 2-3   Display

2.2.5 FRONT PANEL KEYS (FULL KEYPAD MODEL)

The following keys are located on the front panel shown in Figure 2-2:

0 - 9 - These keys enter a number whenever number entry is required.

F1 - This key is dealer programmable to control a specific function (see Section 2.3.4).

F2 - This key is dealer programmable to control a specific function (see Section 2.3.4). In addition, in menus, it provides the Clear (CLR) function.

F3 - This key is dealer programmable to control a specific function (see Section 2.3.4). In addition, in menus, it provides the Enter (ENT) function.

∗ - This key is dealer programmable to control a specific function (see Section 2.3.4). In addition, in menus, it provides the Scroll Left (◀) function.

 # - This key is dealer programmable to control a specific function (see Section 2.3.4). In addition, in menus, it provides the Scroll Right (▶) function.

2.2.6 DISPLAY

The following information is indicated by the display shown in Figure 2-3:

Alphanumeric Display - This eight-character area of the display indicates alphanumeric messages and feature selection information.

S - Standard scanning is enabled (see Section 2.3.11). Standard and radio wide scanning cannot be enabled at the same time.

⌐¬ - The current conventional channel is in the standard scan list (see Section 2.3.11).

☎ - Telephone (interconnect) mode is selected with SMARTNET/SmartZone channels only (Section 2.5.6).

➤ - Radio-wide scan is enabled (see Section 2.3.11).

▲ - Repeater talk-around is enabled (see Section 2.4.9).

C - A SMARTNET/SmartZone private call is occurring (see Sections 2.5.4 and 2.5.5).

◀ - The conventional monitor mode is enabled (see Section 2.4.4).

P - The selected conventional channel is a priority channel (see Section 2.4.12).

LOW - Low transmit power is selected on a conventional channel (see Section 2.4.10).

BUSY - A busy system or transmit channel is being detected by the Busy Channel Lockout feature (see Section 2.4.5).

⊟ ⊞ - The battery needs recharging (see Section 2.3.6).

🔒 - The keypad has been locked by pressing the Keypad Lock option switch (see Section 2.3.5).

2.3 GENERAL OPERATION

2.3.1 INTRODUCTION

This section (2.3) describes features available with both trunked and conventional operation. For information on features unique to conventional channels, refer to Section 2.4, and for information on features unique to SMARTNET/SmartZone channels, refer to Section 2.5.

2.3.2 TURNING POWER ON AND SETTING VOLUME

Power is turned on and off by the On-Off/Volume switch on the top panel. When power is initially turned on, an alert tone sounds and the radio software version is momentarily displayed. If a SMARTNET/SmartZone channel is selected, the zone alias is then displayed followed by the unit ID (see page 13). The selected channel is then indicated.

To turn power off, turn the On-Off/Volume knob counterclockwise until a click occurs. The display may remain on for a few seconds after power is turned off. It is recommended that power not be turned back on again until the display is blank.

The relative volume level can be determined by noting the position of the index on the On-Off/Volume knob. To enable a reference tone for setting the volume, proceed as follows:

- If key press tones are enabled (see Section 2.3.10), a short tone sounds when front panel keys are pressed.

- If a conventional channel is selected and the Monitor option switch is programmed (see Section 2.4.4), pressing that switch unsquelches/squelches the receiver and either voice or background noise is heard. If a SMARTNET/SmartZone channel is selected, the receiver cannot be manually unsquelched.

2.3.3 BACKLIGHT

The backlight for the display and keypad can be manually turned on by pressing the Backlight option switch if it is available. It can also be dealer programmed to automatically turn on when any key is pressed. It then automatically turns off after the programmed delay so that battery drain is minimized.

2.3.4 OPTION SWITCHES

The programmable option switches are as follows, and the programmable functions are shown in Table 2-1.

- F1, F2, F3
- ✱, # (full keypad 15-key models only)
- AUX, FCN (on side)

If the radio is programmed with both conventional and SMARTNET/SmartZone channels (see Section 2.3.12), these option switches can control a different set of functions for each channel type. For example, the F1 switch could select Hi/Lo Power when a conventional channel is selected and Private Calls when a SMARTNET/SmartZone channel is selected. If no option switch has been programmed to control a particular function, that function may not be available or may be in a fixed mode.

2.3.5 KEYPAD LOCK

If the Keypad Lock option switch has been programmed, the keypad can be locked (disabled) to prevent keys from being accidentally pressed. To lock the keypad, press this switch and a locked keypad is indicated by the 🔒 icon in the display. To unlock the keypad again, press and hold the Keypad Lock switch until a tone sounds (approximately 1 second). The keypad can also be disabled by programming. It is then permanently disabled and cannot be re-enabled by the user.

2.3.6 LOW BATTERY INDICATION

When the battery voltage falls below a preset level, the ![battery icon] icon appears in the display. This icon stays on until power is turned off. In addition, the following low battery indications may be programmed to occur:

- The amber BATT indicator on the top panel lights.
- A beep sounds once per minute in the standby mode.
- A beep sounds each time the PTT switch is pressed.

The battery should be recharged as soon as practical after a low battery indication appears. Refer to Section 5 for more battery information. There is also a battery saver function that can be enabled by programming. This function uses the RSSI level to determine when the site is very near and then automatically switches to the low transmit power output level.

2.3.7 CHANNEL AND ZONE SELECTION

Channel Select

To change the current channel, rotate the 16-position channel selector knob on the top panel to the desired position. With SMARTNET/SmartZone channels, the channel is always indicated by alias (name). With conventional channels, the channel number or frequency may also be displayed (see Section 2.4.2).

Zone Select

A zone is a group of up to any 16 conventional and SMARTNET/SmartZone channels defined by programming (see Section 1.2.4). Up to 16 zones can be programmed for a total of 16 x 16 or 256 channels. One use of zones may be to select groups of channels programmed for operation in different geographical areas or radio systems. Zones are selected as follows:

1. Press the Zone option switch and the alias (name) of the current zone is flashed in the display.

2. Use the number keys to enter the desired zone number or scroll through the available zones using the ◀ and ▶ keys.

3. Once the desired zone is displayed, press the ENT key or wait 4 seconds.

Table 2-1   Option Switch Functions

Function	Conv. Mode	Smart-Net Mode	Smart-Zone Mode	See Section
Backlight	X	X	X	2.3.3
Call Alert		X	X	2.5.7
Call Response		X	X	2.5.4, 2.5.5
Displayed Information	X			2.4.2
Emergency		X	X	2.5.10
High/Low Power	X			2.4.10
Home Zone	X	X	X	2.3.8
Keypad Lock	X	X	X	2.3.5
Keypad Programming	X			2.7
Message		X	X	2.5.8
Monitor	X			2.4.4
Normal/Selective	X			2.4.6
Phone		X	X	2.5.6
Priority	X			2.4.12
Private Call		X	X	2.5.4, 2.5.5
Radio Wide Scan	X	X	X	2.3.11
Repeater Talk-Around	X			2.4.9
Scan	X	X	X	2.3.11
Scan Edit	X			2.4.11
Site Lock			X	2.5.14
Site Search			X	2.5.14
Status		X	X	2.5.9
Tones On-Off	X	X	X	2.3.10
Zone	X	X	X	2.3.7

2.3.8 HOME ZONE

The radio can be programmed with a home zone. Then when power is turned on, the radio can be programmed so that either the home or last selected zone is automatically selected.

If the Home Zone option switch is programmed, it can be used to quickly select or change the home zone. To select the home zone, momentarily press this switch. Then to change the home zone to the currently selected zone, press and hold this switch until a tone sounds (approximately 1 second).

2.3.9 TIME-OUT TIMER

The time-out timer disables the transmitter if it is keyed for longer than the programmed time. On each

channel it can be programmed for times from 15 seconds up to 3 minutes, 45 seconds or disabled (not used). If the transmitter is keyed continuously for longer than the programmed time, the transmitter is disabled and an invalid condition tone sounds. Five seconds before time-out occurs, an alert tone sounds to indicate that time-out is approaching. The timer and tone are reset by releasing the PTT switch.

One use of this feature is to prevent a channel from being kept busy for an extended period by an accidentally keyed transmitter. It can also prevent possible transmitter damage caused by transmitting for an excessively long period. Conventional channels can also be programmed with the Penalty and Conversation timers that are described in Sections 2.4.7 and 2.4.8.

2.3.10 TONE ENABLE/DISABLE

The supervisory tones (see Section 2.6) can be enabled and disabled by the Tones On-Off option switch if it is programmed. When tones are enabled by this switch, "TONE ON" is momentarily displayed and a tone sounds. Conversely, when tones are disabled, "TONE OFF" is displayed and no tone sounds. If the Tones On-Off option switch is not programmed, tones are fixed in the on or off mode by programming.

2.3.11 SCANNING

Introduction

Scanning cycles through a list of channels, called a "scan list", checking each for messages. When a message is detected that your 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).

There are two basic scan modes: Standard and Radio Wide. The Standard mode is unique to the type of channel selected (conventional or SMARTNET/ SmartZone), and the Radio Wide mode is the same regardless of the channel type selected. Only one of these scan modes can be enabled at a time. Therefore, if standard scanning is enabled while radio wide scanning is occurring, radio wide scanning is automatically

disabled and vice versa. More information on these modes follows.

Standard Scanning

Standard scanning monitors only channels that are the same type as that currently selected. Therefore, if a conventional channel is selected, only conventional channels are scanned, and if a SMARTNET channel is selected, only SMARTNET channels are scanned. Standard scanning is turned on and off by the Scan option switch as follows. If this switch is not programmed, standard scanning is not available.

- To turn standard scanning on, press the Scan option switch. Scanning is enabled when the "**S**" icon is indicated in the upper left corner of the display and SCAN x (conventional) or SCAN ON (SMARTNET/SmartZone) is briefly displayed. The "x" is the number of the conventional scan list (1, 2, or 3) that is selected. Refer to Section 2.4.11 for more information.

- To turn scanning off, press the Scan option switch again. The "**S**" icon is then no longer indicated and "SCAN OFF" is briefly displayed.

- If the zone or channel is changed while scanning is selected, scanning continues on the same or a different scan list (see scan list information which follows).

Radio Wide Scanning

Radio wide scanning monitors the channels in the preprogrammed radio wide scan list (see information which follows). This list may contain up to 16 channels of any type (conventional or SMARTNET/Smart-Zone) assigned to any zone. Radio wide scanning is turned on and off by the Radio Wide Scan option switch as follows. If this switch is not programmed, radio wide scanning is not available.

- To turn radio wide scanning on, press the Radio Wide Scan option switch. The ⚡ icon is then displayed continuously and "RWS ON" is displayed briefly.

- To turn radio wide scanning off, press the Radio Wide Scan option switch again. The ⧉ icon is then no longer indicated and "RWS OFF" is displayed briefly.

- If the zone or channel is changed while radio wide scanning, radio wide scanning continues normally.

Scan Resume Delay

When a message is received or transmitted while scanning, there is a programmable delay before scanning resumes. The delay after receiving a call prevents another message from being received before a response can be made, and the delay after transmitting a call ensures that a response is heard to your call instead of another message occurring on some other channel.

Standard Mode Scan List

NOTE: The selected channel is always scanned.

With conventional operation when using the full keypad (15-key) model, up to three scan lists can be programmed. The list that is scanned is selected by the Scan option switch as described in Section 2.4.11. Selecting another conventional channel does not change the current scan list. In addition, the scan lists are user programmable if the Scan Edit option switch is programmed. With limited keypad (3-key) models, only Scan List 1 can be scanned, and it is not user programmable.

With SMARTNET/SmartZone operation, each channel can be programmed so that one of up to three different scan lists is automatically selected. Channels can also be programmed so that scanning is automatically disabled when they are selected. SMARTNET/SmartZone scan lists are not user selectable or programmable.

Radio Wide Mode Scan List

With radio wide scanning, there is only one preprogrammed scan list available regardless of the type of channel selected, and it is not user programmable.

Determining Which Channels are in Scan List

Channels in the radio wide and standard SMARTNET/SmartZone scan lists are not indicated. With standard conventional scanning, the selected channel is in the current scan list if the box ⬚ icon (around "**S**") is indicated in the upper left corner of the display.

Nuisance Channel Delete

With standard scanning, both conventional and SMARTNET/SmartZone channels can be temporarily deleted from the scan list. This feature is not available with radio wide scanning. Proceed as follows:

NOTE: The selected channel and conventional priority channels cannot be deleted from the scan list.

1. While receiving a message on the channel to be deleted, press and hold the Scan option switch until the alert tone sounds (about 1 second).

2. The channel is then deleted and scanning of the remaining channels in the scan list resumes.

3. Deleted channels are added back into the scan list if either of the following occur:

   - Scanning is turned off and then on again using the Scan switch.
   - Transceiver power is turned off and then on again.

2.3.12 CONVENTIONAL AND SMARTNET/ SMARTZONE OPERATION

Introduction

Each selectable channel is programmable for either conventional, SMARTNET, or SmartZone operation. For example, Zone 1/Channel 1 could be a conventional channel, Zone 1/Channel 2 a SMARTNET channel, and so on. More information on these modes follows.

Conventional Operation

This is a non-trunked operating mode which accesses independent radio channels (there is no automatic access to several channels as with trunked oper-

ation). Monitoring before transmitting may not occur automatically in this mode, so the channel may have to be manually monitored before transmitting (see Section 2.4.3). Selecting a conventional channel selects a transmit and receive frequency and other parameters such as Call Guard squelch coding.

SMARTNET/SmartZone Operation

This is a trunked operating mode that uses ID codes to select which mobiles are being called and which calls are received. Monitoring is performed automatically and special messages and tones indicate busy and out-of-range conditions. Enhanced features include roaming (SmartZone only), telephone, private, and emergency calls, Call Alert, and messaging. Operating features unique to SMARTNET/SmartZone channels are described in Section 2.5.

This radio supports only the SMARTNET II trunking protocol. It does not support the SMARTNET I (also referred to as Type I) protocol. When a SMARTNET or SmartZone channel is selected or the radio is powered up on a SMARTNET/SmartZone channel, it searches for a control channel and attempts to register on the radio system. Once a control channel is found, the alias (name) of the selected channel is displayed. If a control channel could not be found (because of an out of range condition or the system ID is not correct, for example), "NO SYS" is displayed and the radio continues to search for a control channel.

The control channel transmits and receives system information to and from all radios registered on the system. Therefore, once a control channel is found, it is continuously monitored for incoming call information and is used to make call requests. The radio automatically changes to a traffic channel to place and receive calls and then returns to the control channel when the call is complete.

2.4 CONVENTIONAL FEATURES

2.4.1 INTRODUCTION

The following information describes features unique to the conventional operating mode (described briefly in Section 2.1.2). Refer to Section 2.3 for information on features common to all operating modes, and to Section 2.5 for information on features unique to the SMARTNET/SmartZone mode.

2.4.2 DISPLAY MODE SELECTION

If the Displayed Information option switch is programmed, the display mode used to indicate conventional channels can be user selected. Pressing this switch cycles between the following modes. The selected mode does not change when power is turned off. If the Displayed Information option switch is not programmed, the Alias mode is always used.

Alias - The preprogrammed alphanumeric tag for the channel is displayed.

Number - The channel number from 1-16 is displayed.

Frequency - The receive frequency of the selected channel is displayed in megahertz.

2.4.3 MONITORING BEFORE TRANSMITTING

With conventional operation, channels are monitored automatically or manually as follows:

Automatic Channel Monitoring

If the selected channel is programmed for the Busy Channel Lockout feature, monitoring is performed automatically. Refer to the description of this feature in Section 2.4.5 for more information.

Manual Channel Monitoring

The automatic monitoring just described may not be programmed or it may occasionally disable the transmitter even if the channel is not in use. In this case, the channel must be monitored manually as follows:

Rx Indicator - With scanning disabled, note if the green RX indicator on the top panel is on. If it is not, the channel is not being used and the call can be transmitted. If it is on, a carrier is being detected, so the channel may be busy (see next paragraph).

Monitor Mode - There may be times when the busy indication is displayed even though no one is using the channel. Monitoring should then be performed by disabling Call Guard squelch using the Normal/ Selective option switch as described in Section 2.4.6 or the monitor mode described next.

2.4.4 MONITOR MODE

The monitor mode temporarily disables squelch control features (such as Call Guard squelch) so that all messages are heard on the selected channel. It also overrides the Busy Channel Lockout feature (see next section) and temporarily halts scanning.

To monitor the selected transmit channel, select the monitor mode by briefly pressing the Monitor option switch (if available). The ◀ icon is displayed and the receiver unsquelches (even if no carrier is detected). To disable the monitor mode and return to normal operation, press the Monitor switch a second time.

To monitor the selected receive channel instead of the transmit channel, press and hold the Monitor switch until the alert tone sounds (approximately 1 second). This function may be useful, for example, during weak signal conditions if intermittent squelching makes a message difficult to understand.

2.4.5 BUSY CHANNEL LOCKOUT

The Busy Channel Lockout feature (also called Transmit Disable On Busy) automatically disables the transmitter if the channel is busy when the PTT switch is pressed. When a busy condition is detected by this feature, the transmitter is disabled, "BUSY" is indicated in the lower part of the display, and a tone similar to a standard telephone busy tone sounds until the PTT switch is released. This feature is programmed to operate in one of the following modes on each channel:

  Off - The transmitter keys even if the channel is busy.
  Noise - The transmitter is disabled if any signal is detected on the channel.
  Tone - The transmitter is disabled if the detected squelch coding is not correct.

If busy override is permitted by programming, it is possible to transmit even when the transmitter is disabled by this feature. Simply quickly release the PTT switch and press it again.

2.4.6 CALL GUARD SQUELCH

General

Call Guard® squelch (also called CTCSS/DCS signaling) can be programmed on conventional channels. This feature eliminates distracting messages intended for others using the channel by using a subaudible tone or digital code to control the squelch. This tone or code is unique to a user or talk group on that channel. It is transmitted by the mobile placing a call, and if Call Guard squelch is programmed in the mobile receiving the call, it must detect the correct tone or code to receive the call.

Call Guard Squelch Enable/Disable

To disable Call Guard (Selective) squelch so that all messages on the selected or scanned channels are heard, press the Normal/Selective option switch if programmed. The receiver unsquelches only if a carrier is detected. To re-enable Call Guard squelch, press the Normal/Selective switch again.

When Call Guard squelch is disabled by this switch, "SQ NORM" is flashed on the lower line of the display, and when it is enabled, "SQ SLCT" is flashed. The selected mode does not change when other channels are selected or power is cycled. Call Guard squelch can also be disabled by the monitor mode described in Section 2.4.4.

Changing the Call Guard Code

If using the full keypad (15-key) model and the ability to change Call Guard codes has been enabled by programming, the transmit and receive codes from one channel can be temporarily or permanently reassigned to all channels of the current zone. Proceed as follows:

1. Using the number keys, enter the number of the channel that is programmed with the code you want to reassign to all channels (only channels 1-9 can be selected). See Section 2.4.2 for information on how to display channel numbers.

2. The display then briefly indicates "CODE x", where "x" is the key that was pressed. The codes assigned

to that channel are then reassigned to all the other channels in the current zone. The reassignments remain in effect even after power is cycled.

3. To restore all Call Guard codes in the current zone to the original settings, press the "0" key.

2.4.7 PENALTY TIMER

A penalty timer may be programmed on conventional channels to prevent transmissions for a period of time after the time-out timer described in Section 2.3.9 disables the transmitter. The penalty timer starts when the PTT switch is released after the transmitter has been disabled. If the PTT switch is pressed during the penalty time, the time-out indication occurs again. A beep sounds when the penalty timer expires and the transmitter can then be keyed.

2.4.8 CONVERSATION TIMER

A conversation timer can be programmed on conventional channels to limit the total length of a conversation rather than just the length of each transmission as with the time-out timer. This timer is reset when the time between transmissions exceeds the penalty time just described. A warning tone sounds 5 seconds before the conversation timer expires. When it expires, the transmitter is disabled and a warning tone sounds. The transmitter remains disabled for the length of the penalty time, and a beep sounds when it can be keyed again.

2.4.9 REPEATER TALK-AROUND

Normally, all transmissions go through a repeater which usually increases range. However, if out of range of the repeater, you cannot talk to anyone else on that channel even though the mobile you are calling may be only a short distance away. To allow communication when this situation occurs, repeater talk-around can be used to transmit on the receive frequency. This allows direct communication with a mobile without going through a repeater.

Repeater talk-around can be selected if the Repeater Talk-Around option switch is programmed. When talk-around is enabled by this switch, the ▲ icon is displayed and "RTA ON" is flashed in the display. Then when it is disabled by pressing this

switch again, that icon is no longer displayed and "RTA OFF" is flashed. Changing channels or turning power off does not change the selected talk-around mode.

2.4.10 POWER OUTPUT SELECT

If the High/Low Power option switch is programmed and power selection is permitted on the current channel by programming, either high or low transmitter power can be selected. Generally, the high power setting transmits longer distances but uses more battery power, and the opposite occurs with the low power setting. When the low power is selected on the current channel, "LOW" is indicated continuously near the bottom of the display.

Pressing the High/Low Power switch toggles the power setting. The new level is flashed in the display when this switch is pressed as "HI POWER" or "LO POWER". If power selection is not permitted on the channel, the fixed power level is flashed and no power change occurs. Turning power off or changing channels does not change the power setting selected for a channel.

2.4.11 CONVENTIONAL MODE SCANNING

General

The following information describes scanning features unique to conventional operation. Scan operation common to all modes is described in Section 2.3.11, and scan operation unique to SMARTNET/ SmartZone operation is described in Section 2.5.12.

Selecting a Scan List

When standard scanning with full keypad (15-key) models, one of up to three scan lists can be selected. These lists can be user programmed as described in the information which follows. With limited keypad (3-key) models, only one scan list is available and is not user programmable. However, nuisance channels can still be temporarily deleted as described in Section 2.3.11.

Proceed as follows to select a scan list with full keypad models:

1. Press the Scan option switch to enable scanning. The currently selected scan list is momentarily indicated as "Scan x", where "x" is the list number (1-3).

2. To select one of the other lists, press the number key corresponding to the desired list (1-3) and the selected list is then momentarily displayed as "Scan x". The selected scan list is stored in memory and does not change until this procedure is repeated.

Programming a Scan List

With full keypad (15-key) models, each of the three scan lists is user programmable if the Scan Edit option switch is programmed and user programming of the list is allowed. Otherwise, the channels in these lists are determined by dealer programming. User scan list programming is not available with limited keypad (3-key) models. Proceed as follows to program a scan list:

1. Make sure all scanning is off (neither the standard scan "**S**" icon or radio-wide scan ➤ icon is displayed).

2. Press the Scan Edit option switch and then within 2 seconds press the number key corresponding to the scan list you want to edit (1-3). If a list is not selected within the allotted time, the last active conventional standard scan list is automatically selected. The selected list is indicated as "SCAN x". If user programming is disabled on a list, "NO LIST" is momentarily displayed and it cannot be edited.

3. Select the channel you want to add or delete using the ◀ and ▶ keys. To change zones, press the F1 key and select the new zone.

4. If the selected channel is in the scan list, the box ⬜ around "**S**" is indicated in the upper left corner of the display. To add the channel to the scan list, press the "1" key, and to delete the channel, press the "2" key.

   NOTE: The priority channel cannot be deleted (see Section 2.4.12).

5. To exit this mode and save the changes, press the ENT or CLR key.

Transmitting in Scan Mode

Each conventional scan list can be programmed for one of the following modes. These modes determine if priority sampling occurs and also the channel on which transmissions occur while scanning. Refer to the next section for more information.

No Priority - No priority channel sampling occurs when the list is selected. The radio transmits on the selected channel.

Priority/Tx Priority - Priority sampling occurs and the priority channel is the one programmed in the selected scan list. The radio transmits on the priority channel.

Priority/Tx Selected - Priority sampling occurs and the priority channel is the one programmed in the selected scan list. The radio transmits on the selected channel.

Priority on Selected - The priority channel is always the selected channel. The radio transmits on the selected channel.

Talkback - No priority sampling occurs. The radio transmits on the channel of a call while scanning is halted. Then once scanning resumes, it transmits on the selected channel.

2.4.12 PRIORITY CHANNEL SAMPLING

General

The priority channel sampling feature ensures that when standard scanning, messages on the priority channel are not missed while listening to a message on some other channel. The transceiver can be programmed so that the priority channel is a fixed channel associated with the current scan list, the currently selected channel, or not used (see preceding section). When the selected channel is a priority channel, **"P"** is indicated in the upper right part of the display.

Priority channel sampling occurs only with Standard conventional scanning. It does not occur with Radio Wide scanning, when listening to any type of SMARTNET/SmartZone call, or when transmitting. A series of "ticks" may be heard when the priority

channel is sampled while listening to a message on some other channel.

The priority sampling times are programmed by the following parameters:

Lookback Time A - This time determines how often the priority channel is checked for activity. Times of 0.25-4.00 seconds in 0.25-second steps can be programmed.

Lookback Time B - This time determines how often the priority channel is checked once an incorrect Call Guard (CTCSS/DCS) code is detected. Since it takes much longer to detect an incorrect Call Guard signal than a carrier, this time should be relatively long to prevent the interruptions from making a message difficult to understand. Times of 0.5-8.0 seconds can be programmed in 0.5-second steps.

Changing The Priority Channel

If a specific priority channel is associated with the current scan list, it can be changed if the Priority option switch is programmed. Proceed as follows:

1. Make sure all scanning is off (neither the standard scan "**S**" icon nor radio-wide scan ⚡ icon displayed).

2. Select the channel that you want to be the priority channel using the channel selector switch on the top panel. If the channel is in a different zone, also select the appropriate zone.

3. Press the Priority option switch and the "**P**" icon is displayed to indicate that the selected channel is now the priority channel.

2.4.13 STANDARD CONVENTIONAL CALLS

Standard conventional calls are calls to or from other mobile units on the selected channel. The proper coded Call Guard signaling (see Section 2.4.6) may need to be transmitted for them to receive your call and also for you to receive their calls. Proceed as follows to place and receive these calls:

Placing a Standard Conventional Call

1. Turn power on and set the volume as described in Section 2.3.2. Select the channel programmed for the mobile you want to call (see Section 2.3.7).

2. Monitor the channel automatically or manually as described in Section 2.4.3.

3. Press the PTT switch and the call proceeds as follows:

   • If the Busy Channel Lockout feature is programmed on the channel, the transmitter is automatically disabled if the channel is busy (see Section 2.4.5).

   • Otherwise, busy and out-of-range conditions are not indicated and speaking can begin after monitoring the channel.

4. Press (and hold) the PTT switch to talk and release it to listen.

Receiving a Standard Conventional Call

1. Select or scan the channel programmed for the call you want to receive (refer to Sections 2.3.11 and 2.4.11 for more scanning information).

2. When the call is received, press the PTT switch to talk and release it to listen. If scanning, you may have to respond before scanning resumes to ensure that the response occurs on the channel of the call.

2.4.14 DTMF/ANI SIGNALING

DTMF (Dual Tone Multi-Frequency) tones can be generated manually or automatically for ANI (Automatic Number Identification) and other purposes. The following options may be enabled by dealer programming for each conventional channel:

DTMF Keypad - With full keypad (15-key) models only, pressing 0-9, ＊ , or # on the keypad while holding the PTT switch transmits the corresponding tone until the key is released.

Pre-Tx ANI - A preprogrammed ANI sequence is automatically sent when you press the PTT switch.

Post-TX ANI - A preprogrammed ANI sequence is automatically sent each time you release the PTT switch.

Disabled - All DTMF signaling is disabled.

2.5 SMARTNET/SMARTZONE FEATURES

2.5.1 INTRODUCTION

The following information describes features unique to the SMARTNET and SmartZone operating modes described briefly in Section 2.3.12. Refer to Section 2.3 for information on features common to all operating modes, and to Section 2.4 for information on features unique to the conventional mode.

2.5.2 VIEWING UNIT ID

Each radio in a SMARTNET system is identified with a system ID and Unit ID. To display the Unit ID, make sure that a SMARTNET channel is selected and then turn power off and then on again. The software version number, current zone, and Unit ID are then displayed in sequence. The six-digit Unit ID is displayed as IDxxxxxx.

2.5.3 STANDARD GROUP CALLS

Standard group calls are between you and another mobile, group of mobiles, or a control station (a radio at a fixed location). Most calls you make will probably be this type.

Placing a Standard Group Call

1. Turn power on and set the volume as described in Section 2.3.2. Select the channel programmed for the talk group you want to call (see Section 2.3.7). A regular or announcement talk group can be selected.

2. Press the PTT switch and when the alert tone sounds, begin talking. Other indications that may occur are as follows:

   - If the busy tone sounds and "BUSY" is displayed, the system is busy. Release the PTT switch and wait for the call back tone to sound. Then press the PTT switch within 3 seconds and begin talking.

   - If the radio system cannot be accessed within 500 ms of pressing the PTT switch, a continuous tone sounds until the system is accessed or the PTT switch is released.

   - If your unit ID is invalid, the call is being made to an invalid group ID, or group calls are not allowed, "INVALID ID" is displayed and an alert tone sounds.

Receiving a Standard Call

Group calls are automatically received if a SMARTNET/SmartZone channel is selected. The display continues to indicate the selected channel alias (name) when a call is received.

2.5.4 ENHANCED PRIVATE CONVERSATION CALLS

General

Private calls allow you to place a call to a specific mobile unit. Either the Enhanced Private Conversation™ or Private Conversation II™ modes may be programmed depending on the capabilities of the radio system. The Enhanced Private Conversation mode is described in the following information, and the Private Conversation II mode is described in Section 2.5.5.

The Private Call option switch is required to place these calls, and either that switch or the Call Response option switch is required to receive them. Proceed as follows.

Placing an Enhanced Private Conversation Call

This call can be initiated by selecting the unit ID from a call list (list entry) or by directly entering it using the keypad (direct entry). Direct entry is available with full keypad (15-key) models only. Proceed as follows:

List Entry Method (All Models)

1. With a SMARTNET/SmartZone channel selected, momentarily press the Private Call option switch. The private call mode is indicated by "**C**" in the upper part of the display. The tag (alias) of the last ID called is displayed if it matches an ID in your call list. Otherwise, the last ID called is displayed.

2. Enter the index of the desired ID if you know it or scroll through the list using the ◀ and ▶ keys until you find the desired ID. Press the **CLR** key to cancel the call.

3. Press the PTT switch or the **ENT** key to initiate the call. The display then indicates the alias of the destination radio. Proceed to the bulleted list following the next method for conditions that may occur next.

Direct Entry Method (Full Keypad Models Only)

1. With a SMARTNET/SmartZone channel selected, press and hold the Private Call option switch until a tone sounds (approximately 1 second). The last ID called is displayed, and the private call mode is indicated by "**C**" in the upper part of the display.

2. Using the 0-9 keys, enter the 6-digit ID of the mobile unit you are calling. Press the ◀ key to erase the last digit entered or press the **CLR** key to cancel the call.

3. Press the PTT switch or the **ENT** key to initiate the call. If the entered ID is invalid, "INVALID" is momentarily displayed and the call is not initiated. If the entered ID is valid, the display indicates the alias of the ID if it matches an ID in your call list. Otherwise, the ID you entered continues to be displayed. Any of the following conditions may then occur:

   • If the radio you are calling is on the air, telephone type "ringing" is heard for 20 seconds or until the called party answers.

   • If the called party answers and the call is successful, the person's voice is heard and the call is carried on the same as a group call. To end the call at any time, press the **CLR** key.

   • If the called party does not answer within 20 seconds, "NO ANSWR" is displayed and a continuous tone sounds. End the call by pressing the **CLR** key.

   • If the called radio is not in service, no ringing is heard, "NO ACK" is displayed, and a continuous tone sounds. End the call by pressing the **CLR** key.

• If neither your radio nor the radio being called is authorized to make unit-to-unit calls, "REJECT" is displayed and a continuous tone sounds. End the call by pressing the **CLR** key.

• If the called party answers but the radio system is busy, four low tones sound and "BUSY" and "WAIT" are alternately displayed. When the system is no longer busy, the called party automatically responds.

• If an out-of-range condition exists or the radio system is not in service, "LOST CALL" is displayed and a continuous tone sounds. End the call by pressing the **CLR** key.

Receiving an Enhanced Private Conversation Call

These calls are automatically received if a SMARTNET/SmartZone channel is selected. Proceed as follows:

1. When a call is received, a recurring unit call tone (three beeps) sounds for up to 20 seconds, and "CALL RCV" and the current channel alias are alternately displayed.

2. To answer the call, press the Private Call option switch and then the PTT switch and begin talking. The private call mode is indicated by "**C**" in the upper part of the display. The alias of the incoming call is displayed if the ID is in your call list. Otherwise, the unit ID is displayed. *NOTE: If the Private Call option switch is not pressed before the PTT switch, a group call is transmitted on the selected group.*

   • To end the call when the conversation is complete or at any other time, press the **CLR** key.

   • If unit-to-unit (private) calls are not permitted (Private Call switch not programmed), press the Call Response option switch, if available, to answer the call.

   • If the call is not answered within 20 seconds, it is automatically terminated.

   • If the radio system is busy, four low tones sound and "BUSY" and "WAIT" are alternately

displayed. When the system is no longer busy, the call back tone (four beeps) is heard and your radio automatically starts transmitting. Press the PTT switch to continue the call.

- To ignore an incoming call, press the **CLR** key or wait 20 seconds until the recurring unit call tone stops sounding. *NOTE: If the CLR key is programmed for the Call function, it will not clear the call.*

2.5.5 PRIVATE CONVERSATION II CALLS

General

Private calls allow you to place a call to a specific mobile unit. Either the Enhanced Private Conversation™ or Private Conversation II™ modes may be programmed depending on the capabilities of the radio system. Operation in the Enhanced Private Conversation mode was described in Section 2.5.4, and operation in the Private Conversation II mode is described in the following information.

The Private Call option switch is required to place these calls, and either that switch or the Call Response option switch is required to receive them. Proceed as follows.

Placing a Private Conversation II Call

This call can be initiated by selecting the unit ID from a call list (list entry) or by directly entering it using the keypad (direct entry). Direct entry is available with full keypad (15-key) models only. Proceed as follows:

List Entry Method (All Models)

1. With a SMARTNET/SmartZone channel selected, momentarily press the Private Call option switch. The private call mode is indicated by "**C**" in the upper part of the display. The tag (alias) of the last ID called is displayed if it matches an ID in your call list. Otherwise, the last ID called is displayed.

2. Enter the index of the desired ID if you know it or scroll through the list using the ◀ and ▶ keys until you find the desired ID. Press the **CLR** key to cancel the call.

3. Press the PTT switch to initiate the call. The display then indicates the alias of the destination radio. Wait approximately 1 second and then begin talking. Proceed to the bulleted list which follows the next method for conditions that may then occur.

Direct Entry Method (Full Keypad Models Only)

1. With a SMARTNET/SmartZone channel selected, press and hold the Private Call option switch until a tone sounds (approximately 1 second). The last ID called is displayed and the private call mode is indicated by "**C**" in the upper part of the display.

2. Using the 0-9 keys, enter the 6-digit ID of the unit you are calling. Press the ◀ key to erase the last digit entered or press the **CLR** key to cancel the call.

3. Press the PTT switch to initiate the call. If the entered ID is invalid, "INVALID" is momentarily displayed and the call is not initiated. If the entered ID is valid, the display indicates the alias of the ID if it matches an ID in your call list. Otherwise, the ID you entered continues to be displayed. Wait approximately 1 second and then begin talking. Any of the following conditions may then occur.

- If the called party answers and the call is successful, the person's voice is heard and the call is carried on the same as a group call. To end the call at any time, press the **CLR** key.

- If the radio system is busy, four low tones sound and the "BUSY" and "WAIT" are alternately displayed. When the system is no longer busy, the call back tone (four beeps) is heard and a channel is automatically acquired. Press the PTT switch to continue the call.

Receiving a Private Conversation II Call

Unit-to-unit calls are automatically received if a SMARTNET/SmartZone channel is selected. Proceed as follows:

1. When a call is received, an alert tone sounds and the caller's voice is heard. While voice is heard, "**C**" is indicated in the upper part of the display and "CALL RCV" and the current channel alias are alternately displayed.

2. To answer the call, press the Private Call option switch and then the PTT switch and begin talking. The private call mode is indicated by "**C**" in the upper part of the display. The alias of the incoming call is displayed if the ID is in your call list. Otherwise, the unit ID is displayed. *NOTE: If the Private Call option switch is not pressed before the PTT switch, a group call is transmitted on the selected group.*

   • To end the call when the conversation is complete or at any other time, press the **CLR** key. If the call is not answered within 20 seconds, it is automatically terminated.

   • If private calls are not permitted (Private Call switch not programmed), press the Call Response option switch, if available, to answer the call.

2.5.6 TELEPHONE CALLS

General

   Telephone calls allow calls to be placed and received over the public telephone system using the transceiver. If the transceiver is programmed for telephone calls (Phone option switch programmed), they are placed and received as follows:

Placing a Telephone Call

   Telephone calls can be placed by selecting the number from a preprogrammed phone number list (list entry) or by directly entering it using the keypad (direct entry). Direct entry is available with full keypad (15-key) models only. Proceed as follows:

List Entry Method (All Models)

1. With a SMARTNET/SmartZone channel selected, momentarily press the Phone option switch. The phone mode is indicated by the ☎ icon, and the display indicates the alias of the last called telephone number if it is in your phone number list. Otherwise, the last called telephone number is displayed.

2. Enter the index of the desired telephone number if you know it or scroll through the list using the ◀ and ▶ keys until you find the desired number. Press the **CLR** key to cancel the call.

3. Press the PTT switch or the **ENT** key to initiate the call. The display indicates "WAIT" while the connection to the phone system is occurring. Once connected, the normal dial tone is heard and the alias of the number being called is displayed. The radio then automatically dials the telephone number and the normal ringing or busy tone is heard. Proceed to the bulleted list which follows the next method for conditions that may then occur.

Direct Entry Method (Full Keypad Models Only)

1. With a SMARTNET/SmartZone channel selected, press and hold the Phone option switch until a tone sounds (approximately 1 second). The last phone number called is displayed, and the phone mode is indicated by the ☎ icon.

2. Enter the number using the **0-9** and **#** keys. To dial a ✳ character, press F1 and then the ✳ key. To enter a pause (indicated by "P"), press the F1, ✳, and then **#** keys. The number scrolls to the left in the display so that the seven right-most digits are always displayed. Numbers up to 16 digits (including pauses) can be entered. Press the **CLR** key to cancel the call.

3. Press the PTT switch or the **ENT** key to initiate the call. The display indicates "WAIT" while the connection to the phone system is occurring. Once connected, the normal dial tone is heard and the alias of the number being called is displayed. The radio then automatically dials the telephone number and the normal ringing or busy tone is heard. Any of the following conditions may then occur.

   • After the called party answers, press the PTT switch to talk and release it to listen. You cannot talk and listen at the same time because the radio cannot transmit and receive at the same time. Each time the PTT switch is released, a tone is heard by the other party that indicates when a response can be made. To end the call when the conversation is complete or at any other time, press the **CLR** key.

   • If enabled by dealer programming, a number can be dialed during a call by simply holding down the PTT switch and dialing the number.

- If an out-of-range condition exists or the radio system is not in service, "LOST CALL" is displayed and a continuous tone sounds. End the call by pressing the **CLR** key.

- If you are not authorized to make telephone calls, "REJECT" is displayed and a continuous tone sounds. End the call by pressing the **CLR** key.

- If the radio system is busy, "BUSY" is displayed and a busy tone sounds. The call automatically proceeds when the radio system becomes available. If the call is ended before it proceeds, your position in queue is lost.

Answering a Telephone Call

Telephone calls are automatically received if a SMARTNET/SmartZone channel is selected. Proceed as follows:

1. When a telephone call is received, "ringing" similar to a standard telephone is heard. The display alternately indicates "PHONE" and the current channel alias.

2. To answer the call, press the Phone option switch and the phone mode is indicated by the ☎ icon. Press the PTT switch to talk and release it to listen.

3. To end the call when the conversation is complete or at any other time, press the **CLR** key. Also press the **CLR** key to ignore an incoming call and end it without answering. *NOTE: If the CLR key is programmed for the Phone function, it will not clear the call.*

2.5.7 CALL ALERT

The Call Alert™ feature allows pages to be sent and received. Proceed as follows:

Sending a Page

Pages can be placed by selecting the unit ID from a preprogrammed list (list entry) or by directly entering it using the keypad (direct entry). Direct entry is available with full keypad (15-key) models only.

List Entry Method (All Models)

1. With a SMARTNET/SmartZone channel selected, momentarily press the Call Alert option switch. The tag (alias) of the last ID called is displayed if it matches an ID in your call list. Otherwise, the last ID called is displayed.

2. Enter the index of the desired ID if you know it or scroll through the list using the ◀ and ▶ keys until you find the desired ID. Press the **CLR** key to cancel the call.

3. Press the PTT switch or the **ENT** key to send the page. The display then indicates the alias of the radio being paged. Proceed to the bulleted list which follows the next method for conditions that may then occur.

Direct Entry Method (Full Keypad Models Only)

1. With a SMARTNET/SmartZone channel selected, press and hold the Call Alert option switch until a tone sounds (approximately 1 second). The last ID called or paged is displayed.

2. Using the **0-9** keys, enter the 6-digit ID of the unit you are calling. Press the ◀ key to erase the last digit entered or press the **CLR** key to cancel the page.

3. Press the PTT switch or the **ENT** key to send the page. If the entered ID is invalid, "INVALID" is momentarily displayed and the page is not sent. If the entered ID is valid, the display indicates the alias of the ID if it matches an ID in your call list. Otherwise, the ID you entered continues to be displayed. The page is then sent and any of the following conditions may then occur.

- If the radio you are paging is on the air and received your page, a signaling success tone (six beeps) sounds and the display momentarily indicates "ACK RCVD". The alias of the selected channel is then displayed continuously.

- If the radio you are paging is not in service, a tone sounds and "NO ACK" is displayed. Press the **CLR** key to cancel the page.

Answering a Page

1. When a page is received, the display alternately indicates "PAGE RCV" and the alias of the current channel and a recurring received page tone sounds (six beeps) sounds.

2. To clear and ignore the page, press the **CLR** key. *NOTE: If the CLR key is programmed for the Private Call function, it will not clear the page.*

3. Answering a page is the same as placing a private call. Therefore, press the Private Call option switch and follow the instructions for placing a private call in Sections 2.5.4 or 2.5.5, whichever is applicable.

2.5.8 MESSAGING

The messaging feature allows preprogrammed messages to be sent to your dispatcher. Up to 16 messages can be preprogrammed, and they are identified by a tag (alias). If a Message option switch is programmed, messages are sent as follows:

1. Momentarily press the Message option switch. The alias of the last message sent is displayed.

2. Enter the index of the desired message if you know it or scroll through the list using the ◀ and ▶ keys until you find the desired message. Press the **CLR** key to cancel the message.

3. Press the PTT switch or the **ENT** key to send the message. When the message is received and acknowledged by the dispatcher, a signaling success tone (six beeps) sounds and the display returns to the normal channel indication. If there is no acknowledgment after 6 seconds, a tone sounds and "NO ACK" is displayed. Press the **CLR** key to return to normal operation.

2.5.9 SENDING STATUS CONDITIONS

The status feature allows the current status to be sent to a dispatcher. Up to eight status conditions can be preprogrammed, and they are identified by an alias (name). If the Status option switch is programmed, status conditions are sent as follows:

1. Momentarily press the Status option switch. The alias of the last status sent is displayed.

2. To change the displayed status, enter the index of the desired status if you know it or scroll through the list using the ◀ and ▶ keys until you find the desired status. Press the **CLR** key to cancel this function.

3. Press the PTT switch or the **ENT** key to send the status. When the message is received and acknowledged by the dispatcher, a signaling success tone (six beeps) sounds and the display returns to the normal channel indication. If there is no acknowledgment after 6 seconds, a tone sounds and "NO ACK" is displayed. Press the **CLR** key to return to normal operation.

2.5.10 EMERGENCY ALARM AND CALL

Introduction

Emergency Alarms and Calls are separate functions that can be individually enabled or disabled on each SMARTNET/SmartZone system. The Emergency option switch is also required for these functions, and it is always the lower button (FCN) on the side when it is used. Emergency Alarms and Calls are transmitted on the emergency talk group programmed on the selected system.

Emergency Alarms

An emergency alarm is a special data transmission that alerts a dispatcher of an emergency situation. Proceed as follows to activate an emergency alarm:

1. Select a SMARTNET/SmartZone channel that has this feature enabled and then press the Emergency option switch. The radio then begins automatically transmitting an emergency alarm data message and "EMERGNCY" is indicated in the display for 3 seconds.

2. When the emergency alarm is acknowledged, the emergency acknowledge tone (two beeps) sounds. Silent operation may also be programmed in which case no tone sounds and there is no indication that an acknowledgment occurred.

3. The radio continues to transmit this message until an acknowledgment is received or the programmed number of attempts have been made. To exit this mode, power must be turned off and then on again.

Emergency Calls

An emergency call urgently requests access to a voice channel. To place this call, proceed as follows:

1. Select a SMARTNET/SmartZone channel that has this feature enabled and press the Emergency option switch. The emergency mode is indicated when "EMERGNCY" is indicated in the display for 3 seconds.

2. To place the emergency call, manually press the PTT switch and begin speaking as with a standard call. All group calls which follow are then emergency calls (private, telephone, and call alert calls are not allowed). If the channel is changed, the call is made on the emergency talk group programmed for the new channel.

3. To exit this mode, power must be turned off and then on again.

2.5.11 FAILSOFT OPERATION

If a failure occurs in the SMARTNET/Smart-Zone system so that it cannot be used, the transceiver automatically enters the failsoft mode. When this mode is selected, the display alternately indicates "FAILSOFT" and the alias of the selected channel.

When in the failsoft mode, operation is in the conventional mode on a preprogrammed failsoft channel. If a transmission is attempted before a failsoft channel is located, a continuous tone sounds until the PTT switch is released. When the radio system returns to normal operation, this condition is automatically detected and normal operation resumes.

2.5.12 SMARTNET/SMARTZONE SCANNING

Scanning on a SMARTNET/Smartzone channel is similar to the standard scanning described in Section 2.3.11. Each channel can be programmed with a different scan list that includes up to 16 channels, one of which can be a priority channel.

Scanning is enabled/disabled by the Scan option switch. In addition, channels can be programmed so that scanning automatically starts whenever the channel is selected. Scanning is temporarily disabled and "**S**" turns off if a channel is selected that has scan-

ning disabled. Then when a channel is selected again that permits scanning, it is automatically re-enabled.

In addition to calls on channels in the scan list, pages, private calls, and telephone calls are received while scanning. Messages on the priority channel are received while listening to lower priority messages. However, private and telephone calls are not interrupted by calls on the priority channel.

2.5.13 DYNAMIC REGROUPING

The dynamic regrouping feature allows a dispatcher to switch users to a dynamically defined channel to receive an important message. Dynamic regrouping operates as follows:

1. When this command is received, the alternating dynamic regrouping tone sounds, the transceiver automatically changes to the regrouping channel, and the display alternately indicates "REGROUP" and the alias of the selected channel. All transmitting and receiving then occurs on this channel.

2. To reset all talk and announcement groups to normal so that only the designated regrouping channel is on the dynamic group, manually select the designated regrouping channel if you know it. If this channel is not selected or there is no designated regrouping channel, all transmissions occur on the dynamically assigned group regardless of which channel is selected, and the regrouping tone sounds each time the PTT switch is pressed.

3. When regrouping is canceled by the dispatcher, transceiver operation returns to normal.

2.5.14 SMARTZONE FEATURES

Introduction

As described in Section 2.3.12, the SmartZone® mode provides wide area coverage by allowing roaming between SMARTNET and conventional sites. SmartZone operation is the same as SMARTNET with the following additional features:

Determining Current Site

To determine the current radio site, momentarily press the Site Search option switch (if programmed). If

currently registered on a site, "SITE x" is displayed, where "x" is the site number. If the site is locked (see following), "LOCK x" is displayed instead. The display then indicates the RSSI (Receive Signal Strength Indicator) value of the current site as "RSSI x" and then returns to displaying the channel alias.

Searching For a New Site

To display the RSSI level of the current site, press the Site Search option switch (if programmed). The current site number is then displayed as "SITE x" followed by the RSSI level as "RSSI x". If the Site Search option switch is not pressed again, this mode is automatically exited and the normal channel information again displayed.

To scroll through the other programmed sites, repeatedly press the Site Search option switch while "SITE x" or "RSSI x" is displayed. Each time it is pressed, the information for the next site is displayed. To select the displayed site, simply do not press the switch again and that site is selected when the normal channel display returns. If site lock is on when site search is entered (see following), the radio will be locked on the new site when this function is exited.

Locking/Unlocking a Site

It is sometimes desirable to stay on the current site regardless of signal level. To lock the radio on the current site so that it does not search for another, press the Site Lock option switch (if programmed). The display then momentarily indicates "LOCK x" to indicate that the current site is locked ("x" is the current site number). To unlock the site, press the Lock switch again and "UNLOCK" is momentarily displayed.

When locked on a site, it is still possible to search for a different site using the site search function described in the preceding section. When a new site is found, the radio is then locked on that site.

2.6 SUPERVISORY TONES

Single Beep (Alert Tone)

- Power was turned on and a successful power-up sequence occurred (Section 2.3.2).

- The time-out timer is about to expire or the penalty timer has expired (Sections 2.3.9 and 2.4.7).
- The conversation timer is about to expire (Section 2.4.8).
- The system received your page but the paged mobile is not on the air (Section 2.5.7).
- Telephone interconnect is not operational (Section 2.5.6).

Continuous Tone (Invalid or No Acknowledge Condition)

- A transmission is being attempted on an unprogrammed channel or a conventional channel programmed as receive-only.
- The transmitter is disabled by the busy channel lockout feature (Section 2.4.5).
- The transmitter has been disabled by the time-out timer feature (Section 2.3.9).
- The transmitter has been disabled by the conversation timer (Section 2.4.8).
- An out-of-range condition exists (SMARTNET/ SmartZone only).
- A transmission is being attempted before the penalty timer has expired (Section 2.4.7).
- Dynamic regrouping has been exited but the dynamic regrouping channel is still selected (Section 2.5.13).
- The paged mobile did not acknowledge the page (Section 2.5.7).
- The message that was sent has not been acknowledged (Section 2.5.8).
- The status condition that was sent has not been acknowledged (Section 2.5.9).

Single Short Medium-Pitch Tone

- A valid key has been pressed.

Single Short Low-Pitch Tone

- An invalid key has been pressed.

Six Beeps (Recurring)

- The page was received (Section 2.5.7).

Three Beeps (Recurring)

- A unit-to-unit call was received (Section 2.5.4).

Six Beeps

- The paged radio received the page and acknowledged it (Section 2.5.7).
- The message that was sent has been received and acknowledged (Section 2.5.8).
- The status condition that was sent has been received and acknowledged (Section 2.5.9).

Two Beeps

- The emergency alarm condition was acknowledged (Section 2.5.10).

Gurgle-Like Tone

- Dynamic regrouping has occurred (Section 2.5.13).
- Dynamic regrouping has occurred but the regrouping channel is not selected (Section 2.5.13).

Four Low Tones (Busy Signal)

- The radio system is busy or a busy condition exists when making a telephone call.

Four Alternating High and Low Tones

- A channel is available after a busy condition occurred (SMARTNET/SmartZone only).

2.7 KEYPAD PROGRAMMING

2.7.1 INTRODUCTION

NOTE: Keypad programming is available with full keypad (15-key) models only.

Keypad programming is available if the Keypad Programming option switch is programmed. It is then selected by simply pressing this switch (no password is required). Keypad programming allows conventional channel parameters such as the transmit and receive frequency and Call Guard squelch code to be changed. In addition, it allows several conventional mode timers to be changed. It cannot be used to reprogram disabled channels or SMARTNET/SmartZone channels.

2.7.2 MENU DESCRIPTION

A menu is used to select parameters to be changed in the keypad programming mode. When the Keypad Programming mode is selected by pressing the option switch, the "**P**" and "**G**" icons are displayed (see Figure 2-3) along with the first menu parameter "ZONE CHG".

The four main menu parameters are listed below, and descriptions are located in the indicated section. Press the ◀ and ▶ keys to display the desired parameter and then press the **ENT** key to select it. Pressing the **CLR** key in any of the four main menus exits the keypad programming mode. Pressing it in the other menus returns to the previous menu. A flowchart showing the keypad programming mode menu structure is located in Figure 2-4.

- ZONE CHG (2.7.3)
- CHAN CHG (2.7.4)
- SYS PRM (2.7.5)
- CHAN PRM (2.7.6)
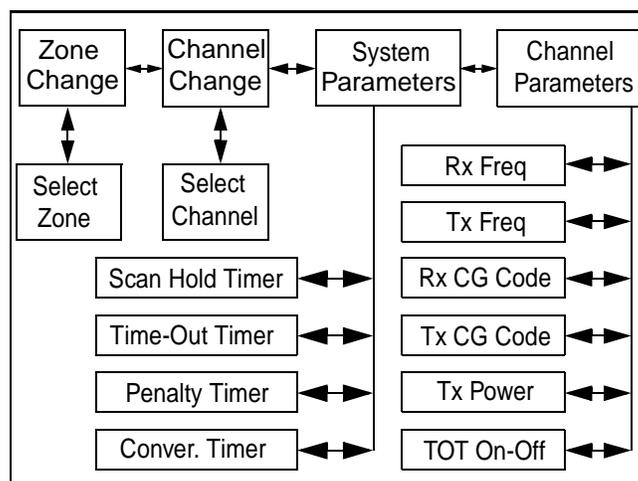
Figure 2-4   Keypad Programming Menu Flowchart

2.7.3 ZONE CHANGE PARAMETER

The "ZONE CHG" menu parameter selects the zone containing the conventional channel to be reprogrammed. It does not change the zone selected for normal operation. Enter the zone number or scroll through the programmed zones by pressing the ◀ and ▶ keys. When the desired zone is displayed, select it by pressing the **ENT** key.

2.7.4 CHANNEL CHANGE PARAMETER

The "CHAN CHG" menu parameter selects the conventional channel to be reprogrammed. Disabled or SMARTNET/SmartZone channels cannot be selected. This does not change the channel selected for normal operation.

Enter the channel number or scroll through the programmed channels by pressing the ◀ and ▶ keys. When the desired channel is displayed, select it by pressing the **ENT** key.

2.7.5 SYSTEM PARAMETERS

The "SYS PRM" menu parameter selects the conventional mode timer to be reprogrammed (see following). Press the ◀ and ▶ keys to display the desired timer and then press the **ENT** key to select it.

SCAN TMR - Selects the Scan Hold timer. Press the ◀ and ▶ keys to decrement/increment the timer in 0.5-second steps, and press the "0" key to disable the timer (set it to 0 seconds). When the desired value is displayed, store it by pressing the **ENT** key.

TX TMR - Selects the transmit time-out timer. Press the ◀ and ▶ keys to decrement/increment the timer in 15-second steps, and press the "0" key to disable the timer (set it to 0 seconds). When the desired value is displayed, press the **ENT** key to store it.

PEN TMR - Selects the penalty timer. Press the ◀ and ▶ keys to decrement/increment the timer in 15-second steps, and press the "0" key to disable the timer (set it to 0 seconds). When the desired value is displayed, store it by pressing the **ENT** key.

CONV TMR - Selects the conversation timer. Press the ◀ and ▶ keys to decrement/increment the timer in 30-second steps, and press the "0" key to disable the timer (set it to 0 seconds). When the desired value is displayed, store it by pressing the **ENT** key.

2.7.6 CHANNEL PARAMETERS

The "CHAN PRM" menu parameter selects the conventional channel parameter to be reprogrammed (see following). Press the ◀ and ▶ keys to display the desired parameter and then press the **ENT** key to select it.

RX FREQ - Selects the receive channel frequency. Press the ◀ and ▶ keys to move the cursor left and right, and press the 0-9 keys to enter a digit. When the desired frequency is displayed, store it by pressing the **ENT** key.

TX FREQ - Same as RX FREQ above.

RX CODE - Selects the receive Call Guard (CTCSS/DCS) code. Press the "0" key to display the first available code, and press it again to toggle between types (CTCSS and DCS). Press the ◀ and ▶ keys to scroll through the available codes. When the desired code is displayed, store it by pressing the **ENT** key.

TX CODE - Same as RX CODE above.

TX POWER - Selects the desired power output level. Press the ◀ and ▶ keys to scroll through the following choices. When the desired setting is displayed, store it by pressing the **ENT** key.

- POWER HI - High transmit power
- POWER LO - Low transmit power
- POWER SW - Switchable power selectable by the High/Low power switch. This choice is not available if that switch is not programmed.

TX TMR - Enables or disables the time-out timer on the current channel. Press the ◀ and ▶ keys to toggle between the on and off mode, and when the desired setting is displayed, store it by pressing the **ENT** key.

SECTION 3   TRANSCEIVER PROGRAMMING
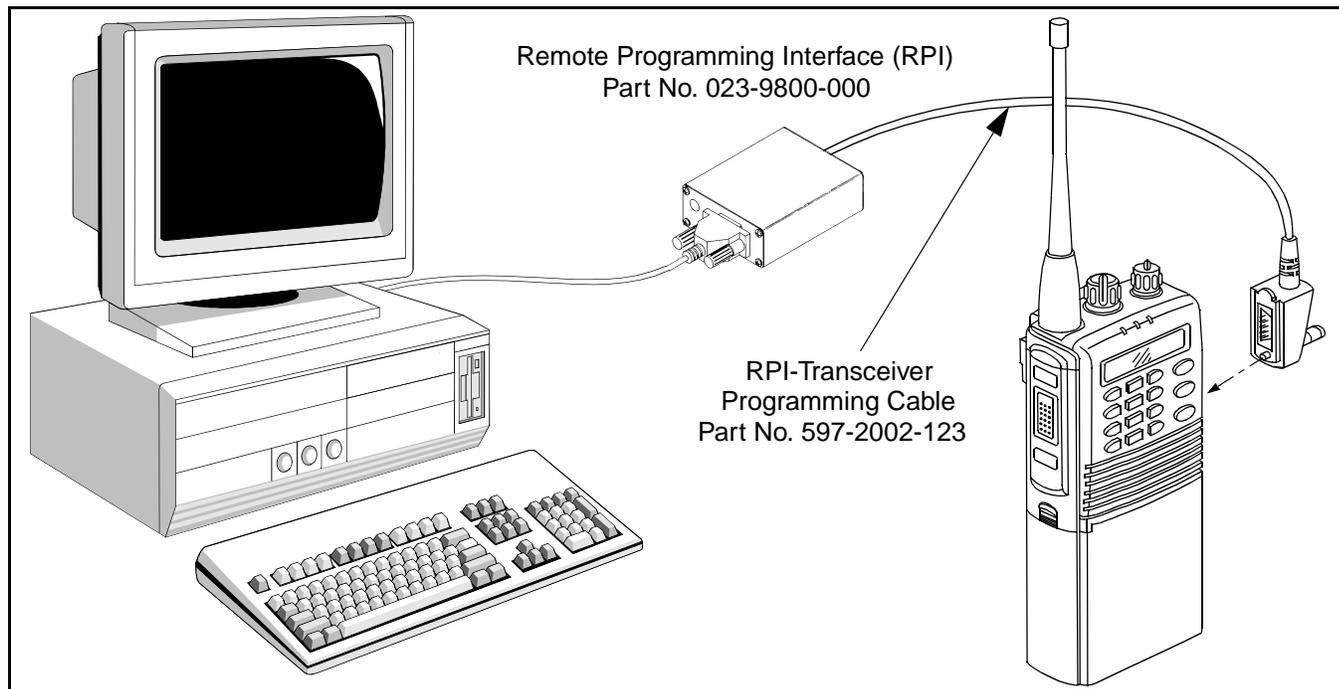
Figure 3-1   Programming Setup

3.1 GENERAL

3.1.1 PROGRAMMING SETUP

The following items are required to program the transceiver and control unit. 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
- Remote Prog. Interface (RPI) P.N. 023-9800-000
- Cables from the RPI to the computer and transceiver
- EFJohnson PCTrunk programming software.

3.1.2 COMPUTER DESCRIPTION

The computer used to run this program should meet the following minimum requirements:

- Windows® 3.1, 95/98, or NT 3.51
- Intel® 486 processor or equivalent
- At least 4 MB of RAM
- A hard disk drive with at least 5 MB of free space
- An available serial port

NOTE: With the descriptions which follow, 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 your Help Screens and manuals included with your Windows software.

3.1.3 PCTRUNK SOFTWARE INSTALLATION

The PCTrunk software is supplied on two 3-1/2" diskettes. 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 the preceding section.

2. Insert PCTrunk Disk 1 in the disk drive of your computer.

3. **Windows 3.1 or NT -** In the Program Manager, double click the SETUP.EXE file on PCTrunk Disk 1 or click this file name and select File > Run.

Windows 95/98 - 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 \Program Files\PCTrunk. If you wish to use some other directory, click Browse and select it or type the name.

3.1.4 CONNECTING RPI TO COMPUTER AND TRANSCEIVER

RPI Information

The RPI provides the required interface between the computer and transceiver. It converts the RS-232 logic levels from the computer to the 5V logic levels required by the transceiver microprocessor and vice versa.

The current RPI available for programming transceivers of this type is Part No. 023-9800-000. Earlier RPI's, such as 023-9750-000 and 023-5810-000 can also be used. However, the -9800- RPI is the only one that has the speaker and microphone audio jacks required to perform the alignment described in Section 6. In addition, it is the only RPI that can be used to Flash program the transceiver to update the operating software.

Cable Information

The cables from the RPI to the computer and transceiver are not included with the RPI. The -9800-RPI has a female DB9 connector for the computer connection. Since most computer serial ports have a male DB9 or DB25 connector, a male DB9 to female DB9 or DB25 is usually required. This is a standard cable available at most computer supply stores. A suitable cable is also listed in Table 1-1.

The cable from the RPI to the transceiver connects from the RPI to the accessory connector of the transceiver. A schematic diagram of this cable is shown in Figure 3-2. The -122 version of this cable can also be used because the extra wire connected to pin 8 is not required with this radio.
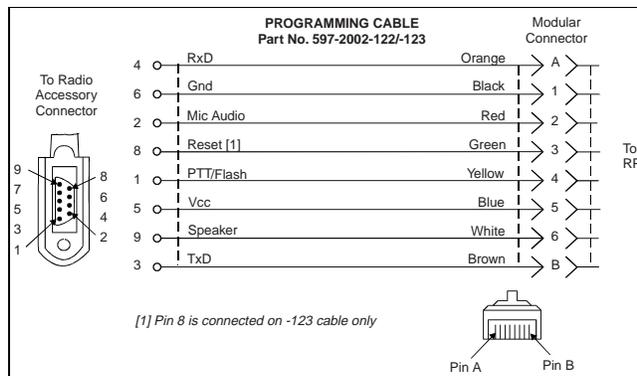
Figure 3-2 RPI -Transceiver Cable Schematic

3.1.5 STARTING AND EXITING

To Start PCTrunk From Windows 3.1

In the Program Manager, open the PCTrunk group window. Then double-click the PCTrunk icon.

To Start PCTrunk From Windows 95/98

Click the Start button and select the PCTrunk group. Then double-click the PCTrunk icon.

To Exit PCTrunk:

Select File > Exit or press ALT + F4.

3.1.6 PROGRAMMING FILE TYPES

Programming data is stored in a disk file that can be saved, read, copied, and deleted (see Section 3.3.1). The file that is stored for each programming session has the .DAT extension.

3.1.7 HELP FILES

To display help information on the current screen, click Help in the menu bar or press F1.

3.1.8 SCREEN TYPES

The following types of screens are displayed:

Radio-Wide - These screens program parameters that are the same for all systems and channels. Separate screens are displayed for General, Conventional, SMARTNET/SmartZone, and Portable Options parameters. Refer to Section 3.4 for more information on these screens.

System - These screens program the parameters that are unique to the displayed Conventional, SMARTNET, or SmartZone system. The system to be edited is selected as described in Section 3.1.10.

Channel - This screen programs unique channel parameters and assigns channels to each zone. The specific parameters indicated in this screen are determined by the type of system selected in the "Type" box (Conventional, SMARTNET, SmartZone).

The preceding screens are displayed in cascade style or they can be minimized or resized as desired. To cascade the active screens, select Window > Cascade from the menu bar (see Section 3.3.6). To pop a screen to the front, click the applicable button shown in the following illustration or select it in the Window menu. For example, if the Channel screen is displayed and you want to quickly pop the Radio-Wide screen to the front, click the Radio-Wide button. These buttons can be displayed and hidden by clicking Window > Toolbar.

Screen Pop-Up Buttons and File Size Indicator

3.1.9 FILE SIZE INDICATION

The maximum number of channels that can be programmed may be limited by the available memory space in the radio as described in Section 1.2.4. A running indication of the amount of memory used by the current data if it was downloaded to the radio is displayed by a bar graph in the toolbar as shown above. When the bar reaches the right end, the available memory is full and some channels may need to be deleted if more information remains to be programmed.

3.1.10 CREATING AND DISPLAYING SYSTEMS

To create a new SMARTNET or SmartZone system, select Systems > Add Systems and then the desired system type from the menu bar (see Section 3.3.6). This menu is also used to delete a system. Only

one conventional system can be set up, and it is automatically created when a programming file is opened as described in Section 3.1.6. Therefore, there is no option to add a conventional system.

Only one system can be displayed at a time. Therefore, to edit information in one of the systems, display that system by selecting Window in the menu bar and then the system to be edited. Systems are identified by number and type. However, in the Channel screen, channels or talk groups from any programmed system can be set up. Therefore, it does not matter which system is selected when programming channel information.

3.2 PROGRAMMING PROCEDURE

The following is a general procedure you can use to program a transceiver.

3.2.1 PRELIMINARY

1. Select a programming file as follows:

   Create a New File - To start with a new file containing default parameters, select File > New and then the frequency band of the radio (VHF/UHF/800 MHz).

   Open An Existing File - To open an existing file stored on disk, select File > Open and then the file to be opened.

   Upload a File From a Radio - To transfer a file from a radio to the computer to edit or use as a basis to program another radio, connect the radio to the computer as described in Section 3.1.4. Then turn the radio on and select Upload from the menu bar.

2. Before or after creating the programming file, be sure the correct type (77xx portable) is selected by the Radio Type menu (see Section 3.3.2).

3. A conventional system is automatically set up when a new programming file is created. If SMARTNET or SmartZone systems are also to be programmed, set up at least one of that type as described in Section 3.1.10.

3.2.2 PROGRAMMING RADIO WIDE PARAMETERS

1. To display the Radio Wide screens, click the Radio Wide button or select Window > Radio Wide Parameters in the menu bar (see Section 3.1.8).

2. Program the applicable information in these screens as described in Section 3.4.

3.2.3 PROGRAMMING CONVENTIONAL CHANNELS

NOTE: If no conventional channels are programmed, skip this section.

1. Make sure the conventional system is displayed by selecting Window > Conventional in the menu bar.

2. If required, display the Conventional System programming screens by clicking the System button or selecting Window > Conventional System (see Section 3.1.8).

3. Program the conventional systems and channels as described in Section 3.5.

3.2.4 PROGRAMMING SMARTNET AND SMARTZONE SYSTEMS

NOTE: If no SMARTNET or SmartZone systems are programmed, skip this section.

1. Make sure the desired SMARTNET or SmartZone system is displayed by selecting Window > SMARTNET/SmartZone in the menu bar.

2. If required, display the programming screens for that system by clicking the System button or selecting Window > SMARTNET/SmartZone System (see Section 3.1.8).

3. Program the SMARTNET/SmartZone system and talk groups as described in Section 3.6.

4. To program additional SMARTNET/SmartZone systems, add a new system as described in Section 3.1.10 and repeat Section 3.6.

3.2.5 PROGRAMMING RADIO (DOWNLOADING FILE)

When all the required programming information has been entered in the various programming screens, the information can be programmed (downloaded) into the radio. When downloading a file, be sure that all connections between the computer and radio are secure, the radio is turned on, and the proper serial port is selected (see Section 3.3.1). Then proceed as follows:

1. Select Download from the menu bar and then the file type to be transferred (programming or scrambling).

   - If no file is currently loaded, a dialog box appears to select the desired file.
   - If a file is already loaded when Download is selected, the current file is transferred to the radio.

2. Repeat for the other file type (if required).

NOTE: The information which follows (Sections 3.3-3.6) provides detailed descriptions of the parameters that are displayed in the various PCTrunk screens.

3.3 MENU COMMANDS

Menu Bar

3.3.1 FILE MENU
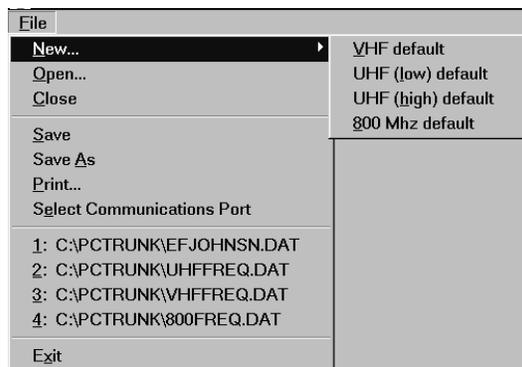
New - Creates a programming file with default parameters for the selected frequency range.

Open - Opens a programming file that was previously saved to disk. If a modified file is currently open, you are asked if that file should be saved before the new file is opened.

Close - Closes the current file. If the file has been modified and the changes have not been saved, you are asked if the changes should be saved before closing.

Save - Saves the current file to disk using the current file name.

Save As - Same as "Save" except you are prompted to enter a new file name if desired.

Print - Prints the information in the current file.

Select Communications Port - Displays the Communications Port dialog box which is used to select the serial port that is used to connect the transceiver to the computer (see Section 3.1.4).

Exit - Closes the PCTrunk program. If the current file has been modified and the changes have not been saved, you are asked if the changes should be saved before closing.

3.3.2 RADIO TYPE MENU
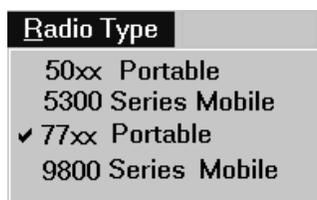
The Radio Type menu show above selects the radio type (77xx Portable) being programmed.

3.3.3 DOWNLOAD MENU

Parameter to 77xx Portable - Transfers the current programming file to the radio connected to the computer.

3.3.4 UPLOAD MENU
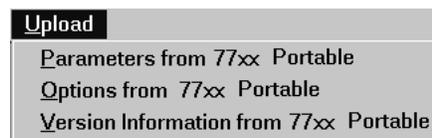
The Upload Menu is displayed only in the opening screen before a programming file is created. The following options are displayed:

Parameters from 77xx Portable - Transfers the programming data from a radio to the PCTrunk program. This data can then be viewed, edited, or saved to a disk file as desired.

Version Information from 77xx Portable - Displays the software version number and serial number of the connected radio.

3.3.5 SYSTEMS MENU

The Systems Menu is used to create new SMARTNET and SmartZone systems. It is also used to delete current systems. Conventional systems cannot be added because only one can be created. Refer to Section 3.1.8 for more information.

3.3.6 WINDOW MENU

The Window Menu is used to select the system to be edited. It can also be used to pop one of the screens to the front. See Section 3.1.8 for more information.

3.3.7 HELP MENU
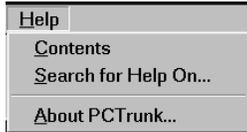
Contents - Displays the help system table of contents.

Search For Help On - Displays the search dialog box that allows searching for a help topic by keyword.

About PCTrunk - Displays the software version number of PCTrunk and the address of the E.F. Johnson Company.

3.4 RADIO-WIDE PARAMETER SCREENS

3.4.1 INTRODUCTION

The radio-wide screens program the parameters that are the same for all systems, channels, and zones. Separate screens are used for General, Conventional, SMARTNET/SmartZone, and Portable Options parameters. Refer to the information which follows.

3.4.2 RADIO-WIDE GENERAL SCREEN
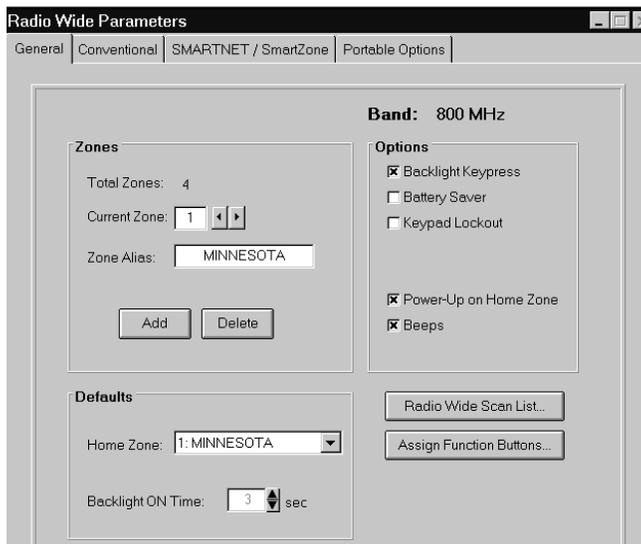
Band

Displays the operating band selected by the Radio Type Menu (see Section 3.3.2). The selected operating band must match that of the radio being

programmed. Currently, only 800 MHz 77xx models are available.

Zones

Total Zones - The total number of zones currently set up. The maximum number allowed is 16. Zones are added by clicking the Add button (see following).

Current Zone - Indicates the currently selected zone. To select another zone, click the up/down arrows.

Zone Alias - Edits the unique alpha identification for the displayed zone. Up to 8 characters can be entered. The zone alias is briefly displayed whenever a new zone is selected. Refer to Section 1.2.4 for more information on zones.

Add (Zones) Button - Adds another zone.

Delete (Zones) Button - Deletes the last zone added.

Defaults

Home Zone - Selects the zone that is selected by the Home Zone option switch if programmed.

Backlight On Time - Selects the length of time that the backlight stays on after any key or the Backlight option switch is pressed (see "Options" which follows and Section 2.3.3).

Options

Backlight Key Press - If checked, the backlight turns on for the "Backlight On Time" above whenever any front panel key is pressed (see Section 2.3.3).

Battery Saver - If checked, low transmit power is automatically selected when the RSSI level indicates that the site is nearby (see Section 2.3.6).

Keypad Lockout - If checked, all front panel keys are disabled and are not available to the user (see Section 2.3.5).

Power-Up On Home Zone - If checked, the home zone is always selected at power-up.

Beeps - If checked, all tones are enabled. Otherwise, no tones sound (see Section 2.3.10).

Radio Wide Scan List

NOTE: The radio-wide scan list cannot be pro-grammed until all channels to be included have been set up as described in the Conventional and SMART-NET/SmartZone sections (3.5 and 3.6, respectively).

Clicking the Radio Wide Scan List button in the General screen displays the following screen which programs the radio-wide scan list described in Section 2.3.11. The buttons and other parameters in this screen are as follows:
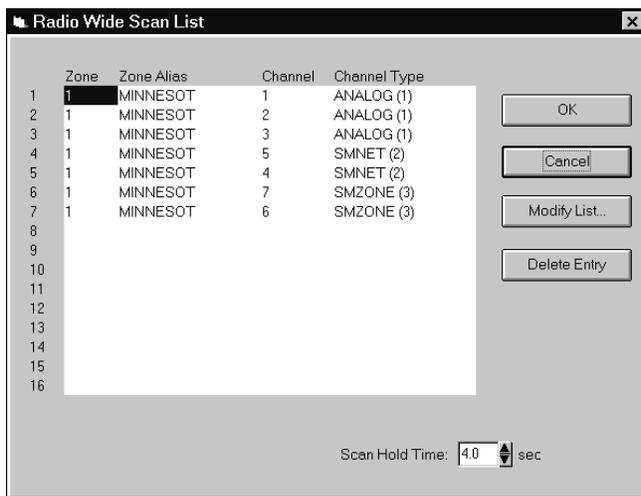
Radio-Wide Scan List Screen

Modify List Screen

Assign Function Buttons

Clicking the "Assign Functions Buttons" Button in the General screen displays the following screen which programs the option switches. Two are located on the side panel and three or five on the front panel as described in Section 2.3.4. These option switches can be programmed with a different set of functions for each operating mode (conventional and SMARTNET/SmartZone).
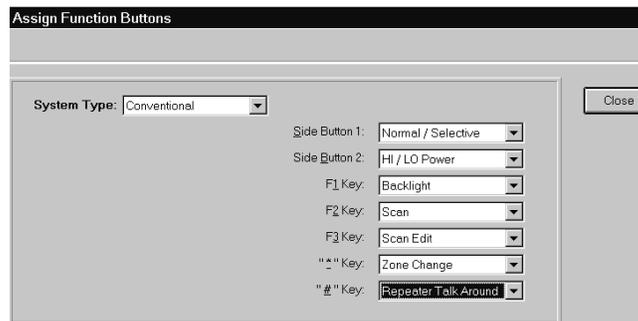
Assign Function Buttons Screen

Modify List... Button - Displays the following screen that selects the channels in each Zone and System that are in this scan list. Select each Zone and then the channels to be included from that zone.

Delete Entry - Deletes the selected channel from the scan list.

Scan Hold Time - This programs the delay that occurs before radio-wide scanning resumes after a message is no longer being received. Times of 0 - 7.5 seconds can be programmed (see Section 2.3.11).

Program the option switches as follows:

1. In the System Type pull-down menu, select the mode to be programmed (either conventional or SMARTNET/SmartZone).

2. To program a switch, click the arrow to display the pull-down menu and then select the desired function from that menu. *NOTE: Side Button 1 is the top (AUX) button and Side Button 2 is the bottom (FCN) button. Also, the * and # keys are not available with limited keypad (3-key) models.*

3. Repeat for all switches and modes to be programmed and then exit this screen by clicking the Close button.

3.4.3 RADIO-WIDE CONVENTIONAL SCREEN
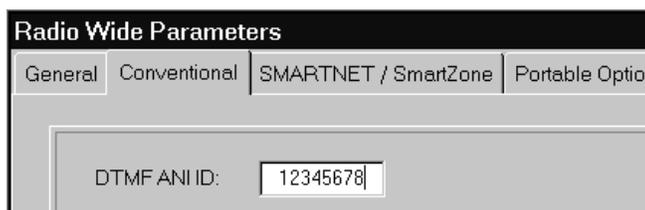
The radio-wide conventional screen is shown above, and it is used to program the DTMF ANI ID. This ID is used on channels programmed for pre- or post-transmit ANI (see Section 3.5.4) and consists of eight digits from 0-9.

3.4.4 RADIO-WIDE SMARTNET/SMARTZONE SCREEN
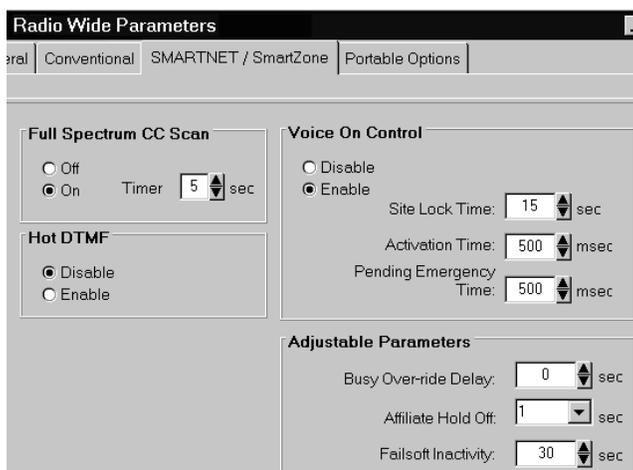
The radio-wide SMARTNET/SmartZone screen is shown above, and is used to program the following parameters:

Full Spectrum CC Scan

In a SmartZone system, if all potential control channel frequencies have been searched, the radio enters a channel-by-channel search across the full spectrum that the radio covers. The timer sets the time it performs this scan before it checks the expected frequencies again. After it checks these frequencies, it returns to full spectrum scanning. This cycle repeats until a control channel is found.

On-Off - Enables or disables full spectrum scan.

Timer - Sets the time that full spectrum scanning occurs as just described.

Hot DTMF

Enable/Disable - When enabled, allows the user to send DTMF tones while transmitting. When disabled, pressing numeric keys (0-9, ✱ , #) while transmitting has no affect.

Voice On Control

With SmartZone operation, some remote sites are designated Voice On Control sites. In these sites, if all available traffic channels are occupied, control channels become traffic channels when additional traffic channels are requested. The Voice On Control parameters determine how the radio reacts to various situations that may occur. For example, when a conversation is complete, the radio may look for a control channel that has become a traffic channel.

Enable/Disable - Determines if the voice on control parameters are active.

Site Lock Time - This is the amount of time a radio remains on the Voice On Control site before looking for another site.

Activation Time - This is the amount of time the radio waits when the control channel comes back from Voice On Control before it transmits any pending ISWs. This prevents all radios on a Voice On Control site from submitting ISWs at the same time.

Pending Emergency Time - This is the amount of time the radio waits to submit an Emergency ISW

after the control channel returns from the Voice On Control mode.

Adjustable Parameters

Busy Override Delay - With SmartZone operation, this is the amount of time a user must press the PTT switch to override a SmartZone busy that occurs because some member of the talk group is present at a site where there are no traffic channels available.

Affiliate Hold Off - With SmartZone operation, this is the delay time that occurs after acquiring the control channel before it sends an affiliation ISW. This prevents all radios on the system from sending affiliation ISWs at the same time.

Failsoft Inactivity - Programs failsoft operation (see Section 2.5.11). If the radio remains inactive (no receive or transmit activity on channel) while operating in the failsoft mode for the programmed time, the radio momentarily leaves the failsoft mode and attempts to find a control channel. If "0" is programmed, the radio does not leave the failsoft mode.

3.4.5 RADIO-WIDE PORTABLE OPTIONS SCREEN
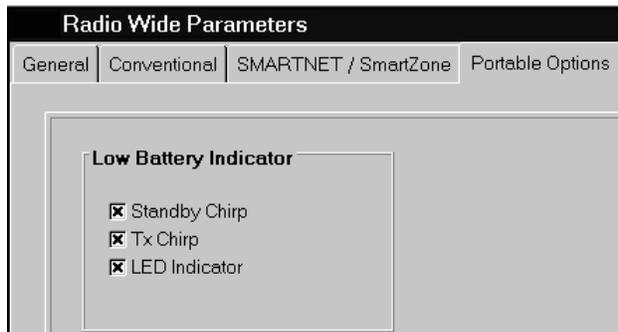
The radio-wide Mobile Options screen is shown above, and is used to program the following parameters (see Section 2.3.6):

Standby Chirp - Selects if a beep sounds every minute while a low battery condition is being detected.

Tx Chirp - Selects if a beep sounds every time the PTT switch is pressed while a low battery condition is being detected.

LED Indicator - Selects if the top panel BAT LED indicates a low battery condition.

3.5 PROGRAMMING CONVENTIONAL SYSTEMS AND CHANNELS

3.5.1 INTRODUCTION

The following information describes how conventional channels are programmed. Conventional systems do not need to be set up because only one can be programmed, and it is automatically set up when the programming file is selected as described in Section 3.1.6. Up to 256 conventional channels can be programmed (if no SMARTNET/SmartZone systems are programmed). Refer to Section 1.2.4 for more information on systems and channels.

The following is the recommended procedure for programming conventional channels:

1. Program the radio-wide information as described in Section 3.4.

2. If other types of systems are programmed, make sure the conventional system is selected by selecting Window > Conventional in the menu bar.

3. Program the conventional system information and then the channel information as follows.

3.5.2 CONVENTIONAL SYSTEM GENERAL SCREEN
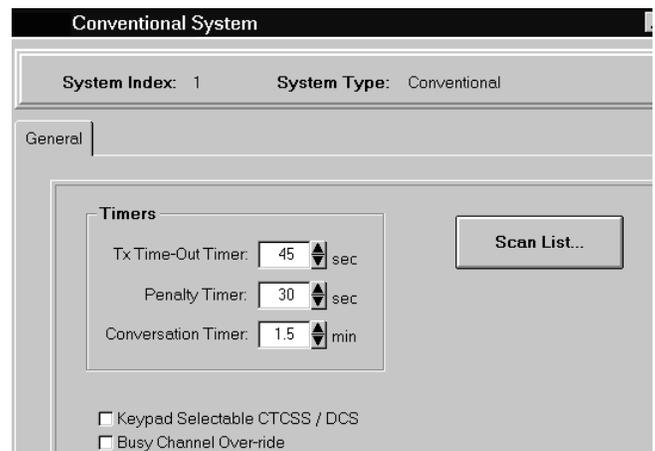
The conventional system General screen is shown above, and it programs the following parameters:

Timers

Tx Time-Out Timer - This timer limits the length of transmissions (Section 2.3.9). Times up to 3 minutes, 45 seconds in 15-second steps can be programmed.

Penalty Timer - This timer disables transmitting after the time-out timer expires (Section 2.4.7). Times up to 3 minutes, 45 seconds in 15-second steps can be programmed.

Conversation Timer - This timer limits the total length of a conversation (Section 2.4.8). Times up to 7.5 minutes in 0.5-minute steps can be programmed.

Keypad Selectable CTCSS/DCS - Selects if CTCSS/DCS (Call Guard) squelch codes can be reassigned using the keypad (see Section 2.4.6).

Busy Channel Override - Selects if the busy channel lockout feature can be overridden by quickly releasing and then pressing the PTT switch (see Section 2.4.5).

Conventional System Scan List Screen

 Scan List Button

Clicking the Scan List button displays the preceding screen which is used to program the conventional scan lists described in Section 2.4.11. Only Scan List 1 is available with limited keypad (3-key) models.

NOTE: The conventional scan lists cannot be programmed until all the conventional channels are programmed. Therefore, first program the channels as described in Sections 3.5.3 and 3.5.4.

To modify a list, click and the screen which follows is displayed. Select the desired scan list in the box on the top and then select the zone and the channels from that zone to be included. Repeat for each zone. Do this for each list programmed. The button deletes the selected channel(s) from the scan list.
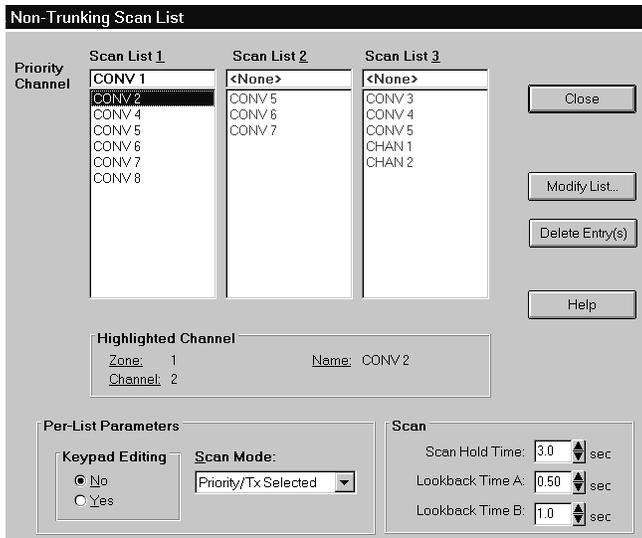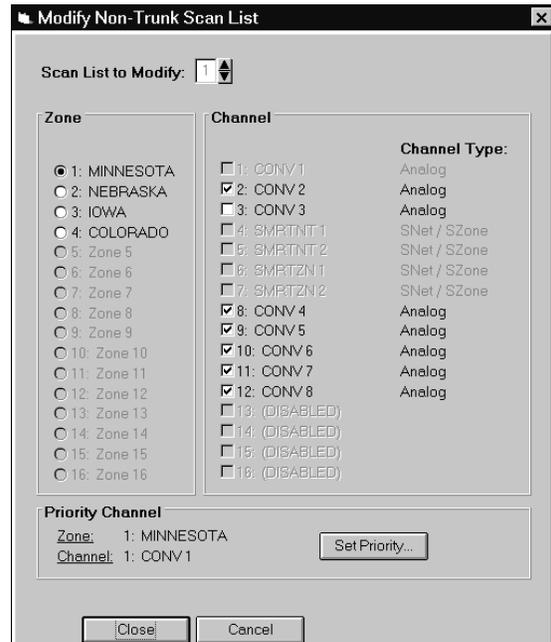
Conventional System Modify Scan List Screen

The following parameters are programmed in the Conventional System Scan List Screen on the left.

Keypad Editing

This function selects if the user is allowed to edit the scan list. This requires the Scan Edit option switch as described in Section 2.4.11. User editing can be enabled and disabled on each scan list.

Scan Mode

Sets the channel on which transmissions occur when the PTT switch is pressed while scanning. A different mode can be programmed for each scan list. In addition, it selects if priority sampling is used and

also the type of priority channel (see the "Priority Channel" description which follows). The following modes are available:

No Priority - Priority sampling does not occur (all channels are scanned in sequence). The radio transmits on the selected channel.

Priority/Tx Priority - Priority sampling occurs and the priority channel is the one programmed in the selected scan list. The radio transmits on the priority channel.

Priority/Tx Selected - Priority sampling occurs and the priority channel is the one programmed in the selected scan list. The radio transmits on the selected channel.

Priority on Sel Chan - The priority channel is always the selected channel (even if the scan list is programmed with a priority channel). The radio transmits on the selected channel.

Talkback Scan - No priority sampling occurs (even if the scan list is programmed with a priority channel). The radio transmits on the channel of a call while scanning is halted. Then when scanning resumes, it transmits on the selected channel.

Scan Timers

Scan Hold Time - Sets the delay that occurs before scanning resumes after a signal is no longer received (see Section 2.3.11).

Lookback Time A - This time determines how often the priority channel is checked for activity. Times of 0.25-4.00 seconds in 0.25-second steps can be programmed.

Lookback Time B - This time determines how often the priority channel is checked once an incorrect Call Guard (CTCSS/DCS) code is detected. Since it takes much longer to detect an incorrect Call Guard signal than a carrier, this time should be relatively long to prevent the interruptions from making a message difficult to understand. Times of 0.5-8.0 seconds can be programmed in 0.5-second steps.

Priority Channel Selection

The Scan Mode parameter in the preceding Conventional System Scan List screen selects if priority channel sampling is enabled on the selected scan list. It also selects the type of priority channel (either fixed or the selected) if applicable.

If the "Priority/Tx Priority" or "Priority/Selected" mode is programmed, fixed priority channel sampling is selected. The fixed priority channel must then be chosen for the scan list. To do this, click the Set Priority... button in the preceding Modify Scan List screen and then select the desired zone/channel. Refer to Section 2.4.12 for more information on priority channel sampling.

3.5.3 SETTING UP CONVENTIONAL CHANNELS

The conventional Channel screen shown in Figure 3-3 which follows is displayed when a conventional channel is selected. This screen programs unique channel parameters and also assigns channels to the selectable zones displayed by the transceiver.

The general procedure for setting up a conventional channel is as follows. Refer to the descriptions which follow this procedure for information on the parameters in the channel screens.

1. Make sure that the desired zone is selected in the Zone box.

2. Select the channel number in the Channels Index box which is to be programmed with the channel. If the channel number display mode is selected (see Section 2.4.2), this will be the number displayed when the channel is selected.

3. To assign a conventional channel, select "Conventional" as the channel type.

4. Click the Modify button to display the screen which enables that channel and programs the alias (tag) and transmit and receive frequencies. Then program the other parameters in the main part of the screen. Refer to the next section for more information.
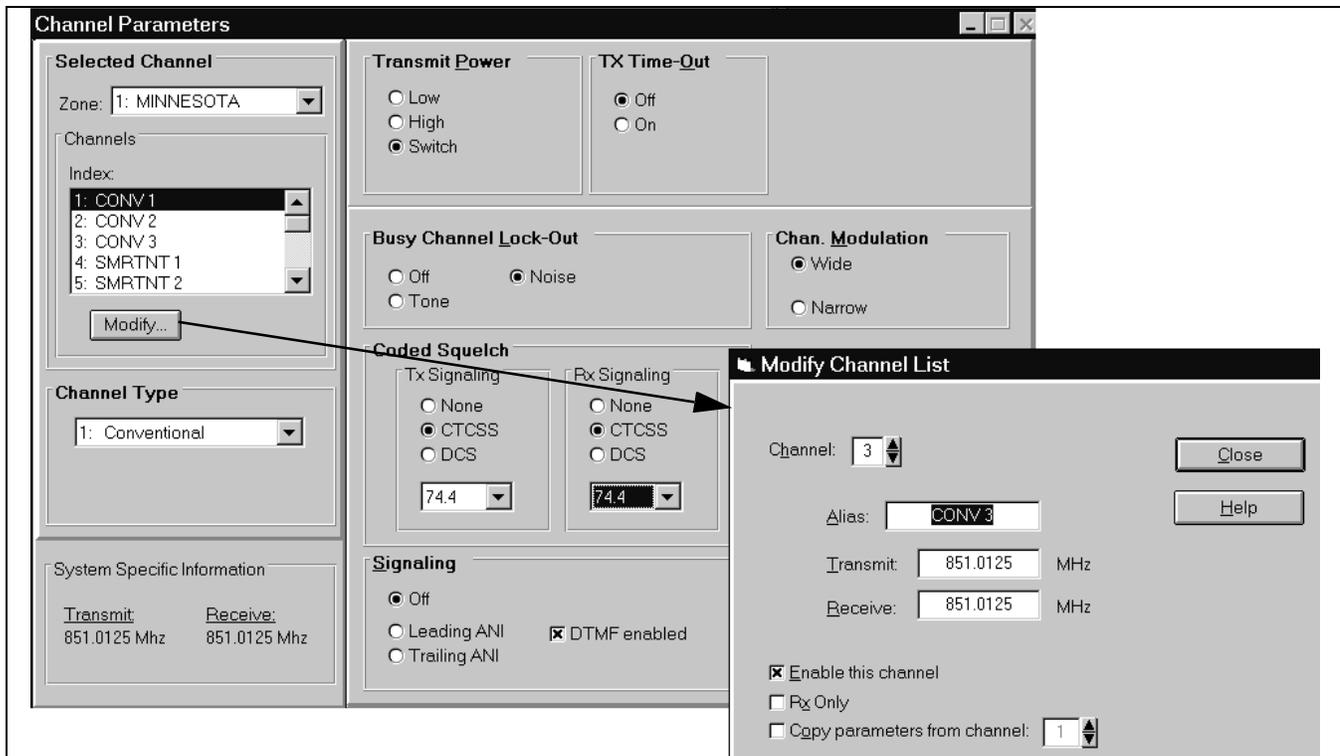
Figure 3-3   Conventional Channel Screen

3.5.4 CONVENTIONAL CHANNEL SCREEN PARAMETERS

The following parameters are programmed in the conventional channel screen shown in Figure 3-3.

Selected Channel

Zone Box - Clicking the arrow to the right of this box displays the available zones. Click on a zone to select it. Zones and zone aliases are set up on the Radio-Wide General screen described in Section 3.4.2.

Channel Index Box - Displays the available channels in the selected zone. The channel type is selected by the Channel Type box below it.

Modify Button - Displays the screen that follows which enables the channel (makes it select-able) and programs the alias (tag) and transmit and receive frequencies.
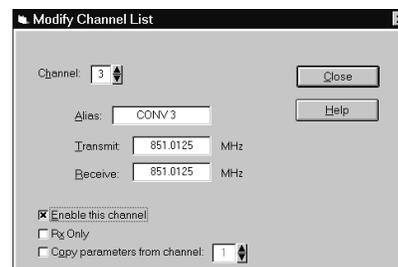
The parameters in this screen are as follows:

Channel - Selects the channel to be edited.
Alias - Programs the identification that is displayed when the channel is selected. Up to 8 characters can be programmed.
Transmit - Programs the transmit frequency of the channel.
Receive - Programs the receive frequency of the channel.
Enable This Channel - The box must be checked for the channel to be selectable.
Rx Only - The box is checked if the channel is receive-only (transmitter disabled).
Copy Parameters From Channel - If another channel is selected, the parameters from that channel are copied to the new channel.

NOTE: Channel numbers not assigned must be programmed for conventional operation and then not enabled in the above screen because SMARTNET/ SmartZone channels cannot be disabled.

Channel Type

Channel Type Box - Selects the specific system from which the channel is selected. All programmed systems are displayed by number and type (conventional, SMARTNET, SmartZone). When a different channel type is selected, the screen for that type of channel is automatically displayed.

System Specific Information - With conventional systems, indicates the frequency of the selected channel without having to select the Modify box.

Transmit Power

Fixes the transmit power on the channel for the high or low level or allows it to be switch selectable (the Hi/Lo Power option switch is then required). Refer to Section 2.4.10 for more information.

Tx Time-Out

Enables or disables the time-out timer on the channel. The time-out timer time is programmed in the conventional system General screen (Section 3.5.2).

Busy Channel Lockout

Off = disabled, Noise = transmit disallowed if carrier is detected, Tone = transmit allowed with carrier detected only if correct Call Guard (CTCSS/ DCS) code is detected.

Coded Squelch

This sets the transmit and receive Call Guard (CTCSS/DCS) coding, if any, used on the channel. If "None" is selected, no code is transmitted and carrier-controlled squelch is used when receiving (Section 2.4.6). The standard Call Guard tones and codes are listed in Table 3-1 on page 3-22.

Signaling

Off - No ANI signaling is used.

Leading ANI - A DTMF-coded ID is sent at the beginning of each transmission. This ID is set in the radio-wide conventional screen (Section 3.4.3).

Trailing ANI - A DTMF-coded ID is sent at the end of each transmission.

DTMF Enabled - With full keypad (15-key) models, allows manual dialing of numbers using the DTMF keypad.

Channel Modulation

This selects if the channel modulation is wideband (5 kHz) or narrowband (2.5 kHz).

3.6 PROGRAMMING SMARTNET/SMARTZONE SYSTEMS AND CHANNELS

3.6.1 INTRODUCTION

To program SMARTNET and SmartZone systems and channels, proceed as follows:

1. Program the SMARTNET/SmartZone radio-wide information as described in Section 3.4.

2. To create a new SMARTNET/SmartZone system, select the Systems > Add Systems in the menu bar (see Section 3.1.10). Up to sixteen systems of any type can be programmed as described in Section 1.2.4.

3. Program the SMARTNET/SmartZone system information as described starting in the next section. Make sure the desired SMARTNET or SmartZone system is displayed by selecting it in the Window menu in the menu bar. Then program the channels as described starting in Section 3.6.8.

3.6.2 SMARTNET/SMARTZONE SYSTEM GENERAL SCREEN
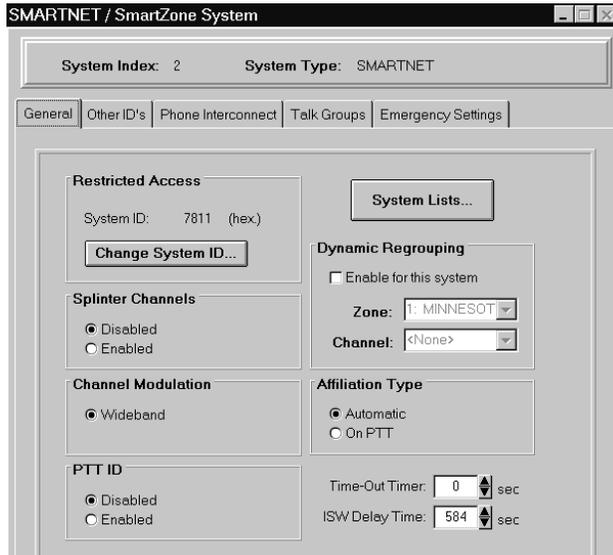
The SMARTNET/SmartZone System General screen is shown above, and it programs the following parameters:

Restricted Access

Change System ID Button - Displays the Change System ID screen which is used to enter the system ID of the system. This ID is entered as a hexadecimal number from 0-9 and A-F. Valid numbers are from 0001-FFFF. The system ID corresponding to the desired ID must also be located in the "key" subdirectory of the program file.

System ID - Read-only field which shows the ID of the system currently being edited.

Splinter Channels

When splinter channels are enabled, the receive and transmit frequencies are 12.5 kHz lower than the normal frequencies. Splinter channels are used only as required in the Mexico and Canada border areas for frequencies between 806 and 820.975 MHz.

Channel Modulation

When "Wideband" is enabled, the radio operates with a 4 kHz maximum deviation between 821.000 and 824.975 MHz and 5 kHz maximum deviation for

all other frequencies. When it is disabled, deviation is 5 kHz with all frequencies.

PTT ID

Enables or disables the PTT ID.

System Lists Button

This button displays the screens used to program the various lists that are unique for each SMARTNET/ SmartZone system. Refer to Section 3.6.7 for more information on these lists.

Dynamic Regrouping

Enable For This System - When this box is checked, a dynamic regrouping channel is enabled. This is a SMARTNET channel which has the corresponding talk group dynamically set by the dispatcher.

Zone - The physical zone containing the dynamic regrouping channel. The value is selected on the Channel Parameters screen.

Channel - The physical channel used for dynamic regrouping. The value is selected on the Channel Parameters screen.

Affiliation Type

Automatic - The radio immediately affiliates with the central controller as soon as it is turned on and automatically re-affiliates each time the talk group is changed.

On PTT - The radio affiliates with the central controller only when the PTT switch is pressed.

Time-Out Timer

Programs the time-out timer setting for the system. It can be programmed for 0 min, 15 sec up to 3 min, 45 sec or it can be disabled (see Section 2.3.9).

ISW Delay Time

Increasing or decreasing this value changes the transmission timing of ISWs relative to the reception of OSWs.

3.6.3 SMARTNET/SMARTZONE SYSTEM OTHER ID'S SCREEN
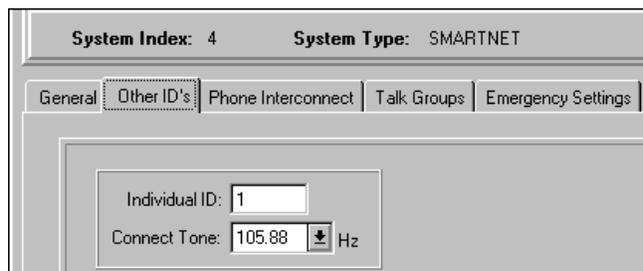
The SMARTNET/SmartZone Other ID's screen is shown above, and it programs the following parameters.

Individual ID - Uniquely identifies the radio on a particular system. Each radio must have a different Unit ID. Valid Unit IDs are from 1-49152.

Connect Tone - The tone expected by the controller on the traffic channel to verify that a subscriber transmission is occurring. This tone should be set the same as it is in the controller.

3.6.4 SMARTNET/SMARTZONE SYSTEM PHONE INTERCONNECT SCREEN

The SMARTNET/SmartZone Phone Interconnect screen is shown above, and the parameters it programs are as follows:

Phone Interconnect

Refer to Section 2.5.6 for more information on telephone calls.

Disabled - Telephone calls cannot be placed or received.

Answer Only - Telephone calls can be received but not placed.

List Only - Telephone calls can be placed and received, and numbers can be recalled from memory only.

Unlimited - Telephone calls can be placed and received, and numbers can be recalled from memory or dialed using the front panel keypad (full keypad 15-key models only).

Private Call

Same as above, but for private (unit-to-unit) calls. Refer to Sections 2.5.4 and 2.5.5 for more information.

Private Call II

Programs either standard (Private Conversation II™) or enhanced (Enhanced Private Conversation™) private calls as follows:

Standard - The user does not receive any feedback when the called radio is not active in the system. Only a "No Answer" is received if the called radio does not answer.

Enhanced - When a call is placed, the system tells the user if the called radio is currently active in the system and within range. The calling radio displays "NO ACK" if the called radio is not active in the system and "NO ANSWR" if it is active but does not answer.

Phone DTMF Timing

Initial Delay - Delay from 50-500 milliseconds from when a traffic channel is granted for phone interconnect to the start of the dialing out of the phone number.

Digit Duration - Duration from 50-500 milliseconds of each phone number digit.

Inter-Digit Delay - Delay from 50-500 milliseconds between each digit of a phone number.

3.6.5 SMARTNET/SMARTZONE SYSTEM TALK GROUPS SCREEN
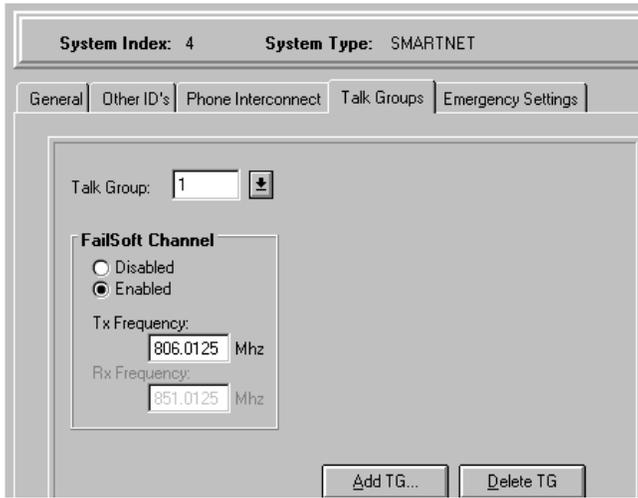
The SMARTNET/SmartZone Talk Groups screen is used to set up SMARTNET/SmartZone talk groups and program unique talk group information. This screen is shown above, and the parameters it programs are as follows:

Talk Group - Selects the talk group to program. This is the actual ID of the talk group. Talk groups are added or deleted by clicking the Add TG or Delete TG button (see following). Talk groups are assigned to channels on the channel screen (see Section 3.6.9).

Add TG... - Clicking this button displays a dialog box that adds a new talk group. The alias (alphatag) of up to 8 characters is entered, and the new group is then added after the others that are already set up. Each SMARTNET/SmartZone system can be programmed with up to 256 talk groups.

Delete TG - Clicking this button deletes the currently selected talk group (the one displayed in the "Talk Group" box).

Failsoft Channel

Enable - Enables a failsoft channel on the talk group if a controller failure occurs (see Section 2.5.11).

Disable - The failsoft mode is not entered if the controller fails.

Tx/Rx Frequency - Programs the failsoft channel frequency if "Enabled" is checked.

3.6.6 SMARTNET/SMARTZONE SYSTEM EMERGENCY SETTINGS SCREEN

The SMARTNET/SmartZone Emergency Settings screen and the parameters it programs are as follows:
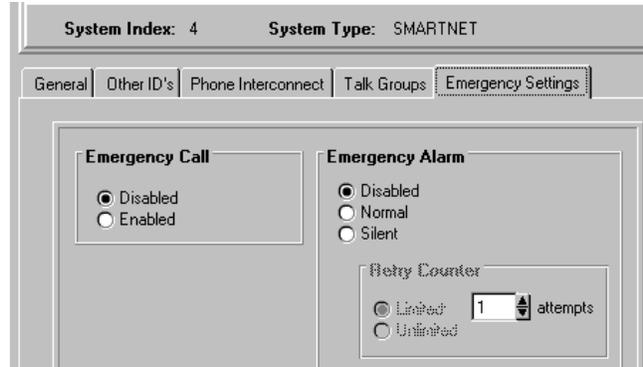
Emergency Call

Enable - When the Emergency option switch and then the PTT switch are pressed, an emergency group call is transmitted.

Disable - An emergency group call is not authorized.

Emergency Alarm

Disabled - No emergency signal is sent when the user presses the Emergency option switch.

Normal - When the user presses the Emergency option switch, an emergency signal is sent to the dispatcher. Audio and visual feedback is provided by the radio.

Silent - Same as "Normal" except no audio or visual feedback is provided.

Retry Counter - When "Unlimited" is selected, an emergency call is repeated until acknowledged or canceled. When "Limited" is checked, calls are attempted only the specified number of times.

3.6.7 SMARTNET/SMARTZONE SYSTEM LISTS SCREENS

Clicking the [System Lists...] button in the General screen described in Section 3.6.2 displays the screens used to program the various lists that are unique for each SMARTNET/SmartZone system. These screens are as follows:

Trunking Phone List Screen
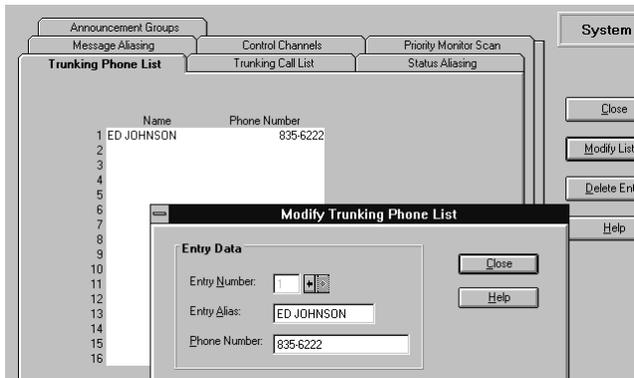
This screen programs the phone number list if used (see Section 2.5.6). To edit this list, click the Trunking Phone List tab and then the "Modify List" button on the right side of the screen. The following information is then programmed in the dialog box that is displayed:

Entry Number - This box selects the entry to be edited. The scroll bars to the right of this box select the desired entry. A phone list can contain up to 16 entries. Selecting a new entry number automatically validates and stores the current entry. If the current entry contains an invalid field (for example, too many digits in the phone number), the entry number does not change and the invalid field is highlighted.

Entry Alias - Up to 8 characters can be entered to identify the phone number. This identification is displayed when phone numbers are selected by the user from the list. Only uppercase letters can be entered, so lowercase letters are automatically converted to uppercase by the program.

Phone Number - This is the number dialed when the location is selected. Characters that can be entered

include 0-9, #, (,), and P (a "P" programs a pause). The maximum number of digits excluding (,) and spaces is 16, and the maximum including (,) and spaces is 24.

Close - Clicking this button verifies the current entry, stores it, and then closes the dialog box. If the current entry contains an invalid field, the dialog box does not close and the invalid field is highlighted.

Help - Accesses the Help screen. Help can also be selected at any time by pressing the F1 key.

Message Aliasing Screen
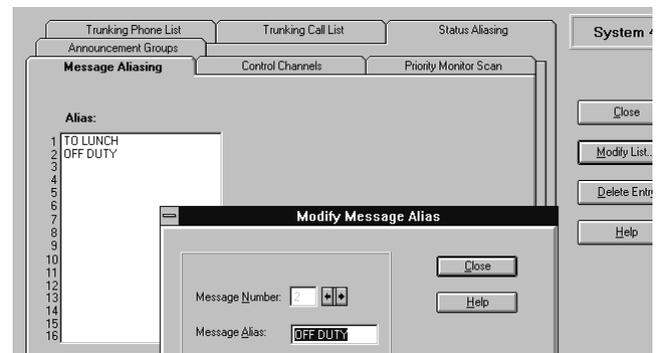
This screen associates an alias (name) with each message number (see Section 2.5.8). To edit this list, click the Message Aliasing tab and then the "Modify List" button on the right side. The following information is then programmed in the dialog box that is displayed:

Message Number - This box selects the message to be edited. The scroll bars to the right of this box select the desired message number.

Message Alias - Programs the alias which can be up to any 8 alphanumeric characters.

Close Button - Validates the entry and closes the dialog box. The entry is also validated when another message number is selected.

Announcement Groups Screen
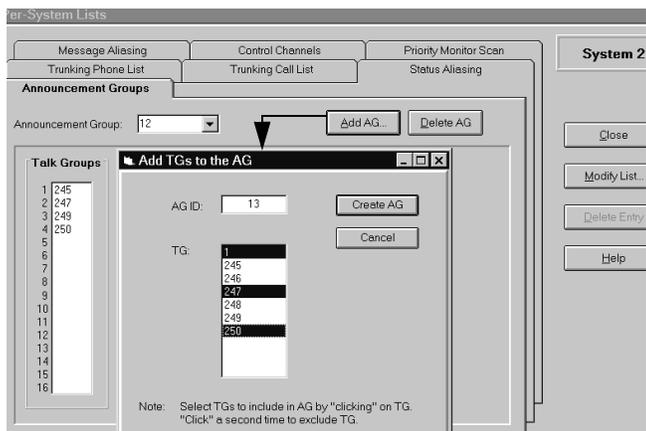
This screen programs the announcement groups that are used to communicate with several talk groups simultaneously. There can be up to 3 announcement groups per system, and each announcement group can have up to 15 talk groups.

To create an announcement group, click the "Add AG" button and the "Add TGs to the AG" screen shown above is displayed. Enter the announcement group ID, click the talk groups to select/de-select those that are to be included, and then create the announcement group by clicking the "Create AG" button. To delete the current announcement group, click the "Delete AG" button.
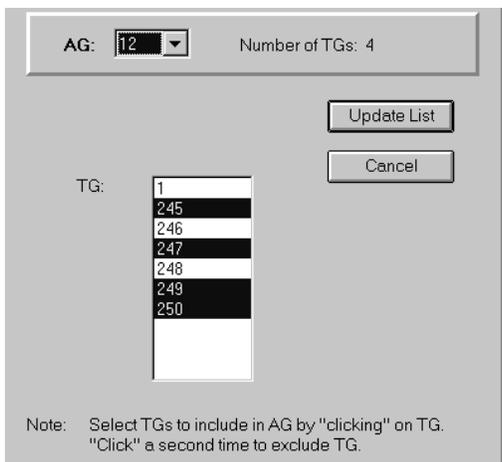
To edit an announcement group, click the "Modify List" button on the right and the preceding

screen is displayed. Select the announcement group to be edited from a pull-down menu selecting by clicking the "AG" arrow. Then click the talk groups to select/de-select them and then click the "Update List" button to make the changes.

Control Channels Screen
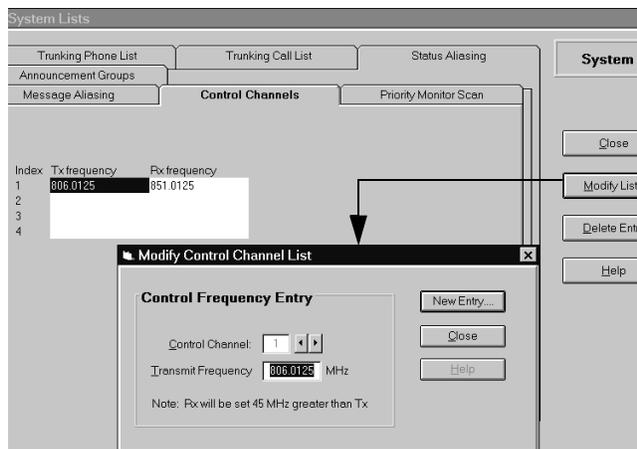
This screen allows the system manager to view and edit the control channels. Each SMARTNET system can have up to four control channels, and each SmartZone system can have up to 32 control channels. Only one control channel is active at a time.

To edit this list, click the Control Channels tab and then the "Modify List" button on the right side. The following information is then programmed in the dialog box that is displayed:

Control Channel - Selects the control channel to be edited. To add a new channel, click the "New Entry" button.

Frequency - The transmit and receive frequency of the control channel. These are the mobile frequencies, not the repeater frequencies. Only multiples of 5 kHz and 6.25 kHz are valid. With 800 MHz frequencies, a receive frequency 45 MHz above the transmit frequency is automatically entered.

New Entry Button - Click this button to display the dialog box used to add another control channel.

Trunking Call List Screen
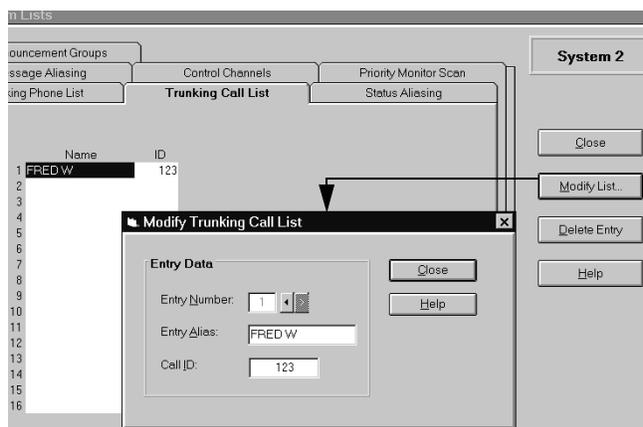
This screen is shown above, and it allows the list of IDs used for private calls to be programmed. A maximum of 16 IDs can be programmed (see Sections 2.5.4 and 2.5.5).

To edit this list, click the Trunking Call List tab and then the "Modify List" button on the right side. This following information is then programmed in the dialog box that is displayed:

Entry Number - This box selects the entry to be edited. The scroll bars to the right of this box select the desired entry. A private call list can contain up to 16 entries. Selecting a new entry number automatically validates and stores the current entry. If the current entry contains an invalid field, the entry number does not change and the invalid field is highlighted.

Entry Alias - Up to 8 characters can be entered to identify the user being called. This identification is displayed when the mobile to be called is selected by the user from the list. Only uppercase letters can be entered, so lowercase letters are automatically converted to uppercase by the program.

Call ID - This is the ID of the radio being called. Valid entries are 1-65535. A "0" is detected as no entry.

Close Button - Verifies the current entry, stores it, and then closes the dialog box. If the current entry contains an invalid field, the dialog box does not close and the invalid field is highlighted.

Priority Monitor Scan Screen
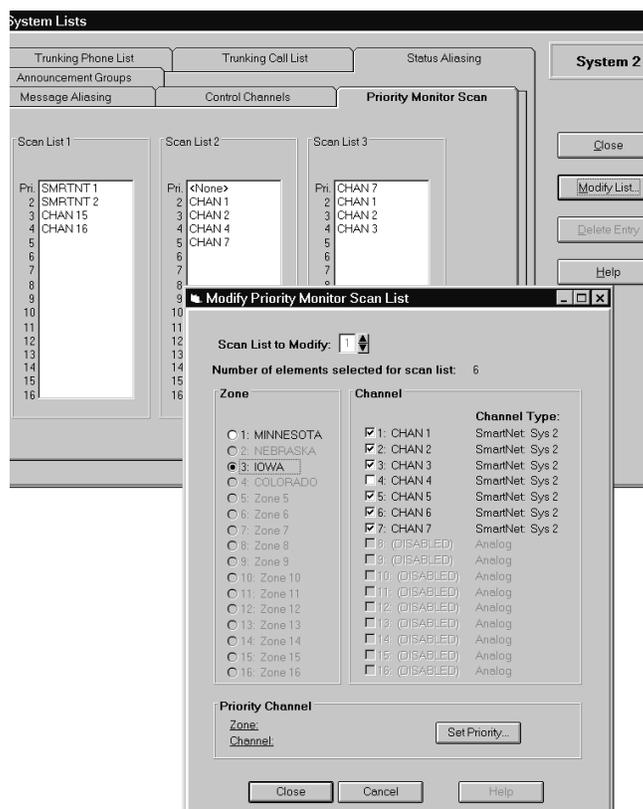
This screen programs up to three Priority Monitor scan lists that are allowed. Each scan list can contain up to 15 channels plus a priority channel (see Section 2.5.12). These channels must be from the same SMARTNET/SmartZone system. Channels set up for other systems are not allowed.

To edit a list, click the Priority Monitor Scan tab and then click the "Modify List" button on the right side. A screen similar to the bottom screen shown above is then displayed to select the channels to be included in that scan list. Select channels as follows:

1. Select the scan list to be edited by clicking the scroll bars next to the "Scan List To Modify" box.

2. Select the first zone with channels to be included and select the desired channels. Repeat for the other zones.

3. To select the priority channel, click the Set Priority button. Then select the desired Zone/Channel or "None" if no priority channel is to be scanned.

4. Repeat the preceding steps for the other scan lists if applicable.

Status Aliasing Screen
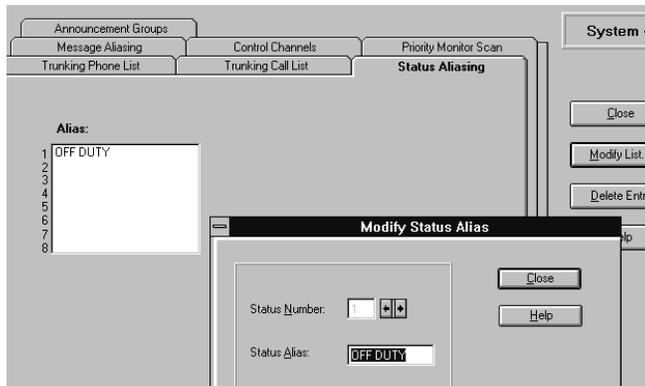
This screen is shown above, and it programs the alias for each of up to eight status conditions that can be sent. The meaning of each status number is defined by the system manager. Refer to Section 2.5.9 for more information.

To edit this list, click the Status Aliasing tab and then the "Modify List" button on the right side. The following information is then programmed in the dialog box that is displayed:

Status Number - The scroll bars to the right of this box select the status number that is to be edited.

Status Alias - Programs up to 8 characters that identify the status. This identification is displayed when the user selects a status condition.

3.6.8 SETTING UP SMARTNET/SMART-ZONE CHANNELS

The SMARTNET/SmartZone Channel screen shown in Figure 3-4 is displayed when the SMARTNET or SmartZone channel type is selected. This screen programs unique channel parameters and also assigns channels to the selectable zones displayed by the transceiver.

The general procedure for setting up a SMARTNET/SmartZone channel is as follows. Refer to the descriptions which follow this procedure for information on SMARTNET/SmartZone Channel screen parameters.

1. Make sure that the desired zone is selected in the Zone box.

2. Select the channel number in the Channels Index box which is to be programmed with the channel.

3. To set up a SMARTNET channel, select "SMARTNET" as the channel type, and to set up a SmartZone channel, select "SmartZone".

4. Click the Modify button to display the dialog box shown in the lower part of Figure 3-4. This box programs the alias (tag) that is displayed when it is selected.

5. Program the other parameters in the main part of the screen (see information which follows).

3.6.9 SMARTNET/SMARTZONE CHANNEL SCREEN PARAMETERS

The following parameters are programmed in the SMARTNET/SmartZone channel screen shown in Figure 3-4.

Selected Channel

Zone Box - Clicking the arrow to the right of this box displays the available zones. Click on a zone to select it. Zones and zone aliases are set up on the Radio-Wide General screen described in Section 3.4.2.

Channel Index Box - Displays the channels in the selected zone. The channel type is selected by the Channel Type box below it.

Modify... - Displays the screen shown in the lower part of Figure 3-4. The parameters programmed in this screen are as follows:

Channel - Selects the channel to be edited.
Alias - Programs the identification that is displayed when the channel is selected. Up to 8 characters can be programmed.
Transmit - Not programmable because the transmit frequency is dynamically assigned over the air ("Trunked" is always displayed).
Receive - Dynamically assigned like the transmit frequency.
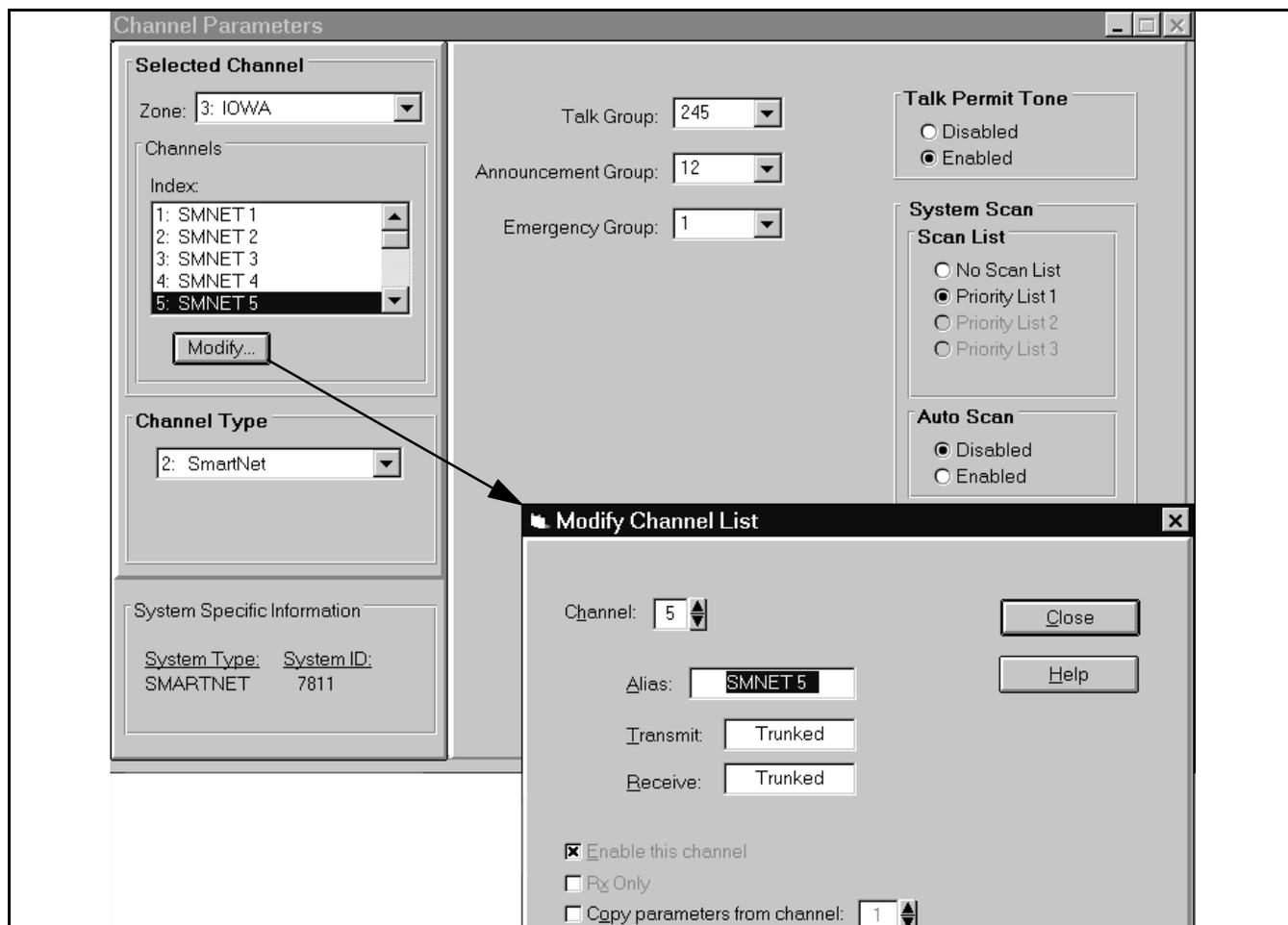
Figure 3-4   SMARTNET/SmartZone Channel Screen

Enable This Channel - Not used because SMART-NET/SmartZone channels are always enabled if set up. To disable a channel so that it is not selectable, choose the conventional type and do not check this box.

Copy Parameters From Channel - If another channel is selected in the box, the parameters from that channel are copied to the new channel.

Channel Type

Channel Type Box - Selects the specific system from which the channel is selected. All programmed systems are displayed by number and type (conventional, SMARTNET, SmartZone). When a different channel type is selected, the screen for that type of channel is automatically displayed.

Other Screen Parameters

System Specific Information - With SMARTNET/SmartZone systems, indicates the system ID programmed on the system General screen (see Section 3.6.2).

Talk Group - Selects the talk group selected by that channel. Talk groups are programmed in the Talk Group screen described in Section 3.6.5.

Announcement Group - Selects one of up to three announcement groups selected by the channel. Refer to "Announcement Group Screen" in Section 3.6.7 for more information.

Emergency Group - Selects the talk group used for emergency calls.

Talk Permit Tone - When enabled, a short tone sounds after a request for a group call has been approved by the main controller. This indicates that speaking can begin. When disabled, no audio feedback is used to indicate when speaking can begin.

System Scan - Selects the Priority Monitor Scan list selected by the channel (see "Priority Monitor Scan Screen" description in Section 3.6.7). If "No Scan

List" is programmed, scanning is not selectable on that channel.

Auto Scan - When enabled and a channel is selected, the radio automatically begins scanning the scan list associated with that channel. When disabled, scanning can only be started manually by the Scan option switch.

Table 3-1   Call Guard (CTCSS/DCS) Codes and Tones

Recommended Tone Call Guard Codes									
Code	**Freq**	**Code**	**Freq**	**Code**	**Freq**	**Code**	**Freq**	**Code**	**Freq**
01	67.0	10	94.8	19	127.3	28	173.8	38*	250.3
02	71.9	11**	97.4	20	131.8	29	179.9	39**	69.3
03	74.4	12	100.0	21	136.5	30	186.2	40**	206.5
04	77.0	13	103.5	22	141.3	31	192.8	41**	229.1
05	79.7	14	107.2	23	146.2	32	203.5	42**	254.1
06	82.5	15	110.9	24	151.4	33	210.7		
07	85.4	16	114.8	25	156.7	34*	218.1		
08	88.5	17	118.8	26	162.2	35*	225.7		
09	91.5	18	123.0	27	167.9	37*	241.8		

* 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	

800 MHz Channels

FCC Chan. No.	Mobile Rx Freq.	Mobile Tx Freq	FCC Chan. No.	Mobile Rx Freq.	Mobile Tx Freq	FCC Chan. No.	Mobile Rx Freq	Mobile Tx Freq
1	851.0125	806.0125	9	851.2125	806.2125	17	851.4125	806.4125
2	851.0375	806.0375	10	851.2375	806.2375	18	851.4375	806.4375
3	851.0625	806.0625	11	851.2625	806.2625	19	851.4625	806.4625
4	851.0875	806.0875	12	851.2875	806.2875	20	851.4875	806.4875
5	851.1125	806.1125	13	851.3125	806.3125	21	851.5125	806.5125
6	851.1375	806.1375	14	851.3375	806.3375	22	851.5375	806.5375
7	851.1625	806.1625	15	851.3625	806.3625	23	851.5625	806.5625
8	851.1875	806.1875	16	851.3875	806.3875	24	851.5875	806.5875

800 MHz Channels

FCC Chan. No.	Mobile Rx Freq.	Mobile Tx Freq	FCC Chan. No.	Mobile Rx Freq.	Mobile Tx Freq	FCC Chan. No.	Mobile Rx Freq	Mobile Tx Freq
25	851.6125	806.6125	75	852.8625	807.8625	125	854.1125	809.1125
26	851.6375	806.6375	76	852.8875	807.8875	126	854.1375	809.1375
27	851.6625	806.6625	77	852.9125	807.9125	127	854.1625	809.1625
28	851.6875	806.6875	78	852.9375	807.9375	128	854.1875	809.1875
29	851.7125	806.7125	79	852.9625	807.9625	129	854.2125	809.2125
30	851.7375	806.7375	80	852.9875	807.9875	130	854.2375	809.2375
31	851.7625	806.7625	81	853.0125	808.0125	131	854.2625	809.2625
32	851.7875	806.7875	82	853.0375	808.0375	132	854.2875	809.2875
33	851.8125	806.8125	83	853.0625	808.0625	133	854.3125	809.3125
34	851.8375	806.8375	84	853.0875	808.0875	134	854.3375	809.3375
35	851.8625	806.8625	85	853.1125	808.1125	135	854.3625	809.3625
36	851.8875	806.8875	86	853.1375	808.1375	136	854.3875	809.3875
37	851.9125	806.9125	87	853.1625	808.1625	137	854.4125	809.4125
38	851.9375	806.9375	88	853.1875	808.1875	138	854.4375	809.4375
39	851.9625	806.9625	89	853.2125	808.2125	139	854.4625	809.4625
40	851.9875	806.9875	90	853.2375	808.2375	140	854.4875	809.4875
41	852.0125	807.0125	91	853.2625	808.2625	141	854.5125	809.5125
42	852.0375	807.0375	92	853.2875	808.2875	142	854.5375	809.5375
43	852.0625	807.0625	93	853.3125	808.3125	143	854.5625	809.5625
44	852.0875	807.0875	94	853.3375	808.3375	144	854.5875	809.5875
45	852.1125	807.1125	95	853.3625	808.3625	145	854.6125	809.6125
46	852.1375	807.1375	96	853.3875	808.3875	146	854.6375	809.6375
47	852.1625	807.1625	97	853.4125	808.4125	147	854.6625	809.6625
48	852.1875	807.1875	98	853.4375	808.4375	148	854.6875	809.6875
49	852.2125	807.2125	99	853.4625	808.4625	149	854.7125	809.7125
50	852.2375	807.2375	100	853.4875	808.4875	150	854.7375	809.7375
51	852.2625	807.2625	101	853.5125	808.5125	151	854.7625	809.7625
52	852.2875	807.2875	102	853.5375	808.5375	152	854.7875	809.7875
53	852.3125	807.3125	103	853.5625	808.5625	153	854.8125	809.8125
54	852.3375	807.3375	104	853.5875	808.5875	154	854.8375	809.8375
55	852.3625	807.3625	105	853.6125	808.6125	155	854.8625	809.8625
56	852.3875	807.3875	106	853.6375	808.6375	156	854.8875	809.8875
57	852.4125	807.4125	107	853.6625	808.6625	157	854.9125	809.9125
58	852.4375	807.4375	108	853.6875	808.6875	158	854.9375	809.9375
59	852.4625	807.4625	109	853.7125	808.7125	159	854.9625	809.9625
60	852.4875	807.4875	110	853.7375	808.7375	160	854.9875	809.9875
61	852.5125	807.5125	111	853.7625	808.7625	161	855.0125	810.0125
62	852.5375	807.5375	112	853.7875	808.7875	162	855.0375	810.0375
63	852.5625	807.5625	113	853.8125	808.8125	163	855.0625	810.0625
64	852.5875	807.5875	114	853.8375	808.8375	164	855.0875	810.0875
65	852.6125	807.6125	115	853.8625	808.8625	165	855.1125	810.1125
66	852.6375	807.6375	116	853.8875	808.8875	166	855.1375	810.1375
67	852.6625	807.6625	117	853.9125	808.9125	167	855.1625	810.1625
68	852.6875	807.6875	118	853.9375	808.9375	168	855.1875	810.1875
69	852.7125	807.7125	119	853.9625	808.9625	169	855.2125	810.2125
70	852.7375	807.7375	120	853.9875	808.9875	170	855.2375	810.2375
71	852.7625	807.7625	121	854.0125	809.0125	171	855.2625	810.2625
72	852.7875	807.7875	122	854.0375	809.0375	172	855.2875	810.2875
73	852.8125	807.8125	123	854.0625	809.0625	173	855.3125	810.3125
74	852.8375	807.8375	124	854.0875	809.0875	174	855.3375	810.3375

800 MHz Channels

FCC Chan. No.	Mobile Rx Freq.	Mobile Tx Freq	FCC Chan. No.	Mobile Rx Freq.	Mobile Tx Freq	FCC Chan. No.	Mobile Rx Freq	Mobile Tx Freq
175	855.3625	810.3625	225	856.6125	811.6125	275	857.8625	812.8625
176	855.3875	810.3875	226	856.6375	811.6375	276	857.8875	812.8875
177	855.4125	810.4125	227	856.6625	811.6625	277	857.9125	812.9125
178	855.4375	810.4375	228	856.6875	811.6875	278	857.9375	812.9375
179	855.4625	810.4625	229	856.7125	811.7125	279	857.9625	812.9625
180	855.4875	810.4875	230	856.7375	811.7375	280	857.9875	812.9875
181	855.5125	810.5125	231	856.7625	811.7625	281	858.0125	813.0125
182	855.5375	810.5375	232	856.7875	811.7875	282	858.0375	813.0375
183	855.5625	810.5625	233	856.8125	811.8125	283	858.0625	813.0625
184	855.5875	810.5875	234	856.8375	811.8375	284	858.0875	813.0875
185	855.6125	810.6125	235	856.8625	811.8625	285	858.1125	813.1125
186	855.6375	810.6375	236	856.8875	811.8875	286	858.1375	813.1375
187	855.6625	810.6625	237	856.9125	811.9125	287	858.1625	813.1625
188	855.6875	810.6875	238	856.9375	811.9375	288	858.1875	813.1875
189	855.7125	810.7125	239	856.9625	811.9625	289	858.2125	813.2125
190	855.7375	810.7375	240	856.9875	811.9875	290	858.2375	813.2375
191	855.7625	810.7625	241	857.0125	812.0125	291	858.2625	813.2625
192	855.7875	810.7875	242	857.0375	812.0375	292	858.2875	813.2875
193	855.8125	810.8125	243	857.0625	812.0625	293	858.3125	813.3125
194	855.8375	810.8375	244	857.0875	812.0875	294	858.3375	813.3375
195	855.8625	810.8625	245	857.1125	812.1125	295	858.3625	813.3625
196	855.8875	810.8875	246	857.1375	812.1375	296	858.3875	813.3875
197	855.9125	810.9125	247	857.1625	812.1625	297	858.4125	813.4125
198	855.9375	810.9375	248	857.1875	812.1875	298	858.4375	813.4375
199	855.9625	810.9625	249	857.2125	812.2125	299	858.4625	813.4625
200	855.9875	810.9875	250	857.2375	812.2375	300	858.4875	813.4875
201	856.0125	811.0125	251	857.2625	812.2625	301	858.5125	813.5125
202	856.0375	811.0375	252	857.2875	812.2875	302	858.5375	813.5375
203	856.0625	811.0625	253	857.3125	812.3125	303	858.5625	813.5625
204	856.0875	811.0875	254	857.3375	812.3375	304	858.5875	813.5875
205	856.1125	811.1125	255	857.3625	812.3625	305	858.6125	813.6125
206	856.1375	811.1375	256	857.3875	812.3875	306	858.6375	813.6375
207	856.1625	811.1625	257	857.4125	812.4125	307	858.6625	813.6625
208	856.1875	811.1875	258	857.4375	812.4375	308	858.6875	813.6875
209	856.2125	811.2125	259	857.4625	812.4625	309	858.7125	813.7125
210	856.2375	811.2375	260	857.4875	812.4875	310	858.7375	813.7375
211	856.2625	811.2625	261	857.5125	812.5125	311	858.7625	813.7625
212	856.2875	811.2875	262	857.5375	812.5375	312	858.7875	813.7875
213	856.3125	811.3125	263	857.5625	812.5625	313	858.8125	813.8125
214	856.3375	811.3375	264	857.5875	812.5875	314	858.8375	813.8375
215	856.3625	811.3625	265	857.6125	812.6125	315	858.8625	813.8625
216	856.3875	811.3875	266	857.6375	812.6375	316	858.8875	813.8875
217	856.4125	811.4125	267	857.6625	812.6625	317	858.9125	813.9125
218	856.4375	811.4375	268	857.6875	812.6875	318	858.9375	813.9375
219	856.4625	811.4625	269	857.7125	812.7125	319	858.9625	813.9625
220	856.4875	811.4875	270	857.7375	812.7375	320	858.9875	813.9875
221	856.5125	811.5125	271	857.7625	812.7625	321	859.0125	814.0125
222	856.5375	811.5375	272	857.7875	812.7875	322	859.0375	814.0375
223	856.5625	811.5625	273	857.8125	812.8125	323	859.0625	814.0625
224	856.5875	811.5875	274	857.8375	812.8375	324	859.0875	814.0875

800 MHz Channels

FCC Chan. No.	Mobile Rx Freq.	Mobile Tx Freq	FCC Chan. No.	Mobile Rx Freq.	Mobile Tx Freq	FCC Chan. No.	Mobile Rx Freq	Mobile Tx Freq
325	859.1125	814.1125	375	860.3625	815.3625	425	861.6125	816.6125
326	859.1375	814.1375	376	860.3875	815.3875	426	861.6375	816.6375
327	859.1625	814.1625	377	860.4125	815.4125	427	861.6625	816.6625
328	859.1875	814.1875	378	860.4375	815.4375	428	861.6875	816.6875
329	859.2125	814.2125	379	860.4625	815.4625	429	861.7125	816.7125
330	859.2375	814.2375	380	860.4875	815.4875	430	861.7375	816.7375
331	859.2625	814.2625	381	860.5125	815.5125	431	861.7625	816.7625
332	859.2875	814.2875	382	860.5375	815.5375	432	861.7875	816.7875
333	859.3125	814.3125	383	860.5625	815.5625	433	861.8125	816.8125
334	859.3375	814.3375	384	860.5875	815.5875	434	861.8375	816.8375
335	859.3625	814.3625	385	860.6125	815.6125	435	861.8625	816.8625
336	859.3875	814.3875	386	860.6375	815.6375	436	861.8875	816.8875
337	859.4125	814.4125	387	860.6625	815.6625	437	861.9125	816.9125
338	859.4375	814.4375	388	860.6875	815.6875	438	861.9375	816.9375
339	859.4625	814.4625	389	860.7125	815.7125	439	861.9625	816.9625
340	859.4875	814.4875	390	860.7375	815.7375	440	861.9875	816.9875
341	859.5125	814.5125	391	860.7625	815.7625	441	862.0125	817.0125
342	859.5375	814.5375	392	860.7875	815.7875	442	862.0375	817.0375
343	859.5625	814.5625	393	860.8125	815.8125	443	862.0625	817.0625
344	859.5875	814.5875	394	860.8375	815.8375	444	862.0875	817.0875
345	859.6125	814.6125	395	860.8625	815.8625	445	862.1125	817.1125
346	859.6375	814.6375	396	860.8875	815.8875	446	862.1375	817.1375
347	859.6625	814.6625	397	860.9125	815.9125	447	862.1625	817.1625
348	859.6875	814.6875	398	860.9375	815.9375	448	862.1875	817.1875
349	859.7125	814.7125	399	860.9625	815.9625	449	862.2125	817.2125
350	859.7375	814.7375	400	860.9875	815.9875	450	862.2375	817.2375
351	859.7625	814.7625	401	861.0125	816.0125	451	862.2625	817.2625
352	859.7875	814.7875	402	861.0375	816.0375	452	862.2875	817.2875
353	859.8125	814.8125	403	861.0625	816.0625	453	862.3125	817.3125
354	859.8375	814.8375	404	861.0875	816.0875	454	862.3375	817.3375
355	859.8625	814.8625	405	861.1125	816.1125	455	862.3625	817.3625
356	859.8875	814.8875	406	861.1375	816.1375	456	862.3875	817.3875
357	859.9125	814.9125	407	861.1625	816.1625	457	862.4125	817.4125
358	859.9375	814.9375	408	861.1875	816.1875	458	862.4375	817.4375
359	859.9625	814.9625	409	861.2125	816.2125	459	862.4625	817.4625
360	859.9875	814.9875	410	861.2375	816.2375	460	862.4875	817.4875
361	860.0125	815.0125	411	861.2625	816.2625	461	862.5125	817.5125
362	860.0375	815.0375	412	861.2875	816.2875	462	862.5375	817.5375
363	860.0625	815.0625	413	861.3125	816.3125	463	862.5625	817.5625
364	860.0875	815.0875	414	861.3375	816.3375	464	862.5875	817.5875
365	860.1125	815.1125	415	861.3625	816.3625	465	862.6125	817.6125
366	860.1375	815.1375	416	861.3875	816.3875	466	862.6375	817.6375
367	860.1625	815.1625	417	861.4125	816.4125	467	862.6625	817.6625
368	860.1875	815.1875	418	861.4375	816.4375	468	862.6875	817.6875
369	860.2125	815.2125	419	861.4625	816.4625	469	862.7125	817.7125
370	860.2375	815.2375	420	861.4875	816.4875	470	862.7375	817.7375
371	860.2625	815.2625	421	861.5125	816.5125	471	862.7625	817.7625
372	860.2875	815.2875	422	861.5375	816.5375	472	862.7875	817.7875
373	860.3125	815.3125	423	861.5625	816.5625	473	862.8125	817.8125
374	860.3375	815.3375	424	861.5875	816.5875	474	862.8375	817.8375

800 MHz Channels

FCC Chan. No.	Mobile Rx Freq.	Mobile Tx Freq	FCC Chan. No.	Mobile Rx Freq.	Mobile Tx Freq	FCC Chan. No.	Mobile Rx Freq	Mobile Tx Freq
475	862.8625	817.8625	525	864.1125	819.1125	575	865.3625	820.3625
476	862.8875	817.8875	526	864.1375	819.1375	576	865.3875	820.3875
477	862.9125	817.9125	527	864.1625	819.1625	577	865.4125	820.4125
478	862.9375	817.9375	528	864.1875	819.1875	578	865.4375	820.4375
479	862.9625	817.9625	529	864.2125	819.2125	579	865.4625	820.4625
480	862.9875	817.9875	530	864.2375	819.2375	580	865.4875	820.4875
481	863.0125	818.0125	531	864.2625	819.2625	581	865.5125	820.5125
482	863.0375	818.0375	532	864.2875	819.2875	582	865.5375	820.5375
483	863.0625	818.0625	533	864.3125	819.3125	583	865.5625	820.5625
484	863.0875	818.0875	534	864.3375	819.3375	584	865.5875	820.5875
485	863.1125	818.1125	535	864.3625	819.3625	585	865.6125	820.6125
486	863.1375	818.1375	536	864.3875	819.3875	586	865.6375	820.6375
487	863.1625	818.1625	537	864.4125	819.4125	587	865.6625	820.6625
488	863.1875	818.1875	538	864.4375	819.4375	588	865.6875	820.6875
489	863.2125	818.2125	539	864.4625	819.4625	589	865.7125	820.7125
490	863.2375	818.2375	540	864.4875	819.4875	590	865.7375	820.7375
491	863.2625	818.2625	541	864.5125	819.5125	591	865.7625	820.7625
492	863.2875	818.2875	542	864.5375	819.5375	592	865.7875	820.7875
493	863.3125	818.3125	543	864.5625	819.5625	593	865.8125	820.8125
494	863.3375	818.3375	544	864.5875	819.5875	594	865.8375	820.8375
495	863.3625	818.3625	545	864.6125	819.6125	595	865.8625	820.8625
496	863.3875	818.3875	546	864.6375	819.6375	596	865.8875	820.8875
497	863.4125	818.4125	547	864.6625	819.6625	597	865.9125	820.9125
498	863.4375	818.4375	548	864.6875	819.6875	598	865.9375	820.9375
499	863.4625	818.4625	549	864.7125	819.7125	599	865.9625	820.9625
500	863.4875	818.4875	550	864.7375	819.7375	600	865.9875	820.9875
501	863.5125	818.5125	551	864.7625	819.7625	-	866.0000	821.0000
502	863.5375	818.5375	552	864.7875	819.7875	601	866.0125	821.0125
503	863.5625	818.5625	553	864.8125	819.8125	-	866.0250	821.0250
504	863.5875	818.5875	554	864.8375	819.8375	602	866.0375	821.0375
505	863.6125	818.6125	555	864.8625	819.8625	603	866.0500	821.0500
506	863.6375	818.6375	556	864.8875	819.8875	604	866.0625	821.0625
507	863.6625	818.6625	557	864.9125	819.9125	605	866.0750	821.0750
508	863.6875	818.6875	558	864.9375	819.9375	606	866.0875	821.0875
509	863.7125	818.7125	559	864.9625	819.9625	607	866.1000	821.1000
510	863.7375	818.7375	560	864.9875	819.9875	608	866.1125	821.1125
511	863.7625	818.7625	561	865.0125	820.0125	609	866.1250	821.1250
512	863.7875	818.7875	562	865.0375	820.0375	610	866.1375	821.1375
513	863.8125	818.8125	563	865.0625	820.0625	611	866.1500	821.1500
514	863.8375	818.8375	564	865.0875	820.0875	612	866.1625	821.1625
515	863.8625	818.8625	565	865.1125	820.1125	613	866.1750	821.1750
516	863.8875	818.8875	566	865.1375	820.1375	614	866.1875	821.1875
517	863.9125	818.9125	567	865.1625	820.1625	615	866.2000	821.2000
518	863.9375	818.9375	568	865.1875	820.1875	616	866.2125	821.2125
519	863.9625	818.9625	569	865.2125	820.2125	617	866.2250	821.2250
520	863.9875	818.9875	570	865.2375	820.2375	618	866.2375	821.2375
521	864.0125	819.0125	571	865.2625	820.2625	619	866.2500	821.2500
522	864.0375	819.0375	572	865.2875	820.2875	620	866.2625	821.2625
523	864.0625	819.0625	573	865.3125	820.3125	621	866.2750	821.2750
524	864.0875	819.0875	574	865.3375	820.3375	622	866.2875	821.2875

800 MHz Channels

FCC Chan. No.	Mobile Rx Freq.	Mobile Tx Freq	FCC Chan. No.	Mobile Rx Freq.	Mobile Tx Freq	FCC Chan. No.	Mobile Rx Freq	Mobile Tx Freq
623	866.3000	821.3000	671	866.9250	821.9250	717	867.5500	822.5500
624	866.3125	821.3125	672	866.9375	821.9375	718	867.5625	822.5625
625	866.3250	821.3250	673	866.9500	821.9500	719	867.5750	822.5750
626	866.3375	821.3375	674	866.9625	821.9625	720	867.5875	822.5875
627	866.3500	821.3500	675	866.9750	821.9750	721	867.6000	822.6000
628	866.3625	821.3625	676	866.9875	821.9875	722	867.6125	822.6125
629	866.3750	821.3750	-	867.0000	822.0000	723	867.6250	822.6250
630	866.3875	821.3875	677	867.0125	822.0125	724	867.6375	822.6375
631	866.4000	821.4000	-	867.0250	822.0250	725	867.6500	822.6500
632	866.4125	821.4125	678	867.0375	822.0375	726	867.6625	822.6625
633	866.4250	821.4250	679	867.0500	822.0500	727	867.6750	822.6750
634	866.4375	821.4375	680	867.0625	822.0625	728	867.6875	822.6875
635	866.4500	821.4500	681	867.0750	822.0750	729	867.7000	822.7000
636	866.4625	821.4625	682	867.0875	822.0875	730	867.7125	822.7125
637	866.4750	821.4750	683	867.1000	822.1000	731	867.7250	822.7250
638	866.4875	821.4875	684	867.1125	822.1125	732	867.7375	822.7375
-	866.5000	821.5000	685	867.1250	822.1250	733	867.7500	822.7500
639	866.5125	821.5125	686	867.1375	822.1375	734	867.7625	822.7625
-	866.5250	821.5250	687	867.1500	822.1500	735	867.7750	822.7750
640	866.5375	821.5375	688	867.1625	822.1625	736	867.7875	822.7875
641	866.5500	821.5500	689	867.1750	822.1750	737	867.8000	822.8000
642	866.5625	821.5625	690	867.1875	822.1875	738	867.8125	822.8125
643	866.5750	821.5750	691	867.2000	822.2000	739	867.8250	822.8250
644	866.5875	821.5875	692	867.2125	822.2125	740	867.8375	822.8375
645	866.6000	821.6000	693	867.2250	822.2250	741	867.8500	822.8500
646	866.6125	821.6125	694	867.2375	822.2375	742	867.8625	822.8625
647	866.6250	821.6250	695	867.2500	822.2500	743	867.8750	822.8750
648	866.6375	821.6375	696	867.2625	822.2625	744	867.8875	822.8875
649	866.6500	821.6500	697	867.2750	822.2750	745	867.9000	822.9000
650	866.6625	821.6625	698	867.2875	822.2875	746	867.9125	822.9125
651	866.6750	821.6750	699	867.3000	822.3000	747	867.9250	822.9250
652	866.6875	821.6875	700	867.3125	822.3125	748	867.9375	822.9375
653	866.7000	821.7000	701	867.3250	822.3250	749	867.9500	822.9500
654	866.7125	821.7125	702	867.3375	822.3375	750	867.9625	822.9625
655	866.7250	821.7250	703	867.3500	822.3500	751	867.9750	822.9750
656	866.7375	821.7375	704	867.3625	822.3625	752	867.9875	822.9875
657	866.7500	821.7500	705	867.3750	822.3750	-	868.0000	823.0000
658	866.7625	821.7625	706	867.3875	822.3875	753	868.0125	823.0125
659	866.7750	821.7750	707	867.4000	822.4000	-	868.0250	823.0250
660	866.7875	821.7875	708	867.4125	822.4125	754	868.0375	823.0375
661	866.8000	821.8000	709	867.4250	822.4250	755	868.0500	823.0500
662	866.8125	821.8125	710	867.4375	822.4375	756	868.0625	823.0625
663	866.8250	821.8250	711	867.4500	822.4500	757	868.0750	823.0750
664	866.8375	821.8375	712	867.4625	822.4625	758	868.0875	823.0875
665	866.8500	821.8500	713	867.4750	822.4750	759	868.1000	823.1000
666	866.8625	821.8625	714	867.4875	822.4875	760	868.1125	823.1125
667	866.8750	821.8750	-	867.5000	822.5000	761	868.1250	823.1250
668	866.8875	821.8875	715	867.5125	822.5125	762	868.1375	823.1375
669	866.9000	821.9000	-	867.5250	822.5250	763	868.1500	823.1500
670	866.9125	821.9125	716	867.5375	822.5375	764	868.1625	823.1625

800 MHz Channels

FCC Chan. No.	Mobile Rx Freq.	Mobile Tx Freq	FCC Chan. No.	Mobile Rx Freq.	Mobile Tx Freq	FCC Chan. No.	Mobile Rx Freq	Mobile Tx Freq
765	868.1750	823.1750	815	868.8000	823.8000	-	869.4250	824.4250
766	868.1875	823.1875	816	868.8125	823.8125	-	869.4375	824.4375
767	868.2000	823.2000	817	868.8250	823.8250	-	869.4500	824.4500
768	868.2125	823.2125	818	868.8375	823.8375	-	869.4625	824.4625
769	868.2250	823.2250	819	868.8500	823.8500	-	869.4750	824.4750
770	868.2375	823.2375	820	868.8625	823.8625	-	869.4875	824.4875
771	868.2500	823.2500	821	868.8750	823.8750	-	869.5000	824.5000
772	868.2625	823.2625	822	868.8875	823.8875	-	869.5125	824.5125
773	868.2750	823.2750	823	868.9000	823.9000	-	869.5250	824.5250
774	868.2875	823.2875	824	868.9125	823.9125	-	869.5375	824.5375
775	868.3000	823.3000	825	868.9250	823.9250	-	869.5500	824.5500
776	868.3125	823.3125	826	868.9375	823.9375	-	869.5625	824.5625
777	868.3250	823.3250	827	868.9500	823.9500	-	869.5750	824.5750
778	868.3375	823.3375	828	868.9625	823.9625	-	869.5875	824.5875
779	868.3500	823.3500	829	868.9750	823.9750	-	869.6000	824.6000
780	868.3625	823.3625	830	868.9875	823.9875	-	869.6125	824.6125
781	868.3750	823.3750	-	869.0000	824.0000	-	869.6250	824.6250
782	868.3875	823.3875	-	869.0125	824.0125	-	869.6375	824.6375
783	868.4000	823.4000	-	869.0250	824.0250	-	869.6500	824.6500
784	868.4125	823.4125	-	869.0375	824.0375	-	869.6625	824.6625
785	868.4250	823.4250	-	869.0500	824.0500	-	869.6750	824.6750
786	868.4375	823.4375	-	869.0625	824.0625	-	869.6875	824.6875
787	868.4500	823.4500	-	869.0750	824.0750	-	869.7000	824.7000
788	868.4625	823.4625	-	869.0875	824.0875	-	869.7125	824.7125
789	868.4750	823.4750	-	869.1000	824.1000	-	869.7250	824.7250
790	868.4875	823.4875	-	869.1125	824.1125	-	869.7375	824.7375
791	868.5000	823.5000	-	869.1250	824.1250	-	869.7500	824.7500
792	868.5125	823.5125	-	869.1375	824.1375	-	869.7625	824.7625
793	868.5250	823.5250	-	869.1500	824.1500	-	869.7750	824.7750
794	868.5375	823.5375	-	869.1625	824.1625	-	869.7875	824.7875
795	868.5500	823.5500	-	869.1750	824.1750	-	869.8000	824.8000
796	868.5625	823.5625	-	869.1875	824.1875	-	869.8125	824.8125
797	868.5750	823.5750	-	869.2000	824.2000	-	869.8250	824.8250
798	868.5875	823.5875	-	869.2125	824.2125	-	869.8375	824.8375
799	868.6000	823.6000	-	869.2250	824.2250	-	869.8500	824.8500
800	868.6125	823.6125	-	869.2375	824.2375	-	869.8625	824.8625
801	868.6250	823.6250	-	869.2500	824.2500	-	869.8750	824.8750
802	868.6375	823.6375	-	869.2625	824.2625	-	869.8875	824.8875
803	868.6500	823.6500	-	869.2750	824.2750	-	869.9000	824.9000
804	868.6625	823.6625	-	869.2875	824.2875	-	869.9125	824.9125
805	868.6750	823.6750	-	869.3000	824.3000	-	869.9250	824.9250
806	868.6875	823.6875	-	869.3125	824.3125	-	869.9375	824.9375
807	868.7000	823.7000	-	869.3250	824.3250	-	869.9500	824.9500
808	868.7125	823.7125	-	869.3375	824.3375	-	869.9625	824.9625
809	868.7250	823.7250	-	869.3500	824.3500	-	869.9750	824.9750
810	868.7375	823.7375	-	869.3625	824.3625	-	869.9875	824.9875
811	868.7500	823.7500	-	869.3750	824.3750			
812	868.7625	823.7625	-	869.3875	824.3875			
813	868.7750	823.7750	-	869.4000	824.4000			
814	868.7875	823.7875	-	869.4125	824.4125			

SECTION 4   CIRCUIT DESCRIPTION

NOTE: A block diagram of the RF and logic units is located on page 8-3.

4.1 POWER SWITCHING AND REGULATION

4.1.1 POWER SWITCHING

Unswitched battery voltage is applied to the power amplifier module and power control circuit in the RF unit. Otherwise, all power is switched by P-channel MOSFETs Q402 and Q403 in the logic unit. The LVCC supply is produced by Q402 and the VCC supply is produced by Q403. When the on-off switch is turned on, the output of switching transistor Q401 goes low which turns Q402 and Q403 on. This applies switched 7.5 volts to 5-volt regulators IC401 and IC402, the audio amplifier stages, and other parts of the transceiver.

When the power switch is turned off, the base of Q401 is pulled low by R402 which turns Q401 off and the collector goes high. However, because of diode D401, Q402 and Q403 do not turn off until C403 charges through R404. This provides a slight turn-off delay to give the microprocessor time to take over power off control. The microprocessor immediately detects power turn off by monitoring the OFFREQI signal on pin 23. It then changes the OFFREQ output on pin 73 to a high level which turns Q401 again on until current settings have been saved to memory and other required power down functions have been performed.

4.1.2 5-VOLT REGULATORS (IC401, IC402)

Regulator IC401 in the logic unit provides the +5L (5V) logic supply, and regulator IC402 provides the +5V supply. The +5V supply is in turn switched by Q404-Q406 to provide the R5V, T5V, and +5S supplies. These transistors are controlled by signals from the microprocessor.

The low battery detect signal is provided by a voltage divider formed by R406 and R407. These resistors divide down the 7.5V Vcc supply to produce the BATIN signal that is applied to pin 38 of the microprocessor.

4.2 SYNTHESIZER DESCRIPTION

4.2.1 INTRODUCTION

The synthesizer output signal is produced by a VCO (Voltage-Controlled Oscillator) in the RF unit. The VCO frequency is controlled by a DC voltage produced by the phase detector in synthesizer chip IC1. The phase detector senses the phase and frequency of the two input signals. One signal is the reference frequency from TCXO X3 and the other is from the VCO. If these signals are not the same frequency, the phase detector changes the VCO control voltage which changes the VCO frequency until both signals are synchronized. The VCO is then "locked" on frequency.

Channels are selected by programming the counters in IC1 to divide by different numbers. This programming data comes from the microprocessor on the logic board. The frequency stability of the synthesizer in both the receive and transmit modes is determined by the stability of TCXO X3. The stability of this device is 1.5 PPM from –22° to +140° F (–30° to +60° C). The VCO output signal is buffered and then fed to the receiver as the first injection signal and to the transmitter as the transmit signal.

4.2.2 VCO (IC3), BUFFERS (Q10-Q12)

Supply voltage to VCO IC3 is from CPV regulator IC2 and active filter Q1 on the IF board. Q1 functions as a capacitance multiplier to provide filtering of the 6-volt supply to the VCO. R2 and zener diode D2 provide bias, and C7 provides the capacitance that is multiplied. If a noise pulse or other voltage change appears on the collector, the base voltage does not change because of C7 and D2. Therefore, it does not appear on the emitter.

The VCO control voltage is applied to pin 8 of IC3, and the transmit audio/data modulation signal is applied to pin 1. The modulation signal is also applied to the TCXO as described in the next section. The output signal of the VCO on pin 4 is applied to a T-splitter formed by R57-R62. This network routes the VCO signal to buffer amplifiers Q11/Q10 and also to Q12. These stages provide amplification and isolate

the VCO from the receiver and transmitter and the counters in synthesizer IC1.

A switching circuit on the output of Q10 routes the VCO signal to the receiver in the receive mode and the transmitter in the transmit mode. In the receive mode, the R5V receive supply is applied to R12 and current flows through R12, D7A, and R51. Since D7A is forward biased, it presents a low impedance path to first mixer Q2 in the receiver. D7C is then reverse biased, so there is a high impedance path to the transmitter.

The 5V receive supply is also applied to R78 and current flows through R78, D7B, and R79. This results in less reverse bias and therefore charge on D7C to permit faster switching. In the transmit mode, the 5V receive supply is no longer present, so both D7A and D7B are reverse biased. D7C is forward biased by the current path through R50 and R51.

4.2.3 VCO AND TCXO MODULATION

Both the VCO and TCXO are modulated in order to achieve the required frequency response. If only the VCO was modulated, the phase detector in IC1 would sense the frequency change and increase or decrease the VCO control voltage to counteract the change (especially at the lower audio frequencies). Conversely, if only the TCXO was modulated, the VCO frequency would not change fast enough (especially at the higher audio frequencies).

However, by modulating both the VCO and TCXO, the two phase detector inputs remain in phase and no frequency shift is sensed. This produces a relatively flat audio response. Potentiometer B4 in IC209 is used to balance these signals and potentiometers B1 and B3 are used to set the data and audio deviation level. IC4 is an amplifier, and R73 sets the frequency of the TCXO by adjusting the DC bias of IC4.

4.2.4 SYNTHESIZER CHIP (IC1)

Synthesizer chip IC1 contains a prescaler, A, N, and reference counters, and a phase detector. Channels are selected by programming the A, N, and reference counters to divide by a certain number. This programming is performed by the microprocessor via the serial data bus which consists of lines PLLSK, PLLSO, and PLLST (pins 9-11 of IC1).

The divide numbers are chosen so that when the VCO is operating at the correct frequency, the VCO-derived input to the phase detector is the same frequency as the TCXO-derived input. The TCXO-derived input is produced by the reference counter in IC1. This counter divides the 14.925 MHz TCXO frequency by 2388 to produce a 6.25 kHz input to the phase detector. Using a 6.25 kHz reference frequency allows channels to be changed in 6.25 kHz steps.

The VCO-derived input is produced by dividing the VCO frequency using the prescaler and N counter in IC1. The divide number of the prescaler is controlled by the output signal from the A counter. The A and N counters function as follows:

Both the A and N counters begin counting down from the programmed number. When the A counter reaches zero, it halts until the N counter reaches zero. Both counters then reset and the cycle repeats. The A counter is always programmed with a smaller number than the N counter. When the A counter is counting down, the control output to the prescaler causes the prescaler to divide by 129. Then when the A counter is halted, the control output changes states and the prescaler divides by 128.

4.2.5 LOCK DETECT (Q13)

When the synthesizer is locked on frequency, the LD (Lock Detect) output of IC1 (pin 7) is a high signal. This turns lock detect transistor Q13 off and the ULOCK signal fed to the microprocessor is low. When an unlocked condition is indicated, low-going pulses appear on pin 7. Q13 then turns on and the ULOCK signal goes high. The transceiver is then disabled by the logic and an error condition is indicated in the display.

4.2.6 CHARGE PUMP (Q1, Q2), LOOP FILTER

The charge pump circuit consisting of Q1 and Q2 charges and discharges C4 and C5 in the loop filter to produce the VCO control voltage. Supply voltage to Q1 is provided by CPV regulator IC2 on the IF board.

Pulses which control the charge pump are output by synthesizer IC1 on pins 15 and 16. When the VCO is on the correct frequency, both phase detector outputs are in phase. Pin 15 is then high and pin 16 is low which turns both Q1 and Q2 off. Then if the VCO

frequency is low, the VCO-derived input to the phase detector is lower than the TCXO-derived input (or the phase lags the TCXO-derived input). Pin 15 of IC1 then pulses low and turns Q1 on. This charges the loop filter capacitors which increases the VCO control voltage. The VCO frequency then increases until the phase detector inputs are again the same frequency and phase. If the VCO frequency is too high, pin 16 pulses high which discharges the loop filter capacitors.

The loop filter is formed by R7-R9 and C4/C5. This is a low-pass filter which controls synthesizer stability and lock-up time and suppresses the 6.25 kHz reference frequency.

4.3 RECEIVER CIRCUIT DESCRIPTION

NOTE: A block diagram of the RF and logic units is located on page 8-3.

4.3.1 RF AMPLIFIER (Q1), FIRST MIXER (Q2)

The receive signal from the antenna is fed through low-pass filter FI7 and the antenna switch (see Section 4.4.2) to bandpass filter FI1. This filter attenuates the image and other unwanted frequencies and also prevents the injection signal from being fed out to the antenna.

The signal is then fed to RF amplifier Q1. Impedance matching with FI1 is provided by L32, C4, C138, and R104. The RF amplifier is used to recover filter losses and improve the sensitivity of the receiver. The output of Q1 is fed to FI2 which is a bandpass filter similar to FI1. Impedance matching is provided by L5 and C7.

From FI2 the signal is fed to gate 1 of first mixer Q2. This is a dual-gate MOSFET device which mixes the receive frequency with the first injection frequency to produce a first IF of 45.225 MHz (low-side injection is used). The injection frequency is from the synthesizer, and it is fed through a low-pass filter consisting of C22-C24 and L12. This filter attenuates harmonic frequencies present in the injection signal. A 3-dB pad consisting of R9-R11 provides the required input level to the mixer, and L11 and C12 provide matching.

Impedance matching on the input of Q2 is provided by C11, L6-L8, and L33. Likewise, imped-

ance matching on the output is provided by C15, L9, L10, C18, C19, and R99. The first IF signal is then fed to four-pole crystal filter FI3. This filter attenuates wideband noise, adjacent channels, frequencies resulting from intermodulation, and other frequencies close to the receive channel.
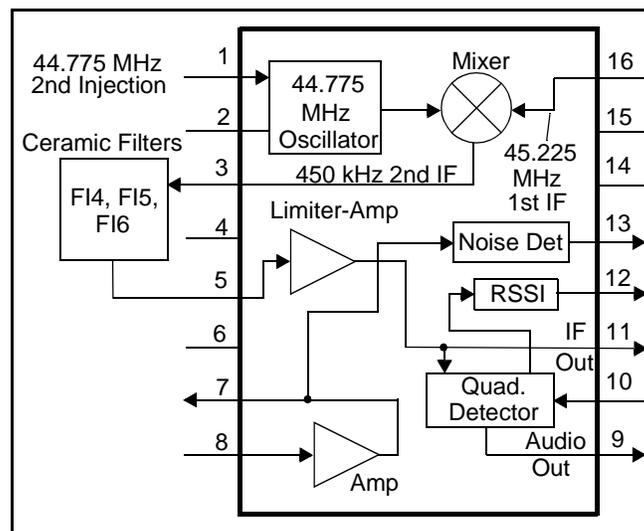
Figure 4-1   Limiter/Mixer/Detector IC3

4.3.2 IF AMPLIFIER (Q2), LIMITER/DETECTOR (IC3)

From crystal filter FI3, the IF signal is fed to IF amplifier Q2 on the IF board. This stage provides the required input level to the next stage. The signal is then fed to limiter/detector IC3. This device contains second mixer and oscillator, limiter, detector, squelch, and RSSI stages (see Figure 4-1).

The IF signal is fed in on pin 16 which is the input of an internal mixer.The 45.225 MHz first IF signal is mixed with the 44.775 MHz second injection signal to produce a second IF of 450 kHz. The 44.775 injection signal is produced by multiplying the TCXO frequency by three. This multiplication is performed by Q18 and other components.

The 450 kHz second IF is fed out of IC3 on pin 3 and applied to ceramic filters FI6, FI5, and FI4. These filters are used to attenuate wideband noise. A switching network consisting of D13-D16 routes the IF signal through all three filters with narrow band and NPSPAC operation, and through only FI4 with wideband operation. This switching network is controlled by WIDE and NAR signals from Q19-Q21. The W/N

input signal to these transistors is high for narrow band channels. Therefore, with narrow band channels, D14/D16 are forward biased and D13/D15 reverse biased and vice versa for wideband channels.

The 450 kHz signal from these filters is then fed back into IC3 on pin 5 and applied to a limiter-amplifier stage. From the limiter the signal is fed to the quadrature detector. An external phase-shift network connected to pins 10 and 11 shifts the phase of one of the detector inputs by 90° at 450 kHz (the other inputs are unshifted in phase). This network consists of C17 and ceramic discriminator X1. The detector is adjusted for wide and narrow band channels by Q3, R8, and C16. The detected audio signal is then amplified and fed out of IC3 on pin 9.

4.3.3 SQUELCH CIRCUIT (IC4A/B, IC5A)

The audio output signal on pin 9 of IC3 contains audio and also high-frequency noise. This signal is fed to the receive audio and data processing circuits on the logic board (Section 4.6.1) and also to the squelch circuit. The amount of noise in this signal tends to be inversely proportional to signal strength (the higher the noise level, the lower the signal strength and vice versa). Therefore, it can be used for squelch control.

A bandpass filter that passes only noise frequencies occurring above the audio band is formed by an op amp in IC3 and external components. The input to this filter is pin 8 and frequency determining components (R17-R19, C20, C21) are connected to pin 7. Other components on the input such as Q4 provide frequency and wide/narrow band compensation, and thermistors R14/R26 provide temperature compensation. The input audio/noise level is adjusted by R13. The detected noise output on pin 13 of IC3 is applied to pin 32 of the microprocessor in the logic unit.

4.4 TRANSMITTER DESCRIPTION

NOTE: A block diagram of the RF and logic units is located on page 8-3.

4.4.1 AMPLIFIER (Q9), DRIVER (Q8)

In the transmit mode, the VCO output signal is the transmit frequency. It is switched to the transmitter by the switching circuit consisting of D7 and other components (see Section 4.2.2) and applied to amplifier Q9. Power to this stage and also Q8 is the 7.5-volt battery supply switched by Q16 and Q17. This switch is controlled by the switched T5V supply. Therefore, when the transmit mode is selected, the TX5V supply goes high which causes the output of Q17 to go low and turn switch Q16 on.

The output signal from Q9 is fed to driver Q8 which provides additional amplification. Impedance matching with IC1 is provided by L15, C62, and a resistive pad consisting of R41-R43. Power amplifier module IC1 provides up to 3 watts of RF power at the antenna jack. It contains three internal amplifier stages, each of which has a separate supply voltage (VCC1-VCC3). The supply voltage to the first stage (VCC1) is from the power control circuit, and the supply voltage to the last two stages (VCC2/VCC3) is the unswitched battery supply.

4.4.2 ANTENNA SWITCH AND LOW-PASS FILTER

The antenna is switched between the receiver and transmitter by an antenna switch consisting of D11, D1-D3, and several other components. In the transmit mode, the TMUT input on pin 2 of Q7 is high. The T5V supply on pin 4 then appears on pin 3 and current flows through R20, L14, D11, D3, and L1/D1 and L2/D2. Since D11 and D3 are forward biased, the transmit signal has a low impedance path to the antenna.

L14/C31, L1/C2/D1, and L2/D2/C17 each form discrete quarter-wave line that is AC grounded at one end. When one end of a quarter-wave line is AC grounded, the other end presents a high impedance to the quarter-wave frequency. Therefore, L14/C31 isolate the 5-volt battery supply from transmitter RF, and the other two circuits isolate the receiver. In the receive mode, D11 and D1-D3 are no longer forward biased. Therefore, the receive signal has a high-impedance path into the transmitter and a low-impedance path into the receiver. From the antenna switch the transmit signal is fed to low-pass filter FI7. This filter attenuates harmonic frequencies occurring above the transmit band.

4.4.3 POWER CONTROL (IC2A/B)

The power output circuit maintains a steady power output level by controlling the supply voltage to the first stage in power module IC1 (VCC1). The output power is monitored using a directional coupler consisting of L34, L13, C33, C35, D4, D5, and several other components. Reflected (reverse) power is detected by L13/D5, and forward power is detected by L12/D4. These couplers produce a DC voltage that is proportional to the reverse or forward power.

The forward power signal is amplified by IC2A and is combined with the reverse power signal on pin 6 of IC2B. If there is no reverse power being detected, IC2B amplifies only the difference between the forward power signal on pin 6 and the reference voltage on pin 5. This reference voltage controls the power output, and it is set by the control logic through potentiometer 2 in IC209 in the logic unit.

As forward or reverse power increases, the output voltage on pin 7 decreases. Q5 and Q6 then turn off more which decreases the supply voltage applied to VCC1 of IC1. Power then decreases to maintain a stable output. The opposite occurs if forward or reverse power decrease. The power decrease resulting from an increase in reverse power prevents transmitter damage which may result if excessive power is reflected back into the transmitter. This may occur, for example, if the transmitter is keyed with a defective antenna.

4.5 CONTROL LOGIC AND DISPLAY

NOTE: A block diagram of the RF and logic units is located on page 8-3.

4.5.1 CONTROL LOGIC

The digital control logic is based on 8-bit CMOS microprocessor IC306. The operating speed is set by 9.8304 MHz crystal X2. A clock shift signal applied through D301. This signal goes high to shift the clock frequency slightly when the second harmonic interferes with the receive signal.

A serial data bus formed by MSI, MSO, and MSCK (pins 49-51) is used to transfer data to and

from two external devices. They are 16K x 8 EEPROM IC304 and DTMF encoder IC303. Another serial port formed by XTXD and XRXD is used to transfer programming data to and from an external computer. This port is fed out of the transceiver on pins 6 and 7 of the accessory connector. Descriptions of the IC306 pins are located in Table 4-1.

4.5.2 DISPLAY ASSEMBLY DESCRIPTION

IC1 on the display board is an intelligent LCD display controller/driver. It communicates with the microprocessor on the logic board over a serial bus consisting of MSCK (serial clock) and MSO (serial data), and DISST (display strobe) signals. IC1 is set for 1/3 bias and 1/5 duty cycle and drives an 8-character, 14-segment display at a 98 Hz frame frequency. The LCD display (DS6) has 127 segments that are driven by a 34-segment signal with 4 common lines.

4.6 RECEIVE AUDIO PROCESSING

4.6.1 BANDPASS FILTER (IC101)

The receive audio and data signal from the IF module in the RF unit is called DET. It is applied to IC101 in the receive audio circuit, IC102 in the receive data circuit, and IC110 in the SMARTNET data circuit. The receive audio circuit operates as follows, and the other circuits are described in later sections.

The DET signal is applied to IC101 which is a bandpass filter which passes frequencies from 300-3000 Hz. This attenuates Call Guard (CTCSS/DCS) signaling and high-frequency harmonics. This filter also provides de-emphasis of the audio signal.

On the input of IC101, pin 1 of Q110 is low in the wideband mode and high in the narrow band mode. Therefore, R102 is grounded in the wideband mode to lower the input level to IC101. This maintains a constant audio output level since the higher deviation in the wideband mode results in a higher input level. Also on the input of IC101, the NPSPAC line controlling Q111 is high when a NPSPAC channel is selected and low at other times. This grounds R167 in the NPSPAC mode to lower the input level since NPSPAC channel deviation is higher than narrow band deviation.

Table 4-1 Microprocessor IC306 Pin Descriptions

Pin Name	Port Name	Input or Output	Description	Active High or Low
1	RES	Input	Reset pulse input	-
2	XTAL	Input	System clock connection terminal	-
3	EXTAL	Input	System clock connection terminal	-
4	FWE	Input	Not used	-
5	MDI	Input	Flash ROM data import control (L=load)	Low
6	MDO	-	Not used	-
7	NMI	-	Not used (external pull-up)	-
8	STBY	-	Not used	-
9	VCC	-	Supply voltage	-
10	CSHIFT	Output	Clock shift control (H=shift)	High
11	-	-	Not used	-
12	INTS	I/O	-	-
13	RxD	-	Not used (external pull-up)	-
14	TxD	-	Not used (external pull-up)	-
15	VSS	-	Ground	-
16	DTMFSO	Output	Segment data for LCD driver	-
17	EXTDC	Input	Option signal input	-
18	DTMFCK	Output	Clock signal for LDC driver	-
19	-	-	-	-
20	FCN	Input	FCN button switch	Low
21	AUX	Input	AUX button switch	Low
22	DPOTST	Output	Digi-pot strobe signal	-
23	OFFREQI	Input	Main voltage supply switch	Low
24	QSELOI	Input	Channel select switch input	-
25	-	-	-	-
26	SN_RX	Input	SMARTNET receive data input	-
27	TXDATA	Output	Subaudible tone/main audio signal out	-
28	RXDATA	Input	Receive data input	-
29	BWC	Output	Transmit/receive data filter bandwidth signal output	High
30	KEYR3	Input	Key matrix scan in	-
31	KeyR2	Input	Key matrix scan in	-
32	NOISE	Input	Noise pulse input/squelch control	-
33	MMUTE	Output	Mutes microphone audio signal (L=mute)	Low
34	TXPREC	Output	Subaudible signaling tone/damp signal output	-
35	TEST	Output	Bypass transmit data filter (H=Normal/no bypass)	High
36	L5V	-	Supply voltage	-
37	L5V	-	Supply voltage	-
38	BATIN	Input	Low battery voltage detection	-
39	RSSI	Input	RSSI (Receive Signal Strength Indicator)	-
40	-	-	-	-
41	-	-	-	-
42	-	-	-	-
43	-	-	-	-
44	-	-	-	-
45	-	-	-	-
46	VSS	-	Ground	-

Table 4-1   Microprocessor IC306 Pin Descriptions (Continued)

Pin Name	Port Name	Input or Output	Description	Active High or Low
47	KEYR1	Input	Key matrix scan	-
48	KEYR2	Input	Key matrix scan	-
49	MSO	Output	Serial data output	-
50	MSI	Input	Serial data input	-
51	MSCK	Output	Serial data clock	-
52	R5C	Output	R5V supply control signal	High
53	BEEP	Output	Audio beep tone	-
54	T5C	Output	T5V supply control signal	High
55	TMUT	Output	Automatic Power Control (APC) circuit control signal	High
56	NPSPAC	Output	Controls NPSPAC channel audio level (H=NPSPAC channel)	High
57	-	-	-	-
58	-	-	-	-
59	L5V	-	Supply voltage	
60	ULOCK	Input	PLL unlocked signal (H = unlocked)	High
61	TA	Output	Talk-around mode control signal (L=talk-around)	Low
62	PLLST	Output	PLL strobe	-
63	PLLSO	Output	PLL data	-
64	PLLSK	Output	PLL clock	-
65	W/N	Output	Wide/narrow band switching (H=narrow band)	High
66	PT	Output	Compander control signal (L=active)	Low
67	DISST	Output	LCD driver chip enable signal	-
68	DISEN	Output	LCD driver chip enable signal	-
69	-	-	-	-
70	VSS	-	Ground	-
71	VSS	-	Ground	-
72	-	-	-	-
73	OFFRQ	Output	Power off control signal (H=hold power on)	Low
74	KEYS3	Output	Keypad matrix scan	-
75	KEYS2	Output	Keypad matrix scan	-
76	KEYS1	Output	Keypad matrix scan	-
77	KEYS0	Output	Keypad matrix scan	-
78	CLR/CODE	Output	Optional encryption control signal	Low
79	OPTB	Output	Option signal	Low
80	BATLED	Output	BAT LED control signal (L=LED on)	Low
81	BKLED	Output	LCD backlight control signal (L=backlight on)	Low
82	DTMFMT	Output	DTMF mute control signal (L=mute)	Low
83	-	-	-	-
84	RMUT	Output	Receive audio mute control signal (L=receive audio mute)	Low
85	AMUT	Output	Audio amplifier supply voltage control (H=enabled)	High
86	QSEL0	Input	Channel select switch signal	-
87	QSEL1	Input	Channel select switch signal	-
88	QSEL2	Input	Channel select switch signal	-
89	QSEL3	Input	Channel select switch signal	-
90	BSYLED	Output	BUSY LED control signal (L=LED on)	Low
91	TXLED	Output	TX LED control signal (L-LED on)	Low
92	VSS	-	Ground	-

Table 4-1   Microprocessor IC306 Pin Descriptions (Continued)

Pin Name	Port Name	Input or Output	Description	Active High or Low
93	S5C	Output	RF 5C supply control signal	High
94	-	-	-	-
95	SN_TR	Output	SMARTNET circuit control signal (H=SMARTNET Tx Data)	High
96	EEPCS	Output	EEPROM chip select signal	-
97	XTXD	Output	Programming data out	-
98	XRXD	Input	Programming data in	-
99	PTTIN	Input	PTT switch	Low
100	-	-	-	-

4.6.2 EXPANDER (IC208)

From this filter the signal is fed to pin 7 of the expander in IC208. When companding is enabled by a low input on the PT input of IC208, this stage provides 1:2 expansion of the audio signal to remove the 2:1 compression that occurred when it was transmitted. This compression and then expansion reduces the amount of noise present in the audio signal. When the PT input is high, companding is disabled and the signal if fed through IC208 without expansion. *NOTE: Companding is not currently used with this radio.*

The audio signal is fed out of IC208 on pin 15 and then fed to audio mute gate IC103. This gate is controlled by the RMUTE output (pin 84) of the microprocessor. The audio is also muted by the audio amplifier as described in the information which follows.

4.6.3 AUDIO AMPLIFIER (IC104-IC106)

From gate IC103, the audio signal is fed to volume control R117 which sets the input level to the audio amplifiers. Also applied at this point are the DTMF and beep tones. Muting of the DTMF tones is provided by Q101 which is controlled by the DTMFMT output (pin 82) of the microprocessor. The beep tones are synthesized by the BEEP output (pin 53) of the microprocessor.

The input level to the audio amplifiers is also controlled by Q112 which lowers the input level by grounding R168. Both the NPSPAC and W/B (wide/narrow band) lines control Q112. Resistor R168 is grounded only in the narrow band/non-NPSPAC mode (see preceding information for line levels).

With normal operation when the internal speaker is used, IC105 and IC106 provide the required amplification. However, when an external speaker-microphone is connected to pin 1 of the accessory jack (a load of approximately 1k ohm or less), Q102 and Q105 turn on and Q109 turns off. This disables IC105 and IC106, and enables IC104.

The supply voltage to all three audio amplifier stages is controlled by Q106 and Q107. When the audio is muted such as when no tones are sounding or no message is being received, the AMUT output of the microprocessor (pin 85) is low. This turns off both Q106 and Q107 and removes supply voltage from the audio amplifiers. This helps conserve battery power. The receive audio signal is also muted by gate IC103 as previously described.

4.7 RECEIVE AND TRANSMIT DATA PROCESSING

4.7.1 RECEIVE DATA FILTER/DETECTOR (IC102A/B, IC107A/B)

The receive data (and audio) signal (DET) from the IF board is also routed to the receive data filter formed by IC102B and IC102A. This is a low-pass filter which attenuates voice and other harmonic frequencies above the data band.

The passband of this filter is controlled by the BWC signal applied to Q103. When digital Call Guard data or a low-frequency Call Guard tone is being detected, the BWC signal is high which turns on Q103. The cut-off frequency of the filter is then approximately 150 Hz. Then when a high-frequency Call Guard tone is received, Q103 turns off and the

cut-off frequency is approximately 190 Hz. Q103 lowers the cut-off frequency of the filter by switching additional capacitance into the filter.

From the filter the data signal is applied to a DC restoration circuit formed by IC107B and IC107A. This circuit converts the data signal from AC floating at half supply to a digital signal at 0- and 5-volt levels that can be read by the microprocessor. IC107B is a standard noninverting amplifier with a gain of approximately 5.6 set by R139 and R140 (R140 is AC grounded by C129). Diodes D101 and D102 charge and discharge C129 to establish a DC reference on pins 2 and 6 of IC107 that is the average of the positive and negative going alternations of the data signal.

The amplified data signal is applied to pin 3 of IC107A. When this level rises above the reference level on pin 2, the output on pin 1 goes high (5 volts). Conversely, when the data signal falls below the reference level, the output goes low (0 volts). In the transmit mode, Q104 is turned on which effectively grounds pin 3 of IC107A and forces the output on pin 1 low.

4.7.2 TRANSMIT DATA FILTER (IC206B/ IC206A)

The transmit data signal is produced by the TXDATA and TXPREC outputs of the microprocessor (pins 27 and 34, see Table 4-1). A pseudo sine wave is produced by the four voltage levels that can be produced by these outputs. This signal is fed to a transmit data filter formed by IC206B and IC206A. This filter is the same as receive data filter IC102B and IC102A described in the preceding section. This filter attenuates harmonics present in the waveform produced by the microprocessor.

The output and input of the data filter is fed to gate IC203. This gate is used to bypass the transmit data circuit during alignment so that a wide range of harmonic frequencies are passed for use in setting modulation balance. The control signal to this gate is the TEST signal from pin 35 of the microprocessor. This signal is low when the transmit data filter is bypassed.

The signal is then routed to pin 7 or gate IC210 which selects either it or the SMARTNET data signal

from IC113B. The data output signal on IC210, pin 1 is then applied to pin 24 of IC209 which is the input to one of the digitally controlled potentiometers in that device. The data modulation level is set during alignment and controlled by the logic. The output on pins 22 and 23 is then fed to IC201 where it is combined with the transmit audio signal (see Section 4.8.3).

4.8 TRANSMIT AUDIO PROCESSING

4.8.1 GATE (IC204), HIGH-PASS FILTER (IC202)

The microphone audio signal is applied to pin 2 of one of the gates in IC204. This signal may come from the internal microphone or an external microphone connected to pin 8 of the accessory connector. This gate is controlled by the MMUTE signal from pin 33 or the microprocessor. When this signal is low, the microphone audio signal is muted.

The transmit DTMF tone is applied to pin 6 of IC204 which is the input of the other gate in that device. This gate is controlled by the DTMFMT signal from pin 82 of the microprocessor, and when that signal is low, the DTMF tone is muted.

The transmit audio and DTMF signals are then combined and applied to pin 3 of compandor IC208. When companding is enabled by a low input on the PT input of IC208, this stage provides 2:1 compression of the audio signal. This compression and then re-expansion when it is received reduces the amount of noise present in the audio signal. When the PT input of IC208 is high, companding is disabled and the signal is fed through IC208 without compression. *NOTE: Companding is not currently used with this radio.*

The transmit audio/DTMF signal is fed out of IC208 on pin 2 and applied to a high-pass filter formed by IC202A. This filter has a –3 dB cutoff frequency of approximately 300 Hz to attenuate frequencies that could cause interference with the Call Guard signals.*

4.8.2 LIMITER (IC202B)

Pre-emphasis of the DTMF tone or microphone audio signals is provided by C205/ R211. IC202B is an amplifier functioning as a limiter (limiting occurs when it saturates). Limiting prevents overmodulation

caused by high input levels from the internal or external microphone. The bias voltage to this stage and also to IC201A is produced by voltage divider R208/R207.

4.8.3 LOW-PASS FILTER (IC205A/B)

IC205A and IC205B form a low-pass splatter filter which attenuates frequencies above approximately 3 kHz. This prevents adjacent channel interference caused by the harmonic frequencies which result from amplitude limiting.

The output signal from this filter is applied to IC209 which contains four logic-controlled potentiometers. The transmit audio signal is applied to potentiometer 3 on pin 20 and fed out on pin 19 which is the wiper of that potentiometer. The potentiometers in this device are adjusted by the control logic via the serial data bus (MSCK/MSO). The transmit audio/DTMF level is set when the transceiver is aligned.

The transmit audio/DTMF signal is then fed to IC201 where it is combined with the transmit data/ SMARTNET data signal if applicable. The output signal on pin 4 of IC201 is then fed to the VCO in the RF unit and also to pins 7 and 8 of IC209. The signal fed to the RF unit (MOD) modulates the VCO, and the signal fed to IC209 is level adjusted and fed out on pin 6 and applied to the RF unit where it modulates the TCXO. The potentiometer is set by the logic during alignment, and is used to balance the VCO and TCXO modulation signals.

4.9 SMARTNET DATA PROCESSING

Both the transmit and receive SMARTNET/ SmartZone data signals are applied to a filter formed by IC112A/B and IC113B. Switching of these signals is provided by gate IC110 which is controlled by the SN_TR signal from pin 95 of the microprocessor. When this signal is high, the transmit data signal on pin 6 is selected is routed to the filter, and when it is low the receive data signal on pin 7 is routed to the filter.

IC112B, IC112A, and IC113B form a 1800 Hz low-pass filter which attenuates unwanted frequencies above the SMARTNET/SmartZone data band. The output of this filter on U113B, pin 7 is then fed to IC114A/B which provide DC restoration when data is being received. The signal is also fed to gate IC210 in the transmit data circuit to be transmitted when applicable.

The DC restoration circuit formed by IC114A/B and IC113A is similar to the receive data circuit described in Section 4.7.1. It converts the data signal from AC floating at half supply to DC levels of 0 and 5 volts that can be detected by the microprocessor. Diodes D104 and D105 charge and discharge C158 and C157 to establish a DC reference on pin 2 of comparator IC113A that is the average of the positive and negative going alternations. Q106 turns on in the transmit mode which grounds pin 2 and disables this circuit.

In the transmit mode, gate IC210 selects either the SMARTNET data signal or the Call Guard data signal. It is controlled by the same SN_TR signal that controls IC110. The output signal on pin 1 is then applied to potentiometer 1 in IC209. Refer to Section 4.7.2 for more information on this circuit.

SECTION 5   BATTERY PACK AND CHARGER INFORMATION

5.1 BATTERY PACK

CAUTION

Dispose of these batteries in accordance with local regulations. Do not dispose in a land fill. Do not incinerate because an explosion may result.

5.1.1 GENERAL

Standard 1400 mAH Battery Pack, Part Number 587-8150-135, contains six size AA nickel metal-hydride (Ni-MH) batteries connected in series. Also inside the pack are a diode, thermistor, and thermal circuit breaker. The diode protects against reverse polarity when charging and also prevents discharge of the battery through the charger. The thermistor is used by the rapid charger to sense battery temperature.

Intrinsically Safe 1400 mAH Battery Pack, Part Number 587-8150-136, is similar to the standard pack except that it has a thermal fuse and series resistors connected to the negative terminal of the battery. This resistor limits current if a short circuit occurs.

The battery pack is a sealed unit that is not intended to be serviced. If the pack fails to hold a charge or is defective for some other reason, it must be replaced with a new unit. The batteries in this pack have a nominal capacity of 1400 mAH. Typical operating time before recharge is as follows. This assumes that the transceiver is in the standby mode (receive, audio squelched) 90% of the time, the receive mode (receive, rated audio out) 5% of the time, and the transmit mode 5% of the time.

Power Setting	Operating Time
1 watt	8.6 hours
3 watts	7.5 hours

5.1.2 BATTERY CARE

With proper care, a battery pack should provide many months of service. Some causes of shortened battery life are as follows:

- Repeated deep discharge. Recharging should take place soon after the low battery indication appears. This indication appears when the battery pack voltage drops to 6.3 volts which is approximately 1 volt per cell. Do not regularly continue operating the transceiver until it is completely nonfunctional.

- Regularly recharging a battery after only light use. This may result in shortened operating time. If this has caused shortened operating time, it may be possible to restore it to normal by performing three complete discharge/charge cycles.

- Frequent use at temperature extremes. Maximum battery life is achieved if the ambient temperature when using or recharging a battery is 68-86° F (20-30° C). The recommended temperature ranges for the various battery functions are as follows.

Function	Fahrenheit	Celsius
Charging	+50 to +104°	+10 to +40°
Actual Use	+14 to +140°	−10 to +60°
Storage	−22 to +122°	−30 to +50°

- Regularly leaving fully charged battery packs in the charger for extended periods (such as longer than over a weekend).

- A short circuit condition that causes overheating that could vent hydrogen and reduce life.

5.2 RAPID CHARGER

The single-unit rapid charger that is used to charge this battery pack is listed in Table 1-1. Also required is either the 117 or 220 VAC power supply. The pack can be charged while attached to the transceiver; however, charge time may be slightly longer. Typical charge time is as follows. This assumes that the battery is discharged to the point where the low battery indication appears.

Typical Battery Charge Time = 1 hour

This charger uses state-of-the-art $\Delta T/\Delta t$ (change in temperature/change in time) and $-\Delta V$ (negative

change in voltage) sensing to determine when the battery is nearly fully charged. This type of sensing prolongs battery pack life because overcharging is minimized.

Operation is in the fast charge mode until the battery pack is approximately 95% charged. Charging is then in the slow mode until the pack is removed from the charger. With these battery packs, the fast rate is approximately 1400 mA and the slow rate is approximately 70 mA.

When the battery is inserted in the charger, the red charge indicator turns on continuously to indicate that charging in the fast mode is occurring. If this indicator flashes at a slow rate when the pack is inserted, it indicates that charging is occurring at the slow rate because battery parameters are not within the required range. The battery temperature must be within +50 to +104° F (+10 to +40° C) and the battery voltage must be above 6 volts for rapid charging to occur. When these parameters reach the normal range, the charger automatically switches to the fast rate.

The primary method used by these chargers to detect a fully charged battery is to sense the point at which the battery temperature begins increasing at a faster rate ($\Delta T/\Delta t$). This normally provides the first indication that the battery is fully charged. If this method does not indicate a charged battery, the charger also detects a negative change in battery voltage (minus ΔV) which also indicates a fully charged battery.

To provide fail-safe operation, the charger also switches to the slow rate if the battery temperature rises above approximately 113° F or total charge time in the fast mode exceeds approximately 1.5 hours.

When the battery is fully charged, the charge indicator begins flashing at a rapid rate and the slow charge rate is selected. The charger then remains in this mode until the battery is removed from the charger.

SECTION 6 ALIGNMENT PROCEDURE AND PERFORMANCE TESTS
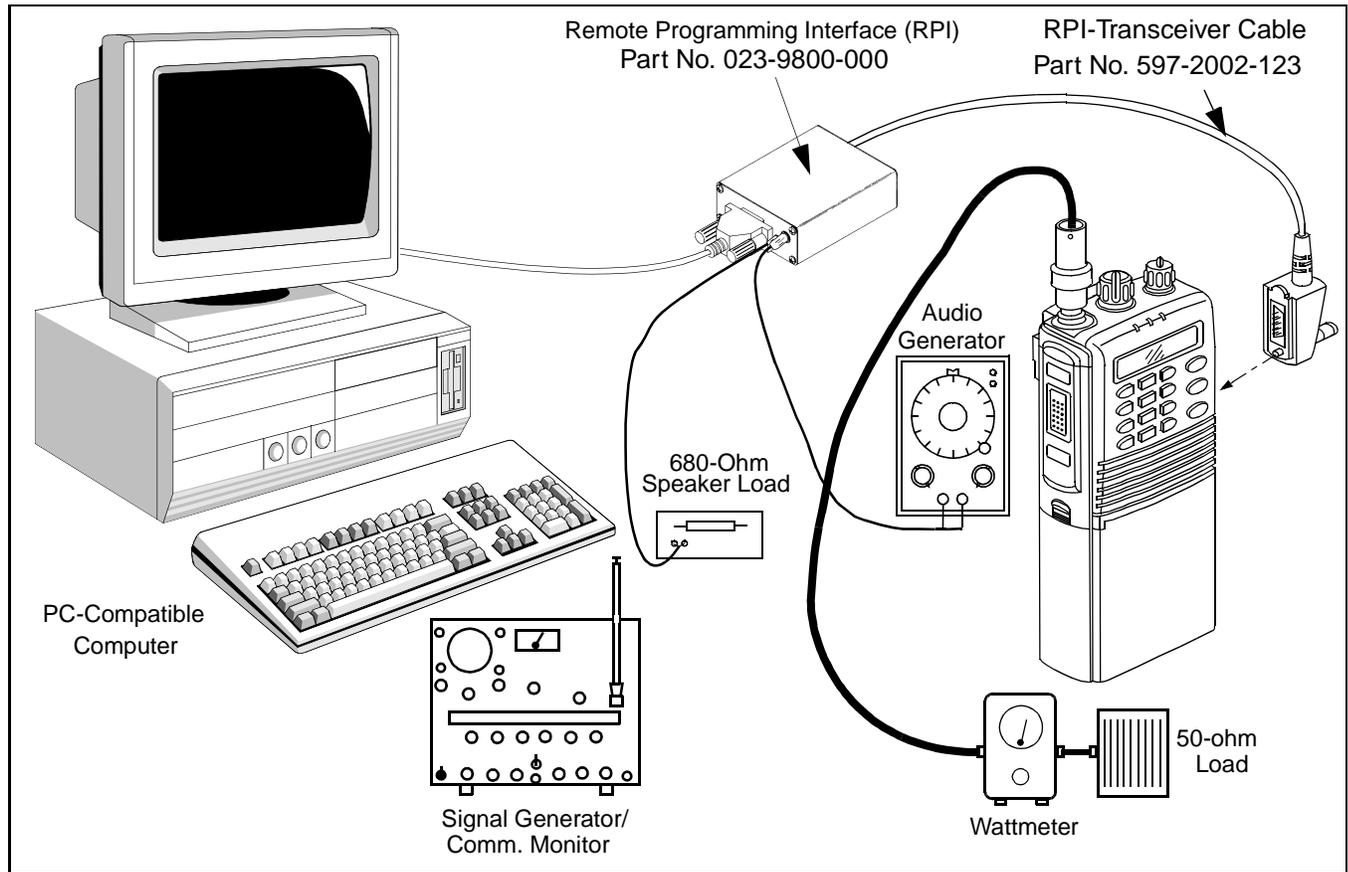
Figure 6-1   Alignment Setup Diagram

6.1 GENERAL

6.1.1 INTRODUCTION

The alignment procedure described in this section should be performed if repairs are made that could affect the factory alignment. In addition, before a transceiver is initially placed in service, the performance tests in Sections 6.8 and 6.9 should be performed.

To perform the alignment described in this section, special PCTune software (see Table 1-1) and the same basic computer setup used for programming is required. This equipment is shown above and also described in Section 3.1. Only Remote Programming Interface (RPI), Part No. 023-9800-000, can be used because it is the only RPI that has microphone and speaker audio jacks that are required for alignment.

Only two adjustments are made manually and the others are made digitally using the PCTune software. The two manual adjustments are squelch sensitivity and TCXO frequency, and if they do not need to be reset, the transceiver can be tuned without removing the cover.

This transceiver does not have a special test mode that is selected. The PCTune software automatically selects the frequencies and other test conditions that are required to perform the alignment. If the transceiver must be controlled manually to perform such things as testing or troubleshooting, program temporary conventional channels.

6.1.2 TEST SETUP

Connect the test setup shown in Figure 6-1. Additional information follows on equipment in this setup.

Antenna Jack Adapter - The transceiver antenna jack is an SMA female type. Therefore, some sort of adapter may be required to connect test equipment to this jack. An SMA male to BNC female adapter is available by ordering Part No. 515-3102-060.

RF Signal Generator - When connecting the generator to the antenna jack, use at least a 6 dB pad between the generator and transceiver. This protects the generator if the transmitter is accidentally keyed and also ensures that a 50-ohm load exists. The input levels listed in the PCTune screens are at the antenna jack, so increase the generator output accordingly.

Power Source - If a battery is used to provide transceiver power during alignment, make sure it is in good condition and fully charged. Power output levels are with 7.5 volts applied to the transceiver. Typical current when transmitting at high power is 2.0 A.

Wattmeter/Load - The wattmeter and dummy load must measure and dissipate up to approximately 4 watts. For accurate power output measurement at 800 MHz, use a minimum number of connectors with a Teflon or better dielectric. If coaxial cable is used, it should be a minimum length of a low-loss type.

Audio Generator - The audio generator is connected to the larger (1/8") mono phone jack of the RPI shown below.

Speaker Audio Out Jack   Mic Audio In Jack

2.6 mm/3/32" Phone Jack   3.6 mm/1/8" Phone Jack
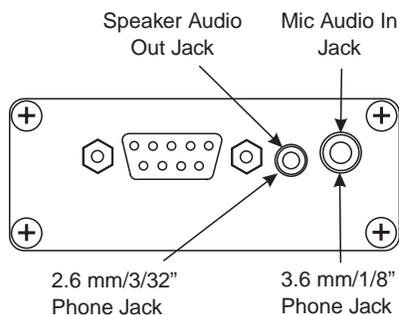
Speaker Load - The speaker load is connected to the smaller (3/32") mono phone jack of the RPI as shown above. This is a low level audio output that requires a load of approximately 680 ohms.

Computer and RPI - The RPI is connected to the computer and transceiver as described in Section 3.1.4. Note that RPI, Part No. 023-9800-000 must be used. Other RPI's do not have the jacks required to inject mic audio and monitor speaker audio with a computer connected to the accessory jack.

6.1.3 TUNE SOFTWARE

General

The PCTune software is a Windows®-based program. Minimum software and hardware requirements are as follows:

- Windows® 95
- 486DX2-66 or faster microprocessor
- 4 megabytes of RAM
- 3 megabytes free space available on hard drive
- An available serial port

Software Installation

Proceed as follows to install this software:

1. Close all applications that are currently running (other than Windows).

2. Insert the disk containing the PCTune software in drive A: (or B:).

3. From the Windows 95 taskbar, choose RUN and open SETUP.EXE on drive A: (or B:). Alternatively, use File Explorer and double click SETUP.EXE.

4. Follow the instructions on the screen. The program is automatically loaded on the hard drive and startup shortcuts or groups are created.

Starting PCTune

Select Start in the taskbar, then Programs > PCTune > PCTune.

Exiting PCTune

Click the PCTune logo on the left end of the title bar and select "Close" or click the "X" button on the right end of the title bar.
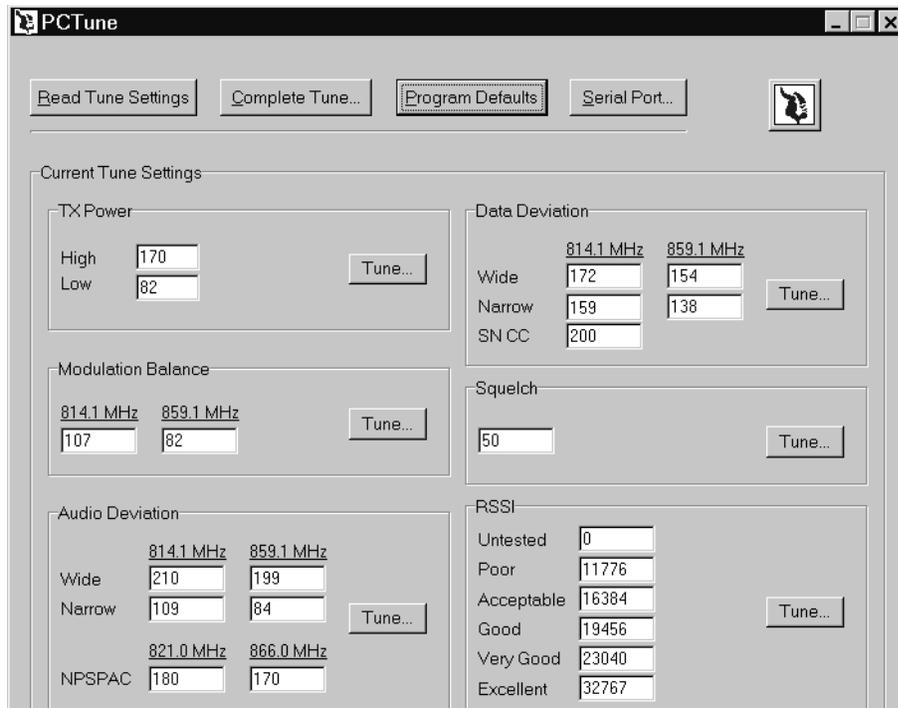
Figure 6-2   PCTune Main Screen

6.1.4 PRELIMINARY SETUP

1. With transceiver power turned off, connect the RPI to an unused serial port of the computer. Then connect the RPI to the accessory jack of the transceiver using the cable indicated in Figure 6-1.

2. Start the PCTune program as described in the preceding section and click the "Serial Port" button near the top to display the selected serial port. Change to the port being used if necessary.

3. Turn transceiver power on and the green indicator on the RPI should light. Move the slide switch to the other position if this indicator is amber.

6.1.5 MAIN PCTUNE SCREEN

The main PCTune screen is shown in Figure 6-2 above. The various adjustments that are performed are show in the six boxes in the lower part of this screen. To perform just one adjustment or perform the adjustments individually, click the "Tune" button for the applicable adjustment. To perform a complete alignment and have the program automatically step through all adjustments, click the "Complete Tune" button on the top. The functions of the various buttons in this screen are as follows:

Read Tune Settings Button - Reads and displays the various tune settings currently stored in the radio.

Complete Tune Button - Initiates the complete tuning procedure as just described.

Program Defaults Button - Programs the transceiver with the default settings for the various adjustments. This can be used to quickly restore a radio to typical settings.

Serial Port Button - Selects the serial port that is used to connect the RPI to the computer. This setting only needs to be made the first time the program is run or if a different serial port is used.

Tune Buttons - These buttons are used to perform individual adjustments without having to go through the complete alignment procedure (see paragraph at the beginning of this section).

EF Johnson Logo Button - Clicking this button displays the PCTune version number.
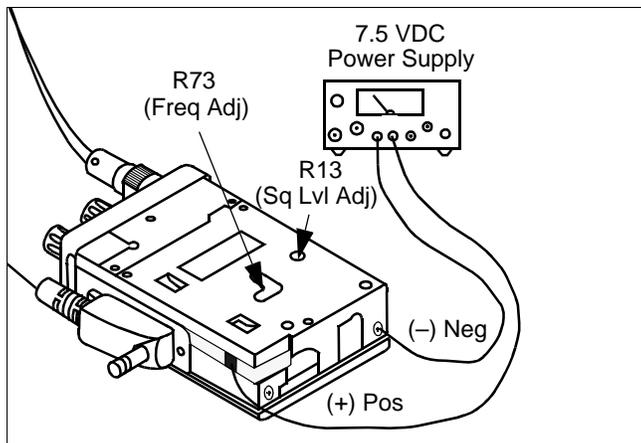
Figure 6-3   Connecting DC Power

6.1.6 REMOVING TRANSCEIVER COVER

NOTE: The transceiver cover needs to be removed only if the frequency and squelch adjustments described in Sections 6.2.1 and 6.6 need to be reset.

The frequency and squelch noise level adjustments are made by manually resetting controls on the RF board. To access these controls, proceed as follows:

1. Remove the battery, belt clip, and back cover as described in Section 1.11.

2. An external power supply must then be connected to the transceiver as shown in Figure 6-3.

6.2 TRANSMIT FREQUENCY AND POWER

6.2.1 FREQUENCY ADJUSTMENT

Frequency adjustment should be performed with the ambient temperature near the TCXO calibration reference of 77° F (25° C). This ensures that the frequency will be within tolerance at the temperature extremes. Proceed as follows:

NOTE: The transmitter immediately keys when the following function is selected. To turn the transmitter on and off, click the "Toggle" button (see screen which follows).

1. Connect a wattmeter and dummy load to the antenna jack as shown in Figure 6-1.

2. Click the "Complete Tune" button to automatically go from one adjustment to the next or click the "Tune" button in the "Tx Power" box to perform only this adjustment.

3. Monitor the transmit frequency with a communications monitor set to the frequency displayed on the screen.

4. At room temperature, this frequency should be within ± 400 Hz. If readjustment is required, remove the cover as described in Section 6.1.6 and adjust R73 (see Figure 6-3) for the correct frequency. This also adjusts the receive frequency.

Transmit Power Adjustment Screen

6.2.2 POWER OUTPUT ADJUSTMENT

Set the high and low power output by clicking the arrows or moving the button in the scroll bar. The relative power level is indicated by the number in the box. Set the high and low power levels as follows:

High Power Level = 3.0 watts
Low Power Level = 1.0 watt

6.3 MODULATION BALANCE

1. If manually selecting each test, click the "Tune" button in the "Modulation Balance" box. Otherwise, this function is selected automatically when the "Complete Tune" button is clicked.

2. View the transmit modulation waveform on the CRT of a communication monitor. If applicable, set the monitor for de-emphasis off, high-pass filter off, low-pass filter 3 kHz, and FM peak detection active.

3. Follow the instructions on the screen and adjust for the best demodulated square wave with minimum tilt and overshoot.

6.4 AUDIO DEVIATION

1. If manually selecting each test, click the "Tune" button in the "Audio Deviation" box. Otherwise, this function is selected automatically when the "Complete Tune" button is clicked.

2. Inject a 1 kHz signal at the level indicated on the screen into the Mic Audio jack of the RPI (see Section 6.1.2).

3. Monitor the transmit modulation signal with a communication monitor and follow the instructions on the screen to adjust the wideband, narrow band, and NPSPAC (see Section 1.2.5) deviation.

6.5 DATA DEVIATION

1. If manually selecting each test, click the "Tune" button in the "Data Deviation" box. Otherwise, this function is selected automatically when the "Complete Tune" button is clicked.

2. Monitor the transmit modulation signal with a communication monitor and follow the instructions on the screen to adjust the wideband, narrow band, and SMARTNET/SmartZone control channel data deviation.

6.6 SQUELCH ADJUST

The input level to the noise squelch circuit is set by R13 on the IF board, and the squelch threshold level is set by the PCTune software. The factory setting of R13 should not need to be changed, so step 3

which follows can normally be skipped. Proceed as follows to set the squelch:

1. If manually selecting each test, click the "Tune" button in the "Squelch" box. Otherwise, this function is selected automatically when the "Complete Tune" button is clicked.

2. Connect an RF signal generator to the antenna jack using a 6 dB or greater pad. Set the generator for the channel frequency and modulation indicated on the screen.

3. If R13 must be adjusted (see preceding), remove the transceiver cover and connect power as described in Section 6.1.6. Temporarily set the squelch for "50" on the "Squelch" screen and adjust R13 (see Figure 6-3) so that the squelch just opens (audio is heard) at 8-9 dB SINAD.

4. Readjust the squelch level as indicated on the screen so that the squelch opens and closes between the indicated SINAD levels.

6.7 RSSI ADJUST

NOTE: Improperly setting the RSSI levels can result in degraded SmartZone roaming operation. Therefore, do not change the default settings unless you are familiar with how roaming will be affected.

The function which adjusts the RSSI levels is available only by clicking the "Tune" button in the "RSSI" box. It is not displayed in the Complete Tune mode for the reason just described. The default values that are programmed by clicking the "Program Defaults" button (see Section 6.1.5) should not be changed unless you are familiar with how these levels control site switching in a SmartZone system.

PERFORMANCE TESTS

6.8 RECEIVER PERFORMANCE TESTS

6.8.1 PRELIMINARY SETUP

This transceiver does not have a special test mode that can be selected to perform testing. Therefore, temporary conventional channels are programmed to perform this function. Program channels near the low, middle, and high ends of the band (wideband, narrow band or both) and with and without Call Guard (CTCSS/DCS) squelch as applicable. In addition, to check high and low power and talk-around operation, program High/Low Power and Repeater Talk-Around option switches. Proceed as follows to check receiver operation:

1. Select the channel near the center of the band (around 860 MHz).

2. Connect the signal generator to the antenna jack (see Section 6.1.2 for more information). Set the output to the channel frequency, modulated with 1 kHz at 3 kHz (wideband channels) or 1.5 kHz deviation (narrow band channels).

6.8.2 SINAD SENSITIVITY

NOTE: The audio output level of the accessory connector is at a lower level than at the internal speaker. In addition, the internal speaker automatically mutes when a load of approximately 1k ohm or less is connected to this output.

1. Connect a SINAD meter to the speaker output of the RPI (see Section 6.1.2).

2. Decrease the signal generator output to obtain a 12 dB reading on the SINAD meter. The signal generator output should be 0.35 µV maximum. If required, temporarily readjust squelch for "0" as described in Section 6.6. (after clicking "Read Tune Settings" to note the current setting).

3. Check both wide and narrow band channels if applicable, and also check the channels on each end of the band. Reset the squelch to the previous level if it was changed.

6.8.3 SQUELCH SENSITIVITY

With the test setup used for the preceding test, slowly increase the signal generator output until the squelch just opens (audio is enabled). Then decrease the signal generator output until it just closes. The squelch should open after 12 dB SINAD and close before 6 dB SINAD.

6.8.4 AUDIO POWER AND DISTORTION

CAUTION

Grounding either speaker terminal may damage the audio amplifier. Therefore, make sure that any meter connected across the speaker has floating inputs.

To measure audio output power, the actual level across the speaker must be measured because full output power is not available at the accessory connector. If a load of approximately 1k ohm or less is connected to the speaker output of the accessory connector, it must be disconnected to enable the internal speaker. Proceed as follows:

1. Remove the transceiver cover and connect power as described in Section 6.1.6. Carefully turn the front cover over to access the speaker.

2. Connect an AC voltmeter and distortion meter across the speaker (make sure they have floating inputs). Alternatively, 100 µF, non-polarized capacitors can be used in series with the leads.

3. Set the signal generator output for –60 dBm (220 µV). Minimum audio power should be 0.5 watt across the 16-ohm speaker (2.8 V rms). Distortion should be less than 5% at 0.5 watt.

6.8.5 RECEIVER CURRENT DRAIN

Maximum transceiver current with 0.5-watt audio output is 300 mA. With the receiver squelched, it should be 92 mA maximum.

6.9 TRANSMITTER PERFORMANCE TESTS

6.9.1 POWER OUTPUT

Refer to Section 6.8.1 for information on test channels. Proceed as follows:

1. Connect a wattmeter and dummy load to the antenna jack as described in Section 6.1.2.

2. Key the transmitter and high power output should be 2.8-3.5 watts. Check channels on both ends of the band.

3. Select the talk-around mode by pressing the Talk-Around option switch. The talk-around mode is indicated by ▲ in the display. Key the transmitter and power output should be 2.5 watts or greater. Check channels on both ends of the band.

4. Select the low power mode by pressing the High/ Low Power option switch. Low power is indicated by "LOW" in the lower part of the display. Power output should be 0.8-1.2 watt in the standard mode and 0.7-1.2 watt in the talk-around mode.

6.9.2 TRANSMIT FREQUENCY

Monitor the transmit frequency with a communication monitor set to the channel frequency. At room temperature, the frequency should be within $\pm$ 400 Hz. This also checks the receive frequency.

6.9.3 TRANSMIT MODULATION

1. Select a channel not programmed for Call Guard (CTCSS/DCS) squelch and monitor the transmit signal with a communication monitor. Speak into the microphone with a normal voice and modulation should be approximately 3.4 kHz (wideband) or 1.4 kHz (narrow band).

2. Select a channel programmed for Call Guard squelch and with no voice or other microphone input signal, data deviation should be 1.0 kHz (wideband) or 0.8 kHz (narrow band) $\pm$ 200 Hz.

3. Speak into the microphone with the channel programmed for Call Guard squelch selected. Maximum total audio and Call Guard deviation should be 4.7 kHz (wideband) or 2.3 kHz (narrow band).

6.9.4 TRANSMITTER CURRENT DRAIN

Maximum current drain in the transmit mode should be as follows:

High Power, Standard Mode - 1.75 A
High Power, Talk-Around Mode - 2.0 A
Low Power, both modes - 1.3 A

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SECTION 7   PARTS LIST

Ref No.	Description	Part No.
	CHASSIS PARTS	
EP 01	B-3826B #1125-3A (chassis flex)	022-3906-001
EP 02	B-3827C #1125-3B (PTT sw flex)	022-3907-001
F 1	MCA-3 (CCV-3A) fuse	022-3907-037
J 1	3A3-M10 antenna connector	022-3906-124
MP 01	1125 metal chassis-2	022-3906-196
MP 02	1125 top plastic panel (b)-2	022-3907-057
MP 03	1591 top rubber sheet	022-3906-276
MP 04	Screw, 0-1 fh m2x4.5 ni b	022-3907-068
MP 05	VR nut (E)	022-3906-222
MP 06	VR nut (F)	022-3906-223
MP 07	VR nut (I)	022-3906-224
MP 08	1125 top seal	022-3906-271
MP 10	Knob N230 (large)	022-3907-067
MP 12	Knob N231 (small)	022-3907-066
MP 13	1125 accessory jack cover	022-3906-204
MP 16	Screw m2x4.5 zk	022-3906-211
MP 17	Screw B 4	022-3906-212
MP 18	1591 rear plastic panel-1	022-3907-056
MP 22	1591 contact base	022-3906-245
MP 23	1125 battery release button-1	022-3906-228
MP 24	1125 battery release spring-1	022-3906-232
MP 25	1125 plus terminal(A)-1	022-3906-236
MP 26	1591 plus plate	022-3906-246
MP 27	1125 fuse plate	022-3906-237
MP 28	1591 contact pin	022-3906-234
MP 29	Spring (F) rubber contact	022-3906-225
MP 30	1125 minus plate	022-3906-235
MP 32	Screw ph b0 2x4 sus	022-3906-221
MP 33	Screw ph m2x6 sus	022-3906-218
MP 34	Screw ph m2x9 sus	022-3906-219
MP 35	Screw ph m2x23 sus zk	022-3906-220
MP 36	Screw ph 0 m2 x3.5 ni	022-3906-215
MP 37	Screw 1 m2x4.5 zk for RF PA	022-3906-211
MP 39	Screw ph 0 m2 x3.5 ni	022-3906-215
MP 43	Screw ph b0 2x4 sus	022-3906-221
MP 45	Screw ph m2x2.5 zk	022-3906-216
MP 46	1591 RF shield-2	022-3907-063
MP 47	Round stut (G)	022-3906-275
MP 49	1591 antenna jack plate	022-3907-073

Ref No.	Description	Part No.
MP 50	Himerio-sheet (X)	022-3906-268
MP 52	FCC serial No. sticker (AZ)-1	022-3907-061
MP 59	Insulation plate (BI)	022-3907-071
MP 60	2176 earth plate	022-3907-076
MP 61	Thermal sheet (I)	022-3907-075
MP 62	Rubber sheet (L)	022-3907-072
MP 63	Sponge (cp) srcn	022-3906-269
MP 64	Sponge (BJ)	022-3907-070
	JACK ASSEMBLY	
J 01	YM-260 accessory jack	022-3906-125
EP 01	B-3829C (#1125-3A) flex circuit	022-3906-003
MP 01	1125 jack panel-1	022-3906-198
MP 02	1125 jack rubber (A)-1	022-3906-238
MP 03	1125 jack plate	022-3906-233
MP 04	Screw ph m2x2.5 zk	022-3906-216
MP 05	1591 jack sheet	022-3906-279
	DISPLAY ASSEMBLY	
C 1	C1608 CH 1H 330J-T-A	022-3906-070
C 2	680P C1608 B	022-3906-355
C 3	C1608 JB 1C 473K-T-A	022-3906-080
C 4	C1608 JB 1C 104KT-N	022-3906-614
C 5	C1608 CH 1H 330J-T-A	022-3906-070
C 6	C1608 JB 1C 104KT-N	022-3906-614
C 7	C1608 JB 1C 104KT-N	022-3906-614
DS 1	LNG310M6URA LED	022-3906-637
DS 2	LNG310M6URA LED	022-3906-637
DS 3	SEC1601C LED	022-3906-101
DS 4	SEC1401C	022-3906-100
DS 5	SEC 1801C LED	022-3906-102
DS 6	LD-BU10394J	022-3907-036
DS 7	LNG310M6URA LED	022-3906-637
DS 8	LNG310M6URA LED	022-3906-637
EP 1	B-5186A #2176-2D display PC bd 10-key	022-3907-006
	B-5186A #2176-3D display PC bd 3-key	022-3907-086
EP 2	SRCN-1125-SG	022-3906-240
EP 3	LCD reflector plate	022-3907-048

DISPLAY ASSEMBLY

Ref No.	Description	Part No.
IC 1	LC75834W	022-3907-015
J 1	52204-2990	022-3906-128
J 2	AXN820735	022-3906-132
MP 01	10-key front panel (plastic)	022-3907-058
	3-key front panel (plastic)	022-3907-087
MP 04	10-key rubber keypad	022-3907-077
	3-key rubber keypad	022-3907-089
MP 06	1125 sp rubber-1 (10-key)	022-3906-270
	1121 mic seal-1 (3-key)	022-3907-090
MP 07	1125 LCD holder	022-3906-227
MP 08	1591 front plate-1	022-3907-059
MP 09	Screw ph no.0b01.4x4.5ni	022-3906-266
MP 10	Screw ph b0 #.0-3 m1.4x3.5 blk	022-3906-214
MP 11	1125 front seal	022-3906-239
MP 12	Screw b0 2x4 ni (bt)	022-3906-213
MP 15	1125 display plate (10-key)	022-3906-243
	1591 display plate (3-key)	022-3907-088
MP 16	Sponge (cp) srcn	022-3906-269
Q 1	2SA1576 S transistor	022-3906-029
Q 2	2SA1576 S transistor	022-3906-029
Q 3	2SA1576 S transistor	022-3906-029
Q 4	2SA1576 S transistor	022-3906-029
R 01	ERJ3GEYJ 103V resistor	022-3906-163
R 02	EFJ3GEYJ 151 V resistor	022-3906-145
R 03	ERJ3GEYJ 332 V resistor	022-3906-159
R 07	NTCCM16084LH 473KC resistor	022-3907-053
R 08	ERJ3GEYJ 473 V resistor	022-3906-171
R 09	ERJ3GEYJ 104 V resistor	022-3906-175
R 11	ERJ3GEYJ 473 V resistor	022-3906-171
R 12	ERJ3GEYJ 102 V resistor	022-3906-154
R 13	ERJ3GEYJ 473 V resistor	022-3906-171
R 14	ERJ3GEYJ 102 V resistor	022-3906-154
R 15	ERJ3GEYJ 473 V resistor	022-3906-171
R 16	ERJ3GEYJ821V resistor	022-3906-153
R 17	EFJ3GEYJ 151 V resistor	022-3906-145
R 18	12K ERJ3GE resistor	022-3906-164

Ref No.	Description	Part No.
	3-KEY ASSEMBLY	
EP 1	B-5188B #2176-3D (3-key PC bd)	022-3907-091
C 1	C1608 CH 1H 330J-T-A	022-3906-070
C 2	C1608 CH 1H 330J-T-A	022-3906-070
C 3	C1608 CH 1H 330J-T-A	022-3906-070
C 4	C1608 CH 1H 330J-T-A	022-3906-070
C 5	C1608 CH 1H 330J-T-A	022-3906-070
DS 1	LN1371G-(TR) display/LED	022-3906-098
DS 2	LN1371G-(TR) display/LED	022-3906-098
DS 3	LN1371G-(TR) display/LED	022-3906-098
DS 4	LN1371G-(TR) display/LED	022-3906-098
J 1	AXN720535	022-3906-131
MC 1	EM-123H microphone	022-3906-195
Q 1	2SA1576 S transistor	022-3906-029
R 1	ERJ3GEYJ 333 V resistor	022-3906-169
R 2	ERJ3GEYJ 104 V resistor	022-3906-175
R 3	ERJ3GEYJ 104 V resistor	022-3906-175
R 4	ERJ3GEYJ 104 V resistor	022-3906-175
R 5	ERJ3GEYJ 104 V resistor	022-3906-175
R 6	ERJ3GEYJ 221 V resistor	022-3906-288
R 8	ERJ3GEYJ 103V resistor	022-3906-163
R 10	ERJ3GEYJ 121V resistor	022-3906-144
R 11	ERJ3GEYJ 121V resistor	022-3906-144
R 12	ERJ3GEYJ 103V resistor	022-3906-163
SP 1	EAS3P127J speaker	022-3906-058
W 1	ERDS2T0 resistor to spkr	022-3906-877
W 2	ERDS2T0 resistor to spkr	022-3906-877
W 3	OPC-677	022-3907-069
W 4	OPC-677	022-3907-069
	10-KEY ASSEMBLY	
EP 1	B-5187C #2176-2D (10-key PC bd)	022-3907-007
C 1	C1608 CH 1H 330J-T-A	022-3906-070
C 2	C1608 CH 1H 330J-T-A	022-3906-070
C 3	C1608 CH 1H 330J-T-A	022-3906-070
C 4	C1608 CH 1H 330J-T-A	022-3906-070

10-KEY ASSEMBLY

Ref No.	Description	Part No.
C 5	C1608 CH 1H 330J-T-A	022-3906-070
DS 1	LN1371G-(TR) display/LED	022-3906-098
DS 2	LN1371G-(TR) display/LED	022-3906-098
DS 3	LN1371G-(TR) display/LED	022-3906-098
DS 4	LN1371G-(TR) display/LED	022-3906-098
J 1	AXN720535	022-3906-131
MC 1	EM-123H microphone	022-3906-195
Q 1	2SA1576 S transistor	022-3906-029
R 1	ERJ3GEYJ 333 V resistor	022-3906-169
R 2	ERJ3GEYJ 104 V resistor	022-3906-175
R 3	ERJ3GEYJ 104 V resistor	022-3906-175
R 4	ERJ3GEYJ 104 V resistor	022-3906-175
R 5	ERJ3GEYJ 104 V resistor	022-3906-175
R 10	ERJ3GEYJ 121V resistor	022-3906-144
R 11	ERJ3GEYJ 121V resistor	022-3906-144
R 12	ERJ3GEYJ 103V resistor	022-3906-163
SP 1	EAS3P127J speaker	022-3906-058
W 1	ERDS2T0 resistor to spkr	022-3906-877
W 2	ERDS2T0 resistor to spkr	022-3906-877
W 3	OPC-677	022-3907-069
W 4	OPC-677	022-3907-069

IF ASSEMBLY

Ref No.	Description	Part No.
C 01	4.7 16V MSVA	022-3906-097
C 02	C1068 JB 1H 102K-T-A	022-3906-060
C 03	C1608 JB 1C 473K-T-A	022-3906-080
C 04	TEMSVA 1A 106M-8L	022-3906-096
C 05	C1068 JB 1H 102K-T-A	022-3906-060
C 06	TEMSVA 1A 106M-8L	022-3906-096
C 07	TEMSVA 1A 106M-8L	022-3906-096
C 08	C1608 JB 1C 104KT-N	022-3906-614
C 09	C1608 JB 1E 103KTA	022-3906-063
C 10	C1608 CH 1H 180J-T-A	022-3906-068
C 11	C1608 JB 1E 103KTA	022-3906-063
C 12	C1608 JB 1E 103KTA	022-3906-063
C 13	C1608 JB 1E 103KTA	022-3906-063
C 14	C1608 JB 1E 103KTA	022-3906-063
C 15	4.7 16V MSVA	022-3906-097
C 16	C1068 JB 1H 102K-T-A	022-3906-060

IF ASSEMBLY

Ref No.	Description	Part No.
C 17	C1608 CH 1H 680J-T-A diode	022-3906-798
C 18	C1608 JB 1C 104KT-N	022-3906-614
C 19	C1068 JB 1H 102K-T-A	022-3906-060
C 20	C1608 CH 1H 221J-T-A	022-3906-603
C 21	C1608 CH 1H 221J-T-A	022-3906-603
C 23	C1068 JB 1H 102K-T-A	022-3906-060
C 24	C1068 JB 1H 102K-T-A	022-3906-060
C 25	C1068 JB 1H 102K-T-A	022-3906-060
C 26	C1608 CH 1H 330J-T-A	022-3906-070
C 29	C1608 JB 1C 104KT-N	022-3906-614
C 30	C1608 JB 1E 103KTA	022-3906-063
C 31	C1608 JB 1C 104KT-N	022-3906-614
C 32	820P C1608 B	022-3906-083
C 33	C1608 JB 1C 473K-T-A	022-3906-080
C 34	C1068 JB 1H 102K-T-A	022-3906-060
C 35	C1608 CH 1H 330J-T-A	022-3906-070
D 2	MA8056 M diode	022-3906-049
D 3	MA2S728-(TX) diode	022-3907-026
EP 1	B-5183C (#2176-1C)	022-3907-003
IC 1	TK11350BM	022-3907-020
IC 2	TK11360BM	022-3907-019
IC 3	TA31136FN8(EL) IC	022-3907-008
L 2	ELJNC R56J 0.56U	022-3906-122
Q 1	2SC4081 T107 S transistor	022-3906-031
Q 2	2SK882 GR (TE85L) transistor	022-3906-515
Q 3	DTC144EE TL transistor	022-3906-329
Q 4	UMG2N TL diode	022-3906-250
R 02	ERJ3GEYJ 472 V resistor	022-3906-160
R 04	ERJ3GEUJ 560V resistor	022-3906-142
R 05	ERJ3GEYJ 181 V resistor	022-3906-146
R 07	ERJ3GEYJ 222 V resistor	022-3906-157
R 08	ERJ3GEYJ 272 V resistor	022-3906-158
R 09	ERJ3GEYJ 331 V resistor	022-3906-389
R 12	ERJ3GEYJ 682 V resistor	022-3906-162
R 13	RV-222 (RH03AVAS4J 47K)	022-3906-516
R 14	NTCCM16084LH 104KC	022-3907-052
R 15	ERJ3GEYJ 473 V resistor	022-3906-171
R 16	ERJ3GEYJ 101 V resistor	022-3906-143
R 17	330K ERJ3GE resistor	022-3906-180
R 18	ERJ3GEYJ 102 V resistor	022-3906-154
R 19	ERJ3GEYJ 474 V resistor	022-3906-181
R 20	ERJ3GEYJ 103V resistor	022-3906-163

IF ASSEMBLY

Ref No.	Description	Part No.
R 21	ERJ3GEYJ 104 V resistor	022-3906-175
R 22	ERJ3GEYJ 331 V resistor	022-3906-389
R 23	ERJ3GEYJ 152 V resistor	022-3906-155
R 24	ERJ3GEYJ 122 V resistor	022-3906-390
R 25	ERJ3GEYJ 104 V resistor	022-3906-175
R 26	NTCCM16084BH 222KC	022-3907-055
R 27	ERJ3GEYJ 222 V resistor	022-3906-157
R 28	ERJ3GEYJ 682 V resistor	022-3906-162
X 1	CDBCA450CX24 resistor	022-3906-642

Ref No.	Description	Part No.
R 03	ERJ3GEYJ 101 V resistor	022-3906-143
R 04	ERJ3GEYJ 332 V resistor	022-3906-159
R 05	NTCCM16084BH 152KC	022-3907-054
R 06	EFJ3GEYJ 151 V resistor	022-3906-145
R 07	ERJ3GEYJ 101 V resistor	022-3906-143
R 08	ERJ3GEYJ 122 V resistor	022-3906-390
R 09	ERJ3GEYJ 272 V resistor	022-3906-158

PLL ASSEMBLY

Ref No.	Description	Part No.
EP 1	B-5184C (#2176-1C)	022-3907-004
C 01	TEMSVA 1A 106M-8L	022-3906-096
C 02	C1608 CH 1H 330J-T-A	022-3906-070
C 04	C1608 JB 1C 104KT-N	022-3906-614
C 05	1.5 16V SVA	022-3906-094
C 07	C1608 CH 1H 330J-T-A	022-3906-070
C 08	C1608 CH 1H 330J-T-A	022-3906-070
C 09	C1608 CH 1H 330J-T-A	022-3906-070
C 10	C1068 JB 1H 102K-T-A	022-3906-060
C 11	C1608 CH 1H 150J-T-A	022-3906-067
C 12	C1608 JB 1C 473K-T-A	022-3906-080
C 13	C1608 CH 1H 330J-T-A	022-3906-070
C 14	C1608 JB 1C 473K-T-A	022-3906-080
C 15	C1608 CH 1H 180J-T-A	022-3906-068
C 16	12P C1608 CH	022-3906-066
C 17	C1608 JB 1C 104KT-N	022-3906-614
IC 1	MB15A02PFV-1	022-3907-016
IC 2	TC7S66FU IC	022-3906-020
L 1	MLF1608A 2R2K-T coil	022-3906-514
Q 1	2SA1576 S transistor	022-3906-029
Q 2	2SC4081 T107 S transistor	022-3906-031
Q 3	DTC144EE TL transistor	022-3906-329
R 01	ERJ3GEYJ 562 V resistor	022-3906-161
R 10	ERJ3GEYJ 103V resistor	022-3906-163
R 12	ERJ3GEYJ 472 V resistor	022-3906-160
R 13	ERJ3GEYJ 182 V resistor	022-3906-156
R 14	ERJ3GEYJ 471 V resistor	022-3906-150
R 15	ERJ3GEYJ 682 V resistor	022-3906-162
R 16	270 ERJ3GE resistor	022-3906-147
R 02	NTCCM16084BH 222KC	022-3907-055

Ref No.	Description	Part No.

RF UNIT

Ref No.	Description	Part No.
C 001	C1608 CH 1H 0R3B-T-A	022-3906-468
C 002	C1608 CH 1H 040B-T-A	022-3906-609
C 004	C1608 CH 1H 330J-T-A	022-3906-070
C 005	C1608 CH 1H 330J-T-A	022-3906-070
C 007	C1608 CH 1H 030B-T-A	022-3906-489
C 008	C1608 JB 1C 473K-T-A	022-3906-080
C 009	C1608 CH 1H 330J-T-A	022-3906-070
C 010	C1608 CH 1H 330J-T-A	022-3906-070
C 011	C1608 CH 1H 010B-T-A	022-3906-085
C 012	C1608 CH 1H 330J-T-A	022-3906-070
C 013	C1608 CH 1H 330J-T-A	022-3906-070
C 014	C1608 JB 1E 103KTA	022-3906-063
C 015	C1608 CH 1H 180J-T-A	022-3906-068
C 016	C1608 CH 1H 330J-T-A	022-3906-070
C 017	C1608 JB 1E 103KTA	022-3906-063
C 018	C1608 JB 1E 103KTA	022-3906-063
C 019	C1608 CH 1H 040B-T-A	022-3906-609
C 020	C1608 JB 1E 103KTA	022-3906-063
C 022	C1608 CH 1H 330J-T-A	022-3906-070
C 023	C1608 CH 3R-5B-T-A	022-3906-353
C 024	C1608 CH 3R-5B-T-A	022-3906-353
C 025	C1608 CH 1H 330J-T-A	022-3906-070
C 026	12P C1608 CH	022-3906-066
C 027	C1608 JB 1C 104KT-N	022-3906-614
C 028	C1608 JB 1C 104KT-N	022-3906-614
C 029	C1608 JB 1C 104KT-N	022-3906-614
C 030	C1608 CH 1H 330J-T-A	022-3906-070
C 031	C1608 CH 1H 330J-T-A	022-3906-070
C 032	C1608 CH 1H 330J-T-A	022-3906-070
C 033	C1608 CH 1H 050C-T-A	022-3906-064
C 034	C1608 JB 1H 471K-T-A	022-3906-059

RF UNIT

Ref No.	Description	Part No.	Ref No.	Description	Part No.
C 035	C1608 CH 1H 040B-T-A	022-3906-609	C 084	C1608 CH 1H 330J-T-A	022-3906-070
C 036	C1608 CH 1H 150J-T-A	022-3906-067	C 085	C1608 CH 1H 330J-T-A	022-3906-070
C 037	C1608 CH 1H 330J-T-A	022-3906-070	C 088	C1608 CH 1H 330J-T-A	022-3906-070
C 038	C1608 CH 1H 330J-T-A	022-3906-070	C 089	C1608 JB 1C 104KT-N	022-3906-614
C 040	C1608 JB 1C 473K-T-A	022-3906-080	C 090	C1608 CH 1H 330J-T-A	022-3906-070
C 041	C1608 JB 1H 471K-T-A	022-3906-059	C 091	C1608 JB 1C 473K-T-A	022-3906-080
C 042	C1608 CH 1H 330J-T-A	022-3906-070	C 093	C1608 CH 1H 330J-T-A	022-3906-070
C 043	C1608 CH 1H 330J-T-A	022-3906-070	C 094	C1608 CH 1H 330J-T-A	022-3906-070
C 044	C1608 JB 1H 471K-T-A	022-3906-059	C 095	C1608 JB 1C 104KT-N	022-3906-614
C 045	C1608 JB 1C 104KT-N	022-3906-614	C 096	C1608 CH 1H 330J-T-A	022-3906-070
C 046	C1608 CH 1H 330J-T-A	022-3906-070	C 097	C1608 CH 1H 330J-T-A	022-3906-070
C 047	C1608 CH 1H 330J-T-A	022-3906-070	C 098	C1608 CH 1H 330J-T-A	022-3906-070
C 048	C1608 CH 1H 330J-T-A	022-3906-070	C 100	C1608 CH 1H 330J-T-A	022-3906-070
C 049	C1608 CH 1H 330J-T-A	022-3906-070	C 101	C1608 CH 1H 330J-T-A	022-3906-070
C 050	C1608 CH 1H 330J-T-A	022-3906-070	C 102	C1608 CH 1H 330J-T-A	022-3906-070
C 052	C1608 CH 1H 330J-T-A	022-3906-070	C 103	C1608 CH 1H 330J-T-A	022-3906-070
C 053	4.7 16V MSVA	022-3906-097	C 104	C1608 CH 1H 330J-T-A	022-3906-070
C 054	C1608 CH 1H 330J-T-A	022-3906-070	C 105	C1608 CH 1H 330J-T-A	022-3906-070
C 055	C1608 CH 1H 180J-T-A	022-3906-068	C 106	C1608 CH 1H 330J-T-A	022-3906-070
C 057	4.7 16V MSVA	022-3906-097	C 107	C1608 CH 1H 330J-T-A	022-3906-070
C 058	C1608 CH 1H 330J-T-A	022-3906-070	C 108	C1608 CH 1H 330J-T-A	022-3906-070
C 059	C1608 CH 1H 330J-T-A	022-3906-070	C 109	C1608 CH 1H 330J-T-A	022-3906-070
C 060	C1608 CH 1H 330J-T-A	022-3906-070	C 111	C1608 CH 1H 330J-T-A	022-3906-070
C 062	C1608 CH 1H 050C-T-A	022-3906-064	C 112	C1608 CH 1H 330J-T-A	022-3906-070
C 063	C1608 CH 1H 330J-T-A	022-3906-070	C 114	C1608 JB 1C 473K-T-A	022-3906-080
C 064	C1608 CH 1H 330J-T-A	022-3906-070	C 117	C1608 CH 1H 070D T-A	022-3906-596
C 065	C1608 CH 1H 330J-T-A	022-3906-070	C 119	C1608 JB 1C 473K-T-A	022-3906-080
C 066	C1608 CH 1H 2R5B-T-A	022-3906-071	C 120	C1608 CH 1H 330J-T-A	022-3906-070
C 067	C1608 CH 1H 330J-T-A	022-3906-070	C 121	C1608 CH 1H 330J-T-A	022-3906-070
C 068	C1608 CH 1H 330J-T-A	022-3906-070	C 122	1 C2012 10V B	022-3907-034
C 069	C1608 CH 1H 330J-T-A	022-3906-070	C 124	C1608 JB 1C 104KT-N	022-3906-614
C 070	C1608 CH 1H 330J-T-A	022-3906-070	C 125	C1608 CH 1H 330J-T-A	022-3906-070
C 071	C1608 JB 1H 471K-T-A	022-3906-059	C 126	0.5P C1608 CH 0.1P	022-3906-084
C 072	C1608 CH 1H 330J-T-A	022-3906-070	C 127	C1608 CH 1H 330J-T-A	022-3906-070
C 073	C1608 CH 1H 330J-T-A	022-3906-070	C 128	C1608 JB 1E 103KTA	022-3906-063
C 074	C1608 JB 1C 473K-T-A	022-3906-080	C 129	C1608 JB 1E 103KTA	022-3906-063
C 075	C1608 CH 1H 020B-T-A	022-3906-086	C 130	C1608 JB 1E 103KTA	022-3906-063
C 076	C1608 CH 1H 330J-T-A	022-3906-070	C 131	C1608 CH 1H 330J-T-A	022-3906-070
C 077	C1608 CH 1H 330J-T-A	022-3906-070	C 132	C1608 CH 1H 050C-T-A	022-3906-064
C 078	C1608 CH 1H 050C-T-A	022-3906-064	C 133	C1608 CH 1H 330J-T-A	022-3906-070
C 079	C1608 CH 1H 330J-T-A	022-3906-070	C 134	C1608 CH 1H 030B-T-A	022-3906-489
C 080	C1608 CH 1H 330J-T-A	022-3906-070	C 135	C1608 JB 1E 103KTA	022-3906-063
C 081	C1608 CH 1H 330J-T-A	022-3906-070	C 136	C1608 CH 1H 150J-T-A	022-3906-067
C 082	C1608 CH 1H 330J-T-A	022-3906-070	C 137	C1608 CH 1H 330J-T-A	022-3906-070
C 083	C1608 CH 1H 1R5B-T-A	022-3906-087	C 138	C1608 CH 1H 150J-T-A	022-3906-067

RF UNIT

Ref No.	Description	Part No.	Ref No.	Description	Part No.
C 139	C1608 JB 1C 104KT-N	022-3906-614	L 11	ELJRE 33NJ 33N coil	022-3907-043
C 140	0.5P C1608 CH 0.1P	022-3906-084	L 12	ELJRE 10NJ 10N coil	022-3906-493
			L 13	DCS3220-09 coil	022-3906-121
D 01	MA77 (TW) diode	022-3906-047	L 14	ELJRE 39NJ 39N coil	022-3906-953
D 02	MA77 (TW) diode	022-3906-047	L 15	ELJRE 8N2J 8.2N coil	022-3906-491
D 03	UM9401F diode	022-3906-937	L 16	MLF1608A 1R0M-T coil	022-3906-110
D 04	HSM88AS-TR diode	022-3906-046	L 17	ELJRE 6N8J 6.8N coil	022-3906-496
D 05	HSM88AS-TR diode	022-3906-046	L 19	ELJRE 12NJ 12N coil	022-3906-497
D 06	MA2S111-(TX) diode	022-3906-050	L 20	ELJRE 12NJ 12N coil	022-3906-497
D 07	MA78	022-3906-044	L 22	ELJRE 15NJ 15N coil	022-3906-668
D 09	MA2S111-(TX) diode	022-3906-050	L 23	MLF1608A 1R0M-T coil	022-3906-110
D 10	MA2S111-(TX) diode	022-3906-050	L 24	BLM21P300S	022-3907-044
D 11	UM9401F diode	022-3906-937	L 25	BLM21P300S	022-3907-044
D 13	MA2S077-(TX) diode	022-3907-027	L 26	BLM21P300S	022-3907-044
D 14	MA2S077-(TX) diode	022-3907-027	L 27	MLF1608D R33K 0.33U	022-3907-040
D 15	MA2S077-(TX) diode	022-3907-027	L 28	MLF1608D R33K 0.33U	022-3907-040
D 16	MA2S077-(TX) diode	022-3907-027	L 29	ELJRE 3N9J 3.9N coil	022-3907-042
			L 30	MLF1608A 2R2K-T coil	022-3906-514
EP 1	B-5182C (#2176-1C)	022-3907-002	L 32	ELJRE 10NJ 10N coil	022-3906-493
			L 33	ELJRE 8N2J 8.2N coil	022-3906-491
FI 1	EZF-U860 AM81T filter	022-3906-055	L 34	DCS3220-09 coil	022-3906-121
FI 2	EZF-U860 BM81T filter	022-3906-056			
FI 3	FL-295	022-3907-028	MP 03	1591 module T-shield (under IC1)	022-3906-262
FI 4	SFPC450E-TC01 filter	022-3907-030	MP 04	1781 module plate (VCO-IC1)	022-3906-508
FI 5	CFUM450F	022-3907-031	MP 05	2176 shield plate (over Q2)	022-3907-065
FI 6	SFPC450G-TC01 ceramic	022-3907-029	MP 06	2176 shield sheet (over FI2)	022-3907-074
FI 7	GLP802-2 filter	022-3906-505	MP 07	1591 VCO shield case-1	022-3906-509
			MP 08	1591 VCO sheet (shield insulator)	022-3906-281
IC 1	M67706/SC1140 IC	022-3901-337	MP 09	Grand spring (E)	022-3906-510
IC 1	M67706/SC1140 IC	022-3901-337	MP 10	1591 VCO shield cover plate-1	022-3906-298
IC 2	NJM2904V-TE1 IC	022-3906-016			
IC 3	NVCO-SM-838 S.IC	022-3906-135	Q 01	2SC5015	022-3906-035
IC 4	TC75S54F	022-3907-013	Q 02	3SK177 U72	022-3906-037
			Q 05	2SC4081 T107 S transistor	022-3906-031
J 1	AXK6S30645P	022-3907-046	Q 06	2SB1132 T100 Q transistor	022-3906-030
			Q 07	UMD3 TL diode	022-3906-040
L 02	LQN1A 8N8J04 8.8N coil	022-3906-109	Q 08	2SC3357-T2 RF transistor	022-3907-022
L 05	ELJRE 10NJ 10N coil	022-3906-493	Q 09	2SC3357-T2 RF transistor	022-3907-022
L 06	ELJRE 18NJ 18N coil	022-3906-959	Q 10	2SC4228-T2 R44 transistor	022-3906-033
L 06	ELJRE 18NJ 18N coil	022-3906-959	Q 11	2SC4228-T2 R44 transistor	022-3906-033
L 07	ELJRE 68NG-F coil	022-3906-671	Q 12	2SC4228-T2 R44 transistor	022-3906-033
L 08	ELJRE 39NJ 39N coil	022-3906-953	Q 13	2SA1576 S transistor	022-3906-029
L 09	ELJNC R47K 0.47U coil	022-3907-041	Q 14	XP4601(TX) transistor	022-3906-328
L 1	LQN1A 8N8J04 8.8N coil	022-3906-109	Q 16	2SA1577 T107 Q transistor	022-3906-249
L 10	ELJNC R18K 0.18U coil	022-3906-956	Q 17	DTC144EE TL transistor	022-3906-329

RF UNIT

Ref No.	Description	Part No.	Ref No.	Description	Part No.
Q 18	2SC4215-Y transistor	022-3906-320	R 051	ERJ3GEYJ 472 V resistor	022-3906-160
Q 19	DTA144EE transistor	022-3907-024	R 052	ERJ3GEUJ 560V resistor	022-3906-142
Q 20	DTA144EE transistor	022-3907-024	R 053	39K ERJ3GE resistor	022-3906-170
Q 21	DTC144EE TL transistor	022-3906-329	R 054	DRJ3GEYJ 561 V resistor	022-3906-151
			R 055	ERJ3GEYJ 392 V resistor	022-3906-391
R 001	DRJ3GEYJ 561 V resistor	022-3906-151	R 056	ERJ3GEYJ 222 V resistor	022-3906-157
R 002	ERJ3GEYJ 472 V resistor	022-3906-160	R 057	15 ERJ3GE resistor	022-3906-139
R 003	ERJ3GEYJ 182 V resistor	022-3906-156	R 058	15 ERJ3GE resistor	022-3906-139
R 004	56K ERJ3GE resistor	022-3906-172	R 059	15 ERJ3GE resistor	022-3906-139
R 005	ERJ3GEYJ 333 V resistor	022-3906-169	R 060	270 ERJ3GE resistor	022-3906-147
R 006	ERJ3GEUJ 560V resistor	022-3906-142	R 061	18 ERJ3GE resistor	022-3906-140
R 007	ERJ3GEYJ 181 V resistor	022-3906-146	R 062	270 ERJ3GE resistor	022-3906-147
R 009	270 ERJ3GE resistor	022-3906-147	R 063	ERJ3GEYJ821V resistor	022-3906-153
R 010	18 ERJ3GE resistor	022-3906-140	R 064	ERJ3GEYJ 682 V resistor	022-3906-162
R 011	270 ERJ3GE resistor	022-3906-147	R 065	ERJ3GEYJ 182 V resistor	022-3906-156
R 012	ERJ3GEYJ 102 V resistor	022-3906-154	R 066	ERJ3GEUJ 560V resistor	022-3906-142
R 020	82 MCR10 resistor	022-3907-049	R 067	ERJ3GEYJ 473 V resistor	022-3906-171
R 021	ERJ3GEYJ 102 V resistor	022-3906-154	R 068	ERJ3GEYJ 104 V resistor	022-3906-175
R 022	ERJ3GEYJ 102 V resistor	022-3906-154	R 069	ERJ3GEYJ 104 V resistor	022-3906-175
R 023	ERJ3GEYJ 103V resistor	022-3906-163	R 072	ERJ3GEYJ 104 V resistor	022-3906-175
R 024	ERJ3GEYJ 473 V resistor	022-3906-171	R 073	EVM-1X B54 50K resistor	022-3907-051
R 025	ERJ3GEYJ 103V resistor	022-3906-163	R 074	ERJ3GEYJ 104 V resistor	022-3906-175
R 026	ERJ3GEYJ 104 V resistor	022-3906-175	R 075	ERJ3GEYJ 104 V resistor	022-3906-175
R 027	ERJ3GEYJ 104 V resistor	022-3906-175	R 076	ERJ3GEYJ 223 V resistor	022-3906-167
R 028	56K ERJ3GE resistor	022-3906-172	R 077	ERJ3GEYJ 103V resistor	022-3906-163
R 029	ERJ3GEYJ 333 V resistor	022-3906-169	R 078	ERJ3GEYJ 222 V resistor	022-3906-157
R 030	ERJ3GEYJ 182 V resistor	022-3906-156	R 079	ERJ3GEYJ 272 V resistor	022-3906-158
R 031	ERJ3GEYJ 332 V resistor	022-3906-159	R 080	ERJ3GEYJ 332 V resistor	022-3906-159
R 032	ERJ3GEYJ 104 V resistor	022-3906-175	R 082	ERJ3GEYJ 104 V resistor	022-3906-175
R 033	ERJ3GEYJ 273 V resistor	022-3906-168	R 083	ERJ3GEYJ 220V resistor	022-3906-685
R 034	ERJ3GEYJ 103V resistor	022-3906-163	R 085	ERJ3GEUJ 560V resistor	022-3906-142
R 035	ERJ3GEYJ 224V resistor	022-3906-178	R 086	ERJ3GEYJ 122 V resistor	022-3906-390
R 036	ERJ3GEYJ 221 V resistor	022-3906-288	R 087	ERJ3GEYJ 474 V resistor	022-3906-181
R 037	ERJ3GEYJ 101 V resistor	022-3906-143	R 091	12K ERJ3GE resistor	022-3906-164
R 039	ERJ3GEYJ 473 V resistor	022-3906-171	R 092	ERJ3GEYJ 100V 10 OHM resistor	022-3906-138
R 041	ERJ3GEYJ 471 V resistor	022-3906-150	R 093	15K ERJ3GE resistor	022-3906-165
R 042	ERJ3GEYJ 100V 10 OHM resistor	022-3906-138	R 094	ERJ3GEYJ 103V resistor	022-3906-163
R 043	ERJ3GEYJ 471 V resistor	022-3906-150	R 095	ERJ3GEYJ 223 V resistor	022-3906-167
R 044	ERJ3GEYJ 220V resistor	022-3906-685	R 096	15K ERJ3GE resistor	022-3906-165
R 045	ERJ3GEYJ 272 V resistor	022-3906-158	R 097	ERJ3GEYJ 102 V resistor	022-3906-154
R 046	ERJ3GEYJ 100V 10 ohm resistor	022-3906-138	R 098	ERJ3GEYJ 391 V resistor	022-3906-149
R 047	15 ERJ3GE resistor	022-3906-139	R 099	ERJ3GEYJ 471 V resistor	022-3906-150
R 048	ERJ3GEYJ 472 V resistor	022-3906-160	R 101	ERJ3GEYJ 103V resistor	022-3906-163
R 049	ERJ3GEYJ 122 V resistor	022-3906-390	R 102	ERJ3GEYJ 682 V resistor	022-3906-162
R 050	ERJ3GEYJ 472 V resistor	022-3906-160	R 103	ERJ3GEYJ 272 V resistor	022-3906-158

RF UNIT

Ref No.	Description	Part No.
R 104	DRJ3GEYJ 561 V resistor	022-3906-151
W 1	IPS-1041-2	022-3906-133
W 3	ERJ3GE-JPW V resistor	022-3906-185
W 4	ERJ3GE-JPW V resistor	022-3906-185
W 5	ERJ3GE-JPW V resistor	022-3906-185
W 6	ERJ3GE-JPW V resistor	022-3906-185
X 3	CR-626	022-3907-038

Ref No.	Description	Part No.
	LOGIC UNIT	
C 001	C1608 CH 1H 330J-T-A	022-3906-070
C 002	C1608 CH 1H 330J-T-A	022-3906-070
C 003	C1608 CH 1H 330J-T-A	022-3906-070
C 004	C1608 CH 1H 330J-T-A	022-3906-070
C 005	C1608 CH 1H 330J-T-A	022-3906-070
C 006	C1608 CH 1H 330J-T-A	022-3906-070
C 007	C1608 CH 1H 330J-T-A	022-3906-070
C 008	C1608 CH 1H 330J-T-A	022-3906-070
C 009	C1608 CH 1H 330J-T-A	022-3906-070
C 010	C1608 CH 1H 330J-T-A	022-3906-070
C 011	C1608 CH 1H 330J-T-A	022-3906-070
C 012	C1608 CH 1H 330J-T-A	022-3906-070
C 013	C1608 CH 1H 330J-T-A	022-3906-070
C 014	C1608 CH 1H 330J-T-A	022-3906-070
C 015	C1608 CH 1H 330J-T-A	022-3906-070
C 016	C1608 JB 1E 103KTA	022-3906-063
C 017	C1608 JB 1E 103KTA	022-3906-063
C 018	C1608 JB 1E 103KTA	022-3906-063
C 019	C1608 JB 1E 103KTA	022-3906-063
C 020	C1608 CH 1H 330J-T-A	022-3906-070
C 021	C1608 JF 1C 104Z-T-A	022-3906-076
C 022	C1608 JB 1E 103KTA	022-3906-063
C 023	C1608 CH 1H 330J-T-A	022-3906-070
C 024	C1608 CH 1H 330J-T-A	022-3906-070
C 025	C1608 CH 1H 330J-T-A	022-3906-070
C 026	C1608 JB 1E 103KTA	022-3906-063
C 027	C1608 CH 1H 330J-T-A	022-3906-070
C 028	C1608 CH 1H 330J-T-A	022-3906-070
C 029	C1608 CH 1H 330J-T-A	022-3906-070

LOGIC UNIT

Ref No.	Description	Part No.
C 030	C1608 JB 1C 104KT-N	022-3906-614
C 031	C1608 JB 1C 104KT-N	022-3906-614
C 032	C1608 CH 1H 330J-T-A	022-3906-070
C 033	C1608 CH 1H 330J-T-A	022-3906-070
C 036	C1608 CH 1H 330J-T-A	022-3906-070
C 043	C1608 JF 1C 104Z-T-A	022-3906-076
C 044	C1608 JF 1C 104Z-T-A	022-3906-076
C 045	C1608 JF 1C 104Z-T-A	022-3906-076
C 046	1 C2012 10V B	022-3907-034
C 048	C1608 JF 1C 104Z-T-A	022-3906-076
C 049	C1608 JF 1C 104Z-T-A	022-3906-076
C 051	C1608 JF 1C 104Z-T-A	022-3906-076
C 052	C1608 JF 1C 104Z-T-A	022-3906-076
C 053	C1608 JF 1C 104Z-T-A	022-3906-076
C 054	C1608 JF 1C 104Z-T-A	022-3906-076
C 055	C1608 JB 1E 103KTA	022-3906-063
C 101	C1608 JB 1E 103KTA	022-3906-063
C 102	470P C1608 CH	022-3906-252
C 103	C1068 JB 1H 102K-T-A	022-3906-060
C 104	0.039 C1608 16V B	022-3907-033
C 105	C1608 JB 1E 103KTA	022-3906-063
C 106	C1608 JB 1E 103KTA	022-3906-063
C 107	1 C2012 10V B	022-3907-034
C 108	C1608 JB 1C 104KT-N	022-3906-614
C 109	C1608 JB 1E 103KTA	022-3906-063
C 110	C1608 JB 1C 473K-T-A	022-3906-080
C 111	4.7 C3216 6.3V B	022-3907-035
C 113	C1608 CH 1H 330J-T-A	022-3906-070
C 115	1 C2012 10V B	022-3907-034
C 116	C1608 JB 1C 473K-T-A	022-3906-080
C 118	C1608 JB 1C 104KT-N	022-3906-614
C 121	C1608 JB 1C 104KT-N	022-3906-614
C 122	C1608 JB 1C 104KT-N	022-3906-614
C 123	TEMSVB2 1A 336M-8R	022-3906-095
C 124	C1608 JB 1E 103KTA	022-3906-063
C 125	C1608 JB 1E 103KTA	022-3906-063
C 126	0.0033 C1608 B	022-3906-077
C 127	C1608 JB 1C 104KT-N	022-3906-614
C 128	C1608 JB 1H 222K-T-A	022-3906-061
C 129	4.7 10V MSVA	022-3906-361
C 130	1 C2012 10V B	022-3907-034
C 134	1 C2012 10V B	022-3907-034
C 136	C1608 JB 1C 104KT-N	022-3906-614
C 137	1 C2012 10V B	022-3907-034
C 138	4.7 10V MSVA	022-3906-361

LOGIC UNIT

Ref No.	Description	Part No.	Ref No.	Description	Part No.
C 139	1 C2012 10V B	022-3907-034	C 303	C1608 CH 1H 150J-T-A	022-3906-067
C 140	4.7 10V MSVA	022-3906-361	C 304	C1608 CH 1H 180J-T-A	022-3906-068
C 141	1 C2012 10V B	022-3907-034	C 305	C1608 CH 1H 270J-T-A	022-3906-069
C 142	C1608 JB 1E 103KTA	022-3906-063	C 306	C1608 JF 1C 104Z-T-A	022-3906-076
C 143	1 C2012 10V B	022-3907-034	C 307	C2012 JB 1C 224K-T-A	022-3906-082
C 144	C1608 CH 1H 330J-T-A	022-3906-070	C 308	C1608 JB 1C 473K-T-A	022-3906-080
C 145	1 C2012 10V B	022-3907-034	C 401	C1608 CH 1H 330J-T-A	022-3906-070
C 150	0.0056 C1608 B	022-3906-607	C 402	C1608 CH 1H 330J-T-A	022-3906-070
C 151	0.015 C1608 16V B	022-3901-397	C 403	1 C2012 10V B	022-3907-034
C 152	C1608 JB 1E 103KTA	022-3906-063	C 404	4.7 16V MSVA	022-3906-097
C 153	C1608 JB 1C 473K-T-A	022-3906-080	C 405	C1068 JB 1H 102K-T-A	022-3906-060
C 154	C1608 JB 1H 222K-T-A	022-3906-061	C 406	C1608 CH 1H 330J-T-A	022-3906-070
C 155	C1608 JB 1C 223K-T-A	022-3906-079	C 407	4.7 10V MSVA	022-3906-361
C 156	C1608 JB 1C 682K-T-A	022-3906-088	C 408	C1608 CH 1H 330J-T-A	022-3906-070
C 157	1 C2012 10V B	022-3907-034	C 409	4.7 16V MSVA	022-3906-097
C 158	1 C2012 10V B	022-3907-034	C 410	C1068 JB 1H 102K-T-A	022-3906-060
C 159	C1608 JB 1E 103KTA	022-3906-063	C 411	C1608 CH 1H 330J-T-A	022-3906-070
C 201	C1608 JB 1H 472K-T-A	022-3906-062	C 412	4.7 10V MSVA	022-3906-361
C 202	C1608 JB 1H 472K-T-A	022-3906-062	C 413	C1608 CH 1H 330J-T-A	022-3906-070
C 203	C1608 JB 1H 472K-T-A	022-3906-062	C 414	C2012 JB 1C 224K-T-A	022-3906-082
C 204	1 C2012 10V B	022-3907-034	C 415	4.7 10V MSVA	022-3906-361
C 205	C1608 JB 1H 472K-T-A	022-3906-062	C 416	C1068 JB 1H 102K-T-A	022-3906-060
C 206	C1608 JB 1C 104KT-N	022-3906-614	C 418	C1068 JB 1H 102K-T-A	022-3906-060
C 207	C1608 JB 1C 104KT-N	022-3906-614	C 419	C1608 CH 1H 330J-T-A	022-3906-070
C 208	C1608 JB 1C 473K-T-A	022-3906-080	C 420	C1608 JB 1C 104KT-N	022-3906-614
C 209	1 C2012 10V B	022-3907-034	C 421	C1608 JB 1C 104KT-N	022-3906-614
C 210	0.0033 C1608 B	022-3906-077	C 422	C1068 JB 1H 102K-T-A	022-3906-060
C 211	560P C1608 SL	022-3906-526	C 423	4.7 10V MSVA	022-3906-361
C 212	C1608 CH 1H 560J-T-A	022-3906-601	C 430	C1608 CH 1H 330J-T-A	022-3906-070
C 213	C1608 JB 1H 472K-T-A	022-3906-062	C 431	C1608 CH 1H 330J-T-A	022-3906-070
C 214	1 C2012 10V B	022-3907-034	C 432	C1608 CH 1H 330J-T-A	022-3906-070
C 215	C1608 JB 1E 103KTA	022-3906-063	C 433	C1608 CH 1H 330J-T-A	022-3906-070
C 216	C1608 JB 1E 103KTA	022-3906-063	C 434	C1608 CH 1H 330J-T-A	022-3906-070
C 217	0.0033 C1608 B	022-3906-077	C 435	C1608 CH 1H 330J-T-A	022-3906-070
C 218	C1608 JB 1H 222K-T-A	022-3906-061	C 436	C1608 CH 1H 330J-T-A	022-3906-070
C 219	C1608 JB 1C 104KT-N	022-3906-614	C 437	C1608 CH 1H 330J-T-A	022-3906-070
C 222	1 C2012 10V B	022-3907-034	C 438	C1608 CH 1H 330J-T-A	022-3906-070
C 223	1 C2012 10V B	022-3907-034	C 439	C1608 CH 1H 330J-T-A	022-3906-070
C 224	1 C2012 10V B	022-3907-034	C 440	C1608 CH 1H 330J-T-A	022-3906-070
C 225	C1608 JF 1C 104Z-T-A	022-3906-076	C 441	C1608 CH 1H 330J-T-A	022-3906-070
C 226	4.7 C3216 6.3V B	022-3907-035	C 443	C1608 CH 1H 330J-T-A	022-3906-070
C 227	1 C2012 10V B	022-3907-034	C 444	C1608 CH 1H 330J-T-A	022-3906-070
C 228	C1608 JB 1C 104KT-N	022-3906-614	C 446	C1608 CH 1H 330J-T-A	022-3906-070
C 229	C1608 CH 1H 330J-T-A	022-3906-070	C 447	C1608 CH 1H 330J-T-A	022-3906-070
C 301	C1608 JF 1C 104Z-T-A	022-3906-076	C 448	C1608 CH 1H 330J-T-A	022-3906-070

LOGIC UNIT

Ref No.	Description	Part No.	Ref No.	Description	Part No.
C 449	C1608 CH 1H 330J-T-A	022-3906-070	IC 202	NJM2904V-TE1 IC	022-3906-016
C 450	C1608 CH 1H 330J-T-A	022-3906-070	IC 203	TC4W53FU (TE12L) IC	022-3907-010
C 451	C1608 CH 1H 330J-T-A	022-3906-070	IC 204	TC4W66FU(TE12L) IC	022-3906-022
C 454	C1608 CH 1H 330J-T-A	022-3906-070	IC 205	NJM2904V-TE1 IC	022-3906-016
C 456	1 C2012 10V B	022-3907-034	IC 206	MC33172D IC	022-3906-018
			IC 208	MC33111D	022-3906-311
D 101	MA2S111-(TX) diode	022-3906-050	IC 209	AD8403ARU50	022-3907-014
D 102	MA2S111-(TX) diode	022-3906-050	IC 210	TC4W53FU (TE12L) IC	022-3907-010
D 103	MA2S111-(TX) diode	022-3906-050	IC 303	PCD3312CT IC	022-3906-024
D 104	MA2S111-(TX) diode	022-3906-050	IC 304	X25128SI-2.7T6 IC	022-3907-012
D 105	MA2S111-(TX) diode	022-3906-050	IC 305	S-80842ALNP-EA6	022-3907-009
D 301	MA2S077-(TX) diode	022-3907-027	IC 306	HD64F2144FA20 (FX-2176)	022-3907-017
D 302	MA2S111-(TX) diode	022-3906-050	IC 309	TC7W32FU (TE12L) IC	022-3906-531
D 305	MA8056 M diode	022-3906-049	IC 401	TK11250BM	022-3907-018
D 306	MA8056 M diode	022-3906-049	IC 402	TK11250BM	022-3907-018
D 307	MA8056 M diode	022-3906-049	IC 403	S-81230SG-QB-T1 IC	022-3906-532
D 308	MA8056 M diode	022-3906-049			
D 309	MA2S111-(TX) diode	022-3906-050	J 1	AXK5S30245P	022-3907-047
D 310	MA2S111-(TX) diode	022-3906-050	J 2	52396-0990	022-3906-130
D 311	MA8056 M diode	022-3906-049	J 3	52207-0590	022-3906-129
D 312	MA8160 (TX) diode	022-3907-025	J 4	AXK520145P	022-3907-045
D 313	MA8056 M diode	022-3906-049			
D 401	MA2S111-(TX) diode	022-3906-050	MP 1	Ferrite sheet (C) next to IC306	022-3906-244
D 402	MA2S111-(TX) diode	022-3906-050	MP 3	2176 CPU shield	022-3907-064
D 403	MA8039-L diode	022-3906-251			
			Q 101	DTC144EE TL transistor	022-3906-329
EP 1	B-5185D #2176-2D logic PC bd (10-key)	022-3907-005	Q 102	2SA1576 S transistor	022-3906-029
			Q 103	DTC144EE TL transistor	022-3906-329
	B-5185D #2176-3D logic PC bd (3-key)	022-3907-085	Q 104	DTC144EE TL transistor	022-3906-329
			Q 105	DTC144EE TL transistor	022-3906-329
EP 2	B-3828B (#1125-3A) flex circuit	022-3906-002	Q 106	2SB798-T2 DK transistor	022-3907-021
			Q 107	2SC4081 T107 S transistor	022-3906-031
IC 101	MC33172D IC	022-3906-018	Q 108	DTC144EE TL transistor	022-3906-329
IC 102	MC33172D IC	022-3906-018	Q 109	DTC144EE TL transistor	022-3906-329
IC 103	TC7S66FU IC	022-3906-020	Q 110	UMG2N TL diode	022-3906-250
IC 104	TDA7233D IC	022-3906-530	Q 111	DTC144EE TL transistor	022-3906-329
IC 105	TDA7233D IC	022-3906-530	Q 112	UMG2N TL diode	022-3906-250
IC 106	TDA7233D IC	022-3906-530	Q 201	DTC144EE TL transistor	022-3906-329
IC 107	MC33172D IC	022-3906-018	Q 301	2SC4081 T107 S transistor	022-3906-031
IC 110	TC4W53FU (TE12L) IC	022-3907-010	Q 302	DTC144EE TL transistor	022-3906-329
IC 112	MC33172D IC	022-3906-018	Q 401	2SC4081 T107 S transistor	022-3906-031
IC 113	MC33172D IC	022-3906-018	Q 402	2SJ316-TD diode	022-3906-041
IC 114	MC33172D IC	022-3906-018	Q 403	2SJ316-TD diode	022-3906-041
IC 115	TC7S04FU IC	022-3907-011	Q 404	UMD6 TL diode	022-3907-023
IC 201	TC75S54F	022-3907-013	Q 405	UMD6 TL diode	022-3907-023

LOGIC UNIT

Ref No.	Description	Part No.	Ref No.	Description	Part No.
Q 406	UMD6 TL diode	022-3907-023	R 155	ERJ3GEYJ 203V resistor	022-3906-528
			R 156	ERJ3GEYJ 223V resistor	022-3906-167
R 101	ERJ3GEYJ 154V resistor	022-3906-392	R 157	ERJ3GEYJ 202V resistor	569-0155-202
R 102	ERJ3GEYJ 104 V resistor	022-3906-175	R 158	ERJ3GEYJ 153V resistor	022-3906-165
R 103	ERJ3GEYJ 473 V resistor	022-3906-171	R 159	ERJ3GEYJ 223V resistor	022-3906-167
R 104	ERJ3GEYJ 473 V resistor	022-3906-171	R 160	15K ERJ3GE resistor	022-3906-165
R 105	ERJ3GEYJ 124 V resistor	022-3906-176	R 161	ERJ3GEYJ 333 V resistor	022-3906-169
R 106	ERJ3GEYJ 394V resistor	022-3901-500	R 162	ERJ3GEYJ 333 V resistor	022-3906-169
R 107	ERJ3GEYJ 273 V resistor	022-3906-168	R 163	ERJ3GEYJ 222 V resistor	022-3906-157
R 108	560K ERJ3GE resistor	022-3906-393	R 164	ERJ3GEYJ 104 V resistor	022-3906-175
R 109	ERJ3GEYJ 562 V resistor	022-3906-161	R 165	ERJ3GEYJ 473 V resistor	022-3906-171
R 110	ERJ3GEYJ 154V resistor	022-3906-392	R 166	ERJ3GEYJ 562 V resistor	022-3906-161
R 111	ERJ3GEYJ 104 V resistor	022-3906-175	R 167	56K ERJ3GE resistor	022-3906-172
R 112	ERJ3GEYJ 103V resistor	022-3906-163	R 168	ERJ3GEYJ 272 V resistor	022-3906-158
R 113	ERJ3GEYJ 473 V resistor	022-3906-171	R 169	ERJ3GEYJ 473 V resistor	022-3906-171
R 116	560K ERJ3GE resistor	022-3906-393	R 201	39K ERJ3GE resistor	022-3906-170
R 117	RV-283 (RK0971111) resistor	022-3906-189	R 202	39K ERJ3GE resistor	022-3906-170
R 118	ERJ3GEYJ 682 V resistor	022-3906-162	R 203	ERJ3GEYJ 272 V resistor	022-3906-158
R 119	ERJ3GEYJ 682 V resistor	022-3906-162	R 204	ERJ3GEYJ 473 V resistor	022-3906-171
R 120	ERJ3GEYJ 104 V resistor	022-3906-175	R 205	ERJ3GEYJ 224V resistor	022-3906-178
R 124	ERJ3GEYJ 103V resistor	022-3906-163	R 206	ERJ3GEYJ 272 V resistor	022-3906-158
R 125	ERJ3GEYJ 102 V resistor	022-3906-154	R 207	ERJ3GEYJ 333 V resistor	022-3906-169
R 127	2.7 MCR10	022-3906-136	R 208	56K ERJ3GE resistor	022-3906-172
R 131	2.7 MCR10	022-3906-136	R 210	ERJ3GEYJ 474 V resistor	022-3906-181
R 132	2.7 MCR10	022-3906-136	R 211	ERJ3GEYJ 562 V resistor	022-3906-161
R 133	ERJ3GEYJ 104 V resistor	022-3906-175	R 212	1.2M ERJ3GE resistor	022-3906-856
R 134	ERJ3GEYJ 104 V resistor	022-3906-175	R 213	ERJ3GEYJ 105 V resistor	022-3906-184
R 135	ERJ3GEYJ 473 V resistor	022-3906-171	R 214	ERJ3GEYJ 102 V resistor	022-3906-154
R 136	ERJ3GEYJ 473 V resistor	022-3906-171	R 215	ERJ3GEYJ821V resistor	022-3906-153
R 137	330K ERJ3GE resistor	022-3906-180	R 216	ERJ3GEYJ 474 V resistor	022-3906-181
R 139	560K ERJ3GE resistor	022-3906-393	R 220	39K ERJ3GE resistor	022-3906-170
R 140	ERJ3GEYJ 104 V resistor	022-3906-175	R 221	ERJ3GEYJ 823 V resistor	022-3906-174
R 141	ERJ3GEYJ 104 V resistor	022-3906-175	R 222	ERJ3GEYJ 332 V resistor	022-3906-159
R 142	ERJ3GEYJ 103V resistor	022-3906-163	R 223	ERJ3GEYJ 683V resistor	022-3906-173
R 143	ERJ3GEYJ 183 V resistor	022-3906-166	R 224	ERJ3GEYJ 154V resistor	022-3906-392
R 145	ERJ3GEYJ 103V resistor	022-3906-163	R 225	ERJ3GEYJ 562 V resistor	022-3906-161
R 146	ERJ3GEYJ 104 V resistor	022-3906-175	R 226	ERJ3GEYJ 103V resistor	022-3906-163
R 147	ERJ3GEYJ 222 V resistor	022-3906-157	R 227	ERJ3GEYJ 103V resistor	022-3906-163
R 148	ERJ3GEYJ 122 V resistor	022-3906-390	R 228	ERJ3GEYJ 472 V resistor	022-3906-160
R 149	ERJ3GEYJ 103V resistor	022-3906-163	R 231	ERJ3GEYJ 273 V resistor	022-3906-168
R 150	ERJ3GEYJ 102V resistor	022-3906-154	R 232	ERJ3GEYJ 273 V resistor	022-3906-168
R 151	ERJ3GEYJ 102V resistor	022-3906-154	R 235	ERJ3GEYJ 104 V resistor	022-3906-175
R 152	ERJ3GEYJ 103V resistor	022-3906-163	R 236	ERJ3GEYJ 104 V resistor	022-3906-175
R 153	ERJ3GEYJ 333V resistor	022-3906-169	R 237	ERJ3GEYJ 473 V resistor	022-3906-171
R 154	ERJ3GEYJ 332V resistor	022-3906-159	R 238	ERJ3GEYJ 473 V resistor	022-3906-171

LOGIC UNIT

Ref No.	Description	Part No.	Ref No.	Description	Part No.
R 239	330K ERJ3GE resistor	022-3906-180	R 324	ERJ3GEYJ 104 V resistor	022-3906-175
R 240	ERJ3GEYJ 103V resistor	022-3906-163	R 325	ERJ3GEYJ 104 V resistor	022-3906-175
R 241	ERJ3GEYJ 683V resistor	022-3906-173	R 326	ERJ3GEYJ 104 V resistor	022-3906-175
R 243	ERJ3GEYJ 103V resistor	022-3906-163	R 328	ERJ3GEYJ 104 V resistor	022-3906-175
R 244	ERJ3GEYJ 103V resistor	022-3906-163	R 329	ERJ3GEYJ 104 V resistor	022-3906-175
R 245	ERJ3GEYJ 331 V resistor	022-3906-389	R 330	ERJ3GEYJ 104 V resistor	022-3906-175
R 246	ERJ3GEYJ 182 V resistor	022-3906-156	R 331	ERJ3GEYJ 104 V resistor	022-3906-175
R 247	ERJ3GEYJ 102 V resistor	022-3906-154	R 332	ERJ3GEYJ 104 V resistor	022-3906-175
R 248	ERJ3GEYJ 103V resistor	022-3906-163	R 333	ERJ3GEYJ 104 V resistor	022-3906-175
R 249	ERJ3GEYJ 103V resistor	022-3906-163	R 335	ERJ3GEYJ 471 V resistor	022-3906-150
R 250	ERJ3GEYJ 682 V resistor	022-3906-162	R 336	ERJ3GEYJ 102 V resistor	022-3906-154
R 251	12K ERJ3GE resistor	022-3906-164	R 337	ERJ3GEYJ 471 V resistor	022-3906-150
R 252	ERJ3GEYJ 103V resistor	022-3906-163	R 338	ERJ3GEYJ 223 V resistor	022-3906-167
R 253	ERJ3GEYJ 222 V resistor	022-3906-157	R 339	ERJ3GEYJ 333 V resistor	022-3906-169
R 254	ERJ3GEYJ 154V resistor	022-3906-392	R 401	ERJ3GEYJ 183 V resistor	022-3906-166
R 301	ERJ3GEYJ 474 V resistor	022-3906-181	R 402	ERJ3GEYJ 103V resistor	022-3906-163
R 302	ERJ3GEYJ 104 V resistor	022-3906-175	R 403	ERJ3GEYJ 104 V resistor	022-3906-175
R 303	ERJ3GEYJ 183 V resistor	022-3906-166	R 404	ERJ3GEYJ 104 V resistor	022-3906-175
R 304	12K ERJ3GE resistor	022-3906-164	R 406	200K ERJ3GE	022-3907-050
R 306	ERJ3GEYJ 102 V resistor	022-3906-154	R 407	ERJ3GEYJ 104 V resistor	022-3906-175
R 308	ERJ3GEYJ 103V resistor	022-3906-163	R 408	ERJ3GEYJ 102 V resistor	022-3906-154
R 309	ERJ3GEYJ 103V resistor	022-3906-163			
R 310	ERJ3GEYJ 104 V resistor	022-3906-175	S 1	EC10SP16-51 switch	022-3906-057
R 311	ERJ3GEYJ 102 V resistor	022-3906-154			
R 312	ERJ3GEYJ 103V resistor	022-3906-163	W 10	ERJ3GE-JPW V resistor	022-3906-185
R 313	ERJ3GEYJ 474 V resistor	022-3906-181	W 11	ERJ3GE-JPW V resistor	022-3906-185
R 314	ERJ3GEYJ 224V resistor	022-3906-178	W 4	ERJ3GE-JPW V resistor	022-3906-185
R 315	ERJ3GEYJ 224V resistor	022-3906-178	W 5	ERJ3GE-JPW V resistor	022-3906-185
R 316	ERJ3GEYJ 471 V resistor	022-3906-150	W 6	ERJ3GE-JPW V resistor	022-3906-185
R 317	ERJ3GEYJ 104 V resistor	022-3906-175	W 7	ERJ3GE-JPW V resistor	022-3906-185
R 318	ERJ3GEYJ 471 V resistor	022-3906-150	W 8	ERJ3GE-JPW V resistor	022-3906-185
R 319	ERJ3GEYJ 104 V resistor	022-3906-175	W 9	ERJ3GE-JPW V resistor	022-3906-185
R 320	ERJ3GEYJ 471 V resistor	022-3906-150			
R 321	ERJ3GEYJ 104 V resistor	022-3906-175	X 1	CR-563 crystal	022-3906-542
R 322	ERJ3GEYJ 104 V resistor	022-3906-175	X 2	CR-635	022-3907-039
R 323	ERJ3GEYJ 471 V resistor	022-3906-150			

MP35

MP35

MP18

MP25

Display Board

MP9 (4)
(Display)

EP3
(Display)

EP2
(Display)

DS6
(Display)

MP7
(Display)

MP15
(Display)

MP12 (4)
Display)

MP8
(Display)

Display Board

MP16
(Display)

MP10 (4)
(Display)

10-Key Board

MP4
(Display)

SP1
(10-Key)

MP6
(Display)

MC1
(10-Key)

MP11
(Display)

MP1
(Display)

10-KEY FRONT PANEL

MP15
(Display)

3-Key
Board

MP4
(Display)

MP10 (2)
(Display)

MC1
(3-Key Bd)

SP1
(3-key Bd)

MP6
(Display)

MP11
(Display)

MP1
(Display)

3-KEY FRONT PANEL

MP37 (2)

EP1
(RF Board)

MP4 (2)

J1
(Chassis)

MP49

MP1

MP3
(RF Unit)

MP47 (4)

EP1
(Chassis)

EP2
(Chassis)

MP39 (4)

MP10

MP12

MP6

MP5

MP7

MP2

MP13
(Chassis)

MP17
(Chassis)

MP4 (2)
(Jack Assy)

MP8

MP3

EP1
(Jack Assy)

MP45

J1/MP5
(Jack Assy)

MP36 (4)

MP16 (2)
(Chassis)

MP50
(Pad)

MP1
(Jack Assy)

MP2
(Jack Assy)

MP3
(Jack Assy)

EP2
(Logic Assy)

MP46

EP1
(Logic Board)

MP32

F1

MP33

MP27

MP27

MP34

MP28

MP29

MP32

MP34

MP22

MP23

MP30

MP24

MP26

MP18

MP52
(Sticker)
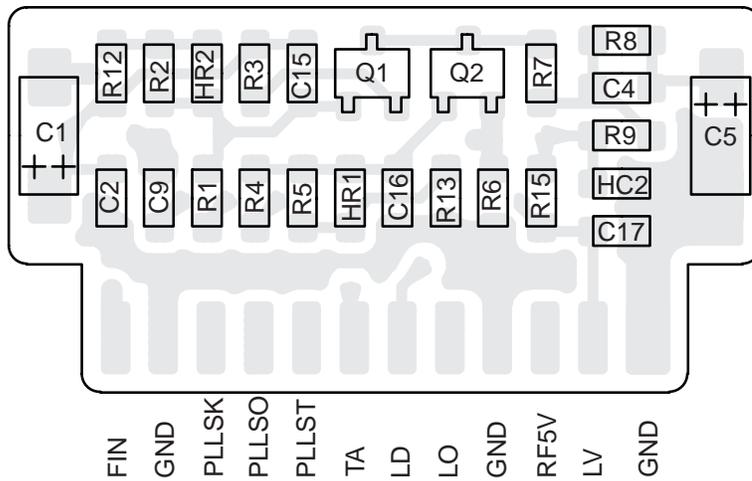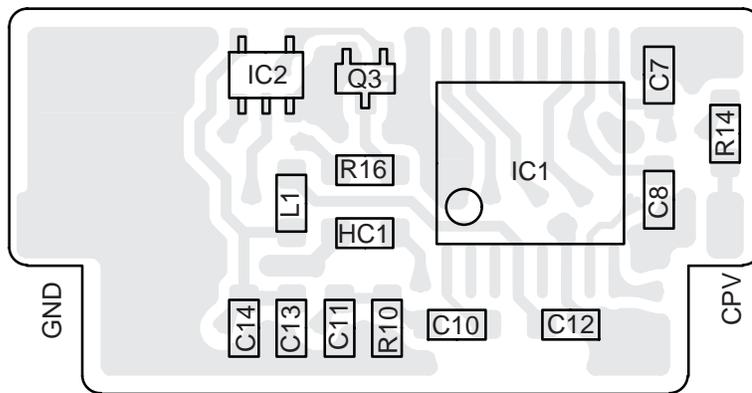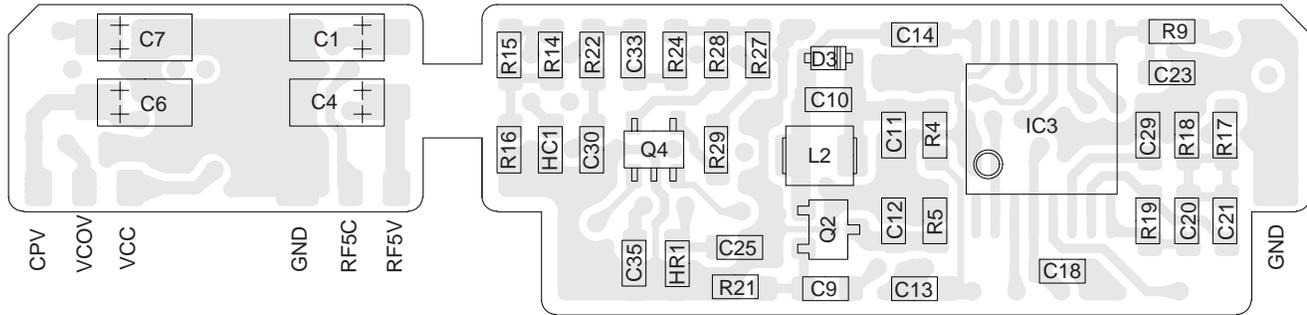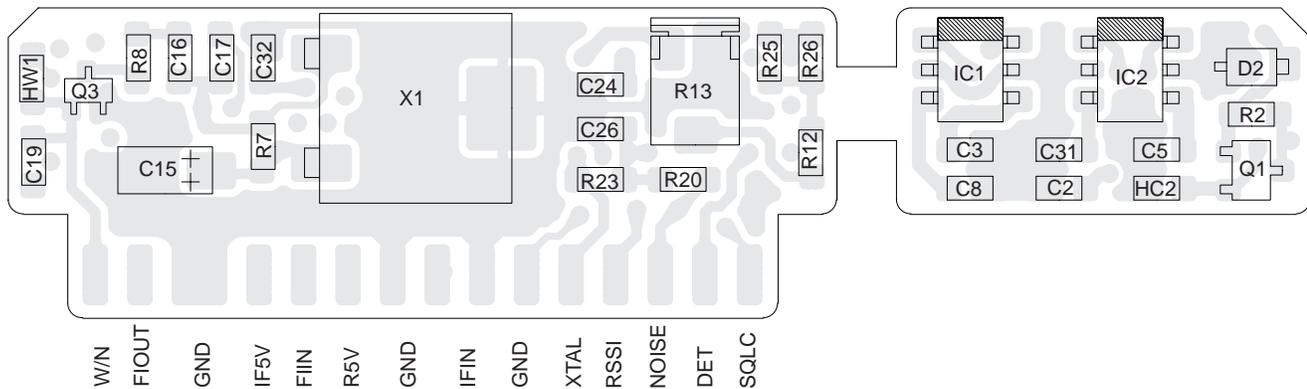
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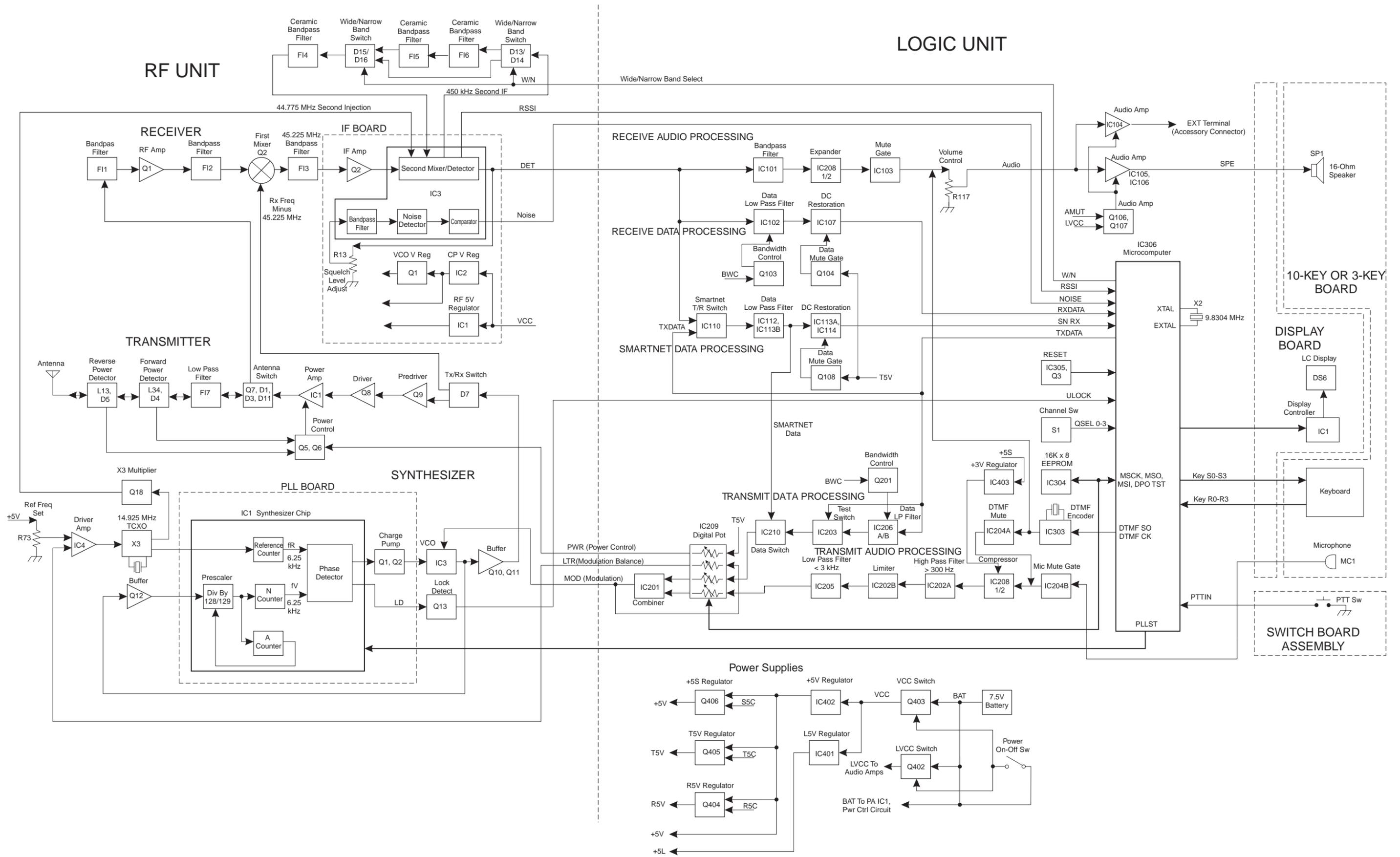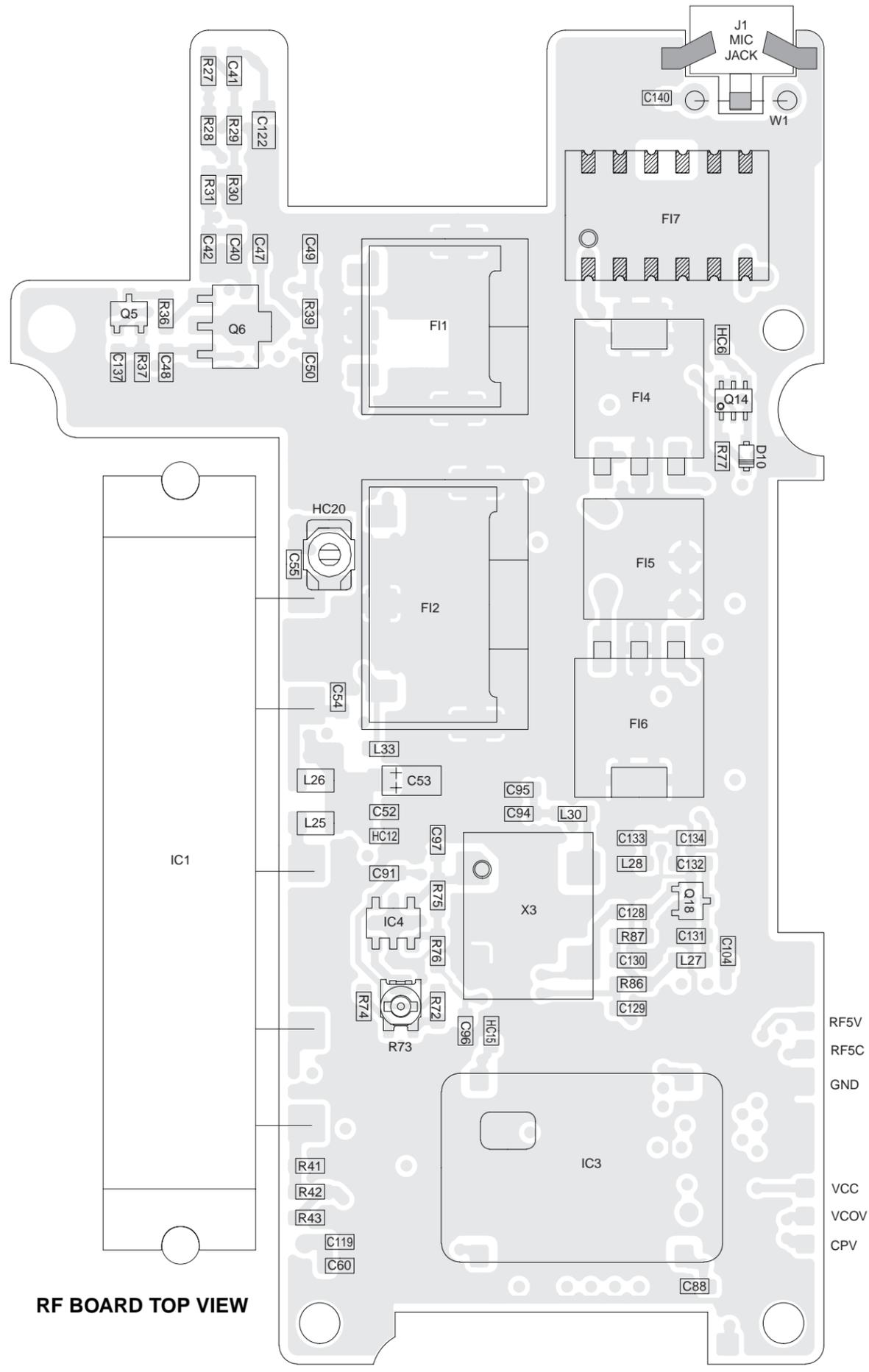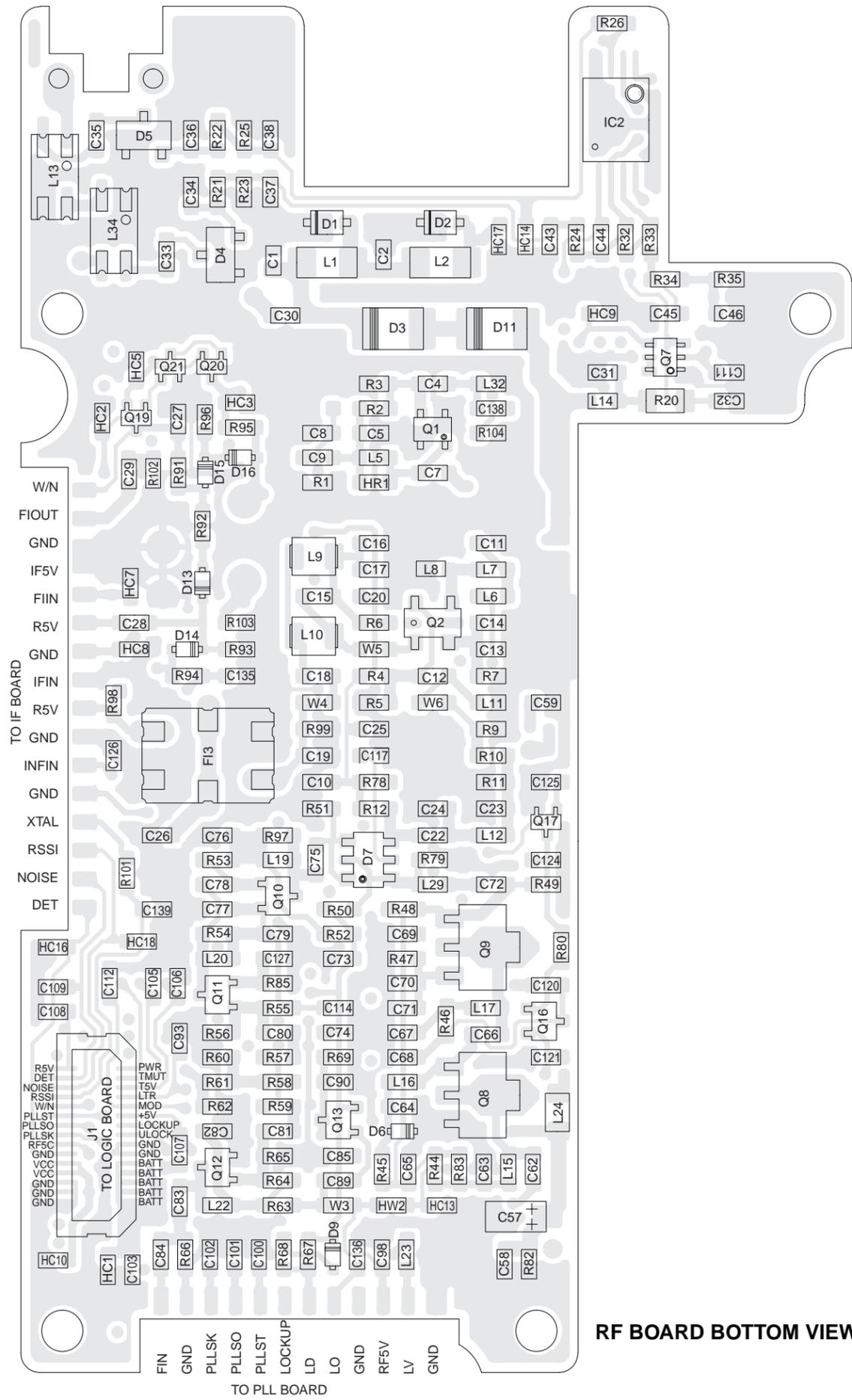
PLL BOARD TOP VIEW

PLL BOARD BOTTOM VIEW

IF BOARD TOP VIEW

IF BOARD BOTTOM VIEW

RF UNIT

LOGIC UNIT

Ceramic Bandpass Filter — FI4
Wide/Narrow Band Switch — D15/D16
Ceramic Bandpass Filter — FI5
Ceramic Bandpass Filter — FI6
Wide/Narrow Band Switch — D13/D14
W/N
Wide/Narrow Band Select

450 kHz Second IF
44.775 MHz Second Injection
RSSI

RECEIVER

Bandpass Filter — FI1
RF Amp — Q1
Bandpass Filter — FI2
First Mixer — Q2
45.225 MHz Bandpass Filter — FI3

IF BOARD
IF Amp — Q2
Second Mixer/Detector — IC3
DET

RECEIVE AUDIO PROCESSING
Bandpass Filter — IC101
Expander — IC208 1/2
Mute Gate — IC103
Volume Control
Audio

Audio Amp — IC104
EXT Terminal (Accessory Connector)

Audio Amp — IC105, IC106
SPE

SP1 16-Ohm Speaker

R117

AMUT / LVCC
Audio Amp — Q106, Q107

Rx Freq Minus 45.225 MHz

Bandpass Filter / Noise Detector / Comparator
Noise

RECEIVE DATA PROCESSING
Data Low Pass Filter — IC102
DC Restoration — IC107
Bandwidth Control — Q103
BWC
Data Mute Gate — Q104

VCO V Reg — Q1
CP V Reg — IC2
R13
Squelch Level Adjust
RF 5V Regulator — IC1
VCC

IC306 Microcomputer
W/N
RSSI
NOISE
RXDATA
SN RX
TXDATA

X2 9.8304 MHz
XTAL
EXTAL

10-KEY OR 3-KEY BOARD

SMARTNET DATA PROCESSING
Smartnet T/R Switch — IC110
Data Low Pass Filter — IC112, IC113B
DC Restoration — IC113A, IC114
TXDATA
Data Mute Gate — Q108
T5V

DISPLAY BOARD
RESET — IC305, Q3
ULOCK
LC Display — DS6
Display Controller — IC1

TRANSMITTER

Antenna
Reverse Power Detector — L13, D5
Forward Power Detector — L34, D4
Low Pass Filter — FI7
Antenna Switch — Q7, D1, D3, D11
Power Amp — IC1
Driver — Q8
Predriver — Q9
Tx/Rx Switch — D7

Power Control — Q5, Q6

Channel Sw — S1
QSEL 0-3

X3 Multiplier
Q18

PLL BOARD / SYNTHESIZER
IC1 Synthesizer Chip
Reference Counter — fR 6.25 kHz
Phase Detector
Charge Pump — Q1, Q2
VCO — IC3
Buffer — Q10, Q11
Lock Detect — Q13

Prescaler Div By 128/129
N Counter — fV 6.25 kHz
A Counter
LD

Ref Freq Set
+5V
R73
Driver Amp — IC4
14.925 MHz TCXO — X3
Buffer — Q12

TRANSMIT DATA PROCESSING
Bandwidth Control — Q201
BWC
IC210 Data Switch
T5V
Test Switch — IC203
Data LP Filter — IC206 A/B

+5S
+3V Regulator — IC403
16K x 8 EEPROM — IC304

MSCK, MSO, MSI, DPO TST
Key S0-S3
Keyboard
Key R0-R3

DTMF Mute — IC204A
DTMF Encoder — IC303
DTMF SO / DTMF CK

TRANSMIT AUDIO PROCESSING
IC209 Digital Pot
PWR (Power Control)
LTR (Modulation Balance)
MOD (Modulation)
IC201 Combiner
Low Pass Filter < 3 kHz — IC205
Limiter — IC202B
High Pass Filter > 300 Hz — IC202A
Compressor — IC208 1/2
Mic Mute Gate — IC204B
MC1 Microphone

PLLST
PTTIN
PTT Sw
SWITCH BOARD ASSEMBLY

SMARTNET Data

Power Supplies

+5S Regulator — Q406 — S5C
+5V Regulator — IC402 — VCC
VCC Switch — Q403
BAT
7.5V Battery

+5V
Power On-Off Sw

T5V Regulator — Q405 — T5C
L5V Regulator — IC401
LVCC Switch — Q402
LVCC To Audio Amps
T5V

R5V Regulator — Q404 — R5C
LVCC To Audio Amps
BAT To PA IC1, Pwr Ctrl Circuit

+5V
+5L

RF BOARD BOTTOM VIEW

RF BOARD TOP VIEW

TO IF BOARD

W/N
FIOUT
GND
IF5V
FIIN
R5V
GND
IFIN
R5V
GND
INFIN
GND
XTAL
RSSI
NOISE
DET

TO LOGIC BOARD

R5V
DET
NOISE
RSSI
W/N
PLLST
PLLSO
PLLSK
RF5C
GND
VCC
VCC
GND
GND
GND

PWR
TMUT
T5V
LTR
MOD
+5V
LOCKUP
ULOCK
GND
GND
BATT
BATT
BATT
BATT
BATT

TO PLL BOARD

FIN
GND
PLLSK
PLLSO
PLLST
LOCKUP
LD
LO
GND
RF5V
LV
GND

J1
MIC
JACK

RF5V
RF5C
GND
VCC
VCOV
CPV

RF BOARD SCHEMATIC

LOGIC BOARD TOP VIEW

On-Off Volume Control

Channel Switch

TO ACCESSORY JACK

To DC Power Flex Circuit

TO PTT BOARD

TO RF UNIT

PWR	R5V
TMUT	DET
T5V	NOISE
LTR	RSSI
MOD	W/N
+5V	PLLST
TA	PLLSO
ULOCK	PLLSK
GND	RF5C
GND	GND
BATT	Vcc
BATT	Vcc
BATT	GND
BATT	GND
BATT	GND

TO DISPLAY UNIT

SPE
SPE
SP
SP
L5V
MSO
MSCK
DISST
DISEN
KEYSO
KEYS1
KEYS2
KEYS3
KEYRO
KEYR1
KEYR2
KEYR3
TXLED
DSYLED
BATLED
BKLED
GND
MICE
MIC
GND
GND

J2: PTT EXTMIC TxD RxD LiVcc GND PSW RESET AFO

J3:
1 GND
AUXB
MICE
FCNB
5 GND

J4:
GND — PTT OUT
TX OUT — PTT IN
TX IN — RX OUT
CLR/CODE — EXTDC
T5C — OPTB
OP1 — AMUTI
OP2 — AMUTO
OP3 — BEEPO
OP4 —
SW BATT — GND

LOGIC BOARD TOP VIEW

DISPLAY BOARD BOTTOM VIEW

Tx LED — DS3
Busy LED — DS4
Batt LED — DS5

DS7
DS2
DS6
DS1
DS8

J2

GND, KEYR3, KEYR2, KEYR1, KEYR0, KEYS3, KEYS2, KEYS1, KEYS0, GND
2 ... 20
1 ... 19
MIC, MICE, GND, GND, BKLED, L5V, GND, GND, SP, SPE

DISPLAY BOARD TOP VIEW

R8 C7 HR2 R3
C2 C5 C6 R18 R7
R9 C4 HR3 HR1

R14 R12 R16 C3 R17

R2

IC1

R11 Q2 R15 Q4

C1

R13 Q3 R1 Q1

J1
29 ... 1

GND, GND, SPE, SP, SP, L5V, DISSO, DISSK, DISST, DISEN, KEYS0, KEYS1, KEYS2, KEYS3, KEYR0, KEYR1, KEYR2, KEYR3, TXLED, BSYLED, BATLED, BKLED, GND, MIC, MICE, GND, GND, GND
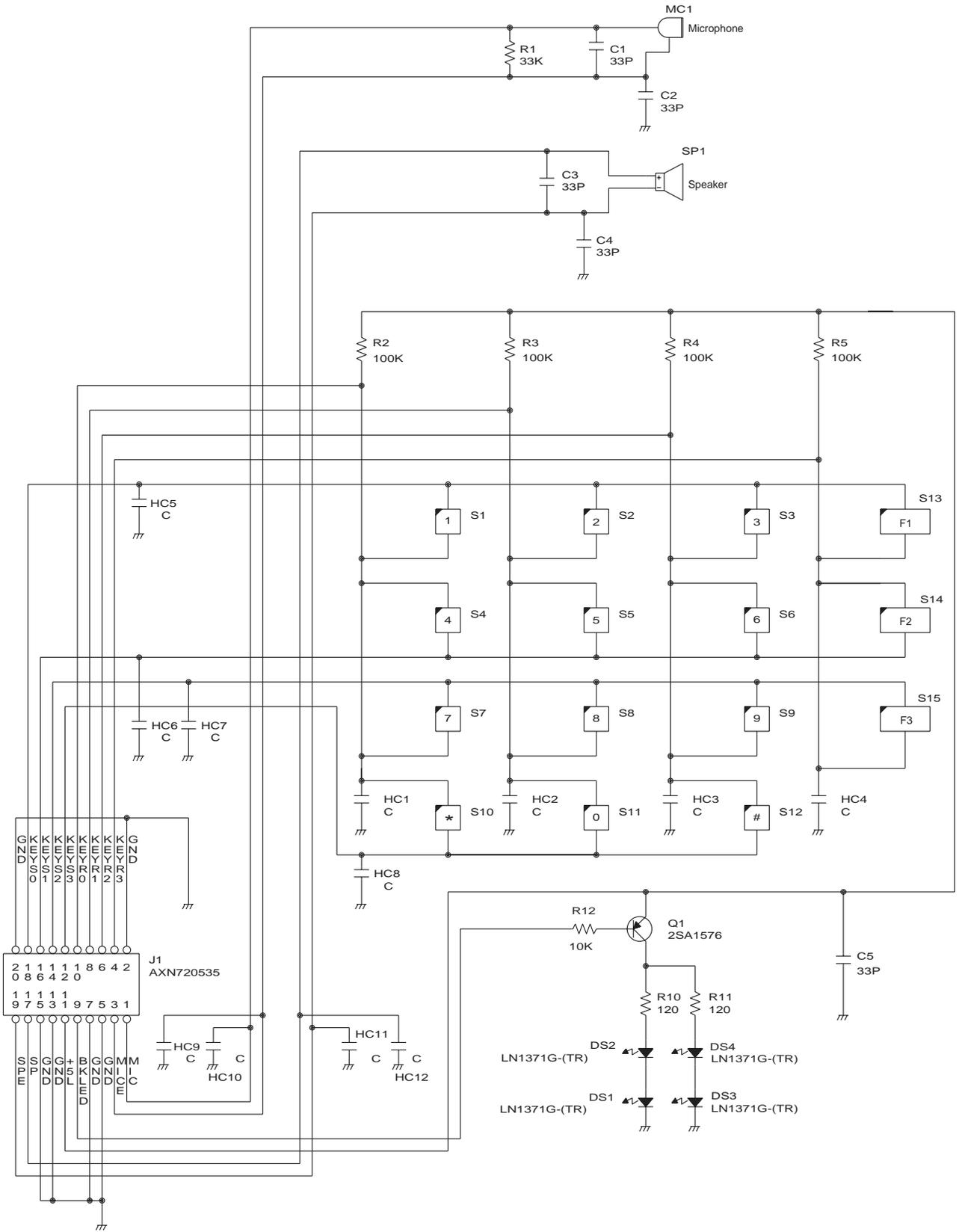
DISPLAY BOARD SCHEMATIC
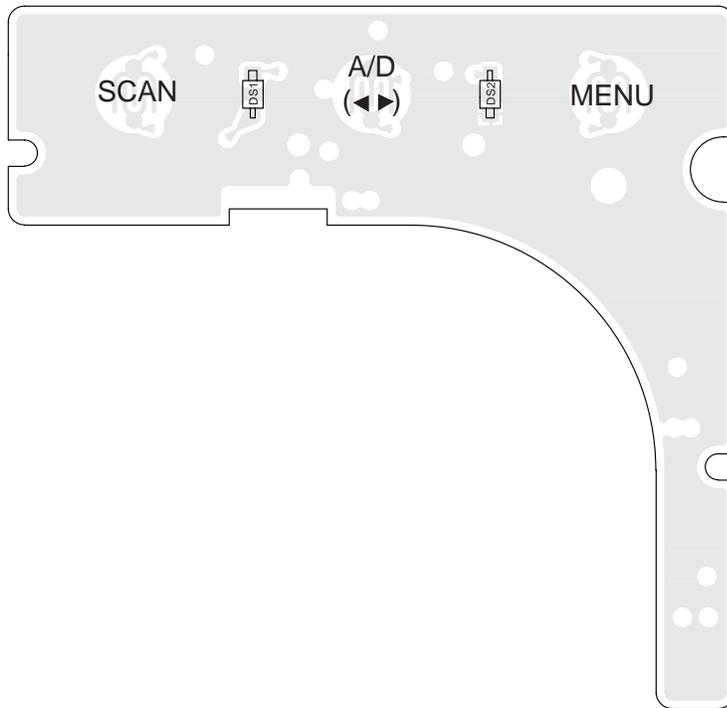
10-KEY BOARD FRONT VIEW

10-KEY BOARD BACK VIEW

10-KEY BOARD SCHEMATIC

3-KEY BOARD FRONT VIEW

3-KEY BOARD BACK VIEW

3-KEY BOARD SCHEMATIC

NOTES

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